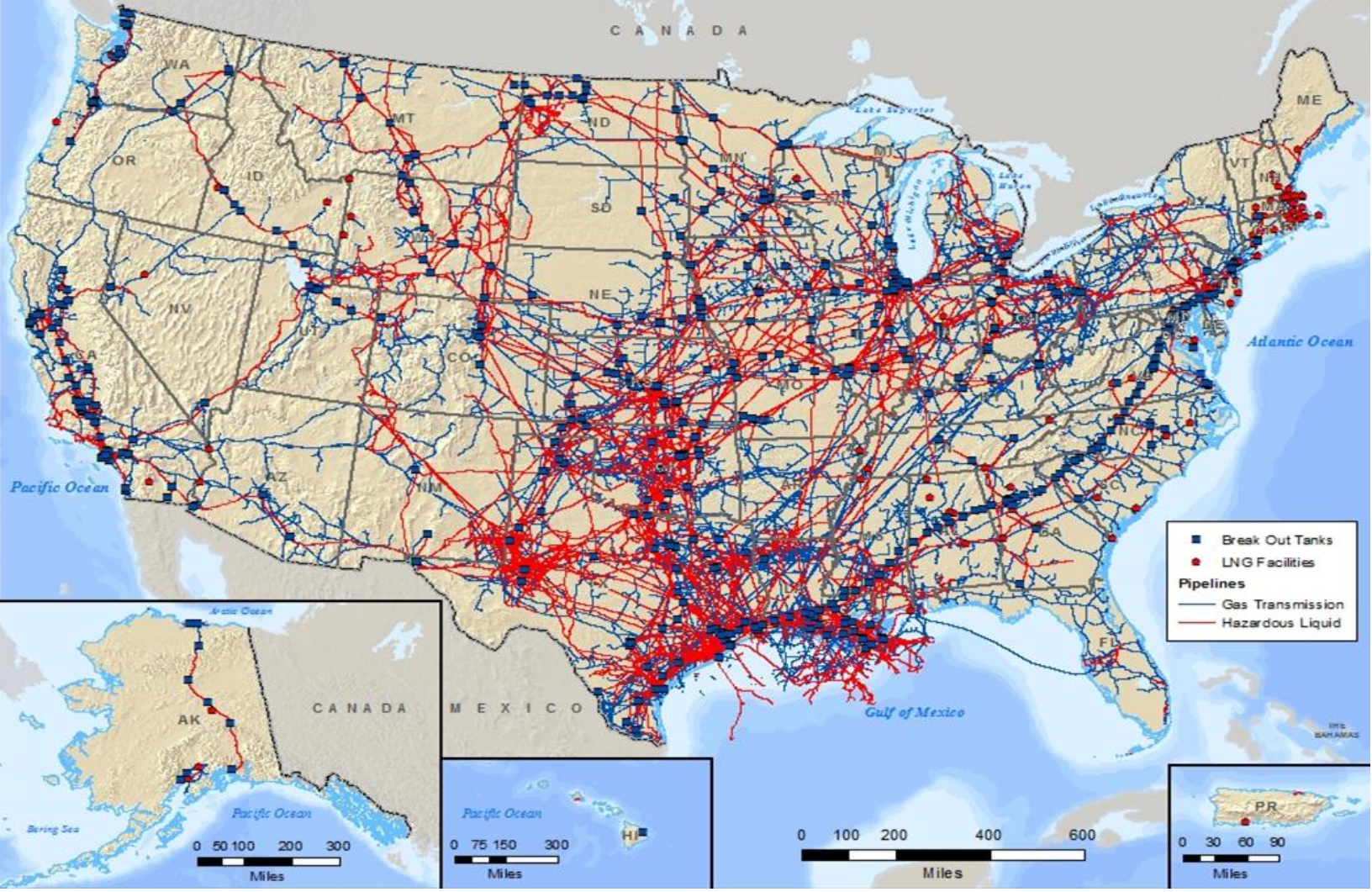

Hazard Mitigation Planning:

Practices for Land Use Planning and Development near Pipelines

2015

FEMA

U.S. Department of Transportation

Pipeline and Hazardous Materials Safety Administration

Hazard Mitigation Planning:
Practices for Land Use Planning and Development near Pipelines

Prepared by the Pipelines and Informed Planning Alliance (PIPA)

Sponsored by the U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA) and the U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA)

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Pipelines and Informed Planning Alliance

PIPA-info.com

On the cover: Map of the United States showing gas transmission pipelines and hazardous liquid pipelines. Projection: Albers Equal Area Conic, December, 2014. Source: United States Department of Transportation, Pipelines and Hazardous Materials Safety Administration (PHMSA), National Pipeline Mapping System (https://www.npms.phmsa.dot.gov/).

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List of Acronyms

API – American Petroleum Institute

BL – baseline

CATS – Community Assistance and Technical Services

CFDA – Catalog of Federal Domestic Assistance

CFR – Code of Federal Regulations

CNW – commercially navigable waterways

CPUC – California Public Utilities Commission

DOT – Department of Transportation

FEMA – Federal Emergency Management Agency

FERC – Federal Energy Regulatory Commission

GAO – Government Accountability Office

GIS – geographic information system

HCA – high consequence area

ICC – International Code Council

ND – new development

NFIP – National Flood Insurance Program

NGL – natural gas liquids

NPMS – National Pipeline Mapping System

NTSB – National Transportation Safety Board

PDF – portable document format

PG&E – Pacific Gas & Electric

PHMSA – Pipeline and Hazardous Materials Safety Administration

PIMMA – Pipeline Information Management Mapping Application

PIPA – Pipelines and Informed Planning Alliance

PSIG – pounds per square inch gauge

ROW – rights-of-way

RP – recommended practice

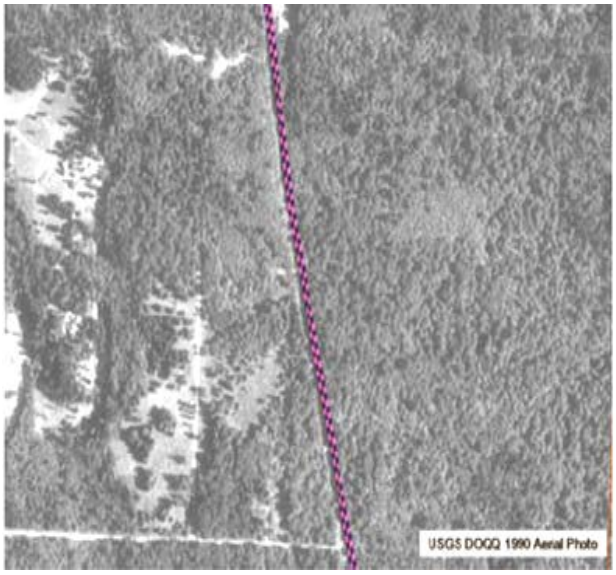
USC – United States Code

Foreword: Recommended Practices for Pipelines and Hazard Mitigation Planning

Hazardous liquid and gas transmission pipelines run through nearly 2,800 of the 3,141 counties in the United States. Pipelines transport hazardous materials that, when released, can pose a significant threat to people as well as the built and natural environment near the pipeline. Pipeline failures are characterized as low-probability, high-consequence events. They do not happen often; however, the residents of any community that have experienced a significant pipeline failure are likely, in retrospect, to wish they had become more aware of the pipeline and informed of the potential risk.

How well do you understand the risks of potential pipeline incidents in your community? One way communities can understand and influence the risks of pipeline failures is through appropriate land use and development policies and practices. Land development in close proximity to hazardous liquid and gas transmission pipelines increases the likelihood of damage to the pipelines and the potential for impact to the community from a pipeline failure. Additionally, without appropriate planning, land development can impede access needed for the safe operation and maintenance of the pipeline and for emergency response in the event of a pipeline accident. Figure 1 illustrates how expanding suburban land development into previously rural areas brings people and pipelines into close proximity.

1990 - Undeveloped land around pipeline



2002 - Same land, developed

Figure 1: Development near a Transmission Pipeline in Washington State 1990-2002
(Sources: U.S. Geological Survey (left) and National Geospatial Intelligence Agency (right))
(U.S. GAO Report, GAO-12-388, Pipeline Safety, March 2012)

Transportation of hazardous liquids and gas by pipeline is safeguarded through many layers of protection designed to prevent and mitigate the consequences of pipeline incidents. These layers of protection begin with established and proven pipeline design, manufacturing, and construction standards before any pipe is placed in the ground. They can include State and local requirements related to land use. They also include Federal regulatory requirements[1] for pipeline operators to rigorously monitor, inspect, maintain, and protect their pipelines. Under those regulatory requirements, pipeline operators develop and maintain management practices to assure the integrity and safe operation of their pipelines. Pipeline operators also document that personnel working on pipelines are qualified to perform the work, recognize abnormal conditions, and respond appropriately to protect life and property.

In densely populated and other high-consequence areas (HCA), pipeline operators take additional protective measures as necessary, including providing extra depth of cover over the pipe, establishing lower allowable operating stress levels, and monitoring. As the Federal agency primarily tasked with regulating the safety of gas and hazardous liquid pipelines, the U.S. Department of Transportation (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA) continually evaluates pipeline operator inspection and accident data to determine when operational practices and requirements need to be enhanced or when other corrective actions must be taken.

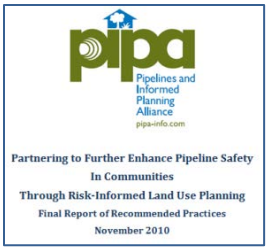
Public awareness and education is another important layer of pipeline safety. Pipeline operators develop and implement public awareness programs to communicate with key stakeholders, including the public, emergency officials, local public officials, and excavators. Operator public awareness programs inform these stakeholders about the potential hazards associated with the materials transported by the pipelines in their neighborhoods, and how to recognize, respond to, and report pipeline accidents.

However, even with these layers of protection, pipeline accidents still occur and, in some cases, impacts to a community can be overwhelming.

This document provides a framework for State, local, and tribal governments to utilize the hazard mitigation planning process to examine ways, through their own authorities, to further reduce the risks to their communities associated with hazardous liquid and gas transmission pipeline failures. The authority to prescribe safety standards for transportation pipelines and pipeline facilities generally falls to PHMSA, and the authority to regulate and enforce pipeline operators falls to both PHMSA and its State partners. However, local governments can use their land use and development authorities to influence what, where, and how to build near existing transmission pipelines and to implement hazard mitigation strategies.

[1] Title 49, Code of Federal Regulations, Subtitle B, Chapter 1, Subchapter D, Parts 190-199.

In response to the Pipeline Safety Improvement Act of 2002[2], the Pipelines and Informed Planning Alliance (PIPA) was formed by PHMSA to develop recommended practices on land use and development near transmission pipelines to reduce the potential risks of pipeline incidents. The PIPA effort involved over 130 stakeholders and culminated in 43 recommended practices published in the PIPA Report, *Partnering to Further Enhance Pipeline Safety In Communities Through Risk-Informed Land Use Planning: Final Report of Recommended Practices*[3] (*PIPA Recommended Practices*).



Following publication of *PIPA Recommended Practices*, the PIPA team, a group of representative stakeholders, began looking at ways to promote the recommended practices and encourage affected stakeholders to adopt and implement them. Through this effort the team became aware of State, local, and tribal hazard mitigation plans required under the Robert T. Stafford Act[4] and administered by the Federal Emergency Management Agency (FEMA).

The PIPA team, in coordination with PHMSA and FEMA, recognized that many of the PIPA recommended practices are, in effect, hazard mitigation strategies and determined that the PIPA recommended practices could be implemented by local communities into the framework of hazard mitigation plans. Mitigation is commonly defined as sustained actions taken to reduce or eliminate long-term risk to people, property, and the environment from hazards and their effects. Hazard mitigation focuses attention and resources on community policies and actions that will produce successive benefits over time. Hazard mitigation strategies include both structural measures, such as strengthening or protecting buildings and infrastructure from the destructive forces of potential hazards, and nonstructural measures, such as the adoption of sound land-use policies or the creation of public awareness programs.

Purpose

This document provides information to assist those involved with State, local, and tribal multi-hazard mitigation planning to identify policies, practices, and actions they can take to reduce risks associated with transmission pipeline failures. Transmission pipelines are constructed by pipeline companies for the transportation and distribution of gas and hazardous liquids. By the nature of the potentially hazardous products they carry, pipelines are a source of potential harm to a community, including the population, environment, private and public property and infrastructure, and businesses, and should be included in the lists of hazards that communities consider as part of their hazard mitigation planning process.

[2] H.R. 3609, 107th Congress, 2001-2002, Public Law 107-355, enacted on December 17, 2002.
[3] Review and download the PIPA Report at http://primis.phmsa.dot.gov/comm/pipa/LandUsePlanning.htm.
[4] Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), 42 U.S.C. 5165, and Title 44 Code of Federal Regulations (CFR) Part 201, as amended by the Disaster Mitigation Act of 2000 (DMA 2000 Public Law 106-390; and the Sandy Recovery Improvement Act of 2013, Public Law (113-2).

Pipelines are critical infrastructure that transport products used for motor and heating fuel, electrical power generation, commercial and industrial applications, and as feedstock for pharmaceuticals and consumer products. Virtually everything in the modern world is either made from oil derivatives or uses oil-based energy to produce it or transport it. Pipeline failures, by loss of the energy products they transport, can impact the local, regional, and national economy. As such, pipelines should be included in the development of hazard mitigation plans as critical infrastructure.

Natural hazards, in particular, can be threats to pipelines. Pipeline failures caused by natural forces result in proportionally more property damage relative to any other cause. The impact from natural hazards to pipelines should be considered in the risk assessment of natural hazards in hazard mitigation plans.

This guidance provides emergency managers, planners, and others with the information resources needed to support this effort, including: how pipelines operate, what hazardous materials are transported through pipelines, what are the causes and potential impacts of pipeline incidents, what is the pipeline safety regulatory structure, and how to find contact information for subject matter experts. This document also provides information to help perform a risk and capability assessment to support the development of a pipeline hazard mitigation strategy. This includes mitigation measures a jurisdictional government might consider including in its hazard mitigation plan to address pipeline hazards.

Pipeline safety is a common goal and a shared responsibility of all stakeholders. PHMSA is the Federal safety authority for ensuring the safe, reliable, and environmentally sound operations of our nation's pipeline transportation system. Through certification or agreement with PHMSA, State pipeline safety agencies may assume some of these responsibilities. PHMSA and most State pipeline safety agencies typically do not have any land use or development authority. State, local, and tribal governments establish land use ordinances, emergency management programs, building and fire codes, zoning and permitting requirements, excavation laws, and may have authority over the siting of certain new pipelines. Areas where State, local, and tribal governments, through their own authorities, can play important roles in developing planning and mitigation strategies to reduce the risks of pipeline failure hazards include:

(1) Pipeline identification and mapping,
(2) Pipeline knowledge and outreach,
(3) Pipeline land records,
(4) Facilitation of stakeholder communications,
(5) Land use and development planning management practices,
(6) Excavation damage prevention,
(7) Risk assessment and overall hazard mitigation planning processes, and
(8) Mitigation measures to address natural hazards.

FEMA Support for Multi-Hazard Mitigation Planning

Hazard mitigation is also a common goal and shared responsibility of all stakeholders. FEMA is the Federal agency responsible for implementing the hazard mitigation planning provisions, under Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended. This provides the legal basis for State, local, and Indian tribal governments to undertake a risk-based approach to reducing risks from natural hazards, through mitigation planning, and makes the development of mitigation plans a condition of receiving certain types of non-emergency grants.

The Stafford Act specifically requires mitigation planning for natural hazards, but not for technological hazards. However, FEMA supports those jurisdictions that choose to consider technological hazards as part of a comprehensive hazard mitigation strategy in their respective mitigations plans. FEMA's How-To Guide # 7, "Integrating Manmade Hazards into Mitigation Planning" (FEMA 386-7)[5], assumes that a community is engaged in the mitigation planning process and serves as a resource to help the community expand the scope of its plan to address technological threats and associated hazards.

Figure 2: Hazard Mitigation Planning Process
(Source: http://www.fema.gov/hazard-mitigation-planning-overview)

Scope

PIPA Recommended Practices and this document were developed for stakeholder use and information in consideration of the risks associated with land use and development near existing hazardous liquid and gas transmission pipelines. *PIPA Recommended Practices* is not intended to apply to production, gathering, and distribution pipeline systems.

[5] FEMA's Multi-Hazard Mitigation Planning Guidance can be helpful in developing and evaluating plans that include these hazards. See How-To Guide # 7 (FEMA 386-7), http://www.fema.gov/library/viewRecord.do?id=1915

PIPA Recommended Practices may not be appropriate for consideration in the siting of new pipelines. There is an extensive network of Federal and State regulatory and judicial processes involved with the evaluation and approval of new transmission pipeline siting and construction. These are beyond the scope of *PIPA Recommended Practices*. Additionally, *PIPA Recommended Practices* does not specifically address environmental resource conservation issues in pipeline rights-of-way.

At the Federal level, PHMSA is not authorized to prescribe the location or routing of any pipeline facilities[6]. The Federal Energy Regulatory Commission (FERC) approves the siting of new interstate natural gas pipelines through a Certification of Public Convenience and Necessity[7]. For more information about the FERC process, see www.ferc.gov/for-citizens/citizen-guides.asp. Several states have agencies charged with siting various energy facilities; in some instances that includes intrastate pipelines. If the state has no agency in charge of pipeline siting, then the responsibility falls to the regular land use authority of local governments along proposed pipeline routes. Check with your state's pipeline safety regulator to find out if your state has an energy facility siting agency and whether it has authority over pipeline siting decisions.

There is typically no Federal permitting process for the routing of interstate hazardous liquid pipelines. If a hazardous liquid pipeline crosses a U.S. international border, then the U.S. State Department takes the lead in the pipeline siting process, similar to FERC's role in siting gas transmission pipelines. However, if the hazardous liquid pipeline does not cross an international border, then the responsibility for approval of the pipeline route falls on the individual states. If the state has no agency in charge of pipeline siting, then the responsibility falls to the regular land use authority of local and tribal governments along the proposed pipeline route.

Local and tribal governments have sought to enact additional mitigation strategies that are outside the scope of *PIPA Recommended Practices*. Several examples of these strategies are provided as case studies in the appendix to this document. They include: (1) local government attempts to regulate pipeline safety standards and (2) differences in the application of the use of eminent domain.

[6] 49 USC § 60104 - Requirements and limitations e) Location and Routing of Facilities
[7] From PST Landowners Guide

Step 1: Organize the resources needed to incorporate potential hazards resulting from gas transmission and hazardous liquid pipeline failures into the existing mitigation planning process. Identify and organize interested members of the community and technical expertise necessary during the planning process.

Organize Resources

Educational Material

- **PIPA Recommended Practices** (www.PIPA-Info.com)

  Throughout this guide, references to pertinent information provided in *PIPA Recommended Practices* are shown by "RP" and the practice number (e.g. RP BL01). Within *PIPA Recommended Practices*, the individual recommended practices are grouped and labeled into one of two scenarios:

  - Baseline (BL) Recommended Practices – These practices should be implemented by stakeholders in preparation for future land use and development.
  - New Development (ND) Recommended Practices – These practices should be implemented by stakeholders when specific new land use and development projects are proposed.

  Also, within *PIPA Recommended Practices*, each recommended practice includes the practice title, a brief practice statement, the stakeholder audience intended to take action to implement the practice, practice details, and references, if applicable.

- **Pipeline Risk Report** (www.PIPA-Info.com)

  The report, *Building Safe Communities: Pipeline Risk and its Application to Local Development Decisions*, was prepared by PHMSA to assist local governments and developers in better understanding potential pipeline risks and to provide a context for the use of *PIPA Recommended Practices*.

- **PHMSA Stakeholder Communication Website** (http://primis.phmsa.dot.gov/comm/)

  PHMSA's Stakeholder Communications website contains a vast amount of information about pipelines. Links to specific information are provided throughout this guide.

- **PIPA Website and Local Government Toolkit** (www.PIPA-Info.com)

  The PIPA Communication Team developed various tools to assist local governments with understanding and implementing PIPA recommended practices.

- **National Pipeline Mapping System (NPMS)** (www.npms.phmsa.dot.gov)

  The NPMS is a geographic information system (GIS) that depicts the national network of gas transmission and hazardous liquid pipelines. RP BL01, *Obtain Transmission Pipeline Mapping Data*, encourages local governments to obtain online access to maps of hazardous liquid and gas transmission pipelines and to incorporate them into their own GIS. NPMS data should be considered no more accurate than +/- 500 feet. Operators may be able to provide more information about the accuracy of their maps in the NPMS and may be able to provide more accurate maps.

  It is recommended that local government agencies establish Pipeline Information Management Mapping Application (PIMMA) accounts to view transmission pipeline data sets at the county level. The application for a PIMMA account is available online. Access to PIMMA allows local government users to view transmission pipeline maps and pipeline attributes for transmission pipelines within their areas of jurisdiction. They may also create or print maps in the Adobe portable document format (PDF). Local government agencies can also request pipeline GIS data in Esri[8] shape file format for transmission pipelines within their areas of jurisdiction.

