

Environmental Assessment

Quiggins Sinkhole Flood Mitigation Project

City of Radcliff, Hardin County, Kentucky

DR-KY-1818-0012

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FEMA

U.S. Department of Homeland Security
Federal Emergency Management Agency – Region IV
Chamblee-Tucker Road – Hollins Building
Atlanta, GA 30341-411

ACRONYMS AND ABBREVIATIONS	ii
SECTION ONE INTRODUCTION	1
SECTION TWO PURPOSE AND NEED.....	1
SECTION THREE ALTERNATIVES	2
3.1 Alternative 1: No Action.....	2
3.2 Alternative 2: Proposed action.....	2
3.3 Alternatives Considered and Dismissed	3
SECTION FOUR AFFECTED ENVIRONMENT AND IMPACTS.....	4
4.1 Physical Resources (Geology and Soils, and Air Quality)	8
4.2 Water Resources (Water Quality (Surface water, ground water), Waters of the u.s. including Wetlands & Floodplains).....	9
4.2.1 Water Quality.....	9
4.2.2 Waters of the U.S. Including Wetlands	10
4.2.3 Floodplains.....	13
4.3 Biological Resources (T&E Species/Critical Habitat, Migratory Birds, Wildlife and Fish).....	13
4.4 Cultural Resources (Historic Properties, American Indian Cultural Resources).....	15
4.4.1 Cultural Resources	15
4.4.2 American Indian Cultural Resources	16
4.5 Socioeconomic Concerns (Environmental Justice, Noise, Traffic, Public Service and Utilities, Public Health and Safety)	17
4.5.1 Environmental Justice.....	17
4.5.2 Air Quality	18
4.5.3 Noise	18
4.5.4 Hazardous Materials	19
4.5.5 Human Health and Safety	19
4.5.6 Socioeconomic Resources	20
4.5.7 Transportation.....	20
4.6 Cumulative Impacts	21
SECTION FIVE PUBLIC INVOLVEMENT, AGENCY COORDINATION AND PERMITS	21
SECTION SIX REFERENCES	22
SECTION SEVEN LIST OF PREPARERS.....	24

Appendices

Appendix A	Figures
Appendix B	Photo Log
Appendix C	Reports
Appendix D	Agency Correspondence
Appendix E	Public Notice of Environmental Assessment

ACRONYMS AND ABBREVIATIONS

36 CFR	Code of Federal Regulations for Protection of Historic Properties
40 CFR	Code of Federal Regulations for Protection of Environment
44 CFR Part 9	Code of Federal Regulations for Floodplain Management and Protection of Wetlands
44 CFR Part 10	Code of Federal Regulations for Environmental Considerations
ACHP	Advisory Council on Historic Preservation
APE	Area of Potential Effects
BFE	Base Flood Elevation
BMPs	Best Management Practices
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CO	carbon monoxide
CWA	Clean Water Act
dB	decibel
DNL	Day-Night Average Sound Level
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FONSI	Finding of No Significant Impact
gpm	gallons per minute
HMGP	Hazard Mitigation Assistance Program (HMGP)
KDAQ	Kentucky Division of Air Quality
KDOW-WQB	Kentucky Division of Water's Water Quality Branch
KDEP-DOW	Kentucky Department for Environmental Protection – Division of Water
KDFWR	Kentucky Department of Fish and Wildlife Resources

KYEM	Kentucky Emergency Management
NAAQS	National Ambient Air Quality Standards
NWI	National Wetlands Inventory
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NO ₂	nitrogen dioxide
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
O ₃	ozone
OSHA	Occupational Safety and Health Administration
Pb	lead
PCN	Pre Construction Notice
PM _{2.5}	particulate matter less than 2.5 microns
PM ₁₀	particulate matter less than 10 microns
RCRA	Resource Conservation and Recovery Act
Section 106	Section of the NHPA that directs federal agencies to consider their undertakings and their effects on historic properties
Section 7	Section of the ESA for “Interagency Cooperation” that directs federal agencies to consider their undertakings and their effects on listed species
SHPO	State Historic Preservation Office
SFHA	Special Flood Hazard Area
SO ₂	Sulfur Dioxide
SWPPP	Stormwater Pollution Prevention Plan
T&E	Threatened & Endangered Species
URS	URS Group, Inc.
USACE	U.S. Army Corps of Engineers
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
WOUS	Waters of the United States

SECTION ONE INTRODUCTION

The Department of Homeland Security's Federal Emergency Management Agency (FEMA) prepared this Environmental Assessment (EA) for the proposed construction of retention basins with sufficient capacity and other drainage elements to resolve frequent flooding in the City of Radcliff, Hardin County, Kentucky through a Hazard Mitigation Grant Program (HMGP) project under sub application number DR-KY-HMGP-1818-0012. FEMA provides HMGP funds to help protect people's lives, health, safety, and improved property.

In accordance with 44 CFR Part 10, FEMA Implementing Procedures, this EA has been prepared pursuant to Section 102 of the National Environmental Policy Act (NEPA) of 1969 (42 USC § 4332) and as implemented by the regulations promulgated by the President's Council on Environmental Quality (CEQ) (40 CFR parts 1500-1508). The purpose of the EA is to analyze the potential environmental impacts of the proposed action, and to determine whether to prepare an Environmental Impact Statement (EIS) or a Finding of No Significant Impact (FONSI).

SECTION TWO PURPOSE AND NEED

The purpose of FEMA's HMGP program is to assist States and communities in rebuilding damaged communities and implementing measures that reduce or eliminate the long-term risk of future damages to infrastructure caused by severe storm events and natural disasters.

The need for this project is to eliminate damages to structures located around the project area and protect the use of two major thoroughfares in the City of Radcliff (City) – South Wilson Road and U.S. Route 31-W. These two roads carry a combined total of approximately 33,790 vehicles per day through the City. The City is adjacent to the U.S. Army's Fort Knox Military Base and most of the incoming and outgoing traffic from the base travels through the City on U.S Route 31-W and South Wilson Road. U.S. Route 31-W is also the major thoroughfare for Hardin County (see Appendix A, Figure 1 for overview map). Repetitive flooding from heavy rains (up to the 1.0 inch storm event) overtops South Wilson Road, causing closure of the road, trapping residents in homes, and causing the re-routing of 4,590 vehicles per day. Flooding from a very large rain event (i.e. 1 % chance storm event) will overtop U.S Route 31-W, causing the re-routing of approximately 29,200 vehicles per day. and flooding many structures in the area. In 1997, 54 homes and commercial businesses in the area were flooded from a 1% chance flood event.

A hydrological study of the existing Quiggins Sinkhole stormwater detention system was performed in 2009 to study the hydrogeology of karst flooding of the Happy Valley drainage area. The study concluded that the Quiggins Sinkhole was capable of discharging floodwaters at approximately 11.9 cubic feet per second (cfs) (about the same flow capacity of a 12-inch pipe or smaller) and that any storm event producing more than one inch of rain in six hours, with vegetation dormant and soil moisture high, would easily flood the sinkhole area.

Based on the history of flooding associated with the volume of water draining into Quiggins Sinkhole after heavy rain events, FEMA has determined that a need exists to provide flood protection for this area of the City.

SECTION THREE ALTERNATIVES

The following section describes the alternatives that were considered in addressing the purpose and need stated in Section Two. In this EA, two alternatives are evaluated: the No Action Alternative and the Proposed Action Alternative (construction of the Quiggins Sinkhole Flood Mitigation Project). Two additional alternatives were considered and were dismissed as they are not feasible for solving the flooding problem.

3.1 ALTERNATIVE 1: NO ACTION

Under the No Action Alternative, the existing drainage into the Quiggins Sinkhole would not change. Frequent flooding would continue to occur due to the large volume of stormwater runoff and the limited intake capacity of the sinkhole.

Under the No Action Alternative both residential and commercial/industrial properties would continue to be flooded, resulting in flood-related property damages. In addition, South Wilson Road and U.S. Route 31-W would continue to be severely impaired during flood events in this portion of the City of Radcliff.

3.2 ALTERNATIVE 2: PROPOSED ACTION

The City proposes to resolve the flooding that frequently occurs within the Happy Valley drainage area by constructing retention basins with sufficient capacity. The project area is located along South Wilson Road and U.S. Route 31-W. The Proposed Action is intended to greatly reduce or eliminate flooding during a 1% chance flood event. The Area of Potential Effect (APE) for the proposed detention basins consists of five separate areas along U.S. Route 31-W and South Wilson Road. The City has also included for review an alternate detention basin site in the event one of the proposed detention sites is not feasible once project construction begins. This site shall be further known as the “Alternate Detention Basin” in this document. Shelby Avenue comprises the northernmost boundary, with Joe Prather Highway comprising the southernmost boundary.

The City already owns the areas that will serve as the proposed and alternate detention basins. These properties will be used as green space in perpetuity. Deed restrictions will prevent development on these properties, which will further reduce flooding risks.

The majority of the project activities would be conducted in the northern part of the project area in an existing depressional area, proposed to be called the Quiggins Basin. The project would begin by clearing vegetation from approximately 24 acres of land within the depressional area once the depressional area is cleared, approximately 132,472 cubic yards of material would be excavated. Following excavation, the surface of the basin would be compacted and approximately 34,561 cubic yards of fill material could be replaced to level the basin. The remaining approximately 97,911 cubic yards of spoils material would be hauled from the site and disposed of at a fill/spoils disposal site located adjacent to the west of U.S. Route 31-W, between the proposed Turner and Quiggins Basins. The newly compacted basin would then be cleaned and hydrologic ally connected to the Quiggins Sinkhole with a box culvert, associated piping to the basin, and two newly constructed headwalls on either side of the culvert.

A low flow channel of approximately 1,530 linear feet would be constructed to connect the proposed drainage within the Quiggins Basin to the existing Quiggins Sinkhole through the box

culvert and associated piping. Approximately 1,500 linear feet of old chain link fencing would be removed and replaced with a four-foot chain link fence at the existing sinkhole site and a gate would be installed to permit routine site access. Erosion-control fencing and best management practices (BMPs) would be used to minimize sedimentation of the waters entering the Quiggins Sinkhole. The newly constructed basin would be seeded with native grasses to stabilize and protect the surface of the basin and prevent erosion.

In addition to the Quiggins Basin, the construction of four additional basins (proposed Wilson, Cato, Turner and Song) will increase stormwater detention capacity during peak storm events. These additional basins would retain stormwater temporarily to allow the Quiggins Sinkhole to drain the stormwater more effectively. The four basins would collectively cover approximately 24 acres; the Wilson Basin would be approximately 7 acres, the Cato Basin approximately 6 acres, the Turner Basin approximately 6 acres, and the Song Basin approximately 5 acres. At each of the basin sites, the land would be cleared of existing vegetation and the individual proposed basins would be excavated, graded, compacted, and revegetated to stabilize the basin surface. Outlet structures from each basin with piping and headwalls would be constructed to connect the individual basins to the Quiggins Basin. A utility cut under Wilson Road to convey the water from these basins to the Quiggins Basin would also be required. For each basin site, erosion control measures, including silt fencing and individual BMPs, would be used to limit surface erosion and silt generation. Each basin would be mechanically compacted and revegetated with native grasses to stabilize the basin surface.

An off-site fill/spoils disposal area has been designated adjacent to the west side of U.S. Route 31-W, between the Turner and Quiggins Basins. The spoils disposal area consists of approximately 9 acres of vacant, mostly unwooded land. Limited clearing of scrub-shrub vegetation (generally consisting of three to four-inch saplings) would take place along U.S. Route 31-W. Once established, the spoils disposal area would be graded to provide smooth contours and to incorporate the use of erosion-control measures to prevent the site from generating silt load to any of the five basin areas. The spoil disposal site would then be revegetated with native grasses (See Appendix A, Figure 2 for all proposed project locations and Appendix B for photos of the proposed project area).

3.3 ALTERNATIVES CONSIDERED AND DISMISSED

Option 1: Enlarging the karst area underground. Due to the unique karst geology of the area, nearly 100 percent of surface water is transported away from the City by sinkholes. Further analysis of this alternative has deemed it to be cost-prohibitive while only minimally addressing the lack of floodwater storage capacity.

Option 2: Construction of a large storm water pump station designed to pump the excess storm water to an offsite area. To accomplish this, 7,600 linear feet of twin 36-inch diameter force mains would need to be constructed to convey the storm water away from the Quiggins Sinkhole area. The water would be pumped to a downstream discharge point, remote from the portion of the Happy Valley Drainage area that is currently subject to flooding impacts. Due to the huge stormwater flows entering the Quiggins Sinkhole and current depression area (more than 1,000 cfs (7,479 gallons) per second during a heavy storm event), very large pumps would need to be installed at the site. Even with the use of these pumps, the reserve storage area of the existing depression area would be insufficient to handle the peak storm flows. As a result, it would be necessary to enlarge the existing depression area to store a larger volume of the storm water

until the pumps could remove the excess volume. The pump station would need to be equipped with three pumps (one of which would be used as a backup pump in case of mechanical issues with the other two pumps) and would need to be equipped with a stand-by generator for power outages.

The costs, logistics, construction requirements, equipment and pipeline routing needs and overall project disruption to the main roadways within the City, when considered collectively, render this alternative not viable for solving the flooding problem.

SECTION FOUR AFFECTED ENVIRONMENT AND IMPACTS

The City is located in Hardin County, Kentucky; near the center of the state. The City is approximately 20 miles southwest of the greater Louisville, Kentucky, metropolitan area. The proposed project is located in the City's Happy Valley drainage area that covers approximately 1.74 square miles. The major road that bisects the project area is U.S. Route 31-W, which is the major thoroughfare for the City and Hardin County. The approximate central coordinates of the proposed project area are latitude 37.811086 and longitude -85.918986.

The following table summarizes the potential impacts of the No Action Alternative and the Proposed Action Alternative and conditions or mitigation measures to offset those impacts. Following the summary table, any resource areas for which potential impacts were identified, as well as high-priority resources, including floodplains, Waters of the U.S (WOUS), environmental justice, biological resources, and cultural resources, are discussed in greater detail.

TABLE 4.1 Summary of Potential Impacts of the No Action and Proposed Action Alternatives

Affected Environment	Impacts from Proposed Action Alternative	Conditions/Mitigation	Impacts from No Action Alternative
<p>4.1 Physical Resources (Geology and Soils, and Air Quality)</p>	<p>No adverse effects on geology and climate change at the site are anticipated due to no construction activities taking place at the sinkhole.</p> <p>Excavation of the five detention basins and potential Alternate basin site and disposal/storage of soils would result in minor, long-term impacts to soils.</p> <p>Short-term, minor impacts to air quality during the construction period.</p>	<p>Implementation of appropriate Best Management Practices (BMPs) would be required at the construction location, including the placement of silt curtains around the Quiggins Sinkhole during construction to protect the planned discharge point from sediment-laden stormwater.</p> <p>Construction contractors would be required to keep fuel-burning equipment running times to a minimum; engines would be properly maintained. During periods of dry weather, construction areas would be watered-down to minimize fugitive dust.</p>	<p>Continued potential for soil erosion and sediment generation within the Quiggins Sinkhole area leading to possible reduction in the ability of the Quiggins Sinkhole to drain the volume of surface stormwater generated from the Happy Valley drainage area.</p>
<p>4.2 Water Resources (Water Quality (Surface Water and Ground Water), Waters of the U.S., Wetlands and Floodplains)</p>	<p>Soils disturbed during construction could cause short-term impacts due to sediments entering downstream surface waters.</p> <p>Groundwater quality would not be adversely impacted.</p> <p>No impacts to regulatory floodplains are anticipated because the project area lies completely outside of designated regulatory floodplains (Appendix A, Figure 3).</p> <p>Permanent impacts on 0.091 acre wetlands, 3,997 linear feet (0.515 acre) of intermittent streams, and 3,895 linear feet (0.271 acre) of ephemeral streams within the entire Quiggins Sinkhole project area.</p>	<p>The City must apply for a National Pollutant Discharge Elimination System (NPDES) permit from the Kentucky Department for Environmental Protection – Division of Water (KDEP-DOW). The NPDES permit entails preparation of a Stormwater Pollution Prevention Plan (SWPPP) prior to construction.</p> <p>Project activities have been permitted by the US Army Corps of Engineers (USACE), Louisville District. Wetland impacts will be mitigated by the purchase of 0.2 acre of wetland bank credit at an approved wetlands mitigation bank in the Salt River watershed. Stream impacts will be mitigated by construction of stormwater management channels in the bottoms of the applicable basins to convey low-flow stormwater from the inlet of the basin to the outlet structure. The City was also issued the following permits: Water Quality Certifications from the KDEP-DOW and a Stream Construction Permit.</p> <p>Use of BMPs will also be implemented.</p>	<p>Flooding of roads, highways, businesses, and residential properties within the Happy Valley Drainage Area from large storm events would continue.</p>
<p>4.3 Biological Resources (T&E Species/Critical Habitat, Migratory Birds, Wildlife and Fish)</p>	<p>Not likely to adversely affect species or their designated critical habitat.</p>	<p>Habitat removal shall only occur between October 15 and March 31 of any given year.</p>	<p>None.</p>

Affected Environment	Impacts from Proposed Action Alternative	Conditions/Mitigation	Impacts from No Action Alternative
4.4 Cultural Resources (Historic Properties, American Indian Cultural Resources)	The proposed project would result in no adverse effects to historic properties, as demonstrated by a historic resources survey and archaeological investigation of the area. While one of the detention basins will be visible from a National Register of Historic Places (NRHP) site, it will not adversely affect this site.	In the event of post review archaeological discoveries on the site, FEMA will place the following condition on the proposed project: If human remains or intact archaeological deposits are uncovered, work in the vicinity of the discovery will stop immediately and all reasonable measures to avoid or minimize harm to the finds will be taken. The subgrantee will ensure that archaeological discoveries are secured in place, that access to the sensitive area is restricted, and that all reasonable measures are taken to avoid further disturbance of the discoveries. The subgrantee's contractor will provide immediate notice of such discoveries to the subgrantee. The subgrantee will notify KYEM and FEMA within 24 hours of the discovery. FEMA will notify the Tribes of the discovery. Work in the vicinity of the discovery may not resume until FEMA has completed consultation with SHPO, Tribes, and other consulting parties as necessary. In the even that unmarked human remains are encountered during permitted activities, all work shall stop immediately and the proper authorities notified in accordance with Kentucky Statutes, Section 72.02.	None.

Affected Environment	Impacts from Proposed Action Alternative	Conditions/Mitigation	Impacts from No Action Alternative
<p>4.5 Socioeconomic Concerns (Environmental Justice, Noise, Traffic, Public Service and Utilities, Public Health and Safety)</p>	<p>All residents of the City would benefit from reliable site access to businesses and residences. With less flood-related costs (flood cleanup, etc.), there would be more money available for other projects in the City.</p> <p>No adverse socioeconomic impacts are anticipated. Temporary jobs would be created during the construction of the detention basin system.</p> <p>The reduction in flooding would provide positive socioeconomic benefits to the City by reducing flood-related business interruptions. The project would also benefit residents by ensuring more reliable roadway access.</p> <p>During construction the commercial businesses would remain open with some limits to access.</p> <p>Short-term, minor impacts to noise levels at the proposed project area during the construction period.</p> <p>Temporary increases in traffic volumes on U.S. Route 31-W and other roads in the immediate vicinity of the project area during construction.</p> <p>Positive impacts to public safety are anticipated because the proposed Quiggins Sinkhole Flood Mitigation Project would reduce potential for flooding events within the Happy Valley Drainage area.</p> <p>No hazardous materials or waste impacts are anticipated.</p>	<p>Construction would take place during normal business hours and equipment would meet all local, State, and Federal noise regulations.</p> <p>Proper signage would direct traffic during construction.</p> <p>Construction vehicles and equipment would be temporarily stored onsite during project construction, and appropriate signage would be posted on affected roadways.</p> <p>All construction activities would be performed using qualified personnel and in accordance with the standards specified in Occupational Safety and Health Administration (OSHA) regulations; appropriate signage and barriers should be in place prior to construction activities to alert pedestrians and motorists of project activities.</p> <p>Any contaminated or hazardous materials discovered, generated, or used during construction would be handled and disposed in accordance with applicable local, State, and Federal regulations.</p>	<p>All communities would continue to be adversely affected by flooding.</p> <p>Continued economic loss due to road closures would affect the City and its citizens, causing business interruptions and flooding to at least 54 structures.</p> <p>Continued flooding of South Wilson Road and U.S. Route 31-W, with access restrictions during flood events.</p> <p>Flooding of South Wilson Road and U.S. Route 31-W and the risk of citizens driving through and into flood waters would continue. Flooding and the associated structural damages would adversely affect safety.</p>
<p>4.6 Cumulative Impacts</p>	<p>None.</p> <p>Cumulative impacts are not anticipated for other past, present, or future projects known in the project area and vicinity.</p>	<p>Use of BMP's and conducting surface water monitoring per issued permits will be required during project construction.</p>	<p>Flooding of roads, highways, businesses, and residential properties and resulting damages within the Happy Valley Drainage Area from large storm events would continue.</p>

4.1 PHYSICAL RESOURCES (GEOLOGY AND SOILS, AND AIR QUALITY)

The proposed project area and Hardin County are underlain by Mississippian-aged carbonate rocks of the St. Genevieve or the St. Louis formation (KGS 2001; Lloyd and Like 1995). The lithology's of the sediments from the St. Genevieve or the St. Louis formations consist primarily of carbonate rocks such as limestone. The 1991 7.5-minute topographic map of the Vine Grove, Kentucky quadrangle shows the project area ranging in elevation from approximately 730 feet above sea level at the Quiggins Sinkhole to approximately 770 feet above sea level at the proposed Song Basin (USGS 1991). Topography in the area of the project area is rolling (QK4 2009) and may be generally characterized as a relatively low-lying sinuous (karst features) drainage area surrounded by areas of higher topography, which appear to be cut by streams flowing radially toward the drainage area.

According to the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) online Web Soil Survey, the project area is immediately underlain by silt loam soils, primarily mapped as the Nolin silt loam, frequently flooded (USDA 2013). This soil type occurs on floodplains, formed from mixed fine silty alluvium, and is characterized as a well-drained material with moderately high to high water movement in restrictive zones and very high available water capacity (USDA 2013). Due to the City's underlying karst formations, the majority of the City drains to 86 known sinkholes.

No Action Alternative – No construction would occur. Soil erosion (caused by flooding in excess of 1.0 inch) would continue to occur within the Quiggins Sinkhole area.

Proposed Action Alternative – Construction of the proposed Quiggins Sinkhole Flood Mitigation project would have limited temporary impacts to the soils of the individual basins and the spoils disposal area during construction.

Per a geotechnical report completed by Mattingly Engineers in 2009 for the Quiggins area (see Appendix C), the excavation and removal of soils within the Quiggins Basin and the other four new basins and the placement of fill in the proposed fill/spoils disposal area would result in minor, long-term impacts to soils. The 2009 geotechnical report found that the soil to be excavated is suitable for fill and could be used for this proposed project and future projects the City may have in the future. The excavated soil would be managed at the proposed fill/spoil disposal site, in accordance with applicable local, State, and Federal regulations.

These impacts include removal of surficial and subsoils from the individual basin sites and transport and placement of this soil in the designated disposal area where the soil would be properly graded out and revegetated. Trenching activities for the installation of culverts and piping from one basin to the Quiggins Sinkhole basin would include the installation of approximately 3,360 linear feet of new concrete piping and 1,980 linear feet of low-flow channel to interconnect the new basins with the Quiggins Sinkhole basin. These drainage basins are designed to gravity feed into the piping or low-flow channel resulting in flow toward the Quiggins Basin, and would not be deep enough to affect the geologic conditions.

Appropriate BMPs would be implemented throughout the project area that include: the installation of silt fences to prevent soil erosion, and floating turbidity curtains or biologs in the water during construction to control sedimentation. Excavated soil and waste materials would be managed and disposed of in accordance with applicable local, State, and Federal regulations at a designated spoils disposal area. If contaminated materials are discovered during the construction activities, the work will cease until the appropriate procedures and permits can be implemented.

4.2 WATER RESOURCES (WATER QUALITY (SURFACE WATER, GROUND WATER), WATERS OF THE U.S. INCLUDING WETLANDS & FLOODPLAINS)

4.2.1 Water Quality

The Clean Water Act, Section 401 provides for statutory authority for state water quality standards programs. Regulatory requirements governing these programs are in 40 CFR 131. States are responsible for reviewing, establishing, and revising water quality standards. The Kentucky Division of Water's Water Quality Branch (KDOW-WQB) is responsible for monitoring and assessing the quality of water in the state's streams, lakes, and wetlands. KDOW-WQB revises water quality standards and criteria, classifies surface waters for designated uses and interprets standards for Kentucky Pollutant Discharge Elimination System permit decisions.

Surface Water

The proposed stormwater management project is related to the 1.74 square miles of the Happy Valley drainage where runoff flows into Quiggins Sinkhole. A hydrological study of the existing Quiggins Sinkhole storm water detention system was performed in 2009 to study the hydrogeology of karst flooding of the Happy Valley drainage area (See Appendix C). The study concluded that the Quiggins Sinkhole was capable of discharging floodwaters at approximately 11.9 cubic feet per second (cfs) (about the same flow capacity of a 12-inch pipe or smaller) and that any storm event producing more than one inch of rain in six hours, with vegetation dormant and soil moisture high, would easily flood the sinkhole area.

Based on topography in the project area, surface water also likely drains toward the Quiggins Sinkhole from surrounding drainages. Due to the large volume of runoff and the limited intake capacity of the sinkhole, flooding and extended ponding frequently occur at the site.

No Action Alternative – No construction would occur and there would be no impacts to surface water. Flooding would continue along South Wilson Road and U.S. Route 31-W.

Proposed Action Alternative – Surrounding roads and structures would be protected from the current frequency of flood events. The Proposed Action Alternative would increase the project area's detention volume by excavating and developing the proposed five detention basins and proposed alternate detention site. These stormwater detention basins will be developed to hold stormwater that would otherwise flood the Quiggins Sinkhole and lead to flooding of the surrounding areas. The applicant will be required to prepare a Storm Water Pollution Prevention Plan (SWPPP) and obtain a NPDES permit for the temporary construction impacts and the permanent impacts to 0.091 acre wetlands, 3,997 linear feet (0.515 acre) of intermittent streams, and 3,895 linear feet (0.271 acre) of ephemeral streams within the entire Quiggins Sinkhole project area. To reduce impacts to surface water, the applicant would implement appropriate BMPs, such as installing silt fences during construction.

In addition to flood control, the construction of the basins may enhance water quality. Sediments collected by the excess runoff could settle out while the rainfall is being temporarily impounded in the constructed basins. The City plans to impound the stored runoff in the basins for the entire duration of each rainfall event and beyond to allow sinkhole backwater to subside. During this period, many of the suspended sediments would settle out.

Groundwater

Project area groundwater is dominated by the Mississippian bedrock aquifer system, mostly consisting of sedimentary carbonate rocks such as limestone, in the area of the site (Lloyd and Like 1995). This aquifer system generally yields an average of 10 gallons per minute (gpm), but may generate volumes as large as 100 gpm. The rocks that comprise the aquifer system in this area are Mississippian in age. Carbonate rocks such as limestone may be subject to solution weathering and development of karst terrain features such as sinkholes and caves. Bedrock in the area of the site is characterized as having high potential for karst terrain development (KGS 2001).

No Action Alternative – No construction would occur and there would be no impacts to groundwater.

Proposed Action Alternative – Construction activities associated with the development of the Quiggins, Cato, Song, Turner, Wilson Basins and potentially the alternate detention basin would not reach a sufficient depth to impact groundwater. Consultation and permitting with U.S. Army Corps of Engineers (USACE) and Kentucky Department for Environmental Protection – Division of Water (KDEP-DOW) has been completed and will address any potential impacts to groundwater associated with construction-related surface water impacts. The City has received Water Quality Certifications from the KDEP-DOW for the following basins: Cato (#2014-026-1, dated 05/29/2014), Turner Lane (#2014-027-1, dated 05/30/2014) and the Fill/Spoil Area (#2014-025-1, 05/29/2014). Water quality exemptions were issued by the KDEP-DOW for the following basins: Wilson Road (letter dated 05/29/2014) and Song (letter dated 05/29/2014). The City has also received a Stream Construction Permit (#20726, dated 11/20/2014, expires 02/19/2015) and the Quiggins Stream Restoration and Flood Mitigation Permit (#2014-023-1, dated 05/22/2014). All copies of the permits are located in Appendix D.

4.2.2 Waters of the U.S. Including Wetlands

Presidential Executive Order (EO) 11990 (Protection of Wetlands) and FEMA implementing regulations for EO 11990 at 44 CFR part 9 require FEMA to avoid, to the extent possible, adverse impact to wetlands. The USACE regulates the discharge of dredged and fill material into WOUS, including wetlands, pursuant to Section 404 of the Clean Water Act (CWA). See Appendix A, Figure 4 for the National Wetlands Inventory (NWI) Map and location of wetlands in the project area.

No Action Alternative – No construction and no impacts to WOUS, including wetlands, would occur.

Proposed Action Alternative – Construction of the proposed five stormwater basins, the interconnecting piping and the development of a spoil disposal area would affect WOUS. The City submitted Pre-Construction Notices (PCN) to the U.S. Army Corps of Engineers (USACE) in 2014. The proposed project has received permits with the USACE under Nationwide numbers

27 and 43. See Appendix D for copies of all PCNs and issued USACE permits. Since the total area of ground disturbance for all five basins and the spoils disposal area is greater than one acre, the City will be required to obtain a National Pollutant Discharge Elimination System (NPDES) permit from KDEP and to prepare a Storm Water Pollution Prevention Plan (SWPPP) prior to construction; this SWPPP must include BMPs to minimize erosion of soils from the construction area and reduce offsite sediment transport. Copies of the NPDES and SWPPP documentation will be required at project closeout.

A breakdown of impacts to WOUS by basin/area:

1. Song Basin – Per USACE Nationwide 43 Permit ID #: LRL-2014-284-JEA dated July 10, 2014: : impacts will occur to 158 linear feet (0.01 acres) of ephemeral stream. No wetlands were identified in this area.
2. Cato Basin – Per USACE Nationwide 43 Permit ID #: LRL-2014-280-JEA, dated July 28, 2014: impacts to 624 linear feet (0.072 acres) of intermittent stream and 200 linear feet (0.021 acres) of ephemeral stream. No wetlands were identified in this area. Permit valid until March 18, 2017.
3. Wilson Road Basin – Per USACE Nationwide 43 Permit ID #: LRL-2014-282-jea, dated July 28, 2014: impacts to 1,384 linear feet (0.078 acres) of ephemeral stream 0.091 acres of wetlands. Permit valued until March 18, 2017.
4. Turner Lane Basin – Per USACE Nationwide 27 Permit ID #: LRL-2014-281-JEA, dated July 25, 2014: impacts to 912 linear feet (0.084 acres) of intermittent stream. No wetlands were identified in this project area. Permit valid until March 18, 2017.
5. Quiggins Basin – Per USACE Nationwide 27 Permit ID #:: LRL-2013-1015-MCK; impacts to 2,105 linear feet (0.16 acres) of ephemeral stream and 1,735 linear feet (0.28 acres) of intermittent stream. No wetlands were identified in this project area.
6. Fill-Spoil Area – Per USACE Nationwide 27 Permit ID #: LRL-2014-283-JEA impacts to 149 linear feet (0.02 acres) of intermittent stream. No wetlands were identified in this project area.

Breakdown of mitigation by basin/area:

1. Song Basin – Construction of a stormwater management channel in the bottom of the basin to convey low-flow stormwater from the inlet of the basin to the outlet structure. Silt fencing, sediment traps, and other appropriate Best Management Practices will be implemented to minimize impacts during construction.
2. Cato Basin:
 - a. The permittee shall only remove trees from within the project area between the dates of October 15th to March 31st.
 - b. The permittee shall provide receipt of payment from the Kentucky Department of Fish and Wildlife Resources (KDFWR) Stream and Wetlands Mitigation Program for the purchase of 869 Adjusted Mitigation Units (AMUS) for stream impacts. The AMUs must be purchased prior to the discharge of fill into “waters of the United States”. The Corps ID No. LRL-2014-207-JEA must accompany the payment. Inquiries regarding credit purchase may be made directly to the KDFWR by calling Mr. Clifford Scott (502) 564-5101, by email at

clifford.scott@ky.gov, or in writing at: Kentucky Department of Fish and Wildlife Resources, Division of Fisheries; #1 Sportsman's Lane; Frankfort, Kentucky 40601. This documentation will be required at project closeout.

3. Wilson Rd. Basin:

- a. The permittee shall only remove trees from within the project area between the dates of October 15th to March 31st.
- b. The permittee shall implement the Stream Restoration and Monitoring Plan for Wilson Road Basin Flood Mitigation Project, Hardin County, Kentucky dated April 28, 2014.
- c. The permittee shall submit an annual monitoring report for five years by the 31st of December until released from monitoring by this office. The first report is due after the first year the project is established. If the project is degraded through sedimentation at the end of the five year monitoring period, the permittee shall provide an alternative mitigation plan
- d. The permittee shall execute a deed restriction¹ on the mitigation site within the appropriate county and submit documentation of the recorded deed restriction to this office after construction is completed and prior to release of the site from monitoring requirements. The submitted deed restriction must be reviewed and approved by the Corps of Engineers prior to being recorded.
- e. The permittee shall provide the District Engineer a receipt of purchase of 0.2 wetlands credits from a Corps approved wetland mitigation bank with a service area that includes Hardin County, Kentucky prior to the discharge of dredged or fill material into "waters of the United States".

4. Turner Lane Basin:

- a. The permittee shall only remove trees from within the project area between the dates of October 15th to March 31st.
- b. The permittee shall implement the Stream Retort ion and Monitoring Plan Turner Lane Stream Restoration and Flood Mitigation Project, Hardin County, Kentucky Dated May 14, 2014.
- c. The permittee shall submit an annual report for five years documenting ecological lift following construction of the project. The report shall be due by 31st of December of each year until release from monitoring by this office. If the project is not providing an ecological life at the end of five year period, the permittee shall provide an alternative plan with remedial actions.
- d. The permittee shall execute a deed restriction on the mitigation site within the appropriate county and submit documentation of the recorded deed restriction to this office after construction is completed.

¹ The deed restriction is a conservation easement that will permanently protect the streams and riparian corridors in the mitigation area from future impacts, and will not allow activities such as channelization or culverting of the stream channels, or cutting down of the planted trees within the riparian corridor.

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- e. [The sub-grantee] must also comply with the individual Water Quality Certification (WQC) Conditions dated May 30, 2014, issued by the KDOW. Documentation of compliance will be required at project closeout.
 5. Quiggins Basin - Since the purpose of the project is to restore the degraded intermittent stream channel within the basin, direct compensation for impacts with this project is not proposed.
 6. Fill-Spoil Area - Since the purpose of the project is to restore the degraded intermittent stream channel within the basin, direct compensation for impacts with this project is not proposed.

4.2.3 Floodplains

EO 11988 (Floodplain Management) and FEMA's implementing regulations at 44 CFR part 9 require FEMA to avoid direct or indirect support of development within the 1% chance floodplain whenever there is a practicable alternative. FEMA Flood Insurance Rate Maps (FIRMs) show Special Flood Hazard Areas (SFHA).

Consistent with EO 11988 and 44 CFR part 9, FIRMs were examined during the preparation of this EA. No portion of the proposed project area is depicted as being located within the 1% chance mapped flood zone, per FEMA FIRM Panel Number 21093C0141D, effective date of August 16, 2007 (Appendix A Figure 3).

No Action Alternative – Not located within the 1% chance mapped flood zone.

Proposed Action Alternative – Not located within the 1% chance mapped flood zone, but adjacent to the 1% chance mapped flood zone.

4.3 BIOLOGICAL RESOURCES (T&E SPECIES/CRITICAL HABITAT, MIGRATORY BIRDS, WILDLIFE AND FISH)

Section 7 of the Endangered Species Act (ESA) of 1973 (16 USC § 1536) requires Federal agencies to determine the effects of their proposed actions on threatened and endangered (T&E) species of fish, wildlife, and plants, and their habitats, and to take steps to conserve and protect these species. The proposed project area is in Hardin County, Kentucky where the following federally listed species have the potential to occur: clubshell (*Pleurobema clava*), rabbitsfoot (*Quadula cylindrica cylindrica*), orangefoot pimpleback (*Plethobasus cooperianus*), sheepnose (*Plethobasus cyphus*), rough pigtoe (*Pleurobema plenum*), fat pocketbook (*Potamilus capax*), Indiana bat (*Myotis sodalis*), gray bat (*Myotis grisescens*) and the proposed for listing: Northern long-eared bat (*Myotis septentrionalis*).

The clubshell, rabbitsfoot, orangefoot pimpleback, sheepnose, rough pigtoe, and fat pocketbook are Unionid mussels that inhabit sand and gravel substrates of small to large rivers (Cicerello and Schuster 2003). These habitat conditions are not present within the proposed basins or spoils disposal area.

Jackson Environmental Consulting Services, LLC, (Jackson Environmental) of Richmond, Kentucky was contracted by URS Group, Inc. to conduct an ecological assessment in support of this EA. The ecological assessment focused on identifying potential Indiana bat and gray bat habitat within the proposed basin boundaries and the spoils disposal area (Appendix C). No

suitable habitat (i.e., surface karst features) was observed within the proposed basins or spoils disposal area for the federally listed threatened gray bat. Four of the five proposed basins (Cato, Turner, Wilson, and Quiggins) contain habitat features that could provide potential summer roosting and foraging habitat for the federally listed endangered Indiana bat. These areas contain mature hardwoods including shagbark hickory (*Carya ovata*), trees with broken tops and sloughing bark, and snags. Observed foraging habitat included forested wetlands and streams, which could serve as potential flight corridors and water sources for foraging Indiana bats.

Hardin County, KY is in a known migratory bird fly way. However, there are no known regular stocking locations (wet ponds and wetlands) for these species in the project area. Sufficient wooded areas exist; however, seasonal tree clearing activities would occur when it is unlikely to impact migratory bird patterns. It is not anticipated this project will not have any long term impacts on migratory birds. Only short term impacts during construction activities are anticipated.

No Action Alternative – No impacts to biological resources, including federally protected species, because no construction would occur.

Proposed Action Alternative – Permanent impacts are anticipated on 9.4 acres of potential summer roosting habitat for the federally listed endangered Indiana bat within four of the five proposed basins (Cato, Turner, Wilson, and Quiggins basins). The removal of this habitat will occur during the unoccupied time (between October 15 and March 31), thus avoiding direct effects to the Indiana bat. The Northern long-eared bat is currently proposed for federal listing and may become listed as early as October 2014. Therefore this species requires consideration under the ESA. The seasonal tree clearing measures implemented for the Indiana bat would provide protection for the Northern long-eared bat. Additionally, an Erosion Prevention and sediment control plan approved by KDOW-WQB will be utilized to minimize sedimentation and erosion to streams that may be used by foraging federally-listed endangered bats and any potential downstream impacts to federally-listed mussels.

FEMA will place the following conditions on the proposed work:

1. Any additional tree removal that may need to occur in the project area may only occur during the allowed seasonal timeframes (October 15 – March 31 of any given year).
2. If new information reveals impacts of the proposed action that may affect listed species or critical habitat in a manner not previously considered, the sub-grantee shall cease project construction and notify FEMA immediately so that the appropriate review and potential appropriate regulatory agency review consultation may occur.
3. If the proposed action is subsequently modified to include activities which were not considered during FEMA review and regulatory agency consultation, the sub-grantee shall cease project construction and notify FEMA immediately so that the appropriate review and potential appropriate regulatory agency review consultation may occur.
4. If new species are listed or critical habitat designated that might be affected by the proposed action, the sub-grantee shall cease project construction and notify FEMA immediately so that the appropriate review and potential appropriate regulatory agency review consultation may occur.

FEMA has made the following determination under Section 7 of the ESA: the proposed action may affect, but not likely adversely affect the Indiana Bat, Gray Bat, listed mussels and their designated critical habitat. While the northern long-eared bat is currently proposed for listing, compliance with the above conditions would avoid direct impacts to the northern long-eared bat and the proposed project will not jeopardize the continued existence of the northern long-eared bat. On 12/09/2014, FEMA received concurrence on this determination from the USFWS Kentucky Field office via electronic mail (Appendix D).

4.4 CULTURAL RESOURCES (HISTORIC PROPERTIES, AMERICAN INDIAN CULTURAL RESOURCES)

Section 106 of the National Historic Preservation Act (NHPA) of 1966, (Public Law 89-665; 16 USC § 470, et seq.) as amended, requires Federal agencies to consider the effects of their actions on historic properties and provide the Advisory Council on Historic Preservation (ACHP) an opportunity to comment on Federal projects prior to implementation. Historic properties are defined as archaeological sites, standing structures, or other historic resources listed in or eligible for listing in the National Register of Historic Places (NRHP). Under Section 106, Federal agencies are responsible for identifying historic properties within the Area of Potential Effects (APE) for an undertaking, assessing the effects of the undertaking on those historic properties, if present, and considering ways to avoid, minimize, and mitigate any adverse effects. In accordance with 36 CFR § 800.4(a), FEMA has defined an APE consistent with the scale and nature of the undertaking. The APE encompasses those areas within which the undertaking may directly or indirectly cause alterations in the character or use of historic properties if any such properties exist. The APE includes the area within which all construction and ground disturbing activity would take place and the view shed of the proposed project (Appendix A, Figure 2).

4.4.1 Cultural Resources

URS conducted a historic resources survey of the APE in 2013 (Higgins et al. 2013). See Appendix C for the survey report. One previously surveyed historic resource (HD 15; Haycraft Inn) was documented during the field survey. The Haycraft Inn was individually listed in the NRHP on August 26, 1988, under Criterion A for local significance in the areas of transportation during circa 1840–1845 and Criterion C in the area of Architecture as a notable example of an early central passage house.

No previously recorded archaeological sites are located within the project boundaries, and 20 archaeological sites are documented within a 2-kilometer radius of the project boundaries. An archaeological survey of the APE for direct impacts, which corresponds to the proposed construction footprint of each of the five basins plus the area for the disposal of spoil material, conducted by URS in 2013 documented one historic archaeological site (15Hd963) and one prehistoric isolated find (IF-1) within the project boundaries (Davies et al. 2013). See Appendix C for the Phase I archaeological report. Site 15Hd963 represents the remains of a late nineteenth to twentieth century farmstead, while IF-1 consisted of a scatter of three non-diagnostic prehistoric lithic artifacts. Both were recommended as not eligible for listing in the NRHP in the URS report.

No Action Alternative – No impacts to cultural resources because no construction would occur.

Proposed Action Alternative – The Haycraft Inn is located adjacent to the Song Basin and is listed in the NRHP. While no portion of the resource would be directly impacted by the Proposed Action Alternative, one of the planned detention basins in the Proposed Action Alternative would be visible from the resource. The existing trees that line both sides of South Wilson Road, which separate the resource from the project boundaries, would not be removed and would partially block the view of the basin from the resource. The historic character of the area has been previously diminished by the prior construction of a large radio tower 0.14 mile north of the resource. While there would be a visual impact to this resource by the Proposed Action Alternative, FEMA has determined that there would be no adverse effect and the Kentucky Heritage Council (SHPO) has concurred. Because of the finding of no adverse effect to historic resources, no mitigation will be necessary.

While historic archaeological site 15H963 and the prehistoric isolated find, IF-1, which are located within the boundaries of the Cato Basin and the Turner Basin, respectively, would be directly impacted by the Proposed Action Alternative, neither is eligible for listing in the NHRP. FEMA has made a determination that the project would have no adverse effect on significant archaeological sites, and the SHPO has concurred (see Appendix D for SHPO concurrence letter).

Due to the potential for post review archaeological discoveries on the site, FEMA will condition approval of the undertaking with the following unexpected discovery clause: If human remains or intact archaeological deposits are uncovered, work in the vicinity of the discovery will stop immediately and all reasonable measures to avoid or minimize harm to the finds will be taken. The City will ensure that archaeological discoveries are secured in place, that access to the sensitive area is restricted, and that all reasonable measures are taken to avoid further disturbance of the discoveries. The City's contractor will provide immediate notice of such discoveries to the subgrantee. The City will notify Kentucky Emergency Management (KYEM) and FEMA within 24 hours of the discovery. FEMA will notify SHPO of the discovery. Work in the vicinity of the discovery may not resume until FEMA has completed consultation with SHPO, Tribes, and other consulting parties as necessary. In the event that unmarked human remains are encountered during permitted activities, all work shall stop immediately and the proper authorities notified in accordance with *Kentucky Statutes, Section 72.02*.

4.4.2 American Indian Cultural Resources

No Action Alternative – No impacts to archaeological sites or above-ground resources because no construction would occur.

Proposed Action Alternative – No known American Indian traditional cultural property affected. On April 10, 2014 FEMA initiated consultation with the following Tribes: Absentee-Shawnee Tribe of Oklahoma, Cherokee Nation, Delaware Nation of Oklahoma, Eastern Band of Cherokee Indians, Eastern Shawnee Tribe of Oklahoma, Miami Tribe of Oklahoma, Peoria Indian Tribe of Oklahoma, Shawnee Tribe, United Keetoowah Band of Cherokee Indians.

The Peoria Tribe of Indians of Oklahoma responded on April 16, 2014, “[the tribe] is unaware of items covered under Native American Graves Protection and Repatriation Act (NAGPRA) to be associated with the proposed project site. These items include: funerary or sacred objects; objects of cultural patrimony; or ancestral human remains. The [tribe] has no objection at this time to the proposed drainage construction program. If, however, at any time items are discovered which fall

under the protection of NAGPRA, the [tribe] requests immediate notification and consultation. In addition state, local and tribal authorities should be advised as to the findings and construction halted until consultation with all concerned parties has occurred.”

The United Keetoowah Band of Cherokee Indians in Oklahoma responded on April 23, 2014, “the [tribe] has reviewed your project under Section 106 of the NHPA, and at this time, have no comments or objections. However, if any inadvertent discoveries of human remains are made, please cease work and contact us immediately.”

The Delaware Nation Cultural Preservation Department responded on May 9, 2014, “[a]s described in your correspondence and upon research of our database(s) and files, we find that the Lenape people occupied this area either prehistorically or historically. However, the location of the project does not endanger cultural or religious sites of interest to the Delaware Nation. Please continue with the project as planned. However, should this project inadvertently uncover an archaeological site or object(s), we request that you halt all construction and ground disturbing activities and immediately contact the appropriate state agencies, as well as our office (within 24 hours). See Appendix D for all Tribal responses.

In the event of archaeological discoveries on the site, FEMA would condition approval of the undertaking with the following unexpected discovery clause: If human remains or intact archaeological deposits are uncovered, work in the vicinity of the discovery will stop immediately and all reasonable measures to avoid or minimize harm to the finds will be taken. The subgrantee will ensure that archaeological discoveries are secured in place, that access to the sensitive area is restricted, and that all reasonable measures are taken to avoid further disturbance of the discoveries. The subgrantee’s contractor will provide immediate notice of such discoveries to the subgrantee. The subgrantee will notify KYEM and FEMA within 24 hours of the discovery. FEMA will notify the Tribes of the discovery. Work in the vicinity of the discovery may not resume until FEMA has completed consultation with SHPO, Tribes, and other consulting parties as necessary. In the even that unmarked human remains are encountered during permitted activities, all work shall stop immediately and the proper authorities notified in accordance with *Kentucky Statutes, Section 72.02*.

4.5 SOCIECONOMIC CONCERNS (ENVIRONMENTAL JUSTICE, NOISE, TRAFFIC, PUBLIC SERVICE AND UTILITIES, PUBLIC HEALTH AND SAFETY)

4.5.1 Environmental Justice

EO 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations) mandates that Federal agencies identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations.

According to the 2010 U.S Census Bureau (USCB), the City has a population of 21,688 individuals. The median household income in the community was \$44,222, with 21 percent of all individuals living below the poverty level. The median household income reported in all of Hardin County was \$48,743, with 14.1 percent of all individuals living below the poverty level. The median household income in the State of Kentucky was \$42,248, with 18.1 percent of individuals living below the poverty level (USCB 2012).

According to the 2010 Census, minorities represented 39 percent, 19.5 percent, and 12.2 percent of Radcliff, Hardin County, and the State of Kentucky populations, respectively. In Radcliff, 18.1 percent of citizens over the age of five are living with a disability. Comparatively, 15.5 percent of people in Hardin County, and 16.8 percent of people in the State of Kentucky, are living with a disability.

No Action Alternative – Construction would not occur and the businesses and residents within the project area would remain at risk for future severe flooding events. There would be no disproportionately high or adverse impact on minority or low-income portions of the population – all populations would continue to be at risk.

Proposed Action Alternative – No disproportionately high or adverse impact on minority or low-income portions of the population; all populations would benefit from the protection provided by the proposed project.

4.5.2 Air Quality

The Clean Air Act (CAA) of 1970 requires that States adopt ambient air quality standards. The standards have been established in order to protect the public from potentially harmful amounts of pollutants. Under the CAA, the U.S. Environmental Protection Agency (EPA) establishes primary and secondary air quality standards. Primary air quality standards protect the public health, including the health of “sensitive populations, such as people with asthma, children, and older adults.” Secondary air quality standards protect public welfare by promoting ecosystems health, and preventing decreased visibility and damage to crops and buildings. EPA has set National Ambient Air Quality Standards (NAAQS) for the following six criteria pollutants: ozone (O₃), particulate matter (PM_{2.5}, PM₁₀), nitrogen dioxide (NO₂), carbon monoxide (CO), sulfur dioxide (SO₂), and lead (Pb). According to the Kentucky Division for Air Quality (KDAQ) Fiscal Year 2012 Annual Report, Hardin County, Kentucky meets all NAAQS criteria (KDAQ 2012).

No Action Alternative – No construction would occur and there would be no impacts on air quality.

Proposed Action Alternative – No long-term impacts on air quality. Short-term impacts on air quality could occur during site work from vehicular emissions and fugitive dust. Emissions from fuel-burning internal combustion engines (e.g., heavy equipment) could temporarily increase the levels of some of the criteria pollutants, including CO, NO₂, O₃, PM₁₀, and non-criteria pollutants such as volatile organic compounds. To reduce the emission of criteria pollutants, fuel-burning equipment running times would be kept to a minimum and engines would be properly maintained. During periods of dry weather, construction areas would be watered-down to minimize fugitive dust.

4.5.3 Noise

Noise is generally defined as unwanted sound. Sound is most commonly measured in decibels (dB) on the A-weighted scale, which is the scale most similar to the range of sounds audible to the human ear. The Day-Night Average Sound Level (DNL) is an average measure of sound. The DNL descriptor is accepted by Federal agencies as a standard for estimating sound impacts and establishing guidelines for compatible land uses. EPA guidelines, and those of many other Federal agencies, state that outdoor sound levels in excess of 55 dB DNL are “normally

unacceptable” for noise-sensitive land uses such as residences, schools, or hospitals. The proposed project area is located in a commercial/residential area and the current noise environment reflects this land usage.

No Action Alternative – No construction would occur and there would be no impacts to noise levels.

Proposed Action Alternative – Temporary short-term increases in noise levels are anticipated during the construction period. To reduce noise levels during that period, construction activities would take place during normal business hours. Equipment and machinery used at the proposed project area during construction would meet all local, state, and Federal noise regulations.

4.5.4 Hazardous Materials

Hazardous substances are defined as any solid, liquid, contained gaseous or semisolid waste, or any combination of wastes that pose a substantial present or potential hazard to human health and the environment. Hazardous substances are primarily generated by industry, hospitals, research facilities, and the government. Improper management and disposal of hazardous substances can lead to pollution of groundwater or other drinking water supplies, and the contamination of surface water and soil. The primary Federal regulations for the management and disposal of hazardous substances are the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA).

No Action Alternative – No construction would occur and there would be no impacts to hazardous materials or waste.

Proposed Action Alternative – No hazardous materials other than petroleum products in construction vehicles would be used; no hazardous waste would be generated. FEMA requires that construction debris, as well as any potentially hazardous materials encountered during construction, be properly handled and disposed of in accordance with applicable local, State, and Federal regulations.

4.5.5 Human Health and Safety

Safety and security issues considered in this Draft EA include the health and safety of the area residents and businesses and the public-at-large, and the protection of personnel involved in activities related to the proposed construction of the new detention basin system.

No Action Alternative – No construction, and therefore no direct impacts on safety of the population. Businesses and residents of this area, including children, would continue to be at risk from flooding.

Proposed Action Alternative – Benefit to the City population by preventing flooding to business and residential structures within the Happy Valley Drainage Area from storms generating more than one inch of rainfall every six hours.

Construction activities could present safety risks to those performing the activities. To minimize risks to human health and safety, all construction activities would be performed using qualified personnel trained in the proper use of the appropriate equipment, including all appropriate safety precautions. Additionally, all activities would be conducted in a safe manner in accordance with the standards specified in the Occupational Safety and Health Administration (OSHA)

regulations. The appropriate signage and barriers would be in place prior to construction activities to alert pedestrians and motorists of project activities. There would be no disproportionate health and safety risks to children.

4.5.6 Socioeconomic Resources

The proposed project area is located in the southern portion of the City, and is surrounded by residential, commercial, and vacant areas. The total population of the City, as measured by the 2010 census, was 21,688 with 64.7 percent of citizens over the age of 16 participating in the work force. Leading employment sectors are management, business, science, and arts occupations (31.0 percent); sales and office occupations (25.3 percent); production, transportation, and material moving occupations (12.0 percent); and service occupations (24.3 percent).

Leading industries include educational, health, and social services (18.5 percent); arts, entertainment, recreation, accommodation, and food services (14.2 percent); professional, scientific, management, administrative and waste management services (11.1 percent); public administration (13.9 percent); and retail trade (13.3 percent).

No Action Alternative – Economic loss due to flood-related road closures would continue, with impacts imposed on the City and its citizens, business interruptions, and continued flooding of at least 54 structures.

Proposed Action Alternative – Impacts on socioeconomic resources would be minimal. No permanent employment positions would be created or lost; temporary jobs would be created during the construction of the new detention basin system.

4.5.7 Transportation

The proposed project is located along an approximately 1.5-mile-long corridor parallel to U.S. Route 31-W and South Wilson Road. Shelby Avenue roughly comprises the northernmost boundary, and Joe Prather Highway roughly comprises the southernmost boundary.

No Action Alternative – No construction would occur. South Wilson Road and U.S. Route 31-W would continue to flood and road access or passage would be restricted during flood conditions.

Proposed Action Alternative – Minor temporary increase in the volume of construction traffic on roads in the immediate vicinity of the proposed project area that could potentially result in a slower traffic flow during the construction phase. To mitigate potential delays, construction vehicles and equipment would be stored on site during project construction, and appropriate signage would be posted on affected roadways.

No negative long-term transportation impacts are anticipated as a result of the proposed project. The proposed project would create positive long-term transportation impacts, as it would lessen the frequency of flooding on the roadways in the project area. Per December 09, 2014 conference call with the City, no Department of Transportation (DOT) permitting is required due to no easement use or access would be needed for the project.

4.6 CUMULATIVE IMPACTS

According to CEQ regulations, cumulative impacts represent the “impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR § 1508.7).” In accordance with NEPA and to the extent reasonable and practical, this EA considers the combined effect of the Proposed Action Alternative and other actions occurring or proposed near the proposed project area.

The project area consists of a mixture of residential, urban, commercial and natural (meadow and woodland) parcels in a mosaic pattern extending to the east and west of Dixie Highway (U.S. Route 31-W) within the city limits of Radcliff, Kentucky. The City Engineer has stated that at the present time there are not any known present or proposed projects slated for the project area. Possible access road repairs and occasional infrastructure improvements to the highway passing through this area may occur, but are not formally planned for implementation at the present time.

The construction of the proposed Quiggins Flood Mitigation Project would result in some minor, short-term impacts on the human environment during construction activities. However, these impacts have already been addressed with the mitigation measures through consultation with the applicable regulatory agencies. Cumulative impacts are not anticipated for other past, present, or future projects known in the project area and vicinity.

SECTION FIVE PUBLIC INVOLVEMENT, AGENCY COORDINATION AND PERMITS

FEMA is the lead agency for conducting the NEPA compliance process for the proposed Quiggins Sinkhole Flood Mitigation Project within the City. As part of NEPA compliance, the City notified the public of the availability of the EA for review at City Hall, located at 411 West Lincoln Trail Boulevard, Radcliff, Kentucky 40160 , through a public notice in the *News-Enterprise* newspaper published on (insert date here) and on the FEMA website at:

<https://www.fema.gov/environmental-planning-and-historic-preservation-program/environmental-documents-public-notices-1>

A 15-day public comment period was specified, beginning on (insert date here) and concluding on (insert date here), during which period the public could submit comment via email at: FEMA-R4EHP@fema.dhs.gov or post to Regional Environmental Officer, DHS/Federal Emergency Management Agency, Region 4, 3003 Chamblee-Tucker Road, Hollins Bldg., Atlanta, GA 30341. FEMA received (insert result) public comments on the EA during the public comment period. See Appendix E for a copy of the notice.

The following agencies and organizations were contacted or consulted during the environmental permitting process during preparation of this Draft EA:

- U.S. Fish and Wildlife Service, Frankfort, Kentucky Ecological Services Field Office

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- U.S. Army Corps of Engineers, Louisville District
 - Kentucky Department for Environmental Protection
 - Kentucky Heritage Council
 - Kentucky Natural Heritage Commission
 - Kentucky Department of Natural Resources and Environmental Protection
 - Kentucky Division of Water
 - Kentucky Division of Fish and Wildlife Resources
 - USDA Natural Resources Conservation Service
 - City of Radcliff Engineering Department
 - Kentucky Department of Transportation

Agency coordination and consultation response letters and e-mails are included in Appendix D.

In accordance with applicable local, State, and Federal regulations, the applicant is responsible for acquiring any additional necessary permits before starting construction at the proposed project area.

SECTION SIX REFERENCES

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SECTION SEVEN LIST OF PREPARERS

Heather D. Batson, MPA

Environmental Protection Specialist
Federal Emergency Management Agency
Region IV
3003 Chamblee-Tucker Road, Hollins Bldg.
Atlanta, GA 30341

Hadley Gilliland, MHP

Historic Preservation Specialist
Federal Emergency Management Agency
Region IV
3003 Chamblee-Tucker Road, Hollins Bldg.
Atlanta, GA 30341

Stephanie Madson, Ph.D.

Regional Environmental Officer
Federal Emergency Management Agency
Region IV
3003 Chamblee-Tucker Road, Hollins Bldg.
Atlanta, GA 30341

Patti Slade

Technical Lead, NEPA Compliance
Atlanta, GA
Contract No. HSFEHQ-09-D-1130,
Task Order No. HSFE60-12-J-0008,
15702708.000UA

Scott Seibel, RPA

Architectural Historian
URS Group, Inc.
12420 Milestone Center Drive, Suite 150
Germantown, MD

Allan Hale, PhD

Senior Environmental Scientist
URS Group, Inc.
525 Vine Street, Suite 1800

Sarah Bell, M.S.

Environmental Scientist
URS Group, Inc.
Cincinnati, OH

Angela Chaisson, CWB®

Independent Technical Review, NEPA
Compliance
URS Group, Inc.
Germantown, MD1000 Abernathy Road,
NE, Suite 900
URS Group, Inc.

APPENDIX A
FIGURES

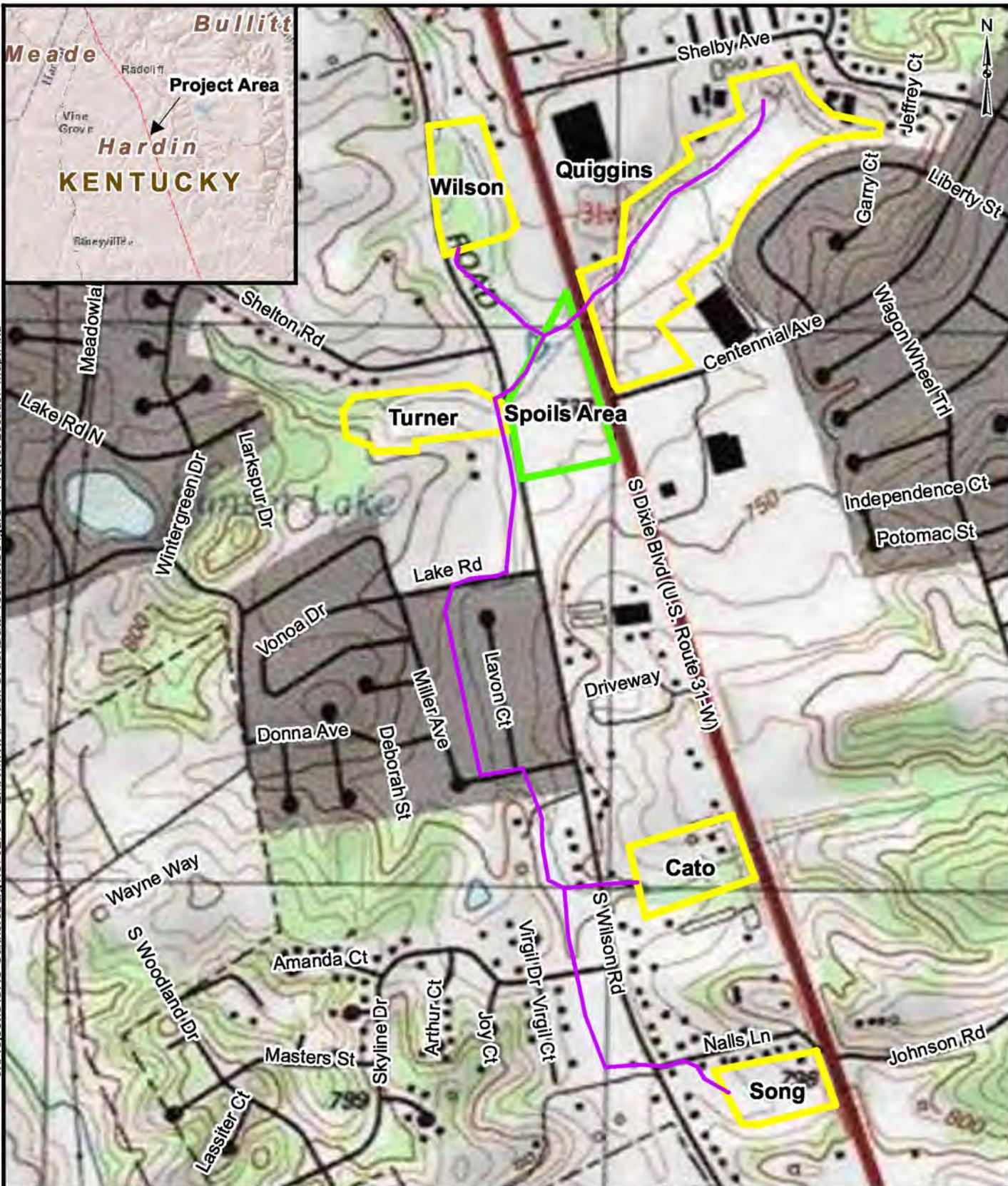


CLIENT	FEMA Region IV			
PROJ	Happy Valley Flood Mitigation, Hardin Co., KY			
REVISION NO	0	DES BY	KJM	03/29/13
SCALE	1:500,000	CHK BY	xxx	00/00/00



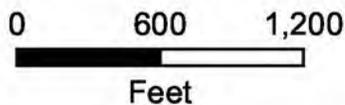
TITLE	Project Location	

J:\Project\U\URS_Gaithersburg\15702708_FEMA_MHTAP_Task Order\Data-Tech\GIS\Figure 1 - Project Location Map.mxd



LEGEND:

-  Piping/Low Flow Channel Connections
-  Detention Basin
-  Spoils Area



Base Map Source: Copyright: © 2013 ESRI, NAVTEQ, DeLorme
Copyright: © 2013 National Geographic Society, i-cubed



FEMA

**FIGURE 1
PROJECT LOCATION MAP**

JOB NO. 15702708



General project area



NFIP

PANEL 0141D

FIRM
FLOOD INSURANCE RATE MAP
HARDIN COUNTY,
KENTUCKY
AND INCORPORATED AREAS

PANEL 141 OF 510
 (SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
HARDIN COUNTY	210094	0141	D
RADCLIFF, CITY OF	210366	0141	D

Notes to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

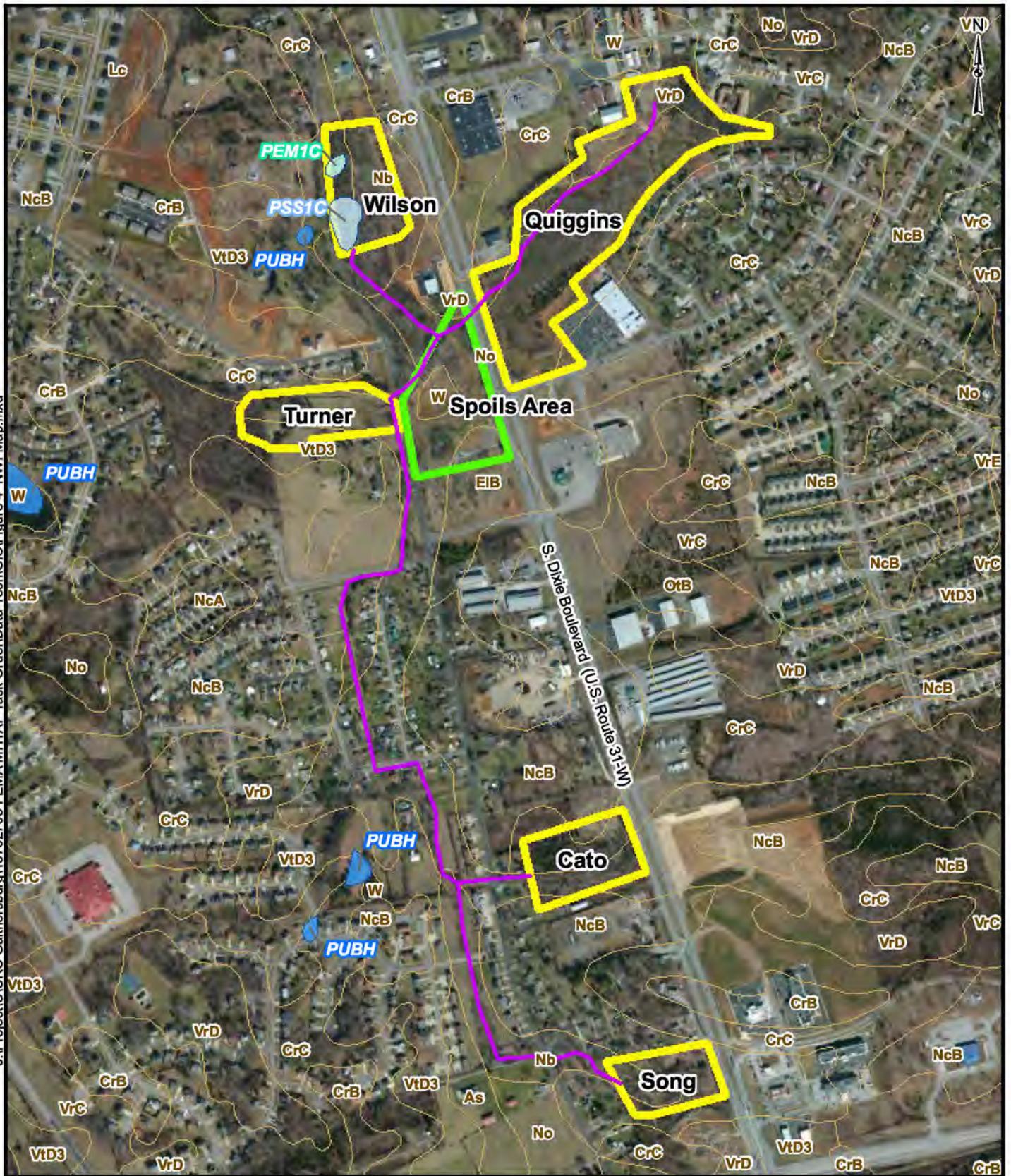


MAP NUMBER
21093C0141D
MAP REVISED
AUGUST 16, 2007

Federal Emergency Management Agency

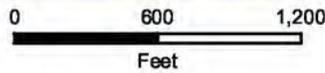
NATIONAL FLOOD INSURANCE PROGRAM

J:\Project\URS_Gaithersburg\15702708_FEMA_MHTAP_Task Order\Data-Tech\GIS\Figure 4_NWI_Map.mxd



LEGEND:

- Piping/Low Flow Channel Connections
 - Detention Basin
 - Spoils Area
 - USDA Soils
- National Wetlands Inventory**
- Freshwater Emergent Wetland
 - Freshwater Forested/Shrub Wetland
 - Freshwater Pond



Base Map Source: Source: Esri, DigitalGlobe, GeoEye, I-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



**FIGURE 4
NWI MAP**

JOB NO. 15702708



APPENDIX B
PHOTO LOG

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 1	
Date: July 2013	
Description: Wetland 1, Spoils Area	

Photo No. 2	
Date: July 2013	
Description: Wetland 2, Spoils Area	



PHOTOGRAPHIC RECORD

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 3	
Date: July 2013	
Description: Wetland 4, Wilson Basin	

Photo No. 4	
Date: July 2013	
Description: Wetland 5, Wilson Basin	



PHOTOGRAPHIC RECORD

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 5	
Date: July 2013	
Description: Wetland 6, Wilson Basin	

Photo No. 6	
Date: July 2013	
Description: Wetland 7, Song Basin	

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 7	
Date: July 2013	
Description: Wetland 8, Song Basin	

Photo No. 8	
Date: July 2013	
Description: Stream A, Spoils Area	

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 9	
Date: July 2013	
Description: Stream A1, Turner Basin	

Photo No. 10	
Date: July 2013	
Description: Stream Aa, Spoils Area	

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 11	
Date: July 2013	
Description: Stream B running through Wetland 3 in Spoils Disposal Area	

Photo No. 12	
Date: July 2013	
Description: Stream C, Turner Basin	

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 13	
Date: July 2013	
Description: Culvert in Stream D, Wilson Basin	

Photo No. 14	
Date: July 2013	
Description: Stream D1, Wilson Basin	

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 15	
Date: July 2013	
Description: Culvert running under Wilson Road; Stream D2, Wilson Basin	

Photo No. 16	
Date: July 2013	
Description: Stream D3, Wilson Basin	



PHOTOGRAPHIC RECORD

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 17	
Date: July 2013	
Description: Stream Da, Wilson Basin	

Photo No. 18	
Date: July 2013	
Description: Stream E, Quiggins Basin	

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 19	
Date: July 2013	
Description: Stream E flowing into the Quiggins Sinkhole, Quiggins Basin	

Photo No. 20	
Date: July 2013	
Description: Stream E1, Quiggins Basin	

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 21	
Date: July 2013	
Description: Stream E2, Quiggins Basin	

Photo No. 22	
Date: July 2013	
Description: Stream E4, Quiggins Basin	

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 23	
Date: July 2013	
Description: Stream E4a, Quiggins Basin	

Photo No. 24	
Date: July 2013	
Description: Stream E4a, Quiggins Basin	

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 25	
Date: July 2013	
Description: Stream E5, Quiggins Basin	

Photo No. 26	
Date: July 2013	
Description: Stream E6, Quiggins Basin	

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 27	
Date: July 2013	
Description: Stream E7, Quiggins Basin	

Photo No. 28	
Date: July 2013	
Description: Stream F, Song Basin	



PHOTOGRAPHIC RECORD

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 29	
Date: July 2013	
Description: Stream G, Cato Basin	

Photo No. 30	
Date: July 2013	
Description: Stream G1, Cato Basin	



PHOTOGRAPHIC RECORD

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 31	
Date: July 2013	
Description: Stream G2, Cato Basin	

Photo No. 32	
Date: July 2013	
Description: Indiana Bat habitat located in the Cato Basin	



PHOTOGRAPHIC RECORD

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 33	
Date: July 2013	
Description: Indiana Bat habitat located in the Wilson Basin	

Photo No. 34	
Date: July 2013	
Description: Indiana Bat potential roost tree located in the Turner Basin	

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 35	
Date: July 2013	
Description: Indiana Bat habitat located in the Quiggins Basin	

Photo No. 36	
Date: February 2013	
Description: 15Hd963 – farmstead remains	

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 37	
Date: February 2013	
Description: Feature 1 at 15Hd963	

Photo No. 38	
Date: February 2013	
Description: Feature 2 at 15Hd963	

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 39	
Date: February 2013	
Description: South Wilson Road near Skyline Drive (HD 876 "L&N Turnpike")	

Photo No. 40	
Date: February 2013	
Description: South Wilson Road (HD 876 "L&N Turnpike")	

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 41	
Date: February 2013	
Description: Haycraft Inn (HD 15), spring house foundation	

Photo No. 42	
Date: February 2013	
Description: Haycraft Inn (HD 15), view from South Wilson Road	



PHOTOGRAPHIC RECORD

Client Name: Federal Emergency Management Agency (FEMA) Department of Homeland Security	Site Location: Quiggins Sinkhole Flood Mitigation Project City of Radcliff, Hardin County, Kentucky HSFEHQ-06-D-0162	Project No. 15702708
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Photo No. 43	
Date: February 2013	
Description: Song Basin location from Haycraft Inn (HD 15)	

APPENDIX C
REPORTS

February 9, 2009

08147L01

Mr. Toby Spalding, PE
City of Radcliff
411 W. Lincoln Trail Blvd.
P.O. Box 519
Radcliff, KY 40159-0519

Re: Geotechnical Exploration
Quiggins Basin Project
Radcliff, Kentucky

Dear Toby:

Mattingly Engineers, LLC has completed a geotechnical exploration at the referenced site, per our proposal dated December 23, 2008. The purpose of the exploration was to evaluate subsurface conditions, including soil horizons and groundwater levels in relation to the proposed expansion of the stormwater detention basin. This letter describes the results of our findings and provides conclusions and recommendations.

1.0 Project Description

We understand that you are planning to excavate about 70-acre-feet of soil from the existing stormwater detention basin in order to create additional storage capacity. The site is mostly tree-covered with some mowed grassy areas to the northeast. The excavated material may be used as fill at off-site locations. Topographic relief across the site is about 6 feet with a gradual slope to the northeast.

2.0 Site Geology

Available geologic mapping (Geologic Map of the Vine Grove Quadrangle, USGS, 1967) shows the site to be underlain by limestone, dolomite, and shale from the St. Louis and Ste. Genevieve Limestone Formations of Mississippian geologic age. This formation is reduced by weathering to a clayey soil 30 to 40 feet thick and is marked by numerous sinks and a few caves.

3.0 Scope of Services

Eight soil test borings (B-1 through B-8) were advanced to a depth of 15 feet below the ground surface. Standard Penetration Testing (SPT) was performed on 2.5-foot to 5-foot intervals. Boring locations were estimated by measuring distances from the existing site features. Ground elevations were referenced to the elevation of the top of the box culvert under Highway 31W and the top of rim elevation for the sewer manhole in the northeast portion of the basin.

In order to monitor long-term groundwater levels, piezometers were installed in borings B-1, B-3, and B-8. The piezometers consisted of a 10-foot section of hand-slotted, 3/4-inch PVC pipe at the bottom of each boring with 3/4-inch PVC riser pipe extending to the ground surface.

Soil samples were returned to the laboratory for further evaluation and testing. Selected samples were subjected to natural moisture content tests and Atterberg limits testing. ASTM testing specifications were observed for all laboratory tests.

4.0 Results of Exploration

Table 1 below presents a summary of the borings. The boring layout, logs, and laboratory test results are included in Attachments 1 to 3, respectively.

Table 1
Summary of Borings

Boring No.	Surface Elevation (ft)	Groundwater Depth (ft)	Groundwater Elevation (ft)	Depth to Bottom of Borehole (ft)	Elevation of Borehole Bottom (ft)
B-1	717.2	5.8	711.4	15.0	702.2
B-2	716.9	8.8	708.1	15.0	701.9
B-3	716.6	3.0	713.6	15.0	701.6
B-4	716.8	10.0	706.8	15.0	701.8
B-5	712.1	7.0	705.1	15.0	697.1
B-6	716.1	8.8	707.3	15.0	701.1
B-7	716.6	-	-	15.0	701.6
B-8	709.1	4.0	705.1	15.0	694.1

The subsurface generally consisted of about 4 to 13 feet of alluvium (soils deposited by water) overlying residuum (soils resulting from weathering of the parent bedrock). The alluvium generally consisted of silt, clay, sand, and gravel. Based on visual classification, the alluvial

silt and clay classify as ML (Silt of Low Plasticity) and CL (Clay of Low Plasticity) according to the Unified Soil Classification System (USCS). They are generally described as brown, orange brown, light brown, dark brown and gray in color; moist to wet in natural moisture content; and soft to medium stiff in strength consistency based on SPT N-values generally ranging from 2 to 8.

Based on visual classification, the alluvial sand and gravel classify as SP (Poorly Graded Sand with Gravel). They are generally described as brown and orange brown in color; moist to wet in natural moisture content; and very loose to dense in relative density based on SPT N-values ranging from 3 to 37.

The underlying residuum generally consisted of lean clay and fat clay with USCS classifications of CL (Clay of Low Plasticity) and CH (Clay of High Plasticity), respectively. They are described as mottled light brown, orange brown, gray, and black in color; moist to wet in natural moisture content; and medium stiff to very stiff in relative density based on SPT N-values ranging from 6 to 22. Chert gravel was encountered in many of the residual soil samples.

Groundwater was encountered in all borings except B-7 at depths ranging from 3.0 to 10.0 feet below ground surface.

5.0 Conclusions and Recommendations

The following recommendations are based on the information available regarding the proposed construction, the results obtained from our soil test borings and laboratory tests, and our experience with similar projects. Because the test borings represent a very small statistical sampling of subsurface conditions, it is possible that conditions may be encountered during construction that are substantially different from those indicated by the soil test borings. In these instances adjustments to design and construction may be necessary.

The excavation for the basin will primarily occur within alluvial silt, clay, sand and gravel. Stabilized groundwater levels were encountered at relatively shallow depths ranging from about 3 to 10 feet. Natural moisture contents of the soils above the water table ranged from about 19% to 32%, indicating moist to wet conditions. If possible, efforts should be made to schedule construction of the project during drier months. The Contractor should be prepared to dewater the site through the use of pumps, sump pits, and ditches. The Contractor must draw his/her own conclusions regarding any dewatering on this project. The Contractor may encounter slower production rates and delays related to high groundwater and overall wet site conditions.

Prior to excavation of the subsurface soils, the ground surface should be stripped of all vegetation, topsoil and any other detrimental debris. This material should be stockpiled separately in order to prevent co-mingling with the subsoils that may be used for fill material

at other locations. Based on the borings, the topsoil thickness will likely be about 6 inches. The Contractor should verify actual stripping depths in the field before construction.

If the subsoils are to be used for structural fill material, it is likely that drying of the soils will be required to obtain a moisture content that is within an acceptable range of the optimum moisture content. The residual fat clay soil, generally encountered at depths below about 8 feet, should not be used within the upper 3 feet of a fill zone that will support buildings or roadways, due to its high shrink-swell potential. Because the residual fat clay was encountered at a depth of 3 feet in boring B-6, the contractor should be aware that fat clay may be encountered at shallower depths in this area.

The Contractor should recognize that the near-surface soils are silty in texture and are moisture sensitive. Repeated construction traffic loadings may create areas which lose strength and "pump" especially if moisture is available. The use of vibratory equipment will further increase the likelihood of "pumping" and should be avoided. These potential problems will be reduced if site construction is scheduled during summer and early fall when soil moisture is reduced by drying and diminished rainfalls.

6.0 Standard of Care

The services performed by Mattingly Engineers, LLC were conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the geotechnical profession practicing under similar conditions in the locality of the project. No other warranty, expressed or implied, is made.

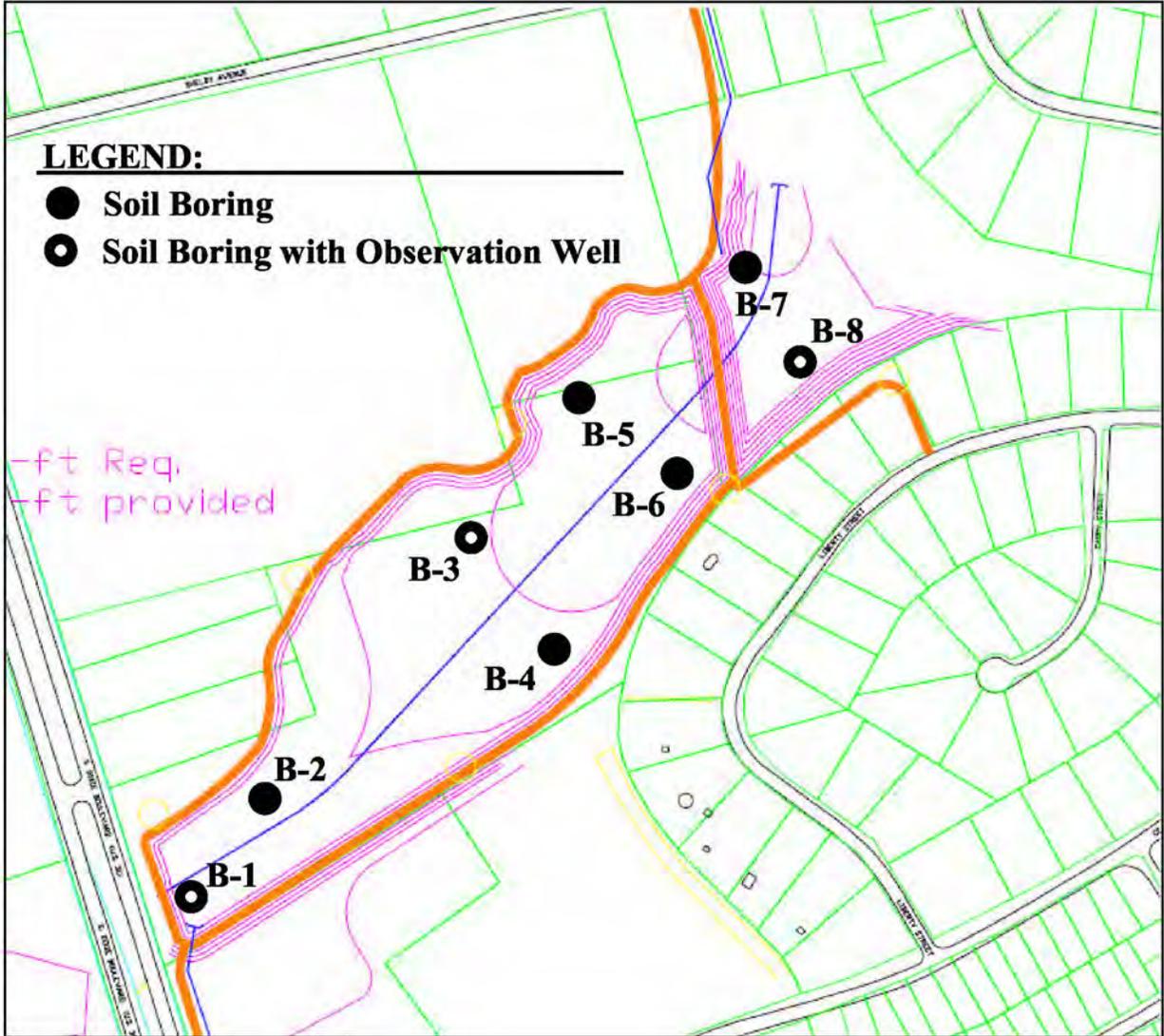
Mattingly Engineers, LLC appreciates the opportunity to provide these services. If you have any questions or comments regarding this report, please call me at (502) 550-3349.

Sincerely,

Michael D. Mattingly, PE
MATTINGLY ENGINEERS, LLC

Attachment 1 – Boring Layout
Attachment 2 – Boring Logs
Attachment 3 – Laboratory Test Results

Attachment 1 – Boring Layout



Boring Layout
Quiggins Basin
Radcliff, Kentucky

Attachment 2 – Boring Logs

Project Number <u>08147</u>	Weather <u>pt. cloudy</u>	Temperature <u>35°</u>
Project Name <u>Quiggins Basin</u>	Depth <u>15.0'</u>	
Location <u>Radcliff, Kentucky</u>	Surface Elevation <u>717.2</u>	
Drilling Co. <u>Greenbaum Associates</u>	Date Started <u>1/22/09</u>	Completed <u>1/22/09</u>
Drill Rig <u>CME 550 ATV</u> Driller <u>Mike Wells</u>	Depth to Water <u>8.8'</u>	Date/Time <u>Immediate</u>
Supervisor <u>Mike Mattingly</u>	Depth to Water <u>5.8'</u>	Date/Time <u>2/6/09</u>

Elevation	Depth	Description	Samples					Comments
			No.	Depth	Blows/6in	N	Rec/Att	
716.7'	0.5'	6" topsoil						
704.2'	13.0'	ALLUVIUM – Silt (ML), brown, moist to wet, medium stiff	1	2.0'-3.5'	3-3-3	6	1.3'/1.5'	NMC=24.9%
			2	5.0'-6.5'	1-2-2	4	1.5'/1.5'	NMC=26.8%
			3	10.0'-11.5'	2-2-3	5	1.5'/1.5'	
			4	13.5'-15.0'	0-3-3	6	1.5'/1.5'	
702.2'	15.0'	RESIDUUM – Fat Clay (CH), dark brown, very moist, medium stiff, some chert gravel						
		Boring Terminated						3/4" Observation Well Installed NMC=Natural Moisture Content

Project Number <u>08147</u>	Weather <u>pt. cloudy</u>	Temperature <u>35°</u>
Project Name <u>Quiggins Basin</u>	Depth <u>15.0'</u>	
Location <u>Radcliff, Kentucky</u>	Surface Elevation <u>716.9'</u>	
Drilling Co. <u>Greenbaum Associates</u>	Date Started <u>1/22/09</u>	Completed <u>1/22/09</u>
Drill Rig <u>CME 550 ATV</u> Driller <u>Mike Wells</u>	Depth to Water <u>8.8'</u>	Date/Time <u>Immediate</u>
Supervisor <u>Mike Mattingly</u>	Depth to Water <u>-</u>	Date/Time <u>-</u>

Elevation	Depth	Description	Samples					Comments
			No.	Depth	Blows/6in	N	Rec/Att	
716.4'	0.5'	6" topsoil						
		ALLUVIUM – Silt (ML), orange brown, gray, moist to very moist, soft to medium stiff, little clay	1	2.0'-3.5'	3-4-4	8	1.3'/1.5'	NMC=21.2%
			2	5.0'-6.5'	1-1-2	3	1.3'/1.5'	NMC=26.0%
			3	10.0'-11.5'	1-2-2	4	1.5'/1.5'	
705.4'	11.5'	RESIDUUM – Fat Clay (CH), dark brown, very moist, stiff, some chert gravel						
			4	13.5'-15.0'	3-3-10	13	1.5'/1.5'	
701.9'	15.0'	Boring Terminated						
								NMC=Natural Moisture Content

Project Number <u>08147</u>	Weather <u>pt. cloudy</u>	Temperature <u>35°</u>
Project Name <u>Quiggins Basin</u>	Depth <u>15.0'</u>	
Location <u>Radcliff, Kentucky</u>	Surface Elevation <u>716.6</u>	
Drilling Co. <u>Greenbaum Associates</u>	Date Started <u>1/22/09</u>	Completed <u>1/22/09</u>
Drill Rig <u>CME 550 ATV</u> Driller <u>Mike Wells</u>	Depth to Water <u>11.0'</u>	Date/Time <u>Immediate</u>
Supervisor <u>Mike Mattingly</u>	Depth to Water <u>3.0'</u>	Date/Time <u>2/6/09</u>

Elevation	Depth	Description	Samples					Comments
			No.	Depth	Blows/6in	N	Rec/Att	
716.3'	0.3'	4" topsoil						
713.6'	3.0'	ALLUVIUM – Poorly graded sand with gravel (SP), brown, wet, very loose	1	2.3'-3.8'	3-1-2	3	1.0'/1.5'	NMC=22.0%
711.6'	5.0'	ALLUVIUM – Lean clay (CL), light brown, wet, soft, some silt						
708.6'	8.0'	ALLUVIUM – Silt (ML), light brown, very moist, medium stiff, some clay	2	5.0'-6.5'	2-2-3	5	1.0'/1.5'	NMC=26.8%
		RESIDUUM – Lean clay (CL), mottled light brown and gray, moist, very stiff	3	10.0'-11.5'	3-6-10	16	1.5'/1.5'	
			4	13.5'-15.0'	7-7-10	17	1.5'/1.5'	
701.6'	15.0'							3/4" Observation Well Installed NMC=Natural Moisture Content
		Boring Terminated						

Project Number <u>08147</u>	Weather <u>pt. cloudy</u>	Temperature <u>35°</u>
Project Name <u>Quiggins Basin</u>	Depth <u>15.0'</u>	
Location <u>Radcliff, Kentucky</u>	Surface Elevation <u>716.8'</u>	
Drilling Co. <u>Greenbaum Associates</u>	Date Started <u>1/22/09</u>	Completed <u>1/22/09</u>
Drill Rig <u>CME 550 ATV</u> Driller <u>Mike Wells</u>	Depth to Water <u>10.0'</u>	Date/Time <u>Immediate</u>
Supervisor <u>Mike Mattingly</u>	Depth to Water <u>-</u>	Date/Time <u>-</u>

Elevation	Depth	Description	Samples					Comments
			No.	Depth	Blows/6in	N	Rec/Att	
716.5'	0.3'	4" topsoil						
712.8'	4.0'	ALLUVIUM – Fat clay with sand (CH), orange brown, very moist, soft, some chert gravel	1	2.0'-3.5'	4-1-1	2	1.0'/1.5'	NMC=25.3%
709.8'	7.0'	ALLUVIUM – Silt (ML), dark brown, wet, soft	2	5.0'-6.5'	1-2-1	3	1.0'/1.5'	NMC=31.9% LL=36% PI=16%
703.8'	13.0'	RESIDUUM – Lean clay (CL), mottled orange brown, gray, moist, very stiff	3	10.0'-11.5'	6-7-9	16	1.5'/1.5'	
701.8'	15.0'	RESIDUUM – Fat clay (CH), orange brown, gray, moist, stiff, little chert gravel	4	13.5'-15.0'	4-4-7	11	1.5'/1.5'	LL=Liquid Limit PI=Plasticity Index
		Boring Terminated						NMC=Natural Moisture Content

Project Number	<u>08147</u>	Weather	<u>pt. cloudy</u>	Temperature	<u>35°</u>
Project Name	<u>Quiggins Basin</u>	Depth	<u>15.0'</u>		
Location	<u>Radcliff, Kentucky</u>	Surface Elevation	<u>712.1</u>		
Drilling Co.	<u>Greenbaum Associates</u>	Date Started	<u>1/22/09</u>	Completed	<u>1/22/09</u>
Drill Rig	<u>CME 550 ATV</u>	Driller	<u>Mike Wells</u>	Depth to Water	<u>7.0'</u>
Supervisor	<u>Mike Mattingly</u>			Date/Time	<u>Immediate</u>
				Depth to Water	<u>-</u>
				Date/Time	<u>-</u>

Elevation	Depth	Description	Samples					Comments
			No.	Depth	Blows/6in	N	Rec/Att	
711.6'	0.5'	6" topsoil						
708.1'	4.0'	ALLUVIUM – Silt (ML), dark brown, moist, soft, some clay, loamy	1	2.0'-3.5'	2-2-1	3	1.3'/1.5'	NMC=31.6%
703.6'	8.5'	RESIDUUM – Lean clay (CL), orange brown, moist, stiff, little sand and chert gravel	2	5.0'-6.5'	2-4-6	10	1.5'/1.5'	NMC=20.3% LL=37% PI=21%
697.1'	15.0'	RESIDUUM – Fat clay (CH), orange brown, black, moist, stiff to very stiff, little chert gravel, saprolitic	3	10.0'-11.5'	3-6-7	13	1.5'/1.5'	LL=Liquid Limit PI=Plasticity Index NMC=Natural Moisture Content
			4	13.5'-15.0'	9-7-10	17	1.5'/1.5'	
		Boring Terminated						

Project Number <u>08147</u>	Weather <u>pt. cloudy</u>	Temperature <u>35°</u>
Project Name <u>Quiggins Basin</u>	Depth <u>15.0'</u>	
Location <u>Radcliff, Kentucky</u>	Surface Elevation <u>716.1</u>	
Drilling Co. <u>Greenbaum Associates</u>	Date Started <u>1/22/09</u>	Completed <u>1/22/09</u>
Drill Rig <u>CME 550 ATV</u> Driller <u>Mike Wells</u>	Depth to Water <u>8.8'</u>	Date/Time <u>Immediate</u>
Supervisor <u>Mike Mattingly</u>	Depth to Water <u>-</u>	Date/Time <u>-</u>

Elevation	Depth	Description	Samples					Comments	
			No.	Depth	Blows/6in	N	Rec/Att		
715.6'	0.5'	6" topsoil							
712.6'	3.5'	ALLUVIUM – Silt (ML), brown, moist to wet, soft	1	2.0'-3.5'	2-1-1	2	1.0'/1.5'	NMC=29.6%	
			2	5.0'-6.5'	13-9-10	19	1.5'/1.5'		
701.1'	15.0'	RESIDUUM – Fat Clay (CH), mottled orange brown, gray, moist to wet, stiff to very stiff	3	10.0'-11.5'	4-4-6	10	1.5'/1.5'	NMC=22.6%	
			4	13.5'-15.0'	3-6-6	12	1.5'/1.5'		
		Boring Terminated						NMC=Natural Moisture Content	

Project Number <u>08147</u>	Weather <u>pt. cloudy</u>	Temperature <u>35°</u>
Project Name <u>Quiggins Basin</u>	Depth <u>15.0'</u>	
Location <u>Radcliff, Kentucky</u>	Surface Elevation <u>716.6'</u>	
Drilling Co. <u>Greenbaum Associates</u>	Date Started <u>1/22/09</u>	Completed <u>1/22/09</u>
Drill Rig <u>CME 550 ATV</u> Driller <u>Mike Wells</u>	Depth to Water <u>Dry</u>	Date/Time <u>Immediate</u>
Supervisor <u>Mike Mattingly</u>	Depth to Water <u>-</u>	Date/Time <u>-</u>

Elevation	Depth	Description	Samples					Comments
			No.	Depth	Blows/6in	N	Rec/Att	
716.3'	0.3'	4" topsoil						
709.6	7.0'	FILL/RESIDUUM – Fat clay (CH), reddish brown, moist, medium stiff, little gravel	1	2.0'-3.5'	3-3-3	6	1.3'/1.5'	NMC=20.9%
			2	5.0'-6.5'	2-3-2	5	1.0'/1.5'	NMC=26.5%
704.1'	12.5'	RESIDUUM – Lean clay (CL), gray, very moist, soft, some silt	3	10.0'-11.5'	1-1-2	3	1.5'/1.5'	
			4	13.5'-15.0'	7-13-9	22	1.2'/1.5'	
701.6'	15.0'	RESIDUUM – Silt (ML), brown, very moist, very stiff, some clay						
		Boring Terminated						NMC=Natural Moisture Content

Project Number <u>08147</u>	Weather <u>pt. cloudy</u>	Temperature <u>35°</u>
Project Name <u>Quiggins Basin</u>	Depth <u>15.0'</u>	
Location <u>Radcliff, Kentucky</u>	Surface Elevation <u>709.1'</u>	
Drilling Co. <u>Greenbaum Associates</u>	Date Started <u>1/22/09</u>	Completed <u>1/22/09</u>
Drill Rig <u>CME 550 ATV</u> Driller <u>Mike Wells</u>	Depth to Water <u>8.8'</u>	Date/Time <u>Immediate</u>
Supervisor <u>Mike Mattingly</u>	Depth to Water <u>4.0'</u>	Date/Time <u>2/6/09</u>

Elevation	Depth	Description	Samples					Comments
			No.	Depth	Blows/6in	N	Rec/Att	
708.6'	0.5'	6" topsoil						
704.6'	4.5'	ALLUVIUM – Poorly graded sand with chert gravel (SP), orange brown, moist, dense	1	2.0'-3.5'	10-22-15	37	1.0'/1.5'	NMC=19.0%
697.1'	12.0'	ALLUVIUM – Lean clay with sand and gravel (CL), brown, wet, very stiff	2	5.0'-6.5'	13-10-12	22	1.0'/1.5'	NMC=30.3%
			3	10.0'-11.5'	10-13-10	23	0'/1.5'	
694.1'	15.0'	RESIDUUM – Fat clay with chert gravel (CH), light brown, gray, very moist, stiff	4	13.5'-15.0'	5-7-5	12	1.5'/1.5'	3/4" Observation Well Installed
		Boring Terminated						NMC=Natural Moisture Content

Attachment 3 – Laboratory Test Results

QUIGGINS HYDROLOGIC STUDY



Architecture Engineering Planning

Groundbreaking by Design.

Prepared for:



RADCLIFF
CITY OF RADCLIFF
Engineering Department
411 West Lincoln Trail Boulevard
Radcliff, Kentucky 40159

Prepared by:

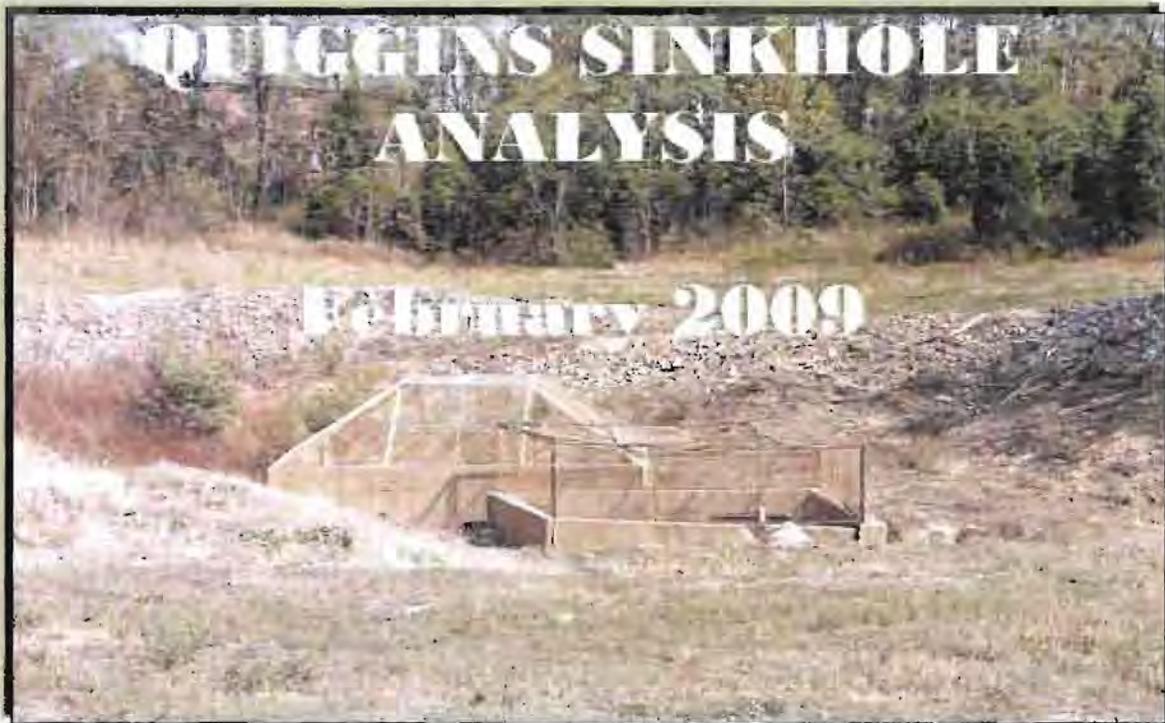


815 West Market Street
Suite 300
Louisville, KY 40202
Ph. (502) 585-2222
Fx. (502) 581-0406

Prepared:

February 2009





Prepared For:



CITY OF RADCLIFF
Engineering Department
411 West Lincoln Trail Boulevard
Radcliff, Kentucky 40159

Prepared By:



Architecture Engineering Planning

Groundbreaking by Design.

815 West Market Street
Suite 300
Louisville, KY 40202
Ph. (502) 585-2222
Fx. (502) 581-0406

TABLE OF CONTENTS

Executive Summary **ES - 1**

1. Purpose **1**

2. Introduction **2**

 A. Watershed Description..... 2

 B. Existing Storm Water Conveyance Systems to Quiggins Sinkhole 3

3. Historic Data **12**

 A. March, 1997 Flood 12

 B. April, 2008 Flood..... 14

4. Engineering Calculations **16**

 A. Analysis Overview..... 16

 B. Basin Calibration..... 16

 C. Existing Conditions Results 17

 D. Proposed Conditions #1 Results..... 20

 E. Proposed Conditions #2 Results..... 23

5. Summary of Results..... **29**

 A. Flood Elevations 29

 B. Sediment Control/Water Quality..... 29

 C. Existing Storm Water Conveyance Channels 30

6. Appendices **Appendix Page 1**

LIST OF TABLES

Table 1 – Quiggins Watershed Summary Chart 2

Table 2 - Storage Volume with Associated Rainfall and South Wilson Road Closure Duration, Existing Conditions..... 18

Table 3 - NOAA Frequencies, Existing 19

Table 4 - Avg. Annual 4-day Rainfall Events Overtopping S. Wilson..... 19

Table 5 - Avg. Annual 4-day Rainfall Events Overtopping S. Wilson..... 19

Table 6 - Storage Volume with Associated Rainfall and South Wilson Road Closure Duration, Post Quiggins Exc. 21

Table 7 - NOAA Freq., Post Quiggins Exc..... 22

QUIGGINS SINKHOLE ANALYSIS

Table 8 - Avg. Annual 4-day Rainfall Events Overtopping S. Wilson	22
Table 9 - Avg. Annual 4-day Rainfall Events Overtopping S. Wilson.....	22
Table 10 - Storage Volume with Associated Rainfall and South Wilson Road Closure Duration, Post Quiggins Basin Excavation and Removing Wilson, Turner, Cato and Song Watersheds.....	24
Table 11 - Wilson Basin	25
Table 12 - Turner Basin	25
Table 13 - Cato Basin	26
Table 14 - Song Basin.....	26
Table 15 - Quiggins Basin With Carryover from Wilson, Turner, Cato and Song	27
Table 16 - NOAA Freq., Post Quiggins +4.....	28
Table 17 - Avg. Annual 4-day Rainfall Events Overtopping S. Wilson.....	28
Table 18 - Avg. Annual 4-day Rainfall Events Overtopping S. Wilson.....	28
Table 19 - Elevation Summary.....	32

LIST OF PICTURES

Picture 1 Quiggins Sinkhole.....	4
Picture 2 Main Channel - Quiggins Basin	5
Picture 3 Hunter's Ridge Channel.....	6
Picture 4 US 31W.....	7
Picture 5 South Wilson Road - Main Channel crossing	8
Picture 6 South Wilson Road - Main Channel.....	9
Picture 7 Lake Road - Main Channel	10
Picture 8 Miller Avenue and Lavon Court - Main Channel	11
Picture 9 Garage Wall - 2643 South Wilson Road	12
Picture 10 Bible Baptist Church	13
Picture 11 2529 South Wilson Road.....	14
Picture 12 2265 South Wilson Road	15

LIST OF EXHIBITS

Exhibit 1 - Watershed to Quiggins Sinkhole and Proposed Basin Locations	Back
Exhibit 2 - Photograph index location map.....	3
Exhibit 3 - NOAA - 1 YR Flood Elevation (725.0).....	Back
Exhibit 4 - NOAA - 2 YR Flood Elevation (726.2).....	Back
Exhibit 5 - NOAA - 5 YR Flood Elevation (727.6).....	Back
Exhibit 6 - NOAA - 10 YR Flood Elevation (728.7).....	Back
Exhibit 7 - NOAA - 25 YR Flood Elevation (730.1).....	Back
Exhibit 8 - NOAA - 50 YR Flood Elevation (731.1).....	Back
Exhibit 9 - NOAA - 100 YR Flood Elevation (732.0).....	Back
Exhibit 10 - NOAA - 200 YR Flood Elevation (732.8).....	Back
Exhibit 11 - HIST - 1997 Flood Elevation (733.2).....	Back

Executive Summary

The Quiggins Sinkhole is the major storm water outfall for the Happy Valley Watershed. The existing improved outlet of the sinkhole cannot accept the rainfall runoff quick enough to prevent backwater flooding of the area. Due to this limited capacity South Wilson Road, between Shelton Road and Fairmont Road, is frequently overtopped due to flooding in the area.

This study analyzed two possible solutions to lowering flood elevations and thus reducing the number of days South Wilson Road is closed. One alternative entails enlarging the ponding area immediately surrounding Quiggins Sinkhole and the other alternative entails adding the construction of four basins within the watershed. Both alternatives will lower flood elevations and reduce the number of days that South Wilson Road will be closed. The alternative with the enlargement of the Quiggins Basin and construction of four basins obviously provides greater flood elevation reductions thus fewer annual road closures than the alternative with excavation only. A community wide benefit would be achieved.

1. Purpose

The purpose of this study is to report the existing basin characteristics, volume, and flood levels for various rainfall events and to determine the benefits provided by two separate alternatives. The first alternative is to enlarge the area immediately surrounding the Quiggins sinkhole. The second alternative would be to enlarge the area surrounding the Quiggins sinkhole and to construct four additional basins upstream to capture and hold runoff during rain events.

The study will also look briefly at secondary benefits associated with the construction of the additional basins upstream. These benefits would include the reduction of peak flows and the reduction of sediment transport into the throat of the main sinkhole.

2. Introduction

A. Watershed Description

Quiggins Sinkhole is located off of US 31W near Shelby Street in Radcliff, Kentucky. The drainage area (shown in Exhibit 1) is bounded by Blackjack Road to the north, Highway 313 to the south, portions of Hilltop Terrace and Meadowlake to the west, and South Boundary Road to the east.

Classified as "rolling" with some steep slopes, the sinkhole area drains approximately 1069.4 acres. As the primary outfall for the watershed, Quiggins sinkhole is prone to flooding, causing roadways to overtop from excessive runoff. With a low point elevation of 720.9, South Wilson Road is repetitively inundated.

The watershed is approximately 60% developed and is characterized as predominately residential. Soils in the area consist mostly of Crider, Nolin, and Vertress (hydrologic soil Type B) and Nicholson (hydrologic soil type C).

Runoff to the sinkhole is conveyed by grassed lined and paved ditches, and by numerous subdivision storm sewer systems and roadway culverts. Besides the Quiggins sinkhole, the watershed includes numerous karst features and smaller sinkholes.

The area that drains to the Lake Road Swallow hole was included in the Quiggins watershed, however an area just south of Highway 313 and east of US 31W was not. There is a potential for the area south of Highway 313 to overflow and enter the Quiggins Drainage area via a culvert under the highway. For the purpose of this report, this area was not included in these calculations.

Table 1 is a summarized description of the watershed:

Table 1 – Quiggins Watershed Summary Chart

Area	1069.4 acres
Terrain	Rolling with some steep slopes
Existing Land Use	60% developed / mostly residential
Soil Types	Crider, Nolin, Vertrees (B) and Nicholson (C)

B. Existing Storm Water Conveyance Systems to Quiggins Sinkhole

Runoff to the sinkhole is conveyed by grass lined and paved ditches, subdivision storm sewer systems and roadway culverts. This section will pictorially describe the Quiggins Sinkhole watershed and the storm water conveyance systems that flow into the Quiggins Sinkhole.

Exhibit 2 attached below is a location index map of the photos and Pictures 1-8 show specific details of the watershed.



Exhibit 2 - Photograph location index map

Picture 1

Quiggins Sinkhole



Quiggins Sinkhole, shown in the picture above, has its inlet protected with a concrete structure. Chain link fence is used as a screen to keep large debris out of the hole. A small portion of the basin is mowed regularly but the majority of the area is primarily wooded.

Picture 2

Main Channel of the Quiggins basin just upstream of the sinkhole



Picture 3

Concrete channel draining the Hunter's Ridge area. This channel is immediately behind the US Cavalry Store and runs from Centennial Avenue down into the Quiggins Basin.



QUIGGINS SINKHOLE ANALYSIS

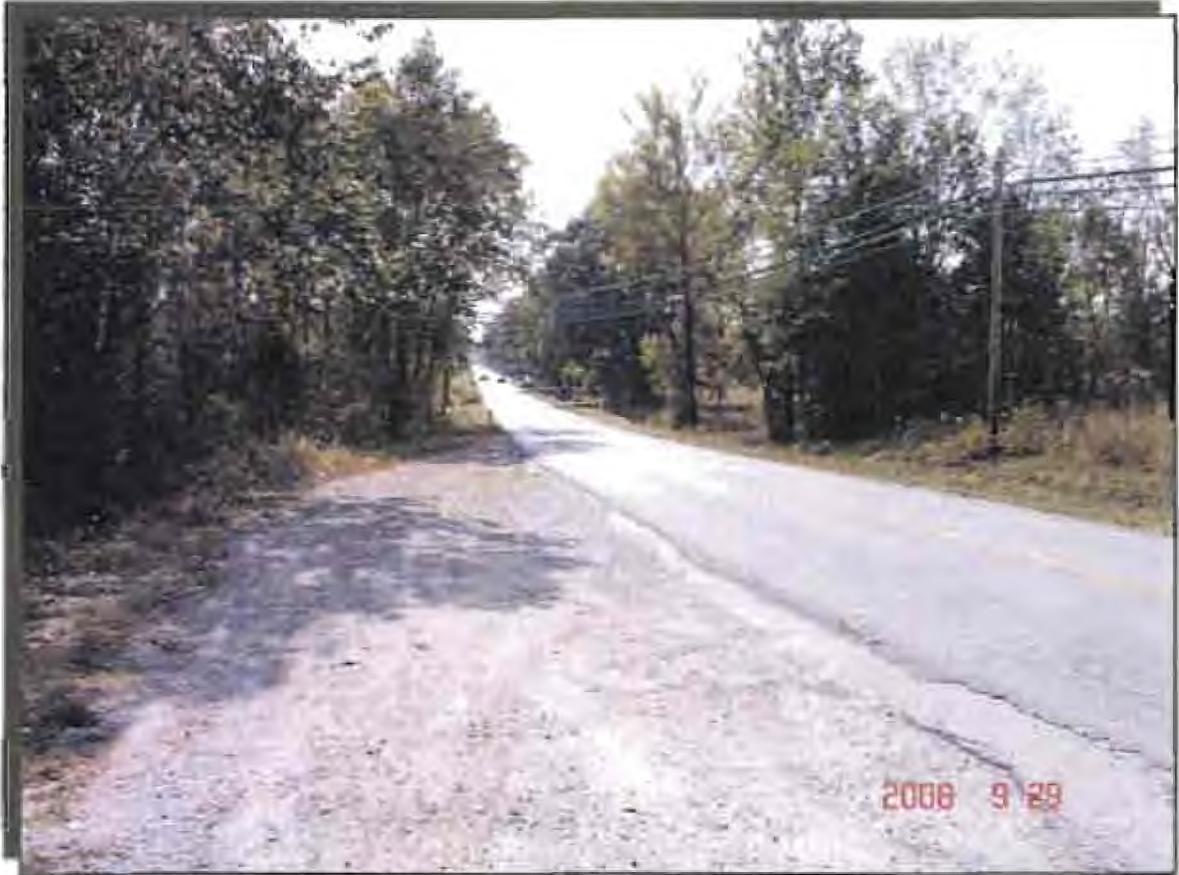
Picture 4

US 31W, main culvert flows under roadway and was one foot under water in 1997.



Picture 5

South Wilson Road where main channel crosses. Roadway is flooded repetitively each year.



Picture 6

Main channel that drains area to the west of South Wilson Road. This ditch runs behind the houses on the south side of Shelton Road.



Picture 7

Main channel that flows from Lake Road down to the culvert that flows under South Wilson Road.



Picture 8

Main channel that flows between homes of Miller Avenue and Lavon Court.



3. Historic Data

There are two major 4-day storm events (February 29 – March 3, 1997 and April 1-4, 2008) that were utilized for the calibration of this analysis. These events were chosen because 4-day historic data was available and flood elevations (from high water marks) were field located and surveyed for both rainfall events. Historic rainfall data for all rainfall events, from January, 1993 through mid-April, 2008, was obtained from the Radcliff Kentucky Wastewater Treatment Plant rain gage to determine the corresponding rainfall for these periods.

A. March, 1997 Flood

The 4-day total for the February 29 – March 3, 1997 storm event was 10.93 inches of rainfall. On October 31, 2008 high water marks from the March, 1997 storm event were surveyed by Qk4. In addition, numerous roadway elevations were surveyed in order to verify spot elevations depicted on the topographic mapping that was utilized for the study. The following high water marks were obtained for the March, 1997 storm:

Picture 9

Garage wall at 2643 South Wilson Drive: Elevation 733.1
(Note discoloration of the garage wall)



Picture 10

Stoop at the Bible Baptist Church, located on Shelby Avenue: Elevation 733.2



Based on the rounded average of the two marks, an elevation of 733.2 for the March, 1997 storm was utilized for the analysis.

B. April, 2008 Flood

The 4-day total for the April 1-4, 2008 storm event was 5.12 inches of rainfall. On October 31, 2008 high water marks from the April, 2008 storm event were surveyed by Qk4. The following high water marks were obtained for the April, 2008 storm:

Picture 11

A mark on the fire hydrant at 2529 South Wilson Road: Elevation 727.0



Picture 12

Edge of Pavement near the mailbox at 2265 South Wilson Road: Elevation 726.9



Based on the rounded average of the two marks, an elevation of 727.0 for the April, 2008 storm was utilized for the analysis.

4. Engineering Calculations

A. Analysis Overview

The analyses for the Quiggins Sinkhole Study were performed by determining flood elevation storage volumes using topographic mapping of the watershed in 0.5' increments between elevation 720.9 and 733.2. Corresponding rainfall depths to achieve each of those elevations were then computed. These calculations were done for three scenarios as follows:

- Existing Conditions
- Proposed Conditions #1: enlarged ponding area for Quiggins sinkhole
- Proposed Conditions #2: enlarged ponding area for Quiggins sinkhole and the construction of four new basins within the watershed (Song, Cato, Turner and Wilson)

Flood elevations for each of the three scenarios were computed for the 1, 2, 5, 10, 25, 50, and 100-year 4-day storm events as well as the historic rainfall event of 1997 (>100 year event) and the average less than 1-year frequency event. The watershed is prone to flooding because Quiggins sinkhole has inadequate outflow potential. A 2006 study by Dr. Currens of the University of Kentucky calculated that the sinkhole could discharge (i.e. accepts flow) at a rate of 11.9 cubic feet per second, or approximately 1 acre-foot per hour. By increasing the ponding area at the sinkhole and/or by constructing additional storage basins within the watershed to collect and hold runoff during rain events, flood elevations can be lowered and subsequent flood damage can be decreased.

B. Basin Calibration

The topographic mapping was used to determine the existing storage volume in the watershed based on the March, 1997 flood elevation of 733.2. A volume of 678 acre-feet or 7.61 inches of runoff is required to match the elevation. The 4-day rainfall total for the March, 1997 event was 10.93 inches. Based on elevation 733.2, 7.61 inches of runoff, or almost 70% of the 10.93 inches of rainfall that actually fell, reached (or contributed to) the sinkhole, causing flooding. The rainfall that was not seen as flood water can be assumed to have infiltrated into the ground, been intercepted by other karst features or impoundments and/or evaporated. Because there was not a means to quantify or measure the discharge rate of the sinkhole or determine a time at which it may have been clogged during the storm event, it is assumed that the sinkhole was clogged and had a zero discharge rate during the four days it was raining.

The existing storage volume in the watershed based on the April, 2008 flood elevation of 727.0 is 293 acre-feet or 3.29 inches of runoff. The 4-day rainfall total for the April, 2008 event was 5.12 inches. Based on elevation 727.0, 3.29 inches of runoff, or 64% of the 5.12 inches of rainfall that actually fell, reached (or contributed to) the sinkhole causing flooding.

The difference between the actual rainfall and the runoff that produced the flood elevation may also be attributed to the previously mentioned factors.

While analyzing these two storm events, it was evident that some portion of the total rainfall from an event contributes or reaches the sinkhole and some portion of the rainfall is lost, possibly due to such factors as infiltration, impoundment, or evaporation, and does not contribute. It was also determined that this runoff ratio will not be the same for every event. Using the two historic storms (70% contribution for the March, 1997 storm and 64% contribution for the April, 2008 storm) a runoff ratio was linearly applied to all storm events between flood elevation 720.9 to 733.2 for the existing and proposed conditions analyses. This method seems logical because a higher rate of runoff can be expected in more intense storm events.

C. Existing Conditions Results

The low elevation of Wilson Road is 720.9 and it is the first roadway within the watershed to be inundated due to flooding. Elevation 720.9 was used as the lower threshold for calculating storage volumes and runoff amounts and elevation 733.2 (the February 29 – March 3, 1997 flood elevation) was used as the upper threshold. The topographic mapping was utilized to calculate existing storage volumes and subsequent runoff amounts at 0.5' increments between elevation 720.9 and elevation 733.2. In addition, the existing volume results and the historic rainfall data were used to estimate the number of days that Wilson Road would be closed, assuming the sinkhole begins to discharge at 11.9 cubic feet per second on the fifth day and any closure due to the rise of the flood waters are ignored.

Table 2 details the storage volume and associated rainfalls for specific flood elevations and the corresponding South Wilson Road Closures for the existing conditions.

Table 3 summarizes the NOAA storm frequencies based on the existing conditions. The 4-day rainfall amount for each storm event is listed along with the corresponding flood elevation for that event. The last column lists the number of days South Wilson Road is closed for that particular storm event.

Table 4 summarizes, for existing conditions, the number of days South Wilson Road can be expected to be closed each year due to storm events with 4-day rainfall amounts that are less than the minimum 1-year ARI designated by NOAA. The 1993-2008 historic data was used to develop yearly average occurrences and rainfall amounts from 1.82" (the minimum amount to close South Wilson Road) to 3.86" (the 1-year, 4-day storm).

Finally, Table 5 summarizes, for existing conditions, the number of days South Wilson Road can be expected to be closed each year due to storm events with 4-day rainfall amounts that exceed 1.82" (including storms that could be classified as a 1-year storm or greater) based on the 1993-2008 historic data.

QUIGGENS SINKHOLE ANALYSIS

Table 2 - Storage Volume with Associated Rainfall and South Wilson Road Closure Duration, Existing Conditions

Elevation Feet	Ex. Storage Cu.Yd.	Ex. Storage Ac.-Ft.	Watershed Acres	Net Rainfall Inches	Runoff Ratio	Total Rainfall Inches	Recession Time Hours	Recession Time Days
720.9	148933	92	1069.4	1.04	0.57	1.82	0	0.0
721.0	152957	95	1069.4	1.06	0.58	1.83	3	0.1
721.5	173075	107	1069.4	1.20	0.58	2.08	15	0.6
722.0	193194	120	1069.4	1.34	0.59	2.28	28	1.2
722.5	215724	134	1069.4	1.50	0.59	2.54	42	1.8
723.0	238253	148	1069.4	1.66	0.60	2.76	56	2.3
723.5	263438	163	1069.4	1.83	0.60	3.05	72	3.0
724.0	288622	179	1069.4	2.01	0.61	3.29	88	3.7
724.5	316460	196	1069.4	2.20	0.61	3.61	106	4.4
725.0	344297	213	1069.4	2.39	0.62	3.86	123	5.1
725.5	374859	232	1069.4	2.61	0.62	4.21	142	5.9
726.0	405421	251	1069.4	2.82	0.63	4.48	162	6.7
726.5	439190	272	1069.4	3.05	0.63	4.85	183	7.6
727.0	472959	293	1069.4	3.29	0.64	5.12	204	8.5
727.5	510344	316	1069.4	3.55	0.64	5.55	228	9.5
728.0	547729	340	1069.4	3.81	0.65	5.86	251	10.5
728.5	589087	365	1069.4	4.10	0.65	6.30	277	11.6
729.0	630445	391	1069.4	4.38	0.66	6.64	303	12.6
729.5	675762	419	1069.4	4.70	0.66	7.12	332	13.8
730.0	721079	447	1069.4	5.02	0.67	7.49	361	15.0
730.5	771697	478	1069.4	5.37	0.67	8.01	392	16.4
731.0	822314	510	1069.4	5.72	0.68	8.41	424	17.7
731.5	879128	545	1069.4	6.11	0.68	8.99	460	19.2
732.0	935942	580	1069.4	6.51	0.69	9.43	496	20.7
732.5	1000981	620	1069.4	6.96	0.69	10.09	537	22.4
733.0	1066019	661	1069.4	7.41	0.70	10.59	578	24.1
733.2	1094437	678	1069.4	7.61	0.70	10.93	596	24.8

Table 3 - NOAA Frequencies, Existing

ARI Years	4-day Inches	Elevation Feet	Recession Days
1	3.86	725.0	5.1
2	4.61	726.2	7.1
5	5.62	727.6	9.7
10	6.43	728.7	12.0
25	7.56	730.1	15.2
50	8.47	731.1	17.8
100	9.42	732.0	20.6
200	10.41	732.8	23.5
*1997	10.93	733.2	24.8

Table 4 - Avg. Annual 4-day Rainfall Events Overtopping S. Wilson

ARI Years	4-day Inches	Elevation Feet	Recession Days	Occurances Number	Total Recession Days
*<1	2.40	722.2	1.4	6.0	8.6

*Excludes NOAA Frequency events, Existing Conditions.

Table 5 - Avg. Annual 4-day Rainfall Events Overtopping S. Wilson

ARI Years	4-day Inches	Elevation Feet	Recession Days	Occurances Number	Total Recession Days
*All	2.87	723.2	2.6	7.2	18.7

*1993-2008 historic data, Existing Conditions.

D. Proposed Conditions #1 Results

Proposed Conditions #1 will entail excavating the area in the vicinity of Quiggins sinkhole in order to provide more basin storage during flooding events. The topographic mapping, which included revised contours for the excavated area (see attached exhibit 1), was used to determine storage volumes and runoff amounts at 0.5' increments for this condition between elevation 720.9 and elevation 733.2. In addition, the proposed volumes and the historic rainfall data were used to estimate the number of days South Wilson Road would be closed with the additional storage volume provided by Proposed Condition #1, using the same assumptions utilized for the existing conditions.

Table 6 details the storage volume and associated rainfalls for specific flood elevations and the corresponding South Wilson Road Closures after excavation within the Quiggins basin (Proposed Conditions #1).

Table 7 summarizes the NOAA storm frequencies based on Proposed Conditions #1. The 4-day rainfall amount for each storm event is listed along with the corresponding flood elevation for that event. The last column list the number of days South Wilson Road is closed for that particular storm event.

Table 8 summarizes, for Proposed Conditions #1, the number of days South Wilson Road can be expected to be closed each year due to storm events with 4-day rainfall amounts that are less than the minimum 1-year ARI designated by NOAA. The 1993-2008 historic data was used to develop yearly average occurrences and rainfall amounts from 3.26" (the minimum amount to close South Wilson Road) to 3.86" (the 1-year, 4-day storm).

Table 9 summarizes, for Proposed Conditions #1, the number of days South Wilson Road can be expected to be closed each year due to storm events with 4-day rainfall amounts that exceed 3.26" (including storms that could be classified as a 1-year storm or greater) based on the 1993-2008 historic data.

QUIGGINS SINKHOLE ANALYSIS

Table 6 - Storage Volume with Associated Rainfall and South Wilson Road Closure Duration, Post Quiggins Exc.

Elevation Feet	Pr. Storage Cu.Yd.	Pr. Storage Ac.-Ft.	Watershed Acres	Net Rainfall Inches	Runoff Ratio	Total Rainfall Inches	Recession Time Hours	Recession Time Days
720.9	280847	174	1069.4	1.95	0.60	3.26	0	0.0
721.0	284862	177	1069.4	1.98	0.60	3.30	3	0.1
721.5	304936	189	1069.4	2.12	0.61	3.48	15	0.6
722.0	325010	201	1069.4	2.26	0.61	3.71	28	1.2
722.5	347123	215	1069.4	2.41	0.62	3.89	42	1.7
723.0	369235	229	1069.4	2.57	0.62	4.14	56	2.3
723.5	393425	244	1069.4	2.74	0.62	4.41	71	3.0
724.0	417614	259	1069.4	2.90	0.63	4.61	86	3.6
724.5	443953	275	1069.4	3.09	0.63	4.90	103	4.3
725.0	470292	292	1069.4	3.27	0.63	5.19	119	5.0
725.5	498970	309	1069.4	3.47	0.64	5.42	137	5.7
726.0	527647	327	1069.4	3.67	0.64	5.73	156	6.5
726.5	559336	347	1069.4	3.89	0.65	5.99	176	7.3
727.0	591025	366	1069.4	4.11	0.65	6.32	195	8.1
727.5	626512	388	1069.4	4.36	0.65	6.70	218	9.1
728.0	661999	410	1069.4	4.60	0.66	6.98	240	10.0
728.5	701878	435	1069.4	4.88	0.66	7.40	265	11.1
729.0	741757	460	1069.4	5.16	0.67	7.70	290	12.1
729.5	786438	487	1069.4	5.47	0.67	8.16	319	13.3
730.0	831118	515	1069.4	5.78	0.68	8.50	347	14.5
730.5	881589	546	1069.4	6.13	0.68	9.02	379	15.8
731.0	932059	578	1069.4	6.48	0.68	9.53	410	17.1
731.5	988793	613	1069.4	6.88	0.69	9.97	446	18.6
732.0	1045526	648	1069.4	7.27	0.69	10.54	482	20.1
732.5	1110534	688	1069.4	7.72	0.70	11.03	523	21.8
733.0	1175542	729	1069.4	8.18	0.70	11.68	564	23.5
733.2	1203955	746	1069.4	8.37	0.70	12.02	582	24.2

Table 7 - NOAA Freq., Post Quiggins Exc.

ARI Years	4-day Inches	Elevation Feet	Recession Days
1	3.86	722.4	1.6
2	4.61	724.0	3.6
5	5.62	725.8	6.2
10	6.43	727.1	8.4
25	7.56	728.8	11.6
50	8.47	730.0	14.3
100	9.42	730.9	16.8
200	10.41	731.9	19.7
*1997	10.93	732.4	21.4

Table 8 - Avg. Annual 4-day Rainfall Events Overtopping S. Wilson

ARI Years	4-day Inches	Elevation Feet	Recession Days	Occurances Number	Total Recession Days
*<1	3.53	721.6	0.8	0.3	0.2

*Excludes NOAA Frequency events, post Quiggins excavation.

Table 9 - Avg. Annual 4-day Rainfall Events Overtopping S. Wilson

ARI Years	4-day Inches	Elevation Feet	Recession Days	Occurances Number	Total Recession Days
*All	4.96	724.6	4.4	1.4	6.2

*1993-2008 historic data, post Quiggins excavation.

E. Proposed Conditions #2 Results

Proposed Conditions #2 will entail excavating the area in the vicinity of Quiggins sinkhole plus constructing four additional basins within the watershed. The four basins (Song, Cato, Turner, and Wilson Road) would intercept flow during storm events that would normally drain directly to Quiggins sinkhole. The basins would impound runoff during a storm event and water from the basins would be released (by a valve system) to drain dry at a later time. The topographic mapping which included revised contours for the excavated area and the four additional basins (see attached Exhibit 1) was used to determine storage volumes and runoff amounts at 0.5' increments for this condition between elevation 720.9 and elevation 733.2. When one or more of the basins is overtopped, the excess runoff contributes to the Quiggins Sinkhole.

South Wilson Road would be overtopped by the 5-year storm event with the construction of the four additional basins. Excavation of the four basins (specifically the construction of dams) is assumed to not lessen the storage volume within the Quiggins sinkhole watershed.

Table 10 details the storage volume and associated rainfalls for specific flood elevations and the corresponding South Wilson Road Closures after excavation within the Quiggins basin and removing the watersheds of four storage basins (Proposed Conditions #2). Closure time reported here is only valid in cases where the constructed basins have the capacity to store the entire storm event.

Tables 11 - 14 summarize the effectiveness of the constructed basins during each of the NOAA storm events. Any overflow amount is reported as "carryover" in the last column when the runoff volume exceeds the storage volume of the basin.

Tables 15 tabulate the responses of the entire Quiggins watershed in Proposed Conditions #2 during each of the NOAA storm events. This was done by equating the carryover volumes to additional rainfall on the reduced watershed area.

Table 16 summarizes the NOAA storm frequencies based on Proposed Conditions #2. The 4-day rainfall amount for each storm event is listed along with the corresponding flood elevation for that event. The last column list the number of days South Wilson Road is closed for that particular storm event.

Table 17 is shown simply to illustrate that, in Proposed Conditions #2, South Wilson Road is not expected to be closed due to storm events with 4-day rainfall amounts that are less than the minimum 1-year ARI designated by NOAA. The 4-day rainfall depth to close South Wilson Road exceeds the 1-year, 4-day event depth of 3.86"

Table 18 summarizes, for Proposed Conditions #2, the number of days South Wilson Road can be expected to be closed each year due to storm events with 4-day rainfall amounts that exceed 4.72" based on the 1993-2008 historic data.

QUIGGINS SINKHOLE ANALYSIS

Table 10 - Storage Volume with Associated Rainfall and South Wilson Road Closure Duration, Post Quiggins Basin Excavation and Removing Wilson, Turner, Cato and Song Watersheds

Elevation	Pr. Storage	Pr. Storage	Watershed	Net Rainfall	Runoff	Total Rainfall	Recession Time	Recession Time
Feet	Cu.Yd.	Ac.-Ft.	Acres	Inches	Ratio	Inches	Hours	Days
720.9	280847	174	702.0	2.98	0.63	4.72	0	0.0
721.0	284862	177	702.0	3.02	0.63	4.79	3	0.1
721.5	304936	189	702.0	3.23	0.63	5.13	15	0.6
722.0	325010	201	702.0	3.44	0.64	5.38	28	1.2
722.5	347123	215	702.0	3.68	0.64	5.75	42	1.7
723.0	369235	229	702.0	3.91	0.65	6.02	56	2.3
723.5	393425	244	702.0	4.17	0.65	6.41	71	3.0
724.0	417614	259	702.0	4.42	0.66	6.70	86	3.6
724.5	443953	275	702.0	4.70	0.67	7.02	103	4.3
725.0	470292	292	702.0	4.98	0.67	7.44	119	5.0
725.5	498970	309	702.0	5.29	0.67	7.89	137	5.7
726.0	527647	327	702.0	5.59	0.67	8.34	156	6.5
726.5	559336	347	702.0	5.93	0.68	8.72	176	7.3
727.0	591025	366	702.0	6.26	0.68	9.21	195	8.1
727.5	626512	388	702.0	6.64	0.69	9.62	218	9.1
728.0	661999	410	702.0	7.01	0.69	10.17	240	10.0
728.5	701878	435	702.0	7.44	0.70	10.62	265	11.1
729.0	741757	460	702.0	7.86	0.70	11.23	290	12.1
729.5	786438	487	702.0	8.33	0.70	11.90	319	13.3
730.0	831118	515	702.0	8.81	0.70	12.58	347	14.5
730.5	881589	546	702.0	9.34	0.70	13.34	379	15.8
731.0	932059	578	702.0	9.88	0.70	14.11	410	17.1
731.5	988793	613	702.0	10.48	0.70	14.97	446	18.6
732.0	1045526	648	702.0	11.08	0.70	15.83	482	20.1
732.5	1110534	688	702.0	11.77	0.70	16.81	523	21.8
733.0	1175542	729	702.0	12.46	0.70	17.79	564	23.5
733.2	1203955	746	702.0	12.76	0.70	18.32	582	24.2

Table 11 - Wilson Basin

ARI Years	NOAA Inches	Runoff Ratio	Net Rainfall Inches	Watershed Acres	Runoff Volume Ac.-Ft.	Storage Ac.-Ft.	Carryover Ac.-Ft.
1	3.86	0.62	2.39	81.5	16.3	42	
2	4.61	0.63	2.90	81.5	19.7	42	
5	5.62	0.64	3.60	81.5	24.4	42	
10	6.43	0.65	4.18	81.5	28.4	42	
25	7.56	0.67	5.07	81.5	34.4	42	
50	8.47	0.68	5.76	81.5	39.1	42	
100	9.42	0.68	6.41	81.5	43.5	42	1.5
200	10.41	0.69	7.18	81.5	48.8	42	6.8
*1997	10.93	0.70	7.65	81.5	52.0	42	10.0

Table 12 - Turner Basin

ARI Years	NOAA Inches	Runoff Ratio	Net Rainfall Inches	Watershed Acres	Runoff Volume Ac.-Ft.	Storage Ac.-Ft.	Carryover Ac.-Ft.
1	3.86	0.62	2.39	94.6	18.9	29	
2	4.61	0.63	2.90	94.6	22.9	29	
5	5.62	0.64	3.60	94.6	28.4	29	
10	6.43	0.65	4.18	94.6	32.9	29	3.9
25	7.56	0.67	5.07	94.6	39.9	29	10.9
50	8.47	0.68	5.76	94.6	45.4	29	16.4
100	9.42	0.68	6.41	94.6	50.5	29	21.5
200	10.41	0.69	7.18	94.6	56.6	29	27.6
*1997	10.93	0.70	7.65	94.6	60.3	29	31.3

Table 13 - Cato Basin

ARI Years	NOAA Inches	Runoff Ratio	Net Rainfall Inches	Watershed Acres	Runoff Volume Ac.-Ft.	Storage Ac.-Ft.	Carryover Ac.-Ft.
1	3.86	0.62	2.39	125.6	25.0	65	
2	4.61	0.63	2.90	125.6	30.4	65	
5	5.62	0.64	3.60	125.6	37.6	65	
10	6.43	0.65	4.18	125.6	43.7	65	
25	7.56	0.67	5.07	125.6	53.0	65	
50	8.47	0.68	5.76	125.6	60.3	65	
100	9.42	0.68	6.41	125.6	67.0	65	2.0
200	10.41	0.69	7.18	125.6	75.2	65	10.2
*1997	10.93	0.70	7.65	125.6	80.1	65	15.1

Table 14 - Song Basin

ARI Years	NOAA Inches	Runoff Ratio	Net Rainfall Inches	Watershed Acres	Runoff Volume Ac.-Ft.	Storage Ac.-Ft.	Carryover Ac.-Ft.
1	3.86	0.62	2.39	65.7	13.1	32	
2	4.61	0.63	2.90	65.7	15.9	32	
5	5.62	0.64	3.60	65.7	19.7	32	
10	6.43	0.65	4.18	65.7	22.9	32	
25	7.56	0.67	5.07	65.7	27.7	32	
50	8.47	0.68	5.76	65.7	31.5	32	
100	9.42	0.68	6.41	65.7	35.1	32	3.1
200	10.41	0.69	7.18	65.7	39.3	32	7.3
*1997	10.93	0.70	7.65	65.7	41.9	32	9.9

QUIGGINS SINKHOLE ANALYSIS

Table 15 - Quiggins Basin With Carryover from Wilson, Turner, Cato and Song

ARI	NOAA	Runoff	Net Rainfall	Watershed	Runoff Volume	Wilson	Turner	Cato	Song	Total	Eq. Net	Eq. Rain	Elevation
Years	Inches	Ratio	Inches	Acres	Ac.-Ft.	Ac.-Ft.	Ac.-Ft.	Ac.-Ft.	Ac.-Ft.	Ac.-Ft.	Inches		Feet
1	3.86	0.62	2.39	702	140.0					140.0	2.39	3.86	<720.9
2	4.61	0.63	2.90	702	169.9					169.9	2.90	4.61	<720.9
5	5.62	0.64	3.60	702	210.4					210.4	3.60	5.62	722.3
10	6.43	0.65	4.18	702	244.5		3.9			248.4	4.25	6.53	723.7
25	7.56	0.67	5.07	702	296.3		10.9			307.2	5.25	7.84	725.4
50	8.47	0.68	5.76	702	336.9		16.4			353.3	6.04	8.88	726.7
100	9.42	0.68	6.41	702	374.7	1.5	21.5	2.0	3.1	402.8	6.89	10.13	728.0
200	10.41	0.69	7.18	702	420.2	6.8	27.6	10.2	7.3	472.1	8.07	11.70	729.3
*1997	10.93	0.70	7.65	702	447.6	10.0	31.3	15.1	9.9	513.8	8.78	12.55	730.0

Table 16 - NOAA Freq., Post Quiggins +4

ARI Years	4-day Inches	Elevation Feet	Recession Days
1	3.86	<720.9	N/A
2	4.61	<720.9	N/A
5	5.62	722.3	1.5
10	6.43	723.7	3.2
25	7.56	725.4	5.6
50	8.47	726.7	7.6
100	9.42	728.0	9.9
200	10.41	729.3	12.9
*1997	10.93	730.0	14.4

Table 17 - Avg. Annual 4-day Rainfall Events Overtopping S. Wilson

ARI Years	4-day Inches	Elevation Feet	Recession Days	Occurances Number	Total Recession Days
*<1	N/A	N/A	N/A	N/A	N/A

*Excludes NOAA Frequency events, post Quiggins excavation.

Table 18 - Avg. Annual 4-day Rainfall Events Overtopping S. Wilson

ARI Years	4-day Inches	Elevation Feet	Recession Days	Occurances Number	Total Recession Days
*All	6.31	723.5	8.7	0.6	5.2

*1993-2008 historic data, post Quiggins excavation.

5. Summary of Results

A. Flood Elevations

Many of the road closures, specifically at South Wilson Road, due to flooding from the Quiggins Sinkhole are caused by storms of lesser magnitude than the 1-year event. Excavation and enlargement of the ponding area of Quiggins Sinkhole nearly eliminates overtopping of South Wilson Road for less than the 1-year storm event. Also, excavation of the Quiggins Sinkhole reduces almost four days of closure time of South Wilson Road for all the 1-year through the March, 1997 flood events.

Excavation of Quiggins Sinkhole plus the construction of four additional basins eliminates overtopping of South Wilson Road for the less than 1-year, the 1-year and 2-year storm events. In addition, there is a reduction of up to 10 days of annual closure time for South Wilson Road for the 5-year through the March, 1997 flood events.

Excavation of Quiggins Sinkhole would lower the 100-year flood elevation by 1.1' and reduce the number of days of South Wilson Road closure from approximately 21 to 17 per year. Excavation of Quiggins Sinkhole plus the construction of four basins would lower the 100 year flood elevation by 4' and reduce the number of days of South Wilson Road closure from approximately 21 days to 10 days per year.

Excavation of Quiggins Sinkhole would lower the 1997 flood elevation by 0.8' and reduce the number of days of South Wilson Road closure from approximately 25 days to 21 days per year. Excavation of Quiggins Sinkhole plus the construction of four basins would lower the 1997 flood elevation by 3.2' and reduce the number of days of South Wilson Road closure from approximately 25 days to 14 days per year.

Table 19 summarizes the flood elevations for each scenario. See exhibits 3 - 11 (behind *Exhibit* tab) for a graphic representation of the flood elevation reductions for each scenario.

B. Sediment Control/Water Quality

In addition to flood control, the construction of the four basins may enhance water quality. Sediments collected by the excess runoff can settle out while the rainfall is being temporarily impounded in the constructed basins. The City of Radcliff plans to impound the stored runoff in the basins for the entire duration of each rainfall event and beyond to allow sinkhole backwater to subside. During this period many of the suspended sediments will settle out.

QUIGGINS SINKHOLE ANALYSIS

One of the predominant soil types within the watershed is Crider Silt Loam. The D_{15} (the diameter on the eroded particle size distribution curve where 15% of the particles by weight are equal to, or smaller than this size) of Crider Silt Loam is 0.0054 mm. The settling velocity, based on a simplified form of Stoke's Law ($V_s=2.81d^2$), is 0.000082 ft/sec. Assuming an average depth of 10' for the proposed basins, the settling of an eroded particle of Crider Silt Loam should occur within 1.4 days. This would indicate that the storage of the runoff and a controlled, screened release could provide an improvement to water quality in the area by settling out eroded soils and other pollutants.

C. Existing Storm Water Conveyance Channels

Within the watershed there are a number of open channels that convey storm water runoff to the Quiggins sinkhole. Two of the main conveyance channels are a concrete lined, flat bottom ditch that flows between the houses on Miller Avenue and Levon Court (See Picture #8) and a rock lined flat bottom ditch that flows from Lake Avenue eastward to the culvert under South Wilson Road (See Picture #7). For existing conditions these channels carry runoff from approximately 429.5 acres of the Quiggins watershed. With the proposed construction of the Song and Cato Basins (which would temporarily impound all of the runoff in the most frequent storm events), a portion of the watershed contributing to the two channels would be reduced and thus the peak flows in the channels would be reduced.

Since the time of concentration/travel time is nearly the same with and without the removal of the Song and Cato Basin watersheds, we can determine a percentage reduction in flow for multiple storm events by determining the percentage reduction in contributing area. Using the Rational Method (but ignoring rainfall intensity, I), $Q = CIA$, reductions can be calculated as follows.

Existing:

Song Basin watershed = 65.7 acres (Rational "C" = 0.50)
Cato Basin watershed = 125.6 acres (Rational "C" = 0.35)
Remaining Area = 238.2 acres (Rational "C" = 0.60)
Total Area = 429.5 acres (weighted Rational "C" = 0.51)
 $C \times A = 0.51 \times 429.5 = 219.0$

Proposed:

Song Basin watershed = 0 acres (Rational "C" = 0.50)
Cato Basin watershed = 0 acres (Rational "C" = 0.35)
Remaining Area = 238.2 acres (Rational "C" = 0.60)
Total Area = 238.2 acres (weighted Rational "C" = 0.60)
 $C \times A = 0.51 \times 238.2 = 142.9$

Comparing the areas (multiplied by their runoff coefficient, Rational "C"), there would be approximately a 35% reduction in peak flow conveyed by the two channels after the basins are constructed. In some higher end, less frequent storm events (greater than the

QUIGGINS SINKHOLE ANALYSIS

25-year, 4-day event) backwater will begin to occur in these two channels and peak flow reductions are not as noticeably beneficial. However, due to the benefits mentioned previously, the backwater condition will occur less frequently and/or at a lower elevation with the excavation of the Quiggins basin and the four other basins within the watershed.

QUIGGINS SINKHOLE ANALYSIS

Table 19 - Elevation Summary

		Existing		Post Quiggins Excavation				Post Quiggins + 4 Excavation			
ARI	NOAA	Elevation	Recession	Elevation	Reduction	Recession	Reduction	Elevation	Reduction	Recession	Reduction
Years	Inches	Feet	Days	Feet	Feet	Days	Days	Feet	Feet	Days	Days
1	3.86	725.0	5.1	722.4	2.6	1.6	3.5	<720.9	>4.8	N/A	N/A
2	4.61	726.2	7.1	724.0	2.2	3.6	3.5	<720.9	>4.8	N/A	N/A
5	5.62	727.6	9.7	725.8	1.8	6.2	3.5	722.3	5.3	1.5	8.2
10	6.43	728.7	12.0	727.1	1.5	8.4	3.6	723.7	5.0	3.2	8.7
25	7.56	730.1	15.2	728.8	1.3	11.6	3.6	725.4	4.6	5.6	9.6
50	8.47	731.1	17.8	730.0	1.1	14.3	3.5	726.7	4.4	7.6	10.2
100	9.42	732.0	20.6	730.9	1.1	16.8	3.8	728.0	4.0	9.9	10.7
200	10.41	732.8	23.5	731.9	0.9	19.7	3.7	729.3	3.5	12.9	10.5
*1997	10.93	733.2	24.8	732.4	0.8	21.4	3.4	730.0	3.2	14.4	10.4

6. Appendices

NOAA Precipitation Frequency Estimates (inches)																		
ARI * (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.35	0.56	0.70	0.96	1.20	1.45	1.58	1.94	2.31	2.81	3.35	3.86	4.62	5.26	7.17	8.82	11.04	13.23
2	0.42	0.67	0.83	1.15	1.44	1.73	1.89	2.32	2.76	3.36	4.00	4.61	5.51	6.26	8.49	10.40	12.96	15.54
5	0.48	0.77	0.97	1.37	1.76	2.11	2.31	2.84	3.38	4.10	4.90	5.62	6.72	7.57	10.05	12.17	14.96	17.83
10	0.53	0.85	1.07	1.55	2.01	2.42	2.65	3.27	3.89	4.71	5.64	6.43	7.71	8.60	11.25	13.53	16.48	19.51
25	0.59	0.94	1.19	1.76	2.35	2.83	3.11	3.87	4.60	5.57	6.70	7.56	9.11	10.04	12.83	15.33	18.43	21.63
50	0.64	1.02	1.29	1.93	2.62	3.16	3.49	4.37	5.19	6.27	7.57	8.47	10.26	11.19	14.06	16.70	19.89	23.19
100	0.69	1.09	1.37	2.10	2.88	3.50	3.88	4.89	5.82	7.01	8.48	9.42	11.47	12.38	15.26	18.05	21.30	24.65
200	0.73	1.15	1.46	2.26	3.16	3.84	4.29	5.45	6.48	7.78	9.45	10.41	12.75	13.60	16.45	19.39	22.67	26.03
500	0.79	1.24	1.56	2.47	3.54	4.32	4.86	6.23	7.42	8.86	10.82	11.77	14.56	15.27	18.01	21.14	24.41	27.72
1000	0.83	1.30	1.63	2.63	3.83	4.70	5.32	6.87	8.19	9.73	11.93	12.86	16.03	16.60	19.18	22.45	25.68	28.92

These precipitation frequency estimates are based on a partial duration series. **ARI** is the Average Recurrence Interval. Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting forces estimates near to appear as zero.