  The NPMS Public Viewer is available to the general public. It allows users to view pipeline maps for a user-specified state and county, but does not offer as many attributes or as large a scale as the password-protected PIMMA viewer does. Pipeline operator contact information is also available in the NPMS and the PIMMA.

- **FEMA How-To Guide #7** (http://www.fema.gov/media-library/assets/documents/4528)

  This FEMA guide, *Integrating Manmade Hazards into Mitigation Planning (FEMA 386-7*), serves as a resource to help communities engaged in the mitigation planning process expand the scope of their plans to address potential technological hazards.

- **Landowner's Guide to Pipelines** (http://pstrust.org/about-pipelines1/landowners-guide-to-pipelines)

  Landowner's Guide to Pipelines is published by the Pipeline Safety Trust. It is intended to provide landowners with basic information about pipeline systems, how pipelines are operated and regulated, what rights and responsibilities a current or future landowner with a pipeline on the property may have, and where to find more information.

- **Pipeline Operators Developer's Handbooks**

  Many pipeline operators produce developer's handbooks and have them available on their websites.

[8] Esri is an international supplier of GIS software, web GIS and geodatabase management applications.

- **Examples of Existing Land Planning Ordinances and Codes** (http://pstrust.org/trust-intiatives-programs/planning-near-pipelines/planning-ordinances)

  The Pipeline Safety Trust website has links to a sampling of ordinances, codes, and other guidance passed in recent years by local and State governments because of concerns regarding development near pipelines.

Planning Team

- **Pipeline Operators** can also be a valuable source of technical information. Those with pipelines in your area can be identified through the NPMS. Pipeline operator contact information may also be available via the PHMSA Community Assistance and Technical Services (CATS) Managers. Additionally, aboveground pipeline markers provide the name and contact information of the company that operates the pipeline.

  RP BL03, *Utilize Information Regarding Development around Transmission Pipelines,* encourages pipeline operators to provide information about transmission pipeline characteristics and associated potential hazards to local governments to enable them to make risk-informed decisions on proposed developments and/or development plans in relation to the pipeline risks. This information is needed to determine specific distances from pipelines where local governments should consider mitigation strategies. Pipeline operators can provide support for modeling fire, explosion, or toxic release impacts that could occur during a transmission pipeline incident for the specific type of land developments covered in RP ND17, and in RP ND19 through RP ND22.

  Hazardous liquid and natural gas transmission pipeline operators are responsible for the safe operation and maintenance of their pipelines. These pipelines are subject to Federal pipeline safety regulations under 49 CFR Parts 190 through 199, administered either directly by PHMSA or by a State agency[9]. Pipeline operator responsibilities include taking actions to avoid pipeline damage or failure, such as: periodic testing and continued maintenance of transmission pipeline facilities, development of emergency plans, performance of leak surveys, continuing surveillance, encroachment mitigation and rights-of-way (ROW) patrolling, and the development and implementation of damage prevention and public awareness programs. Transmission pipeline operators frequently augment Federal regulatory requirements.

[9] While the federal government is primarily responsible for developing, issuing, and enforcing pipeline safety regulations, the pipeline safety statutes provide for states to assume intrastate regulatory, inspection, and enforcement responsibilities under an annual certification. If a state has a certified pipeline safety program, a State agency is responsible for conducting inspections of intrastate pipelines that lie entirely within a state's borders. For more information on federal/state authorities., see http://primis.phmsa.dot.gov/comm/Partnership.htm?nocache=8546

PIPA Recommended Practices frequently references pipeline operator public awareness programs. For public awareness programs, transmission pipeline operators must follow the Federal pipeline safety regulations (49 CFR 192.616, 49 CFR 195.440), which incorporate by reference the general program recommendations of the American Petroleum Institute (API) Recommended Practice (API RP) 1162. Each operator's public awareness program must specifically include provisions to educate stakeholders including:

- the public,
- emergency officials (local, State, or regional officials, agencies, and organizations with emergency response and/or public safety jurisdiction along the pipeline route),
- public officials (local, city, county or State officials and/or their staffs having land use and street/road jurisdiction along the pipeline route), and
- persons engaged in excavation-related activities.

The message types they must deliver include:

1. Pipeline purpose and reliability
2. Awareness of hazards and prevention measures undertaken
3. Emergency preparedness communications
4. Potential hazards
5. Pipeline location information and availability of the NPMS
6. How to get additional information

They are also encouraged to provide the following supplemental messages:

7. Provide information and/or overview of integrity measures undertaken
8. Maintenance construction activity
9. If applicable, provide information about designation of HCA (or other factors unique to segment) and summary of integrity measures undertaken
10. ROW encroachment prevention

Under the Federal regulations, each operator's public awareness program must also include activities to advise affected municipalities, school districts, businesses, and residents of pipeline facility locations. The program and the media used must be as comprehensive as necessary to reach all areas in which the operator transports hazardous liquid or carbon dioxide. The program must be conducted in English and in other languages commonly understood by a significant number and concentration of the non-English speaking population in the operator's area.

- **Public/Citizens** – The public, including private landowners whose land is near transmission pipelines, must be made aware of the risks from potential hazards for efforts to initiate citizen involvement and partnerships to be effective. Many residents assume that current building codes, zoning regulations, subdivision review processes, and permitting will adequately protect them, but this may not be the case. Private landowners may be directly affected by new land use regulations that impose restrictions on development; therefore there may be

significant resistance to adoption of ordinances or other land development practices near transmission pipelines. Education and awareness should be an integral part of the planning process.

- **Developers** – Developers of residential or commercial projects (both large and small) and their professional development staffs (engineers, architects, surveyors, planners, etc.) are frequently direct landowners or have an ownership interest in properties crossed by or near transmission pipeline easements. Like the community, they may also be unaware of pipeline safety issues and may be directly affected by any new regulations that impose restrictions on land use and development.

- **Local Governments –** Local governments can wear different stakeholder "hats" related to land planning near transmission pipelines. They may own and develop land for public purposes, including land in close proximity to pipelines; some local governments own and operate municipal gas distribution systems. Local governments can also promulgate land use and development planning/permitting/zoning requirements.

  There is no national structured framework for regulating land use and development near existing pipelines. This is also complicated in that Federal regulations do not prescribe the size of pipeline rights-of-way, and pipelines may be installed in both public spaces and on private land. While development of the area within the pipeline ROW is typically regulated by agreements between pipeline operators and the public or private landowner, development of the area outside of the pipeline ROW, yet still close to the pipeline, can be influenced by local and State governments.

  Such influence can include enactment of planning, permitting, and zoning regulations and ordinances governing structures built near existing pipelines and establishment of permitting requirements directed at improving safety when developing around pipelines. However, it is considered that very few State or local governments use their land use and planning authorities to specifically address development encroachment on pipelines or to focus on health and safety concerns for populations located near pipelines. Use of land management tools to regulate development provides an increasingly important method for addressing these concerns, especially in areas with rapidly expanding urban footprints that have existing transmission pipeline infrastructure. This can be accomplished to a large extent by encouraging and adopting appropriate PIPA recommended practices, and by encouraging and adopting safe digging practices to prevent excavation damage to pipelines.

  Planners and emergency managers can create skilled collaborative teams for addressing mitigation of pipeline hazards. Emergency managers are often more familiar with locations of existing pipelines and pipeline risks than land use planners. In contrast, land use planners are more familiar with potential land management strategies that can address development encroachment on existing transmission pipelines. Collaboration between these two groups can provide an opportunity for building on the respective skills and knowledge bases these

two groups possess in order to improve community resilience to potential pipeline hazards and reduce risks from land use and development near transmission pipelines.

Communities use a variety of collaborative practices to meet their development management needs while addressing hazard mitigation concerns. Some create equal partnerships between emergency management and planners that build on and extend existing partnerships. Others use skill-specific collaborations that require coalitions created for the specific purpose of addressing hazard mitigation. Smaller communities regularly contract their hazard mitigation planning needs to larger emergency management and planning organizations, such as those in the nearest large urban area. These larger organizations are often more familiar with the potential hazard mitigation techniques, but may lack specific local knowledge.

Despite Federal preemption of pipeline safety regulation, local authorities typically have significant abilities to affect pipeline safety. Local governments have traditionally exercised broad powers to regulate land use and property development, including when in the vicinity of pipelines. Local governments may also have data that can assist pipeline operators in their own facility design and development plans, such as hazard and building data (e.g., where critical facilities and infrastructure are located).

- **U.S. DOT PHMSA**

  Congress sets the framework for pipeline safety regulations through the establishment of laws. The overarching pipeline safety statutes that Congress has passed can be found in U.S. Code, Title 49, Subtitle VIII, Chapter 601. Federal pipeline safety regulations are established under the U. S. Code of Federal Regulations (CFR), Title 49 "Transportation," Parts 190 - 199. The Office of Pipeline Safety, within the U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA), has overall regulatory responsibility for the safety of gas and hazardous liquid pipelines under its jurisdiction. However, there are certain types of pipelines that are outside the scope of PHMSA's Federal pipeline safety jurisdiction. PHMSA-regulated pipelines are defined by Federal regulations found in 49 CFR §191.1, §192.1, §192.8, §195.1, and elsewhere as referenced in those regulations.

  PHMSA Community Assistance and Technical Services (CATS) program managers are located within each PHMSA region. Their mission is to advance public safety, environmental protection, and pipeline reliability by facilitating clear communications among all pipeline stakeholders, including the public, pipeline operators, and government officials. CATS contact information is available online at http://primis.phmsa.dot.gov/comm/CATS.htm, or by calling PHMSA headquarters at 202-366-4595.

- **State Pipeline Safety Regulators**

  Through certification from PHMSA, states can assume pipeline safety responsibilities for *intrastate* gas and/or hazardous liquid pipelines. Intrastate facilities may include gas distribution, gas transmission and hazardous liquid transmission pipelines, as well as

gathering lines, storage fields, and liquefied natural gas facilities. Although gas distribution pipelines are outside the scope of *PIPA Recommended Practices*, the majority of natural gas distribution pipelines are inspected, and much of the enforcement for applicable safety regulations for those pipelines is performed through State regulatory agencies.

States with certification can impose pipeline safety regulations that are more stringent than Federal regulations for intrastate pipelines, but only PHMSA can issue and enforce safety regulations for interstate hazardous liquid and gas transmission pipelines. Through signed agreements, some states assume responsibility for the inspection of *interstate* gas and/or hazardous liquid pipelines. PHMSA's Stakeholder Communications website provides information regarding State pipeline safety regulatory agencies.
http://primis.phmsa.dot.gov/comm/States.htm

Hazardous liquid and natural gas transmission pipelines are part of our nation's critical transportation infrastructure. Because of the important role that pipelines play, additional security considerations are associated with them.[10] Although much information about pipelines is publically accessible, certain security-related and/or proprietary information about pipelines and information that cannot be shared with the public may be needed for emergency managers to make informed decisions during the mitigation planning process. Access to such needed information will require discussions with the pipeline operators to the extent that access to the information is not required by existing regulations.

[10] See Public Law 107-56 USA Patriot Act 2001

Step 2: Identify the characteristics and risks of potential hazards resulting from pipeline failures. It is important to understand how much of the community can be affected by specific hazards, what the potential impacts would be on important community assets, and what the likelihood would be of these events occurring.

Assess Risks

The risk assessment process provides the foundation for the rest of the mitigation planning process. This section provides the following information to support a risk assessment within a hazard mitigation framework:

1) Identify the characteristics of pipelines and pipeline hazards,

2) Profile hazard events, and

3) Identify the likelihood and potential consequences of a pipeline event.

Identify Characteristics of Pipelines and Pipeline Hazards

Pipelines are extremely important to our social and economic well-being, as well as our national economy and security. There are over 2.5 million miles of pipelines in the United States. Our national pipeline infrastructure consists of various types of pipeline systems, both onshore and offshore, including approximately 175,000 miles of hazardous liquid pipelines, 321,000 miles of gas transmission and gathering pipelines, and 2.06 million miles of natural gas distribution pipelines. Additionally, there are 114 active liquefied natural gas plants connected to our gas transmission and distribution systems, and various propane distribution system pipelines.

Figure 3 depicts the complexity and breadth of gas transmission and hazardous liquid pipelines in the U. S.

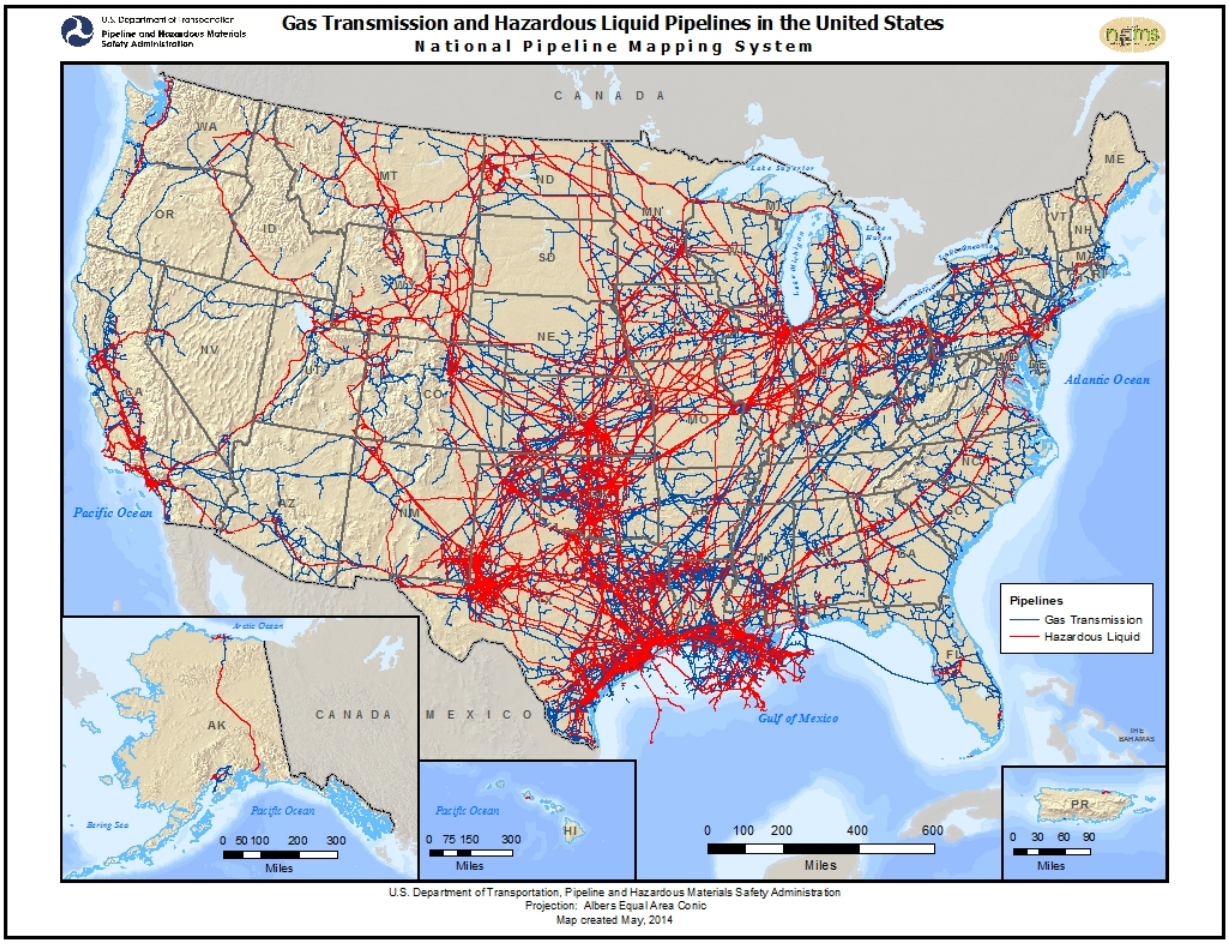


Figure 3: Gas Transmission and Hazardous Liquid Pipelines in U. S.
(Source: U.S. DOT PHMSA, National Pipeline Mapping System)

Pipelines are the safest practical mode for transporting and distributing the tremendous volumes of energy products that we use on a daily basis across our country. A large pipeline can transport roughly two million barrels of gasoline a day. However, like any industry that deals with hazardous materials (hazmat), there is always a potential for risk – ***pipeline accidents do occur, and the impacts to the community can be devastating.***

Under Federal pipeline safety regulations (49 CFR Sections 192.3 and 195.2), a pipeline system is defined as all parts of a pipeline facility through which a hazardous liquid or gas moves in transportation, including piping, valves, and other appurtenances connected to the pipeline, pumping units, fabricated assemblies associated with pumping units, metering and delivery stations, and storage and breakout tanks. Although typically located underground, pipelines may also be located aboveground in various places where operational considerations, such as at pump and compressor stations, or where other conditions, such as harsh environment or geological concerns, make it impracticable for the pipe to be underground.

Categorizing pipelines

Pipelines can be categorized in several ways: by the products they carry, by their function, and by whether they cross the boundary from one state to another.

Categorizing pipelines by the products they carry:

- Gas pipelines carry natural gas and other gases that are flammable, toxic, or corrosive, such as vaporized liquefied petroleum gases (i.e., propane and butane), ethylene, and propylene. Natural gas is the predominant gas transported by and associated with pipelines.
- Hazardous liquid pipelines carry crude oil and refined petroleum products such as gasoline, natural gas liquids, and diesel and jet fuel. Ammonia and liquid carbon dioxide are also considered hazardous liquids and are also transported by hazardous liquid pipelines. A hazardous liquid pipeline can transport batches of different types of refined petroleum. The pipeline operator schedules and tracks the customer's batch or product through the pipeline, including tracking the product being transported, the volume of the product, where it is being transported from and to, and the owner of the product.

Categorizing by function:

- Gathering pipelines transport gas and crude oil away from the points of production (i.e., wellheads) to facilities for processing or refinement or to transmission pipelines.
- Transmission pipelines move gas and hazardous liquids long distances, often across state lines and at high pressures.
- Distribution pipelines are generally smaller lines that take natural gas from transmission pipelines and deliver it to individual homes and businesses. Distribution pipeline systems operate at much lower pressures than transmission pipelines. Distribution pipelines are not associated with hazardous liquids; distribution of hazardous liquids is accomplished via other transportation modes.

Categorizing by *intrastate* versus *inter*state

- *Intra*state pipelines are operated entirely within one state and do not cross state boundaries. However, some pipelines that cross state boundaries may be classified as intrastate if the pipeline ownership changes at the state line.
- *Inter*state pipelines transport products across state boundaries.

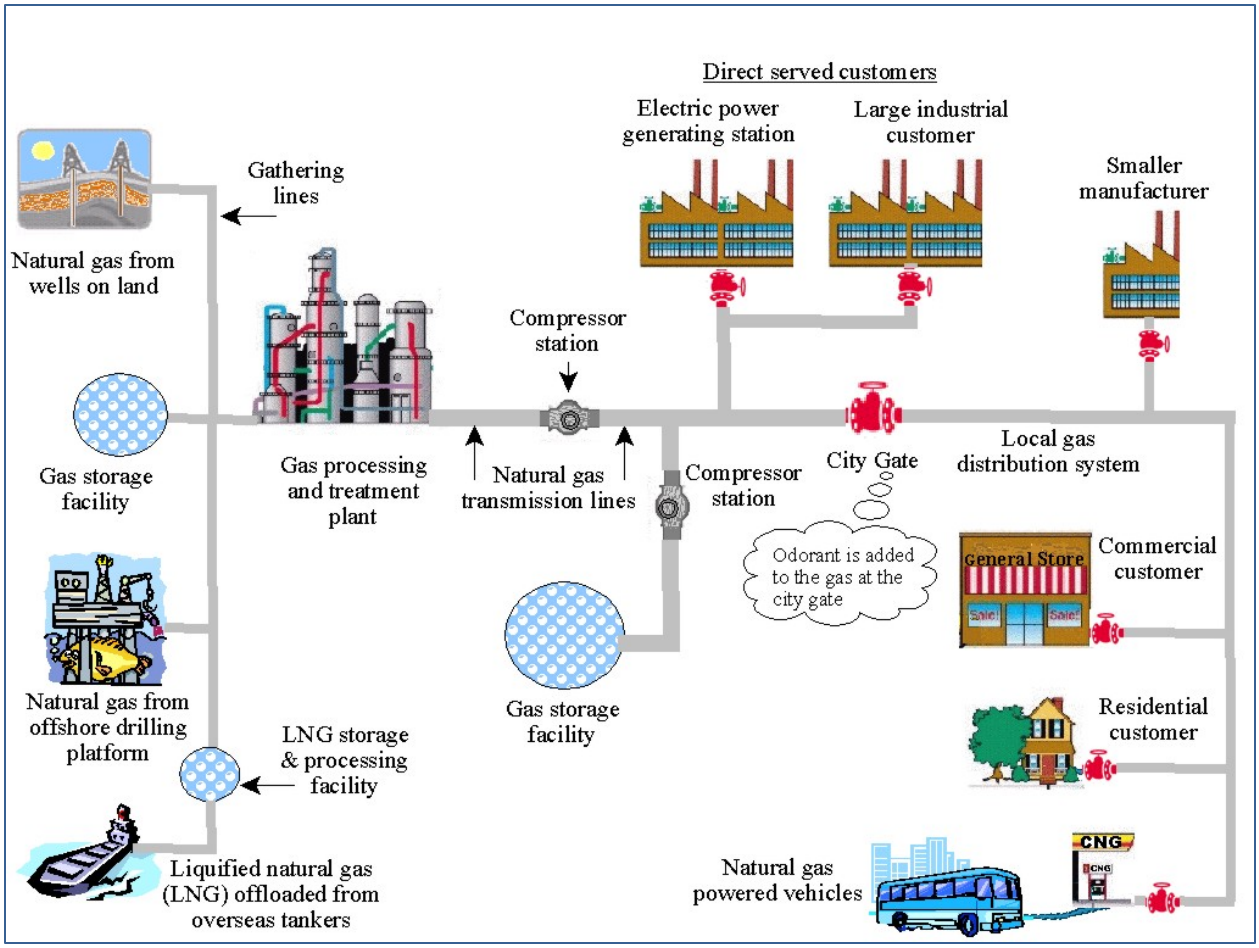


Figure 4: Natural gas pipeline system from production to end user
(Source: U.S. DOT PHMSA)

How Pipelines Work

Gas and hazardous liquid pipelines work basically in the same way. Stated simplistically, a product is put into the pipeline, pressure is applied by some type of pump, and the product is forced to flow toward an area of lower pressure. Flow is maintained until the product reaches its destination. Along the way, pressure is lost due to friction and heat; booster pumps (hazardous liquid) or compressors (natural gas) located along the pipeline are used to boost the pressure and keep the product flowing. Mainline pipelines vary in size from 8” up to 48” but are typically between 24”-36” in diameter.