Rain Information Inches/Rain Day
Year - 1993
Existing Conditions (>1.82"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	-	0.67	0.3	-	-	-	0.01	-	-	-
2	0.02	-	0.34	-	0.5	-	-	-	0.28	-	0.02	-
3	-	-	0.46	-	0.07	-	-	-	0.15	0.18	-	0.14
4	0.99	-	0.54	0.2	0.7	-	-	-	0.12	-	0.2	0.5
5	-	-	0.17	-	-	1.42	-	0.11	-	0.02	0.09	0.95
6	-	-	-	-	0.5	-	-	0.3	-	-	-	0.08
7	0.04	-	0.27	-	-	-	-	-	-	-	0.03	-
8	0.15	-	0.2	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	2.33	-	-	-	-	-	-
10	0.2	-	-	0.92	-	0.59	-	-	-	0.53	-	0.29
11	0.3	0.58	-	-	-	0.1	-	-	-	-	-	0.13
12	0.11	-	-	-	-	0.02	-	-	-	-	-	-
13	0.07	0.27	-	-	0.7	0.23	-	0.45	-	0.03	1.73	-
14	-	0.5	-	0.12	0.2	0.02	-	-	-	0.01	0.17	-
15	0.3	0.3	-	0.37	-	0.53	0.1	-	-	-	1.07	0.26
16	0.1	0.3	-	0.46	-	-	0.13	-	0.51	-	0.07	0.21
17	-	-	0.4	0.14	0.5	-	0.05	-	-	0.27	0.83	0.02
18	0.01	-	-	-	0.1	-	1.45	1.46	0.02	0.25	0.5	0.04
19	-	-	0.03	-	0.97	-	0.6	-	-	0.03	0.2	-
20	0.17	0.57	0.05	-	-	-	-	-	-	3.8	-	0.01
21	0.75	1.8	-	-	-	0.13	-	-	-	0.05	-	-
22	-	-	0.2	-	-	-	0.24	0.01	-	0.02	-	-
23	0.3	-	0.71	-	-	-	0.03	-	0.11	-	-	-
24	0.57	-	-	-	-	-	-	0.21	0.47	-	-	-
25	-	1.03	-	0.13	0.5	0.02	-	0.13	0.05	-	0.06	-
26	-	-	-	0.6	-	0.25	0.47	0.02	0.49	-	0.06	-
27	-	-	0.05	0.2	-	0.2	-	-	-	-	0.36	-
28	-	-	0.1	-	-	-	-	-	0.07	-	-	-
29	-	-	-	-	-	0.52	-	-	-	-	-	-
30	-	-	-	0.09	-	-	-	0.1	-	0.01	0.02	-
31	-	-	-	-	0.49	-	-	0.1	-	0.31	-	-
Total	4.08	5.35	3.52	3.9	5.53	6.36	3.07	2.89	2.28	5.51	5.41	2.63

Rain Information Inches/Rain Day
Year - 1994
Existing Conditions (>1.82"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.19	-	0.1	-	0.02	-	-	-	0.02	-	-	-
2	0.29	-	-	-	-	0.36	-	-	-	-	-	-
3	-	-	0.05	0.29	0.11	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	0.3	-	-	-	1.33
5	-	-	-	0.1	-	0.03	-	0.35	0.6	-	0.43	-
6	-	-	-	0.5	0.45	-	1.12	-	-	-	-	-
7	-	-	0.35	-	0.85	0.13	-	-	-	-	-	-
8	0.25	-	0.33	-	-	-	0.8	-	-	-	-	-
9	-	0.4	-	-	-	1.28	0.8	-	-	0.52	0.43	0.81
10	-	0.15	1.2	0.56	-	-	-	-	-	-	0.15	1.15
11	-	0.19	-	0.6	-	-	-	-	-	-	-	-
12	0.23	0.1	-	-	-	-	-	-	-	-	-	-
13	-	-	0.1	-	-	-	1.05	-	-	0.47	-	-
14	0.02	-	-	-	-	-	0.03	0.13	-	-	-	-
15	-	-	-	0.43	0.49	-	0.06	-	-	-	0.9	-
16	-	-	-	-	-	-	0.05	-	-	-	0.48	0.7
17	0.27	-	-	-	-	-	-	-	0.11	-	-	-
18	1.6	-	0.15	-	-	-	-	-	-	0.35	-	-
19	-	-	-	-	-	-	-	-	-	0.86	-	-
20	-	0.51	0.03	-	-	-	-	0.89	-	-	-	0.03
21	-	-	0.32	-	-	0.38	0.77	0.08	-	-	-	-
22	-	1.3	-	-	-	-	0.27	-	-	0.03	-	0.1
23	-	0.03	-	-	-	-	-	-	1.67	-	-	-
24	0.38	-	0.05	-	-	0.38	-	-	0.11	-	0.2	-
25	-	-	-	-	0.6	-	0.46	-	0.17	-	0.08	-
26	0.66	-	1.05	-	0.1	0.56	-	0.09	0.3	-	0.02	-
27	0.05	-	1.05	1.5	-	-	-	-	-	0.01	1.15	-
28	0.85	-	0.05	-	-	-	0.02	0.1	-	-	-	-
29	0.45	-	-	1.05	-	-	-	0.5	-	-	-	-
30	0.04	-	0.22	1	-	-	-	0.05	-	0.02	-	0.02
31	-	-	-	-	-	-	-	-	-	0.2	-	0.08
Total	5.28	2.68	5.05	6.03	2.62	3.12	5.43	2.49	2.98	2.46	3.84	4.22

Rain Information Inches/Rain Day
Year - 1995
Existing Conditions (>1.82"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.03	-	-	-	1.27	0.2	-	-	0.4	-	0.2	-
2	-	0.15	-	-	0.04	0.23	-	-	-	0.04	0.18	-
3	-	0.21	-	-	-	0.15	-	-	-	1.3	-	-
4	-	-	0.04	-	0.15	-	0.4	-	-	-	-	-
5	-	-	0.45	-	-	-	1.21	2.44	-	3.45	-	-
6	0.89	-	0.08	-	-	-	0.05	0.1	-	-	0.37	-
7	-	0.02	0.82	-	-	-	0.1	2.3	0.02	-	0.17	-
8	0.03	-	-	-	-	0.08	-	0.41	-	-	-	0.06
9	-	-	-	0.05	0.98	0.18	-	0.21	-	-	-	-
10	0.04	-	-	-	0.19	-	-	-	-	-	0.16	-
11	0.35	-	-	0.23	0.02	1.12	-	-	-	-	1	-
12	0.01	-	-	0.67	-	0.05	-	-	-	-	-	-
13	-	-	-	-	1.3	-	-	-	-	0.02	0.47	0.05
14	0.96	0.57	-	-	1.05	-	-	-	-	-	-	-
15	-	1.4	-	-	0.01	-	0.66	-	-	-	-	0.73
16	0.02	0.1	-	0.16	0.28	-	-	0.18	1.45	0.01	-	0.03
17	-	-	-	0.47	2.52	-	-	-	0.06	-	-	0.16
18	-	-	-	0.08	1.51	-	-	-	-	-	-	1.02
19	0.43	-	-	-	0.01	0.02	-	-	-	-	-	0.4
20	-	-	0.27	1.15	-	-	-	-	0.17	0.46	-	-
21	-	-	-	0.41	0.19	0.47	-	-	0.02	0.09	-	-
22	0.02	-	-	-	-	0.02	1.21	-	-	-	-	-
23	-	0.04	0.3	0.96	-	-	0.93	-	0.09	-	0.44	0.02
24	-	-	-	0.05	-	0.38	-	-	-	0.1	-	-
25	-	-	-	0.02	0.04	-	0.21	-	0.02	-	-	-
26	-	-	-	-	-	-	-	-	-	0.07	-	-
27	0.11	0.18	0.27	-	0.98	0.04	0.82	-	-	0.96	0.03	-
28	0.69	0.04	-	-	0.28	0.07	-	-	-	-	-	-
29	-	-	-	0.01	0.04	-	-	-	-	-	-	-
30	-	-	-	0.07	-	0.09	-	-	-	-	-	0.01
31	-	-	-	-	0.05	-	-	-	-	-	-	0.37
Total	3.58	2.71	2.23	4.33	10.91	3.1	5.59	5.64	2.23	6.5	3.02	2.85

Rain Information Inches/Rain Day
Year - 1996
Existing Conditions (>1.82"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.05	0.06	-	0.4	0.04	-	-	-	-	-	0.07	0.24
2	0.67	-	0.03	-	0.25	0.48	0.39	-	-	-	-	0.02
3	-	-	-	-	-	0.28	-	-	0.03	-	-	-
4	-	-	-	0.1	0.02	-	-	-	-	-	-	-
5	-	-	0.88	-	0.78	-	-	-	0.33	-	-	0.33
6	-	-	1.2	-	0.1	1.06	-	-	0.02	-	0.07	0.02
7	-	0.03	0.14	-	0.4	0.63	-	-	0.67	-	0.84	-
8	1	0.31	-	-	1.03	0.62	-	1.19	-	0.06	0.15	0.01
9	-	-	-	-	-	0.45	0.07	-	0.37	0.03	-	-
10	-	-	-	-	-	0.35	-	-	-	0.17	-	-
11	0.33	-	-	-	0.23	0.13	-	7	-	0.02	-	-
12	-	0.05	-	-	-	0.22	-	0.02	0.05	-	-	0.87
13	-	-	-	0.87	0.02	-	-	-	-	-	0.01	-
14	-	0.07	-	-	0.2	-	2.55	-	-	-	-	0.02
15	-	-	0.35	0.27	0.47	-	0.12	-	0.11	-	-	-
16	-	-	0.62	0.02	-	-	-	-	1.1	-	-	1.61
17	-	-	-	-	-	-	-	0.27	0.02	1.55	0.3	0.48
18	1.18	-	-	-	-	0.22	-	-	-	0.66	0.04	-
19	-	1.07	1.2	-	-	0.33	1.8	-	-	-	0.02	-
20	-	0.04	-	0.98	-	-	0.15	-	-	-	-	-
21	-	-	-	-	-	-	0.25	-	0.66	0.03	0.32	0.01
22	-	-	-	0.2	-	-	-	-	-	0.42	0.02	0.06
23	1.4	-	-	0.47	-	-	-	-	-	0.06	0.01	0.67
24	0.15	-	0.03	-	0.02	0.69	-	0.14	-	-	0.02	0.25
25	-	-	0.33	0.2	-	-	-	-	-	0.32	1.13	-
26	0.08	-	-	0.31	4.87	-	-	-	0.04	0.43	0.05	0.04
27	0.05	0.62	-	0.31	0.83	-	-	-	1.07	-	-	0.04
28	0.03	-	0.21	0.34	0.22	-	0.5	-	0.68	0.21	-	0.02
29	-	-	0.02	1	-	-	0.1	-	-	-	0.2	-
30	-	-	-	-	-	-	1	-	0.02	-	0.78	0.03
31	-	-	0.3	-	-	-	0.02	-	-	-	-	0.01
Total	4.94	2.25	5.31	5.47	9.48	5.46	6.95	8.62	5.17	3.96	4.03	4.73

Rain Information Inches/Rain Day
Year - 1997
Existing Conditions (>1.82"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	8.17	0.01	-	0.5	0.02	-	-	-	0.5	-
2	-	-	0.8	-	0.78	0.19	-	-	-	-	0.07	-
3	-	0.4	1	-	0.71	0.02	-	-	0.03	-	0.15	0.27
4	0.28	1.27	0.02	-	-	0.01	-	-	-	-	0.01	0.03
5	0.13	-	0.47	0.21	-	0.49	-	-	-	-	-	-
6	-	-	0.01	-	-	0.74	-	-	-	-	0.41	-
7	-	-	-	-	-	0.17	-	-	-	-	-	-
8	-	0.33	-	-	0.62	1.36	-	-	-	-	-	-
9	0.03	-	0.36	-	-	0.12	-	1.21	0.4	-	-	0.72
10	-	-	-	-	-	0.01	-	0.01	-	-	-	0.32
11	-	-	-	0.05	-	0.08	-	-	0.04	-	-	-
12	-	-	-	0.14	-	-	-	-	-	-	-	-
13	-	0.45	0.36	-	0.02	0.25	-	0.27	-	0.6	-	-
14	-	0.02	0.12	-	0.11	0.88	-	0.03	-	0.27	0.85	-
15	0.4	-	-	-	0.07	0.02	-	-	-	-	-	-
16	0.01	-	-	0.11	0.01	0.2	-	-	-	-	-	-
17	-	-	0.05	-	0.03	0.23	-	-	0.02	-	-	-
18	-	-	2.11	-	0.05	0.29	-	-	-	-	-	-
19	-	0.02	-	0.21	0.62	0.02	0.18	0.02	-	-	-	-
20	0.02	0.02	-	0.01	0.06	-	-	-	0.1	-	-	-
21	-	0.11	-	0.25	-	-	-	1.22	-	-	0.72	0.5
22	0.94	0.02	-	0.08	-	-	-	0.09	0.02	-	-	-
23	0.01	-	-	-	-	-	-	0.02	0.23	0.03	-	-
24	0.8	-	-	-	1.6	-	-	-	0.3	0.93	-	0.83
25	0.01	-	0.41	-	0.05	-	-	-	-	-	-	0.04
26	-	-	-	-	0.02	0.77	-	-	-	0.08	-	0.03
27	0.76	0.41	0.01	0.73	-	0.02	-	0.81	-	-	-	-
28	0.02	0.21	1.34	0.02	0.38	-	-	-	0.1	-	-	-
29	-	0.96	-	-	0.84	0.05	0.5	-	-	-	-	0.19
30	-	-	0.08	0.32	0.01	0.18	-	-	-	-	1	-
31	-	-	0.09	-	0.65	-	-	-	-	0.1	-	-
Total	3.41	4.22	15.4	2.14	6.63	6.6	0.7	3.68	1.24	2.01	3.71	2.93

Rain Information Inches/Rain Day
Year - 1998
Existing Conditions (>1.82"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	-	-	0.06	0.02	-	-	-	-	-	-
2	-	-	0.03	-	-	-	-	-	-	-	0.16	-
3	-	-	0.07	0.46	0.27	0.3	-	-	-	1.44	0.2	-
4	-	-	0.02	0.05	-	1.34	0.19	-	-	-	-	0.02
5	0.51	-	-	-	-	0.34	-	-	-	-	-	-
6	0.82	-	-	-	-	-	-	2	-	-	-	-
7	1.35	0.3	0.32	-	0.56	-	0.65	-	-	0.93	-	0.88
8	0.15	-	1.3	0.95	0.08	-	-	0.14	-	-	-	0.44
9	0.05	-	0.9	0.06	0.01	0.75	-	0.83	-	-	0.36	-
10	-	0.03	-	0.3	0.03	0.73	-	0.03	-	-	-	-
11	-	0.29	0.5	-	-	-	-	0.4	-	-	-	-
12	0.36	0.03	-	-	-	1.02	-	-	-	-	-	0.11
13	0.08	-	-	0.09	-	1.11	0.15	-	-	-	-	0.54
14	0.01	-	-	0.5	-	1.67	0.41	-	-	-	-	-
15	-	-	-	0.33	-	-	0.81	-	-	-	-	-
16	0.03	0.2	0.11	0.43	-	-	0.37	-	-	-	-	-
17	0.1	0.24	0.04	0.01	-	-	-	-	-	-	-	-
18	-	0.04	0.26	0.3	-	-	-	-	-	0.42	-	-
19	-	0.02	0.71	0.38	-	0.3	-	-	0.13	-	-	-
20	0.05	0.1	1	-	0.47	-	-	-	-	-	-	-
21	-	-	-	-	0.1	1.08	-	-	1.9	-	0.56	0.2
22	0.3	-	-	0.1	0.84	-	-	-	-	-	-	-
23	-	0.07	-	-	-	0.9	-	-	-	-	-	-
24	-	-	-	-	0.52	-	-	-	-	-	-	-
25	-	-	0.13	0.07	0.11	-	-	-	0.1	-	-	-
26	-	0.03	-	-	0.34	-	-	-	-	-	-	-
27	-	0.15	-	0.24	-	-	-	-	-	-	-	-
28	-	-	-	0.12	-	-	-	-	-	-	-	-
29	-	-	-	0.85	0.03	0.73	-	0.15	-	-	-	0.05
30	-	-	-	0.81	-	0.09	0.1	-	-	-	0.3	0.05
31	-	-	0.4	-	0.91	-	-	-	-	-	-	-
Total	3.81	1.5	5.79	6.05	4.33	10.38	2.68	3.55	2.13	2.79	1.58	2.29

Rain Information Inches/Rain Day
Year - 1999
Existing Conditions (>1.82"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	0.02	-	0.02	-	0.04	-	-	-	-	0.11	-
2	-	0.03	0.11	-	-	0.44	0.02	-	-	-	0.63	-
3	-	-	0.02	0.35	-	-	-	-	-	-	-	0.05
4	-	0.03	-	0.07	-	-	-	-	-	-	-	0.18
5	-	-	-	-	0.83	0.05	-	-	-	-	-	0.25
6	-	-	0.39	1.05	1.06	0.03	-	-	-	-	-	0.02
7	-	0.17	-	-	-	-	-	-	-	-	-	-
8	1.8	-	0.33	0.02	-	-	-	2.28	0.34	0.28	-	-
9	-	-	0.53	-	-	0.02	-	-	-	3.37	-	-
10	-	-	-	-	-	0.06	0.07	-	-	0.05	-	0.99
11	-	0.22	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	0.9	-	-	-	-	-	-	1.52
13	0.4	-	0.05	-	0.08	0.07	-	-	-	0.02	-	1.93
14	0.02	-	1	0.3	-	0.37	-	-	-	-	-	-
15	-	-	-	0.33	-	-	-	-	-	-	-	-
16	-	0.19	-	-	-	-	-	-	-	-	-	-
17	-	-	-	0.02	0.37	-	0.02	-	-	-	-	-
18	-	-	-	0.1	0.3	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	0.07	0.25	-
20	0.05	-	-	-	-	-	-	-	0.15	-	0.15	0.2
21	-	-	-	-	0.02	-	0.01	-	0.07	-	0.02	-
22	1.57	-	-	-	-	-	-	-	-	-	-	-
23	0.5	-	0.98	-	0.78	0.18	0.13	-	-	-	-	-
24	-	0.02	-	-	-	1	-	-	-	-	-	0.15
25	-	-	-	-	0.02	-	-	-	-	-	0.51	-
26	-	0.98	-	1.31	-	0.11	-	-	-	-	0.22	-
27	-	0.09	-	0.14	-	0.5	-	-	-	-	-	-
28	-	-	-	1.3	-	0.87	-	-	0.07	-	-	-
29	-	-	-	0.03	-	-	-	-	0.24	-	-	-
30	-	-	-	-	-	-	-	-	-	-	-	-
31	1.35	-	0.34	-	0.05	-	-	-	-	-	-	-
Total	5.69	1.75	3.75	5.04	4.41	3.74	0.25	2.28	0.87	3.79	1.89	5.29

Rain Information Inches/Rain Day
Year - 2000
Existing Conditions (>1.82"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	0.02	0.5	-	-	-	-	-	-	-	-
2	0.9	-	-	0.81	0.49	-	-	-	-	-	0.4	0.2
3	3.32	-	0.06	0.75	0.85	-	0.24	0.09	-	-	-	-
4	-	0.03	-	0.4	0.02	-	0.45	-	0.26	-	0.22	-
5	-	-	-	-	-	0.05	0.05	0.1	-	0.18	0.42	-
6	0.02	-	-	-	-	-	0.45	-	-	0.4	-	-
7	-	-	-	0.34	-	-	-	-	-	-	0.38	-
8	0.03	-	-	0.49	-	-	-	0.65	0.5	-	0.77	-
9	0.05	-	-	-	0.06	-	-	-	-	-	-	-
10	-	-	-	0.02	-	-	-	0.37	0.1	-	-	0.2
11	-	-	0.4	0.34	-	-	0.04	-	0.4	-	-	0.11
12	-	-	-	-	-	-	0.47	-	0.41	-	0.7	-
13	-	1.85	-	-	0.79	-	-	-	-	-	-	0.67
14	-	-	-	-	-	0.53	-	-	-	-	-	-
15	-	-	-	-	-	1	-	-	-	-	-	0.15
16	-	-	0.48	-	-	0.02	-	-	-	-	-	2.55
17	0.2	0.14	-	0.25	0.02	0.34	-	-	-	-	-	0.05
18	0.15	2.41	0.5	-	-	0.75	-	0.32	-	-	-	0.07
19	0.18	-	0.93	-	0.25	0.08	0.58	-	-	-	-	-
20	-	-	0.32	0.14	0.02	-	-	-	0.27	-	-	-
21	-	0.2	-	0.02	-	0.29	-	-	0.17	0.06	-	-
22	0.13	0.07	-	-	-	-	-	-	0.4	-	-	-
23	-	0.02	-	0.6	2.33	-	-	1.48	0.07	-	-	-
24	-	0.02	-	0.54	-	0.1	-	1.11	0.55	-	0.23	-
25	0.02	-	-	0.02	0.05	0.2	-	-	1	-	1	-
26	-	0.27	-	-	0.07	0.6	-	0.1	0.07	-	0.3	0.01
27	-	0.25	-	-	0.23	1.3	-	-	-	-	-	-
28	-	0.02	-	-	0.13	0.2	1.83	-	-	-	-	-
29	0.26	-	-	0.05	0.03	-	0.8	-	-	-	-	0.05
30	-	-	-	-	-	-	0.25	-	-	-	-	0.01
31	-	-	-	-	-	-	-	-	-	-	-	-
Total	5.26	5.28	2.71	5.27	5.34	5.46	5.16	4.22	4.2	0.64	4.42	4.07

Rain Information Inches/Rain Day
Year - 2001
Existing Conditions (>1.82"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	0.1	0.21	-	-	-	-	-	-	-	-
2	0.06	-	-	0.02	-	0.02	-	-	-	-	0.28	-
3	-	-	0.7	0.7	-	-	-	0.7	0.45	-	-	-
4	-	0.6	1.34	-	-	0.06	0.1	-	-	-	-	-
5	-	-	-	-	-	0.06	-	-	-	1.1	-	-
6	-	-	-	-	-	0.04	-	-	-	-	-	0.5
7	-	-	-	-	1.4	0.1	-	-	2	-	-	-
8	-	0.2	-	-	0.21	0.02	-	-	-	-	0.01	0.38
9	-	0.61	-	-	-	-	0.04	-	1.1	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	0.14	-	-	2.58	-	0.3	-	-
12	-	0.2	-	-	-	-	-	-	-	1.61	-	0.8
13	-	0.4	-	-	-	-	-	-	-	0.1	-	0.18
14	-	0.85	-	-	-	-	-	-	-	1.85	-	-
15	0.3	0.85	0.21	0.19	-	0.75	-	-	-	0.02	-	-
16	-	0.78	0.2	-	-	-	-	-	-	0.2	-	0.87
17	-	-	-	-	0.07	-	-	-	-	-	-	0.75
18	0.37	-	-	-	0.75	-	0.35	0.16	-	-	-	-
19	0.63	-	-	-	-	-	-	0.53	1	-	0.27	0.03
20	0.02	-	0.32	0.06	-	-	0.94	-	-	-	-	-
21	-	-	0.2	-	0.56	0.13	0.02	-	-	-	-	-
22	-	-	-	-	0.4	-	0.14	-	-	-	-	0.35
23	-	-	-	0.28	0.05	0.1	-	-	0.2	-	0.02	0.3
24	-	-	-	-	0.1	-	-	-	0.18	0.68	0.71	-
25	-	1	-	-	0.02	-	0.07	-	-	-	-	-
26	0.2	-	0.2	-	0.1	1.19	1.63	0.2	-	-	-	-
27	-	0.2	-	-	0.32	0.11	0.03	0.02	-	-	1.38	-
28	-	-	-	-	-	0.05	0.46	0.01	-	-	1.34	-
29	0.45	-	0.5	-	-	0.5	0.22	-	-	-	1.97	-
30	0.5	-	0.25	-	-	-	-	-	-	-	-	-
31	-	-	0.27	-	0.33	-	-	0.5	-	-	-	-
Total	2.53	5.69	4.29	1.46	4.45	3.13	4	4.7	4.93	5.86	5.98	4.16

Rain Information Inches/Rain Day
Year - 2002
Existing Conditions (>1.82"<3.86")

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
	-	0.8	-	-	1.49	-	-	-	-	-	-	-
	-	-	0.32	-	0.84	-	-	-	-	0.04	-	-
	-	-	-	0.19	-	-	-	-	-	-	0.16	-
	-	-	-	-	-	-	-	-	-	0.45	0.03	-
	-	-	-	-	-	0.22	-	-	-	-	1	-
6	0.28	0.1	-	-	1.7	0.73	-	-	-	0.07	-	-
	-	-	-	-	0.03	-	-	-	-	-	-	0.4
8	-	-	0.02	0.15	0.05	-	-	-	-	-	-	-
9	-	-	0.5	0.15	0.12	-	0.1	-	-	0.05	0.1	-
10	0.02	0.25	-	-	-	-	0.29	-	-	2.55	1	0.47
11	-	-	-	0.05	-	0.1	-	-	-	0.67	-	0.32
12	-	-	0.1	-	-	0.77	0.02	-	-	-	-	-
13	-	-	-	1	2.3	0.03	0.38	0.25	-	-	-	0.6
14	-	-	-	0.45	-	-	-	0.55	1.3	-	-	0.02
15	-	-	-	-	-	-	-	-	0.15	-	0.3	-
16	-	-	-	-	0.03	0.04	-	0.2	-	-	-	-
17	-	-	1.36	-	1	-	-	0.1	0.1	-	-	0.15
18	-	-	0.17	-	-	-	0.05	0.17	-	-	-	-
19	0.15	0.13	1.82	-	-	-	-	0.05	-	0.55	-	2.3
20	-	0.55	0.89	0.03	-	-	-	-	0.85	0.15	-	-
21	-	-	-	0.86	-	-	-	-	-	-	0.23	0.3
22	0.2	-	-	-	-	-	0.75	-	-	-	-	0.1
23	0.7	-	-	-	-	-	-	0.02	-	-	-	-
24	1.6	-	-	0.87	-	0.25	-	-	-	-	-	1
25	-	-	0.9	-	0.07	0.06	-	-	-	0.1	-	-
26	-	0.32	1.93	-	-	0.25	-	0.07	3.25	-	0.05	-
27	-	-	-	1.33	-	-	-	0.06	2.3	-	-	-
28	-	-	-	1.08	-	1.79	-	-	-	0.5	-	-
29	-	-	0.4	-	0.35	-	0.1	-	-	0.68	-	-
30	0.33	-	0.3	-	-	-	0.5	-	-	0.05	-	0.56
31	-	-	-	-	-	-	-	-	-	-	-	1.1
Total	3.28	2.15	8.71	6.16	7.98	4.24	2.19	1.47	7.95	5.86	2.87	7.32

Rain Information Inches/Rain Day
Year - 2003
Existing Conditions (>1.82"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.45	-	-	-	0.6	-	0.02	-	0.19	0.5	0.08	-
2	-	-	-	-	-	0.05	0.03	0.18	2.34	-	-	-
3	0.16	0.33	-	-	-	0.53	-	0.66	1.74	-	-	0.11
4	0.3	-	-	-	0.11	0.05	-	0.13	-	-	-	0.33
5	0.4	-	0.05	0.37	2.15	-	-	-	-	-	0.02	0.15
6	-	-	0.03	0.51	-	0.19	0.08	0.03	-	-	0.32	-
7	-	-	-	0.28	0.95	0.6	-	0.02	-	-	-	-
8	-	-	-	0.11	1.17	0.32	0.03	-	-	-	-	-
9	-	-	-	1.24	-	-	0.29	0.12	-	0.02	-	0.03
10	-	0.2	0.02	0.6	-	0.27	0.37	0.09	-	0.07	-	0.63
11	-	-	-	-	1.88	1.38	-	0.06	-	-	0.04	-
12	-	-	0.8	-	-	0.03	-	-	-	-	1.57	-
13	-	-	0.7	-	-	0.18	-	0.04	-	-	-	-
14	-	2.05	-	-	-	0.04	-	-	0.39	0.74	0.1	-
15	-	1.4	-	-	0.44	0.08	0.34	-	0.02	-	0.28	0.17
16	-	0.32	-	-	0.03	1.13	-	-	-	-	0.06	0.29
17	-	-	-	1.25	0.62	-	-	0.03	-	0.3	0.02	-
18	-	-	0.77	-	0.03	-	-	-	-	-	0.97	0.14
19	-	0.25	0.6	-	-	-	-	-	-	-	0.11	0.06
20	-	-	0.26	0.22	0.24	-	-	-	-	-	-	-
21	-	0.85	0.6	0.32	0.01	-	0.44	-	-	0.02	-	-
22	-	1.28	-	-	-	-	0.04	0.98	1.57	-	-	0.03
23	-	0.14	-	-	-	-	-	-	-	-	0.07	0.92
24	-	-	-	-	-	-	-	-	-	-	0.71	-
25	-	-	0.14	0.88	0.43	-	-	-	0.02	0.07	-	-
26	-	-	-	0.12	-	1.76	-	-	-	1	-	-
27	-	0.13	-	-	0.03	-	-	-	0.3	-	1	-
28	0.1	0.03	-	0.05	0.02	-	0.37	-	0.11	0.14	0.27	-
29	-	-	0.49	0.03	-	-	-	0.12	-	-	-	0.79
30	-	-	-	-	-	0.44	-	0.38	0.19	-	-	-
31	0.12	-	-	-	-	-	1.05	0.51	-	-	-	-
Total	1.53	6.98	4.46	5.98	8.71	7.05	3.06	3.35	6.87	2.86	5.62	3.65

Rain Information Inches/Rain Day
Year - 2004
Existing Conditions (>1.82"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.34	-	0.47	-	0.54	-	-	-	-	-	0.66	-
2	0.65	1.04	-	-	0.54	0.03	-	-	0.52	-	1.72	-
3	0.03	-	0.31	-	-	-	0.12	-	-	-	-	-
4	0.61	-	0.1	-	-	-	-	-	-	-	0.12	-
5	0.06	0.86	1.23	0.02	-	-	0.52	0.12	-	-	-	0.2
6	-	0.07	-	-	-	-	0.16	-	-	-	-	0.15
7	-	-	0.02	-	-	-	0.1	-	0.4	-	-	0.85
8	-	0.03	-	-	-	-	-	-	-	-	-	-
9	-	0.04	-	-	-	1.45	0.08	-	-	-	-	0.68
10	0.12	-	-	-	-	-	0.11	-	-	-	-	0.14
11	-	-	-	-	0.1	-	0.13	0.08	-	-	1.78	0.14
12	-	-	-	1	-	0.53	1.38	0.03	-	0.19	0.1	0.03
13	-	-	-	1.35	0.12	-	0.18	-	-	0.4	-	0.01
14	-	-	0.13	0.05	0.26	-	0.32	-	-	0.16	-	-
15	-	-	0.12	-	1.21	0.05	-	-	-	0.06	-	-
16	-	-	0.2	-	0.02	0.44	-	-	-	-	-	-
17	0.39	-	-	-	0.04	1.2	-	-	0.04	-	-	-
18	0.31	-	-	-	-	-	0.03	-	-	1	0.34	-
19	-	-	-	0.04	0.97	-	-	-	-	0.3	0.59	-
20	-	-	0.95	0.01	-	-	-	0.54	-	0.03	0.02	-
21	-	0.05	-	1	-	-	-	-	-	-	0.03	0.02
22	-	-	-	0.42	-	-	1.87	-	-	-	-	-
23	-	-	-	1.49	-	-	-	-	-	0.57	0.14	-
24	-	0.02	-	0.02	0.12	-	-	0.35	-	-	0.55	-
25	0.18	-	-	0.71	1.09	-	-	-	-	-	-	-
26	0.05	-	-	-	2.5	-	0.01	0.1	-	0.22	-	-
27	-	-	-	-	0.2	-	-	-	-	0.6	0.3	-
28	-	-	-	-	0.67	-	-	-	-	0.04	-	-
29	0.05	-	0.65	-	-	-	-	0.63	-	-	-	-
30	-	-	0.26	0.6	2.27	-	0.87	-	-	-	0.8	-
31	-	-	0.06	-	-	-	1.27	-	-	0.03	-	0.05
Total	2.79	2.11	4.5	6.71	10.65	3.7	7.15	1.85	0.96	3.6	7.15	2.27

Rain Information Inches/Rain Day

Year - 2005

Existing Conditions (>1.82"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.53	-	0.01	0.23	0.02	0.09	-	-	0.03	-	0.01	-
2	0.25	0.18	-	0.33	-	0.28	-	-	-	-	-	-
3	0.29	0.03	-	0.01	-	0.51	-	-	-	-	-	0.47
4	0.51	-	0.07	-	-	-	-	-	-	-	-	0.03
5	0.08	-	-	-	-	-	-	-	-	-	-	-
6	0.69	-	0.01	-	-	-	-	-	-	-	0.04	-
7	0.69	0.55	0.37	0.41	-	-	0.19	-	-	0.19	-	-
8	0.08	0.05	0.02	0.15	-	-	-	-	-	-	-	0.56
9	0.02	0.12	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	0.01	-	-	-	-	-	-
11	0.04	-	0.08	0.03	-	0.77	1.5	-	-	-	-	0.03
12	-	-	0.13	0.55	-	0.13	0.41	-	-	-	-	0.04
13	0.67	0.65	0.02	0.14	-	0.43	0.31	-	-	-	0.35	-
14	-	0.19	-	-	0.71	-	0.24	0.27	-	-	0.7	0.07
15	-	-	0.01	0.05	-	-	0.02	-	-	-	0.65	0.57
16	0.02	-	-	-	-	-	0.33	0.42	0.05	-	-	-
17	-	-	-	-	-	-	0.11	0.01	-	-	-	-
18	-	-	-	-	-	-	-	0.66	-	-	-	-
19	0.01	-	0.11	-	1.11	-	-	-	-	-	-	-
20	-	0.54	0.01	-	0.53	-	0.09	0.55	0.16	0.15	-	-
21	-	0.07	-	-	-	-	-	-	-	0.41	-	-
22	0.02	0.01	0.47	0.4	0.01	-	0.84	-	-	0.03	-	-
23	0.01	0.07	0.27	0.04	-	-	-	-	-	0.1	-	-
24	-	0.02	-	0.02	-	-	-	-	-	0.13	-	0.18
25	-	-	0.05	0.01	-	-	-	0.1	0.41	-	-	0.33
26	-	-	-	0.57	-	-	-	0.67	0.12	-	-	0.01
27	-	0.01	1.25	0.02	-	-	-	-	-	-	0.13	-
28	-	0.55	0.34	0.24	-	-	-	0.5	-	-	1.07	0.2
29	0.66	-	0.04	0.93	-	0.45	-	0.32	0.15	-	-	0.02
30	0.02	-	0.02	0.13	-	-	-	3.85	-	-	-	0.17
31	0.01	-	-	-	-	-	-	0.05	-	-	-	0.01
Total	4.6	3.04	3.28	4.26	2.38	2.67	4.04	7.4	0.92	1.01	2.95	2.69

Rain Information Inches/Rain Day
Year - 2006
Existing Conditions (>1.82"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	-	-	-	0.08	-	-	0.01	-	0.32	0.51
2	0.23	0.51	-	0.12	0.85	0.53	-	-	0.03	-	-	-
3	0.02	0.06	-	-	-	-	-	-	-	-	-	-
4	-	0.78	0.05	-	-	0.04	0.06	-	-	-	-	-
5	-	-	-	-	-	-	-	-	0.06	0.03	-	-
6	-	-	-	0.07	-	-	-	-	-	-	0.22	-
7	-	-	-	0.45	0.03	0.16	-	-	-	-	0.64	-
8	-	-	0.04	0.03	-	-	-	0.42	-	-	-	-
9	-	-	0.7	-	0.01	-	-	0.17	-	-	-	-
10	1.15	0.08	-	-	0.41	-	-	1.18	0.14	-	-	-
11	0.15	0.11	0.47	-	0.15	0.62	1.08	-	1.45	0.14	0.11	-
12	-	-	2.04	-	0.02	-	0.05	-	0.7	0.11	-	0.33
13	0.43	-	0.22	-	-	-	1.25	-	0.04	-	0.03	-
14	0.1	-	-	0.01	0.01	-	0.04	0.98	-	-	-	-
15	-	-	-	-	0.1	-	-	0.18	-	-	1.1	-
16	-	0.53	0.01	0.07	0.02	-	-	-	-	1.32	0.45	-
17	1.12	0.25	-	1.03	-	1.71	-	-	-	0.34	-	-
18	-	0.09	-	0.06	0.1	0.38	-	0.11	0.17	-	-	-
19	0.21	-	-	0.06	0.01	0.28	-	-	-	0.51	0.08	-
20	-	-	-	1.05	-	0.03	-	0.94	-	0.01	-	-
21	-	-	0.3	1.61	-	-	2.17	-	-	-	-	0.1
22	2.08	0.1	-	-	-	0.03	0.88	-	4.57	-	-	0.38
23	0.08	-	-	0.02	-	0.32	-	-	2.18	-	-	-
24	-	-	0.05	-	-	-	-	-	0.2	-	-	-
25	-	-	-	-	2.18	-	-	-	-	-	-	0.97
26	-	-	-	0.17	-	0.6	-	-	-	0.42	-	0.06
27	-	-	0.02	-	-	-	0.21	-	0.65	1.79	-	-
28	0.02	-	0.02	-	-	-	0.44	1.8	0.64	0.34	-	-
29	0.33	-	-	0.08	-	-	-	0.03	-	-	0.07	-
30	0.03	-	-	0.34	0.08	-	-	-	0.08	-	0.48	-
31	-	-	0.65	-	-	-	-	-	-	0.16	-	0.67
Total	5.95	2.51	4.57	5.17	3.97	4.78	6.18	5.81	10.92	5.17	3.5	3.02

Rain Information Inches/Rain Day
Year - 2007
Existing Conditions (>1.82"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	0.94	0.18	-	-	-	-	-	-	-	0
2	-	-	-	-	0.59	-	-	-	-	-	-	0.63
3	-	-	-	1	0.21	-	-	-	-	-	-	0.02
4	0.2	0.1	-	-	0.74	0.02	0.06	-	-	-	-	0
5	0.35	-	-	-	0.3	-	2.47	-	-	-	0.03	0
6	-	-	-	-	-	-	-	-	-	-	-	0
7	0.57	-	-	-	-	-	-	-	-	-	-	0.48
8	-	-	-	-	-	0.23	-	-	-	-	-	0.36
9	-	-	-	-	-	-	-	-	1.51	-	-	1.25
10	-	-	0.04	-	-	-	0.2	-	-	-	-	0.65
11	0.3	-	-	0.54	0.1	-	-	-	0.02	-	0.11	0
12	0.1	0.57	-	0.3	-	-	-	-	-	-	0.06	0.43
13	0.77	1	-	0.12	-	-	-	-	-	-	0.03	0
14	0.17	-	0.17	1.45	-	-	-	-	0.05	-	0.27	0
15	0.65	-	0.18	-	0.4	-	-	-	-	-	-	2.53
16	-	-	-	-	0.15	-	-	-	-	0.35	-	0.03
17	-	-	-	-	0.01	-	0.08	-	-	-	-	0
18	-	0.1	-	-	-	-	-	-	-	1.83	-	0
19	-	-	0.65	-	-	0.03	0.87	0.03	-	0.15	-	0
20	-	-	0.16	-	-	-	-	-	-	-	-	0.68
21	0.68	-	-	-	-	-	-	2.36	-	-	0.54	0.06
22	-	-	0.05	-	-	0.07	-	-	-	2.56	-	0.12
23	-	-	-	-	-	0.2	-	-	-	4.36	-	0.16
24	-	1.23	-	-	-	0.52	-	-	-	0.67	-	0
25	-	0.17	-	0.03	-	0.13	-	-	0.23	-	0.37	0
26	-	-	-	0.73	-	0.65	-	-	0.3	0.05	0.84	0.09
27	-	-	-	0.3	-	0.02	0.51	-	0.9	-	-	0
28	-	-	1.13	0.2	-	0.12	0.14	-	0.03	-	0.04	0
29	-	-	-	-	-	0.04	-	0.07	-	-	-	0
30	-	-	0.8	-	-	-	-	0.01	-	-	-	0
31	-	-	0.16	-	-	-	-	-	-	-	-	0.02
Total	3.79	3.17	4.28	4.85	2.5	2.03	4.33	2.47	3.04	9.97	2.29	7.51

Rain Information Inches/Rain Day
Year - 2008
Existing Conditions (>1.82"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.04	0	0	0.5								
2	0	0	0.1	0.02								
3	0	0.1	1.03	1.3								
4	0	0.15	1.78	3.3								
5	0.29	0.35	0	0								
6	0	1	0	0								
7	0	0	0.3	0								
8	0.6	0	0.11	0								
9	0.03	0	0	0.7								
10	1.16	0.02	0.07									
11	0	0.51	0.02									
12	0.01	1.35	0									
13	0.2	0.03	0									
14	0.02	0	0.4									
15	0	0	0.6									
16	0	0	0.25									
17	0.22	0.23	0									
18	0	0	0.23									
19	0	0	2.4									
20	0.03	0	0.02									
21	0	0.5	0									
22	0.03	0.6	0									
23	0	0.05	0									
24	0	0	0									
25	0	0.04	0									
26	0	0.11	0.1									
27	0	0.01	0.52									
28	0	0	0.52									
29	1	0.11	0									
30	0.03		0.12									
31	0.3		0.16									
Total	3.96	5.16	8.73	5.82								

Rain Information Inches/Rain Day
Year - 1993
Existing Conditions (>1.82")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	-	0.67	0.3	-	-	-	0.01	-	-	-
2	0.02	-	0.34	-	0.5	-	-	-	0.28	-	0.02	-
3	-	-	0.46	-	0.07	-	-	-	0.15	0.18	-	0.14
4	0.99	-	0.54	0.2	0.7	-	-	-	0.12	-	0.2	0.5
5	-	-	0.17	-	-	1.42	-	0.11	-	0.02	0.09	0.95
6	-	-	-	-	0.5	-	-	0.3	-	-	-	0.08
7	0.04	-	0.27	-	-	-	-	-	-	-	0.03	-
8	0.15	-	0.2	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	2.33	-	-	-	-	-	-
10	0.2	-	-	0.92	-	0.59	-	-	-	0.53	-	0.29
11	0.3	0.58	-	-	-	0.1	-	-	-	-	-	0.13
12	0.11	-	-	-	-	0.02	-	-	-	-	-	-
13	0.07	0.27	-	-	0.7	0.23	-	0.45	-	0.03	1.73	-
14	-	0.5	-	0.12	0.2	0.02	-	-	-	0.01	0.17	-
15	0.3	0.3	-	0.37	-	0.53	0.1	-	-	-	1.07	0.26
16	0.1	0.3	-	0.46	-	-	0.13	-	0.51	-	0.07	0.21
17	-	-	0.4	0.14	0.5	-	0.05	-	-	0.27	0.83	0.02
18	0.01	-	-	-	0.1	-	1.45	1.46	0.02	0.25	0.5	0.04
19	-	-	0.03	-	0.97	-	0.6	-	-	0.03	0.2	-
20	0.17	0.57	0.05	-	-	-	-	-	-	3.8	-	0.01
21	0.75	1.8	-	-	-	0.13	-	-	-	0.05	-	-
22	-	-	0.2	-	-	-	0.24	0.01	-	0.02	-	-
23	0.3	-	0.71	-	-	-	0.03	-	0.11	-	-	-
24	0.57	-	-	-	-	-	-	0.21	0.47	-	-	-
25	-	1.03	-	0.13	0.5	0.02	-	0.13	0.05	-	0.06	-
26	-	-	-	0.6	-	0.25	0.47	0.02	0.49	-	0.06	-
27	-	-	0.05	0.2	-	0.2	-	-	-	-	0.36	-
28	-	-	0.1	-	-	-	-	-	0.07	-	-	-
29	-	-	-	-	-	0.52	-	-	-	-	-	-
30	-	-	-	0.09	-	-	-	0.1	-	0.01	0.02	-
31	-	-	-	-	0.49	-	-	0.1	-	0.31	-	-
Total	4.08	5.35	3.52	3.9	5.53	6.36	3.07	2.89	2.28	5.51	5.41	2.63

Rain Information Inches/Rain Day
Year - 1994
Existing Conditions (>1.82")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.19	-	0.1	-	0.02	-	-	-	0.02	-	-	-
2	0.29	-	-	-	-	0.36	-	-	-	-	-	-
3	-	-	0.05	0.29	0.11	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	0.3	-	-	-	1.33
5	-	-	-	0.1	-	0.03	-	0.35	0.6	-	0.43	-
6	-	-	-	0.5	0.45	-	1.12	-	-	-	-	-
7	-	-	0.35	-	0.85	0.13	-	-	-	-	-	-
8	0.25	-	0.33	-	-	-	0.8	-	-	-	-	-
9	-	0.4	-	-	-	1.28	0.8	-	-	0.52	0.43	0.81
10	-	0.15	1.2	0.56	-	-	-	-	-	-	0.15	1.15
11	-	0.19	-	0.6	-	-	-	-	-	-	-	-
12	0.23	0.1	-	-	-	-	-	-	-	-	-	-
13	-	-	0.1	-	-	-	1.05	-	-	0.47	-	-
14	0.02	-	-	-	-	-	0.03	0.13	-	-	-	-
15	-	-	-	0.43	0.49	-	0.06	-	-	-	0.9	-
16	-	-	-	-	-	-	0.05	-	-	-	0.48	0.7
17	0.27	-	-	-	-	-	-	-	0.11	-	-	-
18	1.6	-	0.15	-	-	-	-	-	-	0.35	-	-
19	-	-	-	-	-	-	-	-	-	0.86	-	-
20	-	0.51	0.03	-	-	-	-	0.89	-	-	-	0.03
21	-	-	0.32	-	-	0.38	0.77	0.08	-	-	-	-
22	-	1.3	-	-	-	-	0.27	-	-	0.03	-	0.1
23	-	0.03	-	-	-	-	-	-	1.67	-	-	-
24	0.38	-	0.05	-	-	0.38	-	-	0.11	-	0.2	-
25	-	-	-	-	0.6	-	0.46	-	0.17	-	0.08	-
26	0.66	-	1.05	-	0.1	0.56	-	0.09	0.3	-	0.02	-
27	0.05	-	1.05	1.5	-	-	-	-	-	0.01	1.15	-
28	0.85	-	0.05	-	-	-	0.02	0.1	-	-	-	-
29	0.45	-	-	1.05	-	-	-	0.5	-	-	-	-
30	0.04	-	0.22	1	-	-	-	0.05	-	0.02	-	0.02
31	-	-	-	-	-	-	-	-	-	0.2	-	0.08
Total	5.28	2.68	5.05	6.03	2.62	3.12	5.43	2.49	2.98	2.46	3.84	4.22

Rain Information Inches/Rain Day
Year - 1995
Existing Conditions (>1.82")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.03	-	-	-	1.27	0.2	-	-	0.4	-	0.2	-
2	-	0.15	-	-	0.04	0.23	-	-	-	0.04	0.18	-
3	-	0.21	-	-	-	0.15	-	-	-	1.3	-	-
4	-	-	0.04	-	0.15	-	0.4	-	-	-	-	-
5	-	-	0.45	-	-	-	1.21	2.44	-	3.45	-	-
6	0.89	-	0.08	-	-	-	0.05	0.1	-	-	0.37	-
7	-	0.02	0.82	-	-	-	0.1	2.3	0.02	-	0.17	-
8	0.03	-	-	-	-	0.08	-	0.41	-	-	-	0.06
9	-	-	-	0.05	0.98	0.18	-	0.21	-	-	-	-
10	0.04	-	-	-	0.19	-	-	-	-	-	0.16	-
11	0.35	-	-	0.23	0.02	1.12	-	-	-	-	1	-
12	0.01	-	-	0.67	-	0.05	-	-	-	-	-	-
13	-	-	-	-	1.3	-	-	-	-	0.02	0.47	0.05
14	0.96	0.57	-	-	1.05	-	-	-	-	-	-	-
15	-	1.4	-	-	0.01	-	0.66	-	-	-	-	0.73
16	0.02	0.1	-	0.16	0.28	-	-	0.18	1.45	0.01	-	0.03
17	-	-	-	0.47	2.52	-	-	-	0.06	-	-	0.16
18	-	-	-	0.08	1.51	-	-	-	-	-	-	1.02
19	0.43	-	-	-	0.01	0.02	-	-	-	-	-	0.4
20	-	-	0.27	1.15	-	-	-	-	0.17	0.46	-	-
21	-	-	-	0.41	0.19	0.47	-	-	0.02	0.09	-	-
22	0.02	-	-	-	-	0.02	1.21	-	-	-	-	-
23	-	0.04	0.3	0.96	-	-	0.93	-	0.09	-	0.44	0.02
24	-	-	-	0.05	-	0.38	-	-	-	0.1	-	-
25	-	-	-	0.02	0.04	-	0.21	-	0.02	-	-	-
26	-	-	-	-	-	-	-	-	-	0.07	-	-
27	0.11	0.18	0.27	-	0.98	0.04	0.82	-	-	0.96	0.03	-
28	0.69	0.04	-	-	0.28	0.07	-	-	-	-	-	-
29	-	-	-	0.01	0.04	-	-	-	-	-	-	-
30	-	-	-	0.07	-	0.09	-	-	-	-	-	0.01
31	-	-	-	-	0.05	-	-	-	-	-	-	0.37
Total	3.58	2.71	2.23	4.33	10.91	3.1	5.59	5.64	2.23	6.5	3.02	2.85

Rain Information Inches/Rain Day
Year - 1996
Existing Conditions (>1.82")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.05	0.06	-	0.4	0.04	-	-	-	-	-	0.07	0.24
2	0.67	-	0.03	-	0.25	0.48	0.39	-	-	-	-	0.02
3	-	-	-	-	-	0.28	-	-	0.03	-	-	-
4	-	-	-	0.1	0.02	-	-	-	-	-	-	-
5	-	-	0.88	-	0.78	-	-	-	0.33	-	-	0.33
6	-	-	1.2	-	0.1	1.06	-	-	0.02	-	0.07	0.02
7	-	0.03	0.14	-	0.4	0.63	-	-	0.67	-	0.84	-
8	1	0.31	-	-	1.03	0.62	-	1.19	-	0.06	0.15	0.01
9	-	-	-	-	-	0.45	0.07	-	0.37	0.03	-	-
10	-	-	-	-	-	0.35	-	-	-	0.17	-	-
11	0.33	-	-	-	0.23	0.13	-	7	-	0.02	-	-
12	-	0.05	-	-	-	0.22	-	0.02	0.05	-	-	0.87
13	-	-	-	0.87	0.02	-	-	-	-	-	0.01	-
14	-	0.07	-	-	0.2	-	2.55	-	-	-	-	0.02
15	-	-	0.35	0.27	0.47	-	0.12	-	0.11	-	-	-
16	-	-	0.62	0.02	-	-	-	-	1.1	-	-	1.61
17	-	-	-	-	-	-	-	0.27	0.02	1.55	0.3	0.48
18	1.18	-	-	-	-	0.22	-	-	-	0.66	0.04	-
19	-	1.07	1.2	-	-	0.33	1.8	-	-	-	0.02	-
20	-	0.04	-	0.98	-	-	0.15	-	-	-	-	-
21	-	-	-	-	-	-	0.25	-	0.66	0.03	0.32	0.01
22	-	-	-	0.2	-	-	-	-	-	0.42	0.02	0.06
23	1.4	-	-	0.47	-	-	-	-	-	0.06	0.01	0.67
24	0.15	-	0.03	-	0.02	0.69	-	0.14	-	-	0.02	0.25
25	-	-	0.33	0.2	-	-	-	-	-	0.32	1.13	-
26	0.08	-	-	0.31	4.87	-	-	-	0.04	0.43	0.05	0.04
27	0.05	0.62	-	0.31	0.83	-	-	-	1.07	-	-	0.04
28	0.03	-	0.21	0.34	0.22	-	0.5	-	0.68	0.21	-	0.02
29	-	-	0.02	1	-	-	0.1	-	-	-	0.2	-
30	-	-	-	-	-	-	1	-	0.02	-	0.78	0.03
31	-	-	0.3	-	-	-	0.02	-	-	-	-	0.01
Total	4.94	2.25	5.31	5.47	9.48	5.46	6.95	8.62	5.17	3.96	4.03	4.73

Rain Information Inches/Rain Day
Year - 1997
Existing Conditions (>1.82")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	8.17	0.01	-	0.5	0.02	-	-	-	0.5	-
2	-	-	0.8	-	0.78	0.19	-	-	-	-	0.07	-
3	-	0.4	1	-	0.71	0.02	-	-	0.03	-	0.15	0.27
4	0.28	1.27	0.02	-	-	0.01	-	-	-	-	0.01	0.03
5	0.13	-	0.47	0.21	-	0.49	-	-	-	-	-	-
6	-	-	0.01	-	-	0.74	-	-	-	-	0.41	-
7	-	-	-	-	-	0.17	-	-	-	-	-	-
8	-	0.33	-	-	0.62	1.36	-	-	-	-	-	-
9	0.03	-	0.36	-	-	0.12	-	1.21	0.4	-	-	0.72
10	-	-	-	-	-	0.01	-	0.01	-	-	-	0.32
11	-	-	-	0.05	-	0.08	-	-	0.04	-	-	-
12	-	-	-	0.14	-	-	-	-	-	-	-	-
13	-	0.45	0.36	-	0.02	0.25	-	0.27	-	0.6	-	-
14	-	0.02	0.12	-	0.11	0.88	-	0.03	-	0.27	0.85	-
15	0.4	-	-	-	0.07	0.02	-	-	-	-	-	-
16	0.01	-	-	0.11	0.01	0.2	-	-	-	-	-	-
17	-	-	0.05	-	0.03	0.23	-	-	0.02	-	-	-
18	-	-	2.11	-	0.05	0.29	-	-	-	-	-	-
19	-	0.02	-	0.21	0.62	0.02	0.18	0.02	-	-	-	-
20	0.02	0.02	-	0.01	0.06	-	-	-	0.1	-	-	-
21	-	0.11	-	0.25	-	-	-	1.22	-	-	0.72	0.5
22	0.94	0.02	-	0.08	-	-	-	0.09	0.02	-	-	-
23	0.01	-	-	-	-	-	-	0.02	0.23	0.03	-	-
24	0.8	-	-	-	1.6	-	-	-	0.3	0.93	-	0.83
25	0.01	-	0.41	-	0.05	-	-	-	-	-	-	0.04
26	-	-	-	-	0.02	0.77	-	-	-	0.08	-	0.03
27	0.76	0.41	0.01	0.73	-	0.02	-	0.81	-	-	-	-
28	0.02	0.21	1.34	0.02	0.38	-	-	-	0.1	-	-	-
29	-	0.96	-	-	0.84	0.05	0.5	-	-	-	-	0.19
30	-	-	0.08	0.32	0.01	0.18	-	-	-	-	1	-
31	-	-	0.09	-	0.65	-	-	-	-	0.1	-	-
Total	3.41	4.22	15.4	2.14	6.63	6.6	0.7	3.68	1.24	2.01	3.71	2.93

Rain Information Inches/Rain Day
Year - 1998
Existing Conditions (>1.82")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	-	-	0.06	0.02	-	-	-	-	-	-
2	-	-	0.03	-	-	-	-	-	-	-	0.16	-
3	-	-	0.07	0.46	0.27	0.3	-	-	-	1.44	0.2	-
4	-	-	0.02	0.05	-	1.34	0.19	-	-	-	-	0.02
5	0.51	-	-	-	-	0.34	-	-	-	-	-	-
6	0.82	-	-	-	-	-	-	2	-	-	-	-
7	1.35	0.3	0.32	-	0.56	-	0.65	-	-	0.93	-	0.88
8	0.15	-	1.3	0.95	0.08	-	-	0.14	-	-	-	0.44
9	0.05	-	0.9	0.06	0.01	0.75	-	0.83	-	-	0.36	-
10	-	0.03	-	0.3	0.03	0.73	-	0.03	-	-	-	-
11	-	0.29	0.5	-	-	-	-	0.4	-	-	-	-
12	0.36	0.03	-	-	-	1.02	-	-	-	-	-	0.11
13	0.08	-	-	0.09	-	1.11	0.15	-	-	-	-	0.54
14	0.01	-	-	0.5	-	1.67	0.41	-	-	-	-	-
15	-	-	-	0.33	-	-	0.81	-	-	-	-	-
16	0.03	0.2	0.11	0.43	-	-	0.37	-	-	-	-	-
17	0.1	0.24	0.04	0.01	-	-	-	-	-	-	-	-
18	-	0.04	0.26	0.3	-	-	-	-	-	0.42	-	-
19	-	0.02	0.71	0.38	-	0.3	-	-	0.13	-	-	-
20	0.05	0.1	1	-	0.47	-	-	-	-	-	-	-
21	-	-	-	-	0.1	1.08	-	-	1.9	-	0.56	0.2
22	0.3	-	-	0.1	0.84	-	-	-	-	-	-	-
23	-	0.07	-	-	-	0.9	-	-	-	-	-	-
24	-	-	-	-	0.52	-	-	-	-	-	-	-
25	-	-	0.13	0.07	0.11	-	-	-	0.1	-	-	-
26	-	0.03	-	-	0.34	-	-	-	-	-	-	-
27	-	0.15	-	0.24	-	-	-	-	-	-	-	-
28	-	-	-	0.12	-	-	-	-	-	-	-	-
29	-	-	-	0.85	0.03	0.73	-	0.15	-	-	-	0.05
30	-	-	-	0.81	-	0.09	0.1	-	-	-	0.3	0.05
31	-	-	0.4	-	0.91	-	-	-	-	-	-	-
Total	3.81	1.5	5.79	6.05	4.33	10.38	2.68	3.55	2.13	2.79	1.58	2.29

Rain Information Inches/Rain Day
Year - 1999
Existing Conditions (>1.82")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	0.02	-	0.02	-	0.04	-	-	-	-	0.11	-
2	-	0.03	0.11	-	-	0.44	0.02	-	-	-	0.63	-
3	-	-	0.02	0.35	-	-	-	-	-	-	-	0.05
4	-	0.03	-	0.07	-	-	-	-	-	-	-	0.18
5	-	-	-	-	0.83	0.05	-	-	-	-	-	0.25
6	-	-	0.39	1.05	1.06	0.03	-	-	-	-	-	0.02
7	-	0.17	-	-	-	-	-	-	-	-	-	-
8	1.8	-	0.33	0.02	-	-	-	2.28	0.34	0.28	-	-
9	-	-	0.53	-	-	0.02	-	-	-	3.37	-	-
10	-	-	-	-	-	0.06	0.07	-	-	0.05	-	0.99
11	-	0.22	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	0.9	-	-	-	-	-	-	1.52
13	0.4	-	0.05	-	0.08	0.07	-	-	-	0.02	-	1.93
14	0.02	-	1	0.3	-	0.37	-	-	-	-	-	-
15	-	-	-	0.33	-	-	-	-	-	-	-	-
16	-	0.19	-	-	-	-	-	-	-	-	-	-
17	-	-	-	0.02	0.37	-	0.02	-	-	-	-	-
18	-	-	-	0.1	0.3	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	0.07	0.25	-
20	0.05	-	-	-	-	-	-	-	0.15	-	0.15	0.2
21	-	-	-	-	0.02	-	0.01	-	0.07	-	0.02	-
22	1.57	-	-	-	-	-	-	-	-	-	-	-
23	0.5	-	0.98	-	0.78	0.18	0.13	-	-	-	-	-
24	-	0.02	-	-	-	1	-	-	-	-	-	0.15
25	-	-	-	-	0.02	-	-	-	-	-	0.51	-
26	-	0.98	-	1.31	-	0.11	-	-	-	-	0.22	-
27	-	0.09	-	0.14	-	0.5	-	-	-	-	-	-
28	-	-	-	1.3	-	0.87	-	-	0.07	-	-	-
29	-	-	-	0.03	-	-	-	-	0.24	-	-	-
30	-	-	-	-	-	-	-	-	-	-	-	-
31	1.35	-	0.34	-	0.05	-	-	-	-	-	-	-
Total	5.69	1.75	3.75	5.04	4.41	3.74	0.25	2.28	0.87	3.79	1.89	5.29

Rain Information Inches/Rain Day
Year - 2000
Existing Conditions (>1.82")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	0.02	0.5	-	-	-	-	-	-	-	-
2	0.9	-	-	0.81	0.49	-	-	-	-	-	0.4	0.2
3	3.32	-	0.06	0.75	0.85	-	0.24	0.09	-	-	-	-
4	-	0.03	-	0.4	0.02	-	0.45	-	0.26	-	0.22	-
5	-	-	-	-	-	0.05	0.05	0.1	-	0.18	0.42	-
6	0.02	-	-	-	-	-	0.45	-	-	0.4	-	-
7	-	-	-	0.34	-	-	-	-	-	-	0.38	-
8	0.03	-	-	0.49	-	-	-	0.65	0.5	-	0.77	-
9	0.05	-	-	-	0.06	-	-	-	-	-	-	-
10	-	-	-	0.02	-	-	-	0.37	0.1	-	-	0.2
11	-	-	0.4	0.34	-	-	0.04	-	0.4	-	-	0.11
12	-	-	-	-	-	-	0.47	-	0.41	-	0.7	-
13	-	1.85	-	-	0.79	-	-	-	-	-	-	0.67
14	-	-	-	-	-	0.53	-	-	-	-	-	-
15	-	-	-	-	-	1	-	-	-	-	-	0.15
16	-	-	0.48	-	-	0.02	-	-	-	-	-	2.55
17	0.2	0.14	-	0.25	0.02	0.34	-	-	-	-	-	0.05
18	0.15	2.41	0.5	-	-	0.75	-	0.32	-	-	-	0.07
19	0.18	-	0.93	-	0.25	0.08	0.58	-	-	-	-	-
20	-	-	0.32	0.14	0.02	-	-	-	0.27	-	-	-
21	-	0.2	-	0.02	-	0.29	-	-	0.17	0.06	-	-
22	0.13	0.07	-	-	-	-	-	-	0.4	-	-	-
23	-	0.02	-	0.6	2.33	-	-	1.48	0.07	-	-	-
24	-	0.02	-	0.54	-	0.1	-	1.11	0.55	-	0.23	-
25	0.02	-	-	0.02	0.05	0.2	-	-	1	-	1	-
26	-	0.27	-	-	0.07	0.6	-	0.1	0.07	-	0.3	0.01
27	-	0.25	-	-	0.23	1.3	-	-	-	-	-	-
28	-	0.02	-	-	0.13	0.2	1.83	-	-	-	-	-
29	0.26	-	-	0.05	0.03	-	0.8	-	-	-	-	0.05
30	-	-	-	-	-	-	0.25	-	-	-	-	0.01
31	-	-	-	-	-	-	-	-	-	-	-	-
Total	5.26	5.28	2.71	5.27	5.34	5.46	5.16	4.22	4.2	0.64	4.42	4.07

Rain Information Inches/Rain Day
Year - 2001
Existing Conditions (>1.82")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	0.1	0.21	-	-	-	-	-	-	-	-
2	0.06	-	-	0.02	-	0.02	-	-	-	-	0.28	-
3	-	-	0.7	0.7	-	-	-	0.7	0.45	-	-	-
4	-	0.6	1.34	-	-	0.06	0.1	-	-	-	-	-
5	-	-	-	-	-	0.06	-	-	-	1.1	-	-
6	-	-	-	-	-	0.04	-	-	-	-	-	0.5
7	-	-	-	-	1.4	0.1	-	-	2	-	-	-
8	-	0.2	-	-	0.21	0.02	-	-	-	-	0.01	0.38
9	-	0.61	-	-	-	-	0.04	-	1.1	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	0.14	-	-	2.58	-	0.3	-	-
12	-	0.2	-	-	-	-	-	-	-	1.61	-	0.8
13	-	0.4	-	-	-	-	-	-	-	0.1	-	0.18
14	-	0.85	-	-	-	-	-	-	-	1.85	-	-
15	0.3	0.85	0.21	0.19	-	0.75	-	-	-	0.02	-	-
16	-	0.78	0.2	-	-	-	-	-	-	0.2	-	0.87
17	-	-	-	-	0.07	-	-	-	-	-	-	0.75
18	0.37	-	-	-	0.75	-	0.35	0.16	-	-	-	-
19	0.63	-	-	-	-	-	-	0.53	1	-	0.27	0.03
20	0.02	-	0.32	0.06	-	-	0.94	-	-	-	-	-
21	-	-	0.2	-	0.56	0.13	0.02	-	-	-	-	-
22	-	-	-	-	0.4	-	0.14	-	-	-	-	0.35
23	-	-	-	0.28	0.05	0.1	-	-	0.2	-	0.02	0.3
24	-	-	-	-	0.1	-	-	-	0.18	0.68	0.71	-
25	-	1	-	-	0.02	-	0.07	-	-	-	-	-
26	0.2	-	0.2	-	0.1	1.19	1.63	0.2	-	-	-	-
27	-	0.2	-	-	0.32	0.11	0.03	0.02	-	-	1.38	-
28	-	-	-	-	-	0.05	0.46	0.01	-	-	1.34	-
29	0.45	-	0.5	-	-	0.5	0.22	-	-	-	1.97	-
30	0.5	-	0.25	-	-	-	-	-	-	-	-	-
31	-	-	0.27	-	0.33	-	-	0.5	-	-	-	-
Total	2.53	5.69	4.29	1.46	4.45	3.13	4	4.7	4.93	5.86	5.98	4.16

Rain Information Inches/Rain Day
Year - 2002
Existing Conditions (>1.82")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	0.8	-	-	1.49	-	-	-	-	-	-	-
2	-	-	0.32	-	0.84	-	-	-	-	0.04	-	-
3	-	-	-	0.19	-	-	-	-	-	-	0.16	-
4	-	-	-	-	-	-	-	-	-	0.45	0.03	-
5	-	-	-	-	-	0.22	-	-	-	-	1	-
6	0.28	0.1	-	-	1.7	0.73	-	-	-	0.07	-	-
7	-	-	-	-	0.03	-	-	-	-	-	-	0.4
8	-	-	0.02	0.15	0.05	-	-	-	-	-	-	-
9	-	-	0.5	0.15	0.12	-	0.1	-	-	0.05	0.1	-
10	0.02	0.25	-	-	-	-	0.29	-	-	2.55	1	0.47
11	-	-	-	0.05	-	0.1	-	-	-	0.67	-	0.32
12	-	-	0.1	-	-	0.77	0.02	-	-	-	-	-
13	-	-	-	1	2.3	0.03	0.38	0.25	-	-	-	0.6
14	-	-	-	0.45	-	-	-	0.55	1.3	-	-	0.02
15	-	-	-	-	-	-	-	-	0.15	-	0.3	-
16	-	-	-	-	0.03	0.04	-	0.2	-	-	-	-
17	-	-	1.36	-	1	-	-	0.1	0.1	-	-	0.15
18	-	-	0.17	-	-	-	0.05	0.17	-	-	-	-
19	0.15	0.13	1.82	-	-	-	-	0.05	-	0.55	-	2.3
20	-	0.55	0.89	0.03	-	-	-	-	0.85	0.15	-	-
21	-	-	-	0.86	-	-	-	-	-	-	0.23	0.3
22	0.2	-	-	-	-	-	0.75	-	-	-	-	0.1
23	0.7	-	-	-	-	-	-	0.02	-	-	-	-
24	1.6	-	-	0.87	-	0.25	-	-	-	-	-	1
25	-	-	0.9	-	0.07	0.06	-	-	-	0.1	-	-
26	-	0.32	1.93	-	-	0.25	-	0.07	3.25	-	0.05	-
27	-	-	-	1.33	-	-	-	0.06	2.3	-	-	-
28	-	-	-	1.08	-	1.79	-	-	-	0.5	-	-
29	-	-	0.4	-	0.35	-	0.1	-	-	0.68	-	-
30	0.33	-	0.3	-	-	-	0.5	-	-	0.05	-	0.56
31	-	-	-	-	-	-	-	-	-	-	-	1.1
Total	3.28	2.15	8.71	6.16	7.98	4.24	2.19	1.47	7.95	5.86	2.87	7.32

Rain Information Inches/Rain Day
Year - 2003
Existing Conditions (>1.82")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.45	-	-	-	0.6	-	0.02	-	0.19	0.5	0.08	-
2	-	-	-	-	-	0.05	0.03	0.18	2.34	-	-	-
3	0.16	0.33	-	-	-	0.53	-	0.66	1.74	-	-	0.11
4	0.3	-	-	-	0.11	0.05	-	0.13	-	-	-	0.33
5	0.4	-	0.05	0.37	2.15	-	-	-	-	-	0.02	0.15
6	-	-	0.03	0.51	-	0.19	0.08	0.03	-	-	0.32	-
7	-	-	-	0.28	0.95	0.6	-	0.02	-	-	-	-
8	-	-	-	0.11	1.17	0.32	0.03	-	-	-	-	-
9	-	-	-	1.24	-	-	0.29	0.12	-	0.02	-	0.03
10	-	0.2	0.02	0.6	-	0.27	0.37	0.09	-	0.07	-	0.63
11	-	-	-	-	1.88	1.38	-	0.06	-	-	0.04	-
12	-	-	0.8	-	-	0.03	-	-	-	-	1.57	-
13	-	-	0.7	-	-	0.18	-	0.04	-	-	-	-
14	-	2.05	-	-	-	0.04	-	-	0.39	0.74	0.1	-
15	-	1.4	-	-	0.44	0.08	0.34	-	0.02	-	0.28	0.17
16	-	0.32	-	-	0.03	1.13	-	-	-	-	0.06	0.29
17	-	-	-	1.25	0.62	-	-	0.03	-	0.3	0.02	-
18	-	-	0.77	-	0.03	-	-	-	-	-	0.97	0.14
19	-	0.25	0.6	-	-	-	-	-	-	-	0.11	0.06
20	-	-	0.26	0.22	0.24	-	-	-	-	-	-	-
21	-	0.85	0.6	0.32	0.01	-	0.44	-	-	0.02	-	-
22	-	1.28	-	-	-	-	0.04	0.98	1.57	-	-	0.03
23	-	0.14	-	-	-	-	-	-	-	-	0.07	0.92
24	-	-	-	-	-	-	-	-	-	-	0.71	-
25	-	-	0.14	0.88	0.43	-	-	-	0.02	0.07	-	-
26	-	-	-	0.12	-	1.76	-	-	-	1	-	-
27	-	0.13	-	-	0.03	-	-	-	0.3	-	1	-
28	0.1	0.03	-	0.05	0.02	-	0.37	-	0.11	0.14	0.27	-
29	-	-	0.49	0.03	-	-	-	0.12	-	-	-	0.79
30	-	-	-	-	-	0.44	-	0.38	0.19	-	-	-
31	0.12	-	-	-	-	-	1.05	0.51	-	-	-	-
Total	1.53	6.98	4.46	5.98	8.71	7.05	3.06	3.35	6.87	2.86	5.62	3.65

Rain Information Inches/Rain Day
Year - 2004
Existing Conditions (>1.82")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.34	-	0.47	-	0.54	-	-	-	-	-	0.66	-
2	0.65	1.04	-	-	0.54	0.03	-	-	0.52	-	1.72	-
3	0.03	-	0.31	-	-	-	0.12	-	-	-	-	-
4	0.61	-	0.1	-	-	-	-	-	-	-	0.12	-
5	0.06	0.86	1.23	0.02	-	-	0.52	0.12	-	-	-	0.2
6	-	0.07	-	-	-	-	0.16	-	-	-	-	0.15
7	-	-	0.02	-	-	-	0.1	-	0.4	-	-	0.85
8	-	0.03	-	-	-	-	-	-	-	-	-	-
9	-	0.04	-	-	-	1.45	0.08	-	-	-	-	0.68
10	0.12	-	-	-	-	-	0.11	-	-	-	-	0.14
11	-	-	-	-	0.1	-	0.13	0.08	-	-	1.78	0.14
12	-	-	-	1	-	0.53	1.38	0.03	-	0.19	0.1	0.03
13	-	-	-	1.35	0.12	-	0.18	-	-	0.4	-	0.01
14	-	-	0.13	0.05	0.26	-	0.32	-	-	0.16	-	-
15	-	-	0.12	-	1.21	0.05	-	-	-	0.06	-	-
16	-	-	0.2	-	0.02	0.44	-	-	-	-	-	-
17	0.39	-	-	-	0.04	1.2	-	-	0.04	-	-	-
18	0.31	-	-	-	-	-	0.03	-	-	1	0.34	-
19	-	-	-	0.04	0.97	-	-	-	-	0.3	0.59	-
20	-	-	0.95	0.01	-	-	-	0.54	-	0.03	0.02	-
21	-	0.05	-	1	-	-	-	-	-	-	0.03	0.02
22	-	-	-	0.42	-	-	1.87	-	-	-	-	-
23	-	-	-	1.49	-	-	-	-	-	0.57	0.14	-
24	-	0.02	-	0.02	0.12	-	-	0.35	-	-	0.55	-
25	0.18	-	-	0.71	1.09	-	-	-	-	-	-	-
26	0.05	-	-	-	2.5	-	0.01	0.1	-	0.22	-	-
27	-	-	-	-	0.2	-	-	-	-	0.6	0.3	-
28	-	-	-	-	0.67	-	-	-	-	0.04	-	-
29	0.05		0.65	-	-	-	-	0.63	-	-	-	-
30	-		0.26	0.6	2.27	-	0.87	-	-	-	0.8	-
31	-		0.06		-		1.27	-		0.03		0.05
Total	2.79	2.11	4.5	6.71	10.65	3.7	7.15	1.85	0.96	3.6	7.15	2.27

Rain Information Inches/Rain Day
Year - 2005
Existing Conditions (>1.82")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.53	-	0.01	0.23	0.02	0.09	-	-	0.03	-	0.01	-
2	0.25	0.18	-	0.33	-	0.28	-	-	-	-	-	-
3	0.29	0.03	-	0.01	-	0.51	-	-	-	-	-	0.47
4	0.51	-	0.07	-	-	-	-	-	-	-	-	0.03
5	0.08	-	-	-	-	-	-	-	-	-	-	-
6	0.69	-	0.01	-	-	-	-	-	-	-	0.04	-
7	0.69	0.55	0.37	0.41	-	-	0.19	-	-	0.19	-	-
8	0.08	0.05	0.02	0.15	-	-	-	-	-	-	-	0.56
9	0.02	0.12	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	0.01	-	-	-	-	-	-
11	0.04	-	0.08	0.03	-	0.77	1.5	-	-	-	-	0.03
12	-	-	0.13	0.55	-	0.13	0.41	-	-	-	-	0.04
13	0.67	0.65	0.02	0.14	-	0.43	0.31	-	-	-	0.35	-
14	-	0.19	-	-	0.71	-	0.24	0.27	-	-	0.7	0.07
15	-	-	0.01	0.05	-	-	0.02	-	-	-	0.65	0.57
16	0.02	-	-	-	-	-	0.33	0.42	0.05	-	-	-
17	-	-	-	-	-	-	0.11	0.01	-	-	-	-
18	-	-	-	-	-	-	-	0.66	-	-	-	-
19	0.01	-	0.11	-	1.11	-	-	-	-	-	-	-
20	-	0.54	0.01	-	0.53	-	0.09	0.55	0.16	0.15	-	-
21	-	0.07	-	-	-	-	-	-	-	0.41	-	-
22	0.02	0.01	0.47	0.4	0.01	-	0.84	-	-	0.03	-	-
23	0.01	0.07	0.27	0.04	-	-	-	-	-	0.1	-	-
24	-	0.02	-	0.02	-	-	-	-	-	0.13	-	0.18
25	-	-	0.05	0.01	-	-	-	0.1	0.41	-	-	0.33
26	-	-	-	0.57	-	-	-	0.67	0.12	-	-	0.01
27	-	0.01	1.25	0.02	-	-	-	-	-	-	0.13	-
28	-	0.55	0.34	0.24	-	-	-	0.5	-	-	1.07	0.2
29	0.66	-	0.04	0.93	-	0.45	-	0.32	0.15	-	-	0.02
30	0.02	-	0.02	0.13	-	-	-	3.85	-	-	-	0.17
31	0.01	-	-	-	-	-	-	0.05	-	-	-	0.01
Total	4.6	3.04	3.28	4.26	2.38	2.67	4.04	7.4	0.92	1.01	2.95	2.69

Rain Information Inches/Rain Day
Year - 2006
Existing Conditions (>1.82")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	-	-	-	0.08	-	-	0.01	-	0.32	0.51
2	0.23	0.51	-	0.12	0.85	0.53	-	-	0.03	-	-	-
3	0.02	0.06	-	-	-	-	-	-	-	-	-	-
4	-	0.78	0.05	-	-	0.04	0.06	-	-	-	-	-
5	-	-	-	-	-	-	-	-	0.06	0.03	-	-
6	-	-	-	0.07	-	-	-	-	-	-	0.22	-
7	-	-	-	0.45	0.03	0.16	-	-	-	-	0.64	-
8	-	-	0.04	0.03	-	-	-	0.42	-	-	-	-
9	-	-	0.7	-	0.01	-	-	0.17	-	-	-	-
10	1.15	0.08	-	-	0.41	-	-	1.18	0.14	-	-	-
11	0.15	0.11	0.47	-	0.15	0.62	1.08	-	1.45	0.14	0.11	-
12	-	-	2.04	-	0.02	-	0.05	-	0.7	0.11	-	0.33
13	0.43	-	0.22	-	-	-	1.25	-	0.04	-	0.03	-
14	0.1	-	-	0.01	0.01	-	0.04	0.98	-	-	-	-
15	-	-	-	-	0.1	-	-	0.18	-	-	1.1	-
16	-	0.53	0.01	0.07	0.02	-	-	-	-	1.32	0.45	-
17	1.12	0.25	-	1.03	-	1.71	-	-	-	0.34	-	-
18	-	0.09	-	0.06	0.1	0.38	-	0.11	0.17	-	-	-
19	0.21	-	-	0.06	0.01	0.28	-	-	-	0.51	0.08	-
20	-	-	-	1.05	-	0.03	-	0.94	-	0.01	-	-
21	-	-	0.3	1.61	-	-	2.17	-	-	-	-	0.1
22	2.08	0.1	-	-	-	0.03	0.88	-	4.57	-	-	0.38
23	0.08	-	-	0.02	-	0.32	-	-	2.18	-	-	-
24	-	-	0.05	-	-	-	-	-	0.2	-	-	-
25	-	-	-	-	2.18	-	-	-	-	-	-	0.97
26	-	-	-	0.17	-	0.6	-	-	-	0.42	-	0.06
27	-	-	0.02	-	-	-	0.21	-	0.65	1.79	-	-
28	0.02	-	0.02	-	-	-	0.44	1.8	0.64	0.34	-	-
29	0.33	-	-	0.08	-	-	-	0.03	-	-	0.07	-
30	0.03	-	-	0.34	0.08	-	-	-	0.08	-	0.48	-
31	-	-	0.65	-	-	-	-	-	-	0.16	-	0.67
Total	5.95	2.51	4.57	5.17	3.97	4.78	6.18	5.81	10.92	5.17	3.5	3.02

Rain Information Inches/Rain Day
Year - 2007
Existing Conditions (>1.82")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	0.94	0.18	-	-	-	-	-	-	-	0
2	-	-	-	-	0.59	-	-	-	-	-	-	0.63
3	-	-	-	1	0.21	-	-	-	-	-	-	0.02
4	0.2	0.1	-	-	0.74	0.02	0.06	-	-	-	-	0
5	0.35	-	-	-	0.3	-	2.47	-	-	-	0.03	0
6	-	-	-	-	-	-	-	-	-	-	-	0
7	0.57	-	-	-	-	-	-	-	-	-	-	0.48
8	-	-	-	-	-	0.23	-	-	-	-	-	0.36
9	-	-	-	-	-	-	-	-	1.51	-	-	1.25
10	-	-	0.04	-	-	-	0.2	-	-	-	-	0.65
11	0.3	-	-	0.54	0.1	-	-	-	0.02	-	0.11	0
12	0.1	0.57	-	0.3	-	-	-	-	-	-	0.06	0.43
13	0.77	1	-	0.12	-	-	-	-	-	-	0.03	0
14	0.17	-	0.17	1.45	-	-	-	-	0.05	-	0.27	0
15	0.65	-	0.18	-	0.4	-	-	-	-	-	-	2.53
16	-	-	-	-	0.15	-	-	-	-	0.35	-	0.03
17	-	-	-	-	0.01	-	0.08	-	-	-	-	0
18	-	0.1	-	-	-	-	-	-	-	1.83	-	0
19	-	-	0.65	-	-	0.03	0.87	0.03	-	0.15	-	0
20	-	-	0.16	-	-	-	-	-	-	-	-	0.68
21	0.68	-	-	-	-	-	-	2.36	-	-	0.54	0.06
22	-	-	0.05	-	-	0.07	-	-	-	2.56	-	0.12
23	-	-	-	-	-	0.2	-	-	-	4.36	-	0.16
24	-	1.23	-	-	-	0.52	-	-	-	0.67	-	0
25	-	0.17	-	0.03	-	0.13	-	-	0.23	-	0.37	0
26	-	-	-	0.73	-	0.65	-	-	0.3	0.05	0.84	0.09
27	-	-	-	0.3	-	0.02	0.51	-	0.9	-	-	0
28	-	-	1.13	0.2	-	0.12	0.14	-	0.03	-	0.04	0
29	-	-	-	-	-	0.04	-	0.07	-	-	-	0
30	-	-	0.8	-	-	-	-	0.01	-	-	-	0
31	-	-	0.16	-	-	-	-	-	-	-	-	0.02
Total	3.79	3.17	4.28	4.85	2.5	2.03	4.33	2.47	3.04	9.97	2.29	7.51

Rain Information Inches/Rain Day
Year - 2008
Existing Conditions (>1.82")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.04	0	0	0.5								
2	0	0	0.1	0.02								
3	0	0.1	1.03	1.3								
4	0	0.15	1.78	3.3								
5	0.29	0.35	0	0								
6	0	1	0	0								
7	0	0	0.3	0								
8	0.6	0	0.11	0								
9	0.03	0	0	0.7								
10	1.16	0.02	0.07									
11	0	0.51	0.02									
12	0.01	1.35	0									
13	0.2	0.03	0									
14	0.02	0	0.4									
15	0	0	0.6									
16	0	0	0.25									
17	0.22	0.23	0									
18	0	0	0.23									
19	0	0	2.4									
20	0.03	0	0.02									
21	0	0.5	0									
22	0.03	0.6	0									
23	0	0.05	0									
24	0	0	0									
25	0	0.04	0									
26	0	0.11	0.1									
27	0	0.01	0.52									
28	0	0	0.52									
29	1	0.11	0									
30	0.03		0.12									
31	0.3		0.16									
Total	3.96	5.16	8.73	5.82								

Rain Information Inches/Rain Day
Year - 1993
Proposed Conditions #1 (>3.26"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	-	0.67	0.3	-	-	-	0.01	-	-	-
2	0.02	-	0.34	-	0.5	-	-	-	0.28	-	0.02	-
3	-	-	0.46	-	0.07	-	-	-	0.15	0.18	-	0.14
4	0.99	-	0.54	0.2	0.7	-	-	-	0.12	-	0.2	0.5
5	-	-	0.17	-	-	1.42	-	0.11	-	0.02	0.09	0.95
6	-	-	-	-	0.5	-	-	0.3	-	-	-	0.08
7	0.04	-	0.27	-	-	-	-	-	-	-	0.03	-
8	0.15	-	0.2	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	2.33	-	-	-	-	-	-
10	0.2	-	-	0.92	-	0.59	-	-	-	0.53	-	0.29
11	0.3	0.58	-	-	-	0.1	-	-	-	-	-	0.13
12	0.11	-	-	-	-	0.02	-	-	-	-	-	-
13	0.07	0.27	-	-	0.7	0.23	-	0.45	-	0.03	1.73	-
14	-	0.5	-	0.12	0.2	0.02	-	-	-	0.01	0.17	-
15	0.3	0.3	-	0.37	-	0.53	0.1	-	-	-	1.07	0.26
16	0.1	0.3	-	0.46	-	-	0.13	-	0.51	-	0.07	0.21
17	-	-	0.4	0.14	0.5	-	0.05	-	-	0.27	0.83	0.02
18	0.01	-	-	-	0.1	-	1.45	1.46	0.02	0.25	0.5	0.04
19	-	-	0.03	-	0.97	-	0.6	-	-	0.03	0.2	-
20	0.17	0.57	0.05	-	-	-	-	-	-	3.8	-	0.01
21	0.75	1.8	-	-	-	0.13	-	-	-	0.05	-	-
22	-	-	0.2	-	-	-	0.24	0.01	-	0.02	-	-
23	0.3	-	0.71	-	-	-	0.03	-	0.11	-	-	-
24	0.57	-	-	-	-	-	-	0.21	0.47	-	-	-
25	-	1.03	-	0.13	0.5	0.02	-	0.13	0.05	-	0.06	-
26	-	-	-	0.6	-	0.25	0.47	0.02	0.49	-	0.06	-
27	-	-	0.05	0.2	-	0.2	-	-	-	-	0.36	-
28	-	-	0.1	-	-	-	-	-	0.07	-	-	-
29	-	-	-	-	-	0.52	-	-	-	-	-	-
30	-	-	-	0.09	-	-	-	0.1	-	0.01	0.02	-
31	-	-	-	-	0.49	-	-	0.1	-	0.31	-	-
Total	4.08	5.35	3.52	3.9	5.53	6.36	3.07	2.89	2.28	5.51	5.41	2.63

Rain Information Inches/Rain Day
Year - 1994
Proposed Conditions #1 (>3.26"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.19	-	0.1	-	0.02	-	-	-	0.02	-	-	-
2	0.29	-	-	-	-	0.36	-	-	-	-	-	-
3	-	-	0.05	0.29	0.11	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	0.3	-	-	-	1.33
5	-	-	-	0.1	-	0.03	-	0.35	0.6	-	0.43	-
6	-	-	-	0.5	0.45	-	1.12	-	-	-	-	-
7	-	-	0.35	-	0.85	0.13	-	-	-	-	-	-
8	0.25	-	0.33	-	-	-	0.8	-	-	-	-	-
9	-	0.4	-	-	-	1.28	0.8	-	-	0.52	0.43	0.81
10	-	0.15	1.2	0.56	-	-	-	-	-	-	0.15	1.15
11	-	0.19	-	0.6	-	-	-	-	-	-	-	-
12	0.23	0.1	-	-	-	-	-	-	-	-	-	-
13	-	-	0.1	-	-	-	1.05	-	-	0.47	-	-
14	0.02	-	-	-	-	-	0.03	0.13	-	-	-	-
15	-	-	-	0.43	0.49	-	0.06	-	-	-	0.9	-
16	-	-	-	-	-	-	0.05	-	-	-	0.48	0.7
17	0.27	-	-	-	-	-	-	-	0.11	-	-	-
18	1.6	-	0.15	-	-	-	-	-	-	0.35	-	-
19	-	-	-	-	-	-	-	-	-	0.86	-	-
20	-	0.51	0.03	-	-	-	-	0.89	-	-	-	0.03
21	-	-	0.32	-	-	0.38	0.77	0.08	-	-	-	-
22	-	1.3	-	-	-	-	0.27	-	-	0.03	-	0.1
23	-	0.03	-	-	-	-	-	-	1.67	-	-	-
24	0.38	-	0.05	-	-	0.38	-	-	0.11	-	0.2	-
25	-	-	-	-	0.6	-	0.46	-	0.17	-	0.08	-
26	0.66	-	1.05	-	0.1	0.56	-	0.09	0.3	-	0.02	-
27	0.05	-	1.05	1.5	-	-	-	-	-	0.01	1.15	-
28	0.85	-	0.05	-	-	-	0.02	0.1	-	-	-	-
29	0.45	-	-	1.05	-	-	-	0.5	-	-	-	-
30	0.04	-	0.22	1	-	-	-	0.05	-	0.02	-	0.02
31	-	-	-	-	-	-	-	-	-	0.2	-	0.08
Total	5.28	2.68	5.05	6.03	2.62	3.12	5.43	2.49	2.98	2.46	3.84	4.22

Rain Information Inches/Rain Day
Year - 1995
Proposed Conditions #1 (>3.26"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.03	-	-	-	1.27	0.2	-	-	0.4	-	0.2	-
2	-	0.15	-	-	0.04	0.23	-	-	-	0.04	0.18	-
3	-	0.21	-	-	-	0.15	-	-	-	1.3	-	-
4	-	-	0.04	-	0.15	-	0.4	-	-	-	-	-
5	-	-	0.45	-	-	-	1.21	2.44	-	3.45	-	-
6	0.89	-	0.08	-	-	-	0.05	0.1	-	-	0.37	-
7	-	0.02	0.82	-	-	-	0.1	2.3	0.02	-	0.17	-
8	0.03	-	-	-	-	0.08	-	0.41	-	-	-	0.06
9	-	-	-	0.05	0.98	0.18	-	0.21	-	-	-	-
10	0.04	-	-	-	0.19	-	-	-	-	-	0.16	-
11	0.35	-	-	0.23	0.02	1.12	-	-	-	-	1	-
12	0.01	-	-	0.67	-	0.05	-	-	-	-	-	-
13	-	-	-	-	1.3	-	-	-	-	0.02	0.47	0.05
14	0.96	0.57	-	-	1.05	-	-	-	-	-	-	-
15	-	1.4	-	-	0.01	-	0.66	-	-	-	-	0.73
16	0.02	0.1	-	0.16	0.28	-	-	0.18	1.45	0.01	-	0.03
17	-	-	-	0.47	2.52	-	-	-	0.06	-	-	0.16
18	-	-	-	0.08	1.51	-	-	-	-	-	-	1.02
19	0.43	-	-	-	0.01	0.02	-	-	-	-	-	0.4
20	-	-	0.27	1.15	-	-	-	-	0.17	0.46	-	-
21	-	-	-	0.41	0.19	0.47	-	-	0.02	0.09	-	-
22	0.02	-	-	-	-	0.02	1.21	-	-	-	-	-
23	-	0.04	0.3	0.96	-	-	0.93	-	0.09	-	0.44	0.02
24	-	-	-	0.05	-	0.38	-	-	-	0.1	-	-
25	-	-	-	0.02	0.04	-	0.21	-	0.02	-	-	-
26	-	-	-	-	-	-	-	-	-	0.07	-	-
27	0.11	0.18	0.27	-	0.98	0.04	0.82	-	-	0.96	0.03	-
28	0.69	0.04	-	-	0.28	0.07	-	-	-	-	-	-
29	-	-	-	0.01	0.04	-	-	-	-	-	-	-
30	-	-	-	0.07	-	0.09	-	-	-	-	-	0.01
31	-	-	-	-	0.05	-	-	-	-	-	-	0.37
Total	3.58	2.71	2.23	4.33	10.91	3.1	5.59	5.64	2.23	6.5	3.02	2.85

Rain Information Inches/Rain Day
Year - 1996
Proposed Conditions #1 (>3.26"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.05	0.06	-	0.4	0.04	-	-	-	-	-	0.07	0.24
2	0.67	-	0.03	-	0.25	0.48	0.39	-	-	-	-	0.02
3	-	-	-	-	-	0.28	-	-	0.03	-	-	-
4	-	-	-	0.1	0.02	-	-	-	-	-	-	-
5	-	-	0.88	-	0.78	-	-	-	0.33	-	-	0.33
6	-	-	1.2	-	0.1	1.06	-	-	0.02	-	0.07	0.02
7	-	0.03	0.14	-	0.4	0.63	-	-	0.67	-	0.84	-
8	1	0.31	-	-	1.03	0.62	-	1.19	-	0.06	0.15	0.01
9	-	-	-	-	-	0.45	0.07	-	0.37	0.03	-	-
10	-	-	-	-	-	0.35	-	-	-	0.17	-	-
11	0.33	-	-	-	0.23	0.13	-	7	-	0.02	-	-
12	-	0.05	-	-	-	0.22	-	0.02	0.05	-	-	0.87
13	-	-	-	0.87	0.02	-	-	-	-	-	0.01	-
14	-	0.07	-	-	0.2	-	2.55	-	-	-	-	0.02
15	-	-	0.35	0.27	0.47	-	0.12	-	0.11	-	-	-
16	-	-	0.62	0.02	-	-	-	-	1.1	-	-	1.61
17	-	-	-	-	-	-	-	0.27	0.02	1.55	0.3	0.48
18	1.18	-	-	-	-	0.22	-	-	-	0.66	0.04	-
19	-	1.07	1.2	-	-	0.33	1.8	-	-	-	0.02	-
20	-	0.04	-	0.98	-	-	0.15	-	-	-	-	-
21	-	-	-	-	-	-	0.25	-	0.66	0.03	0.32	0.01
22	-	-	-	0.2	-	-	-	-	-	0.42	0.02	0.06
23	1.4	-	-	0.47	-	-	-	-	-	0.06	0.01	0.67
24	0.15	-	0.03	-	0.02	0.69	-	0.14	-	-	0.02	0.25
25	-	-	0.33	0.2	-	-	-	-	-	0.32	1.13	-
26	0.08	-	-	0.31	4.87	-	-	-	0.04	0.43	0.05	0.04
27	0.05	0.62	-	0.31	0.83	-	-	-	1.07	-	-	0.04
28	0.03	-	0.21	0.34	0.22	-	0.5	-	0.68	0.21	-	0.02
29	-	-	0.02	1	-	-	0.1	-	-	-	0.2	-
30	-	-	-	-	-	-	1	-	0.02	-	0.78	0.03
31	-	-	0.3	-	-	-	0.02	-	-	-	-	0.01
Total	4.94	2.25	5.31	5.47	9.48	5.46	6.95	8.62	5.17	3.96	4.03	4.73

Rain Information Inches/Rain Day
Year - 1997
Proposed Conditions #1 (>3.26"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	8.17	0.01	-	0.5	0.02	-	-	-	0.5	-
2	-	-	0.8	-	0.78	0.19	-	-	-	-	0.07	-
3	-	0.4	1	-	0.71	0.02	-	-	0.03	-	0.15	0.27
4	0.28	1.27	0.02	-	-	0.01	-	-	-	-	0.01	0.03
5	0.13	-	0.47	0.21	-	0.49	-	-	-	-	-	-
6	-	-	0.01	-	-	0.74	-	-	-	-	0.41	-
7	-	-	-	-	-	0.17	-	-	-	-	-	-
8	-	0.33	-	-	0.62	1.36	-	-	-	-	-	-
9	0.03	-	0.36	-	-	0.12	-	1.21	0.4	-	-	0.72
10	-	-	-	-	-	0.01	-	0.01	-	-	-	0.32
11	-	-	-	0.05	-	0.08	-	-	0.04	-	-	-
12	-	-	-	0.14	-	-	-	-	-	-	-	-
13	-	0.45	0.36	-	0.02	0.25	-	0.27	-	0.6	-	-
14	-	0.02	0.12	-	0.11	0.88	-	0.03	-	0.27	0.85	-
15	0.4	-	-	-	0.07	0.02	-	-	-	-	-	-
16	0.01	-	-	0.11	0.01	0.2	-	-	-	-	-	-
17	-	-	0.05	-	0.03	0.23	-	-	0.02	-	-	-
18	-	-	2.11	-	0.05	0.29	-	-	-	-	-	-
19	-	0.02	-	0.21	0.62	0.02	0.18	0.02	-	-	-	-
20	0.02	0.02	-	0.01	0.06	-	-	-	0.1	-	-	-
21	-	0.11	-	0.25	-	-	-	1.22	-	-	0.72	0.5
22	0.94	0.02	-	0.08	-	-	-	0.09	0.02	-	-	-
23	0.01	-	-	-	-	-	-	0.02	0.23	0.03	-	-
24	0.8	-	-	-	1.6	-	-	-	0.3	0.93	-	0.83
25	0.01	-	0.41	-	0.05	-	-	-	-	-	-	0.04
26	-	-	-	-	0.02	0.77	-	-	-	0.08	-	0.03
27	0.76	0.41	0.01	0.73	-	0.02	-	0.81	-	-	-	-
28	0.02	0.21	1.34	0.02	0.38	-	-	-	0.1	-	-	-
29	-	0.96	-	-	0.84	0.05	0.5	-	-	-	-	0.19
30	-	-	0.08	0.32	0.01	0.18	-	-	-	-	1	-
31	-	-	0.09	-	0.65	-	-	-	-	0.1	-	-
Total	3.41	4.22	15.4	2.14	6.63	6.6	0.7	3.68	1.24	2.01	3.71	2.93

Rain Information Inches/Rain Day
Year - 1998
Proposed Conditions #1 (>3.26"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	-	-	0.06	0.02	-	-	-	-	-	-
2	-	-	0.03	-	-	-	-	-	-	-	0.16	-
3	-	-	0.07	0.46	0.27	0.3	-	-	-	1.44	0.2	-
4	-	-	0.02	0.05	-	1.34	0.19	-	-	-	-	0.02
5	0.51	-	-	-	-	0.34	-	-	-	-	-	-
6	0.82	-	-	-	-	-	-	2	-	-	-	-
7	1.35	0.3	0.32	-	0.56	-	0.65	-	-	0.93	-	0.88
8	0.15	-	1.3	0.95	0.08	-	-	0.14	-	-	-	0.44
9	0.05	-	0.9	0.06	0.01	0.75	-	0.83	-	-	0.36	-
10	-	0.03	-	0.3	0.03	0.73	-	0.03	-	-	-	-
11	-	0.29	0.5	-	-	-	-	0.4	-	-	-	-
12	0.36	0.03	-	-	-	1.02	-	-	-	-	-	0.11
13	0.08	-	-	0.09	-	1.11	0.15	-	-	-	-	0.54
14	0.01	-	-	0.5	-	1.67	0.41	-	-	-	-	-
15	-	-	-	0.33	-	-	0.81	-	-	-	-	-
16	0.03	0.2	0.11	0.43	-	-	0.37	-	-	-	-	-
17	0.1	0.24	0.04	0.01	-	-	-	-	-	-	-	-
18	-	0.04	0.26	0.3	-	-	-	-	-	0.42	-	-
19	-	0.02	0.71	0.38	-	0.3	-	-	0.13	-	-	-
20	0.05	0.1	1	-	0.47	-	-	-	-	-	-	-
21	-	-	-	-	0.1	1.08	-	-	1.9	-	0.56	0.2
22	0.3	-	-	0.1	0.84	-	-	-	-	-	-	-
23	-	0.07	-	-	-	0.9	-	-	-	-	-	-
24	-	-	-	-	0.52	-	-	-	-	-	-	-
25	-	-	0.13	0.07	0.11	-	-	-	0.1	-	-	-
26	-	0.03	-	-	0.34	-	-	-	-	-	-	-
27	-	0.15	-	0.24	-	-	-	-	-	-	-	-
28	-	-	-	0.12	-	-	-	-	-	-	-	-
29	-	-	-	0.85	0.03	0.73	-	0.15	-	-	-	0.05
30	-	-	-	0.81	-	0.09	0.1	-	-	-	0.3	0.05
31	-	-	0.4	-	0.91	-	-	-	-	-	-	-
Total	3.81	1.5	5.79	6.05	4.33	10.38	2.68	3.55	2.13	2.79	1.58	2.29

Rain Information Inches/Rain Day
Year - 1999
Proposed Conditions #1 (>3.26"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	0.02	-	0.02	-	0.04	-	-	-	-	0.11	-
2	-	0.03	0.11	-	-	0.44	0.02	-	-	-	0.63	-
3	-	-	0.02	0.35	-	-	-	-	-	-	-	0.05
4	-	0.03	-	0.07	-	-	-	-	-	-	-	0.18
5	-	-	-	-	0.83	0.05	-	-	-	-	-	0.25
6	-	-	0.39	1.05	1.06	0.03	-	-	-	-	-	0.02
7	-	0.17	-	-	-	-	-	-	-	-	-	-
8	1.8	-	0.33	0.02	-	-	-	2.28	0.34	0.28	-	-
9	-	-	0.53	-	-	0.02	-	-	-	3.37	-	-
10	-	-	-	-	-	0.06	0.07	-	-	0.05	-	0.99
11	-	0.22	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	0.9	-	-	-	-	-	-	1.52
13	0.4	-	0.05	-	0.08	0.07	-	-	-	0.02	-	1.93
14	0.02	-	1	0.3	-	0.37	-	-	-	-	-	-
15	-	-	-	0.33	-	-	-	-	-	-	-	-
16	-	0.19	-	-	-	-	-	-	-	-	-	-
17	-	-	-	0.02	0.37	-	0.02	-	-	-	-	-
18	-	-	-	0.1	0.3	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	0.07	0.25	-
20	0.05	-	-	-	-	-	-	-	0.15	-	0.15	0.2
21	-	-	-	-	0.02	-	0.01	-	0.07	-	0.02	-
22	1.57	-	-	-	-	-	-	-	-	-	-	-
23	0.5	-	0.98	-	0.78	0.18	0.13	-	-	-	-	-
24	-	0.02	-	-	-	1	-	-	-	-	-	0.15
25	-	-	-	-	0.02	-	-	-	-	-	0.51	-
26	-	0.98	-	1.31	-	0.11	-	-	-	-	0.22	-
27	-	0.09	-	0.14	-	0.5	-	-	-	-	-	-
28	-	-	-	1.3	-	0.87	-	-	0.07	-	-	-
29	-	-	-	0.03	-	-	-	-	0.24	-	-	-
30	-	-	-	-	-	-	-	-	-	-	-	-
31	1.35	-	0.34	-	0.05	-	-	-	-	-	-	-
Total	5.69	1.75	3.75	5.04	4.41	3.74	0.25	2.28	0.87	3.79	1.89	5.29

Rain Information Inches/Rain Day
Year - 2000
Proposed Conditions #1 (>3.26"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	0.02	0.5	-	-	-	-	-	-	-	-
2	0.9	-	-	0.81	0.49	-	-	-	-	-	0.4	0.2
3	3.32	-	0.06	0.75	0.85	-	0.24	0.09	-	-	-	-
4	-	0.03	-	0.4	0.02	-	0.45	-	0.26	-	0.22	-
5	-	-	-	-	-	0.05	0.05	0.1	-	0.18	0.42	-
6	0.02	-	-	-	-	-	0.45	-	-	0.4	-	-
7	-	-	-	0.34	-	-	-	-	-	-	0.38	-
8	0.03	-	-	0.49	-	-	-	0.65	0.5	-	0.77	-
9	0.05	-	-	-	0.06	-	-	-	-	-	-	-
10	-	-	-	0.02	-	-	-	0.37	0.1	-	-	0.2
11	-	-	0.4	0.34	-	-	0.04	-	0.4	-	-	0.11
12	-	-	-	-	-	-	0.47	-	0.41	-	0.7	-
13	-	1.85	-	-	0.79	-	-	-	-	-	-	0.67
14	-	-	-	-	-	0.53	-	-	-	-	-	-
15	-	-	-	-	-	1	-	-	-	-	-	0.15
16	-	-	0.48	-	-	0.02	-	-	-	-	-	2.55
17	0.2	0.14	-	0.25	0.02	0.34	-	-	-	-	-	0.05
18	0.15	2.41	0.5	-	-	0.75	-	0.32	-	-	-	0.07
19	0.18	-	0.93	-	0.25	0.08	0.58	-	-	-	-	-
20	-	-	0.32	0.14	0.02	-	-	-	0.27	-	-	-
21	-	0.2	-	0.02	-	0.29	-	-	0.17	0.06	-	-
22	0.13	0.07	-	-	-	-	-	-	0.4	-	-	-
23	-	0.02	-	0.6	2.33	-	-	1.48	0.07	-	-	-
24	-	0.02	-	0.54	-	0.1	-	1.11	0.55	-	0.23	-
25	0.02	-	-	0.02	0.05	0.2	-	-	1	-	1	-
26	-	0.27	-	-	0.07	0.6	-	0.1	0.07	-	0.3	0.01
27	-	0.25	-	-	0.23	1.3	-	-	-	-	-	-
28	-	0.02	-	-	0.13	0.2	1.83	-	-	-	-	-
29	0.26	-	-	0.05	0.03	-	0.8	-	-	-	-	0.05
30	-	-	-	-	-	-	0.25	-	-	-	-	0.01
31	-	-	-	-	-	-	-	-	-	-	-	-
Total	5.26	5.28	2.71	5.27	5.34	5.46	5.16	4.22	4.2	0.64	4.42	4.07

Rain Information Inches/Rain Day
Year - 2001
Proposed Conditions #1 (>3.26"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	0.1	0.21	-	-	-	-	-	-	-	-
2	0.06	-	-	0.02	-	0.02	-	-	-	-	0.28	-
3	-	-	0.7	0.7	-	-	-	0.7	0.45	-	-	-
4	-	0.6	1.34	-	-	0.06	0.1	-	-	-	-	-
5	-	-	-	-	-	0.06	-	-	-	1.1	-	-
6	-	-	-	-	-	0.04	-	-	-	-	-	0.5
7	-	-	-	-	1.4	0.1	-	-	2	-	-	-
8	-	0.2	-	-	0.21	0.02	-	-	-	-	0.01	0.38
9	-	0.61	-	-	-	-	0.04	-	1.1	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	0.14	-	-	2.58	-	0.3	-	-
12	-	0.2	-	-	-	-	-	-	-	1.61	-	0.8
13	-	0.4	-	-	-	-	-	-	-	0.1	-	0.18
14	-	0.85	-	-	-	-	-	-	-	1.85	-	-
15	0.3	0.85	0.21	0.19	-	0.75	-	-	-	0.02	-	-
16	-	0.78	0.2	-	-	-	-	-	-	0.2	-	0.87
17	-	-	-	-	0.07	-	-	-	-	-	-	0.75
18	0.37	-	-	-	0.75	-	0.35	0.16	-	-	-	-
19	0.63	-	-	-	-	-	-	0.53	1	-	0.27	0.03
20	0.02	-	0.32	0.06	-	-	0.94	-	-	-	-	-
21	-	-	0.2	-	0.56	0.13	0.02	-	-	-	-	-
22	-	-	-	-	0.4	-	0.14	-	-	-	-	0.35
23	-	-	-	0.28	0.05	0.1	-	-	0.2	-	0.02	0.3
24	-	-	-	-	0.1	-	-	-	0.18	0.68	0.71	-
25	-	1	-	-	0.02	-	0.07	-	-	-	-	-
26	0.2	-	0.2	-	0.1	1.19	1.63	0.2	-	-	-	-
27	-	0.2	-	-	0.32	0.11	0.03	0.02	-	-	1.38	-
28	-	-	-	-	-	0.05	0.46	0.01	-	-	1.34	-
29	0.45	-	0.5	-	-	0.5	0.22	-	-	-	1.97	-
30	0.5	-	0.25	-	-	-	-	-	-	-	-	-
31	-	-	0.27	-	0.33	-	-	0.5	-	-	-	-
Total	2.53	5.69	4.29	1.46	4.45	3.13	4	4.7	4.93	5.86	5.98	4.16

Rain Information Inches/Rain Day
Year - 2002
Proposed Conditions #1 (>3.26"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	0.8	-	-	1.49	-	-	-	-	-	-	-
2	-	-	0.32	-	0.84	-	-	-	-	0.04	-	-
3	-	-	-	0.19	-	-	-	-	-	-	0.16	-
4	-	-	-	-	-	-	-	-	-	0.45	0.03	-
5	-	-	-	-	-	0.22	-	-	-	-	1	-
6	0.28	0.1	-	-	1.7	0.73	-	-	-	0.07	-	-
7	-	-	-	-	0.03	-	-	-	-	-	-	0.4
8	-	-	0.02	0.15	0.05	-	-	-	-	-	-	-
9	-	-	0.5	0.15	0.12	-	0.1	-	-	0.05	0.1	-
10	0.02	0.25	-	-	-	-	0.29	-	-	2.55	1	0.47
11	-	-	-	0.05	-	0.1	-	-	-	0.67	-	0.32
12	-	-	0.1	-	-	0.77	0.02	-	-	-	-	-
13	-	-	-	1	2.3	0.03	0.38	0.25	-	-	-	0.6
14	-	-	-	0.45	-	-	-	0.55	1.3	-	-	0.02
15	-	-	-	-	-	-	-	-	0.15	-	0.3	-
16	-	-	-	-	0.03	0.04	-	0.2	-	-	-	-
17	-	-	1.36	-	1	-	-	0.1	0.1	-	-	0.15
18	-	-	0.17	-	-	-	0.05	0.17	-	-	-	-
19	0.15	0.13	1.82	-	-	-	-	0.05	-	0.55	-	2.3
20	-	0.55	0.89	0.03	-	-	-	-	0.85	0.15	-	-
21	-	-	-	0.86	-	-	-	-	-	-	0.23	0.3
22	0.2	-	-	-	-	-	0.75	-	-	-	-	0.1
23	0.7	-	-	-	-	-	-	0.02	-	-	-	-
24	1.6	-	-	0.87	-	0.25	-	-	-	-	-	1
25	-	-	0.9	-	0.07	0.06	-	-	-	0.1	-	-
26	-	0.32	1.93	-	-	0.25	-	0.07	3.25	-	0.05	-
27	-	-	-	1.33	-	-	-	0.06	2.3	-	-	-
28	-	-	-	1.08	-	1.79	-	-	-	0.5	-	-
29	-	-	0.4	-	0.35	-	0.1	-	-	0.68	-	-
30	0.33	-	0.3	-	-	-	0.5	-	-	0.05	-	0.56
31	-	-	-	-	-	-	-	-	-	-	-	1.1
Total	3.28	2.15	8.71	6.16	7.98	4.24	2.19	1.47	7.95	5.86	2.87	7.32

Rain Information Inches/Rain Day
Year - 2003
Proposed Conditions #1 (>3.26"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.45	-	-	-	0.6	-	0.02	-	0.19	0.5	0.08	-
2	-	-	-	-	-	0.05	0.03	0.18	2.34	-	-	-
3	0.16	0.33	-	-	-	0.53	-	0.66	1.74	-	-	0.11
4	0.3	-	-	-	0.11	0.05	-	0.13	-	-	-	0.33
5	0.4	-	0.05	0.37	2.15	-	-	-	-	-	0.02	0.15
6	-	-	0.03	0.51	-	0.19	0.08	0.03	-	-	0.32	-
7	-	-	-	0.28	0.95	0.6	-	0.02	-	-	-	-
8	-	-	-	0.11	1.17	0.32	0.03	-	-	-	-	-
9	-	-	-	1.24	-	-	0.29	0.12	-	0.02	-	0.03
10	-	0.2	0.02	0.6	-	0.27	0.37	0.09	-	0.07	-	0.63
11	-	-	-	-	1.88	1.38	-	0.06	-	-	0.04	-
12	-	-	0.8	-	-	0.03	-	-	-	-	1.57	-
13	-	-	0.7	-	-	0.18	-	0.04	-	-	-	-
14	-	2.05	-	-	-	0.04	-	-	0.39	0.74	0.1	-
15	-	1.4	-	-	0.44	0.08	0.34	-	0.02	-	0.28	0.17
16	-	0.32	-	-	0.03	1.13	-	-	-	-	0.06	0.29
17	-	-	-	1.25	0.62	-	-	0.03	-	0.3	0.02	-
18	-	-	0.77	-	0.03	-	-	-	-	-	0.97	0.14
19	-	0.25	0.6	-	-	-	-	-	-	-	0.11	0.06
20	-	-	0.26	0.22	0.24	-	-	-	-	-	-	-
21	-	0.85	0.6	0.32	0.01	-	0.44	-	-	0.02	-	-
22	-	1.28	-	-	-	-	0.04	0.98	1.57	-	-	0.03
23	-	0.14	-	-	-	-	-	-	-	-	0.07	0.92
24	-	-	-	-	-	-	-	-	-	-	0.71	-
25	-	-	0.14	0.88	0.43	-	-	-	0.02	0.07	-	-
26	-	-	-	0.12	-	1.76	-	-	-	1	-	-
27	-	0.13	-	-	0.03	-	-	-	0.3	-	1	-
28	0.1	0.03	-	0.05	0.02	-	0.37	-	0.11	0.14	0.27	-
29	-	-	0.49	0.03	-	-	-	0.12	-	-	-	0.79
30	-	-	-	-	-	0.44	-	0.38	0.19	-	-	-
31	0.12	-	-	-	-	-	1.05	0.51	-	-	-	-
Total	1.53	6.98	4.46	5.98	8.71	7.05	3.06	3.35	6.87	2.86	5.62	3.65

Rain Information Inches/Rain Day
Year - 2004
Proposed Conditions #1 (>3.26"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.34	-	0.47	-	0.54	-	-	-	-	-	0.66	-
2	0.65	1.04	-	-	0.54	0.03	-	-	0.52	-	1.72	-
3	0.03	-	0.31	-	-	-	0.12	-	-	-	-	-
4	0.61	-	0.1	-	-	-	-	-	-	-	0.12	-
5	0.06	0.86	1.23	0.02	-	-	0.52	0.12	-	-	-	0.2
6	-	0.07	-	-	-	-	0.16	-	-	-	-	0.15
7	-	-	0.02	-	-	-	0.1	-	0.4	-	-	0.85
8	-	0.03	-	-	-	-	-	-	-	-	-	-
9	-	0.04	-	-	-	1.45	0.08	-	-	-	-	0.68
10	0.12	-	-	-	-	-	0.11	-	-	-	-	0.14
11	-	-	-	-	0.1	-	0.13	0.08	-	-	1.78	0.14
12	-	-	-	1	-	0.53	1.38	0.03	-	0.19	0.1	0.03
13	-	-	-	1.35	0.12	-	0.18	-	-	0.4	-	0.01
14	-	-	0.13	0.05	0.26	-	0.32	-	-	0.16	-	-
15	-	-	0.12	-	1.21	0.05	-	-	-	0.06	-	-
16	-	-	0.2	-	0.02	0.44	-	-	-	-	-	-
17	0.39	-	-	-	0.04	1.2	-	-	0.04	-	-	-
18	0.31	-	-	-	-	-	0.03	-	-	1	0.34	-
19	-	-	-	0.04	0.97	-	-	-	-	0.3	0.59	-
20	-	-	0.95	0.01	-	-	-	0.54	-	0.03	0.02	-
21	-	0.05	-	1	-	-	-	-	-	-	0.03	0.02
22	-	-	-	0.42	-	-	1.87	-	-	-	-	-
23	-	-	-	1.49	-	-	-	-	-	0.57	0.14	-
24	-	0.02	-	0.02	0.12	-	-	0.35	-	-	0.55	-
25	0.18	-	-	0.71	1.09	-	-	-	-	-	-	-
26	0.05	-	-	-	2.5	-	0.01	0.1	-	0.22	-	-
27	-	-	-	-	0.2	-	-	-	-	0.6	0.3	-
28	-	-	-	-	0.67	-	-	-	-	0.04	-	-
29	0.05	-	0.65	-	-	-	-	0.63	-	-	-	-
30	-	-	0.26	0.6	2.27	-	0.87	-	-	-	0.8	-
31	-	-	0.06	-	-	-	1.27	-	-	0.03	-	0.05
Total	2.79	2.11	4.5	6.71	10.65	3.7	7.15	1.85	0.96	3.6	7.15	2.27

Rain Information Inches/Rain Day
Year - 2005
Proposed Conditions #1 (>3.26"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.53	-	0.01	0.23	0.02	0.09	-	-	0.03	-	0.01	-
2	0.25	0.18	-	0.33	-	0.28	-	-	-	-	-	-
3	0.29	0.03	-	0.01	-	0.51	-	-	-	-	-	0.47
4	0.51	-	0.07	-	-	-	-	-	-	-	-	0.03
5	0.08	-	-	-	-	-	-	-	-	-	-	-
6	0.69	-	0.01	-	-	-	-	-	-	-	0.04	-
7	0.69	0.55	0.37	0.41	-	-	0.19	-	-	0.19	-	-
8	0.08	0.05	0.02	0.15	-	-	-	-	-	-	-	0.56
9	0.02	0.12	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	0.01	-	-	-	-	-	-
11	0.04	-	0.08	0.03	-	0.77	1.5	-	-	-	-	0.03
12	-	-	0.13	0.55	-	0.13	0.41	-	-	-	-	0.04
13	0.67	0.65	0.02	0.14	-	0.43	0.31	-	-	-	0.35	-
14	-	0.19	-	-	0.71	-	0.24	0.27	-	-	0.7	0.07
15	-	-	0.01	0.05	-	-	0.02	-	-	-	0.65	0.57
16	0.02	-	-	-	-	-	0.33	0.42	0.05	-	-	-
17	-	-	-	-	-	-	0.11	0.01	-	-	-	-
18	-	-	-	-	-	-	-	0.66	-	-	-	-
19	0.01	-	0.11	-	1.11	-	-	-	-	-	-	-
20	-	0.54	0.01	-	0.53	-	0.09	0.55	0.16	0.15	-	-
21	-	0.07	-	-	-	-	-	-	-	0.41	-	-
22	0.02	0.01	0.47	0.4	0.01	-	0.84	-	-	0.03	-	-
23	0.01	0.07	0.27	0.04	-	-	-	-	-	0.1	-	-
24	-	0.02	-	0.02	-	-	-	-	-	0.13	-	0.18
25	-	-	0.05	0.01	-	-	-	0.1	0.41	-	-	0.33
26	-	-	-	0.57	-	-	-	0.67	0.12	-	-	0.01
27	-	0.01	1.25	0.02	-	-	-	-	-	-	0.13	-
28	-	0.55	0.34	0.24	-	-	-	0.5	-	-	1.07	0.2
29	0.66	-	0.04	0.93	-	0.45	-	0.32	0.15	-	-	0.02
30	0.02	-	0.02	0.13	-	-	-	3.85	-	-	-	0.17
31	0.01	-	-	-	-	-	-	0.05	-	-	-	0.01
Total	4.6	3.04	3.28	4.26	2.38	2.67	4.04	7.4	0.92	1.01	2.95	2.69

Rain Information Inches/Rain Day
Year - 2006
Proposed Conditions #1 (>3.26"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	-	-	-	0.08	-	-	0.01	-	0.32	0.51
2	0.23	0.51	-	0.12	0.85	0.53	-	-	0.03	-	-	-
3	0.02	0.06	-	-	-	-	-	-	-	-	-	-
4	-	0.78	0.05	-	-	0.04	0.06	-	-	-	-	-
5	-	-	-	-	-	-	-	-	0.06	0.03	-	-
6	-	-	-	0.07	-	-	-	-	-	-	0.22	-
7	-	-	-	0.45	0.03	0.16	-	-	-	-	0.64	-
8	-	-	0.04	0.03	-	-	-	0.42	-	-	-	-
9	-	-	0.7	-	0.01	-	-	0.17	-	-	-	-
10	1.15	0.08	-	-	0.41	-	-	1.18	0.14	-	-	-
11	0.15	0.11	0.47	-	0.15	0.62	1.08	-	1.45	0.14	0.11	-
12	-	-	2.04	-	0.02	-	0.05	-	0.7	0.11	-	0.33
13	0.43	-	0.22	-	-	-	1.25	-	0.04	-	0.03	-
14	0.1	-	-	0.01	0.01	-	0.04	0.98	-	-	-	-
15	-	-	-	-	0.1	-	-	0.18	-	-	1.1	-
16	-	0.53	0.01	0.07	0.02	-	-	-	-	1.32	0.45	-
17	1.12	0.25	-	1.03	-	1.71	-	-	-	0.34	-	-
18	-	0.09	-	0.06	0.1	0.38	-	0.11	0.17	-	-	-
19	0.21	-	-	0.06	0.01	0.28	-	-	-	0.51	0.08	-
20	-	-	-	1.05	-	0.03	-	0.94	-	0.01	-	-
21	-	-	0.3	1.61	-	-	2.17	-	-	-	-	0.1
22	2.08	0.1	-	-	-	0.03	0.88	-	4.57	-	-	0.38
23	0.08	-	-	0.02	-	0.32	-	-	2.18	-	-	-
24	-	-	0.05	-	-	-	-	-	0.2	-	-	-
25	-	-	-	-	2.18	-	-	-	-	-	-	0.97
26	-	-	-	0.17	-	0.6	-	-	-	0.42	-	0.06
27	-	-	0.02	-	-	-	0.21	-	0.65	1.79	-	-
28	0.02	-	0.02	-	-	-	0.44	1.8	0.64	0.34	-	-
29	0.33	-	-	0.08	-	-	-	0.03	-	-	0.07	-
30	0.03	-	-	0.34	0.08	-	-	-	0.08	-	0.48	-
31	-	-	0.65	-	-	-	-	-	-	0.16	-	0.67
Total	5.95	2.51	4.57	5.17	3.97	4.78	6.18	5.81	10.92	5.17	3.5	3.02

Rain Information Inches/Rain Day
Year - 2007
Proposed Conditions #1 (>3.26"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	0.94	0.18	-	-	-	-	-	-	-	0
2	-	-	-	-	0.59	-	-	-	-	-	-	0.63
3	-	-	-	1	0.21	-	-	-	-	-	-	0.02
4	0.2	0.1	-	-	0.74	0.02	0.06	-	-	-	-	0
5	0.35	-	-	-	0.3	-	2.47	-	-	-	0.03	0
6	-	-	-	-	-	-	-	-	-	-	-	0
7	0.57	-	-	-	-	-	-	-	-	-	-	0.48
8	-	-	-	-	-	0.23	-	-	-	-	-	0.36
9	-	-	-	-	-	-	-	-	1.51	-	-	1.25
10	-	-	0.04	-	-	-	0.2	-	-	-	-	0.65
11	0.3	-	-	0.54	0.1	-	-	-	0.02	-	0.11	0
12	0.1	0.57	-	0.3	-	-	-	-	-	-	0.06	0.43
13	0.77	1	-	0.12	-	-	-	-	-	-	0.03	0
14	0.17	-	0.17	1.45	-	-	-	-	0.05	-	0.27	0
15	0.65	-	0.18	-	0.4	-	-	-	-	-	-	2.53
16	-	-	-	-	0.15	-	-	-	-	0.35	-	0.03
17	-	-	-	-	0.01	-	0.08	-	-	-	-	0
18	-	0.1	-	-	-	-	-	-	-	1.83	-	0
19	-	-	0.65	-	-	0.03	0.87	0.03	-	0.15	-	0
20	-	-	0.16	-	-	-	-	-	-	-	-	0.68
21	0.68	-	-	-	-	-	-	2.36	-	-	0.54	0.06
22	-	-	0.05	-	-	0.07	-	-	-	2.56	-	0.12
23	-	-	-	-	-	0.2	-	-	-	4.36	-	0.16
24	-	1.23	-	-	-	0.52	-	-	-	0.67	-	0
25	-	0.17	-	0.03	-	0.13	-	-	0.23	-	0.37	0
26	-	-	-	0.73	-	0.65	-	-	0.3	0.05	0.84	0.09
27	-	-	-	0.3	-	0.02	0.51	-	0.9	-	-	0
28	-	-	1.13	0.2	-	0.12	0.14	-	0.03	-	0.04	0
29	-	-	-	-	-	0.04	-	0.07	-	-	-	0
30	-	-	0.8	-	-	-	-	0.01	-	-	-	0
31	-	-	0.16	-	-	-	-	-	-	-	-	0.02
Total	3.79	3.17	4.28	4.85	2.5	2.03	4.33	2.47	3.04	9.97	2.29	7.51

Rain Information Inches/Rain Day
Year - 2008
Proposed Conditions #1 (>3.26"<3.86")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.04	0	0	0.5								
2	0	0	0.1	0.02								
3	0	0.1	1.03	1.3								
4	0	0.15	1.78	3.3								
5	0.29	0.35	0	0								
6	0	1	0	0								
7	0	0	0.3	0								
8	0.6	0	0.11	0								
9	0.03	0	0	0.7								
10	1.16	0.02	0.07									
11	0	0.51	0.02									
12	0.01	1.35	0									
13	0.2	0.03	0									
14	0.02	0	0.4									
15	0	0	0.6									
16	0	0	0.25									
17	0.22	0.23	0									
18	0	0	0.23									
19	0	0	2.4									
20	0.03	0	0.02									
21	0	0.5	0									
22	0.03	0.6	0									
23	0	0.05	0									
24	0	0	0									
25	0	0.04	0									
26	0	0.11	0.1									
27	0	0.01	0.52									
28	0	0	0.52									
29	1	0.11	0									
30	0.03		0.12									
31	0.3		0.16									
Total	3.96	5.16	8.73	5.82								

Rain Information Inches/Rain Day
Year - 1993
Proposed Conditions #1 (>3.26")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	-	0.67	0.3	-	-	-	0.01	-	-	-
2	0.02	-	0.34	-	0.5	-	-	-	0.28	-	0.02	-
3	-	-	0.46	-	0.07	-	-	-	0.15	0.18	-	0.14
4	0.99	-	0.54	0.2	0.7	-	-	-	0.12	-	0.2	0.5
5	-	-	0.17	-	-	1.42	-	0.11	-	0.02	0.09	0.95
6	-	-	-	-	0.5	-	-	0.3	-	-	-	0.08
7	0.04	-	0.27	-	-	-	-	-	-	-	0.03	-
8	0.15	-	0.2	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	2.33	-	-	-	-	-	-
10	0.2	-	-	0.92	-	0.59	-	-	-	0.53	-	0.29
11	0.3	0.58	-	-	-	0.1	-	-	-	-	-	0.13
12	0.11	-	-	-	-	0.02	-	-	-	-	-	-
13	0.07	0.27	-	-	0.7	0.23	-	0.45	-	0.03	1.73	-
14	-	0.5	-	0.12	0.2	0.02	-	-	-	0.01	0.17	-
15	0.3	0.3	-	0.37	-	0.53	0.1	-	-	-	1.07	0.26
16	0.1	0.3	-	0.46	-	-	0.13	-	0.51	-	0.07	0.21
17	-	-	0.4	0.14	0.5	-	0.05	-	-	0.27	0.83	0.02
18	0.01	-	-	-	0.1	-	1.45	1.46	0.02	0.25	0.5	0.04
19	-	-	0.03	-	0.97	-	0.6	-	-	0.03	0.2	-
20	0.17	0.57	0.05	-	-	-	-	-	-	3.8	-	0.01
21	0.75	1.8	-	-	-	0.13	-	-	-	0.05	-	-
22	-	-	0.2	-	-	-	0.24	0.01	-	0.02	-	-
23	0.3	-	0.71	-	-	-	0.03	-	0.11	-	-	-
24	0.57	-	-	-	-	-	-	0.21	0.47	-	-	-
25	-	1.03	-	0.13	0.5	0.02	-	0.13	0.05	-	0.06	-
26	-	-	-	0.6	-	0.25	0.47	0.02	0.49	-	0.06	-
27	-	-	0.05	0.2	-	0.2	-	-	-	-	0.36	-
28	-	-	0.1	-	-	-	-	-	0.07	-	-	-
29	-	-	-	-	-	0.52	-	-	-	-	-	-
30	-	-	-	0.09	-	-	-	0.1	-	0.01	0.02	-
31	-	-	-	-	0.49	-	-	0.1	-	0.31	-	-
Total	4.08	5.35	3.52	3.9	5.53	6.36	3.07	2.89	2.28	5.51	5.41	2.63

Rain Information Inches/Rain Day
Year - 1994
Proposed Conditions #1 (>3.26")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.19	-	0.1	-	0.02	-	-	-	0.02	-	-	-
2	0.29	-	-	-	-	0.36	-	-	-	-	-	-
3	-	-	0.05	0.29	0.11	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	0.3	-	-	-	1.33
5	-	-	-	0.1	-	0.03	-	0.35	0.6	-	0.43	-
6	-	-	-	0.5	0.45	-	1.12	-	-	-	-	-
7	-	-	0.35	-	0.85	0.13	-	-	-	-	-	-
8	0.25	-	0.33	-	-	-	0.8	-	-	-	-	-
9	-	0.4	-	-	-	1.28	0.8	-	-	0.52	0.43	0.81
10	-	0.15	1.2	0.56	-	-	-	-	-	-	0.15	1.15
11	-	0.19	-	0.6	-	-	-	-	-	-	-	-
12	0.23	0.1	-	-	-	-	-	-	-	-	-	-
13	-	-	0.1	-	-	-	1.05	-	-	0.47	-	-
14	0.02	-	-	-	-	-	0.03	0.13	-	-	-	-
15	-	-	-	0.43	0.49	-	0.06	-	-	-	0.9	-
16	-	-	-	-	-	-	0.05	-	-	-	0.48	0.7
17	0.27	-	-	-	-	-	-	-	0.11	-	-	-
18	1.6	-	0.15	-	-	-	-	-	-	0.35	-	-
19	-	-	-	-	-	-	-	-	-	0.86	-	-
20	-	0.51	0.03	-	-	-	-	0.89	-	-	-	0.03
21	-	-	0.32	-	-	0.38	0.77	0.08	-	-	-	-
22	-	1.3	-	-	-	-	0.27	-	-	0.03	-	0.1
23	-	0.03	-	-	-	-	-	-	1.67	-	-	-
24	0.38	-	0.05	-	-	0.38	-	-	0.11	-	0.2	-
25	-	-	-	-	0.6	-	0.46	-	0.17	-	0.08	-
26	0.66	-	1.05	-	0.1	0.56	-	0.09	0.3	-	0.02	-
27	0.05	-	1.05	1.5	-	-	-	-	-	0.01	1.15	-
28	0.85	-	0.05	-	-	-	0.02	0.1	-	-	-	-
29	0.45	-	-	1.05	-	-	-	0.5	-	-	-	-
30	0.04	-	0.22	1	-	-	-	0.05	-	0.02	-	0.02
31	-	-	-	-	-	-	-	-	-	0.2	-	0.08
Total	5.28	2.68	5.05	6.03	2.62	3.12	5.43	2.49	2.98	2.46	3.84	4.22

Rain Information Inches/Rain Day
Year - 1995
Proposed Conditions #1 (>3.26")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.03	-	-	-	1.27	0.2	-	-	0.4	-	0.2	-
2	-	0.15	-	-	0.04	0.23	-	-	-	0.04	0.18	-
3	-	0.21	-	-	-	0.15	-	-	-	1.3	-	-
4	-	-	0.04	-	0.15	-	0.4	-	-	-	-	-
5	-	-	0.45	-	-	-	1.21	2.44	-	3.45	-	-
6	0.89	-	0.08	-	-	-	0.05	0.1	-	-	0.37	-
7	-	0.02	0.82	-	-	-	0.1	2.3	0.02	-	0.17	-
8	0.03	-	-	-	-	0.08	-	0.41	-	-	-	0.06
9	-	-	-	0.05	0.98	0.18	-	0.21	-	-	-	-
10	0.04	-	-	-	0.19	-	-	-	-	-	0.16	-
11	0.35	-	-	0.23	0.02	1.12	-	-	-	-	1	-
12	0.01	-	-	0.67	-	0.05	-	-	-	-	-	-
13	-	-	-	-	1.3	-	-	-	-	0.02	0.47	0.05
14	0.96	0.57	-	-	1.05	-	-	-	-	-	-	-
15	-	1.4	-	-	0.01	-	0.66	-	-	-	-	0.73
16	0.02	0.1	-	0.16	0.28	-	-	0.18	1.45	0.01	-	0.03
17	-	-	-	0.47	2.52	-	-	-	0.06	-	-	0.16
18	-	-	-	0.08	1.51	-	-	-	-	-	-	1.02
19	0.43	-	-	-	0.01	0.02	-	-	-	-	-	0.4
20	-	-	0.27	1.15	-	-	-	-	0.17	0.46	-	-
21	-	-	-	0.41	0.19	0.47	-	-	0.02	0.09	-	-
22	0.02	-	-	-	-	0.02	1.21	-	-	-	-	-
23	-	0.04	0.3	0.96	-	-	0.93	-	0.09	-	0.44	0.02
24	-	-	-	0.05	-	0.38	-	-	-	0.1	-	-
25	-	-	-	0.02	0.04	-	0.21	-	0.02	-	-	-
26	-	-	-	-	-	-	-	-	-	0.07	-	-
27	0.11	0.18	0.27	-	0.98	0.04	0.82	-	-	0.96	0.03	-
28	0.69	0.04	-	-	0.28	0.07	-	-	-	-	-	-
29	-	-	-	0.01	0.04	-	-	-	-	-	-	-
30	-	-	-	0.07	-	0.09	-	-	-	-	-	0.01
31	-	-	-	-	0.05	-	-	-	-	-	-	0.37
Total	3.58	2.71	2.23	4.33	10.91	3.1	5.59	5.64	2.23	6.5	3.02	2.85

Rain Information Inches/Rain Day
Year - 1996
Proposed Conditions #1 (>3.26")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.05	0.06	-	0.4	0.04	-	-	-	-	-	0.07	0.24
2	0.67	-	0.03	-	0.25	0.48	0.39	-	-	-	-	0.02
3	-	-	-	-	-	0.28	-	-	0.03	-	-	-
4	-	-	-	0.1	0.02	-	-	-	-	-	-	-
5	-	-	0.88	-	0.78	-	-	-	0.33	-	-	0.33
6	-	-	1.2	-	0.1	1.06	-	-	0.02	-	0.07	0.02
7	-	0.03	0.14	-	0.4	0.63	-	-	0.67	-	0.84	-
8	1	0.31	-	-	1.03	0.62	-	1.19	-	0.06	0.15	0.01
9	-	-	-	-	-	0.45	0.07	-	0.37	0.03	-	-
10	-	-	-	-	-	0.35	-	-	-	0.17	-	-
11	0.33	-	-	-	0.23	0.13	-	7	-	0.02	-	-
12	-	0.05	-	-	-	0.22	-	0.02	0.05	-	-	0.87
13	-	-	-	0.87	0.02	-	-	-	-	-	0.01	-
14	-	0.07	-	-	0.2	-	2.55	-	-	-	-	0.02
15	-	-	0.35	0.27	0.47	-	0.12	-	0.11	-	-	-
16	-	-	0.62	0.02	-	-	-	-	1.1	-	-	1.61
17	-	-	-	-	-	-	-	0.27	0.02	1.55	0.3	0.48
18	1.18	-	-	-	-	0.22	-	-	-	0.66	0.04	-
19	-	1.07	1.2	-	-	0.33	1.8	-	-	-	0.02	-
20	-	0.04	-	0.98	-	-	0.15	-	-	-	-	-
21	-	-	-	-	-	-	0.25	-	0.66	0.03	0.32	0.01
22	-	-	-	0.2	-	-	-	-	-	0.42	0.02	0.06
23	1.4	-	-	0.47	-	-	-	-	-	0.06	0.01	0.67
24	0.15	-	0.03	-	0.02	0.69	-	0.14	-	-	0.02	0.25
25	-	-	0.33	0.2	-	-	-	-	-	0.32	1.13	-
26	0.08	-	-	0.31	4.87	-	-	-	0.04	0.43	0.05	0.04
27	0.05	0.62	-	0.31	0.83	-	-	-	1.07	-	-	0.04
28	0.03	-	0.21	0.34	0.22	-	0.5	-	0.68	0.21	-	0.02
29	-	-	0.02	1	-	-	0.1	-	-	-	0.2	-
30	-	-	-	-	-	-	1	-	0.02	-	0.78	0.03
31	-	-	0.3	-	-	-	0.02	-	-	-	-	0.01
Total	4.94	2.25	5.31	5.47	9.48	5.46	6.95	8.62	5.17	3.96	4.03	4.73

Rain Information Inches/Rain Day
Year - 1997
Proposed Conditions #1 (>3.26")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	8.17	0.01	-	0.5	0.02	-	-	-	0.5	-
2	-	-	0.8	-	0.78	0.19	-	-	-	-	0.07	-
3	-	0.4	1	-	0.71	0.02	-	-	0.03	-	0.15	0.27
4	0.28	1.27	0.02	-	-	0.01	-	-	-	-	0.01	0.03
5	0.13	-	0.47	0.21	-	0.49	-	-	-	-	-	-
6	-	-	0.01	-	-	0.74	-	-	-	-	0.41	-
7	-	-	-	-	-	0.17	-	-	-	-	-	-
8	-	0.33	-	-	0.62	1.36	-	-	-	-	-	-
9	0.03	-	0.36	-	-	0.12	-	1.21	0.4	-	-	0.72
10	-	-	-	-	-	0.01	-	0.01	-	-	-	0.32
11	-	-	-	0.05	-	0.08	-	-	0.04	-	-	-
12	-	-	-	0.14	-	-	-	-	-	-	-	-
13	-	0.45	0.36	-	0.02	0.25	-	0.27	-	0.6	-	-
14	-	0.02	0.12	-	0.11	0.88	-	0.03	-	0.27	0.85	-
15	0.4	-	-	-	0.07	0.02	-	-	-	-	-	-
16	0.01	-	-	0.11	0.01	0.2	-	-	-	-	-	-
17	-	-	0.05	-	0.03	0.23	-	-	0.02	-	-	-
18	-	-	2.11	-	0.05	0.29	-	-	-	-	-	-
19	-	0.02	-	0.21	0.62	0.02	0.18	0.02	-	-	-	-
20	0.02	0.02	-	0.01	0.06	-	-	-	0.1	-	-	-
21	-	0.11	-	0.25	-	-	-	1.22	-	-	0.72	0.5
22	0.94	0.02	-	0.08	-	-	-	0.09	0.02	-	-	-
23	0.01	-	-	-	-	-	-	0.02	0.23	0.03	-	-
24	0.8	-	-	-	1.6	-	-	-	0.3	0.93	-	0.83
25	0.01	-	0.41	-	0.05	-	-	-	-	-	-	0.04
26	-	-	-	-	0.02	0.77	-	-	-	0.08	-	0.03
27	0.76	0.41	0.01	0.73	-	0.02	-	0.81	-	-	-	-
28	0.02	0.21	1.34	0.02	0.38	-	-	-	0.1	-	-	-
29	-	0.96	-	-	0.84	0.05	0.5	-	-	-	-	0.19
30	-	-	0.08	0.32	0.01	0.18	-	-	-	-	1	-
31	-	-	0.09	-	0.65	-	-	-	-	0.1	-	-
Total	3.41	4.22	15.4	2.14	6.63	6.6	0.7	3.68	1.24	2.01	3.71	2.93

Rain Information Inches/Rain Day
Year - 1998
Proposed Conditions #1 (>3.26")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	-	-	0.06	0.02	-	-	-	-	-	-
2	-	-	0.03	-	-	-	-	-	-	-	0.16	-
3	-	-	0.07	0.46	0.27	0.3	-	-	-	1.44	0.2	-
4	-	-	0.02	0.05	-	1.34	0.19	-	-	-	-	0.02
5	0.51	-	-	-	-	0.34	-	-	-	-	-	-
6	0.82	-	-	-	-	-	-	2	-	-	-	-
7	1.35	0.3	0.32	-	0.56	-	0.65	-	-	0.93	-	0.88
8	0.15	-	1.3	0.95	0.08	-	-	0.14	-	-	-	0.44
9	0.05	-	0.9	0.06	0.01	0.75	-	0.83	-	-	0.36	-
10	-	0.03	-	0.3	0.03	0.73	-	0.03	-	-	-	-
11	-	0.29	0.5	-	-	-	-	0.4	-	-	-	-
12	0.36	0.03	-	-	-	1.02	-	-	-	-	-	0.11
13	0.08	-	-	0.09	-	1.11	0.15	-	-	-	-	0.54
14	0.01	-	-	0.5	-	1.67	0.41	-	-	-	-	-
15	-	-	-	0.33	-	-	0.81	-	-	-	-	-
16	0.03	0.2	0.11	0.43	-	-	0.37	-	-	-	-	-
17	0.1	0.24	0.04	0.01	-	-	-	-	-	-	-	-
18	-	0.04	0.26	0.3	-	-	-	-	-	0.42	-	-
19	-	0.02	0.71	0.38	-	0.3	-	-	0.13	-	-	-
20	0.05	0.1	1	-	0.47	-	-	-	-	-	-	-
21	-	-	-	-	0.1	1.08	-	-	1.9	-	0.56	0.2
22	0.3	-	-	0.1	0.84	-	-	-	-	-	-	-
23	-	0.07	-	-	-	0.9	-	-	-	-	-	-
24	-	-	-	-	0.52	-	-	-	-	-	-	-
25	-	-	0.13	0.07	0.11	-	-	-	0.1	-	-	-
26	-	0.03	-	-	0.34	-	-	-	-	-	-	-
27	-	0.15	-	0.24	-	-	-	-	-	-	-	-
28	-	-	-	0.12	-	-	-	-	-	-	-	-
29	-	-	-	0.85	0.03	0.73	-	0.15	-	-	-	0.05
30	-	-	-	0.81	-	0.09	0.1	-	-	-	0.3	0.05
31	-	-	0.4	-	0.91	-	-	-	-	-	-	-
Total	3.81	1.5	5.79	6.05	4.33	10.38	2.68	3.55	2.13	2.79	1.58	2.29

Rain Information Inches/Rain Day
Year - 1999
Proposed Conditions #1 (>3.26")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	0.02	-	0.02	-	0.04	-	-	-	-	0.11	-
2	-	0.03	0.11	-	-	0.44	0.02	-	-	-	0.63	-
3	-	-	0.02	0.35	-	-	-	-	-	-	-	0.05
4	-	0.03	-	0.07	-	-	-	-	-	-	-	0.18
5	-	-	-	-	0.83	0.05	-	-	-	-	-	0.25
6	-	-	0.39	1.05	1.06	0.03	-	-	-	-	-	0.02
7	-	0.17	-	-	-	-	-	-	-	-	-	-
8	1.8	-	0.33	0.02	-	-	-	2.28	0.34	0.28	-	-
9	-	-	0.53	-	-	0.02	-	-	-	3.37	-	-
10	-	-	-	-	-	0.06	0.07	-	-	0.05	-	0.99
11	-	0.22	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	0.9	-	-	-	-	-	-	1.52
13	0.4	-	0.05	-	0.08	0.07	-	-	-	0.02	-	1.93
14	0.02	-	1	0.3	-	0.37	-	-	-	-	-	-
15	-	-	-	0.33	-	-	-	-	-	-	-	-
16	-	0.19	-	-	-	-	-	-	-	-	-	-
17	-	-	-	0.02	0.37	-	0.02	-	-	-	-	-
18	-	-	-	0.1	0.3	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	0.07	0.25	-
20	0.05	-	-	-	-	-	-	-	0.15	-	0.15	0.2
21	-	-	-	-	0.02	-	0.01	-	0.07	-	0.02	-
22	1.57	-	-	-	-	-	-	-	-	-	-	-
23	0.5	-	0.98	-	0.78	0.18	0.13	-	-	-	-	-
24	-	0.02	-	-	-	1	-	-	-	-	-	0.15
25	-	-	-	-	0.02	-	-	-	-	-	0.51	-
26	-	0.98	-	1.31	-	0.11	-	-	-	-	0.22	-
27	-	0.09	-	0.14	-	0.5	-	-	-	-	-	-
28	-	-	-	1.3	-	0.87	-	-	0.07	-	-	-
29	-	-	-	0.03	-	-	-	-	0.24	-	-	-
30	-	-	-	-	-	-	-	-	-	-	-	-
31	1.35	-	0.34	-	0.05	-	-	-	-	-	-	-
Total	5.69	1.75	3.75	5.04	4.41	3.74	0.25	2.28	0.87	3.79	1.89	5.29

Rain Information Inches/Rain Day
Year - 2000
Proposed Conditions #1 (>3.26")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	0.02	0.5	-	-	-	-	-	-	-	-
2	0.9	-	-	0.81	0.49	-	-	-	-	-	0.4	0.2
3	3.32	-	0.06	0.75	0.85	-	0.24	0.09	-	-	-	-
4	-	0.03	-	0.4	0.02	-	0.45	-	0.26	-	0.22	-
5	-	-	-	-	-	0.05	0.05	0.1	-	0.18	0.42	-
6	0.02	-	-	-	-	-	0.45	-	-	0.4	-	-
7	-	-	-	0.34	-	-	-	-	-	-	0.38	-
8	0.03	-	-	0.49	-	-	-	0.65	0.5	-	0.77	-
9	0.05	-	-	-	0.06	-	-	-	-	-	-	-
10	-	-	-	0.02	-	-	-	0.37	0.1	-	-	0.2
11	-	-	0.4	0.34	-	-	0.04	-	0.4	-	-	0.11
12	-	-	-	-	-	-	0.47	-	0.41	-	0.7	-
13	-	1.85	-	-	0.79	-	-	-	-	-	-	0.67
14	-	-	-	-	-	0.53	-	-	-	-	-	-
15	-	-	-	-	-	1	-	-	-	-	-	0.15
16	-	-	0.48	-	-	0.02	-	-	-	-	-	2.55
17	0.2	0.14	-	0.25	0.02	0.34	-	-	-	-	-	0.05
18	0.15	2.41	0.5	-	-	0.75	-	0.32	-	-	-	0.07
19	0.18	-	0.93	-	0.25	0.08	0.58	-	-	-	-	-
20	-	-	0.32	0.14	0.02	-	-	-	0.27	-	-	-
21	-	0.2	-	0.02	-	0.29	-	-	0.17	0.06	-	-
22	0.13	0.07	-	-	-	-	-	-	0.4	-	-	-
23	-	0.02	-	0.6	2.33	-	-	1.48	0.07	-	-	-
24	-	0.02	-	0.54	-	0.1	-	1.11	0.55	-	0.23	-
25	0.02	-	-	0.02	0.05	0.2	-	-	1	-	1	-
26	-	0.27	-	-	0.07	0.6	-	0.1	0.07	-	0.3	0.01
27	-	0.25	-	-	0.23	1.3	-	-	-	-	-	-
28	-	0.02	-	-	0.13	0.2	1.83	-	-	-	-	-
29	0.26	-	-	0.05	0.03	-	0.8	-	-	-	-	0.05
30	-	-	-	-	-	-	0.25	-	-	-	-	0.01
31	-	-	-	-	-	-	-	-	-	-	-	-
Total	5.26	5.28	2.71	5.27	5.34	5.46	5.16	4.22	4.2	0.64	4.42	4.07

Rain Information Inches/Rain Day
Year - 2001
Proposed Conditions #1 (>3.26")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	0.1	0.21	-	-	-	-	-	-	-	-
2	0.06	-	-	0.02	-	0.02	-	-	-	-	0.28	-
3	-	-	0.7	0.7	-	-	-	0.7	0.45	-	-	-
4	-	0.6	1.34	-	-	0.06	0.1	-	-	-	-	-
5	-	-	-	-	-	0.06	-	-	-	1.1	-	-
6	-	-	-	-	-	0.04	-	-	-	-	-	0.5
7	-	-	-	-	1.4	0.1	-	-	2	-	-	-
8	-	0.2	-	-	0.21	0.02	-	-	-	-	0.01	0.38
9	-	0.61	-	-	-	-	0.04	-	1.1	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	0.14	-	-	2.58	-	0.3	-	-
12	-	0.2	-	-	-	-	-	-	-	1.61	-	0.8
13	-	0.4	-	-	-	-	-	-	-	0.1	-	0.18
14	-	0.85	-	-	-	-	-	-	-	1.85	-	-
15	0.3	0.85	0.21	0.19	-	0.75	-	-	-	0.02	-	-
16	-	0.78	0.2	-	-	-	-	-	-	0.2	-	0.87
17	-	-	-	-	0.07	-	-	-	-	-	-	0.75
18	0.37	-	-	-	0.75	-	0.35	0.16	-	-	-	-
19	0.63	-	-	-	-	-	-	0.53	1	-	0.27	0.03
20	0.02	-	0.32	0.06	-	-	0.94	-	-	-	-	-
21	-	-	0.2	-	0.56	0.13	0.02	-	-	-	-	-
22	-	-	-	-	0.4	-	0.14	-	-	-	-	0.35
23	-	-	-	0.28	0.05	0.1	-	-	0.2	-	0.02	0.3
24	-	-	-	-	0.1	-	-	-	0.18	0.68	0.71	-
25	-	1	-	-	0.02	-	0.07	-	-	-	-	-
26	0.2	-	0.2	-	0.1	1.19	1.63	0.2	-	-	-	-
27	-	0.2	-	-	0.32	0.11	0.03	0.02	-	-	1.38	-
28	-	-	-	-	-	0.05	0.46	0.01	-	-	1.34	-
29	0.45	-	0.5	-	-	0.5	0.22	-	-	-	1.97	-
30	0.5	-	0.25	-	-	-	-	-	-	-	-	-
31	-	-	0.27	-	0.33	-	-	0.5	-	-	-	-
Total	2.53	5.69	4.29	1.46	4.45	3.13	4	4.7	4.93	5.86	5.98	4.16

Rain Information Inches/Rain Day
Year - 2002
Proposed Conditions #1 (>3.26")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	0.8	-	-	1.49	-	-	-	-	-	-	-
2	-	-	0.32	-	0.84	-	-	-	-	0.04	-	-
3	-	-	-	0.19	-	-	-	-	-	-	0.16	-
4	-	-	-	-	-	-	-	-	-	0.45	0.03	-
5	-	-	-	-	-	0.22	-	-	-	-	1	-
6	0.28	0.1	-	-	1.7	0.73	-	-	-	0.07	-	-
7	-	-	-	-	0.03	-	-	-	-	-	-	0.4
8	-	-	0.02	0.15	0.05	-	-	-	-	-	-	-
9	-	-	0.5	0.15	0.12	-	0.1	-	-	0.05	0.1	-
10	0.02	0.25	-	-	-	-	0.29	-	-	2.55	1	0.47
11	-	-	-	0.05	-	0.1	-	-	-	0.67	-	0.32
12	-	-	0.1	-	-	0.77	0.02	-	-	-	-	-
13	-	-	-	1	2.3	0.03	0.38	0.25	-	-	-	0.6
14	-	-	-	0.45	-	-	-	0.55	1.3	-	-	0.02
15	-	-	-	-	-	-	-	-	0.15	-	0.3	-
16	-	-	-	-	0.03	0.04	-	0.2	-	-	-	-
17	-	-	1.36	-	1	-	-	0.1	0.1	-	-	0.15
18	-	-	0.17	-	-	-	0.05	0.17	-	-	-	-
19	0.15	0.13	1.82	-	-	-	-	0.05	-	0.55	-	2.3
20	-	0.55	0.89	0.03	-	-	-	-	0.85	0.15	-	-
21	-	-	-	0.86	-	-	-	-	-	-	0.23	0.3
22	0.2	-	-	-	-	-	0.75	-	-	-	-	0.1
23	0.7	-	-	-	-	-	-	0.02	-	-	-	-
24	1.6	-	-	0.87	-	0.25	-	-	-	-	-	1
25	-	-	0.9	-	0.07	0.06	-	-	-	0.1	-	-
26	-	0.32	1.93	-	-	0.25	-	0.07	3.25	-	0.05	-
27	-	-	-	1.33	-	-	-	0.06	2.3	-	-	-
28	-	-	-	1.08	-	1.79	-	-	-	0.5	-	-
29	-	-	0.4	-	0.35	-	0.1	-	-	0.68	-	-
30	0.33	-	0.3	-	-	-	0.5	-	-	0.05	-	0.56
31	-	-	-	-	-	-	-	-	-	-	-	1.1
Total	3.28	2.15	8.71	6.16	7.98	4.24	2.19	1.47	7.95	5.86	2.87	7.32

Rain Information Inches/Rain Day
Year - 2003
Proposed Conditions #1 (>3.26")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.45	-	-	-	0.6	-	0.02	-	0.19	0.5	0.08	-
2	-	-	-	-	-	0.05	0.03	0.18	2.34	-	-	-
3	0.16	0.33	-	-	-	0.53	-	0.66	1.74	-	-	0.11
4	0.3	-	-	-	0.11	0.05	-	0.13	-	-	-	0.33
5	0.4	-	0.05	0.37	2.15	-	-	-	-	-	0.02	0.15
6	-	-	0.03	0.51	-	0.19	0.08	0.03	-	-	0.32	-
7	-	-	-	0.28	0.95	0.6	-	0.02	-	-	-	-
8	-	-	-	0.11	1.17	0.32	0.03	-	-	-	-	-
9	-	-	-	1.24	-	-	0.29	0.12	-	0.02	-	0.03
10	-	0.2	0.02	0.6	-	0.27	0.37	0.09	-	0.07	-	0.63
11	-	-	-	-	1.88	1.38	-	0.06	-	-	0.04	-
12	-	-	0.8	-	-	0.03	-	-	-	-	1.57	-
13	-	-	0.7	-	-	0.18	-	0.04	-	-	-	-
14	-	2.05	-	-	-	0.04	-	-	0.39	0.74	0.1	-
15	-	1.4	-	-	0.44	0.08	0.34	-	0.02	-	0.28	0.17
16	-	0.32	-	-	0.03	1.13	-	-	-	-	0.06	0.29
17	-	-	-	1.25	0.62	-	-	0.03	-	0.3	0.02	-
18	-	-	0.77	-	0.03	-	-	-	-	-	0.97	0.14
19	-	0.25	0.6	-	-	-	-	-	-	-	0.11	0.06
20	-	-	0.26	0.22	0.24	-	-	-	-	-	-	-
21	-	0.85	0.6	0.32	0.01	-	0.44	-	-	0.02	-	-
22	-	1.28	-	-	-	-	0.04	0.98	1.57	-	-	0.03
23	-	0.14	-	-	-	-	-	-	-	-	0.07	0.92
24	-	-	-	-	-	-	-	-	-	-	0.71	-
25	-	-	0.14	0.88	0.43	-	-	-	0.02	0.07	-	-
26	-	-	-	0.12	-	1.76	-	-	-	1	-	-
27	-	0.13	-	-	0.03	-	-	-	0.3	-	1	-
28	0.1	0.03	-	0.05	0.02	-	0.37	-	0.11	0.14	0.27	-
29	-	-	0.49	0.03	-	-	-	0.12	-	-	-	0.79
30	-	-	-	-	-	0.44	-	0.38	0.19	-	-	-
31	0.12	-	-	-	-	-	1.05	0.51	-	-	-	-
Total	1.53	6.98	4.46	5.98	8.71	7.05	3.06	3.35	6.87	2.86	5.62	3.65

Rain Information Inches/Rain Day
Year - 2004
Proposed Conditions #1 (>3.26")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.34	-	0.47	-	0.54	-	-	-	-	-	0.66	-
2	0.65	1.04	-	-	0.54	0.03	-	-	0.52	-	1.72	-
3	0.03	-	0.31	-	-	-	0.12	-	-	-	-	-
4	0.61	-	0.1	-	-	-	-	-	-	-	0.12	-
5	0.06	0.86	1.23	0.02	-	-	0.52	0.12	-	-	-	0.2
6	-	0.07	-	-	-	-	0.16	-	-	-	-	0.15
7	-	-	0.02	-	-	-	0.1	-	0.4	-	-	0.85
8	-	0.03	-	-	-	-	-	-	-	-	-	-
9	-	0.04	-	-	-	1.45	0.08	-	-	-	-	0.68
10	0.12	-	-	-	-	-	0.11	-	-	-	-	0.14
11	-	-	-	-	0.1	-	0.13	0.08	-	-	1.78	0.14
12	-	-	-	1	-	0.53	1.38	0.03	-	0.19	0.1	0.03
13	-	-	-	1.35	0.12	-	0.18	-	-	0.4	-	0.01
14	-	-	0.13	0.05	0.26	-	0.32	-	-	0.16	-	-
15	-	-	0.12	-	1.21	0.05	-	-	-	0.06	-	-
16	-	-	0.2	-	0.02	0.44	-	-	-	-	-	-
17	0.39	-	-	-	0.04	1.2	-	-	0.04	-	-	-
18	0.31	-	-	-	-	-	0.03	-	-	1	0.34	-
19	-	-	-	0.04	0.97	-	-	-	-	0.3	0.59	-
20	-	-	0.95	0.01	-	-	-	0.54	-	0.03	0.02	-
21	-	0.05	-	1	-	-	-	-	-	-	0.03	0.02
22	-	-	-	0.42	-	-	1.87	-	-	-	-	-
23	-	-	-	1.49	-	-	-	-	-	0.57	0.14	-
24	-	0.02	-	0.02	0.12	-	-	0.35	-	-	0.55	-
25	0.18	-	-	0.71	1.09	-	-	-	-	-	-	-
26	0.05	-	-	-	2.5	-	0.01	0.1	-	0.22	-	-
27	-	-	-	-	0.2	-	-	-	-	0.6	0.3	-
28	-	-	-	-	0.67	-	-	-	-	0.04	-	-
29	0.05	-	0.65	-	-	-	-	0.63	-	-	-	-
30	-	-	0.26	0.6	2.27	-	0.87	-	-	-	0.8	-
31	-	-	0.06	-	-	-	1.27	-	-	0.03	-	0.05
Total	2.79	2.11	4.5	6.71	10.65	3.7	7.15	1.85	0.96	3.6	7.15	2.27

Rain Information Inches/Rain Day
Year - 2005
Proposed Conditions #1 (>3.26")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.53	-	0.01	0.23	0.02	0.09	-	-	0.03	-	0.01	-
2	0.25	0.18	-	0.33	-	0.28	-	-	-	-	-	-
3	0.29	0.03	-	0.01	-	0.51	-	-	-	-	-	0.47
4	0.51	-	0.07	-	-	-	-	-	-	-	-	0.03
5	0.08	-	-	-	-	-	-	-	-	-	-	-
6	0.69	-	0.01	-	-	-	-	-	-	-	0.04	-
7	0.69	0.55	0.37	0.41	-	-	0.19	-	-	0.19	-	-
8	0.08	0.05	0.02	0.15	-	-	-	-	-	-	-	0.56
9	0.02	0.12	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	0.01	-	-	-	-	-	-
11	0.04	-	0.08	0.03	-	0.77	1.5	-	-	-	-	0.03
12	-	-	0.13	0.55	-	0.13	0.41	-	-	-	-	0.04
13	0.67	0.65	0.02	0.14	-	0.43	0.31	-	-	-	0.35	-
14	-	0.19	-	-	0.71	-	0.24	0.27	-	-	0.7	0.07
15	-	-	0.01	0.05	-	-	0.02	-	-	-	0.65	0.57
16	0.02	-	-	-	-	-	0.33	0.42	0.05	-	-	-
17	-	-	-	-	-	-	0.11	0.01	-	-	-	-
18	-	-	-	-	-	-	-	0.66	-	-	-	-
19	0.01	-	0.11	-	1.11	-	-	-	-	-	-	-
20	-	0.54	0.01	-	0.53	-	0.09	0.55	0.16	0.15	-	-
21	-	0.07	-	-	-	-	-	-	-	0.41	-	-
22	0.02	0.01	0.47	0.4	0.01	-	0.84	-	-	0.03	-	-
23	0.01	0.07	0.27	0.04	-	-	-	-	-	0.1	-	-
24	-	0.02	-	0.02	-	-	-	-	-	0.13	-	0.18
25	-	-	0.05	0.01	-	-	-	0.1	0.41	-	-	0.33
26	-	-	-	0.57	-	-	-	0.67	0.12	-	-	0.01
27	-	0.01	1.25	0.02	-	-	-	-	-	-	0.13	-
28	-	0.55	0.34	0.24	-	-	-	0.5	-	-	1.07	0.2
29	0.66	-	0.04	0.93	-	0.45	-	0.32	0.15	-	-	0.02
30	0.02	-	0.02	0.13	-	-	-	3.85	-	-	-	0.17
31	0.01	-	-	-	-	-	-	0.05	-	-	-	0.01
Total	4.6	3.04	3.28	4.26	2.38	2.67	4.04	7.4	0.92	1.01	2.95	2.69

Rain Information Inches/Rain Day
Year - 2006
Proposed Conditions #1 (>3.26")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	-	-	-	0.08	-	-	0.01	-	0.32	0.51
2	0.23	0.51	-	0.12	0.85	0.53	-	-	0.03	-	-	-
3	0.02	0.06	-	-	-	-	-	-	-	-	-	-
4	-	0.78	0.05	-	-	0.04	0.06	-	-	-	-	-
5	-	-	-	-	-	-	-	-	0.06	0.03	-	-
6	-	-	-	0.07	-	-	-	-	-	-	0.22	-
7	-	-	-	0.45	0.03	0.16	-	-	-	-	0.64	-
8	-	-	0.04	0.03	-	-	-	0.42	-	-	-	-
9	-	-	0.7	-	0.01	-	-	0.17	-	-	-	-
10	1.15	0.08	-	-	0.41	-	-	1.18	0.14	-	-	-
11	0.15	0.11	0.47	-	0.15	0.62	1.08	-	1.45	0.14	0.11	-
12	-	-	2.04	-	0.02	-	0.05	-	0.7	0.11	-	0.33
13	0.43	-	0.22	-	-	-	1.25	-	0.04	-	0.03	-
14	0.1	-	-	0.01	0.01	-	0.04	0.98	-	-	-	-
15	-	-	-	-	0.1	-	-	0.18	-	-	1.1	-
16	-	0.53	0.01	0.07	0.02	-	-	-	-	1.32	0.45	-
17	1.12	0.25	-	1.03	-	1.71	-	-	-	0.34	-	-
18	-	0.09	-	0.06	0.1	0.38	-	0.11	0.17	-	-	-
19	0.21	-	-	0.06	0.01	0.28	-	-	-	0.51	0.08	-
20	-	-	-	1.05	-	0.03	-	0.94	-	0.01	-	-
21	-	-	0.3	1.61	-	-	2.17	-	-	-	-	0.1
22	2.08	0.1	-	-	-	0.03	0.88	-	4.57	-	-	0.38
23	0.08	-	-	0.02	-	0.32	-	-	2.18	-	-	-
24	-	-	0.05	-	-	-	-	-	0.2	-	-	-
25	-	-	-	-	2.18	-	-	-	-	-	-	0.97
26	-	-	-	0.17	-	0.6	-	-	-	0.42	-	0.06
27	-	-	0.02	-	-	-	0.21	-	0.65	1.79	-	-
28	0.02	-	0.02	-	-	-	0.44	1.8	0.64	0.34	-	-
29	0.33	-	-	0.08	-	-	-	0.03	-	-	0.07	-
30	0.03	-	-	0.34	0.08	-	-	-	0.08	-	0.48	-
31	-	-	0.65	-	-	-	-	-	-	0.16	-	0.67
Total	5.95	2.51	4.57	5.17	3.97	4.78	6.18	5.81	10.92	5.17	3.5	3.02

Rain Information Inches/Rain Day
Year - 2007
Proposed Conditions #1 (>3.26")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	0.94	0.18	-	-	-	-	-	-	-	0
2	-	-	-	-	0.59	-	-	-	-	-	-	0.63
3	-	-	-	1	0.21	-	-	-	-	-	-	0.02
4	0.2	0.1	-	-	0.74	0.02	0.06	-	-	-	-	0
5	0.35	-	-	-	0.3	-	2.47	-	-	-	0.03	0
6	-	-	-	-	-	-	-	-	-	-	-	0
7	0.57	-	-	-	-	-	-	-	-	-	-	0.48
8	-	-	-	-	-	0.23	-	-	-	-	-	0.36
9	-	-	-	-	-	-	-	-	1.51	-	-	1.25
10	-	-	0.04	-	-	-	0.2	-	-	-	-	0.65
11	0.3	-	-	0.54	0.1	-	-	-	0.02	-	0.11	0
12	0.1	0.57	-	0.3	-	-	-	-	-	-	0.06	0.43
13	0.77	1	-	0.12	-	-	-	-	-	-	0.03	0
14	0.17	-	0.17	1.45	-	-	-	-	0.05	-	0.27	0
15	0.65	-	0.18	-	0.4	-	-	-	-	-	-	2.53
16	-	-	-	-	0.15	-	-	-	-	0.35	-	0.03
17	-	-	-	-	0.01	-	0.08	-	-	-	-	0
18	-	0.1	-	-	-	-	-	-	-	1.83	-	0
19	-	-	0.65	-	-	0.03	0.87	0.03	-	0.15	-	0
20	-	-	0.16	-	-	-	-	-	-	-	-	0.68
21	0.68	-	-	-	-	-	-	2.36	-	-	0.54	0.06
22	-	-	0.05	-	-	0.07	-	-	-	2.56	-	0.12
23	-	-	-	-	-	0.2	-	-	-	4.36	-	0.16
24	-	1.23	-	-	-	0.52	-	-	-	0.67	-	0
25	-	0.17	-	0.03	-	0.13	-	-	0.23	-	0.37	0
26	-	-	-	0.73	-	0.65	-	-	0.3	0.05	0.84	0.09
27	-	-	-	0.3	-	0.02	0.51	-	0.9	-	-	0
28	-	-	1.13	0.2	-	0.12	0.14	-	0.03	-	0.04	0
29	-	-	-	-	-	0.04	-	0.07	-	-	-	0
30	-	-	0.8	-	-	-	-	0.01	-	-	-	0
31	-	-	0.16	-	-	-	-	-	-	-	-	0.02
Total	3.79	3.17	4.28	4.85	2.5	2.03	4.33	2.47	3.04	9.97	2.29	7.51

Rain Information Inches/Rain Day
Year - 2008
Proposed Conditions #1 (>3.26")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.04	0	0	0.5								
2	0	0	0.1	0.02								
3	0	0.1	1.03	1.3								
4	0	0.15	1.78	3.3								
5	0.29	0.35	0	0								
6	0	1	0	0								
7	0	0	0.3	0								
8	0.6	0	0.11	0								
9	0.03	0	0	0.7								
10	1.16	0.02	0.07									
11	0	0.51	0.02									
12	0.01	1.35	0									
13	0.2	0.03	0									
14	0.02	0	0.4									
15	0	0	0.6									
16	0	0	0.25									
17	0.22	0.23	0									
18	0	0	0.23									
19	0	0	2.4									
20	0.03	0	0.02									
21	0	0.5	0									
22	0.03	0.6	0									
23	0	0.05	0									
24	0	0	0									
25	0	0.04	0									
26	0	0.11	0.1									
27	0	0.01	0.52									
28	0	0	0.52									
29	1	0.11	0									
30	0.03		0.12									
31	0.3		0.16									
Total	3.96	5.16	8.73	5.82								

Rain Information Inches/Rain Day
Year - 1993
Proposed Conditions #2 (>4.72")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	-	0.67	0.3	-	-	-	0.01	-	-	-
2	0.02	-	0.34	-	0.5	-	-	-	0.28	-	0.02	-
3	-	-	0.46	-	0.07	-	-	-	0.15	0.18	-	0.14
4	0.99	-	0.54	0.2	0.7	-	-	-	0.12	-	0.2	0.5
5	-	-	0.17	-	-	1.42	-	0.11	-	0.02	0.09	0.95
6	-	-	-	-	0.5	-	-	0.3	-	-	-	0.08
7	0.04	-	0.27	-	-	-	-	-	-	-	0.03	-
8	0.15	-	0.2	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	2.33	-	-	-	-	-	-
10	0.2	-	-	0.92	-	0.59	-	-	-	0.53	-	0.29
11	0.3	0.58	-	-	-	0.1	-	-	-	-	-	0.13
12	0.11	-	-	-	-	0.02	-	-	-	-	-	-
13	0.07	0.27	-	-	0.7	0.23	-	0.45	-	0.03	1.73	-
14	-	0.5	-	0.12	0.2	0.02	-	-	-	0.01	0.17	-
15	0.3	0.3	-	0.37	-	0.53	0.1	-	-	-	1.07	0.26
16	0.1	0.3	-	0.46	-	-	0.13	-	0.51	-	0.07	0.21
17	-	-	0.4	0.14	0.5	-	0.05	-	-	0.27	0.83	0.02
18	0.01	-	-	-	0.1	-	1.45	1.46	0.02	0.25	0.5	0.04
19	-	-	0.03	-	0.97	-	0.6	-	-	0.03	0.2	-
20	0.17	0.57	0.05	-	-	-	-	-	-	3.8	-	0.01
21	0.75	1.8	-	-	-	0.13	-	-	-	0.05	-	-
22	-	-	0.2	-	-	-	0.24	0.01	-	0.02	-	-
23	0.3	-	0.71	-	-	-	0.03	-	0.11	-	-	-
24	0.57	-	-	-	-	-	-	0.21	0.47	-	-	-
25	-	1.03	-	0.13	0.5	0.02	-	0.13	0.05	-	0.06	-
26	-	-	-	0.6	-	0.25	0.47	0.02	0.49	-	0.06	-
27	-	-	0.05	0.2	-	0.2	-	-	-	-	0.36	-
28	-	-	0.1	-	-	-	-	-	0.07	-	-	-
29	-	-	-	-	-	0.52	-	-	-	-	-	-
30	-	-	-	0.09	-	-	-	0.1	-	0.01	0.02	-
31	-	-	-	-	0.49	-	-	0.1	-	0.31	-	-
Total	4.08	5.35	3.52	3.9	5.53	6.36	3.07	2.89	2.28	5.51	5.41	2.63

Rain Information Inches/Rain Day
Year - 1994
Proposed Conditions #2 (>4.72")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.19	-	0.1	-	0.02	-	-	-	0.02	-	-	-
2	0.29	-	-	-	-	0.36	-	-	-	-	-	-
3	-	-	0.05	0.29	0.11	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	0.3	-	-	-	1.33
5	-	-	-	0.1	-	0.03	-	0.35	0.6	-	0.43	-
6	-	-	-	0.5	0.45	-	1.12	-	-	-	-	-
7	-	-	0.35	-	0.85	0.13	-	-	-	-	-	-
8	0.25	-	0.33	-	-	-	0.8	-	-	-	-	-
9	-	0.4	-	-	-	1.28	0.8	-	-	0.52	0.43	0.81
10	-	0.15	1.2	0.56	-	-	-	-	-	-	0.15	1.15
11	-	0.19	-	0.6	-	-	-	-	-	-	-	-
12	0.23	0.1	-	-	-	-	-	-	-	-	-	-
13	-	-	0.1	-	-	-	1.05	-	-	0.47	-	-
14	0.02	-	-	-	-	-	0.03	0.13	-	-	-	-
15	-	-	-	0.43	0.49	-	0.06	-	-	-	0.9	-
16	-	-	-	-	-	-	0.05	-	-	-	0.48	0.7
17	0.27	-	-	-	-	-	-	-	0.11	-	-	-
18	1.6	-	0.15	-	-	-	-	-	-	0.35	-	-
19	-	-	-	-	-	-	-	-	-	0.86	-	-
20	-	0.51	0.03	-	-	-	-	0.89	-	-	-	0.03
21	-	-	0.32	-	-	0.38	0.77	0.08	-	-	-	-
22	-	1.3	-	-	-	-	0.27	-	-	0.03	-	0.1
23	-	0.03	-	-	-	-	-	-	1.67	-	-	-
24	0.38	-	0.05	-	-	0.38	-	-	0.11	-	0.2	-
25	-	-	-	-	0.6	-	0.46	-	0.17	-	0.08	-
26	0.66	-	1.05	-	0.1	0.56	-	0.09	0.3	-	0.02	-
27	0.05	-	1.05	1.5	-	-	-	-	-	0.01	1.15	-
28	0.85	-	0.05	-	-	-	0.02	0.1	-	-	-	-
29	0.45	-	-	1.05	-	-	-	0.5	-	-	-	-
30	0.04	-	0.22	1	-	-	-	0.05	-	0.02	-	0.02
31	-	-	-	-	-	-	-	-	-	0.2	-	0.08
Total	5.28	2.68	5.05	6.03	2.62	3.12	5.43	2.49	2.98	2.46	3.84	4.22

Rain Information Inches/Rain Day
Year - 1995
Proposed Conditions #2 (>4.72")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.03	-	-	-	1.27	0.2	-	-	0.4	-	0.2	-
2	-	0.15	-	-	0.04	0.23	-	-	-	0.04	0.18	-
3	-	0.21	-	-	-	0.15	-	-	-	1.3	-	-
4	-	-	0.04	-	0.15	-	0.4	-	-	-	-	-
5	-	-	0.45	-	-	-	1.21	2.44	-	3.45	-	-
6	0.89	-	0.08	-	-	-	0.05	0.1	-	-	0.37	-
7	-	0.02	0.82	-	-	-	0.1	2.3	0.02	-	0.17	-
8	0.03	-	-	-	-	0.08	-	0.41	-	-	-	0.06
9	-	-	-	0.05	0.98	0.18	-	0.21	-	-	-	-
10	0.04	-	-	-	0.19	-	-	-	-	-	0.16	-
11	0.35	-	-	0.23	0.02	1.12	-	-	-	-	1	-
12	0.01	-	-	0.67	-	0.05	-	-	-	-	-	-
13	-	-	-	-	1.3	-	-	-	-	0.02	0.47	0.05
14	0.96	0.57	-	-	1.05	-	-	-	-	-	-	-
15	-	1.4	-	-	0.01	-	0.66	-	-	-	-	0.73
16	0.02	0.1	-	0.16	0.28	-	-	0.18	1.45	0.01	-	0.03
17	-	-	-	0.47	2.52	-	-	-	0.06	-	-	0.16
18	-	-	-	0.08	1.51	-	-	-	-	-	-	1.02
19	0.43	-	-	-	0.01	0.02	-	-	-	-	-	0.4
20	-	-	0.27	1.15	-	-	-	-	0.17	0.46	-	-
21	-	-	-	0.41	0.19	0.47	-	-	0.02	0.09	-	-
22	0.02	-	-	-	-	0.02	1.21	-	-	-	-	-
23	-	0.04	0.3	0.96	-	-	0.93	-	0.09	-	0.44	0.02
24	-	-	-	0.05	-	0.38	-	-	-	0.1	-	-
25	-	-	-	0.02	0.04	-	0.21	-	0.02	-	-	-
26	-	-	-	-	-	-	-	-	-	0.07	-	-
27	0.11	0.18	0.27	-	0.98	0.04	0.82	-	-	0.96	0.03	-
28	0.69	0.04	-	-	0.28	0.07	-	-	-	-	-	-
29	-	-	-	0.01	0.04	-	-	-	-	-	-	-
30	-	-	-	0.07	-	0.09	-	-	-	-	-	0.01
31	-	-	-	-	0.05	-	-	-	-	-	-	0.37
Total	3.58	2.71	2.23	4.33	10.91	3.1	5.59	5.64	2.23	6.5	3.02	2.85

Rain Information Inches/Rain Day
Year - 1996
Proposed Conditions #2 (>4.72")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.05	0.06	-	0.4	0.04	-	-	-	-	-	0.07	0.24
2	0.67	-	0.03	-	0.25	0.48	0.39	-	-	-	-	0.02
3	-	-	-	-	-	0.28	-	-	0.03	-	-	-
4	-	-	-	0.1	0.02	-	-	-	-	-	-	-
5	-	-	0.88	-	0.78	-	-	-	0.33	-	-	0.33
6	-	-	1.2	-	0.1	1.06	-	-	0.02	-	0.07	0.02
7	-	0.03	0.14	-	0.4	0.63	-	-	0.67	-	0.84	-
8	1	0.31	-	-	1.03	0.62	-	1.19	-	0.06	0.15	0.01
9	-	-	-	-	-	0.45	0.07	-	0.37	0.03	-	-
10	-	-	-	-	-	0.35	-	-	-	0.17	-	-
11	0.33	-	-	-	0.23	0.13	-	7	-	0.02	-	-
12	-	0.05	-	-	-	0.22	-	0.02	0.05	-	-	0.87
13	-	-	-	0.87	0.02	-	-	-	-	-	0.01	-
14	-	0.07	-	-	0.2	-	2.55	-	-	-	-	0.02
15	-	-	0.35	0.27	0.47	-	0.12	-	0.11	-	-	-
16	-	-	0.62	0.02	-	-	-	-	1.1	-	-	1.61
17	-	-	-	-	-	-	-	0.27	0.02	1.55	0.3	0.48
18	1.18	-	-	-	-	0.22	-	-	-	0.66	0.04	-
19	-	1.07	1.2	-	-	0.33	1.8	-	-	-	0.02	-
20	-	0.04	-	0.98	-	-	0.15	-	-	-	-	-
21	-	-	-	-	-	-	0.25	-	0.66	0.03	0.32	0.01
22	-	-	-	0.2	-	-	-	-	-	0.42	0.02	0.06
23	1.4	-	-	0.47	-	-	-	-	-	0.06	0.01	0.67
24	0.15	-	0.03	-	0.02	0.69	-	0.14	-	-	0.02	0.25
25	-	-	0.33	0.2	-	-	-	-	-	0.32	1.13	-
26	0.08	-	-	0.31	4.87	-	-	-	0.04	0.43	0.05	0.04
27	0.05	0.62	-	0.31	0.83	-	-	-	1.07	-	-	0.04
28	0.03	-	0.21	0.34	0.22	-	0.5	-	0.68	0.21	-	0.02
29	-	-	0.02	1	-	-	0.1	-	-	-	0.2	-
30	-	-	-	-	-	-	1	-	0.02	-	0.78	0.03
31	-	-	0.3	-	-	-	0.02	-	-	-	-	0.01
Total	4.94	2.25	5.31	5.47	9.48	5.46	6.95	8.62	5.17	3.96	4.03	4.73

Rain Information Inches/Rain Day
Year - 1997
Proposed Conditions #2 (>4.72")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	8.17	0.01	-	0.5	0.02	-	-	-	0.5	-
2	-	-	0.8	-	0.78	0.19	-	-	-	-	0.07	-
3	-	0.4	1	-	0.71	0.02	-	-	0.03	-	0.15	0.27
4	0.28	1.27	0.02	-	-	0.01	-	-	-	-	0.01	0.03
5	0.13	-	0.47	0.21	-	0.49	-	-	-	-	-	-
6	-	-	0.01	-	-	0.74	-	-	-	-	0.41	-
7	-	-	-	-	-	0.17	-	-	-	-	-	-
8	-	0.33	-	-	0.62	1.36	-	-	-	-	-	-
9	0.03	-	0.36	-	-	0.12	-	1.21	0.4	-	-	0.72
10	-	-	-	-	-	0.01	-	0.01	-	-	-	0.32
11	-	-	-	0.05	-	0.08	-	-	0.04	-	-	-
12	-	-	-	0.14	-	-	-	-	-	-	-	-
13	-	0.45	0.36	-	0.02	0.25	-	0.27	-	0.6	-	-
14	-	0.02	0.12	-	0.11	0.88	-	0.03	-	0.27	0.85	-
15	0.4	-	-	-	0.07	0.02	-	-	-	-	-	-
16	0.01	-	-	0.11	0.01	0.2	-	-	-	-	-	-
17	-	-	0.05	-	0.03	0.23	-	-	0.02	-	-	-
18	-	-	2.11	-	0.05	0.29	-	-	-	-	-	-
19	-	0.02	-	0.21	0.62	0.02	0.18	0.02	-	-	-	-
20	0.02	0.02	-	0.01	0.06	-	-	-	0.1	-	-	-
21	-	0.11	-	0.25	-	-	-	1.22	-	-	0.72	0.5
22	0.94	0.02	-	0.08	-	-	-	0.09	0.02	-	-	-
23	0.01	-	-	-	-	-	-	0.02	0.23	0.03	-	-
24	0.8	-	-	-	1.6	-	-	-	0.3	0.93	-	0.83
25	0.01	-	0.41	-	0.05	-	-	-	-	-	-	0.04
26	-	-	-	-	0.02	0.77	-	-	-	0.08	-	0.03
27	0.76	0.41	0.01	0.73	-	0.02	-	0.81	-	-	-	-
28	0.02	0.21	1.34	0.02	0.38	-	-	-	0.1	-	-	-
29	-	0.96	-	-	0.84	0.05	0.5	-	-	-	-	0.19
30	-	-	0.08	0.32	0.01	0.18	-	-	-	-	1	-
31	-	-	0.09	-	0.65	-	-	-	-	0.1	-	-
Total	3.41	4.22	15.4	2.14	6.63	6.6	0.7	3.68	1.24	2.01	3.71	2.93

Rain Information Inches/Rain Day
Year - 1998
Proposed Conditions #2 (>4.72")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	-	-	0.06	0.02	-	-	-	-	-	-
2	-	-	0.03	-	-	-	-	-	-	-	0.16	-
3	-	-	0.07	0.46	0.27	0.3	-	-	-	1.44	0.2	-
4	-	-	0.02	0.05	-	1.34	0.19	-	-	-	-	0.02
5	0.51	-	-	-	-	0.34	-	-	-	-	-	-
6	0.82	-	-	-	-	-	-	2	-	-	-	-
7	1.35	0.3	0.32	-	0.56	-	0.65	-	-	0.93	-	0.88
8	0.15	-	1.3	0.95	0.08	-	-	0.14	-	-	-	0.44
9	0.05	-	0.9	0.06	0.01	0.75	-	0.83	-	-	0.36	-
10	-	0.03	-	0.3	0.03	0.73	-	0.03	-	-	-	-
11	-	0.29	0.5	-	-	-	-	0.4	-	-	-	-
12	0.36	0.03	-	-	-	1.02	-	-	-	-	-	0.11
13	0.08	-	-	0.09	-	1.11	0.15	-	-	-	-	0.54
14	0.01	-	-	0.5	-	1.67	0.41	-	-	-	-	-
15	-	-	-	0.33	-	-	0.81	-	-	-	-	-
16	0.03	0.2	0.11	0.43	-	-	0.37	-	-	-	-	-
17	0.1	0.24	0.04	0.01	-	-	-	-	-	-	-	-
18	-	0.04	0.26	0.3	-	-	-	-	-	0.42	-	-
19	-	0.02	0.71	0.38	-	0.3	-	-	0.13	-	-	-
20	0.05	0.1	1	-	0.47	-	-	-	-	-	-	-
21	-	-	-	-	0.1	1.08	-	-	1.9	-	0.56	0.2
22	0.3	-	-	0.1	0.84	-	-	-	-	-	-	-
23	-	0.07	-	-	-	0.9	-	-	-	-	-	-
24	-	-	-	-	0.52	-	-	-	-	-	-	-
25	-	-	0.13	0.07	0.11	-	-	-	0.1	-	-	-
26	-	0.03	-	-	0.34	-	-	-	-	-	-	-
27	-	0.15	-	0.24	-	-	-	-	-	-	-	-
28	-	-	-	0.12	-	-	-	-	-	-	-	-
29	-	-	-	0.85	0.03	0.73	-	0.15	-	-	-	0.05
30	-	-	-	0.81	-	0.09	0.1	-	-	-	0.3	0.05
31	-	-	0.4	-	0.91	-	-	-	-	-	-	-
Total	3.81	1.5	5.79	6.05	4.33	10.38	2.68	3.55	2.13	2.79	1.58	2.29

Rain Information Inches/Rain Day
Year - 1999
Proposed Conditions #2 (>4.72")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	0.02	-	0.02	-	0.04	-	-	-	-	0.11	-
2	-	0.03	0.11	-	-	0.44	0.02	-	-	-	0.63	-
3	-	-	0.02	0.35	-	-	-	-	-	-	-	0.05
4	-	0.03	-	0.07	-	-	-	-	-	-	-	0.18
5	-	-	-	-	0.83	0.05	-	-	-	-	-	0.25
6	-	-	0.39	1.05	1.06	0.03	-	-	-	-	-	0.02
7	-	0.17	-	-	-	-	-	-	-	-	-	-
8	1.8	-	0.33	0.02	-	-	-	2.28	0.34	0.28	-	-
9	-	-	0.53	-	-	0.02	-	-	-	3.37	-	-
10	-	-	-	-	-	0.06	0.07	-	-	0.05	-	0.99
11	-	0.22	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	0.9	-	-	-	-	-	-	1.52
13	0.4	-	0.05	-	0.08	0.07	-	-	-	0.02	-	1.93
14	0.02	-	1	0.3	-	0.37	-	-	-	-	-	-
15	-	-	-	0.33	-	-	-	-	-	-	-	-
16	-	0.19	-	-	-	-	-	-	-	-	-	-
17	-	-	-	0.02	0.37	-	0.02	-	-	-	-	-
18	-	-	-	0.1	0.3	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	0.07	0.25	-
20	0.05	-	-	-	-	-	-	-	0.15	-	0.15	0.2
21	-	-	-	-	0.02	-	0.01	-	0.07	-	0.02	-
22	1.57	-	-	-	-	-	-	-	-	-	-	-
23	0.5	-	0.98	-	0.78	0.18	0.13	-	-	-	-	-
24	-	0.02	-	-	-	1	-	-	-	-	-	0.15
25	-	-	-	-	0.02	-	-	-	-	-	0.51	-
26	-	0.98	-	1.31	-	0.11	-	-	-	-	0.22	-
27	-	0.09	-	0.14	-	0.5	-	-	-	-	-	-
28	-	-	-	1.3	-	0.87	-	-	0.07	-	-	-
29	-	-	-	0.03	-	-	-	-	0.24	-	-	-
30	-	-	-	-	-	-	-	-	-	-	-	-
31	1.35	-	0.34	-	0.05	-	-	-	-	-	-	-
Total	5.69	1.75	3.75	5.04	4.41	3.74	0.25	2.28	0.87	3.79	1.89	5.29

Rain Information Inches/Rain Day
Year - 2000
Proposed Conditions #2 (>4.72")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	0.02	0.5	-	-	-	-	-	-	-	-
2	0.9	-	-	0.81	0.49	-	-	-	-	-	0.4	0.2
3	3.32	-	0.06	0.75	0.85	-	0.24	0.09	-	-	-	-
4	-	0.03	-	0.4	0.02	-	0.45	-	0.26	-	0.22	-
5	-	-	-	-	-	0.05	0.05	0.1	-	0.18	0.42	-
6	0.02	-	-	-	-	-	0.45	-	-	0.4	-	-
7	-	-	-	0.34	-	-	-	-	-	-	0.38	-
8	0.03	-	-	0.49	-	-	-	0.65	0.5	-	0.77	-
9	0.05	-	-	-	0.06	-	-	-	-	-	-	-
10	-	-	-	0.02	-	-	-	0.37	0.1	-	-	0.2
11	-	-	0.4	0.34	-	-	0.04	-	0.4	-	-	0.11
12	-	-	-	-	-	-	0.47	-	0.41	-	0.7	-
13	-	1.85	-	-	0.79	-	-	-	-	-	-	0.67
14	-	-	-	-	-	0.53	-	-	-	-	-	-
15	-	-	-	-	-	1	-	-	-	-	-	0.15
16	-	-	0.48	-	-	0.02	-	-	-	-	-	2.55
17	0.2	0.14	-	0.25	0.02	0.34	-	-	-	-	-	0.05
18	0.15	2.41	0.5	-	-	0.75	-	0.32	-	-	-	0.07
19	0.18	-	0.93	-	0.25	0.08	0.58	-	-	-	-	-
20	-	-	0.32	0.14	0.02	-	-	-	0.27	-	-	-
21	-	0.2	-	0.02	-	0.29	-	-	0.17	0.06	-	-
22	0.13	0.07	-	-	-	-	-	-	0.4	-	-	-
23	-	0.02	-	0.6	2.33	-	-	1.48	0.07	-	-	-
24	-	0.02	-	0.54	-	0.1	-	1.11	0.55	-	0.23	-
25	0.02	-	-	0.02	0.05	0.2	-	-	1	-	1	-
26	-	0.27	-	-	0.07	0.6	-	0.1	0.07	-	0.3	0.01
27	-	0.25	-	-	0.23	1.3	-	-	-	-	-	-
28	-	0.02	-	-	0.13	0.2	1.83	-	-	-	-	-
29	0.26	-	-	0.05	0.03	-	0.8	-	-	-	-	0.05
30	-	-	-	-	-	-	0.25	-	-	-	-	0.01
31	-	-	-	-	-	-	-	-	-	-	-	-
Total	5.26	5.28	2.71	5.27	5.34	5.46	5.16	4.22	4.2	0.64	4.42	4.07

Rain Information Inches/Rain Day
Year - 2001
Proposed Conditions #2 (>4.72")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	0.1	0.21	-	-	-	-	-	-	-	-
2	0.06	-	-	0.02	-	0.02	-	-	-	-	0.28	-
3	-	-	0.7	0.7	-	-	-	0.7	0.45	-	-	-
4	-	0.6	1.34	-	-	0.06	0.1	-	-	-	-	-
5	-	-	-	-	-	0.06	-	-	-	1.1	-	-
6	-	-	-	-	-	0.04	-	-	-	-	-	0.5
7	-	-	-	-	1.4	0.1	-	-	2	-	-	-
8	-	0.2	-	-	0.21	0.02	-	-	-	-	0.01	0.38
9	-	0.61	-	-	-	-	0.04	-	1.1	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	0.14	-	-	2.58	-	0.3	-	-
12	-	0.2	-	-	-	-	-	-	-	1.61	-	0.8
13	-	0.4	-	-	-	-	-	-	-	0.1	-	0.18
14	-	0.85	-	-	-	-	-	-	-	1.85	-	-
15	0.3	0.85	0.21	0.19	-	0.75	-	-	-	0.02	-	-
16	-	0.78	0.2	-	-	-	-	-	-	0.2	-	0.87
17	-	-	-	-	0.07	-	-	-	-	-	-	0.75
18	0.37	-	-	-	0.75	-	0.35	0.16	-	-	-	-
19	0.63	-	-	-	-	-	-	0.53	1	-	0.27	0.03
20	0.02	-	0.32	0.06	-	-	0.94	-	-	-	-	-
21	-	-	0.2	-	0.56	0.13	0.02	-	-	-	-	-
22	-	-	-	-	0.4	-	0.14	-	-	-	-	0.35
23	-	-	-	0.28	0.05	0.1	-	-	0.2	-	0.02	0.3
24	-	-	-	-	0.1	-	-	-	0.18	0.68	0.71	-
25	-	1	-	-	0.02	-	0.07	-	-	-	-	-
26	0.2	-	0.2	-	0.1	1.19	1.63	0.2	-	-	-	-
27	-	0.2	-	-	0.32	0.11	0.03	0.02	-	-	1.38	-
28	-	-	-	-	-	0.05	0.46	0.01	-	-	1.34	-
29	0.45	-	0.5	-	-	0.5	0.22	-	-	-	1.97	-
30	0.5	-	0.25	-	-	-	-	-	-	-	-	-
31	-	-	0.27	-	0.33	-	-	0.5	-	-	-	-
Total	2.53	5.69	4.29	1.46	4.45	3.13	4	4.7	4.93	5.86	5.98	4.16

Rain Information Inches/Rain Day
Year - 2002
Proposed Conditions #2 (>4.72")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	0.8	-	-	1.49	-	-	-	-	-	-	-
2	-	-	0.32	-	0.84	-	-	-	-	0.04	-	-
3	-	-	-	0.19	-	-	-	-	-	-	0.16	-
4	-	-	-	-	-	-	-	-	-	0.45	0.03	-
5	-	-	-	-	-	0.22	-	-	-	-	1	-
6	0.28	0.1	-	-	1.7	0.73	-	-	-	0.07	-	-
7	-	-	-	-	0.03	-	-	-	-	-	-	0.4
8	-	-	0.02	0.15	0.05	-	-	-	-	-	-	-
9	-	-	0.5	0.15	0.12	-	0.1	-	-	0.05	0.1	-
10	0.02	0.25	-	-	-	-	0.29	-	-	2.55	1	0.47
11	-	-	-	0.05	-	0.1	-	-	-	0.67	-	0.32
12	-	-	0.1	-	-	0.77	0.02	-	-	-	-	-
13	-	-	-	1	2.3	0.03	0.38	0.25	-	-	-	0.6
14	-	-	-	0.45	-	-	-	0.55	1.3	-	-	0.02
15	-	-	-	-	-	-	-	-	0.15	-	0.3	-
16	-	-	-	-	0.03	0.04	-	0.2	-	-	-	-
17	-	-	1.36	-	1	-	-	0.1	0.1	-	-	0.15
18	-	-	0.17	-	-	-	0.05	0.17	-	-	-	-
19	0.15	0.13	1.82	-	-	-	-	0.05	-	0.55	-	2.3
20	-	0.55	0.89	0.03	-	-	-	-	0.85	0.15	-	-
21	-	-	-	0.86	-	-	-	-	-	-	0.23	0.3
22	0.2	-	-	-	-	-	0.75	-	-	-	-	0.1
23	0.7	-	-	-	-	-	-	0.02	-	-	-	-
24	1.6	-	-	0.87	-	0.25	-	-	-	-	-	1
25	-	-	0.9	-	0.07	0.06	-	-	-	0.1	-	-
26	-	0.32	1.93	-	-	0.25	-	0.07	3.25	-	0.05	-
27	-	-	-	1.33	-	-	-	0.06	2.3	-	-	-
28	-	-	-	1.08	-	1.79	-	-	-	0.5	-	-
29	-	-	0.4	-	0.35	-	0.1	-	-	0.68	-	-
30	0.33	-	0.3	-	-	-	0.5	-	-	0.05	-	0.56
31	-	-	-	-	-	-	-	-	-	-	-	1.1
Total	3.28	2.15	8.71	6.16	7.98	4.24	2.19	1.47	7.95	5.86	2.87	7.32

Rain Information Inches/Rain Day
Year - 2003
Proposed Conditions #2 (>4.72")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.45	-	-	-	0.6	-	0.02	-	0.19	0.5	0.08	-
2	-	-	-	-	-	0.05	0.03	0.18	2.34	-	-	-
3	0.16	0.33	-	-	-	0.53	-	0.66	1.74	-	-	0.11
4	0.3	-	-	-	0.11	0.05	-	0.13	-	-	-	0.33
5	0.4	-	0.05	0.37	2.15	-	-	-	-	-	0.02	0.15
6	-	-	0.03	0.51	-	0.19	0.08	0.03	-	-	0.32	-
7	-	-	-	0.28	0.95	0.6	-	0.02	-	-	-	-
8	-	-	-	0.11	1.17	0.32	0.03	-	-	-	-	-
9	-	-	-	1.24	-	-	0.29	0.12	-	0.02	-	0.03
10	-	0.2	0.02	0.6	-	0.27	0.37	0.09	-	0.07	-	0.63
11	-	-	-	-	1.88	1.38	-	0.06	-	-	0.04	-
12	-	-	0.8	-	-	0.03	-	-	-	-	1.57	-
13	-	-	0.7	-	-	0.18	-	0.04	-	-	-	-
14	-	2.05	-	-	-	0.04	-	-	0.39	0.74	0.1	-
15	-	1.4	-	-	0.44	0.08	0.34	-	0.02	-	0.28	0.17
16	-	0.32	-	-	0.03	1.13	-	-	-	-	0.06	0.29
17	-	-	-	1.25	0.62	-	-	0.03	-	0.3	0.02	-
18	-	-	0.77	-	0.03	-	-	-	-	-	0.97	0.14
19	-	0.25	0.6	-	-	-	-	-	-	-	0.11	0.06
20	-	-	0.26	0.22	0.24	-	-	-	-	-	-	-
21	-	0.85	0.6	0.32	0.01	-	0.44	-	-	0.02	-	-
22	-	1.28	-	-	-	-	0.04	0.98	1.57	-	-	0.03
23	-	0.14	-	-	-	-	-	-	-	-	0.07	0.92
24	-	-	-	-	-	-	-	-	-	-	0.71	-
25	-	-	0.14	0.88	0.43	-	-	-	0.02	0.07	-	-
26	-	-	-	0.12	-	1.76	-	-	-	1	-	-
27	-	0.13	-	-	0.03	-	-	-	0.3	-	1	-
28	0.1	0.03	-	0.05	0.02	-	0.37	-	0.11	0.14	0.27	-
29	-	-	0.49	0.03	-	-	-	0.12	-	-	-	0.79
30	-	-	-	-	-	0.44	-	0.38	0.19	-	-	-
31	0.12	-	-	-	-	-	1.05	0.51	-	-	-	-
Total	1.53	6.98	4.46	5.98	8.71	7.05	3.06	3.35	6.87	2.86	5.62	3.65

Rain Information Inches/Rain Day
Year - 2004
Proposed Conditions #2 (>4.72")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.34	-	0.47	-	0.54	-	-	-	-	-	0.66	-
2	0.65	1.04	-	-	0.54	0.03	-	-	0.52	-	1.72	-
3	0.03	-	0.31	-	-	-	0.12	-	-	-	-	-
4	0.61	-	0.1	-	-	-	-	-	-	-	0.12	-
5	0.06	0.86	1.23	0.02	-	-	0.52	0.12	-	-	-	0.2
6	-	0.07	-	-	-	-	0.16	-	-	-	-	0.15
7	-	-	0.02	-	-	-	0.1	-	0.4	-	-	0.85
8	-	0.03	-	-	-	-	-	-	-	-	-	-
9	-	0.04	-	-	-	1.45	0.08	-	-	-	-	0.68
10	0.12	-	-	-	-	-	0.11	-	-	-	-	0.14
11	-	-	-	-	0.1	-	0.13	0.08	-	-	1.78	0.14
12	-	-	-	1	-	0.53	1.38	0.03	-	0.19	0.1	0.03
13	-	-	-	1.35	0.12	-	0.18	-	-	0.4	-	0.01
14	-	-	0.13	0.05	0.26	-	0.32	-	-	0.16	-	-
15	-	-	0.12	-	1.21	0.05	-	-	-	0.06	-	-
16	-	-	0.2	-	0.02	0.44	-	-	-	-	-	-
17	0.39	-	-	-	0.04	1.2	-	-	0.04	-	-	-
18	0.31	-	-	-	-	-	0.03	-	-	1	0.34	-
19	-	-	-	0.04	0.97	-	-	-	-	0.3	0.59	-
20	-	-	0.95	0.01	-	-	-	0.54	-	0.03	0.02	-
21	-	0.05	-	1	-	-	-	-	-	-	0.03	0.02
22	-	-	-	0.42	-	-	1.87	-	-	-	-	-
23	-	-	-	1.49	-	-	-	-	-	0.57	0.14	-
24	-	0.02	-	0.02	0.12	-	-	0.35	-	-	0.55	-
25	0.18	-	-	0.71	1.09	-	-	-	-	-	-	-
26	0.05	-	-	-	2.5	-	0.01	0.1	-	0.22	-	-
27	-	-	-	-	0.2	-	-	-	-	0.6	0.3	-
28	-	-	-	-	0.67	-	-	-	-	0.04	-	-
29	0.05	-	0.65	-	-	-	-	0.63	-	-	-	-
30	-	-	0.26	0.6	2.27	-	0.87	-	-	-	0.8	-
31	-	-	0.06	-	-	-	1.27	-	-	0.03	-	0.05
Total	2.79	2.11	4.5	6.71	10.65	3.7	7.15	1.85	0.96	3.6	7.15	2.27

Rain Information Inches/Rain Day
Year - 2005
Proposed Conditions #2 (>4.72")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.53	-	0.01	0.23	0.02	0.09	-	-	0.03	-	0.01	-
2	0.25	0.18	-	0.33	-	0.28	-	-	-	-	-	-
3	0.29	0.03	-	0.01	-	0.51	-	-	-	-	-	0.47
4	0.51	-	0.07	-	-	-	-	-	-	-	-	0.03
5	0.08	-	-	-	-	-	-	-	-	-	-	-
6	0.69	-	0.01	-	-	-	-	-	-	-	0.04	-
7	0.69	0.55	0.37	0.41	-	-	0.19	-	-	0.19	-	-
8	0.08	0.05	0.02	0.15	-	-	-	-	-	-	-	0.56
9	0.02	0.12	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	0.01	-	-	-	-	-	-
11	0.04	-	0.08	0.03	-	0.77	1.5	-	-	-	-	0.03
12	-	-	0.13	0.55	-	0.13	0.41	-	-	-	-	0.04
13	0.67	0.65	0.02	0.14	-	0.43	0.31	-	-	-	0.35	-
14	-	0.19	-	-	0.71	-	0.24	0.27	-	-	0.7	0.07
15	-	-	0.01	0.05	-	-	0.02	-	-	-	0.65	0.57
16	0.02	-	-	-	-	-	0.33	0.42	0.05	-	-	-
17	-	-	-	-	-	-	0.11	0.01	-	-	-	-
18	-	-	-	-	-	-	-	0.66	-	-	-	-
19	0.01	-	0.11	-	1.11	-	-	-	-	-	-	-
20	-	0.54	0.01	-	0.53	-	0.09	0.55	0.16	0.15	-	-
21	-	0.07	-	-	-	-	-	-	-	0.41	-	-
22	0.02	0.01	0.47	0.4	0.01	-	0.84	-	-	0.03	-	-
23	0.01	0.07	0.27	0.04	-	-	-	-	-	0.1	-	-
24	-	0.02	-	0.02	-	-	-	-	-	0.13	-	0.18
25	-	-	0.05	0.01	-	-	-	0.1	0.41	-	-	0.33
26	-	-	-	0.57	-	-	-	0.67	0.12	-	-	0.01
27	-	0.01	1.25	0.02	-	-	-	-	-	-	0.13	-
28	-	0.55	0.34	0.24	-	-	-	0.5	-	-	1.07	0.2
29	0.66	-	0.04	0.93	-	0.45	-	0.32	0.15	-	-	0.02
30	0.02	-	0.02	0.13	-	-	-	3.85	-	-	-	0.17
31	0.01	-	-	-	-	-	-	0.05	-	-	-	0.01
Total	4.6	3.04	3.28	4.26	2.38	2.67	4.04	7.4	0.92	1.01	2.95	2.69

Rain Information Inches/Rain Day
Year - 2006
Proposed Conditions #2 (>4.72")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	-	-	-	0.08	-	-	0.01	-	0.32	0.51
2	0.23	0.51	-	0.12	0.85	0.53	-	-	0.03	-	-	-
3	0.02	0.06	-	-	-	-	-	-	-	-	-	-
4	-	0.78	0.05	-	-	0.04	0.06	-	-	-	-	-
5	-	-	-	-	-	-	-	-	0.06	0.03	-	-
6	-	-	-	0.07	-	-	-	-	-	-	0.22	-
7	-	-	-	0.45	0.03	0.16	-	-	-	-	0.64	-
8	-	-	0.04	0.03	-	-	-	0.42	-	-	-	-
9	-	-	0.7	-	0.01	-	-	0.17	-	-	-	-
10	1.15	0.08	-	-	0.41	-	-	1.18	0.14	-	-	-
11	0.15	0.11	0.47	-	0.15	0.62	1.08	-	1.45	0.14	0.11	-
12	-	-	2.04	-	0.02	-	0.05	-	0.7	0.11	-	0.33
13	0.43	-	0.22	-	-	-	1.25	-	0.04	-	0.03	-
14	0.1	-	-	0.01	0.01	-	0.04	0.98	-	-	-	-
15	-	-	-	-	0.1	-	-	0.18	-	-	1.1	-
16	-	0.53	0.01	0.07	0.02	-	-	-	-	1.32	0.45	-
17	1.12	0.25	-	1.03	-	1.71	-	-	-	0.34	-	-
18	-	0.09	-	0.06	0.1	0.38	-	0.11	0.17	-	-	-
19	0.21	-	-	0.06	0.01	0.28	-	-	-	0.51	0.08	-
20	-	-	-	1.05	-	0.03	-	0.94	-	0.01	-	-
21	-	-	0.3	1.61	-	-	2.17	-	-	-	-	0.1
22	2.08	0.1	-	-	-	0.03	0.88	-	4.57	-	-	0.38
23	0.08	-	-	0.02	-	0.32	-	-	2.18	-	-	-
24	-	-	0.05	-	-	-	-	-	0.2	-	-	-
25	-	-	-	-	2.18	-	-	-	-	-	-	0.97
26	-	-	-	0.17	-	0.6	-	-	-	0.42	-	0.06
27	-	-	0.02	-	-	-	0.21	-	0.65	1.79	-	-
28	0.02	-	0.02	-	-	-	0.44	1.8	0.64	0.34	-	-
29	0.33	-	-	0.08	-	-	-	0.03	-	-	0.07	-
30	0.03	-	-	0.34	0.08	-	-	-	0.08	-	0.48	-
31	-	-	0.65	-	-	-	-	-	-	0.16	-	0.67
Total	5.95	2.51	4.57	5.17	3.97	4.78	6.18	5.81	10.92	5.17	3.5	3.02

Rain Information Inches/Rain Day
Year - 2007
Proposed Conditions #2 (>4.72")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	-	0.94	0.18	-	-	-	-	-	-	-	0
2	-	-	-	-	0.59	-	-	-	-	-	-	0.63
3	-	-	-	1	0.21	-	-	-	-	-	-	0.02
4	0.2	0.1	-	-	0.74	0.02	0.06	-	-	-	-	0
5	0.35	-	-	-	0.3	-	2.47	-	-	-	0.03	0
6	-	-	-	-	-	-	-	-	-	-	-	0
7	0.57	-	-	-	-	-	-	-	-	-	-	0.48
8	-	-	-	-	-	0.23	-	-	-	-	-	0.36
9	-	-	-	-	-	-	-	-	1.51	-	-	1.25
10	-	-	0.04	-	-	-	0.2	-	-	-	-	0.65
11	0.3	-	-	0.54	0.1	-	-	-	0.02	-	0.11	0
12	0.1	0.57	-	0.3	-	-	-	-	-	-	0.06	0.43
13	0.77	1	-	0.12	-	-	-	-	-	-	0.03	0
14	0.17	-	0.17	1.45	-	-	-	-	0.05	-	0.27	0
15	0.65	-	0.18	-	0.4	-	-	-	-	-	-	2.53
16	-	-	-	-	0.15	-	-	-	-	0.35	-	0.03
17	-	-	-	-	0.01	-	0.08	-	-	-	-	0
18	-	0.1	-	-	-	-	-	-	-	1.83	-	0
19	-	-	0.65	-	-	0.03	0.87	0.03	-	0.15	-	0
20	-	-	0.16	-	-	-	-	-	-	-	-	0.68
21	0.68	-	-	-	-	-	-	2.36	-	-	0.54	0.06
22	-	-	0.05	-	-	0.07	-	-	-	2.56	-	0.12
23	-	-	-	-	-	0.2	-	-	-	4.36	-	0.16
24	-	1.23	-	-	-	0.52	-	-	-	0.67	-	0
25	-	0.17	-	0.03	-	0.13	-	-	0.23	-	0.37	0
26	-	-	-	0.73	-	0.65	-	-	0.3	0.05	0.84	0.09
27	-	-	-	0.3	-	0.02	0.51	-	0.9	-	-	0
28	-	-	1.13	0.2	-	0.12	0.14	-	0.03	-	0.04	0
29	-	-	-	-	-	0.04	-	0.07	-	-	-	0
30	-	-	0.8	-	-	-	-	0.01	-	-	-	0
31	-	-	0.16	-	-	-	-	-	-	-	-	0.02
Total	3.79	3.17	4.28	4.85	2.5	2.03	4.33	2.47	3.04	9.97	2.29	7.51

Rain Information Inches/Rain Day
Year - 2008
Proposed Conditions #2 (>4.72")

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.04	0	0	0.5								
2	0	0	0.1	0.02								
3	0	0.1	1.03	1.3								
4	0	0.15	1.78	3.3								
5	0.29	0.35	0	0								
6	0	1	0	0								
7	0	0	0.3	0								
8	0.6	0	0.11	0								
9	0.03	0	0	0.7								
10	1.16	0.02	0.07									
11	0	0.51	0.02									
12	0.01	1.35	0									
13	0.2	0.03	0									
14	0.02	0	0.4									
15	0	0	0.6									
16	0	0	0.25									
17	0.22	0.23	0									
18	0	0	0.23									
19	0	0	2.4									
20	0.03	0	0.02									
21	0	0.5	0									
22	0.03	0.6	0									
23	0	0.05	0									
24	0	0	0									
25	0	0.04	0									
26	0	0.11	0.1									
27	0	0.01	0.52									
28	0	0	0.52									
29	1	0.11	0									
30	0.03		0.12									
31	0.3		0.16									
Total	3.96	5.16	8.73	5.82								

April, 2008 Flood



April, 2008 Flood



April, 2008 Flood



April, 2008 Flood



April, 2008 Flood



Exhibits

EXHIBIT 1
WATERSHED TO QUIGGINS SINKHOLE
AND PROPOSED BASIN LOCATIONS

SCALE 1" = 800'

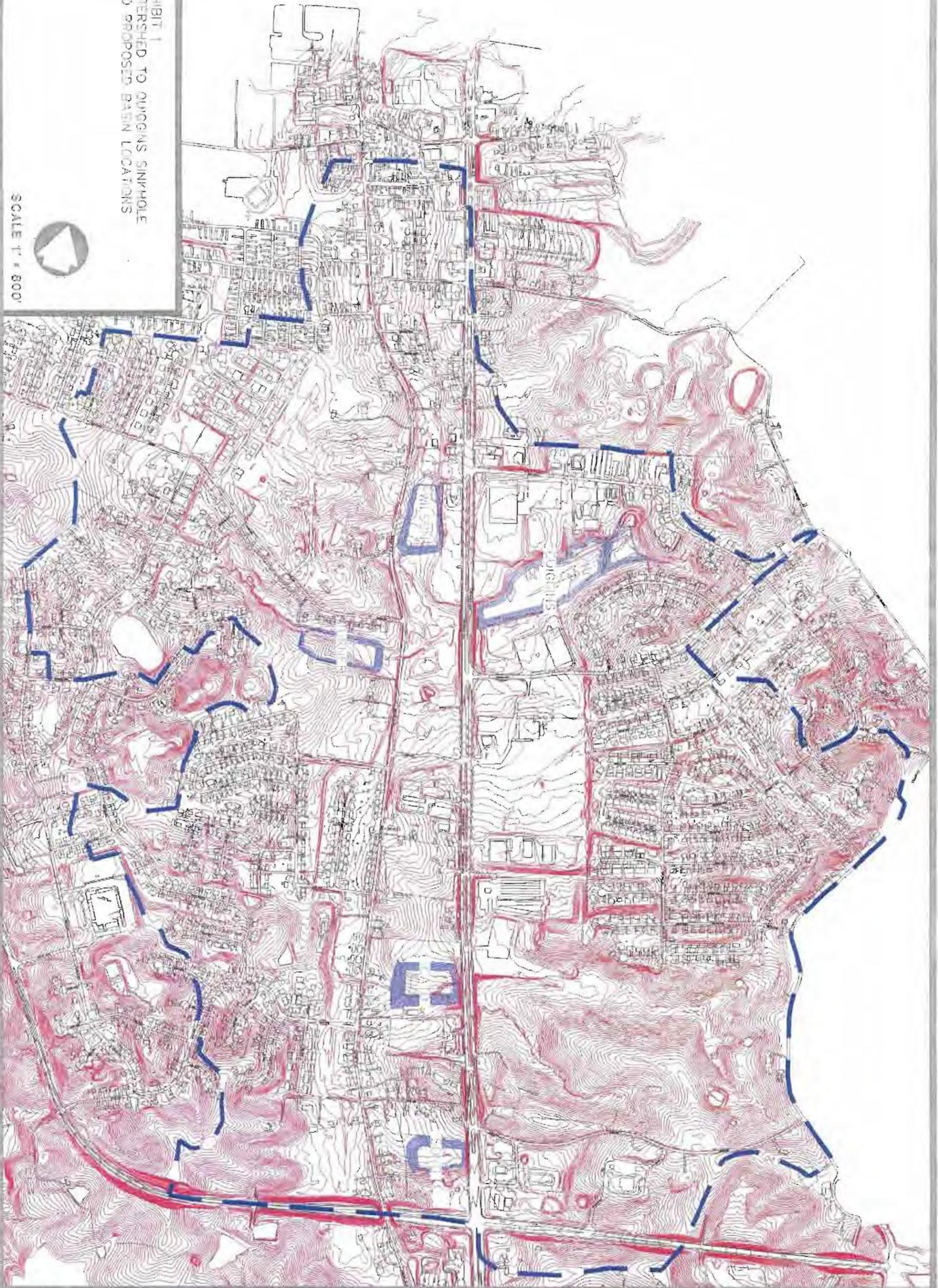
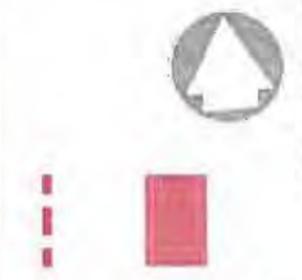




EXHIBIT 3
NOAA - 1YR FLOOD
ELEVATION (725.0)

POTENTIAL AREA
REMOVED FROM FLOODING
WITH QUIGGINS BASIN
EXCAVATION (722.4)

ADDITIONAL AREA REMOVED
WITH QUIGGINS-4 BASIN
EXCAVATION (<720.0)



SCALE 1" = 300'





Engineering
Construction

EXHIBIT 4
NOAA - 2YR FLOOD
ELEVATION (726.2)
POTENTIAL AREA
REMOVED FROM FLOODING
WITH QUIGGINS BASIN
EXCAVATION (724.0)
ADDITIONAL AREA REMOVED
WITH QUIGGINS+4 BASIN
EXCAVATION (720.9)



SCALE 1" = 300'





EXHIBIT 5
NOAA - 5YR FLOOD
ELEVATION (727.6)

POTENTIAL AREA
REMOVED FROM FLOODING
WITH ORIGINAL BASIN
EXCAVATION (725.8)

ADDITIONAL AREA REMOVED
WITH DUNSONS+4 BASIN
EXCAVATION (722.3)



SCALE 1" = 300'

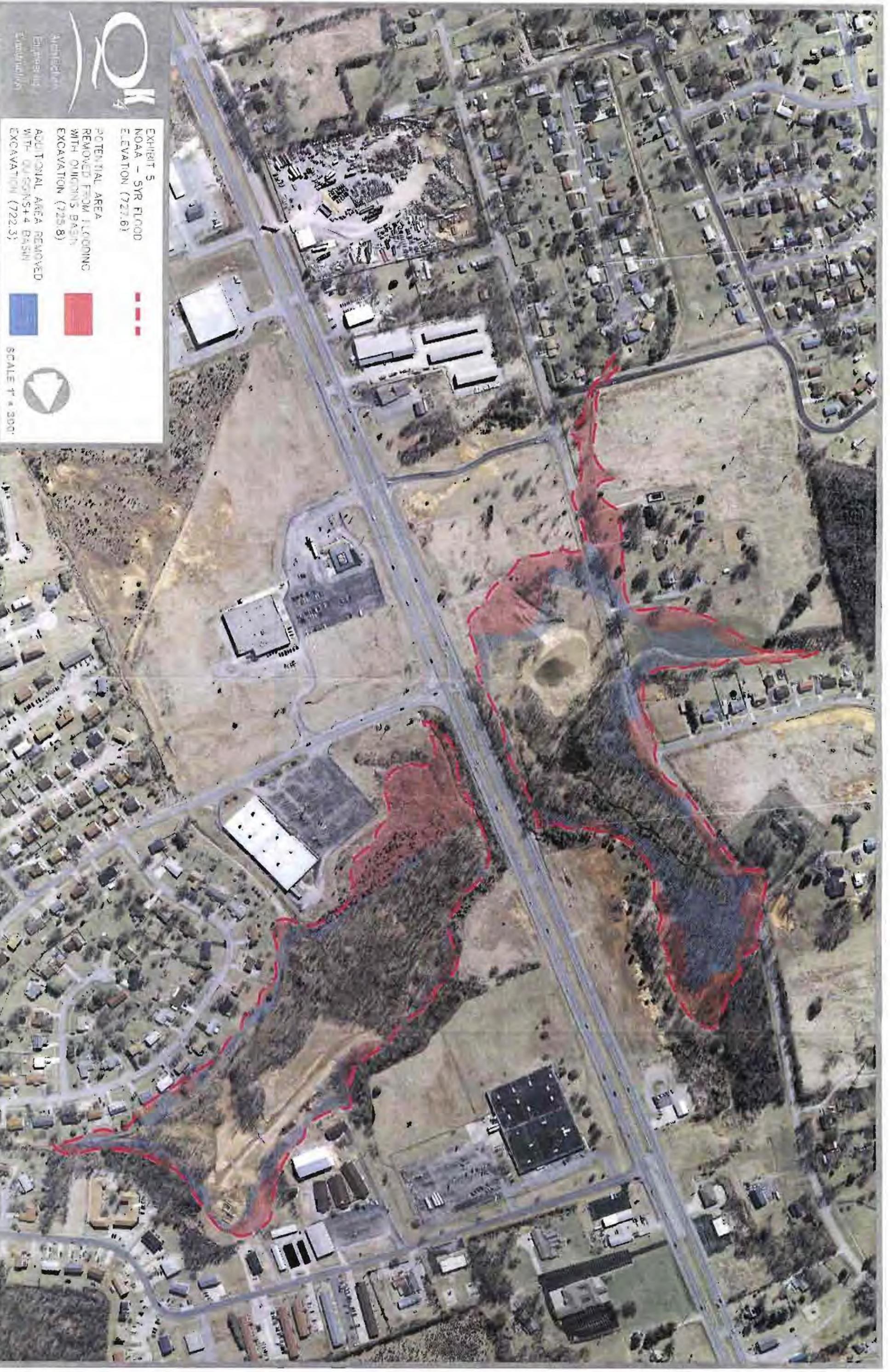




 EXHIBIT 5
 NOAA - 10 YR FLOOD
 ELEVATION (723.7)

 POTENTIAL AREA
 REMOVED FROM FLOODING
 WITH CULVERTS+4' BASIN
 EXCAVATION (727.1)

 ADDITIONAL AREA REMOVED
 WITH CULVERTS+4' BASIN
 EXCAVATION (723.7)

 SCALE 1" = 300'



Architectural
Engineering
Construction

EXHIBIT 7
NOAA - 25HR FLOOD
ELEVATION (730.1)
POTENTIAL AREA
REMOVED FROM FLOODING
WITH QUIGGINS BASIN
EXCAVATION (728.8)
ADDITIONAL AREA PLUMBED
WITH QUIGGINS BASIN
EXCAVATION (728.4)



SCALE 1" = 300'



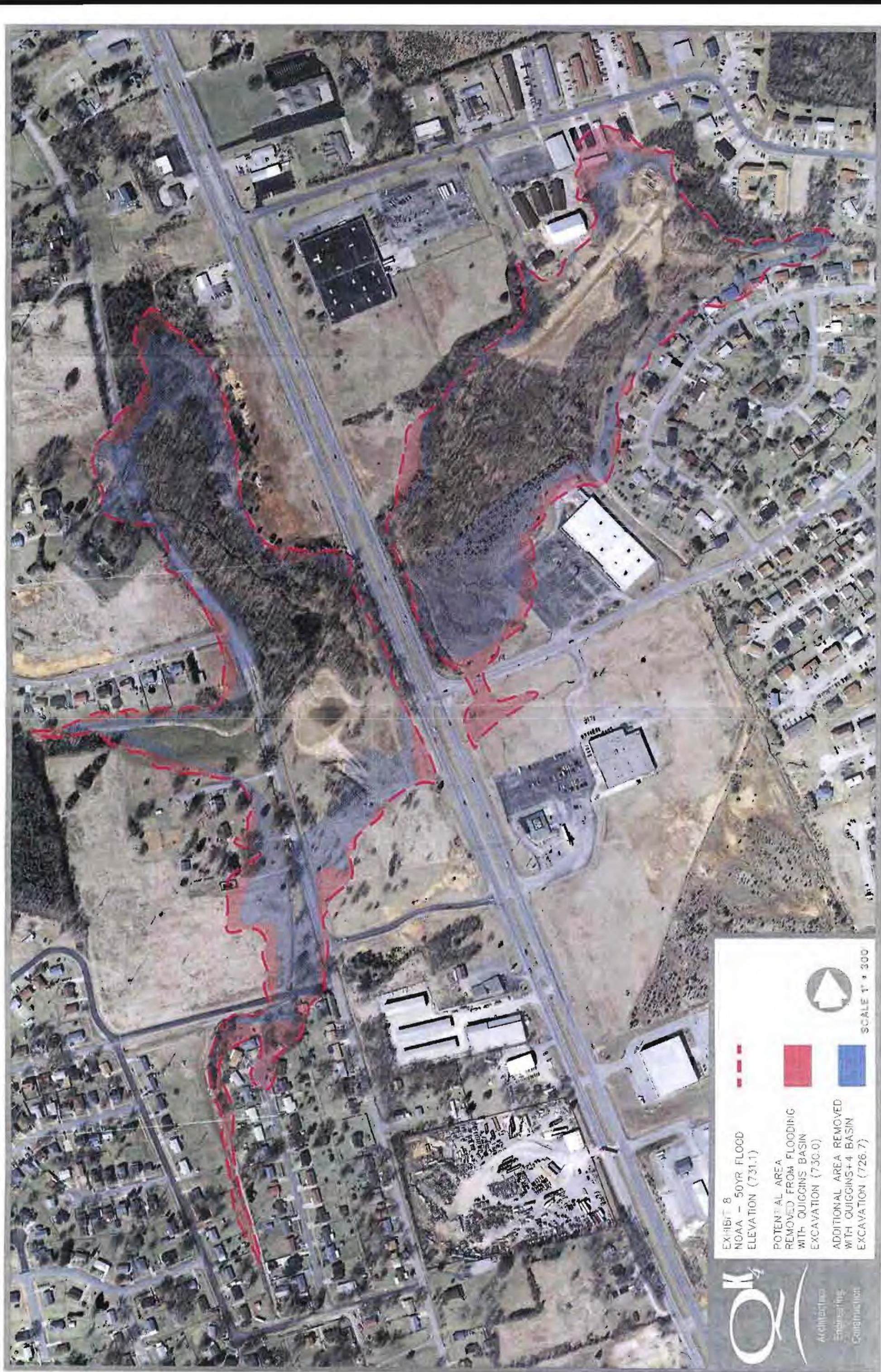


EXHIBIT 8
NOAA - 50YR FLOOD
ELEVATION (731.1)

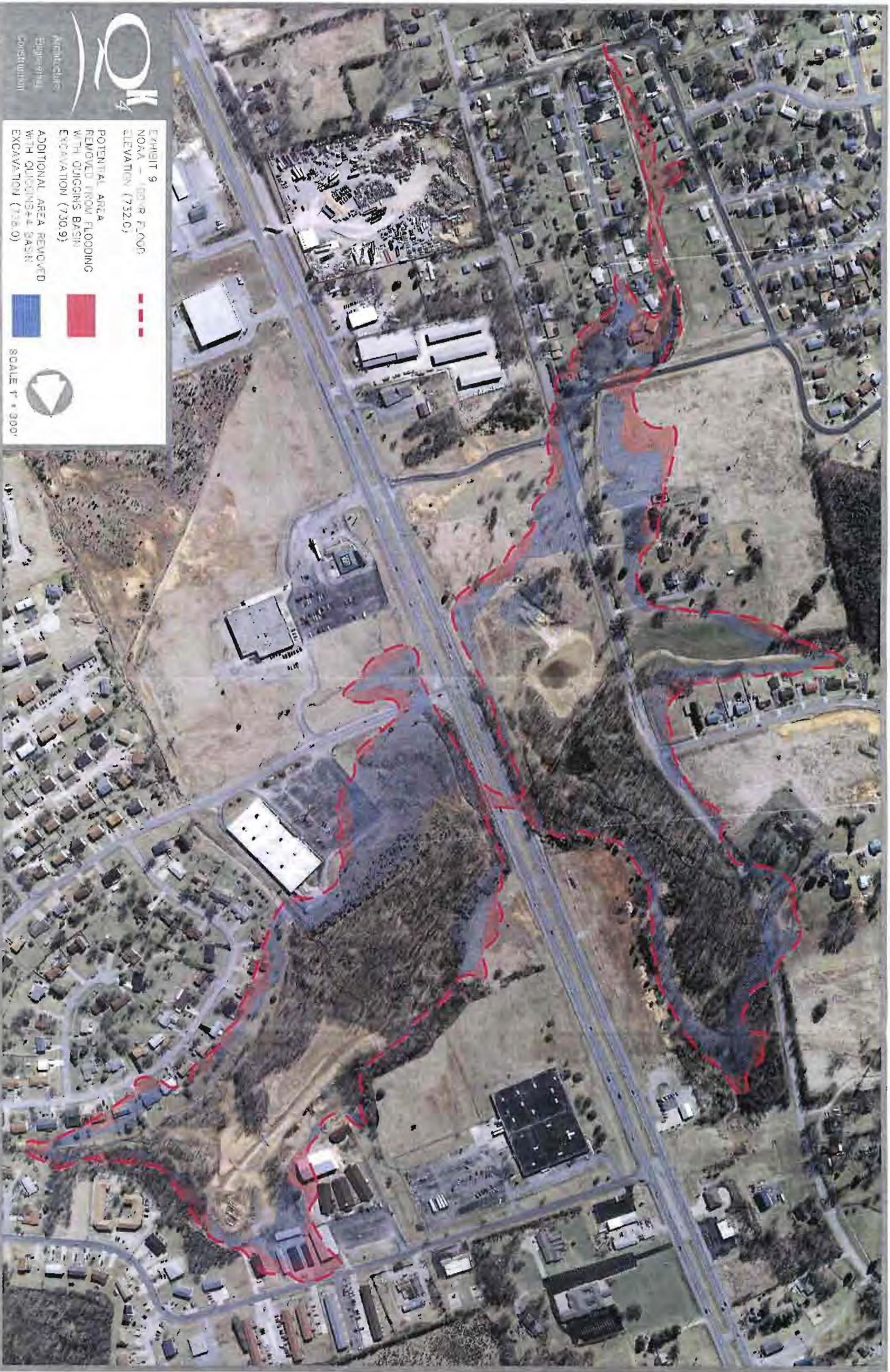
POTENTIAL AREA
REMOVED FROM FLOODING
WITH QUIGGINS BASIN
EXCAVATION (730.0)

ADDITIONAL AREA REMOVED
WITH QUIGGINS+4 BASIN
EXCAVATION (726.7)



SCALE 1" = 300'





Architects
Engineering
Construction

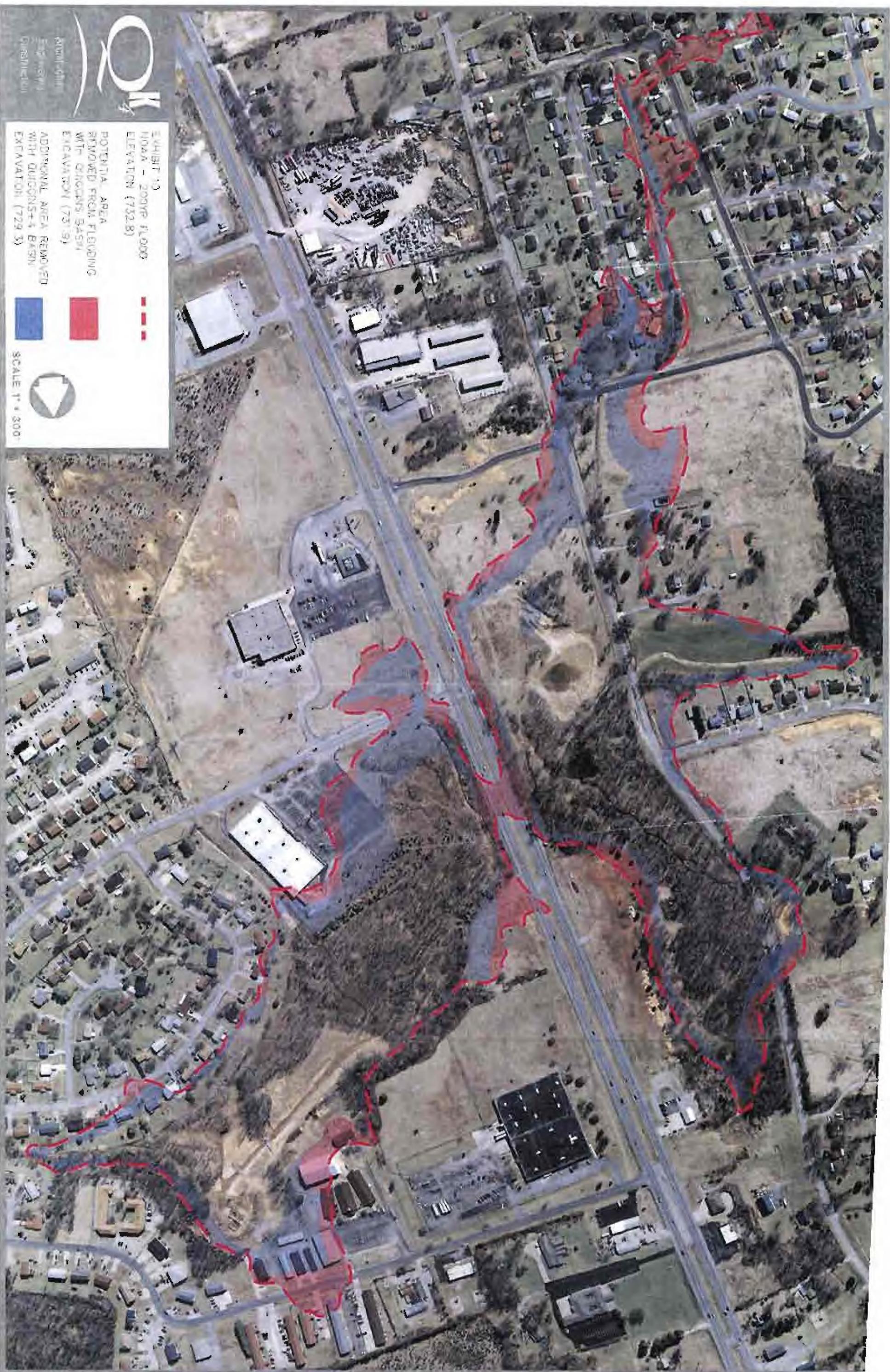
EXHIBIT 9
NOAA - 100YR FLOOD
ELEVATION (732.0)

POTENTIAL AREA
REMOVED FROM FLOODING
WITH DUGGINS BASIN
EXCAVATION (730.9)

ADDITIONAL AREA REMOVED
WITH DUGGINS BASIN
EXCAVATION (728.0)



SCALE 1" = 300'



Kentel-Ginn
Engineering
Construction

EXHIBIT 10
HOA - 200yr FLOOD
ELEVATION (732.8)



POTENTIAL AREA
REMOVED FROM FLOODING
WITH CHOCOMAS BASIN
EXCAVATION (731.9)



ADDITIONAL AREA REMOVED
WITH QUICONS+4 BASIN
EXCAVATION (729.3)



SCALE 1" = 300'

Investigation
Engineering
Construction



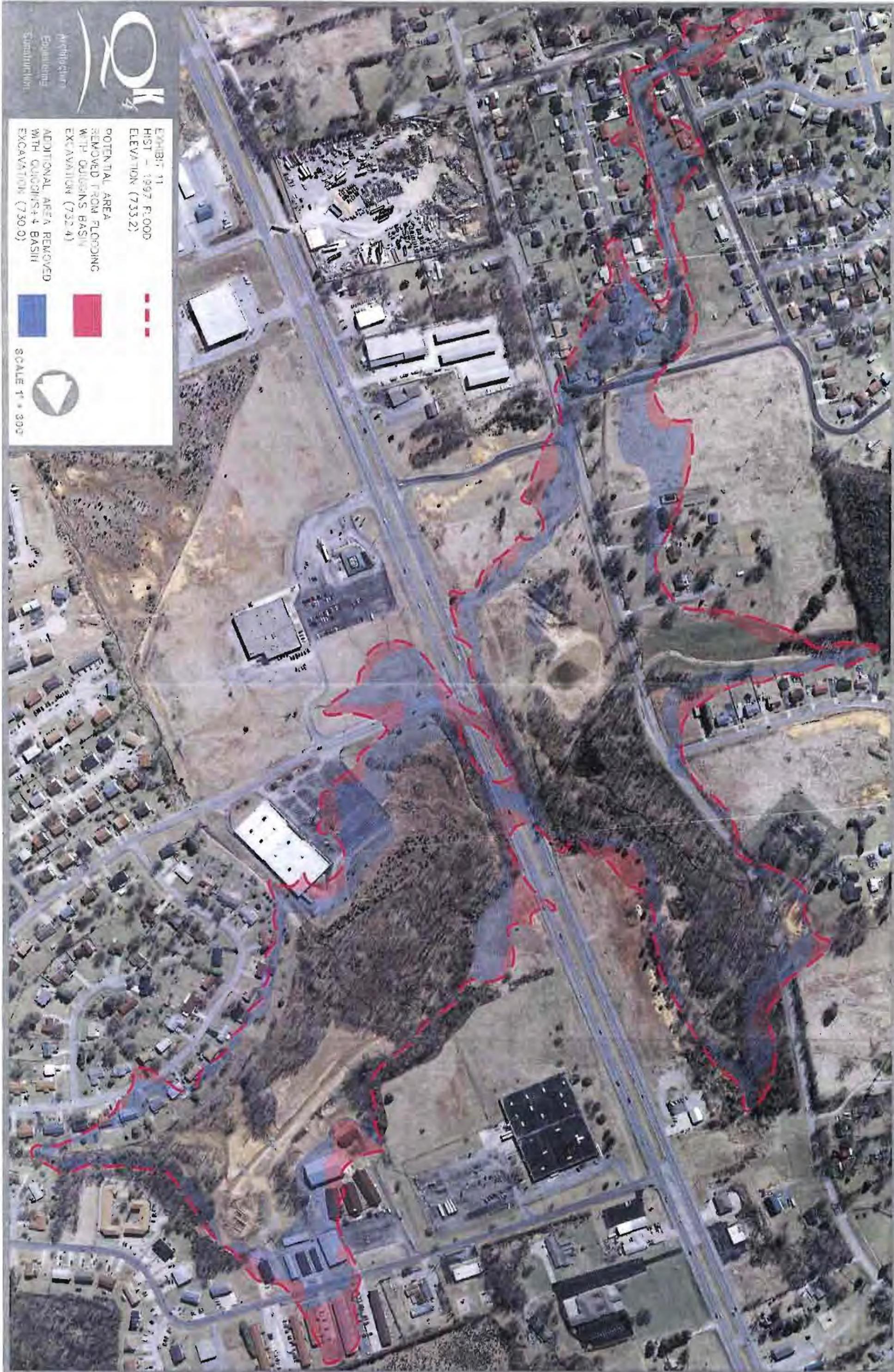
EXHIBIT 11
HIST - 1997 FLOOD
ELEVATION (733.2)

POTENTIAL AREA
REMOVED FROM FLOODING
WITH OULIGINS BASIN
EXCAVATION (732.4)

ADDITIONAL AREA REMOVED
WITH OULIGINS + 4 BASIN
EXCAVATION (730.0)



SCALE 1" = 300'



Ecological Assessment for the Quiggins / Happy Valley Flood Mitigation Project Site, City of Radcliff, Hardin County, Kentucky



Prepared for:
URS Group, Inc.
12420 Milestone Center Drive, Suite 150
Germantown, Maryland 20876



Prepared By:
Jackson Environmental
Consulting Services, LLC
1586 Boonesborough Road
Richmond, Kentucky 40475



**Ecological Assessment
for the
Quiggins / Happy Valley Flood Mitigation Project Site
City of Radcliff, Hardin County, Kentucky**

Prepared by:

Jackson Environmental Consulting Services, LLC
1586 Boonesborough Road
Richmond, Kentucky 40475

and

URS Group, Inc.
Contract No. HSFEHQ-09-D-1130
Task Order No. HSFE60-12-J-0008

September 24, 2013

TABLE OF CONTENTS

TABLE OF CONTENTS	I
LIST OF TABLES	II
LIST OF ATTACHMENTS	II
LIST OF ACRONYMS	III
1.0 INTRODUCTION	1
2.0 METHODS	2
2.1 Waters of the United States – “Other Waters”	2
2.1.1 Streams/Other Waters Investigation	2
2.1.2 Perennial/Intermittent/Ephemeral Conversion Zones	3
2.2 Wetland Investigation	4
2.3 Special Status Species	5
2.0 RESULTS	6
2.3. Song Basin	8
2.3.1. General Site Description.....	8
2.3.2. Current Land Cover/Land Use	8
2.3.3. Vegetation	8
2.3.4. Soil Characteristics	8
2.3.5. Streams/Other Waters.....	8
2.3.6. Wetlands.....	9
2.3.7. Special Status Species Habitat.....	9
2.4. Cato Basin	10
2.4.1. General Site Description.....	10
2.4.2. Current Land Cover/Land Use	10
2.4.3. Vegetation	10
2.4.4. Soil Characteristics	10
2.4.5. Streams/Other Waters.....	10
2.4.6. Wetlands.....	11
2.4.7. Special Status Species Habitat.....	11
2.5. Turner Basin	12
2.5.1. General Site Description.....	12
2.5.2. Current Land Cover/Land Use	12
2.5.3. Vegetation	12
2.5.4. Soil Characteristics	12
2.5.5. Streams/Other Waters.....	12
2.5.6. Wetlands.....	13
2.5.7. Special Status Species Habitat.....	13
2.6. Wilson Basin	14
2.6.1. General Site Description.....	14
2.6.2. Current Land Cover/Land Use	14
2.6.3. Vegetation	14
2.6.4. Soil Characteristics	14

2.6.5.	Streams/Other Waters.....	14
2.6.6.	Wetlands.....	15
2.6.7.	Special Status Species Habitat.....	16
2.7.	Quiggins Basin	17
2.7.1.	General Site Description.....	17
2.7.2.	Current Land Cover/Land Use	17
2.7.3.	Vegetation	17
2.7.4.	Soil Characteristics.....	17
2.7.5.	Streams/Other Waters.....	17
2.7.6.	Wetlands.....	19
2.7.7.	Special Status Species Habitat.....	19
2.8.	Spoils Disposal Area	20
2.8.1.	General Site Description.....	20
2.8.2.	Current Land Cover/Land Use	20
2.8.3.	Vegetation	20
2.8.4.	Soil Characteristics.....	20
2.8.5.	Streams/Other Waters.....	20
2.8.6.	Wetlands.....	21
2.8.7.	Special Status Species Habitat.....	22
3.0	CONCLUSION	23
4.0	REFERENCES	24

LIST OF TABLES

Table 1.	QHEI/HHEI Narrative Ratings.....	2
Table 2.	ORAM Classification.....	4
Table 3.	Weather Conditions for Dates During and Three Days Prior to the Ecological Assessment.....	5
Table 4.	Potential Jurisdictional Streams/Other Waters Summary Table.....	6
Table 5.	Wetland Summary Table	7

LIST OF ATTACHMENTS

Attachment 1	Project Maps
Attachment 2	Wetland, Stream, and Special Status Species Habitat Photos
Attachment 3	Ohio Environmental Protection Agency’s Qualitative Habitat Evaluation Index (QHEI) data sheets and Primary Headwater Habitat Evaluation Index (HHEI) data sheets
Attachment 4	Ohio Environmental Protection Agency’s Ohio Rapid Assessment Method (ORAM) wetland data sheets
Attachment 5	Agency Communication

LIST OF ACRONYMS

EA	Environmental Assessment
EOHWM	End of Ordinary High Water Mark
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
GPS	Global Positioning System
HHEI	Headwater Habitat Evaluation Index
KDFWR	Kentucky Department of Fish and Wildlife Resources
KSNPC	Kentucky State Nature Preserves Commission
NEPA	National Environmental Policy Act
NRCS	Natural Resource Conservation Service
NWI	National Wetlands Inventory
OEPA	Ohio Environmental Protection Agency
OHWM	Ordinary High Water Mark
ORAM	Ohio Rapid Assessment Method
PHWH	Primary Headwater Habitat Stream
QHEI	Qualitative Habitat Evaluation Index
SCS	Soil Conservation Service
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WOUS	Waters of the United States

1.0 INTRODUCTION

Jackson Environmental Consulting Services, LLC, (Jackson Environmental) of Richmond, Kentucky was contracted by URS Group, Inc. to conduct an ecological assessment of an approximately 57-acre property for the proposed Quiggins / Happy Valley Flood Mitigation Project in Hardin County, Kentucky. The project consists of five proposed stormwater basins and a proposed spoils disposal area located approximately one mile north of the intersection of U.S. Highway 31W (Dixie Highway) and Kentucky Highway 313 in the City of Radcliff (Attachment 1).

The project components are mapped on the United States Geological Survey (USGS) Vine Grove quadrangle, 7.5-minute series map; are located in the Mitchell Plain Level IV Ecoregion; and are approximately centered at the coordinates recorded in decimal degrees (dd.ddddd) mapped using the World Geodetic System 1984:

- Song Basin: N 37.79699 W 85.91732
- Cato Basin: N 37.80805 W 85.91905
- Turner Basin: N 37.80787 W 85.92459
- Wilson Basin: N 37.81157 W 85.92364
- Quiggins Basin: N 37.81120 W 85.91905
- Spoils Disposal Area: N 37.80805 W 85.92181

The proposed basins and spoils disposal area are located outside the Federal Emergency Management Agency (FEMA) 100-year floodplain (Attachment 1).

An ecological assessment was conducted for the areas proposed for construction of the basins and spoils disposal area (project site) to provide information in support of FEMA's environmental compliance responsibilities under Presidential disaster declaration (DR-1818-KY) for this project (DR-1818-0012). The ecological assessment and this report are being used in support of a National Environmental Policy Act (NEPA) Environmental Assessment (EA) being prepared for this project.

The tasks performed on the project site included:

- 1) Preliminary identification of Waters of the U.S. (WOUS), including wetlands, under the jurisdiction of the U.S. Army Corps of Engineers (USACE). Wetlands were identified in accordance with the USACE manual (Environmental Laboratory 1987) and classified according to Cowardin et al. (1979);
- 2) cursory review of the project site to identify any potential habitat for special-status species; and,
- 3) Preparation of a report of findings for the above tasks, suitable for submission to regulatory agencies.

This report is based upon Jackson Environmental's interpretation of site conditions at the time of the field survey. The USACE will make the final determination regarding the extent of jurisdictional WOUS, including wetlands, streams, and other waters, and the U.S. Fish and Wildlife Service (USFWS) will make the final determination regarding the effect, if any, on special-status species.

2.0 METHODS

2.1 Waters of the United States – “Other Waters”

All other waters include intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce including any such waters which are or could be used by interstate or foreign travelers for recreational or other purposes; or from which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or which are used or could be used for industrial purpose by industries in interstate commerce (33 CFR 328).

The proposed basins were surveyed on July 1, July 2, and July 3, 2013 to identify the extent of potential jurisdictional “other waters” and Perennial/Intermittent/Ephemeral conversion zones, and for the presence of wetlands. Representative photographs of each wetland and stream are presented in in alpha-numeric order in Attachment 2.

2.1.1 Streams/Other Waters Investigation

Jurisdictional extent of streams was determined by the presence and/or absence of an Ordinary High Water Mark (OHWM) with a defined bed and bank. Streams were delineated by traversing upstream or downstream from an identifiable landmark (i.e., confluence of two streams, road intersection) to the “end of ordinary high water mark” (EOHWM) or the boundary of the proposed basin. Streams were measured in linear feet. Unnamed tributaries delineated during this survey were assigned arbitrary names (e.g. Stream A, Stream B, and Steam C, etc.) to identify them for reporting purposes.

The Ohio Environmental Protection Agency (OEPA) Primary Headwater Habitat Evaluation Index (HHEI) and Qualitative Habitat Evaluation Index (QHEI) scoring systems were used for streams within the proposed basins and spoils disposal area under study, and recorded on the data sheets presented in Attachment 3.

To convey general stream habitat quality to the public, the OEPA has assigned narrative ratings to QHEI and HHEI scores (Table 1). The QHEI method is generally considered appropriate for water bodies with drainage basins greater than 1 square mile, if natural pools are greater than 15.75 inches or 40 centimeters in depth, or if the water feature is shown as a blue-line stream on USGS 7.5-minute topographic quadrangle maps.

Table 1. QHEI/HHEI Narrative Ratings

QHEI		HHEI	
Rating	Score	Rating	Score
Excellent	≥70	Class III	>70
Good	55-69	Class II	30-70
Fair	43-54	Class I	<30
Poor	30-42	Not applicable	
Very Poor	<30		

HHEI assessments are applicable to streams with a “defined bed and bank, with either continuous or periodically flowing water, with watershed area less than or equal to 1

square mile, and a maximum depth of water pools equal to or less than 15.75 inches” (OEPA, 2012).

Streams were mapped using a Trimble Geo XH 6000 series handheld Global Positioning System (GPS) unit with sub-meter accuracy. The extent of potential “other waters” of the United States was determined by the presence or absence of an OHWM with a defined bed and bank.

2.1.2 Perennial/Intermittent/Ephemeral Conversion Zones

Perennial/Intermittent/Ephemeral conversion zones were determined in accordance with the recommended protocol of the OEPA *Field Evaluation Manual for Ohio's Primary Headwater Habitat Streams, Version 3.0* (2012). The definitions for the stream types provided by this protocol are stated below:

Continuous flow. Streams with permanent water flow in the stream channel, also referred to as **perennial** or **permanent** flow. There are two general types of continuously flowing primary headwater streams:

1. **Superficial flow.** Streams with continuous flow on the surface of the stream bed substrate. Streams with superficial flow maintain surface flowing water at most times of the year (except for years of extreme drought) due to constant infiltration of surface runoff and/or groundwater recharge from subsurface aquifers. These streams may have Class II primary headwater habitat stream (PHWH) biology (if warm in summer) or Class III PHWH biology (if cold to cool in summer).

2. **Interstitial flow.** Streams with continuous flow that occurs seasonally under the surface of the stream bed within the interstitial spaces of coarse substrate, or cracks in bedrock; also called **interrupted flow**. Streams with interstitial flow have visually dry stream beds with isolated pools of water that are hydraulically connected by slowly moving water. At times of sustained drought, this type of stream may only have water flowing within the subsurface alluvium. The perennial flow is maintained by either deep groundwater recharge from the water table, or from surface wetlands. These streams can maintain either a Class II (if warm in summer) or Class III type biology (if cold to cool in summer) in isolated pools of water, or in the interstitial spaces of the subsurface hyporheic zone, depending on the origin of the flowing water. The biology in warm water interstitial streams tends toward the intermittent stream type (see below) during sustained drought.

Periodical flow. Streams with water that stops flowing along the stream channel during periods of no precipitation and/or groundwater recharge. There are two general types of periodical flow:

1. **Intermittent flow.** Also called **temporary flow** or **summer-dry** streams. Seasonally these streams have flow for extended periods of time, but gradually reach a state where there are either isolated pools of water that are not hydraulically connected by sub-surface flow, or a dry channel. Biology may be present in wet hyporheic subsurface substrate. These streams usually have a warm water Class II type of biology present from roughly October to June.

2. Ephemeral flow. These streams are normally dry with only episodic flow during and after precipitation events. These streams normally have a dry stream channel with no evidence of isolated pools of water and may have Class I type biology present seasonally in the spring.

2.2 Wetland Investigation

The proposed basins and spoils disposal area were reviewed for the presence of wetlands using the wetland definition outlined in the USACE Wetlands Delineation Manual (Environmental Laboratory, 1987) in conjunction with the procedures outlined in the 2012 USACE Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region Version 2.0. USFWS National Wetland Inventory (NWI) maps were also reviewed.

Jackson Environmental biologists identified approximate wetland boundaries through a pedestrian site reconnaissance, which included identifying vegetation communities, a geomorphologic assessment of hydrology, soils identification when necessary, and notation of existing disturbance. Wetlands were assigned arbitrary names (e.g. Wetland 1, Wetland 2, and Wetland 3, etc.) to identify them for reporting purposes.

Approximate wetland boundaries were recorded using a hand held Trimble Geo XH 6000 series GPS unit with sub-meter accuracy. The OEPA Ohio Rapid Assessment Method (ORAM) assessment method was used to determine the relative ecological quality and level of disturbance of a particular wetland. Wetlands were scored on the basis of hydrology, upland buffer, habitat alteration, special wetland communities, and vegetation communities. Pertinent data was recorded on the data sheets presented in Attachment 4, and representative photographs were taken as presented in Attachment 2.

Each of the proposed basins and the spoils disposal area were further divided into subcategories under ORAM v5.0, resulting in a score that describes the wetland using a range from 0 (low quality and high disturbance) to 100 (high quality and low disturbance). ORAM wetland score ratings are listed in Table 2.

Table 2. ORAM Classification

ORAM Category	Score	Description
I	0 to 29.9	Low Quality; High Disturbance
I & II	30 to 34.9	Transition between categories I & II
II	30 to 59.9	Moderate Quality; Moderate Disturbance
Transitional II and III	60 to 64.9	Transition between categories II & III
III	60 to 100	High Quality; Low Disturbance

Plant Life of Kentucky (Jones, 2005) was used to confirm certain plant identifications, and the USACE, *2012 National Wetland Plant List – Eastern Mountains and Piedmont Region* was used to determine wetland indicator status for the dominant species. The Natural Resource Conservation Service’s (NRCS) online soil survey data from Hardin County was used to determine the Soil Conservation Service’s (SCS) map units and evaluate the potential for the occurrence of hydric soils within the proposed basins and spoils disposal area.

Weather conditions (i.e., rain, humidity, and temperature), which potentially affect hydrologic indicators, were recorded using Weather Underground, Inc., (www.wunderground.com) three days prior to and during the field investigation (Table 3). On July 1, 2103, a record rain event occurred with a total of 2.29 inches of rain. Conditions were recorded in Fort Knox, Kentucky approximately six miles from the proposed basins and spoils disposal area.

This high precipitation volume influenced the amount of water observed within the streams and wetland areas identified for the study area.

Table 3. Weather Conditions for Dates During and Three Days Prior to the Ecological Assessment

Date	Precipitation (inches)	Temperature		Humidity	
		High (°F)	Low (°F)	High (%)	Low (%)
28-Jun-13	0.00	85	69	91	43
29-Jun-13	0.28	82	61	98	53
30-Jun-13	0.00	79	60	100	59
1-Jul-13	2.29	77	62	100	65
2-Jul-13	0.00	81	64	100	56
3-Jul-13	0.00	81	60	100	58

Note: Days of the ecological assessment are indicated in bold.

°F = degrees Fahrenheit

2.3 Special Status Species

Prior to conducting the field investigation, Jackson Environmental obtained Geographic Information System (GIS) data layers from the Kentucky Department of Fish and Wildlife Resources (KDFWR)–Kentucky State Nature Preserves Commission (KSNPC) Database. This data includes reported special status species locations and managed areas. Jackson Environmental also contacted the USFWS and KDFWR to obtain a list of endangered species that could occur in the project area (Attachment 5). Eight special status species occur in Hardin County: the clubshell (*Pleurobema clava*), rabbitsfoot (*Quadula cylindrica cylindrica*), orangefoot pimpleback (*Plethobasus cooperianus*), sheepnose (*Plethobasus cyphus*), rough pigtoe (*Pleurobema plenu*), fat pocketbook (*Potamilus capax*), Indiana bat (*Myotis sodalis*) and gray bat (*Myotis grisescens*).

The clubshell, rabbitsfoot, orangefoot pimpleback, sheepnose, rough pigtoe, and fat pocketbook are Unionid mussels that inhabit sand and gravel substrates of small to large rivers (Cicerello and Schuster, 2003). These habitat conditions are not present within the proposed basins or spoils disposal area. Therefore, the ecological walkover included a cursory review limited to potential Indiana bat and gray bat habitat in the proposed basin and spoils disposal boundaries.

Representative photographs of potential special species habitat are presented in Attachment 2.

2.0 RESULTS

The figures presented in Attachment 1 show the locations of potential jurisdictional streams/other Waters of the U.S., wetlands, and potential special species habitat in the proposed basins and spoils disposal area.

A summary of the potential jurisdictional streams/other Waters of the U.S. is presented in Table 4, and a summary of the wetlands identified during the ecological assessment is presented in Table 5. Additional description of each identified stream and wetland is presented in the text that follows for each basin and spoils disposal area.

Table 4. Potential Jurisdictional Streams / Other Waters Summary Table

Stream	Survey Area	Length (linear feet)	Stream Class	QHEI	HHEI
A	Spoils Disposal Area	216	Intermittent	27.5	—
Aa	Spoils Disposal Area	384	Ephemeral	29	—
B	Spoils Disposal Area	258	Ephemeral	—	6
A1	Turner Basin	839	Intermittent	38	—
C	Turner Basin	188	Intermittent	44	--
D	Wilson Basin	651	Ephemeral	41	--
D1	Wilson Basin	794	Ephemeral	--	36
Da	Wilson Basin	353	Ephemeral	--	50
D2	Wilson Basin	237	Ephemeral	--	26
D3	Wilson Basin	367	Ephemeral	--	12
E	Quiggins Basin	1783	Intermittent	43.5	--
E1	Quiggins Basin	335	Ephemeral	—	6
E1a	Quiggins Basin	33	Ephemeral	—	6
E2	Quiggins Basin	70	Ephemeral	—	7
E4	Quiggins Basin	612	Ephemeral	—	6
E4a	Quiggins Basin	345	Ephemeral	—	17
E4b	Quiggins Basin	117	Ephemeral	--	6
E5	Quiggins Basin	60	Ephemeral	--	6
E6	Quiggins Basin	473	Ephemeral	--	35
E7	Quiggins Basin	152	Ephemeral	--	6
F	Song Basin	498	Ephemeral	31	--
G	Cato Basin	693	Ephemeral	52	--
G1	Cato Basin	214	Ephemeral	43	--
G2	Cato Basin	66	Ephemeral		6

(—) denotes assessment was not performed

Table 5. Wetland Summary Table

Wetland ID	Basin ID	Size (acres)	Latitude	Longitude	Cowardin Class	Wetland Type	ORAM Score	ORAM Category
Wetland 1	Spoils Disposal Area	2.04	37.80830	85.92208	Palustrine	Emergent	35	2
Wetland 2	Spoils Disposal Area	0.72*	37.80908	85.92225	Palustrine	Forested	59	2
Wetland 3	Spoils Disposal Area	0.03	37.80738	85.92207	Palustrine	Forested	23	1
Wetland 4	Wilson	0.64	37.81097	85.92402	Palustrine	Forested	56	2
Wetland 5	Wilson	0.57	37.81156	85.92351	Palustrine	Emergent	30	1/2
Wetland 6	Wilson	0.10	37.81192	85.92413	Palustrine	Forested	59	2
Wetland 7	Song	0.02	37.79674	85.91767	Palustrine	Emergent	17	1
Wetland 8	Song	0.01	37.79660	85.91801	Palustrine	Emergent	15	1

*Wetland 2 extends outside of the northern boundary of the proposed Spoils Disposal Area. Although the total mapped wetland acreage has been provided, only approximately 0.36 acre of this wetland is located within the proposed Spoils Disposal Area.

2.3. Song Basin

2.3.1. General Site Description

The area proposed for the Song basin is characterized as old field habitat. Topography in the proposed basin is moderately sloping in the north section of the proposed basin and very steep to the south outside the proposed basin, where it was observed that loose fill material had been deposited in the past. The remaining areas of the proposed basin can be described as generally flat to gently sloping. Elevation in the proposed Song basin is an average of 798 feet above sea level. Hydrologic features include one ephemeral stream and two wetlands (Attachment 1).

2.3.2. Current Land Cover/Land Use

The land cover within and surrounding the proposed Song basin is primarily urban with land use generally consisting of residential and commercial properties, roads, powerlines, natural gas pipelines, water pipelines, and municipal sewer pipelines. Portions of the proposed basin have previously been used for agriculture, and Stream F within the basin has been channelized in the past (Attachment 1).

2.3.3. Vegetation

The proposed Song basin currently supports a plant community that is characteristic of an old field and early successional forest, and is dominated by a mixture of grasses, forbs, and shrubs with sparse patches of Eastern red cedar (*Juniperus virginiana*) and young hardwoods, primarily red maple (*Acer rubrum*).

2.3.4. Soil Characteristics

The NRCS soil survey for Hardin County maps two soil series associated with the proposed Song basin – Newark Silt Loam (Nb) and Nicholson Silt Loam (NcB) (Attachment 1); these series are not listed as hydric by the SCS or NRCS (USDA, 2012). The Newark series consists of very deep, somewhat poorly drained soils formed in mixed alluvium from limestone, shale, siltstone, sandstone, and loess. The soil is on nearly level floodplains and in depressions. Slope ranges from 0 to 3 percent.

The Nicholson series consists of very deep, moderately well-drained soils with a slowly permeable fragipan in the subsoil. The soils formed in a mantle of loess or silty material underlain by residuum of limestone, calcareous shale, and siltstone. The soil is on upland ridgetops. Slopes range from 0 to 20 percent.

2.3.5. Streams/Other Waters

The USGS topographic Vine Grove quadrangle (7.5-minute series) map indicates that no blue-line streams are located within the proposed Song basin. Jackson Environmental observed one unnamed ephemeral tributary (Stream F) during the field investigations (Attachment 1).

Stream F - Stream F extends 498 feet downstream of a culvert crossing under Dixie Highway, through Wetland 7, to the EOHWM, which was located within Wetland 8. All 498 feet of hydrologic flow was identified as ephemeral (Attachment 2). Stream F has areas of severe erosion that have caused the stream channel to become deeply incised and

created areas with deep standing pools. Because pools depths measuring greater than 15.75 inches were observed, a QHEI assessment was performed to assess the general stream habitat quality. The resulting QHEI score was 31 (Attachment 3), giving Stream F a rating of poor (Table 1).

2.3.6. Wetlands

Two wetlands, Wetland 7 and Wetland 8, were identified within the proposed Song basin (Table 5). These wetlands were not shown on USGS topographic maps or USFWS NWI maps.

Wetland 7 - A 0.02-acre area in the floodplain of Stream F was identified as a palustrine emergent wetland designated Wetland 7 (Attachments 1 and 2). The field investigation of Wetland 7 identified the presence of hydric soils, hydrology, and hydrophytic vegetation. Wetland 7 formed due to the braiding of Stream F which created a floodplain wetland. Hydrology for Wetland 7 originates from the flooding of braided channels of Stream F that pass through the wetland, precipitation, and storm-water drainage from upland elevations. Water drains from the wetland via Stream F. A significant nexus was observed where Stream F flows into and out of the wetland, supplying water to the wetland during frequent flood events. Wetland 7 is dominated by field grasses. The OEPA ORAM score for this wetland was 17, classifying it as a category 1 wetland having low quality and high disturbance.

Wetland 8 - A 0.01-acre area located at the end of Stream F was identified as a palustrine emergent wetland designated Wetland 8 (Attachments 1 and 2). Field investigation of Wetland 8 observed the presence of hydric soils, hydrology, and hydrophytic vegetation. Wetland 8 formed due to the channel of Stream F ending and fanning out into sheet flow. Hydrology for Wetland 8 originates from Stream F flowing into the wetland, precipitation, and storm-water drainage from upland elevations. Water drains from the wetland via sheet flow that disperses evenly over the landscape. A significant nexus was observed where Stream F flows into Wetland 8, acting as a direct supply of water to the wetland. Wetland 8 is dominated by field grasses. The OEPA ORAM score for this wetland was 15, classifying it as a category 1 wetland having low quality and high disturbance.

2.3.7. Special Status Species Habitat

No special status species habitat was observed within the Song Basin.

2.4. Cato Basin

2.4.1. General Site Description

The proposed Cato basin is characterized as primarily undeveloped forest with areas of past agricultural pasture. Topography in the proposed basin is moderately sloping, with elevations averaging approximately 798 feet above sea level. Hydrologic features include three ephemeral tributaries located within the proposed basin (Table 4).

2.4.2. Current Land Cover/Land Use

The land cover within and surrounding the proposed Cato basin is primarily urban with land use generally consisting of residential and commercial properties, roads, power-lines, natural gas pipelines, water pipelines and municipal sewer pipelines. Portions of the proposed basin have previously been used for agriculture, and several of the streams within the basin have been channelized (Attachment 1).

2.4.3. Vegetation

The proposed Cato basin currently supports a plant community that is characteristic of an upland area dominated by a mixture of deciduous and coniferous trees. Dominant overstory and mid-story species include swamp white oak (*Quercus bicolor*), red maple, shagbark hickory (*Carya ovata*), short leaf pine (*Pinus echinata*), and southern red oak (*Q. falcata*).

2.4.4. Soil Characteristics

The NRCS soil survey for Hardin County maps three soil series associated with the proposed Cato basin (Attachment 1). These series are not listed as hydric by SCS or NRCS. The soil series present in the proposed basin include the Crider Silt Loam (CrC), Nicholson Silt Loam (NcB), and Nolin Silt Loam (No) (USDA, 2012).

The Crider series consists of very deep, well-drained, moderately permeable soils on uplands. They formed in a loess mantle and the underlying residuum from limestone. Slopes range from 0 to 30 percent.

The Nicholson series consists of very deep, moderately well-drained soils with a slowly permeable fragipan in the subsoil. The soils formed in a mantle of loess or silty material underlain by residuum of limestone, calcareous shale, and siltstone. The soil is on upland ridgetops. Slopes range from 0 to 20 percent.

The Nolin series consists of very deep well-drained soils formed in alluvium derived from limestones, sandstones, siltstones, shales, and loess. These nearly level to moderately steep soils are on floodplains, in depressions which receive runoff from surrounding slopes, or on natural levees of major streams and rivers. Slope ranges from 0 to 25 percent, but is predominantly 0 to 3 percent.

2.4.5. Streams/Other Waters

The USGS topographic Vine Grove quadrangle (7.5-minute series) maps one blue-line stream located within the proposed Cato basin (Stream G). Two additional ephemeral tributaries (Streams G1 and G2) were observed during field investigations (Attachments 1 and 2).

Stream G - Stream G extends 693 feet downstream from a culvert that crosses under Dixie Highway to the western edge of the proposed basin boundary. Stream G is mapped as a blue-line stream on the Vine Grove USGS 7.5-minute topographic quadrangle; however field investigations documented this stream as ephemeral (Attachment 2). This field determination was based upon site conditions after a record rain-event two days prior to the field investigation of this area. No flowing water was observed in the channel and only small pools of standing water remained. Changes in historic stream flows for this channel could possibly be the result of land use changes in the surrounding areas. One of these land use changes includes a constructed drainage basin that was built on the opposite side of Dixie Highway, which may have altered the natural hydrology of this area. Since Stream G was identified as a blue-line stream on the USGS 7.5-minute topographic quadrangle map, Jackson Environmental performed a QHEI assessment to assess the general stream quality. The resulting QHEI score was 52 (Attachment 3), rating the stream as fair (Table 1).

Stream G1 - Stream G1 extends 214 feet upstream of its confluence with Stream G to a culvert that runs under Dixie Highway, of which all 214 feet of hydrologic flow was identified as ephemeral (Attachment 2). Because pool depths measuring close to 15.75 inches deep were observed within the stream channel and displayed potential habitat for aquatic organisms, general stream quality for Stream G1 was assessed using the QHEI assessment. The resulting QHEI score was 31 (Attachment 3), rating the stream as poor (Table 1).

Stream G2 - Stream G2 extends 66 feet upstream of its confluence with Stream G to the EOHWM, of which all 66 feet of hydrologic flow was identified as ephemeral (Attachment 2). General stream quality was assessed using the HHEI assessment because it was not mapped as a blue-line stream, and has drainage area less than 1 square mile and no pools measuring 40 centimeters or greater. The HHEI score for Stream G2 was 6 (Attachment 3), rating it as a class I stream (Table 1).

2.4.6. Wetlands

No wetlands were identified within the proposed Cato basin.

2.4.7. Special Status Species Habitat

The proposed Cato basin is primarily composed of mature hardwood forest with mature shagbark hickory trees, as well as several snags (Attachment 2). One potential roost tree was identified during the field survey. Stream G also provides a potential flight corridor and water source for foraging bats. Therefore, much of this basin provides potential Indiana bat roosting and foraging habitat. No suitable habitat was observed within the proposed Cato basin for the federally listed threatened gray bat.

2.5. Turner Basin

2.5.1. General Site Description

The proposed Turner basin is characterized primarily as agricultural pasture with areas of second growth forest. Topography in the proposed basin is generally flat to gently sloping, with elevations ranging between approximately 750 feet and 730 feet above sea level. Hydrologic features include two intermittent streams located within the proposed basin (Table 4).

2.5.2. Current Land Cover/Land Use

The land cover within and surrounding the proposed Turner basin is primarily urban with land use generally consisting of residential and commercial properties, roads, power-lines, natural gas pipelines, water pipelines, and municipal sewer pipelines. Portions of the proposed basin have previously been used for agriculture and the streams within the basin have been channelized (Attachment 1).

2.5.3. Vegetation

The proposed Turner basin currently supports a plant community that is characteristic of pastures in Kentucky with a portion of the basin in second growth forest, and vegetation dominated by a mixture of grasses and young hardwoods such as red maple, white oak (*Q. alba*), and southern red oak.

2.5.4. Soil Characteristics

The NRCS soil survey for Hardin County maps two soil series associated with the proposed Turner basin (Attachment 1). These series are not listed as hydric by SCS or NRCS. The soil series present in the proposed basin include the Nolin Silt Loam (No) and Vertrees Silt Loam, 6 to 20 percent, severely eroded (VtD3) (USDA, 2012).

The Nolin series consists of very deep well-drained soils formed in alluvium derived from limestones, sandstones, siltstones, shales, and loess. These nearly level to moderately steep soils are on floodplains, in depressions which receive runoff from surrounding slopes, or on natural levees of major streams and rivers. Slope ranges from 0 to 25 percent, but is predominantly 0 to 3 percent.

The Vertrees series consists of very deep, well-drained soils formed in residuum from limestone interbedded with siltstone and shale. These gently sloping to steep soils are on ridges and side slopes. Slopes range from 2 to 30 percent.

2.5.5. Streams/Other Waters

The USGS topographic Vine Grove (7.5-minute series) quadrangle maps two blue-line streams (Streams A1 and C) located within the proposed Turner basin (Attachments 1 and 2).

Stream A1 - Stream A1 extends 839 feet upstream of a culvert crossing under to the edge of the proposed basin; all of the 839 feet of hydrologic flow surveyed was identified as intermittent (Attachment 2). Stream A1 was identified as a blue-line stream on the USGS topographic map; therefore a QHEI assessment was performed to determine the general

stream quality. The resulting QHEI score was 38 (Attachment 3), rating the stream as poor (Table 1).

Stream C - Stream C extends 188 feet upstream of the confluence with Stream A1 to the edge of the proposed basin crossing under a bridge to a residential property; all 188 feet of hydrologic flow surveyed was identified as intermittent (Attachment 2). Stream C was identified as a blue-line stream on the USGS 7.5-minute topographic quadrangle map; therefore, Jackson Environmental performed a QHEI assessment to assess the general stream quality. The resulting QHEI score was 44 (Attachment 3), rating the stream as fair (Table 1).

2.5.6. Wetlands

No wetlands were identified within the proposed Turner basin.

2.5.7. Special Status Species Habitat

A large mature shagbark hickory was identified as a potential Indiana bat roost tree (Attachment 2). Therefore, the Turner basin provides potential Indiana bat roosting habitat. No suitable habitat was observed within the proposed Turner basin for the gray bat.

2.6. Wilson Basin

2.6.1. General Site Description

The proposed Wilson basin is characterized as primarily undeveloped forest with areas of tall grass field. Topography in the proposed basin is moderately sloping, with elevations averaging approximately 730 feet above sea level. Hydrologic features include five ephemeral streams and three wetlands located within the proposed basin (Table 4).

2.6.2. Current Land Cover/Land Use

The land cover within and surrounding the proposed Wilson basin is primarily urban with land use generally consisting of residential and commercial properties, roads, power-lines, natural gas pipelines, water pipelines and municipal sewer pipelines. Portions of the proposed basin have previously been developed (Attachment 1).

2.6.3. Vegetation

The proposed Wilson basin currently supports a plant community that is characteristic of a bottomland area dominated by forest dominated by a mixture of deciduous trees. Dominant overstory and mid-story species include American sycamore (*Platanus occidentalis*), red maple, southern red oak, and swamp white oak.

2.6.4. Soil Characteristics

The NRCS soil survey for Hardin County maps two soil series associated with the proposed Wilson basin (Attachment 1). These series are not listed as hydric by SCS or NRCS. The soil series present in the proposed basin include the Crider Silt Loam (CrC) and Newark Silt Loam (Nb) (USDA, 2012).

The Crider series consists of very deep, well-drained, moderately permeable soils on uplands. They formed in a loess mantle and the underlying residuum from limestone. Slopes range from 0 to 30 percent.

The Newark series consists of very deep, somewhat poorly drained soils formed in mixed alluvium from limestone, shale, siltstone, sandstone, and loess. The soil is on nearly level floodplains and in depressions. Slope ranges from 0 to 3 percent.

2.6.5. Streams/Other Waters

The USGS topographic Vine Grove quadrangle (7.5-minute series) maps one blue-line stream (Stream D) located within the proposed Wilson basin (Attachment 1). Four additional unnamed ephemeral tributaries (Streams D1, D2, D3, and Da) were observed during field investigations (Attachments 1 and 2).

Stream D - Stream D extends 651 feet downstream of a culvert at the edge of the proposed basin to the EOHWM within Wetland 5. Because the stream lost flow in many areas and was pooled, all 651 feet of hydrologic flow were identified as ephemeral (Attachment 2). Although Stream D was determined to be ephemeral it is identified as a blue-line stream on the USGS 7.5-minute topographic quadrangle; therefore, a QHEI assessment was performed to assess the general stream quality. The resulting QHEI score was 41 (Attachment 3), rating the stream as poor (Table 1).

Stream D1 - Stream D1 extends 794 feet downstream of a culvert at the edge of the proposed basin running under Wilson Road to the southern edge of the proposed edge of the Wilson basin. All 794 feet of hydrologic flow was identified as ephemeral (Attachment 2). General stream quality was assessed using the HHEI assessment because it was not identified as a blue-line stream, and has drainage area less than 1 square mile and no pools measuring 15.75 inches or greater. The HHEI score for Stream D1 was 36 (Attachment 3), rating it as a class II stream (Table 1).

Stream D2 - Stream D2 extends 237 feet downstream of a culvert at the edge of the proposed basin running under Wilson Road to the confluence with Stream D1. All 237 feet of hydrologic flow was identified as ephemeral (Attachment 2). General stream quality was assessed using the HHEI assessment because it was not identified as a blue-line stream, and has drainage area less than 1 square mile and no pools measuring 15.75 inches or greater. The HHEI score for Stream D2 was 26 (Attachment 3), rating it as a class I stream (Table 1).

Stream D3 - Stream D3 extends 367 feet upstream of the EOHWM to the confluence with Stream D. All 367 feet of hydrologic flow was identified as ephemeral (Attachment 2). General stream quality was assessed using the HHEI assessment because it was not identified as a blue-line stream, and has drainage area less than 1 square mile and no pools measuring 15.75 inches or greater. The HHEI score for Stream D3 was 12 (Attachment 3), rating it as a class I stream (Table 1).

Stream Da - Stream Da extends 353 feet upstream of the confluence with Stream D1 to a headcut within Wetland 5 serving as the EOHWM. All 367 feet of hydrologic flow was identified as ephemeral (Attachment 2). General stream quality was assessed using the HHEI assessment because it was not identified as a blue-line stream, and has drainage area less than 1 square mile, and no pools measuring 15.75 inches or greater. The HHEI score for Stream Da was 50 (Attachment 3), rating it as a class II stream (Table 1).

2.6.6. Wetlands

Three wetlands, Wetland 4, Wetland 5, and Wetland 6, were identified within the proposed Wilson basin (Attachments 1 and 2). Wetland 4 and Wetland 6 are shown on the USFWS National Wetland Inventory.

Wetland 4 - A 0.64-acre area adjacent to Wilson Road and part of the floodplains of Streams D1 and D2 was identified as a palustrine forested wetland (Wetland 4) (Attachments 2 and 4). Field investigation of Wetland 4 observed the presence of hydric soils, hydrology, and hydrophytic vegetation. Wetland 4 receives its hydrology from regular flooding of Streams D1 and D2, precipitation, and storm-water drainage from upland elevations. Water drains within the wetland from the uphill areas near Wilson Road via sheet flow, then Stream D1. The entire delineated Stream D2 channel flows through Wetland 4, providing water during precipitation events. A significant nexus was observed between Wetland 4 and Stream D1 since the wetland directly drains into Stream D1. Wetland 4 is dominated by hardwood forest. Other species include various ferns, sedges (*Carex* spp.), soft rush (*Juncus effusus*), and cattails (*Typha latifolia*). The OEPA ORAM score for this wetland was 56, classifying it as a category 2 wetland having moderate quality and low disturbance.

Wetland 5 - A 0.57-acre area in the Wilson basin was identified as a palustrine emergent wetland (Wetland 5) (Attachments 2 and 4). Field investigation of Wetland 5 identified the presence of hydric soils, hydrology, and hydrophytic vegetation. Wetland 5 formed from Streams D and D3 flowing into the wetland. Wetland 5 receives its hydrology from Streams D and D3, precipitation and storm-water drainage from upland elevations. Water flows into the wetland via Streams D and D3, both stream channels end within the wetland creating providing water to the wetland. Water then flows through the wetland and either drains into Stream D1 or into Stream Da via sheet flow or small braided channels that traverse Wetland 5. Wetland 5 has significant nexus with both Streams D1 and Da. Wetland 5 is dominated by field grasses. Other species include sedges, soft rush, black willow (*Salix nigra*), and cattails. The OEPA ORAM score for this wetland was 30, classifying it as a transition category 1 to 2, transitioning between low and moderate quality.

Wetland 6 - A 0.10-acre area adjacent to Wilson Road and part of the floodplains of Stream D1 was identified as a palustrine forested wetland (Wetland 6) (Attachments 2 and 4). Field investigation of Wetland 6 identified the presence of hydric soils, hydrology, and hydrophytic vegetation. Wetland 6 receives its hydrology from regular flooding of Stream D1, precipitation, and storm-water drainage from upland elevations. Water flows in and out of the wetland via Stream D1. A significant nexus was observed between Wetland 6 and Stream D1 since the wetland directly drains into Stream D1. Wetland 6 formed within the floodplain of Stream D1 and is dominated by hardwood forest. Other species include various ferns, sedges, and soft rush. The OEPA ORAM score for this wetland was 59, classifying it as a category 2 wetland having moderate quality and low disturbance.

2.6.7. Special Status Species Habitat

The proposed Wilson basin is primarily composed of hardwood forest with forested wetlands, trees with broken tops and sloughing bark, and several snags (Attachment 2). The forested wetlands which comprise the majority of the Wilson basin area provide potential roosting and foraging habitat for the Indiana bat. No suitable habitat was observed within the proposed Wilson basin for the gray bat.

2.7. Quiggins Basin

2.7.1. General Site Description

The proposed Quiggins basin is characterized as primarily undeveloped forest with areas of mowed pasture. Topography in the proposed basin is moderately sloping. Elevation in the proposed Quiggins basin averages approximately 730 feet above sea level. Hydrologic features include the Quiggins sinkhole, one intermittent stream, and nine ephemeral streams located within the proposed basin (Table 4).

2.7.2. Current Land Cover/Land Use

The land cover within and surrounding the proposed Quiggins basin is primarily urban with land use generally consisting of residential and commercial properties, roads, power-lines, natural gas pipelines, water pipelines and municipal sewer pipelines. Portions of the proposed basin have previously been used for agriculture and several of the streams within the basin have been channelized (Attachment 1).

2.7.3. Vegetation

The proposed Quiggins basin currently supports a plant community that is characteristic of a bottomland area, dominated by mixed deciduous forest species, including American sycamore, American beech (*Fagus grandifolia*), red maple, southern red oak, and swamp white oak.

2.7.4. Soil Characteristics

The NRCS soil survey for Hardin County maps three soil series associated with the proposed Quiggins basin (Attachment 1). These series are not listed as hydric by SCS or NRCS. The soil series present in the proposed basin include the Crider Silt Loam (CrC), Nolin Silt Loam (No), Vertrees Silt Loam, slopes 12 to 20 percent (VrD), and an area with water (W).

The Crider series consists of very deep, well-drained, moderately permeable soils on uplands. They formed in a loess mantle and the underlying residuum from limestone. Slopes range from 0 to 30 percent.

The Nolin series consists of very deep well-drained soils formed in alluvium derived from limestones, sandstones, siltstones, shales, and loess. These nearly level to moderately steep soils are on floodplains, in depressions which receive runoff from surrounding slopes, or on natural levees of major streams and rivers. Slope ranges from 0 to 25 percent, but is predominantly 0 to 3 percent.

The Vertrees series consists of very deep, well-drained soils formed in residuum from limestone interbedded with siltstone and shale. These gently sloping to steep soils are on ridges and side slopes. Slopes range from 2 to 30 percent.

2.7.5. Streams/Other Waters

The USGS topographic Vine Grove quadrangle (7.5-minute series) maps one unnamed blue-line stream (Stream E) within the proposed Quiggins basin (Attachment 1). Additionally, nine unnamed ephemeral tributaries (Streams E1, E1a, E2, E4, E4a, E4b, E5, E6, and E7) were observed during the field investigation (Attachments 1 and 2).

Stream E - Stream E extends 1,783 feet downstream from a culvert crossing under Dixie Highway to the Quiggins sinkhole into which Stream E drains. All 1,783 feet of hydrologic flow was identified as intermittent (Attachment 2). Stream E was identified as a blue-line stream on the USGS 7.5-minute topographic quadrangle map; therefore, Jackson Environmental performed a QHEI assessment to assess the general stream quality. The resulting QHEI score was 43.5 (Attachment 3), rating the stream as fair (Table 1).

Stream E1 - Stream E1 extends 335 feet upstream of its confluence with Stream E to the EOHWM. All 335 feet of hydrologic flow was identified as ephemeral (Attachment 2). General stream quality was assessed using the HHEI assessment because it was not identified as a blue-line stream, and has drainage area less than 1 square mile and no pools measuring 15.75 inches or greater. The HHEI score for Stream E1 was 6 (Attachment 3), rating it as a class I stream (Table 1).

Stream E1a - Stream E1a extends 33 feet upstream of its confluence with Stream E1a to the EOHWM. All 33 feet of hydrologic flow was identified as ephemeral (Attachment 2). General stream quality was assessed using the HHEI assessment because it was not identified as a blue-line stream, and has drainage area less than 1 square mile and no pools measuring 15.75 inches or greater. The HHEI score for Stream E1a was 6 (Attachment 3), rating it as a class I stream (Table 1).

Stream E2 - Stream E2 extends 70 feet upstream of its confluence with Stream E to the EOHWM. All 70 feet of hydrologic flow was identified as ephemeral (Attachment 2). General stream quality was assessed using the HHEI assessment because it was not identified as a blue-line stream, and has drainage area less than 1 square mile and no pools measuring 15.75 inches or greater. The HHEI score for Stream E2 was 7 (Attachment 3), rating it as a class I stream (Table 1).

Stream E4 - Stream E4 extends 612 feet upstream of its confluence with Stream E to the proposed Quiggins basin boundary. All 612 feet of hydrologic flow was identified as ephemeral (Attachment 2). Stream E4 connects to a concrete storm drain that lies outside of the proposed basin. General stream quality was assessed using the HHEI assessment because it was not identified as a blue-line stream, and has drainage area less than 1 square mile and no pools measuring 15.75 inches or greater. The HHEI score for Stream E4 was 6 (Attachment 3), rating it as a class I stream (Table 1).

Stream E4a - Stream E4a extends 345 feet downstream of its confluence with Stream E4 to the EOHWM, where the stream turned to sheet flow. All 345 feet of hydrologic flow was identified as ephemeral (Attachment 2). General stream quality was assessed using the HHEI assessment because it was not identified as a blue-line stream, and has drainage area less than 1 square mile and no pools measuring 15.75 inches or greater. The HHEI score for Stream E4a was 17 (Attachment 3), rating it as a class I stream (Table 1).

Stream E4b - Stream E4b extends 117 feet upstream of its confluence with Stream E4 to the EOHWM. All 117 feet of hydrologic flow was identified as ephemeral (Attachment 2). General stream quality was assessed using the HHEI assessment because it was not identified as a blue-line stream, and has drainage area less than 1 square mile and no pools measuring 15.75 inches or greater. The HHEI score for Stream E4b was 6 (Attachment 3), rating it as a class I stream (Table 1).

Stream E5 - Stream E5 extends 60 feet upstream of its confluence with Stream E to the EOHWM. All 60 feet of hydrologic flow was identified as ephemeral (Attachment 2). General stream quality was assessed using the HHEI assessment because it was not identified as a blue-line stream, and has drainage area less than 1 square mile and no pools measuring 15.75 inches or greater. The HHEI score for Stream E5 was 6 (Attachment 3), rating it as a class I stream (Table 1).

Stream E6 - Stream E6 extends 473 feet upstream of its confluence with Stream E to the EOHWM. All 473 feet of hydrologic flow was identified as ephemeral (Attachment 2). General stream quality was assessed using the HHEI assessment because it was not identified as a blue-line stream, and has drainage area less than 1 square mile and no pools measuring 15.75 inches or greater. The HHEI score for Stream E6 was 35 (Attachment 3), rating it as a class II stream (Table 1).

Stream E7 - Stream E7 extends 152 feet upstream of its confluence with Stream E to the EOHWM. All 152 feet of hydrologic flow was identified as ephemeral (Attachment 2). General stream quality was assessed using the HHEI assessment because it was not identified as a blue-line stream, and has drainage area less than 1 square mile and no pools measuring 15.75 inches or greater. The HHEI score for Stream E7 was 6 (Attachment 3), rating it as a class I stream (Table 1).

2.7.6. Wetlands

No wetlands were identified within the proposed Quiggins basin.

2.7.7. Special Status Species Habitat

A portion of the proposed Quiggins basin is composed of hardwood forest with mature trees, as well as several snags, including one potential roost tree that was mapped during the field survey, that could provide potential roosting habitat for the Indiana bat (Attachment 2). Stream E provides a potential flight corridor and water source for foraging Indiana bats. No suitable habitat was observed within the proposed Quiggins basin for the gray bat.

2.8. Spoils Disposal Area

2.8.1. General Site Description

The proposed spoils disposal area is characterized as primarily former agricultural pasture with small patches of forested habitat. Topography in the proposed spoils disposal area is moderately sloping, with elevations averaging approximately 730 feet above sea level. Hydrologic features include one intermittent stream, two ephemeral streams, and three wetlands (Attachment 1).

2.8.2. Current Land Cover/Land Use

The land cover within and surrounding the proposed spoils disposal area is primarily urban with land use generally consisting of residential and commercial properties, roads, power-lines, natural gas pipelines, water pipelines and municipal sewer pipelines. Portions of the proposed spoils disposal area have previously been developed or used as pasture, and the streams within the spoils disposal area have been channelized (Attachment 1).

2.8.3. Vegetation

The proposed spoils disposal area currently supports a plant community that is characteristic of mowed pasture, with the southern and northern portions of the area in second growth forest (Attachment 1). Pasture areas are dominated by a mixture of grasses; forested habitats are comprised of hardwood species such as, red maple, white oak, southern red oak, and American sycamore.

2.8.4. Soil Characteristics

The NRCS soil survey for Hardin County maps three soil series associated with the proposed spoils disposal area (Attachment 1). These series are not listed as hydric by SCS or NRCS. The soil series present in the proposed spoils disposal area include the Elk Silt Loam (EIB), Nolin Silt Loam (No), and Vertrees Silt Loam, slopes 12 to 20 percent (VrD) (USDA, 2012).

The Elk series consists of very deep, well-drained, moderately permeable soils formed in mixed alluvium from limestone, siltstone, shale, sandstone, and loess. Slopes primarily range from 0 to 12 percent, but extend to 40 percent in some areas.

The Nolin series consists of very deep well-drained soils formed in alluvium derived from limestones, sandstones, siltstones, shales, and loess. These nearly level to moderately steep soils are on floodplains, in depressions which receive runoff from surrounding slopes, or on natural levees of major streams and rivers. Slope ranges from 0 to 25 percent, but is predominantly 0 to 3 percent.

The Vertrees series consists of very deep, well-drained soils formed in residuum from limestone interbedded with siltstone and shale. These gently sloping to steep soils are on ridges and side slopes. Slopes range from 2 to 30 percent.

2.8.5. Streams/Other Waters

The USGS topographic Vine Grove quadrangle (7.5-minute series) maps one unnamed blue-line stream located within the proposed spoils disposal area. However, due to the

creation of a drainage basin since the last topographic survey, the blue-line stream has been altered, creating two channels (Streams A and Aa). One unnamed intermittent stream and two unnamed ephemeral tributaries (Streams A, Aa, and B) were observed during field investigations (Attachments 1 and 2).

Stream A - Stream A extends 216 feet downstream of a culvert that crosses under Wilson Road to the EOHWM. All 216 feet of hydrologic flow was identified as intermittent (Attachment 2). The stream empties into a manmade storm water drainage basin, designated as Wetland 1. Stream A was identified as a blue-line stream on the USGS 7.5-minute topographic quadrangle map; therefore, Jackson Environmental performed a QHEI assessment to assess the general stream quality. The resulting QHEI score was 27.5 (Attachment 3), rating the stream as very poor (Table 1).

Stream Aa - Stream Aa appeared to be remnant of the historic channel of Stream A prior to it being altered to divert water into Wetland 1. This remnant channel extends 384 feet downstream of its confluence with Stream A to where flows through a culvert under Dixie Highway (Attachment 2). Since sections of Stream Aa are identified as a blue-line stream on the USGS 7.5-minute topographic quadrangle map, Jackson Environmental performed a QHEI assessment to assess the general stream quality. The resulting QHEI score was 29 (Attachment 3), rating the stream as very poor (Table 1).

Stream B - Stream B extends 258 feet upstream of its confluence with Wetland 1 to the EOHWM at a drainage ditch located near a sewer pump station. All 258 feet of hydrologic flow was identified as ephemeral (Attachment 2). General stream quality was assessed using the HHEI assessment because it was not identified as a blue-line stream, and has drainage area less than 1 square mile and no pools measuring 15.75 inches or greater. The HHEI score for Stream B was 6 (Attachment 3), rating it as a class I stream (Table 1).

2.8.6. Wetlands

Three wetlands, Wetland 1, Wetland 2, and Wetland 3, were identified within the proposed spoils disposal area (Attachments 1 and 2).

Wetland 1 - A 2.04-acre area was identified as a palustrine emergent wetland (Wetland 1) (Attachment 2). Field investigation of Wetland 1 observed the presence of hydric soils, hydrology, and hydrophytic vegetation. Wetland 1 is a manmade drainage basin, dominated by emergent wetland plants. During precipitation events the basin retains water for an extended period of time.

A 2.29-inch rain event occurred one day prior to the field investigations (Table 3). This rainfall event inundated the area identified as Wetland 1 (Attachment 1). Due to the depth of water in this area, vegetation could not be observed; therefore, the wetland boundary was delineated based upon the water's edge.

The OEPA ORAM score for this wetland was 35, classifying it as a category 2 wetland having moderate quality (Attachment 4).

Wetland 2 - A 0.72-acre area located across a small berm from Stream A was identified as a palustrine forested wetland (Wetland 2) (Attachment 2). Field investigation of Wetland 2 identified the presence of hydric soils, hydrology, and hydrophytic vegetation.

Wetland 2 formed within a depression associated with the construction of a berm in the creation of Wetland 1. Wetland 2 retains water for extended periods of time, and the clay soils within the wetland impede water percolation, contributing to water retention. Wetland 2 receives its hydrology from an unnamed stream outside of the proposed basin boundary, precipitation, and storm water runoff from upland areas. Water discharges from Wetland 2 via a small channel at the southeast corner of the wetland and sheet flow along the eastern edge of the wetland into Stream Aa. A significant nexus was observed between Wetland 2 and Stream Aa. Approximately half of Wetland 2 is located within the proposed spoils disposal area boundary. The OEPA ORAM score for this wetland was 59, classifying it as a category 2 wetland having moderate quality and moderate disturbance (Attachment 4).

Wetland 3 - A 0.03-acre area located within a former fill area was identified as a small palustrine forested wetland (Wetland 3) (Attachment 2). Field investigation of Wetland 3 observed the presence of hydric soils, hydrology, and hydrophytic vegetation. Wetland 3 formed due to a depression in eroded fill material associated with past land development. Stream B flows through Wetland 3. Wetland 3 receives its hydrology from stream flow from ephemeral Stream B and precipitation. Water discharges from Wetland 2 via Stream B, where it then flows into Wetland 1. Since Stream B flows through Wetland 2 a significant nexus exists between Wetland 2 and Stream Aa. The OEPA ORAM score for this wetland was 23, classifying it as a category 1 wetland having low quality (Attachment 4).

2.8.7. Special Status Species Habitat

No special status species habitat was observed within the proposed spoils disposal area.

3.0 CONCLUSION

Within the five proposed basins and spoils disposal area, 24 stream channels, totaling 9,738 feet, were identified as potential jurisdictional waters ("other waters") of the United States within the area of investigation. Four stream channels, totaling 3,026 feet, were classified as intermittent and 20 stream channels, totaling 6,712 feet, were classified as ephemeral.

Eight wetlands totaling 4.13 acres were identified within the area of investigation, all eight of which could be considered jurisdictional. Four of the wetlands are forested wetlands and four are emergent wetlands. All wetlands fall within the Cowardin Palustrine wetland classification. OEPA ORAM scores ranged from 15 to 59, with three wetlands rated as Category 1, one wetland rated as a transition from Category 1 to 2, and four wetlands rated as Category 2.

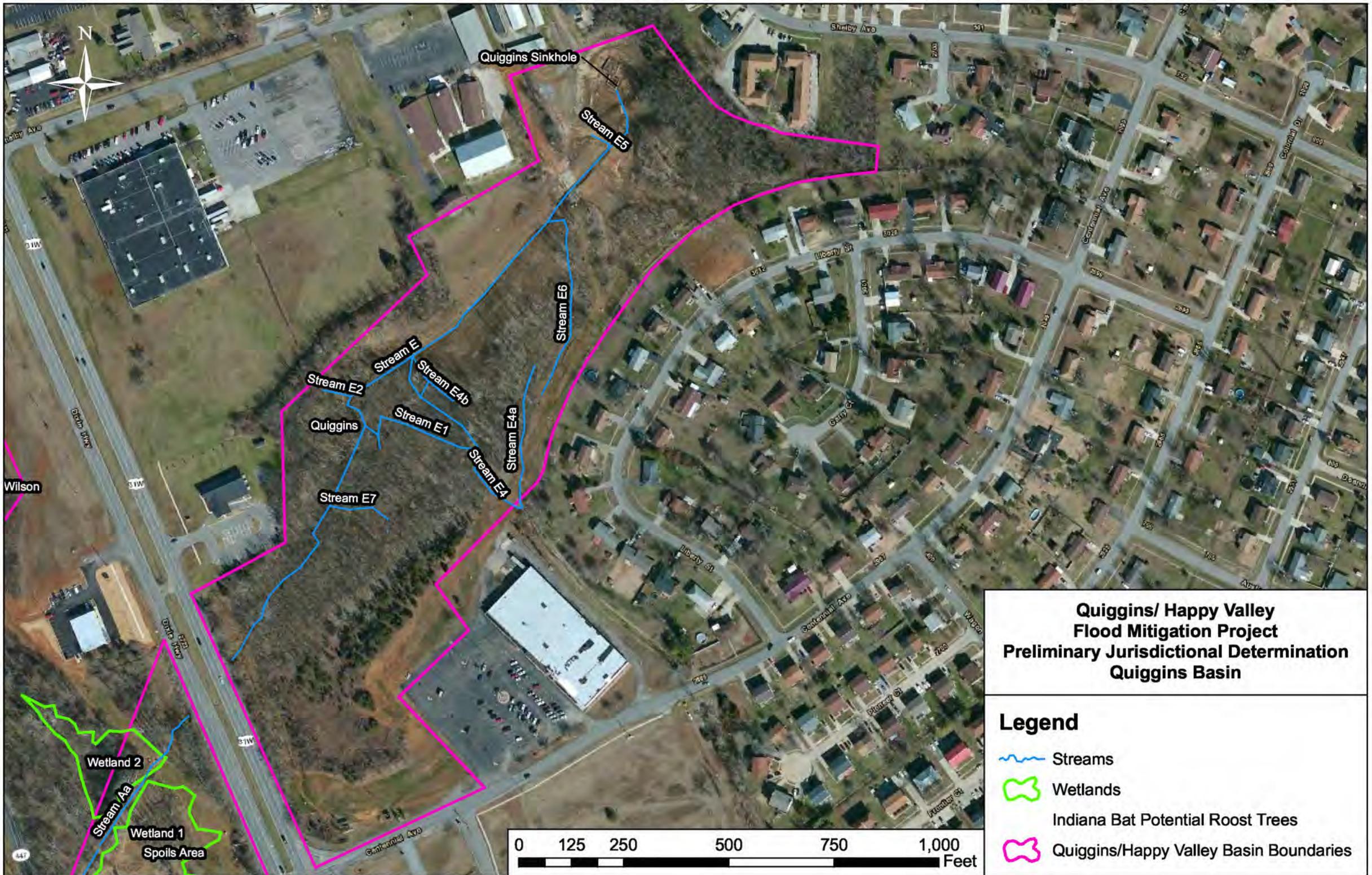
A cursory review of potential habitat of two special status species, the federally endangered Indiana bat and the federally threatened gray bat, was performed within the proposed basins and spoils disposal area. No suitable habitat was observed within the proposed basins or spoils disposal area for the gray bat. Three of the six proposed basins (Cato, Wilson, and Quiggins) contain habitat features that could provide potential foraging and summer roosting habitat for the Indiana bat; the Turner basin contains potential summer roosting habitat for the Indiana bat.

4.0 REFERENCES

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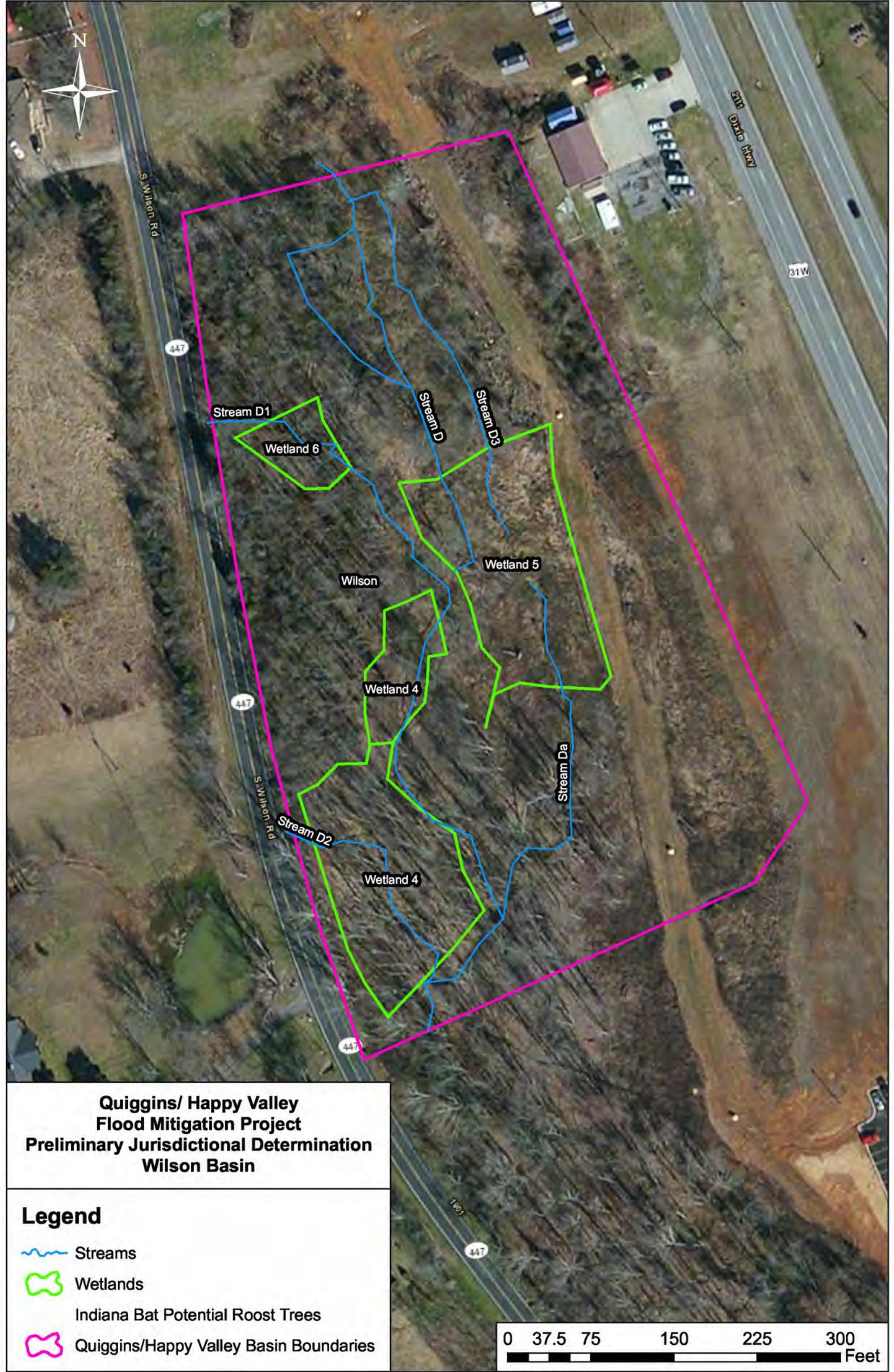
Attachment 1

Project Maps



**Quiggins/ Happy Valley
Flood Mitigation Project
Preliminary Jurisdictional Determination
Quiggins Basin**

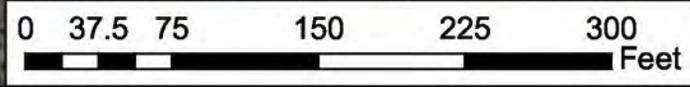
- Legend**
- Streams
 - Wetlands
 - Indiana Bat Potential Roost Trees
 - Quiggins/Happy Valley Basin Boundaries



**Quiggins/ Happy Valley
Flood Mitigation Project
Preliminary Jurisdictional Determination
Wilson Basin**

Legend

-  Streams
-  Wetlands
-  Indiana Bat Potential Roost Trees
-  Quiggins/Happy Valley Basin Boundaries

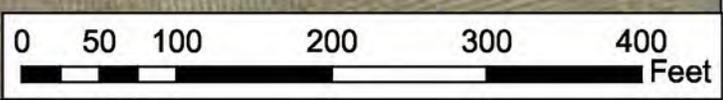


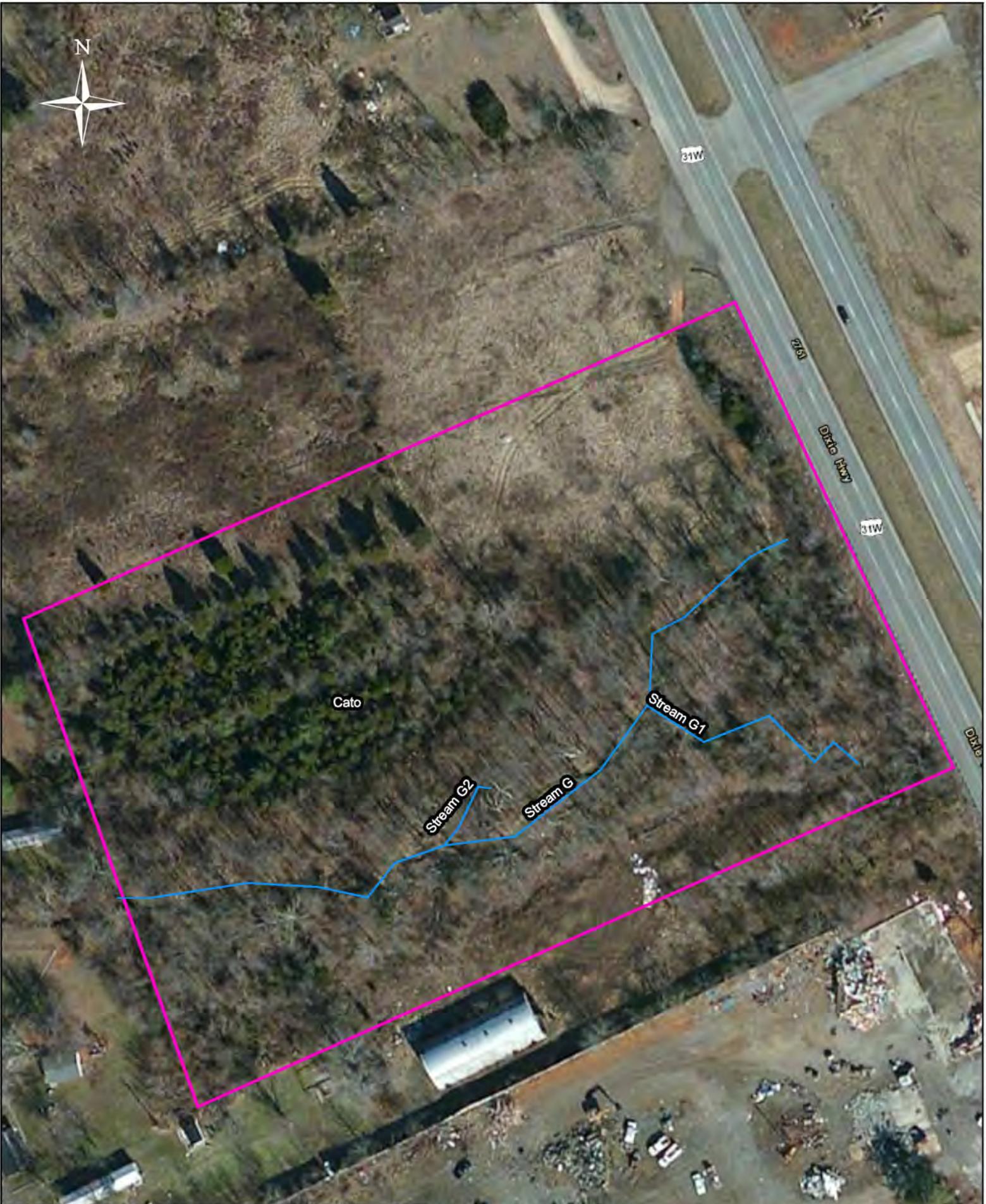


**Quiggins/ Happy Valley
Flood Mitigation Project
Preliminary Jurisdictional Determination
Turner Basin**

Legend

-  Streams
-  Wetlands
-  Indiana Bat Potential Roost Trees
-  Quiggins/Happy Valley Basin Boundaries

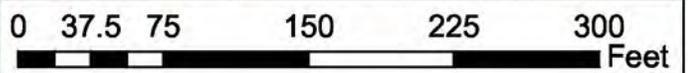


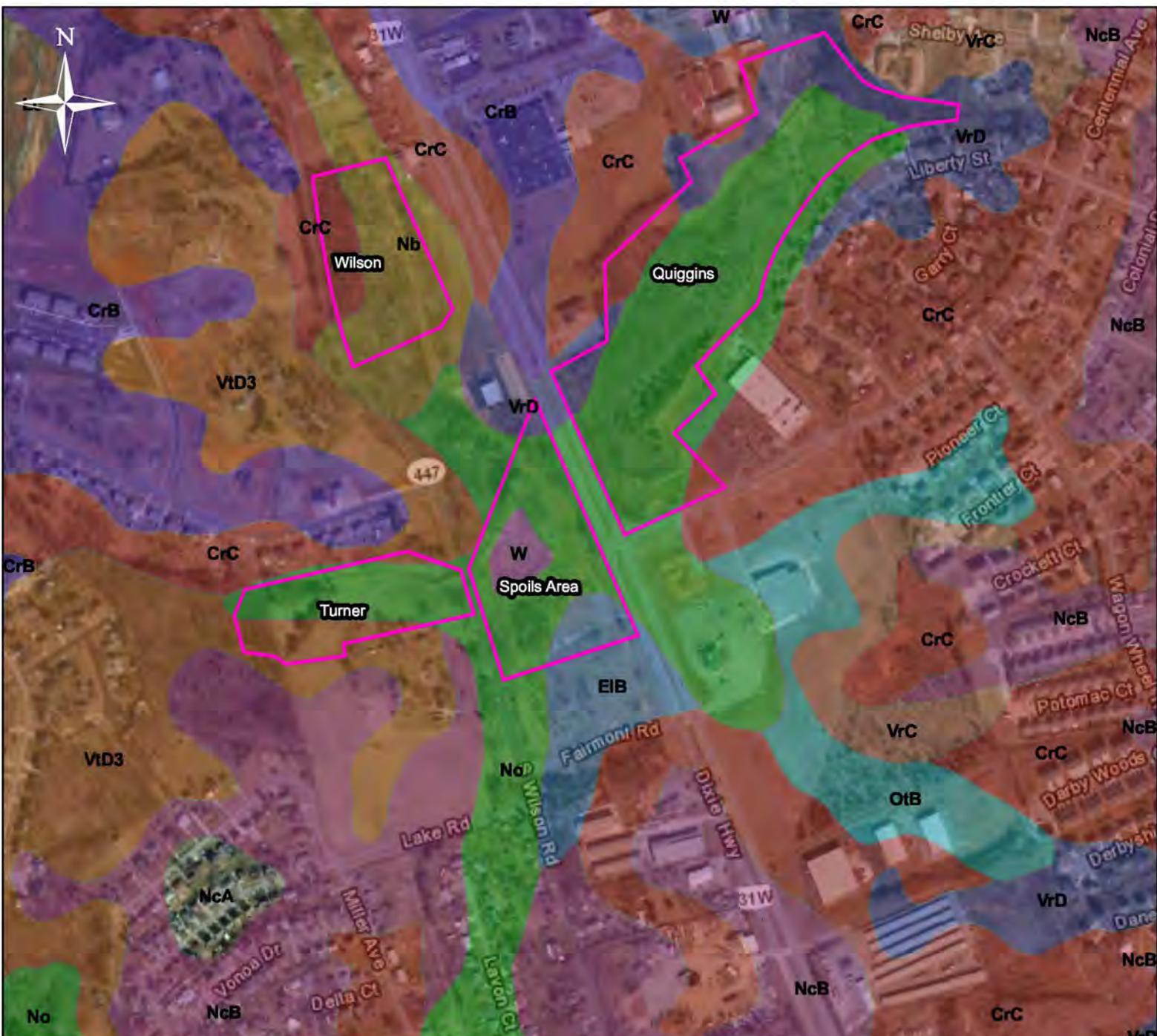


**Quiggins/ Happy Valley
Flood Mitigation Project
Preliminary Jurisdictional Determination
Cato Basin**

Legend

-  Streams
-  Wetlands
-  Indiana Bat Potential Roost Trees
-  Quiggins/Happy Valley Basin Boundaries





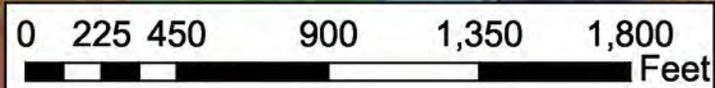
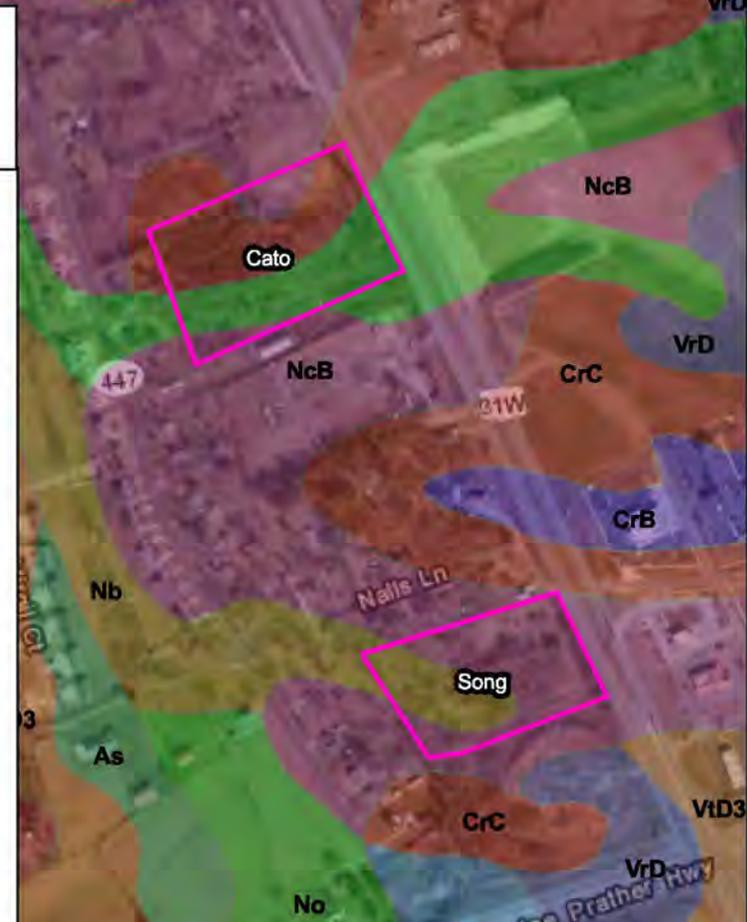
**Quiggins/ Happy Valley
Flood Mitigation Project
Preliminary Jurisdictional Determination**

Legend

 Quiggins/Happy Valley Basin Boundaries

Soils Index

-  As, Ashton Silt Loam
-  CrB, Crider Silt Loam, 2-6% slopes
-  CrC, Crider Silt Loam, 6-12% slopes
-  EIB, Elk Silt Loam, 6-12% slopes
-  Nb, Newark Silt Loam
-  NcB, Nicholson Silt Loam, 2-6% slopes
-  No, Nolin Silt Loam
-  OtB, Otwell Silt Loam, 2-6% slopes
-  VrC, Vertrees Silt Loam, 6-12% percent slopes
-  VrD, Vertrees Silt Loam, 12-20% percent slopes
-  VrE, Vertrees Silt Loam, 12-20% percent slopes
-  VtD3, Vertrees Silt Loam, 6-20% percent, severely eroded
-  W, Water

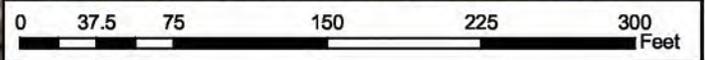




**Quiggins/ Happy Valley
Flood Mitigation Project
Preliminary Jurisdictional Determination
Song Basin**

Legend

-  Streams
-  Wetlands
-  Indiana Bat Potential Roost Trees
-  Quiggins/Happy Valley Basin Boundaries



Attachment 1

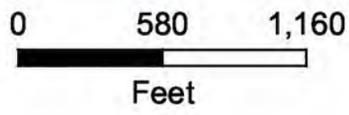
Project Maps

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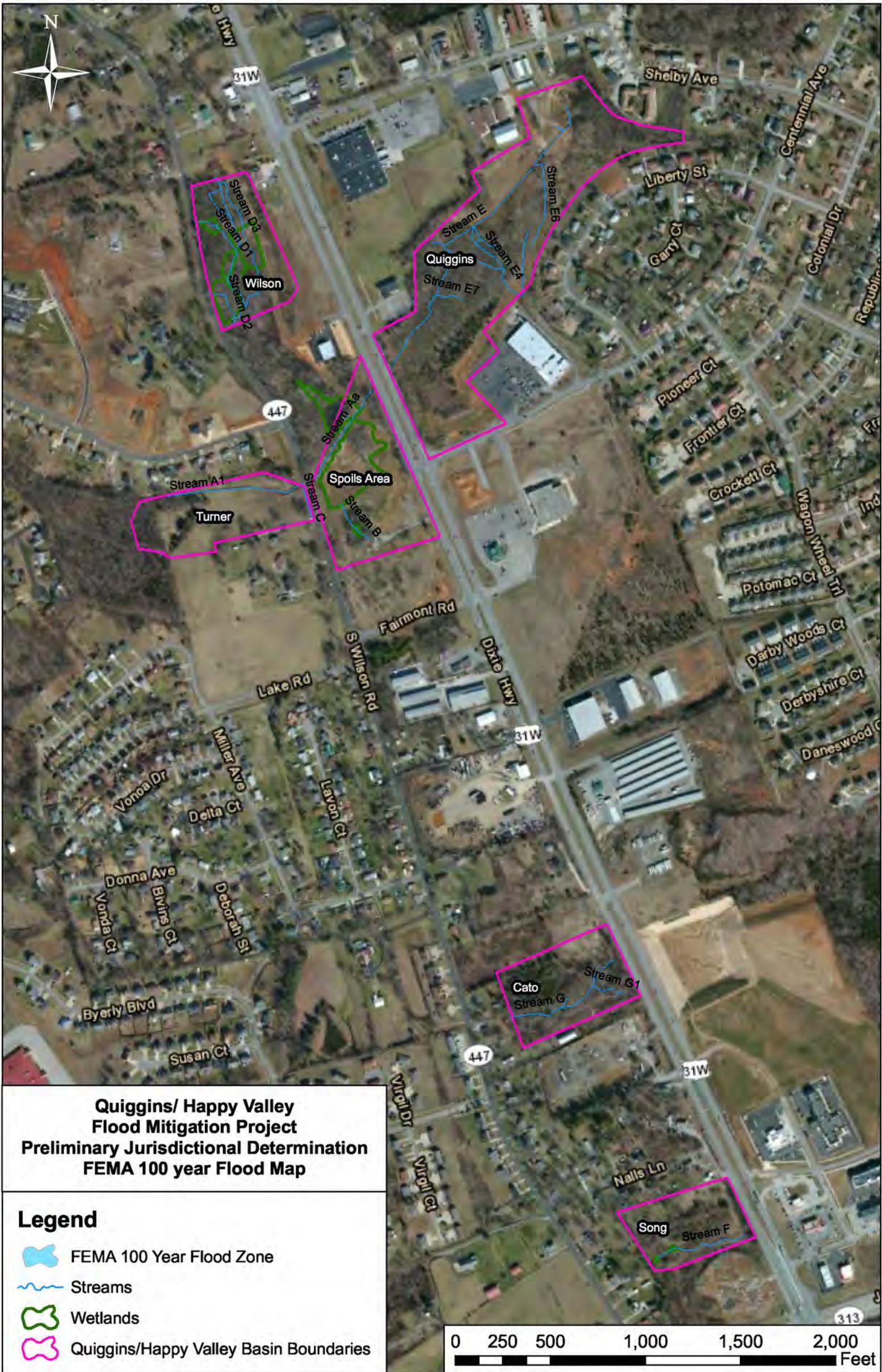
LEGEND:

-  Detention Basin
-  Spoils Disposal Area
-  Streams
-  Wetlands
-  Indiana Bat Potential Roost Tree



PROJECT OVERVIEW MAP

Base Map Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Attachment 2

Wetland, Stream, and Special Status Species Habitat Photos

Attachment 2

Wetland, Stream, and Special Status Species Habitat Photos

PHOTOGRAPHIC RECORD

Client Name:

Federal Emergency Management Agency (FEMA) Department of Homeland Security

Site Location:

Quiggins Sinkhole Flood Mitigation Project
City of Radcliff, Hardin County, Kentucky
HSFEHQ-06-D-0162

Photo No. 1**Date:**

July 2013

Description:

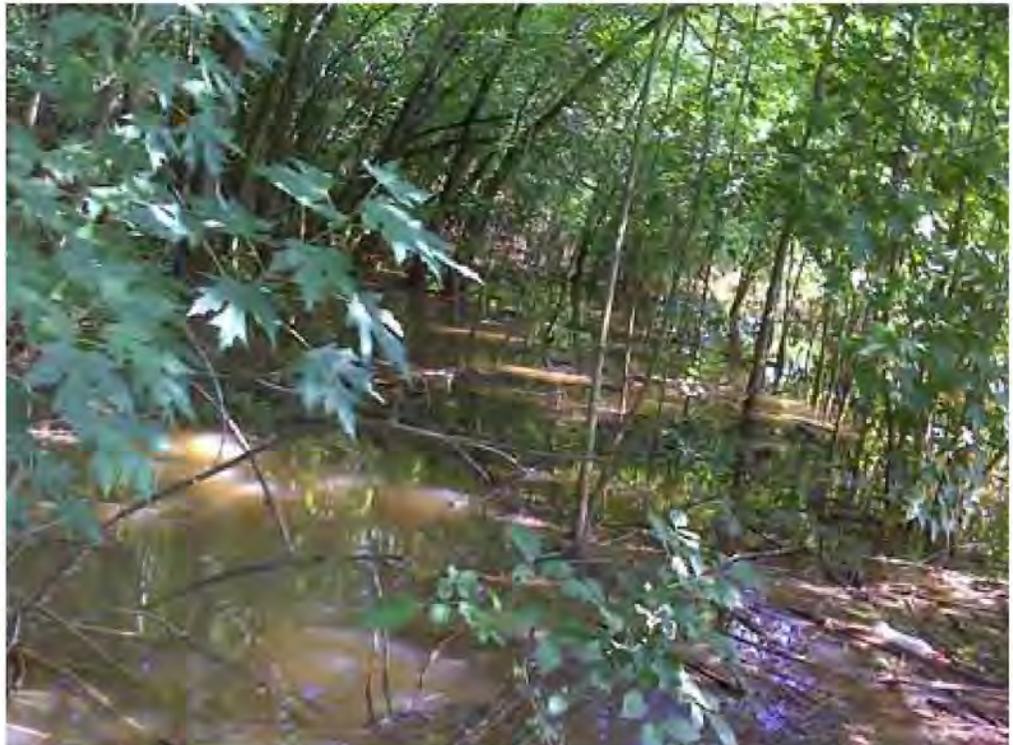
Wetland 1, Spoils Disposal Area

**Photo No. 2****Date:**

July 2013

Description:

Wetland 2, Spoils Disposal Area



PHOTOGRAPHIC RECORD

Client Name:

Federal Emergency Management
Agency (FEMA) Department of
Homeland Security

Site Location:

Quiggins Sinkhole Flood Mitigation Project
City of Radcliff, Hardin County, Kentucky
HSFEHQ-06-D-0162

Photo No. 3**Date:**

July 2013

Description:

Wetland 4, Wilson Basin

**Photo No. 4****Date:**

July 2013

Description:

Wetland 5, Wilson Basin



PHOTOGRAPHIC RECORD

Client Name:

Federal Emergency Management
Agency (FEMA) Department of
Homeland Security

Site Location:

Quiggins Sinkhole Flood Mitigation Project
City of Radcliff, Hardin County, Kentucky
HSFEHQ-06-D-0162

Photo No. 5**Date:**

July 2013

Description:

Wetland 6, Wilson Basin

**Photo No. 6****Date:**

July 2013

Description:

Wetland 7, Song Basin



PHOTOGRAPHIC RECORD

Client Name:

Federal Emergency Management Agency (FEMA) Department of Homeland Security

Site Location:

Quiggins Sinkhole Flood Mitigation Project
City of Radcliff, Hardin County, Kentucky
HSFEHQ-06-D-0162

Photo No. 7**Date:**

July 2013

Description:

Wetland 8, Song Basin

**Photo No. 8****Date:**

July 2013

Description:

Stream A, Spoils Disposal Area



PHOTOGRAPHIC RECORD

Client Name:

Federal Emergency Management Agency (FEMA) Department of Homeland Security

Site Location:

Quiggins Sinkhole Flood Mitigation Project
City of Radcliff, Hardin County, Kentucky
HSFEHQ-06-D-0162

Photo No. 9**Date:**

July 2013

Description:

Stream A1, Turner Basin

**Photo No. 10****Date:**

July 2013

Description:

Stream Aa,, Spoils Disposal Area



PHOTOGRAPHIC RECORD

Client Name:

Federal Emergency Management Agency (FEMA) Department of Homeland Security

Site Location:

Quiggins Sinkhole Flood Mitigation Project
City of Radcliff, Hardin County, Kentucky
HSFEHQ-06-D-0162

Photo No. 11**Date:**

July 2013

Description:

Stream B running through Wetland 3 in Spoils Disposal Area

**Photo No. 12****Date:**

July 2013

Description:

Stream C, Turner Basin



PHOTOGRAPHIC RECORD

Client Name:

Federal Emergency Management Agency (FEMA) Department of Homeland Security

Site Location:

Quiggins Sinkhole Flood Mitigation Project
City of Radcliff, Hardin County, Kentucky
HSFEHQ-06-D-0162

Photo No. 13**Date:**

July 2013

Description:

Culvert in Stream D,
Wilson Basin

**Photo No. 14****Date:**

July 2013

Description:

Stream D1, Wilson Basin



PHOTOGRAPHIC RECORD

Client Name:

Federal Emergency Management
Agency (FEMA) Department of
Homeland Security

Site Location:

Quiggins Sinkhole Flood Mitigation Project
City of Radcliff, Hardin County, Kentucky
HSFEHQ-06-D-0162

Photo No. 15**Date:**

July 2013

Description:

Culvert running under
Wilson Road; Stream D2,
Wilson Basin

**Photo No. 16****Date:**

July 2013

Description:

Stream D3, Wilson Basin



PHOTOGRAPHIC RECORD

Client Name:

Federal Emergency Management Agency (FEMA) Department of Homeland Security

Site Location:

Quiggins Sinkhole Flood Mitigation Project
City of Radcliff, Hardin County, Kentucky
HSFEHQ-06-D-0162

Photo No. 17**Date:**

July 2013

Description:

Stream Da, Wilson Basin

**Photo No. 18****Date:**

July 2013

Description:

Stream E, Quiggins Basin



PHOTOGRAPHIC RECORD

Client Name:

Federal Emergency Management Agency (FEMA) Department of Homeland Security

Site Location:

Quiggins Sinkhole Flood Mitigation Project
City of Radcliff, Hardin County, Kentucky
HSFEHQ-06-D-0162

Photo No. 19**Date:**

July 2013

Description:

Stream E flowing into the Quiggins Sinkhole; Quiggins Basin

**Photo No. 20****Date:**

July 2013

Description:

Stream E1, Quiggins Basin



PHOTOGRAPHIC RECORD

Client Name:

Federal Emergency Management Agency (FEMA) Department of Homeland Security

Site Location:

Quiggins Sinkhole Flood Mitigation Project
City of Radcliff, Hardin County, Kentucky
HSFEHQ-06-D-0162

Photo No. 21**Date:**

July 2013

Description:

Stream E2, Quiggins Basin

**Photo No. 22****Date:**

July 2013

Description:

Stream E4, Quiggins Basin



PHOTOGRAPHIC RECORD

Client Name:

Federal Emergency Management
Agency (FEMA) Department of
Homeland Security

Site Location:

Quiggins Sinkhole Flood Mitigation Project
City of Radcliff, Hardin County, Kentucky
HSFEHQ-06-D-0162

Photo No. 23**Date:**

July 2013

Description:

Stream E4a, Quiggins
Basin

**Photo No. 24****Date:**

July 2013

Description:

Stream E4a, Quiggins
Basin



PHOTOGRAPHIC RECORD

Client Name:

Federal Emergency Management Agency (FEMA) Department of Homeland Security

Site Location:

Quiggins Sinkhole Flood Mitigation Project
City of Radcliff, Hardin County, Kentucky
HSFEHQ-06-D-0162

Photo No. 25**Date:**

July 2013

Description:

Stream E5, Quiggins Basin

**Photo No. 26****Date:**

July 2013

Description:

Stream E6, Quiggins Basin



PHOTOGRAPHIC RECORD

Client Name:

Federal Emergency Management Agency (FEMA) Department of Homeland Security

Site Location:

Quiggins Sinkhole Flood Mitigation Project
City of Radcliff, Hardin County, Kentucky
HSFEHQ-06-D-0162

Photo No. 27**Date:**

July 2013

Description:

Stream E7, Quiggins Basin

**Photo No. 28****Date:**

July 2013

Description:

Stream F, Song Basin



PHOTOGRAPHIC RECORD

Client Name:

Federal Emergency Management Agency (FEMA) Department of Homeland Security

Site Location:

Quiggins Sinkhole Flood Mitigation Project
City of Radcliff, Hardin County, Kentucky
HSFEHQ-06-D-0162

Photo No. 29**Date:**

July 2013

Description:

Stream G, Cato Basin

**Photo No. 30****Date:**

July 2013

Description:

Stream G1, Cato Basin



PHOTOGRAPHIC RECORD

Client Name:

Federal Emergency Management Agency (FEMA) Department of Homeland Security

Site Location:

Quiggins Sinkhole Flood Mitigation Project
City of Radcliff, Hardin County, Kentucky
HSFEHQ-06-D-0162

Photo No. 31**Date:**

July 2013

Description:

Stream G2, Cato Basin

**Photo No. 32****Date:**

July 2013

Description:

Indiana Bat habitat located in the Cato Basin



PHOTOGRAPHIC RECORD

Client Name:

Federal Emergency Management Agency (FEMA) Department of Homeland Security

Site Location:

Quiggins Sinkhole Flood Mitigation Project
City of Radcliff, Hardin County, Kentucky
HSFEHQ-06-D-0162

Photo No. 33**Date:**

July 2013

Description:

Indiana Bat habitat located in the Wilson Basin

**Photo No. 34****Date:**

July 2013

Description:

Indiana Bat potential roost tree located in the Turner Basin



PHOTOGRAPHIC RECORD

Client Name:

Federal Emergency Management Agency (FEMA) Department of Homeland Security

Site Location:

Quiggins Sinkhole Flood Mitigation Project
City of Radcliff, Hardin County, Kentucky
HSFEHQ-06-D-0162

Photo No. 35**Date:**

July 2013

Description:

Indiana Bat habitat located in the Quiggins Basin



Attachment 3

OEPA QHEI and HHEI Data Sheets

Attachment 3

OEPA QHEI and HHEI Data Sheets

Stream & Location: Stream A

RM: _____ Date: 7/12/13

Keith Bowlin, Tyler Newman

Scorers Full Name & Affiliation: Jackson Environmental

River Code: _____

STORET #: _____

Lat./ Long.: _____

18

Office verified location

1] SUBSTRATE Check **ONLY** Two substrate TYPE BOXES; estimate % or note every type present

Check ONE (Or 2 & average)

BEST TYPES		OTHER TYPES		ORIGIN		QUALITY	
<input type="checkbox"/> BDR/SLABS [10]	<input type="checkbox"/> POOL RIFFLE	<input checked="" type="checkbox"/> HARDPAN [4]	<input type="checkbox"/> POOL RIFFLE	<input type="checkbox"/> LIMESTONE [1]	<input checked="" type="checkbox"/> SILT	<input checked="" type="checkbox"/> HEAVY [-2]	3
<input type="checkbox"/> BOULDER [9]	<input type="checkbox"/>	<input type="checkbox"/> DETRITUS [3]	<u>60</u> <u>40</u>	<input type="checkbox"/> TILLS [1]	<input type="checkbox"/>	<input type="checkbox"/> MODERATE [-1]	
<input type="checkbox"/> COBBLE [8]	<input type="checkbox"/>	<input type="checkbox"/> MUCK [2]	<input type="checkbox"/>	<input type="checkbox"/> WETLANDS [0]	<input type="checkbox"/>	<input type="checkbox"/> NORMAL [0]	
<input type="checkbox"/> GRAVEL [7]	<input type="checkbox"/>	<input checked="" type="checkbox"/> SILT [2]	<u>40</u> <u>40</u>	<input checked="" type="checkbox"/> HARDPAN [0]	<input type="checkbox"/>	<input type="checkbox"/> FREE [1]	
<input type="checkbox"/> SAND [6]	<input type="checkbox"/>	<input type="checkbox"/> ARTIFICIAL [0]	<input type="checkbox"/>	<input type="checkbox"/> SANDSTONE [0]	<input type="checkbox"/>	<input type="checkbox"/> EXTENSIVE [-2]	
<input type="checkbox"/> BEDROCK [5]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> RIP/RAP [0]	<input type="checkbox"/>	<input checked="" type="checkbox"/> MODERATE [-1]	

NUMBER OF BEST TYPES: 4 or more [2] 3 or less [0]

Comments _____

2] INSTREAM COVER Indicate presence 0 to 3: 0 Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

<input type="checkbox"/> UNDERCUT BANKS [1]	<input checked="" type="checkbox"/> POOLS > 70cm [2]	<input type="checkbox"/> OXBOWS, BACKWATERS [1]	5
<input checked="" type="checkbox"/> OVERHANGING VEGETATION [1]	<input type="checkbox"/> ROOTWADS [1]	<input type="checkbox"/> AQUATIC MACROPHYTES [1]	
<input type="checkbox"/> SHALLOWS (IN SLOW WATER) [1]	<input type="checkbox"/> BOULDERS [1]	<input type="checkbox"/> LOGS OR WOODY DEBRIS [1]	
<input type="checkbox"/> ROOTMATS [1]	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Comments _____

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

<input type="checkbox"/> HIGH [4]	<input type="checkbox"/> EXCELLENT [7]	<input type="checkbox"/> NONE [6]	<input type="checkbox"/> HIGH [3]
<input type="checkbox"/> MODERATE [3]	<input type="checkbox"/> GOOD [5]	<input type="checkbox"/> RECOVERED [4]	<input type="checkbox"/> MODERATE [2]
<input checked="" type="checkbox"/> LOW [2]	<input type="checkbox"/> FAIR [3]	<input type="checkbox"/> RECOVERING [3]	<input checked="" type="checkbox"/> LOW [1]
<input type="checkbox"/> NONE [1]	<input checked="" type="checkbox"/> POOR [1]	<input checked="" type="checkbox"/> RECENT OR NO RECOVERY [1]	

Comments _____

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

<input type="checkbox"/> NONE / LITTLE [3]	<input checked="" type="checkbox"/> WIDE > 50m [4]	<input checked="" type="checkbox"/> FOREST, SWAMP [3]	<input type="checkbox"/> CONSERVATION TILLAGE [1]
<input type="checkbox"/> MODERATE [2]	<input type="checkbox"/> MODERATE 10-50m [3]	<input checked="" type="checkbox"/> SHRUB OR OLD FIELD [2]	<input type="checkbox"/> URBAN OR INDUSTRIAL [0]
<input checked="" type="checkbox"/> HEAVY / SEVERE [1]	<input checked="" type="checkbox"/> NARROW 5-10m [2]	<input type="checkbox"/> RESIDENTIAL, PARK, NEW FIELD [1]	<input type="checkbox"/> MINING / CONSTRUCTION [0]
	<input type="checkbox"/> VERY NARROW < 5m [1]	<input type="checkbox"/> FENCED PASTURE [1]	
	<input type="checkbox"/> NONE [0]	<input type="checkbox"/> OPEN PASTURE, ROWCROP [0]	

Comments _____

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

<input checked="" type="checkbox"/> > 1m [6]	<input checked="" type="checkbox"/> POOL WIDTH > RIFFLE WIDTH [2]	<input type="checkbox"/> TORRENTIAL [-1]	<input checked="" type="checkbox"/> SLOW [1]
<input checked="" type="checkbox"/> 0.7-1m [4]	<input type="checkbox"/> POOL WIDTH = RIFFLE WIDTH [1]	<input type="checkbox"/> VERY FAST [1]	<input type="checkbox"/> INTERSTITIAL [-1]
<input type="checkbox"/> 0.4-0.7m [2]	<input type="checkbox"/> POOL WIDTH < RIFFLE WIDTH [0]	<input type="checkbox"/> FAST [1]	<input type="checkbox"/> INTERMITTENT [-2]
<input type="checkbox"/> 0.2-0.4m [1]		<input type="checkbox"/> MODERATE [1]	<input type="checkbox"/> EDDIES [1]
<input type="checkbox"/> < 0.2m [0]			

Comments _____

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: NO RIFFLE [metric=0]

<input type="checkbox"/> BEST AREAS > 10cm [2]	<input type="checkbox"/> MAXIMUM > 50cm [2]	<input type="checkbox"/> STABLE (e.g., Cobble, Boulder) [2]	<input type="checkbox"/> NONE [2]
<input type="checkbox"/> BEST AREAS 5-10cm [1]	<input type="checkbox"/> MAXIMUM < 50cm [1]	<input type="checkbox"/> MOD. STABLE (e.g., Large Gravel) [1]	<input type="checkbox"/> LOW [1]
<input type="checkbox"/> BEST AREAS < 5cm [metric=0]		<input type="checkbox"/> UNSTABLE (e.g., Fine Gravel, Sand) [0]	<input type="checkbox"/> MODERATE [0]
			<input type="checkbox"/> EXTENSIVE [-1]

Comments _____

6] GRADIENT (ft/mi) VERY LOW - LOW [2-4] MODERATE [6-10] HIGH - VERY HIGH [10-6]

DRAINAGE AREA (m²)

% POOL: 100 % GLIDE: _____ % RUN: _____ % RIFFLE: _____

Comments _____

A) SAMPLED REACH

Check ALL that apply

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- 1st -sample pass- 2nd
- HIGH
 - UP
 - NORMAL
 - LOW
 - DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st --sample pass-- 2nd
- < 20 cm
 - 20-40 cm
 - 40-70 cm
 - > 70 cm/ CTB
 - SECCHI DEPTH

B) AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

D) MAINTENANCE

- Circle some & COMMENT
- PUBLIC / PRIVATE / BOTH / NA
 - ACTIVE / HISTORIC / BOTH / NA
 - YOUNG / ~~SUCCESSION~~ / OLD
 - SPRAY / SNAG / REMOVED
 - MODIFIED / DIPPED OUT / NA
 - LEVEED / ONE SIDED
 - RELOCATED / CUTOFFS
 - MOVING-BEDLOAD-STABLE
 - ARMoured / SLUMPS
 - ISLANDS / SCURED
 - IMPOUNDED / DESICCATED
 - FLOOD CONTROL / DRAINAGE

E) ISSUES

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

F) MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x} width
- entrench. ratio
- Legacy Tree:

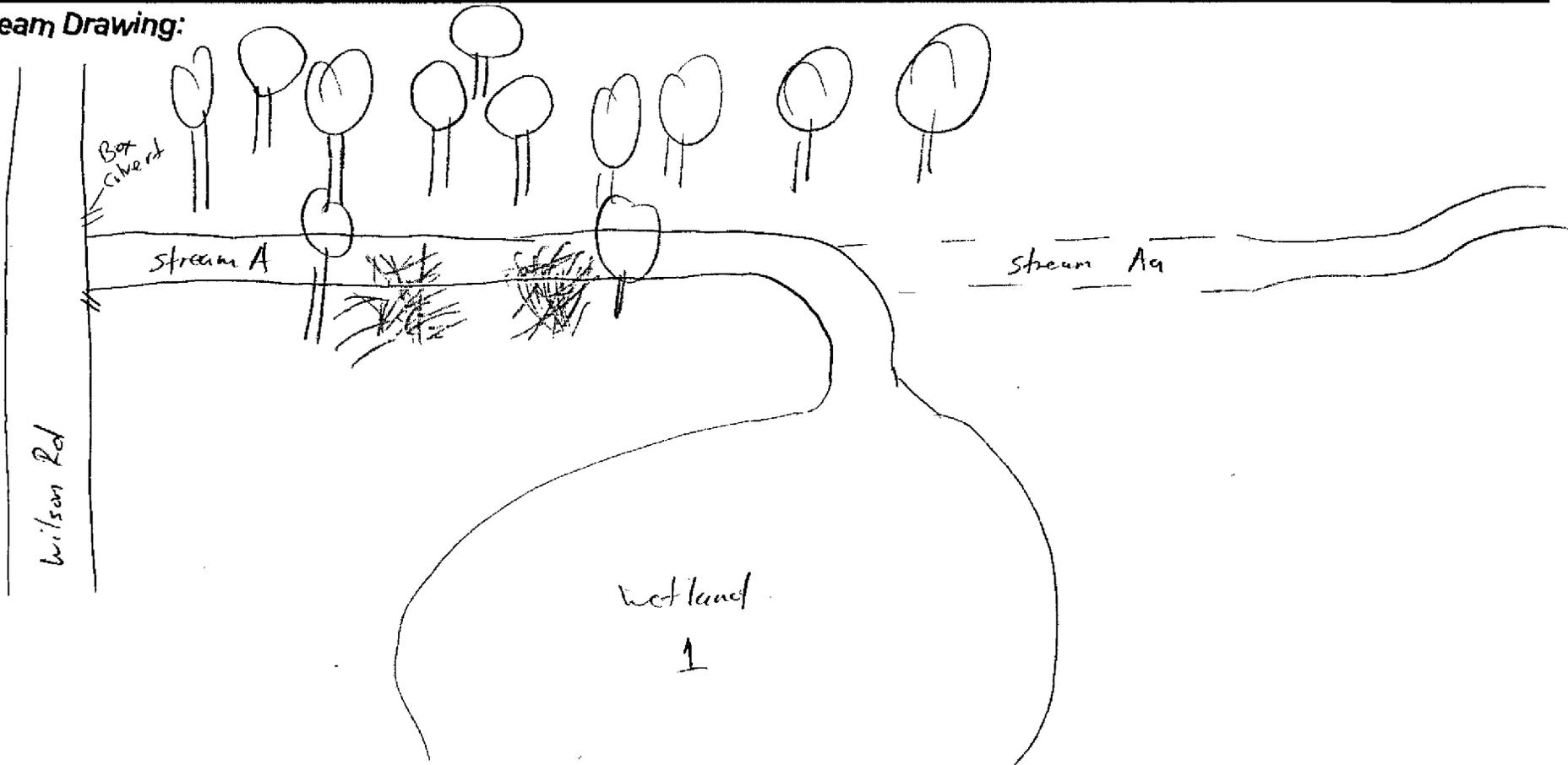
CANOPY

- 1st pass _____ cm
- 2nd pass _____ cm
- > 85% OPEN
 - 55% - < 85%
 - 30% - < 55%
 - 10% - < 30%
 - < 10% - CLOSED

C) RECREATION

- AREA DEPTH
- POOL: > 100ft² > 3ft

Stream Drawing:



Stream & Location: Aa RM: _____ Date: / /
Keith Bol. In, Tyler Newman Scorers Full Name & Affiliation:
 River Code: _____ STORET #: _____ Lat./ Long.: _____ /B Office verified location

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES, estimate % or note every type present

BEST TYPES	POOL RIFFLE	OTHER TYPES	POOL RIFFLE	ORIGIN	QUALITY
<input type="checkbox"/> BLDG/SLABS [10]	<input type="checkbox"/>	<input checked="" type="checkbox"/> HARDPAN [4]	<u>100</u> <u>100</u>	<input type="checkbox"/> LIMESTONE [1]	<input type="checkbox"/> HEAVY [-2]
<input type="checkbox"/> BOULDER [9]	<input type="checkbox"/>	<input type="checkbox"/> DETRITUS [3]	<input type="checkbox"/>	<input type="checkbox"/> TILLS [1]	<input type="checkbox"/> MODERATE [-1]
<input type="checkbox"/> COBBLE [8]	<input type="checkbox"/>	<input type="checkbox"/> MUCK [2]	<input type="checkbox"/>	<input type="checkbox"/> WETLANDS [0]	<input checked="" type="checkbox"/> NORMAL [0]
<input type="checkbox"/> GRAVEL [7]	<input type="checkbox"/>	<input type="checkbox"/> SILT [2]	<input type="checkbox"/>	<input checked="" type="checkbox"/> HARDPAN [0]	<input type="checkbox"/> FREE [1]
<input type="checkbox"/> SAND [6]	<input type="checkbox"/>	<input type="checkbox"/> ARTIFICIAL [0]	<input type="checkbox"/>	<input type="checkbox"/> SANDSTONE [0]	<input type="checkbox"/> EXTENSIVE [-2]
<input type="checkbox"/> BEDROCK [5]	<input type="checkbox"/>			<input type="checkbox"/> RIP/RAP [0]	<input type="checkbox"/> MODERATE [-1]
(Score natural substrates; ignore sludge from point-sources)				<input type="checkbox"/> LACUSTURINE [0]	<input checked="" type="checkbox"/> NORMAL [0]
NUMBER OF BEST TYPES: <input type="checkbox"/> 4 or more [2] <input checked="" type="checkbox"/> 3 or less [0]				<input type="checkbox"/> SHALE [-1]	<input type="checkbox"/> NONE [1]
Comments <u>clay stream bed</u>				<input type="checkbox"/> COAL FINES [-2]	

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

<input type="checkbox"/> UNDERCUT BANKS [1]	<input type="checkbox"/> POOLS > .70cm [2]	<input type="checkbox"/> OXBOWS, BACKWATERS [1]	<input type="checkbox"/> EXTENSIVE >75% [11]
<input type="checkbox"/> OVERHANGING VEGETATION [1]	<input type="checkbox"/> ROOTWADS [1]	<input type="checkbox"/> AQUATIC MACROPHYTES [1]	<input type="checkbox"/> MODERATE 25-75% [7]
<u>1</u> <input type="checkbox"/> SHALLOWS (IN SLOW WATER) [1]	<input type="checkbox"/> BOULDERS [1]	<u>1</u> <input type="checkbox"/> LOGS OR WOODY DEBRIS [1]	<input checked="" type="checkbox"/> SPARSE 5-<25% [3]
<input type="checkbox"/> ROOTMATS [1]			<input type="checkbox"/> NEARLY ABSENT <5% [1]

Comments
Amount 5

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
<input type="checkbox"/> HIGH [4]	<input type="checkbox"/> EXCELLENT [7]	<input type="checkbox"/> NONE [6]	<input type="checkbox"/> HIGH [3]
<input type="checkbox"/> MODERATE [3]	<input type="checkbox"/> GOOD [5]	<input type="checkbox"/> RECOVERED [4]	<input type="checkbox"/> MODERATE [2]
<input checked="" type="checkbox"/> LOW [2]	<input type="checkbox"/> FAIR [3]	<input type="checkbox"/> RECOVERING [3]	<input checked="" type="checkbox"/> LOW [1]
<input type="checkbox"/> NONE [1]	<input checked="" type="checkbox"/> POOR [1]	<input checked="" type="checkbox"/> RECENT OR NO RECOVERY [1]	

Comments
channelized and eroded

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

EROSION	RIPARIAN WIDTH	FLOOD PLAIN QUALITY
<input type="checkbox"/> NONE/LITTLE [3]	<input type="checkbox"/> WIDE > 50m [4]	<input checked="" type="checkbox"/> FOREST, SWAMP [3]
<input checked="" type="checkbox"/> MODERATE [2]	<input type="checkbox"/> MODERATE 10-50m [3]	<input type="checkbox"/> SHRUB OR OLD FIELD [2]
<input type="checkbox"/> HEAVY/SEVERE [1]	<input type="checkbox"/> NARROW 5-10m [2]	<input type="checkbox"/> RESIDENTIAL, PARK, NEW FIELD [1]
	<input type="checkbox"/> VERY NARROW < 5m [1]	<input type="checkbox"/> FENCED PASTURE [1]
	<input type="checkbox"/> NONE [0]	<input type="checkbox"/> OPEN PASTURE, ROWCROP [0]
		<input type="checkbox"/> CONSERVATION TILLAGE [1]
		<input type="checkbox"/> URBAN OR INDUSTRIAL [0]
		<input type="checkbox"/> MINING / CONSTRUCTION [0]

Comments
Channel 5
Riparian 8

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH Check ONE (ONLY!)	CHANNEL WIDTH Check ONE (Or 2 & average)	CURRENT VELOCITY Check ALL that apply	Recreation Potential Primary Contact Secondary Contact (circle one and comment on back)
<input type="checkbox"/> > 1m [6]	<input type="checkbox"/> POOL WIDTH > RIFFLE WIDTH [2]	<input type="checkbox"/> TORRENTIAL [-1]	Pool / Current 2
<input type="checkbox"/> 0.7-1m [4]	<input checked="" type="checkbox"/> POOL WIDTH = RIFFLE WIDTH [1]	<input checked="" type="checkbox"/> SLOW [1]	
<input type="checkbox"/> 0.4-0.7m [2]	<input type="checkbox"/> POOL WIDTH < RIFFLE WIDTH [0]	<input type="checkbox"/> VERY FAST [1]	
<input type="checkbox"/> 0.2-0.4m [1]		<input type="checkbox"/> FAST [1]	
<input checked="" type="checkbox"/> < 0.2m [0]		<input type="checkbox"/> MODERATE [1]	

Comments
Indicate for reach - pools and riffles.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average)

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
<input type="checkbox"/> BEST AREAS > 10cm [2]	<input type="checkbox"/> MAXIMUM > 50cm [2]	<input type="checkbox"/> STABLE (e.g., Cobble, Boulder) [2]	<input type="checkbox"/> NONE [2]
<input checked="" type="checkbox"/> BEST AREAS 5-10cm [1]	<input checked="" type="checkbox"/> MAXIMUM < 50cm [1]	<input type="checkbox"/> MOD. STABLE (e.g., Large Gravel) [1]	<input type="checkbox"/> LOW [1]
<input type="checkbox"/> BEST AREAS < 5cm [metric=0]		<input checked="" type="checkbox"/> UNSTABLE (e.g., Fine Gravel, Sand) [0]	<input checked="" type="checkbox"/> MODERATE [0]
			<input type="checkbox"/> EXTENSIVE [-1]

Comments
Riffle / Run 2

6] GRADIENT (ft/mi) VERY LOW / LOW [2-4] MODERATE [6-10] HIGH / VERY HIGH [10-6]

DRAINAGE AREA (mi²)

% POOL: 10 **% GLIDE:** 0

% RUN: 40 **% RIFFLE:** 55

Gradient 3

A) SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

120m
meters

CANOPY

- > 85% - OPEN
- 55% - 85%
- 30% - 55%
- 10% - 30%
- < 10% - CLOSED

STAGE

- 1st - sample pass - 2nd
- HIGH
 - UP
 - NORMAL
 - LOW
 - DRY

CLARITY

- 1st - sample pass - 2nd
- < 20 cm
 - 20 - 40 cm
 - 40 - 70 cm
 - > 70 cm / CTB
 - SECCHI DEPTH

- 1st _____ cm
- 2nd _____ cm

C) RECREATION

- AREA DEPTH
- POOL: > 100 ft² > 3ft

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

Stream Aa begins as an ephemeral overflow channel to stream A entering wetland 1 (Drainage basin); Stream is then fed by wetland 2 in a small channel; Stream then runs to a culvert that crosses under Dixie Highway.

B) AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs / SSOs / OUTFALLS

D) MAINTENANCE

- Circle some & COMMENT
- PUBLIC / PRIVATE / BOTH (NA)
 - ACTIVE / HISTORIC / BOTH / NA
 - YOUNG SUCCESSION - OLD
 - SPRAY / SNAG / REMOVED
 - MODIFIED / DIPPED OUT / NA
 - LEVEED / ONE SIDED
 - RELOCATED / CUTOFFS
 - MOVING - BEDLOAD - STABLE
 - ARMOURED / SLUMPS
 - ISLANDS / SCOURED
 - IMPOUNDED / DESICCATED
 - FLOOD CONTROL / DRAINAGE

E) ISSUES

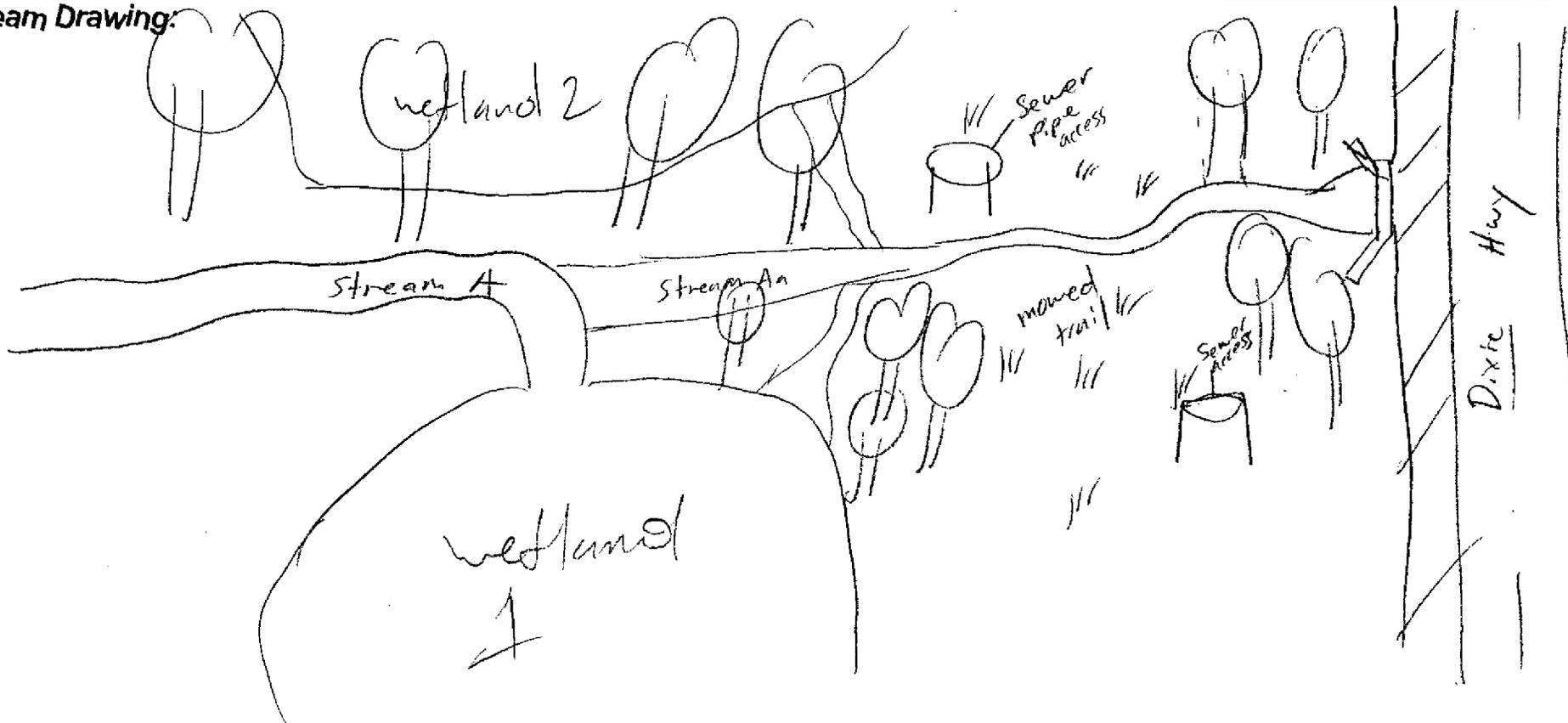
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT & GRIME
- CONTAMINATED / LANDFILL
- BMPs - CONSTRUCTION - SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL (WETLAND) / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

F) MEASUREMENTS

- x width
- x depth
- max. depth
- x bankfull width
- bankfull x depth
- W/D ratio
- bankfull max. depth
- floodprone x² width
- entrench. ratio

Legacy Tree:

Stream Drawing:





Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) :

6

SITE NAME/LOCATION Stream R

SITE NUMBER _____ RIVER BASIN _____ DRAINAGE AREA (mi²) _____

LENGTH OF STREAM REACH (ft) 258 LAT. _____ LONG. _____ RIVER CODE _____ RIVER MILE _____

DATE 7/2/2013 SCORER K. Bouch COMMENTS _____

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL NONE / NATURAL CHANNEL RECOVERED RECOVERING RECENT OR NO RECOVERY
MODIFICATIONS:

1. **SUBSTRATE** (Estimate percent of every type of substrate present. Check ONLY two predominant substrate TYPE boxes (Max of 40). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.)

TYPE	PERCENT	TYPE	PERCENT
<input type="checkbox"/> BLDR SLABS [16 pts]	_____	<input type="checkbox"/> SILT [3 pt]	_____
<input type="checkbox"/> BOULDER (>256 mm) [16 pts]	_____	<input type="checkbox"/> LEAF PACK/WOODY DEBRIS [3 pts]	_____
<input type="checkbox"/> BEDROCK [16 pt]	_____	<input type="checkbox"/> FINE DETRITUS [3 pts]	_____
<input type="checkbox"/> COBBLE (65-256 mm) [12 pts]	_____	<input checked="" type="checkbox"/> CLAY or HARDPAN [0 pt]	<u>100</u>
<input type="checkbox"/> GRAVEL (2-64 mm) [9 pts]	_____	<input type="checkbox"/> MUCK [0 pts]	_____
<input type="checkbox"/> SAND (<2 mm) [6 pts]	_____	<input type="checkbox"/> ARTIFICIAL [3 pts]	_____

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock (A) 0 (B) 1

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: _____ TOTAL NUMBER OF SUBSTRATE TYPES: 1

2. **Maximum Pool Depth** (Measure the maximum pool depth within the 61 meter (200 ft) evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check ONLY one box):

<input type="checkbox"/> > 30 centimeters [20 pts]	<input type="checkbox"/> > 5 cm - 10 cm [15 pts]
<input type="checkbox"/> > 22.5 - 30 cm [30 pts]	<input type="checkbox"/> < 5 cm [5 pts]
<input type="checkbox"/> > 10 - 22.5 cm [25 pts]	<input checked="" type="checkbox"/> NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS _____ MAXIMUM POOL DEPTH (centimeters): 0

3. **BANK FULL WIDTH** (Measured as the average of 3-4 measurements) (Check ONLY one box):

<input type="checkbox"/> > 4.0 meters (> 13') [30 pts]	<input type="checkbox"/> > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
<input type="checkbox"/> > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	<input checked="" type="checkbox"/> ≤ 1.0 m (≤ 3' 3") [5 pts]
<input type="checkbox"/> > 1.5 m - 3.0 m (> 4' 8" - 9' 7") [20 pts]	

COMMENTS _____ AVERAGE BANKFULL WIDTH (meters): 5

HHEI Metric Points

Substrate Max = 40
1

A + B

Pool Depth Max = 30
0

Bankfull Width Max = 30
5

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH		FLOODPLAIN QUALITY	
L	R	L	R
<input type="checkbox"/> Wide > 10m	<input type="checkbox"/> Moderate 5-10m	<input type="checkbox"/> Mature Forest, Wetland	<input type="checkbox"/> Immature Forest, Shrub or Old Field
<input checked="" type="checkbox"/> Moderate 5-10m	<input type="checkbox"/> Narrow <5m	<input type="checkbox"/> Residential, Park, New Field	<input type="checkbox"/> Fenced Pasture
<input type="checkbox"/> Narrow <5m	<input type="checkbox"/> None	<input type="checkbox"/> Conservation Tillage	<input type="checkbox"/> Urban or Industrial
<input type="checkbox"/> None		<input type="checkbox"/> Open Pasture, Row Crop	<input type="checkbox"/> Mining or Construction

COMMENTS Entrenched stream with shrubs and immature trees

FLOW REGIME (At Time of Evaluation) (Check ONLY one box):

<input type="checkbox"/> Stream Flowing	<input type="checkbox"/> Moist Channel, isolated pools, no flow (intermittent)
<input type="checkbox"/> Subsurface flow with isolated pools (Interstitial)	<input checked="" type="checkbox"/> Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check ONLY one box):

<input type="checkbox"/> None	<input checked="" type="checkbox"/> 0.5	<input type="checkbox"/> 1.0	<input type="checkbox"/> 2.0	<input type="checkbox"/> 3.0
<input type="checkbox"/> 0.5	<input type="checkbox"/> 1.5	<input type="checkbox"/> 2.5	<input type="checkbox"/> >3	

STREAM GRADIENT ESTIMATE

<input type="checkbox"/> Flat (0.5 ft/100 ft)	<input type="checkbox"/> Flat to Moderate	<input checked="" type="checkbox"/> Moderate (2 ft/100 ft)	<input type="checkbox"/> Moderate to Severe	<input type="checkbox"/> Severe (10 ft/100 ft)
---	---	--	---	--

ADDITIONAL STREAM INFORMATION (This information must also be completed):

QHEI PERFORMED? - Yes No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

WWH Name: _____ Distance from Evaluated Stream _____
 CWH Name: _____ Distance from Evaluated Stream _____
 EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Vine Grove NRCS Soil Map Page: _____ NRCS Soil Map Stream Order _____
County: Hardin Township / City: Radcliff, KY

MISCELLANEOUS

Base Flow Conditions? (Y/N): Y Date of last precipitation: 7/1/2013 Quantity: _____

Photograph Information: _____

Elevated Turbidity? (Y/N): N Canopy (% open): 50%

Were samples collected for water chemistry? (Y/N): N (Note lab sample no. or id. and attach results) Lab Number: _____

Field Measures: Temp (°C) _____ Dissolved Oxygen (mg/l) _____ pH (S.U.) _____ Conductivity (µmhos/cm) _____

Is the sampling reach representative of the stream (Y/N) Y If not, please explain: _____

Additional comments/description of pollution impacts: Possible sewage discharge from pump/station, stream flow originates from a road side drainage ditch

BIOTIC EVALUATION

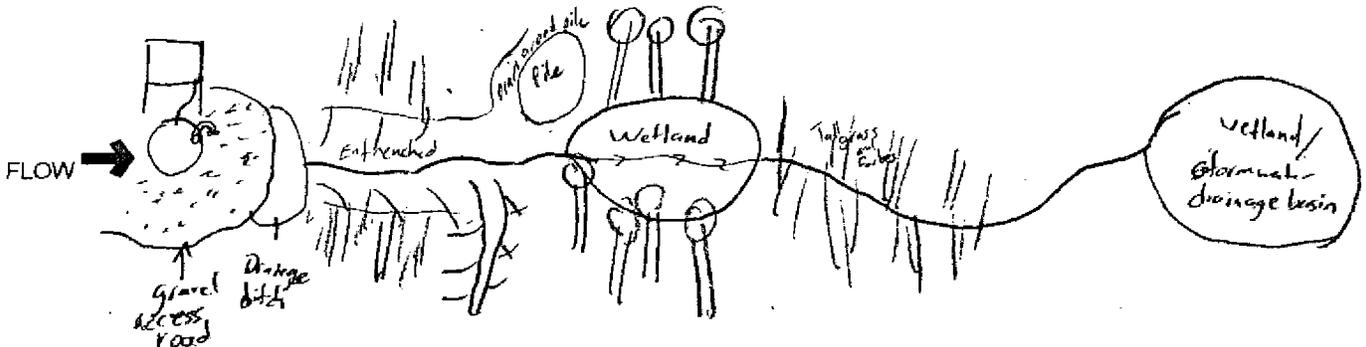
Performed? (Y/N): N (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

Fish Observed? (Y/N) _____ Voucher? (Y/N) _____ Salamanders Observed? (Y/N) _____ Voucher? (Y/N) _____
Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) _____ Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) _____

Comments Regarding Biology: _____

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location



Stream & Location: Stream A1

RM: Date: 7/2/2012

Keith Bowling, Tyler Newman

Scorers Full Name & Affiliation: Jackson Environmental

River Code: - - -

STORET #: - - -

Lat./ Long.: (NAD 83, decimal)

18

Office verified location

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES. estimate % or note every type present

Check ONE (Or 2 & average)

Substrate assessment table with categories: BEST TYPES, OTHER TYPES, ORIGIN, QUALITY. Includes checkboxes for BLDR/SLABS, BOULDER, COBBLE, GRAVEL, SAND, BEDROCK, HARDPAN, DETRITUS, MUCK, SILT, ARTIFICIAL, LIMESTONE, TILLS, WETLANDS, SANDSTONE, RIP/RAP, LACUSTURINE, SHALE, COAL FINES, HEAVY, MODERATE, NORMAL, FREE, EXTENSIVE, NONE.

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

AMOUNT Check ONE (Or 2 & average)

Instream Cover assessment table with categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS. Includes checkboxes for presence and amount.

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

Channel Morphology assessment table with categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes checkboxes for HIGH, MODERATE, LOW, NONE, EXCELLENT, GOOD, FAIR, POOR, NONE, RECOVERED, RECOVERING, RECENT OR NO RECOVERY, HIGH, MODERATE, LOW.

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

Bank Erosion and Riparian Zone assessment table with categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY. Includes checkboxes for NONE, MODERATE, HEAVY/SEVERE, WIDE, MODERATE, NARROW, VERY NARROW, NONE, FOREST/SWAMP, SHRUB/OLD FIELD, RESIDENTIAL/PARK/NEW FIELD, FENCED PASTURE, OPEN PASTURE/ROWCROP, CONSERVATION TILLAGE, URBAN OR INDUSTRIAL, MINING/CONSTRUCTION.

5) POOL / GLIDE AND RIFFLE / RUN QUALITY

Pool / Glide and Riffle / Run Quality assessment table with categories: MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY, Recreation Potential. Includes checkboxes for depth, width, velocity, and recreation potential.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). NO RIFFLE [metric=0]

Riffle / Run Quality assessment table with categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes checkboxes for riffle depth, run depth, substrate, and embeddedness.

Gradient and Drainage Area assessment table with categories: GRADIENT, DRAINAGE AREA. Includes checkboxes for gradient and drainage area.

A) SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- HIGH
- UP
- NORMAL
- LOW
- DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st - sample pass - 2nd
- < 20 cm
- 20-40 cm
- 40-70 cm
- > 70 cm / CTB
- SECCHI DEPTH

meters

CANOPY

- > 85% - OPEN
- 55% - 85%
- 30% - 55%
- 10% - 30%
- < 10% - CLOSED

- 1st _____ cm
- 2nd _____ cm

C) RECREATION

- AREA DEPTH
- POOL: >100ft² >3ft

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

B) AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

D) MAINTENANCE

Circle some & COMMENT

- PUBLIC (PRIVATE) BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMOURED / SLUMPS
- ISLANDS / SCoured
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

They had been recently pruned

E) ISSUES

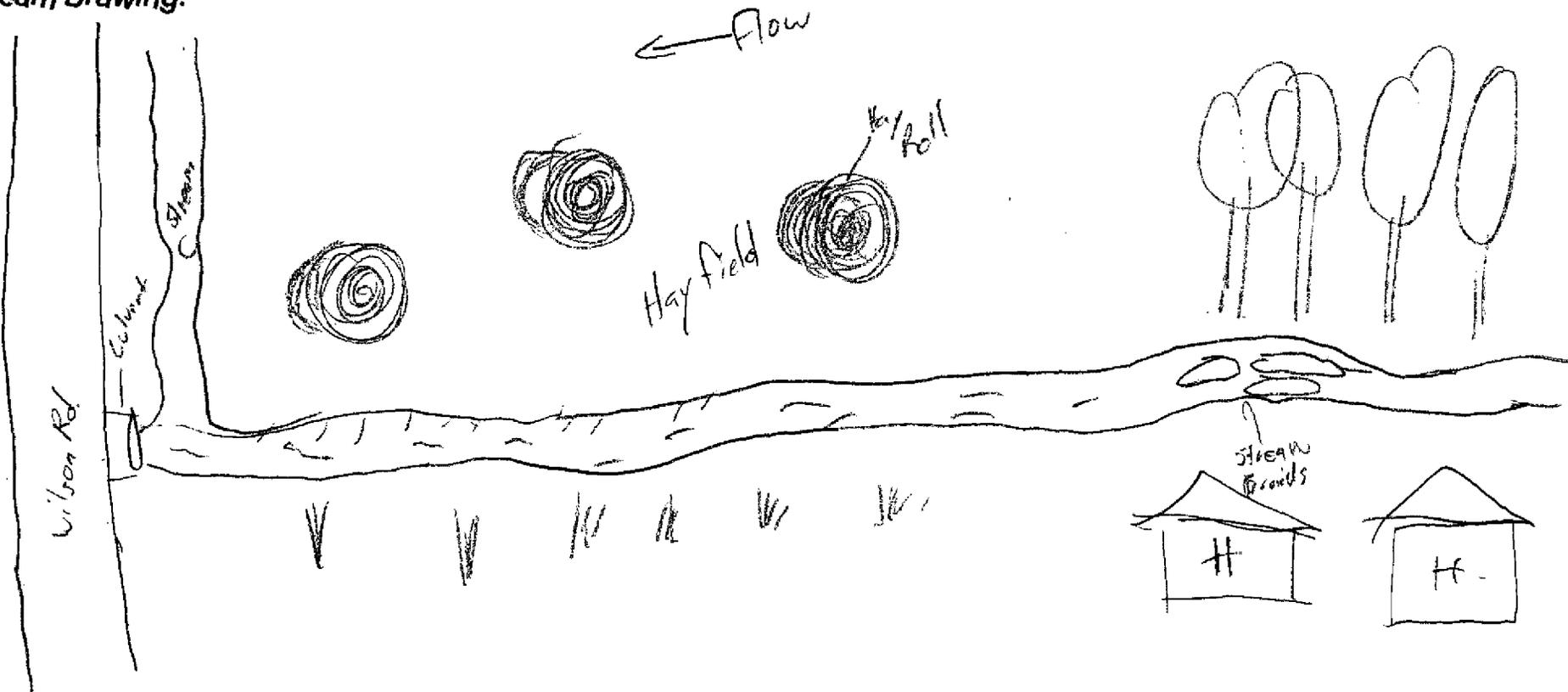
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- *BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

F) MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone x^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Stream C

RM: Date: 07/02/13

Scorers Full Name & Affiliation: Keith Bowlin/Tyler Newman FELC

River Code: STORET #: Lat./Long.: 18 Office verified location

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

Check ONE (Or 2 & average)

Form for Substrate assessment including categories: BEST TYPES, OTHER TYPES, ORIGIN, POOL RIFFLE, and QUALITY. Includes checkboxes for various substrate types and a score box for 15.

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

AMOUNT

Check ONE (Or 2 & average)

Form for Instream Cover assessment including categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS. Includes checkboxes and a score box for 9.

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

Form for Channel Morphology assessment including categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes checkboxes and a score box for 5.

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

Form for Bank Erosion and Riparian Zone assessment including categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY, CONSERVATION TILLAGE, URBAN OR INDUSTRIAL, MINING / CONSTRUCTION. Includes checkboxes and a score box for 2.

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

Form for Pool / Glide and Riffle / Run Quality assessment including categories: MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY, Recreation Potential. Includes checkboxes and a score box for 4.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average).

Form for Riffle / Run Quality assessment including categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes checkboxes and a score box for 3.

Form for Gradient assessment including categories: DRAINAGE AREA, GRADIENT, % POOL, % GLIDE, % RUN, % RIFFLE. Includes checkboxes and a score box for 6.

A) SAMPLED REACH

Check ALL that apply

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

1st -sample pass- 2nd

- HIGH
- UP
- NORMAL
- LOW
- DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

200 m
meters

CLARITY

1st -sample pass- 2nd

- < 20 cm
- 20-40 cm
- 40-70 cm
- > 70 cm/ CTB
- SECCHI DEPTH

CANOPY

1st _____ cm

2nd _____ cm

- > 85% - OPEN
- 55% - 85%
- 30% - 55%
- 10% - 30%
- < 10% - CLOSED

C) RECREATION

AREA DEPTH
POOL: >100ft² >3ft

B) AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

D) MAINTENANCE

- PUBLIC / PRIVATE (BOTH) / NA
- ACTIVE / HISTORIC / (BOTH) / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

Circle some & COMMENT

E) ISSUES

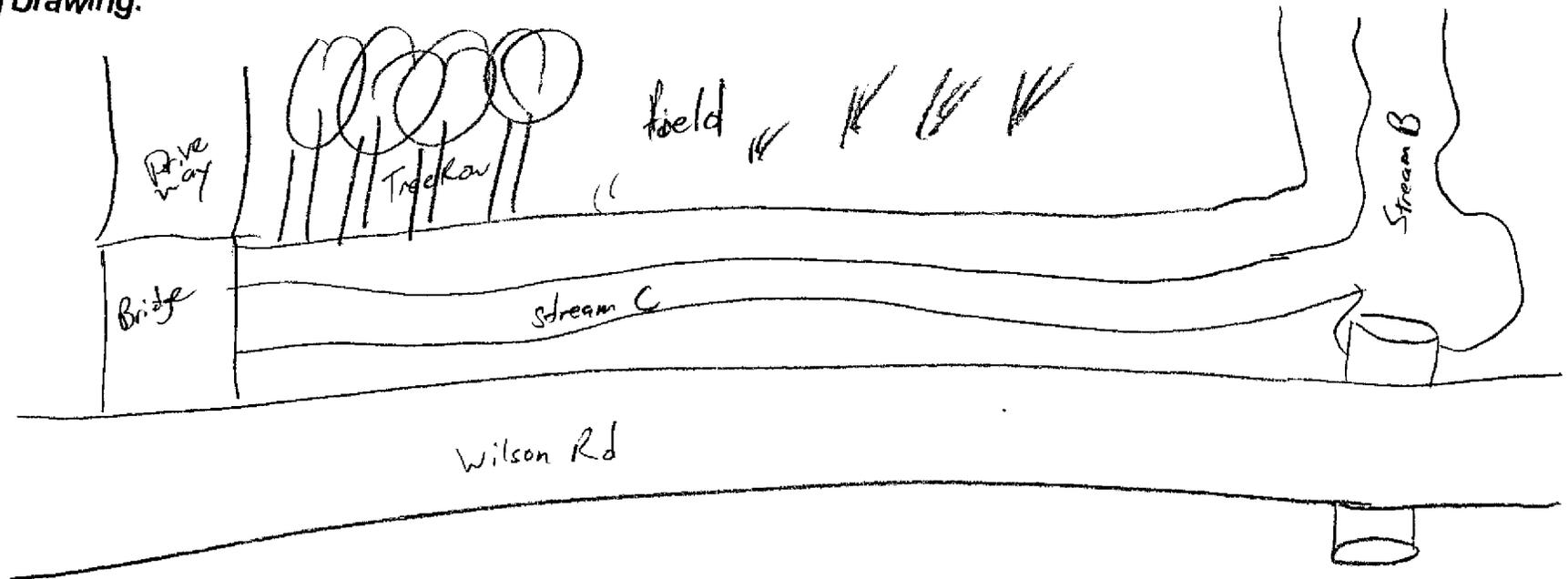
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK (EROSION) SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

F) MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Stream D

RM: Date: 7/2/2013

K. Bowlin T. Newman

Scorers Full Name & Affiliation:

River Code:

STORET #:

Lat./ Long.:

18

Office verified location

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES, estimate % or note every type present

Check ONE (Or 2 & average)

BEST TYPES

POOL RIFFLE

OTHER TYPES

POOL RIFFLE

ORIGIN

QUALITY

- BDLR/SLABS [10]
BOULDER [9]
COBBLE [8]
GRAVEL [7]
SAND [6]
BEDROCK [5]

- POOL RIFFLE

- HARDPAN [4]
DETRITUS [3]
MUCK [2]
SILT [2]
ARTIFICIAL [0]

- POOL RIFFLE

- LIMESTONE [1]
TILLS [1]
WETLANDS [0]
HARDPAN [0]
SANDSTONE [0]
RIP/RAP [0]
LACUSTURINE [0]
SHALE [-1]
COAL FINES [-2]

SILT

EMBEDDEDNESS

- HEAVY [-2]
MODERATE [-1]
NORMAL [0]
FREE [1]
EXTENSIVE [-2]
MODERATE [-1]
NORMAL [0]
NONE [1]

Substrate Maximum 20 5

NUMBER OF BEST TYPES: 4 or more [2] 3 or less [0]

Comments

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts

AMOUNT

Check ONE (Or 2 & average)

- UNDERCUT BANKS [1]
OVERHANGING VEGETATION [1]
SHALLOWS (IN SLOW WATER) [1]
ROOTMATS [1]

- POOLS > 70cm [2]
ROOTWADS [1]
BOULDERS [1]

- OXBOWS/BACKWATERS [1]
AQUATIC MACROPHYTES [1]
LOGS OR WOODY DEBRIS [1]

- EXTENSIVE >75% [11]
MODERATE 25-75% [7]
SPARSE 5-<25% [3]
NEARLY ABSENT <5% [1]

Cover Maximum 20 9

Comments

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

SINUOSITY

DEVELOPMENT

CHANNELIZATION

STABILITY

- HIGH [4]
MODERATE [3]
LOW [2]
NONE [1]

- EXCELLENT [7]
GOOD [5]
FAIR [3]
POOR [1]

- NONE [6]
RECOVERED [4]
RECOVERING [3]
RECENT OR NO RECOVERY [1]

- HIGH [3]
MODERATE [2]
LOW [1]

Channel Maximum 20 11

Comments

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION

RIPARIAN WIDTH

FLOOD PLAIN QUALITY

- NONE/LITTLE [3]
MODERATE [2]
HEAVY/SEVERE [1]

- WIDE > 50m [4]
MODERATE 10-50m [3]
NARROW 5-10m [2]
VERY NARROW < 5m [1]
NONE [0]

- FOREST, SWAMP [3]
SHRUB OR OLD FIELD [2]
RESIDENTIAL, PARK, NEW FIELD [1]
FENCED PASTURE [1]
OPEN PASTURE, ROWCROP [0]

- CONSERVATION TILLAGE [1]
URBAN OR INDUSTRIAL [0]
MINING / CONSTRUCTION [0]

Indicate predominant land use(s) past 100m riparian.

Riparian Maximum 10 8

Comments

5) POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH

CHANNEL WIDTH

CURRENT VELOCITY

Check ONE (ONLY)

Check ONE (Or 2 & average)

Check ALL that apply

- > 1m [6]
0.7-<1m [4]
0.4-<0.7m [2]
0.2-<0.4m [1]
< 0.2m [0]

- POOL WIDTH > RIFFLE WIDTH [2]
POOL WIDTH = RIFFLE WIDTH [1]
POOL WIDTH < RIFFLE WIDTH [0]

- TORRENTIAL [-1]
VERY FAST [1]
FAST [1]
MODERATE [1]
SLOW [1]
INTERSTITIAL [-1]
INTERMITTENT [-2]
EDDIES [1]

Indicate for reach - pools and riffles.

Recreation Potential Primary Contact Secondary Contact

Pool / Current Maximum 12 4

Comments

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

Check ONE (Or 2 & average)

NO RIFFLE [metric=0]

RIFFLE DEPTH

RUN DEPTH

RIFFLE / RUN SUBSTRATE

RIFFLE / RUN EMBEDDEDNESS

- BEST AREAS > 10cm [2]
BEST AREAS 5-10cm [1]
BEST AREAS < 5cm [metric=0]

- MAXIMUM > 50cm [2]
MAXIMUM < 50cm [1]

- STABLE (e.g., Cobble, Boulder) [2]
MOD. STABLE (e.g., Large Gravel) [1]
UNSTABLE (e.g., Fine Gravel, Sand) [0]

- NONE [2]
LOW [1]
MODERATE [0]
EXTENSIVE [-1]

Riffle / Run Maximum 8 0

Comments

6) GRADIENT

DRAINAGE AREA

ft/mi

- VERY LOW LOW [2-4]
MODERATE [6-10]
HIGH VERY HIGH [10-6]

mi²

% POOL:

% GLIDE:

% RUN:

% RIFFLE:

Gradient Maximum 10 4

A) SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- 1st -sample pass- 2nd
- HIGH
 - UP
 - NORMAL
 - LOW
 - DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st -sample pass- 2nd
- < 20 cm
 - 20-40 cm
 - 40-70 cm
 - > 70 cm/ CTB
 - SECCHI DEPTH

B) AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

D) MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCOURED
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

Circle some & COMMENT

E) ISSUES

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

F) MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

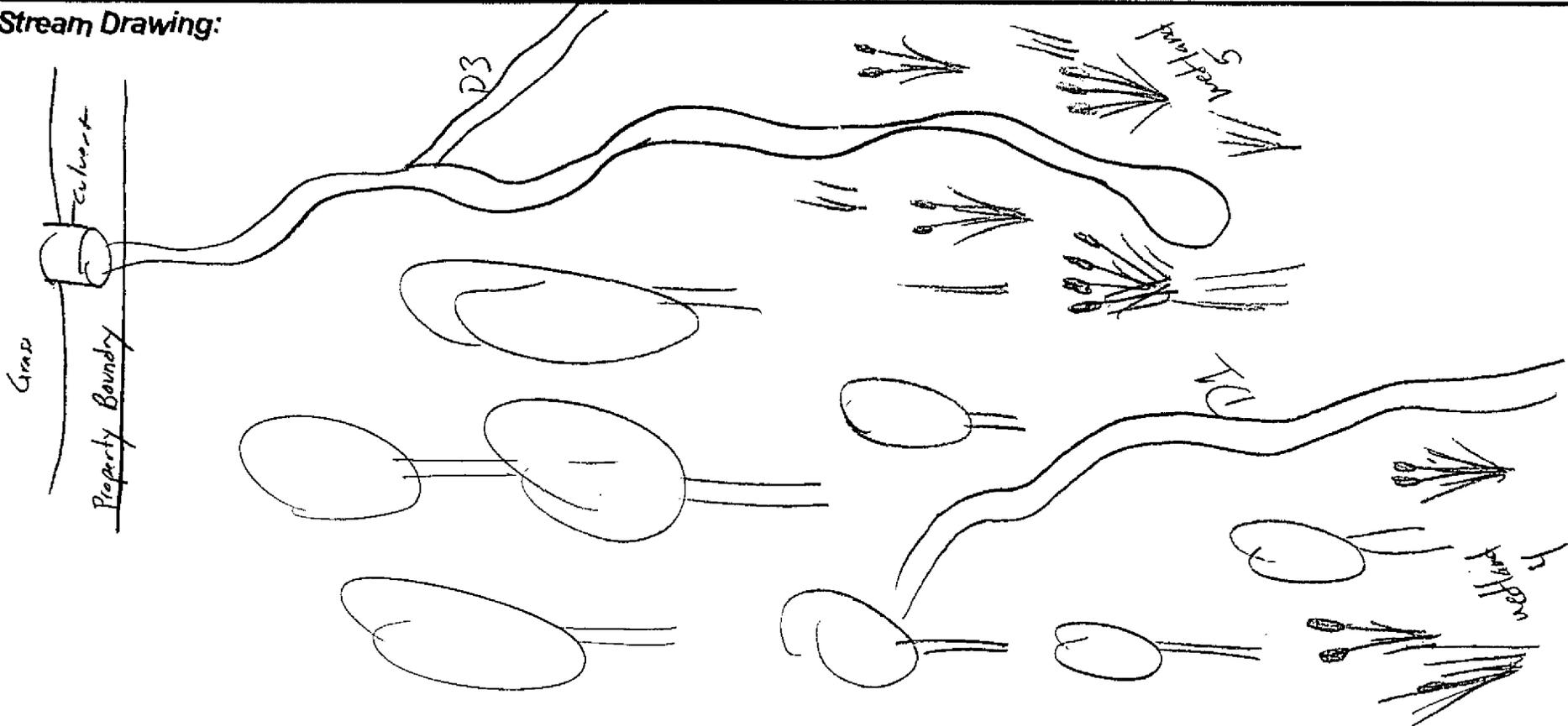
CANOPY

- 1st pass _____ cm
- 2nd pass _____ cm
- > 85% - OPEN
 - 65% - < 85%
 - 30% - < 55%
 - 10% - < 30%
 - < 10% - CLOSED

C) RECREATION

- AREA DEPTH
- POOL: > 100ft² > 3ft

Stream Drawing:





Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) :

36

SITE NAME/LOCATION Stream D

SITE NUMBER _____ RIVER BASIN _____ DRAINAGE AREA (mi²) _____

LENGTH OF STREAM REACH (ft) _____ LAT. _____ LONG. _____ RIVER CODE _____ RIVER MILE _____

DATE 7/2/2013 SCORER K. Bowlin COMMENTS _____

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for instructions

STREAM CHANNEL NONE / NATURAL CHANNEL RECOVERED RECOVERING RECENT OR NO RECOVERY

MODIFICATIONS:

1. **SUBSTRATE** (Estimate percent of every type of substrate present. Check ONLY two predominant substrate TYPE boxes (Max of 40). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE	PERCENT	TYPE	PERCENT
<input type="checkbox"/> BLD R SLABS [16 pts]	_____	<input type="checkbox"/> SILT [3 pt]	_____
<input type="checkbox"/> BOULDER (>256 mm) [16 pts]	_____	<input checked="" type="checkbox"/> LEAF PACK/WOODY DEBRIS [3 pts]	_____
<input type="checkbox"/> BEDROCK [16 pt]	_____	<input type="checkbox"/> FINE DETRITUS [3 pts]	_____
<input type="checkbox"/> COBBLE (65-256 mm) [12 pts]	_____	<input checked="" type="checkbox"/> CLAY or HARDSAN [0 pt]	_____
<input type="checkbox"/> GRAVEL (2-64 mm) [9 pts]	_____	<input type="checkbox"/> MUCK [0 pts]	_____
<input type="checkbox"/> SAND (<2 mm) [6 pts]	_____	<input type="checkbox"/> ARTIFICIAL [3 pts]	_____

Total Percentages of Bldr Slabs, Boulder, Cobble, Bedrock: 0 (A) 3 (B) 3

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: _____ TOTAL NUMBER OF SUBSTRATE TYPES: 3

2. **Maximum Pool Depth** (Measure the maximum pool depth within the 61 meter (200 ft) evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check ONLY one box):

<input type="checkbox"/> > 30 centimeters [20 pts]	<input checked="" type="checkbox"/> > 5 cm - 10 cm [15 pts]
<input type="checkbox"/> > 22.5 - 30 cm [30 pts]	<input type="checkbox"/> < 5 cm [5 pts]
<input type="checkbox"/> > 10 - 22.5 cm [25 pts]	<input type="checkbox"/> NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS _____ MAXIMUM POOL DEPTH (centimeters): 15

3. **BANK FULL WIDTH** (Measured as the average of 3-4 measurements) (Check ONLY one box):

<input type="checkbox"/> > 4.0 meters (> 13') [30 pts]	<input checked="" type="checkbox"/> > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
<input type="checkbox"/> > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	<input type="checkbox"/> ≤ 1.0 m (≤ 3' 3") [5 pts]
<input type="checkbox"/> > 1.5 m - 3.0 m (> 4' 8" - 9' 7") [20 pts]	

COMMENTS Entrenched AVERAGE BANKFULL WIDTH (meters): 15

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY *NOTE: River Left (L) and Right (R) as looking downstream*

RIPARIAN WIDTH		FLOODPLAIN QUALITY	
L	R	L	R
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Wide >10m	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Mature Forest, Wetland
<input type="checkbox"/>	Moderate 5-10m	<input type="checkbox"/>	Immature Forest, Shrub or Old Field
<input type="checkbox"/>	Narrow <5m	<input type="checkbox"/>	Residential, Park, New Field
<input type="checkbox"/>	None	<input type="checkbox"/>	Fenced Pasture
		<input type="checkbox"/>	Conservation Tillage
		<input type="checkbox"/>	Urban or Industrial
		<input type="checkbox"/>	Open Pasture, Row Crop
		<input type="checkbox"/>	Mining or Construction

COMMENTS _____

FLOW REGIME (At Time of Evaluation) (Check ONLY one box):

<input checked="" type="checkbox"/> Stream Flowing	<input type="checkbox"/> Moist Channel, isolated pools, no flow (Intermittent)
<input type="checkbox"/> Subsurface flow with isolated pools (Interstitial)	<input type="checkbox"/> Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check ONLY one box):

<input type="checkbox"/> None	<input type="checkbox"/> 1.0	<input type="checkbox"/> 2.0	<input type="checkbox"/> 3.0
<input type="checkbox"/> 0.5	<input type="checkbox"/> 1.5	<input checked="" type="checkbox"/> 2.5	<input type="checkbox"/> >3

STREAM GRADIENT ESTIMATE

<input type="checkbox"/> Flat (0.5 ft/100 ft)	<input type="checkbox"/> Flat to Moderate	<input checked="" type="checkbox"/> Moderate (2 ft/100 ft)	<input type="checkbox"/> Moderate to Severe	<input type="checkbox"/> Severe (10 ft/100 ft)
---	---	--	---	--

ADDITIONAL STREAM INFORMATION (This information must also be completed):

QHEI PERFORMED? - Yes No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

WWH Name: _____ Distance from Evaluated Stream _____
 CWH Name: _____ Distance from Evaluated Stream _____
 EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Vine Grove NRCS Soil Map Page: _____ NRCS Soil Map Stream Order _____
County: Hardin Township / City: Rad cliff, KY

MISCELLANEOUS

Base Flow Conditions? (Y/N): Y Date of last precipitation: 7/1/2013 Quantity: _____

Photograph Information: _____

Elevated Turbidity? (Y/N): _____ Canopy (% open): _____

Were samples collected for water chemistry? (Y/N): _____ (Note lab sample no. or id. and attach results) Lab Number: _____

Field Measures: Temp (°C) _____ Dissolved Oxygen (mg/l) _____ pH (S.U.) _____ Conductivity (µmhos/cm) _____

Is the sampling reach representative of the stream (Y/N) _____ If not, please explain: _____

Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

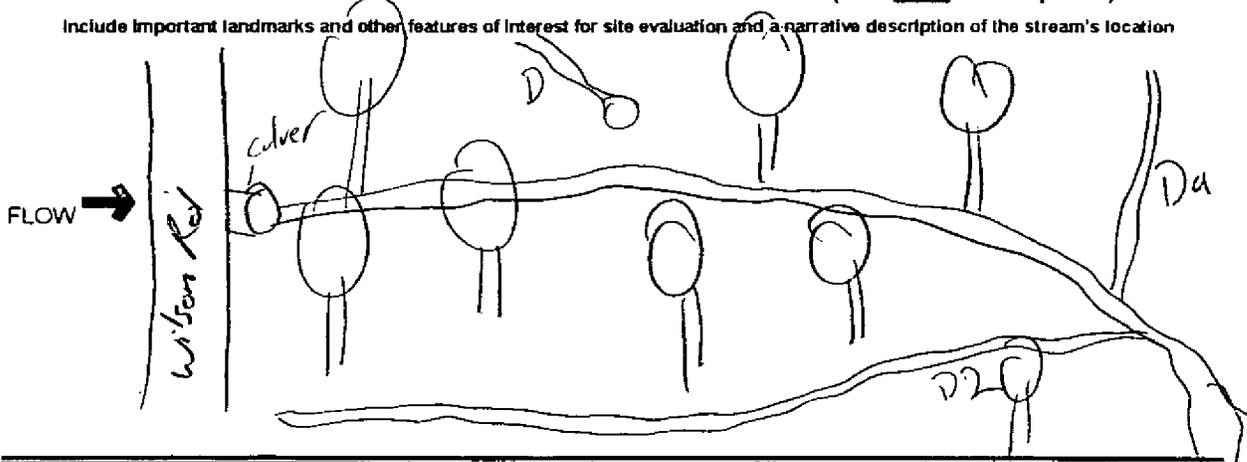
Performed? (Y/N): N (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

Fish Observed? (Y/N) _____ Voucher? (Y/N) _____ Salamanders Observed? (Y/N) _____ Voucher? (Y/N) _____
Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) _____ Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) _____

Comments Regarding Biology: _____

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location





Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) :

26

SITE NAME/LOCATION Stressor D2

SITE NUMBER _____ RIVER BASIN _____ DRAINAGE AREA (mi²) _____

LENGTH OF STREAM REACH (ft) _____ LAT. _____ LONG. _____ RIVER CODE _____ RIVER MILE _____

DATE 7/2/2013 SCORER K. Bowlin COMMENTS _____

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL NONE / NATURAL CHANNEL RECOVERED RECOVERING RECENT OR NO RECOVERY
MODIFICATIONS:

1. **SUBSTRATE** (Estimate percent of every type of substrate present. Check ONLY two predominant substrate TYPE boxes (Max of 40). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.)

TYPE	PERCENT	TYPE	PERCENT
<input type="checkbox"/> BLDR SLABS [16 pts]	_____	<input type="checkbox"/> SILT [3 pt]	_____
<input type="checkbox"/> BOULDER (>256 mm) [16 pts]	_____	<input checked="" type="checkbox"/> LEAF PACKWOODY DEBRIS [3 pts]	_____
<input type="checkbox"/> BEDROCK [18 pt]	_____	<input type="checkbox"/> FINE DEBRITUS [3 pts]	_____
<input type="checkbox"/> COBBLE (65-256 mm) [12 pts]	_____	<input checked="" type="checkbox"/> CLAY or HARDPAN [0 pt]	_____
<input type="checkbox"/> GRAVEL (2-64 mm) [9 pts]	_____	<input type="checkbox"/> MUCK [0 pts]	_____
<input type="checkbox"/> SAND (<2 mm) [6 pts]	_____	<input type="checkbox"/> ARTIFICIAL [3 pts]	_____

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock 0 (A) 3 (B) 3

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: _____ TOTAL NUMBER OF SUBSTRATE TYPES: 3

2. **Maximum Pool Depth** (Measure the maximum pool depth within the 61 meter (200 ft) evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check ONLY one box):

<input type="checkbox"/> > 30 centimeters [20 pts]	<input type="checkbox"/> > 5 cm - 10 cm [15 pts]
<input type="checkbox"/> > 22.5 - 30 cm [30 pts]	<input checked="" type="checkbox"/> < 5 cm [5 pts]
<input type="checkbox"/> > 10 - 22.5 cm [25 pts]	<input type="checkbox"/> NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS _____ MAXIMUM POOL DEPTH (centimeters): 5

3. **BANK FULL WIDTH** (Measured as the average of 3-4 measurements) (Check ONLY one box):

<input type="checkbox"/> > 4.0 meters (> 13') [30 pts]	<input checked="" type="checkbox"/> > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
<input type="checkbox"/> > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	<input type="checkbox"/> ≤ 1.0 m (≤ 3' 3") [5 pts]
<input type="checkbox"/> > 1.5 m - 3.0 m (> 4' 8" - 9' 7") [20 pts]	

COMMENTS _____ AVERAGE BANKFULL WIDTH (meters) 15

HHEI Metric Points

Substrate Max = 40

6

A + B

Pool Depth Max = 30

5

Bankfull Width Max = 30

15

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH		FLOODPLAIN QUALITY	
L	R	L	R
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
(Per Bank)		(Most Predominant per Bank)	
Wide >10m		Mature Forest, Wetland	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Moderate 5-10m		Immature Forest, Shrub or Old Field	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Narrow <5m		Residential, Park, New Field	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
None		Fenced Pasture	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Conservation Tillage	
		Urban or Industrial	
		Open Pasture, Row Crop	
		Mining or Construction	

COMMENTS _____

FLOW REGIME (At Time of Evaluation) (Check ONLY one box):

<input checked="" type="checkbox"/> Stream Flowing	<input type="checkbox"/> Moist Channel, isolated pools, no flow (Intermittent)
<input type="checkbox"/> Subsurface flow with isolated pools (Interstitial)	<input type="checkbox"/> Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check ONLY one box):

<input type="checkbox"/> None	<input type="checkbox"/> 1.0	<input type="checkbox"/> 2.0	<input type="checkbox"/> 3.0
<input type="checkbox"/> 0.5	<input type="checkbox"/> 1.5	<input checked="" type="checkbox"/> 2.5	<input type="checkbox"/> >3

STREAM GRADIENT ESTIMATE

<input type="checkbox"/> Flat (0.5 ft/100 ft)	<input type="checkbox"/> Flat to Moderate	<input type="checkbox"/> Moderate (2 ft/100 ft)	<input type="checkbox"/> Moderate to Severe	<input type="checkbox"/> Severe (10 ft/100 ft)
---	---	---	---	--

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - Yes No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

WWH Name: _____ Distance from Evaluated Stream _____
 CWH Name: _____ Distance from Evaluated Stream _____
 EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Vine Grove NRCS Soil Map Page: _____ NRCS Soil Map Stream Order _____
County: Harden Township/City: Radcliff, KY

MISCELLANEOUS

Base Flow Conditions? (Y/N): Y Date of last precipitation: 7/1/2013 Quantity: 2.29 in
Photograph Information: _____
Elevated Turbidity? (Y/N): N Canopy (% open): 10%
Were samples collected for water chemistry? (Y/N): N (Note lab sample no. or id. and attach results) Lab Number: _____
Field Measures: Temp (°C) _____ Dissolved Oxygen (mg/l) _____ pH (S.U.) _____ Conductivity (µmhos/cm) _____
Is the sampling reach representative of the stream (Y/N) _____ If not, please explain: _____

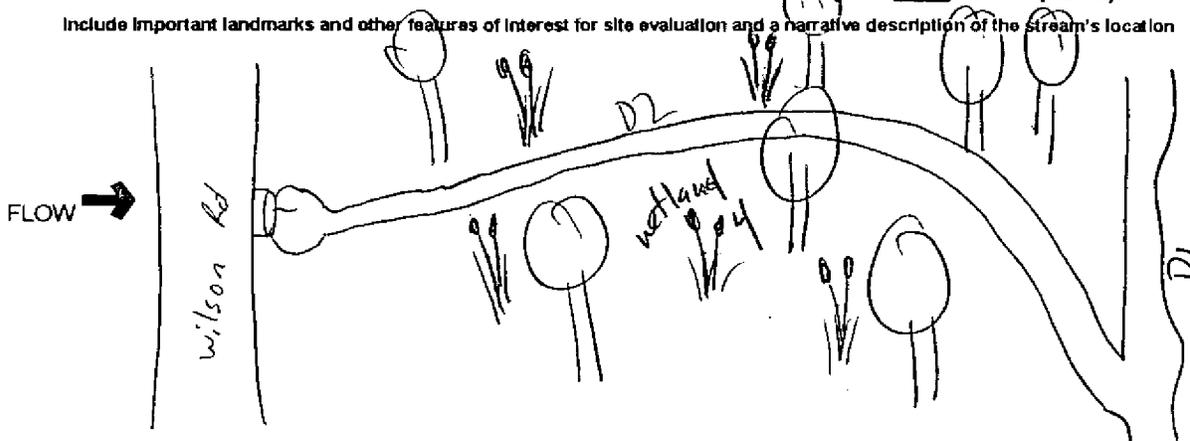
Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

Performed? (Y/N): N (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)
Fish Observed? (Y/N) _____ Voucher? (Y/N) _____ Salamanders Observed? (Y/N) _____ Voucher? (Y/N) _____
Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) _____ Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) _____
Comments Regarding Biology: _____

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location





Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) :

12

SITE NAME/LOCATION D3

SITE NUMBER _____ RIVER BASIN _____ DRAINAGE AREA (mi²) _____

LENGTH OF STREAM REACH (ft) _____ LAT. _____ LONG. _____ RIVER CODE _____ RIVER MILE _____

DATE 7/3/2013 SCORER K. Bowlin COMMENTS _____

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PWH Streams" for Instructions

STREAM CHANNEL: NONE/NATURAL CHANNEL RECOVERED RECOVERING RECENT OR NO RECOVERY

MODIFICATIONS:

1. **SUBSTRATE** (Estimate percent of every type of substrate present. Check ONLY two predominant substrate TYPE boxes (Max of 40). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.)

TYPE	PERCENT	TYPE	PERCENT
<input type="checkbox"/> BLDG SLABS [16 pts]	_____	<input type="checkbox"/> SILT [3 pts]	_____
<input type="checkbox"/> BOULDER (>256 mm) [16 pts]	_____	<input checked="" type="checkbox"/> LEAF PACKWOODY DEBRIS [3 pts]	_____
<input type="checkbox"/> BEDROCK [16 pts]	_____	<input type="checkbox"/> FINE DETRITUS [3 pts]	_____
<input type="checkbox"/> COBBLE (65-256 mm) [12 pts]	_____	<input checked="" type="checkbox"/> CLAY or HARDPAN [0 pts]	_____
<input type="checkbox"/> GRAVEL (2-64 mm) [9 pts]	_____	<input type="checkbox"/> MUCK [0 pts]	_____
<input type="checkbox"/> SAND (<2 mm) [6 pts]	_____	<input type="checkbox"/> ARTIFICIAL [3 pts]	_____

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock 0 (A) 3 (B) 2

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: _____ TOTAL NUMBER OF SUBSTRATE TYPES: 2

2. **Maximum Pool Depth** (Measure the maximum pool depth within the 61 meter (200 ft) evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check ONLY one box):

<input type="checkbox"/> > 30 centimeters [20 pts]	<input type="checkbox"/> > 5 cm - 10 cm [15 pts]
<input type="checkbox"/> > 22.5 - 30 cm [30 pts]	<input checked="" type="checkbox"/> < 5 cm [5 pts]
<input type="checkbox"/> > 10 - 22.5 cm [25 pts]	<input type="checkbox"/> NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS _____ MAXIMUM POOL DEPTH (centimeters): 5

3. **BANK FULL WIDTH** (Measured as the average of 3-4 measurements) (Check ONLY one box):

<input type="checkbox"/> > 4.0 meters (> 13') [30 pts]	<input type="checkbox"/> > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
<input type="checkbox"/> > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	<input checked="" type="checkbox"/> ≤ 1.0 m (≤ 3' 3") [5 pts]
<input type="checkbox"/> > 1.5 m - 3.0 m (> 4' 8" - 9' 7") [20 pts]	

COMMENTS _____ AVERAGE BANKFULL WIDTH (meters): 5

HHEI Metric Points

Substrate Max = 40

2

A + B

Pool Depth Max = 30

5

Bankfull Width Max = 30

5

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH		FLOODPLAIN QUALITY	
<input checked="" type="checkbox"/> L <input checked="" type="checkbox"/> R (Per Bank)	Wide >10m	<input type="checkbox"/> L <input type="checkbox"/> R (Most Predominant per Bank)	Mature Forest, Wetland
<input type="checkbox"/> Moderate 5-10m		<input checked="" type="checkbox"/> Immature Forest, Shrub or Old Field	
<input type="checkbox"/> Narrow <5m		<input type="checkbox"/> Residential, Park, New Field	
<input type="checkbox"/> None		<input type="checkbox"/> Fenced Pasture	
		<input type="checkbox"/> L <input type="checkbox"/> R	Conservation Tillage
			Urban or Industrial
			Open Pasture, Row Crop
			Mining or Construction

COMMENTS _____

4. **FLOW REGIME** (At Time of Evaluation) (Check ONLY one box):

<input type="checkbox"/> Stream Flowing	<input checked="" type="checkbox"/> Moist Channel, isolated pools, no flow (Intermittent)
<input type="checkbox"/> Subsurface flow with isolated pools (Interstitial)	<input type="checkbox"/> Dry channel, no water (Ephemeral)

COMMENTS Ephemeral channel, precipitation event occurred 2 days prior to survey

5. **SINUOSITY** (Number of bends per 61 m (200 ft) of channel) (Check ONLY one box):

<input type="checkbox"/> None	<input checked="" type="checkbox"/> 1.0	<input type="checkbox"/> 2.0	<input type="checkbox"/> 3.0
<input type="checkbox"/> 0.5	<input type="checkbox"/> 1.5	<input type="checkbox"/> 2.5	<input type="checkbox"/> >3

6. **STREAM GRADIENT ESTIMATE**

<input type="checkbox"/> Flat (0.5 ft/100 ft)	<input checked="" type="checkbox"/> Flat to Moderate	<input type="checkbox"/> Moderate (2 ft/100 ft)	<input type="checkbox"/> Moderate to Severe	<input type="checkbox"/> Severe (10 ft/100 ft)
---	--	---	---	--

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - Yes No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

WWH Name: _____ Distance from Evaluated Stream _____
 CWH Name: _____ Distance from Evaluated Stream _____
 EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Vine Grove NRCS Soil Map Page: _____ NRCS Soil Map Stream Order _____
County: Hardin Township/City: Radcliff KY

MISCELLANEOUS

Base Flow Conditions? (Y/N): Date of last precipitation: 7/11/2013 Quantity: 2.29"

Photograph Information: _____

Elevated Turbidity? (Y/N): _____ Canopy (% open): _____

Were samples collected for water chemistry? (Y/N): (Note lab sample no. or id. and attach results) Lab Number: _____

Field Measures: Temp (°C) _____ Dissolved Oxygen (mg/l) _____ pH (S.U.) _____ Conductivity (µmhos/cm) _____

Is the sampling reach representative of the stream (Y/N) _____ If not, please explain: _____

Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

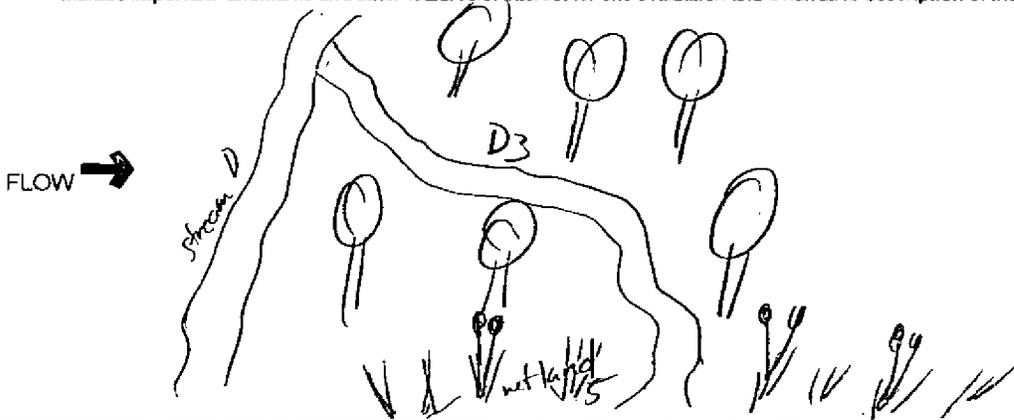
Performed? (Y/N): (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

Fish Observed? (Y/N) _____ Voucher? (Y/N) _____ Salamanders Observed? (Y/N) _____ Voucher? (Y/N) _____
Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) _____ Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) _____

Comments Regarding Biology: _____

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location





Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) :

50

SITE NAME/LOCATION DA

SITE NUMBER _____ RIVER BASIN _____ DRAINAGE AREA (mi²) _____

LENGTH OF STREAM REACH (ft) _____ LAT. _____ LONG. _____ RIVER CODE _____ RIVER MILE _____

DATE 7/2/2013 SCORER K. Bowler COMMENTS _____

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL: NONE / NATURAL CHANNEL RECOVERED RECOVERING RECENT OR NO RECOVERY
MODIFICATIONS:

1. SUBSTRATE (Estimate percent of every type of substrate present. Check ONLY two predominant substrate TYPE boxes (Max of 40). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.)

TYPE	PERCENT	TYPE	PERCENT
<input type="checkbox"/> BLDR SLABS [16 pts]	_____	<input type="checkbox"/> SILT [3 pt]	_____
<input type="checkbox"/> BOULDER (>256 mm) [16 pts]	_____	<input checked="" type="checkbox"/> LEAF PACKWOODY DEBRIS [3 pts]	_____
<input type="checkbox"/> BEDROCK [16 pt]	_____	<input type="checkbox"/> FINE DETRITUS [3 pts]	_____
<input type="checkbox"/> COBBLE (65-256 mm) [12 pts]	_____	<input checked="" type="checkbox"/> CLAY or HARDPAN [0 pt]	_____
<input type="checkbox"/> GRAVEL (2-64 mm) [9 pts]	_____	<input type="checkbox"/> MUCK [0 pts]	_____
<input type="checkbox"/> SAND (<2 mm) [6 pts]	_____	<input type="checkbox"/> ARTIFICIAL [3 pts]	_____

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock _____ (A) **3** (B) **2**

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: _____ TOTAL NUMBER OF SUBSTRATE TYPES: _____

2. Maximum Pool Depth (Measure the maximum pool depth within the 61 meter (200 ft) evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check ONLY one box):

<input type="checkbox"/> > 30 centimeters [20 pts]	<input type="checkbox"/> > 5 cm - 10 cm [15 pts]
<input checked="" type="checkbox"/> > 22.5 - 30 cm [30 pts]	<input type="checkbox"/> < 5 cm [5 pts]
<input type="checkbox"/> > 10 - 22.5 cm [25 pts]	<input type="checkbox"/> NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS _____ MAXIMUM POOL DEPTH (centimeters): **25**

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check ONLY one box):

<input type="checkbox"/> > 4.0 meters (> 13') [30 pts]	<input type="checkbox"/> > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
<input type="checkbox"/> > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	<input type="checkbox"/> ≤ 1.0 m (≤ 3' 3") [5 pts]
<input checked="" type="checkbox"/> > 1.5 m - 3.0 m (> 4' 8" - 9' 7") [20 pts]	

COMMENTS _____ AVERAGE BANKFULL WIDTH (meters): **20**

HHEI Metric Points

Substrate Max = 40

5

A + B

Pool Depth Max = 30

25

Bankfull Width Max = 30

20

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH		FLOODPLAIN QUALITY	
<input checked="" type="checkbox"/> L <input checked="" type="checkbox"/> R (Per Bank)	Wide > 10m	<input type="checkbox"/> L <input type="checkbox"/> R (Most Predominant per Bank)	Mature Forest, Wetland
<input type="checkbox"/> Moderate 5-10m		<input checked="" type="checkbox"/> Immature Forest, Shrub or Old Field	
<input type="checkbox"/> Narrow <5m		<input type="checkbox"/> Residential, Park, New Field	
<input type="checkbox"/> None		<input type="checkbox"/> Fenced Pasture	
		<input type="checkbox"/> Conservation Tillage	
		<input type="checkbox"/> Urban or Industrial	
		<input type="checkbox"/> Open Pasture, Row Crop	
		<input type="checkbox"/> Mining or Construction	

COMMENTS _____

FLOW REGIME (At Time of Evaluation) (Check ONLY one box):

<input checked="" type="checkbox"/> Stream Flowing	<input type="checkbox"/> Moist Channel, isolated pools, no flow (Intermittent)
<input type="checkbox"/> Subsurface flow with isolated pools (Interstitial)	<input type="checkbox"/> Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check ONLY one box):

<input type="checkbox"/> None	<input type="checkbox"/> 1.0	<input checked="" type="checkbox"/> 2.0	<input type="checkbox"/> 3.0
<input type="checkbox"/> 0.5	<input type="checkbox"/> 1.5	<input type="checkbox"/> 2.5	<input type="checkbox"/> >3

STREAM GRADIENT ESTIMATE

<input type="checkbox"/> Flat (0.5 ft/100 ft)	<input checked="" type="checkbox"/> Flat to Moderate	<input type="checkbox"/> Moderate (2 ft/100 ft)	<input type="checkbox"/> Moderate to Severe	<input type="checkbox"/> Severe (10 ft/100 ft)
---	--	---	---	--

ADDITIONAL STREAM INFORMATION (This information must also be completed):

QHEI PERFORMED? - Yes No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

WWH Name: _____ Distance from Evaluated Stream _____
 CWH Name: _____ Distance from Evaluated Stream _____
 EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Vine Grove NRCS Soil Map Page: _____ NRCS Soil Map Stream Order _____
County: Hardin Township / City: Radcliff KY

MISCELLANEOUS

Base Flow Conditions? (Y/N): Y Date of last precipitation: 7/1/2013 Quantity: 2.29"
Photograph Information: _____
Elevated Turbidity? (Y/N): N Canopy (% open): 10%
Were samples collected for water chemistry? (Y/N): N (Note lab sample no. or id. and attach results) Lab Number: _____
Field Measures: Temp (°C) _____ Dissolved Oxygen (mg/l) _____ pH (S.U.) _____ Conductivity (µmhos/cm) _____
Is the sampling reach representative of the stream (Y/N) _____ If not, please explain: _____

Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

Performed? (Y/N): N (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)
Fish Observed? (Y/N) _____ Voucher? (Y/N) _____ Salamanders Observed? (Y/N) _____ Voucher? (Y/N) _____
Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) _____ Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) _____
Comments Regarding Biology: _____

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location

FLOW 

Stream & Location: Stream E RM: Date: 7/3/2013

Scorers Full Name & Affiliation:

River Code: STORET #: Lat./ Long.: 18 Office verified location

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

Substrate assessment table with categories: BEST TYPES, OTHER TYPES, ORIGIN, QUALITY, and NUMBER OF BEST TYPES. Includes checkboxes for various substrate types and a score of 2.

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

Instream Cover assessment table with categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, BACKWATERS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS, and AMOUNT. Includes checkboxes and a score of 10.

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

Channel Morphology assessment table with categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, and STABILITY. Includes checkboxes and a score of 11.

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

Bank Erosion and Riparian Zone assessment table with categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY, and CONSERVATION. Includes checkboxes and a score of 6.5.

5) POOL / GLIDE AND RIFFLE / RUN QUALITY

Pool / Glide and Riffle / Run Quality assessment table with categories: MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY, and Recreation Potential. Includes checkboxes and a score of 6.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average).

Riffle / Run Quality assessment table with categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, and RIFFLE / RUN EMBEDDEDNESS. Includes checkboxes and a score of 2.

6) GRADIENT (ft/mi) DRAINAGE AREA (mi^2) % POOL: % GLIDE: % RUN: % RIFFLE: Gradient Maximum 10. Includes a score of 6.

A) SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- 1st -sample pass- 2nd
- HIGH
 - UP
 - NORMAL
 - LOW
 - DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st -sample pass- 2nd
- < 20 cm
 - 20-40 cm
 - 40-70 cm
 - > 70 cm/ CTB
 - SECCHI DEPTH

B) AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

D) MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG SUCCESSION OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCOURED
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

Circle some & COMMENT

E) ISSUES

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK EROSION SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

F) MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone x^2 width
- entrench. ratio

Legacy Tree:

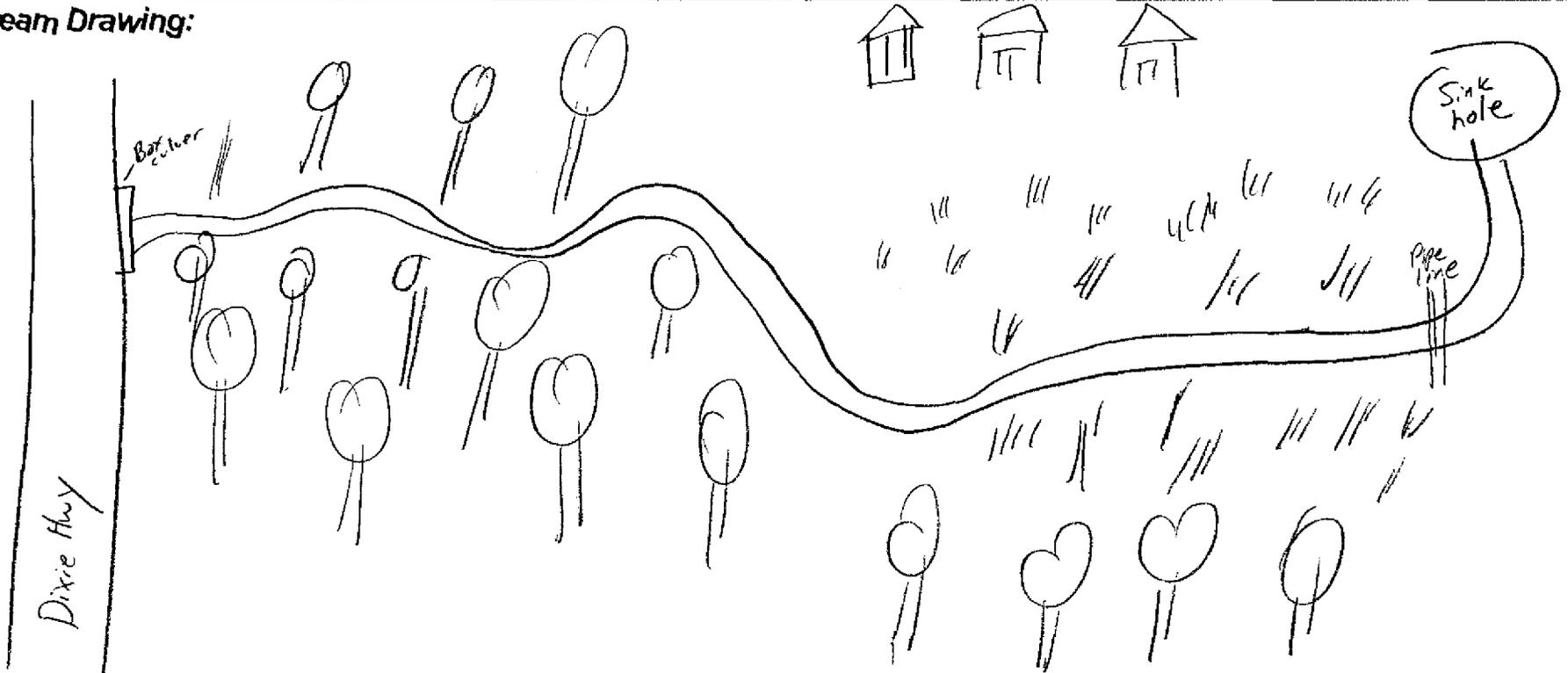
CANOPY

- 1st pass _____ cm
- 2nd pass _____ cm
- > 85% OPEN
 - 55%-85%
 - 30%-55%
 - 10%-30%
 - < 10% - CLOSED

C) RECREATION

- AREA DEPTH
- POOL: >100ft² >3ft

Stream Drawing:





Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) :

6

SITE NAME/LOCATION Stream C2

SITE NUMBER _____ RIVER BASIN _____ DRAINAGE AREA (mi²) _____

LENGTH OF STREAM REACH (ft) _____ LAT. _____ LONG. _____ RIVER CODE _____ RIVER MILE _____

DATE 7/3/13 SCORER _____ COMMENTS _____

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for instructions

STREAM CHANNEL NONE / NATURAL CHANNEL RECOVERED RECOVERING RECENT OR NO RECOVERY

MODIFICATIONS:

1. SUBSTRATE (Estimate percent of every type of substrate present. Check ONLY two predominant substrate TYPE boxes (Max of 40). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE	PERCENT	TYPE	PERCENT
<input type="checkbox"/> BLDR SLABS [16 pts]	_____	<input type="checkbox"/> SILT [3 pt]	_____
<input type="checkbox"/> BOULDER (>256 mm) [16 pts]	_____	<input type="checkbox"/> LEAF PACKWOODY DEBRIS [3 pts]	_____
<input type="checkbox"/> BEDROCK [16 pt]	_____	<input type="checkbox"/> FINE DETRITUS [3 pts]	_____
<input type="checkbox"/> COBBLE (65-256 mm) [12 pts]	_____	<input checked="" type="checkbox"/> CLAY or HARDPAN [0 pt]	_____
<input type="checkbox"/> GRAVEL (2-64 mm) [9 pts].	_____	<input type="checkbox"/> MUCK [0 pts]	_____
<input type="checkbox"/> SAND (<2 mm) [6 pts]	_____	<input type="checkbox"/> ARTIFICIAL [3 pts]	_____

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock _____ (A) 0

TOTAL NUMBER OF SUBSTRATE TYPES: (B) 1

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: _____ TOTAL NUMBER OF SUBSTRATE TYPES: _____

2. Maximum Pool Depth (Measure the maximum pool depth within the 61 meter (200 ft) evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check ONLY one box):

<input type="checkbox"/> > 30 centimeters [20 pts]	<input type="checkbox"/> > 5 cm - 10 cm [15 pts]
<input type="checkbox"/> > 22.5 - 30 cm [30 pts]	<input type="checkbox"/> < 5 cm [5 pts]
<input type="checkbox"/> > 10 - 22.5 cm [25 pts]	<input checked="" type="checkbox"/> NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS _____ MAXIMUM POOL DEPTH (centimeters): _____

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check ONLY one box):

<input type="checkbox"/> > 4.0 meters (> 13') [30 pts]	<input type="checkbox"/> > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
<input type="checkbox"/> > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	<input checked="" type="checkbox"/> ≤ 1.0 m (≤ 3' 3") [5 pts]
<input type="checkbox"/> > 1.5 m - 3.0 m (> 4' 8" - 9' 7") [20 pts]	

COMMENTS _____ AVERAGE BANKFULL WIDTH (meters) _____

HHEI Metric Points

Substrate Max = 40

A + B

Pool Depth Max = 30

Bankfull Width Max = 30

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH		FLOODPLAIN QUALITY	
L	R	L	R
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	(Per Bank)	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	(Most Predominant per Bank)
<input type="checkbox"/> <input type="checkbox"/>	Wide >10m	<input type="checkbox"/> <input type="checkbox"/>	Mature Forest, Wetland
<input type="checkbox"/> <input type="checkbox"/>	Moderate 5-10m	<input type="checkbox"/> <input type="checkbox"/>	Immature Forest, Shrub or Old Field
<input type="checkbox"/> <input type="checkbox"/>	Narrow <5m	<input type="checkbox"/> <input type="checkbox"/>	Residential, Park, New Field
<input type="checkbox"/> <input type="checkbox"/>	None	<input type="checkbox"/> <input type="checkbox"/>	Fenced Pasture
		<input type="checkbox"/> <input type="checkbox"/>	Conservation Tillage
		<input type="checkbox"/> <input type="checkbox"/>	Urban or Industrial
		<input type="checkbox"/> <input type="checkbox"/>	Open Pasture, Row Crop
		<input type="checkbox"/> <input type="checkbox"/>	Mining or Construction

COMMENTS _____

FLOW REGIME (At Time of Evaluation) (Check ONLY one box):

<input type="checkbox"/> Stream Flowing	<input type="checkbox"/> Moist Channel, isolated pools, no flow (Intermittent)
<input type="checkbox"/> Subsurface flow with isolated pools (Interstitial)	<input checked="" type="checkbox"/> Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check ONLY one box):

<input type="checkbox"/> None	<input type="checkbox"/> 1.0	<input type="checkbox"/> 2.0	<input type="checkbox"/> 3.0
<input checked="" type="checkbox"/> 0.5	<input type="checkbox"/> 1.5	<input type="checkbox"/> 2.5	<input type="checkbox"/> >3

STREAM GRADIENT ESTIMATE

<input type="checkbox"/> Flat (0.5 ft/100 ft)	<input checked="" type="checkbox"/> Flat to Moderate	<input type="checkbox"/> Moderate (2 ft/100 ft)	<input type="checkbox"/> Moderate to Severe	<input type="checkbox"/> Severe (10 ft/100 ft)
---	--	---	---	--

ADDITIONAL STREAM INFORMATION (This information Must Also be Completed):

QHEI PERFORMED? - Yes No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

WWH Name: _____ Distance from Evaluated Stream _____
 CWH Name: _____ Distance from Evaluated Stream _____
 EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Vine Grove NRCS Soil Map Page: _____ NRCS Soil Map Stream Order _____
County: Hardin Township / City: Roadsiff, KY

MISCELLANEOUS

Base Flow Conditions? (Y/N): Y Date of last precipitation: 7/1/13 Quantity: 2.29
Photograph Information: _____
Elevated Turbidity? (Y/N): N Canopy (% open): 10%
Were samples collected for water chemistry? (Y/N): N (Note lab sample no. or id. and attach results) Lab Number: _____
Field Measures: Temp (°C) _____ Dissolved Oxygen (mg/l) _____ pH (S.U.) _____ Conductivity (µmhos/cm) _____
Is the sampling reach representative of the stream (Y/N): Y If not, please explain: _____

Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

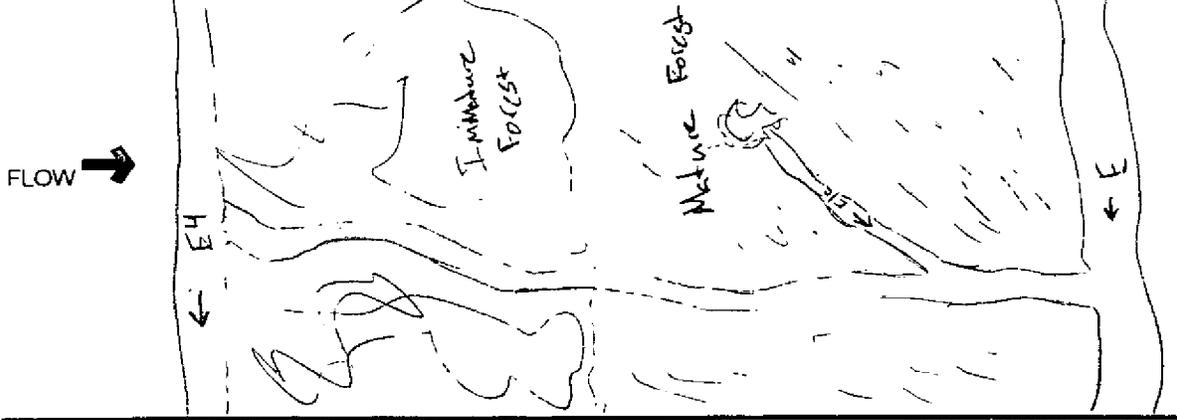
Performed? (Y/N): N (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

Fish Observed? (Y/N) _____ Voucher? (Y/N) _____ Salamanders Observed? (Y/N) _____ Voucher? (Y/N) _____
Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) _____ Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) _____

Comments Regarding Biology: _____

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location





Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) :

6

SITE NAME/LOCATION FL

SITE NUMBER _____ RIVER BASIN _____ DRAINAGE AREA (mi²) _____

LENGTH OF STREAM REACH (ft) _____ LAT. _____ LONG. _____ RIVER CODE _____ RIVER MILE _____

DATE 7/2/2013 SCORER T. Kevin Krullin COMMENTS small ephemeral trib. w/ stream EL

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL NONE/NATURAL CHANNEL RECOVERED RECOVERING RECENT OR NO RECOVERY
MODIFICATIONS:

1. SUBSTRATE (Estimate percent of every type of substrate present. Check ONLY two predominant substrate TYPE boxes (Max of 40). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.)

TYPE	PERCENT	TYPE	PERCENT
<input type="checkbox"/> BLDR SLABS [16 pts]	_____	<input type="checkbox"/> SILT [3 pt]	_____
<input type="checkbox"/> BOULDER (>256 mm) [16 pts]	_____	<input type="checkbox"/> LEAF PACKWOODY DEBRIS [3 pts]	_____
<input type="checkbox"/> BEDROCK [16 pt]	_____	<input type="checkbox"/> FINE DETRITUS [3 pts]	_____
<input type="checkbox"/> COBBLE (65-256 mm) [12 pts]	_____	<input checked="" type="checkbox"/> CLAY or HARDPAN [0 pt]	<u>100</u>
<input type="checkbox"/> GRAVEL (2-64 mm) [9 pts]	_____	<input type="checkbox"/> MUCK [0 pts]	_____
<input type="checkbox"/> SAND (<2 mm) [6 pts]	_____	<input type="checkbox"/> ARTIFICIAL [3 pts]	_____

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock (A) (B)

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: TOTAL NUMBER OF SUBSTRATE TYPES:

2. Maximum Pool Depth (Measure the maximum pool depth within the 61 meter (200 ft) evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check ONLY one box):

<input type="checkbox"/> > 30 centimeters [20 pts]	<input type="checkbox"/> > 5 cm - 10 cm [15 pts]
<input type="checkbox"/> > 22.5 - 30 cm [30 pts]	<input type="checkbox"/> < 5 cm [5 pts]
<input type="checkbox"/> > 10 - 22.5 cm [25 pts]	<input checked="" type="checkbox"/> NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS _____ MAXIMUM POOL DEPTH (centimeters):

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check ONLY one box):

<input type="checkbox"/> > 4.0 meters (> 13') [30 pts]	<input type="checkbox"/> > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
<input type="checkbox"/> > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	<input checked="" type="checkbox"/> ≤ 1.0 m (≤ 3' 3") [5 pts]
<input type="checkbox"/> > 1.5 m - 3.0 m (> 4' 8" - 9' 7") [20 pts]	

COMMENTS _____ AVERAGE BANKFULL WIDTH (meters)

HHEI Metric Points

Substrate Max = 40

1

A + B

Pool Depth Max = 30

0

Bankfull Width Max = 30

5

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY *NOTE: River Left (L) and Right (R) as looking downstream*

RIPARIAN WIDTH		FLOODPLAIN QUALITY	
L	R	L	R
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	(Per Bank)	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	(Most Predominant per Bank)
<input type="checkbox"/> <input type="checkbox"/>	Wide >10m	<input type="checkbox"/> <input type="checkbox"/>	Mature Forest, Wetland
<input type="checkbox"/> <input type="checkbox"/>	Moderate 5-10m	<input type="checkbox"/> <input type="checkbox"/>	Immature Forest, Shrub or Old Field
<input type="checkbox"/> <input type="checkbox"/>	Narrow <5m	<input type="checkbox"/> <input type="checkbox"/>	Residential, Park, New Field
<input type="checkbox"/> <input type="checkbox"/>	None	<input type="checkbox"/> <input type="checkbox"/>	Fenced Pasture
<input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/>	Conservation Tillage
		<input type="checkbox"/> <input type="checkbox"/>	Urban or Industrial
		<input type="checkbox"/> <input type="checkbox"/>	Open Pasture, Row Crop
		<input type="checkbox"/> <input type="checkbox"/>	Mining or Construction

COMMENTS _____

FLOW REGIME (At Time of Evaluation) (Check ONLY one box):

<input type="checkbox"/> Stream Flowing	<input type="checkbox"/> Moist Channel, isolated pools, no flow (Intermittent)
<input type="checkbox"/> Subsurface flow with isolated pools (Interstitial)	<input checked="" type="checkbox"/> Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check ONLY one box):

<input checked="" type="checkbox"/> None	<input type="checkbox"/> 1.0	<input type="checkbox"/> 2.0	<input type="checkbox"/> 3.0
<input type="checkbox"/> 0.5	<input type="checkbox"/> 1.5	<input type="checkbox"/> 2.5	<input type="checkbox"/> >3

STREAM GRADIENT ESTIMATE

<input checked="" type="checkbox"/> Flat (0.5 ft/100 ft)	<input type="checkbox"/> Flat to Moderate	<input type="checkbox"/> Moderate (2 ft/100 ft)	<input type="checkbox"/> Moderate to Severe	<input type="checkbox"/> Severe (10 ft/100 ft)
--	---	---	---	--

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - Yes No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

WWH Name: _____ Distance from Evaluated Stream _____
 CWH Name: _____ Distance from Evaluated Stream _____
 EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Vine Grove NRCS Soil Map Page: _____ NRCS Soil Map Stream Order _____
County: Hardin Township / City: Rustcliff KY

MISCELLANEOUS

Base Flow Conditions? (Y/N): Y Date of last precipitation: 7/1/13 Quantity: 2.79"

Photograph Information: _____

Elevated Turbidity? (Y/N): N Canopy (% open): _____

Were samples collected for water chemistry? (Y/N): N (Note lab sample no. or id. and attach results) Lab Number: _____

Field Measures: Temp (°C) _____ Dissolved Oxygen (mg/l) _____ pH (S.U.) _____ Conductivity (µmhos/cm) _____

Is the sampling reach representative of the stream (Y/N): Y If not, please explain: _____

Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

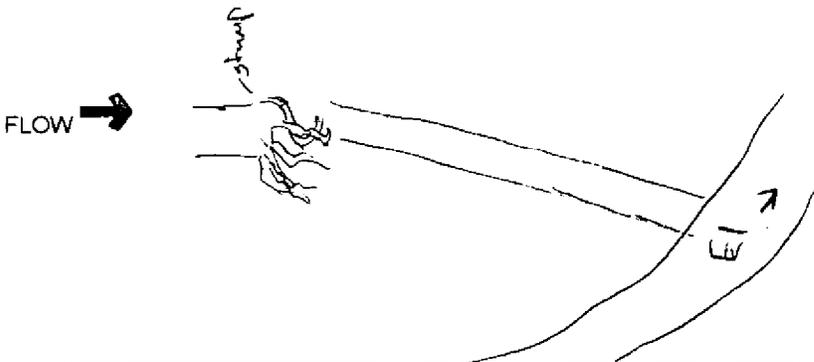
Performed? (Y/N): N (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

Fish Observed? (Y/N) _____ Voucher? (Y/N) _____ Salamanders Observed? (Y/N) _____ Voucher? (Y/N) _____
Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) _____ Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) _____

Comments Regarding Biology: _____

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location





Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) :

7

SITE NAME/LOCATION E 2

SITE NUMBER _____ RIVER BASIN _____ DRAINAGE AREA (mi²) _____

LENGTH OF STREAM REACH (ft) _____ LAT. _____ LONG. _____ RIVER CODE _____ RIVER MILE _____

DATE 7/3/13 SCORER T. Newson K. Beullin COMMENTS Stream begins at old bridge dam

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for instructions

STREAM CHANNEL NONE/NATURAL CHANNEL RECOVERED RECOVERING RECENT OR NO RECOVERY
MODIFICATIONS:

1. **SUBSTRATE** (Estimate percent of every type of substrate present. Check ONLY two predominant substrate TYPE boxes (Max of 40). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.)

TYPE	PERCENT	TYPE	PERCENT
<input type="checkbox"/> BLDR SLABS [16 pts]	_____	<input type="checkbox"/> SILT [3 pt]	_____
<input type="checkbox"/> BOULDER (>256 mm) [16 pts]	_____	<input type="checkbox"/> LEAF PACK/WOODY DEBRIS [3 pts]	_____
<input type="checkbox"/> BEDROCK [16 pt]	_____	<input type="checkbox"/> FINE DETRITUS [3 pts]	_____
<input type="checkbox"/> COBBLE (65-256 mm) [12 pts]	_____	<input checked="" type="checkbox"/> CLAY or HARDPAN [0 pt]	_____
<input type="checkbox"/> GRAVEL (2-64 mm) [9 pts]	_____	<input checked="" type="checkbox"/> MUCK [0 pts]	_____
<input type="checkbox"/> SAND (<2 mm) [6 pts]	_____	<input type="checkbox"/> ARTIFICIAL [3 pts]	_____

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock (A) 0 (B) 2

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: _____ TOTAL NUMBER OF SUBSTRATE TYPES: 2

2. **Maximum Pool Depth** (Measure the maximum pool depth within the 61 meter (200 ft) evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check ONLY one box):

<input type="checkbox"/> > 30 centimeters [20 pts]	<input type="checkbox"/> > 5 cm - 10 cm [15 pts]
<input type="checkbox"/> > 22.5 - 30 cm [30 pts]	<input type="checkbox"/> < 5 cm [5 pts]
<input type="checkbox"/> > 10 - 22.5 cm [25 pts]	<input checked="" type="checkbox"/> NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS _____ MAXIMUM POOL DEPTH (centimeters): 0

3. **BANK FULL WIDTH** (Measured as the average of 3-4 measurements) (Check ONLY one box):

<input type="checkbox"/> > 4.0 meters (> 13') [30 pts]	<input type="checkbox"/> > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
<input type="checkbox"/> > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	<input checked="" type="checkbox"/> ≤ 1.0 m (≤ 3' 3") [5 pts]
<input type="checkbox"/> > 1.5 m - 3.0 m (> 4' 8" - 9' 7") [20 pts]	

COMMENTS _____ AVERAGE BANKFULL WIDTH (meters) 5

HHEI Metric Points

Substrate Max = 40

2

A + B

Pool Depth Max = 30

0

Bankfull Width Max=30

5

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH		FLOODPLAIN QUALITY	
L	R	L	R
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Wide >10m		Mature Forest, Wetland	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Moderate 5-10m		Immature Forest, Shrub or Old Field	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Narrow <5m		Residential, Park, New Field	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
None		Fenced Pasture	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Conservation Tillage	
		Urban or Industrial	
		Open Pasture, Row Crop	
		Mining or Construction	

COMMENTS _____

FLOW REGIME (At Time of Evaluation) (Check ONLY one box):

<input type="checkbox"/> Stream Flowing	<input type="checkbox"/> Moist Channel, isolated pools, no flow (Intermittent)
<input type="checkbox"/> Subsurface flow with isolated pools (Interstitial)	<input checked="" type="checkbox"/> Dry channel, no water (Ephemeral)

COMMENTS precipitation event two days prior

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check ONLY one box):

<input checked="" type="checkbox"/> None	<input type="checkbox"/> 1.0	<input type="checkbox"/> 2.0
<input type="checkbox"/> 0.5	<input type="checkbox"/> 1.5	<input type="checkbox"/> >3
	<input type="checkbox"/> 2.5	

STREAM GRADIENT ESTIMATE

<input type="checkbox"/> Flat (0.5 ft/100 ft)	<input type="checkbox"/> Flat to Moderate	<input type="checkbox"/> Moderate (2 ft/100 ft)	<input checked="" type="checkbox"/> Moderate to Severe	<input type="checkbox"/> Severe (10 ft/100 ft)
---	---	---	--	--

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - Yes No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

- WWH Name: _____ Distance from Evaluated Stream _____
 CWH Name: _____ Distance from Evaluated Stream _____
 EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Vine Grove NRCS Soil Map Page: _____ NRCS Soil Map Stream Order _____
County: Harden Township/City: Radcliff KY

MISCELLANEOUS

Base Flow Conditions? (Y/N): Y Date of last precipitation: 7/1/2013 Quantity: 2.79

Photograph Information: _____

Elevated Turbidity? (Y/N): _____ Canopy (% open): _____

Were samples collected for water chemistry? (Y/N): Y (Note lab sample no. or id. and attach results) Lab Number: _____

Field Measures: Temp (°C) _____ Dissolved Oxygen (mg/l) _____ pH (S.U.) _____ Conductivity (µmhos/cm) _____

Is the sampling reach representative of the stream (Y/N) Y If not, please explain: _____

Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

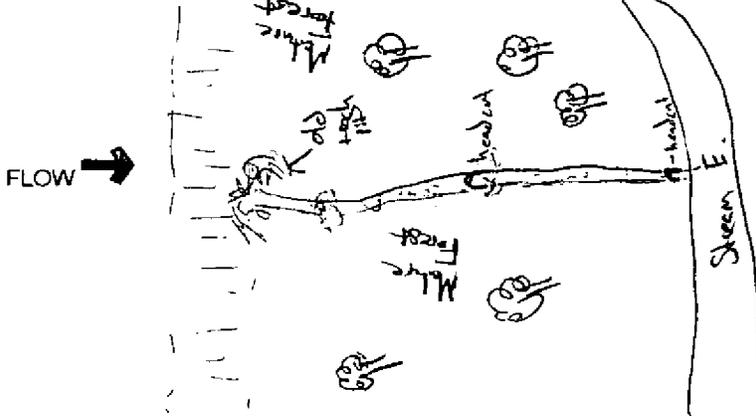
Performed? (Y/N): Y (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

Fish Observed? (Y/N) _____ Voucher? (Y/N) _____ Salamanders Observed? (Y/N) _____ Voucher? (Y/N) _____
Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) _____ Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) _____

Comments Regarding Biology: _____

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location





Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) :

6

SITE NAME/LOCATION E4

SITE NUMBER _____ RIVER BASIN _____ DRAINAGE AREA (mi²) _____

LENGTH OF STREAM REACH (ft) _____ LAT. _____ LONG. _____ RIVER CODE _____ RIVER MILE _____

DATE 7/3/2013 SCORER Ki Bowlin COMMENTS _____

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL NONE/NATURAL CHANNEL RECOVERED RECOVERING RECENT OR NO RECOVERY
MODIFICATIONS:

1. **SUBSTRATE** (Estimate percent of every type of substrate present. Check ONLY two predominant substrate TYPE boxes (Max of 40). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.)

TYPE	PERCENT	TYPE	PERCENT
<input type="checkbox"/> BLDR SLABS [16 pts]	_____	<input type="checkbox"/> SILT [3 pt]	_____
<input type="checkbox"/> BOULDER (>256 mm) [16 pts]	_____	<input type="checkbox"/> LEAF PACK/WOODY DEBRIS [3 pts]	_____
<input type="checkbox"/> BEDROCK [16 pt]	_____	<input type="checkbox"/> FINE DETRITUS [3 pts]	_____
<input type="checkbox"/> COBBLE (65-256 mm) [12 pts]	_____	<input checked="" type="checkbox"/> CLAY or HARDPAN [0 pt]	_____
<input type="checkbox"/> GRAVEL (2-64 mm) [9 pts]	_____	<input type="checkbox"/> MUCK [0 pts]	_____
<input type="checkbox"/> SAND (<2 mm) [6 pts]	_____	<input type="checkbox"/> ARTIFICIAL [3 pts]	_____

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock (A) (B)

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: _____ TOTAL NUMBER OF SUBSTRATE TYPES:

2. **Maximum Pool Depth** (Measure the maximum pool depth within the 61 meter (200 ft) evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check ONLY one box):

<input type="checkbox"/> > 30 centimeters [20 pts]	<input type="checkbox"/> > 5 cm - 10 cm [15 pts]
<input type="checkbox"/> > 22.5 - 30 cm [30 pts]	<input type="checkbox"/> < 5 cm [5 pts]
<input type="checkbox"/> > 10 - 22.5 cm [25 pts]	<input checked="" type="checkbox"/> NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS _____ MAXIMUM POOL DEPTH (centimeters):

3. **BANK FULL WIDTH** (Measured as the average of 3-4 measurements) (Check ONLY one box):

<input type="checkbox"/> > 4.0 meters (> 13') [30 pts]	<input type="checkbox"/> > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
<input type="checkbox"/> > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	<input checked="" type="checkbox"/> ≤ 1.0 m (≤ 3' 3") [5 pts]
<input type="checkbox"/> > 1.5 m - 3.0 m (> 4' 8" - 9' 7") [20 pts]	

COMMENTS _____ AVERAGE BANKFULL WIDTH (meters)

HHEI Metric Points

Substrate Max = 40

A + B

Pool Depth Max = 30

Bankfull Width Max=30

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY NOTE: River Left (L) and Right (R) as looking downstream

RIPARIAN WIDTH		FLOODPLAIN QUALITY	
L	R	L	R
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> (Per Bank) Wide >10m	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> (Most Predominant per Bank) Mature Forest, Wetland
<input type="checkbox"/>	<input type="checkbox"/> Moderate 5-10m	<input type="checkbox"/>	<input type="checkbox"/> Immature Forest, Shrub or Old Field
<input type="checkbox"/>	<input type="checkbox"/> Narrow <5m	<input type="checkbox"/>	<input type="checkbox"/> Residential, Park, New Field
<input type="checkbox"/>	<input type="checkbox"/> None	<input type="checkbox"/>	<input type="checkbox"/> Fenced Pasture
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Conservation Tillage
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Urban or Industrial
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Open Pasture, Row Crop
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Mining or Construction

COMMENTS _____

FLOW REGIME (At Time of Evaluation) (Check ONLY one box):

<input type="checkbox"/> Stream Flowing	<input checked="" type="checkbox"/> Moist Channel, isolated pools, no flow (Intermittent)
<input type="checkbox"/> Subsurface flow with isolated pools (Interstitial)	<input type="checkbox"/> Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check ONLY one box):

<input type="checkbox"/> None	<input type="checkbox"/> 1.0	<input type="checkbox"/> 2.0	<input type="checkbox"/> 3.0
<input checked="" type="checkbox"/> 0.5	<input type="checkbox"/> 1.5	<input type="checkbox"/> 2.5	<input type="checkbox"/> >3

STREAM GRADIENT ESTIMATE

<input type="checkbox"/> Flat (0.5 ft/100 ft)	<input type="checkbox"/> Flat to Moderate	<input type="checkbox"/> Moderate (2 ft/100 ft)	<input checked="" type="checkbox"/> Moderate to Severe	<input type="checkbox"/> Severe (10 ft/100 ft)
---	---	---	--	--

ADDITIONAL STREAM INFORMATION (This information must also be completed):

QHEI PERFORMED? - Yes No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

- WWH Name: _____ Distance from Evaluated Stream _____
 CWH Name: _____ Distance from Evaluated Stream _____
 EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Vine Grove NRCS Soil Map Page: _____ NRCS Soil Map Stream Order _____
County: Hardin Township / City: Radcliff KY

MISCELLANEOUS

Base Flow Conditions? (Y/N): Y Date of last precipitation: 7/1/2013 Quantity: 2.29

Photograph Information: _____

Elevated Turbidity? (Y/N): N Canopy (% open): 10%

Were samples collected for water chemistry? (Y/N): N (Note lab sample no. or id. and attach results) Lab Number: _____

Field Measures: Temp (°C) _____ Dissolved Oxygen (mg/l) _____ pH (S.U.) _____ Conductivity (µmhos/cm) _____

Is the sampling reach representative of the stream (Y/N) _____ If not, please explain: _____

Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

Performed? (Y/N): N (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

Fish Observed? (Y/N) _____ Voucher? (Y/N) _____ Salamanders Observed? (Y/N) _____ Voucher? (Y/N) _____
Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) _____ Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) _____

Comments Regarding Biology: _____

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location

FLOW →



Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) :

17

SITE NAME/LOCATION Stream E4c

SITE NUMBER _____ RIVER BASIN _____ DRAINAGE AREA (mi²) _____

LENGTH OF STREAM REACH (ft) _____ LAT. _____ LONG. _____ RIVER CODE _____ RIVER MILE _____

DATE 7/3/2013 SCORER T. Newman K. Postle COMMENTS _____

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL NONE / NATURAL CHANNEL RECOVERED RECOVERING RECENT OR NO RECOVERY
MODIFICATIONS:

1. SUBSTRATE (Estimate percent of every type of substrate present. Check ONLY two predominant substrate TYPE boxes (Max of 40). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.)

TYPE	PERCENT	TYPE	PERCENT
<input type="checkbox"/> BLD R SLABS [16 pts]	_____	<input checked="" type="checkbox"/> SILT [3 pt] -	_____
<input type="checkbox"/> BOULDER (>256 mm) [16 pts]	_____	<input type="checkbox"/> LEAF PACK/WOODY DEBRIS [3 pts]-	_____
<input type="checkbox"/> BEDROCK [16 pt]	_____	<input type="checkbox"/> FINE DETRITUS [3 pts]	_____
<input type="checkbox"/> COBBLE (65-256 mm) [12 pts]-	_____	<input checked="" type="checkbox"/> CLAY or HARDPAN [0 pt] -	_____
<input type="checkbox"/> GRAVEL (2-64 mm) [9 pts]	_____	<input type="checkbox"/> MUCK [0 pts]	_____
<input type="checkbox"/> SAND (<2 mm) [8 pts]	_____	<input type="checkbox"/> ARTIFICIAL [3 pts]	_____

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock (A) 3 (B) 4

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: _____ TOTAL NUMBER OF SUBSTRATE TYPES: _____

2. Maximum Pool Depth (Measure the maximum pool depth within the 61 meter (200 ft) evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check ONLY one box):

<input type="checkbox"/> > 30 centimeters [20 pts]	<input type="checkbox"/> > 5 cm - 10 cm [15 pts]
<input type="checkbox"/> > 22.5 - 30 cm [30 pts]	<input checked="" type="checkbox"/> < 5 cm [5 pts]
<input type="checkbox"/> > 10 - 22.5 cm [25 pts]	<input type="checkbox"/> NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS _____ MAXIMUM POOL DEPTH (centimeters): _____

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check ONLY one box):

<input type="checkbox"/> > 4.0 meters (> 13') [30 pts]	<input type="checkbox"/> > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
<input type="checkbox"/> > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	<input checked="" type="checkbox"/> ≤ 1.0 m (≤ 3' 3") [5 pts]
<input type="checkbox"/> > 1.5 m - 3.0 m (> 4' 8" - 9' 7") [20 pts]	

COMMENTS _____ AVERAGE BANKFULL WIDTH (meters) _____

HHEI Metric Points

Substrate Max = 40

7

A + B

Pool Depth Max = 30

5

Bankfull Width Max=30

5

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY (NOTE: River Left (L) and Right (R) as looking downstream)

RIPARIAN WIDTH		FLOODPLAIN QUALITY	
L	R	L	R
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wide >10m		Mature Forest, Wetland	Conservation Tillage
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Moderate 5-10m		Immature Forest, Shrub or Old Field	Urban or Industrial
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Narrow <5m		Residential, Park, New Field	Open Pasture, Row Crop
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
None		Fenced Pasture	Mining or Construction

COMMENTS _____

FLOW REGIME (At Time of Evaluation) (Check ONLY one box):

<input checked="" type="checkbox"/> Stream Flowing	<input type="checkbox"/> Moist Channel, isolated pools, no flow (Intermittent)
<input type="checkbox"/> Subsurface flow with isolated pools (Intermittent)	<input type="checkbox"/> Dry channel, no water (Ephemeral)

COMMENTS Substrate ephemeral stream bed by storm water drainage. Rain event 2 days prior.

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check ONLY one box):

<input type="checkbox"/> None	<input checked="" type="checkbox"/> 1.0	<input type="checkbox"/> 2.0
<input type="checkbox"/> 0.5	<input type="checkbox"/> 1.5	<input type="checkbox"/> 2.5
		<input type="checkbox"/> 3.0
		<input type="checkbox"/> >3

STREAM GRADIENT ESTIMATE

<input checked="" type="checkbox"/> Flat (0.5 ft/100 ft)	<input type="checkbox"/> Flat to Moderate	<input type="checkbox"/> Moderate (2 ft/100 ft)	<input type="checkbox"/> Moderate to Severe	<input type="checkbox"/> Severe (10 ft/100 ft)
--	---	---	---	--

ADDITIONAL STREAM INFORMATION (This information Must Also be Completed):

QHEI PERFORMED? - Yes No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

WWH Name: _____ Distance from Evaluated Stream _____
 CWH Name: _____ Distance from Evaluated Stream _____
 EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Vine Grove NRCS Soil Map Page: _____ NRCS Soil Map Stream Order _____
County: Hardin Township / City: Radcliff, KY

MISCELLANEOUS

Base Flow Conditions? (Y/N): Y Date of last precipitation: 7/1/2013 Quantity: 2.29"
Photograph Information: _____
Elevated Turbidity? (Y/N): N Canopy (% open): _____
Were samples collected for water chemistry? (Y/N): N (Note lab sample no. or id. and attach results) Lab Number: _____
Field Measures: Temp (°C) _____ Dissolved Oxygen (mg/l) _____ pH (S.U.) _____ Conductivity (µmhos/cm) _____
Is the sampling reach representative of the stream (Y/N): Y If not, please explain: _____

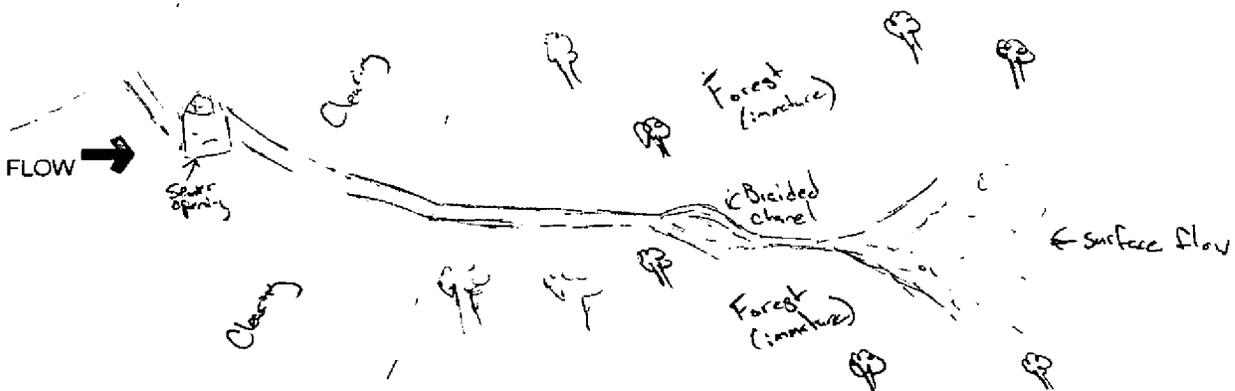
Additional comments/description of pollution impacts: fed by storm water drainage, considerable pollutants
drain into stream

BIOTIC EVALUATION

Performed? (Y/N): N (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)
Fish Observed? (Y/N) ? Voucher? (Y/N) _____ Salamanders Observed? (Y/N) _____ Voucher? (Y/N) _____
Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) _____ Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) _____
Comments Regarding Biology: _____

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location





Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) :

6

SITE NAME/LOCATION F4R

SITE NUMBER _____ RIVER BASIN _____ DRAINAGE AREA (mi²) _____

LENGTH OF STREAM REACH (ft) _____ LAT. _____ LONG. _____ RIVER CODE _____ RIVER MILE _____

DATE _____ SCORER T. H. ... COMMENTS _____

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL: NONE / NATURAL CHANNEL RECOVERED RECOVERING RECENT OR NO RECOVERY
MODIFICATIONS:

1. SUBSTRATE (Estimate percent of every type of substrate present. Check ONLY two predominant substrate TYPE boxes (Max of 40). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.)

TYPE	PERCENT	TYPE	PERCENT
<input type="checkbox"/> BLDR SLABS [16 pts]	_____	<input type="checkbox"/> SILT [3 pt]	_____
<input type="checkbox"/> BOULDER (>256 mm) [16 pts]	_____	<input type="checkbox"/> LEAF PACK/WOODY DEBRIS [3 pts]	_____
<input type="checkbox"/> BEDROCK [16 pt]	_____	<input type="checkbox"/> FINE DETRITUS [3 pts]	_____
<input type="checkbox"/> COBBLE (65-256 mm) [12 pts]	_____	<input checked="" type="checkbox"/> CLAY or HARDPAN [0 pt]	_____
<input type="checkbox"/> GRAVEL (2-64 mm) [9 pts]	_____	<input type="checkbox"/> MUCK [0 pts]	_____
<input type="checkbox"/> SAND (<2 mm) [6 pts]	_____	<input type="checkbox"/> ARTIFICIAL [3 pts]	_____

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock (A) (B)

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: _____ TOTAL NUMBER OF SUBSTRATE TYPES:

2. Maximum Pool Depth (Measure the maximum pool depth within the 61 meter (200 ft) evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check ONLY one box):

<input type="checkbox"/> > 30 centimeters [20 pts]	<input type="checkbox"/> > 5 cm - 10 cm [15 pts]
<input type="checkbox"/> > 22.5 - 30 cm [30 pts]	<input type="checkbox"/> < 5 cm [5 pts]
<input type="checkbox"/> > 10 - 22.5 cm [25 pts]	<input checked="" type="checkbox"/> NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS _____ MAXIMUM POOL DEPTH (centimeters):

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check ONLY one box):

<input type="checkbox"/> > 4.0 meters (> 13') [30 pts]	<input type="checkbox"/> > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
<input type="checkbox"/> > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	<input checked="" type="checkbox"/> ≤ 1.0 m (≤ 3' 3") [5 pts]
<input type="checkbox"/> > 1.5 m - 3.0 m (> 4' 8" - 9' 7") [20 pts]	

COMMENTS _____ AVERAGE BANKFULL WIDTH (meters)

HHEI Metric Points

Substrate Max = 40

A + B

Pool Depth Max = 30

Bankfull Width Max = 30

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY *NOTE: River Left (L) and Right (R) as looking downstream*

RIPARIAN WIDTH		FLOODPLAIN QUALITY	
L	R	L	R
<input checked="" type="checkbox"/> <input type="checkbox"/>	(Per Bank) Wide >10m	<input type="checkbox"/> <input type="checkbox"/>	(Most Predominant per Bank) Mature Forest, Wetland
<input type="checkbox"/> <input checked="" type="checkbox"/>	Moderate 5-10m	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	Immature Forest, Shrub or Old Field
<input type="checkbox"/> <input type="checkbox"/>	Narrow <5m	<input type="checkbox"/> <input type="checkbox"/>	Residential, Park, New Field
<input type="checkbox"/> <input type="checkbox"/>	None	<input type="checkbox"/> <input type="checkbox"/>	Fenced Pasture
<input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/>	Conservation Tillage
		<input type="checkbox"/> <input type="checkbox"/>	Urban or Industrial
		<input type="checkbox"/> <input type="checkbox"/>	Open Pasture, Row Crop
		<input type="checkbox"/> <input type="checkbox"/>	Mining or Construction

COMMENTS _____

FLOW REGIME (At Time of Evaluation) (Check ONLY one box):

<input type="checkbox"/> Stream Flowing	<input type="checkbox"/> Moist Channel, isolated pools, no flow (Intermittent)
<input type="checkbox"/> Subsurface flow with isolated pools (Interstitial)	<input type="checkbox"/> Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check ONLY one box):

<input checked="" type="checkbox"/> None	<input type="checkbox"/> 1.0	<input type="checkbox"/> 2.0	<input type="checkbox"/> 3.0
<input type="checkbox"/> 0.5	<input type="checkbox"/> 1.5	<input type="checkbox"/> 2.5	<input type="checkbox"/> >3

STREAM GRADIENT ESTIMATE

<input checked="" type="checkbox"/> Flat (0.5 ft/100 ft)	<input type="checkbox"/> Flat to Moderate	<input type="checkbox"/> Moderate (2 ft/100 ft)	<input type="checkbox"/> Moderate to Severe	<input type="checkbox"/> Severe (10 ft/100 ft)
--	---	---	---	--

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - Yes No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

- WWH Name: _____ Distance from Evaluated Stream _____
 CWH Name: _____ Distance from Evaluated Stream _____
 EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Vine Grove NRCS Soil Map Page: _____ NRCS Soil Map Stream Order _____
County: Hardin Township / City: Ruddiff, KY

MISCELLANEOUS

Base Flow Conditions? (Y/N): Y Date of last precipitation: 7/1/13 Quantity: 2.29"

Photograph Information: _____

Elevated Turbidity? (Y/N): N Canopy (% open): _____

Were samples collected for water chemistry? (Y/N): N (Note lab sample no. or id. and attach results) Lab Number: _____

Field Measures: Temp (°C) _____ Dissolved Oxygen (mg/l) _____ pH (S.U.) _____ Conductivity (µmhos/cm) _____

Is the sampling reach representative of the stream (Y/N) Y If not, please explain: _____

Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

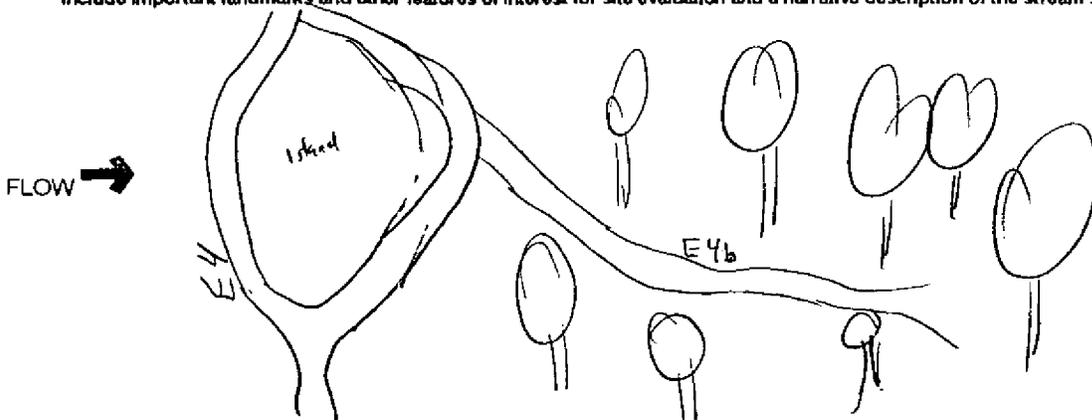
Performed? (Y/N): N (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

Fish Observed? (Y/N) _____ Voucher? (Y/N) _____ Salamanders Observed? (Y/N) _____ Voucher? (Y/N) _____
Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) _____ Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) _____

Comments Regarding Biology: _____

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location





Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) :

6

SITE NAME/LOCATION E 5

SITE NUMBER _____ RIVER BASIN _____ DRAINAGE AREA (mi²) _____

LENGTH OF STREAM REACH (ft) _____ LAT. _____ LONG. _____ RIVER CODE _____ RIVER MILE _____

DATE 7/3/2013 SCORER Ki Bowlin COMMENTS _____

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL: NONE/NATURAL CHANNEL RECOVERED RECOVERING RECENT OR NO RECOVERY
MODIFICATIONS:

1. SUBSTRATE (Estimate percent of every type of substrate present. Check ONLY two predominant substrate TYPE boxes (Max of 40). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.)

TYPE	PERCENT	TYPE	PERCENT
<input type="checkbox"/> BLDR SLABS [16 pts]	_____	<input type="checkbox"/> SILT [3 pt]	_____
<input type="checkbox"/> BOULDER (>256 mm) [16 pts]	_____	<input type="checkbox"/> LEAF PACK/WOODY DEBRIS [3 pts]	_____
<input type="checkbox"/> BEDROCK [16 pt]	_____	<input type="checkbox"/> FINE DETRITUS [3 pts]	_____
<input type="checkbox"/> COBBLE (65-256 mm) [12 pts]	_____	<input checked="" type="checkbox"/> CLAY or HARDPAN [0 pt]	_____
<input type="checkbox"/> GRAVEL (2-64 mm) [9 pts]	_____	<input type="checkbox"/> MUCK [0 pts]	_____
<input type="checkbox"/> SAND (<2 mm) [6 pts]	_____	<input type="checkbox"/> ARTIFICIAL [3 pts]	_____

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock (A) (B)

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: TOTAL NUMBER OF SUBSTRATE TYPES:

2. Maximum Pool Depth (Measure the maximum pool depth within the 61 meter (200 ft) evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check ONLY one box):

<input type="checkbox"/> > 30 centimeters [20 pts]	<input type="checkbox"/> > 5 cm - 10 cm [15 pts]
<input type="checkbox"/> > 22.5 - 30 cm [30 pts]	<input type="checkbox"/> < 5 cm [5 pts]
<input type="checkbox"/> > 10 - 22.5 cm [25 pts]	<input checked="" type="checkbox"/> NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS _____ MAXIMUM POOL DEPTH (centimeters):

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check ONLY one box):

<input type="checkbox"/> > 4.0 meters (> 13') [30 pts]	<input type="checkbox"/> > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
<input type="checkbox"/> > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	<input checked="" type="checkbox"/> ≤ 1.0 m (≤ 3' 3") [5 pts]
<input type="checkbox"/> > 1.5 m - 3.0 m (> 4' 8" - 9' 7") [20 pts]	

COMMENTS _____ AVERAGE BANKFULL WIDTH (meters)

HHEI Metric Points

Substrate Max = 40

1

A + B

Pool Depth Max = 30

0

Bankfull Width Max=30

5

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY (NOTE: River Left (L) and Right (R) as looking downstream)

RIPARIAN WIDTH		FLOODPLAIN QUALITY	
L	R	L	R
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Wide >10m	<input type="checkbox"/>	<input type="checkbox"/> (Most Predominant per Bank) Mature Forest, Wetland
<input type="checkbox"/>	<input type="checkbox"/> Moderate 5-10m	<input type="checkbox"/>	<input type="checkbox"/> Immature Forest, Shrub or Old Field
<input type="checkbox"/>	<input type="checkbox"/> Narrow <5m	<input type="checkbox"/>	<input type="checkbox"/> Residential, Park, New Field
<input type="checkbox"/>	<input type="checkbox"/> None	<input type="checkbox"/>	<input type="checkbox"/> Fenced Pasture
		<input type="checkbox"/>	<input type="checkbox"/> Conservation Tillage
		<input type="checkbox"/>	<input type="checkbox"/> Urban or Industrial
		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Open Pasture, Row Crop
		<input type="checkbox"/>	<input type="checkbox"/> Mining or Construction

COMMENTS _____

FLOW REGIME (At Time of Evaluation) (Check ONLY one box):

<input type="checkbox"/> Stream Flowing	<input type="checkbox"/> Moist Channel, isolated pools, no flow (Intermittent)
<input type="checkbox"/> Subsurface flow with isolated pools (Interstitial)	<input checked="" type="checkbox"/> Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check ONLY one box):

<input checked="" type="checkbox"/> None	<input type="checkbox"/> 1.0	<input type="checkbox"/> 2.0
<input type="checkbox"/> 0.5	<input type="checkbox"/> 1.5	<input type="checkbox"/> 2.5
		<input type="checkbox"/> 3.0
		<input type="checkbox"/> >3

STREAM GRADIENT ESTIMATE

<input type="checkbox"/> Flat (0.5 ft/100 ft)	<input type="checkbox"/> Flat to Moderate	<input type="checkbox"/> Moderate (2 ft/100 ft)	<input type="checkbox"/> Moderate to Severe	<input checked="" type="checkbox"/> Severe (10 ft/100 ft)
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ADDITIONAL STREAM INFORMATION (This information must also be completed):

QHEI PERFORMED? - Yes No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

WWH Name: _____ Distance from Evaluated Stream _____
 CWH Name: _____ Distance from Evaluated Stream _____
 EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Vine Grove NRCS Soil Map Page: _____ NRCS Soil Map Stream Order _____
County: Hardin Township / City: Radcliff KY

MISCELLANEOUS

Base Flow Conditions? (Y/N): N Date of last precipitation: 7/1/2013 Quantity: 2.29"
Photograph Information: _____
Elevated Turbidity? (Y/N): _____ Canopy (% open): _____
Were samples collected for water chemistry? (Y/N): _____ (Note lab sample no. or id. and attach results) Lab Number: _____
Field Measures: Temp (°C) _____ Dissolved Oxygen (mg/l) _____ pH (S.U.) _____ Conductivity (µmhos/cm) _____
Is the sampling reach representative of the stream (Y/N) _____ If not, please explain: _____

Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

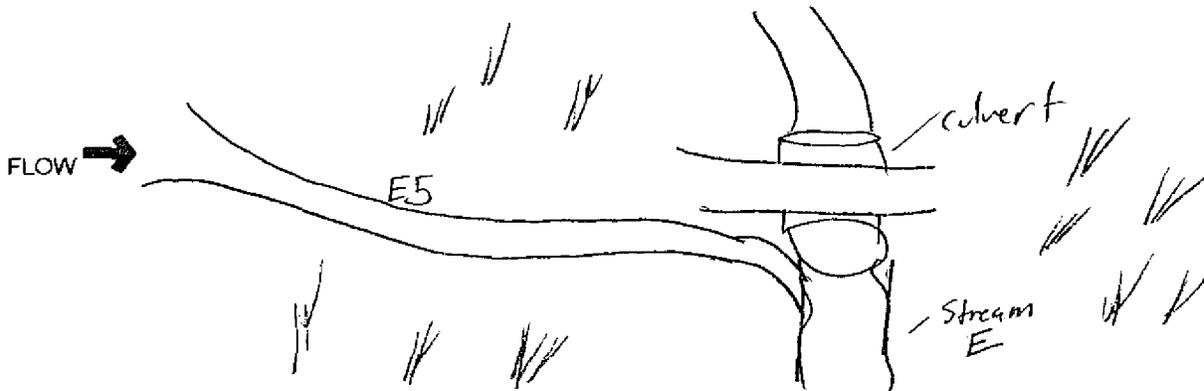
Performed? (Y/N): N (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

Fish Observed? (Y/N) _____ Voucher? (Y/N) _____ Salamanders Observed? (Y/N) _____ Voucher? (Y/N) _____
Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) _____ Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) _____

Comments Regarding Biology: _____

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location





Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) :

35

SITE NAME/LOCATION EG

SITE NUMBER _____ RIVER BASIN _____ DRAINAGE AREA (mi²) _____

LENGTH OF STREAM REACH (ft) _____ LAT. _____ LONG. _____ RIVER CODE _____ RIVER MILE _____

DATE 7/3/2013 SCORER K. Bowlin COMMENTS _____

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PWHH Streams" for Instructions

STREAM CHANNEL NONE / NATURAL CHANNEL RECOVERED RECOVERING RECENT OR NO RECOVERY
MODIFICATIONS:

1. SUBSTRATE (Estimate percent of every type of substrate present. Check ONLY two predominant substrate TYPE boxes (Max of 40). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.)

TYPE	PERCENT	TYPE	PERCENT
<input type="checkbox"/> BLDR SLABS [16 pts]	_____	<input type="checkbox"/> SILT [3 pt]	_____
<input type="checkbox"/> BOULDER (>256 mm) [16 pts]	_____	<input checked="" type="checkbox"/> LEAF PACK/WOODY DEBRIS [3 pts]	_____
<input type="checkbox"/> BEDROCK [16 pt]	_____	<input type="checkbox"/> FINE DETRITUS [3 pts]	_____
<input type="checkbox"/> COBBLE (65-256 mm) [12 pts]	_____	<input checked="" type="checkbox"/> CLAY or HARDPAN [0 pt]	_____
<input type="checkbox"/> GRAVEL (2-64 mm) [9 pts]	_____	<input type="checkbox"/> MUCK [0 pts]	_____
<input type="checkbox"/> SAND (<2 mm) [6 pts]	_____	<input type="checkbox"/> ARTIFICIAL [3 pts]	_____

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock: (A) 3 (B) 2

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: 3 TOTAL NUMBER OF SUBSTRATE TYPES: 2

2. Maximum Pool Depth (Measure the maximum pool depth within the 61 meter (200 ft) evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check ONLY one box):

<input type="checkbox"/> > 30 centimeters [20 pts]	<input checked="" type="checkbox"/> > 5 cm - 10 cm [15 pts]
<input type="checkbox"/> > 22.5 - 30 cm [30 pts]	<input type="checkbox"/> < 5 cm [5 pts]
<input type="checkbox"/> > 10 - 22.5 cm [25 pts]	<input type="checkbox"/> NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS _____ MAXIMUM POOL DEPTH (centimeters): 15

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check ONLY one box):

<input type="checkbox"/> > 4.0 meters (> 13') [30 pts]	<input checked="" type="checkbox"/> > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
<input type="checkbox"/> > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	<input type="checkbox"/> ≤ 1.0 m (≤ 3' 3") [5 pts]
<input type="checkbox"/> > 1.5 m - 3.0 m (> 4' 8" - 9' 7") [20 pts]	

COMMENTS _____ AVERAGE BANKFULL WIDTH (meters): 15

HHEI Metric Points

Substrate Max = 40

5

A + B

Pool Depth Max = 30

15

Bankfull Width Max=30

15

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH

- L R (Per Bank)
- Wide >10m
- Moderate 5-10m
- Narrow <5m
- None

FLOODPLAIN QUALITY

- L R (Most Predominant per Bank)
- Mature Forest, Wetland
- Immature Forest, Shrub or Old Field
- Residential, Park, New Field
- Fenced Pasture

- L R
- Conservation Tillage
- Urban or Industrial
- Open Pasture, Row Crop
- Mining or Construction

COMMENTS _____

FLOW REGIME (At Time of Evaluation) (Check ONLY one box):

- Stream Flowing
- Subsurface flow with isolated pools (Interstitial)
- Moist Channel, isolated pools, no flow (Intermittent)
- Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check ONLY one box):

- None
- 0.5
- 1.0
- 1.5
- 2.0
- 2.5
- 3.0
- >3

STREAM GRADIENT ESTIMATE

- Flat (0.5 ft/100 ft)
- Flat to Moderate
- Moderate (2 ft/100 ft)
- Moderate to Severe
- Severe (10 ft/100 ft)

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - Yes No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

WWH Name: _____ Distance from Evaluated Stream _____
 CWH Name: _____ Distance from Evaluated Stream _____
 EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Vine Grove NRCS Soil Map Page: _____ NRCS Soil Map Stream Order _____
County: Hardin Township / City: Rudoliff, KY

MISCELLANEOUS

Base Flow Conditions? (Y/N): Y Date of last precipitation: 7/1/2013 Quantity: 2.29"
Photograph Information: _____
Elevated Turbidity? (Y/N): N Canopy (% open): 20%
Were samples collected for water chemistry? (Y/N): _____ (Note lab sample no. or id. and attach results) Lab Number: _____
Field Measures: Temp (°C) _____ Dissolved Oxygen (mg/l) _____ pH (S.U.) _____ Conductivity (µmhos/cm) _____
Is the sampling reach representative of the stream (Y/N) _____ If not, please explain: _____

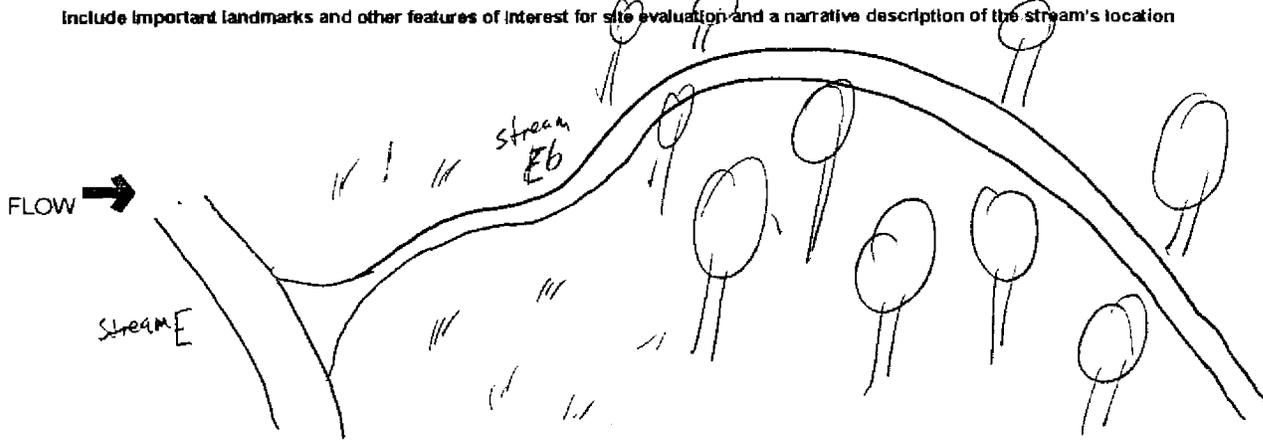
Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

Performed? (Y/N): N (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)
Fish Observed? (Y/N) _____ Voucher? (Y/N) _____ Salamanders Observed? (Y/N) _____ Voucher? (Y/N) _____
Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) _____ Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) _____
Comments Regarding Biology: _____

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location





Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) : 6

SITE NAME/LOCATION Stream E7 SITE NUMBER _____ RIVER BASIN _____ DRAINAGE AREA (mi²) _____
 LENGTH OF STREAM REACH (ft) _____ LAT. _____ LONG. _____ RIVER CODE _____ RIVER MILE _____
 DATE 7/3/2013 SCORER K. Baker T. Newman COMMENTS _____

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PWH Streams" for Instructions

STREAM CHANNEL: NONE/NATURAL CHANNEL RECOVERED RECOVERING RECENT OR NO RECOVERY
 MODIFICATIONS: _____

1. SUBSTRATE (Estimate percent of every type of substrate present. Check *ONLY* two predominant substrate TYPE boxes (Max of 40). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.)

TYPE	PERCENT	TYPE	PERCENT
<input type="checkbox"/> <input type="checkbox"/> BLDR SLABS [16 pts]	_____	<input type="checkbox"/> <input type="checkbox"/> SILT [3 pt]	_____
<input type="checkbox"/> <input type="checkbox"/> BOULDER (>256 mm) [16 pts]	_____	<input type="checkbox"/> <input type="checkbox"/> LEAF PACK/WOODY DEBRIS [3 pts]	_____
<input type="checkbox"/> <input type="checkbox"/> BEDROCK [16 pt]	_____	<input type="checkbox"/> <input type="checkbox"/> FINE DETRITUS [3 pts]	_____
<input type="checkbox"/> <input type="checkbox"/> COBBLE (65-256 mm) [12 pts]	_____	<input checked="" type="checkbox"/> <input type="checkbox"/> CLAY or HARDPAN [0 pt]	_____
<input type="checkbox"/> <input type="checkbox"/> GRAVEL (2-64 mm) [9 pts]	_____	<input type="checkbox"/> <input type="checkbox"/> MUCK [0 pts]	_____
<input type="checkbox"/> <input type="checkbox"/> SAND (<2 mm) [8 pts]	_____	<input type="checkbox"/> <input type="checkbox"/> ARTIFICIAL [3 pts]	_____

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock (A) 0 (B) 1

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: _____ TOTAL NUMBER OF SUBSTRATE TYPES: 1

2. Maximum Pool Depth (Measure the maximum pool depth within the 61 meter (200 ft) evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check *ONLY* one box):

<input type="checkbox"/> > 30 centimeters [20 pts]	<input type="checkbox"/> > 5 cm - 10 cm [15 pts]
<input type="checkbox"/> > 22.5 - 30 cm [30 pts]	<input type="checkbox"/> < 5 cm [5 pts]
<input type="checkbox"/> > 10 - 22.5 cm [25 pts]	<input checked="" type="checkbox"/> NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS _____ MAXIMUM POOL DEPTH (centimeters): 6

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check *ONLY* one box):

<input type="checkbox"/> > 4.0 meters (> 13') [30 pts]	<input type="checkbox"/> > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
<input type="checkbox"/> > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	<input checked="" type="checkbox"/> ≤ 1.0 m (≤ 3' 3") [5 pts]
<input type="checkbox"/> > 1.5 m - 3.0 m (> 4' 8" - 9' 7") [20 pts]	

COMMENTS _____ AVERAGE BANKFULL WIDTH (meters) 5

HHEI Metric Points

Substrate Max = 40

1

A + B

Pool Depth Max = 30

0

Bankfull Width Max=30

5

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY

☆NOTE: River Left (L) and Right (R) as looking downstream

RIPARIAN WIDTH		FLOODPLAIN QUALITY		L	R
<input type="checkbox"/> <input type="checkbox"/>	Wide >10m	<input type="checkbox"/> <input type="checkbox"/>	Mature Forest, Wetland	<input type="checkbox"/> <input type="checkbox"/>	Conservation Tillage
<input type="checkbox"/> <input type="checkbox"/>	Moderate 5-10m	<input type="checkbox"/> <input type="checkbox"/>	Immature Forest, Shrub or Old Field	<input type="checkbox"/> <input type="checkbox"/>	Urban or Industrial
<input type="checkbox"/> <input type="checkbox"/>	Narrow <5m	<input type="checkbox"/> <input type="checkbox"/>	Residential, Park, New Field	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	Open Pasture, Row Crop
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	None	<input type="checkbox"/> <input type="checkbox"/>	Fenced Pasture	<input type="checkbox"/> <input type="checkbox"/>	Mining or Construction

COMMENTS _____

FLOW REGIME (At Time of Evaluation) (Check *ONLY* one box):

Stream Flowing Moist Channel, isolated pools, no flow (Intermittent)

Subsurface flow with isolated pools (Interstitial) Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check *ONLY* one box):

None 1.0 2.0 3.0

0.5 1.5 2.5 >3

STREAM GRADIENT ESTIMATE

Flat (0.5 #/100 ft) Flat to Moderate Moderate (2 #/100 ft) Moderate to Severe Severe (10 #/100 ft)

ADDITIONAL STREAM INFORMATION (This information Must Also be Completed):

QHEI PERFORMED? - Yes No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

WWH Name: _____ Distance from Evaluated Stream _____
 CWH Name: _____ Distance from Evaluated Stream _____
 EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Vine Grove NRCS Soil Map Page: _____ NRCS Soil Map Stream Order _____
County: Hardin Township / City: Radcliff KY

MISCELLANEOUS

Base Flow Conditions? (Y/N): Y Date of last precipitation: 7/1/2013 Quantity: 229"
Photograph Information: _____
Elevated Turbidity? (Y/N): N Canopy (% open): _____
Were samples collected for water chemistry? (Y/N): N (Note lab sample no. or id. and attach results) Lab Number: _____
Field Measures: Temp (°C) _____ Dissolved Oxygen (mg/l) _____ pH (S.U.) _____ Conductivity (µmhos/cm) _____
Is the sampling reach representative of the stream (Y/N) Y If not, please explain: _____

Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

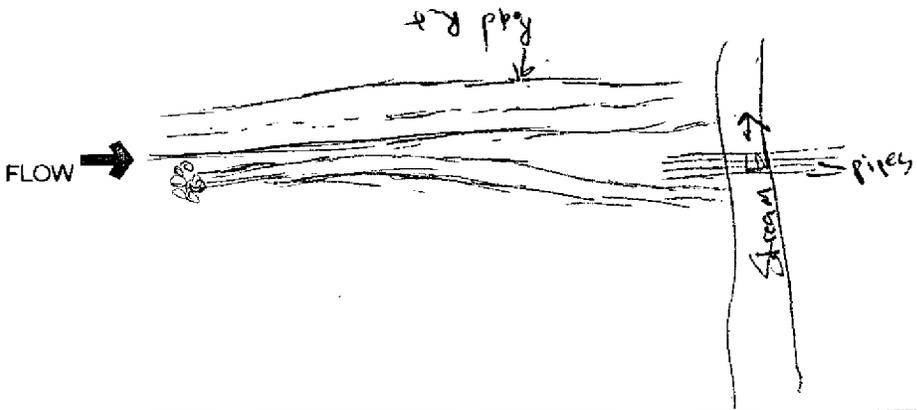
Performed? (Y/N): N (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

Fish Observed? (Y/N) _____ Voucher? (Y/N) _____ Salamanders Observed? (Y/N) _____ Voucher? (Y/N) _____
Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) _____ Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) _____

Comments Regarding Biology: _____

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location



Stream & Location: Stream F

RM: Date: 7/3/13

Scorers Full Name & Affiliation:

River Code: STORET #: Lat./ Long.: 18 Office verified location

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES: estimate % or note every type present

Check ONE (Or 2 & average)

Form for Substrate assessment including categories: BEST TYPES, OTHER TYPES, ORIGIN, and QUALITY. Includes checkboxes for various substrate types and a numerical score box containing '2'.