Various system components such as valves, storage tanks, metering stations, and city gate stations are used to direct, control, and measure product flow. Products are extracted or removed from the pipeline at their destinations, where the products are stored, transferred to alternate transportation modes, or consumed.

Gas pipelines only transport a single gas product. The majority of gas pipelines transport natural gas.

The majority of hazardous liquid pipelines transport either crude oil or refined petroleum products. Crude oil pipelines transport crude oil from oilfields to refineries where the oil is processed into dozens of useful products. From the refinery, the refined products are transported through pipelines to terminals or local distribution centers. A refined products pipeline can transport dozens of products and grades of gasoline at a time through a process called "batching" as seen in Figure 5. When a customer's batch reaches a defined delivery point, the product is then placed into a storage tank. Petroleum products move through a pipeline at speeds between 2.5 to 5.0 mph. It takes about two weeks for a gallon of gasoline to travel from a Gulf Coast refiner to New Jersey.

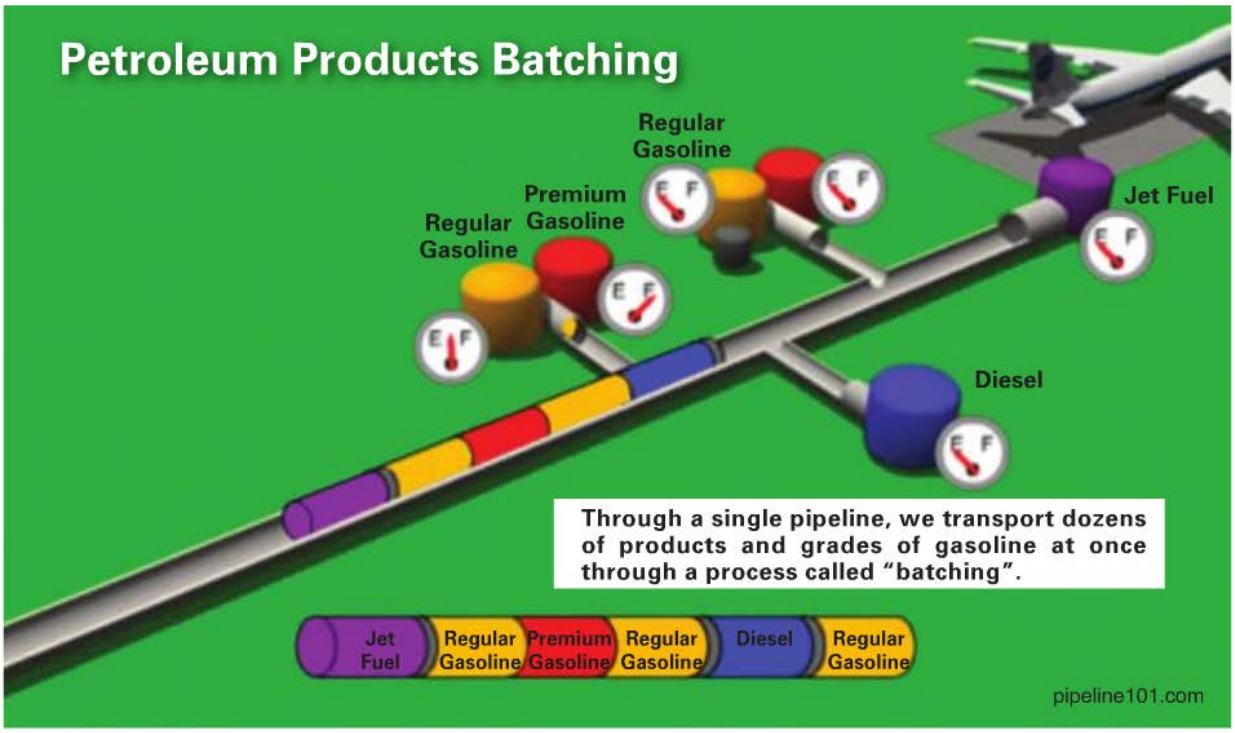


Figure 5: Batching of Refined Petroleum Products
(Sources: U.S. DOT and National Association of State Fire Marshals, *Pipeline Emergencies*, 1st ed.)

Following are descriptions of key components of pipeline systems that may be located in your community.

Transmission Pipeline Rights-of-Way

A transmission pipeline rights-of-way (ROW) is a relatively narrow, unobstructed strip of land, and is typically established through acquisitions, by the pipeline operator, of easements or permits that provide the operator the rights to construct, operate, and maintain the pipeline along contiguous properties. The width of a pipeline ROW can vary from a few to hundreds of feet. There may be one or more pipelines located in a single ROW. Additionally, the pipeline can be located anywhere within the boundaries of an easement or ROW. Thus, it is important to always

notify the pipeline operator before digging in a pipeline ROW. This can usually be accomplished by calling 811 in accordance with the State damage prevention laws.

While a pipeline operator can control the types of activities that take place on its pipeline ROW through rights granted in easements, pipeline operators typically do not have authority over activities that take place outside of but near the ROW. However, activities both on and outside the ROW can potentially impact the integrity and safety of the pipeline and, consequently, can potentially impact areas outside of the ROW.

Property developers/owners and local governments should have an understanding of the elements of and rights conveyed in a transmission pipeline easement (RP BL07). Sometimes private and public easements overlap and an assessment is required to determine which easement takes priority. Local governments should be aware of these situations and contact the pipeline operator when they receive requests to work in joint easements.

Figure 6 illustrates a pipeline ROW with two underground pipelines represented by the dashed yellow lines. It illustrates a typical development that occurs as suburbs extend into rural areas. This transmission pipeline ROW is clearly defined yet blends with the surrounding area. The shed and playground equipment in the picture are outside the ROW, but the landowners are still able to enjoy use of the land.

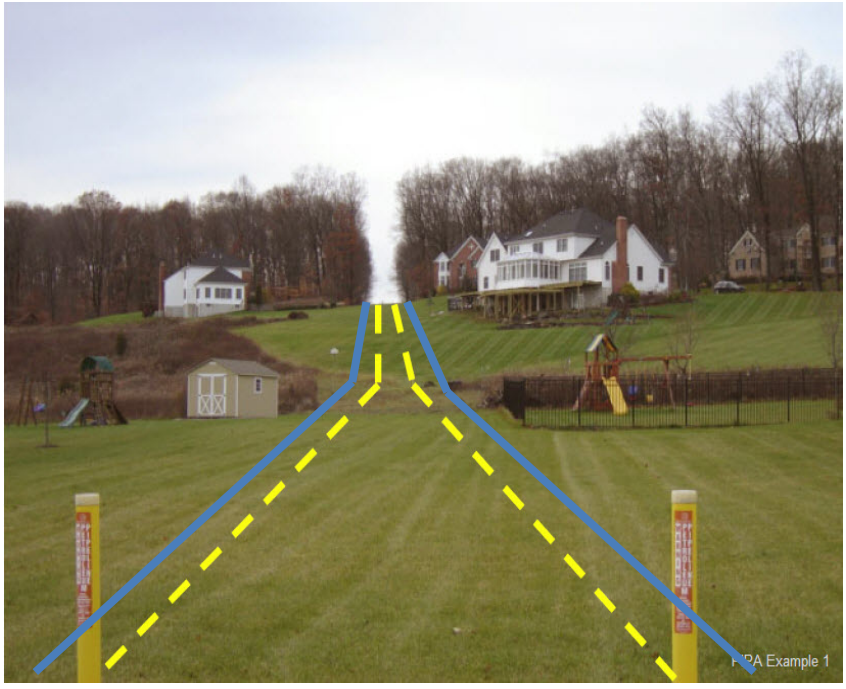


Figure 6: Pipeline ROW through rural area
(Source: *PIPA Recommended Practices*)

Appendix D of *PIPA Recommended Practices* provides guidance in determining the types of proposed land uses of a pipeline ROW that are typically acceptable or unacceptable to pipeline operators. Transmission pipeline operators should communicate in a documented and timely

manner with property developers/owners to prevent or rectify encroachments within a transmission pipeline ROW (RP BL13).

As development encroaches on previously rural areas, land for utilities may become scarce; therefore multiple utilities may share a single utility corridor. Figure 7 illustrates a pipeline corridor shared with an electric utility and an asphalt walking path. In shared ROW space, the need for coordination increases among various stakeholders.

Figure 7: Pipeline corridor shared by electric utility and walking path
(Source: *PIPA Recommended Practices*)

Transmission pipelines ROW have the potential to be utilized for the benefit of the community and/or the property developer/owner while still maintaining the safety and integrity of the transmission pipeline facilities. Property developers/owners and local governments should work with the pipeline operators to explore possible uses of the property. These could include utilizing the transmission pipeline easement to create green spaces, parks, golf courses, hike and bike trails, horse trails, and other recreational spaces (RP ND08).

After a transmission pipeline is installed, the pipeline ROW is maintained by the pipeline operator to allow for inspection and to enable maintenance and repairs. Extensive landscaping or other obstructions can impede the operator's inspection of and access to the pipeline. Some vegetation clearing is usually necessary within the ROW for safety and/or access. Pipeline operators should notify stakeholders of ROW maintenance activities (RP BL12).

Access to a pipeline ROW and the type of vegetation in and near the ROW are important considerations when new development near the ROW is being planned. Trees and other vegetation should be planned and located to reduce the potential of interference with transmission pipeline operations, maintenance, and inspections (RP ND15).

Pump and Compressor Stations, Breakout Tanks, and Tank Farms

Pumps and compressors provide the force and pressure to move liquid and gas products through a pipeline system. Pump stations and tank farms are commonly associated with hazardous liquid pipelines; compressor stations are associated with gas pipelines. Generally only line-pipe and associated appurtenances are located within a pipeline ROW. Tank farms and pump and compressor stations are generally located on company-owned property off of the ROW.

Pump and compressor stations are placed at regular intervals along hazardous liquid and gas transmission pipelines (e.g., every 20 to 100 miles) as needed to sustain necessary pipeline pressures and flows. The number and power of pumps and compressors within a station are selected based on parameters such as the needed operating pressure, product type, distance, and elevations of the pipeline. They generally occupy from 15 to 40 acres of land.

Pumping stations may be attended or unattended. “Unattended” is a relative term – some pumping stations may be unattended only during off-shift hours, while others may be unattended for much longer periods. Unattended stations are typically monitored through the operator’s system control and data acquisition system, and equipment can be started, isolated or shut down either automatically or through remote actuation. For example, pumps may be designed to automatically shut down if abnormal operating conditions are detected, including high temperatures, low flow, excessive pressure, or high lubricating oil temperatures.

Breakout tanks are used to relieve surges or to receive and store hazardous liquids for later reinjection into the pipeline system for further transport. Tank farms are for the storage of crude oil and/or refined products. The storage of liquids is an important element in the pipeline system. Storage tanks are used along the pipeline to hold the refined products for delivery to a customer at a later date. The capacity of aboveground storage tanks or facilities can vary widely.

Aboveground transmission pipeline facilities, such as compressor stations, pumping stations, regulator stations, launcher/receiver stations, and other pipeline appurtenances may generate noise and odors. While these may not be initially noticed in some settings, they may be noticeable when land use is modified or a development is placed near the facility. These changes may place people in close proximity to the aboveground pipeline facilities for extended periods of time. Plans for land use and development should attempt to minimize exposures to these types of facilities (RP ND18).

Figure 8a: Hazardous liquid pumping station
(Source: Louisiana Department of Transportation and Development, http://www.dotd.la.gov/programs_grants/loop/)

Figure 8b: Gas transmission compressor station
(Source: U.S DOT PHMSA, *Introduction to Pipelines*)

Figure 8c: Hazardous liquid tank farm
(Source: U.S DOT PHMSA, *Introduction to Pipelines*)

Valves

Valves are critical and essential components for controlling the flow and pressure of product in a pipeline system. There are many types of valves used to control the rate of flow in a line, to open or shut down a line in an emergency or as needed for maintenance, or to serve as automatic pressure relief devices. Valves can be identified by type or by function. They may be manually actuated, automatic, or remotely controlled.

In the event of an emergency along a transmission line or large distribution line, remotely actuated isolation valves may be used to shut down the pipeline, or field operations personnel may have to respond and manually operate the valves. Mainline valves are positioned along a pipeline system every 2.5 to 20 miles apart. Valve assemblies typically require an area of approximately 2,500 square feet and an access road to enable operators to shut valves in a timely manner to minimize the impact (duration and volume of release) of a pipeline incident. Development plans should clearly indicate the access to transmission pipeline shutoff valves. Valve access routes should be coordinated with the transmission pipeline operators and should consider access to areas that may be locked or gated for security and privacy purposes (i.e., private or gated communities, secured facilities, etc.) (RP ND23).

Figure 9: Aboveground Valve on Natural Gas Pipeline
(Source: Argonne National Laboratory. Managed and operated by UChicago Argonne, LLC, for the U.S. Department of Energy under Contract No. DE-AC02-06CH11357)

City Gate Stations

A city gate station is typically operated by a municipality or local gas utility company and interconnects the gas transmission pipeline with a local gas distribution system.

City gate stations are composed of arrays of valves, pipes, and pressure reduction devices designed to meter and heat the gas prior to reducing its pressure so that it can be delivered safely to customers through distribution networks consisting of local gas mains, smaller-diameter service lines, and individual customer meters.

Odorant is typically added to the gas at a city gate station so that gas leaks can be detected by the human nose. As with compressor and pump stations, city gate station operations can result in noise, odor, and vibration that may be nuisances to adjacent development (RP ND18).

Figure 10: City gate gas measurement and regulating station
(Source: Argonne National Laboratory. Managed and operated by UChicago Argonne, LLC, for the U.S. Department of Energy under Contract No. DE-AC02-06CH11357)

Inline Tool Launchers/Receivers

Figure 11, below, shows a launcher/receiver station for inline tools. Inline tools are used to perform various maintenance and inspection operations on a pipeline. The tools are inserted into the pipeline through the launcher. The launcher is then closed and the pressure-driven flow of the product in the pipeline is used to push the inline tool through the pipe. Inline tools are removed from the pipeline at a downstream receiver trap.

Figure 11: Inline tool launcher/receiver
(Source: http://www.en.wikipedia.org/wiki/Pipeline_transport. From the Wikimedia Commons, a freely licensed media file repository.)

Figure 12, below, shows an inline tool being prepared for insertion into a launcher. Large diameter pipelines require larger inline tools and, subsequently, larger amounts of space to launch the tools. Inline inspection tool launcher/receiver facilities are usually smaller than pipeline pump stations or compressor stations and typically consist of one or more short sections of above-ground pipe, valves, and other control equipment, and may include buildings, generators, and storage areas. Inline tool launching and receiving facilities are normally fenced and surfaced with gravel.

Figure 12: Large diameter inline tool
(Source: Courtesy of Sempra Energy)

Pipeline Markers

Since pipelines are usually buried underground, line markers and warning signs are located at frequent intervals along transmission pipeline rights-of-way. They are also found where pipelines intersect streets, highways, railways or waterways, and at other prominent points along the ROW. Markers warn only that a transmission pipeline is located in an area; they do not depict and should not be used to determine the exact location of the pipeline. Markers also identify the product transported in the line, and provide the name of the pipeline operator and a telephone number to call in the event of an emergency.

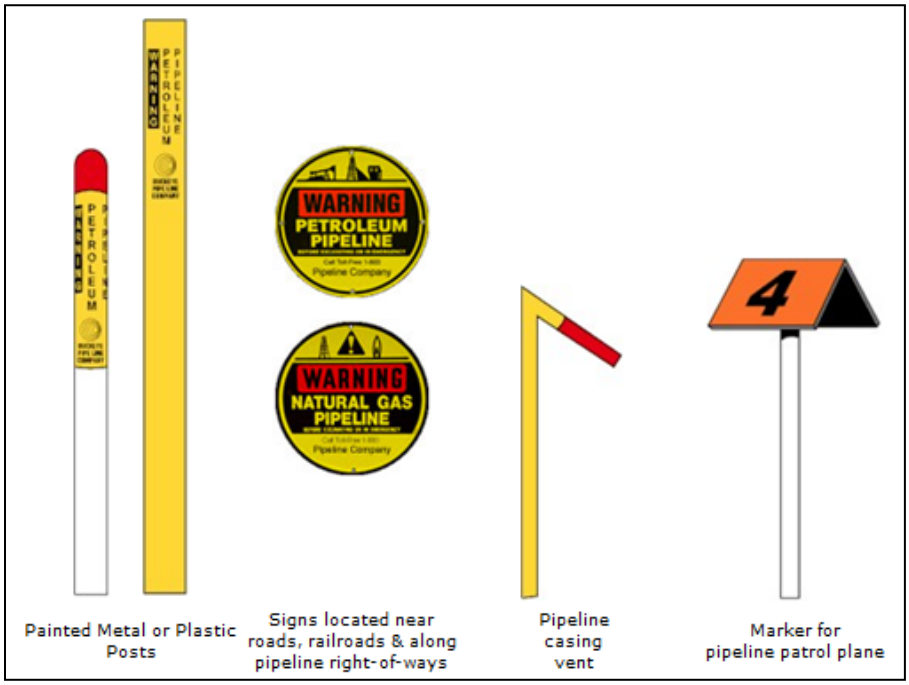


Figure 13: Pipeline markers
(Source: U.S. DOT PHMSA)

Pipeline Maintenance, Repair, and Replacement

Figure 14 shows a large diameter pipeline being repaired. Notice the amount of room needed for repair activities. A pipeline replacement project may require an even greater construction area.

Figure 14: Repair of large diameter pipeline, removal of rock
(Source: U.S DOT PHMSA)

Physical and Chemical Properties and Hazards of Products Transported by Pipeline

Understanding pipeline threats and potential hazards begins with knowing what materials are being transported and understanding their physical and chemical properties. Hazard mitigation planners should check with pipeline operators to determine what products are transported through the pipelines.

In general, larger pipelines operating at higher pressures carry more energy. The closer the pipeline is to people and the greater the inability of the pipeline operator to shut off the flow of the product swiftly, the greater the potential hazards and the potential severity of the consequences from a pipeline event.

Hazardous Liquids

Hazardous liquid pipelines may carry a variety of crude oil and refined petroleum products with widely varying physical and chemical properties. Material safety data sheets for specific products and emergency response guidebooks are good sources of information for determining the physical and chemical properties of hazardous liquids in pipelines.

Hazardous liquid pipelines transport products typically used for: transportation (gasoline, diesel fuel, kerosene, aviation gasoline, jet fuels, natural gas liquids (NGL)), heating fuels (heating oil,

liquid propane, liquefied natural gas, NGL), feedstock for consumer products (carbon dioxide, ethane, crude oil, NGL), and agriculture (anhydrous ammonia, diesel fuel).

Some things to know:

- Hazardous liquid spills can spread over land and water, flowing into valleys, ravines, and waterways. They present the potential for ecological damage and contamination of drinking water supplies to occur some distance from the point of initial release. Weather conditions and water temperatures greatly influence the behavior of oil and refined petroleum products in the environment.
- Oil spills can be controlled by chemical dispersion, combustion, mechanical containment, and/or adsorption. Spills may take weeks, months, or even years to clean up.
- Most refined petroleum products are highly fluid, often clear, spread rapidly over land or water surfaces, have a strong odor and a high evaporation rate, and are usually flammable. They penetrate porous surfaces such as dirt and sand. They do not tend to adhere to surfaces; flushing with water generally removes them. Volatile components (the strong smell from oil products) of oil can burn the eyes and skin and irritate the nose, eyes and mouth.
- Most crude oils are heavier and less toxic than refined petroleum products, but because they do not evaporate, they remain in the environment longer. They are characteristically viscous, sticky or tarry, and brown or black. Flushing with water will not readily remove spilled crude oils from surfaces, but the oil does not readily penetrate porous surfaces.
- Over time, crude oil, if allowed to weather and mix with dirt, may sink in water, making a swift response to an oil spill in water critical. In turbulent water, spilled crude oil is typically driven to the bottom of the river where it tends to stick to rocks, which can make clean-up more difficult.
- Crude oil pipelines may transport “sour” crudes with high concentrations of hydrogen sulfide, a colorless, very poisonous, and flammable gas with the characteristic foul odor of rotten eggs. Exposure to hydrogen sulfide, even in low concentrations, can cause death. The OSHA personal exposure limit for hydrogen sulfide is 10 ppm, and the immediately dangerous to life and health value is 300 ppm.
- Diluted bitumen is a form of crude oil that is extracted from bituminous sands (also known as “oil sands” or “tar sands”). These “sands” refer to a mixture of sand, water, clay, and bitumen (the heaviest of hydrocarbon mixtures found in crude petroleum).

  Bitumen extracted from tar sands is a heavy, sticky, viscous solid or semisolid form that does not easily flow at normal oil pipeline temperatures. Typically it is diluted through the addition of a diluent, such as natural gas condensates or naphtha, or chemically split before it can be transported by pipeline.

- Gasoline is a product of refined petroleum that is highly flammable and is easily ignited when released into air. At 10 percent of its lower explosive limit, the atmospheric concentration of gasoline vapors in air is 1,400 ppm. This is above the threshold limit value/time weighted average for toxicity, and should be regarded as an unsafe environment. Gasoline may contain various amounts of other refined products, such as benzene, or additives to alter its chemical properties.
- Distillates, such as diesel fuel and jet fuel, are combustible liquids but produce fewer vapors than gasoline. Diesel and jet fuel vapors are not easily detected with a combustible gas indicator due to their low vapor pressures.
- All refined petroleum products have vapors that are heavier than air and a specific gravity of less than 1.0. Vapors will collect in low areas, while spills will float on the surface of water. Spills and vapors may migrate long distances along waterways and low-lying terrain, and through drain tiles, sewers, or other conduits. Refined petroleum products have increased volatility when released under pressure as aerosols. Warm temperatures can increase the volatility of refined petroleum products.
- Liquefied gases that are lighter than air in their vapor state, such as anhydrous ammonia, can collect in low areas until the vapors "heat up" and rise. In addition, highly volatile liquids, such as propane, butane, and ethylene, will form a vapor cloud when released to the atmosphere and have vapor pressures exceeding 276 kilopascals (40 pounds per square inch absolute) at 37.8^{o}C (100°F). Their vapors may extend beyond any visible vapor cloud. Ethane, propane, butanes, and pentanes are also referred to as natural gas liquids.
- Anhydrous ammonia is a highly volatile liquid that is transported under pressure as a liquefied gas. If released, it will immediately return to a gaseous state and rapidly expand 850 times in volume. Anhydrous ammonia is highly toxic and corrosive. Its vapors are extremely irritating and may be fatal if inhaled, ingested, or absorbed through the skin. It is used as an agricultural fertilizer and as an industrial refrigerant. It can also be used in the illegal production of methamphetamine and as such can become the target of theft. Ammonia vapors have a sharp, pungent odor that may act as a warning to help prevent potentially dangerous exposures.

Natural Gas

Natural gas is the predominant product transported by gas pipelines. Natural gas is a clean-burning fuel that consists of approximately 94 percent methane, 4 percent ethane, and 2 percent other gases, including butane, carbon dioxide, nitrogen, and isopentane. It is widely used as a fuel for residential, commercial, and industrial purposes. Natural gas may also be used as a vehicle motor fuel when compressed in high-pressure cylinders.

Some things to know:

- Natural gas is odorless, colorless, and tasteless in its natural state. It is lighter than air and will rise.
- Natural gas is nontoxic, but can present inhalation hazards. If released within an enclosed area, it can displace oxygen and act as a simple asphyxiant.
- When mixed with the proper amount of air, natural gas can burn. The explosive limits are 4 percent to 15 percent gas in air. A combustible gas indicator or flammable gas detector calibrated on methane is required to determine the concentration of natural gas vapors present.
- Natural gas vapors will quickly flash back to their source when ignited.
- Natural gas fires give off tremendous amounts of radiant heat and present significant exposure concerns.
- Natural gas trapped in an enclosed area or confined space can cause a significant explosion if ignited. If ventilating an enclosed space, the hazard may momentarily increase as the air/gas mixture passes through the explosive range.
- Although natural gas can exist as a liquid or gas, with few exceptions it is transported via pipeline in its gaseous form.
- Natural gas leaked under asphalt, concrete, frozen ground, et cetera, will move laterally from its source via any path of least resistance (e.g., underground conduits and pipe casings). Soil that has been disturbed by excavation will allow for the easier passage of natural gas. In addition, certain soils may cause added odorants to be "scrubbed" from the natural gas.
- Unintended gas transmission pipeline releases pose a primarily acute hazard. If an ignition source exists, a release of gas can result in an immediate fire or explosion near the point of the release. This hazard is reduced over a relatively short period after the release ends as the gas disperses. If the natural gas migrates, vapors can accumulate inside a building so that the hazard remains longer and poses a threat of explosion in the building.

Profiling Pipeline Events

The potential hazards of transmission pipeline releases vary according to the failure mode of the pipeline, the commodity released, the operating conditions of the pipeline at the time of the incident, and the characteristics of the surrounding area. The varying behaviors of the products released during a pipeline incident will present different challenges for hazard mitigation.

Gas and hazardous liquid releases can impact people and the environment, resulting in human injuries or fatalities from inhalation or ingestion of toxins, or exposure to a fire or explosion, as well as potential ecological damage and contamination of drinking water supplies. Depending on the location and severity of the pipeline incident, the hazards can result in:

- Serious injuries, including fatalities;

- Damages to the built environment, including residential, commercial, and industrial structures, and other infrastructure;
- Environmental impacts, such as pollution of air, waterways and drinking water sources, and contamination of environmentally sensitive areas;
- Impacts and closures to critical infrastructure and services, such as transportation routes, emergency medical services, and government services (first responders), that can slow disaster response and recovery efforts;
- Short- and long-term residential, commercial, and industrial energy supply losses;
- Short- and long-term disruption of local businesses and regional economies; and
- Short- and long-term displacement of residential communities or businesses.

Pipeline incidents can have effects that ripple throughout local and regional economies, resulting in localized shortages and/or increases in the prices of gasoline, diesel fuel, home heating oil, or natural gas. In addition, disruptions could result in the inability of some manufacturers to produce products such as plastics, pharmaceuticals, and many chemicals that rely on oil and natural gas as manufacturing feedstock.

Determining the Potential Hazard Area

The potential hazard area of a pipeline incident may be calculated using various commercially or publicly available models that have been developed to help predict the impacts of pipeline releases on nearby areas. These models support analysis of such elements as release volumes, release paths along land or water, flammable and toxic vapor dispersion in air, radiant heat from a fire, blast overpressures from an explosion, and resultant impacts on human health, property, and the environment.

Calculations to determine potential hazard areas are different for gas and hazardous liquid transmission pipelines. The basic criteria used by natural gas transmission pipeline operators to calculate this distance, termed the potential impact circle, is provided in Appendix I: Calculation of Site-Specific Planning Area Distances, of *PIPA Recommended Practices*. The model for these calculations is also addressed in the gas transmission pipeline integrity management regulations (49 CFR 192.903).

Determining a site-specific planning area for a hazardous liquid pipeline is potentially much more complex because of the flow characteristics of released liquids and the effect of the terrain surrounding the pipeline on the flow path of the release. Assessing the potential consequences of releases from pipelines in specific locations should be based on a pipeline- and location-specific evaluation of the following four elements:

1. *Which commodity or commodities might be released?* A list of commodities potentially transported in a specific pipeline may be obtained from the pipeline operator.

2. *How much of the transported commodity might be released?* The answer to this differs at different locations along a pipeline and can be derived from pipeline flow

rates, spill detection time, pipeline shutdown time, drain down volume, and other technical factors. These factors may be discussed with the pipeline operator.

3. *Where might the released substance go?* The answer to this is derived by considering the released commodity, release volume, and potential flow paths over land and water, as well as potential air dispersion. Overland flow can be affected by factors such as gas or liquid properties, topography at and near the spill location, soil type, nearby drainage systems, and flow barriers. Similarly, flow in water can be affected by the water flow rate and direction and properties of the spilled product. Air dispersion can be affected by the properties of released vapors and wind direction and speed.

4. *What locations might be impacted?* This question is answered by considering how potential impacts, including thermal impacts from fire, blast overpressure from explosion, toxic and asphyxiation effects, and environmental contamination could affect locations where the released commodity travels. Planned evacuation routes should be considered when performing these assessments.

Planners should communicate with pipeline operators in determining the answers to these elements. It should be noted also that determining the answers to the last two questions above for pipeline releases that occur as a result of and coincident with natural hazard events can be complicated in that some of the factors that determine where a released substance goes may be impacted by the natural hazard event. For example, earthquakes may shift the topography of the land, shift the location of the pipeline, and even change the course of water flows.

Pipeline Failure Causes

Pipeline failure data identifies the major causes of pipeline accidents, which can aid in determining the most cost-effective hazard mitigation strategies. As reported by PHMSA's Office of Pipeline Safety, the major causes of pipeline accidents include: corrosion, excavation damage, incorrect operation, material/weld/equipment failure, natural force damage, and other outside force damage. Pipelines with different characteristics and operating environments have different susceptibilities to these failure causes. This results in different failure probabilities from different causes at different points along the pipeline.

In addition to the lengths of pipe that make up transmission pipeline segments on a right-of-way, transmission pipeline systems include ancillary facilities, such as pump stations, tank facilities and compressor and regulator/metering stations. These facilities are often adjacent or beyond the right-of-way and on operator-owned property that is frequently protected by security fencing. The predominant failure causes and failure modes are different for these ancillary pipeline facilities than for line pipe. Consequently, hazard mitigation planners should be aware of what parts of a transmission pipeline system are in the vicinity of their communities in order to better understand the potential pipeline threats that should be addressed in their planning.

Examples of Pipeline Incidents

Following are several examples of pipeline failure incidents. These examples represent different pipeline types, failure modes, and potential impacts based on the different hazardous materials they were transporting. Several of these examples illustrate pipelines that were installed prior to the developments near the pipelines.

Gas Transmission Pipeline Incidents

Appomattox, Virginia

Pictured in Figure 15 is the impact area of a natural gas pipeline incident that occurred in Appomattox, Virginia, in 2008.[11]

The 30-inch diameter natural gas pipeline was installed in 1955. It was operating at 800 pounds per square inch gauge (psig) when it ruptured, creating a crater 37 feet long by 15 feet deep. It is believed that a nearby power line was caught in the rush of the escaping gas and came loose, striking the ground and sparking. This resulted in the ignition of the gas, and the resulting explosion produced a large fireball that burned an area almost ¼ mile wide. The dashed yellow line in Figure 15 represents the pipeline route.

Figure 15: Appomattox, VA 2008
(Source: Pipeline Safety Trust)

[11] Information about the September 14, 2008 Transco Pipeline Accident in Appomattox Virginia from Pipeline Safety Trust website http://pstrust.org/about-pipelines1/map-of-major-incidents/transco-virgina-accident

Though the county was primarily rural, there was a cluster of homes near the pipeline. This incident resulted in five of the nearby residents being injured; three suffered second- and third-degree burns. Property damage was extensive. Ninety-five homes were affected, and two homes were destroyed.

The firefighters that responded to the explosion were all volunteers, and the fire department had previously worked with the pipeline operator to prepare for pipeline incidents. Because of the coordinated training, the fire department was knowledgeable of the actions the operator would take, and the operator knew the fire department's roles. This foreknowledge and preparation was credited with resulting in fewer injuries.

The community of Appomattox employed a local emergency operations plan and a designated Appomattox County Emergency Planning Coordinator. An incident command was set up to coordinate the response to the pipeline incident, and a public information officer was designated to provide clear and consistent information to the media and others.[12]

The cause of the pipeline failure incident at Appomattox is attributed to external corrosion of the pipe. Contributing to the corrosion may have been extremely corrosive soil conditions, combined with failures in the pipeline's protective coating and cathodic protection system.

San Bruno, California

A natural gas transmission pipeline failed in San Bruno, California, in 2010. The 30-inch-diameter pipeline was operating at 400 psig. The incident resulted in eight fatalities, numerous injuries, and the destruction of 38 homes. The U.S. Geological Survey registered the shock wave resulting from the explosion as an earthquake of 1.1 magnitude.

The National Transportation Safety Board determined that the probable cause of the accident was the Pacific Gas and Electric Company's (PG&E) inadequate quality assurance and quality control in 1956 during its Line 132 relocation project. This allowed the installation of a substandard and poorly welded pipe section with a visible seam weld flaw that over time grew to a critical size, causing the pipeline to rupture in 2010 during a pressure increase stemming from poorly planned electrical work at PG&E's Milpitas Terminal. Also, PG&E had an inadequate pipeline integrity management program, which failed to detect and repair or remove the defective pipe section.

Contributing to the accident were the California Public Utilities Commission's (CPUC) and the U.S. Department of Transportation's exemptions of existing pipelines from the regulatory requirement for pressure testing, which likely would have detected the installation defects. Also contributing to the accident was the CPUC's failure to detect the inadequacies of PG&E's pipeline integrity management program.

[12] Article: *Lessons Learned: Pipeline Emergency Response at 2008 Appomattox (VA) Natural Gas Explosion*. FireEngineering.com, March 22, 3013.

Contributing to the severity of the accident were the lack of either automatic shutoff valves or remote control valves on the line and PG&E's flawed emergency response procedures and delay in isolating the rupture to stop the flow of gas.

Figure 16, below, illustrates the impact area of the San Bruno pipeline incident. The impacted homes were over 500 feet from the pipeline. The yellow dashed line in Figure 16 represents the pipeline route; the orange lines designate the calculated potential impact area. It should be noted that homes outside the calculated potential impact area were damaged and destroyed, possibly as a result of wind-driven flames and heat. The consequences of this incident were compounded because the resulting gas explosion compromised a water main and necessitated that firefighters truck in water from outside sources and drag their fire hoses nearly 4,000 feet, about three-fourths of a mile, to access working fire hydrants.[13] The pipeline was installed in the mid-1950s, prior to construction of the subdivision.

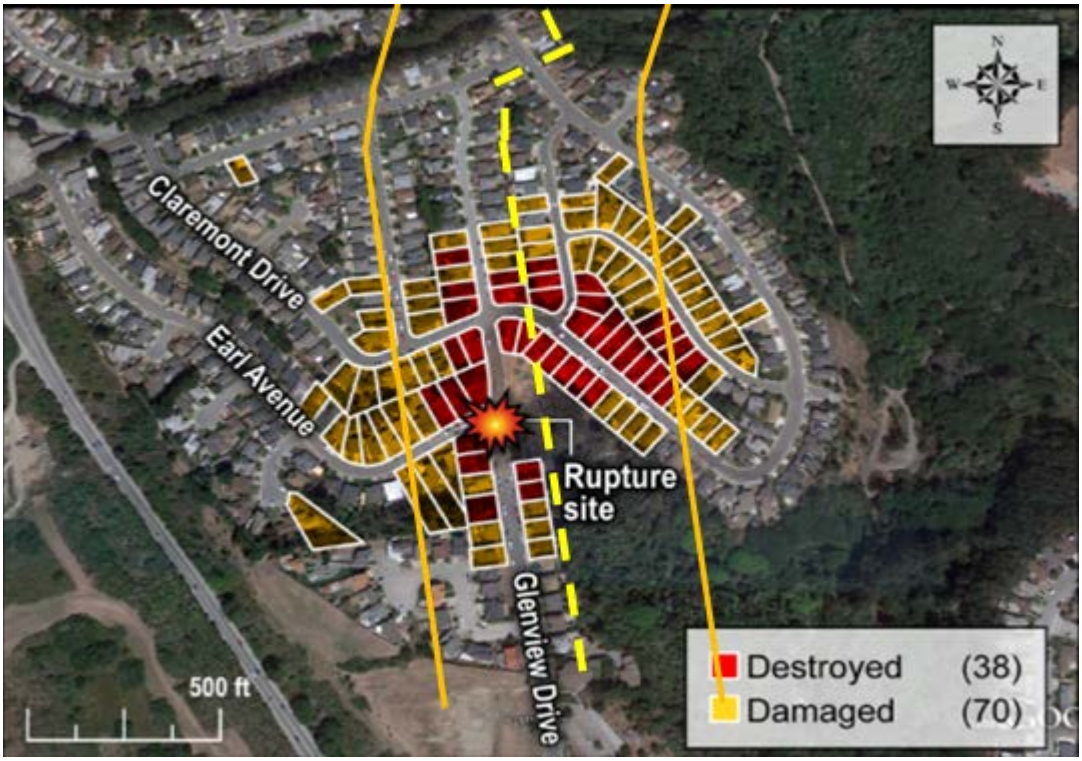


Figure 16: San Bruno, CA 2010
(Source: National Transportation Safety Board)

Hazardous Liquid Pipeline Event – Refined Product

Bellingham, Washington

[13] NTSB Number: PAR-11-01 Pacific Gas and Electric Company Natural Gas Transmission Pipeline Rupture and Fire, San Bruno, California, September 9, 2010

Figures 17 and 18, below, relate to a pipeline incident that occurred in Bellingham, Washington, in 1999. In that incident, a 16-inch-diameter hazardous liquid pipeline ruptured near a Bellingham water treatment plant and released about 237,000 gallons of gasoline into a creek that flowed through Whatcom Falls Park. About 1.5 hours after the pipeline rupture the gasoline, which had flowed along approximately 1.5 miles of the creek, ignited and burned. Three people were killed and eight injured as a result of the incident. A single family home and the water treatment plant were severely damaged.[14]

Figure 17: Water Treatment Plant Damage, Bellingham, WA
(Source: Used with permission from the Whatcom County Photo Archives)

[14] NTSB Report PAR-02/02 Pipeline Rupture and Subsequent Fire in Bellingham, Washington June 10, 1999
http://www.ntsb.gov/doclib/reports/2002/PAR0202.pdf

Figure 18: Path of Fire Resulting From Pipeline Rupture, Bellingham, WA
(Source: National Transportation Safety Board)

The National Transportation Safety Board identified several factors in the probable cause of the Bellingham accident, including:

1. Prior damage to the pipe that occurred during a 1994 water treatment plant modification project and inadequate inspection by Olympic Pipe Line Company (the operator) of the contractor's work performed during the project.
2. Inaccurate evaluation of in-line pipeline inspection results, leading to the operator's decision not to excavate and examine the damaged section of pipe.
3. Failure to test, under approximate operating conditions, all safety devices associated with the facility before activating it.
4. Failure to investigate and correct the conditions leading to the repeated unintended closing of an inlet block valve.
5. The operator's practice of performing database development work on the supervisory control and data acquisition system while it was being used to operate the pipeline, which led to the system becoming non-responsive at a critical time during pipeline operations.

Hazardous Liquid Pipeline Events – Crude Oil

Romeoville, Illinois

A crude oil spill can have a significant impact on land and development in close proximity to the pipeline. Figure 19 shows a scene in Romeoville, Illinois, where a heavy crude oil pipeline leaked beneath the street pavement in 2010. The leak was determined to have spilled about 270,000 gallons of oil. Damages, including the cost of the environmental remediation, totaled about $46.6 million. Federal oversight costs added another $550,000. On the day of the accident, the fire department evacuated 50 persons from 11 nearby businesses. Twenty-three area businesses were closed for one to nine days. The Romeoville Public Works Department temporarily plugged one sanitary sewer line, which disrupted several nearby businesses for a day. Firefighters initially tried to contain the spilled oil, but the release volume was too great to control with the equipment they had.

Figure 19: Large Crude Oil Spill, Romeoville, IL, September 2010
(Source: National Transportation Safety Board)

The National Transportation Safety Board determined that the probable cause of the pipeline leak was erosion of the pipe wall caused by water jet impingement from a leaking 6-inch-diameter water pipe located 5 inches below the oil pipeline.