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts; 2-Moderate amounts; 3-Highest quality

AMOUNT

Check ONE (Or 2 & average)

Form for Instream Cover assessment including categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, BACKWATERS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS. Includes checkboxes and a numerical score box containing '7'.

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

Form for Channel Morphology assessment including categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes checkboxes and a numerical score box containing '5'.

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

Form for Bank Erosion and Riparian Zone assessment including categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY, CONSERVATION TILLAGE, URBAN OR INDUSTRIAL, MINING / CONSTRUCTION. Includes checkboxes and a numerical score box containing '5'.

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

Form for Pool / Glide and Riffle / Run Quality assessment including categories: MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY, Recreation Potential. Includes checkboxes and a numerical score box containing '8'.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). NO RIFFLE [metric=0]

Form for Riffle / Run Embeddedness assessment including categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes checkboxes and a numerical score box containing '0'.

Form for Gradient assessment including categories: DRAINAGE AREA, GRADIENT. Includes checkboxes and a numerical score box containing '4'.

A) SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L LINE
- OTHER

STAGE

- HIGH
- UP
- NORMAL
- LOW
- DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st --sample pass-- 2nd
- < 20 cm
- 20-40 cm
- 40-70 cm
- > 70 cm / CTB
- SECCHI DEPTH

meters

CANOPY

- > 85% - OPEN
- 55% - < 85%
- 30% - < 55%
- 10% - < 30%
- < 10% - CLOSED

- 1st _____ cm
- 2nd _____ cm

C) RECREATION

- AREA DEPTH
- POOL: > 100ft² > 3ft

B) AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

D) MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

Circle some & COMMENT

E) ISSUES

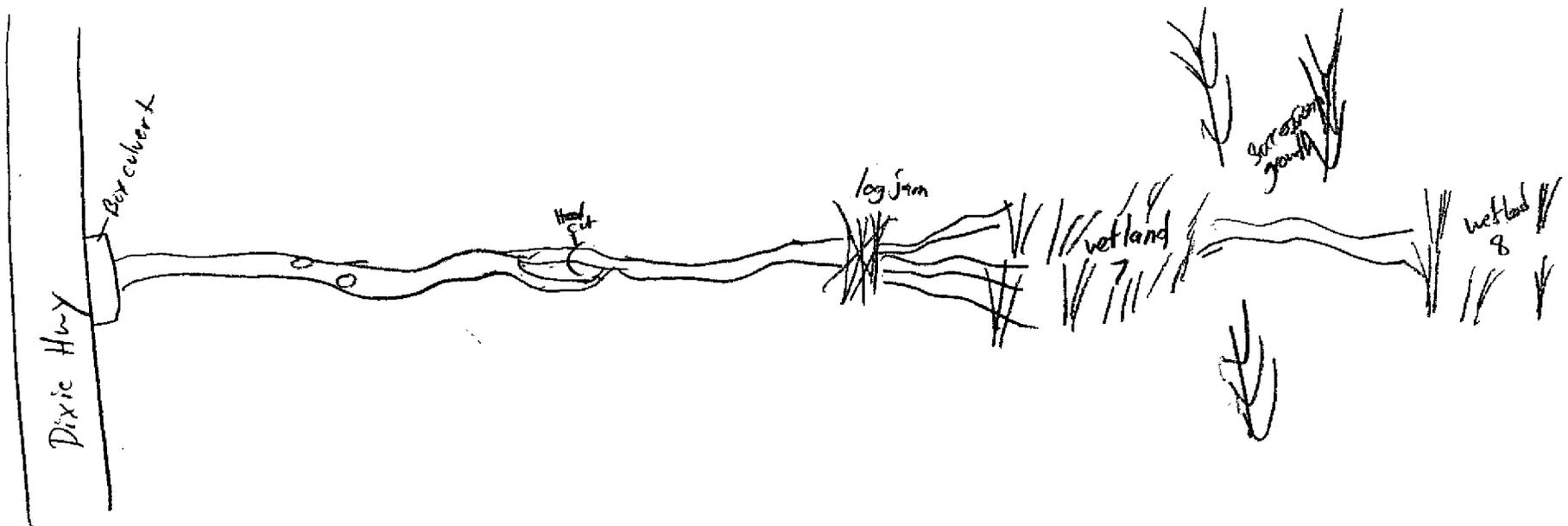
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

F) MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone x^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Stream 6 Keith Bowlin Tyler Newman Scorer's Full Name & Affiliation: Jackson Environmental Consulting

River Code: STORET #: Lat./ Long.: 18 Office verified location

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present. Includes categories: BEST TYPES, OTHER TYPES, ORIGIN, and QUALITY. Includes a 'Substrate' score box with value 9.

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts; 2-Moderate amounts; 3-Highest quality. Includes categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, BACKWATERS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS. Includes an 'Amount' score box with value 10.

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average). Includes categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes a 'Channel' score box with value 10.

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average). Includes categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY, CONSERVATION TILLAGE, URBAN OR INDUSTRIAL, MINING / CONSTRUCTION. Includes a 'Riparian' score box with value 7.

5) POOL / GLIDE AND RIFFLE / RUN QUALITY MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY. Includes a 'Recreation Potential' box with 'Primary Contact' and 'Secondary Contact' options. Includes a 'Pool / Current' score box with value 7.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species. Includes categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes a 'Riffle / Run' score box with value 3.

6) GRADIENT (ft/mi), DRAINAGE AREA (mi^2), % POOL, % GLIDE, % RUN, % RIFFLE. Includes a 'Gradient' score box with value 6.

A) SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- 1st - sample pass - 2nd
- HIGH
 - UP
 - NORMAL
 - LOW
 - DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st - sample pass - 2nd
- < 20 cm
 - 20-40 cm
 - 40-70 cm
 - > 70 cm / CTB
 - SECCHI DEPTH

B) AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

D) MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG / SUCCESSION / OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCOURED
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

Circle some & COMMENT

Some areas mature forest others successional

E) ISSUES

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

F) MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

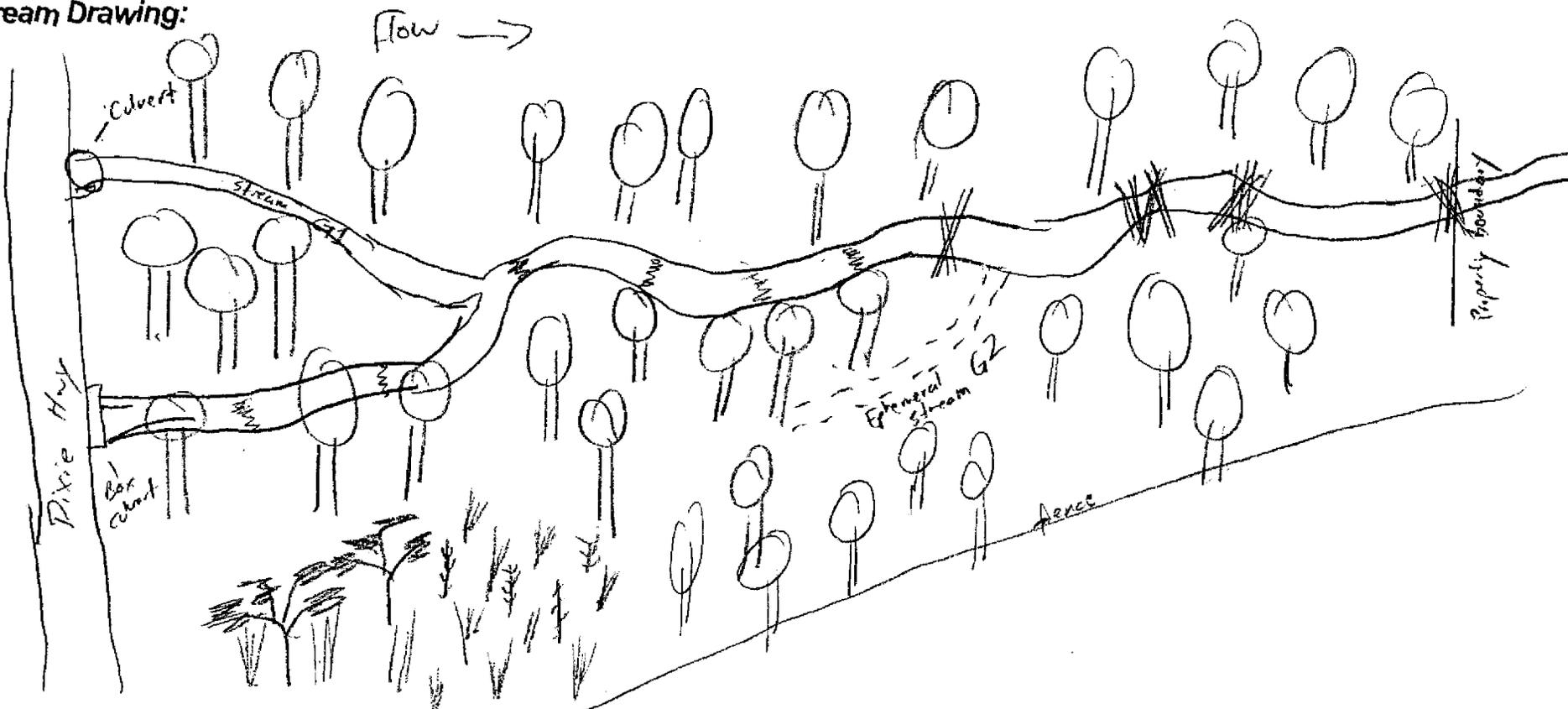
CANOPY

- 1st pass _____ cm
- 2nd pass _____ cm
- > 85% OPEN
 - 55% - < 85%
 - 30% - < 55%
 - 10% - < 30%
 - < 10% - CLOSED

C) RECREATION

- AREA DEPTH
- POOL: > 100ft² > 3ft

Stream Drawing:



Stream & Location: Stream G1 RM: Date: 7/3/13
Keith Bowlin, Tyler Newman Scorers Full Name & Affiliation: Jackson Environmental

River Code: STORET #: Lat./ Long.: 18 Office verified location

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES: estimate % or note every type present

Table with columns: BEST TYPES, OTHER TYPES, ORIGIN, QUALITY. Includes checkboxes for BLDR/SLABS, BOULDER, COBBLE, GRAVEL, SAND, BEDROCK, HARDPAN, DETRITUS, MUCK, SILT, ARTIFICIAL, LIMESTONE, TILLS, WETLANDS, SANDSTONE, RIP/RAP, LACUSTURINE, SHALE, COAL FINES, HEAVY, MODERATE, NORMAL, FREE, EXTENSIVE, MODERATE, NORMAL, NONE.

2) INSTREAM COVER Indicate presence 0 to 3. 0-Absent; 1-Very small amounts... AMOUNT Check ONE (Or 2 & average). Includes checkboxes for UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, BACKWATERS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS, EXTENSIVE, MODERATE, SPARSE, NEARLY ABSENT.

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average). Includes SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes checkboxes for HIGH, MODERATE, LOW, NONE, EXCELLENT, GOOD, FAIR, POOR, NONE, RECOVERED, RECOVERING, RECENT OR NO RECOVERY, HIGH, MODERATE, LOW.

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average). Includes EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY, CONSERVATION TILLAGE, URBAN OR INDUSTRIAL, MINING / CONSTRUCTION, HEAVY / SEVERE, VERY NARROW, NONE, FOREST SWAMP, SHRUB OR OLD FIELD, RESIDENTIAL PARK, NEW FIELD, FENCED PASTURE, OPEN PASTURE, ROWCROP.

5) POOL / GLIDE AND RIFFLE / RUN QUALITY MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY. Includes checkboxes for >1m, 0.7-1m, 0.4-0.7m, 0.2-0.4m, <0.2m, POOL WIDTH > RIFFLE WIDTH, POOL WIDTH = RIFFLE WIDTH, POOL WIDTH < RIFFLE WIDTH, TORRENTIAL, SLOW, VERY FAST, INTERSTITIAL, FAST, INTERMITTENT, MODERATE, EDDIES.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species. Includes RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes checkboxes for BEST AREAS > 10cm, BEST AREAS 5-10cm, BEST AREAS < 5cm, MAXIMUM > 50cm, MAXIMUM < 50cm, STABLE, MOD. STABLE, UNSTABLE, NONE, LOW, MODERATE, EXTENSIVE.

6) GRADIENT (ft/mi) DRAINAGE AREA (mi^2). Includes checkboxes for VERY LOW, LOW, MODERATE, HIGH, VERY HIGH, % POOL, % GLIDE, % RUN, % RIFFLE.

A) SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L-LINE
- OTHER

STAGE

- 1st -sample pass- 2nd
- HIGH
 - UP
 - NORMAL
 - LOW
 - DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st --sample pass-- 2nd
- < 20 cm
 - 20-40 cm
 - 40-70 cm
 - > 70 cm/ CTB
 - SECCHI DEPTH

B) AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

D) MAINTENANCE

Circle some & COMMENT

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION OLD *young forest*
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD STABLE
- ARMoured / SLUMPS
- ISLANDS / SCOURED
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

E) ISSUES

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

F) MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone x^2 width
- entrench. ratio

Legacy Tree:

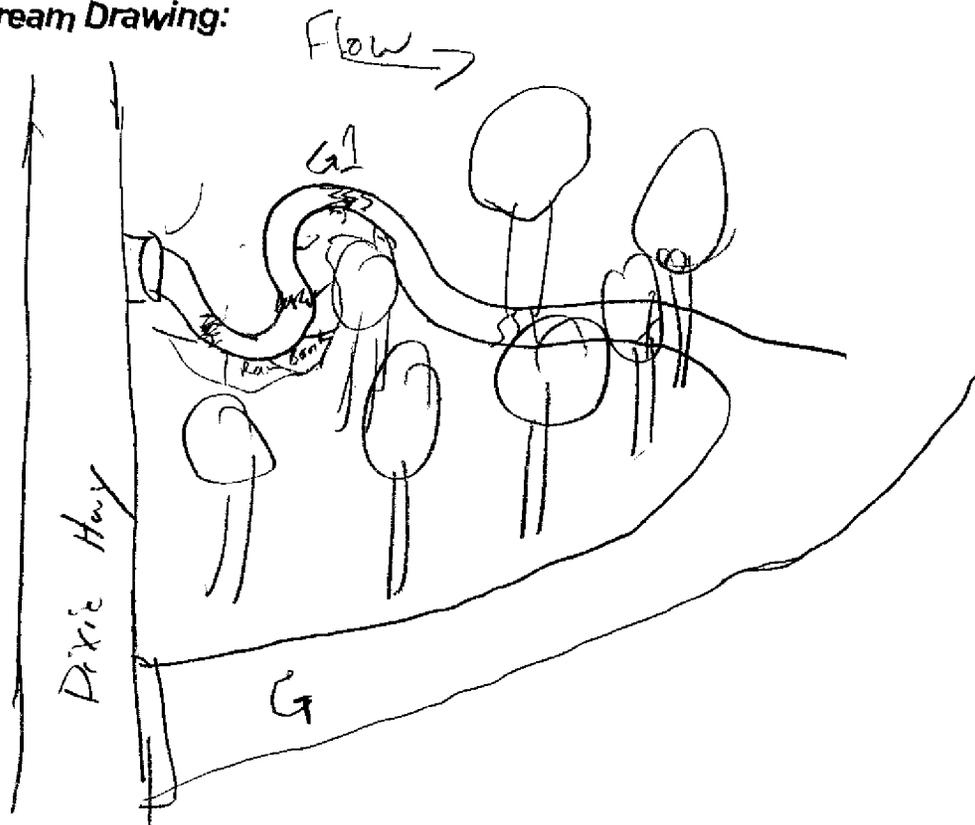
C) RECREATION

- AREA DEPTH
POOL: >100ft² >3ft

CANOPY

- 1st pass _____ cm
2nd pass _____ cm
- > 85% - OPEN
 - 55% - 85%
 - 30% - 55%
 - 10% - 30%
 - < 10% - CLOSED

Stream Drawing:





Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) :

6

SITE NAME/LOCATION Stream 62

SITE NUMBER _____ RIVER BASIN _____ DRAINAGE AREA (mi²) _____

LENGTH OF STREAM REACH (ft) _____ LAT. _____ LONG. _____ RIVER CODE _____ RIVER MILE _____

DATE 7/3/2013 SCORER K. B. Smith COMMENTS _____

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL: NONE / NATURAL CHANNEL RECOVERED RECOVERING RECENT OR NO RECOVERY
MODIFICATIONS:

1. **SUBSTRATE** (Estimate percent of every type of substrate present. Check ONLY two predominant substrate TYPE boxes (Max of 40). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.)

TYPE	PERCENT	TYPE	PERCENT
<input type="checkbox"/> BLDR SLABS [16 pts]	_____	<input type="checkbox"/> SILT [3 pt]	_____
<input type="checkbox"/> BOULDER (>256 mm) [16 pts]	_____	<input type="checkbox"/> LEAF PACK/WOODY DEBRIS [3 pts]	_____
<input type="checkbox"/> BEDROCK [16 pt]	_____	<input type="checkbox"/> FINE DETRITUS [3 pts]	_____
<input type="checkbox"/> COBBLE (65-256 mm) [12 pts]	_____	<input checked="" type="checkbox"/> CLAY or HARDPAN [0 pt]	_____
<input type="checkbox"/> GRAVEL (2-64 mm) [9 pts]	_____	<input type="checkbox"/> MUCK [0 pts]	_____
<input type="checkbox"/> SAND (<2 mm) [8 pts]	_____	<input type="checkbox"/> ARTIFICIAL [3 pts]	_____

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock (A) 0 (B) 1

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: 0 TOTAL NUMBER OF SUBSTRATE TYPES: 1

2. **Maximum Pool Depth** (Measure the maximum pool depth within the 61 meter (200 ft) evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check ONLY one box):

<input type="checkbox"/> > 30 centimeters [20 pts]	<input type="checkbox"/> > 5 cm - 10 cm [15 pts]
<input type="checkbox"/> > 22.5 - 30 cm [30 pts]	<input type="checkbox"/> < 5 cm [5 pts]
<input type="checkbox"/> > 10 - 22.5 cm [25 pts]	<input checked="" type="checkbox"/> NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS _____ MAXIMUM POOL DEPTH (centimeters): 0

3. **BANK FULL WIDTH** (Measured as the average of 3-4 measurements) (Check ONLY one box):

<input type="checkbox"/> > 4.0 meters (> 13') [30 pts]	<input type="checkbox"/> > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
<input type="checkbox"/> > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	<input checked="" type="checkbox"/> ≤ 1.0 m (≤ 3' 3") [5 pts]
<input type="checkbox"/> > 1.5 m - 3.0 m (> 4' 8" - 9' 7") [20 pts]	

COMMENTS _____ AVERAGE BANKFULL WIDTH (meters): 5

HHEI Metric Points

Substrate Max = 40

1

A + B

Pool Depth Max = 30

0

Bankfull Width Max = 30

5

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY *NOTE: River Left (L) and Right (R) as looking downstream*

RIPARIAN WIDTH		FLOODPLAIN QUALITY	
L	R	L	R
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> (Per Bank) Wide >10m	<input type="checkbox"/>	<input type="checkbox"/> (Most Predominant per Bank) Mature Forest, Wetland
<input type="checkbox"/>	<input type="checkbox"/> Moderate 5-10m	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Immature Forest, Shrub or Old Field
<input type="checkbox"/>	<input type="checkbox"/> Narrow <5m	<input type="checkbox"/>	<input type="checkbox"/> Residential, Park, New Field
<input type="checkbox"/>	<input type="checkbox"/> None	<input type="checkbox"/>	<input type="checkbox"/> Fenced Pasture
		<input type="checkbox"/>	<input type="checkbox"/> Conservation Tillage
		<input type="checkbox"/>	<input type="checkbox"/> Urban or Industrial
		<input type="checkbox"/>	<input type="checkbox"/> Open Pasture, Row Crop
		<input type="checkbox"/>	<input type="checkbox"/> Mining or Construction

COMMENTS _____

FLOW REGIME (At Time of Evaluation) (Check ONLY one box):

<input type="checkbox"/> Stream Flowing	<input checked="" type="checkbox"/> Moist Channel, isolated pools, no flow (Intermittent)
<input type="checkbox"/> Subsurface flow with isolated pools (Interstitial)	<input type="checkbox"/> Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check ONLY one box):

<input checked="" type="checkbox"/> None	<input type="checkbox"/> 1.0	<input type="checkbox"/> 2.0
<input type="checkbox"/> 0.5	<input type="checkbox"/> 1.5	<input type="checkbox"/> >3
		<input type="checkbox"/> 2.5

STREAM GRADIENT ESTIMATE

<input type="checkbox"/> Flat (0.5 ft/100 ft)	<input checked="" type="checkbox"/> Flat to Moderate	<input type="checkbox"/> Moderate (2 ft/100 ft)	<input type="checkbox"/> Moderate to Severe	<input type="checkbox"/> Severe (10 ft/100 ft)
---	--	---	---	--

ADDITIONAL STREAM INFORMATION (This information Must Also be Completed):

QHEI PERFORMED? - Yes No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

WWH Name: _____ Distance from Evaluated Stream _____
 CWH Name: _____ Distance from Evaluated Stream _____
 EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Vine Grove NRCS Soil Map Page: _____ NRCS Soil Map Stream Order _____
County: Hardin Township / City: Radcliff KY

MISCELLANEOUS

Base Flow Conditions? (Y/N): Y Date of last precipitation: 7/1/2013 Quantity: 229"
Photograph Information: _____
Elevated Turbidity? (Y/N): N Canopy (% open): 20%
Were samples collected for water chemistry? (Y/N): N (Note lab sample no. or id. and attach results) Lab Number: _____
Field Measures: Temp (°C) _____ Dissolved Oxygen (mg/l) _____ pH (S.U.) _____ Conductivity (µmhos/cm) _____
Is the sampling reach representative of the stream (Y/N) Y If not, please explain: _____

Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

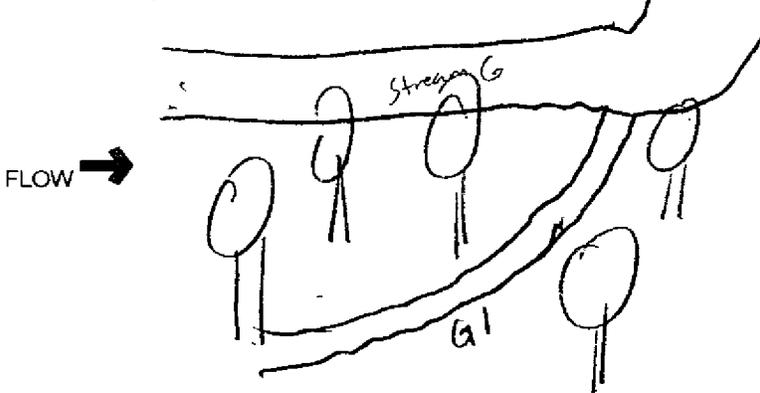
Performed? (Y/N): N (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

Fish Observed? (Y/N) _____ Voucher? (Y/N) _____ Salamanders Observed? (Y/N) _____ Voucher? (Y/N) _____
Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) _____ Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) _____

Comments Regarding Biology: _____

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location



Attachment 4

OEPA ORAM Data Sheets

Site: Wetland 1 Rater(s): K. Bowlin T. Newman Date: 7/2/2013

2 2

Metric 1. Wetland Area (size).

max 6 pts. subtotal

Select one size class and assign score.

- >50 acres (>20.2ha) (6 pts)
- 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- 10 to <25 acres (4 to <10.1ha) (4 pts)
- 3 to <10 acres (1.2 to <4ha) (3 pts)
- 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- <0.1 acres (0.04ha) (0 pts)

4 6

Metric 2. Upland buffers and surrounding land use.

max 14 pts. subtotal

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4)
- NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

2b. Intensity of surrounding land use. Select one or double check and average.

- VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- LOW. Old field (>10 years), shrubland, young second growth forest. (5)
- MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

17 23

Metric 3. Hydrology.

max 30 pts. subtotal

3a. Sources of Water. Score all that apply.

- High pH groundwater (5)
- Other groundwater (3)
- Precipitation (1)
- Seasonal/Intermittent surface water (3)
- Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.

- 100 year floodplain (1)
- Between stream/lake and other human use (1)
- Part of wetland/upland (e.g. forest), complex (1)
- Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.

- >0.7 (27.6in) (3)
- 0.4 to 0.7m (15.7 to 27.6in) (2)
- <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.

- Semi- to permanently inundated/saturated (4)
- Regularly inundated/saturated (3)
- Seasonally inundated (2)
- Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- None or none apparent (12)
- Recovered (7)
- Recovering (3)
- Recent or no recovery (1)

Check all disturbances observed

- ditch
- tile
- dike
- weir
- stormwater input
- point source (nonstormwater)
- filling/grading
- road bed/RR track
- dredging
- other drainage basin

4 27

Metric 4. Habitat Alteration and Development.

max 20 pts. subtotal

4a. Substrate disturbance. Score one or double check and average.

- None or none apparent (4)
- Recovered (3)
- Recovering (2)
- Recent or no recovery (1)

4b. Habitat development. Select only one and assign score.

- Excellent (7)
- Very good (6)
- Good (5)
- Moderately good (4)
- Fair (3)
- Poor to fair (2)
- Poor (1)

4c. Habitat alteration. Score one or double check and average.

- None or none apparent (9)
- Recovered (6)
- Recovering (3)
- Recent or no recovery (1)

Check all disturbances observed

- mowing
- grazing
- clearcutting
- selective cutting
- woody debris removal
- toxic pollutants
- shrub/sapling removal
- herbaceous/aquatic bed removal
- sedimentation
- dredging
- farming
- nutrient enrichment

22

subtotal this page

Site: Wetland 1 Rater(s): K. Bowlin T. Newman Date: 7/2/2013



subtotal this page

max 10 pts. subtotal 0 27

Metric 5. Special Wetlands.

Check all that apply and score as indicated.

- Bog (10)
- Fen (10)
- Old growth forest (10)
- Mature forested wetland (5)
- Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- Lake Erie coastal/tributary wetland-restricted hydrology (5)
- Lake Plain Sand Prairies (Oak Openings) (10)
- Relict Wet Prairies (10)
- Known occurrence state/federal threatened or endangered species (10)
- Significant migratory songbird/water fowl habitat or usage (10)
- Category 1 Wetland. See Question 1 Qualitative Rating (-10)

max 20 pts. subtotal 8 35

Metric 6. Plant communities, interspersions, microtopography.

6a. Wetland Vegetation Communities.

Score all present using 0 to 3 scale.

- Aquatic bed
- 1 Emergent
- Shrub
- 2 Forest
- 1 Mudflats
- Open water
- Other _____

6b. horizontal (plan view) Interspersion.

Select only one.

- High (5)
- Moderately high(4)
- Moderate (3)
- Moderately low (2)
- Low (1)
- None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- Extensive >75% cover (-5)
- Moderate 25-75% cover (-3)
- Sparse 5-25% cover (-1)
- Nearly absent <5% cover (0)
- Absent (1)

6d. Microtopography.

Score all present using 0 to 3 scale.

- Vegetated hummocks/tussucks
- 2 Coarse woody debris > 15cm (6in)
- Standing dead >25cm (10in) dbh
- Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

35 GRAND TOTAL(max 100 pts)

Refer to the most recent ORAM Score Calibration Report for the scoring breakpoints between wetland categories at the following address: <http://www.epa.state.oh.us/dsw/401/401.html>

Site: Wetland 2 Rater(s): K. Bowlin T. Newman Date: 7/2/2013

2 2

Metric 1. Wetland Area (size).

max 0 pts. subtotal

Select one size class and assign score.

- >50 acres (>20.2ha) (6 pts)
- 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- 10 to <25 acres (4 to <10.1ha) (4 pts)
- 3 to <10 acres (1.2 to <4ha) (3 pts)
- 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- <0.1 acres (0.04ha) (0 pts)

11 13

Metric 2. Upland buffers and surrounding land use.

max 14 pts. subtotal

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4)
- NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

2b. Intensity of surrounding land use. Select one or double check and average.

- VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- LOW. Old field (>10 years), shrubland, young second growth forest. (5)
- MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

22 35

Metric 3. Hydrology.

max 30 pts. subtotal

3a. Sources of Water. Score all that apply.

- High pH groundwater (5)
- Other groundwater (3)
- Precipitation (1)
- Seasonal/intermittent surface water (3)
- Perennial surface water (lake or stream) (5)

3c. Maximum water depth. Select only one and assign score.

- >0.7 (27.6in) (3)
- 0.4 to 0.7m (15.7 to 27.6in) (2)
- <0.4m (<15.7in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- None or none apparent (12)
- Recovered (7)
- Recovering (3)
- Recent or no recovery (1)

3b. Connectivity. Score all that apply.

- 100 year floodplain (1)
- Between stream/lake and other human use (1)
- Part of wetland/upland (e.g. forest), complex (1)
- Part of riparian or upland corridor (1)

3d. Duration inundation/saturation. Score one or dbl check.

- Semi- to permanently inundated/saturated (4)
- Regularly inundated/saturated (3)
- Seasonally inundated (2)
- Seasonally saturated in upper 30cm (12in) (1)

Check all disturbances observed	
<input type="checkbox"/> ditch	<input type="checkbox"/> point source (nonstormwater)
<input type="checkbox"/> tile	<input type="checkbox"/> filling/grading
<input type="checkbox"/> dike	<input type="checkbox"/> road bed/RR track
<input type="checkbox"/> weir	<input type="checkbox"/> dredging
<input type="checkbox"/> stormwater input	<input type="checkbox"/> other _____

15 50

Metric 4. Habitat Alteration and Development.

max 20 pts. subtotal

4a. Substrate disturbance. Score one or double check and average.

- None or none apparent (4)
- Recovered (3)
- Recovering (2)
- Recent or no recovery (1)

4b. Habitat development. Select only one and assign score.

- Excellent (7)
- Very good (6)
- Good (5)
- Moderately good (4)
- Fair (3)
- Poor to fair (2)
- Poor (1)

4c. Habitat alteration. Score one or double check and average.

- None or none apparent (9)
- Recovered (6)
- Recovering (3)
- Recent or no recovery (1)

Check all disturbances observed	
<input type="checkbox"/> mowing	<input type="checkbox"/> shrub/sapling removal
<input type="checkbox"/> grazing	<input type="checkbox"/> herbaceous/aquatic bed removal
<input type="checkbox"/> clearcutting	<input checked="" type="checkbox"/> sedimentation
<input type="checkbox"/> selective cutting	<input type="checkbox"/> dredging
<input type="checkbox"/> woody debris removal	<input type="checkbox"/> farming
<input type="checkbox"/> toxic pollutants	<input checked="" type="checkbox"/> nutrient enrichment

50

subtotal this page

Site: Wetland 2 Rater(s): K. Bowlin T. Newman Date: 7/2/2013

75

subtotal this page

0 50

max 10 pts.

subtotal

Metric 5. Special Wetlands.

Check all that apply and score as indicated.

- Bog (10)
- Fen (10)
- Old growth forest (10)
- Mature forested wetland (5)
- Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- Lake Erie coastal/tributary wetland-restricted hydrology (5)
- Lake Plain Sand Prairies (Oak Openings) (10)
- Relict Wet Prairies (10)
- Known occurrence state/federal threatened or endangered species (10)
- Significant migratory songbird/water fowl habitat or usage (10)
- Category 1 Wetland. See Question 1 Qualitative Rating (-10)

9 59

max 20 pts.

subtotal

Metric 6. Plant communities, interspersions, microtopography.

6a. Wetland Vegetation Communities.

Score all present using 0 to 3 scale.

- Aquatic bed
- Emergent
- Shrub
- 3 Forest
- Mudflats
- Open water
- Other

6b. horizontal (plan view) Interspersion.

Select only one.

- High (5)
- 3 Moderately high(4)
- Moderate (3)
- Moderately low (2)
- Low (1)
- None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- 0 Extensive >75% cover (-5)
- Moderate 25-75% cover (-3)
- Sparse 5-25% cover (-1)
- Nearly absent <5% cover (0)
- Absent (1)

6d. Microtopography.

Score all present using 0 to 3 scale.

- 4 1 Vegetated hummocks/tussocks
- 2 Coarse woody debris >15cm (6in)
- Standing dead >25cm (10in) dbh
- 1 Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

59 GRAND TOTAL(max 100 pts)

Refer to the most recent ORAM Score Calibration Report for the scoring breakpoints between wetland categories at the following address: <http://www.epa.state.oh.us/dsw/401/401.html>

Site: Wetland 3 Rater(s): K. Bowlin T. Newman Date: 7/2/2013

19

subtotal this page

0	19
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max 10 pts.

subtotal

Metric 5. Special Wetlands.

Check all that apply and score as indicated.

- Bog (10)
- Fen (10)
- Old growth forest (10)
- Mature forested wetland (5)
- Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- Lake Erie coastal/tributary wetland-restricted hydrology (5)
- Lake Plain Sand Prairies (Oak Openings) (10)
- Relict Wet Prairies (10)
- Known occurrence state/federal threatened or endangered species (10)
- Significant migratory songbird/water fowl habitat or usage (10)
- Category 1 Wetland. See Question 1 Qualitative Rating (-10)

4	23
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max 20 pts.

subtotal

Metric 6. Plant communities, interspersions, microtopography.

6a. Wetland Vegetation Communities.

Score all present using 0 to 3 scale.

- Aquatic bed
- Emergent
- Shrub
- Forest
- Mudflats
- Open water
- Other _____

6b. horizontal (plan view) Interspersion.

Select only one.

- High (5)
- Moderately high(4)
- Moderate (3)
- Moderately low (2)
- Low (1)
- None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- Extensive >75% cover (-5)
- Moderate 25-75% cover (-3)
- Sparse 5-25% cover (-1)
- Nearly absent <5% cover (0)
- Absent (1)

6d. Microtopography.

Score all present using 0 to 3 scale.

- Vegetated hummocks/tussucks
- Coarse woody debris >15cm (6in)
- Standing dead >25cm (10in) dbh
- Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality.
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

23

GRAND TOTAL(max 100 pts)

Refer to the most recent ORAM Score Calibration Report for the scoring breakpoints between wetland categories at the following address: <http://www.epa.state.oh.us/csw/401/401.html>

Site: Wetland 3 Rater(s): K. Bowlin T. Newman Date: 7/2/2013

0 0

Metric 1. Wetland Area (size).

max 6 pts. subtotal Select one size class and assign score.

- >50 acres (>20.2ha) (6 pts)
- 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- 10 to <25 acres (4 to <10.1ha) (4 pts)
- 3 to <10 acres (1.2 to <4ha) (3 pts)
- 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- <0.1 acres (0.04ha) (0 pts)

6 6

Metric 2. Upland buffers and surrounding land use.

max 14 pts. subtotal 2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4)
- NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

2b. Intensity of surrounding land use. Select one or double check and average.

- VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- LOW. Old field (>10 years), shrubland, young second growth forest. (5)
- MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

11 12

Metric 3. Hydrology.

max 30 pts. subtotal 3a. Sources of Water. Score all that apply.

- High pH groundwater (5)
- Other groundwater (3)
- Precipitation (1)
- Seasonal/intermittent surface water (3)
- Perennial surface water (lake or stream) (5)

3c. Maximum water depth. Select only one and assign score.

- >0.7 (27.6in) (3)
- 0.4 to 0.7m (15.7 to 27.6in) (2)
- <0.4m (<15.7in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- None or none apparent (12)
- Recovered (7)
- Recovering (3)
- Recent or no recovery (1)

3b. Connectivity. Score all that apply.

- 100 year floodplain (1)
- Between stream/lake and other human use (1)
- Part of wetland/upland (e.g. forest), complex (1)
- Part of riparian or upland corridor (1)

3d. Duration inundation/saturation. Score one or dbl check.

- Semi- to permanently inundated/saturated (4)
- Regularly inundated/saturated (3)
- Seasonally inundated (2)
- Seasonally saturated in upper 30cm (12in) (1)

Check all disturbances observed	
<input checked="" type="checkbox"/> ditch	<input checked="" type="checkbox"/> point source (nonstormwater)
<input type="checkbox"/> tile	<input checked="" type="checkbox"/> filling/grading
<input type="checkbox"/> dike	<input type="checkbox"/> road bed/RR track
<input type="checkbox"/> weir	<input type="checkbox"/> dredging
<input checked="" type="checkbox"/> stormwater input	<input type="checkbox"/> other _____

7 19

Metric 4. Habitat Alteration and Development.

max 20 pts. subtotal 4a. Substrate disturbance. Score one or double check and average.

- None or none apparent (4)
- Recovered (3)
- Recovering (2)
- Recent or no recovery (1)

4b. Habitat development. Select only one and assign score.

- Excellent (7)
- Very good (6)
- Good (5)
- Moderately good (4)
- Fair (3)
- Poor to fair (2)
- Poor (1)

4c. Habitat alteration. Score one or double check and average.

- None or none apparent (9)
- Recovered (6)
- Recovering (3)
- Recent or no recovery (1)

Check all disturbances observed	
<input type="checkbox"/> mowing	<input type="checkbox"/> shrub/sapling removal
<input type="checkbox"/> grazing	<input type="checkbox"/> herbaceous/aquatic bed removal
<input type="checkbox"/> clearcutting	<input checked="" type="checkbox"/> sedimentation
<input type="checkbox"/> selective cutting	<input type="checkbox"/> dredging
<input type="checkbox"/> woody debris removal	<input type="checkbox"/> farming
<input type="checkbox"/> toxic pollutants	<input type="checkbox"/> nutrient enrichment

19

subtotal this page

Site: Wetland 4 Rater(s): K. Bowlin T. Newman Date: _____

2 2

Metric 1. Wetland Area (size).

max 6 pts. subtotal

Select one size class and assign score.

- >50 acres (>20.2ha) (6 pts)
- 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- 10 to <25 acres (4 to <10.1ha) (4 pts)
- 3 to <10 acres (1.2 to <4ha) (3 pts)
- 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- <0.1 acres (0.04ha) (0 pts)

11 13

Metric 2. Upland buffers and surrounding land use.

max 14 pts. subtotal

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4)
- NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

2b. Intensity of surrounding land use. Select one or double check and average.

- VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- LOW. Old field (>10 years), shrubland, young second growth forest. (5)
- MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

25 38

Metric 3. Hydrology.

max 30 pts. subtotal

3a. Sources of Water. Score all that apply.

- High pH groundwater (5)
- Other groundwater (3)
- Precipitation (1)
- Seasonal/Intermittent surface water (3)
- Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.

- 100 year floodplain (1)
- Between stream/lake and other human use (1)
- Part of wetland/upland (e.g. forest), complex (1)
- Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.

- >0.7 (27.6in) (3)
- 0.4 to 0.7m (15.7 to 27.6in) (2)
- <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.

- Semi- to permanently inundated/saturated (4)
- Regularly inundated/saturated (3)
- Seasonally inundated (2)
- Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- None or none apparent (12)
- Recovered (7)
- Recovering (3)
- Recent or no recovery (1)

Check all disturbances observed	
<input type="checkbox"/> ditch	<input type="checkbox"/> point source (nonstormwater)
<input type="checkbox"/> tile	<input type="checkbox"/> filling/grading
<input type="checkbox"/> dike	<input type="checkbox"/> road bed/RR track
<input type="checkbox"/> weir	<input type="checkbox"/> dredging
<input checked="" type="checkbox"/> stormwater input	<input type="checkbox"/> other _____

18 56

Metric 4. Habitat Alteration and Development.

max 20 pts. subtotal

4a. Substrate disturbance. Score one or double check and average.

- None or none apparent (4)
- Recovered (3)
- Recovering (2)
- Recent or no recovery (1)

4b. Habitat development. Select only one and assign score.

- Excellent (7)
- Very good (6)
- Good (5)
- Moderately good (4)
- Fair (3)
- Poor to fair (2)
- Poor (1)

4c. Habitat alteration. Score one or double check and average.

- None or none apparent (9)
- Recovered (6)
- Recovering (3)
- Recent or no recovery (1)

Check all disturbances observed	
<input type="checkbox"/> mowing	<input type="checkbox"/> shrub/sapling removal
<input type="checkbox"/> grazing	<input type="checkbox"/> herbaceous/aquatic bed removal
<input type="checkbox"/> clearcutting	<input type="checkbox"/> sedimentation
<input type="checkbox"/> selective cutting	<input type="checkbox"/> dredging
<input type="checkbox"/> woody debris removal	<input type="checkbox"/> farming
<input type="checkbox"/> toxic pollutants	<input type="checkbox"/> nutrient enrichment

56
subtotal this page

Site: Wetland 4 Rater(s): K. Bowlin T. Newman Date: 7/13/2013

13

subtotal this page

0 54

max 10 pts.

subtotal

Metric 5. Special Wetlands.

Check all that apply and score as indicated.

- Bog (10)
- Fen (10)
- Old growth forest (10)
- Mature forested wetland (5)
- Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- Lake Erie coastal/tributary wetland-restricted hydrology (5)
- Lake Plain Sand Prairies (Oak Openings) (10)
- Relict Wet Prairies (10)
- Known occurrence state/federal threatened or endangered species (10)
- Significant migratory songbird/water fowl habitat or usage (10)
- Category 1 Wetland. See Question 1 Qualitative Rating (-10)

3 57

max 20 pts.

subtotal

Metric 6. Plant communities, interspersions, microtopography.

6a. Wetland Vegetation Communities.

Score all present using 0 to 3 scale.

- Aquatic bed
- Emergent
- Shrub
- Forest
- Mudflats
- Open water
- Other

6b. horizontal (plan view) Interspersion.

Select only one.

- High (5)
- Moderately high(4)
- Moderate (3)
- Moderately low (2)
- Low (1)
- None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- Extensive >75% cover (-5)
- Moderate 25-75% cover (-3)
- Sparse 5-25% cover (-1)
- Nearly absent <5% cover (0)
- Absent (1)

6d. Microtopography.

Score all present using 0 to 3 scale.

- Vegetated hummocks/tussocks
- Coarse woody debris >15cm (6in)
- Standing dead >25cm (10in) dbh
- Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

66

GRAND TOTAL(max 100 pts)

Refer to the most recent ORAM Score Calibration Report for the scoring breakpoints between wetland categories at the following address: <http://www.epa.state.oh.us/dsw/401/401.html>

Site: Wetland 5 Rater(s): K. Bowlin T. Newman Date: 7/3/2013

2 2

Metric 1. Wetland Area (size).

max 6 pts. subtotal

Select one size class and assign score.

- >50 acres (>20.2ha) (6 pts)
- 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- 10 to <25 acres (4 to <10.1ha) (4 pts)
- 3 to <10 acres (1.2 to <4ha) (3 pts)
- 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- <0.1 acres (0.04ha) (0 pts)

7 9

Metric 2. Upland buffers and surrounding land use.

max 14 pts. subtotal

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4)
- NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

2b. Intensity of surrounding land use. Select one or double check and average.

- VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- LOW. Old field (>10 years), shrubland, young second growth forest. (5)
- MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

9 18

Metric 3. Hydrology.

max 30 pts. subtotal

3a. Sources of Water. Score all that apply.

- High pH groundwater (5)
- Other groundwater (3)
- Precipitation (1)
- Seasonal/intermittent surface water (3)
- Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.

- 100 year floodplain (1)
- Between stream/lake and other human use (1)
- Part of wetland/upland (e.g. forest), complex (1)
- Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.

- >0.7 (27.6in) (3)
- 0.4 to 0.7m (15.7 to 27.6in) (2)
- <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.

- Semi- to permanently inundated/saturated (4)
- Regularly inundated/saturated (3)
- Seasonally inundated (2)
- Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- None or none apparent (12)
- Recovered (7)
- Recovering (3)
- Recent or no recovery (1)

Check all disturbances observed

- | | |
|---|---|
| <input type="checkbox"/> ditch | <input type="checkbox"/> point source (nonstormwater) |
| <input type="checkbox"/> tile | <input type="checkbox"/> filling/grading |
| <input type="checkbox"/> dike | <input type="checkbox"/> road bed/RR track |
| <input type="checkbox"/> weir | <input type="checkbox"/> dredging |
| <input type="checkbox"/> stormwater input | <input type="checkbox"/> other _____ |

7 25

Metric 4. Habitat Alteration and Development.

max 20 pts. subtotal

4a. Substrate disturbance. Score one or double check and average.

- None or none apparent (4)
- Recovered (3)
- Recovering (2)
- Recent or no recovery (1)

4b. Habitat development. Select only one and assign score.

- Excellent (7)
- Very good (6)
- Good (5)
- Moderately good (4)
- Fair (3)
- Poor to fair (2)
- Poor (1)

4c. Habitat alteration. Score one or double check and average.

- None or none apparent (9)
- Recovered (6)
- Recovering (3)
- Recent or no recovery (1)

Check all disturbances observed

- | | |
|---|---|
| <input type="checkbox"/> mowing | <input type="checkbox"/> shrub/sapling removal |
| <input type="checkbox"/> grazing | <input type="checkbox"/> herbaceous/aquatic bed removal |
| <input type="checkbox"/> clearcutting | <input type="checkbox"/> sedimentation |
| <input type="checkbox"/> selective cutting | <input type="checkbox"/> dredging |
| <input type="checkbox"/> woody debris removal | <input type="checkbox"/> farming |
| <input type="checkbox"/> toxic pollutants | <input type="checkbox"/> nutrient enrichment |

25

subtotal this page

Site: Wetland 5 Rater(s): K. Bowler T. Newman Date: 7/3/2013

5

subtotal this page

0	25
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max 10 pts.

subtotal

Metric 5. Special Wetlands.

Check all that apply and score as indicated.

- Bog (10)
- Fen (10)
- Old growth forest (10)
- Mature forested wetland (5)
- Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- Lake Erie coastal/tributary wetland-restricted hydrology (5)
- Lake Plain Sand Prairies (Oak Openings) (10)
- Relict Wet Praires (10)
- Known occurrence state/federal threatened or endangered species (10)
- Significant migratory songbird/water fowl habitat or usage (10)
- Category 1 Wetland. See Question 1 Qualitative Rating (-10)

5	30
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max 10 pts.

subtotal

Metric 6. Plant communities, interspersions, microtopography.

6a. Wetland Vegetation Communities.

Score all present using 0 to 3 scale.

- Aquatic bed
- Emergent
- Shrub
- Forest
- Mudflats
- Open water
- Other

6b. horizontal (plan view) Interspersion.

Select only one.

- High (5)
- Moderately high(4)
- Moderate (3)
- Moderately low (2)
- Low (1)
- None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- Extensive >75% cover (-5)
- Moderate 25-75% cover (-3)
- Sparse 5-25% cover (-1)
- Nearly absent <5% cover (0)
- Absent (1)

6d. Microtopography.

Score all present using 0 to 3 scale.

- Vegetated hummocks/tussocks
- Coarse woody debris >15cm (6in)
- Standing dead >25cm (10in) dbh
- Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

30	GRAND TOTAL(max 100 pts)
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Refer to the most recent ORAM Score Calibration Report for the scoring breakpoints between wetland categories at the following address: <http://www.epa.state.oh.us/dsw/401/401.htm>

Site: <u>Wetland 6</u>	Rater(s): <u>K. Bowlin T. Newman</u>	Date: <u>7/3/2013</u>
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2	2
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Metric 1. Wetland Area (size).

max 6 pts. subtotal

Select one size class and assign score.

- >50 acres (>20.2ha) (6 pts)
- 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- 10 to <25 acres (4 to <10.1ha) (4 pts)
- 3 to <10 acres (1.2 to <4ha) (3 pts)
- 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- <0.1 acres (0.04ha) (0 pts)

14	16
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Metric 2. Upland buffers and surrounding land use.

max 14 pts. subtotal

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4)
- NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

2b. Intensity of surrounding land use. Select one or double check and average.

- VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- LOW. Old field (>10 years), shrubland, young second growth forest. (5)
- MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

21	37
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Metric 3. Hydrology.

max 30 pts. subtotal

3a. Sources of Water. Score all that apply.

- High pH groundwater (5)
- Other groundwater (3)
- Precipitation (1)
- Seasonal/intermittent surface water (3)
- Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.

- 100 year floodplain (1)
- Between stream/lake and other human use (1)
- Part of wetland/upland (e.g. forest), complex (1)
- Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.

- >0.7 (27.6in) (3)
- 0.4 to 0.7m (15.7 to 27.6in) (2)
- <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.

- Semi- to permanently inundated/saturated (4)
- Regularly inundated/saturated (3)
- Seasonally inundated (2)
- Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- None or none apparent (12)
- Recovered (7)
- Recovering (3)
- Recent or no recovery (1)

Check all disturbances observed

- | | |
|---|---|
| <input type="checkbox"/> ditch | <input type="checkbox"/> point source (nonstormwater) |
| <input type="checkbox"/> tile | <input type="checkbox"/> filling/grading |
| <input type="checkbox"/> dike | <input type="checkbox"/> road bed/RR track |
| <input type="checkbox"/> weir | <input type="checkbox"/> dredging |
| <input type="checkbox"/> stormwater input | <input type="checkbox"/> other _____ |

18	55
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Metric 4. Habitat Alteration and Development.

max 20 pts. subtotal

4a. Substrate disturbance. Score one or double check and average.

- None or none apparent (4)
- Recovered (3)
- Recovering (2)
- Recent or no recovery (1)

4b. Habitat development. Select only one and assign score.

- Excellent (7)
- Very good (6)
- Good (5)
- Moderately good (4)
- Fair (3)
- Poor to fair (2)
- Poor (1)

4c. Habitat alteration. Score one or double check and average.

- None or none apparent (9)
- Recovered (6)
- Recovering (3)
- Recent or no recovery (1)

Check all disturbances observed

- | | |
|---|---|
| <input type="checkbox"/> mowing | <input type="checkbox"/> shrub/sapling removal |
| <input type="checkbox"/> grazing | <input type="checkbox"/> herbaceous/aquatic bed removal |
| <input type="checkbox"/> clearcutting | <input type="checkbox"/> sedimentation |
| <input type="checkbox"/> selective cutting | <input type="checkbox"/> dredging |
| <input type="checkbox"/> woody debris removal | <input type="checkbox"/> farming |
| <input type="checkbox"/> toxic pollutants | <input type="checkbox"/> nutrient enrichment |

55

subtotal this page

Site: Wetland 6 Rater(s): Ki Bowling T. Newman Date: 7/3/2013

4

subtotal this page

0

55

max 10 pts.

subtotal

Metric 5. Special Wetlands.

Check all that apply and score as indicated.

- Bog (10)
- Fen (10)
- Old growth forest (10)
- Mature forested wetland (5)
- Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- Lake Erie coastal/tributary wetland-restricted hydrology (5)
- Lake Plain Sand Prairies (Oak Openings) (10)
- Relict Wet Prairies (10)
- Known occurrence state/federal threatened or endangered species (10)
- Significant migratory songbird/water fowl habitat or usage (10)
- Category 1 Wetland. See Question 1 Qualitative Rating (-10)

4

59

max 20 pts.

subtotal

Metric 6. Plant communities, interspersions, microtopography.

6a. Wetland Vegetation Communities.

Score all present using 0 to 3 scale.

- Aquatic bed
- Emergent
- Shrub
- Forest
- Mudflats
- Open water
- Other _____

6b. horizontal (plan view) Interspersion.

Select only one.

- High (5)
- Moderately high(4)
- Moderate (3)
- Moderately low (2)
- Low (1)
- None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- Extensive >75% cover (-5)
- Moderate 25-75% cover (-3)
- Sparse 5-25% cover (-1)
- Nearly absent <5% cover (0)
- Absent (1)

6d. Microtopography.

Score all present using 0 to 3 scale.

- Vegetated hummocks/tussocks
- Coarse woody debris >15cm (6in)
- Standing dead >25cm (10in) dbh
- Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

59

GRAND TOTAL(max 100 pts)

Refer to the most recent ORAM Score Calibration Report for the scoring breakpoints between wetland categories at the following address: <http://www.epa.state.oh.us/dsw/401/401.html>

Site: <u>Wetland 7</u>	Rater(s): <u>K. Bowlin T. Newnan</u>	Date: <u>7/3/2013</u>
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1	1
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Metric 1. Wetland Area (size).

- max 6 pts. subtotal
- Select one size class and assign score.
- >50 acres (>20.2ha) (6 pts)
 - 25 to <50 acres (10.1 to <20.2ha) (5 pts)
 - 10 to <25 acres (4 to <10.1ha) (4 pts)
 - 3 to <10 acres (1.2 to <4ha) (3 pts)
 - 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
 - 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
 - <0.1 acres (0.04ha) (0 pts)

12	13
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Metric 2. Upland buffers and surrounding land use.

- max 14 pts. subtotal
- 2a. Calculate average buffer width. Select only one and assign score. Do not double check.
- WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
 - MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4)
 - NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
 - VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)
- 2b. Intensity of surrounding land use. Select one or double check and average.
- VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
 - LOW. Old field (>10 years), shrubland, young second growth forest. (5)
 - MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
 - HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

10	23
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Metric 3. Hydrology.

- max 30 pts. subtotal
- 3a. Sources of Water. Score all that apply.
- High pH groundwater (5)
 - Other groundwater (3)
 - Precipitation (1)
 - Seasonal/intermittent surface water (3)
 - Perennial surface water (lake or stream) (5)
- 3b. Connectivity. Score all that apply.
- 100 year floodplain (1)
 - Between stream/lake and other human use (1)
 - Part of wetland/upland (e.g. forest), complex (1)
 - Part of riparian or upland corridor (1)
- 3c. Maximum water depth. Select only one and assign score.
- >0.7 (27.6in) (3)
 - 0.4 to 0.7m (15.7 to 27.6in) (2)
 - <0.4m (<15.7in) (1)
- 3d. Duration inundation/saturation. Score one or dbl check.
- Semi- to permanently inundated/saturated (4)
 - Regularly inundated/saturated (3)
 - Seasonally inundated (2)
 - Seasonally saturated in upper 30cm (12in) (1)
- 3e. Modifications to natural hydrologic regime. Score one or double check and average.
- | | | | | | | | | | | | |
|---|--|--------------------------------|---|-------------------------------|--|-------------------------------|--|-------------------------------|-----------------------------------|---|--------------------------------------|
| <ul style="list-style-type: none"> <input type="checkbox"/> None or none apparent (12) <input type="checkbox"/> Recovered (7) <input checked="" type="checkbox"/> Recovering (3) <input type="checkbox"/> Recent or no recovery (1) | <p>Check all disturbances observed</p> <table style="width:100%;"> <tr> <td><input type="checkbox"/> ditch</td> <td><input type="checkbox"/> point source (nonstormwater)</td> </tr> <tr> <td><input type="checkbox"/> tile</td> <td><input type="checkbox"/> filling/grading</td> </tr> <tr> <td><input type="checkbox"/> dike</td> <td><input type="checkbox"/> road bed/RR track</td> </tr> <tr> <td><input type="checkbox"/> weir</td> <td><input type="checkbox"/> dredging</td> </tr> <tr> <td><input type="checkbox"/> stormwater input</td> <td><input type="checkbox"/> other _____</td> </tr> </table> | <input type="checkbox"/> ditch | <input type="checkbox"/> point source (nonstormwater) | <input type="checkbox"/> tile | <input type="checkbox"/> filling/grading | <input type="checkbox"/> dike | <input type="checkbox"/> road bed/RR track | <input type="checkbox"/> weir | <input type="checkbox"/> dredging | <input type="checkbox"/> stormwater input | <input type="checkbox"/> other _____ |
| <input type="checkbox"/> ditch | <input type="checkbox"/> point source (nonstormwater) | | | | | | | | | | |
| <input type="checkbox"/> tile | <input type="checkbox"/> filling/grading | | | | | | | | | | |
| <input type="checkbox"/> dike | <input type="checkbox"/> road bed/RR track | | | | | | | | | | |
| <input type="checkbox"/> weir | <input type="checkbox"/> dredging | | | | | | | | | | |
| <input type="checkbox"/> stormwater input | <input type="checkbox"/> other _____ | | | | | | | | | | |

6	29
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Metric 4. Habitat Alteration and Development.

- max 20 pts. subtotal
- 4a. Substrate disturbance. Score one or double check and average.
- None or none apparent (4)
 - Recovered (3)
 - Recovering (2)
 - Recent or no recovery (1)
- 4b. Habitat development. Select only one and assign score.
- Excellent (7)
 - Very good (6)
 - Good (5)
 - Moderately good (4)
 - Fair (3)
 - Poor to fair (2)
 - Poor (1)
- 4c. Habitat alteration. Score one or double check and average.
- | | | | | | | | | | | | | | |
|--|---|---------------------------------|--|----------------------------------|---|---------------------------------------|--|--|-----------------------------------|---|----------------------------------|---|--|
| <ul style="list-style-type: none"> <input type="checkbox"/> None or none apparent (9) <input type="checkbox"/> Recovered (6) <input checked="" type="checkbox"/> Recovering (3) <input type="checkbox"/> Recent or no recovery (1) | <p>Check all disturbances observed</p> <table style="width:100%;"> <tr> <td><input type="checkbox"/> mowing</td> <td><input type="checkbox"/> shrub/sapling removal</td> </tr> <tr> <td><input type="checkbox"/> grazing</td> <td><input type="checkbox"/> herbaceous/aquatic bed removal</td> </tr> <tr> <td><input type="checkbox"/> clearcutting</td> <td><input type="checkbox"/> sedimentation</td> </tr> <tr> <td><input type="checkbox"/> selective cutting</td> <td><input type="checkbox"/> dredging</td> </tr> <tr> <td><input type="checkbox"/> woody debris removal</td> <td><input type="checkbox"/> farming</td> </tr> <tr> <td><input type="checkbox"/> toxic pollutants</td> <td><input type="checkbox"/> nutrient enrichment</td> </tr> </table> | <input type="checkbox"/> mowing | <input type="checkbox"/> shrub/sapling removal | <input type="checkbox"/> grazing | <input type="checkbox"/> herbaceous/aquatic bed removal | <input type="checkbox"/> clearcutting | <input type="checkbox"/> sedimentation | <input type="checkbox"/> selective cutting | <input type="checkbox"/> dredging | <input type="checkbox"/> woody debris removal | <input type="checkbox"/> farming | <input type="checkbox"/> toxic pollutants | <input type="checkbox"/> nutrient enrichment |
| <input type="checkbox"/> mowing | <input type="checkbox"/> shrub/sapling removal | | | | | | | | | | | | |
| <input type="checkbox"/> grazing | <input type="checkbox"/> herbaceous/aquatic bed removal | | | | | | | | | | | | |
| <input type="checkbox"/> clearcutting | <input type="checkbox"/> sedimentation | | | | | | | | | | | | |
| <input type="checkbox"/> selective cutting | <input type="checkbox"/> dredging | | | | | | | | | | | | |
| <input type="checkbox"/> woody debris removal | <input type="checkbox"/> farming | | | | | | | | | | | | |
| <input type="checkbox"/> toxic pollutants | <input type="checkbox"/> nutrient enrichment | | | | | | | | | | | | |

29

subtotal this page

Site: Wetland 7 Rater(s): K. Bowlin TiNewman Date: 7/3/2013

-12

subtotal this page

-10

19

max 10 pts.

subtotal

Metric 5. Special Wetlands.

Check all that apply and score as indicated.

- Bog (10)
- Fen (10)
- Old growth forest (10)
- Mature forested wetland (5)
- Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- Lake Erie coastal/tributary wetland-restricted hydrology (5)
- Lake Plain Sand Prairies (Oak Openings) (10)
- Relict Wet Prairies (10)
- Known occurrence state/federal threatened or endangered species (10)
- Significant migratory songbird/water fowl habitat or usage (10)
- Category 1 Wetland. See Question 1 Qualitative Rating (-10)

-2

17

max 20 pts.

subtotal

Metric 6. Plant communities, interspersions, microtopography.

6a. Wetland Vegetation Communities.

Score all present using 0 to 3 scale.

- Aquatic bed
- Emergent
- Shrub
- Forest
- Mudflats
- Open water
- Other _____

6b. horizontal (plan view) Interspersion.

Select only one.

- High (5)
- Moderately high(4)
- Moderate (3)
- Moderately low (2)
- Low (1)
- None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- Extensive >75% cover (-5)
- Moderate 25-75% cover (-3)
- Sparse 5-25% cover (-1)
- Nearly absent <5% cover (0)
- Absent (1)

6d. Microtopography.

Score all present using 0 to 3 scale.

- Vegetated hummocks/tussocks
- Coarse woody debris >15cm (6in)
- Standing dead >25cm (10in) dbh
- Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

17

GRAND TOTAL(max 100 pts)

Site: Wetland 8 Rater(s): K. Bowlin T. Newman Date: July 3, 2013

0 0

Metric 1. Wetland Area (size).

max 6 pts. subtotal

Select one size class and assign score.

- >50 acres (>20.2ha) (6 pts)
- 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- 10 to <25 acres (4 to <10.1ha) (4 pts)
- 3 to <10 acres (1.2 to <4ha) (3 pts)
- 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- <0.1 acres (0.04ha) (0 pts)

9 9

Metric 2. Upland buffers and surrounding land use.

max 14 pts. subtotal

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4)
- NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

2b. Intensity of surrounding land use. Select one or double check and average.

- VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- LOW. Old field (>10 years), shrubland, young second growth forest. (5)
- MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

10 19

Metric 3. Hydrology.

max 30 pts. subtotal

3a. Sources of Water. Score all that apply.

- High pH groundwater (5)
- Other groundwater (3)
- Precipitation (1)
- Seasonal/intermittent surface water (3)
- Perennial surface water (lake or stream) (5)

3c. Maximum water depth. Select only one and assign score.

- >0.7 (27.6in) (3)
- 0.4 to 0.7m (15.7 to 27.6in) (2)
- <0.4m (<15.7in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- None or none apparent (12)
- Recovered (7)
- Recovering (3)
- Recent or no recovery (1)

3b. Connectivity. Score all that apply.

- 100 year floodplain (1)
- Between stream/lake and other human use (1)
- Part of wetland/upland (e.g. forest), complex (1)
- Part of riparian or upland corridor (1)

3d. Duration inundation/saturation. Score one or dbl check.

- Semi- to permanently inundated/saturated (4)
- Regularly inundated/saturated (3)
- Seasonally inundated (2)
- Seasonally saturated in upper 30cm (12in) (1)

Check all disturbances observed	
<input type="checkbox"/> ditch	<input type="checkbox"/> point source (nonstormwater)
<input type="checkbox"/> tile	<input type="checkbox"/> filling/grading
<input type="checkbox"/> dike	<input type="checkbox"/> road bed/RR track
<input type="checkbox"/> weir	<input type="checkbox"/> dredging
<input type="checkbox"/> stormwater input	<input type="checkbox"/> other _____

6 25

Metric 4. Habitat Alteration and Development.

max 20 pts. subtotal

4a. Substrate disturbance. Score one or double check and average.

- None or none apparent (4)
- Recovered (3)
- Recovering (2)
- Recent or no recovery (1)

4b. Habitat development. Select only one and assign score.

- Excellent (7)
- Very good (6)
- Good (5)
- Moderately good (4)
- Fair (3)
- Poor to fair (2)
- Poor (1)

4c. Habitat alteration. Score one or double check and average.

- None or none apparent (9)
- Recovered (6)
- Recovering (3)
- Recent or no recovery (1)

Check all disturbances observed	
<input type="checkbox"/> mowing	<input type="checkbox"/> shrub/sapling removal
<input type="checkbox"/> grazing	<input type="checkbox"/> herbaceous/aquatic bed removal
<input type="checkbox"/> clearcutting	<input type="checkbox"/> sedimentation
<input type="checkbox"/> selective cutting	<input type="checkbox"/> dredging
<input type="checkbox"/> woody debris removal	<input type="checkbox"/> farming
<input type="checkbox"/> toxic pollutants	<input type="checkbox"/> nutrient enrichment

25

subtotal this page

Site: Wetland 8 Rater(s): K. Bowlin T. Newman Date: 7/3/2013

-10

subtotal this page

-10

15

Metric 5. Special Wetlands.

max 10 pts. subtotal Check all that apply and score as indicated.

- Bog (10)
- Fen (10)
- Old growth forest (10)
- Mature forested wetland (5)
- Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- Lake Erie coastal/tributary wetland-restricted hydrology (5)
- Lake Plain Sand Prairies (Oak Openings) (10)
- Relict Wet Prairies (10)
- Known occurrence state/federal threatened or endangered species (10)
- Significant migratory songbird/water fowl habitat or usage (10)
- Category 1 Wetland. See Question 1 Qualitative Rating (-10)

0

15

max 20 pts. subtotal

Metric 6. Plant communities, interspersions, microtopography.

6a. Wetland Vegetation Communities.

Score all present using 0 to 3 scale.

- Aquatic bed
- Emergent
- Shrub
- Forest
- Mudflats
- Open water
- Other _____

6b. horizontal (plan view) Interspersion.

Select only one.

- High (5)
- Moderately high(4)
- Moderate (3)
- Moderately low (2)
- Low (1)
- None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- Extensive >75% cover (-5)
- Moderate 25-75% cover (-3)
- Sparse 5-25% cover (-1)
- Nearly absent <5% cover (0)
- Absent (1)

6d. Microtopography.

Score all present using 0 to 3 scale.

- Vegetated hummocks/tussocks
- Coarse woody debris >15cm (6in)
- Standing dead >25cm (10in) dbh
- Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
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Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
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high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

15

GRAND TOTAL(max 100 pts)

Refer to the most recent ORAM Score Calibration Report for the scoring breakpoints between wetland categories at the following address: <http://www.epa.state.oh.us/dsw/401/401.html>

Attachment 5

Agency Communication

Attachment 5

Agency Communication

Keith Bowlin

From: Miller, Jessica [jessica_miller@fws.gov]
Sent: Thursday, August 08, 2013 12:58 PM
To: Keith Bowlin
Subject: species list for Hardin County, KY

Keith,

Thank you for requesting a list of federally listed species that are known to occur or have the potential to occur within Hardin County, Kentucky. The U.S. Fish and Wildlife Service (Service) offers the following comments in accordance with the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*).

Because there is no site-specific project information at this time, the Service cannot make site-specific recommendations. However, the Service has searched our database and compiled a list of federally listed species that are known to occur or have the potential to occur within the area of interest. Those species are:

Group	Species	Common name	Legal* Status
Mammals	<i>Myotis grisescens</i>	gray bat	E
	<i>Myotis sodalis</i>	Indiana bat	E
Mussels	<i>Pleurobema clava</i>	clubshell	E
	<i>Plethobasus cooperianus</i>	orangefoot pimpleback	E
	<i>Plethobasus cyphus</i>	sheepnose	E
	<i>Pleurobema plenum</i>	rough pigtoe	E
	<i>Potamilus capax</i>	fat pocketbook	E

* Key to notations: E = Endangered, T = Threatened, C = Candidate, CH = Critical Habitat

We must advise you that collection records available to the Service may not be all-inclusive. Our database is a compilation of collection records made available by various individuals and resource agencies. This information is seldom based on comprehensive surveys of all potential habitats and thus does not necessarily provide conclusive evidence that protected species are present or absent at a specific locality.

Thank you again for your request. Your concern for the protection of endangered and threatened species is greatly appreciated. Please let us know how we can further assist you as you plan your project.

--

Jessica Blackwood Miller
 Fish & Wildlife Biologist
 Kentucky Field Office
 U.S. Fish & Wildlife Service
 330 W. Broadway, Suite 265
 Frankfort, KY 40601
 Ph: (502) 695-0468 ext. 104
 Fax: (502) 695-1024

Keith Bowlin

From: Carr, Sunni (FW) [Sunni.Carr@ky.gov]
Sent: Thursday, August 08, 2013 3:43 PM
To: Keith Bowlin
Subject: RE: Threatened and endanger species for Hardin County.

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Species Information

Federal Threatened, Endangered, and Candidate Species observations for selected coun

Linked life history provided courtesy of [NatureServe Explorer](#).

Records may include both recent and historical observations.

[US Status Definitions](#) [Kentucky Status Definitions](#)

List Federal Threatened, Endangered, and Candidate Species observations i selected county.

Selected county is: Hardin.

Scientific Name and Life History	Common Name and Pictures	Class	County	US Status	KY Status	WAP	
Myotis grisescens	Gray Myotis	Mammalia	Hardin	LE	T	Yes	E
Myotis sodalis	Indiana Bat	Mammalia	Hardin	LE	E	Yes	E
Pleurobema clava	Clubshell	Bivalvia	Hardin	LE, XN	E	Yes	E
Quadrula cylindrica cylindrica	Rabbitsfoot	Bivalvia	Hardin	PT	T	Yes	E

4 species are listed

[Privacy Policy](#) | [Disclaimer](#) | [Individuals with Disabilities](#) |

Attached you will find a list of Federally listed Threatened/Endangered Species for Hardin County, KY. List was generated on 8/8/2013.

Sunni L. Carr

Wildlife Diversity Coordinator
Kentucky Dept. of Fish and Wildlife Resources
#1 Sportsman's Lane
Frankfort, Kentucky 40601
800-858-1549 ext 4446
502-221-1377 cell
502-564-4519 fax

From: Keith Bowlin [mailto:kcb@jacksonenvironmental.com]
Sent: Thursday, August 08, 2013 3:32 PM
To: Carr, Sunni (FW)
Cc: Hines, Brooke (FW)
Subject: Threatened and endanger species for Hardin County.

Ms. Carr,

I'm a biologist with Jackson Environmental Consulting. I am currently working on a project in Hardin County and at the end of June I had contacted Fish and Wildlife about obtaining a list of T&E species for Hardin County. The person I talked to from the information center referred me to the state species list by county. I have been requested to obtain a hard copy communication from an individual with the agency for my reporting and was told you are the person I should contact. If you could please send me a list of T&E species or refer me to some who could I would greatly appreciate it. I have copied Brooke Hines on this email because the Indiana bats and the gray bat were on the online list and thought she may be able to comment on this conversation. Thank you for your time and hope to hear from you soon.

Keith C. Bowlin
Aquatic Ecologist

Jackson Environmental Consulting Services LLC
A Service-Disabled Veteran-Owned Small Business
1586 Boonesborough Rd.
Richmond, KY 40475

PH: (859) 623-0499
CL: (859) 358-4125
FX: (859) 623-2676

Final Report

Historic Resources Survey for Proposed Drainage Improvements in the Happy Valley Drainage Area, Hardin County, Kentucky

November 2013



FEMA

Federal Emergency Management Agency
Region IV
3003 Chamblee Tucker Road
Atlanta, GA 30341

This document was prepared by

URS Group, Inc.
12420 Milestone Center Drive, Suite 150
Germantown, MD 20876

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Acknowledgements

Prepared by:

Holly Higgins (CRA)
Elizabeth Heavrin (CRA)
Scott Seibel, RPA (URS)
Peter Regan, RPA (URS)

Principal Investigator

Rob Karwedsky

Project Manager

Brett Bowen

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ABSTRACT

URS Group, Inc. (URS), with support from its subcontractor Cultural Resource Analysts, Inc. (CRA), conducted a historic resource survey of proposed flood control measures, including water retention ponds, in support of federal funding for the City of Radcliff's Quiggins Sinkhole/Happy Valley Flood Mitigation Project in Hardin County, Kentucky. This investigation was conducted for Federal Emergency Management Agency (FEMA) Region IV.

The proposed project was designed to increase the area's detention volume by excavating and developing approximately 6 acres in the Quiggins Sinkhole area near US 31W into a functional basin (referred to as the Quiggins Basin). Additionally, the project includes the construction of four new detention basins (Cato, Song, Turner, and Wilson Basins) and an area used to deposit spoil from basin construction. The six individual areas, all located along an approximately 1.5-mile-long corridor parallel to US 31W and South Wilson Road, range in size from 1.9 to 9.7 hectares (ha; 4.6 to 24.0 acres) and have a combined area of approximately 22.9 ha (56.6 acres).

The survey was conducted to comply with federal regulations implementing Section 106 of the National Historic Preservation Act, concerning the effect of federal undertakings on historic properties listed in or eligible for listing in the National Register of Historic Places (NRHP). The implementing regulations are published in the Code of Federal Regulations at 36 CFR Part 800. Federal actions include using federal funds or granting a federal permit. For the purpose of the historic resource survey, the Area of Potential Effects (APE) was defined to include a 200-foot radius around each proposed basin and spoil area.

Field investigations were conducted by CRA architectural historians in February 2013. The purpose of the historic resource survey was to identify and document above-ground resources 50 years of age or older located within the APE that are listed or potentially eligible for listing in the NRHP; evaluate their eligibility for listing in the NRHP and recommend boundaries, if eligible; and evaluate the effect of the project on any properties included, or eligible for listing, in the NRHP. One previously surveyed historic resource (HD 15) and 26 previously unidentified historic resources (HD 876-901) were documented during the field survey. None of the previously unidentified historic resources appear eligible for listing in the NRHP.

URS has concluded that Site 1, the Haycraft Inn (HD 15), currently listed in the NRHP, continues to be eligible. While the detention pond will be visible from Site 1, it will not adversely affect the qualities for which the property is eligible for listing in the NRHP. Therefore, URS recommends that the proposed project will have no adverse effect on properties listed, or eligible for listing, in the NRHP.

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS	iii
SECTION ONE INTRODUCTION	1-1
1.1 Project Description and Area of Potential Effect.....	1-1
1.2 Report Organization.....	1-4
SECTION TWO ENVIRONMENTAL SETTING	2-1
2.1 Geology and Topography	2-1
2.2 Hydrology	2-1
2.3 Soils.....	2-1
2.4 Current Land Use.....	2-2
SECTION THREE HISTORIC CONTEXT	3-1
3.1 Pre-Settlement Exploration (1750–1775).....	3-1
3.2 Early Settlement (1775–1820/1830).....	3-1
3.3 Antebellum (1820/1830–1861).....	3-2
3.4 Civil War (1861–1865).....	3-3
3.5 Postbellum: Readjustment and Industrialization (1865–1915).....	3-4
3.6 Industrial and Commercial Consolidation (1915–1945).....	3-5
3.7 Modern Era (1945–Present).....	3-7
SECTION FOUR PREVIOUS INVESTIGATIONS	4-1
4.1 Previous Investigations	4-1
4.2 Map Data.....	4-2
4.3 Expected Conditions	4-3
SECTION FIVE RESEARCH DESIGN	5-1
5.1 Objectives	5-1
5.2 Methods.....	5-1
5.2.1 Research.....	5-1
5.2.2 Field Survey.....	5-1
SECTION SIX SURVEY RESULTS.....	6-1
6.1 Overview of the Area of Potential Effect	6-1
6.2 Site 1	6-1
6.2.1 Description.....	6-1
6.2.2 NRHP Evaluation.....	6-6
6.2.3 Determination of Effect	6-11
6.3 Site 2.....	6-11
6.3.1 Description.....	6-11
6.3.2 NRHP Evaluation.....	6-15
6.3.3 Determination of Effect	6-15
6.4 Site 3	6-15
6.4.1 Description.....	6-16
6.4.2 NRHP Evaluation.....	6-16
6.4.3 Determination of Effect	6-17
6.5 Site 4	6-17
6.5.1 Description.....	6-17
6.5.2 NRHP Evaluation.....	6-19
6.5.3 Determination of Effect	6-19

TABLE OF CONTENTS

6.6	Site 5	6-20
	6.6.1 Description.....	6-20
	6.6.2 NRHP Evaluation.....	6-20
	6.6.3 Determination of Effect	6-20
6.7	Site 6	6-22
	6.7.1 Description.....	6-22
	6.7.2 NRHP Evaluation.....	6-22
	6.7.3 Determination of Effect	6-22
6.8	Site 7	6-22
	6.8.1 Description.....	6-23
	6.8.2 NRHP Evaluation.....	6-23
	6.8.3 Determination of Effect	6-23
6.9	Site 8	6-25
	6.9.1 Description.....	6-25
	6.9.2 NRHP Evaluation.....	6-25
	6.9.3 Determination of Effect	6-26
6.10	Site 9	6-26
	6.10.1 Description.....	6-26
	6.10.2 NRHP Evaluation.....	6-26
	6.10.3 Determination of Effect	6-28
6.11	Site 10	6-28
	6.11.1 Description.....	6-28
	6.11.2 NRHP Evaluation.....	6-30
	6.11.3 Determination of Effect	6-30
6.12	Site 11	6-30
	6.12.1 Description.....	6-30
	6.12.2 NRHP Evaluation.....	6-31
	6.12.3 Determination of Effect	6-34
6.13	Site 12	6-34
	6.13.1 Description.....	6-34
	6.13.2 NRHP Evaluation.....	6-34
	6.13.3 Determination of Effect	6-34
6.14	Site 13	6-35
	6.14.1 Description.....	6-35
	6.14.2 NRHP Evaluation.....	6-38
	6.14.3 Determination of Effect	6-38
6.15	Site 14	6-38
	6.15.1 Description.....	6-38
	6.15.2 NRHP Evaluation.....	6-39
	6.15.3 Determination of Effect	6-39
6.16	Site 15	6-39
	6.16.1 Description.....	6-39
	6.16.2 NRHP Evaluation.....	6-41
	6.16.3 Determination of Effect	6-41
6.17	Site 16	6-41
	6.17.1 Description.....	6-42

TABLE OF CONTENTS

	6.17.2 NRHP Evaluation.....	6-42
	6.17.3 Determination of Effect	6-42
6.18	Site 17	6-44
	6.18.1 Description.....	6-44
	6.18.2 NRHP Evaluation.....	6-44
	6.18.3 Determination of Effect	6-46
6.19	Site 18	6-46
	6.19.1 Description.....	6-46
	6.19.2 NRHP Evaluation.....	6-48
	6.19.3 Determination of Effect	6-48
6.20	Site 19	6-48
	6.20.1 Description.....	6-48
	6.20.2 NRHP Evaluation.....	6-50
	6.20.3 Determination of Effect	6-50
6.21	Site 20	6-50
	6.21.1 Description.....	6-50
	6.21.2 NRHP Evaluation.....	6-52
	6.21.3 Determination of Effect	6-52
6.22	Site 21	6-52
	6.22.1 Description.....	6-52
	6.22.2 NRHP Evaluation.....	6-53
	6.22.3 Determination of Effect	6-53
6.23	Site 22	6-53
	6.23.1 Description.....	6-53
	6.23.2 NRHP Evaluation.....	6-55
	6.23.3 Determination of Effect	6-55
6.24	Site 23	6-55
	6.24.1 Description.....	6-55
	6.24.2 NRHP Evaluation.....	6-56
	6.24.3 Determination of Effect	6-56
6.25	Site 24	6-56
	6.25.1 Description.....	6-56
	6.25.2 NRHP Evaluation.....	6-58
	6.25.3 Determination of Effect	6-58
6.26	Site 25	6-58
	6.26.1 Description.....	6-58
	6.26.2 NRHP Evaluation.....	6-59
	6.26.3 Determination of Effect	6-59
6.27	Site 26	6-59
	6.27.1 Description.....	6-59
	6.27.2 NRHP Evaluation.....	6-61
	6.27.3 Determination of Effect	6-61
6.28	Site 27	6-61
	6.28.1 Description.....	6-61
	6.28.2 NRHP Evaluation.....	6-63
	6.28.3 Determination of Effect	6-63

TABLE OF CONTENTS

SECTION SEVEN CONCLUSIONS AND RECOMMENDATIONS.....	7-1
SECTION EIGHT REFERENCES CITED.....	8-1

Figures

Figure 1-1: Project Location	1-2
Figure 1-2: Project Areas and Historic Resources Area of Potential Effects	1-3
Figure 4-1: 1925 Oil and Gas Map of Hardin County, Kentucky	4-4
Figure 4-2: 1937 General Highway Map, Hardin County, Kentucky.....	4-5
Figure 4-3: 1946 USGS Map	4-6
Figure 4-4: 1960 USGS Map	4-7
Figure 6-1. Commercial development along US 31W.....	6-2
Figure 6-2. Non-historic Ranch houses along Liberty Avenue	6-2
Figure 6-3. Non-historic Ranch houses along Liberty Avenue	6-3
Figure 6-4. Non-historic development along Shelby Avenue	6-3
Figure 6-5: Cultural Resource Locations.....	6-4
Figure 6-6: HD 15: Overview of the Haycraft Inn property	6-5
Figure 6-7: HD 15: Northwesterly view of the Haycraft Inn.....	6-5
Figure 6-8: HD 15: Southeasterly view of the Haycraft Inn.....	6-7
Figure 6-9: HD 15: Northeasterly view of outbuilding	6-7
Figure 6-10: HD 15: Westerly view of southernmost garage	6-8
Figure 6-11: HD 15: Westerly view of northernmost garage	6-8
Figure 6-12: HD 15: Springhouse foundation	6-9
Figure 6-13: HD 15: Dry-laid rock retaining wall	6-9
Figure 6-14: HD 15 NRHP Boundary	6-10
Figure 6-15. HD 15: Northeasterly view towards proposed detention pond	6-12
Figure 6-16. HD 15: Large radio tower located north of the Haycraft Inn.....	6-12
Figure 6-17. HD 876: Northerly view of South Wilson Road from the Haycraft Inn.....	6-13
Figure 6-18. HD 876: Shoulder of South Wilson Road.....	6-13
Figure 6-19. HD 876: Northerly view of South Wilson Road near its intersection with Skyline Drive.....	6-14
Figure 6-20. HD 877: Southwesterly view of residence.....	6-14
Figure 6-21. HD 878: Southwesterly view of residence.....	6-18
Figure 6-22. HD 878: Garage	6-18
Figure 6-23. HD 879: Pipe culvert along South Wilson Road	6-21
Figure 6-24. HD 880: Metal pipe culvert along South Wilson Road	6-21
Figure 6-25. HD 881: Box culvert along South Wilson Road.....	6-24
Figure 6-26. HD 882: Box culvert along South Wilson Road.....	6-24
Figure 6-27. HD 883: Westerly view of residence	6-27
Figure 6-28. HD 883: Box culvert forming part of the driveway	6-27
Figure 6-29. HD 884: Northwesterly view of residence.....	6-29
Figure 6-30. HD 884: Concrete slab bridge forming part of the driveway.....	6-29
Figure 6-31. HD 885: Westerly view of residence	6-32
Figure 6-32. HD 885: Westerly view of garage.....	6-32

TABLE OF CONTENTS

Figure 6-33. HD 885: Concrete slab bridge forming part of the driveway..... 6-33
Figure 6-34. HD 886: Box culvert along South Wilson Road..... 6-33
Figure 6-35. HD 887: Easterly view of residence..... 6-36
Figure 6-36. HD 887: Westerly view of garage..... 6-36
Figure 6-37. HD 887: Concrete block box culvert forming part of the driveway 6-37
Figure 6-38. HD 888: Easterly view of residence and garage 6-37
Figure 6-39. HD 889: Southeasterly view of residence..... 6-40
Figure 6-40. HD 889: Easterly view of garage..... 6-40
Figure 6-41. HD 890: Northeasterly view of residence..... 6-43
Figure 6-42. HD 890: Easterly view of garage..... 6-43
Figure 6-43. HD 891: Northeasterly view of residence..... 6-45
Figure 6-44. HD 891: Easterly view of garage..... 6-45
Figure 6-45. HD 892: Northeasterly view of residence..... 6-47
Figure 6-46. HD 892: Easterly view of garages 6-47
Figure 6-47. HD 893: Southwesterly view of residence..... 6-49
Figure 6-48. HD 893: Southerly view of garage..... 6-49
Figure 6-49. HD 894: Southeasterly view of residence..... 6-51
Figure 6-50. HD 895: Southeasterly view of residence..... 6-51
Figure 6-51. HD 896: Southerly view of residence 6-54
Figure 6-52. HD 897: Southeasterly view of residence..... 6-54
Figure 6-53. HD 898: Southerly view of residence 6-57
Figure 6-54. HD 898: Southwesterly view of garage 6-57
Figure 6-55. HD 899: Southwesterly view of residence..... 6-60
Figure 6-56. HD 900: Box culvert along US 31W 6-60
Figure 6-57. HD 901: Double box culvert along US 31W 6-62

Tables

Table 2-1: Project Soils..... 2-2

Appendices

- Appendix A Historic Resources Summary Table
- Appendix B Qualifications of Investigators

Acronyms and Abbreviations

APE	Area of Potential Effect
CFR	Code of Federal Regulations
CRA	Cultural Resource Analysts, Inc.
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
hectares	ha
KHC	Kentucky Heritage Council
L&N	Louisville and Nashville
MRA	Multiple Resource Area
NHPA	National Historic Preservation Act
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
OSS	Official Soil Series Description
URS	URS Group, Inc.
USDA	U.S. Department of Agriculture

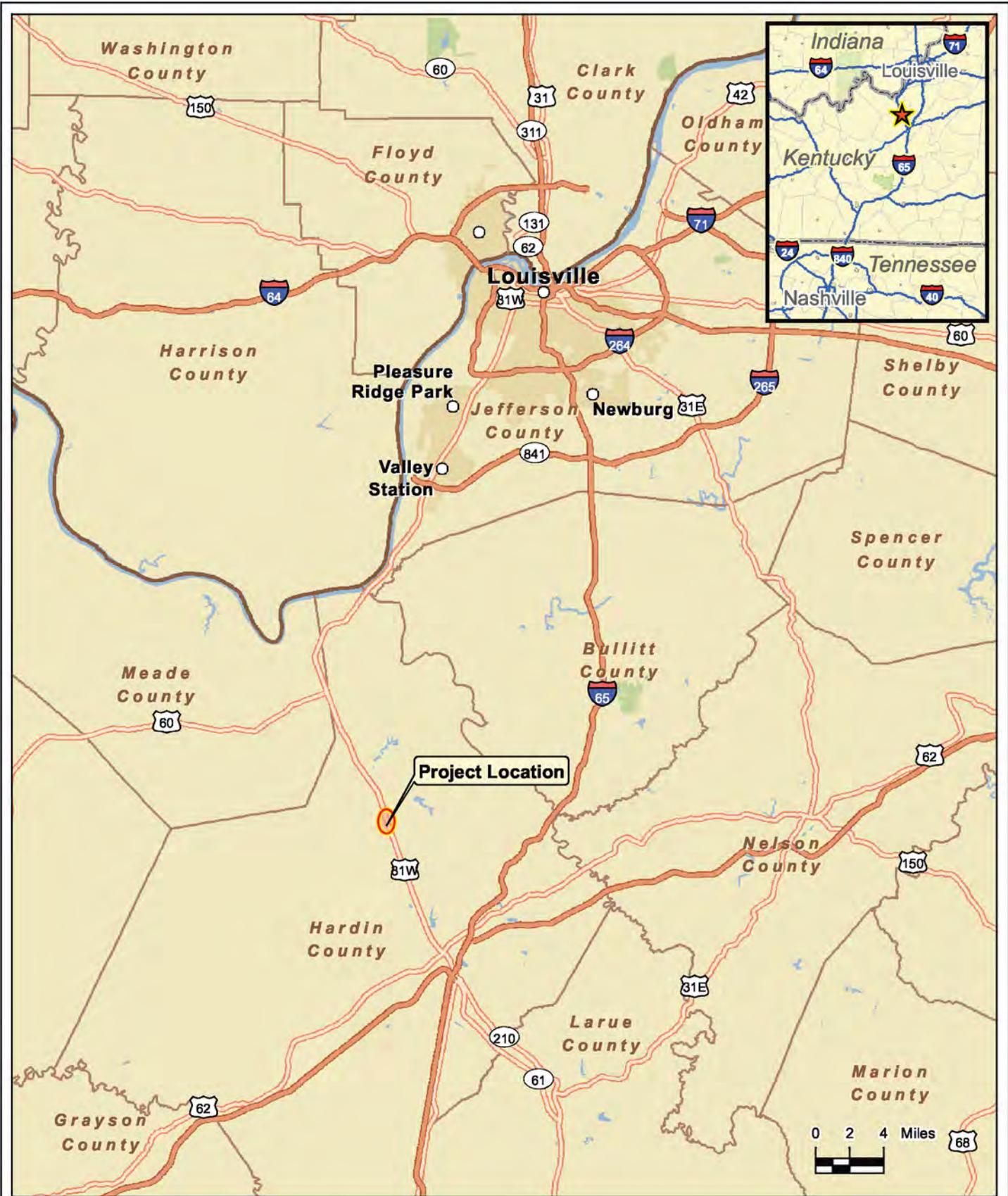
SECTION ONE INTRODUCTION**1.1 PROJECT DESCRIPTION AND AREA OF POTENTIAL EFFECT**

URS Group, Inc. (URS), with support from its subcontractor Cultural Resource Analysts, Inc. (CRA), conducted a historic resource survey of proposed flood control measures, including water retention ponds, in support of federal funding for the City Radcliff's Quiggins Sinkhole/Happy Valley Flood Mitigation Project in Hardin County, Kentucky (Figure 1-1). This investigation was conducted for Federal Emergency Management Agency (FEMA) Region IV. Incorporated in 1956, the City of Radcliff is located in northern Hardin County approximately 20 miles south of the Louisville Metro area. The proposed stormwater management project is for the 1.74 square miles of the Happy Valley drainage where runoff flows into Quiggins Sinkhole. The Quiggins Sinkhole serves as the area's primary terminus for stormwater runoff. Due to the large volume of runoff and the limited intake capacity of the sinkhole, flooding and extended ponding occurs. Several times a year, rain events cause the flooding of South Wilson Road, west of US 31W. A larger rain event will also cause flooding of US 31W, the main thoroughfare for the City of Radcliff.

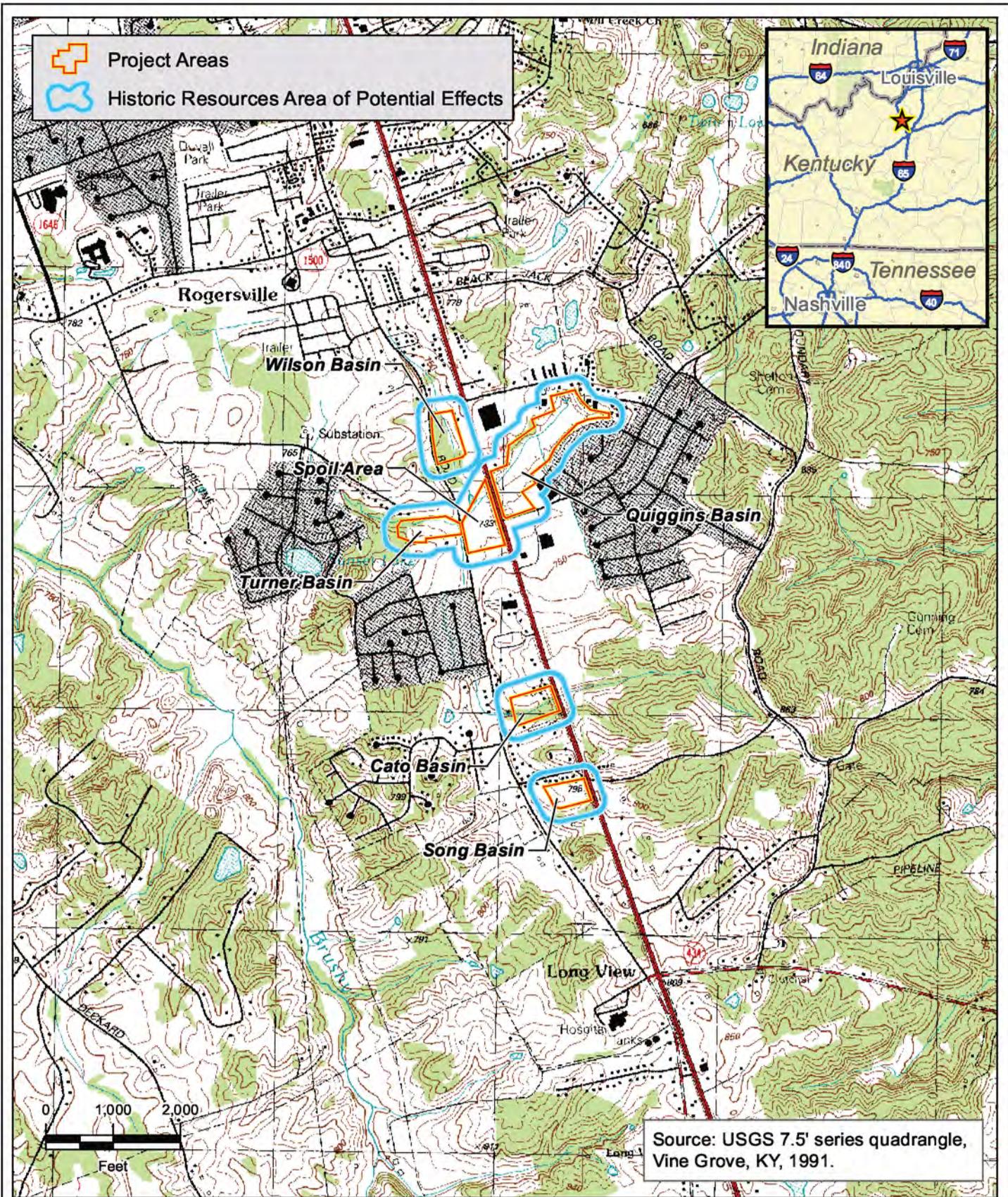
The project seeks to increase the area's detention volume by excavating and developing approximately 2.4 hectares (6 acres) in the Quiggins Sinkhole area near US 31W into a functional basin (referred to as the Quiggins Basin). Additionally, the project includes the construction of four new detention basins (Cato, Song, Turner, and Wilson Basins) and an area to deposit spoil from basin construction. The six individual areas, all located along an approximately 1.5-mile-long corridor parallel to US 31W and South Wilson Road, range in size from 1.9 to 9.7 hectares (4.6 to 24.0 acres) and have a combined area of approximately 22.9 hectares (56.6 acres),

The survey was conducted to comply with federal regulations implementing Section 106 of the National Historic Preservation Act (NHPA), concerning the effect of federal undertakings on historic properties listed, or eligible for listing, in the National Register of Historic Places (NRHP). The implementing regulations are published in the Code of Federal Regulations at 36 CFR Part 800. Federal actions include using federal funds or granting a federal permit. For the purpose of the historic resource survey, the Area of Potential Effect (APE) was defined to include a 200-foot radius around each proposed basin and spoil area (Figure 1-2). The APE was delineated in consultation with the Kentucky Heritage Council (KHC) to account for potential direct and indirect impacts on historic properties; the appropriateness of the APE was verified by an architectural historian in the field.

Field investigations were conducted by CRA architectural historians Holly Higgins and John Dickerson in February 2013. The purpose of the historic resource survey was to identify and document above-ground resources 50 years of age or older located within the APE that are listed or potentially eligible for listing in the NRHP; evaluate their eligibility for listing in the NRHP and recommend boundaries, if eligible; and evaluate the effect of the project on any properties included, or eligible for listing, in the NRHP.



CLIENT FEMA Region IV						TITLE Project Location	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						 12420 Milestone Center Dr. Germantown, MD 20876	
REVISION NO	0	DES BY	KJM	03/29/13	PROJ NO	15702708	
SCALE	1:500,000	CHK BY	xxx	00/00/00	FIGURE	1-1	
<small>\\09041\er\FEMA\Region IV - Qiggin\Simhole Phase I Archeology\F. Data Management\GIS\Project\loc_hla_20130329.mxd</small>				PM	SS	03/29/13	



CLIENT FEMA Region IV				TITLE Project Areas and Historic Resources Area of Potential Effects	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY					
REVISION NO	0	DES BY	KJM	03/29/13	PROJ NO 15702708
SCALE	1:24,000	CHK BY	xxx	00/00/00	
100.00.41env\FEMA\Region IV - Quiggins Sinkhole Phase I Architecture		PM	SS	03/29/13	FIGURE 1-2



12420 Milestone Center Dr.
 Germantown, MD 20876

Robert Karwedsky of URS served as the Principal Investigator. Holly Higgins of CRA served as the lead architectural historian and conducted the historic resource survey with John Dickerson, also of CRA. Ms. Higgins also prepared aspects of the report, along with Scott Seibel, who served as the Task Manager, and Ralph Koziarski of URS. Elizabeth Heavrin of CRA managed the CRA work tasks and provided technical review. Graphical support was provided by CRA and Kevin McMaster and Brad Krueger of URS. Mark Edwards of URS provided QA/QC of the report.

1.2 REPORT ORGANIZATION

Following this Introduction the report includes six sections of text including: Environmental Setting, Historic Context, Previous Investigations, Research Design, Survey Results, and Conclusions and Recommendations. The References Cited completes the body of the report. Appendix A, which contains the survey forms, and Appendix B, containing the qualifications of investigators, follow the body of the report.

SECTION TWO ENVIRONMENTAL SETTING**2.1 GEOLOGY AND TOPOGRAPHY**

Hardin County is underlain by Mississippian-aged carbonate rocks of the St. Genevieve and/or the St. Louis formation (Kentucky Geological Survey 2001; Lloyd and Lyke 1995). The lithologies of the sediments from the St. Genevieve and/or the St. Louis formations consist primarily of carbonate rocks such as limestone. According to the 1991 7.5 minute topographic map of the Vine Grove, Kentucky quadrangle, the designated site area ranges in elevation from approximately 730 at the Quiggins Sinkhole to approximately 770 feet above sea level at the southernmost (Song) property/parcel (USGS 1991).

2.2 HYDROLOGY

A prior report indicates that topography in the area of the site is rolling (QK4 2009) and may be generally characterized as a relatively low-lying sinuous drainage area surrounded by areas of higher topography that appear to be cut by unnamed streams flowing radially toward the drainage area. The self-contained drainage of the sinkhole is located between the drainage areas of two north-tending streams. It is approximately 0.6 miles east of Brushy Fork and 1.5 miles west of Mill Creek. Mill Creek flows north where it empties into the Salt River, approximately 11 miles away from the project area. Brushy Fork empties into Otter Creek 5.9 miles northwest of the project area, and Otter Creek drains into the Ohio River 13.9 miles northwest of the project area.

2.3 SOILS

According to the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) online Web Soil Survey, the Happy Valley drainage area is immediately underlain by silt loam soils (NRCS WSS 2013). There have been six distinct soil units recorded within the project area boundaries, with Nolin silt loam and Newark silt loam being the most common. The NRCS Official Soil Series Description (OSS) resource describes Nolin series soils as very deep, well drained, moderately steep soil occurring in flood plains and wet depressions (NRCS OSS 2013). Meanwhile, the Newark series soil is described as a very deep, somewhat poorly drained alluvial soil formed on nearly level flood plains and depressions (NRCS OSS 2013). The remaining soil types from the area are similar and are described as occurring on flood plains, being formed of mixed fine silty alluvium, and characterized as well-drained material with moderately high to high water movement in restrictive zones and very high available water capacity (NRCS OSS 2013). Project soils are summarized below in Table 2-1.

Table 2-1: Project Soils

Soil Name	Percent Slope	Taxonomic Class	Drainage Class	Flooding frequency
Newark Series	n/a	Fine-silty, mixed, active, nonacid mesic Fluventic Endoaquepts	Somewhat poor	Occasional to frequent
Nolin silt loam	n/a	Fine-silty, mixed, active, mesic Dystric Fluventic Eutrudepts	Well drained	Frequent
Nicholson silt loam	2–6%	Fine-silty, active, mesic Oxyaquic Fragiudalfs	Moderate to well drained	n/a
Crider silt loam	6–12%	Fine-silty, mixed, active, mesic Typic Paleudalfs	Well drained	n/a
Elk silt loam	2–6%	Fine-silty, mixed, active, mesic Ultic Hapludalfs	Well drained	n/a
Vertrees silt loam	12–20%	Fine, mixed, semiactive, mesic Typic Paleudalfs	Well drained	n/a

2.4 CURRENT LAND USE

The project area consists largely of fallow agricultural land, much of which is overgrown with woods. Portions of the project area have been disturbed by paved roads and public utility lines associated with surrounding suburban developments. The area south of Radcliff, Kentucky, features extensive suburban residential lots punctuated by open fields and small wooded plots. Remnant agricultural fields are present, but do not become common until several miles west of the project area. The area approximately 1 miles to the east is largely wooded.

SECTION THREE HISTORIC CONTEXT

The Historic period of Kentucky spans six temporal sub-periods, beginning with the Pre-Settlement Exploration, Early Settlement, Antebellum, Civil War, Postbellum: Readjustment and Industrialization, and the Industrial and Commercial Consolidation. The time following the end of World War II in 1945 is considered the Modern Era.

3.1 PRE-SETTLEMENT EXPLORATION (1750–1775)

South-central Kentucky has a rich and varied history beginning with the European explorers who moved into what was to become the state of Kentucky during the mid-eighteenth century. Initial exploration was conducted primarily by French traders, land speculators, and government agents (Pollack 1990:5). One of the primary motivations for exploration was the prospect of inexpensive land, especially after the Donelson Line (1771) pushed the western boundary of settlement to the Kentucky River. “Long Hunters,” such as Daniel Boone, spent extended periods of time in Kentucky. The information they gathered would be critical to the later settlement of Kentucky (Pollack 1990:587-589).

Early encounters with Native American groups living in the area were generally brief and often violent. The predominant Native American groups living in Kentucky during the period of contact included Shawnee, Cherokee, Chickasaw, Yuchi, and Mosopelea (McBride and McBride 2008). The Shawnee were by far the largest group occupying the majority of the state, while the Cherokee and Yuchi occupied settlements along the upper Cumberland and Kentucky Rivers. The Mosopelea were also known to have occupied portions of southern Kentucky near the mouth of the Cumberland River. Chickasaw settlements were generally limited to the western portion of the state along the Ohio River. Native American groups known to have visited portions of the state included the Illinois, Miami, Iroquois, and Delaware; however, these generally only involved short-term forays by small hunting parties or for trade with existing groups (Swanton 1953). Kentucky became known as “the dark and bloody ground” during this period, which some believe describes the era of conflict between Native American groups and early explorers; others interpret the phrase as an allusion to the frequent conflicts between Native American groups amidst the turmoil and disruption brought about by increasing Euro-American influence and settlement.

3.2 EARLY SETTLEMENT (1775–1820/1830)

As the western borders were extended, settlers, encouraged by Long Hunter accounts, began to enter Kentucky by way of the Cumberland Gap and the Ohio River (Lewis 1996:187). The first settlements spanned the Bluegrass, the Pennyroyal, and Appalachian regions (McBride and McBride 2008:909). It is within this time that the basic governmental organization of Kentucky was formed. Towns, counties, and the economic, banking, and transportation systems necessary to sustain them were developed (Pollack 1990:6).

During the Revolutionary War (1775–1783), many Native American tribes, including the Chickasaw, were allied with the British, and this lent incentive to assault the settlers. Settlers lived in forts and stations to protect themselves (Pollack 1990:590). The year 1777 was so

violent that it was dubbed the year of “the terrible sevens.” Many settlements were abandoned (Lewis 1996:188-189), and development was hindered until the end of the war in 1783, when the violence abated.

The end of the Revolutionary War marked an era of population growth and town development. Settlers no longer inhabited forts and stations to protect themselves. Farmsteads were established and stations began to develop into towns. The settlers spanned from the lower classes to the gentry, and were primarily British, although Scottish, Scotch-Irish, and Germans are also noted (Pollack 1990:590-591). The gentry immigrated from Virginia, Maryland, and North Carolina (Abernethy 1962:67; Barnhart 1941:19-22; Coleman 1940:15), and established plantations that used slave labor and grew one or more cash crops. Popular commodities included livestock, grains, and tobacco.

According to the first U.S. census taken in 1790, Kentucky had a population of 73,677. By 1792, it was granted statehood. Cities began to develop, although the population remained primarily rural (Lewis 1996:191). Agricultural goods were traded and non-local goods were imported via rivers and improved road systems. Despite improved transportation systems, the cost of trade was unfavorable, and many towns looked to local industry as a solution. Tobacco and hemp factories, salt works, iron works, gristmills and home manufacturers were established. Kentucky produced 90 percent of the gunpowder for the War of 1812. The Jackson Purchase of 1818 acquired the rest of the land now known as Kentucky (McBride and McBride 2008:920). Because of its proximity to developed regions, and lacking the threat of hostile Native Americans, “The Purchase” built up quickly. By the Antebellum, it too was part of a growing Kentucky (Pollack 1990:594-598).

3.3 ANTEBELLUM (1820/1830–1861)

The Antebellum period began inauspiciously with the depression of the early 1820s (McBride and McBride 2008:921). By 1825, the nation, including Kentucky, began to recover. Populations and industries boomed. This early portion of the Antebellum can be viewed as the period of the river town. The growing steamboat industry created new landings along Kentucky’s rivers, which developed into towns and cities (Pollack 1990:599). River improvements were necessary to support industries. Locks were built to promote navigability, especially during the drier seasons (Crocker 1976:14, 22). Most notably, the Portland Canal, built around the Falls of the Ohio, was completed in 1830 and brought commercial success to Louisville (Hepner and Whyne 1992).

Other transportation improvements included roads and railways. Existing roads were widened and repaired, and new roads were built. Railroad construction began slowly, as a single stretch between Lexington and Frankfort took almost 20 years to complete. By 1860, railroads connected prominent cities, such as Lexington and Louisville, throughout the state, and they also had connections to Nashville and Memphis (Pollack 1990:600,603).

Kentucky’s industry during the Antebellum was focused on agricultural and mineral resources, including iron, salt, and coal (McBride and McBride 2008). Agricultural industries included

mills, factories, and distilleries. Iron furnaces were predominantly located in the Appalachian, Tennessee Cumberland, and Pennyroyal regions (Pollack 1990:605). Salt works could be observed throughout the state during the early Antebellum, with the largest example being the Goose Creek Salt Works of Clay County. However, because of improved transportation, salt could be imported at a lower cost, making it unprofitable for most to produce. Salt and mineral springs existed at resorts for healing and entertainment purposes. In 1820, the first commercial coal mine was opened in Muhlenberg County. By 1845, the first modern mining community was established and was the prototype of similar towns to follow. The mining town of Peach Orchard consisted of 40 houses, a store, and mills (Crowe-Carraco 1983:78-79). The coal industry would expand to have a significant impact on Kentucky (Pollack 1990:605).

Continuing improvements in transportation and increasing industrialization encouraged the growth of cities, rural populations, and county seats (Lewis 1996:194-195). Increased imports led to lower cost of goods, and the demand for agricultural commercialization. Plantations and farms expanded throughout Kentucky's regions, especially in the Bluegrass (McBride and McBride 2008:925). Commercial products were consistent with those grown in earlier periods, with new emphasis on hemp and tobacco. Hemp was directly linked to the marketability of the cotton industry in the south, and was the cash crop of many planters and farmers. Tobacco was cultivated especially in the Pennyroyal region, where soil was rich. It is within these tobacco production areas that the largest plantations with the most slaves existed (Pollack 1990:601-602). Kentucky's slave population during the Antebellum rose from 165,213 in 1830 to 225,483 at the start of the Civil War (Lewis 1996:195).

Louisville, in particular, showed remarkable growth during the Antebellum. In 1810, toward the end of the Early Settlement Period, Louisville was the fourth largest city in the state with a population of 1,375. In 1830, it was the largest with a population of over 10,000, and by 1860 that figure reached 68,033. Louisville's industry boomed, largely due to its railroads and the increased trade the Portland Canal allowed (Pollack 1990: 596,603). By the end of the Antebellum, it had become the largest manufacturing center in the south, and the twelfth largest in the country (Share 1982:33).

3.4 CIVIL WAR (1861–1865)

At the time of the Civil War, Kentucky was a slave state, opposed to succession. The state attempted military neutrality, but by the end of 1861, Union and Confederate troops began moving in (McBride and McBride 2008). Kentucky was divided into a Union north and a Confederate south. Louisville accommodated the state's Union headquarters. Confederate troops abandoned Kentucky by 1862, largely because of the attacks upon Tennessee Forts Donelson and Henry by Ulysses S. Grant. Raids and guerilla activities continued throughout the state, particularly in the Appalachians (Pollack 1990: 606-609).

Kentucky was not physically devastated by the war to the same extent as states to the south and east, as most major battles and campaigns took place outside its borders. Still, the war had a serious impact on the state's economy and industry. Trade was adversely affected, especially livestock and hemp (McBride and McBride 2008). Tied to the cotton industry, hemp, as

previously noted, was a particularly valuable crop, and demand for hemp increased as cotton crops became scarce during and immediately after the war (Alexander 1976:263). Transportation systems were impacted by war activities, especially regional railroads. Rivers, such as the Green River, were in fact closed during this time. Early in the war, Kentucky's economy suffered money shortages, limited credit, and low prices on goods. By 1863, the economy rebounded due to a higher demand for Kentucky products, such as grain and hemp. Mining, agriculture, and other industries were affected depending on their locations and types. The nitrate mines did well because they fulfilled the war's demand for gunpowder. Iron furnaces in the Appalachian and Bluegrass regions were Union suppliers. In contrast, the iron industry in the Jackson Purchase and the Pennyroyal were adversely affected by the transportation hindrances the war posed (Pollack 1990:609-610).

Most industries were affected by the declining labor force. Kentuckians who joined the Union Army numbered 100,000, and 25,000 to 40,000 joined the Confederacy. Approximately one-third of these soldiers died from disease or battle (Harrison 1975:95). The agricultural industry suffered from the loss of slaves. By 1863, many slaves were leaving Kentucky; they were granted freedom for enlisting in the Union Army, and Kentucky was the only state that was not recruiting (Pollack 1990:610-611). By 1864, Kentucky recruitment centers developed, and within four months, 14,000 slaves had volunteered (Berlin 1982: 194).

3.5 POSTBELLUM: READJUSTMENT AND INDUSTRIALIZATION (1865–1915)

The Postbellum period was a time of growth and change in transportation, commerce and manufacturing, demographic trends, and agricultural methods. In 1900, Kentucky had the second highest value of farm products after Texas, as the physical devastation of war was minimal and some railroads previously existed throughout the state (McBride and McBride 2008).

Railroads connected select Kentucky cities before the war, and Louisville had lines running to Memphis and Nashville. Rivers had been an important form of transportation, but could not compete with the speed and weather resistance of the railroad (Pollack 1996:629, 632). Postwar increases in rail use and construction brought markets closer, made goods cheaper, and facilitated the shipment of goods and raw materials. The increase in the number of railroad lines also promoted leisure travel, especially to mineral spring resorts throughout the state (Channing 1977; Tapp and Klotter 1977).

Other transportation developments in this time included the introduction of bicycles in the late 1800s, enabling citizens to travel farther than they could on foot (McBride and McBride 2008:936). Road construction integrated the state, but was completed in a piecemeal fashion. The electric streetcar was established in many cities in the 1890s. Interurban lines promoted the interaction between rural and urban areas, and centralized retail trade. Improvements in transportation and communication, like the introduction of the telephone in the late 1800s, were the impetus for suburban growth. Residents could commute to the city and enjoy its amenities, and still have the rural benefits of lawns and gardens (Pollack 1996:628).

Postbellum commerce and manufacturing saw the decline of small-scale local manufacturing, which could not compete with the larger factories. Most of these large manufacturers were out of state, and their products were imported (McBride and McBride 2008:947). Some smaller operations consolidated to form large corporations. Mass production and the growing desire for consumer goods stimulated retail trade. Wage labor increased the purchasing power of individuals and motivated the industry to produce more goods (Pollack 1996:627-628).

Many industries declined during the Postbellum, including iron foundries, brick and tile manufacturing, and hemp. Hemp was eventually replaced by cheaper substitutes. Many other industries thrived. Lumber changed from an individual or small-scale industry to a commercial one, especially in the Bluegrass Region. Coal mining was of increasing importance in the state, and its focus was primarily on exportation of the resource. In 1910, three-quarters of the timber and at least 85 percent of coal in the Appalachian Mountain region was owned by out-of-state companies. This trend could be observed throughout the state (Pollack 1990:637-639).

Traditional agricultural methods evolved as farming became a more commercial industry (McBride and McBride 2008). Railroads enabled the export of crops and livestock. White burley tobacco became a popular crop because it grew well in most of the state and was marketable. Tobacco production increased more than 70 percent from 1870 to 1900 (Tapp and Klotter 1977). Freed slaves who had agricultural knowledge and, to a lesser degree, European immigrants often provided the labor. Labor organization ranged from wage labor to sharecropping. Many African Americans seeking autonomy preferred to rent land. Still, these farms tended to be half the size and worth of their counterparts. Workers tended to live on the farm or work seasonally, keeping a residence in the city (Pollack 1996:615).

In 1865, the Thirteenth Amendment was ratified without Kentucky's support (McBride and McBride 2008:939). Freed slaves who preferred not to continue living rurally moved to urban areas. Immigrants also moved into cities to seek manufacturing jobs. As populations rose in the cities, the demand for jobs and housing was great, and the overcrowding resulted in tenement housing and poor sanitation (McBride and McBride 2008:937). Many families shared bathroom facilities and polluted water sources. African American housing was segregated in most cities by the late 1800s. Formal ordinances promoting segregation were common after 1910 (Rice 1968).

3.6 INDUSTRIAL AND COMMERCIAL CONSOLIDATION (1915–1945)

Two World Wars, Prohibition, the Great Depression, and New Deal policies influenced Kentucky during this time. Manufacturing and commerce, agriculture, urbanization, and industrialization underwent significant change. Kentucky did not industrialize as rapidly as much of the country, and its economy remained largely grounded in agriculture. Farming as a way of life declined, as many farmers worked part-time off the farm as wage laborers. Mechanization, such as the use of tractors, became more popular, and the number of tenant farmers increased. Agriculture became more commercial as marketable crops like tobacco were emphasized. The industry was revived from the depression when cigarette popularity increased 75 percent between the years 1939 and 1945 (Pollack 1990:655). The agriculture industry was also affected by the Agricultural Adjustment Act, a New Deal Policy that enabled the federal government to

regulate crops and livestock, including tobacco, which stimulated exhausted soils and increased prices on goods (Pollack 1990:655).

Urban growth continued in this period, as greater numbers searched for work in the cities. The increase of multi-family tenements and apartments led to calls for improvements in urban living. Sanitation and sewage systems, electricity, and indoor plumbing became available in most urban homes. Rural areas continued to lack these facilities. As suburbs expanded, many of these growing neighborhoods became independently incorporated so they could secure the amenities and services that the city could not provide (Pollack 1990:647).

Retail trade and consumerism experienced growth, largely due to improvements in mass production of goods, especially plastics (Pollack 1990:657). Retail stores and the introduction of the large chain stores gave Kentuckians access to these goods and to jobs. Wage labor became more common as employment in the retail industry grew rapidly. Women entered the work force, including retail, manufacturing, and industry. The majority of women in the work force were African Americans (Pollack 1990:657).

The African American population decreased during this time (Odum 1936:470). The highest concentration was in rural tobacco production. Segregation of neighborhoods increased, partially because many upper and middle class citizens began to leave the city centers and move to suburban areas (McBride and McBride 2008). The foreign population in Kentucky also decreased at this time, abetted by the 1921 Immigration Law. Since fewer immigrant workers were available to northern industries, many opted to recruit heavily from southern states, spurring the emigration of Kentucky citizens (Pollack 1990:648).

Local small-scale manufacturing and industries declined or consolidated as mass production outside of the state grew. Whiskey distilling led all other industries in cash returns before prohibition (Clark 1960 [1939]). Because of Prohibition, many distillery workers lost their jobs and home distilling increased. Prohibition ended in 1935 in Kentucky, two years after the rest of the nation, but 90 of the 120 counties in the state opted to remain dry, and home-production continued in those areas. The mining population provided an ample market for these distillers (Pollack 1990:654).

Living conditions slowly improved in coal mining towns as modern amenities were introduced, but the mining industry was hurt by the Depression, and many businesses were forced to cut wages and maintenance repairs. In turn, workers were motivated to unionize. Despite mechanization, the lumber industry declined as a new awareness of deforestation was born and National Forests were established (Eller 1982:119). By this time, many of the best trees had been cut.

In the latter stages of this time period, New Deal policies, implemented by agencies such as the Works Progress Administration, granted Kentucky improved access to mass communications. Public transportation dramatically improved with the introduction of bus lines and taxi services. Automobiles and trucks became more attainable because of assembly line production, roads were paved and new ones were built, and some railroads were built (Channing 1977). Improvements

in transportation led to more jobs, economic growth, and a developing tourism industry, and further integrated Kentucky (Pollack 1990:660).

During World War II, manufacturing in Kentucky, and particularly in the Hardin County area, expanded as the economy was geared towards wartime production. The Louisville area became a center of rubber production and of jeep assembly at the city's Ford factory. Louisville also saw the construction of a munitions plant (Channing 1977). Nearby Fort Knox, first built in 1861, was greatly expanded during the war as a training area for mechanized infantry and armored units (U.S. Army Installation Management Command 2013).

3.7 MODERN ERA (1945–PRESENT)

The major trends in Kentucky history after World War II were the developments of transportation networks and civil rights. The construction of the interstate highway system and state turnpikes, and the rise of state parks were major economic developments and contributed significantly to the state's tourism industry (The Columbia Electronic Encyclopedia 2013). Industry continued to supplant agriculture in terms of economic importance, and during the energy crises of the 1970s, Kentucky mines saw increased demands for their coal as access to foreign fuels became hindered (Channing 1977). In the 1970s, Kentucky's urban population began to outnumber its rural population (Channing 1977).

The Civil Rights movement in Kentucky made great early progress due in part to support from progressive governor Lawrence Wetherby. In the mid-1950s, Wetherby promoted school desegregation in the state and refused to sign a statement supported by many other southern governors that opposed integration after the Supreme Court's decision in the *Brown v. Board of Education* case (Kebler 1986). In 1963, Governor Edward Thompson Breathitt won the gubernatorial election by promoting racial equality (Brinson and Williams 2001). Governor Breathitt supported the Civil Rights Act of 1964, and was successful in pushing a civil rights bill through the Kentucky State Assembly in 1966 (Brinson and Williams 2001). In spite of this progress, the African American population of Kentucky continues to be disproportionately affected by poverty, its associated crime, and underachievement (Kentucky Commission on Human Rights 2009).

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SECTION FOUR PREVIOUS INVESTIGATIONS

Before entering the field, available surveys, reports, studies, maps, and other data pertinent to the project area were identified and reviewed. This task began with an investigation of the records of the KHC (FY13_1380). Geographic Information System (GIS) data provided by the KHC indicated that one architectural resource 50 years of age or older (HD 15) had been previously identified within the APE for the proposed project.

4.1 PREVIOUS INVESTIGATIONS

Two portions of the Louisville and Nashville (L&N) Turnpike were surveyed previously (HD 93 and HD 399). The section known as HD 93 was deemed eligible for listing in the NRHP in 1983 by Catherine C. Harned of the Hardin County Planning and Development Commission (KHC Survey and Register Files). This quarter-mile section of the turnpike was at the intersection of US 31W and KY 434, south of the project area and not within any of the APEs. At the time it was surveyed, it was the only undisturbed portion of the turnpike still extant. The portion of the turnpike known as HD 399 was listed in the NRHP on June 13, 1996, under Criterion A for Transportation and Criterion C for Engineering. It was also surveyed by L. Webb of KHC in April 1998 (Schenian 1993; KHC Survey and Register Files). Three stone bridges and a quarry associated with the construction of the bridges are also included in the survey and nomination. The 3-mile long segment is on Ft. Knox property, beginning at its northern boundary; it is located north of the project area and not within any of the APEs.

The Hardin County Multiple Resource Area (MRA) NRHP nomination was also consulted during research for this project (Thomason 1986a). Site 1 (HD 15). The Haycraft Inn, was surveyed as part of a countywide survey in which 143 individual resources, including four historic districts, were ultimately included in the MRA.

The Haycraft Inn was individually listed in the NRHP on August 26, 1988, under Criterion A for local significance in the areas of transportation during circa 1840–1845 and Criterion C in the area of Architecture as a notable example of an early central passage house. When listed, the property included two contributing and two non-contributing structures located on 1.81 acres (Thomason 1986b:1). The contributing structures are the house and the ca. 1820 springhouse. The non-contributing structures are both barns built in the 1960s. The original portion constructed by Lewis Coleman circa 1814 and added onto and operated as an inn circa 1820 by Daniel and Elizabeth Haycraft, was an important stagecoach stop along the L&N Turnpike during the early to mid-nineteenth century. It is the only remaining stagecoach stop in Hardin County and was known in accounts of the period for its hospitality (Thomason 1986b:1-2). A small portion of the northeastern corner of the property lies within the southwest corner of the APE of the Wilson Basin. The springhouse foundation is located within this portion.

4.2 MAP DATA

In addition to the file search, archival research also included a review of available maps, used to help identify potential historic properties (structures) within the area of potential effect for the proposed project. The following maps were reviewed:

- 1925 Oil and Gas Map of Hardin County, Kentucky (Kentucky Geological Survey);
- 1936 Map of Hardin County, Kentucky (Wilder);
- 1937 General Highway Map, Hardin County, Kentucky (Kentucky Department of Highways [KDOH]);
- 1946 Vine Grove, Kentucky, 15-minute series topographic quadrangle (United States Geological Survey [USGS]);
- 1949 General Highway Map, Hardin County, Kentucky (Kentucky State Highway Department [KSHD]);
- 1958 General Highway Map, Hardin County, Kentucky (KDOH);
- 1960 Vine Grove, Kentucky, 7.5-minute series topographic quadrangle (USGS); and
- 1991 Vine Grove, Kentucky, 7.5-minute series topographic quadrangle (USGS).

The 1925 Oil and Gas Map of Hardin County, Kentucky, depicts two structures in the vicinity of the APE (Figure 4-1). These structures are no longer extant or have been replaced. The 1936 Map of Hardin County, Kentucky, also depicts two buildings in the vicinity of the APE. Again, these have been replaced with newer structures or are no longer extant. The 1937 General Highway Map, Hardin County, Kentucky, again depicts two buildings within the APE (Figure 4-2). However, these structures are no longer extant.

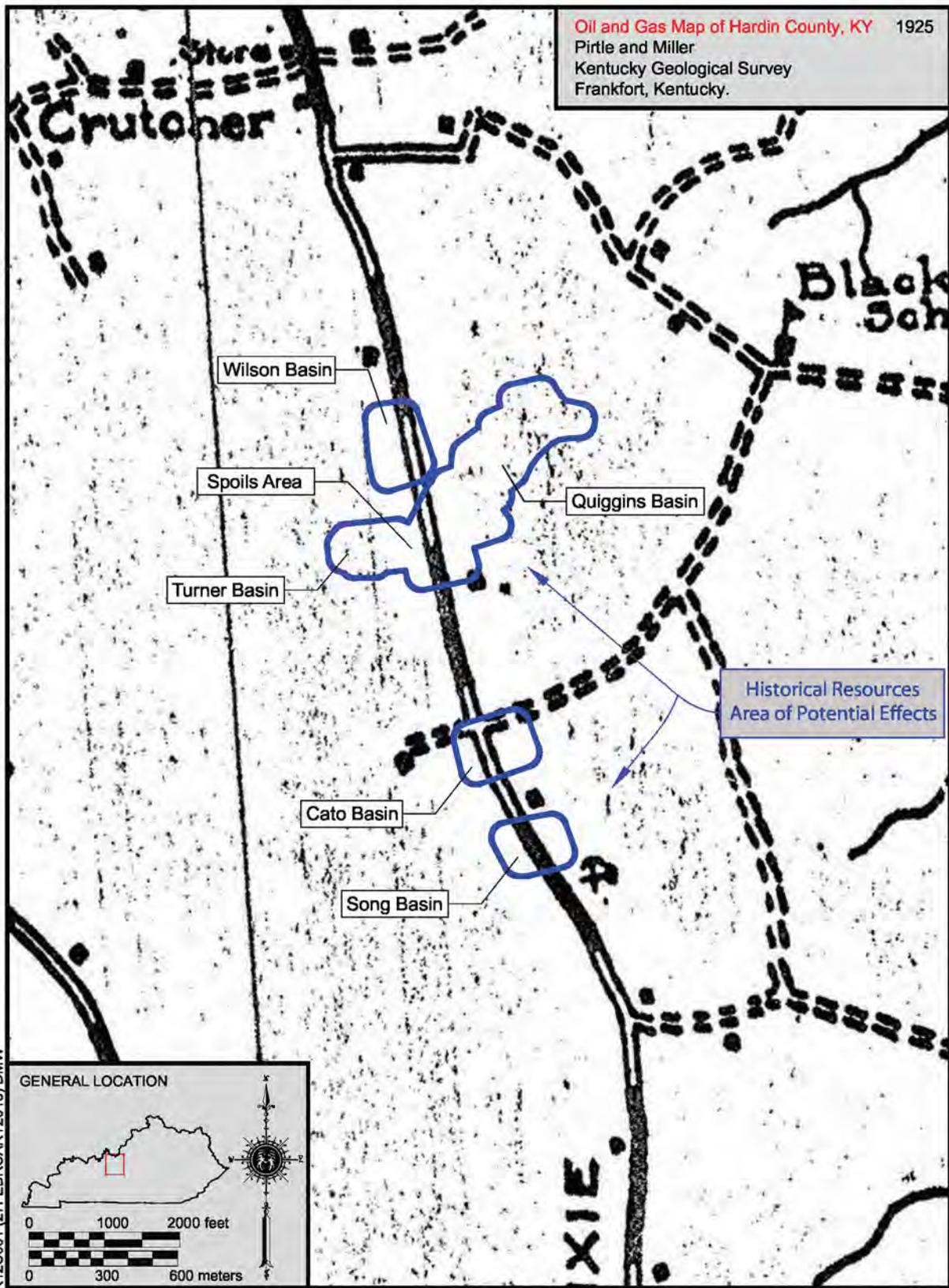
The 1946 Vine Grove, Kentucky, 15-minute topographic quadrangle shows 11 buildings in the vicinity of the APE (Figure 4-3). All but one of these buildings have been demolished or replaced by newer structures. The remaining building is Site 1 (HD 15). The 1949 General Highway Map, Hardin County, Kentucky, depicts 10 buildings within the APE. Four of these structures have been demolished. Five are still extant, but are not considered eligible for listing in the NRHP. The remaining structure is Site 1 (HD 15).

The 1958 General Highway Map, Hardin County, Kentucky, shows two buildings in the APE. One is Site 1 (HD 15). The other structure is not eligible for listing in the NRHP. The 1960 Vine Grove, Kentucky, 7.5-minute topographic quadrangle depicts 49 structures in the APE (Figure 4-4). Approximately half of these structures are no longer extant. One is Site 1 (HD 15). The remaining structures are not eligible for listing in the NRHP. The 1991 Vine Grove, Kentucky, 7.5-minute topographic quadrangle shows 49 structures in the APE. The majority of these structures were constructed during the late twentieth century. Approximately one-quarter of these structures have been demolished. One structure is Site 1 (HD 15). The remaining structures are not eligible for listing in the NRHP.

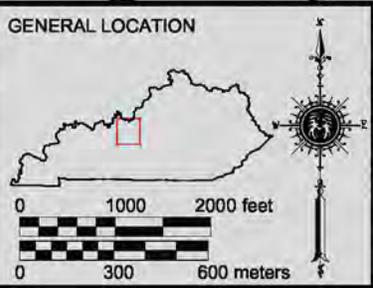
4.3 EXPECTED CONDITIONS

Based on the review of historic map data, at least 10 historic age structures could be present within the APE. It was expected that any historic structures extant within the APE would consist of houses and associated agricultural buildings, mainly of vernacular styles.

Oil and Gas Map of Hardin County, KY 1925
 Pirtle and Miller
 Kentucky Geological Survey
 Frankfort, Kentucky.



K12U001 (27FEBRUARY2013) DMW



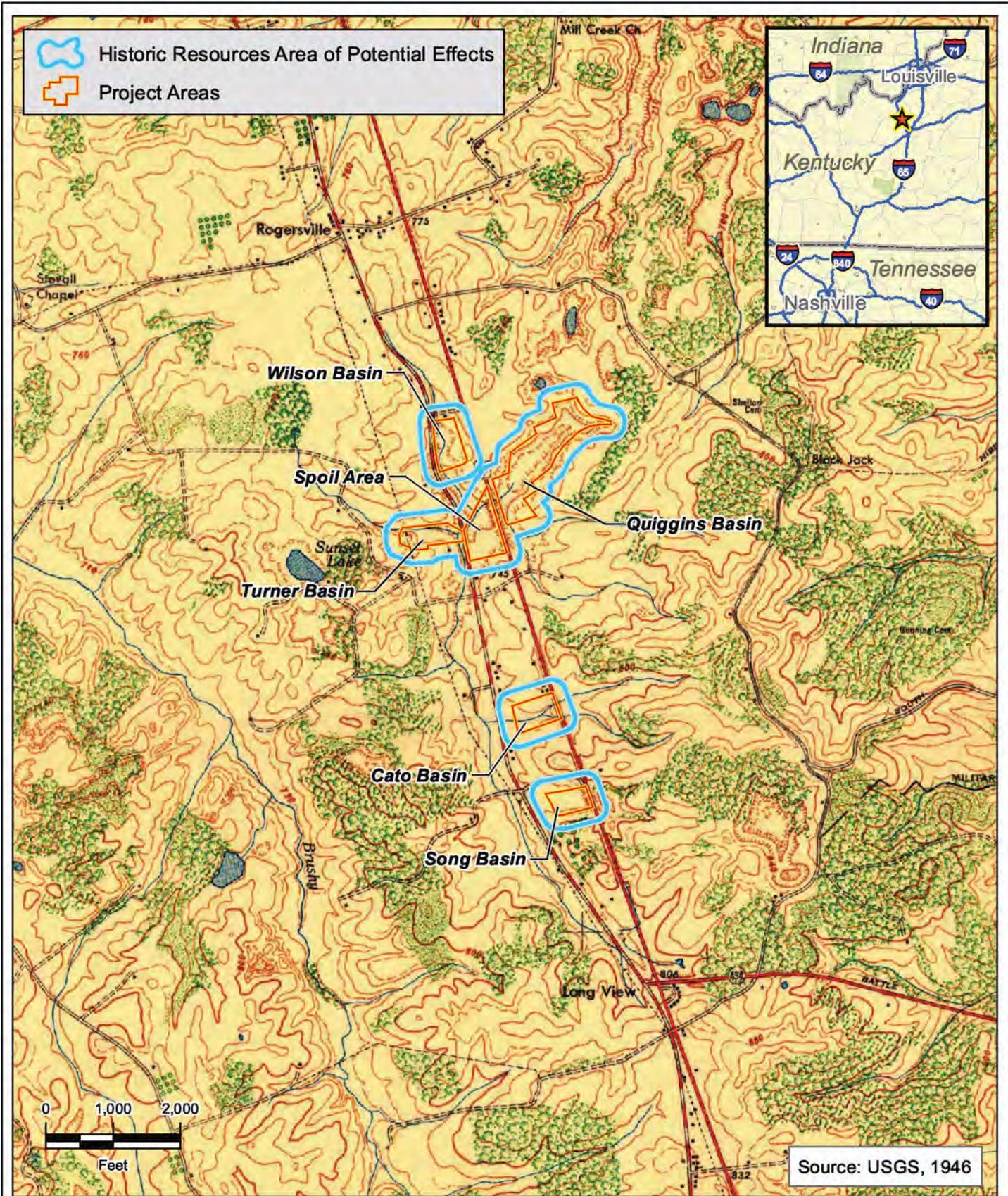
CLIENT FEMA Region IV			
PROJ Happy Valley Flood Mitigation, Hardin Co., KY			
REVISION NO	0	DES BY	BAK 04/17/2013
SCALE	1 inch = 2,000 ft (609.6 meters)	DR BY	BAK 04/17/2013
<small>\\10.90.4.1\arm\FEMARegion IV - Quiggins Sinkhole Phase I Archaeology\G. Reports & Deliverables\1.2 Draft Deliverables\Figures\Phase I AH</small>		CHK BY	SS 05/17/2013



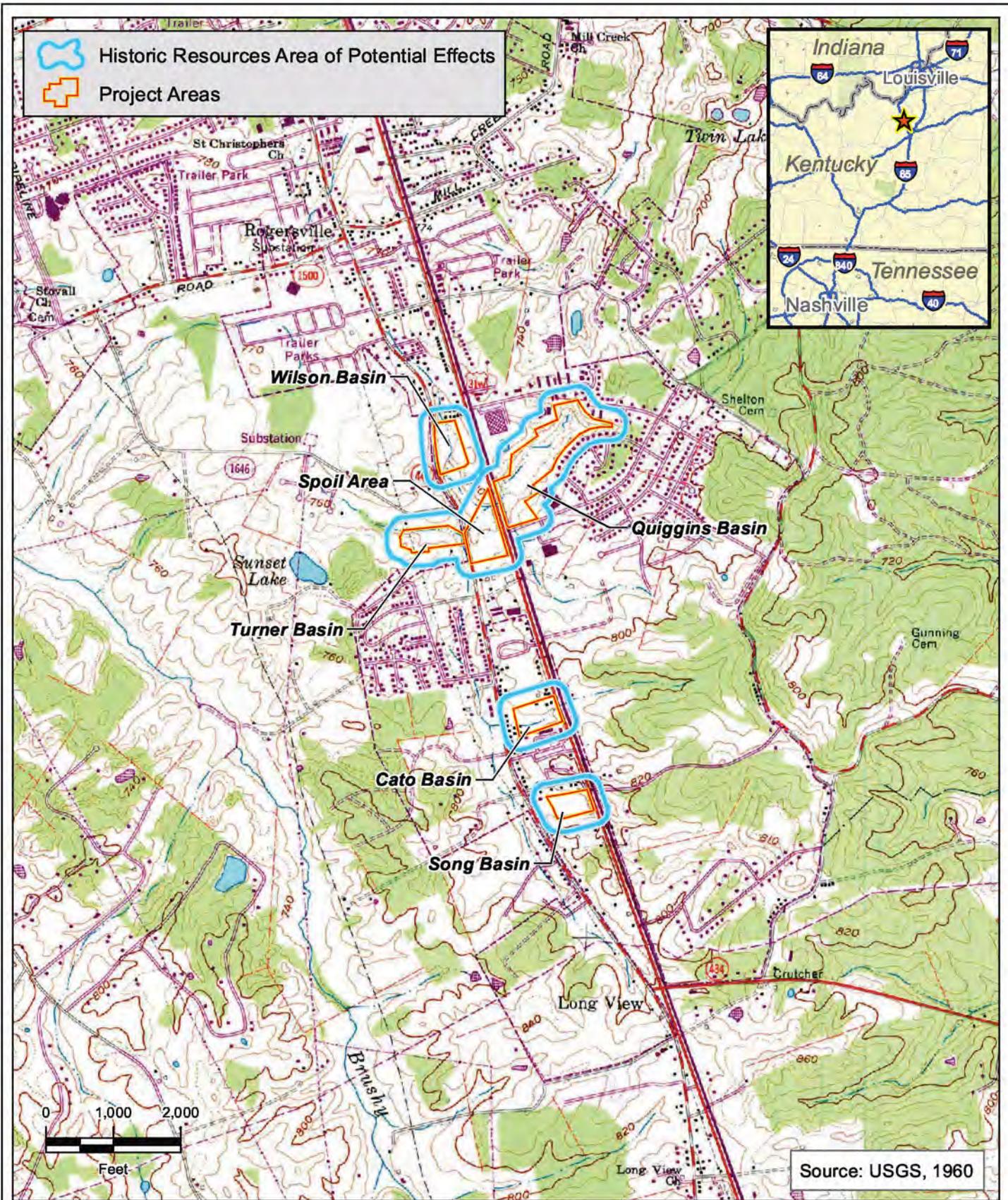
TITLE 1925 Oil and Gas Map of Hardin County, Kentucky	
 12420 Milestone Center Dr. Germantown, MD 20876	PROJ NO 15702708
	FIGURE 4-1



CLIENT FEMA Region IV					TITLE APE depicted on a portion of the 1937 General Highway Map, Hardin County, Kentucky		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY					 12420 Milestone Center Dr. Germantown, MD 20876		FIGURE 4-2	
REVISION NO	0	DES BY	KJM				03/29/13	
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<small>U:\030_A1\env\FEMA\Region IV - Quiggins Sinkhole Phase I Analysis.dwg US Data Manager\030_A1\env\FEMA\Region IV - Quiggins Sinkhole Phase I Analysis.dwg</small>				PM	SS	03/29/13		



CLIENT FEMA Region IV				TITLE 1946 USGS Map				
PROJ Happy Valley Flood Mitigation, Hardin Co., KY								
REVISION NO	0	DES BY	KJM	03/29/13		 12420 Milestone Center Dr. Germantown, MD 20876	PROJ NO	15702708
SCALE	1:24,000	CHK BY	xxx	00/00/00			FIGURE	4-3
<small>U:\030_A1\env\FEMA\Region IV - Quiggins Sinkhole Phase 1 Anchor.dwg US Data Manager.com\07.8 GISD\Projects\map_1946.km, 2013/03/29.mxd</small>				PM			SS	03/29/13



CLIENT FEMA Region IV				TITLE 1960 USGS Map		
PROJ Happy Valley Flood Mitigation, Hardin Co., KY				 12420 Milestone Center Dr. Germantown, MD 20876		
REVISION NO	0	DES BY	KJM			03/29/13
SCALE	1:24,000	CHK BY	xxx	00/00/00	FIGURE 4-4	
<small>U:\03041\FEMA\Region IV - Quiggins Sinkhole Phase I Analysis\GIS Data\Map\gcm05.8 GIS\Project\map_1960_M.R_20130229.mxd</small>				PM	SS	03/29/13

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SECTION FIVE RESEARCH DESIGN

5.1 OBJECTIVES

The objectives of the historic resource survey were to identify and document **all** above-ground resources 50 years of age or older located within the APE; evaluate their eligibility for listing in the NRHP; recommend boundaries, if eligible; and evaluate the effect of the proposed project on any properties included, or eligible for listing, in the NRHP. Background research was conducted to assist in the identification of historic structures and contextualize any resources documented as a result of the field investigations.

5.2 METHODS

The survey was conducted in accordance with the *Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation* (National Park Service [NPS] 1983). In addition, guidelines offered in the following documents were followed: *National Register Bulletin #24 Guidelines for Local Surveys: A Basis for Preservation Planning* (NPS 1985); *Kentucky Historic Resources Survey Manual* (KHC); and *Specifications for Conducting Fieldwork and Preparing Cultural Resource Assessment Reports* (Sanders 2006).

5.2.1 Research

Before entering the field, available surveys, reports, studies, maps, and other data pertinent to the project area were identified and reviewed. This task began with an investigation of the records of the KHC (FY13_1380). GIS data received from the KHC indicated that one architectural resource 50 years of age or older (HD 15) was previously identified within the APE for the proposed project.

5.2.2 Field Survey

The proposed project area encompassed six non-contiguous, irregular-shaped parcels of land adjacent to US 31W and South Wilson Road ranging in size from 1.9 to 9.7 hectares (4.6 to 24.0 acres). The APE for the survey was a 200-foot radius buffer around each of the six parcels. The CRA investigators identified all historic-age structures and buildings within the APE. Digital photographs were taken of 27 above-ground resources identified as a result of the research. The historic resources were documented on Kentucky Individual Buildings Survey Forms (Appendix A).

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SECTION SIX SURVEY RESULTS**6.1 OVERVIEW OF THE AREA OF POTENTIAL EFFECT**

The APE for the five proposed detention basins and the spoil area consists of the footprint of the six separate areas along US 31W and South Wilson Road as well as a 200-foot radius buffer zone around each area. Shelby Avenue roughly comprises the northernmost boundary, whereas Joe Prather Highway roughly comprises the southernmost boundary. Commercial development dating to the late twentieth and early twenty-first centuries comprises the entire APE along US 31W (Figure 6-1). The portion of the APE located east of US 31W is comprised of a Ranch house subdivision and several apartment complexes that were constructed circa 1970 (Figures 6-2 to 6-4). These buildings are less than 50 years old and do not meet the age or significance thresholds to merit evaluation for listing in the NRHP.

Twenty-seven historic-age resources were formally documented during the investigation (Sites 1-27 [HD 15, HD 876-901]; Figure 6-5). One historic resource, Site 1 (HD 15), the Haycraft Inn, is listed in the NRHP, and the remaining 26 six historic resources were newly identified. Kentucky Individual Buildings Survey forms for each will be submitted separately to the KHC.

6.2 SITE 1

KHC Survey #: HD 15

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 594649 N: 4185267

Property Address: 2315 S. Wilson Rd.
Radcliff, KY 40160

Owner Information: John and Teresa Emary
2315 S. Wilson Rd.
Radcliff, KY 40160

Deed: 1047-703

Construction Date: circa 1814, circa 1820

6.2.1 Description

The Haycraft Inn is located at 2315 South Wilson Road, approximately 0.09 miles north of its intersection with Shelton Road (Figure 6-5). The site comprises approximately 1.711 acres. Only a small portion of the property lies within the APE along South Wilson Road. This section exhibits a steep hill that rises from the road with numerous trees (Figure 6-6).

The inn, now a private residence, was constructed in two sections. The original, circa 1814 section is a two-story, three-bay (w/d/w), single-pile central passage house. The circa 1820 addition is a two-story, five-bay (w/w/d/w/w), single-pile central passage house (Figure 6-7). The circa 1820 section is taller than the earlier section. The north exterior wall of the circa 1814 section forms the connection between the two sections. The later section is in essence a larger version of the earlier section. Both sections are constructed of brick laid in a Flemish bond pattern and situated beneath an asphalt shingle roof. The original doors of both façade entrances



Figure 6-1. Commercial development along U.S. 31W.



Figure 6-2. Non-historic Ranch houses along Liberty Avenue.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708		
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-1 and 6-2		
REVISION NO	0	DES BY	BAK	04/17/2013	 12420 Milestone Center Dr. Germantown, MD 20876			
SCALE	N/A	DR BY	BAK	04/17/2013				
<small>110.90.4.1emif FEMA Region IV - Quiggin Sinkhole Phase 1 Archaeology/G. Reports & Deliverables/1.2 Draft Deliverables/ Figures/Phase 1AH</small>				CHK BY		SS	05/17/2013	

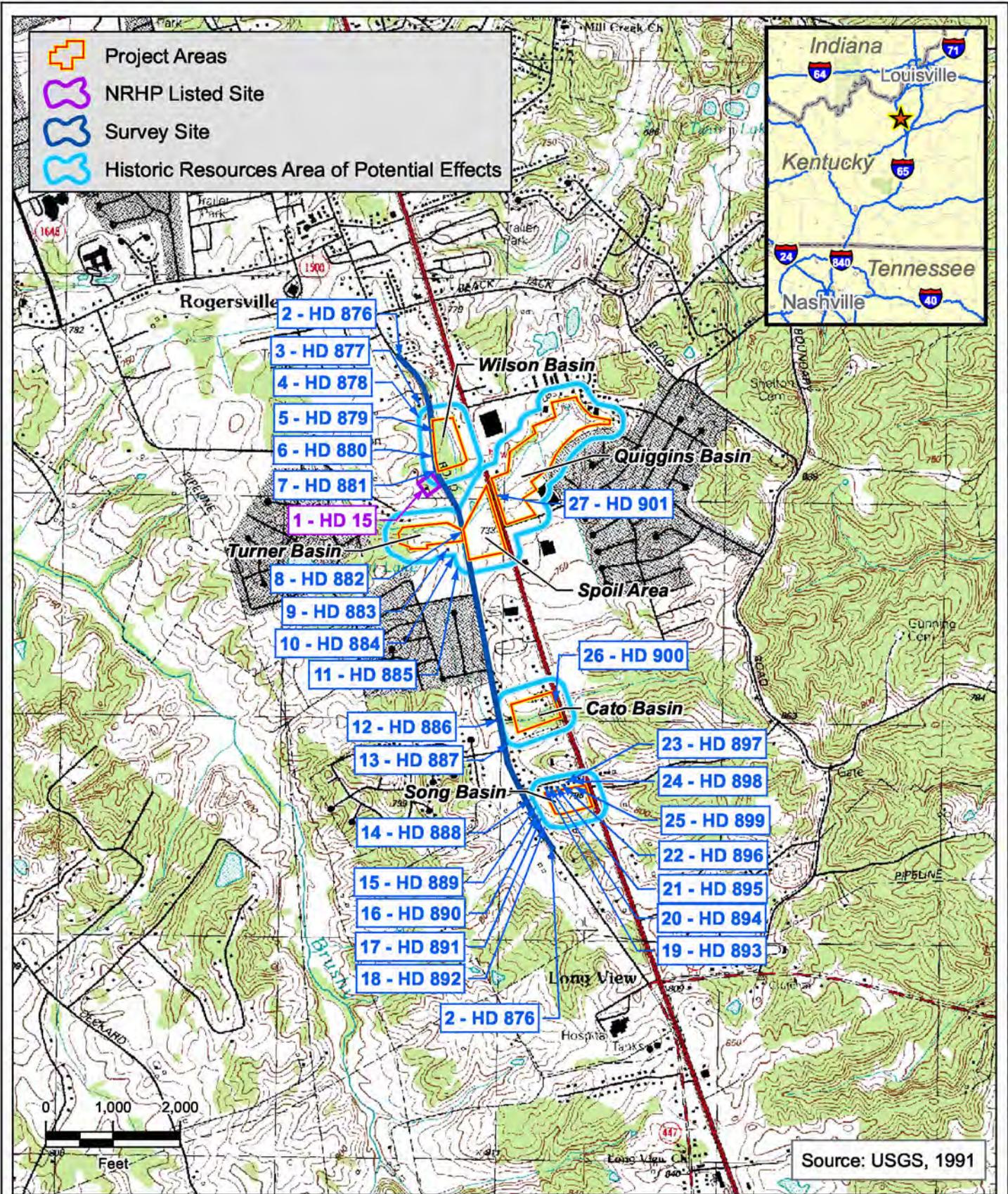


Figure 6-3. Non-historic Ranch houses along Liberty Avenue.



Figure 6-4. Non-historic development along Shelby Avenue.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-3 and 6-4	
REVISION NO	0	DES BY	BAK	04/17/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	BAK	04/17/2013			
<small>110.99.4.1emif FEMA Region IV - Quiggin Sinkhole Phase 1 Archaeology/G. Reports & Deliverables/2 Draft Deliverables/ Figures/Phase 1AH</small>		CHK BY	xx	00/00/2013			



CLIENT FEMA Region IV			
PROJ Happy Valley Flood Mitigation, Hardin Co., KY			
REVISION NO	0	DES BY	KJM 03/29/13
SCALE	1:24,000	CHK BY	xxx 00/00/00
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	TITLE Cultural Resource Locations	
	 12420 Milestone Center Dr. Germantown, MD 20876	
	PROJ NO	15702708
	FIGURE	6-5



Figure 6-6. HD 15: Overview of the Haycraft Inn property.



Figure 6-7. HD 15: Northwesterly view of the Haycraft Inn.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-6 and 6-7	
REVISION NO	0	DES BY	BAK	04/17/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	BAK	04/17/2013			
<small>11030.4.1emifEMARegion IV - Quiggin Sinkhole Phase 1 Archaeology/G. Reports & Deliverables/1.2 Draft Deliverables/Figures/Phase 1AH</small>				CHK BY		SS	05/17/2013

have been replaced with wood Craftsman doors. They open onto identical Greek Revival porches consisting of a pediment with a dentilled cornice supported by Ionic columns. These porches were added circa 1910 (Thomason 1986b:1). The porches lead into a raised grassy area enclosed by a white picket fence and a mortared rock retaining wall. Windows consist of six-over-six, double-hung wood sashes flanked by louvered shutters. Interior brick chimneys rise from the peak of the roof at the south elevation of the circa 1814 section and at the north and south elevations of the circa 1820 section.

A small, front-gabled frame addition clad with vinyl siding beneath an asphalt shingle roof at the center of the north elevation encloses a secondary entry. A large, partial-width wood deck sheltered beneath a shed roof supported by wood posts is attached to the rear elevation (Figure 6-8). The porch is enclosed with spindled wood balusters.

A small, front-gabled outbuilding is located approximately 26 feet north of the residence (Figure 6-9). It is situated on a stone foundation beneath an asphalt shingle roof and clad with vinyl siding. A wood door is located slightly west of the center of the south elevation.

A garage is located approximately 40 feet southwest of the residence (Figure 6-10). It is a one-story, front-gabled concrete block structure. A sectional garage door is located at the center of the east elevation. A side-gabled roof addition attached to the center of the north elevation shelters a poured concrete patio. This garage was constructed circa 1960 (Thomason 1986b:1).

Another circa 1960 garage is located approximately 50 feet west of the residence (Figure 6-11). It is a one-story, three-bay (d/d/d), side-gabled frame structure clad with vinyl siding beneath an asphalt shingle roof. The outer, garage bay doors consist of vinyl sectional doors, whereas the center pedestrian door is comprised of a paneled wood door with six lights.

The springhouse foundation is approximately 186 feet northeast and downhill from the residence (Figure 6-12). The foundation is composed of dry-laid stones set in a rectangle below grade. The foundation is currently being used as a retaining wall for a small pond.

A dry-laid rock retaining wall is located approximately 140 feet east and downhill from the residence, along South Wilson Road (Figure 6-13). It is constructed using thin courses of stone with flat coping.

The springhouse foundation and dry-laid rock retaining wall lie within the APE. No other structures on the Haycraft Inn property are within the APE.

6.2.2 NRHP Evaluation

Listed. Site 1 was listed in the NRHP on August 26, 1988, under Criterion A at a local significance level in the areas of transportation during circa 1840–1845, and Criterion C in the area of Architecture as a notable example of an early central passage house (Thomason 1986b:1). A summary of the NRHP nomination is included in the *Previous Investigations* section of this report. It appears there have been few changes to the property since it was listed in the NRHP. URS and CRA believe that the Haycraft Inn continues to retain enough integrity to convey its significance; thus, we concur with the eligibility determination. The current NRHP boundary encompasses the residence, structures, and parcel historically associated with the property (Figure 6-14).



Figure 6-8. HD 15: Southeasterly view of the Haycraft Inn.



Figure 6-9. HD 15: Northeasterly view of outbuilding.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-8 and 6-9	
REVISION NO	0	DES BY	BAK	04/17/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	BAK	04/17/2013			
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Figure 6-10. HD 15: Westerly view of southernmost garage.



Figure 6-11. HD 15: Westerly view of northernmost garage.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-10 and 6-11	
REVISION NO	0	DES BY	KAH	09/16/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	KAH	09/16/2013			
<small>\\1030.4.1\emf\FEMA\Region IV - Quiggin Sinkhole Phase 1 Archaeology\G. Reports & Deliverables\1.2 Draft Deliverables\Figures\Phase 1A.H</small>				CHK BY			

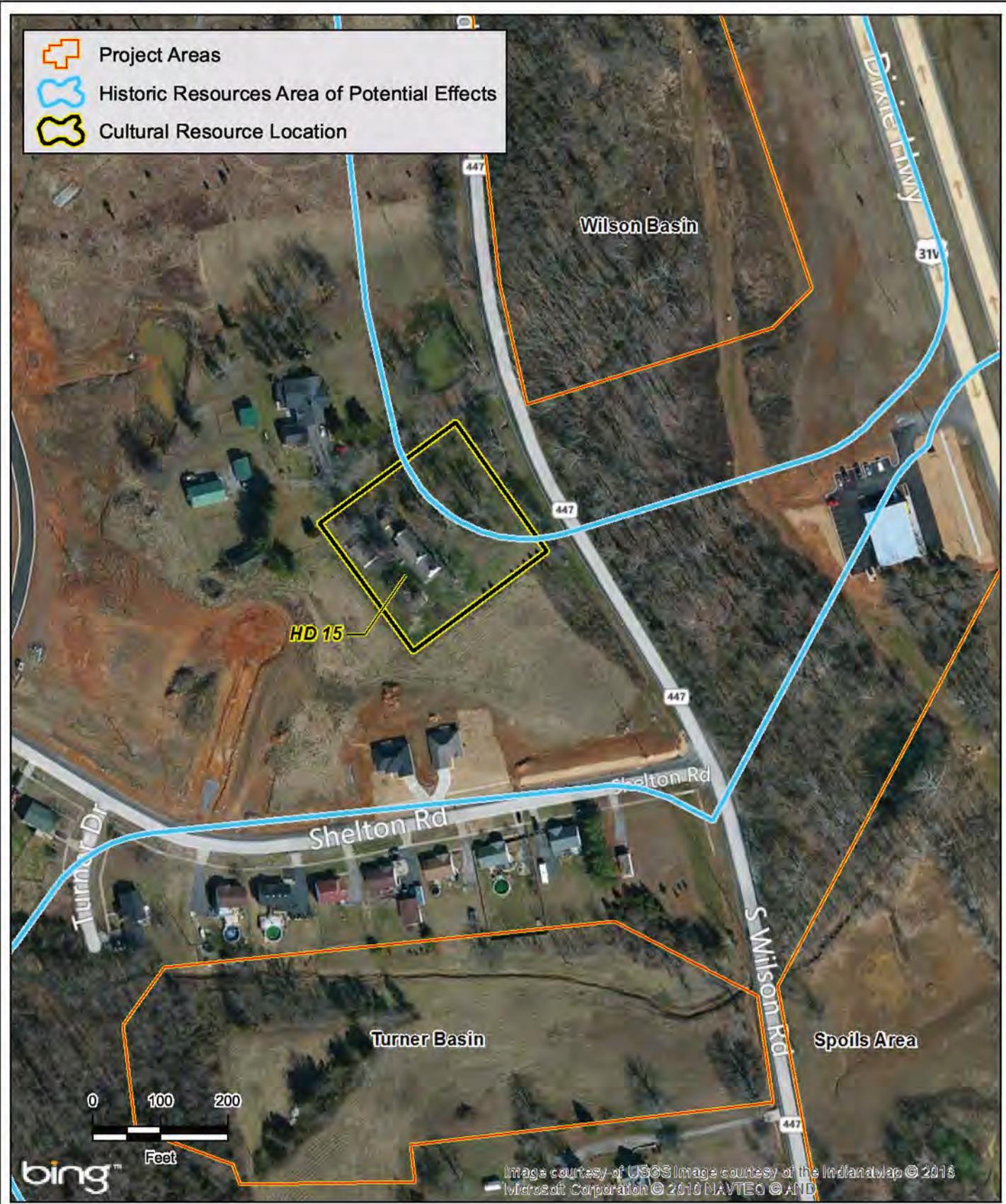


Figure 6-12. HD 15: Springhouse foundation.



Figure 6-13. HD 15: Dry-laid rock retaining wall.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708		
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						 12420 Milestone Center Dr. Germantown, MD 20876		FIGURE 6-12 and 6-13
REVISION NO	0	DES BY	KAH	09/16/2013	<small>W10.99.4.1emifEMARegion IV - Quiggin Sinkhole Phase 1 Archaeology/G. Reports & Deliverables/1.2 Draft Deliverables/ Figures/Phase 1AH</small>			
SCALE	N/A	DR BY	KAH	09/16/2013				
		CHK BY						



CLIENT FEMA Region IV					TITLE HD 15 NRHP Boundary		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						12420 Milestone Center Dr. Germantown, MD 20876		FIGURE 6-14
REVISION NO	0	DES BY	KJM			03/29/13		
SCALE	1:2,400	CHK BY	xxx	00/00/00				
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6.2.3 Determination of Effect

No Adverse Effect. While the construction of the proposed detention pond is located adjacent to the Haycraft Inn property and will introduce to the area a form of development not typical of the landscape, Site 1 is located at the western edge of the APE. The detention pond is located approximately 40 feet from the property boundary and 221 feet from the Haycraft Inn and will be visible from the residence; however, the trees lining both sides of South Wilson Road will not be removed with the construction of this project and will partially block the view of the detention pond (Figure 6-15) (T. Spalding, personal communication, February 12, 2013). Additionally, a large radio tower is located approximately 0.14 mile north of the residence and visible from the residence (Figure 6-16), which has already diminished the historic character of the area. The proposed detention pond will not further compromise the historic character of the site due to the obscuring effects of vegetation and existing visual intrusions. Thus, it is our opinion that the proposed undertaking will avoid adverse effects on the Haycraft Inn.

6.3 SITE 2

KHC Survey #: HD 876

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 594654 N: 4185631

E: 594785 N: 4185171

E: 594970 N: 4184322

Property Address: S. Wilson Rd.
Radcliff, KY 40160

Owner Information: City of Radcliff
411 W. Lincoln Trail
Radcliff, KY 40160

Deed: N/A

Construction Date: circa 1837

6.3.1 Description

The former L&N Turnpike, now known as South Wilson Road, winds north-south through the City of Radcliff, roughly parallel to US 31W. The turnpike was originally constructed using the macadamized method, in which crushed limestone formed a smooth, water-resistant roadway. It has since been paved numerous times with asphalt. No evidence of this original paving surface is visible along this segment. The drainage ditches that were originally excavated have been filled in or altered along the segment of the turnpike that lies within the APEs for the Cato Basin, Turner Basin, Wilson Basin, and the Spoil Area and adjacent, but just outside, of the APE for the Song Basin. It does not appear that the turnpike has been realigned. Most of the land adjacent to the turnpike has been developed throughout the mid- to late twentieth century (Figures 6-11 and 6-17 to 6-19).



Figure 6-15. HD 15: Northeasterly view towards proposed location of detention pond.



Figure 6-16. Large radio tower located north of the Haycraft Inn.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-15 and 6-16	
REVISION NO	0	DES BY	KAH	09/16/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	KAH	09/16/2013			
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Figure 6-17. HD876: Northerly view of South Wilson Road from the Haycraft Inn.



Figure 6-18. HD876: Shoulder of South Wilson Road.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-17 and 6-18	
REVISION NO	0	DES BY	BAK	04/17/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	BAK	04/17/2013			
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Figure 6-19. HD876: Northwesterly view of South Wilson Road near its intersection with Skyline Drive.



Figure 6-20. HD 877: Southwesterly view of residence.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708		
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						 12420 Milestone Center Dr. Germantown, MD 20876		FIGURE 6-19 and 6-20
REVISION NO	0	DES BY	BAK	04/17/2013				
SCALE	N/A	DR BY	BAK	04/17/2013				
<small>110.99.4.1 Item FEMA Region IV - Quiggin Sinkhole Phase 1 Archaeology/G. Reports & Deliverables/1.2 Draft Deliverables/ Figures/Phase 1A.H</small>				CHK BY	xx			00/00/2013

6.3.2 NRHP Evaluation

Not Eligible. The L&N Turnpike was the first improved road in this area and provided a route out of the Ohio River bottoms to the Tennessee state line. First proposed in 1825, construction began in 1837 on Section 2, which runs from the Salt River to Elizabethtown, with toll gates located every 5 miles. Tolls were 2 cents for each person, 4 cents for a horse or mule, 16 cents for a four-wheel carriage and 25 cents for a cart or wagon. Daily fare for a stagecoach trip from Louisville to Nashville was 12 dollars (Moore and Scherer 2009:8). The turnpike was constructed using the macadamized method, crushed limestone that formed a smooth, water-resistant roadway. Travelers could now travel from Louisville to Nashville in three days. Traffic reached its peak with 25 to 50 freight wagons a day, in addition to stagecoaches, carriages, and horseback riders, during the 1850s and began to decline after 1859, when the Louisville and Nashville Railroad was constructed through the area. However, the turnpike was heavily used by Union troops during the Civil War. The turnpike was replaced by the Dixie Highway in 1915 and closed in 1918 after the establishment of Camp Knox due to its proximity to artillery ranges (Kleber 1992:580; Bridges to the Past, n.d.). A portion of the turnpike on Fort Knox property was listed in the NRHP on June 13, 1996 (Bridges to the Past [Bridge #1] 2013; Schenian 1993).

This portion of the turnpike which is located within the APE is not eligible for inclusion in the NRHP under Criterion A, B, or C. It lacks the historic character and setting associated with an early nineteenth-century road. This segment exhibits none of the original paving, and the drainage ditches have been heavily altered. Additionally, only one residence associated with the turnpike's period of significance remains. All other structures located along the segment date to the mid- to late twentieth century. Consequently, we recommend that this segment of the L&N Turnpike be considered not eligible for listing in the NRHP under Criterion A, B, or C.

6.3.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.4 SITE 3

KHC Survey #: HD 877

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 594626 N: 4185615

Property Address: 2121 S. Wilson Rd.
Radcliff, KY 40160

Owner Information: Earl Taylor
2121 S. Wilson Rd.
Radcliff, KY 40160

Deed: 1301-775

Construction Date: 1941

6.4.1 Description

Site 3 is comprised of a residence and non-historic garage located at 2121 South Wilson Road, approximately 0.17 mile south of its intersection with Horseshoe Court. The structures are situated on a grassy, approximately 1.5 acre parcel that rises slightly from the road. A vinyl post and rail fence surrounds the residence and an asphalt driveway leads from the road to the residence and garage. According to the Hardin County PVA, the property dates to 1941.

The residence is a one-and-one-half-story, three-bay (w/d/w), frame American Small House clad with vinyl siding beneath a v-crimp metal roof (Figure 6-20). It is situated on a concrete block foundation. The residence comprises approximately 1318 square feet of living space.

The central, primary entry is comprised of a wood door with three lights set behind a metal storm door that opens onto a single bay concrete block porch. The front gabled porch roof is supported by brick piers and the porch is surrounded by a brick half wall with the open spaces between the wall and roof enclosed with wood latticework. Windows are comprised of one-over-one, double-hung wood sashes set behind aluminum storm windows and flanked by louvered shutters. Basement windows are comprised of aluminum fixed sashes.

A one-story, side-gabled addition is attached to the south (side) elevation and is clad with the same wall and roof material. Two vinyl windows flanked by louvered shutters are located at the east and west corners of the south elevation of the addition. Two, one-story, shed roof additions are attached to the rear elevation and are also clad with the same wall and roof material.

6.4.2 NRHP Evaluation

Not Eligible. Research has not revealed any ties to events or persons of historic significance; therefore the property is not eligible for listing in the NRHP under Criterion A or B. Additionally, the American Small House type was constructed from the 1930s to the 1950s to address increasing demand for housing and to meet FHA minimum standards. The American Small House is generally a single story in height, with a square or rectangular plan, a side-gabled roof, tightly massed, and minimal detail. The FHA minimum standard plans on which many American Small House plans were based featured houses that ranged from 534 to 750 square feet of living space (Ames and McClelland 2002: part 3). Appurtenances such as small porticoes, porches, dormers, and garages were easily and commonly incorporated into American Small Houses at an additional cost. Different stylistic elements were sometimes applied, such as Colonial Revival, Tudor Revival, or Craftsman elements.

The American Small House represented the predominant house type constructed in the United States from the mid-1930s into the early 1950s (Georgia Historic Preservation Division [GHPD] 2008). Because this house type was so predominant, examples must meet exhibit exceptional characteristics and outstanding integrity to be individually eligible for listing in the NRHP under Criterion C. The example located at Site 3 does not. It is a common example found throughout the United States dating from the mid-twentieth century. While it does retain its original door and windows, the original cladding material has been replaced, significantly compromising its integrity of association, feeling, design, materials and workmanship. The rear addition has also compromised its integrity of design, materials and workmanship. Therefore, we recommend that Site 3 is not eligible for listing in the NRHP under Criteria A, B or C.

6.4.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.5 SITE 4

KHC Survey #: HD 878

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 594628 N: 4185592

Property Address: 2137 S. Wilson Rd.
Radcliff, KY 40160

Owner Information: Paul Tibbits
2371 Blueball Rd.
Rineyville, KY 40162

Deed: N/A

Construction Date: 1946

6.5.1 Description

Site 4 is comprised of a residence and garage located at 2137 South Wilson Road, approximately 0.18 mile south of its intersection with Horseshoe Court. The structures are situated on a grassy, approximately 0.75 acre parcel that rises slightly from the road. A gravel driveway leads from the road to the garage and residence. According to the Hardin County PVA, the property dates to 1946.

The residence is a one-story, four-bay (w/d/www/w), double-pile, hip roof, frame Compact Ranch house with additions. It is clad with vinyl siding beneath an asphalt shingle roof and situated on a concrete block foundation (Figure 6-21). An interior brick chimney rises from the center of the roof above the entry. The residence is comprised of 1512 square feet of living space.

The off-center primary entry is comprised of a wood door set behind a metal screen door that opens onto a concrete stoop. Windows are comprised of six-over-six, double-hung vinyl sashes set behind metal screens. A bay window comprised of one-over-one, double-hung vinyl sashes with snap in grids is located immediately north of the primary entry. A shed porch roof supported by fluted columns is attached to the rear elevation.

A one-story, side-gabled addition is attached to the northern elevation and clad with the same wall and roof material. An interior brick chimney rises from the roof peak at the center of the addition. A secondary entry comprised of vinyl French doors that open onto wood steps is located at the center of the façade of the addition. Two, six-over-six, double-hung vinyl sash windows are located at the center of the north elevation. A shed porch roof supported by wood posts is attached to the rear elevation of the addition.

The garage is located approximately 30 feet west of the residence and is a one-story, side-gabled frame structure (Figure 6-22). It is clad with vertical wood siding beneath an asphalt shingle roof. The garage bay is open and is partially covered with a tarp and the window opening has been partially enclosed with plywood.



Figure 6-21. Southwesterly view of residence.



Figure 6-22. HD 878: Garage.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-21 and 6-22	
REVISION NO	0	DES BY	BAK	04/17/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	BAK	04/17/2013			
<small>\\1030.4.1\emf\FEMA\Region IV - Quiggin Sinkhole Phase 1 Archaeology\3. Reports & Deliverables\1.2 Draft Deliverables\Figures\Phase 1A\1</small>				CHK BY			xx

6.5.2 NRHP Evaluation

Not Eligible. Research has not linked this property to events or persons of historic significance; therefore it is not eligible for listing in the NRHP under Criterion A or B. Additionally, Ranch houses are some of the most common residential forms seen in mid-century suburbs across the country. While the style was developed out of a number of other historical styles, including Spanish Colonial Revival and traditional southwestern Ranch houses, the modern Ranch house as it is recognized today was developed by Cliff May in the 1930s. May, an untrained architect, designed his first home in 1931: a low, U-shaped residence with a central courtyard. May continued to design similar residences in California throughout the 1930s. In 1939, he designed the Riviera Ranch subdivision, made up of modern Ranch-style houses in a variety of designs. All exhibited long, low forms with open floor plans, large picture windows, and elements like sliding glass doors that were designed to unite outdoor and indoor spaces (Sullivan et al. 2010:5–11).

As the Ranch house grew in popularity and expanded across the country, various subtypes developed. These styles included simpler versions, such as compact and linear Ranches; courtyard- and half-courtyard styles; more complex plans, such as “alphabet” Ranches that exhibited V, Y, or T plans with angled wings; and Bungalow, Colonial Revival, and Western Ranches (Sullivan et al. 2010:44–55). Nearly all Ranch houses share some common features, however. The Ranch predominantly takes the single story form with side-gable or hip-roofs. In many examples the Ranch has a projecting or cross-gable. The Ranch is usually designed with small porches sheltering entry stoops or a portion of the façade. As opposed to Victorian and bungalow styles, the Ranch did not emphasize gathering in front of the home. This was replaced by the privacy of backyards and patios. The façade's fenestration is typically asymmetrical. The exterior's horizontal quality is accentuated by the low pitched roof and ribbons of windows while the interior displays an open plan for common spaces. Ribbon and large picture windows are one hallmark of this building type usually devoid of any true ornament. The exteriors of Ranch style residences are predominantly constructed of brick, although frame and clapboard variations exist. More recent versions of the style are clad in aluminum or vinyl siding. Associated with the American infatuation with the automobile, the forward-facing one- or two-car garage door became an element of the design. The Ranch gained widespread popularity as a middle class housing form in the 1940s, 1950s and 1960s as the demand for safe and modern neighborhoods and houses in which to raise families increased (Sullivan et al. 2010:16). Because this house type was so predominant, examples must meet exhibit exceptional characteristics and outstanding integrity to be individually eligible for listing in the NRHP under Criterion C.

While the Ranch house located at Site 4 exhibits several of these character-defining features, such as a single-storied form and large facade window, it is not an example of exceptional significance needed for listing in the NRHP. It exhibits elements commonly found on Ranch houses constructed from the period throughout the United States and is undistinguished in terms of its design, style, or other architectural features. The addition of replacement siding and windows and the large addition has also compromised its integrity of design, materials and workmanship. The garage is also an insignificant form. Therefore, we recommend that Site 4 is not eligible for listing in the NRHP under Criteria A, B or C.

6.5.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.6 SITE 5

KHC Survey #: HD 879

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 594668 N: 4185500

Property Address: S. Wilson Rd.
Radcliff, KY 40160

Owner Information: City of Radcliff
411 W. Lincoln Trail
Radcliff, KY 40160

Deed: N/A

Construction Date: circa 1950-1974

6.6.1 Description

Site 5 is comprised of a concrete pipe culvert located along South Wilson Road, approximately 0.25 mile south of its intersection with Horseshoe Court (Figure 6-23). It allows an unnamed tributary of Brushy Creek to pass beneath South Wilson Road. The pipe is surrounded by poured concrete, which forms the deck. Based on its form, the culvert dates to circa 1950-1974.

6.6.2 NRHP Evaluation

Not Eligible. In order to be eligible under Criterion A or B, culverts must display “a high level of integrity in relation to a historical event or broad pattern of history,” such as significant early practices of the Department of Public Roads or the Department of Highways, or with various New Deal programs (Abner 2010:118). Research does not suggest any such associations for this culvert. Culverts are important roadway elements, as they provide a means of drainage under the roadway to prevent roads from flooding. Pipe culverts are usually constructed of a semi-circular, corrugated steel pipe; concrete or earth is then placed over the metal component, forming the deck. This culvert type is one of the two most prevalent types within Kentucky (Kentucky Department of Highways 1945; Kennedy and Johnson 2005: 91, 111). The Kentucky Transportation Cabinet only documents culverts that are greater than 20 feet in length and there are likely thousands more unlisted examples below the 20-foot cutoff. Given their commonness, culverts must exhibit particularly rare or notable design characteristics and excellent integrity to be eligible for listing in the NRHP under Criterion C. While its integrity remains intact, the culvert located at Site 5 is not an exceptional example. Therefore, we recommend that Site 5 is not eligible for listing in the NRHP under Criteria A, B or C.

6.6.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.



Figure 6-23. HD 879: Pipe culvert along South Wilson Road.



Figure 6-24. HD 880: Metal pipe culvert along South Wilson Road.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-23 and 6-24	
REVISION NO	0	DES BY	BAK	04/17/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	BAK	04/17/2013			
<small>11039.4.11emifEMARegion IV - Quiggin Sinkhole Phase 1 Archaeology/G. Reports & Deliverables/2 Draft Deliverables/ Figures/Phase 1AH</small>				CHK BY			xx

6.7 SITE 6

KHC Survey #: HD 880

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 594680 N: 4185387

Property Address: S. Wilson Rd.
Radcliff, KY 40160

Owner Information: City of Radcliff
411 W. Lincoln Trail
Radcliff, KY 40160

Deed: N/A

Construction Date: circa 1925-1949

6.7.1 Description

Site 6 is comprised of a metal pipe culvert located along South Wilson Road, approximately 0.15 mile north of its intersection with Shelton Road (Figure 6-24). It allows an unnamed tributary of Brushy Creek to pass beneath South Wilson Road. The pipe is surrounded by poured concrete, forming the deck, which is deteriorated and spalling. Based on its form, the culvert dates to circa 1925-1949.

6.7.2 NRHP Evaluation

Not Eligible. In order to be eligible under Criterion A or B, culverts must display “a high level of integrity in relation to a historical event or broad pattern of history,” such as significant early practices of the Department of Public Roads or the Department of Highways, or with various New Deal programs (Abner 2010:118). Research does not suggest any such associations for this culvert. Culverts are important roadway elements, as they provide a means of drainage under the roadway to prevent roads from flooding. Pipe culverts are usually constructed of a semi-circular, corrugated steel pipe, concrete or earth is then placed over the metal component, forming the deck. This culvert type is one of the two most prevalent types within Kentucky (Kentucky Department of Highways 1945; Kennedy and Johnson 2005: 91, 111). The Kentucky Transportation Cabinet only documents culverts that are greater than 20 feet in length and there are likely thousands more unlisted examples below the 20-foot cutoff. Therefore, historic culverts must meet more stringent standards to be eligible for listing in the NRHP. While its integrity remains intact, the culvert located at Site 6 is not an exceptional example. Therefore, we recommend that Site 6 is not eligible for listing in the NRHP under Criteria A, B or C.

6.7.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.8 SITE 7

KHC Survey #: HD 881

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 594696 N: 4185327

Property Address: S. Wilson Rd.
Radcliff, KY 40160

Owner Information: City of Radcliff
411 W. Lincoln Trail
Radcliff, KY 40160

Deed: N/A

Construction Date: circa 1950-1974

6.8.1 Description

Site 7 is comprised of a small, concrete box culvert flanked by concrete wing walls along South Wilson Road, bordering Site 1 and approximately 0.11 mile north of its intersection with Shelton Road (Figure 6-25). It allows the water from the spring located on Site 1 to pass beneath South Wilson Road. The concrete is deteriorated, exhibiting spalling, with rebar visible in the wing wall. A description of the dry-laid rock wall located adjacent to the culvert is located within the description for Site 1. Based on its form, the culvert dates to circa 1950-1974.

6.8.2 NRHP Evaluation

Not Eligible. In order to be eligible under Criterion A or B, culverts must display “a high level of integrity in relation to a historical event or broad pattern of history,” such as significant early practices of the Department of Public Roads or the Department of Highways, or with various New Deal programs (Abner 2010:118). Research does not suggest any such associations for this culvert. Concrete box culverts were initially utilized on American Highways during the first decade of the twentieth century, and followed a development similar to that of slab bridges. Box culverts are best suited for minor or seasonal streams, or locations where the height of the structure is restricted. They can be placed in trenches, and require little form or foundation work, making them an economical and practical option (Lichtenstein Consulting Engineers 2000: 221-222). Culverts are important roadway elements, as they provide a means of drainage under the roadway to prevent roads from flooding. They were generally constructed of native stone, sometimes concrete. Two types of culverts were most prevalent: the box culvert and the pipe culvert. The box culvert often acts as a mini-bridge, supporting a span up to 20 feet in length (Kentucky Department of Highways 1945; Kennedy and Johnson 2005: 91, 111). The box culvert is ubiquitous throughout Kentucky, and is, according to Amanda Abner, the state’s most common bridge type built before 1960 (Abner 2010:116). With 1,845 extant box culverts over 20 feet in length listed in the Kentucky bridge database (Abner 2010:116), and likely thousands more unlisted examples below the 20-foot cutoff, historic box culverts must meet more stringent standards to be eligible for listing in the NRHP. The box culvert located at Site 7 is not an exceptional example and its deterioration has compromised its integrity. Therefore, we recommend that Site 7 is not eligible for listing in the NRHP under Criteria A, B or C.

6.8.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.



Figure 6-25. HD 881: Box culvert along South Wilson Road.



Figure 6-26. HD 882: Box culvert along South Wilson Road.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-25 and 6-26	
REVISION NO	0	DES BY	KAH	09/16/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	KAH	09/16/2013			
<small>110.99.4.1emifEMARegion IV - Quiggin Sinkhole Phase I Archaeology/G. Reports & Deliverables/1.2 Draft Deliverables/ Figures/Phase IAH</small>		CHK BY	xx	00/00/2013			

6.9 SITE 8

KHC Survey #: HD 882

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 594696 N: 4185327

Property Address: S. Wilson Rd.
Radcliff, KY 40160

Owner Information: City of Radcliff
411 W. Lincoln Trail
Radcliff, KY 40160

Deed: N/A

Construction Date: circa 1950-1974

6.9.1 Description

Site 8 is comprised of a concrete box culvert flanked by concrete wing walls along South Wilson Road, approximately 0.1 mile south of its intersection with Shelton Road (Figure 6-26). It allows the water from an unnamed tributary of Brushy Creek to pass beneath South Wilson Road. The concrete is deteriorated, exhibiting spalling and cracking along the wing walls. Based on its form, the culvert dates to circa 1950-1974.

6.9.2 NRHP Evaluation

Not Eligible. In order to be eligible under Criterion A or B, culverts must display “a high level of integrity in relation to a historical event or broad pattern of history,” such as significant early practices of the Department of Public Roads or the Department of Highways, or with various New Deal programs (Abner 2010:118). Research does not suggest any such associations for this culvert. Concrete box culverts were initially utilized on American Highways during the first decade of the twentieth century, and followed a development similar to that of slab bridges. Box culverts are best suited for minor or seasonal streams, or locations where the height of the structure is restricted. They can be placed in trenches, and require little form or foundation work, making them an economical and practical option (Lichtenstein Consulting Engineers 2000: 221-222). Culverts are important roadway elements, as they provide a means of drainage under the roadway to prevent roads from flooding. They were generally constructed of native stone, sometimes concrete. Two types of culverts were most prevalent: the box culvert and the pipe culvert. The box culvert often acts as a mini-bridge, supporting a span up to 20 feet in length (Kentucky Department of Highways 1945; Kennedy and Johnson 2005: 91, 111). The box culvert is ubiquitous throughout Kentucky, and is, according to Amanda Abner, the state’s most common bridge type built before 1960 (Abner 2010:116). With 1,845 extant box culverts over 20 feet in length listed in the Kentucky bridge database (Abner 2010:116), and likely thousands more unlisted examples below the 20-foot cutoff, historic box culverts must meet more stringent standards to be eligible for listing in the NRHP. The box culvert located at Site 8 is not an exceptional example and its deterioration has compromised its integrity. Therefore, we recommend that Site 8 is not eligible for listing in the NRHP under Criteria A, B or C.

6.9.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.10 SITE 9

KHC Survey #: HD 883

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 594754 N: 4184985

Property Address: 2483 S. Wilson Rd.
Radcliff, KY 40160

Owner Information: Robert and Sandra Bousym
2483 S. Wilson Rd.
Radcliff, KY 40160

Deed: 1149-745

Construction Date: 1941

6.10.1 Description

Site 9 is comprised of a residence and box culvert located at 2483 South Wilson Road, approximately 0.10 mile south of its intersection with Shelton Road. The structures are situated on a grassy, approximately 1.68 acre parcel that slopes upward from the road, with the residence situated atop the rise. An unnamed tributary of Brushy Creek runs along the road and forms the property's eastern boundary. A long, approximately 232 feet gravel driveway leads from the road to the residence, with brick lamp posts framing the driveway along the creek. Based on the Hardin County PVA, the residence dates to 1941.

The residence is a one-and-one-half-story, three-bay (www/d/www), double-pile, frame side-gabled house, situated on a concrete block foundation and clad with vinyl siding beneath an asphalt shingle roof (Figure 6-27). Front-gabled dormers extend from the slope of the roof at the northern and southern corners and an exterior brick chimney is attached to the eastern corner of the south (side) elevation and extends above the slope of the roof. The recessed, full length open porch has been enclosed with vinyl siding. The residence comprises approximately 1432 square feet of living space.

The central, primary entry is comprised of a vinyl door with a stained glass window that opens onto concrete steps. Windows consist of one-over-one, double-hung vinyl sashes with snap in grids, with the façade windows comprised of twelve light, vinyl picture windows flanked by six light casement sashes.

The concrete box culvert flanked by concrete wing walls is located adjacent to South Wilson Road and forms part of the driveway (Figure 6-28). It allows the unnamed tributary of Brushy Creek to pass beneath.

6.10.2 NRHP Evaluation

Not Eligible. Research has not tied this property to events or persons of historic significance; therefore it is not eligible for listing in the NRHP under Criterion A or B. Additionally, the residence located at Site 9 is an undistinguished building form that lacks the significance



Figure 6-27. HD 883: Westerly view of residence.



Figure 6-28. HD 883: Box culvert forming part of the driveway.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY							
REVISION NO	0	DES BY	KAH	09/16/2013	 12420 Milestone Center Dr. Germantown, MD 20876		FIGURE
SCALE	N/A	DR BY	KAH	09/16/2013			6-27 and 6-28
<small>110.99.4.1 Item FEMA Region IV - Quiggin Sinkhole Phase 1 Archaeology/G. Reports & Deliverables/1.2 Draft Deliverables/ Figures/Phase 1 AH</small>				CHK BY			

necessary for inclusion in the NRHP under Criterion C. It is not of a specific style or significant design nor does it represent a significant construction method. The addition of replacement siding and doors, as well as the enclosure of the open porch, has compromised its integrity of design, materials and workmanship. The concrete box culvert is an extremely common bridge form and therefore must demonstrate exceptional significance and integrity to be eligible for listing in the NRHP. This box culvert is not an exceptional example and is part of a driveway, not a major road. Therefore, we recommend that Site 9 is not eligible for listing in the NRHP under Criteria A, B or C.

6.10.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.11 SITE 10

KHC Survey #: HD 884

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 594761 N: 4184953

Property Address: 2499 S. Wilson Rd.
Radcliff, KY 40160

Owner Information: Carl and Barbara Wiseman
2499 S. Wilson Rd.
Radcliff, KY 40160

Deed: 1007-614

Construction Date: 1963

6.11.1 Description

Site 10 is comprised of a residence and a poured concrete slab bridge located at 2499 South Wilson Road, approximately 0.08 mile north of its intersection with Fairmont Drive. The structures are situated on a grassy, approximately 1.19 acre parcel that slopes upward from the road, with the residence situated atop the rise. An unnamed tributary of Brushy Creek runs along the road and forms the property's eastern boundary. A long, approximately 237 feet gravel driveway leads from the road to the residence. Based on the Hardin County PVA, the residence dates to 1963.

The residence is a one-story, four-bay (w/w/d/www), double-pile, frame Compact Ranch house, clad with a brick veneer beneath an asphalt shingle roof (Figure 6-29). It is situated on a poured concrete foundation and is situated into the hillside so that the southern elevation of the foundation is above grade and functions as a garage. An exterior concrete block chimney is attached to the center of the south elevation. The residence comprises approximately 1340 square feet of living space.

The off-center primary entry is comprised of a paneled vinyl door with a large faceted oval window that opens onto a two-bay poured concrete porch sheltered beneath a shed roof which is supported by metal columns. Windows are comprised of vinyl, sliding sashes with snap in grids flanked by louvered shutters. The large picture window located north of the entry is flanked by



Figure 6-29. HD 884: Northwesterly view of residence.



Figure 6-30. HD 884: Concrete slab bridge forming part of the driveway.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-29 and 6-30	
REVISION NO	0	DES BY	KAH	09/16/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	KAH	09/16/2013			
<small>11030.4.11emifEMARegion IV - Quiggin Sinkhole Phase 1 Archaeology/G. Reports & Deliverables/1.2 Draft Deliverables/ Figures/Phase 1AH</small>		CHK BY					

vinyl, fifteen light casement sashes and the entire window configuration is flanked by louvered shutters. The garage opening is fronted by a sectional garage door.

The poured concrete slab bridge is located adjacent to South Wilson Road and forms part of the driveway (Figure 6-30). It allows the unnamed tributary of Brushy Creek to pass beneath. The bridge is set upon poured concrete abutments and flanked by concrete wing walls. A metal railing lines both sides of the deck.

6.11.2 NRHP Evaluation

Not Eligible. Research has not tied this property to events or persons of historic significance; therefore it is not eligible for listing in the NRHP under Criterion A or B. Additionally, Ranch houses are some of the most common residential forms seen in mid-century suburbs across the country; therefore they must exhibit exceptional characteristics and outstanding integrity to be individually eligible for listing in the NRHP. While the Ranch house located at Site 10 exhibits several character defining features, such as single storied, side-gabled form and a large picture window, it is not an example of exceptional significance needed for listing in the NRHP. The addition of replacement windows and door has compromised its integrity of design, materials and workmanship. In addition, the concrete slab bridge is one of the most common bridge types for small crossings and must meet more stringent standards for consideration for the NRHP. This bridge functions as part of a driveway and not a major road and is not a significant example. Therefore, we recommend that Site 10 is not eligible for listing in the NRHP under Criteria A, B or C.

6.11.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.12 SITE 11

KHC Survey #: HD 885

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 594768 N: 4184913

Property Address: 2529 S. Wilson Rd.
Radcliff, KY 40160

Owner Information: Howard and Gladys Mills
224 Seminole Rd.
Elizabethtown, KY 42701

Deed: 567-230

Construction Date: 1954

6.12.1 Description

Site 11 is comprised of a residence, garage and concrete slab bridge located at 2529 South Wilson Road, approximately 0.06 mile north of its intersection with Fairmont Drive. The structures are situated on a grassy, approximately 1.8 acre parcel, with the residence situated atop a small rise. An unnamed tributary of Brushy Creek runs along the road and forms the property's

eastern boundary. A long, approximately 236 feet gravel driveway leads from the road to the residence and garage. Based on the Hardin County PVA, the residence dates to 1954.

The residence is a one-and-one-half-story, three-bay (www/d/w), double-pile, frame American Small House with a front-gabled projection attached to the northern corner of the façade and a large addition attached to the south elevation (Figure 6-31). It is clad with vinyl siding beneath an asphalt shingle roof and situated on a concrete block foundation. An interior brick chimney extends from the slope of the roof at its center. The residence comprises approximately 1833 square feet of living space.

The off-center primary entry, located at the center of the original residence is comprised of a wood paneled door set behind an aluminum screen door that opens into a concrete stoop with concrete steps leading up to it. A metal railing runs around the edge of the stoop and steps. Windows consist of two-over-two, double-hung aluminum sashes set behind aluminum storm windows located within the northernmost bay and one-over-one, double-hung vinyl sash windows set behind metal screens located within the remaining bays. Paired two-over-two, double-hung aluminum sash windows are located at the center of the front-gabled dormer located at the center of the roof.

The large addition attached to the south (side) elevation doubles the footprint of the original residence, with a one-over-one, double-hung vinyl sash window is located within the southernmost bay of the façade and three one-over-one, double-hung vinyl sash windows located within the northernmost bay. A single garage bay fronted by a sectional garage door is located at the eastern corner of the south (side) elevation, and a pedestrian entry comprised of a vinyl door with nine lights is located at the western corner.

The garage is located approximately 148 feet west of the residence. It is a one-story, side-gabled frame structure, clad with vinyl siding beneath an asphalt shingle roof (Figure 6-32). Three garage bays on the east elevation are fronted by sectional garage doors. A pedestrian entry is located at the eastern corner of the north elevation.

The poured concrete slab bridge is located adjacent to South Wilson Road and forms part of the driveway (Figure 6-33). It allows the unnamed tributary of Brushy Creek to pass beneath. The bridge is set upon poured concrete abutments and flanked by concrete wing walls. A poured concrete curb runs along the north and south sides of the bridge. The bridge is lined by low concrete curbs and lacks railings.

6.12.2 NRHP Evaluation

Not Eligible. Research has not linked this property to events or persons of historic significance; therefore it is not eligible for listing in the NRHP under Criterion A or B. Additionally, the American Small House was one of the most common post war housing forms across the country; therefore they must exhibit exceptional characteristics and outstanding integrity to be individually eligible for listing in the NRHP. The example located at Site 11 does not. It has been significantly altered with the addition of replacement siding and windows, as well as the large addition to the south elevation, compromising its integrity of design, materials and workmanship. In addition, the concrete slab bridge is one of the most common bridge types for small crossings and must meet more stringent standards for consideration for the NRHP. This bridge functions as part of a driveway and not part of a major road and is not a significant example. Therefore, we recommend that Site 11 is not eligible for listing in the NRHP under Criteria A, B or C.



Figure 6-31. HD 885: Westerly view of residence.



Figure 6-32. HD 885: Westerly view of garage.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-31 and 6-32	
REVISION NO	0	DES BY	KAH	09/16/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	KAH	09/16/2013			
<small>\\1030.4.1\emf\FEMA\Region IV - Quiggin Sinkhole Phase I Archaeology\3. Reports & Deliverables\1.2 Draft Deliverables\Figures\Phase I.AH</small>				CHK BY			



Figure 6-33. HD 885: Concrete slab driveway forming part of the driveway.



Figure 6-34. HD 886: Box culvert along South Wilson Road.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-33 and 6-34	
REVISION NO	0	DES BY	KAH	09/16/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	KAH	09/16/2013			
<small>110.99.4.11emifEMARegion IV - Quiggin Sinkhole Phase I Archaeology/G. Reports & Deliverables/1.2 Draft Deliverables/ Figures/Phase IAH</small>				CHK BY			

6.12.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.13 SITE 12

KHC Survey #: HD 886

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 594989 N: 4184202

Property Address: S. Wilson Rd.
Radcliff, KY 40160

Owner Information: City of Radcliff
411 W. Lincoln Trail
Radcliff, KY 40160

Deed: N/A

Construction Date: circa 1950-1974

6.13.1 Description

Site 12 is comprised of a concrete box culvert flanked by concrete wing walls along South Wilson Road, approximately 0.08 mile north of its intersection with Skyline Drive (Figure 6-34). It allows the water from an unnamed tributary of Brushy Creek to pass beneath South Wilson Road. It exhibits minor spalling along the top edge of the deck and wing walls. Based on its form, the culvert dates to circa 1950-1974.

6.13.2 NRHP Evaluation

Not Eligible. In order to be eligible under Criterion A or B, culverts must display “a high level of integrity in relation to a historical event or broad pattern of history,” such as significant early practices of the Department of Public Roads or the Department of Highways, or with various New Deal programs (Abner 2010:118). Research does not suggest any such associations for this culvert. The concrete box culvert is an extremely common bridge form; and therefore must demonstrate exceptional significance and integrity to be eligible for listing in the NRHP. The box culvert located at Site 12 is not an exceptional example because it is undistinguished by size, number of barrels, or ornamentation. Therefore, we recommend that Site 12 is not eligible for listing in the NRHP under Criteria A, B or C.

6.13.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.14 SITE 13**KHC Survey #:** HD 887**Zone:** 16**Quad:** Vine Grove, KY 1991**UTMs:** E: 595044 N: 4184095**Property Address:** 2930 S. Wilson Rd.
Radcliff, KY 40160**Owner Information:** Melvin Compton
2930 S. Wilson Rd.
Radcliff, KY 40160**Deed:** 561-321**Construction Date:** 1949**6.14.1 Description**

Site 13 is comprised of a residence, garage and culvert located at 2930 South Wilson Road, on the eastern side of its intersection with Skyline Drive. A prefabricated shed is also associated with the property. The structures are situated on a level, grassy approximately 0.41 acre parcel. An asphalt driveway leads from the road to the residence and garage. Brick piers frame the driveway at the entrance to the property. The southern pier is extremely deteriorated and on the verge of collapse. According to the Hardin County PVA, the residence dates to 1949.

The residence is a one-and-one-half-story, three-bay (ww/d/ww/d), double-pile, frame American Small House, situated on a concrete block foundation beneath an asphalt shingle roof (Figure 6-35). The façade is clad with vertical wood siding, while the south (side) elevation is clad with particle board and aluminum siding. The residence comprises approximately 1176 square feet of living space.

The central primary entry is comprised of a vinyl replacement door with an oval light that opens onto a single bay concrete porch sheltered beneath a front-gabled porch roof supported by metal columns. Windows are comprised of one-over-one, double-hung vinyl sashes with snap in grids. A recessed, secondary entry is located at the southern corner of the façade and is comprised of a vinyl paneled door with nine lights.

The garage is located approximately 68 feet east of the residence and is a one-story, flat roof frame structure, clad with asbestos siding (Figure 6-36). It is situated on a concrete block foundation beneath a metal panel roof. The garage bay is fronted with plywood. A pedestrian entry is located at the southern corner of the western elevation and is comprised of a wood paneled door and a window opening located at the northern corner of the western elevation has been enclosed with dimensional lumber. The structure is deteriorated, with the northern half of the roof missing and the garage door collapsing into the structure.

The concrete block box culvert is located at the western property boundary and functions as part of the driveway (Figure 6-37). It allows drainage to pass beneath. Portions of the culvert have been parged with concrete.



Figure 6-35. HD 887: Easterly view of residency.



Figure 6-36. HD 887: Westerly view of garage.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-35 and 6-36	
REVISION NO	0	DES BY	KAH	09/16/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	KAH	09/16/2013			
<small>110.99.4.1emif FEMA Region IV - Quiggin Sinkhole Phase 1 Archaeology/G. Reports & Deliverables/1.2 Draft Deliverables/ Figures/Phase 1AH</small>				CHK BY			



Figure 6-37. HD 887: Concrete block box culvert forming part of the driveway.



Figure 6-38. HD 888: Easterly view of residence and garage.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-37 and 6-38	
REVISION NO	0	DES BY	KAH	09/16/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	KAH	09/16/2013			
<small>1110.99.4.11emif FEMA Region IV - Quiggins Sinkhole Phase I Archaeology/G. Reports & Deliverables/1.2 Draft Deliverables/ Figures/Phase I.AH</small>				CHK BY			

6.14.2 NRHP Evaluation

Not Eligible. Research has not tied this property to events or persons of historic significance; therefore it is not eligible for listing in the NRHP under Criterion A or B. Additionally, the American Small House was one of the most common post war housing forms across the country; therefore they must exhibit exceptional characteristics and outstanding integrity to be individually eligible for listing in the NRHP. The example located at Site 13 does not. It has been altered with the addition of replacement siding, windows and doors, compromising its integrity of design, materials and workmanship. In addition, the box culvert is an extremely common bridge form and therefore must demonstrate exceptional significance and integrity to be eligible for listing in the NRHP. This example functions as part of a driveway and not part of a major road and is not a significant example. Therefore, we recommend that Site 13 is not eligible for listing in the NRHP under Criteria A, B or C.

6.14.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.15 SITE 14

KHC Survey #: HD 888

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 595153 N: 4183842

Property Address: 3160 S. Wilson Rd.
Radcliff, KY 40160

Owner Information: Joe Peace
3160 S. Wilson Rd.
Radcliff, KY 40160

Deed: 1014-004

Construction Date: 1950

6.15.1 Description

Site 14 is comprised of a residence and garage located at 3160 South Wilson Road, approximately 0.04 mile south of its intersection with Nalls Lane. The structures are situated on a grassy, approximately .69 acre parcel that rises slightly from the road. An asphalt driveway leads from the road to the residence and garage. According to the Hardin County PVA, the residence dates to 1950.

The residence is a one-story, three-bay (w/d/www), double-pile, side-gabled frame American Small house with attached garage, clad with vinyl siding beneath an asphalt shingle roof (Figure 6-38). It is situated on a concrete block foundation. The residence comprises approximately 729 square feet of living space.

The central, primary entry is comprised of a wood paneled door set behind a metal security door that opens onto concrete stoop. Windows are comprised of two-over-two, double-hung wood sashes set behind aluminum storm windows. The southernmost bay is comprised of a large wood

picture window flanked by smaller two-over-two, double-hung wood sashes. The garage is connected by a one-story, side-gabled breezeway where an identical secondary entry is located.

The garage is a one-story, front-gabled frame structure, also clad with vinyl siding beneath an asphalt shingle roof and situated on a concrete block foundation. The single garage bay is fronted by a segmental garage door.

6.15.2 NRHP Evaluation

Not Eligible. Research has not linked this property to events or persons of historic significance; therefore it is not eligible for listing in the NRHP under Criterion A or B. Additionally, the American Small House was one of the most common post war housing forms across the country; therefore they must exhibit exceptional characteristics and outstanding integrity to be individually eligible for listing in the NRHP. The example located at Site 16 does not. The addition of replacement siding and doors has compromised its integrity of design, materials and workmanship. Therefore, we recommend that Site 14 is not eligible for listing in the NRHP under Criteria A, B or C.

6.15.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.16 SITE 15

KHC Survey #: HD 889

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 595165 N: 4183802

Property Address: 3184 S. Wilson Rd.
Radcliff, KY 40160

Owner Information: Teresa Dekalands
3184 S. Wilson Rd.
Radcliff, KY 40160

Deed: 816-445

Construction Date: 1950

6.16.1 Description

Site 15 is comprised of a residence and garage located at 3184 South Wilson Road, approximately 0.07 mile south of its intersection with Nalls Lane. The structures are situated on a grassy, approximately 1.01 acre parcel that rises slightly from the road. A concrete driveway leads from the road to the residence. According to the Hardin County PVA, the residence dates to 1950.

The residence is a one-and-one-half-story, three-bay (w/w/w), double-pile, frame American Small House with a large addition attached to its south (side) elevation (Figure 6-39). It is situated on a concrete block foundation and clad with vinyl siding beneath an asphalt shingle roof. The front-gabled central porch has been enclosed with vinyl siding. The residence comprises approximately 3273 square feet of living space.



Figure 6-39. HD 889: Southeasterly view of residence.



Figure 6-40. HD 889: Easterly view of garage.

CLIENT FEMA Region IV					TITLE Project Photographs	PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-39 and 6-40	
REVISION NO	0	DES BY	KAH	09/16/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	KAH	09/16/2013			
<small>\\1030.4.1\emf\FEMA\Region IV - Quiggin Sinkhole Phase 1 Archaeology\G. Reports & Deliverables\1.2 Draft Deliverables\Figures\Phase 1A.H</small>							
		CHK BY					

The primary entry is located at the center of the north elevation of the enclosed central porch and is comprised of a vinyl door with nine lights that opens onto concrete steps. Windows are comprised of one-over-one, double-hung vinyl sashes with snap in grids flanked by louvered shutters. One-over-one, double-hung vinyl sashes with snap in grids are located at the center of front-gabled dormers located at the north and south corners of the roof.

A large, two-story, two-bay (w/w), double-pile frame addition is attached to the south elevation and clad with the same wall and roof material. A secondary entry comprised of a vinyl paneled door that opens onto a wood deck is located at the center of the south elevation of the addition. Windows are identical to the original residence.

The garage is located approximately 16 feet east of the residence and is a one-story, front-gabled frame structure, clad with vinyl siding beneath an asphalt shingle roof (Figure 6-40). The garage bay was open at the time of the survey.

6.16.2 NRHP Evaluation

Not Eligible. Research has not tied this property to events or persons of historic significance; therefore it is not eligible for listing in the NRHP under Criterion A or B. Additionally, the American Small House was one of the most common post war housing forms across the country; therefore they must exhibit exceptional characteristics and outstanding integrity to be individually eligible for listing in the NRHP. The example located at Site 15 does not. It has been significantly altered with the addition of replacement siding, windows and doors, as well as the large addition to the south elevation and enclosed façade porch, compromising its integrity of design, materials and workmanship. The garage is also not a significant example and is representative of outbuildings dating to its period of construction. Therefore, we recommend that Site 15 is not eligible for listing in the NRHP under Criteria A, B or C.

6.16.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.17 SITE 16

KHC Survey #: HD 890

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 595186 N: 4183771

Property Address: 3208 S. Wilson Rd.
Radcliff, KY 40160

Owner Information: Sabrina Lowe and Ray Pinkham
3208 S. Wilson Rd.
Radcliff, KY 40160

Deed: 1347-985

Construction Date: 1950

6.17.1 Description

Site 16 is comprised of a residence and garage located at 3208 South Wilson Road, approximately 0.1 mile north of its intersection with Joe Prather Highway. The structures are situated on a grassy, approximately .608 acre parcel that rises slightly from the road. A gravel driveway leads from the road to the residence and garage. According to the Hardin County PVA, the residence dates to 1950.

The residence is a one-and-one-half-story, four-bay (w/w/d/ww), double-pile, side-gabled frame house, situated on a concrete block foundation beneath an asphalt shingle roof (Figure 6-41). It is clad with vinyl siding. An interior brick chimney rises above the slope of the roof at the western corner of the south elevation. The residence comprises approximately 1266 square feet of living space.

The off-center primary entry is comprised of a vinyl paneled door with an oval light that opens onto a wood porch sheltered beneath a shed porch roof supported by wood posts. Façade windows are comprised of one-over-one, double-hung vinyl sashes with snap in grids and secondary windows are comprised of six-over-six, double-hung vinyl sashes. An enclosed porch is attached to the south (side) elevation, enclosed with vinyl siding and situated on brick piers that have been enclosed with poured concrete. A shed roof porch supported by wood posts spans the full length of the rear elevation.

The garage is located approximately 37 feet east of the residence and is a one-story, front-gabled frame structure, clad with weatherboard beneath a metal paneled roof (Figure 6-42). A garage bay, fronted by hinged plywood doors is located at the southern corner of the west elevation. A pedestrian entry comprised of a wood paneled door is located north of the garage bay. A shed roof frame addition is attached to the north elevation, clad with composite siding and is fronted by hinged doors.

6.17.2 NRHP Evaluation

Not Eligible. Research has not linked this property to events or persons of historic significance; therefore it is not eligible for listing in the NRHP under Criterion A or B. Additionally, the residence located at Site 16 is an undistinguished building form that lacks the significance necessary for inclusion in the NRHP under Criterion C. It is not of a specific style or significant design nor does it represent a significant construction method. The addition of replacement siding, windows and doors has compromised its integrity of design, materials and workmanship. Therefore, we recommend that Site 16 is not eligible for listing in the NRHP under Criteria A, B or C.

6.17.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.



Figure 6-41. HD 890: Northeasterly view of residence.



Figure 6-42. HD 890: Easterly view of garage.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-41 and 6-42	
REVISION NO	0	DES BY	KAH	09/16/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	KAH	09/16/2013			
<small>\\10.90.4.11\mif\FEMA\Region IV - Quiggin Sinkhole Phase 1 Archaeology\G. Reports & Deliverables\1.2 Draft Deliverables\Figures\Phase 1A.H</small>				CHK BY			

6.18 SITE 17**KHC Survey #:** HD 891**Zone:** 16**Quad:** Vine Grove, KY 1991**UTMs:** E: 595199 N: 4183750**Property Address:** 3224 S. Wilson Rd.
Radcliff, KY 40160**Owner Information:** William Amburn
3224 S. Wilson Rd.
Radcliff, KY 40160**Deed:** 271-114**Construction Date:** 1954**6.18.1 Description**

Site 17 is comprised of a residence and garage located at 3224 South Wilson Road, approximately 0.08 mile north of its intersection with Joe Prather Highway. The structures are situated on a grassy, hilly, approximately 0.5 acre parcel. A concrete driveway leads from the road to the garage. According to the Hardin County PVA, the residence dates to 1954.

The residence is a one-story, three-bay (w/d/www), double-pile, hip roof frame Bungalow Ranch house, clad with a flagstone veneer beneath an asphalt shingle roof (Figure 6-43). It is situated on a concrete block foundation. The residence comprises approximately 816 square feet of living space.

The central, primary entry is comprised of a wood door with three lights set behind a metal storm door that opens onto a single bay concrete porch. A metal awning shelters the entry and metal railings border the north and south sides of the porch. Windows are comprised of two-over-two, double-hung wood sashes set behind aluminum storm windows. A large wood picture window is located within the southernmost bay and is flanked by smaller, two-over-two, double-hung sashes. The façade windows are sheltered beneath metal awnings. A metal railing borders a rectangular area, possibly a patio, adjacent to the south (side) elevation.

The garage is located approximately 42 feet southeast of the residence. It is a one-story, front-gabled frame structure, clad with ribbed metal (Figure 6-44). The foundation and roof materials are not visible. A metal, sectional garage door fronts the central garage bay.

6.18.2 NRHP Evaluation

Not Eligible. Research has not tied this property to events or persons of historic significance; therefore it is not eligible for listing in the NRHP under Criterion A or B. Additionally, Ranch houses are some of the most common residential forms seen in mid-century suburbs across the country; therefore they must exhibit exceptional characteristics and outstanding integrity to be individually eligible for listing in the NRHP. While the Ranch house located at Site 17 exhibits several character defining features, such as single storied form and a large picture window, it is not an example of exceptional significance needed for listing in the NRHP. It is representative of the thousands of similar Ranch houses constructed throughout the nation. Therefore, we recommend that Site 17 is not eligible for listing in the NRHP under Criteria A, B or C.



Figure 6-43. HD 891: Northeasterly view of residence.



Figure 6-44. HD 891: Easterly view of garage.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-43 and 6-44	
REVISION NO	0	DES BY	KAH	09/16/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	KAH	09/16/2013			
<small>110.99.4.1emifFEMARegion IV - Quiggins Sinkhole Phase 1 Archaeology/G. Reports & Deliverables/1.2 Draft Deliverables/ Figures/Phase 1AH</small>				CHK BY			

6.18.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.19 SITE 18

KHC Survey #: HD 892

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 595215 N: 4183726

Property Address: 3240 S. Wilson Rd.
Radcliff, KY 40160

Owner Information: Ronald and Pamela Sallengs
3240 S. Wilson Rd.
Radcliff, KY 40160

Deed: 1256-613

Construction Date: 1950

6.19.1 Description

Site 18 is comprised of a residence and two garages located at 3240 South Wilson Road, approximately 0.06 mile north of its intersection with Joe Prather Highway. The structures are situated on a grassy, hilly approximately 0.725 acre parcel. A concrete driveway leads up to the residence and garage from the road. According to the Hardin County PVA, the residence dates to 1950.

The residence is a one-and-one-half-story, three-bay (w/d/www), double-pile, frame American Small House with a front-gabled projection located at the northern corner (Figure 6-45). It is situated on a concrete block foundation beneath an asphalt shingle roof and clad with vinyl siding. It comprises approximately 1362 square feet of living space.

The slightly off-center primary entry is comprised of a wood paneled door with a fan light set behind a metal storm door that opens onto single bay concrete porch sheltered beneath a metal awning. Windows are comprised of two-over-two, double-hung wood sashes set behind metal storm windows sheltered beneath a metal awning. The southernmost bay is comprised of a large picture window flanked by smaller two-over-two, double-hung wood sashes. A secondary entry is located at the center of the south (side) elevation and is comprised of a wood paneled door with six lights set behind a metal storm door that opens onto a concrete porch. The shed porch roof is supported by metal columns.

The easternmost garage is located approximately 46 feet east of the residence and is a one-story, front-gabled concrete block structure situated beneath an asphalt shingle roof, oriented to the west (Figure 6-46). The area beneath the gable is clad with vinyl siding and the two garage bays are fronted by sectional garage doors. The westernmost garage is located approximately 30 feet south of the residence and is a one-story, front-gabled concrete block structure situated beneath an asphalt shingle roof, oriented to the north. The area beneath the gable is clad with vinyl siding. A garage bay is located at the center of the north elevation and two window openings located on the west elevation have been enclosed with concrete block.



Figure 6-45. HD 892: Northeasterly view of residence.



Figure 6-46. HD 892: Easterly view of garages.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-45 and 6-46	
REVISION NO	0	DES BY	KAH	09/16/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	KAH	09/16/2013			
<small>110.99.4.1emifEMARegion IV - Quiggin Sinkhole Phase 1 Archaeology/G. Reports & Deliverables/2 Draft Deliverables/ Figures/Phase 1AH</small>				CHK BY			

6.19.2 NRHP Evaluation

Not Eligible. Research has not linked this property to events or persons of historic significance; therefore it is not eligible for listing in the NRHP under Criterion A or B. Additionally, the American Small House was one of the most common post war housing forms across the country; therefore they must exhibit exceptional characteristics and outstanding integrity to be individually eligible for listing in the NRHP. The example located at Site 18 does not. It has been significantly altered with the addition of replacement siding compromising its integrity of design, materials and workmanship. The garages are also not significant examples and are representative of outbuildings dating to the period of construction. Therefore, we recommend that Site 18 is not eligible for listing in the NRHP under Criteria A, B or C.

6.19.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.20 SITE 19

KHC Survey #: HD 893

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 595173 N: 4183901

Property Address: 147 Nalls Ln.
Radcliff, KY 40160

Owner Information: Teresa Dekalands
3184 S. Wilson Rd.
Radcliff, KY 40160

Deed: 1291-459

Construction Date: 1949

6.20.1 Description

Site 19 is comprised of a residence and garage located at 147 Nalls Lane, approximately 0.05 mile east of its intersection with South Wilson Road. The structures are situated on a level, grassy approximately 0.272 acre parcel. An asphalt driveway leads from the road to the garage. According to the Hardin County PVA, the residence dates to 1949.

The residence is a one-story, three-bay (w/d/w), double-pile, side-gabled frame American Small House, situated on a concrete block foundation beneath an asphalt shingle roof and clad with vinyl siding (Figure 6-47). An interior brick chimney rises from the roof peak at its center and a full-length shed roof addition is attached to the rear elevation. The residence comprises approximately 1092 square feet of living space.

The central, primary entry is comprised of a vinyl paneled door with a fanlight that opens onto a single-bay concrete porch sheltered beneath a front-gabled porch roof supported by brick piers with tapered wood posts. Windows consist of one-over-one, double-hung vinyl sashes.

The garage is located approximately 25 feet southwest of the residence and is a one-story, front-gabled concrete block structure (Figure 6-48). The area beneath the gable is clad with vinyl



Figure 6-47. HD 893: Southwesterly view of residence.



Figure 6-48. HD 893: Southerly view of garage.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-47 and 6-48	
REVISION NO	0	DES BY	KAH	09/16/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	KAH	09/16/2013			
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siding. The central garage bay is fronted by a sectional garage door. A window is located at the center of the west (side) elevation.

6.20.2 NRHP Evaluation

Not Eligible. Research has not tied this property to events or persons of historic significance; therefore it is not eligible for listing in the NRHP under Criterion A or B. Additionally, the American Small House was one of the most common post war housing forms across the country; therefore they must exhibit exceptional characteristics and outstanding integrity to be individually eligible for listing in the NRHP. The example located at Site 19 does not. The addition of replacement siding, windows and doors have compromised its integrity of design, materials and workmanship. The garage is also not a significant structure and is representative of similar structure built during the period. Therefore, we recommend that Site 19 is not eligible for listing in the NRHP under Criteria A, B or C.

6.20.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.21 SITE 20

KHC Survey #: HD 894

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 595216 N: 4183907

Property Address: 119 Nalls Ln.
Radcliff, KY 40160

Owner Information: Gold Crest LLC
110 Dawson Ln.
Radcliff, KY 40160

Deed: 1319-674

Construction Date: 1950

6.21.1 Description

Site 20 is comprised of a residence located at 119 Nalls Lane, approximately 0.07 mile east of its intersection with South Wilson Road. It is situated on a level, grassy approximately .517 acre parcel. A poured concrete and asphalt driveway leads from the road to the rear of the residence. According to the Hardin County PVA, the residence dates to 1950.

The residence is a one-story, three-bay (w/d/w), double-pile, side-gabled frame American Small House with a basement (Figure 6-49). It is situated on a poured concrete foundation beneath an asphalt shingle roof and clad with aluminum siding. The residence comprises approximately 1079 square feet of living space.

The central, primary entry is comprised of a wood door set behind a metal security door that opens onto a partial-width concrete porch sheltered beneath a shed porch roof that is supported by metal columns. A metal railing runs the perimeter of the porch. Windows are comprised of



Figure 6-49. HD 894: Southeasterly view of residence.



Figure 6-50. HD 895: Southeasterly view of residence.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-49 and 6-50	
REVISION NO	0	DES BY	KAH	09/16/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	KAH	09/16/2013			
<small>110.99.4.1emif FEMARegion IV - Quiggin Sinkhole Phase I Archaeology/G. Reports & Deliverables/1.2 Draft Deliverables/ Figures/Phase IAH</small>		CHK BY					

one-over-one, double-hung wood sashes set behind aluminum storm windows. Basement windows are comprised of two-light fixed metal sashes.

6.21.2 NRHP Evaluation

Not Eligible. Research has not linked this property to events or persons of historic significance; therefore it is not eligible for listing in the NRHP under Criterion A or B. Additionally, the American Small House was one of the most common post war housing forms across the country; therefore they must exhibit exceptional characteristics and outstanding integrity to be individually eligible for listing in the NRHP. The example located at Site 20 does not. It is not of a specific style or significant design nor does it represent a significant construction method. The addition of replacement siding, windows and doors have compromised its integrity of design, materials and workmanship. The garage is also not a significant structure and is representative of similar structure built during the period. Therefore, we recommend that Site 20 is not eligible for listing in the NRHP under Criteria A, B or C.

6.21.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.22 SITE 21

KHC Survey #: HD 895

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 595260 N: 4183919

Property Address: 91 Nalls Ln.
Radcliff, KY 40160

Owner Information: Oscar and Ruby Barnes
91 Nalls Ln.
Radcliff, KY 40160

Deed: 1092-347

Construction Date: 1951

6.22.1 Description

Site 21 is comprised of a residence located at 91 Nalls Lane, approximately 0.1 mile east of its intersection with South Wilson Road. It is situated on a grassy approximately 1.347 acre parcel that rises slightly to the east, with the house atop the rise. A poured concrete driveway leads from the road to the rear of the residence. According to the Hardin County PVA, the residence dates to 1951.

The residence is a one-and-one-half-story, three-bay (w/d/w), double-pile, front-gabled frame house with a large two-story rear addition (Figure 6-50). It is situated on a concrete block foundation beneath an asphalt shingle roof and clad with asbestos siding. An interior brick chimney extends from the slope of the east side of the roof and two, front-gabled dormers are located at the center of the west side of the roof. The residence comprises approximately 1684 square feet of living space.

The central, primary entry is comprised of a wood door set behind a metal storm door that opens onto a single bay concrete porch sheltered beneath a front-gabled porch roof supported by wood posts. Façade windows are comprised of one-over-one, double-hung vinyl sashes with snap in grids. Dormer windows are comprised of four-light fixed sashes.

The two-story, rear addition is clad with the same wall and roof material, but situated on a poured concrete foundation. Windows consist of one-over-one, double-hung vinyl sashes and are located at the western corner of the north elevation and at the center of the west (side) elevation.

6.22.2 NRHP Evaluation

Not Eligible. Research has not tied this property to events or persons of historic significance; therefore it is not eligible for listing in the NRHP under Criterion A or B. Additionally, the residence located at Site 21 is an undistinguished building form that lacks the significance necessary for inclusion in the NRHP under Criterion C. It is not of a specific style or significant design nor does it represent a significant construction method. The addition of replacement windows and the large rear addition have compromised its integrity of design, materials and workmanship. Therefore, we recommend that Site 21 is not eligible for listing in the NRHP under Criteria A, B or C.

6.22.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.23 SITE 22

KHC Survey #: HD 896

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 595285 N: 4183921

Property Address: 77 Nalls Ln.
Radcliff, KY 40160

Owner Information: N/A

Deed: N/A

Construction Date: Circa 1950-1974

6.23.1 Description

Site 22 is comprised of a residence located at 77 Nalls Lane, approximately 0.12 mile east of its intersection with South Wilson Road. A prefabricated carport and shed are also associated with the property and located east of the residence. The structures are situated on a level, grassy parcel. A gravel parking area is located north of the residence and beneath the carport. Based on its form, the residence appears to date from circa 1950-1974.

The residence is a one-story, four-bay (w/d/ww/w), double-pile, side-gabled frame house (Figure 6-51). It is clad with vinyl siding beneath a corrugated metal roof. The foundation material is not visible.

The slightly east of center primary entry is comprised of a vinyl door with a single light that opens onto a concrete stoop sheltered beneath a metal awning. Windows are comprised of one-



Figure 6-51. HD 896: Southerly view of residence.



Figure 6-52. HD 897: Southeasterly view of residence.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-51 and 6-52	
REVISION NO	0	DES BY	KAH	09/16/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	KAH	09/16/2013			
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over-one-double-hung vinyl sashes, with the westernmost windows being much smaller than the other windows.

6.23.2 NRHP Evaluation

Not Eligible. Research has not linked this property to events or persons of historic significance; therefore it is not eligible for listing in the NRHP under Criterion A or B. Additionally, the residence located at Site 22 is an undistinguished building form that lacks the significance necessary for inclusion in the NRHP under Criterion C. It is not of a specific style or significant design nor does it represent a significant construction method. The addition of replacement siding, windows and doors have compromised its integrity of design, materials and workmanship. Therefore, we recommend that Site 22 is not eligible for listing in the NRHP under Criteria A, B or C.

6.23.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.24 SITE 23

KHC Survey #: HD 897

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 595309 N: 4183934

Property Address: 59 Nalls Ln.
Radcliff, KY 40160

Owner Information: Janice and Melissa Bradley
59 Nalls Ln.
Radcliff, KY 40160

Deed: 1016-548

Construction Date: 1950

6.24.1 Description

Site 23 is comprised of a residence located at 59 Nalls Lane, approximately 0.14 mile east of its intersection with South Wilson Road. A prefabricated shed is also associated with the property and is located south of the residence. The structures are situated on a level, grassy approximately .517 acre parcel. A gravel driveway leads from the road to the residence. According to the Hardin County PVA, the residence dates to 1950.

The residence is a one-and-one-half-story, three-bay (w/d/w), double-pile, side-gabled frame American Small House with a rear front-gabled addition (Figure 6-52). It is situated on a concrete block foundation beneath an asphalt shingle roof and clad with vinyl siding. The residence comprises approximately 1258 square feet of living space.

The off-center primary entry is comprised of a paneled vinyl door with a fanlight set behind a metal storm door that opens onto a concrete stoop sheltered beneath affront-gabled hood supported by square wood posts. Windows consist of one-over-one, double-hung vinyl sashes. A

secondary entry is located at the western corner of the rear elevation and opens onto a wood deck.

6.24.2 NRHP Evaluation

Not Eligible. Research has not tied this property to events or persons of historic significance; therefore it is not eligible for listing in the NRHP under Criterion A or B. Additionally, the American Small House was one of the most common post war housing forms across the country; therefore they must exhibit exceptional characteristics and outstanding integrity to be individually eligible for listing in the NRHP. The example located at Site 23 does not. It is not of a specific style or significant design nor does it represent a significant construction method. The addition of replacement siding, windows and doors have compromised its integrity of design, materials and workmanship. Therefore, we recommend that Site 23 is not eligible for listing in the NRHP under Criteria A, B or C.

6.24.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.25 SITE 24

KHC Survey #: HD 898

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 595325 N: 4183942

Property Address: 109 Nalls Ln.
Radcliff, KY 40160

Owner Information: Kathy Jecker, et al
109 Nalls Ln.
Radcliff, KY 40160

Deed: 1086-337

Construction Date: 1950

6.25.1 Description

Site 24 is comprised of a residence and shed located at 109 Nalls Lane, approximately 0.1 mile north and west of its intersection with US 31W. A prefabricated carport is also associated with the property and is located south of the residence. The structures are situated on a grassy approximately .344 acre parcel that slopes slightly downward to the south and west. A gravel driveway leads from the road to the carport and garage. According to the Hardin County PVA, the residence dates to 1950.

The residence is a one-story, three-bay (w/d/w), single-pile, side-gabled frame house with a large addition attached to the east elevation (Figure 6-53). It is primarily clad with asbestos siding and situated beneath an asphalt shingle roof. The foundation is not visible. The addition is clad with board and batten and ribbed metal. The portion clad with ribbed metal is an enclosed porch. The residence comprises approximately 1152 square feet of living space.



Figure 6-53. HD 898: Southerly view of residence.



Figure 6-54. HD 898: Southwesterly view of garage.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-53 and 6-54	
REVISION NO	0	DES BY	KAH	09/16/2013	 12420 Milestone Center Dr. Germantown, MD 20876		
SCALE	N/A	DR BY	KAH	09/16/2013			
<small>\\10.90.4.11\mif\FEMA\Region IV - Quiggin Sinkhole Phase I Archaeology\3. Reports & Deliverables\1.2 Draft Deliverables\Figures\Phase I.AH</small>				CHK BY			

The off-center, primary entry into the original portion of the house is comprised of a wood door with twelve lights that opens onto a concrete stoop sheltered beneath a front-gabled hood. Windows are comprised of three-over-one, double-hung wood sashes. The majority of the addition windows are comprised of rectangular, fixed sashes, while the windows located at the western corner of the north elevation of the addition are comprised of one-over-one, double-hung vinyl sashes.

The shed is located approximately 30 feet southwest of the residence (Figure 6-54). It is clad with asbestos shingles beneath an asphalt shingle roof. The garage opening is fronted by a wood, hinged garage door.

6.25.2 NRHP Evaluation

Not Eligible. Research has not linked this property to events or persons of historic significance; therefore it is not eligible for listing in the NRHP under Criterion A or B. Additionally, the residence located at Site 24 is an undistinguished building form that lacks the significance necessary for inclusion in the NRHP under Criterion C. It is not of a specific style or significant design nor does it represent a significant construction method. While the original portion of the residence retains its original features, the large addition has compromised its integrity of design, materials and workmanship. The garage is also a standard form dating to the period. Therefore, we recommend that Site 24 is not eligible for listing in the NRHP under Criteria A, B or C.

6.25.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.26 SITE 25

KHC Survey #: HD 899

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 595352 N: 4183919

Property Address: 5 Nalls Ln.
Radcliff, KY 40160

Owner Information: Mina Helmer
5 Nalls Ln.
Radcliff, KY 40160

Deed: 250-037

Construction Date: 1956

6.26.1 Description

Site 25 is comprised of a residence located at 5 Nalls Lane, on the west side of its intersection with US 31W. A prefabricated carport and shed are also associated with the property. The carport is attached to the northern third of the façade and the shed is located to the rear of the residence. The structures are situated on a grassy, approximately 0.172 acre parcel that slopes gently to the south. An asphalt driveway leads from the road to the carport. According to the Hardin County PVA, the residence dates to 1956.

The residence is a one-story, three-bay (ww/d/w), double-pile, front-gabled frame house, situated on a concrete foundation beneath an asphalt shingle roof and clad with aluminum siding (Figure 6-55). An exterior brick chimney that rises above the roof peak is attached to the center of the rear elevation. The residence comprises approximately 768 square feet of living space.

The slightly off-center primary entry is comprised of a wood paneled door set behind a metal screen door that opens onto the asphalt driveway and is sheltered beneath the prefabricated carport. Windows are comprised of one-over-one, double-hung vinyl sashes. Basement windows consist of fixed wood sashes. A secondary entry is located at the center of the south elevation and is comprised of a wood paneled door with a single light set behind an aluminum storm door that opens onto a poured concrete sidewalk. The entry is sheltered beneath a front-gabled hood.

6.26.2 NRHP Evaluation

Not Eligible. Research has not tied this property to events or persons of historic significance; therefore it is not eligible for listing in the NRHP under Criterion A or B. Additionally, the residence located at Site 25 is an undistinguished building form that lacks the significance necessary for inclusion in the NRHP under Criterion C. It is not of a specific style or significant design nor does it represent a significant construction method. The addition of replacement windows and the attached prefabricated carport has compromised its integrity of design, materials and workmanship. Therefore, we recommend that Site 25 is not eligible for listing in the NRHP under Criteria A, B or C.

6.26.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.27 SITE 26

KHC Survey #: HD 900

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 595236 N: 4184277

Property Address: US 31W
Radcliff, KY 40160

Owner Information: City of Radcliff
411 W. Lincoln Trail
Radcliff, KY 40160

Deed: N/A

Construction Date: circa 1925-1949

6.27.1 Description

Site 26 is comprised of a concrete box culvert with concrete wing walls (Figure 6-56), located along US 31W, approximately 0.25 mile north of its intersection with Nalls Lane and situated down an embankment approximately 40 feet west of the highway. It allows an unnamed tributary of Brushy Creek to pass beneath the highway. Large boulders and a portion of poured concrete are located in front of the culvert's opening. The culvert is somewhat deteriorated, with a large



Figure 6-55. HD 899: Southwesterly view of residence.



Figure 6-56. HD 900: Box culvert along US 31W.

CLIENT FEMA Region IV					TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY								
REVISION NO	0	DES BY	KAH	09/16/2013	 12420 Milestone Center Dr. Germantown, MD 20876		FIGURE 6-55 and 6-56	
SCALE	N/A	DR BY	KAH	09/16/2013				
<small>1110.99.4.11emifEMARegion IV - Quiggin Sinkhole Phase 1 Archaeology/G. Reports & Deliverables/1.2 Draft Deliverables/ Figures/Phase 1AH</small>								

crack running the height of the southern wing wall. Based on its form, the culvert dates to circa 1925-1949.

6.27.2 NRHP Evaluation

Not Eligible. In order to be eligible under Criterion A or B, culverts must display “a high level of integrity in relation to a historical event or broad pattern of history,” such as significant early practices of the Department of Public Roads or the Department of Highways, or with various New Deal programs (Abner 2010:118). Research does not suggest any such associations for this culvert. Culverts are important roadway elements, as they provide a means of drainage under the roadway to prevent roads from flooding. The box culvert often acts as a mini-bridge, supporting a span up to 20 feet in length (Kentucky Department of Highways 1945; Kennedy and Johnson 2005: 91, 111). It is the most common culvert type constructed within Kentucky before 1960. The Kentucky Transportation Cabinet only documents culverts that are greater than 20 feet in length and there are likely thousands more unlisted examples below the 20-foot cutoff. Given their commonness, culverts must exhibit particularly rare or notable design characteristics and excellent integrity to be eligible for listing in the NRHP under Criterion C. While its integrity remains intact, the culvert located at Site 26 is not an exceptional example. Therefore, we recommend that Site 26 is not eligible for listing in the NRHP under Criteria A, B or C.

6.27.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

6.28 SITE 27

KHC Survey #: HD 901

Zone: 16

Quad: Vine Grove, KY 1991

UTMs: E: 594952 N: 4185232

Property Address: US 31W
Radcliff, KY 40160

Owner Information: City of Radcliff
411 W. Lincoln Trail
Radcliff, KY 40160

Deed: N/A

Construction Date: 1943

6.28.1 Description

Site 27 is comprised of a concrete double box culvert with concrete wing walls (KYTC Bridge # 047B00032N) located along US 31W, approximately 0.09 mile north of its intersection with Centennial Avenue and situated down an embankment approximately 10 feet east of the highway (Figure 6-57). It allows an unnamed tributary of Brushy Creek to pass beneath the highway. According to the KYTC Historic Bridge Database, it is 28.83 feet in length and dates to 1943.



Figure 6-57. HD 901: Double box culvert along US 31W.

CLIENT FEMA Region IV					TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY							FIGURE 6-57	
REVISION NO	0	DES BY	KAH	09/16/2013	 12420 Milestone Center Dr. Germantown, MD 20876			
SCALE	N/A	DR BY	KAH	09/16/2013				
<small>11030.4.11emifEMARegion IV - Quiggins Sinkhole Phase I Archaeology/G. Reports & Deliverables/1.2 Draft Deliverables/ Figures/Phase I.AH</small>							CHK BY	

6.28.2 NRHP Evaluation

Not Eligible. In order to be eligible under Criterion A or B, culverts must display “a high level of integrity in relation to a historical event or broad pattern of history,” such as significant early practices of the Department of Public Roads or the Department of Highways, or with various New Deal programs (Abner 2010:118). Research does not suggest any such associations for this culvert. Culverts are important roadway elements, as they provide a means of drainage under the roadway to prevent roads from flooding. The box culvert often acts as a mini-bridge, supporting a span up to 20 feet in length (Kentucky Department of Highways 1945; Kennedy and Johnson 2005: 91, 111). It is the most common culvert type constructed within Kentucky before 1960. The Kentucky Transportation Cabinet only documents culverts that are greater than 20 feet in length and there are likely thousands more unlisted examples below the 20-foot cutoff. Given their commonness, culverts must exhibit particularly rare or notable design characteristics and excellent integrity to be eligible for listing in the NRHP under Criterion C. While its integrity remains intact, the culvert located at Site 27 is not an exceptional example. Therefore, we recommend that Site 27 is not eligible for listing in the NRHP under Criteria A, B or C.

6.28.3 Determination of Effect

Since this property is not eligible for the NRHP, there will be no effect on historic properties.

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SECTION SEVEN CONCLUSIONS AND RECOMMENDATIONS

URS, with support from its subcontractor CRA, conducted a historic resource survey of proposed flood control measures, including water retention ponds, in support of federal funding for the City of Radcliff's Quiggins Sinkhole/Happy Valley Flood Mitigation Project in Hardin County, Kentucky. This investigation was conducted for FEMA Region IV. The survey was conducted to comply with federal regulations implementing Section 106 of the NHPA, concerning the effect of federal undertakings on historic properties listed in or eligible for listing in the NRHP. For the purpose of the historic resource survey, the APE was defined to include a 200-foot radius around each proposed basin and spoil area.

One previously surveyed historic resource (HD 15) and 26 previously unidentified historic resources (HD 876 – HD 901) were documented during the field survey. None of the newly identified historic resources appear eligible for listing in the NRHP.

URS has concluded that Site 1 (HD 15), currently listed in the NRHP, continues to be eligible. While the detention pond will be visible from Site 1, it will not adversely affect the qualities for which the property is eligible for listing in the NRHP. Therefore, URS recommends that the proposed project will have no adverse effect on historic above-ground resources listed, or eligible for listing, in the NRHP. No further investigations are recommended.

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Appendix A
Historic Resources Summary Table

Appendix A Historic Resources Summary Table

CRA Resource #	KHC Inventory #	Name/Description of Property	Construction Date	Initial Assessment	Photo Figure #
1	HD 15	Haycraft Inn	ca 1814, ca 1820	Listed	6516, 6520, 6522, 6523, 6521, 6524, 6515, 6518, 6526, 8047
2	HD 876	Louisville and Nashville Turnpike	circa 1837	Ineligible	6499, 6527, 6544
3	HD 877	one-and-one-half-story, three-bay, frame American Small House	1941	Ineligible	6505
4	HD 878	one-story, four-bay, double-pile, hip roof, frame Compact Ranch house and garage	1946	Ineligible	6508, 6510
5	HD 879	concrete pipe culvert	circa 1950-1974	Ineligible	6511
6	HD 880	metal pipe culvert	circa 1925-1949	Ineligible	6512
7	HD 881	concrete box culvert	circa 1950-1974	Ineligible	6514
8	HD 882	concrete box culvert	circa 1950-1974	Ineligible	6530
9	HD 883	one-and-one-half-story, three-bay, double-pile, frame side-gabled house and concrete box culvert	1941	Ineligible	6533, 6531
10	HD 884	one-story, four-bay, double-pile, frame Compact Ranch house and concrete slab bridge	1963	Ineligible	6535, 3536
11	HD 885	one-and-one-half-story, three-bay, frame American Small House with additions, garage and concrete slab bridge	1954	Ineligible	6538, 6539, 6541
12	HD 886	concrete box culvert	circa 1950-1974	Ineligible	6503
13	HD 887	one-and-one-half-story, four-bay, double-pile, frame American Small House, garage and box culvert	1949	Ineligible	6498, 6495, 6497
14	HD 888	one-story, three-bay, double-pile, side-gabled frame American Small House with attached garage	1950	Ineligible	6480
15	HD 889	one-and-one-half-story, three-bay, double-pile, frame American Small House and garage	1950	Ineligible	6492, 6493
16	HD 890	one-and-one-half-story, four-bay, double-pile, side-gabled frame house and garage	1950	Ineligible	6482, 6483
17	HD 891	one-story, three-bay, double-pile, hip roof frame Bungalow Ranch house and garage	1954	Ineligible	6485, 6486
18	HD 892	one-and-one-half-story, three-bay, double-pile, frame American Small House and two garages	1950	Ineligible	6488, 6489
19	HD 893	one-story, three-bay, double-pile, side-gabled frame American Small House and garage	1949	Ineligible	6475, 6477
20	HD 894	one-story, three-bay, double-pile, side-gabled frame American Small House	1950	Ineligible	6474
21	HD 895	one-and-one-half-story, three-bay, double-pile, front-gabled frame house with a two-story rear addition	1951	Ineligible	6471
22	HD 896	one-story, four-bay, double-pile, side-gabled frame house	circa 1950-1974	Ineligible	6469
23	HD 897	one-and-one-half-story, three-bay, double-pile, side-gabled frame American Small House	1950	Ineligible	6467
24	HD 898	one-story, three-bay, single-pile, side-gabled frame house and garage	1950	Ineligible	6464, 6465
25	HD 899	one-story, three-bay, double-pile, front-gabled frame house	1956	Ineligible	6460
26	HD 900	concrete box culvert	circa 1925-1949	Ineligible	6451
27	HD 901	concrete double box culvert	1943	Ineligible	6504

Appendix B
Qualifications of Investigators

Appendix B

Qualifications of Investigators

Elizabeth Heavrin, M.H.P. Elizabeth Heavrin has over 7 years of professional experience in architectural history surveys, historical research, and compliance studies and exceeds the *Secretary of the Interior's Professional Qualification Standards* (36 CFR Part 61). She is Project Manager and Principal Investigator for Cultural Resource Analyst's Department of Architectural and Cultural History, supervising all cultural historic surveys in Kentucky. Ms. Heavrin has served as field supervisor, author, and principal investigator for cultural historic surveys for the transportation, communications, and energy sectors; researched and authored several National Register of Historic Places nominations; and completed creative mitigation projects for projects in Kentucky and throughout the Midwestern and Southeastern United States. She received her Bachelor's Degree in History at the College of William and Mary and her Master's Degree in Historic Preservation at the University of Kentucky.

Holly Higgins, M.S. Holly Higgins has experience in Section 106 compliance, state-level Historic American Buildings Survey documentation, interpretative signage, historic structures reports, and National Register of Historic Places nominations, and meets the *Secretary of the Interior's Professional Qualification Standards* (36 CFR Part 61). She is an Architectural Historian for the Evansville office of Cultural Resource Analysts and has cultural resource management experience in the Midwest and Mid-Atlantic. Holly received her Bachelor's Degree in History from the University of Evansville and her Master's Degree in Historic Preservation from Ball State University.

Robert Karwedsky, M.S. Rob Karwedsky has 34 years of experience as a professional archaeologist specializing in cultural resource management and exceeds the *Secretary of the Interior's Professional Qualification Standards*. Mr. Karwedsky maintains an extensive knowledge of the regulations at 36 CFR 800 implementing Section 106 of the National Historic Preservation Act and what is required for agency (and contractor) compliance with those regulations. Most of his career has been spent as the District Archaeologist for the U.S. Army Corps of Engineers, Nashville District, where he conducted compliance studies and administered contracts for historic and archaeological services in Kentucky, Tennessee, Alabama, and Mississippi. He received his Master's Degree in Anthropology from Florida State University.

Scott Seibel, M. Sc., RPA. Scott Seibel has over 15 years of professional experience in archaeological excavations, research and compliance studies and exceeds the *Secretary of the Interior's Professional Qualification Standards* (36 CFR Part 61). He is the Archaeology Program Manager for the URS Germantown's Cultural Resource Management Group. Mr. Seibel has extensive cultural resource management experience, having served as Principal Investigator or Field Director for over 10,000 acres of Phase I archaeological surveys, dozens of Phase II evaluations and 11 Phase III data recovery excavations within the Southeast, Mid-Atlantic, and Texas. He received his Bachelor's Degree in Archaeological Studies at the University of Texas at Austin and his Master's Degree in Archaeomaterials at the University of Sheffield in England.

Final Report

Phase I Archaeological Investigation for Proposed Drainage Improvements in the Happy Valley Drainage Area, Hardin County, Kentucky

November 2013



FEMA

Federal Emergency Management Agency
Region IV
3003 Chamblee Tucker Road
Atlanta, GA 30341

This document was prepared by

URS Group, Inc.
12420 Milestone Center Drive, Suite 150
Germantown, MD 20876

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Acknowledgements

Prepared by:

Gavin Davies
Ralph Koziarski, PhD
Scott Seibel, MSc, RPA

Principal Investigator

Robert Karwedsky

Project Manager

Patti Slade

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ABSTRACT

URS Group, Inc. (URS), with support from its subcontractor Cultural Resource Analysts, Inc. (CRA), conducted a Phase I archaeological survey for a proposed flood control project that includes water retention ponds, in support of federal funding for the City of Radcliff's Quiggins Sinkhole/Happy Valley Flood Mitigation Project in Hardin County, Kentucky. This investigation was conducted for the Federal Emergency Management Agency (FEMA), Region IV.

The project seeks to increase the area's detention volume by excavating and developing approximately 2.4 hectares (ha; 6 acres) in the Quiggins Sinkhole area near US 31W into a functional basin (referred to as the Quiggins Basin). Additionally, the project includes the construction of four additional new detention basins (Cato, Song, Turner, and Wilson Basins) and an area used to deposit spoil from basin construction (Spoil Area). The six individual areas, all located along an approximately 1.5-mile-long corridor parallel to US 31W and South Wilson Road, range in size from 1.9 to 9.7 ha (4.6 to 24.0 acres) and have a combined area of approximately 22.9 ha (56.6 acres).

The survey was conducted to comply with federal regulations implementing Section 106 of the National Historic Preservation Act, concerning the effect of federal undertakings on historic properties listed in or eligible for listing in the National Register of Historic Places (NRHP). The implementing regulations are published in the Code of Federal Regulations at 36 CFR Part 800. Federal actions include the using federal funds or granting a federal permit. For the purpose of the archaeological survey, the area of potential effect (APE) was defined as the limits of disturbance for each proposed basin and spoil area.

In February 2013, field investigations were conducted that included a combination of pedestrian survey and shovel testing at 20-meter intervals, or judgmentally based on field conditions. The purpose of the survey was to identify and document archaeological resources 50 years of age or older located within the APE that are listed or potentially eligible for listing in the NRHP; evaluate their eligibility for listing in the NRHP and recommend boundaries, if eligible; and evaluate the effect of the project on any properties included in, or eligible for listing in, the NRHP.

The investigations resulted in the discovery of one previously unidentified archaeological site (15Hd963) and one Isolated Find (IF-1). Site 15Hd963 is the remains of a twentieth-century historic farm/residence, and IF-1 consisted of three pieces of prehistoric lithic debitage. Site 15Hd963 is recommended as not eligible for inclusion in the NRHP based on the low density, late date, and poor integrity of the remains. IF-1 does not qualify for a site number and is, therefore, not eligible for inclusion in the NRHP. Therefore, no historic properties occur in the APE that will be affected by the proposed project. No further investigations are recommended.

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TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS	iii
SECTION ONE INTRODUCTION	1-1
SECTION TWO ENVIRONMENTAL SETTING	2-1
2.1 Geology and Topography	2-1
2.2 Hydrology	2-1
2.3 Soils.....	2-1
2.4 Flora and Fauna.....	2-2
2.5 Current Land Use.....	2-4
SECTION THREE CULTURAL CONTEXT	3-1
3.1 Prehistoric Context.....	3-1
3.1.1 Paleoindian Period (ca. 10,000 – 8000 B.C.).....	3-1
3.1.2 Archaic Period (8000 – 1000 B.C.)	3-2
3.1.3 Woodland Period (1000 B.C. – A.D. 900).....	3-4
3.1.4 Late Prehistoric (A.D. 900 – Contact)	3-5
3.2 Historic Context.....	3-7
3.2.1 Pre-Settlement Exploration (1750-1775).....	3-7
3.2.2 Early Settlement (1775-1820/1830).....	3-7
3.2.3 Antebellum (1820/1830-1861).....	3-8
3.2.4 Civil War (1861-1865).....	3-9
3.2.5 Postbellum: Readjustment and Industrialization (1865-1915).....	3-10
3.2.6 Industrial and Commercial Consolidation (1915-1945).....	3-11
3.2.7 Modern Era (1945-Present).....	3-13
SECTION FOUR PREVIOUS INVESTIGATIONS	4-1
4.1 Previous Archaeological Investigations.....	4-1
4.2 Archaeological Site Data	4-4
4.3 Map Data.....	4-6
4.4 Survey Predictions	4-7
SECTION FIVE RESEARCH DESIGN	5-1
5.1 Objectives	5-1
5.2 Methods.....	5-1
5.2.1 Research	5-1
5.2.2 Field Survey	5-1
5.2.3 Laboratory Analysis.....	5-2
SECTION SIX SURVEY RESULTS.....	6-1
6.1 Site 15Hd963	6-1
6.1.1 Site Description.....	6-1
6.1.2 Investigation Methods.....	6-5
6.1.3 Stratigraphy.....	6-5
6.1.4 Artifacts.....	6-5
6.1.5 Features	6-7
6.2 Isolated Finds	6-10
SECTION SEVEN CONCLUSIONS AND RECOMMENDATIONS.....	7-1

TABLE OF CONTENTS

SECTION EIGHT	REFERENCES CITED.....	8-1
----------------------	------------------------------	------------

Figures

Figure 1-1: Project Location	1-3
Figure 1-2: Area of Potential Effects	1-4
Figure 2-1: Project Soils	2-3
Figure 2-2: Disturbance Along Western Edge of Quiggins Basin, Facing South	2-5
Figure 2-3: Disturbance Along Eastern Edge of Cato Basin, Facing North.....	2-5
Figure 4-1: 1946 USGS Map	4-8
Figure 4-2: 1960 USGS Map	4-9
Figure 5-1: Field Survey Methods	5-3
Figure 5-2: Field Survey Methods	5-5
Figure 6-1: Archaeological Site Locations	6-2
Figure 6-2: General Overview of 15Hd963, Facing Southwest.....	6-3
Figure 6-3: Schematic Plan of Site 15Hd963	6-4
Figure 6-4: Representative Soil Profile from Site 15Hd963.....	6-6
Figure 6-5: Construction Debris in Treeline Immediately to the South of Site 15Hd963, Facing South.....	6-8
Figure 6-6: General Overview of Front Side of Feature 1, Site 15Hd963, Facing Southwest	6-8
Figure 6-7: Close-up of Feature 2, Site 15Hd963.....	6-9

Tables

Table 2-1: Project Soils.....	2-2
Table 4-1: Previously Recorded Archaeological Sites in Hardin County	4-4
Table 5-1: Functional Typology (Modified from Orser 1988)	5-6
Table 6-1: Summary of Site 15Hd963	6-1
Table 6-2: Artifacts Recovered from Site 15Hd963	6-7
Table 6-3: Summary of IF-1	6-10

Appendices

Appendix A	Artifact Catalog
Appendix B	Qualifications of Investigators

Acronyms and Abbreviations

AMSL	above mean seal level
APE	Area of Potential Effect
bgs	below ground surface
CFR	Code of Federal Regulations
CRA	Cultural Resource Analysts, Inc.
FEMA	Federal Emergency Management Agency
ft	feet
ha	hectares
IF	Isolated Find
KDOH	Kentucky Department of Highways
km	kilometer
L&N	Louisville and Nashville
m	meter
mi	mile
MRA	Multiple Resource Area
MS	map structure
NHPA	National Historic Preservation Act
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
OSA	Kentucky Office of State Archaeology
OSS	Official Soil Series Description
SHPO	State Historic Preservation Office
sq ft	square feet
sq m	square meters
STP	shovel test pit
URS	URS Group, Inc.
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

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SECTION ONE INTRODUCTION

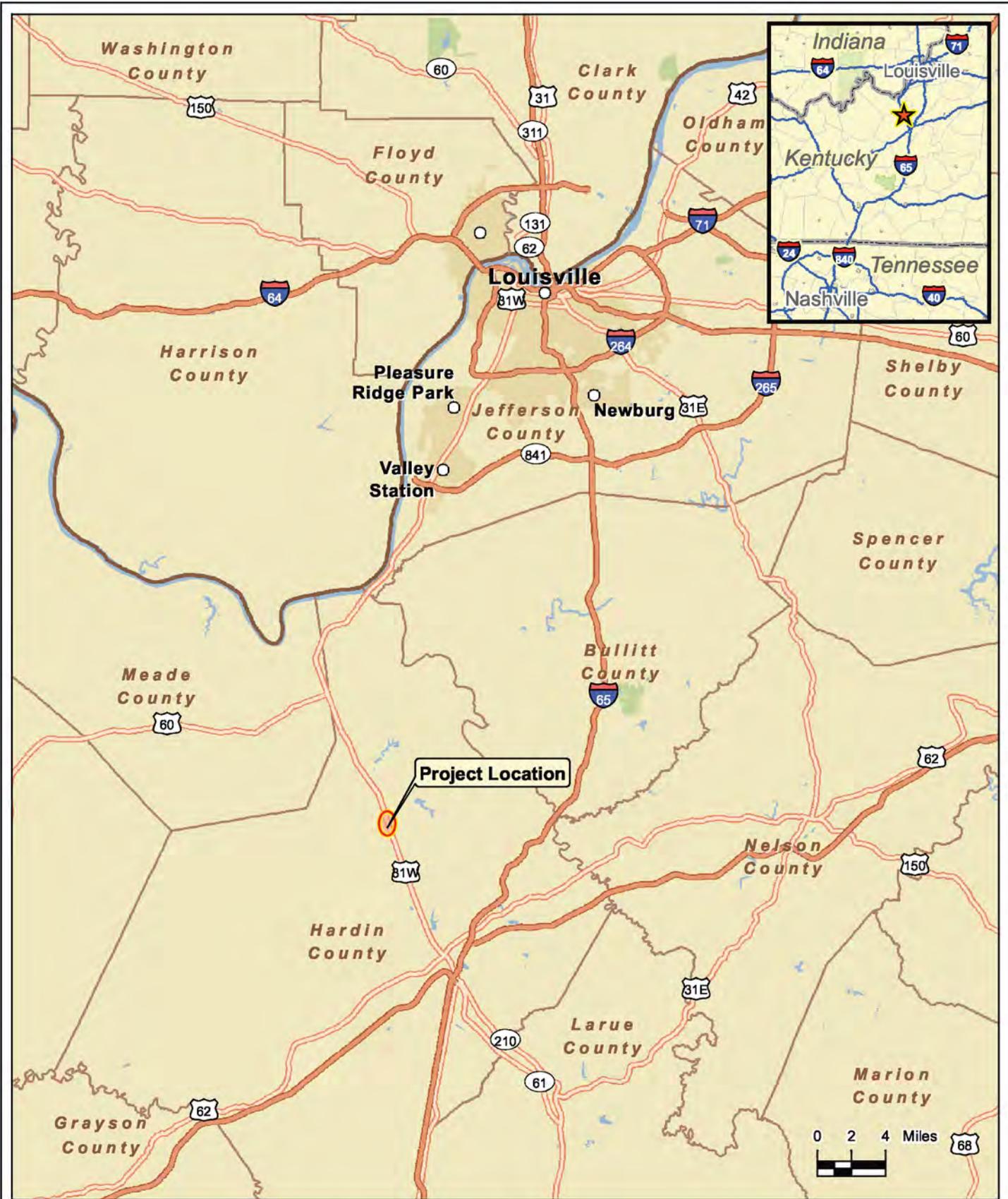
URS Group, Inc. (URS), with support from its subcontractor Cultural Resource Analysts, Inc. (CRA), conducted a Phase I archaeological survey of proposed flood control measures, including water retention ponds, in support of federal-funding for the City of Radcliff's Quiggins Sinkhole/Happy Valley Flood Mitigation Project in Hardin County, Kentucky (Figure 1-1). This investigation was conducted for the Federal Emergency Management Agency (FEMA), Region IV. Incorporated in 1956, the City of Radcliff is located in northern Hardin County approximately 20 miles south of the Louisville metro area. The proposed stormwater management project is for the 1.74 square miles of the Happy Valley drainage where runoff flows into Quiggins Sinkhole. The Quiggins Sinkhole serves as the area's primary terminus for stormwater runoff. Due to the large volume of runoff and the limited intake capacity of the sinkhole, flooding and extended ponding occurs. Several times a year, rain events cause the flooding of South Wilson Road, west of US 31W. A larger rain event will also cause flooding of US 31W, the main thoroughfare for the City of Radcliff.

The project seeks to increase the area's detention volume by excavating and developing approximately 2.4 hectares (ha; 6 acres) in the Quiggins Sinkhole area near US 31W into a functional basin (referred to as the Quiggins Basin). Additionally, the project includes the construction of four new detention basins (Cato, Song, Turner, and Wilson Basins) and an area to deposit spoil from basin construction. The six individual areas are all located along an approximately 1.5-mile-long corridor parallel to US 31W and South Wilson Road, range in size from 1.9 to 9.7 hectares (ha; 4.6 to 24.0 acres), and have a combined area of approximately 22.9 ha (56.6 acres) (Figure 1-2). The Area of Potential Effects (APE) consists of the footprint of the combined six areas. Work was conducted in accordance with Section 106 of the National Historic Preservation Act (NHPA 1966, as amended) and the Kentucky State Historic Preservation Office's *Specifications for Conducting Fieldwork and Preparing Cultural Resource Assessment Reports* (Kentucky State Historic Preservation Office [SHPO]; Sanders 2006).

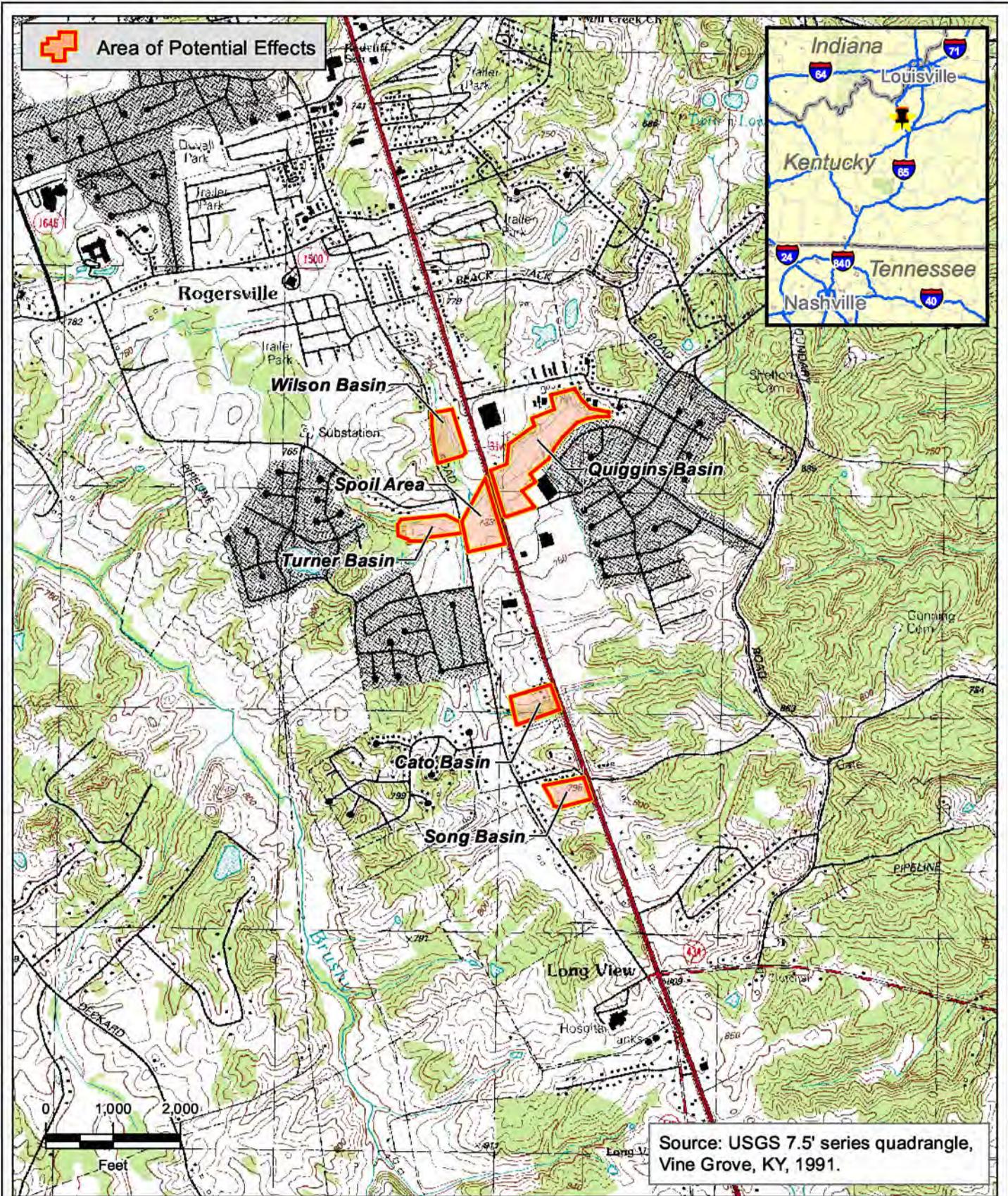
CRA's research included a search of the online National Register of Historic Places (NRHP) records and research at the Kentucky Office of State Archaeology (OSA). Field investigations occurred in February 2013 and included a combination of pedestrian inspection survey and shovel testing at 20-meter (m) intervals, or judgmentally based on field conditions. Robert Karwedsky of URS served as the Principal Investigator. Gavin Davies of CRA served as Field Director and was assisted by CRA field technicians Thomas McAlpine, Daniel Mohorcic, and Karen Taylor. Reporting was compiled by Gavin Davies of CRA and Scott Seibel, who also served as the URS Task Manager, and Ralph Koziarski of URS. Artifact analysis was conducted by Jennifer M. Faberson and Andrew P. Bradbury of CRA, while accessioning of project materials was conducted by Carey O'Reilly, URS Laboratory Director, and Lisa Guerre, also of URS.

Following this Introduction the report includes six sections of text including: Environmental Setting, Cultural Context, Previous Investigations, Research Design, Survey Results, and Conclusions and Recommendations. The References Cited completes the body of the report.

Appendix A, the artifact catalog, and Appendix B, qualifications of investigators, follow the body of the report.



CLIENT FEMA Region IV					TITLE Project Location		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY							FIGURE 1-1	
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Source: USGS 7.5' series quadrangle, Vine Grove, KY, 1991.

CLIENT FEMA Region IV				1	TITLE		Areas of Potential Effects	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY					12420 Milestone Center Dr. Germantown, MD 20876		PROJ NO	15702708
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SECTION TWO ENVIRONMENTAL SETTING**2.1 GEOLOGY AND TOPOGRAPHY**

Hardin County is underlain by Mississippian-aged carbonate rocks of the St. Genevieve and St. Louis formation (Kentucky Geological Survey 2001; Lloyd and Lyke 1995). The lithologies of the sediments from the St. Genevieve and St. Louis formations consist primarily of carbonate rocks such as limestone. According to the 1991 7.5 minute topographic map of the Vine Grove, Kentucky quadrangle, the designated site area ranges in elevation from approximately 730 feet above sea level at the Quiggins Sinkhole to approximately 770 feet above sea level at the southernmost property/parcel (USGS 1991).

2.2 HYDROLOGY

A prior report indicates that topography in the area of the site is rolling (QK4 2009), and may be generally characterized as a relatively low-lying sinuous drainage area surrounded by areas of higher topography that appear to be cut by unnamed streams flowing radially toward the drainage area. The self-contained drainage of the sinkhole is located between two north-tending streams. It is approximately 0.6 mile (mi) east of Brushy Fork and 1.5 mi west of Mill Creek. Mill Creek flows north where it empties into the Salt River, approximately 11 mi away from the project area. Brushy Fork empties into Otter Creek 5.9 mi northwest of the project area, and Otter Creek drains into the Ohio River 13.9 mi northwest of the project area.

2.3 SOILS

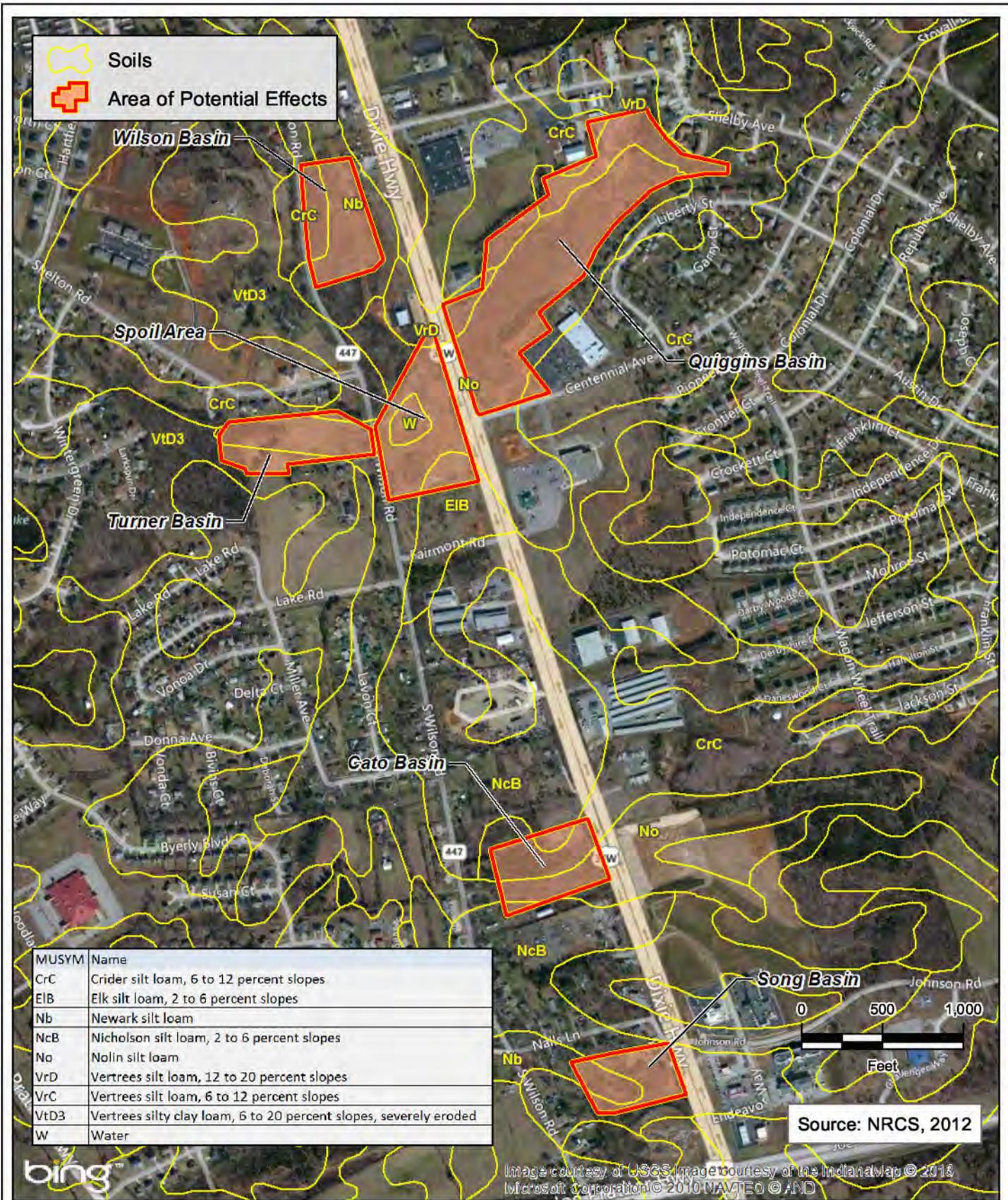
According to the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) online Web Soil Survey, the Happy Valley drainage area is immediately underlain by silt loam soils (NRCS 2013b). Six distinct soil units are recorded within the project area boundaries, with Nolin silt loam and Newark silt loam being the most common (Figure 4). Nolin series soils are very deep, well drained, moderately steep soil occurring in flood plains and wet depressions (NRCS 2013a). Meanwhile, the Newark series soil is described as a very deep, somewhat poorly drained alluvial soil formed on nearly level flood plains and depressions (NRCS 2013a). The remaining soil types from the area are similar and are described as occurring on flood plains, being formed of mixed fine silty alluvium, and characterized as well-drained material with moderately high to high water movement in restrictive zones and very high available water capacity (NRCS 2013a). Project soils are summarized below in Table 2-1 and shown on Figure 2-1.

Table 2-1: Project Soils

Soil Name	Percent Slope	Taxonomic Class	Drainage Class	Flooding Frequency	Typical Profile
Newark Series	n/a	Fine-silty, mixed, active, nonacid mesic Fluventic Endoaquepts	Somewhat poor	Occasional to frequent	Ap 0 - 9 inches silt loam Bw 9 – 15 inches silt loam Bg 15 - 32 inches silt loam Cg 32 – 52 inches silt loam C 52 – 60 inches silt loam and silty clay
Nolin silt loam	n/a	Fine-silty, mixed, active, mesic Dystric Fluventic Eutrudepts	Well drained	Frequent	Ap 0 – 12 inches silt loam Bw1 12 – 25 inches silt loam Bw2 25 – 35 inches silt loam Bw3 35 – 44 inches silt loam Bw4 44 – 74 inches silt loam C 74 – 80 inches silt loam
Nicholson silt loam	2–6 %	Fine-silty, active, mesic Oxyaquic Fragiudalfs	Moderate to well drained	n/a	Ap 0 – 8 inches silt loam Bt1 8 – 22 inches silt loam Bt2 22 – 28 inches silty clay loam Btx 28 – 38 inches silty clay loam Bt3 38 – 50 inches silty clay 2C 50 – 60 inches clay
Crider silt loam	6–12 %	Fine-silty, mixed, active, mesic Typic Paleudalfs	Well drained	n/a	Ap 0 - 8 inches silt loam Bt1 8 - 12 inches silt loam Bt2 12 - 24 inches silt loam Bt3 24 -38 inches silt loam 2Bt4 38 - 50 inches silt clay 2Bt5 50 - 100 inches clay R 100 inches; limestone bedrock.
Elk silt loam	2–6 %	Fine-silty, mixed, active, mesic Ultic Hapludalfs	Well drained	n/a	Ap 0 - 9 inches silt loam BA 9 - 14 inches silt loam Bt1 14 - 30 inches silty clay loam Bt2 30 - 42 inches silty clay loam C 42 - 69 inches silty clay loam
Vertrees silt loam	12–20 %	Fine, mixed, semiaactive, mesic Typic Paleudalfs	Well drained	n/a	Ap 0 - 7 inches silt loam Bt1 7 - 24 inches clay Bt2 24 - 51 inches clay Bt3 51 - 78 inches clay

2.4 FLORA AND FAUNA

Cranfill (1991:233) describes a rich variety of trees and underbrush growing in the swampy sinkhole regions of Hardin County. The dominant tree species include the American elm, red maple, meadow holly, sweetgum, black tupelo, white oak, overcup oak, and pin oak. The underbrush is composed of numerous plant species, but predominantly chokecherry, buttonbrush, swamp loosestrife, swamp rose, and winterberry (Cranfill 1991:234). Underbrush observed in disturbed areas also included common lawn grasses.



 Soils
 Area of Potential Effects

MUSYM	Name
CrC	Crider silt loam, 6 to 12 percent slopes
EIB	Elk silt loam, 2 to 6 percent slopes
Nb	Newark silt loam
NcB	Nicholson silt loam, 2 to 6 percent slopes
No	Nolin silt loam
VrD	Vertrees silt loam, 12 to 20 percent slopes
VrC	Vertrees silt loam, 6 to 12 percent slopes
VtD3	Vertrees silty clay loam, 6 to 20 percent slopes, severely eroded
W	Water

Source: NRCS, 2012

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	FIGURE	2-1

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Wild animals in the region are species commonly found in the eastern woodlands. The most common mammal species in forest-edge and swampy environments are the white-tailed deer, coyote, red fox, raccoon, Virginia opossum, beaver, muskrat, eastern cottontail, and grey squirrel (Kays and Wilson 2002). Common birds in the region are numerous forms of small and medium-sized perching birds, woodpeckers, and raptors (Dunn 2006).

2.5 CURRENT LAND USE

The project area consists largely of fallow agricultural land, much of which is overgrown with woods. Portions of the project area have been disturbed by paved roads, public utility lines, and surrounding suburban developments (Figures 2-2 and 2-3). The area south of Radcliff, Kentucky features extensive suburban residential lots, punctuated by open fields and small wooded plots. Remnant agricultural fields are present, but only become common several miles west of the project area.



Figure 2-2. Disturbance Along Western Edge of Quiggins Basin, Facing South.



Figure 2-3. Disturbance Along Eastern Edge of Cato Basin, Facing North.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 2-2 and 2-3	
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SECTION THREE CULTURAL CONTEXT

3.1 PREHISTORIC CONTEXT

Archaeologists generally divide Kentucky's prehistoric past into three cultural periods: Paleoindian, Archaic, and Woodland, along with two localized periods: Mississippian and Fort Ancient (Pollack 2008). These periods are distinguished by changes in material culture, environmental adaptations, subsistence practices, social organization, and other aspects of culture as reflected in the archeological record. More specific chronological sequences are marked by changes in projectile point styles and ceramics. Hardin County is in the Coalfields section of the Appalachian Mountains Cultural Landscape and is part of the Southeastern Mountains Section of the Upper Cumberland River Drainage. The unique topography of the Upper Cumberland River Drainage area produced a diversity of environmental settings and locales that were suitable for occupation and resource procurement during prehistory. A single prehistoric isolated find, with no diagnostic artifacts was documented during this investigation; therefore, the following is presented as a brief summary rather than a detailed prehistoric context.

3.1.1 Paleoindian Period (ca. 10,000 – 8,000 B.C.)

The earliest period of human occupation in the region is referred to as the Paleoindian period. This period dates from approximately 10,000 to 8,000 B.C. and represents the first verifiable findings of humans in the southeastern United States. The origin of the Paleoindians is the subject of much debate, and there is evidence to suggest earlier human occupation of the North American continent (Adovasio et al. 1999; Clausen et al. 1979; Coe 1964; Dunbar and Webb 1996; Goodyear 1995, 1996, 1999, 2000; Hall 1998a, 1998b; Krieger 1964; McAvoy and McAvoy 1997; Roosevelt 1996, 1998; Wisner 1998a, 1998b; Wormington 1961). Evidence of occupation within the southeastern United States prior to 10,000 B.C. has yet to be conclusively demonstrated.

In Kentucky, the Paleoindian period is typically divided into two broad temporal categories: Early (9,500–8,500 B.C.) and Late (8,500–8,000 B.C.), based on the occurrence of specific point types (Anderson 1990). Early Paleoindian tools are characterized by fluted points comparable to the classic southwestern Clovis and Folsom points. In Kentucky, the Clovis type-name is used, while the “waisted” fishtail forms resembling Folsom points are referred to as Cumberland points. Late Paleoindian points are generally assigned to one of two morphological clusters: Dalton and Lanceolate Plano. Dalton cluster variants include the classic Dalton, as well as Beaver Lake and Quad point types. Lanceolate Plano cluster variants include Plainview and Agate Basin point types.

It was once hypothesized that Paleoindian groups were small, nomadic bands who used a specialized tool kit for the procurement of now extinct megafauna (Mason 1962; Michie 1977). However, it has become increasingly apparent that the Paleoindian subsistence base was more diverse than originally thought. While reliance on megafauna may have been the norm in the western part of North America, southeastern Paleoindian inhabitants may have relied on a more varied diet, including plants and small game (Sassaman et al. 1990:8). In fact, only a few

examples of the direct exploitation of megafauna in the southeastern United States have been documented (cf. Clausen et al. 1979; Webb et al. 1984). Moreover, the importance of meat in the Paleoindian diet can sometimes be overemphasized. Ethnobotanical remains from Meadowcroft rockshelters (Adovasio et al. 1999), Shawnee-Minisink (McNett et al. 1977), and Dutchess Cave Quarry (Funk et al. 1969; Funk and Steadman 1994) indicate that secondary resources such as fish, birds, hawthorn, and nuts were also incorporated into various eastern woodland Paleoindian subsistence systems.

Paleoindian settlement in the southeastern United States is typically characterized by high mobility, high range (territorial) mobility, low population density, and a focal hunting economy (Anderson and Joseph 1988; Gardner 1978; Goodyear 1979; Goodyear et al. 1989; Meltzer 1988; Smith 1986; Steponaitis 1986; Williams and Stoltman 1965). However, some researchers are beginning to question these traditional views and are advocating alternative theories. One such theory is that Paleoindians were less mobile and selected choice areas for initial settlement. Only after this initial area was settled did Paleoindian groups expand into other regions (Sassaman et al. 1990:8). Another theory stipulates that early Holocene mobility patterns would have shifted from logistically based settlement systems to more residentially mobile systems as temperatures warmed and the homogeneity of resource distributions increased (Cable 1992). Cable's "Effective Temperature/Technological Organization" model, as it has come to be known (Anderson and Hanson 1988; Anderson and Schuldenrein 1985), argues that Paleoindian and initial Early Archaic populations may have maintained more stable residences than peoples of the later Early Holocene and Middle Holocene.

3.1.2 Archaic Period (8,000 – 1,000 B.C.)

The transition from the Paleoindian to the Archaic period was associated with a major climate change that occurred at the end of the Ice Age. The formerly cooler, moister climate shifted to an ecologically more productive, warmer, and drier climate, closer to what exists today. Subsistence during this period changed along with the environment, as Pleistocene megafauna became extinct and dietary patterns generally reflected a reliance on a wider variety of species of plants and animals (Coe 1964; Caldwell 1958). Increasingly specialized hunting techniques were also developed, which resulted in a shift from fluted projectile points to side-notched and stemmed points.

The Archaic sequence is traditionally divided into three sub-periods: the Early Archaic (8,000-6,000 B.C.), the Middle Archaic (6,000-4,000 B.C.), and the Late Archaic (4,000-1,000 B.C.). In general, the Archaic is viewed as a lengthy period of adjustment to changing environments brought about by the Holocene warming trend and rising sea level. Caldwell's (1958) model of wide-niche or a "broad spectrum" hunter-gatherer adaptation continues to succinctly define the period for most archaeologists. However, the differences between the cultures at either end of the sequence are immense and indicate that major cultural and adaptational changes occurred during the Archaic period that might not fit a gradual model of change.

Early Archaic lithic assemblages are quite similar to those of the Paleoindian period. Projectile points remain stylistically formalized and show evidence of economizing rejuvenation strategies.

Point types typically associated with the Early Archaic include side-notched and stemmed Kirk and Palmer points as well as bifurcate-base points such as Lost Lake, Pine Tree, MacCorkle, St. Albans, and LeCroy. Hafted endscrapers continue to be well represented, and there is an emphasis on the curation and use of high-quality cryptocrystalline raw material such as chert and high-grade metavolcanics. Cleland (1976) suggested that these attributes indicate a continued focus on hunting and processing of big game animals. In support of this, several researchers (Dragoo 1975:11; Goodyear et al. 1979:104) note that plant-processing tools such as grinding stones are extremely rare in Early Archaic deposits. Faunal remains from Early Archaic associations in the Southeast indicate a widespread emphasis on white-tailed deer, but a variety of smaller game including gray squirrel, raccoon, turkey, and box turtle have also been identified (Goodyear et al. 1979:105). Subsistence data from this period suggests that hunting large game (i.e., white-tailed deer, elk, bison, and antelope on the western margin of the eastern woodlands) was a major element of Early Archaic economies. Nevertheless, significant energy was also devoted to nut/seed gathering and the trapping of smaller terrestrial game and aquatic resources (e.g., mussels, fish, turtle, ducks, geese, quail, turkey, beaver, squirrel, skunk, bobcat, opossum, porcupine, raccoon, and otter).

Developments during the **Middle Archaic** include the manufacture of specialized bone and lithic tools. Ground stone tools, such as those used in plant processing (mortar and pestles) increase in appearance (Jefferies 2008:207). Middle Archaic site types in central Kentucky include small hunting or foray sites and larger, deeply stratified sites occupied for longer periods or repeatedly occupied (Jefferies 2008). Shell middens and burials have sometimes been associated with the stratified sites, particularly in the western portion of the state (Brown and Vierra 1983). One of the most characteristic elements of Middle Archaic material culture is the development of regional point styles. In central Kentucky, diagnostic Middle Archaic projectile point types draw from sequences established in Tennessee (Lewis and Kneburg-Lewis 1961; Chapman 1977), southern Illinois (Fowler 1959; Jeffries and Butler 1983; Styles et al. 1983), and the North Carolina piedmont (Coe 1964). These include various point types such as Stanly, Morrow Mountain, Guilford, Eva, Cypress Creek, Sykes, Matanzas, Godar, Faulkner, and Big Sandy II. Analyses of mortuary programs indicate that societies in the region were largely egalitarian and that status was acquired throughout one's lifetime (Jefferies 2008:209).

The **Late Archaic** is characterized by greater regional specialization, new technologies that more efficiently exploited local resources, and changing settlement and social patterns. Midden data indicate increased sedentism, while grave offerings made of non-local material suggest differing treatment of higher status individuals and some level of change in social organization (Jefferies 1996; Nance 1984, 1986; Winters 1968).

Seasonal patterning intensified during the Late Archaic period. Caldwell (1958) defined Late Archaic subsistence as "primary forest efficiency." The model for Late Archaic settlement and subsistence patterns is that of mobile hunter-gatherers with a band level social structure (Jobe 1983). The size and composition of the mobile groups would vary according to the distribution and availability of resources across the landscape and through the seasons (Boisvert 1986).

Late Archaic people used a wider array of specialized objects such as steatite and sandstone bowls, stone tubes and beads, polished plummets, net sinkers, whistles and rattles, birdstones, boatstones, bone awls, needles, and perforators (Chapman 1975:6). Diagnostic chipped stone artifacts include large straight, expanding, and contracting stem points, and smaller stemmed and side-notched types (Jefferies 1990:153). Late Archaic period sites in the Salt River area include mostly open habitation sites, though specialized resource extraction camps, rockshelters, workshops, and earthen mound sites are also present (Jefferies 2008:216).

The first evidence of cultigens appears in Late Archaic assemblages, and the earliest date documented in Missouri and Kentucky is about 2,300 B.C. (Chomko and Crawford 1978: 405). Sumpweed, sunflower, chenopodium, and maygrass remains were recovered from human paleofeces dating to 1,150 B.C. at Hooton Hollow, a rockshelter in eastern Kentucky (Gremillion 1996).

3.1.3 Woodland Period (1,000 B.C. – A.D. 900)

The Woodland period is marked by the introduction of ceramics, population growth, and an increasingly sedentary way of life. Wild plant and animal resources remained important, but horticulture, based on maize cultivation, eventually formed a major part of the subsistence base. The Woodland period is generally divided into the Early (1,000 – 200 B.C.), Middle (200 B.C. – A.D. 500), and Late (A.D. 500 – 900) based on changes in technology and subsistence patterns.

Early Woodland subsistence patterns represent a continuation from the Late Archaic hunting and gathering. Ceramics first appear during the Early Woodland period, suggesting increased sedentism. The period is also marked by the appearance of social or ritual sites separated from domestic habitations (Railey 1990:250). The Adena complex has been well documented during the Early Woodland period in eastern Kentucky (Milner and Jeffries 1987). Adena and Robbins points, gorgets, copper bracelets, and tools have been found in association with mound burials from this period. In addition to the burial mounds, other Adena earthworks or enclosures may represent small-scale habitation sites (Clay 1985). Rockshelters appear to have remained important during the Early Woodland, although a trend is seen toward open-air camp and village habitations in riverine settings throughout the Woodland period (Applegate 2008).

Diagnostic chipped stone artifacts of the Early Woodland period include leaf-shaped blades and a variety of stemmed projectile points such as Kramer, Wade, Gary, Turkeytail, Cresap, Robbins, and Adena (Chapman and Otto 1976:21; Railey 1996:81). Other artifacts include tubular pipes, gorgets, slate pendants, full grooved axes, hematite celts, and incised stone tablets (Chapman and Otto 1976:210). Early Woodland people also used copper to manufacture beads, bracelets, gorgets, and rings. The earliest ceramics in Kentucky occur in eastern and possibly central Kentucky (Railey 1990, 1996). Most of these specimens are thick, tempered with coarse pieces of lithic material, and have cordmarked, plain, or fabric impressed surfaces. Most often, these ceramics are typed as “Fayette Thick” (Griffin 1943).

The **Middle Woodland** is marked by the proliferation of burial mounds in Kentucky (Applegate 2008). Grave goods, including gorgets, copper bracelets, and tools, are often found in association with the mounds (Applegate 2008). The use of domesticated plants increased from the Early

Woodland, and there is evidence of centralized settlements in Kentucky, with some areas of more dispersed settlement sites (Railey 1990:252). These centralized habitation sites were often complex, with earthen enclosures, specialized activity areas, and processing areas.

Parts of Kentucky participated in the Hopewell Interaction Sphere (Caldwell 1958; Struever 1964). Archaeological sites characteristic of the Hopewell period appear in western and central Kentucky between 200 B.C. and A.D. 700 (Applegate 2008). Hopewell culture contains elaborate geometric earthworks, enclosures, and mounds that are often associated with multiple burials, and a wide array of exotic ceremonial goods. Earthworks and artifact assemblages are similar to Adena types but are unique in their complexity. Grave goods include whole ceramic pots, jewelry, figurines, and diverse highly decorated items that are not found in the Early Woodland period.

Middle Woodland subsistence focused on hunting and collecting activities supplemented by small-scale horticulture. Diagnostic chipped stone artifacts from the Middle Woodland include stemmed points, triangular/lanceolate points related to Copena/McFarland, Steuben Stemmed, Lowe Flared Base, and Chesser Notched points. Middle Woodland ceramics include fabric-marked and cordmarked types (Applegate 2008).

The **Late Woodland** is marked by increased regional variability and horticulture (Pollack and Henderson 2000:615). Ceremonial centers disappeared, trade networks dissipated, and there was less emphasis on burial ceremonialism. There was increased reliance on domesticated plants supplemented by hunting and intensive gathering (Applegate 2008). Regional variants of this pattern emerged within major drainages throughout the region. Upland sites contributed substantial faunal as well as agricultural resources to the subsistence base (Railey 1990).

A major technological change of the Late Woodland was the shift away from the spear and atlatl to the bow and arrow (Shott 1993). This change is inferred from the appearance of small triangular or thin, corner-notched projectile points in the place of the larger projectile points of the earlier periods. Regional variation typifies the ceramics from the Late Woodland period. There is also evidence of the use of chert hoes (Miller and Bergman 1996).

3.1.4 Late Prehistoric (A.D. 900 – Contact)

Mississippian (A.D. 900–1700)

After A.D. 900, Kentucky was the locus of continued Woodland period traditions, but with distinctive subsistence-settlement changes that included permanently settled, agriculturally oriented communities (Pollack 2008). Archaeological site data suggest that a hierarchical settlement system based on surplus agricultural production developed during the Mississippian period (Pauketat 1998). Compared to Woodland groups, Mississippian groups achieved a more advanced level of social and economic complexity. Settlement patterning analysis and archaeological data indicate that these groups operated on a chiefdom level, which included a more intensely stratified society than earlier, and maintained sedentary village lifestyles (Pauketat 1998).

Distinguishing features of large sites include ceremonial centers, plazas, and flat-topped pyramidal mounds. Small occupation sites were also common. Both site types have been identified on major rivers and their tributaries. Corn and squash were subsistence staples, and farming provided the bulk of the diet (Lewis 1996:127). The bow and arrow, primarily used for hunting during the Late Woodland, was also used during Mississippian times for raiding and warfare. Mississippian ceramics are often shell tempered, smoothed, and in many cases decorated (Pollack 2008). Some vessels, like the sharp-shouldered Ramey-incised style jars appear over a wide geographic range throughout the mid-continental United States, and have been argued to represent an elite trade-ware (Pauketat and Emerson 1991). The Mississippian period also saw a florescence of the arts in the American midcontinent and southeast. Finely crafted items recovered from Mississippian sites include, among other things, ceramic effigies, incised clay and shell gorgets, ceremonial ground-stone maces, embossed copper plates, decorated bone implements, and refined chipped stone tools made from locally exotic materials (Kelly 1990; Pauketat and Emerson 1991; Pauketat 1998).

In northern-central Kentucky, the distinction between Mississippian and Fort Ancient cultures post A.D. 1000 is ambiguous (Pollack 2008:679). A clear cultural chronology remains to be established, but the Mississippian cultural sequence spans roughly 400 years from A.D. 1000 to A.D. 1400 (Pollack 2008:680). Sites are generally open habitation sites, often featuring structures but lacking mounds (Pollack 2008:683). Two well-known sites from the region are the Eva Bandman and Shippingport sites. The Eva Bandman site appears to have been a hamlet or small village within the boundaries of what is now Louisville, Kentucky, occupied circa A.D. 1300-1450 (Henderson and Pollack 2004). Two Mississippian components identified at the Shippingport site include an early Mississippian wall-trench structure from the ninth century and a small cluster of structures contemporaneous with those at the Eva Bandman site (French et al. 2006).

Fort Ancient (A.D. 1000–1750)

Chronologically, the Fort Ancient period overlaps with the Mississippian period (Henderson 2008). Agriculture was well established during the Fort Ancient period; corn and beans were the crops most commonly cultivated (Henderson 2008:739). Many Fort Ancient sites are characterized by the remains of permanent villages. Archaeological data suggest that structures within villages were organized in clusters or individual family units. Later in the Fort Ancient period, village construction was concentrated around a central plaza. In general, the emphasis on elaborate mortuary practices that defined earlier periods decreased. The complex hierarchical settlement systems evident in the Mississippian period did not appear to continue into the Fort Ancient period (Henderson and Pollack 2004). In Kentucky, Fort Ancient sites are most common in the northeastern and eastern portions of the state (Henderson 2008:739), with many of the well-documented sites occurring well east of the current project area.

Transitions within the Fort Ancient period are distinguished by increasingly complex ceramic types. Specialized artifacts characteristic of this period include bone tools, ear spoons, and several varieties of pipes (Henderson and Pollack 2004). The Fort Ancient culture appears to have flourished circa 1400–1450. At this time, regional stylistic variations diminish, suggesting

increased long-distance trade, and villages become larger (Henderson 2008:741). After A.D. 1600, the Fort Ancient cultures begin to diminish in Kentucky and elsewhere (Henderson and Pollack 2004).

3.2 HISTORIC CONTEXT

The Historic period of Kentucky spans six temporal sub-periods, beginning with the Pre-Settlement Exploration, Early Settlement, Antebellum, Civil War, Postbellum: Readjustment and Industrialization, and the Industrial and Commercial Consolidation. The time after the end of World War II in 1945 is considered the Modern Era.

3.2.1 Pre-Settlement Exploration (1750–1775)

South-central Kentucky has a rich and varied history beginning with the European explorers who moved into what was to become the state of Kentucky during the mid-eighteenth century. Initial exploration was conducted primarily by French traders, land speculators, and government agents (Pollack 1990:5). One of the primary motivations for exploration was the prospect of inexpensive land, especially after the Donelson Line (1771) pushed the western boundary of settlement to the Kentucky River. “Long Hunters,” such as Daniel Boone, spent extended periods of time in Kentucky. The information they gathered would be critical to the later settlement of Kentucky (Pollack 1990:587-589).

Early encounters with Native American groups living in the area were generally brief and often violent. The predominant Native American groups living in Kentucky during the period of contact included Shawnee, Cherokee, Chickasaw, Yuchi, and Mosopelea (McBride and McBride 2008). The Shawnee were by far the largest group occupying the majority of the state, while the Cherokee and Yuchi occupied settlements along the upper Cumberland and Kentucky Rivers. The Mosopelea were also known to have occupied portions of southern Kentucky near the mouth of the Cumberland River. Chickasaw settlements were generally limited to the western portion of the state along the Ohio River. Native American groups known to have visited portions of the state included the Illinois, Miami, Iroquois, and Delaware; however, these generally only involved short-term forays by small hunting parties or for trade with existing groups (Swanton 1953). Kentucky became known as “the dark and bloody ground” during this period, which some people believe describes the era of conflict between Native American groups and early explorers; others interpret the phrase as an allusion to the frequent conflicts between Native American groups amidst the turmoil and disruption brought about by increasing Euro-American influence and settlement

3.2.2 Early Settlement (1775–1820/1830)

As the western borders expanded, settlers, encouraged by Long Hunter accounts, began to enter Kentucky by way of the Cumberland Gap and the Ohio River (Lewis 1996:187). The first settlements spanned the Bluegrass, the Pennyroyal, and Appalachian regions (McBride and McBride 2008:909). It is within this time period that Kentucky formed its basic governmental

organization. Towns, counties, and the economic, banking, and transportation systems necessary to sustain them were developed (Pollack 1990:6).

During the Revolutionary War (1775–1783), many Native American tribes, including the Chickasaw, were allied with the British, and this lent incentive to assault the settlers. Settlers lived in forts and stations to protect themselves (Pollack 1990:590). The year 1777 was so violent that it was dubbed the year of “the terrible sevens.” Many settlements were abandoned (Lewis 1996:188-189), and development was hindered until the end of the war in 1783, when the violence abated.

The end of the Revolutionary War marked an era of population growth and town development. Settlers no longer inhabited forts and stations to protect themselves. Farmsteads were established and stations began to develop into towns. The settlers spanned from the lower classes to the gentry, and were primarily British, although Scottish, Scotch-Irish, and Germans are also noted (Pollack 1990:590-591). The gentry immigrated from Virginia, Maryland, and North Carolina (Abernethy 1962:67; Barnhart 1941:19-22; Coleman 1940:15) and established plantations that used slave labor and grew one or more cash crops. Popular commodities included livestock, grains, and tobacco.

According to the first U.S. census taken in 1790, Kentucky had a population of 73,677. By 1792, it was granted statehood. Cities began to develop, although the population remained primarily rural (Lewis 1996:191). Agricultural goods were traded and non-local goods were imported via rivers and improved road systems. Despite improved transportation systems, the cost of trade was unfavorable, and many towns looked to local industry as a solution. Tobacco and hemp factories, salt works, iron works, gristmills and home manufacturers were established. Kentucky was the predominant producer of American gunpowder for the War of 1812 (O’Dell 1995). The Jackson Purchase of 1818 acquired the rest of the land now known as Kentucky (McBride and McBride 2008:920). Because of its proximity to developed regions, and lacking the threat of hostile Native Americans, “The Purchase” built up quickly. By the Antebellum, it too was part of a growing Kentucky (Pollack 1990:594-598).

3.2.3 Antebellum (1820/1830-1861)

The Antebellum began inauspiciously with the depression of the early 1820s (McBride and McBride 2008:921). By 1825, the nation, including Kentucky, began to recover. Populations and industries boomed. This early portion of the Antebellum can be viewed as the period of the river town. The growing steamboat industry created new landings along Kentucky’s rivers, which developed into towns and cities (Pollack 1990:599). River improvements were necessary to support industries. Locks were built to promote navigability, especially during the drier seasons (Crocker 1976:14, 22). Most notably, the Portland Canal, built around the Falls of the Ohio, was completed in 1830 and brought commercial success to Louisville (Hepner and Whyne 1992).

Other transportation improvements included roads and railways. Existing roads were widened and repaired, and new roads were built. Railroad construction began slowly, as a single stretch between Lexington and Frankfort took almost 20 years to complete. By 1860, railroads

connected prominent cities, such as Lexington and Louisville, throughout the state, and they also had connections to Nashville and Memphis (Pollack 1990: 600,603).

Kentucky's industry during the Antebellum was focused on agricultural and mineral resources, including iron, salt, and coal (McBride and McBride 2008). Agricultural industries included mills, factories, and distilleries. Iron furnaces were predominantly located in the Appalachian, Tennessee Cumberland, and Pennyroyal regions (Pollack 1990:605). Salt works could be observed throughout the state during the early Antebellum, with the largest example being the Goose Creek Salt Works of Clay County. However, because of improved transportation, salt could be imported at a lower cost, making it unprofitable for most to produce. Salt and mineral springs existed at resorts for healing and entertainment purposes. In 1820, the first commercial coal mine was opened in Muhlenberg County. By 1845, the first modern mining community was established and was the prototype of similar towns to follow. The mining town of Peach Orchard consisted of 40 houses, a store, and mills (Crowe-Carraco 1983:78-79). The coal industry would go on to have a significant impact on Kentucky (Pollack 1990:605).

Continuing improvements in transportation and increasing industrialization encouraged the growth of cities, rural populations, and county seats (Lewis 1996:194-195). Increased imports led to lower cost of goods, and the demand for agricultural commercialization. Plantations and farms expanded throughout Kentucky's regions, especially in the Bluegrass (McBride and McBride 2008:925). Commercial products were consistent with those grown in earlier periods, with new emphasis on hemp and tobacco. Hemp was directly linked to the marketability of the cotton industry in the south, and was the cash crop of many planters and farmers. Tobacco was cultivated especially in the Pennyroyal region, where soil was rich. It is within these tobacco production areas that the largest plantations with the most slaves existed (Pollack 1990:601-602). Kentucky's slave population during the Antebellum rose from 165,213 in 1830 to 225,483 at the start of the Civil War (Lewis 1996:195).

Louisville in particular showed remarkable growth during the Antebellum. In 1810, toward the end of the Early Settlement period, Louisville was the fourth largest city in the state with a population of 1,375; in 1830, it was the largest with a population of over 10,000, and by 1860 that figure reached 68,033 (Share 1982:33). Louisville's industry boomed, largely due to its railroads and the increased trade the Portland Canal allowed (Pollack 1990:596,603). By the end of the Antebellum, it had become the largest manufacturing center in the south, and the twelfth largest in the country (Share 1982:33).

3.2.4 Civil War (1861–1865)

At the time of the Civil War, Kentucky was a slave state, opposed to secession. The state attempted military neutrality, but by the end of 1861, Union and Confederate troops began moving in (McBride and McBride 2008). Kentucky was divided into a Union north and a Confederate south. Louisville accommodated the state's Union headquarters. Confederate troops abandoned Kentucky by 1862, largely because of the attacks upon Tennessee Forts Donelson and Henry by Ulysses S. Grant. Raids and guerilla activities continued throughout the state, particularly in the Appalachians (Pollack 1990: 606-609).

Kentucky was not physically devastated by the war to the same extent as states to the south and east, as most major battles and campaigns took place outside its borders. Still, the war had a serious impact on the state's economy and industry. Trade was adversely affected, especially livestock and hemp (McBride and McBride 2008). Tied to the cotton industry, hemp was a particularly valuable crop, and demand for hemp increased as cotton crops became scarce during and immediately after the war (Alexander 1976:263). Transportation systems were impacted by war activities, especially regional railroads. Rivers, such as the Green River, were not closed during this time. Early in the war, Kentucky's economy suffered money shortages, limited credit, and low prices on goods.

By 1863, the economy rebounded due to a higher demand for Kentucky products, such as grain and hemp. Mining, agriculture, and other industries were affected depending on their locations and types. The nitrate mines did well because they fulfilled the war's demand for gunpowder. Iron furnaces in the Appalachian and Bluegrass regions were Union suppliers. In contrast, the iron industry in the Jackson Purchase and the Pennyroyal were adversely affected by the transportation hindrances the war posed (Pollack 1990:609-610).

Most industries were affected by the declining labor force. Kentuckians who joined the Union Army numbered 100,000, and 25,000 to 40,000 joined the Confederacy; approximately one-third of these soldiers died from disease or battle (Harrison 1975:95). The agricultural industry suffered from the loss of slaves. By 1863, many slaves were leaving Kentucky; they were granted freedom for enlisting in the Union Army, and Kentucky was the only state that was not recruiting (Pollack 1990:610-611). By 1864, Kentucky recruitment centers developed, and within four months, 14,000 slaves had volunteered (Berlin 1982:194).

3.2.5 Postbellum: Readjustment and Industrialization (1865–1915)

The Postbellum was a time of growth and change in transportation, commerce and manufacturing, demographic trends, and agricultural methods. In 1900, Kentucky had the second highest value of farm products after Texas, as the physical devastation of war was minimal and some railroads previously existed throughout the state (McBride and McBride 2008).

Railroads connected select Kentucky cities before the war, and Louisville had lines running to Memphis and Nashville. Rivers had been an important form of transportation, but could not compete with the speed and weather resistance of the railroad (Pollack 1990:629, 632). Postwar increases in rail use and construction brought markets closer, made goods cheaper, and facilitated the shipment of goods and raw materials. The increase in the number of railroad lines also promoted leisure travel, especially to mineral spring resorts throughout the state (Channing 1977; Tapp and Klotter 1977).

Other transportation developments in this time included the introduction of bicycles in the late 1800s, enabling citizens to travel farther than they could on foot (McBride and McBride 2008:936). Road construction integrated the state, but tended to be unkempt. The electric street car was established in many cities in the 1890s. Interurban lines promoted the interaction between rural and urban areas, and centralized retail trade. Improvements in transportation and communication, like the introduction of the telephone in the late 1800s, were the impetus for

suburban growth. Residents could commute to the city and enjoy its amenities, and still have the rural benefits of lawns and gardens (Pollack 1990:628).

Postbellum commerce and manufacturing saw the decline of small-scale local manufacturing, which could not compete with the larger factories. Most of these large manufacturers were out of state, and their products were imported (McBride and McBride 2008:947). Some smaller operations consolidated to form large corporations. Mass production and the growing desire for consumer goods stimulated the retail trade. Wage labor increased the purchasing power of individuals and motivated the industry to produce more goods (Pollack 1996:627-628).

Many industries declined during the Postbellum, including iron foundries, brick and tile manufacturing, and hemp. Hemp was eventually replaced by cheaper substitutes. Many other industries thrived. Lumber changed from an individual or small-scale industry to a commercial one, especially in the Bluegrass region. Coal mining was of increasing importance in the state, and its focus was primarily on exportation of the resource. In 1910, three-quarters of the timber and at least 85 percent of coal in the Appalachian Mountain region was owned by out-of-state companies. This trend could be observed throughout the state (Pollack 1990:637-639).

Traditional agricultural methods evolved as farming became a more commercial industry (McBride and McBride 2008). Railroads enabled the export of crops and livestock. White burley tobacco became a popular crop because it grew well in most of the state and was marketable. Tobacco production increased more than 70 percent from 1870 to 1900 (Tapp and Klotter 1977). Freed slaves who had agricultural knowledge and, to a lesser degree, European immigrants often supplied the labor. Labor organization ranged from wage labor to sharecropping. Many African Americans seeking autonomy preferred to rent land. Still, these farms tended to be half the size and worth of their counterparts. Workers tended to live on the farm or work seasonally, keeping a residence in the city (Pollack 1996:615).

In 1865, the Thirteenth Amendment was ratified without Kentucky's support (McBride and McBride 2008:939). Freed slaves who preferred not to continue living rurally moved to urban areas. Immigrants also moved into cities to seek manufacturing jobs. As populations rose in the cities, the demand for jobs and housing was great, and the overcrowding resulted in tenement housing and poor sanitation (McBride and McBride 2008:937). Many families shared bathroom facilities and polluted water sources. African American housing was segregated in most cities by the late 1800s. Formal ordinances promoting segregation were common after 1910 (Rice 1968).

3.2.6 Industrial and Commercial Consolidation (1915–1945)

Two World Wars, Prohibition, the Great Depression, and New Deal policies influenced Kentucky during this time. Manufacturing and commerce, agriculture, urbanization, and industrialization underwent significant change. Kentucky did not industrialize as rapidly as much of the country, and its economy remained largely grounded in agriculture. Farming as a way of life declined, as many farmers worked part-time off the farm as wage laborers. Mechanization, such as tractors, became more popular, and the number of tenant farmers increased. Agriculture became more commercial as marketable crops like tobacco were emphasized. The industry was revived from the depression when cigarette popularity increased 75 percent between the years

1939 and 1945 (Pollack 1990:655). The agriculture industry was also affected by the Agricultural Adjustment Act, a New Deal Policy that enabled the federal government to regulate crops and livestock, including tobacco, which stimulated exhausted soils and increased prices on goods (Pollack 1990:655).

Urban growth continued in this period, as greater numbers searched for work in the cities. The increase of multi-family tenements and apartments led to calls for improvements in urban living. Sanitation and sewage systems, electricity, and indoor plumbing became available in most urban homes. Rural areas continued to lack these facilities. As suburbs expanded, many of these growing neighborhoods became independently incorporated so they could secure the amenities and services that the city could not provide (Pollack 1990:647).

Retail trade and consumerism experienced growth, largely due to improvements in mass production of goods, especially plastics (Pollack 1990:657). Retail stores and the introduction of the large chain stores gave Kentuckians access to these goods and to jobs. Wage labor became more common as employment in the retail industry grew rapidly. Women entered the work force, including retail, manufacturing, and industry. The majority of women in the work force were African American (Pollack 1990:657).

The African American population decreased during this time (Odum 1936:470). The highest concentration was in rural tobacco production. Segregation of neighborhoods increased, partially because many upper and middle class citizens began to leave the city centers and move to suburban areas (McBride and McBride 2008). The foreign population in Kentucky also decreased at this time, abetted by the 1921 Immigration Law. Since fewer immigrant workers were available to northern industries, many opted to recruit heavily from southern states, spurring the emigration of Kentucky citizens (Pollack 1990:648).

Local small-scale manufacturing and industries declined or consolidated as mass production outside of the state grew. Whiskey distilling led all other industries in cash returns before prohibition (Clark 1960 [1937]). Because of Prohibition, many distillery workers lost their jobs, and home distilling increased. Prohibition ended in 1935 in Kentucky, two years after the rest of the nation, but 90 of the 120 counties in the state opted to remain dry, and home-production continued in those areas. The mining population provided an ample market for these distillers (Pollack 1990:654).

Although living conditions were improving in coal mining towns as modern amenities were introduced, the mining industry was hurt by the Depression, and many businesses were forced to cut wages and maintenance repairs. This motivated workers to unionize. Despite mechanization, the lumber industry declined as a new awareness of deforestation was born and National Forests were established (Eller 1982:119). By this time, many of the best trees had been cut.

In the latter stages of this period, New Deal policies such as the Works Progress Administration granted Kentucky improved access to mass communications. Public transportation dramatically improved with the introduction of bus lines and taxi services. Automobiles and trucks became more attainable because of assembly line production, roads were paved and new ones were built, and some railroads were built (Channing 1977). Improvements in transportation led to more jobs,

economic growth, and a developing tourism industry, and further integrated Kentucky (Pollack 1990:660).

During World War II, manufacturing in Kentucky, and particularly in the Hardin County area expanded as the economy was geared toward wartime production. The Louisville area became a center of rubber production and jeep building at the city's Ford factory, and a munitions plant was constructed in Louisville (Channing 1977). Nearby Fort Knox, first built in 1861, was greatly expanded during the war as a training area for mechanized infantry and armored units (U.S. Army Installation Management Command 2013).

3.2.7 Modern Era (1945–Present)

The major trends in Kentucky history after World War II were the developments of transportation networks and civil rights. The construction of the interstate highway system and state turnpikes, and the rise of state parks were major economic developments and contributed significantly to the state's tourism industry (The Columbia Electronic Encyclopedia 2013). Industry continued to supplant agriculture in terms of economic importance, and during the energy crises of the 1970s, Kentucky mines saw increased demands for their coal as access to foreign fuels became hindered (Channing 1977). In the 1970s, Kentucky's urban population began to outnumber its rural population (Channing 1977).

The Civil Rights movement in Kentucky made great early progress due in part to support from progressive governor Lawrence Wetherby. In the mid-1950s, Wetherby promoted school desegregation in the state and refused to sign a statement supported by many other southern governors that opposed integration after the Supreme Court's decision in the *Brown v. Board of Education* case (Kebler 1986). In 1963, Governor Edward Thompson Breathitt won the gubernatorial election by promoting racial equality (Brinson and Williams 2001). Governor Breathitt supported the Civil Rights Act of 1964, and was successful in pushing a civil rights bill through the Kentucky State Assembly in 1966 (Brinson and Williams 2001). In spite of this progress, the African American population of Kentucky continues to be disproportionately affected by poverty, its associated crime, and underachievement (Kentucky Commission on Human Rights 2009).

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SECTION FOUR PREVIOUS INVESTIGATIONS

Background research was conducted using the National Park Service's (NPS) NRHP Focus online database (NPS 2013) and at the Office of State Archaeology (OSA) (FY13_7554). The search of the NPS Focus records found no archaeological sites listed in the NRHP in the project area or within a 2-kilometer (km) radius of the project area. The OSA file search was conducted between January 21 and 30, 2013. The work at OSA consisted of a review of professional survey reports and records of archaeological sites for an area encompassing a 2 km radius of the project footprint. To further characterize the archaeological resources in the general area, the OSA archaeological site database for the county was reviewed and synthesized. The professional survey reports and archaeological site data in the county provided basic information on the types of archaeological resources likely to occur in the project area and the landforms that were most likely to contain these resources. The results are discussed below.

OSA records revealed that 10 previous professional archaeological surveys have been conducted within a 2 km radius of the project area, and 20 archaeological sites are recorded in this area. An additional survey completed by Brockington and Associates within the 2 km area has not yet been entered into the OSA Geographic Information System.

The OSA records search revealed that three of the 20 sites in the file search area (15Hd411, 15Hd418, and 15Hd723) are historic farms/residences. One site (15Hd413) is a multi-component historic farm/residence and prehistoric open habitation without mounds. Two sites (15Hd256 and 15Hd258) are the locations of stone mounds. The remaining 14 sites (15Hd136, 15Hd137, 15Hd414–15Hd417, 15Hd419, 15Hd610, 15Hd611, 15Hd625, and 15Hd635–15Hd638) are prehistoric open habitations without mounds. The 2 km radius included areas within the Vine Grove, Kentucky, topographic quadrangle (USGS 1991).

4.1 PREVIOUS ARCHAEOLOGICAL INVESTIGATIONS

During the fall of 1978 and the spring and fall of 1979, University of Kentucky personnel conducted an archaeological survey of Fort Knox, Kentucky. The purpose of the surveys was two-fold: to establish a preliminary inventory of archaeological resources on Fort Knox, and to formulate the first approximation of a predictive model of site locations to help manage archaeological resources on the post. The survey was conducted at the request of the United States Army Armor Center and Fort Knox. Field methods consisted of pedestrian surveys and shovel testing. A total of 381 archaeological sites were documented during the course of the survey (O'Malley et al. 1980).

Four of these sites (15Hd136, 15Hd137, 15Hd256, and 15Hd258) were located within the 2 km radius of the current project area, though none are within the APE. Sites 15Hd136 and 15Hd137 are both open habitations without mounds and of indeterminate cultural/temporal affiliation. Site 15Hd136 exhibited evidence of intensive use and was considered potentially eligible for inclusion in the NRHP. Further investigation was recommended to assess its eligibility. Site 15Hd137 was considered an inventory site and not eligible for inclusion in the NRHP (O'Malley et al. 1980).

Site 15Hd256 represents the location of 16 limestone mounds. The date of construction is unknown, as is the site function. Site 15Hd258 represents the location of one limestone mound. The date of construction and site function are unknown for this site, as well. Neither site was assessed due to a lack of information (O'Malley et al. 1980).

In July of 1984, Janzen, Inc. conducted an archaeological survey of two proposed sewer lines for the Radcliff, Kentucky, sewer project in Hardin County, Kentucky (Janzen 1984). The survey was conducted at the request of Winnie Gleason of GRW Engineers in Lexington, Kentucky. Line "D" was 262 m (865 feet [ft]) in length and Line "I" was approximately 975 m (3,200 ft) in length. Field methods consisted of pedestrian survey and shovel testing along both proposed sewer lines. No archaeological sites were identified, and no further work was recommended.

On April 19, 1986, Arrow Enterprises conducted a cultural resource survey of the proposed Fort Knox Substation near Radcliff in Hardin County, Kentucky (Schock 1986). At the request of Doug Oliver of East Kentucky Power Cooperative in Winchester, Kentucky, approximately 0.8 ha (2.0 acres) were investigated by pedestrian survey and shovel testing. No archaeological sites were documented, and project clearance was recommended.

Between February and April of 1998, Pamela A. Schenian conducted an archaeological survey of 15 proposed pine pulpwood harvest tracts in Training Areas 3, 4, 8, 10, and 14 in Fort Knox, Hardin and Meade Counties, Kentucky. A total of 74.7 ha (184.4 acres) were investigated by pedestrian survey and supplemented with shovel testing. Four archaeological sites (15Hd604–15Hd606 and 15Md424) were documented during the course of the survey, none of which were within the 2 km radius (Schenian 1998).

On November 19, 1999, CRA conducted an archaeological survey of the proposed Radcliff cellular communication tower site in Hardin County, Kentucky (Bybee 1999). The survey was conducted at the request of Julia Weigel of ATC Associates, Inc., in Louisville, Kentucky, on behalf of Crown Communication, Inc. (KY032P-A). Approximately 0.35 ha (0.88 acre) were investigated by intensive pedestrian survey and supplemented with shovel testing. No archaeological sites were identified, and no further work was recommended.

In September 2001, Jack M. Schock of Arrow Enterprises conducted an archaeological survey of approximately 67 ha (166 acres) for the proposed Industrial Park in Hardin County, Kentucky (Schock 2001). The survey was conducted at the request of Jesse Lee on behalf of the City of Radcliff. One site (15Hd625) was recorded during this survey; it is not located within the APE. Site 15Hd625 was a low-density, prehistoric lithic scatter. One Late Archaic hafted biface and a few non-diagnostic artifacts were recovered. This site was restricted to plow zone context, and no further work was recommended.

In July and August of 2003, Brian C. King of CRA conducted an archaeological survey for the proposed Elizabethtown to Radcliff Connector in Hardin County. The survey was performed at the request of Tom Springer of QK4 on behalf of the Kentucky Transportation Cabinet. Approximately 259.21 ha (640.52 acres) were investigated by pedestrian survey supplemented with screened shovel testing and controlled surface collection. Eight archaeological sites and

four isolated finds were documented as a result of the survey, four of which were located within 2 km of the proposed Hardin County project (King 2003).

Site 15Hd635 is a moderate-density lithic scatter with an Early Archaic component. The soils were disturbed by agricultural use and the site was determined not eligible for inclusion in the NRHP. No further work was recommended. Sites 15Hd636–15Hd638 are open habitations without mounds consisting of low-density lithic scatters of indeterminate cultural/temporal affiliation. All of the artifacts were confined to the plow zone. The sites were considered not eligible for inclusion in the NRHP, and no further work was recommended (King 2003).

Between March 8 and June 4, 2004, 864 ha (2,135 acres) of proposed training areas at the United States Army Garrison in Fort Knox, Kentucky, were investigated by Gray & Pape, Inc. (Pritchard et al. 2004). The survey was conducted at the request of ICI, LLC, on behalf of the United States Army Garrison. Field methods consisted of surface inspection and screened shovel testing. One previously identified archaeological site (15Hd630) and 17 previously unidentified archaeological sites (15Bu652–15Bu662, 15Hd659–15Hd663, and 15Md460) were documented during the survey. None of these sites were located within the 2 km radius.

In October of 2007, Brockington and Associates, Inc., conducted an archaeological survey of 19 ha (48 acres) leased to the City of Radcliff for a proposed fire training facility in Fort Knox, Kentucky (Temple and Pritchard 2007). The survey was conducted at the request of ICI Services, LLC, in Dumfries, Virginia, on behalf of the United States Army Garrison in Fort Knox, Kentucky. Field methods consisted of pedestrian survey supplemented with screened shovel tests. The survey documented the previously identified Shelton Cemetery and one previously unidentified site (15Hd723).

Site 15Hd723 is a late-nineteenth- to early-twentieth-century farmstead site represented by a brick-lined beehive cistern. No artifacts or additional cultural features were identified. The site was considered not eligible for inclusion in the NRHP, and no further work was recommended (Temple and Pritchard 2007).

Between April 30 and August 10, 2007, Brockington and Associates, Inc., conducted an intensive archaeological and historical evaluation of 29 previously identified archaeological sites and a survey of 252 ha (622 acres). They conducted this work in support of proposed improvements at Godman Airfield and proposed widening and improvement of Wilson Road at the United States Army Installation of Fort Knox in Bullitt, Hardin, and Meade Counties, Kentucky (Allgood and Allgood 2008). The survey was conducted at the request of ICI Services, LLC, in Dumfries, Virginia, on behalf of the United States Army Garrison in Fort Knox, Kentucky. Field methods consisted of systematic screened shovel testing. In addition to the evaluation of the previously documented sites (15Bu308, 15Bu321, 15Bu388, 15Bu389, 15Bu526, 15Bu527, 15Hd114, 15Hd116, 15Hd131, 15Hd144, 15Hd179, 15Hd214, 15Hd245, 15Hd246, 15Hd250–15Hd252, 15Hd403, 15Hd459, 15Hd494, 15Hd543, 15Hd548–15Hd550, 15Hd590, 15Hd610, 15Hd611, 15Hd618, and 15Md172), two previously unidentified sites were documented (15Hd721 and 15Hd722). Sites 15Hd610 and 15Hd611 were located within the 2 km project radius.

Site 15Hd610 was originally documented by Fort Knox personnel in 1997. The site was recorded as an open habitation site with Middle Woodland/Late Woodland/Late Prehistoric occupation. At that time, intact soils were noted despite disturbance to the site from military activities, and additional work was recommended to determine the site’s significance status (Schenian 1997). When revisited, the site had been completely destroyed by military activities. No cultural material was noted or collected. The site was considered not eligible for inclusion in the NRHP (Allgood and Allgood 2008).