The crude oil leak occurred at an industrial park less than a mile from the Des Plaines River and the Chicago Sanitary and Ship Canal. The closest residential areas were about 200 yards from the spill site, which was also within populated and ecologically sensitive areas designated as high consequence areas in Federal pipeline safety regulations (49 CFR 195.450). The pipeline operator recovered 694,000 gallons of oil and water mixture. The EPA also removed about 1.5 million gallons of hazardous waste, 1 million gallons of treated water from a retention pond, 4.4 million gallons of treated sewage lagoon water, and 15,000 cubic yards of contaminated soils. A wildlife response center treated and released 141 turtles and frogs, while another 32 animals were found to have been killed as a result of the leak.

Mayflower, Arkansas

Another crude oil spill occurred in Mayflower, Arkansas, in March 2013. A 20-inch-diameter pipeline carrying heavy crude oil and operating at around 700 psig spilled between 210,000 and 294,000 gallons of crude oil. Isolating valves on either side of the spill location were 18 miles apart. An initial review of the ruptured pipeline found that the failure resulted from an original manufacturing defect in the electronic resistance welded pipe.

In the Mayflower accident, the initial leak occurred between two residences in a subdivision. The plume of crude oil migrated overland about 1.6 miles. Over 30 homes were evacuated, and the residents were displaced for over a month. The oil plume migrated outside the boundaries of the residential subdivision, where the leak originated, via multiple drainage features and existing topographies. These included a city street drainage culvert, a railroad drainage ditch, and existing topographic drainage features. The flow flanked a retail shopping strip center, a state highway, and an interstate highway. The plume crossed under the interstate highway via the highway's storm sewer system, and collected in a wetlands area that the EPA termed as an "inlet cove" feature to nearby Lake Conway. The plume terminated its migration in this inlet cove feature before reaching Lake Conway due to the employment of booming and other natural features.

As a result of the incident, storm drains had to be replaced and affected streets and curbs repaired or replaced. Remediation and restoration included extensive soil and water sampling and debris removal, as well as ecological assessment and the replacement of natural materials and vegetation to help restore the environment.[15] The pipeline was installed in the late 1940s, but the homes near the leak site were constructed much later, in the late 2000s.

Hazardous Liquid Pipeline Events – Anhydrous Ammonia

Kingman, Kansas

Pictured in Figure 20 is an ammonia vapor cloud resulting from the rupture of an 8-inch-diameter pipeline near Kingman, Kansas, in October 2004. Operating at 981 pounds per square inch at the time of the incident, the ruptured pipeline released approximately 204,000 gallons of anhydrous ammonia.

[15] City of Mayflower, Arkansas website article: *ExxonMobil Pipeline Company Responds to Crude Oil Spill in Arkansas.* http://www.cityofmayflower.com/archives/6107

Figure 20: Ammonia vapor cloud from pipeline rupture
(Source: National Transportation Safety Board)

Nobody was killed or injured due to the release; however, the anhydrous ammonia leaked into a creek and killed more than 25,000 fish, including some from threatened species. In response to a 911 call on the rupture, the Kingman County sheriff's office responded to the site and started telephoning residents in 35 nearby houses. The sheriff's office and the fire department blocked roads that could be affected by the moving toxic vapor cloud. The cost of the accident was $680,715, including $459,415 for environmental remediation.

The National Transportation Safety Board determined that the probable cause of the pipeline rupture was a pipe gouge created by heavy equipment damage to the pipeline during construction in 1973, or subsequent excavation activity at an unknown time, which initiated metal fatigue cracking of the pipe and led to the eventual rupture of the pipeline.

Riverview, Florida

Another anhydrous ammonia leak was caused when three teenage boys drilled into (vandalized) a 6-inch-diameter, 30-mile-long pipeline in Riverview, Florida, in 2007. Winds blew the potentially harmful ammonia vapors, prompting Hillsborough County Fire Rescue to evacuate about 300 people. Emergency officials also used reverse 911 to notify 3,659 households of the danger.[16]

This event involved the unified response of numerous local, State and Federal resources, including: local fire rescue, law enforcement, emergency operations center, school board, and

[16] Riverview residents flee ammonia cloud, Tampa Bay Times, Published November 13, 2007
http://www.sptimes.com/2007/11/13/Hillsborough/Riverview_residents_f.shtml

public works department, as well as Florida Emergency Management, Florida Department of Transportation (DOT), Florida Department of Environmental Protection, U.S. DOT, U.S. Environmental Protection Agency, U.S. Coast Guard, and the National Weather Center.

Hazardous Liquid Pipeline Event – Propane

Clarke County, Mississippi

The fire pictured in Figure 21 resulted when a pipeline transporting liquid propane ruptured in a rural area near Carmichael, Mississippi, in November 2007. The pipeline was operating at about 1,405 psig, and about 10,253 barrels (approximately 430,626 gallons) of liquid propane were released and vaporized. The resulting gas cloud expanded over nearby homes and ignited in a large fireball that was heard and seen miles away. Two people were killed, and seven people sustained minor injuries. Additionally, 250 people were evacuated from their homes. Four houses were destroyed, and several others were damaged. About 71.4 acres of grassland and woodland were burned. Property damages resulting from the accident, including the loss of product, were reported as $3,377,247.[17]

Figure 21: Clarke County Mississippi 2007
(Source: U.S. DOT PHMSA, Southern Region, Failure Investigation Report)

[17] NTSB Report Number PAR-09/01 - Rupture of Hazardous Liquid Pipeline With Release and Ignition of Propane http://www.ntsb.gov/investigations/summary/PAR0901.htm

The National Transportation Safety Board determined that the probable cause of the Clarke County pipeline rupture was the failure of a weld that caused the pipe to fracture along the longitudinal seam weld, a portion of the upstream girth weld, and portions of the adjacent pipe joints.

Identify the Likelihood and Consequences of a Pipeline Event

Risk is often thought of as the product of the likelihood of an incident and the consequences of the incident. Pipeline failures are low frequency, high consequence events. To understand the risks of pipeline incidents, statistics about the likelihood and consequences should be understood.

To help determine the risk of pipeline incidents and to provide a comparison to other transportation modes, PHMSA published a report on pipeline risk (Pipeline Risk Report)[18] in 2010 in conjunction with the release of *PIPA Recommended Practices*. The purpose of the *Pipeline Risk Report* is to assist local governments and developers in better understanding pipeline risks relative to other transportation risks and to provide a context for the use of *PIPA Recommended Practices* for development near hazardous liquid and gas transmission pipelines.

The *Pipeline Risk Report* offers comparisons of the frequency of incidents involving death or injury resulting from hazardous materials releases from different transportation modes for the period of 2005- 2009. It indicates that pipelines have lower incident rates than any other mode of hazardous materials transportation. A similar conclusion was reported by the U.S. Government Accountability Office (GAO) in 2002. The GAO Report, GAO-02-785, reported that pipeline operator errors and accidents are fewer than for any other means of transportation (e.g., freight, rail, and barge) for hazardous liquids and natural gas, and that transmission pipelines are the most secure method of transporting hazardous liquids.

Tables 1 and 2, below, provide a summary of the frequency and consequences in terms of fatalities, injuries, property damage, and barrels of spilled hazardous materials, from hazardous liquid and gas transmission pipeline accidents from 2008-2013. The PHMSA website contains the most current annual, state-specific, and composite statistics on pipeline accidents and causes at http://primis.phmsa.dot.gov/comm/reports/safety/PSI.html.

[18] Building Safe Communities: Pipeline Risk and its Application to Local Development Decisions. October, 2010. http://primis.phmsa.dot.gov/comm/publications/PIPA/PIPA-PipelineRiskReport-Final-20101021.pdf

Table 1. Hazardous Liquid Pipelines – All Reported Incidents 2008-2013

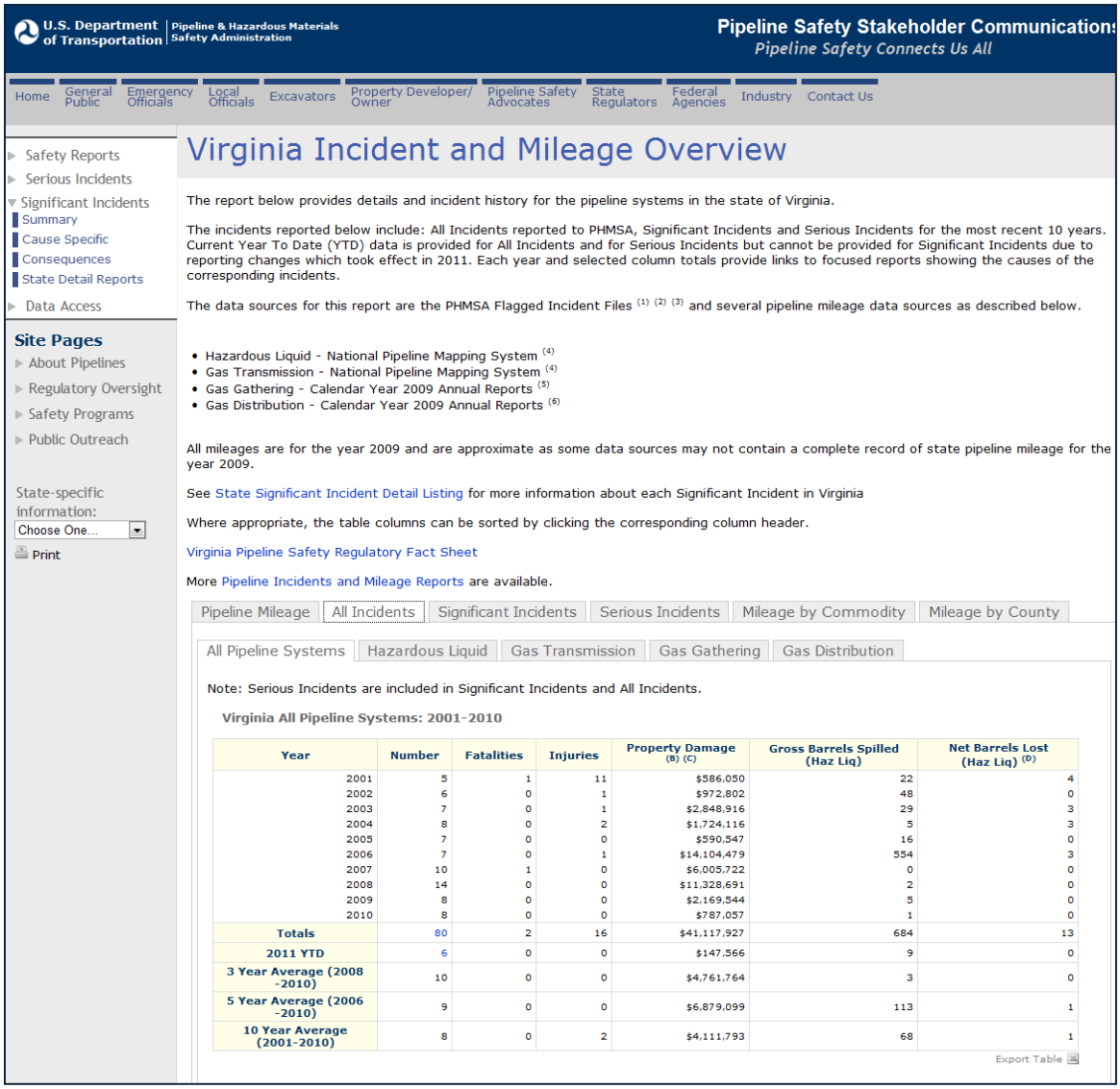
Year	Number of incidents	Gross barrels spilled	Net barrels lost	Fatalities	Injuries	Property damage
2008	368	102,044	69,478	2	2	$136,875,358
2009	336	53,514	31,083	4	4	$63,215,857
2010	346	100,551	49,444	1	4	$1,000,535,833
2011	343	89,032	57,473	1	2	$247,218,221
2012	361	45,934	29,382	3	4	$141,757,400
2013	400	119,290	87,761	1	5	$259,570,835
Total (Avg.)	**2,154 (359)**	**510,365 (85,060.8)**	**394,621 65,770.2)**	**12 (2)**	**21 (3.5)**	**$1,849,173,504 ($308,195,584)**

Table 2. Gas Transmission Pipelines – All Reported Incidents 2008-2013

Year	Number of incidents	Gross barrels spilled	Net barrels lost	Fatalities	Injuries	Property damage
2008	122	N/A	N/A	0	5	$256,011,440
2009	105	N/A	N/A	0	11	$55,911,891
2010	107	N/A	N/A	10	61	$411,031,023
2011	119	N/A	N/A	0	1	$102,748,170
2012	104	N/A	N/A	0	7	$50,956,829
2013	106	N/A	N/A	0	2	$48,914,677
Total (Avg.)	**663 (110.5)**	**NA (NA)**	**NA (NA)**	**10 (1.7)**	**87 (14.5)**	**$925,574,030 ($154,262,338)**

Approaches to Assessing the Likelihood of Pipeline Incidents in Your Community

To gain a perspective on pipeline risk, one approach is to identify the number and/or total length of pipelines in a specific State or local jurisdiction, leverage historic pipeline incident data for specific State or local jurisdictions, and determine the potential likelihood of incidents for the pipelines of interest. Although historical incident data does not accurately predict future incidents, such data can provide the order of magnitude for pipeline incident frequency and impacts that point to the need for mitigation strategies. Historic pipeline incident data for specific State or local jurisdictions can be found on PHMSA's Stakeholder Communications website at http://primis.phmsa.dot.gov/comm/states.htm. Figure 22 illustrates pipeline incident and mileage data for Virginia as reported from PHMSA's website.



U.S. Department of Transportation | Pipeline & Hazardous Materials Safety Administration

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  - Summary
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Virginia Incident and Mileage Overview

The report below provides details and incident history for the pipeline systems in the state of Virginia.

The incidents reported below include: All Incidents reported to PHMSA, Significant Incidents and Serious Incidents for the most recent 10 years. Current Year To Date (YTD) data is provided for All Incidents and for Serious Incidents but cannot be provided for Significant Incidents due to reporting changes which took effect in 2011. Each year and selected column totals provide links to focused reports showing the causes of the corresponding incidents.

The data sources for this report are the PHMSA Flagged Incident Files [1] [2] [3] and several pipeline mileage data sources as described below.

- Hazardous Liquid - National Pipeline Mapping System [4]
- Gas Transmission - National Pipeline Mapping System [4]
- Gas Gathering - Calendar Year 2009 Annual Reports [5]
- Gas Distribution - Calendar Year 2009 Annual Reports [6]

All mileages are for the year 2009 and are approximate as some data sources may not contain a complete record of state pipeline mileage for the year 2009.

See State Significant Incident Detail Listing for more information about each Significant Incident in Virginia

Where appropriate, the table columns can be sorted by clicking the corresponding column header.

Virginia Pipeline Safety Regulatory Fact Sheet

More Pipeline Incidents and Mileage Reports are available.

Pipeline Mileage | All Incidents | Significant Incidents | Serious Incidents | Mileage by Commodity | Mileage by County

All Pipeline Systems | Hazardous Liquid | Gas Transmission | Gas Gathering | Gas Distribution

Note: Serious Incidents are included in Significant Incidents and All Incidents.

Virginia All Pipeline Systems: 2001-2010

Year	Number	Fatalities	Injuries	Property Damage [B] [C]	Gross Barrels Spilled (Haz Liq)	Net Barrels Lost (Haz Liq) [D]
2001	5	1	11	$586,050	22	4
2002	6	0	1	$972,802	48	0
2003	7	0	1	$2,848,916	29	3
2004	8	0	2	$1,724,116	5	3
2005	7	0	0	$590,547	16	0
2006	7	0	1	$14,104,479	554	3
2007	10	1	0	$6,005,722	0	0
2008	14	0	0	$11,328,691	2	0
2009	8	0	0	$2,169,544	5	0
2010	8	0	0	$787,057	1	0
Totals	80	2	16	$41,117,927	684	13
2011 YTD	6	0	0	$147,566	9	0
3 Year Average (2008 -2010)	10	0	0	$4,761,764	3	0
5 Year Average (2006 -2010)	9	0	0	$6,879,099	113	1
10 Year Average (2001-2010)	8	0	2	$4,111,793	68	1

Export Table

Figure 22: Incident and mileage report
(Source: PHMSA Stakeholder Communication Website)

Another approach, taken by the Virginia Department of Emergency Management, is to identify counties with the highest mileage of pipelines as shown in the map in Figure 23. This identification process can lead to more focused communication with operators and prioritized mitigation strategies if the pipeline presents what is perceived to be a 'higher risk', based on the location and potential impacts should an event occur. This higher risk can be based on multiple factors to include life, environmental, economic, cultural/historic, and so on. It is important that States, local communities, and tribes share a common understanding of not only what the potential risk is, but why one place or location may be considered to be a higher priority for mitigation than another. More information about how local governments and pipeline operators

identify and prioritize impacts is provided in the Vulnerability Assessment section of this document.

The pipeline maps can also be overlaid onto maps that show the likelihood of other natural hazards. This can help in identifying possible consequences within a region as well as a specific site. It can also suggest potential mitigation strategies designed to reduce the potential consequences, should a natural hazard event occur.

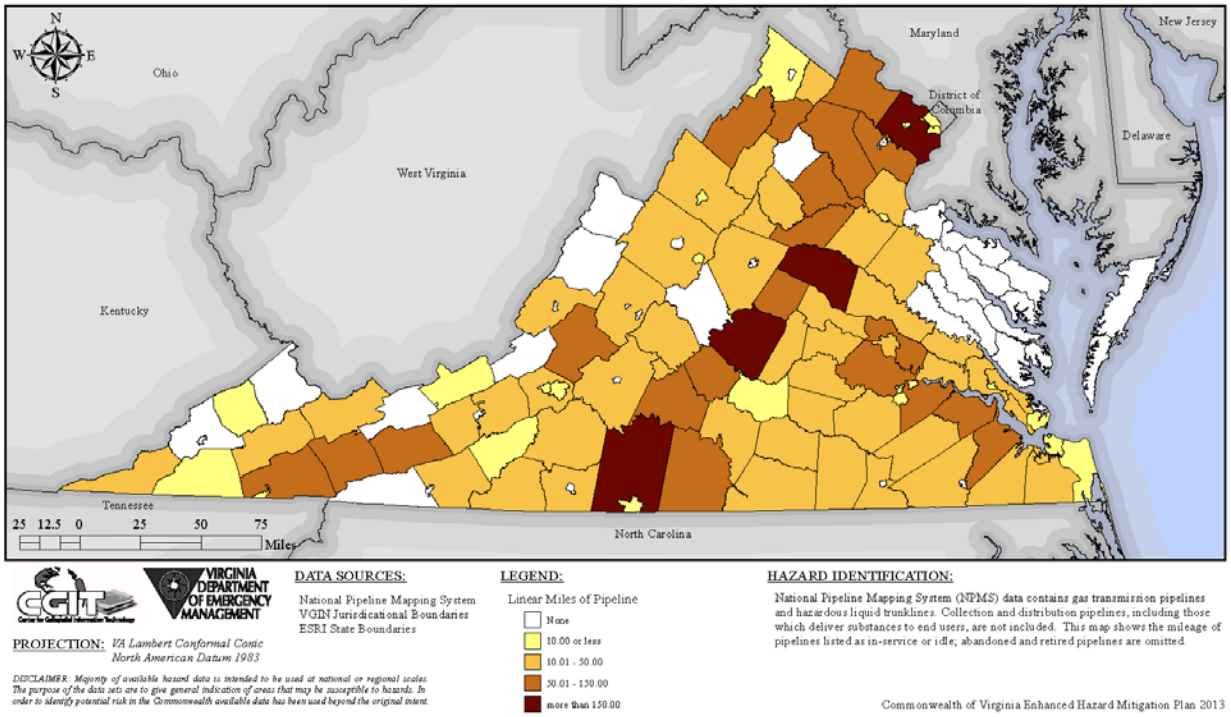

Figure 23: Mapping the location of transmission pipelines
(Source: Commonwealth of Virginia Hazard Mitigation Plan 2012)

Potential Consequences of Pipeline Events

Assessing potential consequences of a pipeline hazard is integral to both the hazard mitigation planning process and to a pipeline operator's integrity management program. Assessment of potential consequences in a hazard mitigation plan is used to identify important community assets that are vulnerable to the impact of each hazard. Pipeline operators evaluate potential consequences to identify pipeline segments that may impact "high consequence areas."

Federal regulation 44 CFR 201.6, Local Mitigation Plans, addresses the plan requirements, planning process, content, and review of local hazard mitigation plans. Section 201.6(c)(2) requires that each plan must include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards. The risk assessment is required to

provide a description of the type, location, and extent of all natural hazards that can affect the jurisdiction, as well as information on previous occurrences of hazard events and on the probability of future hazard events. Each plan must also provide a description of the jurisdiction's vulnerability to those hazards.

The vulnerability assessment typically describes the jurisdiction's vulnerability in terms of:

a. The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas;
b. An estimate of the potential dollar losses to the vulnerable structures and a description of the methodology used to prepare the estimate; and
c. A general description of land uses and development trends within hazard-prone areas so that mitigation options can be considered in future land use decisions.

Consequence Factors of Integrity Management Programs

Federal regulations, 49 CFR Part 192, Subpart O, and Part 195.452, require transmission pipeline operators to develop and implement pipeline integrity management (IM) programs. Integrity management provides a structured process through which pipeline operators identify safety situations specific to their systems. They conduct risk assessments of their pipeline systems, which consider threats to pipeline integrity and the locations (within the areas of potential impact) where a pipeline leak or rupture could do the most harm (high consequence areas). Pipeline systems that meet these criteria are referred to as "covered segments." The regulations require all relevant risk factors to be considered, including geo-technical and local environmental factors. Operators use the risk assessment to prioritize the covered segments and determine what additional preventive and mitigative measures are needed for the highest risk segments.

For hazardous liquid pipelines, high consequence areas (HCA) include:

- High Population Areas and Other Populated Areas
  - High population areas are urbanized areas with a population of at least 50,000 and a population density of at least 1000 people per square mile. Other populated areas are drawn from census bureau data and include incorporated or unincorporated cities, towns, villages, or other residential or commercial areas that are not urbanized areas.
- Unusually Sensitive Areas of Environment
  - Drinking water sources including those supplied by surface water or wells and where a secondary source of water supply is not available.
  - Unusually sensitive ecological areas including locations where critically imperiled species can be found, areas where multiple examples of federally listed threatened and endangered species are found, and areas where migratory water birds concentrate.

- Commercially Navigable Waterways
  - Commercially navigable waterways are identified by the U. S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics.

PHMSA maps the hazardous liquid HCAs in the NPMS. Population data and commercially navigable waterways data are available to the general public. Unusually sensitive area data is only available to pipeline operators. The covered segments include the pipeline inside the HCA and any pipelines outside an HCA which, if they failed, could affect an HCA. Operators use models to predict the potential impacts of pipeline releases on nearby areas and to identify pipelines segments that "can affect" HCAs.

For gas transmission pipelines, high consequence areas (HCA) include:

- Areas where the population within a "potential area of impact" circle contains 20 or more structures intended for human occupancy, buildings housing populations of limited mobility, buildings that would be hard to evacuate (e.g., nursing homes, schools), or buildings and outside areas occupied by more than 20 persons on a specified minimum number of days each year.
- Identified sites are defined as:
  - An outside area or open structure that is occupied by 20 or more persons on at least 50 days in any 12-month period, or
  - A building that is occupied by 20 or more persons on at least 5 days a week for 10 weeks in any 12-month period, or
  - A facility occupied by persons who are confined, are of impaired mobility, or would be difficult to evacuate (e.g., hospitals, prisons, schools, day-care facilities, retirement facilities, or assisted-living facilities).

Operators identify HCAs for gas transmission pipelines, but they are not mapped in the NPMS.

Relationship between Vulnerability Assessment and Integrity Management Consequence Factors

In the context of fulfilling integrity management program requirements, PHMSA guides pipeline operators to maintain focus on the risks of failures in HCAs[19]. If consequences considered in the risk analysis are expanded to include consequences related to operator business performance, then the operator must provide assurance that this approach does not skew decisions away from protection of HCAs. For example, consideration of operator business performance consequences should not result in pipeline segments presenting high risks to HCAs being given lower priority

[19] Gas Transmission Frequently Asked Question 102 (http://primis.phmsa.dot.gov/gasimp/faqs.htm) and Hazardous Liquid Frequently Asked Question (8.18 http://primis.phmsa.dot.gov/iim/faqs.htm)

for integrity assessments than segments with low risks to HCAs but higher business consequences.

Because of this requirement, it is important to understand that buildings in close proximity to pipelines identified in a hazard mitigation plan vulnerability assessment may or may not be included in a HCA and subject to a pipeline operator's integrity management program.

Risk of Natural Hazard Events to Pipelines

Although pipelines should principally be categorized as technological hazards, natural hazard events (referred to in pipeline safety regulations as natural force damage) are cited as one of the seven primary causes of pipeline incidents. Natural hazard damage is cited as the cause of a relatively small percentage of pipeline incidents, yet it can and sometimes does result in some relatively large-scale pipeline failures due to the potential for extremely large and unpredictable forces to act upon pipelines and their associated facilities.

Natural-hazard-caused pipeline failures result in relatively greater percentages of property damage but lower percentages of fatalities and injuries than failures from other causes. Pipeline incidents attributed to natural force damage reported to PHMSA are currently categorized[20] as the result of: earth movement (e.g., earthquakes, subsidence, landslides), heavy rains/flood (e.g., storm surges and tsunami, washouts, scouring, flotation, mudslides), lightning, temperature, high winds, other natural force damage (e.g., wildfires, heavy snow loads), and unspecified natural force damage.

Under the IM program regulations, pipeline operators determine if natural hazards are a significant threat to the integrity of their pipelines. Information that local governments collect about natural hazards can greatly inform pipeline operators about these potential threats.

Operators implement additional preventative and mitigative measures in areas where natural hazards are significant. These measures include, but are not limited to, adding external protection, reducing external stress, relocating or replacing the line, installing slip or expansion joints, installing strain gauges, installing automatic shut-offs, and performing additional leak surveys after significant hazard events. Pipelines in mountainous terrain (which is subject to landslides or mudslides) and pipelines near rivers or river crossings (subject to flooding) should be reviewed to verify that operators properly evaluated the threat of natural force damage. Sometimes earth movement or flooding can significantly displace the pipe, without causing rupture.

PHMSA has issued a number of advisory bulletins over the years to remind pipeline operators of the actions they need to consider regarding natural hazards, including heavy snowfall/abnormally icy weather, flooding, soil subsidence, and hurricanes. PHMSA also has provided information about the impacts of seismic activities on pipeline infrastructure.

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[20] See PHMSA Stakeholder Communications website, All Reported Pipeline Incidents By Cause, http://primis.phmsa.dot.gov/comm/reports/safety/ALLPSIDet_1993_2012_US.html?nocache=8149#_all

Pipeline failures resulting from and in conjunction with natural hazard events can further complicate and compound the response to and recovery from such events. Emergency management organizations and pipeline operators will face some of the same challenges, including:

- The inability to use roads to access trouble areas and control points (such as pipeline shutoff valves);
- The inability of critical personnel to reach needed areas;
- Out-of-service and ineffective communication channels;
- Unresponsive control channels;
- Lost, damaged, and inaccessible response equipment;
- Conflicting and confusing information being received; and
- The increased need to survey affected areas.

These are but a few of the complications that can arise. Coordination among emergency management organizations and pipeline operators is critical and should be considered before, during, and after natural hazard events.

Tables 3 and 4 reflect natural force damage incidents reported for all hazardous liquid and gas transmission pipelines for the ten-year period of 2004-2013.

Table 3. Hazardous Liquid Pipelines – Natural Force Damage 2004-2013

Reported Cause of incident	Number of incidents	% of all incidents	Fatalities	Injuries	Property damage	% of property damage from all incidents & causes
Earth Movement	19	0.5%	0	0	$62,829,034	2.5%
Heavy Rains/Floods	31	0.8%	0	0	$205,421,552	8.2%
Lightning	20	0.5%	0	0	$42,889,182	1.7%
Temperature	54	1.5%	0	0	$9,087,167	0.3%
High Winds	30	0.8%	0	0	$244,985,232	9.8%
Other Natural Force Damage	4	0.1%	0	0	$581,732	0.0%
Unspecified Natural Force Damage	35	0.9%			$326,397	0.0%
Sub Total	193	5.3%	0	0	$566,120,296	22.7%

Table 4. Gas Transmission Pipelines – Natural Force Damage 2004-2013

Reported Cause of incident	Number of incidents	% of all incidents	Fatalities	Injuries	Property damage	% of property damage from all incidents & causes
Earth Movement	23	1.9%	0	0	$13,424,896	0.9%
Heavy Rains/Floods	90	7.7%	0	0	$280,235,208	20.5%
Lightning	17	1.4%	0	0	$1,901,676	0.1%
Temperature	10	0.8%	0	0	$752,059	0.0%
High Winds	14	1.2%	0	0	$108,472,981	7.9%
Other Natural Force Damage	5	0.4%	0	0	$4,840,820	0.3%
Sub Total	159	13.6%	0	0	$409,627,640	30.0%

Step 3: Armed with an understanding of the potential risks, determine the community's priorities based on risk, identify potential mitigation actions, and complete a capability assessment. The result is a hazard mitigation plan and strategy for implementation.

Develop a Mitigation Plan

It is hoped that as awareness of the need for and benefits of hazard mitigation for pipeline risks increases, due in part to development and implementation of multi-hazard mitigation plans, jurisdictions will incorporate appropriate mitigation strategies into existing processes and programs.

The first step in developing a mitigation strategy is to establish goals and identify possible mitigation actions. The next step is to establish which actions are feasible, based on an understanding of the organizational capacity of those agencies or departments tasked with their implementation. A capability assessment helps to determine which mitigation actions are practical and likely to be implemented over time, given a local government's planning and regulatory framework, level of administrative and technical support, amount of fiscal resources and current political climate. In areas with limited planning capability, local governments may need to collaborate more closely with emergency management to implement mitigation strategies.

Identify Mitigation Actions - *PIPA Recommended Practices*

Reducing potential risks from transmission pipeline failures and enhancing safety is best achieved through proper pipeline operation and maintenance by pipeline operators and effective regulatory oversight of operators for compliance with applicable regulations by Federal and State regulators pipeline safety. Local governments can also contribute significantly to reducing pipeline risks by implementing public education, encouraging and implementing effective excavation damage prevention practices, requiring risk-informed planning, design and construction of industrial, commercial, and residential developments near transmission pipelines, and developing and coordinating emergency response planning and preparedness.

All stakeholders can communicate issues concerning pipeline safety and support initiatives to reduce pipeline-related risks. This includes activities such as: following safe excavation practices, including use of the one-call process (e.g., calling 811); monitoring and reporting suspicious activity on pipeline rights-of-way; keeping pipeline ROW free from obstructions and encroachments; and becoming aware of and implementing the PIPA recommended practices for land use and development near transmission pipelines.

Transmission pipeline failures present potential risks that may impact people and property beyond the edge of transmission pipeline ROW. To address these risks, some communities have

imposed zoning restrictions, including fixed-distance building setbacks for development along pipeline ROW.

Building setbacks are typically used by local governments to provide separation between the community and potential threats. However, fixed-distance setbacks from pipelines commonly do not consider specific pipeline attributes, the physical environment in which a specific pipeline operates, or the potential risks resulting from a specific pipeline failure.

Individual transmission pipelines differ in character – some are large-diameter, high-pressure, cross-country pipelines traversing mostly rural areas, while others are located in urban areas and densely populated urban centers. Transmission pipelines operated within urban areas may be located underneath public streets and roadways in areas that are already well developed. The Federal IM regulations attempt to mitigate the potential risks of transmission pipelines located in more densely populated areas by imposing more stringent design, operation, and maintenance requirements. However, each situation is unique relative to the pipeline characteristics and the areas surrounding the pipeline ROW. Thus, implementing a risk-informed approach to land use planning and development and establishing good communication with the transmission pipeline operator is more appropriate than establishing a fixed-distance setback to be applied in all situations. *PIPA Recommended Practices* provides guidance in these areas.

Implementing effective mitigation actions builds a community's capacity for risk-informed land use and development planning near transmission pipelines. When development or new land use is proposed near an existing pipeline, stakeholders should ultimately be able to answer:

Is this land use or development proposal designed for safe integration with the pipeline?

The PIPA recommended practices for consideration by local governments include the following types of mitigation tools:

(1) Pipeline identification and mapping,
(2) Pipeline knowledge and education,
(3) Pipeline land records,
(4) Facilitate stakeholder communications,
(5) Land use and development planning management practices,
(6) Excavation damage prevention practices, and
(7) Mitigation measures from natural hazards.

Some of the recommended practices are meant to be implemented by stakeholders in preparation for future land use and development while others are for consideration when new development is initiated.

Pipeline Identification and Mapping

Being aware that there are pipelines within the borders of a jurisdiction is the first step to determine what can be done to mitigate potential pipeline hazards and to assess needed capabilities.

RP BL01 Obtain Transmission Pipeline Mapping Data

Practice Statement – Local government agencies responsible for land use and development planning or the issuance of development permits should obtain mapping data for all transmission pipelines within their areas of jurisdiction from PHMSA's National Pipeline Mapping System or from the transmission pipeline operators and show these pipelines on maps used for development planning.

Shown in Figure 24, the City of Lenexa, Kansas, Department of Community Development, incorporated gas transmission pipelines into its internal GIS maps.

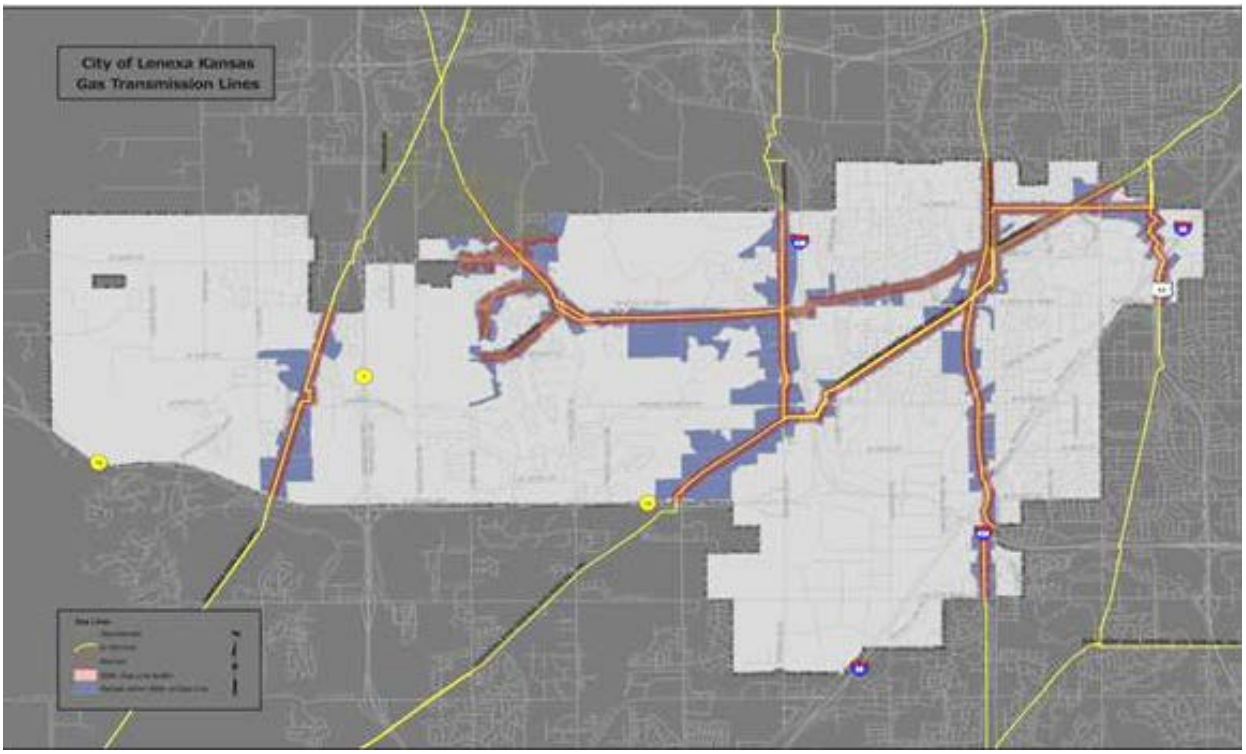

Figure 24: Gas transmission pipelines incorporated into map of City of Lenexa, KS
(Source: City of Lenexa, Kansas)

Figure 25, below, shows a screen capture from the NPMS illustrating the inclusion of pipeline operator contact information.

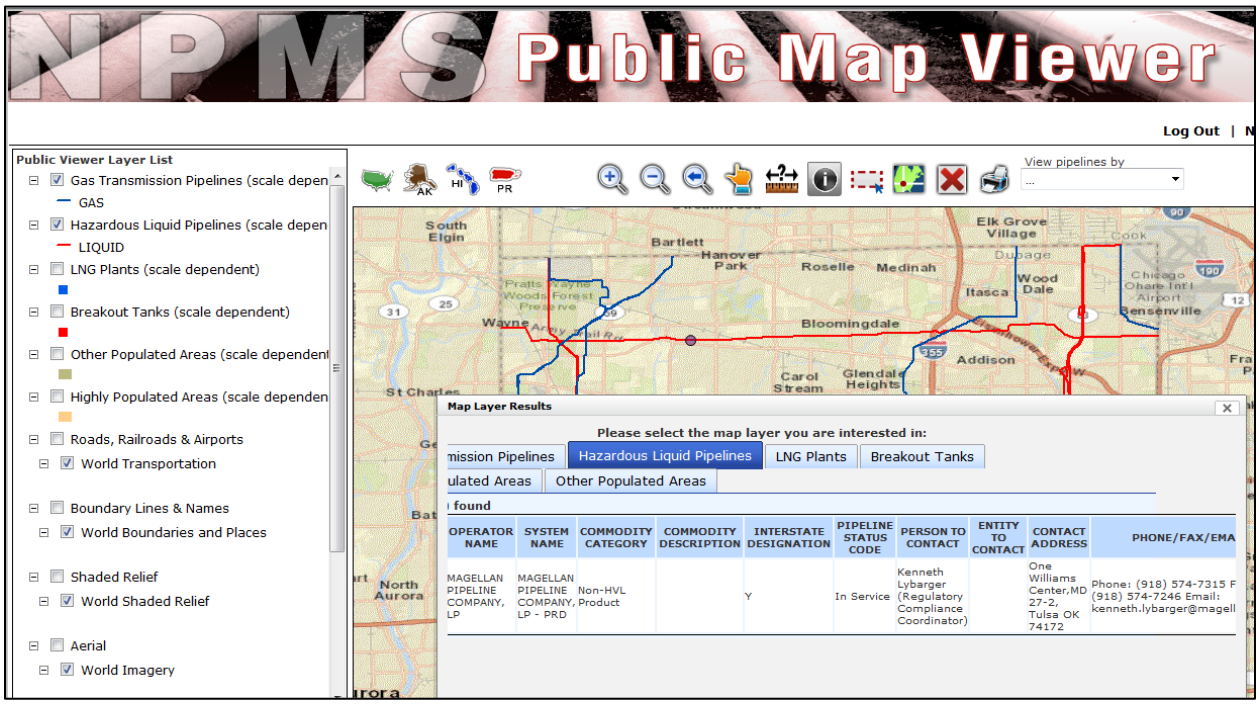

Figure 25: Pipeline operator contact information and pipeline attributes in the NPMS
(Source: National Pipeline Mapping System)

Local governments may need specific pipeline information that is not available in PHMSA's NPMS. For example, the NPMS does not currently provide the operating pressure of a pipeline, and the pipeline diameter is not a required data element. This information will need to be obtained from the specific pipeline operator to help determine the potential impact area of a pipeline.

The lack of key data in the NPMS was cited by the National Safety Transportation Board (NTSB) in its investigation of the 2010 pipeline failure in San Bruno, California[21], as a contributing factor to an emergency response awareness issue. NTSB issued the following safety recommendation:

> *P-11-08: Require operators of natural gas transmission and distribution pipelines and hazardous liquid pipelines to provide system-specific information about their pipeline systems to the emergency response agencies of the communities and jurisdictions in which those pipelines are located. This information should include pipe diameter, operating pressure, product transported, and potential impact radius.*

[21] NTSB Number: PAR-11-01 Pacific Gas and Electric Company Natural Gas Transmission Pipeline Rupture and Fire, San Bruno, California, September 9, 2010

In response to the NTSB safety recommendation, PHMSA began examining issues around the collection and dissemination of additional data through the NPMS.

Pipeline Knowledge & Outreach

Local governments should become knowledgeable about pipelines and the risks associated with potential pipeline failures. They should use their outreach resources to educate their stakeholder constituents about their respective roles in pipeline safety.

The following PIPA recommended practices should be implemented by stakeholders in preparation for future land use and development (BL) and when specific new land use and development projects are proposed (ND).

RP BL03 Utilize Information Regarding Development around Transmission Pipelines

Practice Statement – Transmission pipeline operators should provide information about their pipelines to local governments and property developers/owners who are planning development around their pipelines. Local government authorities regulating development should use this information to establish requirements regarding land use and development around transmission pipelines.

RP ND02 Gather Information for Design of Property Development near Transmission Pipelines

Practice Statement – In designing a proposed property development, the property developer/owner should use all reasonable means to obtain information about transmission pipeline facilities in the area of the proposed development.

RP ND03 Review Acceptability of Proposed Land Use of Transmission Pipeline Right-of-Way Prior to Design

Practice Statement – The property developer/owner should review preliminary information about acceptable land uses on a transmission pipeline right-of-way prior to the design of a property development.

RP ND04 Coordinate Property Development Design and Construction with Transmission Pipeline Operator

Practice Statement – When property development is planned within the consultation zone (RP BL05), the property developer/owner and the transmission pipeline operator should communicate to ensure possible impacts of pipeline incidents and maintenance needs are considered during development design and construction.