Site 15Hd611 was originally documented as an open habitation of unknown cultural/temporal affiliation by Fort Knox personnel in 1997. The site was beneath a dirt road in a graded area surrounding the Gunning Cemetery. Intact soils were noted despite disturbance to the site from military activities and grading of the road. The NRHP status was not assessed, and further work was recommended (Schenian 1997). When the site was revisited, it was heavily disturbed. No diagnostic materials were recovered, and due to a lack of integrity, the site was considered not eligible for inclusion in the NRHP. No further work was recommended (Allgood and Allgood 2008).

On March 29, 2010, Arrow Enterprises conducted an archaeological survey for a proposed housing project in Radcliff, Hardin County, Kentucky (Schock 2010). At the request of Richard Pierce of PDC Companies in Little Rock, Arkansas, 2 ha (5 acres) were investigated by pedestrian survey. No archaeological sites were identified, and project clearance was recommended.

4.2 ARCHAEOLOGICAL SITE DATA

The OSA records show that prior to this survey, 609 archaeological sites had been recorded in Hardin County, none of which are located within the APE (Table 4-1). The majority of previously recorded archaeological sites in Hardin County are reported to be prehistoric open habitations without mounds (n = 308; 50.57 percent) and historic farms/residences (n = 102; 16.75 percent). Other site types recorded in the county consist of cave (n = 1; 0.16 percent), cemetery (n = 14; 2.3 percent), earth mound (n = 4; 0.66 percent), industrial (n = 4; 0.66 percent), isolated find (n = 11; 1.81 percent), military (n = 3; 0.49 percent), mound complex (n = 5; 0.82 percent), open habitation with mounds (n = 1; 0.16 percent), other (n = 15; 2.46 percent), other special activity area (n = 33; 5.42 percent), quarry (n = 2; 0.33 percent), rockshelter (n = 13; 2.13 percent), stone mound (n = 10; 1.64 percent), undetermined (n = 60; 9.85), unspecified (n = 7; 1.15 percent), and workshop (n = 16; 2.63 percent).

Table 4-1: Previously Recorded Archaeological Sites in Hardin County*

Site Type	N**	%
Cave	1	0.16
Cemetery	14	2.3
Earth Mound	4	0.66
Historic Farm/Residence	102	16.75
Industrial	4	0.66

Site Type	N**	%
Isolated Find	11	1.81
Military	3	0.49
Mound Complex	5	0.82
Open Habitation With Mounds	1	0.16
Open Habitation Without Mounds	308	50.57
Other	15	2.46
Other Special Activity Area	33	5.42
Quarry	2	0.33
Rockshelter	13	2.13
Stone Mound	10	1.64
Undetermined	60	9.85
Workshop	16	2.63
Unspecified	7	1.15
Total	609	100
Time Periods Represented:	N	%
Paleoindian	11	1.56
Archaic	107	15.16
Woodland	83	11.76
Late Prehistoric	27	3.82
Indeterminate Prehistoric	227	32.15
Historic	177	25.07
Unspecified	74	10.48
Total	706**	100
Landform:	N	%
Dissected Uplands	267	43.84
Floodplain	129	21.18
Hillside	66	10.84
Other	1	0.16
Terrace	91	14.94
Undissected Uplands	46	7.55
Unspecified	9	1.48
Total	609	100

*Data obtained from OSA and may contain coding errors.

** One site may represent more than one time period.

Most sites recorded in Hardin County are situated on dissected uplands (n = 267; 43.84 percent) and floodplains (n = 129; 21.18 percent). The remaining sites in the county are on hillsides (n = 66; 10.84 percent), other (n = 1; 0.16 percent), terraces (n = 91; 14.94 percent), undissected

uplands (n = 46; 7.55 percent), and unspecified (n = 9; 1.48 percent). The landform types in the current project area are dissected uplands, floodplains, hillsides, and terraces.

Sites most commonly located on dissected uplands are open habitations without mounds (n = 121; 45.32 percent), historic farms/residences (n = 65; 24.34 percent), and other special activity areas (n = 24; 8.99 percent). The predominant site types situated on floodplains are open habitations without mounds (n = 87; 67.44 percent) and historic farms/residences (n = 12; 9.3 percent). Hillsides within Hardin County are represented mostly by rockshelters (n = 12; 18.18 percent), historic farms/residences (n = 11; 16.67 percent), and open habitations without mounds (n = 11; 16.67 percent). The majority of site types on terrace landforms are open habitations without mounds (n = 54; 59.34 percent), undetermined (n = 27; 29.67 percent), and historic farm/residences (n = 6; 6.59 percent).

4.3 MAP DATA

In addition to the file search, a review of available maps was initiated to help identify potential historic properties (buildings and structures) or historic archaeological site locations within the proposed project area. The following maps were reviewed:

- 1925 Oil and Gas Map of Hardin County, Kentucky (Pirtle and Miller)
- 1936 Geological Map of Hardin County, Kentucky (Wilder)
- 1937 Highway and Transportation Map of Hardin County, Kentucky (Kentucky Department of Highways [KDOH])
- 1946 Vine Grove, Kentucky, 15-minute series topographic quadrangle (U.S. Geological Survey [USGS])
- 1949 General Highway Map of Hardin County, Kentucky (KDOH)
- 1958 General Highway Map of Hardin County, Kentucky (KDOH)
- 1960 Vine Grove, Kentucky, 7.5-minute series topographic quadrangle (USGS)
- 1991 Vine Grove, Kentucky, 7.5-minute series topographic quadrangle (USGS)

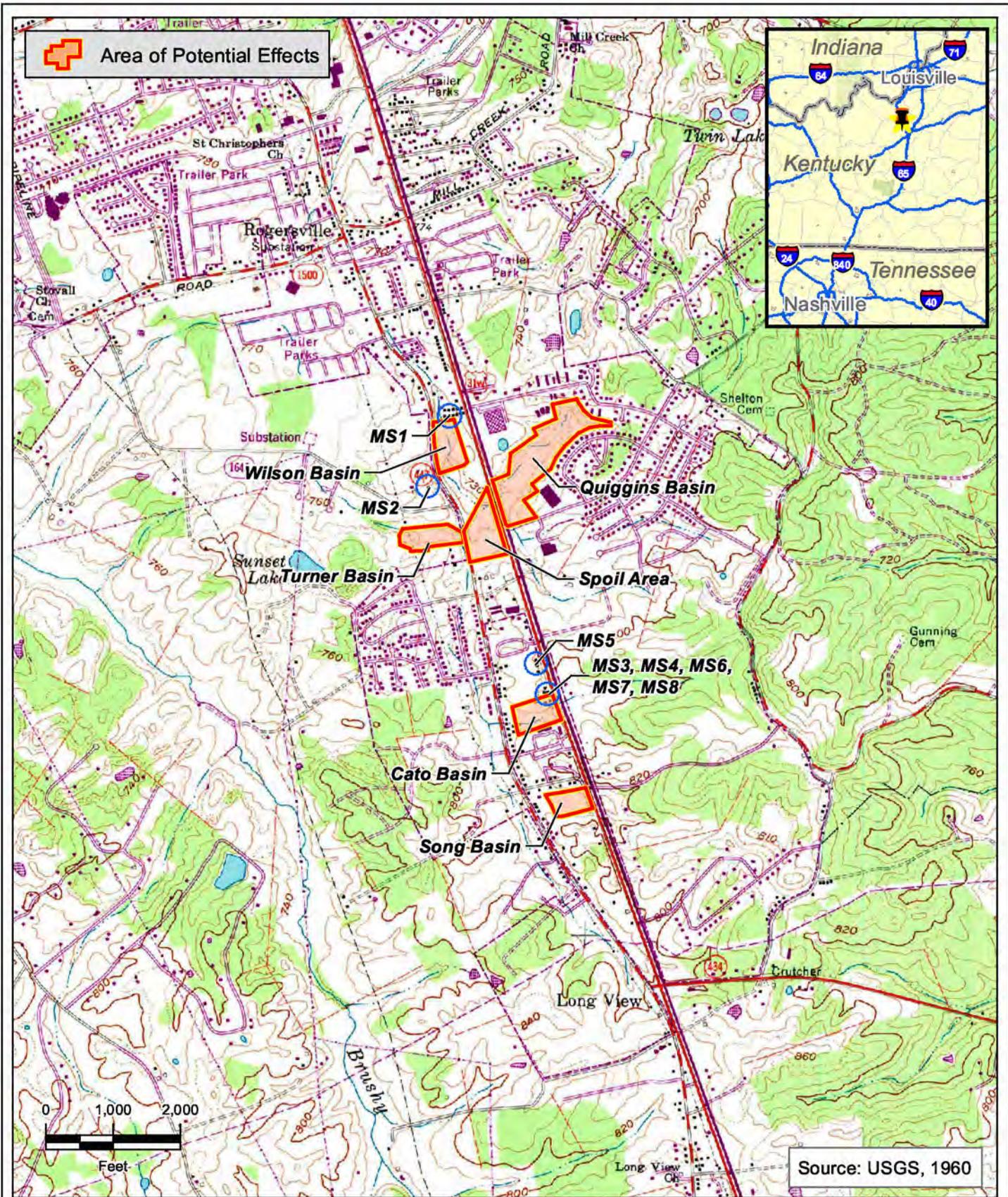
The historic maps provided useful information about the general locations of current and former buildings and structures within and adjacent to the project area. The maps indicated that at least eight map structures (MS) were located in or near the proposed project area. All areas near possible map structures were investigated for archaeological deposits according to accepted survey methods, as described in the methods section of this report. The field investigations determined that two of these buildings (MS 6 and MS 7) corresponded to an archaeological site location (15Hd963). Detailed information regarding the historic map search is provided below.

The earliest map to accurately depict structures within or near the project area is the 1946 USGS map. This map depicts five buildings (MS 1–5) within or near the project area (Figure 4-1), all of which appear to have been residences. On the 1960 USGS map, MS 1 is difficult to identify

because it appears to have been incorporated into a row with five additional buildings (Figure 4-2). However, the remaining three buildings (MS 2–4) identified on the earlier map are all still clearly discernible. Two additional residences (MS 6 and 7) and an outbuilding (MS 8) are also depicted on the 1960 map. The historic materials recovered from Site 15Hd963, located within the Cato Basin APE, almost certainly relate to the former residential structures MS 6 and MS 7.

4.4 SURVEY PREDICTIONS

We can make certain predictions about the kinds of sites that might be encountered in the project area by considering the known distribution of sites in the county, the available information on site types recorded, and the nature of the present project area. Because several buildings are in the project area on the reviewed historic maps, historic sites were the primary site types expected. In addition, the project area included floodplain and terrace landforms, so prehistoric open habitation sites were also considered a possibility.



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1	TITLE 1960 USGS Map
	 12420 Milestone Center Dr. Germantown, MD 20876
PROJ NO 15702708	FIGURE 4-2

1/03/04/1/rev05/FEMARegionIV - Quiggins Sinkhole Phase 1 Annotated
 US Data Map generated by USGS/Project/1960_ar_01_2013/03/29/13.mxd

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SECTION FIVE RESEARCH DESIGN

5.1 OBJECTIVES

The objectives of the Phase I archeological survey were to identify archeological sites within the project area and, if any, assess them, if possible for potential NRHP eligibility. Background research was conducted to assist in the identification of previously recorded archaeological resources and contextualize any sites documented as a result of the field investigations.

5.2 METHODS

5.2.1 Research

Background research was conducted using the NRHP NPS Focus online database (NPS 2013) and at the OSA (FY13_7554). The purpose of the research was to determine if the project area had been previously surveyed for archaeological resources; identify any previously recorded sites that were situated within the project area; provide information concerning what archaeological resources could be expected within the project area; and provide a context for any sites recovered within the project area. Historic maps were used to identify potential historic-era structures that could be in the APE.

5.2.2 Field Survey

The proposed project area encompassed six non-contiguous, irregular shaped parcels of land. The individual parcels ranged in size from 1.9 to 9.7 ha (4.6 to 24.0 acres) and had a combined area of approximately 22.9 ha (56.6 acres), all of which were surveyed. The project area was determined by mapping and confirmed in the field with a Magellan MobileMapper 6 global positioning system (GPS) unit.

Field methods were commensurate with topographic setting and past and current land uses. Figures 5-1 and 5-2 depict the survey methods used within each specific area. Areas subjected to pedestrian survey that were found to be previously disturbed are depicted with a different color than areas with no obvious previous ground disturbance. All relatively level portions of the project area that lacked standing water or obvious evidence of disturbance were subjected to systematic screened shovel testing on a 20 m- (66 ft)-interval grid. The shovel test pit (STP) interval was reduced to 10 m (33 ft) when cultural materials were encountered, as was the case around site 15Hd963 and IF-1. All STPs measured at least 35 cm (14 inches) in diameter and extended well into subsoil. All soil removed from the STPs was screened through 0.64 cm (0.25-inch) mesh hardware cloth, and the sidewalls and bottoms of each STP were examined for cultural material and features. In total, 200 STPs were excavated within the APE.

Sections of the project area that were located on steep slopes or appeared significantly disturbed were subjected to intensive pedestrian survey, which consisted of walking parallel transects at 20 m intervals and visually inspecting the ground surface for cultural material and features. Low-lying areas that appeared to be subject to regular flooding (e.g., the western half of Quiggins Basin and a large portion of the Spoil Area) were subjected to intensive pedestrian survey

supplemented with judgmentally placed STPs. Finally, stream banks displaying clear stratigraphy (e.g., in the Turner Lane Basin) were cleaned and examined for cultural deposits and features. The resulting profiles were drawn and photographed.

Several portions of the project area had been previously disturbed by construction, demolition, landscaping, and/or trenching for underground utilities. The most heavily disturbed portions of the project area were those adjacent to US 31W. These included the western edge of the Quiggins Basin, the eastern half of the Spoil Area, and the eastern edges of the Cato and Song Basins.

5.2.3 Laboratory Analysis

All artifacts were transported to CRA for processing and analysis. Initial processing of the recovered artifacts involved washing the artifacts and sorting them into major material classes. After they dried, the artifacts were analyzed, cataloged, and rebagged according to provenience. CRA analyzed and cataloged artifact data was entered into an MS Access 2000 database based on provenience, group, material, form, decoration, function, vessel segment, color, and quantity. The objectives of laboratory processing and analysis were to determine—to the extent possible—the date, function, cultural affiliation, and potential significance of artifacts, as well as to prepare the artifacts for curation.

Following analysis by CRA, the artifacts and project documentation were transported to the URS laboratory in Gaithersburg, Maryland, for entry into the project MS Access database and accessioning in advance of possible curation. The final disposition of the artifacts has not been determined. They will be either curated with a facility approved by the Kentucky Heritage Council or returned to the landowners. The artifact catalog is included as Appendix A.

All prehistoric lithic artifacts were analyzed and cataloged using standardized procedures. The following information was recorded for lithic artifacts: count, weight, material type, group, class, and, as applicable, subclass. When possible, percent cortex was estimated (0, less than 50 percent, or greater than or equal to 50 percent) and the type of cortex was recorded. The only prehistoric group recovered was debitage.

Historic artifacts were classified using Orser's (1988) functional typology (Table 5-1), which provides a means for interpreting the function of specific historic artifact classes. Within Orser's system, historic artifacts were analyzed according to material type and function, when possible. A sixth category, Unknown, was added to the functional typology to better capture unidentified artifacts. An additional subcategory was also added to the labor category, 5c. Household, to capture artifacts used during household work, e.g., cleaning products.

Map No.: n054-5e109-10 2006
 FSA/NAIP Color Ortho Imagery. Kentucky
 Environmental and Public Protection Cabinet.
 Office of Information Services.



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PROJ	Happy Valley Flood Mitigation, Hardin Co., KY		
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TITLE	Field Survey Methods	
 12420 Milestone Center Dr. Germantown, MD 20876	PROJ NO	15702708
	FIGURE	5-1

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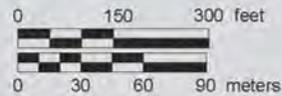
Map No.: n054-5e109-10 2006
 FSA/NAIP Color Ortho Imagery, Kentucky
 Environmental and Public Protection Cabinet,
 Office of Information Services.



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LEGEND

- Archaeological Site
- Disturbed Area (Pedestrian Survey)
- Pedestrian Survey
- Project Boundary
- Shovel Test Survey



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TITLE Field Survey Methods		PROJ NO	15702708
URS 12420 Milestone Center Dr. Germantown, MD 20876		FIGURE	5-2

Table 5-1: Functional Typology (Modified from Orser 1988)

1. Foodways

- a. Procurement – Ammunition, fishhooks, fishing weights, etc.
- b. Preparation – Baking pans, cooking vessels, large knives, etc.
- c. Service – Fine earthenware, flatware, tableware, etc.
- d. Storage – Coarse earthenware, stoneware, glass bottles, canning jars, bottle stoppers, etc.
- e. General Foodways – Unidentified glass and ceramic containers
- f. Floral – Nut shells, seeds, fruit pits, phytoliths, pollen
- g. Faunal – Animal bones, antlers, horns, shells, and other remains.

2. Clothing

- a. Fasteners – Buttons, eyelets, snaps, hooks, eyes, etc.
- b. Manufacture – Needles, pins, scissors, thimbles, etc.
- c. Other – Shoe leather, metal shoe shanks, clothes hangers, etc.

3. Household/Structural

- a. Architectural/Construction – Nails, flat glass, spikes, mortar, bricks, slate, etc.
- b. Hardware – Hinges, tacks, nuts, bolts, staples, hooks, brackets, etc.
- c. Furnishings/Accessories – Stove parts, furniture pieces, lamp parts, fasteners, etc.

4. Personal

- a. Medicinal – Medicine bottles, droppers, etc.
- b. Cosmetic – Hairbrushes, hair combs, jars, etc.
- c. Recreational – Smoking pipes, toys, musical instruments, souvenirs, etc.
- d. Monetary – Coins, etc.
- e. Decorative – Jewelry, hairpins, hatpins, spectacles, etc.
- f. Other – Pocketknives, fountain pens, pencils, ink wells, etc.

5. Labor

- a. Agricultural – Barbed wire, horse shoes, harness buckles, hoes, plow blades, scythe blades, etc.
- b. Industrial – Tools, etc.
- c. Household – Household cleaning products, iron, etc.

6. Unknown

- a. Miscellaneous Artifacts

SECTION SIX SURVEY RESULTS

One previously unrecorded archaeological site (15Hd963) and one Isolated Find (IF-1) were documented and their locations are shown on Figure 6-1. These resources are described below.

6.1 SITE 15HD963

6.1.1 Site Description

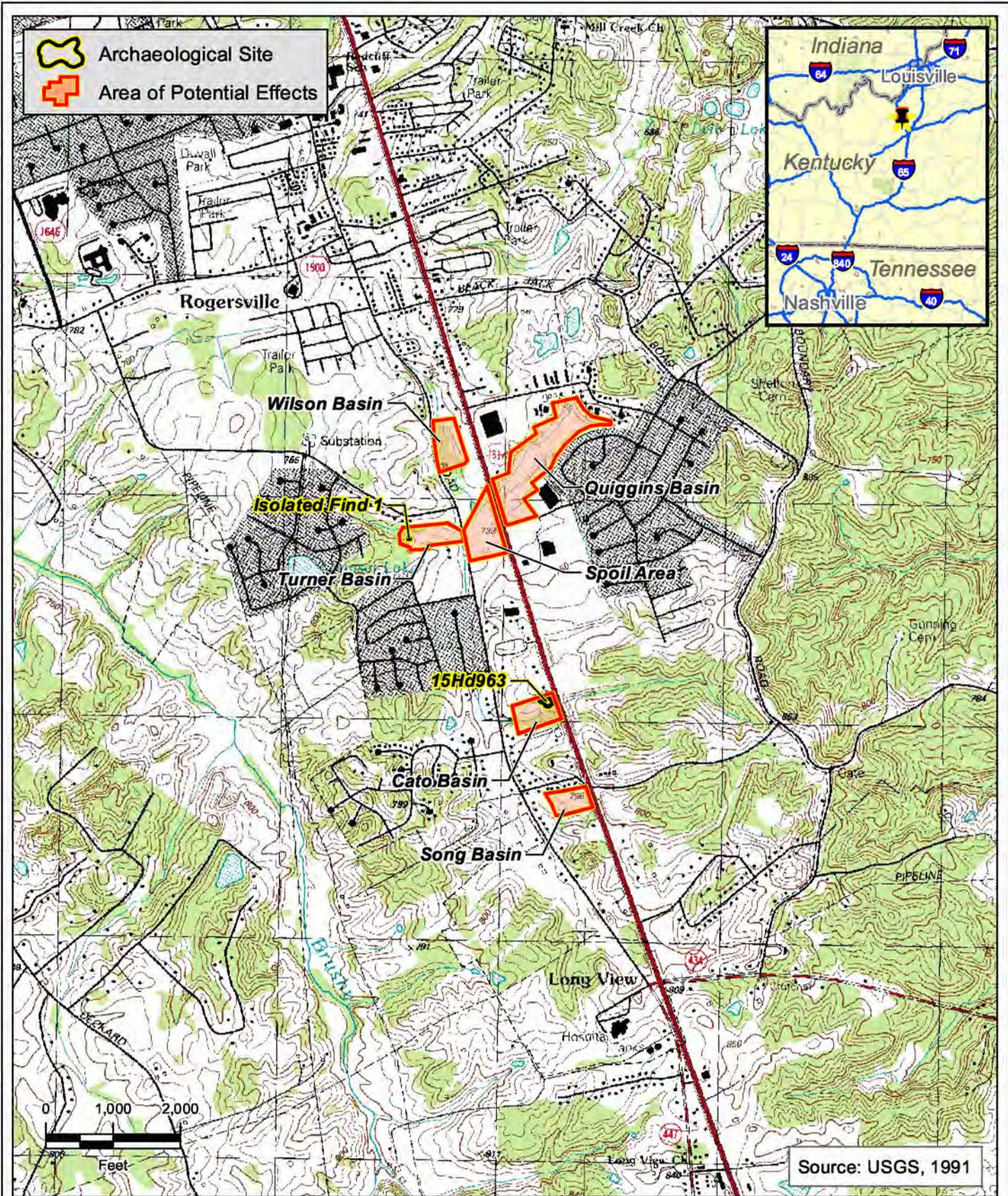
Site 15Hd963 is a twentieth-century, historic farm/residence represented by a light scatter of historic material, an outdoor oven feature, and a subterranean cistern feature. It is located approximately 400 m (1,312 ft) northwest of the intersection of U.S. 31W and Nails Lane in Radcliff, Hardin County, Kentucky (Figure 6-1), which corresponds to the location of a collection of buildings depicted on the 1946 and 1960 USGS maps enumerated as MS 3, MS 4, MS 6, MS 7, and MS 8 (Figures 4-1 and 4-2). The site was situated at an elevation of approximately 232 m (760 ft) above mean seal level (AMSL) on a gently sloping hillside, close to an unnamed, intermittent creek. Vegetation at the site consisted of long grass and weeds, and surface visibility was poor throughout (Figure 6-2). A summary of site data can be found in Table 6-1.

Table 6-1: Summary of Site 15Hd963

Category	Data
Elevation	232 m (760 ft) AMSL
Component(s)	Twentieth century
Site types(s)	Historic farmstead/residence
Size	2,000 sq m (21,528 sq ft)
Distance to nearest water	12 m (39 ft)
Direction to nearest water	South
Type and extent of previous disturbance	Demolition, road construction
Topography	Hillside
Vegetation	Long grass, weeds
Ground surface visibility	Poor
Aspect	Flat
Recommended NRHP status	Not eligible

Notes: m = meter; ft = feet; AMSL = above mean seal level; sq m = square meters; sq ft = square feet

Site dimensions, which were determined by the presence of cultural material recovered from shovel tests, were approximately 40 m (131 ft) north–south by 50 m (164 ft) east–west, totaling 2,000 sq m (21,528 sq ft) (Figure 6-3). The site was bounded by disturbance associated with U.S. 31W to the east, an unnamed drainage to the south, negative STPs to the west, and the project boundary to the north. It is probable that the site extends beyond the project boundary to the north.



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TITLE
Archaeological Site Locations



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Germantown, MD 20876

PROJ NO 15702708

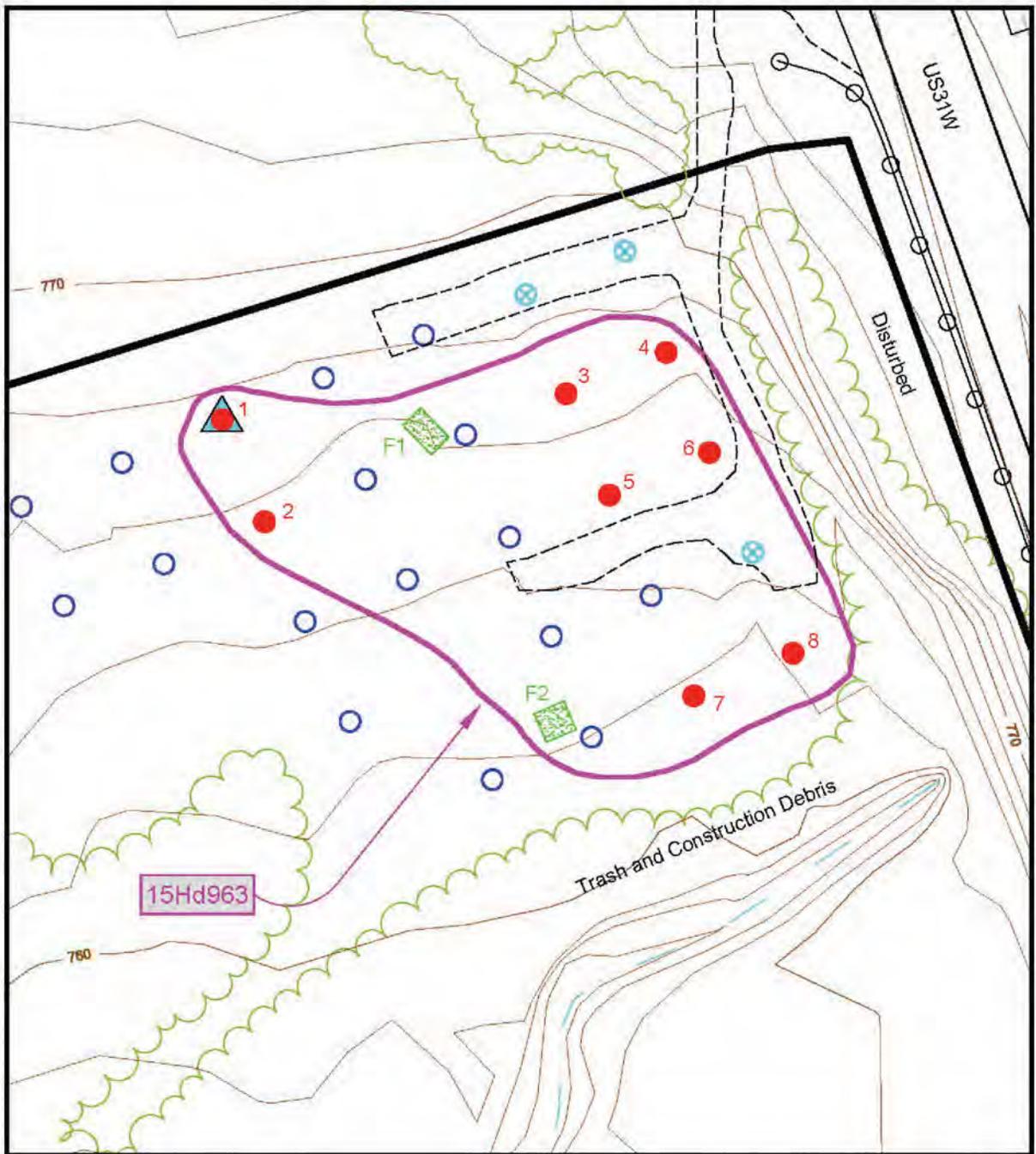
FIGURE 6-1

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Figure 6-2. General Overview of 15Hd963, Facing Southwest.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Quiggins Sinkhole Phase I Archaeology							
REVISION NO	0	DES BY	BAK	04/17/2013	 12420 Milestone Center Dr. Germantown, MD 20876		FIGURE
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LEGEND

- Archaeological Site
- 750 — Contour Line (feet AMSL)
- ▲ Datum: KYSP-Single, NAD83 (N38135351, E4872439)
- Feature
- Gravel
- Negative Shovel Test
- Not Excavated Shovel Test
- Positive Shovel Test
- Project Boundary
- — — — Stream
- Vegetation



0 10 20 30 50 feet
0 5 10 15 meters

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PROJ Happy Valley Flood Mitigation, Hardin Co., KY				
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TITLE Schematic Plan of Site 15Hd963		PROJ NO	15702708
 12420 Milestone Center Dr. Germantown, MD 20876		FIGURE	6-3

6.1.2 Investigation Methods

The site was initially identified as a result of pedestrian survey. The entire site area was subjected to systematic screened shovel testing on a 10 m (33 ft) grid until two consecutive negative STPs were excavated in a row, the project boundary or landform edge was reached, or disturbance was encountered. A total of 16 STPs were excavated within the site boundaries, eight of which yielded historic artifacts. All artifacts from the STPs were bagged according to the STP provenience. An arbitrary datum of N1000 E1000 was established at the location of STP 1. The locations of shovel tests and the datum were mapped with a hand-held Magellan MobileMapper GPS unit, and all site attributes, project boundaries, and physiographic features were drawn on a site plan.

6.1.3 Stratigraphy

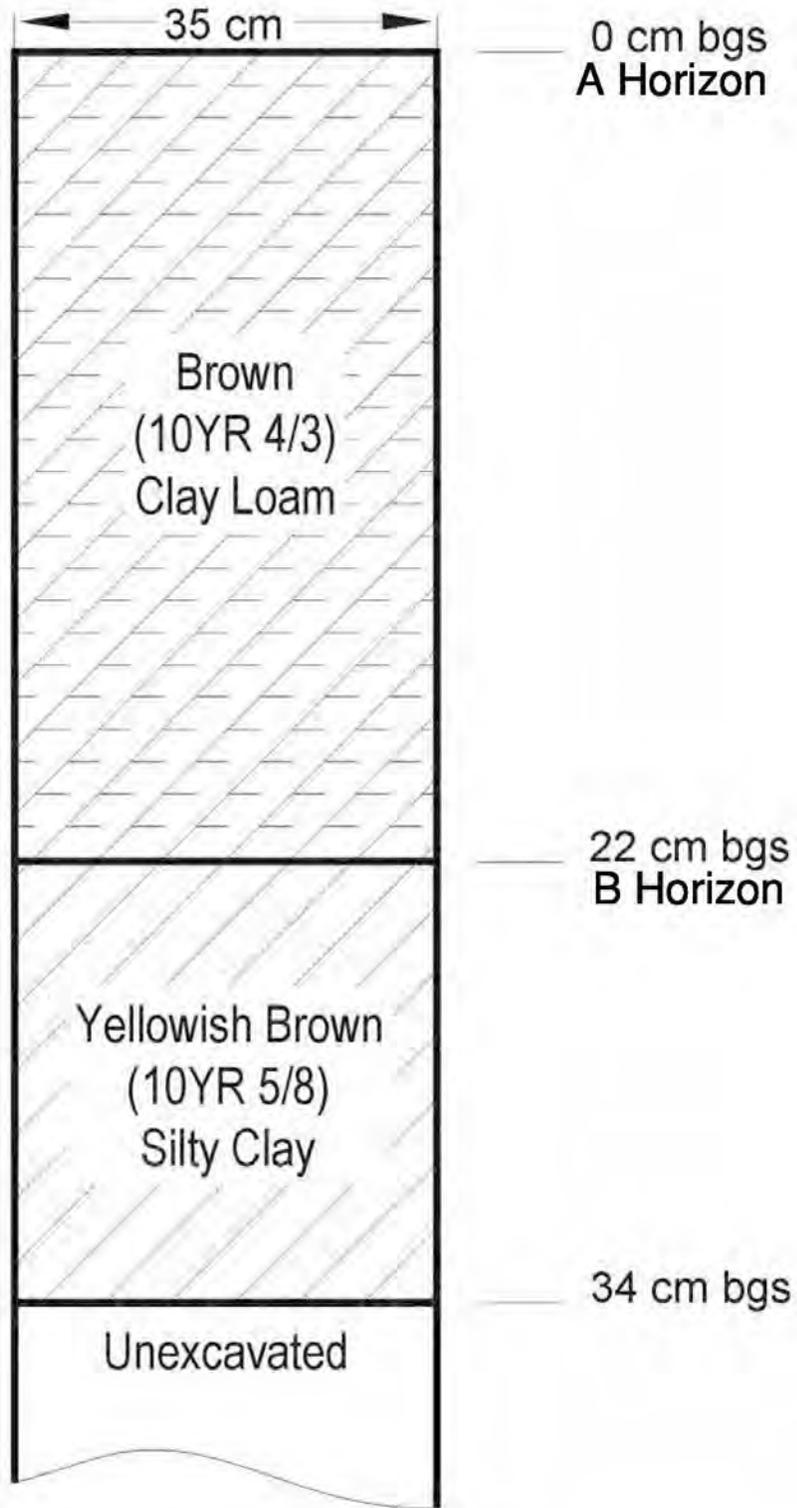
Soil profiles observed during field investigations consisted of a brown (10YR 4/3) silty clay loam A Horizon to approximately 22 cm (9 inches) below ground surface (bgs) followed by a yellowish brown (10YR 5/8) silty clay B Horizon to at least 34 cm (13 inches) bgs (Figure 6-4). The observed soils were generally consistent with both the Crider and Nicholson series soils mapped for the area.

6.1.4 Artifacts

In total, 21 artifacts were recovered from investigations at site 15Hd963 (Table 6-2). The artifacts consisted of Foodways (n = 9; 42.8 percent), Household/Structural (n = 11; 52.4 percent), and Unknown (n = 1; 4.8 percent) remains. The Foodways artifacts from the site consisted entirely of clear and brown glass from jars and/or bottles. The one Unknown artifact is a shard of cobalt blue glass, which could be representative of either the Foodways or Personal groups. Three of the glass shards contained markings consistent with automatic machine molded glass, which dates from the twentieth century to present. Household/Structural artifacts recovered from the included wire nails (n = 5), flat glass (n = 3), and asphalt shingles (n = 3). The wire nails date from 1890 to present.

Although only a low density of artifacts were recovered, they were clearly concentrated between two sections of a gravel driveway (STPs 3–6; Figure 6-3). These sections of driveway likely ran along the north and south sides of one of the former residences (probably MS 7) depicted in this location on the 1947 and 1960 USGS maps (Figures 4-1 and 4-2). The small concentration of material recovered in STPs 1 and 2, to the west of the main concentration, may relate to a second residence (MS 6), which is also depicted on the 1947 and 1960 USGS maps (Figure 4-2). Over 75 percent of the artifacts were recovered from the upper soil stratum. The five artifacts recovered from the lower soil stratum, two glass fragments and three asphalt shingle fragments, came from a single STP, STP 4, in the northeastern corner of the site.

15Hd963 Typical Profile



CLIENT FEMA Region IV						TITLE Representative Soil Profile from Site 15Hd963				
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						12420 Milestone Center Dr. Germantown, MD 20876				
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SCALE	N/A	DR BY	BAK	04/17/2013	FIGURE	6-4				
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Table 6-2: Artifacts Recovered from Site 15Hd963

STP	Stratum/Depth (cm bgs)	Group	Material/Form/Color	N=
1	I / 0-23	Household/Structural	Wire Nail	4
2	I / 0-18	Household/Structural	Aqua Window Glass	1
3	I / 0-22	Household/Structural	Aqua Window Glass	2
4	I / 0-14	Foodways	Clear Glass Fragment	1
		Foodways	Brown Glass Fragment	1
	II / 14-30	Foodways	Clear Glass Jar Fragment	1
		Foodways	Brown Glass Fragment	1
		Household/Structural	Asphalt Shingle	3
5	I / 0-13	Foodways	Clear Glass Fragment	1
6	I / 0-25	Foodways	Clear Glass Jar Fragment	1
		Foodways	Brown Glass Fragment	2
		Household/Structural	Wire Nail	1
7	I / 0-14	Foodways	Clear Glass Fragment	1
8	I / 0-12	Unknown	Cobalt Blue Glass Fragment	1
TOTAL				21

6.1.5 Features

The historic artifacts are almost certainly associated with two former residences (MS 6 and MS 7) that are depicted in this location on USGS maps dating to 1947 (Figure 4-1) and later. Extant evidence of these former structures included a gravel driveway (Figures 6-2 and 6-3) that approached the site from U.S. 31W, a variety of construction/demolition debris in the treeline to the south of the site (Figure 6-5), and two historic features (Features 1 and 2), which are described below.

Feature 1 (Figure 6-6) was located near the center of the site and consisted of a mortared stone barbecue/oven with chimney. The oven is surrounded by overgrown vegetation and appears to have been abandoned for some time. Large cracks in the mortar are present along all sides of the oven. Small metal doors are located on either side of the chimney, beneath the flat baking surface, which consists of concrete slabs. The center of the baking surface is open and contains a metal barbecue-grate. A rectangular opening is located at the center of the oven, along the ground, presumably for cleaning out ash or for venting. The feature is likely contemporary with residences MS 6 and MS 7, which first appeared on maps of the area in 1960.

Feature 2 was located in the southwest corner of the site and consisted of a subterranean cistern constructed of concrete blocks with a section of PVC pipe protruding from one wall (Figure 6-7). Only a small portion of this feature was exposed, so it was not possible to measure it accurately; however, its depth was estimated to be approximately 1.0 m (3.3 ft). This feature also appears to have been related to one of the former structures (MS 6 or MS 7) in this location.



Figure 6-5. Construction Debris in Treeline Immediately South of Site 15Hd963, Facing South.



Figure 6-6. General Overview of Front Face of Feature 1, Site 15Hd963, Facing Southwest.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Happy Valley Flood Mitigation, Hardin Co., KY						FIGURE 6-5 and 6-6	
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Figure 6-7. Close-up of Feature 2, Site 15Hd963.

CLIENT FEMA Region IV				TITLE Project Photographs		PROJ NO 15702708	
PROJ Quiggins Sinkhole Phase I Archaeology						FIGURE 6-7	
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6.2 ISOLATED FINDS

Isolated Find 1 (IF-1) was located at the western end of the Turner Lane Basin on a narrow spur overlooking an unnamed intermittent stream (Figure 6-1). Its Universal Transverse Mercator coordinates are E594570, N4184828, Zone 16, North American Datum of 1927. It consisted of three flakes recovered from a single STP. Two of the flakes were smaller than 0.25 inch in length and approximately 0.1 g (gram) in size. One of these flakes was of the locally occurring Ste. Genevieve chert, and the other was of indeterminate material. The remaining flake (0.5 g) represents the distal portion of a flake that may be of Muldraugh chert. This flake was most likely removed during core reduction activities. Pedestrian survey and shovel testing at 10 m (33 ft) intervals around IF-1 produced no additional cultural material or evidence of intact archaeological deposits. A summary of the isolated find can be found in Table 6-3.

Table 6-3: Summary of IF-1

Category	Data
Elevation	226 m (740 ft) AMSL
Component(s)	Indeterminate prehistoric
Distance to nearest water	50 m (164 ft)
Direction to nearest water	North
Type and extent of previous disturbance	Plowing, percent unknown
Topography	Hillside
Vegetation	Grass and weeds
Ground surface visibility	Less than 10 percent
Aspect	Gently sloping east

Notes: m = meters; ft = feet; AMSL = above mean sea level

SECTION SEVEN CONCLUSIONS AND RECOMMENDATIONS

URS, with support from its subcontractor CRA, conducted an archaeological survey of proposed flood control measures, including water retention ponds, in support of federal funding for the City of Radcliff's Quiggins Sinkhole/Happy Valley Flood Mitigation Project in Hardin County, Kentucky. This investigation was conducted for FEMA, Region IV to comply with federal regulations implementing Section 106 of the NHPA, concerning the effect of federal undertakings on historic properties listed in or eligible for listing in the NRHP. For the purposes of the archaeological survey, the APE was the six individual basins and spoil areas, covering a combined area of approximately 22.9 ha (56.6 acres).

The current investigations resulted in the discovery of one previously unidentified archaeological site (15Hd963) and one Isolated Find (IF-1) located within the APE of the proposed project. No other archaeological sites are located within the project APE. Site 15Hd963 is the remains of a twentieth-century historic farm/residence represented by a light scatter of historic material, an outdoor oven feature, and a subterranean cistern feature. Historic map research indicated a collection of buildings at this location in the mid-twentieth century. The recovered materials from 15Hd963 included a low density of twentieth-century artifacts consistent with the map data. STP profiles show no evidence of significant subsurface deposits. In addition, a large portion of the site had been destroyed by demolition activities prior to this investigation. For these reasons, Site 15Hd963 lacks research potential and is recommended as not eligible for inclusion in the NRHP.

IF-1 consisted of three pieces of prehistoric lithic debitage recovered from a single STP. Given the low density of materials, little else can be said concerning the prehistoric use of this area. IF-1 does not qualify for an archaeological site number and is, therefore, not eligible for inclusion in the NRHP.

URS concludes that no historic properties will be affected by the proposed project's undertaking. No further investigations are recommended.

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Appendix A
Artifact Catalog

Quiggens Sinkhole Phase I

Catalog #	Count	Group	Material	Form	Color	Dec tech/Manuf tech	Comments
Site #: 15HD963							
STP: 1		N 1000	E 1000	Stratum: I	Level:	Feature:	
2.1	3	Household/Structural	Iron	Wire nail			
2.2	1	Household/Structural	Iron	Wire nail			
STP: 2		N 990	E 1000	Stratum: I	Level:	Feature:	
3.1	1	Household/Structural	Glass	Window	Aqua		
STP: 3		N 990	E 1030	Stratum: I	Level:	Feature:	
4.1	2	Household/Structural	Glass	Window	Aqua		
STP: 4		N 1010	E 1040	Stratum: I	Level:	Feature:	
5.1	1	Foodways	Glass	Fragment	Colorless		
5.2	1	Foodways	Glass	Fragment	Brown		
STP: 4		N 1010	E 1040	Stratum: II	Level:	Feature:	
6.1	1	Foodways	Glass	Jar	Colorless	Automatic machine molded	Threaded
6.2	1	Foodways	Glass	Fragment	Brown		
6.3	3	Household/Structural	Asphalt	Shingle			Discarded in lab
STP: 5		N 980	E 1030	Stratum: I	Level:	Feature:	
7.1	1	Foodways	Glass	Fragment	Colorless		
STP: 6		N 980	E 1040	Stratum: I	Level:	Feature:	
8.1	1	Foodways	Glass	Jar	Colorless	Automatic machine molded	Threaded, embossed "FOR.."
8.2	1	Foodways	Glass	Fragment	Brown	Automatic machine molded	Suction scar, embossed "...B-28"
8.3	1	Foodways	Glass	Fragment	Brown		
8.4	1	Household/Structural	Iron	Wire nail			
STP: 7		N 960	E 1030	Stratum: I	Level:	Feature:	
9.1	1	Foodways	Glass	Fragment	Colorless		Large ribbing, thick walls, possible cola bottle?

Additional attribute data are included in the electronic database.

Quiggens Sinkhole Phase I

<i>Catalog #</i>	<i>Count</i>	<i>Group</i>	<i>Material</i>	<i>Form</i>	<i>Color</i>	<i>Dec tech/Manuf tech</i>	<i>Comments</i>
STP: 8		N 960	E 1040	Stratum: I	Level:		Feature:
10.1	1	Unknown	Glass	Fragment	Blue		Embossed "MADE IN..."

Site #: IF-1

<i>STP:</i>	<i>Count</i>	<i>Group</i>	<i>Material</i>	<i>Form</i>	<i>Color</i>	<i>Dec tech/Manuf tech</i>	<i>Comments</i>
1		N 1000	E 1000	Stratum: I	Level:		Feature:
1.1	1	Debitage	Chert	Flake			Smooth cortex, local cobble
1.2	2	Debitage	Chert	Flake			

Grand Total 24

Additional attribute data are included in the electronic database.

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Appendix B
Qualifications of Investigators

Appendix B

Qualifications of Investigators

Robert Karwedsky, M.S. Rob Karwedsky has 34 years of experience as a professional archeologist specializing in cultural resource management. Mr. Karwedsky maintains an extensive knowledge of the regulations at 36 CFR 800 implementing Section 106 of the National Historic Preservation Act and what is required for agency (and contractor) compliance with those regulations. He has spent most of his career as the District Archaeologist for the U.S. Army Corps of Engineers, Nashville District, where he conducted compliance studies and administered contracts for historic and archaeological services in Kentucky, Tennessee, Alabama, and Mississippi. He received his Master's Degree in Anthropology from Florida State University.

Gavin Davies. Mr. Davies is currently serving as a staff archaeologist at CRA. He has directed at least 40 archaeological survey projects in Kentucky for CRA from 2003 to 2006 and 2012 to the present. He has also been a field technician for numerous other survey, testing, and data recovery projects in those years. Before joining CRA, Mr. Davies specialized in Mesoamerican studies at the University of Liverpool with a concentration on the Olmec, and earned a postgraduate diploma in Professional Archaeology from the University of Oxford. After working at CRA for several years, he returned to Scotland to obtain a graduate degree in Bronze Age archaeology at the University of Edinburgh. In 2009, Mr. Davies returned to Kentucky to resume his interest in Mesoamerican studies at the University of Kentucky in pursuit of a doctoral degree. He has completed his coursework and is currently investigating the Maya in Guatemala and the Mexican Yucatan. He is also a Mesoamerican ceramic specialist.

Ralph Koziarski, PhD. Ralph Koziarski has over 12 years of experience in cultural resources management and archaeological research in the Midwest, Southwest, and Pacific Northwestern regions of the United States. His career experience includes field direction, crew supervision and project management of archaeological survey, site testing, and data recovery projects in various environments ranging from arid deserts to temperate rain forests, bottom lands, and coastal zones. He has managed and directed projects for clients that ranged from private landowners and commercial developers to federal and tribal entities, and municipal governments. Among these were the Federal Communications Commission, the U.S. Army Corps of Engineers, Whatcom County, Washington, and the Stillaguamish Tribe of Indians Department of Natural Resources. In addition, he has extensive experience in faunal analysis, public outreach, and education. Dr. Koziarski holds an MS and PhD in Anthropology with a focus on Zooarchaeology from the University of Wisconsin-Milwaukee.

Scott Seibel, MSc, RPA. Scott Seibel has over 15 years of professional experience in archaeological excavations, research and compliance studies and exceeds the *Secretary of the Interior's Professional Qualification Standards* (36 CFR Part 61). He is the Archaeology Program Manager for the URS Germantown's Cultural Resource Management Group. Mr. Seibel has extensive cultural resource management experience, having served as Principal Investigator or Field Director for over 10,000 acres of Phase I archaeological surveys, dozens of Phase II evaluations and 11 Phase III data recovery excavations within the Southeast, Mid-Atlantic, and Texas. He received his Bachelor's Degree in Archaeological Studies at the University of Texas at Austin and his Master's Degree in Archaeomaterials at the University of Sheffield in England.

APPENDIX D
AGENCY CORRESPONDENCE



STEVEN L. BESHEAR
GOVERNOR

LEONARD K. PETERS
SECRETARY

ENERGY AND ENVIRONMENT CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WATER
200 FAIR OAKS LANE, 4TH FLOOR
FRANKFORT, KENTUCKY 40601
www.kentucky.gov
May 22, 2014

City of Radcliff
Attention: Toby Spalding
411 West Lincoln Trail Boulevard
Radcliff, Kentucky 40160

Re: Water Quality Certification #2014-023-1
Quiggins Stream Restoration and Flood
Mitigation Project
USACE ID No.: LRL-2013-1015-mlc
AI No.: 120558; Activity ID: APE20140001
Unnamed Tributaries to Mill Creek
Hardin County, Kentucky

Dear Mr. Spalding:

Pursuant to Section 401 of the Clean Water Act (CWA), the Commonwealth of Kentucky certifies it has reasonable assurances that applicable water quality standards under Kentucky Administrative Regulations Title 401, Chapter 10, established pursuant to Sections 301, 302, 303, 304, 306, and 307 of the CWA, will not be violated by the above referenced project provided that the U.S. Army Corps of Engineers authorizes the activity under 33 CFR part 330, and the attached conditions are met.

All future correspondence on this project must reference **AI No. 120558**. **The attached document is your official Water Quality Certification; please read it carefully.** If you should have any questions concerning the conditions of this water quality certification, please contact Chloe Brantley of my staff at Chloe.Brantley@ky.gov or (502) 564-3410 Extension 4863.

Sincerely,

Adam Jackson, Supervisor
Water Quality Certification Section
Kentucky Division of Water

AJ:CB

Attachments

cc: Toby Spalding, City of Radcliff (via email: tspalding@radcliff.org)
Meagan Chapman, USACE: Louisville District (via email: Meagan.L.Chapman@usace.army.mil)
Lee Andrews, USFWS: Frankfort (via email: Teresa_Welch@fws.gov)
Kiersten Fuchs, Redwing Ecological Services, Inc. (via email: kfuchs@redwingeco.com)
Matt Blake Redwing Ecological Services, Inc. (via email: mblake@redwingeco.com)
Brad Anderson, Redwing Ecological Services, Inc. (via email: banderson@redwingeco.com)
Dale Reynolds, Green and Tradewater Rivers Basin Coordinator (via email: Dale.reynolds@ky.gov)

STEVEN L. BESHEAR
GOVERNOR



LEONARD K. PETERS
SECRETARY

ENERGY AND ENVIRONMENT CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WATER
200 FAIR OAKS LANE, 4TH FLOOR
FRANKFORT, KENTUCKY 40601
www.kentucky.gov

ATTENTION APPLICANT

If your project involves one or more of the following activities, you may need more than one permit from the Kentucky Division of Water.

- *building in a floodplain *road culvert in a stream**
- *streambank stabilization *stream cleanout**
- *utility line crossing a stream**
- *construction sites greater than 1 acre**

- **Construction sites greater than 1 acre will require the filing of a Notice of Intent to be covered under the KPDES General Stormwater Permit. This permit requires the creation of an erosion control plan.**
Contact: Surface Water Permits Branch (SWPB) Support at (502) 564-3410 or SWPBsupport@ky.gov
- **Projects that involve filling in the floodplain will require a floodplain construction permit from the Water Resources Branch.**
Contact: Todd Powers
- **Projects that involve work IN a stream, such as bank stabilization, road culverts, utility line crossings, and stream alteration will require a floodplain permit and a Water Quality Certification from the Division of Water.**
Contact: Adam Jackson

All three contacts listed above can be reached at (502) 564-3410. A complete listing of environmental programs administered by the Kentucky Department for Environmental Protection is available from Pete Goodmann by calling (502) 564-3410.

GENERAL CONDITIONS FOR WATER QUALITY CERTIFICATION

1. Measures shall be taken to prevent or control spills of fuels, lubricants, or other toxic materials used in construction from entering the watercourse.
2. All dredged material shall be removed to an upland location and/or graded on adjacent areas (so long as such areas are not regulated wetlands), to obtain original streamside elevations, i.e. overbank flooding shall not be artificially obstructed.
3. In areas not riprapped or other wise stabilized, revegetation of stream banks and riparian zones shall occur concurrently with project progression. At a minimum, revegetation will approximate pre-disturbance conditions.
4. To the maximum extent practicable, all instream work under this certification shall be performed during low flow.
5. Heavy equipment, e.g. bulldozers, backhoes, draglines, etc., if required for this project, should not be used or operated within the stream channel. In those instances where such instream work is unavoidable, then it shall be performed in such a manner and duration as to minimize resuspension of sediments and disturbance to substrates and bank or riparian vegetation.
6. Any fill or riprap including refuse fill, shall be of such composition that it will not adversely affect the biological, chemical, or physical properties of the receiving waters and/or cause violations of water quality standards. If riprap is utilized, it is to be of such weight and size that bank stress or slump conditions will not be created because of its placement.
7. If there are water supply intakes located downstream that may be affected by increased turbidity and suspended solids, the permittee shall notify the operator when work will be done.
8. Removal of existing riparian vegetation should be restricted to the minimum necessary for project construction.
9. Should evidence of stream pollution or jurisdictional wetland impairment and/or violations of water quality standards occur as a result of this activity (either from a spill or other forms of water pollution), the Kentucky Division of Water shall be notified immediately by calling 800/564-2380.

Water Quality Certification

Quiggins Stormwater Basin Site

Facility Requirements

Permit Number:2014-023-1

Activity ID No.: APE20140001

ACTV000000002 (Unnamed Tributaries to Mill Creek) Quiggins Stream Restoration and Flood Mitigation Project:

Submittal/Action Requirements:

Condition No.	Condition
S-1	The City of Radcliff shall submit notification: Due prior to any construction activity to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor at least 2 weeks prior to the beginning of construction. [Clean Water Act]
S-2	The City of Radcliff shall submit notification: Due when construction is complete to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor. [Clean Water Act]
S-3	The City of Radcliff shall submit as-built drawings: Due within 90 days after completion of construction to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor. [Clean Water Act]
S-4	The City of Radcliff shall submit a monitoring report: Due annually, by the 31st of December to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor. The initial monitoring report shall be due after the first year of project establishment and due annually for five years. This monitoring report must follow the approved mitigation plan. [Clean Water Act]
S-5	The City of Radcliff shall submit written notification: Due at the conclusion of the five (5) year postclosure monitoring period requesting the release of the mitigation site from the monitoring requirements to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor. [Clean Water Act]
S-6	The City of Radcliff shall submit a deed restriction: Due when construction is complete A copy of the deed restriction shall be submitted to and approved by to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor prior to release of the site from monitoring requirements. [Clean Water Act]

Water Quality Certification

Quiggins Stormwater Basin Site

Facility Requirements

Permit Number:2014-023-1

Activity ID No.: APE20140001

ACTV0000000002 (continued):

Narrative Requirements:

Condition No.	Condition
T-1	<p>The work approved by this certification shall be limited to the proposed Quiggins Stream Restoration and Flood Mitigation project in Hardin County, Kentucky (Latitude: 37.811N; Longitude: -85.919W). The proposed project includes the construction of a stormwater detention basin to alleviate flooding issues and provide temporary flood storage upstream of the Quiggins sinkhole and re-establishment of degraded intermittent and ephemeral streams in the bottom of the basin to handle low-flow and stormwater events using natural channel design techniques. In addition, an earthen berm will be repaired in the basin to cover an exposed sewerline and a walking path would be constructed along the top of the berm. The impacts to jurisdictional surface waters include the following:</p> <ul style="list-style-type: none">- Permanent impact to approximately 1,735 linear feet (0.28 acre) of one poor quality intermittent stream- Permanent impact to approximately 2,105 linear feet (0.16 acre) of eight poor quality ephemeral streams <p>Total stream restoration activities proposed in the project include:</p> <ul style="list-style-type: none">- 1,945 linear feet of intermittent stream re-establishment- 2,211 linear feet of ephemeral stream re-establishment, including the removal of a concrete ditch and restoration of 550 linear feet of ephemeral stream channel <p>A riparian buffer (minimum of 50 feet wide along streams) will also be established in the bottom of the basin except for the 550 linear feet of the restored ephemeral stream channel which will have an average of a 15 to 20-foot riparian buffer due to constraints of the existing property boundaries.</p> <p>The long-term success of the proposed stream restoration activities will be evaluated through a five-year monitoring period. Stream stability and vegetation establishment will be quantitatively and qualitatively monitored and annual reports will be submitted to the authorizing agencies to track the progress of the stream mitigation establishment. [Clean Water Act]</p>
T-2	<p>All work performed under this certification shall adhere to the design and specifications set forth in the following documents received by the Kentucky Division of Water:</p> <ul style="list-style-type: none">- 401 Water Quality Certification Application received February 26, 2014- Quiggins Stream Restoration and Flood Mitigation Project, Hardin County, Kentucky received May 8, 2014- Pre-Construction Notification or Nationwide Permit # 27 for Quiggins Stream Restoration and Flood Mitigation Project, Corps ID NO. LRL-2013-1015-mlc. Open date: May 19, 2014; Close date May 28, 2014 <p>- In addition, a site delineation verification visit was conducted January 9, 2014. [Clean Water Act]</p>

Water Quality Certification

Quiggins Stormwater Basin Site

Facility Requirements

Permit Number:2014-023-1

Activity ID No.: APE20140001

ACTV0000000002 (continued):

Narrative Requirements:

Condition No.	Condition
T-3	To document and assess the potential for sedimentation in the stream channels, as-built cross sections, monitoring reports, and Rapid Bioassessment Protocols (RBPs) for use in streams will be evaluated during the five year monitoring period. If degradation through sedimentation is evident or success criteria is not met through the monitoring period, the Kentucky Division of Water, 401 Water Quality Certification Section may request extened monitoring and/or an in-lieu fee payment if the proposed mitigation is determined to not be successful. [Clean Water Act]
T-4	The City of Radcliff is responsible for preventing degradation of waters of the Commonwealth from soil erosion. An erosion and sedimentation control plan must be designed, implemented, and maintained in effective operating condition at all times during construction. [Clean Water Act]
T-5	The City of Radcliff shall properly revegetate and conduct invasive exotic species control in all areas of impacted and/or exposed soils immediately after construction is complete through permanent seeding and planting, mulching, and straw and/or erosion control matting/blanket applications. Streambanks shall be restored with native herbaceous and woody species and erosion control matting/blanketing. [Clean Water Act]
T-6	The Division of Water reserves the right to modify or revoke this certification should it be determined that the activity is in noncompliance with any condition set forth in this certification. [Clean Water Act]
T-7	If construction does not commence within one year of the date of this letter, this certification will become void. A letter requesting a renewal should be submitted. [Clean Water Act]
T-8	Other permits from the Division of Water may be required for this activity. If this activity occurs within a floodplain, a Permit to Construct Across or Along a Stream may be required. Please contact Todd Powers (502-564-3410) for more information. If the project will disturb one acre or more of land, or is part of a larger common plan of development or sale that will ultimately disturb one acre or more of land, a Kentucky Pollution Discharge Elimination System (KPDES) stormwater permit shall be required from the Surface Water Permits Branch. This permit requires the development of a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP must include erosion prevention and sediment control measures. Contact: Surface Water Permits Branch (SWPB) Support (502-564-3410 or SWPBsupport@ky.gov). [Clean Water Act]
T-9	Dredging work shall not be conducted during the fish spawning season, April 15th through June 15th. [Clean Water Act]
T-10	Mitigation for impacts shall begin prior to or concurrently with impacts. [Clean Water Act]
T-11	Check dams are not allowed within the stream channel. [Clean Water Act]

Water Quality Certification

Quiggins Stormwater Basin Site

Facility Requirements

Permit Number:2014-023-1

Activity ID No.: APE20140001

ACTV0000000002 (continued):

Narrative Requirements:

Condition

No. Condition

T-12 Remove all sediment and erosion control measures after re-vegetation has become well-established. [Clean Water Act]



STEVEN L. BESHEAR
GOVERNOR

LEONARD K. PETERS
SECRETARY

ENERGY AND ENVIRONMENT CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WATER
200 FAIR OAKS LANE, 4TH FLOOR
FRANKFORT, KENTUCKY 40601
www.kentucky.gov

May 29, 2014

City of Radcliff
Attention: Toby Spalding
411 West Lincoln Trail Boulevard
Radcliff, Kentucky 40160

Re: Water Quality Certification #2014-026-1
Cato Basin Flood Mitigation Project
USACE ID No.: LRL-2014-280-jea
AI No.: 120558; Activity ID: APE20140003
Unnamed Tributaries to Mill Creek
Hardin County, Kentucky

Dear Mr. Spalding:

Pursuant to Section 401 of the Clean Water Act (CWA), the Commonwealth of Kentucky certifies it has reasonable assurances that applicable water quality standards under Kentucky Administrative Regulations Title 401, Chapter 10, established pursuant to Sections 301, 302, 303, 304, 306, and 307 of the CWA, will not be violated by the above referenced project provided that the U.S. Army Corps of Engineers authorizes the activity under 33 CFR part 330, and the attached conditions are met.

All future correspondence on this project must reference AI No. 120558. The attached document is your official Water Quality Certification; please read it carefully. If you should have any questions concerning the conditions of this water quality certification, please contact Chloe Brantley of my staff at Chloe.Brantley@ky.gov or (502) 564-3410 Extension 4863.

Sincerely,

Adam Jackson, Supervisor
Water Quality Certification Section
Kentucky Division of Water

AJ:CB

Attachments

cc:

Toby Spalding, City of Radcliff (via email: tspalding@radcliff.org)
Jane Archer, USACE: Louisville District (via email: Jane.E.Archer@usace.army.mil)
Lee Andrews, USFWS: Frankfort (via email: Teresa_Welch@fws.gov)
Kiersten Fuchs, Redwing Ecological Services, Inc. (via email: kfuchs@redwingeco.com)
Matt Blake Redwing Ecological Services, Inc. (via email: mblake@redwingeco.com)
Brad Anderson, Redwing Ecological Services, Inc. (via email: banderson@redwingeco.com)
Dale Reynolds, Green and Tradewater Rivers Basin Coordinator (via email: Dale.reynolds@ky.gov)

Water Quality Certification
Happy Valley Flood Mitigation Project
Facility Requirements
Permit Number: WQC#2014-026-1
Activity ID No.: APE20140003

ACTV000000003 (Unnamed Tributaries to Mill Creek) Cato Basin Flood Mitigation Project:

Submittal/Action Requirements:

Condition No.	Condition
S-1	The City of Radcliff shall submit notification: Due prior to any construction activity to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor. A copy of the purchase receipt of 868.8 calculated Adjusted Mitigation Units (AMUs) from the Kentucky Department of Fish and Wildlife Resources, Wetland and Stream Mitigation Program must be submitted for this authorization to be valid and before any fill activities or operations are conducted. [Clean Water Act]
S-2	A copy of the in-lieu fee receipt paid to Kentucky Department of Fish and Wildlife Resources, Wetland and Stream Mitigation Program must be submitted to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor before the beginning of construction. [Clean Water Act]

Narrative Requirements:

Condition No.	Condition
T-1	The work approved by this certification shall be limited to the proposed Cato Basin Flood Mitigation project in Hardin County, Kentucky (Latitude: 37.800647N; Longitude: -85.919151W). The proposed project includes the construction of a stormwater storage basin. The impacts to jurisdictional surface waters include the following: <ul style="list-style-type: none">- Permanent impact to approximately 624 linear feet (0.072 acre) of one poor quality intermittent stream- Permanent impact to approximately 200 linear feet (0.16 acre) of one poor quality ephemeral stream. [Clean Water Act]
T-2	All work performed under this certification shall adhere to the design and specifications set forth in the following documents received by by the Kentucky Division of Water: <ul style="list-style-type: none">- 401 Water Quality Certification Application received February 26, 2014- Preconstruction Notification for Nationwide Permit 43, Cato Basin Flood Mitigation Project, Hardin County, Kentucky received April 14, 2014. [Clean Water Act]
T-3	The City of Radcliff is responsible for preventing degradation of waters of the Commonwealth from soil erosion. An erosion and sedimentation control plan must be designed, implemented, and maintained in effective operating condition at all times during construction. [Clean Water Act]

Water Quality Certification
Happy Valley Flood Mitigation Project
Facility Requirements
Permit Number: WQC#2014-026-1
Activity ID No.: APE20140003

ACTV0000000003 (continued):

Narrative Requirements:

Condition No.	Condition
T-4	The Division of Water reserves the right to modify or revoke this certification should it be determined that the activity is in noncompliance with any condition set forth in this certification. [Clean Water Act]
T-5	If construction does not commence within one year of the date of this letter, this certification will become void. A letter requesting a renewal should be submitted. [Clean Water Act]
T-6	Other permits from the Division of Water may be required for this activity. If this activity occurs within a floodplain, a Permit to Construct Across or Along a Stream may be required. Please contact Todd Powers (502-564-3410) for more information. If the project will disturb one acre or more of land, or is part of a larger common plan of development or sale that will ultimately disturb one acre or more of land, a Kentucky Pollution Discharge Elimination System (KPDES) stormwater permit shall be required from the Surface Water Permits Branch. This permit requires the development of a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP must include erosion prevention and sediment control measures. Contact: Surface Water Permits Branch (SWPB) Support (502-564-3410 or SWPBsupport@ky.gov). [Clean Water Act]
T-7	Dredging work shall not be conducted during the fish spawning season, April 15th through June 15th. [Clean Water Act]
T-8	Mitigation for impacts shall begin prior to or concurrently with impacts. [Clean Water Act]
T-9	Check dams are not allowed within the stream channel. [Clean Water Act]
T-10	Remove all sediment and erosion control measures after re-vegetation has become well-established. [Clean Water Act]



STEVEN L. BESHEAR
GOVERNOR

LEONARD K. PETERS
SECRETARY

ENERGY AND ENVIRONMENT CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WATER
200 FAIR OAKS LANE, 4TH FLOOR
FRANKFORT, KENTUCKY 40601
www.kentucky.gov

May 29, 2014

City of Radcliff
Attention: Toby Spalding
411 West Lincoln Trail Boulevard
Radcliff, Kentucky 40160

Re: Water Quality Certification #2014-025-1
Fill Area Stream Restoration and Flood
Mitigation Project
USACE ID No.: LRL-2014-283-jea
AI No.: 120558; Activity ID:
APE20140001
Unnamed Tributaries to Mill Creek
Hardin County, Kentucky

Dear Mr. Spalding:

Pursuant to Section 401 of the Clean Water Act (CWA), the Commonwealth of Kentucky certifies it has reasonable assurances that applicable water quality standards under Kentucky Administrative Regulations Title 401, Chapter 10, established pursuant to Sections 301, 302, 303, 304, 306, and 307 of the CWA, will not be violated by the above referenced project provided that the U.S. Army Corps of Engineers authorizes the activity under 33 CFR part 330, and the attached conditions are met.

All future correspondence on this project must reference AI No. 120558. The attached document is your official Water Quality Certification; please read it carefully. If you should have any questions concerning the conditions of this water quality certification, please contact Chloe Brantley of my staff at Chloe.Brantley@ky.gov or (502) 564-3410 Extension 4863.

Sincerely,

Adam Jackson, Supervisor
Water Quality Certification Section
Kentucky Division of Water

Page Two
City of Radcliff

AJ:CB

Attachments

cc:

Toby Spalding, City of Radcliff (via email: tspalding@radcliff.org)
Jane Archer, USACE: Louisville District (via email: Jane.E.Archer@usace.army.mil)
Lee Andrews, USFWS: Frankfort (via email: Teresa_Welch@fws.gov)
Kiersten Fuchs, Redwing Ecological Services, Inc. (via email: kfuchs@redwingeco.com)
Matt Blake Redwing Ecological Services, Inc. (via email: mblake@redwingeco.com)
Brad Anderson, Redwing Ecological Services, Inc. (via email: banderson@redwingeco.com)
Dale Reynolds, Green and Tradewater Rivers Basin Coordinator (via email: Dale.reynolds@ky.gov)

Water Quality Certification
Happy Valley Flood Mitigation Project
Facility Requirements
Permit Number: WQC#2014-025-1
Activity ID No.: APE20140001

ACTV000000002 (Fill Area Stream Restoration & Flood Mitigation Pr) Unnamed Tributaries to Mill Creek:

Submittal/Action Requirements:

Condition No.	Condition
S-1	The City of Radcliff shall submit notification: Due prior to any construction activity to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor at least 2 weeks prior to the beginning of construction. [Clean Water Act]
S-2	The City of Radcliff shall submit as-built drawings: Due within 90 days after completion of construction to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor. [Clean Water Act]
S-3	The City of Radcliff shall submit a monitoring report: Due annually, by the 31st of December to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor. The initial monitoring report shall be due after the first year of project establishment and due annually for five years. This monitoring report must follow the approved mitigation plan. [Clean Water Act]
S-4	The City of Radcliff shall submit written notification: Due at the conclusion of the five (5) year postclosure monitoring period requesting the release of the mitigation site from the monitoring requirements to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor. [Clean Water Act]
S-5	The City of Radcliff shall submit a deed restriction: Due when construction is complete, a copy of the deed restriction shall be submitted to and approved by to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor prior to release of the site from monitoring requirements. [Clean Water Act]

Water Quality Certification
Happy Valley Flood Mitigation Project
Facility Requirements
Permit Number: WQC#2014-025-1
Activity ID No.: APE20140001

ACTV0000000002 (continued):

Narrative Requirements:

Condition No.	Condition
T-1	<p>the proposed work approved by this certification shall be limited to the proposed Fill Area Stream Restoration and Flood Mitigation project in Hardin County, Kentucky (Latitude: 37.808046N; Longitude: -85.921828W). The proposed project will reconnect and restore two degraded streams and alleviate flooding in Radcliff by providing a location for fill material placement during the construction of the five separate Happy Valley Flood Mitigation basin projects. The impacts to jurisdictional surface waters include the following:</p> <ul style="list-style-type: none">- Permanent impact to approximately 149 linear feet (0.02 acre) of two poor quality intermittent streams <p>Total stream restoration activities proposed in the project include:</p> <ul style="list-style-type: none">- 573 linear feet of intermittent stream re-establishment- A 50-foot wide riparian buffer will also be established along the re-established stream channel <p>The long-term success of the proposed stream restoration activities will be evaluated through a five-year monitoring period. Stream stability and vegetation establishment shall be quantitatively and qualitatively monitored and annual reports will be submitted to the authorizing agencies to track the progress of the stream mitigation establishment. [Clean Water Act]</p>
T-2	<p>All work performed under this certification shall adhere to the design and specifications set forth in the following documents received by the Kentucky Division of Water:</p> <ul style="list-style-type: none">- 401 Water Quality Certification Application received February 26, 2014- Preconstruction Notification for Nationwide Permit 27, Fill Area Stream Restoration and Flood Mitigation Project, Hardin County, Kentucky received May 22, 2014 <p>- In addition, a site delineation verification visit was conducted January 9, 2014. [Clean Water Act]</p>
T-3	<p>To document and assess the potential for sedimentation in the stream channels, as-built cross sections, monitoring reports, and Rapid Bioassessment Protocols (RBPs) for use in streams will be evaluated during the five year monitoring period. If degradation through sedimentation is evident or success criteria is not met through the monitoring period, the Kentucky Division of Water, 401 Water Quality Certification Section may request extended monitoring and/or an in-lieu fee payment to be submitted if the proposed mitigation is determined to not be successful. [Clean Water Act]</p>

Water Quality Certification
Happy Valley Flood Mitigation Project
Facility Requirements
Permit Number: WQC#2014-025-1
Activity ID No.: APE20140001

ACTV0000000002 (continued):

Narrative Requirements:

Condition No.	Condition
T-4	The City of Radcliff is responsible for preventing degradation of waters of the Commonwealth from soil erosion. An erosion and sedimentation control plan must be designed, implemented, and maintained in effective operating condition at all times during construction. [Clean Water Act]
T-5	The City of Radcliff shall properly revegetate and conduct invasive exotic species control in all areas of impacted and/or exposed soils immediately after construction is complete through permanent seeding and planting, mulching, and straw and/or erosion control matting/blanket applications. Streambanks shall be restored with native herbaceous and woody species and erosion control matting/blanketing. [Clean Water Act]
T-6	The Division of Water reserves the right to modify or revoke this certification should it be determined that the activity is in noncompliance with any condition set forth in this certification. [Clean Water Act]
T-7	If construction does not commence within one year of the date of this letter, this certification will become void. A letter requesting a renewal should be submitted. [Clean Water Act]
T-8	Other permits from the Division of Water may be required for this activity. If this activity occurs within a floodplain, a Permit to Construct Across or Along a Stream may be required. Please contact Todd Powers (502-564-3410) for more information. If the project will disturb one acre or more of land, or is part of a larger common plan of development or sale that will ultimately disturb one acre or more of land, a Kentucky Pollution Discharge Elimination System (KPDES) stormwater permit shall be required from the Surface Water Permits Branch. This permit requires the development of a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP must include erosion prevention and sediment control measures. Contact: Surface Water Permits Branch (SWPB) Support (502-564-3410 or SWPBsupport@ky.gov). [Clean Water Act]
T-9	Dredging work shall not be conducted during the fish spawning season, April 15th through June 15th. [Clean Water Act]
T-10	Mitigation for impacts shall begin prior to or concurrently with impacts. [Clean Water Act]
T-11	Check dams are not allowed within the stream channel. [Clean Water Act]
T-12	Remove all sediment and erosion control measures after re-vegetation has become well-established. [Clean Water Act]



STEVEN L. BESHEAR
GOVERNOR

LEONARD K. PETERS
SECRETARY

ENERGY AND ENVIRONMENT CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WATER
200 FAIR OAKS LANE, 4TH FLOOR
FRANKFORT, KENTUCKY 40601
www.kentucky.gov

May 30, 2014

City of Radcliff
Attention: Toby Spalding
411 West Lincoln Trail Boulevard
Radcliff, Kentucky 40160

Re: Water Quality Certification #2014-027-1
Turner Lane Stream Restoration and Flood
Mitigation Project
USACE ID No.: LRL-2014-281-jea
AI No.: 120558; Activity ID: APE20140005
Unnamed Tributary to Mill Creek
Hardin County, Kentucky

Dear Mr. Spalding:

Pursuant to Section 401 of the Clean Water Act (CWA), the Commonwealth of Kentucky certifies it has reasonable assurances that applicable water quality standards under Kentucky Administrative Regulations Title 401, Chapter 10, established pursuant to Sections 301, 302, 303, 304, 306, and 307 of the CWA, will not be violated by the above referenced project provided that the U.S. Army Corps of Engineers authorizes the activity under 33 CFR part 330, and the attached conditions are met.

All future correspondence on this project must reference **AI No. 120606**. **The attached document is your official Water Quality Certification; please read it carefully.** If you should have any questions concerning the conditions of this water quality certification, please contact Chloe Brantley of my staff at Chloe.Brantley@ky.gov or (502) 564-3410 Extension 4863.

Sincerely,

Adam Jackson, Supervisor
Water Quality Certification Section
Kentucky Division of Water

AJ:CB
Attachments

cc: Toby Spalding, City of Radcliff (via email: tspalding@radcliff.org)
Meagan Chapman, USACE: Louisville District (via email: Meagan.L.Chapman@usace.army.mil)
Lee Andrews, USFWS: Frankfort (via email: Teresa_Welch@fws.gov)
Kiersten Fuchs, Redwing Ecological Services, Inc. (via email: kfuchs@redwingeco.com)
Matt Blake Redwing Ecological Services, Inc. (via email: mblake@redwingeco.com)
Brad Anderson, Redwing Ecological Services, Inc. (via email: banderson@redwingeco.com)
Dale Reynolds, Green and Tradewater Rivers Basin Coordinator (via email: Dale.reynolds@ky.gov)

Water Quality Certification
Happy Valley Flood Mitigation Project
Facility Requirements
Permit Number: WQC#2014-027-1
Activity ID No.: APE20140005

ACTV0000000004 (Unnamed Tributary to Mill Creek) Turner Lane Stream Restoration and Flood Mitigation Project:

Submittal/Action Requirements:

Condition No.	Condition
S-1	The City of Radcliff shall submit notification: Due prior to any construction activity to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor at least 2 weeks prior to the beginning of construction. [Clean Water Act]
S-2	The City of Radcliff submit notification: Due when construction is complete to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor. [Clean Water Act]
S-3	The City of Radcliff submit as-built drawings: Due within 90 days after completion of construction to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor. [Clean Water Act]
S-4	The City of Radcliff shall submit a monitoring report: Due annually, by the 31st of December to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor. The initial monitoring report shall be due after the first year of project establishment and due annually for five years. This monitoring report must follow the approved mitigation plan. [Clean Water Act]
S-5	The City of Radcliff shall submit written notification: Due at the conclusion of the five (5) year postclosure monitoring period requesting the release of the mitigation site from the monitoring requirements to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor. [Clean Water Act]
S-6	The City of Radcliff shall submit a deed restriction: Due when construction is complete. A copy of the deed restriction shall be submitted to and approved by to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor prior to release of the site from monitoring requirements. [Clean Water Act]

Water Quality Certification
Happy Valley Flood Mitigation Project
Facility Requirements
Permit Number: WQC#2014-027-1
Activity ID No.: APE20140005

ACTV0000000004 (continued):

Narrative Requirements:

Condition No.	Condition
T-1	<p>The work approved by this certification shall be limited to the proposed Turner Lane Stream Restoration and Flood Mitigation project in Hardin County, Kentucky (Latitude: 37.807867N; Longitude: -85.924625W). The proposed project includes the restoration of a degraded stream and the construction of a stormwater storage basin to alleviate downstream flooding of roads and private properties in Radcliff. The impacts to jurisdictional surface waters include the following:</p> <ul style="list-style-type: none">- Permanent impact to approximately 912 linear feet (0.084 acre) of one poor quality intermittent stream <p>Total stream restoration activities proposed in the project include:</p> <ul style="list-style-type: none">- 912 linear feet of intermittent stream re-establishment <p>A 50 foot riparian buffer will also be established along the re-established stream channel</p> <p>The long-term success of the proposed stream restoration activities will be evaluated through a five-year monitoring period. Stream stability and vegetation establishment will be quantitatively and qualitatively monitored and annual reports will be submitted to the authorizing agencies to track the progress of the stream mitigation establishment. [Clean Water Act]. [Clean Water Act]</p>
T-2	<p>All work performed under this certification shall adhere to the design and specifications set forth in the following documents received by the Kentucky Division of Water:</p> <ul style="list-style-type: none">- 401 Water Quality Certification Application received February 26, 2014- Pre-Construction Notification or Nationwide Permit # 27 for Turner Lane Stream Restoration and Flood Mitigation Project, Hardin County, Kentucky received May 21, 2014 <p>- In addition, a site delineation verification visit was conducted January 9, 2014. [Clean Water Act]</p>
T-3	<p>To document and assess the potential for sedimentation in the stream channel, as-built cross sections, monitoring reports, and Rapid Bioassessment Protocols (RBPs) for use in streams will be evaluated during the five year monitoring period. If degradation through sedimentation is evident or success criteria is not met through the monitoring period, the Kentucky Division of Water, 401 Water Quality Certification Section may request extended monitoring and/or an in-lieu fee payment if the proposed mitigation is determined to not be successful. [Clean Water Act]</p>

Water Quality Certification
Happy Valley Flood Mitigation Project
Facility Requirements
Permit Number: WQC#2014-027-1
Activity ID No.: APE20140005

ACTV0000000004 (continued):

Narrative Requirements:

Condition No.	Condition
T-4	The City of Radcliff is responsible for preventing degradation of waters of the Commonwealth from soil erosion. An erosion and sedimentation control plan must be designed, implemented, and maintained in effective operating condition at all times during construction. [Clean Water Act]
T-5	The City of Radcliff shall properly revegetate and conduct invasive exotic species control in all areas of impacted and/or exposed soils immediately after construction is complete through permanent seeding and planting, mulching, and straw and/or erosion control matting/blanket applications. Streambanks shall be restored with native herbaceous and woody species and erosion control matting/blanketing. [Clean Water Act]
T-6	The Division of Water reserves the right to modify or revoke this certification should it be determined that the activity is in noncompliance with any condition set forth in this certification. [Clean Water Act]
T-7	If construction does not commence within one year of the date of this letter, this certification will become void. A letter requesting a renewal should be submitted. [Clean Water Act]
T-8	Other permits from the Division of Water may be required for this activity. If this activity occurs within a floodplain, a Permit to Construct Across or Along a Stream may be required. Please contact Todd Powers (502-564-3410) for more information. If the project will disturb one acre or more of land, or is part of a larger common plan of development or sale that will ultimately disturb one acre or more of land, a Kentucky Pollution Discharge Elimination System (KPDES) stormwater permit shall be required from the Surface Water Permits Branch. This permit requires the development of a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP must include erosion prevention and sediment control measures. Contact: Surface Water Permits Branch (SWPB) Support (502-564-3410 or SWPBsupport@ky.gov). [Clean Water Act]
T-9	Dredging work shall not be conducted during the fish spawning season, April 15th through June 15th. [Clean Water Act]
T-10	Mitigation for impacts shall begin prior to or concurrently with impacts. [Clean Water Act]
T-11	Check dams are not allowed within the stream channel. [Clean Water Act]
T-12	Remove all sediment and erosion control measures after re-vegetation has become well-established. [Clean Water Act]



STEVEN L. BESHEAR
GOVERNOR

LEONARD K. PETERS
SECRETARY

ENERGY AND ENVIRONMENT CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WATER
200 FAIR OAKS LANE, 4TH FLOOR
FRANKFORT, KENTUCKY 40601
www.kentucky.gov

May 29, 2014

City of Radcliff
Attention: Toby Spalding
411 West Lincoln Trail Boulevard
Radcliff, Kentucky 40160

Re: 401 Water Quality Certification Exemption
Song Basin Flood Mitigation Project
USACE ID No.: LRL-2014-284-jea
AI No: 120606; Activity ID: APE20140004
Unnamed Tributary to Mill Creek
Hardin County, Kentucky

Dear Mr. Spalding:

We have received your Application for Permit to Construct Across or Along a Stream and/or Water Quality Certification. Based on the information contained in this application, it appears that your project does not require a Section 401 Water Quality Certification because impacts associated with the proposed project are limited to 158 linear feet (0.01 acre) of poor, ephemeral stream for which stormwater management channels are proposed for mitigation. If this understanding of your project is incorrect or the scope of this project changes, contact our office for a re-evaluation; a Water Quality Certification may be required.

Although an Individual WQC is not needed, other permits from the Division of Water may be required. If this activity occurs within a floodplain, a Permit to Construct Across or Along a Stream may be required. Please contact Todd Powers (502-564-3410) for more information. If the project will disturb one acre or more of land, or is part of a larger common plan of development or sale that will ultimately disturb one acre or more of land, a Kentucky Pollution Discharge Elimination System (KPDES) stormwater permit shall be required from the Surface Water Permits Branch. This permit requires the development of a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP must include erosion prevention and sediment control measures. Contact: Surface Water Permits Branch (SWPB) Support (502-564-3410 or SWPBsupport@ky.gov)

You are responsible for preventing degradation of waters of the Commonwealth from soil erosion. All projects are required to implement best management practices, and any measures for sediment and erosion control must be maintained in effective operating condition at all times during construction.

Page Two

All future correspondence on this project must reference **AI No. 120606**. If you should have any questions concerning this letter, please contact me at Chloe.Brantley@ky.gov or (502) 564-3410 Extension 4863.

Sincerely,



Chloe Brantley, Project Manager
Water Quality Certification Section
Kentucky Division of Water

AJ:CB

cc: Toby Spalding, City of Radcliff (via email: tspalding@radcliff.org)
Jane Archer, USACE: Louisville District (via email: Jane.E.Archer@usace.army.mil)
Kiersten Fuchs, Redwing Ecological Services, Inc. (via email: kfuchs@redwingeco.com)
Matt Blake Redwing Ecological Services, Inc. (via email: mblake@redwingeco.com)
Brad Anderson, Redwing Ecological Services, Inc. (via email: banderson@redwingeco.com)



STEVEN L. BESHEAR
GOVERNOR

LEONARD K. PETERS
SECRETARY

ENERGY AND ENVIRONMENT CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WATER
200 FAIR OAKS LANE, 4TH FLOOR
FRANKFORT, KENTUCKY 40601
www.kentucky.gov

May 30, 2014

City of Radcliff
Attention: Toby Spalding
411 West Lincoln Trail Boulevard
Radcliff, Kentucky 40160

Re: 401 Water Quality Certification Exemption
Wilson Road Basin Flood Mitigation Project
USACE ID No.: LRL-2014-282-jea
AI No: 120606; Activity ID: APE20140006
Unnamed Tributaries to Mill Creek
Hardin County, Kentucky

Dear Mr. Spalding:

We have received your Application for Permit to Construct Across or Along a Stream and/or Water Quality Certification. Based on the information contained in this application, it appears that your project does not require a Section 401 Water Quality Certification because impacts associated with the proposed project are limited to 1,384 linear feet (0.078 acre) of four poor, ephemeral streams and 0.091 acre of wetland. Proposed mitigation for these impacts will consist of establishment of stormwater management channels for ephemeral stream impacts and the purchase of wetland mitigation credits from an approved wetland mitigation bank in the Salt River Watershed. **The required purchased of wetland mitigation credits are calculated at 0.2 acre and the City of Radcliff must provide documentation of the purchase of these credits to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor.** If this understanding of your project is incorrect or the scope of this project changes, contact our office for a re-evaluation; a Water Quality Certification may be required.

Although an Individual WQC is not needed, other permits from the Division of Water may be required. If this activity occurs within a floodplain, a Permit to Construct Across or Along a Stream may be required. Please contact Todd Powers (502-564-3410) for more information. If the project will disturb one acre or more of land, or is part of a larger common plan of development or sale that will ultimately disturb one acre or more of land, a Kentucky Pollution Discharge Elimination System (KPDES) stormwater permit shall be required from the Surface Water Permits Branch. This permit requires the development of a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP must include erosion prevention and sediment control measures. Contact: Surface Water Permits Branch (SWPB) Support (502-564-3410 or SWPBsupport@ky.gov)

You are responsible for preventing degradation of waters of the Commonwealth from soil erosion. All projects are required to implement best management practices, and any measures for sediment and erosion control must be maintained in effective operating condition at all times during construction.



STEVEN L. BESHEAR
GOVERNOR

LEONARD K. PETERS
SECRETARY

ENERGY AND ENVIRONMENT CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WATER
200 FAIR OAKS LANE, 4TH FLOOR
FRANKFORT, KENTUCKY 40601
www.kentucky.gov

April 7, 2014

City of Radcliff
Attention: Toby Spalding
411 West Lincoln Trail Boulevard
Radcliff, Kentucky 40601

Re: 401 Water Quality Certification Exemption
Happy Valley Flood Mitigation Project-
Alternate Basin
AI No: 120606; Activity ID: APE20140002
USACE ID No. LRL-2014-15-mlc
Hardin County, Kentucky

Dear Mr. Spalding:

We have received your Application for Permit to Construct Across or Along a Stream and/or Water Quality Certification. Based on the information contained in this application, it appears that your project does not require a Section 401 Water Quality Certification due to jurisdictional impacts below our thresholds and conditions. The purpose of the project is to alleviate flooding in Radcliff by providing stormwater storage through the construction of a stormwater storage basin. The proposed permanent impacts to jurisdictional waters will include approximately 0.053 acre of emergent/scrub wetland and 0.034 acre of open water pond. If this understanding of your project is incorrect or the scope of this project changes, contact our office for a re-evaluation; a Water Quality Certification may be required.

Although an Individual WQC is not needed, other permits from the Division of Water may be required. If this activity occurs within a floodplain, a Permit to Construct Across or Along a Stream may be required. Please contact Todd Powers (502-564-3410) for more information. If the project will disturb one acre or more of land, or is part of a larger common plan of development or sale that will ultimately disturb one acre or more of land, a Kentucky Pollution Discharge Elimination System (KPDES) stormwater permit shall be required from the Surface Water Permits Branch. This permit requires the development of a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP must include erosion prevention and sediment control measures. Contact: Surface Water Permits Branch (SWPB) Support (502-564-3410 or SWPBsupport@ky.gov)

You are responsible for preventing degradation of waters of the Commonwealth from soil erosion. All projects are required to implement best management practices, and any measures for sediment and erosion control must be maintained in effective operating condition at all times during construction.

All future correspondence on this project must reference **AI No. 120606**. If you should have any questions concerning this letter, please contact me at Chloe.Brantley@ky.gov or (502) 564-3410 Extension 4863.

Sincerely,

A handwritten signature in black ink that reads "Chloe Brantley". The signature is written in a cursive, flowing style.

Chloe Brantley, Project Manager
Water Quality Certification Section
Kentucky Division of Water

AJ:CB

cc: Meagan Chapman, USACE: Louisville District (via email: Meagan.L.Chapman@usace.army.mil)
Toby Spalding, City of Radcliff (via email: tspalding@radcliff.org)
Kiersten Fuchs, Redwing Ecological Services, Inc. (via email: kfuchs@redwingeco.com)

Page Two

All future correspondence on this project must reference **AI No. 120606**. If you should have any questions concerning this letter, please contact me at Chloe.Brantley@ky.gov or (502) 564-3410 Extension 4863.

Sincerely,

A handwritten signature in black ink that reads "Chloe Brantley". The signature is written in a cursive, flowing style.

Chloe Brantley, Project Manager
Water Quality Certification Section
Kentucky Division of Water

AJ:CB

cc: Toby Spalding, City of Radcliff (via email: tspalding@radcliff.org)
Jane Archer, USACE: Louisville District (via email: Jane.E.Archer@usace.army.mil)
Kiersten Fuchs, Redwing Ecological Services, Inc. (via email: kfuchs@redwingeco.com)
Matt Blake Redwing Ecological Services, Inc. (via email: mblake@redwingeco.com)
Brad Anderson, Redwing Ecological Services, Inc. (via email: banderson@redwingeco.com)



**PRECONSTRUCTION NOTIFICATION FOR
NATIONWIDE PERMIT 27**

**FILL AREA STREAM RESTORATION AND
FLOOD MITIGATION PROJECT
Hardin County, Kentucky**

Submitted to:

**U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT**

May 2014



May 22, 2014

Ms. Jane Archer
Regulatory Specialist, Regulatory Branch
U.S. Army Corps of Engineers
Louisville District
600 Dr. Martin Luther King, Jr. Place
Louisville, KY 40202

**Subject: Preconstruction Notification for Nationwide Permit 27
Fill Area Stream Restoration and Flood Mitigation Project
Hardin County, Kentucky
Redwing Project No.: 08-035-02
USACE ID No.: LRL-2014-283-jea**

Dear Ms. Archer:

On behalf of the City of Radcliff, Redwing Ecological Services, Inc. (Redwing) is pleased to submit this Preconstruction Notification (PCN) in support of Nationwide Permit (NWP) 27 for the Fill Area Stream Restoration and Flood Mitigation project in Hardin County, Kentucky.

The City has applied for a grant for the project from the Federal Emergency Management Agency (FEMA), and is working through the approval process with FEMA. The FEMA grant involves the construction of five stormwater basins and utilization of one area for fill deposition in Radcliff, Kentucky in order to alleviate flooding issues by providing flood storage during storm events. The Fill Area Stream Restoration and Flood Mitigation Project (Fill Area) is being proposed within the Fill Area located on the west side of Dixie Highway (US 31W) (Figure 1). The project area is located between Dixie Highway (US 31W) and South Wilson Road (KY 447) and is approximately 7.9 acres in size (Figure 2). Jurisdictional waters of the U.S. within the Fill Area total 329 linear feet (0.046 acre) and include two intermittent streams (Figure 3).

This report includes the required project information for this permit application. The proposed project will require permanent impacts to 149 linear feet (0.02 acre) of intermittent stream.

REQUIRED INFORMATION

The following information is submitted as a PCN under NWP 27 in support of the above-mentioned project, per guidance in the Federal Register (Vol. 77; No. 34; Tuesday, February 21, 2012; Section B, Part 27).

1. *Name, address, and telephone number of the prospective permittee.*

Mr. Toby Spalding, PE
City of Radcliff
411 West Lincoln Trail Boulevard
Radcliff, KY 40160
(270) 351-4714

2. *Location of proposed project.*

The proposed project is located in Radcliff, Kentucky between Dixie Highway (US 31W) and South Wilson Road (KY 447), (Figure 2) and is approximately 7.9 acres in size.

3. *Description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause; any other NWP(s), regional general permits(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity.*

The purpose of this project is to reconnect and restore two degraded streams and to alleviate flooding in Radcliff by providing a location for fill material placement during the construction of five separate stormwater storage basins. The Fill Area project is located in a watershed that drains to the Quiggins sinkhole. The sinkhole does not have the capacity to handle the amount of stormwater that it receives and frequently causes stormwater to back up within the existing depression and upstream during rain events causing flooding of upstream roads and properties. Historically, Intermittent Stream 1 was relocated into a man-made basin to try to alleviate some of the flooding issues; however, this area couldn't provide enough flood storage to alleviate flooding problems. The project will require impacts to 149 linear feet (0.02 acre) of intermittent stream (Figure 3).

Feature	Impact Length (feet)	Impact Area (acres)	Quality	Status
Intermittent Stream 1	96	0.013	Poor	Jurisdictional
Intermittent Stream 2	53	0.007	Poor	Jurisdictional
Jurisdictional Features Total	149	0.020		

Construction activities for the Fill Area include filling of the project area with excess soil from the five Happy Valley Flood Mitigation basin projects in order to extend Centennial Avenue to the west from Dixie Highway to South Wilson Road. Intermittent Stream 1 in the Fill Area will be re-established adjacent to its former stream alignment along the northern boundary of the property to restore and reconnect the stream reach within the project area. All appropriate erosion control measures will be installed. Intermittent stream restoration activities are discussed in the attached *Stream Restoration and Monitoring Plan* (Appendix E). A Section 401 Water Quality Certification application package has been submitted to the Kentucky Division of Water (KDOW) and is currently under review. A Stream Construction Permit exemption was issued by the KDOW Floodplain Management Section on January 14, 2014.

4. *Delineation of special aquatic and other waters of U.S. on the project site.*

Jurisdictional waters of the U.S., including wetlands, were delineated within the project area by Redwing wetland scientists on September 17 and November 14, 2013. A discussion of Redwing's delineation methodology and results is presented below.

The delineation was accomplished through documentation of the presence/absence of hydric soils, wetland hydrology, and hydrophytic vegetation per the guidelines of the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region-Version 2.0* (April 2012). A jurisdictional determination of open waters, such as streams and ponds, within the project corridors was made based on the presence/absence of ordinary high water mark (OHWM), defined bed and bank features, and flow regime. Soil, hydrology and vegetation data were collected on Routine Wetland Determination Data Forms for four points within the project area and are included as Appendix A. The quality of the on-site intermittent streams was assessed using the Rapid Bioassessment Protocol (RBP) developed by the U.S. Environmental Protection Agency. RBP forms for both intermittent streams are included

as Appendix B. A Preliminary Jurisdictional Determination Form is included as Appendix C. The results of the delineation were field verified by the USACE during a site visit on December 19, 2013.

Jurisdictional features within the Fill Area project area are limited to two intermittent streams totaling 329 linear feet (0.046 acre) (Figure 3). These features are summarized in the following table:

Feature	Stream Length (feet)	Area (acres)	Quality	Status
Intermittent Stream 1	259	0.036	Poor	Jurisdictional
Intermittent Stream 2	70	0.010	Poor	Jurisdictional
Jurisdictional Features Total	329	0.046		

The jurisdictional features and on-site habitats in the project area are discussed below:

No wetlands were identified within the Fill Area site. General characteristics of the project area are discussed below in terms of soils, hydrology, and vegetation.

Soils: The SSURGO Database for Hardin and Larue Counties, Kentucky (2009), maps the Fill Area project area as being underlain by Elk silt loam, Nolin silt loam, Vertrees silt loam, and water (Figure 4). None of these soils is on the Hydric Soils List for Hardin and Larue Counties. No field indicators of hydric soil were observed during the field assessment.

Hydrology: The main sources of hydrology to the Fill Area site include precipitation, surface runoff from adjacent uplands, and flow from Intermittent Stream 1 into a man-made detention basin located on the site. Hydrology indicators observed within the project area during the field assessment included sediment deposits at two data points (DP-2 and DP-4), drift deposits at one data point (DP-4), water-stained leaves at one data point (DP-2), an algal crust or mat at one data point (DP-3), a sparsely vegetated concave surface at one data point (DP-2), and a positive FAC-neutral test at four data points (DP-1, DP-2, DP-3, and DP-4). The project area is located outside the 100-year floodplain (Figure 5).

Vegetation: The primary habitats within the Fill Area site include open field and upland woods. In addition, a man-made detention basin is located in the north-central portion of the site. Plant species commonly observed within the open field habitat include eastern cottonwood (*Populus deltoides*), black locust (*Robinia pseudoacacia*), green ash (*Fraxinus pennsylvanica*), tall fescue (*Schedonorus arundinaceus*), red clover (*Trifolium pratense*), Chinese lespedeza (*Lespedeza cuneata*), yellow foxtail (*Setaria glauca*), white clover (*Trifolium repens*), English plantain (*Plantago lanceolata*), Bermudagrass (*Cynodon dactylon*), American pokeweed (*Phytolacca americana*), and Canada goldenrod (*Solidago canadensis*). These species are listed as upland (UPL), facultative upland (FACU), facultative (FAC), and facultative wetland (FACW) in the National Wetland Plant List (NWPL) (2014).

Plant species commonly observed within the upland woods habitat include silver maple (*Acer saccharinum*), black locust, eastern cottonwood, green ash, bush honeysuckle (*Lonicera maackii*), Japanese honeysuckle (*Lonicera japonica*), poison ivy (*Toxicodendron radicans*), and ground ivy (*Glechoma hederacea*). These species are listed as UPL, FACU, FAC, and FACW on the NWPL (2014).

The man-made detention basin is dominated by a monoculture of pink knotweed (*Persicaria bicornis*), which is listed as FACW on the NWPL (2014).

Two intermittent streams were identified within the Fill Area site, as described below:

Intermittent Stream 1 measures 259 linear feet (0.036 acre) within the project area and is represented as a blue-line stream on the USGS topographic map. The channel enters the site from the northwest and flows generally northeast through the northern portion of the site, ultimately discharging into a man-made detention basin located in the north-central portion of the site. The stream has been fully channelized within the project area. The channel ranges from four to eight feet wide, with banks ranging from two to five feet in height and a substrate consisting of silt, gravel, and cobble material. Water in the channel was present only in standing pools during the field assessment. Based on an RBP score of 74, Intermittent Stream 1 is considered poor quality.

Intermittent Stream 2 measures 70 linear feet (0.010 acre) within the project area and is represented as a blue-line stream on the USGS topographic map. The channel enters the site from the north and flows generally east in the northeast portion of the site until it exits the site via a culvert under Dixie Highway. The stream has been fully channelized within the project area. The channel ranges from two to six feet wide, with banks ranging from one to three feet in height and a substrate consisting of silt, sand, gravel, and cobble material. No water was present in the channel during the field assessment. Based on an RBP score of 67, Intermittent Stream 2 is considered poor quality.

5. *Discussion of compensatory mitigation proposal that offsets unavoidable losses of waters of the United States or justification explaining why compensatory mitigation should not be required.*

The purpose of the project is to restore and reconnect 573 feet of the degraded Intermittent Stream 1 channel within the proposed Fill Area; therefore, direct compensation for impacts to jurisdictional waters associated with this project is not proposed. Intermittent Stream 1 will be re-established adjacent to its former streambed with natural meanders, riffles, and pools. Details are provided in the *Stream Restoration and Monitoring Plan* (Appendix E).

6. *Identification of threatened/endangered species or critical habitat potentially affected by the proposed work.*

The potential for the proposed project to affect federally-protected species listed by the U.S. Fish and Wildlife Service (USFWS) as occurring in Hardin County, Kentucky is summarized in the following table.

Species	Common Name	Status	Habitat Present?	Species Present?
Mammals				
<i>Myotis grisescens</i>	Gray Bat	E	No	Unknown
<i>Myotis sodalis</i>	Indiana Bat	E	Summer only	Unknown
Mussels				
<i>Pleurobema clava</i>	Clubshell	E	No	No
<i>Plethobasus cooperianus</i>	Orangefoot Pimpleback	E	No	No
<i>Plethobasus cyphyus</i>	Sheepnose	E	No	No
<i>Pleurobema plenum</i>	Rough Pigtoe	E	No	No
<i>Potamilus capax</i>	Fat Pocketbook	E	No	No

E = Federally Endangered Species

Potential summer habitat for the federally-endangered Indiana bat was identified within the project area and is addressed below. No habitat for the gray bat or any of the endangered mussel species listed for Hardin County was observed on the site.

Indiana Bat: Based on maps provided by the USFWS, the project is not located within a designated zone of known Indiana bat summer habitat. Potential summer habitat for the Indiana bat, which includes snags and live trees with exfoliating bark or cavities, was identified within the project site during the field assessment. No winter habitat for this species, which includes caves and abandoned mines, was observed on the site.

The USFWS has concurred that this project will not have an adverse effect on any federally listed species. The concurrence letter from the USFWS is provided as Appendix D.

7. *Identification of historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places.*

Archaeological and cultural historic surveys have been completed for all of the proposed flood mitigation stormwater basins adjacent to the Fill Area, but not the Fill Area site. FEMA has provided the archaeological and cultural historic reports to the USACE for the five basin projects as well as the concurrence letter from the Kentucky Heritage Council.

SUMMARY

In summary, this report serves as Preconstruction Notification under NWP 27 for the construction of Fill Area Stream Restoration and Flood Mitigation Project in Hardin County, Kentucky. The proposed project will involve the restoration through re-establishment of 573 linear feet of Intermittent Stream 1. A *Stream Restoration and Monitoring Plan* is provided as Appendix E.

We respectfully request your concurrence with the applicability of a NWP 27 for the proposed project. Please contact Matt Blake or Kiersten Fuchs at (502) 625-3009 with any questions regarding this submittal or the overall project.

Sincerely,



L. Matthew Blake
Project Ecologist II

BY:MB



Kiersten R. Fuchs
Principal
Senior Wildlife Biologist

cc: Ms. Chloe Brantley – Kentucky Division of Water (electronic copy)
Ms. Geneva J. Brawner – Kentucky Emergency Management (electronic copy)
Mr. Toby Spalding – City of Radcliff

Attachments: Figures
Photographs
Appendix A – Wetland Determination Data Forms
Appendix B – Rapid Bioassessment Protocol Data Forms
Appendix C – Preliminary Jurisdictional Determination Form
Appendix D – U.S. Fish and Wildlife Service Concurrence Letter
Appendix E – Stream Restoration and Monitoring Plan

Source: Aerial from KYAPED (c) 2012

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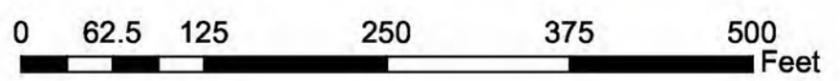
DIXIE HIGHWAY (US 31W)

FILL AREA

S WILSON ROAD (KY 447)

Legend

 Project Boundary



**FILL AREA STREAM RESTORATION
AND FLOOD MITIGATION PROJECT
HARDIN COUNTY, KENTUCKY**

REVISED DATE: 05-19-14 DRAWN BY: BMB/EDB



**AERIAL PHOTOGRAPH
MAP**

FIGURE 2



April 14, 2014

Ms. Jane Archer
Regulatory Specialist, Regulatory Branch
U.S. Army Corps of Engineers
Louisville District
600 Dr. Martin Luther King, Jr. Place
Louisville, KY 40202

**Subject: Preconstruction Notification for Nationwide Permit 43
Cato Basin Flood Mitigation Project
Hardin County, Kentucky
Redwing Project No.: 08-035-02
USACE ID No.: 2014-280-jea**

Dear Ms. Archer:

On behalf of the City of Radcliff, Redwing Ecological Services, Inc. (Redwing), is pleased to submit this Preconstruction Notification (PCN) in support of a Nationwide Permit (NWP) 43 for the Cato Basin Flood Mitigation (Cato Basin) project in Hardin County, Kentucky.

The City has applied for a grant for the project from the Federal Emergency Management Agency (FEMA), and is working through the approval process with FEMA. The proposed project involves the construction of four stormwater basins and utilization of one area for fill deposition in Radcliff, Kentucky in order to alleviate flooding issues by providing flood storage during storm events. This NWP 43 application package is for the Cato Basin project which includes construction of a stormwater basin with inlet and outlet structures. The project area is located on the west side of Dixie Highway (US 31W), approximately 0.4 mile north of the intersection of Dixie Highway and Joe Prather Highway (KY 313) and is approximately 6.6 acres (Figures 1 and 2).

This report includes the required project information for this permit application. The proposed project will require permanent impacts to 624 linear feet (0.072 acre) of intermittent stream and 200 linear feet (0.021 acre) of ephemeral stream. The City of Radcliff is proposing an in-lieu fee payment to the Kentucky Department of Fish and Wildlife Resources (KDFWR) Stream and Wetland Mitigation Program for the mitigation of this project.

REQUIRED INFORMATION

The following information is submitted as a PCN under NWP 43 in support of the above-mentioned project, per guidance in the Federal Register (Vol. 77, No. 34, Tuesday, February 21, 2012).

1. *Name, address, and telephone number of the prospective permittee.*

Mr. Toby Spalding, PE
City of Radcliff
411 West Lincoln Trail Boulevard
Radcliff, KY 40160
(270) 351-4714

2. *Location of proposed project.*

The proposed Cato Basin Project is located west of Dixie Highway (US 31W), approximately 0.4 mile north of the intersection of Dixie Highway and Joe Prather Highway (KY 313) and is approximately 6.6 acres (Figure 2).

3. *Description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause; any other NWP(s), regional general permits(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity.*

The purpose of this project is to alleviate flooding in Radcliff by providing stormwater storage through the construction of a stormwater storage basin. The Cato Basin project will require impacts to 624 linear feet (0.072 acre) of intermittent stream and 200 linear feet (0.021 acre) of ephemeral stream (Figure 3). Construction activities for the Cato Basin include clearing of approximately five acres of brush and trees, installation of all appropriate erosion control measures and the cut and fill of approximately 50,000 cubic yards of material for the construction of a berm and final restoration of the site. Impacts to the intermittent and ephemeral streams will be mitigated through in-lieu fee payment to the KDFWR Stream and Wetland Mitigation Program. Silt fencing, sediment traps, and other appropriate Best Management Practices will be implemented to minimize impacts during construction.

Basin Name	Feature	Impact Length (feet)	Impact Area (acres)	Quality	Status	Type of Mitigation
Cato Basin	Ephemeral Stream 1	200	0.021	Poor	Jurisdictional	in-lieu fee
	Intermittent Stream 1	624	0.072	Poor	Jurisdictional	in-lieu fee
	Jurisdictional Features Total	824	0.093			

A Section 401 Water Quality Certification application package has been submitted to the Kentucky Division of Water (KDOW) and is currently under review. A Stream Construction Permit exemption was issued by the KDOW – Floodplain Management Section for this project on January 14, 2014.

4. *Delineation of special aquatic and other waters of U.S. on the project site.*

Jurisdictional waters of the U.S., including wetlands, were delineated within the various project corridors by Redwing wetland scientists on September 11, 12, 16, and 17, and November 14, 2013. A discussion of Redwing's delineation methodology and results is presented below.

METHODOLOGY

The wetland delineation was accomplished through documentation of the presence/absence of hydric soils, wetland hydrology, and hydrophytic vegetation per the guidelines of the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and*

Piedmont Region (Version 2.0) (April 2012). A jurisdictional determination of open waters, such as streams and ponds, within the project corridors was made based on the presence/absence of ordinary high water mark (OHWM), defined bed and bank features, and flow regime. Soil, hydrology and vegetation data were collected on a Routine Wetland Determination Data Form for one point in the project area and is provided as Appendix A. The quality of the on-site intermittent stream was assessed using the Rapid Bioassessment Protocol (RBP) developed by the U.S. Environmental Protection Agency and is provided in Appendix B. A Preliminary Jurisdictional Determination Form is provided as Appendix C of this package. The results of the delineation were field verified by the USACE during a site visit on December 19, 2013.

RESULTS

Jurisdictional features within the Cato Basin project area are limited to one intermittent stream measuring 700 linear feet (0.080 acre) and one ephemeral stream measuring 200 linear feet (0.021 acre) (Figure 3).

These features are summarized in the following table:

Basin Name	Feature	Stream Length (feet)	Area (acres)	Quality	Status
Cato Basin	Ephemeral Stream 1	200	0.021	Poor	Jurisdictional
	Intermittent Stream 1	700	0.080	Poor	Jurisdictional
	Jurisdictional Features Total	900	0.101		

The jurisdictional features and on-site habitats in each project area are discussed below:

No wetlands were identified within the Cato Basin project area. General characteristics of the project area are discussed below in terms of soils, hydrology, and vegetation.

Soils: The SSURGO Database for Hardin and Larue Counties, Kentucky (2005), maps the Cato Basin project area as being underlain by Crider silt loam, Nicholson silt loam, and Nolin silt loam (Figure 4). None of these soils are on the Hydric Soils List for Hardin and Larue Counties. No field indicators of hydric soil were observed during the field assessment.

Hydrology: The main sources of hydrology to the Cato Basin project area include precipitation and surface runoff from adjacent uplands. No hydrology indicators were observed within the project area during the field assessment. The project area is located outside the 100-year floodplain (Figure 5).

Vegetation: The primary habitats within the Cato Basin project area include upland open field/scrub and upland woods. Plant species commonly observed within the upland open field/scrub habitat include common mimosa (*Albizia julibrissin*), staghorn sumac (*Rhus typhina*), Allegheny blackberry (*Rubus allegheniensis*), multiflora rose (*Rosa multiflora*), Canada goldenrod (*Solidago canadensis*), Johnsongrass (*Sorghum halepense*), poison ivy (*Toxicodendron radicans*), crown vetch (*Securigera varia*), and showy ticktrefoil (*Desmodium canadense*). These species are listed as obligate upland (UPL), facultative upland (FACU), and facultative (FAC) on the *National Wetland Plant List – Eastern Mountain Piedmont Region (NWPL)* (2014).

Plant species commonly observed within the upland woods habitat include sugar maple (*Acer saccharum*), coralberry (*Symphoricarpos orbiculatus*), black cherry (*Prunus serotina*), hackberry (*Celtis occidentalis*), sycamore (*Platanus occidentalis*), poison ivy, riverbank grape (*Vitis riparia*), Virginia creeper (*Parthenocissus quinquefolia*), and trumpet creeper (*Campsis radicans*). These species are listed as FACU, FAC, and facultative wetland

(FACW) on the NWPL (2014).

One intermittent stream and one ephemeral stream were identified within the Cato Basin project area, as described below:

Intermittent Stream 1 measures 700 linear feet (0.08 acre) within the project area and is represented as a blue-line on the USGS topographic map. The channel enters the site from the east via a culvert across Dixie Highway and flows generally west through the site, exiting the project area to the west. The channel ranges from two to eight feet wide, with banks ranging from two to six feet in height, and a substrate consisting of silt, sand, gravel, and cobble material. Flowing water was observed in portions of the channel during the field assessment, but it was mostly present in standing pools. Based on an RBP score of 112, Intermittent Stream 1 is considered poor quality.

Ephemeral Stream 1 measures 200 linear feet (0.021 acre) within the project area. The channel enters the site from the southeast via a culvert across Dixie Highway and flows into Intermittent Stream 1. The channel ranges from three to six feet wide, with banks ranging from two to seven feet in height, and a substrate consisting of silt, sand, gravel, and cobble material. No water was present in the channel during the field assessment. Based on the lack of significant aquatic habitat, Ephemeral Stream 1 is considered poor quality.

5. Discussion of compensatory mitigation proposal that offsets unavoidable losses of waters of the United States or justification explaining why compensatory mitigation should not be required.

Ephemeral and Intermittent stream impacts for the Cato Basin are less than 0.1 acre. Mitigation for both stream impacts will be provided through in-lieu fee payment to the KDFWR Stream and Wetland Mitigation Program by the City of Radcliff.

6. Identification of threatened/endangered species or critical habitat potentially affected by the proposed work.

The potential for the proposed project to affect federally-protected species listed by the U.S. Fish and Wildlife Service (USFWS) as occurring in Hardin County, Kentucky is summarized in the following table.

Species	Common Name	Status	Habitat Present?	Species Present?
Mammals				
<i>Myotis grisescens</i>	Gray Bat	E	No	Unknown
<i>Myotis sodalis</i>	Indiana Bat	E	Summer only	Unknown
Mussels				
<i>Pleurobema clava</i>	Clubshell	E	No	No
<i>Plethobasus cooperianus</i>	Orangefoot Pimpleback	E	No	No
<i>Plethobasus cyphus</i>	Sheepnose	E	No	No
<i>Pleurobema plenum</i>	Rough Pigtoe	E	No	No
<i>Potamilus capax</i>	Fat Pocketbook	E	No	No

E = Federally Endangered Species

Potential summer habitat for the federally-endangered Indiana bat was identified within the project area, and is addressed below. No habitat for any of the endangered mussel species listed for Hardin County was observed on the site.

Indiana Bat: Based on maps provided by the USFWS, the project is not located within a designated zone of known Indiana bat habitat. Potential summer habitat for the Indiana bat,

which and includes snags and live trees with exfoliating bark or cavities, was identified within the project site during the field assessment. No winter habitat for this species, which includes caves and abandoned mines, was observed on the site.

The USFWS has concurred that this project will not have an adverse effect on any federally listed species. The concurrence letter from the USFWS is provided as Appendix D.

7. *Identification of historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places.*

Archaeological and cultural historic surveys have been completed for all of the project areas except for the Fill Area. FEMA has provided the archaeological and cultural historic reports to the USACE for the Cato Basin project as well as the concurrence letter from the Kentucky Heritage Council.

SUMMARY

In summary, this report serves as Preconstruction Notification under NWP 43 for the construction of Cato Basin Flood Mitigation project in Hardin County, Kentucky. The proposed project will impact 624 linear feet (0.072 acre) of intermittent stream and 200 linear feet (0.021 acre) of ephemeral stream. Mitigation for these impacts will be provided by a proposed in-lieu fee payment to the KDFWR Stream and Wetland Mitigation Program.

We respectfully request your concurrence with the applicability of a NWP 43 for the proposed project. Please contact Matt Blake or Kiersten Fuchs at (502) 625-3009 with any questions regarding this submittal or the overall project.

Sincerely,



L. Matthew Blake
Project Ecologist II



Kiersten R. Fuchs
Principal
Senior Wildlife Biologist

cc: Ms. Chloe Brantley – Kentucky Division of Water (electronic copy)
Ms. Geneva J. Brawner – Kentucky Emergency Management (electronic copy)
Mr. Toby Spalding – City of Radcliff

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Appendix B – Rapid Bioassessment Protocol Form
Appendix C – Preliminary Jurisdictional Determination Form
Appendix D – U.S. Fish and Wildlife Service Concurrence Letter

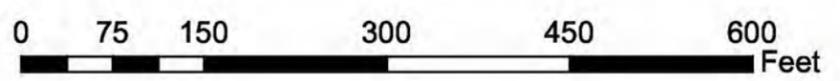
Source: Aerial from KYAPED (c) 2012

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Legend

 Project Boundary



**CATO BASIN
FLOOD MITIGATION PROJECT
HARDIN COUNTY, KENTUCKY**

REVISED DATE: 04-07-14 DRAWN BY: BMB

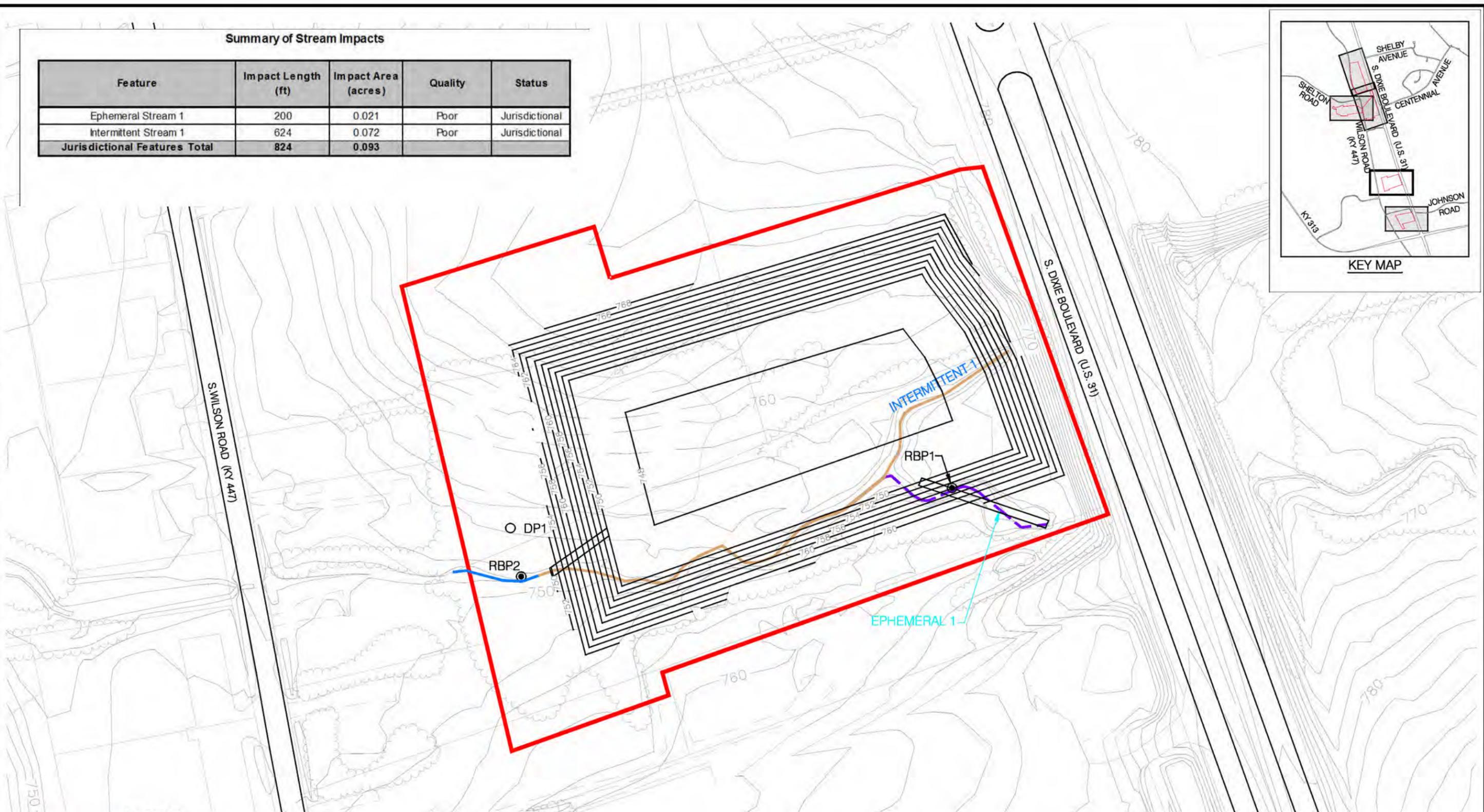
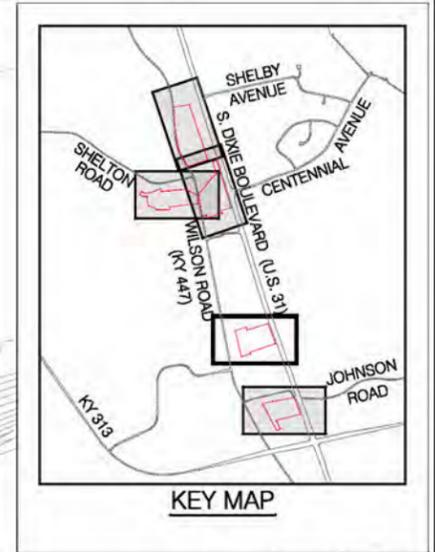


**AERIAL PHOTOGRAPH
MAP**

FIGURE 2

Summary of Stream Impacts

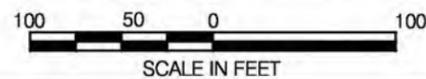
Feature	Impact Length (ft)	Impact Area (acres)	Quality	Status
Ephemeral Stream 1	200	0.021	Poor	Jurisdictional
Intermittent Stream 1	624	0.072	Poor	Jurisdictional
Jurisdictional Features Total	824	0.093		



LEGEND

- PROJECT BOUNDARY
- INTERMITTENT STREAM
- INTERMITTENT STREAM IMPACT
- - - EPHEMERAL STREAM IMPACT
- PROPOSED INLET/OUTLET STRUCTURE
- DP1 WETLAND DETERMINATION DATA POINT
- RBP1 RAPID BIOASSESSMENT PROTOCOL POINT

NOTE: JURISDICTIONAL WATER/WETLAND BOUNDARIES WERE DELINEATED AND SURVEYED USING GLOBAL POSITIONING SYSTEM EQUIPMENT BY REDWING WETLAND SCIENTISTS ON SEPTEMBER 11, 2013. THESE BOUNDARIES WERE FIELD VERIFIED BY THE U.S. ARMY CORPS OF ENGINEERS ON DECEMBER 19, 2013. USE OF THIS MAP IS FOR PRELIMINARY PLANNING PURPOSES ONLY.



CATO BASIN
FLOOD MITIGATION PROJECT
HARDIN COUNTY, KENTUCKY

REVISED DATE: 04-14-14

DRAWN BY: BMB/EDB



WATER/WETLAND
LOCATION AND
IMPACTS MAP

FIGURE 3



**PRECONSTRUCTION NOTIFICATION FOR
NATIONWIDE PERMIT 43**

**SONG BASIN FLOOD MITIGATION PROJECT
Hardin County, Kentucky**

Submitted to:

**U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT**

April 2014



April 17, 2014

Ms. Jane Archer
Regulatory Specialist, Regulatory Branch
U.S. Army Corps of Engineers
Louisville District
600 Dr. Martin Luther King, Jr. Place
Louisville, KY 40202

**Subject: Preconstruction Notification for Nationwide Permit 43
Song Basin Flood Mitigation Project
Hardin County, Kentucky
Redwing Project No.: 08-035-02
USACE ID No.: LRL-2014-284-jea**

Dear Ms. Archer:

On behalf of the City of Radcliff, Redwing Ecological Services, Inc. (Redwing), is pleased to submit this Preconstruction Notification (PCN) in support of a Nationwide Permit (NWP) 43 for the Song Basin Flood Mitigation project (Song Basin) in Hardin County, Kentucky.

The City has applied for a grant for the project from the Federal Emergency Management Agency (FEMA), and is working through the approval process with FEMA. The proposed project involves the construction of four stormwater basins and utilization of one area for fill deposition in Radcliff, Kentucky in order to alleviate flooding issues by providing flood storage during storm events. This NWP 43 application package is for the Song Basin project which includes a stormwater basin and inlet and outlet structures. The project area is located west of Dixie Highway (US 31W, approximately 500 feet north of the intersection of Dixie Highway and Joe Prather Highway (KY 313) and is approximately 5.0 acres (Figures 1 and 2).

This report includes the required project information for this permit application. The proposed project will require permanent impacts to 158 linear feet (0.01 acre) of ephemeral stream.

REQUIRED INFORMATION

The following information is submitted as a PCN under NWP 43 in support of the above-mentioned project, per guidance in the Federal Register (Vol. 77, No. 34, Tuesday, February 21, 2012).

1. *Name, address, and telephone number of the prospective permittee.*

Mr. Toby Spalding, PE
City of Radcliff
411 West Lincoln Trail Boulevard
Radcliff, KY 40160
(270) 351-4714

2. *Location of proposed project.*

The proposed Song Basin Project is located west of Dixie Highway (US 31W), approximately 500 feet north of the intersection of Dixie Highway and Joe Prather Highway (KY 313) and is approximately 5.0 acres (Figures 1 and 2).

3. *Description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause; any other NWP(s), regional general permits(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity.*

The purpose of this project is to alleviate flooding in Radcliff by providing stormwater storage through the construction of a stormwater storage basin. The Song Basin project will require impacts to 158 linear feet (0.01 acre) of ephemeral stream (Figure 3). Construction activities for the Song Basin include clearing of approximately four acres of brush and trees, installation of all appropriate erosion control measures and the cut and fill of approximately 20,000 cubic yards of material for the construction of the basin and final restoration of the site. Ephemeral stream impacts will be mitigated by the construction of a stormwater management channel in the bottom of the basin to convey low-flow stormwater from the inlet of the basin to the outlet structure. Silt fencing, sediment traps, and other appropriate Best Management Practices will be implemented to minimize impacts during construction.

Basin Name	Feature	Impact Length (feet)	Impact Area (acres)	Quality	Status
Song Basin	Ephemeral Stream 1	158	0.01	Poor	Jurisdictional
	Jurisdictional Features Total	158	0.01		

A Section 401 Water Quality Certification application package has been submitted to the Kentucky Division of Water (KDOW) and is currently under review. A Stream Construction Permit exemption was issued by the KDOW - Floodplain Management Section on January 14, 2014.

4. *Delineation of special aquatic and other waters of U.S. on the project site.*

Jurisdictional waters of the U.S., including wetlands, were delineated within the project area by Redwing wetland scientists on September 11, 2013. A discussion of Redwing's delineation methodology and results is presented below.

METHODOLOGY

The delineation was accomplished through documentation of the presence/absence of hydric soils, wetland hydrology, and hydrophytic vegetation per the guidelines of the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region (Version 2.0)* (April 2012). A jurisdictional determination of open waters, such as streams and ponds, within the project corridors was made based on the presence/absence of ordinary high water mark (OHWM), defined bed and bank features, and flow regime. Soil, hydrology and vegetation data were collected on Routine Wetland Determination Data Forms for 2 points throughout the project area and are included as Appendix A. A Preliminary Jurisdictional Determination Form is attached as Appendix B. The results of the delineation were field verified by the USACE during a site visit on December 19, 2013.

RESULTS

Only one jurisdictional feature was identified within the Song Basin project area. One ephemeral stream measuring 293 linear feet (0.019 acre) was identified (Figure 3) and is summarized in the following table:

Basin Name	Feature	Stream Length (feet)	Area (acres)	Quality	Status
Song Basin	Ephemeral Stream 1	293	0.019	Poor	Isolated
	Jurisdictional Features Total	293	0.019		

No wetlands were identified within the Song Basin project area. General characteristics of the project area are discussed below in terms of soils, hydrology, and vegetation.

Soils: The USDA Soil Survey Geographic (SSURGO) Database for Hardin and Larue Counties, Kentucky (2005), maps the Song Basin project area as being underlain by Newark silt loam and Nicholson silt loam (Figure 4). Newark silt loam, which is classified as hydric-by-inclusion, is on the Hydric Soils List for Hardin and Larue Counties. No field indicators of hydric soil were observed during the field assessment.

Hydrology: The main sources of hydrology to the Song Basin project area include precipitation and surface runoff from adjacent uplands. Hydrology indicators observed within the project area during the field assessment included saturated soil conditions at one data point (DP-2). The project area is located outside the 100-year floodplain (Figure 5).

Vegetation: The primary habitats within the Song Basin project area include open field/scrub and upland scrub/young woods. Plant species commonly observed within the open field/scrub habitat include Eastern red cedar (*Juniperus virginiana*), winged sumac (*Rhus copallinum*), redbud (*Cercis canadensis*), multiflora rose (*Rosa multiflora*), Japanese honeysuckle (*Lonicera japonica*), Canada goldenrod (*Solidago canadensis*), mistflower (*Conoclinium coelestinum*), purpletop grass (*Tridens flavus*), and white snakeroot (*Ageratina altissima*). These species are listed as facultative upland (FACU) and facultative (FAC) on the *National Wetland Plant List – Eastern Mountains and Piedmont Region* (NWPL) (2014).

Plant species commonly observed within the upland scrub/young woods habitat include Eastern red cedar, black walnut (*Juglans nigra*), sassafras (*Sassafras albidum*), sugar maple (*Acer saccharum*), coralberry (*Symphoricarpos orbiculatus*), Chinese privet (*Ligustrum sinense*), multiflora rose, Allegheny blackberry (*Rubus allegheniensis*), and Japanese honeysuckle. These species are listed as FACU on the NWPL (2014).

One jurisdictional ephemeral stream was identified within the Song Basin project area:

Ephemeral Stream 1 measures 293 linear feet (0.019 acre) within the project area, with no apparent surface connection to downstream waters of the U.S. The channel enters the site from the east via a culvert across Dixie Highway and eventually disappears into an upland area in the southern portion of the site. The channel ranges from six inches to five feet wide, with banks ranging from three inches to two feet in height, and a substrate consisting of silt. Standing water was present during the field assessment, although no flowing water was observed. Based on the lack of significant aquatic habitat, Ephemeral Stream 1 is considered poor quality.

5. Discussion of compensatory mitigation proposal that offsets unavoidable losses of waters of the United States or justification explaining why compensatory mitigation should not be required.

Ephemeral stream impacts for the Song Basin project are less than 0.1 acre. Mitigation for ephemeral stream impacts will be provided through the establishment of a stormwater management channel in the bottom of the basin. The stormwater management channel will be equivalent in length to the impacted ephemeral stream channel. The stormwater management channel will be recreated to handle baseflow and low-intensity storm events. Permanent photo stations will be established along the stormwater management channel. The channel will be photo-documented for stability and the presence of sediment during a site visit once a year for three years and annual reports will be submitted to the U.S. Army Corps of Engineers (USACE) by December 31 of the monitoring year.

6. *Identification of threatened/endangered species or critical habitat potentially affected by the proposed work.*

The potential for the proposed project to affect federally-protected species listed by the U.S. Fish and Wildlife Service (USFWS) as occurring in Hardin County, Kentucky is summarized in the following table.

Species	Common Name	Status	Habitat Present?	Species Present?
Mammals				
<i>Myotis grisescens</i>	Gray Bat	E	No	Unknown
<i>Myotis sodalis</i>	Indiana Bat	E	Summer only	Unknown
Mussels				
<i>Pleurobema clava</i>	Clubshell	E	No	No
<i>Plethobasus cooperianus</i>	Orangefoot Pimpleback	E	No	No
<i>Plethobasus cyphus</i>	Sheepnose	E	No	No
<i>Pleurobema plenum</i>	Rough Pigtoe	E	No	No
<i>Potamilus capax</i>	Fat Pocketbook	E	No	No

E = Federally Endangered Species

Potential summer habitat for the federally-endangered Indiana bat was identified within the project areas, and is addressed below. No habitat for any of the endangered mussel species listed for Hardin County was observed on the site.

Indiana Bat: Based on maps provided by the USFWS, the project is not located within a designated zone of known Indiana bat summer maternity habitat. Potential summer habitat for the Indiana bat, which includes snags and live trees with exfoliating bark or cavities, was identified within the project site during the field assessment. No winter habitat for this species, which includes caves and abandoned mines, was observed on the site.

The USFWS has concurred that this project will not have an adverse effect on any federally listed species. The concurrence letter from the USFWS is provided as Appendix C.

7. *Identification of historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places.*

Archaeological and cultural historic surveys have been completed for the project area, and FEMA has provided the archaeological and cultural historic reports to the USACE for the Song Basin project as well as the concurrence letter from the Kentucky Heritage Council.

SUMMARY

In summary, this report serves as Preconstruction Notification under NWP 43 for the construction of the Song Basin Flood Mitigation Project in Hardin County, Kentucky. The proposed project will impact 158 linear feet (0.01 acre) of ephemeral stream. Mitigation for these impacts will consist of the establishment of a stormwater management channel.

We respectfully request your concurrence with the applicability of a NWP 43 for the proposed project. Please contact Matt Blake or Kiersten Fuchs at (502) 625-3009 with any questions regarding this submittal or the overall project.

Sincerely,



L. Matthew Blake
Project Ecologist II



Kiersten R. Fuchs
Principal
Senior Wildlife Biologist

cc: Ms. Chloe Brantley – Kentucky Division of Water (electronic copy)
Ms. Geneva J. Brawner – Kentucky Emergency Management (electronic copy)
Mr. Toby Spalding – City of Radcliff

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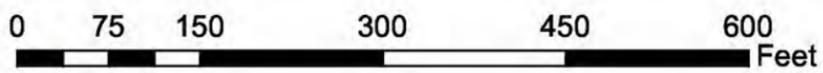
Source: Aerial from KYAPED (c) 2012

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Legend

 Project Boundary



SONG BASIN
FLOOD MITIGATION PROJECT
HARDIN COUNTY, KENTUCKY

REVISED DATE: 04-07-14 DRAWN BY: BMB

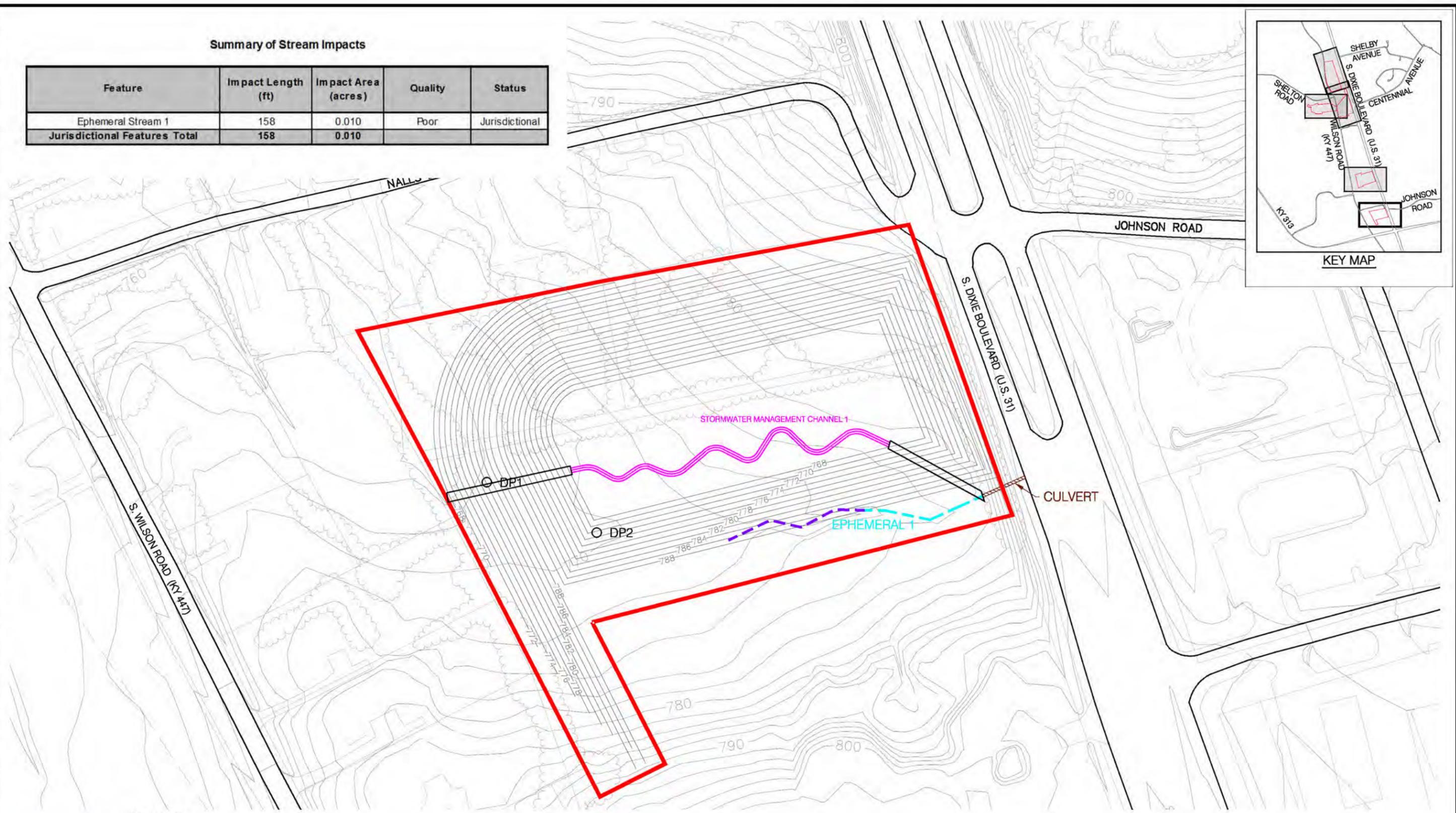


AERIAL PHOTOGRAPH
MAP

FIGURE 2

Summary of Stream Impacts

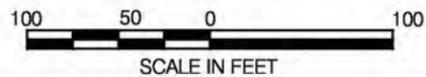
Feature	Impact Length (ft)	Impact Area (acres)	Quality	Status
Ephemeral Stream 1	158	0.010	Poor	Jurisdictional
Jurisdictional Features Total	158	0.010		



LEGEND

- PROJECT BOUNDARY
- - - EPHEMERAL STREAM
- - - EPHEMERAL STREAM IMPACT
- DP1 WETLAND DETERMINATION DATA POINT
- ~ ~ ~ STORMWATER MANAGEMENT CHANNEL
- PROPOSED INLET OR OUTLET STRUCTURE

NOTE: JURISDICTIONAL WATERWETLAND BOUNDARIES WERE DELINEATED AND SURVEYED USING GLOBAL POSITIONING SYSTEM EQUIPMENT BY REDWING WETLAND SCIENTISTS ON SEPTEMBER 11, 2013. THESE BOUNDARIES WERE FIELD VERIFIED BY THE U.S. ARMY CORPS OF ENGINEERS. USE OF THIS MAP IS FOR PRELIMINARY PLANNING PURPOSES ONLY.



**SONG BASIN
FLOOD MITIGATION PROJECT
HARDIN COUNTY, KENTUCKY**

REVISED DATE: 04-14-14 DRAWN BY: EDB/BJD



WATERWETLAND
LOCATION AND
IMPACTS MAP

FIGURE 3



**PRECONSTRUCTION NOTIFICATION FOR
NATIONWIDE PERMIT 43**

**WILSON ROAD BASIN FLOOD MITIGATION PROJECT
Hardin County, Kentucky**

Submitted to:

**U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT**

April 2014



April 28, 2014

Ms. Jane Archer
Regulatory Specialist, Regulatory Branch
U.S. Army Corps of Engineers
Louisville District
600 Dr. Martin Luther King, Jr. Place
Louisville, KY 40202

**Subject: Preconstruction Notification for Nationwide Permit 43
Wilson Road Basin Flood Mitigation Project
Hardin County, Kentucky
Redwing Project No.: 08-035-02
USACE ID No.: LRL-2014-282-jea**

Dear Ms. Archer:

On behalf of the City of Radcliff, Redwing Ecological Services, Inc. (Redwing), is pleased to submit this Preconstruction Notification (PCN) in support of Nationwide Permit (NWP) 43 for the Wilson Road Basin Flood Mitigation (Wilson Road Basin) project in Hardin County, Kentucky.

The City has applied for a grant for the project from the Federal Emergency Management Agency (FEMA), and is working through the approval process with FEMA. The proposed project involves the construction of four stormwater basins and utilization of one area for fill deposition in Radcliff, Kentucky in order to alleviate flooding issues by providing flood storage during storm events. This NWP 43 application package is for the Wilson Road Basin, which includes inlet and outlet structures and three stormwater management channels. The Wilson Road Basin is approximately 10.4 acres and is located east of South Wilson Road (KY 447), approximately 500 feet north of the intersection of South Wilson Road and Shelton Road (Figures 1 and 2). Jurisdictional waters of the U.S. within the project area totals 0.243 acre and include two intermittent streams, four ephemeral streams, and two wetlands (Figure 3).

This report includes the required project information for this permit application. The proposed project will require permanent impacts to 1,384 linear feet (0.078 acre) of ephemeral stream; and 0.091 acre of wetland.

REQUIRED INFORMATION

The following information is submitted as a PCN under NWP 43 in support of the above-mentioned project, per guidance in the Federal Register (Vol. 77, No. 34, Tuesday, February 21, 2012).

1. *Name, address, and telephone number of the prospective permittee.*

Mr. Toby Spalding, PE
City of Radcliff
411 West Lincoln Trail Boulevard
Radcliff, KY 40160
(270) 351-4714

2. *Location of proposed project.*

The proposed Wilson Road Basin project is located east of South Wilson Road (KY 447), approximately 500 feet north of the intersection of South Wilson Road and Shelton Road in Radcliff, Kentucky (Figure 2) and is approximately 10.4 acres.

3. *Description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause; any other NWP(s), regional general permits(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity.*

The purpose of this project is to alleviate flooding in Radcliff by providing stormwater storage through the construction of a stormwater storage basin. The Wilson Road Basin project will require impacts to 0.091 acre of wetland and 1,384 linear feet (0.078 acre) of ephemeral stream (Figure 3) and are shown in the following table.

Basin Name	Feature	Impact Length (feet)	Impact Area (acres)	Quality	Status	Type of Mitigation
Wilson Road Basin	Wetland 1	N/A	0.017	N/A	Jurisdictional	Wetland Bank
	Wetland 2	N/A	0.074	N/A	Jurisdictional	Wetland Bank
	Wetland Total	N/A	0.091			
	Ephemeral Stream 1	110	0.008	Poor	Jurisdictional	SMS
	Ephemeral Stream 2	424	0.015	Poor	Jurisdictional	SMS
	Ephemeral Stream 3	642	0.044	Poor	Jurisdictional	SMS
	Ephemeral Stream 4	208	0.011	Poor	Jurisdictional	SMS
	Ephemeral Stream Total	1,384	0.078			
	Jurisdictional Features Total	1,384	0.169			

Construction activities for the Wilson Road Basin include clearing of approximately six acres of brush and trees, installation of all appropriate erosion control measures and cut and fill of approximately 20,000 cubic yards of material for the construction of a berm and final restoration of the site. Silt fencing, sediment traps, and other appropriate Best Management Practices will be implemented to minimize impacts during construction. A Section 401 Water Quality Certification application package has been submitted to the Kentucky Division of Water (KDOW) and is currently under review. A Stream Construction Permit exemption was issued by the KDOW Floodplain Management Section on January 14, 2014.

4. *Delineation of special aquatic and other waters of U.S. on the project site.*

Jurisdictional waters of the U.S., including wetlands, were delineated within the various project corridors by Redwing wetland scientists on September 16 and 17, and November 14, 2013. A discussion of Redwing's delineation methodology and results is presented below.

METHODOLOGY

The delineation was accomplished through documentation of the presence/absence of hydric soils, wetland hydrology, and hydrophytic vegetation per the guidelines of the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region (Version 2.0)* (April 2012). A jurisdictional determination of open waters, such as streams and ponds, within the project corridors was made based on the presence/absence of ordinary high water mark (OHWM), defined bed and bank features, and flow regime. Soil, hydrology and vegetation data were collected on Routine Wetland Determination Data Forms for 5 points throughout the project area and are included as Appendix A. The quality of on-site

intermittent streams was assessed using the Rapid Bioassessment Protocol (RBP) developed by the U.S. Environmental Protection Agency and are included as Appendix B. A Preliminary Jurisdictional Determination Form is provided as Appendix C. The results of the delineation were field verified by the USACE during a site visit on December 19, 2013.

RESULTS

Jurisdictional features within the project are limited to two wetlands totaling 0.104 acre, two intermittent streams measuring 577 linear feet (0.059 acre) and four ephemeral streams totaling 1,432 linear feet (0.080 acre) (Figure 3).

These features are summarized in the following table:

Basin Name	Feature	Stream Length (feet)	Area (acres)	Quality	Status
Wilson Road Basin	Wetland 1	N/A	0.017	N/A	Jurisdictional
	Wetland 2	N/A	0.087	N/A	Jurisdictional
	Wetland Total	N/A	0.104		
	Ephemeral Stream 1	110	0.008	Poor	Jurisdictional
	Ephemeral Stream 2	424	0.015	Poor	Jurisdictional
	Ephemeral Stream 3	642	0.044	Poor	Jurisdictional
	Ephemeral Stream 4	256	0.013	Poor	Jurisdictional
	Ephemeral Stream Total	1,432	0.080		
	Intermittent Stream 1	490	0.056	Average	Jurisdictional
	Intermittent Stream 2	87	0.003	Poor	Jurisdictional
	Intermittent Stream Total	577	0.059		
	Jurisdictional Features Total	2,010	0.243		

The jurisdictional water/wetland features and on-site habitats in the project area are discussed below:

Two wetlands totaling 0.104 acre were identified within the Wilson Road Basin project area. Wetland 1 measures 0.017 acre. Wetland 2 measures 0.087 acre. General characteristics of the project area are discussed below in terms of soils, hydrology, and vegetation.

Soils: The SSURGO Database for Hardin and Larue Counties, Kentucky (2005), maps the Wilson Road Basin project area as being underlain by Crider silt loam and Newark silt loam (Figure 4). Of these soils, only Newark silt loam, which is classified as hydric-by-inclusion, is on the Hydric Soils List for Hardin and Larue Counties. Field indicators of hydric soil observed within the project area during the field assessment include depleted matrix, which was observed at two data points (DP-1 and DP-3).

Hydrology: The main sources of hydrology to the Wilson Road Basin project area include precipitation and surface runoff from adjacent uplands. Hydrology indicators observed within the project area during the field assessment included oxidized rhizospheres on living roots at one data point (DP-3), drift deposits at one data point (DP-5), and a positive FAC-neutral test at four data points (DP-2, DP-3, DP4, and DP-5). The project area is located outside the 100-year floodplain (Figure 5).

Vegetation: The primary habitats within the Wilson Road Basin project area include open field/scrub and upland woods. Plant species commonly observed within the open field/scrub habitat include hackberry (*Celtis occidentalis*), green ash (*Fraxinus pennsylvanica*), black willow (*Salix nigra*), white mulberry (*Morus alba*), Canada goldenrod (*Solidago canadensis*), Johnsongrass (*Sorghum halepense*), poison ivy (*Toxicodendron*

radicans), hog peanut (*Amphicarpaea bracteata*), soft rush (*Juncus effusus*), Korean lespedeza (*Kummerowia stipulacea*), kudzu (*Pueraria montana*), and poison hemlock (*Conium maculatum*). These species are listed as upland (UPL), facultative upland (FACU), facultative (FAC), facultative wetland (FACW), and obligate wetland (OBL) in the National Wetland Plant List – Eastern Mountains and Piedmont Region (NWPL) (2014).

Plant species commonly observed within the upland woods habitat include sugar maple (*Acer saccharum*), coralberry (*Symphoricarpos orbiculatus*), flowering dogwood (*Cornus florida*), sassafras (*Sassafras albidum*), green ash, Eastern red cedar (*Juniperus virginiana*), black cherry (*Prunus serotina*), poison ivy, and Japanese honeysuckle (*Lonicera japonica*). These species are listed as FACU, FAC, and FACW on the NWPL (2014).

Plant species commonly observed within Wetland 1 include green ash, red maple (*Acer rubrum*), buttonbush (*Cephalanthus occidentalis*), soft rush, and shallow sedge (*Carex lurida*). These species are listed as FAC, FACW, and OBL on the NWPL (2014).

Plant species commonly observed within Wetland 2 include green ash, black willow, red maple, shallow sedge, jewelweed (*Impatiens capensis*), and soft rush. These species are listed as FAC, FACW, and OBL on the NWPL (2014).

Two intermittent streams and four ephemeral streams were identified within the Wilson Road Basin project area:

Intermittent Stream 1 measures 490 linear feet (0.056 acre) within the project area and is represented as a blue-line on the USGS topographic map. The stream begins where Ephemeral Stream 2 begins to show intermittent character and flows generally southeast through the southern portion of the site, exiting the project area to the south. The channel ranges from three to seven feet wide, with banks ranging from one to two feet in height, and a substrate consisting of silt, gravel, and cobble material. Flowing water was observed in most of the channel during the field assessment. Based on an RBP score of 132, Intermittent Stream 1 is considered average quality.

Intermittent Stream 2 measures 87 linear feet (0.003 acre) within the project area. The stream begins at a spring located on the west side of Wilson Road, enters the site from the west, and flows generally southeast through the western portion of the site until it flows into Intermittent Stream 1. The channel ranges from one to two feet wide, with banks ranging from one to two feet in height, and a substrate consisting of silt. Flowing water was observed in most of the channel during the field assessment. Based on an RBP score of 112, Intermittent Stream 2 is considered poor quality.

Ephemeral Stream 1 measures 110 linear feet (0.008 acre) within the project area. The stream enters the site from the north and flows generally south through the northern portion of the project area until it loses its bed and bank and becomes an upland drainage swale, which eventually drains into Ephemeral Stream 3. The channel ranges from one to five feet wide, with banks ranging from two inches to one foot in height, and a substrate consisting of silt. No water was present in the channel during the field assessment. Based on the lack of significant aquatic habitat, Ephemeral Stream 1 is considered poor quality.

Ephemeral Stream 2 measures 424 linear feet (0.015 acre). The channel begins in the old field/scrub habitat located in the eastern portion of the project area and flows generally south until it begins to display characteristics more representative of an intermittent stream. The channel ranges from one to five feet wide, with banks ranging from 6 to 18 inches in height, and a substrate consisting of silt. No water was present in the channel during the field assessment. Based on the lack of significant aquatic habitat, Ephemeral Stream 2 is considered poor quality.

Ephemeral Stream 3 measures 642 linear feet (0.044 acre). The channel begins in the upland woods habitat located in the northwestern portion of the project area and flows generally south until it flows into Ephemeral Stream 2. The channel ranges from one to two feet wide, with banks ranging from two to four inches in height, and a substrate consisting of silt. No water was present in the channel during the field assessment. Based on the lack of significant aquatic habitat, Ephemeral Stream 3 is considered poor quality.

Ephemeral Stream 4 measures 256 linear feet (0.013 acre). The channel starts on the east side of Wetland 2 and flows south into Intermittent Stream 1. The channel ranges from 1.5 to four feet wide, with banks ranging from 0.5 to 2.5 feet, and a substrate consisting of silt. Water was present in pools during the field assessment. Based on the lack of significant aquatic habitat, Ephemeral Stream 4 is considered poor quality.

5. *Discussion of compensatory mitigation proposal that offsets unavoidable losses of waters of the United States or justification explaining why compensatory mitigation should not be required.*

Ephemeral stream impacts for the Wilson Road Basin Project are less than 0.1 acre. Mitigation for ephemeral stream impacts will be provided through the establishment of stormwater management channels in the bottom of the proposed basin. The stormwater management channels will be equivalent in length to the impacted ephemeral stream channels in the project area. The channels will be created within the bottom of the basin to handle baseflow and low-intensity storm events. Cross-sectional and photographic monitoring will occur immediately after construction and for five years following project completion. The proposed mitigation for stream impacts is addressed in the *Stream Mitigation Plan* (Appendix E).

Wetland impacts will be mitigated through the purchase of wetland mitigation bank credits at a 2:1 ratio. The wetland mitigation will consist of the purchase of 0.2 acre of wetland bank credit at an approved wetland mitigation bank in the Salt River watershed.

6. *Identification of threatened/endangered species or critical habitat potentially affected by the proposed work.*

The potential for the proposed project to affect federally-protected species listed by the U.S. Fish and Wildlife Service (USFWS) as occurring in Hardin County, Kentucky is summarized in the following table.

Species	Common Name	Status	Habitat Present?	Species Present?
Mammals				
<i>Myotis grisescens</i>	Gray Bat	E	No	Unknown
<i>Myotis sodalis</i>	Indiana Bat	E	Summer only	Unknown
Mussels				
<i>Pleurobema clava</i>	Clubshell	E	No	No
<i>Plethobasus cooperianus</i>	Orangefoot Pimpleback	E	No	No
<i>Plethobasus cyphus</i>	Sheepnose	E	No	No
<i>Pleurobema plenum</i>	Rough Pigtoe	E	No	No
<i>Potamilus capax</i>	Fat Pocketbook	E	No	No

E = Federally Endangered Species

Potential summer habitat for the federally-endangered Indiana bat was identified within the project areas, and is addressed below. No habitat for the gray bat or any of the endangered mussel species listed for Hardin County was observed on the site.

Indiana Bat: Based on maps provided by the USFWS, the project is not located within a designated zone of known Indiana bat summer maternity habitat. Potential summer habitat for the Indiana bat, which includes snags and live trees with exfoliating bark or cavities, was identified within the project site during the field assessment. No winter habitat for this species, which includes caves and abandoned mines, was observed on the site.

The USFWS has concurred that this project will not have an adverse effect on any federally listed species. The concurrence letter from the USFWS is provided as Appendix D.

7. *Identification of historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places.*

Archaeological and cultural historic surveys have been completed for the project area. FEMA has provided the archaeological and cultural historic reports to the USACE for the project as well as the concurrence letter from the Kentucky Heritage Council.

SUMMARY

In summary, this report serves as Preconstruction Notification under NWP 43 for the construction of the Wilson Road Basin Flood Mitigation Project in Hardin County, Kentucky. The proposed project will impact 1,384 linear feet (0.078 acre) of ephemeral stream, and 0.091 acre of wetland. Mitigation for these impacts will consist of establishment of stormwater management channels for ephemeral stream impacts and the purchase of wetland mitigation credit from an approved wetland mitigation bank in the Salt River watershed. A *Stream Mitigation Plan* is provided as Appendix E.

We respectfully request your concurrence with the applicability of a NWP 43 for the proposed project. Please contact Matt Blake or Kiersten Fuchs at (502) 625-3009 with any questions regarding this submittal or the overall project.