Pipeline Land Records

Many land documents should be recorded in order to provide public access to the records and public notice (i.e., constructive notice) of encumbrances on affected property. Recording land documents is the official means by which interests in real property are made a matter of public record, and is necessary when public access is needed to information related to easements, encroachment agreements, partial releases, letters of no objection, etc.,. Affected parties are charged with "constructive notice" of all recorded documents. Unrecorded easements and other interests may be challenged if a subsequent purchaser of a property subject to an easement buys it with no actual notice of the easement or other interest.

RP BL07 Understand the Elements of a Transmission Pipeline Easement

Practice Statement – Property developers/owners should have an understanding of the elements of and rights conveyed in a transmission pipeline easement.

RP BL08 Manage Land Records

Practice Statement – Land use agreements between pipeline operators and property owners should be documented and managed and, when necessary, recorded.

RP BL09 Document and Record Easement Amendments

Practice Statement – Easement amendments should be documented, managed and recorded.

RP BL18 Disclose Transmission Pipeline Easements in Real Estate Transactions

Practice Statement – As part of all real estate sales contracts, each state should require the disclosure of known transmission pipeline easements on the property.

RP ND07 Define Blanket Easement Agreements When Necessary

Practice Statement – Upon request by the landowner, a transmission pipeline easement agreement may be defined to an acceptable, reasonable, and safe width and explicit location. State statutes or local government regulations may require easements to be defined prior to the approval of rezoning, subdivision plats and development permits.

RP ND10 Record Transmission Pipeline Easements on Development Plans and Final Plats

Practice Statement – Local governments should require all recorded development plans and final plats to clearly show the location of transmission pipeline easements and identify the pipeline operators.

RP ND26 Use, Document, Record and Retain Encroachment Agreements or Permits

Practice Statement – Encroachment agreements should be used, documented, recorded and retained when a transmission pipeline operator agrees to allow a property

developer/owner or local government to encroach on the pipeline right-of-way for a long or perpetual duration in a manner that conflicts with the activities allowed on the easement.

RP ND27 Use, Document and Retain Letters of No Objection and Conditional Approval Letters

Practice Statement – Transmission pipeline operators may use, document and retain "letters of no objection" in agreeing to land use activities on or near a transmission pipeline right-of-way. Such land uses may or may not be temporary.

RP ND28 Document, Record and Retain Partial Releases

Practice Statement – Partial releases may be used to allow some part of the transmission pipeline right-of-way to be released from certain easement conditions, and should be documented, recorded and retained.

Facilitate Stakeholder Communications

Communication is a key element when developing near transmission pipeline rights-of-way. *PIPA Recommended Practices* includes several recommendations to facilitate such communication. Two key recommendations are identified in RP BL04 and RP BL05: defining consultation zones, and establishing ordinances to compel property developers/owners to communicate with pipeline operators. Appendix B of *PIPA Recommended Practices* includes a model ordinance to help local governments craft consultation zone ordinances to require property developers/owners to consult with transmission pipeline operators when applying for land use or development permits for properties within a consultation zone.

Optimally, the consultation zone distance should be measured from the transmission pipeline centerline and should be based on the specific characteristics of the pipeline (e.g., pipeline diameter, operating pressure, potential spill volumes, transported commodities, unrestrained flow characteristics of transported commodities) and the local conditions of the area surrounding the pipeline (e.g., topography, population density, vegetation, structures). Local governments should work with the pipeline operators to determine site-specific pipeline characteristics when developing their consultation zone distances. Appendix I of *PIPA Recommended Practices* provides more information regarding the calculation of site-specific planning area distances.

Absent site-specific information, a standard consultation zone distance, of 660 feet on either side of the pipeline centerline, should be used for natural gas transmission pipelines, and a range from 660 to 1,000 feet should be considered for hazardous liquid pipelines. When determining consultation zone distances, consideration should be given to the accuracy of the maps used. NPMS data should be considered no more accurate than +/- 500 feet.

RP BL04 Adopt Transmission Pipeline Consultation Zone Ordinance

Practice Statement – Local governments should adopt land development procedures requiring property developers/owners to consult with transmission pipeline operators early in the development process, so that development designs minimize risks to the populace living or working nearby and are consistent with the needs and legal rights of the operators.

RP BL05 Define Transmission Pipeline Consultation Zone

Practice Statement – Local governments should define a "consultation zone" to provide a mechanism for communication between property developers/owners and operators of nearby transmission pipelines when new land uses and property developments are being planned.

RP BL06 Implement New Development Planning Areas around Transmission Pipelines

Practice Statement – Local governments should consider implementing "planning areas" to enhance safety when new land use and property development is planned near transmission pipelines.

RP BL10 Implement Communications Plan

Practice Statement – Transmission pipeline operators should develop and implement effective communications plans when communicating acceptable transmission pipeline right-of-way uses and activities to property developers/owners and other stakeholders.

RP BL11 Effectively Communicate Pipeline Risk and Risk Management Information

Practice Statement – Transmission pipeline operators should identify barriers to effectively communicating with stakeholders and use communication techniques designed to overcome those barriers and effectively engage stakeholders to communicate with them regarding pipeline risks and how the operator manages such risks.

Figure 26 illustrates a gas line buffer map created by the City of Lenexa, Kansas, to support its consultation zone ordinance. The ordinance reads as follows:

Consultation Zone for Gas Transmission Pipelines and Electrical Transmission Easements

When any proposed development is found to fall within 500 feet of any gas transmission pipeline easement or electrical transmission easement the developer will be required to meet with the holder of the gas pipeline or electrical power easement to allow for review of the proposed plans for the development. Final plans will not be approved by the City of Lenexa until a letter from the easement holder giving approval of the proposed development plans is received. If for any reason the plans are revised another letter from the easement holder will need to accompany the revised plans

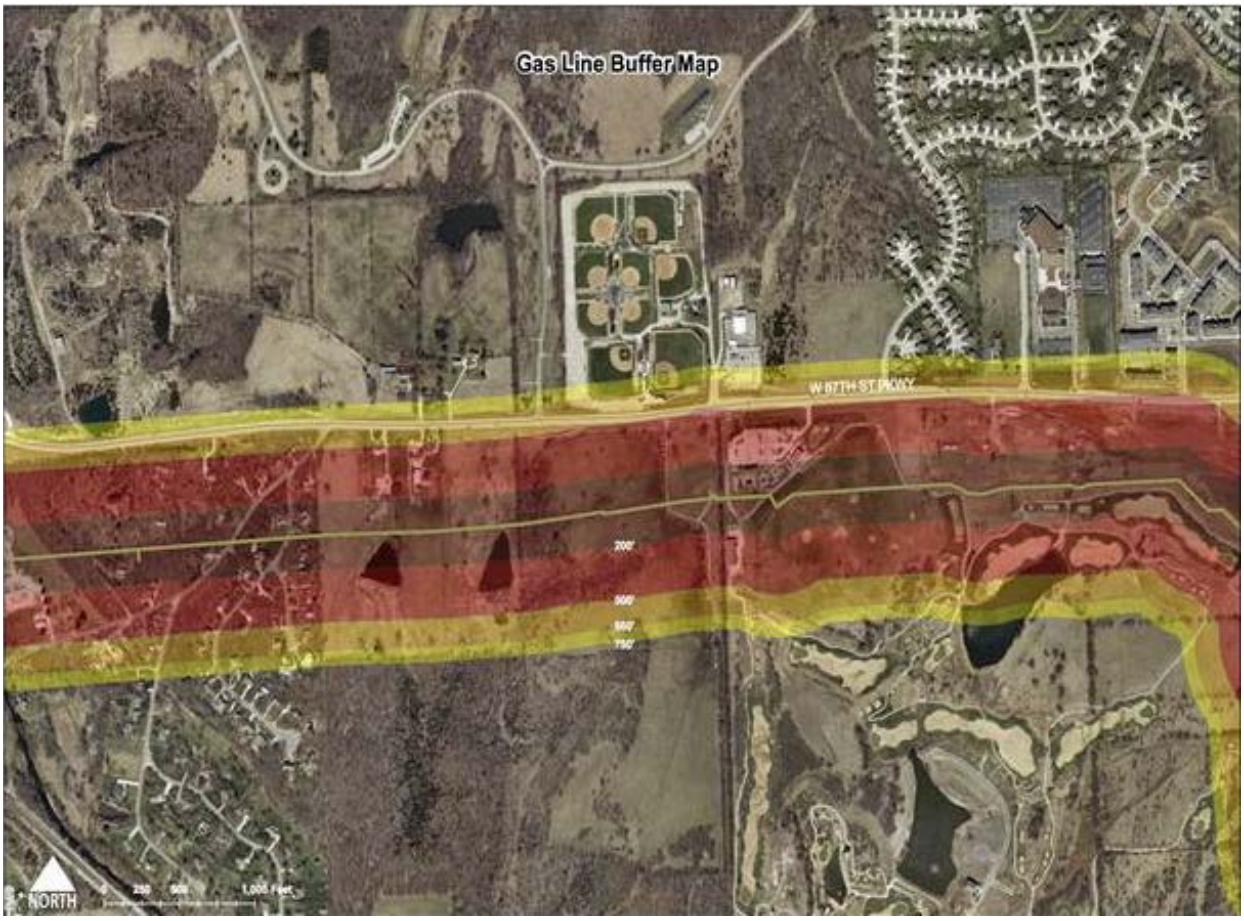

Figure 26: Consultation zone for gas transmission pipelines
(Source: City of Lenexa, Kansas)

Land Use and Development Planning Management Practices

A review for the safe integration of a proposed development with a transmission pipeline should be conducted in a manner similar to that of an environmental site assessment. A tool, *Checklist for Planning, Design, Communication, Permitting, and Site Plan Review*, to assist local governments, developers, and pipeline operators with the review of proposed land use and development projects near transmission pipelines, is provided online at **http://primis.phmsa.dot.gov/comm/pipa/pipa_audience_local_government.htm**.

To help accommodate the PIPA recommendations, local government agencies should consider allowing site planning flexibility in the development of commercial, industrial, or residential property whenever a transmission pipeline is located in, or in close proximity to, the proposed development property (RP ND09). This should include collaboration in identifying alternative land uses with respect to pipeline safety and pipeline-related access and maintenance.

Alternative uses could include utilizing the transmission pipeline easement to create green spaces, parks, golf courses, hike and bike trails, horse trails, and other recreational spaces (RP

ND08). Appendix C, Incorporating Transmission Pipeline ROW in New Developments, of *PIPA Recommended Practices*, describes considerations and includes visual examples that illustrate both successful collaborative efforts and situations to avoid. Discussion among the local government, property developers, and pipeline operators could result, for example, in safely integrating within a transmission pipeline ROW green spaces for the enjoyment of the whole community.

Although past developments cannot be changed, they can serve as good examples to inform future decisions. Local governments are encouraged to review existing land use and development next to transmission pipelines to identify scenarios where better design decisions could have reduced risks. Emergency evacuation procedures and assembly area locations should be reviewed to include consideration of potential threats from pipeline failures.

Below is a list of the key considerations to review the safe integration of developments with pipeline ROW, with references to pertinent PIPA recommended practices:

- Consider ways to decrease the population density near pipeline ROW (RP ND09).
- Consider measures to prevent excavation damage to pipelines during construction and in the future (RP BL15, RP ND08, RP ND12, RP ND16, RP ND22, RP ND24).
- Review potentials for other types of damages to pipelines from developments (e.g., water run-off, interference with cathodic protection systems) (RP ND11, RP ND12, RP ND13, RP ND14, RP ND16, RP ND17).
- Review plans to ensure adequate access to the pipeline facilities and ROW, access for emergency response vehicles, access to and capacity of water and other resources needed for emergency response (RP BL06, RP ND 12, RP ND14, RP ND 16, RP ND 17, RP ND 19, RP ND 20, RP ND21, RP ND22, RP ND23).
- Review abilities for safe and timely evacuations, especially for difficult-to-evacuate populations (RP ND12, RP ND17, RP ND20, RP ND22).
- Review plans for enhanced fire protection and/or building fire endurance if needed[22] (RP ND11, RP ND 17, RP ND20, RP ND 21, RP ND22).
- Review pathways for potential gas or hazardous liquid migration in the event of a pipeline release (RP ND13, RP ND14, RP ND16, RP ND19).
- Review plans to minimize the consequences of a pipeline incident. Consider:
    - Is there minimum separation within the ROW from other structures?
    - Are buildings clustered away from the pipelines?
    - Are higher-density or difficult-to-evacuate developments located with a maximum separation from the pipeline?
    - Are open spaces located closest to the pipeline, thereby creating buffers? (RP ND09, RP ND11, RP ND12, RP ND13, RP ND14, RP ND16, RP ND17, RP ND19, RP ND20)
- Review selection and design of vegetation (RP ND15).
- Consider the effects of noise and odor from pipeline operations (RP ND18).

[22] Reference National Fire Protection Association, NFPA 1: Fire Code, Ed. 2012

- Consider escalation of risks due to cascading effects (RP ND19, RP ND21).
- Consider proposed use of pipeline ROW for alternative use such as green spaces, parks, golf courses, hike and bike trails, horse trails, and other recreational spaces. See Appendix C of *PIPA Recommended Practices* for examples (RP ND 08).

Specific design considerations and recommendations are provided in the PIPA report for: roads, parking lots and parking structures; aboveground water management, sanitary systems, utilities, and related infrastructure; public safety and enforcement facilities; public assembly areas; vegetation; and residential, mixed-use, commercial, industrial, and institutional land use developments. Following are the PIPA recommended practices for specific development types that describe considerations for the safe integration of the development with the pipeline.

RP ND06 Require Consideration of Transmission Pipeline Facilities in Land Development Design

Practice Statement – Whenever development is proposed on property containing transmission pipeline facilities, local governments should require that the submitted land development plans address in detail the steps necessary to safely integrate the transmission pipeline into the design of the project.

RP ND08 Collaborate on Alternate Use and Development of Transmission Pipeline Right-of-Way

Practice Statement – Property developers/owners, local governments and transmission pipeline operators may collaborate on alternative use of the transmission pipeline right-of-way and related maintenance.

RP ND09 Provide Flexibility for Developing Open Space along Transmission Pipeline Rights-of-Way

Practice Statement – Local governments should consider allowing site planning flexibility in the development of commercial, industrial or residential property whenever a transmission pipeline is located in, or in close proximity to, the proposed development.

RP ND11 Reduce Transmission Pipeline Risk through Design and Location of New Parking Lots and Parking Structures

Practice Statement – Parking lots and parking structures should be preferentially located and designed to reduce the consequences that could result from a transmission pipeline incident and to reduce potential interference with transmission pipeline maintenance and inspections.

RP ND12 Reduce Transmission Pipeline Risk through Design and Location of New Roads

Practice Statement – Roads and associated appurtenances should be preferentially located and designed to reduce the consequences that could result from a transmission

pipeline incident and reduce the potential of interference with pipeline operations and maintenance.

RP ND13 Reduce Transmission Pipeline Risk through Design and Location of New Utilities and Related Infrastructure

Practice Statement – Utilities (both above and below ground) and related infrastructure should be preferentially located and designed to reduce the consequences that could result from a transmission pipeline incident and to reduce the potential of interference with transmission pipeline maintenance and inspections.

RP ND14 Reduce Transmission Pipeline Risk through Design and Location of Aboveground Water Management Infrastructure

Practice Statement – Storm water and irrigation water management facilities**,** retention ponds, and other above-ground water management infrastructure should be preferentially located and designed to reduce the consequences that could result from a transmission pipeline incident and to reduce the potential of interference with transmission pipeline operations and maintenance.

RP ND15 Plan and Locate Vegetation to Prevent Interference with Transmission Pipeline Activities

Practice Statement – Trees and other vegetation should be planned and located to reduce the potential of interference with transmission pipeline operations, maintenance, and inspections.

RP ND16 Locate and Design Water Supply and Sanitary Systems to Prevent Contamination and Excavation Damage

Practice Statement – Individual water supplies (water wells), small public/private water systems and sanitary disposal systems (septic tanks, leach or drain fields) should be designed and located to prevent excavation damage to transmission pipelines, interference with transmission pipeline maintenance and inspections, and environmental contamination in the event of a transmission pipeline incident.

RP ND17 Reduce Transmission Pipeline Risk in New Development for Residential, Mixed-Use, and Commercial Land Use

Practice Statement – New development within a transmission pipeline planning area (RP BL06) should be designed and buildings located to reduce the consequences that could result from a transmission pipeline incident and to provide adequate access to the pipeline for operations and maintenance.

RP ND18 Consider Transmission Pipeline Operation Noise and Odor in Design and Location of Residential, Mixed-Use, and Commercial Land Use Development

Practice Statement – Consider noise, odor and other issues when planning and locating developments near above-ground transmission pipeline facilities, such as compressor stations, pumping stations, odorant equipment, regulator stations and other pipeline appurtenances.

RP ND19 Reduce Transmission Pipeline Risk through Design and Location of New Industrial Land Use Development

Practice Statement – New industrial land use development within a transmission pipeline planning area (RP BL06) should be designed and buildings located to reduce the consequences that could result from a transmission pipeline incident and reduce the potential of interference with transmission pipeline operations and maintenance.

RP ND20 Reduce Transmission Pipeline Risk through Location, Design, and Construction of New Institutional Land Use Developments

Practice Statement – New development of institutional facilities that may be difficult to evacuate within a transmission pipeline planning area (RP BL06) should be designed and the facilities located and constructed to reduce the consequences that could result from a transmission pipeline incident. Such facilities should also be located to reduce the potential of interference with transmission pipeline operations and maintenance activities. Emergency plans for these facilities should consider potential transmission pipeline incidents.

RP ND21 Reduce Transmission Pipeline Risk through Design and Location of New Public Safety and Enforcement Facilities

Practice Statement – New development of emergency responder facilities within a transmission pipeline planning area (RP BL06) should be designed and the facilities located and constructed to reduce the consequences that could result from a transmission pipeline incident. Such facilities should also be designed and located to avoid the potential of interference with pipeline operations and maintenance. Planning for these facilities should include emergency plans that consider the effects of a transmission pipeline incident.

RP ND22 Reduce Transmission Pipeline Risk through Design and Location of New Places of Mass Public Assembly (Future Identified Sites)

Practice Statement – New development of places of potential mass public assembly within a transmission pipeline planning area (RP BL06) should be designed and the facilities located and constructed to reduce the consequences of a potential transmission pipeline incident, the risk of excavation damage to the pipeline, and the potential of interference with transmission pipeline operations and maintenance. Planning for these facilities should include emergency plans that consider the effects of a potential pipeline incident.

RP ND23 Consider Site Emergency Response Plans in Land Use Development

Practice Statement – Emergency response plan requirements should be considered in new land use development within a planning area (RP BL06) to reduce the risks of a transmission pipeline incident.

Excavation Damage Prevention

A large portion of serious pipeline incidents are caused by excavation damage. Excavation damage most often occurs because of a weakness or breakdown in implementation of the damage prevention process. This may include:

- Gaps in damage prevention laws or inadequate and ineffective inspection and enforcement,
- Insufficient or ineffective public education and awareness,
- Failure to call before digging or to wait the necessary time for underground facilities to be located and marked,
- Untimely or inaccurate facility locates, and
- Inadequate mapping in-house or with the one-call center.

Each state has a damage prevention law in place that requires an excavator to call a one-call center before digging. In any area of the country, excavators can simply dial "811" to reach the one-call center.

However, some State excavation damage prevention laws include exemptions from one-call system participation. Exemptions may increase the likelihood of excavation damage to pipelines, which could increase the potential risk. Where possible, it is suggested that local governments require all excavators to notify pipeline operators before beginning any excavation. PHMSA provides more information about damage prevention online at http://primis.phmsa.dot.gov/comm/DamagePrevention.htm.

All stakeholders have a responsibility to prevent excavation damage to pipelines and help ensure pipeline safety.

Excavation Damage Prevention – Prior to Development

RP BL14 Participate to Improve State Excavation Damage Prevention Programs

Practice Statement – All pipeline safety stakeholders should participate in the work of organizations seeking to make improvements to State excavation damage prevention programs, especially efforts to reduce exemptions from participation in one-call systems.

RP BL15 Enhance Damage Prevention Practices near High-Priority Subsurface Facilities

Practice Statement – Transmission pipeline operators should implement enhanced damage prevention practices within the transmission pipeline right-of-way to ensure that pipeline operators and excavators meet on-site prior to excavation activity near high-priority subsurface facilities.

RP BL16 Halt Dangerous Excavation Activities near Transmission Pipelines

Practice Statement – Transmission pipeline operators should have procedures and established contacts with local enforcement personnel in order to act appropriately to halt dangerous excavation activities that may damage their pipelines and potentially cause an immediate threat to life or property.

RP BL17 Map Abandoned Pipelines

Practice Statement – When a transmission pipeline operator abandons a transmission pipeline, information regarding the abandoned pipeline should be maintained and included in the information provided to the one-call center.

Excavation Damage Prevention – During Construction

Preventing excavation damage to pipelines during construction is a mitigation measure that should begin during the development's design phase.