Sincerely,



L. Matthew Blake
Project Ecologist II



Kiersten R. Fuchs
Principal
Senior Wildlife Biologist

cc: Ms. Chloe Brantley – Kentucky Division of Water (electronic copy)
Ms. Geneva J. Brawner – Kentucky Emergency Management (electronic copy)
Mr. Toby Spalding – City of Radcliff

Attachments: Figures
Photographs
Appendix A – Wetland Determination Data Forms
Appendix B – Rapid Bioassessment Protocol Forms
Appendix C – Preliminary Jurisdictional Determination Form
Appendix D – U.S. Fish and Wildlife Service Concurrence Letter
Appendix E – Stream Mitigation Plan

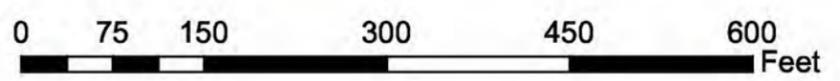
Source: Aerial from KYAPED (c) 2012

P:\2008 Projects\08-035-02-City of Radcliff\Stormwater Basins\Figures\Repermitting\Wilson Road\Mitigation Plan Aerial Map.mxd, 04-21-2014, ebowman



Legend

 Project Boundary



**WILSON ROAD BASIN
FLOOD MITIGATION PROJECT
HARDIN COUNTY, KENTUCKY**

REVISED DATE: 04-21-14 DRAWN BY: BMB/EDB



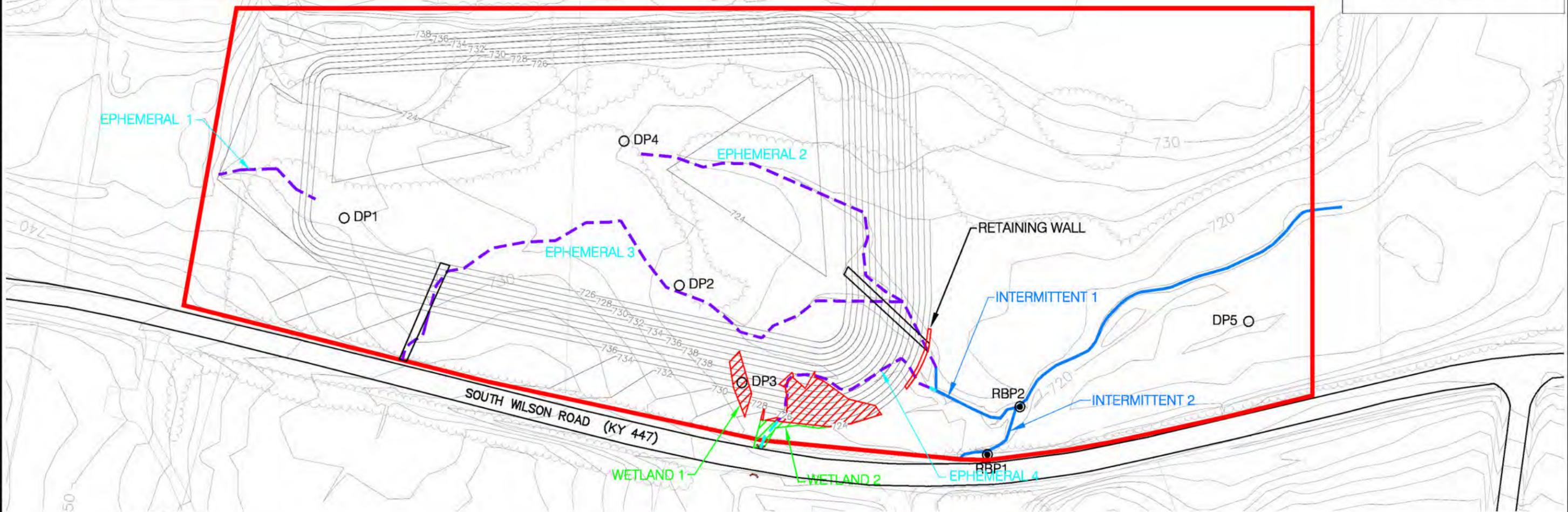
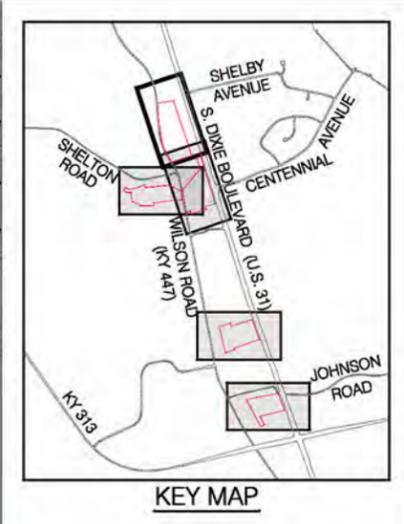
**AERIAL PHOTOGRAPH
MAP**

FIGURE 2

P:\2008 Projects\08-035-02-City of Radcliff Stormwater Basins\Figures\Repermitting\Wilson Road\PCN - Water/Wetland_LocationImpacts , Fig 3 - Wilson Road Basin, Eric Bowman, 4/21/2014 10:33 AM

Summary of Water/Wetland Impacts

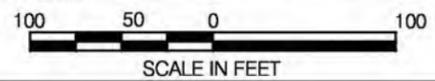
Feature	Impact Length (ft)	Impact Area (acres)	Quality	Status
Wetland 1	N/A	0.017	N/A	Jurisdictional
Wetland 2	N/A	0.074	N/A	Jurisdictional
Wetland Total	N/A	0.091		
Ephemeral Stream 1	110	0.008	Poor	Jurisdictional
Ephemeral Stream 2	424	0.015	Poor	Jurisdictional
Ephemeral Stream 3	642	0.044	Poor	Jurisdictional
Ephemeral Stream 4	208	0.011	Poor	Jurisdictional
Ephemeral Stream Total	1,384	0.078		
Jurisdictional Features Total	1,384	0.169		



LEGEND

- PROJECT BOUNDARY
- INTERMITTENT STREAM
- - - EPHEMERAL STREAM
- - - EPHEMERAL STREAM IMPACT
- ▨ WETLAND
- ▨ WETLAND IMPACT
- PROPOSED INLET/OUTLET STRUCTURE
- DP1 WETLAND DETERMINATION DATA POINT
- RBP1 RAPID BIOASSESSMENT PROTOCOL POINT

NOTE: JURISDICTIONAL WATER/WETLAND BOUNDARIES WERE DELINEATED AND SURVEYED USING GLOBAL POSITIONING SYSTEM EQUIPMENT BY REDWING WETLAND SCIENTISTS ON SEPTEMBER 16 - 17, 2013 AND NOVEMBER 14, 2013. THESE BOUNDARIES WERE VERIFIED BY THE U.S. ARMY CORPS OF ENGINEERS ON DECEMBER 19, 2013. USE OF THIS MAP IS FOR PRELIMINARY PLANNING PURPOSES ONLY.



WILSON ROAD BASIN
FLOOD MITIGATION PROJECT
HARDIN COUNTY, KENTUCKY

REVISED DATE: 04-21-14 DRAWN BY: EDB/BJD



WATER/WETLAND
LOCATION AND
IMPACTS MAP

FIGURE 3



**PRE-CONSTRUCTION NOTIFICATION FOR
NATIONWIDE PERMIT 27**

**QUIGGINS STREAM RESTORATION AND
FLOOD MITIGATION PROJECT
HARDIN COUNTY, KENTUCKY**

Submitted to:

**U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT**

May 2014



May 7, 2014

Ms. Meagan Chapman
Regulatory Specialist, Regulatory Branch
U.S. Army Corps of Engineers
Louisville District
600 Dr. Martin Luther King Jr. Place
Louisville, KY 40202

**Subject: Preconstruction Notification for NWP 27
Quiggins Stream Restoration and Flood Mitigation Project
Hardin County, Kentucky
Redwing Project No.: 08-035-02
USACE ID No.: LRL-2013-1015-mlc**

Dear Ms. Chapman:

Redwing Ecological Services, Inc. (Redwing) on behalf of the City of Radcliff, is pleased to submit this Preconstruction Notification (PCN) under Nationwide Permit (NWP) 27 for the proposed Quiggins Stream Restoration and Flood Mitigation Project in Hardin County, Kentucky. The City of Radcliff is requesting a NWP 27 to restore a degraded intermittent stream, restore four degraded ephemeral streams, and re-establish the upper portion of an ephemeral stream in place of an existing concrete channel, resulting in a net increase of aquatic resources. These stream restoration activities will be completed during the construction of a stormwater detention basin that is being established to alleviate upstream flooding issues and provide temporary flood storage upstream of the Quiggins sinkhole. Additionally, an existing earthen berm will be repaired in the proposed basin to cover an exposed sewerline, and a walking path constructed on top of the berm.

The approximately 14-acre site is located adjacent to Dixie Highway (US 31W) and approximately 0.25 mile south of the intersection of Dixie Highway and Shelby Avenue (Figure 1). The site is an existing natural depression containing young wooded habitat with thick understory and open mowed field (Figure 2). On-site waters total approximately 1,735 linear feet (0.28 acre) of intermittent stream and 2,105 linear feet (0.16 acre) of ephemeral stream (Figure 3). The project site receives stormwater from the watershed to the west, north, and south, and eventually flows to the Quiggins sinkhole to the northeast. Currently, the sinkhole does not have the capacity to handle the amount of stormwater runoff it receives which results in flooding of local roadways and properties upstream of the sinkhole during heavy rain events.

This report includes the required project information for this permit application. The proposed project will require permanent impacts to approximately 1,735 linear feet (0.28 acre) of intermittent stream and 2,105 linear feet (0.16 acre) of ephemeral stream (Figure 4).

REQUIRED INFORMATION

The following information is submitted as Notification under NWP 27 for the above-mentioned project, per guidance in the Federal Register (Vol. 77, No. 34, Tuesday, February 21, 2012, Section B Part 27).

1. *Name, address, and telephone number of the prospective permittee.*

Mr. Toby Spalding, PE
City of Radcliff
411 West Lincoln Trail Boulevard
Radcliff, KY 40160
(270) 351-4714

2. *Location of proposed project.*

The 14-acre basin is located east of Dixie Highway (US 31W) and approximately 0.25 mile south of the intersection of Dixie Highway and Shelby Avenue (Figure 1).

3. *Brief description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause; any other NWP(s), regional general permits(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity.*

The purpose of this project is to alleviate flooding issues upstream of the project site through the construction of a stormwater basin within an existing depressional, low-lying area in order to detain stormwater before it enters the Quiggins sinkhole to the northeast of the site. As part of the project, one degraded intermittent stream and four degraded ephemeral streams will be restored to convey water through the basin to the Quiggins sinkhole. An existing concrete lined ditch will be demolished and a natural stream channel will be re-established along the upper portion of Ephemeral Stream 7. Additionally an existing earthen berm will be repaired in the basin to cover an exposed sewerline and will have a walking path constructed on top of it. Intermittent Stream 1 will flow through a culvert under the repaired earthen berm during low flow events. Approximately 155 feet of Intermittent Stream 1 will be culverted in order to repair the earthen berm and cover the exposed sewerline.

The Quiggins sinkhole and adjacent low-lying, depressional area receives runoff from an approximate 1,100-acre watershed to the west of the property. Currently the sinkhole does not have the capacity to handle the amount of stormwater runoff it receives and frequently causes stormwater to back up within the existing depression during rain events causing flooding of roads and properties upstream of the proposed basin location. The proposed stormwater basin will increase the storage capacity of the existing depressional area thereby decreasing upstream flooding, increasing infiltration of surface runoff, and detaining runoff upstream of the sinkhole to allow the sinkhole to function properly. The existing on-site intermittent and ephemeral streams are poor quality and restoration of the streams within the basin will help convey water to the sinkhole during low-flows and smaller storm events while providing a net increase in aquatic resources.

Proposed permanent impacts to jurisdictional water/wetlands will include approximately 1,735 linear feet (0.28 acre) of poor quality intermittent stream and 2,105 linear feet (0.16 acre) of poor quality ephemeral stream. Impacts associated with the project are shown on Figure 4 and summarized in Table 1 below.

Table 1: Stream Impact Summary

Feature	Impact Length (feet)	Impact Area (acres)	Status
Intermittent Stream 1	1,735	0.28	Jurisdictional
Intermittent Stream Total	1,735	0.28	
Ephemeral Stream 2	650	0.02	Jurisdictional
Ephemeral Stream 3	100	0.01	Jurisdictional
Ephemeral Stream 4	180	0.004	Jurisdictional
Ephemeral Stream 5	10	0.0003	Jurisdictional
Ephemeral Stream 6	75	0.003	Jurisdictional
Ephemeral Stream 7	565	0.03	Jurisdictional
Ephemeral Stream 8	55	0.01	Jurisdictional
Ephemeral Stream 9	470	0.08	Jurisdictional
Ephemeral Stream Total	2,105	0.16	
Total Jurisdictional Waters	3,840	0.44	

The proposed project will include the excavation of six to ten feet of soil from the existing depression area to increase the storage capacity of the basin. Intermittent Stream 1 will be re-established in the bottom of the basin to handle low-flow events from the culvert under Dixie Highway, through the basin and to the Quiggins sinkhole. Four ephemeral stream channels will also be re-established to convey stormwater from surrounding properties. An existing concrete ditch will be removed, and the upper portion of Ephemeral Stream 7 will be re-established as a boulder step channel in its place (see Figure 5 in the attached Stream Restoration and Monitoring Plan in Appendix B).

No other direct or indirect adverse environmental effects will result from this project. No other NWP, regional general permit, or individual permit will be necessary for project authorization of this project. A Section 401 Water Quality Certification application package has been submitted to the Kentucky Division of Water (KDOW) and is currently under review. A Stream Construction Permit was issued by the KDOW Floodplain Management Section on February 19, 2014.

4. *Delineation of affected special aquatic sites including wetlands.*

All streams identified in this NWP 27 application were field delineated by Redwing ecologists during a site visit on August 13, 2008, and the results of the delineation were reconfirmed by Redwing on September 17, 2013. A jurisdictional determination of streams within the project area was made based on the presence/absence of ordinary high water mark (OHWM), defined bed and bank features, and flow regime. A *Preconstruction Notification and Waiver Request for Nationwide Permit 43* for this project was submitted to the U.S. Army Corps of Engineers (USACE) on November 7, 2013, which summarized the results of the delineation in detail. Following a verification site visit by the USACE and subsequent coordination, the delineation was modified to change Ephemeral Stream 1 to Intermittent Stream 1. Based on the revised delineation, jurisdictional waters on the site include 1,735 linear feet (0.28 acre) of intermittent stream and 2,105 linear feet (0.16 acre) of ephemeral stream (Figure 3). A summary of waters/wetlands verified by the USACE within the project area is presented on the following table:

Table 2: Water/Wetland Summary

Feature	Stream Length (feet)	Stream Area (acres)	Quality
Intermittent Stream 1	1,735	0.28	Poor
Intermittent Stream Total	1,735	0.28	
Ephemeral Stream 2	650	0.02	Poor
Ephemeral Stream 3	100	0.01	Poor
Ephemeral Stream 4	180	0.004	Poor
Ephemeral Stream 5	10	0.0003	Poor
Ephemeral Stream 6	75	0.003	Poor
Ephemeral Stream 7	565	0.03	Poor
Ephemeral Stream 8	55	0.008	Poor
Ephemeral Stream 9	470	0.08	Poor
Ephemeral Stream Total	2,105	0.16	
Total Jurisdictional Waters	3,840	0.44	

A non-jurisdictional roadside ditch in the southwest portion of the property will be eliminated with the extension of the existing box culvert under Dixie Highway to the east approximately 30 feet (Figure 4). Additionally, the non-jurisdictional concrete ditch to the east of the U.S. Calvary store and south of the property will be removed and a 550-foot portion of Ephemeral Stream 7 will be re-established in its place to transport stormwater into the basin. Currently, the velocity of the water flowing through the concrete ditch is very high and the force of the water has blown out the ephemeral channel below, causing unstable banks, erosion, and the formation of multiple channels through this area of the site.

5. *Discussion of compensatory mitigation proposal that offsets unavoidable losses of waters of the United States or justification explaining why compensatory mitigation should not be required.*

Impacts to jurisdictional waters associated with this project total approximately 1,735 linear feet (0.28 acre) of poor quality intermittent stream and 2,105 linear feet (0.16 acre) of poor quality ephemeral stream. The purpose of this project is to restore the degraded channels within the proposed stormwater basin and the removal of an upstream concrete channel; therefore, direct compensation for impacts to jurisdictional waters associated with this project is not proposed. Approximately 1,945 linear feet of Intermittent Stream 1 will be re-established and 1,661 linear feet of four ephemeral streams will be re-established in the bottom of the basin to handle low-flow events. An existing concrete channel will also be removed and replaced with 550 linear feet of natural channel along an upper portion of Ephemeral Stream 7 to the southwest of the basin. An approximately 8.6-acre riparian buffer area will be established in the bottom of the basin. The proposed stream mitigation for this project is discussed further in the Stream Restoration and Monitoring Plan, which is attached as Appendix B.

6. *Identification of threatened/endangered species or critical habitat potentially affected by the proposed work.*

Table 3 summarizes the species listed by the U.S. Fish and Wildlife Service (USFWS) as potentially occurring in Hardin County, Kentucky. The status of potential species is summarized below.

Table 3: Summary of Threatened and Endangered Species for Hardin County, Kentucky

Species	Common Name	Status	Habitat Present	Species Present
Mammals				
<i>Myotis grisescens</i>	Gray Bat	E	Yes	No
<i>Myotis sodalis</i>	Indiana Bat	E	Yes	Unknown
Mussels				
<i>Pleurobema clava</i>	Clubshell	E	No	No

E = Federally Endangered Species

Gray Bat (*Myotis grisescens*): The preferred summer and winter roosting habitat for this federally endangered species includes limestone caves. Summer foraging habitat includes forested areas along banks of intermittent and perennial streams and lakes near cave entrances. The Quiggins sinkhole to the northeast of the property does not contain habitat for the gray bat because water flows into the sinkhole during rain events and the sinkhole is regularly flooded. No other caves, rock shelters or mine portals are present on the site. The riparian woods along the intermittent and ephemeral streams provide limited foraging habitat for the gray bat because of the intermittent and ephemeral nature of the stream channels on the site which does not provide a constant flow of water.

Indiana Bat (*Myotis sodalis*): The preferred habitat for this federally endangered species includes both winter and summer habitats. Winter hibernacula habitat consists of limestone caves with pools, rock shelters, and abandoned mine portals. Summer maternity and foraging habitat includes dead trees or live trees with exfoliating bark or cracks, located either on upper slopes or along streams (USFWS, 2007). The Quiggins sinkhole to the northeast of the site does not provide winter habitat for the Indiana bat for the reasons mentioned above for the gray bat. No other caves, rock shelters, or mine portals are present on the property. The riparian woods habitat on the site represent marginal summer foraging and roosting habitat for the Indiana bat. Prior to the issuance of the original NWP 43 for this project on March 9, 2010, all Indiana bat habitat was cleared on the site in February of 2009. Over the last four years, some small areas of bat habitat have developed across the site. To avoid any impact to the Indiana bat during its maternity/roosting period, potential Indiana bat habitat trees were identified on site, and will be cut down during the off season between October 15 and March 31. Informal consultation with the USFWS was coordinated for this project in 2009 and a letter of concurrence was received on May 13, 2009. A copy of this letter has been attached as Appendix A of this permit package. It is anticipated that the proposed project will likely have no adverse effect on this species.

Based on the field delineation and the tree clearing restrictions, the proposed project is not likely to have an adverse impact on federally threatened/endangered species or their critical habitat.

7. Identification of historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places.

Archaeological and cultural historic surveys have been completed for the Quiggin's stormwater basin project area except for the Fill Area. FEMA has provided the archaeological and cultural historic reports to the USACE for the Quiggins Basin Project as well as the concurrence letter from the Kentucky Heritage Council.

SUMMARY

In summary, this document serves as Notification under NWP 27 in support of the proposed Quiggins Stream Restoration and Flood Mitigation Project in Hardin County, Kentucky. The proposed project will impact 1,735 linear feet (0.28 acre) of poor quality intermittent stream and 2,105 linear feet (0.16 acre) of poor quality ephemeral stream. The proposed project will involve the restoration through re-establishment of 1,945 linear feet of intermittent stream and 2,211 linear feet of ephemeral stream. A Stream Restoration and Monitoring Plan has been attached as Appendix B.

We respectfully request your concurrence with the applicability of a NWP 27 with a waiver request for the proposed project. Please contact Matt Blake or Kiersten Fuchs of Redwing at (502) 625-3009 with any questions regarding this submittal or the overall project.

Sincerely,



L. Matthew Blake
Project Ecologist II

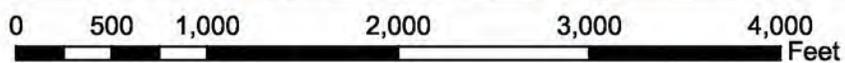


Kiersten R. Fuchs
Principal
Senior Wildlife Biologist

P:\2008 Project\08-035-City of Radcliff\08-035-02-City of Radcliff Stormwater Basins\Reports\Quiggins Basin\Revised PCN\Revised PCN - Quiggins.doc

cc: Ms. Chloe Brantley – Kentucky Division of Water (electronic copy)
Ms. Geneva J. Brawner – Kentucky Emergency Management (electronic copy)
Mr. Toby Spalding – City of Radcliff

Attachments: Figures
Appendix A – U.S. Fish and Wildlife Service Concurrence Letter
Appendix B – Stream Restoration and Monitoring Plan



QUIGGINS STREAM RESTORATION AND
FLOOD MITIGATION PROJECT
HARDIN COUNTY, KENTUCKY



AERIAL PHOTOGRAPH

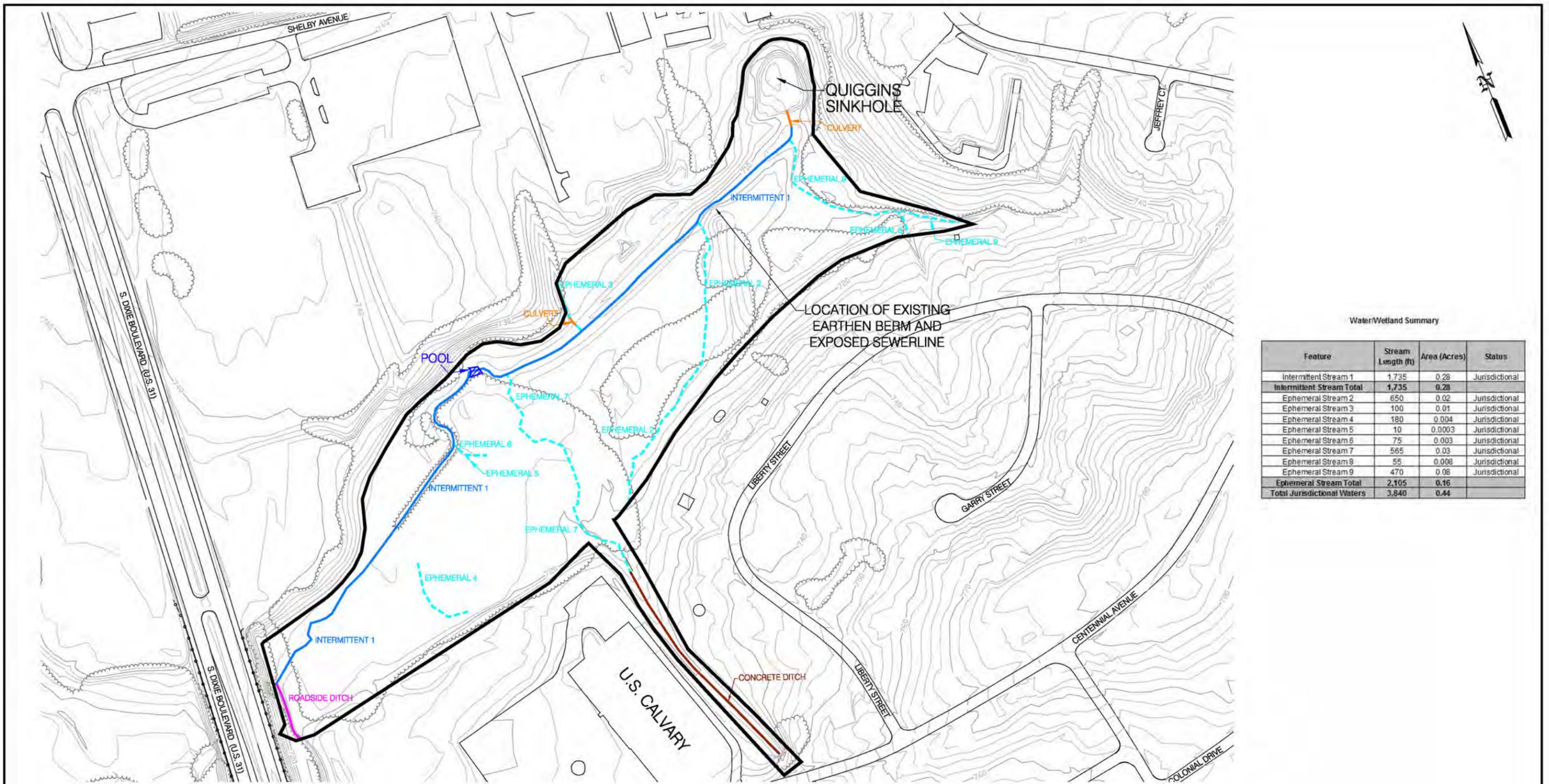
FILE: 08-035-02/Figs/PCN-Quiggins/Aerial

REDWING PROJECT 08-035-02

REVISION DATE: 5/1/2014

DRAWN BY LMB

FIGURE 2



Water/Wetland Summary

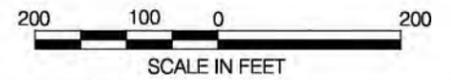
Feature	Stream Length (ft)	Area (Acres)	Status
Intermittent Stream 1	1,735	0.28	Jurisdictional
Intermittent Stream Total	1,735	0.28	
Ephemeral Stream 2	650	0.02	Jurisdictional
Ephemeral Stream 3	100	0.01	Jurisdictional
Ephemeral Stream 4	180	0.004	Jurisdictional
Ephemeral Stream 5	10	0.0003	Jurisdictional
Ephemeral Stream 6	75	0.003	Jurisdictional
Ephemeral Stream 7	565	0.03	Jurisdictional
Ephemeral Stream 8	55	0.008	Jurisdictional
Ephemeral Stream 9	470	0.08	Jurisdictional
Ephemeral Stream Total	2,105	0.16	
Total Jurisdictional Waters	3,840	0.44	

LEGEND

- SITE BOUNDARY
- JURISDICTIONAL EPHEMERAL STREAM
- JURISDICTIONAL INTERMITTENT STREAM
- ROADSIDE DITCH
- CULVERT
- CONCRETE DITCH
- POOL LOCATION

NOTE: JURISDICTIONAL WATER/WETLAND BOUNDARIES WERE DELINEATED AND SURVEYED USING GLOBAL POSITIONING SYSTEM EQUIPMENT BY REDWING WETLAND SCIENTISTS ON AUGUST 13, 2008; SEPTEMBER 17, 2013; AND DECEMBER 19, 2013. THESE BOUNDARIES WERE FIELD VERIFIED BY THE U.S. ARMY CORPS OF ENGINEERS ON DECEMBER 19, 2013.

SOURCE: BASE MAP PROVIDED BY CITY OF RADCLIFF



QUIGGINS STREAM RESTORATION AND FLOOD MITIGATION PROJECT
HARDIN COUNTY, KENTUCKY

FILENAME: /Repermitting/Quiggins/Mit/Basin2perUSACE visit021114-repermit
PROJECT No.: 08-035-02 DRAWN BY: BMA/BJD
REVISION DATE: 05-05-2014



WATER/WETLAND LOCATION MAP

FIGURE 3



**PRECONSTRUCTION NOTIFICATION FOR
NATIONWIDE PERMIT 27**

**TURNER LANE STREAM RESTORATION AND FLOOD
MITIGATION PROJECT
Hardin County, Kentucky**

Submitted to:

**U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT**

May 2014



May 14, 2014

Ms. Jane Archer
Regulatory Specialist, Regulatory Branch
U.S. Army Corps of Engineers
Louisville District
600 Dr. Martin Luther King, Jr. Place
Louisville, KY 40202

**Subject: Preconstruction Notification for Nationwide Permit 27
Turner Lane Stream Restoration and Flood Mitigation Project
Hardin County, Kentucky
Redwing Project No.: 08-035-02
USACE ID No.: LRL-2014-281-jea**

Dear Ms. Archer:

On behalf of the City of Radcliff, Redwing Ecological Services, Inc. (Redwing), is pleased to submit this Preconstruction Notification (PCN) in support of Nationwide Permit (NWP) 27 for the Turner Lane Stream Restoration and Flood Mitigation project in Hardin County, Kentucky.

The City has applied for a grant for the project from the Federal Emergency Management Agency (FEMA) and is working through the approval process with FEMA. The FEMA grant involves the construction of four stormwater basins and utilization of one area for fill deposition in Radcliff, Kentucky in order to alleviate flooding issues by providing flood storage during storm events. The Turner Lane Stream Restoration Project is being proposed within one of the stormwater basins located on the west side of Dixie Highway (US 31W) (Figure 1). The project area is located west of South Wilson Road (KY 447) approximately 300 feet south of the intersection of South Wilson Road and Shelton Road, and is approximately 6.6 acres in size (Figure 2). Jurisdictional waters of the U.S. within the Turner Lane project area total 0.111 acre and include two intermittent streams (Figure 3).

This report includes the required project information for this permit application. The proposed project will require permanent impacts to 912 linear feet (0.084 acre) of intermittent stream.

REQUIRED INFORMATION

The following information is submitted as a PCN under NWP 27 in support of the above-mentioned project, per guidance in the Federal Register (Vol. 77; No. 34; Tuesday, February 21, 2012; Section B, Part 27).

1. *Name, address, and telephone number of the prospective permittee.*

Mr. Toby Spalding, PE
City of Radcliff
411 West Lincoln Trail Boulevard
Radcliff, KY 40160
(270) 351-4714

2. *Location of proposed project.*

The proposed Turner Lane Stream Restoration and Flood Mitigation project is located in Radcliff, Kentucky west of South Wilson Road (KY 447), approximately 300 feet south of the intersection of South Wilson Road and Shelton Road (Figure 2), and is approximately 6.6 acres.

3. *Description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause; any other NWP(s), regional general permits(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity.*

The purpose of this project is to restore a degraded stream and to alleviate downstream flooding of roads and private properties in Radcliff by providing stormwater storage through the construction of a stormwater storage basin. The Turner Lane Basin is located in a watershed that drains to the Quiggins sinkhole. The sinkhole does not have the capacity to handle the amount of stormwater that it receives and frequently causes stormwater to back up within the existing depression during rain events causing flooding of upstream roads and properties. The stormwater basin is being proposed in the upper watershed to increase infiltration of surface runoff, detain runoff upstream of the sinkhole and decrease sedimentation to streams lower in the watershed. The project will require impacts to 912 linear feet (0.084 acre) of intermittent stream (Figure 3) as summarized in the table below.

Feature	Impact Length (feet)	Impact Area (acres)	Status
Intermittent Stream 1	912	0.084	Jurisdictional
Jurisdictional Features Total	912	0.084	

Construction activities for the Turner Lane Basin include clearing of approximately two acres of brush and trees, and the cut and fill of approximately 44,000 cubic yards of material for the construction of a berm and final restoration of the site. Silt fencing, sediment traps, and other appropriate Best Management Practices will be implemented to minimize impacts during construction. The restoration of Intermittent Stream 1 will be accomplished through onsite stream re-establishment within the basin. Intermittent stream restoration activities are discussed in the attached *Stream Restoration and Monitoring Plan* (Appendix E). A Section 401 Water Quality Certification application package has been submitted to the Kentucky Division of Water (KDOW) and is currently under review. A Stream Construction Permit exemption was issued by the KDOW Floodplain Management Section on January 14, 2014.

4. *Delineation of special aquatic and other waters of U.S. on the project site.*

Jurisdictional waters of the U.S., including wetlands, were delineated within the project area by Redwing wetland scientists on September 12 and November 14, 2013. A discussion of Redwing's delineation methodology and results is presented below.

The delineation was accomplished through documentation of the presence/absence of hydric soils, wetland hydrology, and hydrophytic vegetation per the guidelines of the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region Version 2.0* (April 2012). A jurisdictional determination of open waters, such as streams and ponds, within the project corridors was made based on the presence/absence of ordinary high water mark (OHWM), defined bed and bank features, and flow regime. Soil, hydrology and vegetation data were collected on Routine Wetland Determination Data Forms for

one point within the project area and are included as Appendix A. The quality of on-site intermittent streams was assessed using the Rapid Bioassessment Protocol (RBP) developed by the U.S. Environmental Protection Agency. RBP forms for both intermittent streams are included as Appendix B. A Preliminary Jurisdictional Determination Form is attached as Appendix C. The results of the delineation were field verified by the USACE during a site visit on December 19, 2013.

Jurisdictional features within the Turner Lane Basin project area are limited to two intermittent streams totaling 1,238 linear feet (0.111 acre) as presented in Figure 3. These features are summarized in the following table:

Feature	Stream Length (feet)	Area (acres)	Quality	Status
Intermittent Stream 1	1,070	0.098	Poor	Jurisdictional
Intermittent Stream 2	168	0.013	Poor	Jurisdictional
Jurisdictional Features Total	1,238	0.111		

The jurisdictional features and on-site habitats in the project area are discussed below:

No wetlands were identified within the Turner Lane Basin project area. General characteristics of the project area are discussed below in terms of soils, hydrology, and vegetation.

Soils: The SSURGO Database for Hardin and Larue Counties, Kentucky (2009), maps the Turner Lane Basin project area as being underlain by Crider silt loam, Nolin silt loam, and Vertrees silty clay loam (Figure 4). None of these soils are on the Hydric Soils List for Hardin and Larue Counties. No field indicators of hydric soil were observed during the field assessment.

Hydrology: The main sources of hydrology to the Turner Lane Basin project area include precipitation and surface runoff from adjacent uplands. No wetland hydrology indicators were observed within the project area during the field assessment. The project area is located outside the 100-year floodplain (Figure 5).

Vegetation: The primary habitats within the Turner Lane Basin project area include open field and upland woods. Plant species commonly observed within the open field habitat include Johnsongrass (*Sorghum halepense*), crown vetch (*Securigera varia*), showy ticktrefoil (*Desmodium canadense*), tall fescue (*Festuca arundinacea*), yellow foxtail (*Setaria pumila*), tall ironweed (*Vernonia angustifolia*), annual ragweed (*Ambrosia artemisiifolia*), red clover (*Trifolium pratense*), and devil's beggartick (*Bidens frondosa*). These species are listed as upland (UPL), facultative upland (FACU), facultative (FAC), and facultative wetland (FACW) on the National Wetland Plant List (NWPL) (2014).

Plant species commonly observed within the upland woods habitat include sugar maple (*Acer saccharum*), sassafras (*Sassafras albidum*), hackberry (*Celtis occidentalis*), white ash (*Fraxinus americana*), bush honeysuckle (*Lonicera maackii*), Eastern red cedar (*Juniperus virginiana*), Japanese honeysuckle (*Lonicera japonica*), poison ivy (*Toxicodendron radicans*), and Virginia creeper (*Parthenocissus quinquefolia*). These species are listed as UPL, FACU, FAC, and FACW on the NWPL (2014).

Two intermittent streams were identified within the Turner Lane Basin project area:

Intermittent Stream 1 measures 1,070 linear feet (0.098 acre) within the project area and is represented as a blue-line on the USGS topographic map. The channel enters the site from the northwest and flows generally east through the site, exiting the project area to the east

through a culvert under South Wilson Road. The stream has been fully channelized within the project area. The channel ranges from two to six feet wide, with banks ranging from eight inches to two feet in height, and a substrate consisting of silt, gravel, and cobble material. No water was present in the channel during the field assessment. Based on an RBP score of 59, Intermittent Stream 1 is considered poor quality.

Intermittent Stream 2 measures 168 linear feet (0.013 acre) within the project area and is represented as a blue-line on the USGS topographic map. The channel enters the site from the southeast and flows generally north along the eastern boundary of the site until it flows into Intermittent Stream 2. The stream has been fully channelized within the project area. The channel ranges from one to six feet wide, with banks ranging from eight inches to one foot in height, and a substrate consisting of silt, gravel, and cobble material. No water was present in the channel during the field assessment. Based on an RBP score of 63, Intermittent Stream 2 is considered poor quality.

5. *Discussion of compensatory mitigation proposal that offsets unavoidable losses of waters of the United States or justification explaining why compensatory mitigation should not be required.*

The purpose of the project is to restore the degraded intermittent stream channel within the proposed flood mitigation basin; therefore, direct compensation for impacts to jurisdictional waters associated with this project is not proposed. Intermittent Stream 1 will be re-established in the flood mitigation basin with natural meanders, riffles, and pools. Details are provided in the *Stream Restoration and Monitoring Plan* (Appendix E).

6. *Identification of threatened/endangered species or critical habitat potentially affected by the proposed work.*

The potential for the proposed project to affect federally-protected species listed by the U.S. Fish and Wildlife Service (USFWS) as occurring in Hardin County, Kentucky is summarized in the following table.

Species	Common Name	Status	Habitat Present?	Species Present?
Mammals				
<i>Myotis grisescens</i>	Gray Bat	E	No	Unknown
<i>Myotis sodalis</i>	Indiana Bat	E	Summer only	Unknown
Mussels				
<i>Pleurobema clava</i>	Clubshell	E	No	No
<i>Plethobasus cooperianus</i>	Orangefoot Pimpleback	E	No	No
<i>Plethobasus cyphus</i>	Sheepnose	E	No	No
<i>Pleurobema plenum</i>	Rough Pigtoe	E	No	No
<i>Potamilus capax</i>	Fat Pocketbook	E	No	No

E = Federally Endangered Species

Potential summer habitat for the federally-endangered Indiana bat was identified within the project areas, and is addressed below. No habitat for any of the endangered mussel species listed for Hardin County was observed on the site.

Indiana Bat: Based on maps provided by the USFWS, the project is not located within a designated zone of known summer maternity Indiana bat habitat. Potential summer habitat for the Indiana bat, which includes snags and live trees with exfoliating bark or cavities, was identified within the project site during the field assessment. No winter habitat for this species, which includes caves and abandoned mines, was observed on the site.

The USFWS has concurred that this project will not have an adverse effect on any federally listed species. The concurrence letter from the USFWS is provided as Appendix D.

7. *Identification of historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places.*

Archaeological and cultural historic surveys have been completed for the project area, and FEMA has provided the archaeological and cultural historic reports to the USACE for this project as well as the concurrence letter from the Kentucky Heritage Council.

SUMMARY

In summary, this report serves as Preconstruction Notification under NWP 27 for the construction of the Turner Lane Stream Restoration and Flood Mitigation Project in Hardin County, Kentucky. The proposed project will involve the re-establishment of 912 linear feet of intermittent stream and construction of a flood mitigation basin. A *Stream Restoration and Monitoring Plan* is provided as Appendix E.

We respectfully request your concurrence with the applicability of a NWP 27 for the proposed project. Please contact Matt Blake or Kiersten Fuchs at (502) 625-3009 with any questions regarding this submittal or the overall project.

Sincerely,



L. Matthew Blake
Project Ecologist II



Kiersten R. Fuchs
Principal
Senior Wildlife Biologist

cc: Ms. Chloe Brantley – Kentucky Division of Water (electronic copy)
Ms. Geneva J. Brawner – Kentucky Emergency Management (electronic copy)
Mr. Toby Spalding – City of Radcliff

Attachments: Figures
Photographs
Appendix A – Wetland Determination Data Form
Appendix B – Rapid Bioassessment Protocol Data Forms
Appendix C – Preliminary Jurisdictional Determination Form
Appendix D – USFWS Concurrence Letter
Appendix E – Stream Restoration and Monitoring Plan

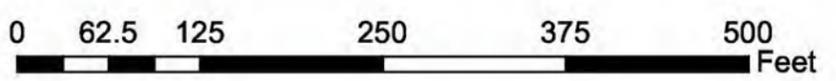
Source: Aerial from KYAPED (c) 2012

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Legend

 Project Boundary



**TURNER LANE STREAM RESTORATION
AND FLOOD MITIGATION PROJECT
HARDIN COUNTY, KENTUCKY**

REVISED DATE: 05-06-14 DRAWN BY: BMB/EDB



**AERIAL PHOTOGRAPH
MAP**

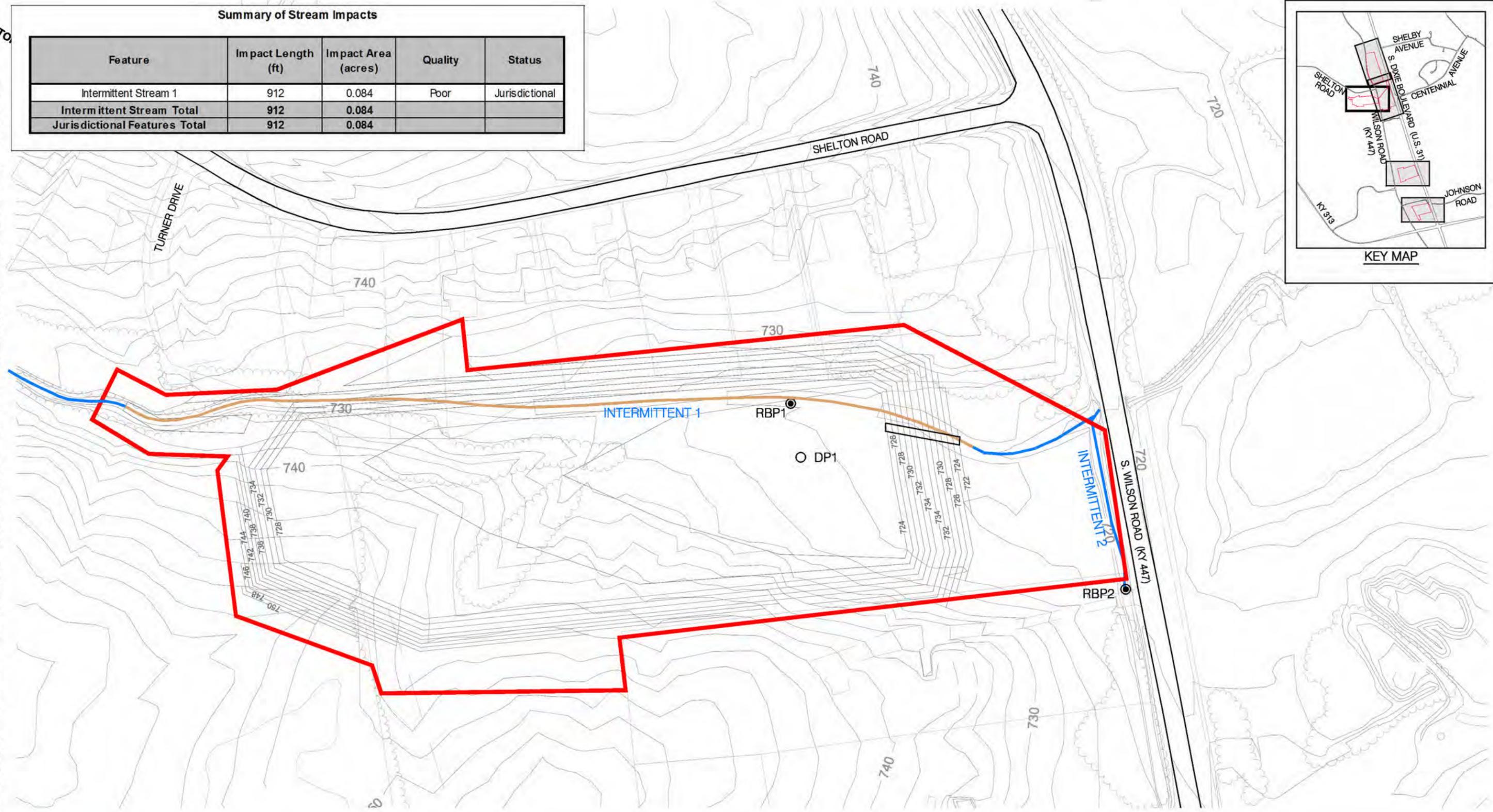
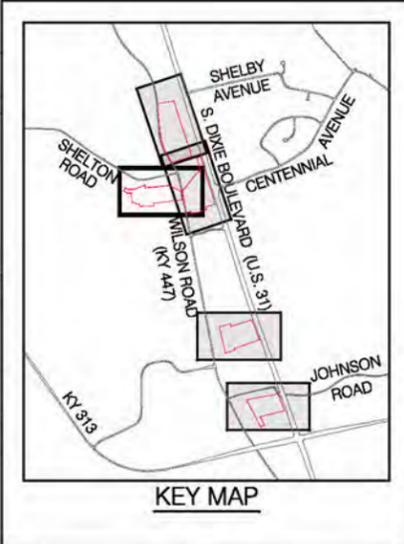
FIGURE 2

SHELTON

P:\2008 Projects\08-035-02-City of Radcliff Stormwater Basins\Figures\Repermitting\Turner Lane\Fig 3 - waterwetlandlocationimpact , Fig 7 - Turner Lane Basin, Blair Barnes, 5/12/2014 9:25 AM

Summary of Stream Impacts

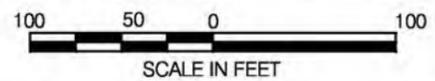
Feature	Impact Length (ft)	Impact Area (acres)	Quality	Status
Intermittent Stream 1	912	0.084	Poor	Jurisdictional
Intermittent Stream Total	912	0.084		
Jurisdictional Features Total	912	0.084		



LEGEND

- PROJECT BOUNDARY
- INTERMITTENT STREAM
- INTERMITTENT STREAM IMPACT
- PROPOSED OUTLET STRUCTURE
- DP1 WETLAND DETERMINATION DATA POINT
- RBP1 RAPID BIOASSESSMENT PROTOCOL POINT

NOTE: JURISDICTIONAL WATER/WETLAND BOUNDARIES WERE DELINEATED AND SURVEYED USING GLOBAL POSITIONING SYSTEM EQUIPMENT BY REDWING WETLAND SCIENTISTS ON SEPTEMBER 12, 2013. THESE BOUNDARIES WERE FIELD VERIFIED BY THE U.S. ARMY CORPS OF ENGINEERS ON DECEMBER 19, 2013. USE OF THIS MAP IS FOR PRELIMINARY PLANNING PURPOSES ONLY.



TURNER LANE STREAM RESTORATION AND FLOOD MITIGATION PROJECT
HARDIN COUNTY, KENTUCKY

REVISED DATE: 04-01-14 | DRAWN BY: BMB



WATER/WETLAND LOCATION AND IMPACTS MAP

FIGURE 3



DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
P.O. BOX 59
LOUISVILLE KY 40201-0059
FAX: (502) 315-6677
<http://www.lrl.usace.army.mil/>

July 25, 2014

Operations Division
Regulatory Branch (South)
ID No. LRL-2014-281-jea

Ms. Kiersten Fuchs
Redwing Ecological Services, Incorporated
1139 South Fourth Street
Louisville, Kentucky 40203

Dear Ms. Fuchs:

This is in response to your request for authorization to construct a stormwater storage basin to alleviate flooding issues in the Radcliff area by providing flood storage during storm events. The proposed Turner Lane Stream Restoration and Flood Mitigation project would involve impacts to 912 linear feet (0.084 acre) of an unnamed intermittent stream of Falling Springs. The proposed 6.6-acre site is located west of South Wilson Road (KY 447), approximately 300 feet south of the intersection of South Wilson Road and Shelton Road in Radcliff, Hardin County, Kentucky. Construction activities for this basin include clearing of approximately 2 acres of brush and trees and the cut and fill of approximately 44,000 cubic yards of material for the construction of a berm and restoration of the site. The restoration of the intermittent stream would be accomplished by re-establishing the stream in the flood mitigation basin to provide natural sinuosity and establishing riffles and pools to provide grade control and aquatic habitat. An approximately 2.2-acre riparian area (minimum 50 feet wide along both stream banks) would also be established in the bottom of the basin. Best management practices would be implemented to minimize impacts during construction. The information supplied by you was reviewed to determine whether a Department of the Army (DA) permit will be required under the provisions of Section 404 of the Clean Water Act.

Your project is considered a discharge of dredged and/or fill material associated with stream and wetland restoration activities. The project is authorized under the provisions of 33 CFR 330 Nationwide Permit (NWP) No. 27, Aquatic Habitat Restoration, Establishment, and Enhancement Activities, as published in the Federal Register February 21, 2012. Under the provisions of this authorization, you must comply with the enclosed Terms and General Conditions for Nationwide Permit No. 27 and the following Special Conditions:

1. The permittee shall only remove trees from within the project area between the dates of October 15th to March 31st.
2. The permittee shall implement the Stream Restoration and Monitoring Plan Turner Lane Stream Restoration and Flood Mitigation Project, Hardin County, Kentucky dated May 14, 2014.
3. The permittee shall submit an annual report for five years documenting ecological lift following construction of the project. The report shall be due by 31st of December of each year until released from monitoring by this office. If the project is not providing an ecological lift at the end of five year period, the permittee shall provide an alternative plan with remedial actions.
4. The permittee shall execute a deed restriction on the mitigation site within the appropriate county and submit documentation of the recorded deed restriction to this office after construction is completed.

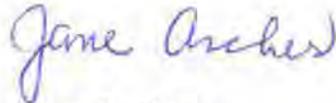
You must also comply with the enclosed individual Water Quality Certification (WQC) Conditions dated May 30, 2014, issued by the Kentucky Division of Water (KDOW).

This decision is valid until **March 18, 2017**. The enclosed Compliance Certification should be signed and returned when the project is completed. If your project is not completed by this date or if your project is modified, you must contact us for another permit determination in accordance with the rules and regulations in effect at that time. Please note that we also perform periodic inspections to ensure compliance with our permit conditions and applicable Federal laws. A copy of this letter is being sent to the appropriate coordinating agencies and to the City of Radcliff (see enclosure for addresses).

Attached to this verification that the project is authorized by NWP No. 27 are a preliminary jurisdictional determination (JD), a Notification of Appeal Process (NAP) fact sheet, and Request for Appeal (RFA) form. However, a preliminary JD is not appealable and impacting "waters of the U.S." identified in the preliminary JD will result in you waiving the right to request an approved JD at a later date. An approved JD may be requested (which may be appealed), by contacting me for further instruction.

If you have any questions, please contact this office by writing to the above address, ATTN: CELRL-OP-FS, or by calling me at (502) 315-6682. All correspondence pertaining to this matter should refer to our ID No. LRL-2014-281-jea.

Sincerely,



Jane Archer
Regulatory Specialist
Regulatory Branch

Enclosures



DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
P.O. BOX 59
LOUISVILLE KY 40201-0059
FAX: (502) 315-6677
<http://www.lrl.usace.army.mil/>
July 25, 2014

Operations Division
Regulatory Branch (South)
ID No. LRL-2014-283-jea

Ms. Kiersten Fuchs
Redwing Ecological Services, Incorporated
1139 South Fourth Street
Louisville, Kentucky 40203

Dear Ms. Fuchs:

This is in response to your request for authorization to impact a total of 149 linear feet of two intermittent streams to reconnect and restore two degraded streams and to alleviate flooding in Radcliff by providing a location for fill material placement during the construction of five separate stormwater storage basins. The proposed 7.9-acre site is located between Dixie Highway (US 31W) and South Wilson Road (KY 447) in Radcliff, Hardin County, Kentucky. Construction activities for the Fill Area would include filling of the project area with excess soil from the five Happy Valley Flood Mitigation basin projects in order to extend Centennial Avenue to the west from Dixie Highway to South Wilson Road. The project would impact a total of 0.02 acre of "waters of the United States." The information supplied by you was reviewed to determine whether a Department of the Army (DA) permit will be required under the provisions of Section 404 of the Clean Water Act.

Your project is considered a discharge of dredged and/or fill material associated with stream and wetland restoration activities. The project is authorized under the provisions of 33 CFR 330 Nationwide Permit (NWP) No. 27, Aquatic Habitat Restoration, Establishment, and Enhancement Activities, as published in the Federal Register February 21, 2012. Under the provisions of this authorization, you must comply with the enclosed Terms and General Conditions for Nationwide Permit No. 27 and the following Special Conditions:

1. The permittee shall conduct the removal of any trees associated with the project between the dates of October 15th to March 31st.
2. The permittee shall implement the Stream Restoration and Monitoring Plan for Fill Area Stream Restoration and Flood Mitigation Project, Hardin County, Kentucky dated May 22, 2014.
3. The permittee shall submit an annual report documenting ecological lift. The first report is due by 31 December following construction and each year for 5 years. If the project is not providing an ecological lift at the end of the five year period, the permittee shall provide an alternative plan.

4. The permittee shall execute a deed restriction on the site within the appropriate county and submit documentation of the recorded deed restriction to this office after construction is completed. The submitted deed restriction shall be reviewed and approved by the Corps of Engineers prior to being recorded.

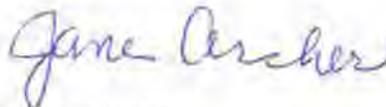
You must also comply with the enclosed individual Water Quality Certification (WQC) issued by the Kentucky Division of Water (KDOW) dated May 29, 2014.

This decision is valid until **March 18, 2017**. The enclosed Compliance Certification should be signed and returned when the project is completed. If your project is not completed by this date or if your project is modified, you must contact us for another permit determination in accordance with the rules and regulations in effect at that time. Please note that we also perform periodic inspections to ensure compliance with our permit conditions and applicable Federal laws. A copy of this letter is being sent to City of Radcliff and to the coordinating agencies (see enclosure for addresses).

Attached to this verification that the project is authorized by NWP No. 27 are a preliminary jurisdictional determination (JD), a Notification of Appeal Process (NAP) fact sheet, and Request for Appeal (RFA) form. However, a preliminary JD is not appealable and impacting "waters of the U.S." identified in the preliminary JD will result in you waiving the right to request an approved JD at a later date. An approved JD may be requested (which may be appealed), by contacting me for further instruction.

If you have any questions, please contact this office by writing to the above address, ATTN: CELRL-OP-FS, or by calling me at (502) 315-6682. All correspondence pertaining to this matter should refer to our ID No. LRL-2014-283-jea.

Sincerely,



Jane Archer
Regulatory Specialist
Regulatory Branch

Enclosures



DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
P.O. BOX 59
LOUISVILLE KY 40201-0059
FAX: (502) 315-6677
<http://www.lrl.usace.army.mil/>

July 2, 2014

Operations Division
Regulatory Branch (South)
ID No. LRL-2013-1015-mck

Mr. Matt Blake
Redwing Ecological Services, Inc.
1139 South Fourth Street
Louisville, Kentucky 40203

Dear Mr. Blake:

This is in response to your request on behalf of the City of Radcliff for authorization to perform aquatic habitat, restoration, establishment and enhancement activities to unnamed intermittent and ephemeral tributaries to Falling Springs of Mill Creek, located east of Dixie Highway (US 31W) and approximately 0.25 mile south of the intersection of Dixie Highway and Shelby Avenue Radcliff, Hardin County, Kentucky. The proposed project would include the discharge of fill material into 1,735 linear feet (0.28 acre) of an unnamed intermittent tributary and 2,105 linear feet (0.16 acre) of unnamed ephemeral tributaries. Approximately 1,945 linear feet of Intermittent Stream 1 and 1,661 linear feet of ephemeral streams (7, 3, and 9) would be re-established in the bottom of the basin. This includes removing and replacing an existing concrete lined channel with 550 linear feet of natural channel along an upper portion of Ephemeral Stream 7. Approximately 8.3 acres of riparian buffer area would be established. Additionally, an earthen berm would be repaired in the basin to cover an exposed sewerline, with a walking path constructed on top of the berm. Approximately 155 linear feet of Intermittent Stream 1 would be placed into a culvert through the earthen berm.

The information supplied by you was reviewed to determine whether a Department of the Army (DA) permit will be required under the provisions of Section 404 of the Clean Water Act.

This project is considered a discharge of fill material associated with stream and wetland restoration activities. The project is authorized under the provisions of Nationwide Permit (NWP) No. 27, Aquatic Habitat Restoration, Establishment, and Enhancement Activities, as published in the Federal Register February 21, 2012. Under the provisions of this authorization, you must comply with the enclosed Terms and General Conditions for NWP No. 27 and the following Special Conditions:

1. The permittee shall implement the plan in accordance with the plan titled, "Pre-Construction Notification for Nationwide Permit 27,

Quiggins Stream Restoration and Flood Mitigation Project Hardin County, Kentucky," dated May 2014 and all subsequently obtained supplemental information submitted by or on behalf of the permittee.

2. The permittee must conduct all removal of trees associated with the project between the dates of October 15th to March 31st.

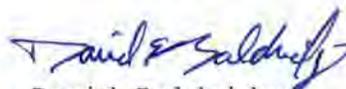
The City of Radcliff must also comply with the enclosed Individual Water Quality Certification (WQC), issued by the Kentucky Division of Water on May 22, 2014 (WQC#2014-023-1 and AI No. 120558). The City of Radcliff may proceed with the project without further contact or verification from us.

This decision is valid until March 18, 2017. The enclosed Compliance Certification should be signed and returned when the project is completed. If this project is not completed by this date or if this project is modified, the City of Radcliff must contact us for another permit determination in accordance with the rules and regulations in effect at that time. Note that we also perform periodic inspections to ensure compliance with our permit conditions and applicable Federal laws. Copies of this letter are being sent to the permittee and to the appropriate coordinating agencies (see enclosure for addresses).

Attached to this verification are a preliminary jurisdictional determination (JD), a Notification of Appeal Process (NAP) fact sheet, and Request for Appeal (RFA) form. However, a preliminary JD is not appealable and impacting "waters of the United States" identified in the preliminary JD will result in the City of Radcliff waiving the right to request an approved JD at a later date. An approved JD may be requested (which may be appealed), by contacting the project manager for further instruction.

If you have any questions, please contact this office by writing to the above address, ATTN: CELRL-OP-FS, or by calling Ms. Meagan Knuckles at 502-315-6709. All correspondence pertaining to this matter should refer to our ID No. LRL-2013-1015-mck.

Sincerely,



David Baldrige
Acting Chief, South Section
Regulatory Branch

Enclosures

Terms of Nationwide Permit No. 27
Aquatic Habitat Restoration, Establishment, and Enhancement Activities

Activities in waters of the United States associated with the restoration, enhancement, and establishment of tidal and non-tidal wetlands and riparian areas, the restoration and enhancement of non-tidal streams and other non-tidal open waters, and the rehabilitation or enhancement of tidal streams, tidal wetlands, and tidal open waters, provided those activities result in net increases in aquatic resource functions and services.

To the extent that a Corps permit is required, activities authorized by this NWP include, but are not limited to: the removal of accumulated sediments; the installation, removal, and maintenance of small water control structures, dikes, and berms, as well as discharges of dredged or fill material to restore appropriate stream channel configurations after small water control structures, dikes, and berms, are removed; the installation of current deflectors; the enhancement, restoration, or establishment of riffle and pool stream structure; the placement of in-stream habitat structures; modifications of the stream bed and/or banks to restore or establish stream meanders; the backfilling of artificial channels; the removal of existing drainage structures, such as drain tiles, and the filling, blocking, or reshaping of drainage ditches to restore wetland hydrology; the installation of structures or fills necessary to establish or re-establish wetland or stream hydrology; the construction of small nesting islands; the construction of open water areas; the construction of oyster habitat over unvegetated bottom in tidal waters; shellfish seeding; activities needed to reestablish vegetation, including plowing or disking for seed bed preparation and the planting of appropriate wetland species; re-establishment of submerged aquatic vegetation in areas where those plant communities previously existed; re-establishment of tidal wetlands in tidal waters where those wetlands previously existed; mechanized land clearing to remove non-native invasive, exotic, or nuisance vegetation; and other related activities. Only native plant species should be planted at the site.

This NWP authorizes the relocation of non-tidal waters, including non-tidal wetlands and streams, on the project site provided there are net increases in aquatic resource functions and services.

Except for the relocation of non-tidal waters on the project site, this NWP does not authorize the conversion of a stream or natural wetlands to another aquatic habitat type (e.g., stream to wetland or vice versa) or uplands. Changes in wetland plant communities that occur when wetland hydrology is more fully restored during wetland rehabilitation activities are not considered a conversion to another aquatic habitat type. This NWP does not authorize stream channelization. This NWP does not authorize the relocation of tidal waters or the conversion of tidal waters, including tidal wetlands, to other aquatic uses, such as the conversion of tidal wetlands into open water impoundments.

Compensatory mitigation is not required for activities authorized by this NWP since these activities must result in net increases in aquatic resource functions and services.

Reversion. For enhancement, restoration, and establishment activities conducted: (1) In accordance with the terms and conditions of a binding stream or wetland enhancement or restoration agreement, or a wetland establishment agreement, between the landowner and the U.S. Fish and Wildlife Service (FWS), the Natural Resources Conservation Service (NRCS), the Farm Service Agency (FSA), the National Marine Fisheries Service (NMFS), the National Ocean Service (NOS), U.S. Forest Service (USFS), or their designated state cooperating agencies; (2) as voluntary wetland restoration, enhancement, and establishment actions documented by the NRCS or USDA Technical Service Provider pursuant to NRCS Field Office Technical Guide standards; or (3) on reclaimed surface coal mine lands, in accordance with a Surface Mining Control and Reclamation Act permit issued by the Office of Surface Mining Reclamation and Enforcement (OSMRE) or the applicable state agency, this NWP also authorizes any future discharge of dredged or fill material associated with the reversion of the area to its documented prior condition and use (i.e., prior to the restoration, enhancement, or establishment activities). The reversion must occur within five years after expiration of a limited term wetland restoration or establishment agreement or permit, and is authorized in these circumstances even if the discharge occurs after this NWP expires. The five-year reversion limit does not apply to agreements without time limits reached between the landowner and the FWS, NRCS, FSA, NMFS, NOS, USFS, or an appropriate state cooperating agency. This NWP also authorizes discharges of dredged or fill material in waters of the United States for the reversion of wetlands that were restored, enhanced, or established on prior-converted cropland or on uplands, in accordance with a binding agreement between the landowner and NRCS, FSA, FWS, or their

designated state cooperating agencies (even though the restoration, enhancement, or establishment activity did not require a section 404 permit). The prior condition will be documented in the original agreement or permit, and the determination of return to prior conditions will be made by the Federal agency or appropriate state agency executing the agreement or permit. Before conducting any reversion activity the permittee or the appropriate Federal or state agency must notify the district engineer and include the documentation of the prior condition. Once an area has reverted to its prior physical condition, it will be subject to whatever the Corps Regulatory requirements are applicable to that type of land at the time. The requirement that the activity results in a net increase in aquatic resource functions and services does not apply to reversion activities meeting the above conditions. Except for the activities described above, this NWP does not authorize any future discharge of dredged or fill material associated with the reversion of the area to its prior condition. In such cases a separate permit would be required for any reversion.

Reporting. For those activities that do not require pre-construction notification, the permittee must submit to the district engineer a copy of: (1) The binding stream enhancement or restoration agreement or wetland enhancement, restoration, or establishment agreement, or a project description, including project plans and location map; (2) the NRCS or USDA Technical Service Provider documentation for the voluntary stream enhancement or restoration action or wetland restoration, enhancement, or establishment action; or (3) the SMCRA permit issued by OSMRE or the applicable state agency. The report must also include information on baseline ecological conditions on the project site, such as a delineation of wetlands, streams, and/or other aquatic habitats. These documents must be submitted to the district engineer at least 30 days prior to commencing activities in waters of the United States authorized by this NWP.

Notification: The permittee must submit a pre-construction notification to the district engineer prior to commencing any activity (see general condition 31), except for the following activities:

(1) Activities conducted on non-Federal public lands and private lands, in accordance with the terms and conditions of a binding stream enhancement or restoration agreement or wetland enhancement, restoration, or establishment agreement between the landowner and the U.S. FWS, NRCS, FSA, NMFS, NOS, USFS or their designated state cooperating agencies;

(2) Voluntary stream or wetland restoration or enhancement action, or wetland establishment action, documented by the NRCS or USDA Technical Service Provider pursuant to NRCS Field Office Technical Guide standards; or

(3) The reclamation of surface coal mine lands, in accordance with an SMCRA permit issued by the OSMRE or the applicable state agency.

However, the permittee must submit a copy of the appropriate documentation to the district engineer to fulfill the reporting requirement. (Sections 10 and 404)

Note: This NWP can be used to authorize compensatory mitigation projects, including mitigation banks and in-lieu fee projects. However, this NWP does not authorize the reversion of an area used for a compensatory mitigation project to its prior condition, since compensatory mitigation is generally intended to be permanent.



**US Army Corps
of Engineers.**
Louisville District

Nationwide Permit Conditions

The following General Conditions must be followed in order for any authorization by NWP to be valid:

1. Navigation. (a) No activity may cause more than a minimal adverse effect on navigation.

(b) Any safety lights and signals prescribed by the US Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the US.

(c) The permittee understands and agrees that, if future operations by the US require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the US. No claim shall be made against the US on account of any such removal or alteration.

2. Aquatic Life Movements. No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species.

3. Spawning Areas. Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

4. Migratory Bird Breeding Areas. Activities in waters of the US that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

5. Shellfish Beds. No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48, or is a shellfish seeding or habitat restoration activity authorized by NWP 27.

6. Suitable Material. No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).

7. Water Supply Intakes. No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

8. Adverse Effects From Impoundments. If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

9. Management of Water Flows. To the maximum extent practicable, the pre-construction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization and storm water management activities, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation activities).

10. Fills Within 100-Year Floodplains. The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

11. Equipment. Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

12. Soil Erosion and Sediment Controls. Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high

tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the US during periods of low-flow or no-flow.

13. Removal of Temporary Fills. Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

14. Proper Maintenance. Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety and compliance with applicable NWP general conditions, as well as any activity-specific conditions added by the district engineer to an NWP authorization.

15. Single and Complete Project. The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

16. Wild and Scenic Rivers. No activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a "study river" for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency responsible for the designated Wild and Scenic River or study river (e.g., National Park Service, US Forest Service, US Fish and Wildlife Service).

17. Tribal Rights. No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

18. Endangered Species. (a) No activity is authorized under any NWP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which "may affect" a listed species or critical habitat, unless Section 7 consultation addressing the effects of the proposed activity has been completed.

(b) Federal agencies should follow their own procedures for complying with the requirements of the ESA. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address ESA compliance for the NWP activity, or whether additional ESA consultation is necessary.

(c) Non-federal permittees must submit a pre-construction notification (PCN) to the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the PCN must include the name(s) of the endangered or threatened species that might be affected by the proposed work or that utilize the designated critical habitat that might be affected by the proposed work. The district engineer will determine whether the proposed activity "may affect" or will have "no effect" on listed species and designated critical habitat and will notify the non-Federal applicant of the Corps' determination within 45 days of receipt of a complete PCN. In cases where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the project, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification the proposed activities will have "no effect" on listed species or critical habitat, or until Section 7 consultation has been completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from Corps.

(d) As a result of formal or informal consultation with the USFWS or NMFS the district engineer may add species-specific regional endangered species conditions to the NWPs.

(e) Authorization of an activity by a NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the USFWS or the NMFS, The Endangered Species Act prohibits any person subject to the jurisdiction of the US to take a listed species, where "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The word "harm" in the definition of "take" means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.

(f) Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the USFWS and NMFS at <http://www.fws.gov/> or <http://www.fws.gov/ipac> and <http://www.noaa.gov/fisheries.html> respectively.

19. Migratory Birds and Bald and Golden Eagles. The permittee is responsible for obtaining any "take" permits required under the USFWS's regulations governing compliance with the Migratory Bird Treaty Act or the Bald and Golden Eagle Protection Act. The permittee should contact the appropriate local office of the USFWS to determine if such "take" permits are required for a particular activity.

20. Historic Properties. (a) In cases where the district engineer determines that the activity may affect properties listed, or eligible for listing, in the National Register of Historic Places, the activity is not authorized, until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.

(b) Federal permittees should follow their own procedures for complying with the requirements of Section 106 of the National Historic Preservation Act. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address section 106 compliance for the NWP activity, or whether additional section 106 consultation is necessary.

(c) Non-federal permittees must submit a pre-construction notification to the district engineer if the authorized activity may have the potential to cause effects to any historic properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties may be affected by the proposed work or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of or potential for the presence of historic resources can be sought from the State Historic Preservation Officer or Tribal Historic Preservation Officer, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). When reviewing pre-construction notifications, district engineers will comply with the current procedures for addressing the requirements of Section 106 of the National Historic Preservation Act. The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts, which may include background research, consultation, oral history interviews, sample field investigation, and field survey. Based on the information submitted and these efforts, the district engineer shall determine whether the proposed activity has the potential to cause an effect on the historic properties. Where the non-Federal applicant has identified historic properties on which the activity may have the potential to cause effects and notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects or that consultation under Section 106 of the NHPA is complete.

(d) The district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA Section 106 consultation is required. Section 106 consultation is not required when the Corps determines that the activity does not have the potential to cause effects on historic properties (see 36 CFR §800.3(a)). If NHPA section 106 consultation is required and will occur, the district engineer will notify the non-Federal applicant that he or she cannot begin work until Section 106 consultation is completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

(e) Prospective permittees should be aware that section 110k of the NHPA (16 U.S.C. 470h-2(k)) prevents the Corps from granting a permit or other assistance to an applicant who,

with intent to avoid the requirements of Section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the activity on historic properties.

21. Discovery of Previously Unknown Remains and Artifacts. If you discover any previously unknown historic, cultural or archeological remains and artifacts while accomplishing the activity authorized by this permit, you must immediately notify the district engineer of what you have found, and to the maximum extent practicable, avoid construction activities that may affect the remains and artifacts until the required coordination has been completed. The district engineer will initiate the Federal, Tribal and state coordination required to determine if the items or remains warrant recovery effort or if the site is eligible for listing in the National Register of Historic Places.

22. Designated Critical Resource Waters. Critical resource waters include, NOAA-managed marine sanctuaries and marine monuments, and National Estuarine Research Reserves. The district engineer may designate, after notice and opportunity for public comment, additional waters officially designated by a state as having particular environmental or ecological significance, such as outstanding national resource waters or state natural heritage sites. The district engineer may also designate additional critical resource waters after notice and opportunity for public comment.

(a) Discharges of dredged or fill material into waters of the US are not authorized by NWP's 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, 50, 51, and 52 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.

(b) For NWP's 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, and 38, notification is required in accordance with general condition 31, for any activity proposed in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWP's only after it is determined that the impacts to the critical resource waters will be no more than minimal.

23. Mitigation. The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that adverse effects on the aquatic environment are minimal:

(a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the US to the maximum extent practicable at the project site (i.e., on site).

(b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating for resource losses) will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal.

(c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1/10-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse effects of the proposed activity are minimal, and provides a project-specific waiver of this requirement. For wetland losses of 1/10-acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in minimal adverse effects on the aquatic environment. Compensatory mitigation projects provided to offset losses of aquatic resources must comply with the applicable provisions of 33 CFR part 332.

(1) The prospective permittee is responsible for proposing an appropriate compensatory mitigation option if compensatory mitigation is necessary to ensure that the activity results in minimal adverse effects on the aquatic environment.

(2) Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, wetland restoration should be the first compensatory mitigation option considered.

(3) If permittee-responsible mitigation is the proposed option, the prospective permittee is responsible for submitting a mitigation plan. A conceptual or detailed mitigation plan may be used by the district engineer to make the decision on the NWP verification request, but a final mitigation plan that addresses the applicable requirements of 33 CFR 332.4(c)(2) – (14) must be approved by the district engineer before the permittee begins work in waters of the US, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation (see 33 CFR 332.3(k)(3)).

(4) If mitigation bank or in-lieu fee program credits are the proposed option, the mitigation plan only needs to address the baseline conditions at the impact site and the number of credits to be provided.

(5) Compensatory mitigation requirements (e.g., resource type and amount to be provided as compensatory mitigation, site protection, ecological performance standards, monitoring requirements) may be addressed through conditions added to the NWP authorization, instead of components of a compensatory mitigation plan.

(d) For losses of streams or other open waters that require pre-construction notification, the district engineer may require compensatory mitigation, such as stream rehabilitation, enhancement, or preservation, to ensure that the activity results in minimal adverse effects on the aquatic environment.

(e) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of 1/2-acre, it cannot be used to authorize any project resulting in the loss of greater than 1/2-acre of waters of the US, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that a project already meeting the established acreage limits also satisfies the minimal impact requirement associated with the NWPs.

(f) Compensatory mitigation plans for projects in or near streams or other open waters will normally include a requirement for the restoration or establishment, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, riparian areas may be the only compensatory mitigation required. Riparian areas should consist of native species. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address documented water quality or habitat loss concerns. If it is not possible to establish a riparian area on both sides of a stream, or if the waterbody is a lake or coastal waters, then restoring or establishing a riparian area along a single bank or shoreline may be sufficient. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.

(g) Permittees may propose the use of mitigation banks, in-lieu fee programs, or separate permittee-responsible mitigation. For activities resulting in the loss of marine or estuarine resources, permittee-responsible compensatory mitigation may be environmentally preferable if there are no mitigation banks or in-lieu fee programs in the area that have marine or estuarine credits available for sale or transfer to the permittee. For permittee-responsible mitigation, the special conditions of the NWP verification must clearly indicate the party or parties responsible for the implementation and performance of the compensatory mitigation project, and, if required, its long-term management.

(h) Where certain functions and services of waters of the US are permanently adversely affected, such as the conversion of a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse effects of the project to the minimal level.

24. Safety of Impoundment Structures. To ensure that all impoundment structures are safely designed, the district engineer may require non-Federal applicants to demonstrate that the structures comply with established state dam safety criteria or have been designed by qualified persons. The district engineer may also require documentation that the design has

been independently reviewed by similarly qualified persons, and appropriate modifications made to ensure safety.

25. Water Quality. Where States and authorized Tribes, or EPA where applicable, have not previously certified compliance of an NWP with CWA Section 401, individual 401 Water Quality Certification must be obtained or waived (see 33 CFR 330.4(c)). The district engineer or State or Tribe may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

26. Coastal Zone Management. In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). The district engineer or a State may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

27. Regional and Case-By-Case Conditions. The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or USEPA in its section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

28. Use of Multiple Nationwide Permits. The use of more than one NWP for a single and complete project is prohibited, except when the acreage loss of waters of the US authorized by the NWPs does not exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the US for the total project cannot exceed 1/3-acre.

29. Transfer of Nationwide Permit Verifications. If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature: "When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below."

(Transferee)

(Date)

30. Compliance Certification. Each permittee who receives an NWP verification letter from the Corps must provide a signed certification documenting completion of the authorized activity and any required compensatory mitigation. The success of any required permittee-responsible mitigation, including the achievement of ecological performance standards, will be addressed separately by the district engineer. The Corps will provide the permittee the certification document with the NWP verification letter. The certification document will include:

(a) A statement that the authorized work was done in accordance with the NWP authorization, including any general, regional, or activity-specific conditions;

(b) A statement that the implementation of any required compensatory mitigation was completed in accordance with the permit conditions. If credits from a mitigation bank or in-lieu fee program are used to satisfy the compensatory mitigation requirements, the certification must include the documentation required by 33 CFR 332.3(l)(3) to confirm that the permittee secured the appropriate number and resource type of credits; and

(c) The signature of the permittee certifying the completion of the work and mitigation.

31. **Pre-Construction Notification (PCN).** (a) **Timing.** Where required by the terms of the NWP, the prospective permittee must notify the district engineer by submitting a PCN as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, if the PCN is determined to be incomplete, notify the prospective permittee within that 30 day period to request the additional information necessary to make the PCN complete. As a general rule, district engineers will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either:

(1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer, or

(2) 45 calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 18 that listed species or critical habitat might be affected or in the vicinity of the project, or to notify the Corps pursuant to general condition 20 that the activity may have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that there is "no effect" on listed species or "no potential to cause effects" on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or Section 106 of the National Historic Preservation (see 33 CFR 330.4(g)) has been completed. Also, work cannot begin under NWPs 21, 49, or 50 until the permittee has received written approval from the Corps. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee may not begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2).

(b) **Contents of Pre-Construction Notification:** The PCN must be in writing and include the following information:

(1) Name, address and telephone numbers of the prospective permittee;

(2) Location of the proposed project;

(3) A description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause, including the anticipated amount of loss of water of the US expected to result from the NWP activity, in acres, linear feet, or other appropriate unit of measure; any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity. The description should be sufficiently detailed to allow the district engineer to determine that the adverse effects of the project will be minimal and to determine the need for compensatory mitigation. Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the project and when provided results in a quicker decision. Sketches should contain sufficient detail to provide an illustrative description of the proposed activity (e.g., a conceptual plan), but do not need to be detailed engineering plans).

(4) The PCN must include a delineation of wetlands, other special aquatic sites, and waters, such as lakes and ponds, and perennial, intermittent, and ephemeral streams, on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters on the project site, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many waters of the US. The 45 day period will not start until the delineation has been submitted to or completed by the Corps, as appropriate;

(5) If the proposed activity will result in the loss of greater than 1/10-acre of wetlands and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied, or explaining why the adverse effects are minimal and why compensatory mitigation should not be required. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan.

(6) If any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, for non-Federal applicants the PCN must include the name(s) of those endangered or threatened species that might be affected by the proposed work or utilize the designated critical habitat that may be affected by the proposed work. Federal applicants must provide documentation demonstrating compliance with the Endangered Species Act, and

(7) For an activity that may affect a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, for non-Federal applicants the PCN must state which historic property may be affected by the proposed work or include a vicinity map indicating the location of the historic property. Federal applicants must provide documentation demonstrating compliance with Section 106 of the National Historic Preservation Act.

(c) **Form of PCN Notification:** The standard individual permit application form (Form ENG 4345) may be used, but the completed application form must clearly indicate that it is a PCN and must include all of the information required in paragraphs (b)(1) through (7) of this general condition. A letter containing the required information may also be used.

(d) **Agency Coordination:** (1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the project's adverse environmental effects to a minimal level.

(2) For all NWP activities that require PCN notification and result in the loss of greater than 1/2-acre of waters of the US, for NWP 21, 29, 39, 40, 42, 43, 44, 50, 51, and 52 activities that require PCN notification and will result in the loss of greater than 300 linear feet of intermittent and ephemeral stream bed, and for all NWP 48 activities that require PCN notification, the district engineer will immediately provide (e.g., via e-mail, facsimile transmission, overnight mail, or other expeditious manner) a copy of the complete PCN to the appropriate Federal or state offices (USFWS, state natural resource or water quality agency, EPA, State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Office (THPO), and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will have 10 calendar days from the date the material is transmitted to telephone or fax the district engineer notice that they intend to provide substantive, site-specific comments. The comments must explain why the agency believes the adverse effects will be more than minimal. If so contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the PCN notification. The district engineer will fully consider agency comments received within the specified time frame concerning the proposed activity's compliance with the terms and conditions of the NWPs, including the need for mitigation to ensure the net adverse environmental effects to the aquatic environment of the proposed activity are minimal. The district engineer will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each PCN notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5.

(3) In cases of where the prospective permittee is not a Federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act.

(4) Applicants are encouraged to provide the Corps with either electronic files or multiple copies of PCN notifications to expedite agency coordination.

Further Information

1. District Engineers have authority to determine if an activity complies with the terms and conditions of an NWP.

2. NWPs do not obviate the need to obtain other federal, state, or local permits, approvals, or authorizations required by law.

3. NWPs do not grant any property rights or exclusive privileges.

4. NWPs do not authorize any injury to the property or rights of others.

5. NWPs do not authorize interference with any existing or proposed Federal project.

Water Quality Certification

Happy Valley Flood Mitigation Project

Facility Requirements

Permit Number: WQC#2014-027-1

Activity ID No.: APE20140005

ACTV0000000004 (Unnamed Tributary to Mill Creek) Turner Lane Stream Restoration and Flood Mitigation Project:

Submittal/Action Requirements:

Condition No.	Condition
S-1	The City of Radcliff shall submit notification; Due prior to any construction activity to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor at least 2 weeks prior to the beginning of construction. [Clean Water Act]
S-2	The City of Radcliff submit notification; Due when construction is complete to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor. [Clean Water Act]
S-3	The City of Radcliff submit as-built drawings; Due within 90 days after completion of construction to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor. [Clean Water Act]
S-4	The City of Radcliff shall submit a monitoring report; Due annually, by the 31st of December to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor. The initial monitoring report shall be due after the first year of project establishment and due annually for five years. This monitoring report must follow the approved mitigation plan. [Clean Water Act]
S-5	The City of Radcliff shall submit written notification; Due at the conclusion of the five (5) year postclosure monitoring period requesting the release of the mitigation site from the monitoring requirements to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor. [Clean Water Act]
S-6	The City of Radcliff shall submit a deed restriction; Due when construction is complete. A copy of the deed restriction shall be submitted to and approved by to the Kentucky Division of Water, 401 Water Quality Certification Section Project Manager or Supervisor prior to release of the site from monitoring requirements. [Clean Water Act]

Water Quality Certification
Happy Valley Flood Mitigation Project
Facility Requirements
Permit Number: WQC#2014-027-1
Activity ID No.: APE20140005

ACTV0000000004 (continued):

Narrative Requirements:

Condition No.	Condition
T-1	<p>The work approved by this certification shall be limited to the proposed Turner Lane Stream Restoration and Flood Mitigation project in Hardin County, Kentucky (Latitude: 37.807867N; Longitude: -85.924625W). The proposed project includes the restoration of a degraded stream and the construction of a stormwater storage basin to alleviate downstream flooding of roads and private properties in Radcliff. The impacts to jurisdictional surface waters include the following:</p> <ul style="list-style-type: none">- Permanent impact to approximately 912 linear feet (0.084 acre) of one poor quality intermittent stream <p>Total stream restoration activities proposed in the project include:</p> <ul style="list-style-type: none">- 912 linear feet of intermittent stream re-establishment <p>A 50 foot riparian buffer will also be established along the re-established stream channel</p> <p>The long-term success of the proposed stream restoration activities will be evaluated through a five-year monitoring period. Stream stability and vegetation establishment will be quantitatively and qualitatively monitored and annual reports will be submitted to the authorizing agencies to track the progress of the stream mitigation establishment. [Clean Water Act]. [Clean Water Act]</p>
T-2	<p>All work performed under this certification shall adhere to the design and specifications set forth in the following documents received by the Kentucky Division of Water:</p> <ul style="list-style-type: none">- 401 Water Quality Certification Application received February 26, 2014- Pre-Construction Notification or Nationwide Permit # 27 for Turner Lane Stream Restoration and Flood Mitigation Project, Hardin County, Kentucky received May 21, 2014 <p>- In addition, a site delineation verification visit was conducted January 9, 2014. [Clean Water Act]</p>
T-3	<p>To document and assess the potential for sedimentation in the stream channel, as-built cross sections, monitoring reports, and Rapid Bioassessment Protocols (RBPs) for use in streams will be evaluated during the five year monitoring period. If degradation through sedimentation is evident or success criteria is not met through the monitoring period, the Kentucky Division of Water, 401 Water Quality Certification Section may request extended monitoring and/or an in-lieu fee payment if the proposed mitigation is determined to not be successful. [Clean Water Act]</p>

Water Quality Certification
Happy Valley Flood Mitigation Project
Facility Requirements
Permit Number: WQC#2014-027-1
Activity ID No.: APE20140005

ACTV0000000004 (continued):

Narrative Requirements:

Condition No.	Condition
T-4	The City of Radcliff is responsible for preventing degradation of waters of the Commonwealth from soil erosion. An erosion and sedimentation control plan must be designed, implemented, and maintained in effective operating condition at all times during construction. [Clean Water Act]
T-5	The City of Radcliff shall properly revegetate and conduct invasive exotic species control in all areas of impacted and/or exposed soils immediately after construction is complete through permanent seeding and planting, mulching, and straw and/or erosion control matting/blanket applications. Streambanks shall be restored with native herbaceous and woody species and erosion control matting/blanketing. [Clean Water Act]
T-6	The Division of Water reserves the right to modify or revoke this certification should it be determined that the activity is in noncompliance with any condition set forth in this certification. [Clean Water Act]
T-7	If construction does not commence within one year of the date of this letter, this certification will become void. A letter requesting a renewal should be submitted. [Clean Water Act]
T-8	Other permits from the Division of Water may be required for this activity. If this activity occurs within a floodplain, a Permit to Construct Across or Along a Stream may be required. Please contact Todd Powers (502-564-3410) for more information. If the project will disturb one acre or more of land, or is part of a larger common plan of development or sale that will ultimately disturb one acre or more of land, a Kentucky Pollution Discharge Elimination System (KPDES) stormwater permit shall be required from the Surface Water Permits Branch. This permit requires the development of a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP must include erosion prevention and sediment control measures. Contact: Surface Water Permits Branch (SWPB) Support (502-564-3410 or SWPBsupport@ky.gov). [Clean Water Act]
T-9	Dredging work shall not be conducted during the fish spawning season, April 15th through June 15th. [Clean Water Act]
T-10	Mitigation for impacts shall begin prior to or concurrently with impacts. [Clean Water Act]
T-11	Check dams are not allowed within the stream channel. [Clean Water Act]
T-12	Remove all sediment and erosion control measures after re-vegetation has become well-established. [Clean Water Act]

Compliance Certification:

Permit Number: LRL-2014-281-jea

Name of Permittee: City of Radcliff

Date of Issuance: July 25, 2014

Upon completion of the activity authorized by this permit and any mitigation required by this permit, sign this certification and return it to the following address:

U.S. Army Corps of Engineers
CELRL-OP-FS
P.O. Box 59
Louisville, Kentucky 40201

Please note that your permitted activity is subject to a compliance inspection by an U.S. Army Corps of Engineers representative. If you fail to comply with this permit you are subject to permit suspension, modification, or revocation.

I hereby certify that the work authorized by the above referenced permit has been completed in accordance with the terms and conditions of the said permit, and required mitigation was completed in accordance with the permit conditions.

Signature of Permittee

Date

ADDRESS FOR COORDINATING AGENCIES

Mr. Lee Andrews
U.S. Fish & Wildlife Service
JC Watts Federal Building
330 West Broadway, Room 265
Frankfort, KY 40601

Mr. Peter Goodman
Acting Director
Kentucky Energy & Environment Cabinet
Division of Water
200 Fair Oaks, 4th Floor
Frankfort, KY 40601

ADDRESS FOR PERMITTEE

Mr. Toby Spalding, PE
City of Radcliff
411 West Lincoln Trail Boulevard
Radcliff, Kentucky 40160

ATTACHMENT

PRELIMINARY JURISDICTIONAL DETERMINATION FORM

BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR PRELIMINARY JURISDICTIONAL DETERMINATION (JD): May 27, 2014

B. NAME AND ADDRESS OF PERSON REQUESTING PRELIMINARY JD:

City of Radcliff
c/o Mr. Toby Spalding
411 West Lincoln Trail Boulevard
Radcliff, Kentucky 40160

Represented by:
Redwing Ecological Services, Inc.
1139 South Fourth Street
Louisville, KY 40203

C. DISTRICT OFFICE, FILE NAME, AND NUMBER: Louisville District (CELRL-OP-FS), Turner Lane Stream Restoration and Flood Mitigation Project, LRL-2014-281-jea

D. PROJECT LOCATION(S) AND BACKGROUND INFORMATION: The proposed Turner Lane Stream Restoration and Flood Mitigation project involves the construction of a stormwater basin in Radcliff, Kentucky in order to alleviate flooding issues by providing flood storage during storm events. The project is located west of South Wilson Road (KY 447) approximately 300 feet south of the intersection of Shelton Road and South Wilson Road, and is approximately 6.6 acres.

(USE THE ATTACHED TABLE TO DOCUMENT MULTIPLE WATERBODIES AT DIFFERENT SITES)

State: Kentucky County/parish/borough: Hardin City: Radcliff
Center coordinates of site (lat/long in degree decimal format):
Lat. 37.8082° N, Long. 85.9241° W

Name of nearest waterbody: Flow through Quiggins sinkhole exits at Falling Springs, which is a tributary of Mill Creek

Identify (estimate) amount of waters in the review area:

Non-wetland waters: 1,238 linear feet: width (ft) and/or 0.111 acre
Cowardin Class: R4SB
Stream Flow: Intermittent
Wetlands: acre
Cowardin Class:

Name of any water bodies on the site that have been identified as Section 10 waters:

Tidal:
Non-Tidal:

E. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

- Office (Desk) Determination. Date:
 Field Determination. Date(s): December 19, 2013

1. The Corps of Engineers believes that there may be jurisdictional waters of the United States on the subject site, and the permit applicant or other affected party who requested this preliminary JD is hereby advised of his or her option to request and obtain an approved jurisdictional determination (JD) for that site. Nevertheless, the permit applicant or other person who requested this preliminary JD has declined to exercise the option to obtain an approved JD in this instance and at this time.

2. In any circumstance where a permit applicant obtains an individual permit, or a Nationwide General Permit (NWP) or other general permit verification requiring "pre-construction notification" (PCN) or requests verification for a non-reporting NWP or other general permit, and the permit applicant has not requested an approved JD for the activity, the permit applicant is hereby made aware of the following: (1) the permit applicant has elected to seek a permit authorization based on a preliminary JD, which does not make an official determination of jurisdictional waters; (2) that the applicant has the option to request an approved JD before accepting the terms and conditions of the permit authorization, and that basing a permit authorization

on an approved JD could possibly result in less compensatory mitigation being required or different special conditions; (3) that the applicant has the right to request an individual permit rather than accepting the terms and conditions of the NWP or other general permit authorization; (4) that the applicant can accept a permit authorization and thereby agree to comply with all the terms and conditions of that permit, including whatever mitigation requirements the Corps has determined to be necessary; (5) that undertaking any activity in reliance upon the subject permit authorization without requesting an approved JD constitutes the applicant's acceptance of the use of the preliminary JD, but that either form of JD will be processed as soon as is practicable; (6) accepting a permit authorization (e.g., signing a proffered individual permit) or undertaking any activity in reliance on any form of Corps permit authorization based on a preliminary JD constitutes agreement that all wetlands and other water bodies on the site affected in any way by that activity are jurisdictional waters of the United States, and precludes any challenge to such jurisdiction in any administrative or judicial compliance or enforcement action, or in any administrative appeal or in any Federal court; and (7) whether the applicant elects to use either an approved JD or a preliminary JD, that JD will be processed as soon as is practicable. Further, an approved JD, a proffered individual permit (and all terms and conditions contained therein), or individual permit denial can be administratively appealed pursuant to 33 C.F.R. Part 331, and that in any administrative appeal, jurisdictional issues can be raised (see 33 C.F.R. 331.5(a)(2)). If, during that administrative appeal, it becomes necessary to make an official determination whether CWA jurisdiction exists over a site, or to provide an official delineation of jurisdictional waters on the site, the Corps will provide an approved JD to accomplish that result, as soon as is practicable.

This preliminary JD finds that there "may be" waters of the United States on the subject project site, and identifies all aquatic features on the site that could be affected by the proposed activity, based on the following information.

SUPPORTING DATA. Data reviewed for preliminary JD (check all that apply - checked items should be included in case file and, where checked and requested, appropriately reference sources below):

- Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant.
- Data sheets prepared/submitted by or on behalf of the applicant/consultant.
 - Office concurs with data sheets/delineation report.
 - Office does not concur with data sheets/delineation report.
- Data sheets prepared by the Corps.
- Corps navigable waters' study.
- U.S. Geological Survey Hydrologic Atlas.
 - USGS NHD data.
 - USGS 8 and 11 digit HUC maps.
- U.S. Geological Survey map(s). Cite scale & quad name: 1:24,000 - Vine Grove quad.
- USDA Natural Resources Conservation Service Soil Survey. Citation: USDA Soil Survey Geographic Database for Hardin and Larue Counties, Kentucky (2005)
- National wetlands inventory map(s). Cite name:
- State/Local wetland inventory map(s)
- FEMA/FIRM maps: 100-year Floodplain Elevation is: (National Geodetic Vertical Datum of 1929)
- Photographs: Aerial (Name & Date): Kentucky Statewide 1 Meter Aerial Imagery (2012) - KY12
or Other (Name & Date): Site photographs - September 12, 2013;
- Previous determination(s). File no. and date of response letter
- Other information (please specify):

IMPORTANT NOTE: The information recorded on this form has not necessarily been verified by the Corps and should not be relied upon for later jurisdictional determinations.

Jane Archer 5/28/14
Signature and date of
Regulatory Project Manager
(REQUIRED)

Tom Hill 5-27-14
Signature and date of
person requesting preliminary JD
(REQUIRED, unless obtaining the signature is
impracticable)

Site number	Latitude	Longitude	Cowardin Class	Estimated amount of aquatic resource in review area	Class of aquatic resource
Turner Lane Basin – Intermittent Stream 1	37.8082° N	85.9241° W	R4SB	1,070 linear feet	non-section 10 / non-wetland
Turner Lane Basin – Intermittent Stream 2	37.8076° N	85.9229° W	R4SB	168 linear feet	non-section 10 / non-wetland

**SUBMITTAL OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND
REQUEST FOR APPEAL**

Applicant: City of Radcliff		File Number: LRL-2014-281	Date: 7/25/14
Attached is:			See Section below
	INITIAL PROFFERED PERMIT (Standard Permit or Letter of permission)		A
	PROFFERED PERMIT (Standard Permit or Letter of permission)		B
	PERMIT DENIAL		C
	APPROVED JURISDICTIONAL DETERMINATION		D
X	PRELIMINARY JURISDICTIONAL DETERMINATION		E

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at http://www.usace.army.mil/CECW/Pages/reg_materials.aspx or Corps regulations at 33 CFR Part 331.

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- **ACCEPT:** If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- **OBJECT:** If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit

- **ACCEPT:** If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- **APPEAL:** If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

C: PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

D: APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- **ACCEPT:** You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
- **APPEAL:** If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

E: PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The Preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

If you have questions regarding this decision and/or the appeal process you may contact:
Ms. Jane Archer
U.S. Army Corps of Engineers
P.O. Box 59, Rm 752
Attn: CELRL-OP-FN
Louisville, Kentucky 40201-0059
(502) 315-6680

If you only have questions regarding the appeal process you may also contact:
U.S. Army Corps of Engineers
ATTN: Appeal Review Officer CELRD-PD-REG
550 Main Street, Room 10524
Cincinnati, OH 45202-3222
TEL (513) 684-6212; FAX (513) 684-2460

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15 day notice of any site investigation, and will have the opportunity to participate in all site investigations.

<hr/> Signature of appellant or agent.	Date:	Telephone number:
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DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
P.O. BOX 59
LOUISVILLE KY 40201-0059
FAX: (502) 315-6677
<http://www.lrl.usace.army.mil/>

July 28, 2014

Operations Division
Regulatory Branch (South)
ID No. LRL-2014-282-jea

Ms. Kiersten R. Fuchs
Redwing Ecological Services, Incorporated
1139 South Fourth Street
Louisville, Kentucky 40203

Dear Ms. Fuchs:

This is in response to your request for authorization to impact 0.091 acre of wetland and 1,384 linear feet (0.078 acre) of ephemeral streams for the establishment of stormwater storage basin (Wilson Road Basin) to alleviate flooding in Radcliff, Kentucky. The proposed 10.4-acre site is located east of South Wilson Road (KY 477), approximately 500 feet north of the intersection of South Wilson Road and Shelton Road in Radcliff, Hardin County, Kentucky. Construction activities for the Wilson Road Basin include clearing of approximately 6 acres of brush and trees, installation of erosion control measures and cut and fill of approximately 20,000 cubic yards of material for the construction of a berm and final restoration of the site. The information supplied by you was reviewed to determine whether a Department of the Army (DA) permit will be required under the provisions of Section 404 of the Clean Water Act.

Your project is considered a discharge of dredged and/or fill material associated with construction of stormwater management facilities. The project is authorized under the provisions of 33 CFR 330 Nationwide Permit (NWP) No. 43, Stormwater Management Facilities, as published in the Federal Register February 21, 2012. Under the provisions of this authorization, you must comply with the enclosed Terms and General Conditions for Nationwide Permit No. 43 and the following Special Conditions:

1. Any tree removal within the project area shall be completed between the dates of October 15th and March 31st.
2. The permittee shall implement the Stream Restoration and Monitoring Plan for Wilson Road Basin Flood Mitigation Project, Hardin County, Kentucky dated April 28, 2014.
3. The permittee shall submit an annual monitoring report for five years by 31st of December until released from monitoring by this office.

The first report is due after the first year the project is established. If the project is degraded through sedimentation at the end of the five year monitoring period, the permittee shall provide an alternative mitigation plan.

4. The permittee shall execute a deed restriction on the mitigation site within the appropriate county and submit documentation of the recorded deed restriction to this office after construction is completed and prior to release of the site from monitoring requirements. The submitted deed restriction must be reviewed and approved by the Corps of Engineers prior to being recorded.

5. The permittee shall provide the District Engineer a receipt of purchase of 0.2 wetland credits from a Corps approved wetland mitigation bank with a service area that includes Hardin County, Kentucky prior to the discharge of dredged or fill material into "waters of the United States".

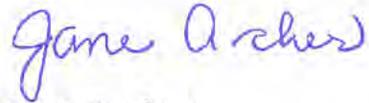
Since the Kentucky Division of Water (KDOW) has denied the required Water Quality Certification (WQC) for NWP No. 43, subject to Section 401 of the Clean Water Act for this particular NWP, the City of Radcliff must apply for and receive an individual WQC for this project. If the KDOW fails to respond to the request for authorization within 60 calendar days, the WQC is considered waived. The responsibility for obtaining the state WQC rests with the City of Radcliff. Once they obtain an individual WQC, they may proceed with the project without further contact or verification from us.

This decision is valid until March 18, 2017. The enclosed Compliance Certification should be signed and returned when the project is completed. If your project is not completed by this date or if your project is modified, you must contact us for another permit determination in accordance with the rules and regulations in effect at that time. Please note that we also perform periodic inspections to ensure compliance with our permit conditions and applicable Federal laws. A copy of this letter is being sent to City of Radcliff and the coordinating agencies (see enclosure for addresses).

Attached to this verification that the project is authorized by NWP No. 43 are a preliminary jurisdictional determination (JD), a Notification of Appeal Process (NAP) fact sheet, and Request for Appeal (RFA) form. However, a preliminary JD is not appealable and impacting "waters of the U.S." identified in the preliminary JD will result in you waiving the right to request an approved JD at a later date. An approved JD may be requested (which may be appealed), by contacting me for further instruction.

If you have any questions, please contact this office by writing to the above address, ATTN: CELRL-OP-FS, or by calling me at (502) 315-6682. All correspondence pertaining to this matter should refer to our ID No. LRL-2014-282-jea.

Sincerely,



Jane Archer
Regulatory Specialist
Regulatory Branch

Enclosures



DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
P.O. BOX 59
LOUISVILLE KY 40201-0059
FAX: (502) 315-6677
<http://www.lrl.usace.army.mil/>

April 2, 2014

Operations Division
Regulatory Branch (South)
ID No. LRL-2014-15-mlc

Mr. Matthew Blake
Redwing Ecological Services, Inc.
1139 South Fourth Street
Louisville, Kentucky 40203

Dear Mr. Blake:

This is in response to your request for authorization to construct a stormwater basin to alleviate flooding located on the property along the west side of South Wilson Road (KY 447), approximately 700 feet north of the intersection of South Wilson Road and Shelton Road, Radcliff, Hardin County, Kentucky. Construction activities for this basin would include clearing of approximately 1 acre of brush and trees, and the construction of a berm. The construction of the stormwater basin would permanently impact 0.034 acre of open water pond 1 and 0.053 acre of the emergent/scrub wetland 1. The project would impact a total of 0.087 acre of "waters of the United States." The information supplied by you was reviewed to determine whether a Department of the Army (DA) permit will be required under the provisions of Section 404 of the Clean Water Act.

This project is considered a discharge of fill material associated with construction of stormwater management facilities. The project is authorized under the provisions of Nationwide Permit (NWP) No. 43, Stormwater Management Facilities, as published in the Federal Register February 21, 2012. Under the provisions of this authorization, you must comply with the enclosed Terms and General Conditions for Nationwide Permit No. 43 and the following Special Condition:

The permittee must conduct all removal of trees associated with the project between the dates of October 15th to March 31st.

Since the Kentucky Division of Water (KDOW) has denied the required Water Quality Certification (WQC) for NWP No. 43, subject to Section 401 of the Clean Water Act for this particular NWP, the City of Radcliff must apply for and receive an individual WQC for this project. If the KDOW fails to respond to the request for authorization within 60

calendar days, the WQC is considered waived. The responsibility for obtaining the state WQC rests with the City of Radcliff. Once they obtain an individual WQC, they may proceed with the project without further contact or verification from us.

This decision is valid until March 18, 2017. The enclosed Compliance Certification should be signed and returned when the project is completed. If this project is not completed by this date or if this project is modified, the City of Radcliff must contact us for another permit determination in accordance with the rules and regulations in effect at that time. Note that we also perform periodic inspections to ensure compliance with our permit conditions and applicable Federal laws. Copies of this letter are being sent to the applicant, the City of Radcliff and to the appropriate coordinating agencies (see enclosure for addresses).

Attached to this verification are a preliminary jurisdictional determination (JD), a Notification of Appeal Process (NAP) fact sheet, and Request for Appeal (RFA) form. However, a preliminary JD is not appealable and impacting "waters of the United States" identified in the preliminary JD will result in the City of Radcliff waiving the right to request an approved JD at a later date. An approved JD may be requested (which may be appealed), by contacting the project manager for further instruction.

If you have any questions, please contact this office by writing to the above address, ATTN: CELRL-OP-FS, or by calling Ms. Meagan Chapman at 502-315-6709. All correspondence pertaining to this matter should refer to our ID No. LRL-2014-15-mlc.

Sincerely,



Lee Anne Devine
Chief, South Section
Regulatory Branch

Enclosures



DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
P.O. BOX 59
LOUISVILLE KY 40201-0059
FAX: (502) 315-6677
<http://www.lrl.usace.army.mil/>

July 28, 2014

Operations Division
Regulatory Branch (South)
ID No. LRL-2014-280-jea

Ms. Kiersten R. Fuchs
Redwing Ecological Services, Incorporated
1139 South Fourth Street
Louisville, Kentucky 40203

Dear Ms. Fuchs:

This is in response to your request for authorization to impact 624 linear feet (0.072 acre) of intermittent stream and 200 linear feet (0.021 acre) of ephemeral stream to alleviate flooding in Radcliff by providing stormwater storage through the construction of a stormwater storage basin (Cato Basin). The proposed 6.6-acre site is located west of Dixie Highway (US 31W) approximately 0.4 mile north of the intersection of Dixie Highway and Joe Prather Highway (KY 313) in Radcliff, Hardin County, Kentucky. Construction activities for the Cato Basin include clearing of approximately 5 acres of brush and trees, installation of appropriate erosion control measures and the cut and fill of approximately 50,000 cubic yards of material for the construction of a berm and final restoration of the site. The information supplied by you was reviewed to determine whether a Department of the Army (DA) permit will be required under the provisions of Section 404 of the Clean Water Act.

Your project is considered a discharge of dredged and/or fill material associated with construction of stormwater management facilities. The project is authorized under the provisions of 33 CFR 330 Nationwide Permit (NWP) No. 43, Stormwater Management Facilities, as published in the Federal Register February 21, 2012. Under the provisions of this authorization, you must comply with the enclosed Terms and General Conditions for Nationwide Permit No. 43 and the following Special Conditions:

1. The permittee must conduct all removal of trees associated with the project between the dates of October 15th to March 31st.

2. The permittee shall provide receipt of payment from the Kentucky Department of Fish and Wildlife Resources (KDFWR) Stream and Wetland Mitigation Program for the purchase of 869 Adjusted Mitigation Units (AMUS) for stream impacts. The AMUs must be purchased prior to the discharge of fill into "waters of the United States". The Corps ID No. LRL-2014-280-jea must accompany the payment. Inquiries regarding credit purchase may be made directly to KDFWR by calling Mr. Clifford Scott (502) 564-5101, by email at: clifford.scott@ky.gov, or in

writing at: Kentucky Department of Fish and Wildlife Resources, Division of Fisheries; #1 Sportsman's Lane; Frankfort, Kentucky 40601.

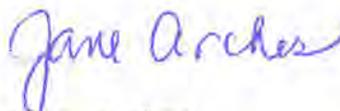
Since the Kentucky Division of Water (KDOW) has denied the required Water Quality Certification (WQC) for NWP No. 43, subject to Section 401 of the Clean Water Act for this particular NWP, the City of Radcliff must apply for and receive an individual WQC for this project. If the KDOW fails to respond to the request for authorization within 60 calendar days, the WQC is considered waived. The responsibility for obtaining the state WQC rests with the City of Radcliff. Once they obtain an individual WQC, they may proceed with the project without further contact or verification from us.

This decision is valid until **March 18, 2017**. The enclosed Compliance Certification should be signed and returned when the project is completed. If your project is not completed by this date or if your project is modified, you must contact us for another permit determination in accordance with the rules and regulations in effect at that time. Note that we also perform periodic inspections to ensure compliance with our permit conditions and applicable Federal laws. A copy of this letter is being sent to City of Radcliff and to the coordinating agencies (see enclosure for addresses).

Attached to this verification that the project is authorized by NWP No. 43 are a preliminary jurisdictional determination (JD), a Notification of Appeal Process (NAP) fact sheet, and Request for Appeal (RFA) form. However, a preliminary JD is not appealable and impacting "waters of the U.S." identified in the preliminary JD will result in you waiving the right to request an approved JD at a later date. An approved JD may be requested (which may be appealed), by contacting me for further instruction.

If you have any questions, please contact this office by writing to the above address, ATTN: CELRL-OP-FS, or by calling me at (502) 315-6682. All correspondence pertaining to this matter should refer to our ID No. LRL-2014-280-jea.

Sincerely,



Jane Archer
Regulatory Specialist
Regulatory Branch

Enclosures



DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
P.O. BOX 59
LOUISVILLE, KENTUCKY 40201-0059

REPLY TO
ATTENTION OF:

July 10, 2014

Operations Division
Regulatory Branch (South)
ID No. LRL-2014-284-jea

Ms. Kiersten R. Fuchs
Redwing Ecological Services, Incorporated
1139 South Fourth Street
Louisville, Kentucky 40203

Dear Ms. Fuchs:

This is in response to your request for authorization to impact 158 linear feet of ephemeral stream to construct a stormwater storage basin to alleviate flooding on the property located west of Dixie Highway (US 31W), approximately 500 feet north of the intersection of Dixie Highway and Joe Prather Highway (KY 313) in Radcliff, Hardin County, Kentucky. Construction activities for this basin would include clearing of approximately 4 acres of brush and trees, installation of appropriate erosion control measures and the cut and fill of approximately 20,000 cubic yards of material for the construction of the basin and restoration of the site. The project would impact a total of 0.01 acre of "waters of the United States." The information supplied by you was reviewed to determine whether a Department of the Army (DA) permit will be required under the provisions of Section 404 of the Clean Water Act.

Your project is considered a discharge of dredged and/or fill material associated with construction of stormwater management facilities. The project is authorized under the provisions of 33 CFR 330 Nationwide Permit (NWP) No. 43, Stormwater Management Facilities, as published in the Federal Register February 21, 2012. Under the provisions of this authorization, you must comply with the enclosed Terms and General Conditions for Nationwide Permit No. 43 and the following Special Conditions:

1. The permittee must conduct all removal of trees associated with the project between the dates of October 15th to March 31st.
2. The permittee shall provide an annual report including photo documentation of the channel to the U.S. Army Corps of Engineers for three consecutive years. The annual report is due by 31st of December until released from monitoring by this office. The first report is due after the first year the project is established. If the channel is degraded through sedimentation at the end of the three year monitoring period, the applicant shall provide an alternative mitigation plan.

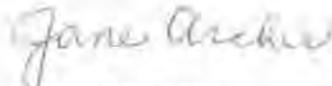
Since the Kentucky Division of Water (KDOW) has denied the required Water Quality Certification (WQC) for NWP No. 43, subject to Section 401 of the Clean Water Act for this particular NWP, the City of Radcliff must apply for and receive an individual WQC for this project. If the KDOW fails to respond to the request for authorization within 60 calendar days, the WQC is considered waived. The responsibility for obtaining the state WQC rests with the City of Radcliff. Once they obtain an individual WQC, they may proceed with the project without further contact or verification from us.

This decision is valid until March 18, 2017. The enclosed Compliance Certification should be signed and returned when the project is completed. If your project is not completed by this date or if your project is modified, you must contact us for another permit determination in accordance with the rules and regulations in effect at that time. Please note that we also perform periodic inspections to ensure compliance with our permit conditions and applicable Federal laws. A copy of this letter is being sent to your agent and to the appropriate coordinating agencies (see enclosure for addresses).

Attached to this verification that the project is authorized by NWP No. 43 are a preliminary jurisdictional determination (JD), a Notification of Appeal Process (NAP) fact sheet, and Request for Appeal (RFA) form. However, a preliminary JD is not appealable and impacting "waters of the United States" identified in the preliminary JD will result in you waiving the right to request an approved JD at a later date. An approved JD may be requested (which may be appealed), by contacting me for further instruction.

If you have any questions, please contact this office by writing to the above address, ATTN: CELRL-OP-FS, or by calling me at (502) 315-6682. All correspondence pertaining to this matter should refer to our ID No. LRL-2014-284-jea.

Sincerely,



Jane Archer
Regulatory Specialist
Regulatory Branch

Enclosures

Terms for Nationwide Permit No. 43
Stormwater Management Facilities

Discharges of dredged or fill material into non-tidal waters of the United States for the construction of stormwater management facilities, including stormwater detention basins and retention basins and other stormwater management facilities; the construction of water control structures, outfall structures and emergency spillways; and the construction of low impact development integrated management features such as bioretention facilities (e.g., rain gardens), vegetated filter strips, grassed swales, and infiltration trenches. This NWP also authorizes, to the extent that a section 404 permit is required, discharges of dredged or fill material into non-tidal waters of the United States for the maintenance of stormwater management facilities. Note that stormwater management facilities that are determined to be waste treatment systems under 33 CFR 328.3(a)(8) are not waters of the United States, and maintenance of these waste treatment systems generally does not require a section 404 permit.

The discharge must not cause the loss of greater than 1/2-acre of non-tidal waters of the United States, including the loss of no more than 300 linear feet of stream bed, unless for intermittent and ephemeral stream beds the district engineer waives the 300 linear foot limit by making a written determination concluding that the discharge will result in minimal adverse effects. This NWP does not authorize discharges into non-tidal wetlands adjacent to tidal waters. This NWP does not authorize discharges of dredged or fill material for the construction of new stormwater management facilities in perennial streams.

Notification: For the construction of new stormwater management facilities, or the expansion of existing stormwater management facilities, the permittee must submit a pre-construction notification to the district engineer prior to commencing the activity. (See general condition 31.) Maintenance activities do not require pre-construction notification if they are limited to restoring the original design capacities of the stormwater management facility. (Section 404)



**US Army Corps
of Engineers.**
Louisville District

Nationwide Permit Conditions

The following General Conditions must be followed in order for any authorization by NWP to be valid:

1. **Navigation.** (a) No activity may cause more than a minimal adverse effect on navigation.
(b) Any safety lights and signals prescribed by the US Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the US.
(c) The permittee understands and agrees that, if future operations by the US require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the US. No claim shall be made against the US on account of any such removal or alteration.
2. **Aquatic Life Movements.** No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species.
3. **Spawning Areas.** Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.
4. **Migratory Bird Breeding Areas.** Activities in waters of the US that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.
5. **Shellfish Beds.** No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48, or is a shellfish seeding or habitat restoration activity authorized by NWP 27.
6. **Suitable Material.** No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).
7. **Water Supply Intakes.** No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.
8. **Adverse Effects From Impoundments.** If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.
9. **Management of Water Flows.** To the maximum extent practicable, the pre-construction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization and storm water management activities, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation activities).
10. **Fills Within 100-Year Floodplains.** The activity must comply with applicable FEMA-approved state or local floodplain management requirements.
11. **Equipment.** Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.
12. **Soil Erosion and Sediment Controls.** Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high

tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the US during periods of low-flow or no-flow.

13. **Removal of Temporary Fills.** Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

14. **Proper Maintenance.** Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety and compliance with applicable NWP general conditions, as well as any activity-specific conditions added by the district engineer to an NWP authorization.

15. **Single and Complete Project.** The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

16. **Wild and Scenic Rivers.** No activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a "study river" for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency responsible for the designated Wild and Scenic River or study river (e.g., National Park Service, US Forest Service, US Fish and Wildlife Service).

17. **Tribal Rights.** No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

18. **Endangered Species.** (a) No activity is authorized under any NWP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which "may affect" a listed species or critical habitat, unless Section 7 consultation addressing the effects of the proposed activity has been completed.

(b) Federal agencies should follow their own procedures for complying with the requirements of the ESA. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address ESA compliance for the NWP activity, or whether additional ESA consultation is necessary.

(c) Non-federal permittees must submit a pre-construction notification (PCN) to the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the PCN must include the name(s) of the endangered or threatened species that might be affected by the proposed work or that utilize the designated critical habitat that might be affected by the proposed work. The district engineer will determine whether the proposed activity "may affect" or will have "no effect" to listed species and designated critical habitat and will notify the non-Federal applicant of the Corps' determination within 45 days of receipt of a complete PCN. In cases where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the project, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification the proposed activities will have "no effect" on listed species or critical habitat, or until Section 7 consultation has been completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from Corps.

(d) As a result of formal or informal consultation with the USFWS or NMFS the district engineer may add species-specific regional endangered species conditions to the NWPs.

(e) Authorization of an activity by a NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the USFWS or the NMFS, The Endangered Species Act prohibits any person subject to the jurisdiction of the US to take a listed species, where "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The word "harm" in the definition of "take" means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.

(f) Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the USFWS and NMFS at <http://www.fws.gov> or <http://www.fws.gov/ipac> and <http://www.noaa.gov/fisheries.html> respectively.

19. Migratory Birds and Bald and Golden Eagles. The permittee is responsible for obtaining any "take" permits required under the USFWS's regulations governing compliance with the Migratory Bird Treaty Act or the Bald and Golden Eagle Protection Act. The permittee should contact the appropriate local office of the USFWS to determine if such "take" permits are required for a particular activity.

20. Historic Properties. (a) In cases where the district engineer determines that the activity may affect properties listed, or eligible for listing, in the National Register of Historic Places, the activity is not authorized, until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.

(b) Federal permittees should follow their own procedures for complying with the requirements of Section 106 of the National Historic Preservation Act. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address section 106 compliance for the NWP activity, or whether additional section 106 consultation is necessary.

(c) Non-federal permittees must submit a pre-construction notification to the district engineer if the authorized activity may have the potential to cause effects to any historic properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties may be affected by the proposed work or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of or potential for the presence of historic resources can be sought from the State Historic Preservation Officer or Tribal Historic Preservation Officer, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). When reviewing pre-construction notifications, district engineers will comply with the current procedures for addressing the requirements of Section 106 of the National Historic Preservation Act. The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts, which may include background research, consultation, oral history interviews, sample field investigation, and field survey. Based on the information submitted and these efforts, the district engineer shall determine whether the proposed activity has the potential to cause an effect on the historic properties. Where the non-Federal applicant has identified historic properties on which the activity may have the potential to cause effects and notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects or that consultation under Section 106 of the NHPA is complete.

(d) The district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA Section 106 consultation is required. Section 106 consultation is not required when the Corps determines that the activity does not have the potential to cause effects on historic properties (see 36 CFR §800.3(a)). If NHPA section 106 consultation is required and will occur, the district engineer will notify the non-Federal applicant that he or she cannot begin work until Section 106 consultation is completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

(e) Prospective permittees should be aware that section 110k of the NHPA (16 U.S.C. 470h-2(k)) prevents the Corps from granting a permit or other assistance to an applicant who,

with intent to avoid the requirements of Section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the activity on historic properties.

21. Discovery of Previously Unknown Remains and Artifacts. If you discover any previously unknown historic, cultural or archeological remains and artifacts while accomplishing the activity authorized by this permit, you must immediately notify the district engineer of what you have found, and to the maximum extent practicable, avoid construction activities that may affect the remains and artifacts until the required coordination has been completed. The district engineer will initiate the Federal, Tribal and state coordination required to determine if the items or remains warrant recovery effort or if the site is eligible for listing in the National Register of Historic Places.

22. Designated Critical Resource Waters. Critical resource waters include, NOAA-managed marine sanctuaries and marine monuments, and National Estuarine Research Reserves. The district engineer may designate, after notice and opportunity for public comment, additional waters officially designated by a state as having particular environmental or ecological significance, such as outstanding national resource waters or state natural heritage sites. The district engineer may also designate additional critical resource waters after notice and opportunity for public comment.

(a) Discharges of dredged or fill material into waters of the US are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, 50, 51, and 52 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.

(b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, and 38, notification is required in accordance with general condition 31, for any activity proposed in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWPs only after it is determined that the impacts to the critical resource waters will be no more than minimal.

23. Mitigation. The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that adverse effects on the aquatic environment are minimal:

(a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the US to the maximum extent practicable at the project site (i.e., on site).

(b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating for resource losses) will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal.

(c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1/10-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse effects of the proposed activity are minimal, and provides a project-specific waiver of this requirement. For wetland losses of 1/10-acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in minimal adverse effects on the aquatic environment. Compensatory mitigation projects provided to offset losses of aquatic resources must comply with the applicable provisions of 33 CFR part 332.

(1) The prospective permittee is responsible for proposing an appropriate compensatory mitigation option if compensatory mitigation is necessary to ensure that the activity results in minimal adverse effects on the aquatic environment.

(2) Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, wetland restoration should be the first compensatory mitigation option considered.

(3) If permittee-responsible mitigation is the proposed option, the prospective permittee is responsible for submitting a mitigation plan. A conceptual or detailed mitigation plan may be used by the district engineer to make the decision on the NWP verification request, but a final mitigation plan that addresses the applicable requirements of 33 CFR 332.4(c)(2) – (14) must be approved by the district engineer before the permittee begins work in waters of the US, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation (see 33 CFR 332.3(k)(3)).

(4) If mitigation bank or in-lieu fee program credits are the proposed option, the mitigation plan only needs to address the baseline conditions at the impact site and the number of credits to be provided.

(5) Compensatory mitigation requirements (e.g., resource type and amount to be provided as compensatory mitigation, site protection, ecological performance standards, monitoring requirements) may be addressed through conditions added to the NWP authorization, instead of components of a compensatory mitigation plan.

(d) For losses of streams or other open waters that require pre-construction notification, the district engineer may require compensatory mitigation, such as stream rehabilitation, enhancement, or preservation, to ensure that the activity results in minimal adverse effects on the aquatic environment.

(e) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of 1/2-acre, it cannot be used to authorize any project resulting in the loss of greater than 1/2-acre of waters of the US, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that a project already meeting the established acreage limits also satisfies the minimal impact requirement associated with the NWPs.

(f) Compensatory mitigation plans for projects in or near streams or other open waters will normally include a requirement for the restoration or establishment, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, riparian areas may be the only compensatory mitigation required. Riparian areas should consist of native species. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address documented water quality or habitat loss concerns. If it is not possible to establish a riparian area on both sides of a stream, or if the waterbody is a lake or coastal waters, then restoring or establishing a riparian area along a single bank or shoreline may be sufficient. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.

(g) Permittees may propose the use of mitigation banks, in-lieu fee programs, or separate permittee-responsible mitigation. For activities resulting in the loss of marine or estuarine resources, permittee-responsible compensatory mitigation may be environmentally preferable if there are no mitigation banks or in-lieu fee programs in the area that have marine or estuarine credits available for sale or transfer to the permittee. For permittee-responsible mitigation, the special conditions of the NWP verification must clearly indicate the party or parties responsible for the implementation and performance of the compensatory mitigation project, and, if required, its long-term management.

(h) Where certain functions and services of waters of the US are permanently adversely affected, such as the conversion of a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse effects of the project to the minimal level.

24. Safety of Impoundment Structures. To ensure that all impoundment structures are safely designed, the district engineer may require non-Federal applicants to demonstrate that the structures comply with established state dam safety criteria or have been designed by qualified persons. The district engineer may also require documentation that the design has

been independently reviewed by similarly qualified persons, and appropriate modifications made to ensure safety.

25. Water Quality. Where States and authorized Tribes, or EPA where applicable, have not previously certified compliance of an NWP with CWA Section 401, individual 401 Water Quality Certification must be obtained or waived (see 33 CFR 330.4(c)). The district engineer or State or Tribe may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

26. Coastal Zone Management. In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). The district engineer or a State may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

27. Regional and Case-By-Case Conditions. The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or USEPA in its section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

28. Use of Multiple Nationwide Permits. The use of more than one NWP for a single and complete project is prohibited, except when the acreage loss of waters of the US authorized by the NWPs does not exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the US for the total project cannot exceed 1/3-acre.

29. Transfer of Nationwide Permit Verifications. If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature: "When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below."

(Transferee)

(Date)

30. Compliance Certification. Each permittee who receives an NWP verification letter from the Corps must provide a signed certification documenting completion of the authorized activity and any required compensatory mitigation. The success of any required permittee-responsible mitigation, including the achievement of ecological performance standards, will be addressed separately by the district engineer. The Corps will provide the permittee the certification document with the NWP verification letter. The certification document will include:

(a) A statement that the authorized work was done in accordance with the NWP authorization, including any general, regional, or activity-specific conditions;

(b) A statement that the implementation of any required compensatory mitigation was completed in accordance with the permit conditions. If credits from a mitigation bank or in-lieu fee program are used to satisfy the compensatory mitigation requirements, the certification must include the documentation required by 33 CFR 332.3(l)(3) to confirm that the permittee secured the appropriate number and resource type of credits; and

(c) The signature of the permittee certifying the completion of the work and mitigation.

31. Pre-Construction Notification (PCN). (a) Timing. Where required by the terms of the NWP, the prospective permittee must notify the district engineer by submitting a PCN as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, if the PCN is determined to be incomplete, notify the prospective permittee within that 30 day period to request the additional information necessary to make the PCN complete. As a general rule, district engineers will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either:

(1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or

(2) 45 calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 18 that listed species or critical habitat might be affected or in the vicinity of the project, or to notify the Corps pursuant to general condition 20 that the activity may have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that there is "no effect" on listed species or "no potential to cause effects" on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or Section 106 of the National Historic Preservation (see 33 CFR 330.4(g)) has been completed. Also, work cannot begin under NWPs 21, 49, or 50 until the permittee has received written approval from the Corps. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee may not begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2).

(b) Contents of Pre-Construction Notification: The PCN must be in writing and include the following information:

(1) Name, address and telephone numbers of the prospective permittee;

(2) Location of the proposed project;

(3) A description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause, including the anticipated amount of loss of water of the US expected to result from the NWP activity, in acres, linear feet, or other appropriate unit of measure; any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity. The description should be sufficiently detailed to allow the district engineer to determine that the adverse effects of the project will be minimal and to determine the need for compensatory mitigation. Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the project and when provided results in a quicker decision. Sketches should contain sufficient detail to provide an illustrative description of the proposed activity (e.g., a conceptual plan), but do not need to be detailed engineering plans);

(4) The PCN must include a delineation of wetlands, other special aquatic sites, and waters, such as lakes and ponds, and perennial, intermittent, and ephemeral streams, on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters on the project site, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many waters of the US. The 45 day period will not start until the delineation has been submitted to or completed by the Corps, as appropriate;

(5) If the proposed activity will result in the loss of greater than 1/10-acre of wetlands and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied, or explaining why the adverse effects are minimal and why compensatory mitigation should not be required. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan.

(6) If any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, for non-Federal applicants the PCN must include the name(s) of those endangered or threatened species that might be affected by the proposed work or utilize the designated critical habitat that may be affected by the proposed work. Federal applicants must provide documentation demonstrating compliance with the Endangered Species Act; and

(7) For an activity that may affect a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, for non-Federal applicants the PCN must state which historic property may be affected by the proposed work or include a vicinity map indicating the location of the historic property. Federal applicants must provide documentation demonstrating compliance with Section 106 of the National Historic Preservation Act.

(c) Form of PCN Notification: The standard individual permit application form (Form ENG 4345) may be used, but the completed application form must clearly indicate that it is a PCN and must include all of the information required in paragraphs (b)(1) through (7) of this general condition. A letter containing the required information may also be used.

(d) Agency Coordination: (1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the project's adverse environmental effects to a minimal level.

(2) For all NWP activities that require PCN notification and result in the loss of greater than 1/2-acre of waters of the US, for NWP 21, 29, 39, 40, 42, 43, 44, 50, 51, and 52 activities that require PCN notification and will result in the loss of greater than 300 linear feet of intermittent and ephemeral stream bed, and for all NWP 48 activities that require PCN notification, the district engineer will immediately provide (e.g., via e-mail, facsimile transmission, overnight mail, or other expeditious manner) a copy of the complete PCN to the appropriate Federal or state offices (USFWS, state natural resource or water quality agency, EPA, State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Office (THPO), and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will have 10 calendar days from the date the material is transmitted to telephone or fax the district engineer notice that they intend to provide substantive, site-specific comments. The comments must explain why the agency believes the adverse effects will be more than minimal. If so contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the PCN notification. The district engineer will fully consider agency comments received within the specified time frame concerning the proposed activity's compliance with the terms and conditions of the NWPs, including the need for mitigation to ensure the net adverse environmental effects to the aquatic environment of the proposed activity are minimal. The district engineer will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each PCN notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5.

(3) In cases of where the prospective permittee is not a Federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act.

(4) Applicants are encouraged to provide the Corps with either electronic files or multiple copies of PCN notifications to expedite agency coordination.

Further Information

1. District Engineers have authority to determine if an activity complies with the terms and conditions of an NWP.

2. NWPs do not obviate the need to obtain other federal, state, or local permits, approvals, or authorizations required by law.

3. NWPs do not grant any property rights or exclusive privileges.

4. NWPs do not authorize any injury to the property or rights of others.

5. NWPs do not authorize interference with any existing or proposed Federal project.

Compliance Certification:

Permit Number: LRL-2014-282-jea

Name of Permittee: City of Radcliff

Date of Issuance: July 28, 2014

Upon completion of the activity authorized by this permit and any mitigation required by this permit, sign this certification and return it to the following address:

U.S. Army Corps of Engineers
CELRL-OP-FS
P.O. Box 59
Louisville, Kentucky 40201

Please note that your permitted activity is subject to a compliance inspection by an U.S. Army Corps of Engineers representative. If you fail to comply with this permit you are subject to permit suspension, modification, or revocation.

I hereby certify that the work authorized by the above referenced permit has been completed in accordance with the terms and conditions of the said permit, and required mitigation was completed in accordance with the permit conditions.

Signature of Permittee

Date

ATTACHMENT

PRELIMINARY JURISDICTIONAL DETERMINATION FORM

BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR PRELIMINARY JURISDICTIONAL DETERMINATION (JD): May 27, 2014

B. NAME AND ADDRESS OF PERSON REQUESTING PRELIMINARY JD:

City of Radcliff
c/o Mr. Toby Spalding
411 West Lincoln Trail Boulevard
Radcliff, Kentucky 40160

Represented by:
Redwing Ecological Services, Inc.
1139 South Fourth Street
Louisville, KY 40203

C. DISTRICT OFFICE, FILE NAME, AND NUMBER: Louisville District (CELRL-OP-FS), Wilson Road Basin Mitigation Project, LRL-2014-282-jea

D. PROJECT LOCATION(S) AND BACKGROUND INFORMATION: The proposed Wilson Road Basin Flood Mitigation Project involves the construction of a stormwater basin in Radcliff, Kentucky in order to alleviate flooding issues by providing flood storage during storm events. The proposed Wilson Road Basin project is located east of South Wilson Road (KY 447), approximately 500 feet north of the intersection of South Wilson Road and Shelton Road and is approximately 10.4 acres.

(USE THE ATTACHED TABLE TO DOCUMENT MULTIPLE WATERBODIES AT DIFFERENT SITES)

State: Kentucky County/parish/borough: Hardin City: Radcliff
Center coordinates of site (lat/long in degree decimal format):
Lat. 37.811329° N, Long 85.923869° W

Name of nearest waterbody: Flow through Quiggins sinkhole exits at Falling Springs, which is a tributary of Mill Creek.

Identify (estimate) amount of waters in the review area:
Non-wetland waters: 2,010 linear feet: width (ft) and/or acre.
Cowardin Class: R4SB, R6
Stream Flow: Intermittent, Ephemeral
Wetlands: 0.104 acre.
Cowardin Class: PFO

Name of any water bodies on the site that have been identified as Section 10 waters:
Tidal:
Non-Tidal:

E. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

- Office (Desk) Determination. Date:
 Field Determination. Date(s): December 19, 2014

1. The Corps of Engineers believes that there may be jurisdictional waters of the United States on the subject site, and the permit applicant or other affected party who requested this preliminary JD is hereby advised of his or her option to request and obtain an approved jurisdictional determination (JD) for that site. Nevertheless, the permit applicant or other person who requested this preliminary JD has declined to exercise the option to obtain an approved JD in this instance and at this time.

2. In any circumstance where a permit applicant obtains an individual permit, or a Nationwide General Permit (NWP) or other general permit verification requiring "pre-construction notification" (PCN), or requests verification for a non-reporting NWP or other general permit, and the permit applicant has not requested an approved JD for the activity, the permit applicant is hereby made aware of the following: (1) the permit applicant has elected to seek a permit authorization based on a preliminary JD, which does not make an official determination of jurisdictional waters; (2) that the applicant has the option to request an approved JD before accepting the terms and conditions of the permit authorization, and that basing a permit authorization

on an approved JD could possibly result in less compensatory mitigation being required or different special conditions; (3) that the applicant has the right to request an individual permit rather than accepting the terms and conditions of the NWP or other general permit authorization; (4) that the applicant can accept a permit authorization and thereby agree to comply with all the terms and conditions of that permit, including whatever mitigation requirements the Corps has determined to be necessary; (5) that undertaking any activity in reliance upon the subject permit authorization without requesting an approved JD constitutes the applicant's acceptance of the use of the preliminary JD, but that either form of JD will be processed as soon as is practicable; (6) accepting a permit authorization (e.g., signing a proffered individual permit) or undertaking any activity in reliance on any form of Corps permit authorization based on a preliminary JD constitutes agreement that all wetlands and other water bodies on the site affected in any way by that activity are jurisdictional waters of the United States, and precludes any challenge to such jurisdiction in any administrative or judicial compliance or enforcement action, or in any administrative appeal or in any Federal court; and (7) whether the applicant elects to use either an approved JD or a preliminary JD, that JD will be processed as soon as is practicable. Further, an approved JD, a proffered individual permit (and all terms and conditions contained therein), or individual permit denial can be administratively appealed pursuant to 33 C.F.R. Part 331, and that in any administrative appeal, jurisdictional issues can be raised (see 33 C.F.R. 331.5(a)(2)). If, during that administrative appeal, it becomes necessary to make an official determination whether CWA jurisdiction exists over a site, or to provide an official delineation of jurisdictional waters on the site, the Corps will provide an approved JD to accomplish that result, as soon as is practicable.

This preliminary JD finds that there "may be" waters of the United States on the subject project site, and identifies all aquatic features on the site that could be affected by the proposed activity, based on the following information:

SUPPORTING DATA. Data reviewed for preliminary JD (check all that apply - checked items should be included in case file and, where checked and requested, appropriately reference sources below):

- Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant:
- Data sheets prepared/submitted by or on behalf of the applicant/consultant.
 - Office concurs with data sheets/delineation report.
 - Office does not concur with data sheets/delineation report.
- Data sheets prepared by the Corps:
- Corps navigable waters' study:
- U.S. Geological Survey Hydrologic Atlas:
 - USGS NHD data.
 - USGS 8 and 11 digit HUC maps.
- U.S. Geological Survey map(s). Cite scale & quad name: 1:24,000 – Vine Grove quad.
- USDA Natural Resources Conservation Service Soil Survey. Citation: USDA Soil Survey Geographic Database for Hardin and Larue Counties, Kentucky (2005)
- National wetlands inventory map(s). Cite name:
- State/Local wetland inventory map(s):
- FEMA/FIRM maps: 100-year Floodplain Elevation is: (National Geodetic Vertical Datum of 1929)
- Photographs: Aerial (Name & Date): Kentucky Statewide 1 Meter Aerial Imagery (2012) – KY1Z or Other (Name & Date): Site photographs – September 16, 2013;
- Previous determination(s). File no. and date of response letter:
- Other information (please specify):

IMPORTANT NOTE: The information recorded on this form has not necessarily been verified by the Corps and should not be relied upon for later jurisdictional determinations.

Game Archer 5/28/14
Signature and date of
Regulatory Project Manager
(REQUIRED)

K. R. R. 5-27-14
Signature and date of
person requesting preliminary JD
(REQUIRED, unless obtaining the signature is
impracticable)

Site number	Latitude	Longitude	Cowardin Class	Estimated amount of aquatic resource in review area	Class of aquatic resource
Wilson Road Basin – Wetland 1	37.8111° N	85.9241° W	PFO	0.017 acre	non-section 10 / wetland
Wilson Road Basin – Wetland 2	37.8109° N	85.9241° W	PFO	0.087 acre	non-section 10 / wetland
Wilson Road Basin – Ephemeral Stream 1	37.8125° N	85.9239° W	R6	110 linear feet	non-section 10 / non-wetland
Wilson Road Basin – Ephemeral Stream 2	37.8110° N	85.9234° W	R6	424 linear feet	non-section 10 / non-wetland
Wilson Road Basin – Ephemeral Stream 3	37.8113° N	85.9239° W	R6	642 linear feet	non-section 10 / non-wetland
Wilson Road Basin – Ephemeral Stream 4	37.8106° N	85.9239° W	R6	256 linear feet	non-section 10 / non-wetland
Wilson Road Basin – Intermittent Stream 1	37.8103° N	85.9239° W	R4SB	490 linear feet	non-section 10 / non-wetland
Wilson Road Basin – Intermittent Stream 2	37.8104° N	85.9241° W	R4SB	87 linear feet	non-section 10 / non-wetland

**NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCEEDINGS AND
REQUEST FOR APPEAL**

Applicant: City of Radcliff		File Number: LRL-2014-282	Date: 7/28/14
Attached is:			See Section below
	INITIAL PROFFERED PERMIT (Standard Permit or Letter of permission)	A	
	PROFFERED PERMIT (Standard Permit or Letter of permission)	B	
	PERMIT DENIAL	C	
	APPROVED JURISDICTIONAL DETERMINATION	D	
X	PRELIMINARY JURISDICTIONAL DETERMINATION	E	

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at http://www.usace.army.mil/CECW/Pages/reg_materials.aspx or Corps regulations at 33 CFR Part 331

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- **ACCEPT:** If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- **OBJECT:** If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit

- **ACCEPT:** If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- **APPEAL:** If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

C: PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

D: APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- **ACCEPT:** You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
- **APPEAL:** If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

E: PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The Preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

If you have questions regarding this decision and/or the appeal process you may contact:

Ms. Jane Archer
U.S. Army Corps of Engineers
P.O. Box 59, Rm 752
Attn: CELRL-OP-FN
Louisville, Kentucky 40201-0059
(502) 315-6680

If you only have questions regarding the appeal process you may also contact:

U.S. Army Corps of Engineers
ATTN: Appeal Review Officer CELRD-PD-REG
550 Main Street, Room 10524
Cincinnati, OH 45202-3222
TEL (513) 684-6212; FAX (513) 684-2460

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15 day notice of any site investigation, and will have the opportunity to participate in all site investigations.

Signature of appellant or agent.	Date:	Telephone number:
----------------------------------	-------	-------------------

ADDRESS FOR COORDINATING AGENCIES

Mr. Lee Andrews
U.S. Fish & Wildlife Service
JC Watts Federal Building
330 West Broadway, Room 265
Frankfort, KY 40601

Mr. Peter Goodman
Acting Director
Kentucky Energy & Environment Cabinet
Division of Water
200 Fair Oaks, 4th Floor
Frankfort, KY 40601

Mr. Doug Dawson
Environmental Section Chief
Kentucky Department of Fish
and Wildlife Resources
#1 Sportsman's Lane
Frankfort, KY 40601

ADDRESS FOR PERMITTEE

Mr. Toby Spalding, PE
City of Radcliff
411 West Lincoln Trail Boulevard
Radcliff, KY 40160



STEVEN L. BESHEAR
GOVERNOR

ENERGY AND ENVIRONMENT CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WATER
200 FAIR OAKS LANE, 4TH FLOOR
FRANKFORT, KENTUCKY 40601
www.kentucky.gov

LEONARD K. PETERS
SECRETARY

STREAM CONSTRUCTION PERMIT

For Construction In Or Along A Stream

Issued to: **City of Radcliff**
Address: **411 W Lincoln Trail Blvd**
Radcliff, KY 40160

Permit expires on
February 19, 2015

Permit No. **20726**

In accordance with KRS 151.250 and KRS 151.260, the Energy and Environment Cabinet approves the application dated **November 20, 2013** for construction of a stormwater basin and re-creation of five ephemeral streams in the floodplain, with coordinates 37.8114, -85.9189, in **Hardin County**. AI: 120558

There shall be no deviation from the plans and specifications submitted and hereby approved unless the proposed change shall first have been submitted to and approved in writing by the Cabinet. This approval is subject to the attached limitations. **Please read these limitations carefully!** If you are unable to adhere to these limitations for any reason, please contact this office prior to construction.

This permit is valid from the standpoint of stream obstruction only. Issuance of this permit does not relieve the permittee from the responsibility of obtaining any other permits or licenses required by this Cabinet and other state, federal and local agencies. Specifically if the project involves work in a stream, such as bank stabilization, dredging, relocation, or in designated wetlands, a 401 Water Quality Certification from the Division of Water will be required.

his permit is nontransferable and is not valid unless actual construction of this authorized work is begun prior to the expiration date noted above. Any violation of the Water Resources Act of 1966 as amended is subject to penalties as set forth in KRS 151.990.

If you have any questions regarding this permit, please call Mr. Solitha Dharman at (502) 564-3410.

Issued February 19, 2014.

Todd Powers, P.E., Supervisor
Floodplain Management Section
Surface Water Permit Branch

TAP/SD/kec

pc: Louisville Regional Office
Murray Wanner - Radcliff Floodplain Coordinator
Kiersten Fuchs, Agent (by email)
File

From: [Miller, Jessica](#)
To: [Batson, Heather](#)
Cc: [FEMA-R4EHP](#)
Subject: Re: Happy Valley / Quiggins Sinkhole, Hardin County, City of Radcliff, KY (FEMA-HMGP-1818-0012) - ESA Determination
Date: Tuesday, December 09, 2014 4:21:05 PM

Heather,

Thank you for providing the additional information about the project. We concur with your "may affect - not likely to adversely affect" determinations for the gray bat, Indiana bat, and federally listed mussel species. We also concur that the proposed project is not likely to jeopardize the continued existence of the northern long-eared bat. ESA compliance is based on the adherence of the conditions that you stated in your email, including that of restricting tree removal to the unoccupied season, October 15 through March 31.

Jessi Miller

On Tue, Dec 9, 2014 at 3:37 PM, Batson, Heather <Heather.Batson@fema.dhs.gov> wrote:

Good Afternoon, Jessi:

It was a pleasure speaking with you today. The SOW for the Federal Action, in brief:

Due to flooding of roads and homes, the City of Radcliff is proposing to construct 5 basins in the Happy Valley area. Due to an existing sinkhole (Quiggins Sinkhole), and its low flow rate, frequent flooding is an issue in moderate to severe events. The City proposes to address the flooding by creating 5 basins: Quiggins, Turner, Cato, Wilson and Song. Project construction will involve: fill removal, compaction, some vegetation removal and basin shaping. The following federally listed species are known to occur in Hardin County, KY: gray bat (*Myotis grisescens*), Indiana bat (*Myotis sodalist*), and several species of mussels. In addition, the northern long-eared bat is currently proposed for listing under the ESA and may be listed during project implementation.

From technical data received for the project, the following has occurred in the project area:

In 2009, a consultant for the City of Radcliff coordinated with the U.S. Fish and Wildlife Service (USFWS) regarding a prior proposed Quiggins stormwater basin project and the felling of 38 potential Indiana bat roost trees prior to a April 1, 2009 deadline (See attached 2009 USFWS letter). The USFWS approved the future removal of the remaining forested habitat within the proposed basin during the summer of 2009. The USFWS also stated that, based on the removal of all potential Indiana bat roost trees, and the absence of cave entrances and no additional inlets or outlets associated with Quiggins Sinkhole, the prior proposed (basin construction) project was not likely to adversely affect the Indiana bat or

the gray bat.

FEMA is also in receipt of the following USFWS correspondence:

1. 12/17/2013, addressing project compliance/concurrence with Section 7 of the ESA (addressed to the City's consulting engineer)

To assure compliance under Section 7 of the ESA, FEMA will place the following conditions on the proposed work:

1. Any additional tree removal that may need to occur in the project area may only occur during the allowed seasonal timeframes (Jessi: what would those time frames be for Hardin County, KY?)
2. If new information reveals impacts of the proposed action that may affect listed species or critical habitat in a manner not previously considered, the sub-grantee shall cease project construction and notify FEMA immediately so that the appropriate review and potential appropriate regulatory agency review consultation may occur.
3. If the proposed action is subsequently modified to include activities which were not considered during FEMA review and regulatory agency consultation, the sub-grantee shall cease project construction and notify FEMA immediately so that the appropriate review and potential appropriate regulatory agency review consultation may occur.
4. If new species are listed or critical habitat designated that might be affected by the proposed action, the sub-grantee shall cease project construction and notify FEMA immediately so that the appropriate review and potential appropriate regulatory agency review consultation may occur.

As discussed via telephone and a review of the available information: based on the SOW and existing conditions at the site, FEMA has made the following determination under Section 7 of the Endangered Species Act (as amended):

The proposed project may affect, but not likely adversely affect the Indiana Bat, Gray Bat and listed mussels. While the northern long-eared bat is currently proposed for listing, compliance with the above conditions would avoid direct impacts to the northern long-eared bat and the proposed project will not jeopardize the continued existence of the northern long-eared bat.

FEMA requests your response to this e-mail to document the agencies compliance under Section 7 of the ESA. If you have any questions or need any clarification, please feel free to contact me.

Heather D. Batson

Environmental Protection Specialist
FEMA Region IV/Hazard Mitigation Assistance Branch

3003 Chamblee-Tucker Road - Hollins Bldg.
Atlanta, Ga 30341

Desk: 770-220-5304

iPhone: 404-984-6783
Fax: 770-220-5440
heather.batson@fema.dhs.gov

"The Hazard Mitigation Assistance Branch supports our State and Local partners in reducing the impact of natural hazards by funding mitigation activities that strengthen community resilience to disasters."

--

Jessica Blackwood Miller
Fish & Wildlife Biologist
Kentucky Field Office
U.S. Fish & Wildlife Service
330 W. Broadway, Suite 265
Frankfort, KY 40601
Ph: (502) 695-0468 ext. 104
Fax: (502) 695-1024



United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kentucky Ecological Services Field Office
330 West Broadway, Suite 265
Frankfort, Kentucky 40601
(502) 695-0468

December 17, 2013

Mr. L. Matthew Blake
Ms. Kiersten R. Fuchs
Redwing Ecological Services, Inc.
1139 South Fourth Street
Louisville, KY 40203

Re: FWS 2014-B-0109; Redwing Project 08-035-02; City of Radcliff; Happy Valley Flood Mitigation Project; located in Hardin County, Kentucky

Dear Mr. Blake and Ms. Fuchs:

The U.S. Fish and Wildlife Service (Service) has reviewed your December 2, 2013 correspondence regarding the above-referenced project. The correspondence requests our concurrence that the proposed project would not likely adversely affect the following federally listed species. The Service offers the following comments in accordance with the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*).

Gray bat

Gray bats roost, breed, rear young, and hibernate in caves or cave-like features year round and forage on a variety of flying aquatic and terrestrial insects present along streams, rivers, and lakes. Your correspondence states that there are no caves, rockshelters, or mine portals within the action area of the proposed project and that only small intermittent and ephemeral streams are present in the proposed project area. An Erosion Prevention and Sediment Control Plan approved by the Kentucky Division of Water will be utilized to minimize sedimentation and erosion to streams that may be used by foraging gray bats. Because of the lack of potential gray bat hibernacula and roosting habitat within the action area of the proposed project and the utilization of measures to minimize impacts to gray bat foraging, we believe that any impacts to the species would be insignificant and/or discountable. Therefore, the Service concurs that the proposed project is not likely to adversely affect the gray bat.

Federally listed mussels

The report lists five species of federally listed mussels that are known to occur or potentially occur in Hardin County, Kentucky. Because the project site does not include any perennial streams, mussel species will not be directly affected by the proposed project. An Erosion Prevention and Sediment Control Plan approved by the Kentucky Division of Water will be utilized to minimize any indirect effects of sedimentation and erosion to nearby water resources. Based on this, the Service believes that any impacts to federally listed mussels as a result of the proposed project would be insignificant and/or discountable and, therefore, concurs that the proposed project is not likely to adversely affect federally listed mussel species.

Indiana bat

The proposed project site is located within habitat designated as "potential habitat" for the Indiana bat and we believe that: (1) forested areas in the vicinity of and on the project area may potentially provide suitable summer roosting and foraging habitat for the Indiana bat; and (2) caves, rockshelters, and

abandoned underground mines in the vicinity of and on the project area may potentially provide suitable wintering habitat for the Indiana bat. Your correspondence states that there are no caves, rockshelters, or mine portals within the action area of the proposed project. Your correspondence identifies 9.4 acres of suitable Indiana bat roosting habitat that will be cleared as a part of the proposed project. The removal of this habitat will occur during the unoccupied time (between October 15 and March 31), thus avoiding direct effects to the Indiana bat. You state that the forested habitat proposed to be removed comprises 0.1% of the total forested habitat in a 2.5-mile radius surrounding the proposed project area and that 53% of that total area surrounding the project is currently forested habitat. Much of this forested habitat is found in large forested blocks, including habitat at Fort Knox. The proposed tree removal will occur at five different sites in an urbanized landscape in the City of Radcliff. Based on all this site-specific information, we believe that any indirect effects to the Indiana bat would be insignificant and/or discountable. Therefore, we concur that the proposed project is not likely to adversely affect the Indiana bat.

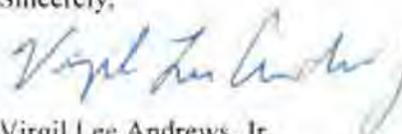
Northern long-eared bat

The northern long-eared bat is currently proposed for federal listing under the ESA and may become listed as early as October 2014. Federal action agencies are required to confer with the Service if a proposed action will jeopardize the continued existence of a species proposed for listing. The entire state of Kentucky is considered potential habitat for the northern long-eared bat. During the summer, northern long-eared bats typically roost singly or in colonies in a wide-variety of forested habitats, where they seek shelter during daylight hours underneath bark or in cavities/crevices of both live trees and snags, including relatively small trees and snags that are less than 5 inches in diameter at breast height (DBH). Because the seasonal clearing measure avoids direct impacts to the northern long-eared bats, and the action area of the proposed project is small relative the entire range of the species, the Service believes that the proposed project will not jeopardize the continued existence of the northern long-eared bat. Although species proposed for listing are not afforded protection under the ESA, when a species is listed, the prohibitions against jeopardizing its continued existence and unauthorized take are effective immediately, regardless of an action's stage of completion. If the project is not completed by the time the species is listed under the ESA, additional evaluation may be recommended to address take as a result of indirect effects to the species.

Provided the seasonal tree clearing measure, as described above, is adhered to, we believe that the requirements of Section 7 of the Endangered Species Act of 1973 would be fulfilled for the project. The obligations under Section 7 of the Act must be reconsidered if (1) the seasonal tree clearing measure, as described above, is not adhered to, (2) new information reveals impacts of the proposed action that may affect listed species or critical habitat in a manner not previously considered, (3) the proposed action is subsequently modified to include activities which were not considered during this consultation, or (4) new species are listed or critical habitat designated that might be affected by the proposed action.

Thank you again for your request. Your concern for the protection of endangered and threatened species is greatly appreciated. If you have any questions regarding the information that we have provided, please contact Jessi Miller at (502) 695-0468 extension 104.

Sincerely,



Virgil Lee Andrews, Jr.



STEVEN L. BESHEAR
GOVERNOR

**TOURISM, ARTS AND HERITAGE CABINET
KENTUCKY HERITAGE COUNCIL**

BOB STEWART
SECRETARY

THE STATE HISTORIC PRESERVATION OFFICE
300 WASHINGTON STREET
FRANKFORT, KENTUCKY 40601
PHONE (502) 564-7005
FAX (502) 564-5820
www.heritage.ky.gov

CRAIG A. POTTS
EXECUTIVE DIRECTOR AND
STATE HISTORIC PRESERVATION OFFICER

January 6, 2014

Hadley Howell Gilliland
Historic Preservation Specialist
FEMA Region IV
3003 Chamblee Tucker Road
Hollins Bldg.
Atlanta, GA 30341-4112

RE: FEMA Project HMGP-1818-0012, Hardin County, Kentucky

Dear Ms. Gilliland,

Thank you for correspondence regarding the above referenced project. Based on the information provided, we concur with the FEMA determination of **NO ADVERSE EFFECT** for the proposed undertaking.

Should you have any questions, feel free to contact Yvonne Sherrick of my staff at 502- 564-7005 ext 113.

Sincerely,

Craig A. Potts
Executive Director and
State Historic Preservation Officer

CP:40585

JAN 16 2014



The Delaware Nation
Cultural Preservation Office
P.O. Box 825 - 31064 State Highway 281- Anadarko, OK 73005
Phone: 405/247-2448 – Fax: 405/247-8905

NAGPRA ext. 1180
Section 106 ext. 1181
Museum ext. 1181
Library ext. 1196
Clerk ext. 1182

May 9, 2014

RE: FEMA Determination of Eligibility and Effect
FEMA Project HMGP-1818-0012
Hardin County, Kentucky

Dear Hadley Howell Gilliland,

The Delaware Nation Cultural Preservation Department received correspondence regarding the above referenced project. Our office is committed to protecting sites important to tribal heritage, culture and religion. Furthermore, the tribe is particularly concerned with archaeological sites that may contain human burials or remains, and associated funerary objects.

As described in your correspondence and upon research of our database(s) and files, we find that the Lenape people occupied this area either prehistorically or historically. However, the location of the project does not endanger cultural or religious sites of interest to the Delaware Nation. Please continue with the project as planned. However, should this project inadvertently uncover an archaeological site or object(s), we request that you halt all construction and ground disturbance activities and immediately contact the appropriate state agencies, as well as our office (within 24 hours).

Please Note the Delaware Nation, the Delaware Tribe of Indians, and the Stockbridge Munsee Band of Mohican Indians are the only Federally Recognized Delaware/Lenape entities in the United States and consultation must be made only with designated staff of these three tribes. We appreciate your cooperation in contacting the Delaware Nation Cultural Preservation Office to conduct proper Section 106 consultation. Should you have any questions regarding this email or future consultation feel free to contact our offices at 405-247-2448 or by email tfrancis@delawarenation.com.

Sincerely,

Mrs. Tamara Francis Fourkiller
Cultural Preservation Director

CC: Kandess Botone (Director's Assistant)
kbotone@delawarenation.com

From: [Lisa LaRue-Baker - UKB THPO](#)
To: [FEMA-R4EHP](#)
Cc: [verna](#); [Ernestine Berry](#)
Subject: HMGP-1818-0012, Hardin County, KY
Date: Wednesday, April 23, 2014 3:56:45 PM

The United Keetoowah Band of Cherokee Indians in Oklahoma has reviewed your project under Section 106 of the NHPA, and at this time, have no comments or objections. However, if any inadvertent discoveries of human remains are made, please cease work and contact us immediately.

Lisa C. Baker

Acting THPO
United Keetoowah Band of Cherokee Indians in Oklahoma
PO Box 746
Tahlequah, OK 74465

c 918.822.1952
ukbthpo-larue@yahoo.com

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PEORIA TRIBE OF INDIANS OF OKLAHOMA

118 S. Eight Tribes Trail (918) 540-2535 FAX (918) 540-2538

P.O. Box 1527

MIAMI, OKLAHOMA 74355

CHIEF
John P. Froman

SECOND CHIEF
Jason Dollarhide

April 16, 2014

Hadley Howell Gilliland
Historic Preservation Specialist
US Department of Homeland Security
FEMA Region IV
3003 Chamblee-Tucker Road
Atlanta, GA 30341

**Re: FEMA Determination of Eligibility and Effect
FEMA Project HMGP-1818-0012; Hardin County, Kentucky**

Dear Ms. Gilliland,

Thank you for providing notice of the referenced project. The Peoria Tribe of Indians of Oklahoma is unaware of any documentation directly linking Indian Religious Sites to the proposed project location. There appear to be no objects of cultural significance or artifacts linked to our tribe located on or near the project location, therefore we concur with FEMA's finding of no adverse effect.

The Peoria Tribe of Indians of Oklahoma is unaware of items covered under NAGPRA (Native American Graves Protection and Repatriation Act) to be associated with the proposed project site. These items include: funerary or sacred objects; objects of cultural patrimony; or ancestral human remains.

The Peoria Tribe has no objection at this time to the proposed drainage construction program. If, however, at any time items are discovered which fall under the protection of NAGPRA, the Peoria Tribe requests immediate notification and consultation. In addition state, local and tribal authorities should be advised as to the findings and construction halted until consultation with all concerned parties has occurred.

Thank you,

Cynthia Stacy
Special Projects Manager/NAGPRA

TREASURER
Aaron Wayne Blalock

SECRETARY
Don Giles

FIRST COUNCILMAN
Carolyn Ritchey

SECOND COUNCILMAN
Craig Harper

THIRD COUNCILMAN
Alan Goforth

APPENDIX E
PUBLIC NOTICE OF ENVIRONMENTAL ASSESSMENT

**JOINT FEDERAL, STATE, LOCAL
PUBLIC NOTICE**

The Federal Emergency Management Agency and Kentucky Emergency Management Agency have received the following application for Federal and State grant funding.

Applicant:

City of Radcliff, Hardin County, Kentucky, USA
411 West Lincoln Trail Boulevard
Radcliff, Kentucky 40160

Project Title:

FEMA HMGP-DR-KY-1818-0012, Quiggins/Happy Valley Sink Hole Mitigation Project

Purpose for Environmental Assessment:

The Department of Homeland Security's Federal Emergency Management Agency (FEMA) prepared this Environmental Assessment (EA) for the proposed construction of retention basins with sufficient capacity and other drainage elements to resolve frequent flooding in the City of Radcliff, Hardin County, Kentucky through a Hazard Mitigation Grant Program (HMGP) project under sub application number DR-KY-HMGP-1818-0012. FEMA provides HMGP funds to help protect people's lives, health, safety, and improved property.

In accordance with 44 CFR Part 10, FEMA Implementing Procedures, this EA has been prepared pursuant to Section 102 of the National Environmental Policy Act (NEPA) of 1969 (42 USC § 4332) and as implemented by the regulations promulgated by the President's Council on Environmental Quality (CEQ) (40 CFR parts 1500-1508). The purpose of the EA is to analyze the potential environmental impacts of the proposed action, and to determine whether to prepare an Environmental Impact Statement (EIS) or a Finding of No Significant Impact (FONSI).

Purpose for Executive Orders 11988 & 11990:

Presidential Executive Orders 11988 and 11990 require all federal actions in or affecting the floodplain or wetlands be reviewed for opportunities to relocate, and evaluate for social, economic, historical, environmental, legal and safety considerations.

Proposed location and scope of work for the Environmental Assessment and E.O. 11988:

The project area encompasses two major thoroughfares in the City of Radcliff (City) – South Wilson Road and U.S. Route 31-W. These two roads carry a combined total of approximately 33,790 vehicles per day through the City. The City is adjacent to the U.S. Army's Fort Knox Military Base and most of the incoming and outgoing traffic from the base travels through the City on U.S Route 31-W and South Wilson Road. U.S. Route 31-W is also the major thoroughfare for Hardin County. Repetitive flooding from heavy rains (up to the 1.0 inch storm event) overtops South Wilson Road, causing closure of the road, trapping residents in homes, and causing the re-routing of 4,590 vehicles per day. Flooding from a very large rain event (i.e. 1% chance storm event) will overtop U.S Route 31-W, causing the re-routing of approximately 29,200 vehicles per day and flooding many structures in the area. In 1997, 54 homes and commercial businesses in the area were flooded from a 1% chance flood event. The processes for reviewing alternatives for this project are further detailed in the EA.

Comment Period:

Comments are solicited from the public; local, state or federal agencies; and other interested parties in order to consider and evaluate the impacts of the proposed project and to participate in the process of identifying alternatives and analyzing their impacts. The EA is available for public review at the Radcliff City Hall located at 411 West Lincoln Trail Boulevard, Radcliff, Kentucky 40160 and online at:

<https://www.fema.gov/environmental-planning-and-historic-preservation-program/environmental-documents-public-notices-1>

If you have any questions about the project, or wish to receive a copy of the drawings, requests can be made to the contact below or via e-mail to: FEMA-R4EHP@fema.dhs.gov.

Comments should be made in writing within 15 days of this notice to the contact and address listed below or via email to: FEMA-R4EHP@fema.dhs.gov.

Regional Environmental Officer
DHS/Federal Emergency Management Agency, Region 4
3003 Chamblee-Tucker Road, Hollins Bldg.
Atlanta, GA 30341