RP ND24 Install Temporary Markers on Edge of Transmission Pipeline Right-of-Way Prior to Construction Adjacent to Right-of-Way

Practice Statement – The property developer/owner should install temporary right-of-way (ROW) survey markers or fencing on the edge of the transmission pipeline ROW or buffer zone, as determined by the transmission pipeline operator, prior to construction to provide a clearly defined boundary. The property developer/owner should ensure that the temporary markers or fencing are maintained throughout the course of construction.

RP ND25 Contact Transmission Pipeline Operator Prior to Excavating or Blasting

Practice Statement – Anyone planning to conduct excavating, blasting and/or seismic activities should consult with affected transmission pipeline operators well in advance of commencing these activities. Excavating and blasting have the potential to affect soil stability or lead to movement or settling of the soil surrounding the transmission pipeline.

Mitigation Measures from Natural Hazards

Policies and actions used to mitigate natural hazards may also be applicable to mitigate potential pipeline hazards.

For example, fire is clearly a potential hazard resulting from pipeline failures. Mitigation measures similar to those for wildfires may be appropriate to address that risk. FEMA provides a document, *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, which offers an

index of possible mitigation measures for fire and other natural hazards. It is available online at http://www.fema.gov/library/viewRecord.do?id=6938.

Roseville, California, is a community that considered fire and hazardous materials in its mitigation plan. The city was interested in improving its fire rating to allow for multi-story construction in future developments, and it has the largest rail yard west of the Mississippi, through which pass significant amounts of hazardous materials and freight. https://www.roseville.ca.us/fire/preparedness/hazard_mitigation_plan.asp

Water or land spills from hazardous liquid pipelines also present potential environmental threats. Executive Orders[23] 11988, Floodplain Management, and 11990, Protection of Wetlands, should be considered when planning pipeline hazard mitigation in floodplains, wetlands, or other environmentally sensitive areas.

Performing Capability Assessments

A capability assessment has two primary components: an inventory of a local jurisdiction's relevant plans, ordinances, or programs already in place, and an analysis of its capacity to implement those plans, ordinances, or programs.

Funding Capabilities

Several different types of funding may be available to assist State and local governments to develop mitigation programs that address potential pipeline risks. PHMSA has several grant programs that may provide assistance[24].

US DOT PHMSA Federally-Funded Programs

Funding under Federal grant programs is subject to the availability of appropriations, as well as any directive or restriction made with respect to such funds in the law.

- *Technical Assistance Grants* – PHMSA's Technical Assistance Grants program awards enable local governments, communities, and groups of individuals to obtain funding for technical assistance in the form of engineering or other scientific analysis of pipeline safety issues and to help promote public participation in official proceedings (universities are not eligible). Enhancing hazard mitigation plans to address potential hazards from pipeline failures would be an eligible activity under the program. The grant opportunity typically opens around January/February and is awarded around September of each year. In 2013 the amount of any grant may not exceed $100,000 for a single grant recipient. Catalog of Federal Domestic Assistance (CFDA) Number 20.710. Authorized under 49 USC §60130.

[23] EO 11988 (http://water.epa.gov/lawsregs/guidance/wetlands/eo11988.cfm); EO 11990 (http://water.epa.gov/lawsregs/guidance/wetlands/eo11990.cfm)
[24] http://primis.phmsa.dot.gov/comm/DamagePreventionGrantsToStates.htm

- *State Damage Prevention Grants* – The purpose of PHMSA's State damage prevention grants is to establish comprehensive State programs designed to prevent damage to underground pipelines in states that do not have such programs and to improve damage prevention programs in states that do. In 2013 the amount of any grant may not exceed $100,000 for a single grant recipient. CFDA Number 20.720. Authorized under 49 USC §60134.
- *PHMSA Pipeline Safety Program One-Call Grants* – PHMSA's one-call grants are designed to provide funding to State agencies in promoting damage prevention, including changes with their State underground damage prevention laws, related compliance activities, training, and public education. State agencies that participate in the pipeline safety program are eligible to apply for one-call grant funding on an annual basis, with a maximum request amount of $45,000 per state. A state may provide funds received under this section directly to any one-call notification system if the state substantially adopts the Common Ground Alliance Best Practices. CFDA Number 20.721. Authorized under 49 USC §6106.

Pipeline Operator Contributions

In addition to providing technical expertise, pipeline operators may also be a source of materials, such as pipeline awareness promotional materials, to assist jurisdictions in implementing mitigation actions for potential pipeline threats and associated hazards. Charitable contributions may be available from pipeline operators as well. As noted in Appendix D of API RP 1162[25]:

> *While contributions and civic causes are not in themselves a public awareness effort, companies should consider appropriate opportunities where public awareness messages can be conveyed as a part of or in publicity of the contribution. Examples include:*

- *Contributions of gas detection equipment to the local volunteer fire department*
- *Donation of funds to acquire or improve nature preserves or green space*
- *Sponsorship of emergency responders to fire training school*

State Capabilities

The following State agencies may have either direct or indirect roles in hazard mitigation. They can play a key role in reducing pipeline risks within a State and in improving the effectiveness of hazard mitigation activities.

[25] American Petroleum Institute (API) Recommended Practice (RP) 1162, "Public Awareness Programs for Pipeline Operators". API RP 1162 is incorporated by reference in Federal pipeline safety regulations 49 CFR §192.616 and §195.440.

Emergency Management Organizations

The primary mission of a State emergency management organization is to protect the lives and property of the State's citizens from emergencies and disasters, by coordinating State emergency preparedness, response, recovery, and mitigation programs. The emergency management organization's responsibility is to ensure comprehensive, efficient, and effective responses to emergencies and disasters, including providing assistance in the absence of Federal aid. In this role, State emergency management organizations are usually charged with supporting hazard mitigation planning. State emergency management organizations may also work with the U.S. Environmental Protection Agency and its State partners on oil spill response drills.

State Fire Marshals

State fire marshals are generally the senior fire officials in their states. Their responsibilities vary from state to state, but they tend to be responsible for fire safety code adoption and enforcement, fire and arson investigation, fire incident data reporting and analysis, public education, and advising State governors and legislatures on fire protection. Some State fire marshals are responsible for fire-fighter training, hazardous materials incident responses, wild land fires, and the regulation of natural gas pipelines and other pipelines. Most State fire marshals are appointed by their State's governor or other high-ranking State official. In some jurisdictions, regional fire protection service authorities exist to enable cooperative planning and response among multiple and adjacent fire protection jurisdictions. This enables the participating jurisdictions to leverage extended planning and response capabilities and resources.

State Departments of Transportation (DOT)

State DOTs are responsible for building, maintaining, and operating state roads, bridges, and tunnels, including repairs and replacements after natural disasters. State DOTs routinely factor flood hazards into the planning and design of transportation infrastructure. In some cases seismic hazards are also considered.

State and Territorial Environmental Agencies

State and territorial environment agencies have major responsibilities regarding the environmental consequences of accidents and disasters. These agencies play major roles in hazardous materials containment, testing, and abatement, and provide oversight to the joint permitting processes that oversee any activity with potential impacts to rivers, streams or wetlands.[26]

Local/Regional Capabilities

With respect to addressing potential pipeline hazards, local jurisdictions control land use through codes and ordinances, planning, zoning, and permitting. These local governmental functions are

[26] Clean Water Act, Section 401, "Permits and Licenses – Certification" and Section 404, "Regulations." (http://water.epa.gov/lawsregs/rulesregs/)

enabled through State laws and regulations, and can contribute significantly to mitigation of pipeline threats and associated hazards. Local jurisdictional programs are also extremely relevant as State agencies generally manage State facilities in a manner that is consistent and complementary of local comprehensive planning and zoning.

Many states use uniform statewide building codes for new construction and building repairs or additions. Local hazard mitigation strategies can reflect local land use requirements and building codes and may contribute significantly to mitigating potential pipeline threats and associated hazards.

Following are some typical means by which local jurisdictions may control land use and development.

- *Comprehensive citywide and countywide plans* are prepared by local planning commissions and address the jurisdiction's policies regarding physical development of land within a jurisdiction's boundaries. Generally, transportation, utilities, land use, recreation, and housing are addressed, but these may be enhanced or supported by sector plans, general plans, growth policy plans, utilities plans, capital improvement plans, and major road plans.
- *Zoning ordinances* provide for the public health, safety, and general welfare of the citizens of a jurisdiction. They are used to regulate or restrict the location and use of buildings, structures, and land for residence, trade, industry, and other purposes. They restrict the height, number of stories, and size of buildings and other structures, and the size of yards, courts, and other open spaces on a lot or tract. They are defined through official land use plans for property publicly and privately owned within the jurisdiction. They help to guide, control, and regulate the future growth and development of the jurisdiction, and provide for the administration of such plans.
- *Land subdivision and development ordinances* are prescribed by statute. They generally provide for the harmonious development of the jurisdiction and its environs, including the coordination of roads within the subdivided land, with other existing or planned roads, or with the state or regional plan, or with the plans of municipalities in or near the region. They provide for adequate open spaces for traffic, light, air and recreation; for the conservation or production of adequate transportation, water, drainage and sanitary facilities; and for the avoidance of population congestion. They also provide for the avoidance of such scattered or premature subdivision of land as would involve danger or injury to health, safety or prosperity by reason of the lack of water supplies, drainage, transportation or other public services, or that would necessitate an excessive expenditure of public funds for the supply of such services. They also control the manner in which roads are to be graded and improved, and water, sewer, and other utility mains, piping, connections, or other facilities are to be installed.

- *Building codes* are sets of rules that specify the minimum acceptable levels of safety for constructed objects such as buildings and other structures. The main purpose of building codes is to protect the health, safety, and general welfare of the public, as they relate to the construction and occupancy of buildings and structures. A building code is codified into law of a particular jurisdiction when formally enacted by the appropriate authority.

  Building codes are usually a combination of prescriptive requirements that spell out exactly how something is to be done, and performance requirements which just outline what the required level of performance is. In recent history, the trend has been for building codes to move to more prescriptive requirements and less performance requirements.

The major model building codes used in the United States are developed by International Code Council (ICC). ICC is dedicated to developing model codes and standards used in the design, build and compliance process to construct safe, sustainable, affordable and resilient structures. Many U.S. communities and many global markets choose the International Codes (I-Codes).

The I-Codes published by ICC are a complete set of comprehensive, coordinated building safety and fire prevention codes that benefit public safety and support the industry's need for one set of codes without regional limitations.

Fifty states and the District of Columbia have adopted the I-Codes at the state or jurisdictional level. Federal agencies including the Architect of the Capitol, General Services Administration, National Park Service, Department of State, U.S. Forest Service and the Department of Veterans Affairs also enforce the I-Codes. The Department of Defense references the International Building Code for constructing military facilities, including those that house U.S. troops around the world and at home. Amtrak uses the International Green Construction Code for new and extensively renovated sites and structures. Puerto Rico and the U.S. Virgin Islands enforce one or more of the I-Codes.

  FEMA develops and produces multi-hazard mitigation guidance that focuses on creating disaster-resilient communities to reduce loss of life and property. FEMA develops publications, guidance materials, tools, technical bulletins, and recovery advisories that incorporate the most up-to-date building codes, flood-proofing requirements, seismic design standards, and wind design requirements for new construction and the repair of existing buildings. FEMA partners with the Internal Code Council to support the development and adoption of model building codes and standards.

- *Floodplain management* provisions for development within regulated floodplains have typically been addressed by standalone ordinances adopted for voluntary participation in the National Flood Insurance Program (NFIP). The designated NFIP coordinating agency of a local government may find benefit in discussing potential oil spill consequences with

pipeline operators. The data from this program may inform pipeline operators of locations where flooding is more likely to impact pipelines.

- *Regional Cooperative Development* occurs when the physical land use of an area extends beyond the boundaries of a single jurisdiction. An example of this would be the development or extension of new interstates, railways, and airports. Transmission pipelines often cross jurisdictional boundaries. Multi-jurisdictional cooperation in mitigation planning for potential pipeline threats and associated hazards could benefit all stakeholders involved.

Emergency Response Preparedness for Pipeline Emergencies

Planning for emergency response needs should be considered when development occurs in close proximity to a transmission pipeline right-of-way. While not a mitigation action, the importance of emergency preparedness is critical to protect the community in the event of a pipeline release. Some key resources for emergency preparedness include:

- *Pipeline Emergencies Training*

  Several pipeline emergency training resources are available at no cost. The most comprehensive of these is the second edition of "Pipeline Emergencies," available for free at www.pipelineemergencies.com.

- *Emergency Response Guidebook*

  PHMSA's Emergency Response Guidebook contains information about pipelines, including:

  - A basic overview of pipeline types, associated structures and markers;
  - Indications of pipeline leaks and ruptures; and
  - The fundamentals of a safe and effective response.

  Product information, as well as the physical state and pressure of the product in the pipeline, is critical to responders to initiate public protective actions as soon as possible. Initial isolation zones and downwind protective action distances are listed in the Guidebook. To learn more about PHMSA's Emergency Response Guidebook, visit http://phmsa.dot.gov/hazmat.

- *Hazardous Materials Cooperative Research Program Report 5: Guide for Assessing Community Emergency Response Needs and Capabilities for Hazardous Materials Releases*

  This guide, published through the Transportation Research Board's Hazardous Materials Cooperative Research Program, provides step-by-step guidance on assessing hazardous materials emergency response needs at the State, regional, and local levels. The report also addresses matching State, regional, and local capabilities with potential emergencies involving different types of hazardous materials, and offers an assessment on how

quickly resources can be expected to be brought to bear in an emergency. The report is available online at http://www.trb.org/Main/Blurbs/165201.aspx.

- *Pipeline Operators*

  Fire, police, and other response agencies are encouraged to regularly conduct pipeline emergency drills and practice exercises with pipeline operators to improve their preparedness to respond to emergencies.

Step 4: Implement the hazard mitigation plan and associated mitigation projects in day-to-day organizational operations. Conduct periodic evaluations and make revisions, as needed, to ensure the relevance and success of an ongoing program. Regularly review and revise the hazard mitigation plan as necessary.

Implement Plan and Monitor Progress

Baseline vs. New Development Recommend Practices

To build a community's capacity to build near transmission pipelines, there are practices they can put in place in anticipation of new development, and practices to be implemented when new development is initiated. The optimal time for local governments to address the risk of new development in close proximity to transmission pipelines is before development is proposed, when informed decisions and appropriate communications can take place.

Communication about requirements for development near transmission pipelines early in the land acquisition and planning phase will help to avoid costly project changes or delays and ensure optimum land use considerations and pipeline safety.

Benefits of Enhanced Hazard Mitigation Plans for Pipelines

Pipeline operators, emergency management, and the community all benefit from incorporating pipelines into the hazard mitigation planning process.

Benefits to the Community

States, local communities, and tribes today are susceptible to a variety of natural, technological, and human-caused hazards. It is important that they develop hazard mitigation plans to understand the potential hazards communities face and develop appropriate mitigation actions. Mitigation planning provides a process for communities to evaluate the hazards, and take into consideration the at-risk populations, buildings, transportation routes and key facilities.

Communities have an obligation to understand the potential risks they face. Knowledge of these risks allows them to make informed decisions about how to manage the risks and develop needed capabilities.

Hazard mitigation planning traditionally focused on planning for natural hazards. However, events such as the September 11, 2001, terrorist attacks and a natural gas transmission pipeline incident in San Bruno, California, in 2010, suggested the need to incorporate human-caused and technological threats and hazards into all aspects of emergency management planning.

Including pipelines in the development of state and community hazard mitigation plans will help institutionalize the consideration of potential pipeline risks to the community. Potential risks and

a community's tolerance to risk change over time. State, Tribal and local hazard mitigation plans are updated every five years. Updates to these living documents can capture new event information, identify strategies that have been implemented and the effects from the actions taken, and identify new (if needed) strategies based on increased hazard impact knowledge, improved technology, and changes in partnerships. Periodic review of hazard mitigation plans allows communities to evaluate their plans and address changes.

Including pipelines into the hazard mitigation planning process will also benefit emergency managers to build, sustain and improve their capability to prepare for, protect against, respond to, recover from, and mitigate all hazards.

Benefits to Pipeline Operators

Participation in State, local, and tribal hazard mitigation planning processes can benefit pipeline operators in several ways. These include providing enhanced opportunities to:

- Exchange and communicate information regarding potential pipeline threats and hazards,
- Convey information regarding pipeline safety and integrity,
- Gain increased stakeholder acceptance regarding the need to protect the pipeline rights-of-way and to perform needed maintenance and repairs,
- Develop relationships to facilitate the coordination of emergency response plans, and
- Build improved relationships with community leaders and emergency management officials.

These opportunities can help operators raise the bar on pipeline safety by developing partnerships with safety regulators and other key State, local, and tribal government stakeholders. Better-informed governmental organizations can help to improve pipeline safety in many ways, including:

- Enhancing pipeline safety through land use and development regulation;
- Establishing enhanced requirements affecting excavation damage prevention;
- Improving the communication of pipeline safety, pipeline awareness, and damage prevention information as a result of their credibility with constituents; and
- Enhancing understanding of their associated roles in emergency preparedness, response, and recovery.

States, local communities, and tribes utilize a variety of resources in the development of their hazard mitigation plans to identify and assess natural hazards that can threaten pipelines and other infrastructure. Natural hazards include floods, hurricanes, tornados, severe winter weather, wildfires, drought, landslides, land subsidence, and earthquakes. Developing cooperative relationships with States, local communities, and tribes relative to hazard mitigation can provide pipeline operators with data and information that can help assess the potential impacts of these threats to their pipelines.

During natural hazard events such as floods and hurricanes, State, local, and tribal emergency management organizations establish incident command systems[27]. An incident command system is a standardized, on-scene, all-hazards incident management approach that:

- Allows for the integration of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure;
- Enables a coordinated response among various jurisdictions and functional agencies, both public and private; and
- Establishes common processes for planning and managing resources.

Cooperation and coordination with an incident command system during a natural hazard event can facilitate the acquisition and sharing of information needed by and from the pipeline operator and enable timely prevention and mitigation actions to address potential pipeline threats and ensure the safety of potentially affected pipelines. This may require that one or more pipeline operator personnel who have emergency management responsibilities receive training and certification in the incident command system.

[27] FEMA, Incident Command System (ICS), http://www.fema.gov/emergency/nims/IncidentCommandSystem.shtm

Appendix: Examples of Local Government Efforts To Reduce Impacts

Following are a few examples of local government efforts to reduce the impacts of pipelines on their communities by enforcing local ordinances that are not preempted by Federal law[28].

Franchise agreements

One of the most fundamental relationships between a pipeline operator and a municipal or county government is an agreement governing the operator's ability to operate in the public rights-of-way (ROW) within the government jurisdiction's geographic area. These agreements have a number of names, including: franchise agreement, crossing permit, and right-of-way use agreement. They generally address the pipeline operator's rights to use the public ROW under prescribed conditions. They also, among other things, assign costs and risks to the parties, govern pipeline replacement and abandonment activities, and allocate the costs of moving the pipeline for other local government projects. Frequently, local governments require pipeline operators to maintain insurance and to post performance bonds and other financial protection for the local government, and require indemnification in the event of an incident.

Shortly after the 1999 Olympic Pipeline incident in Bellingham, Washington[29], the City of Seattle declined to renew Olympic Pipeline's franchise to operate within the City unless the agreement included certain conditions. The City indicated that it would shut the pipeline down if those conditions were not met. The pipeline operator challenged the City in court.

The case ended up in the U. S. Court of Appeals, Ninth Circuit, which held that the City could not impose inspection or testing requirements on the operator through the franchise agreement, as those were governed by and preempted by the Federal Pipeline Safety Act[30]. However, the Court held out several items that the city could include without running afoul of the preemption issue. Those included liability insurance and franchise fees and the right to terminate the franchise under certain conditions. In addition, the Court indicated that when acting in a proprietary, rather than regulatory role, the City could "still contractually require that Olympic perform safety tests of the pipeline," although it found that the City was acting in a regulatory role in attempting to impose conditions through the franchise.

A page on the website of Washington's Municipal Research and Services Center provides some examples of franchise agreements providing for large ($100M) liability policies and other terms of importance to cities. Some of the franchise agreements listed on the page also require operators to comply with all local permitting requirements.

The page can be accessed at:
http://www.mrsc.org/subjects/pubsafe/pipesafetylocgov.aspx#Jurisdiction

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[28] 49 U.S.C. Chapter 601

[29] NTSB Report PAR-02/02 Pipeline Rupture and Subsequent Fire in Bellingham, Washington June 10, 1999 http://www.ntsb.gov/doclib/reports/2002/PAR0202.pdf

[30] Olympic Pipeline Company v. City of Seattle (9th Cir. 2006)

It includes links to several documents that provide background information on a range of pipeline issues. It includes some land use ordinances enacted by Washington cities. These ordinances implement consultation zones, setbacks, and limitations on construction or additions to structures that house hard-to-evacuate populations near pipelines.

Local zoning not preempted for non-FERC lines (intrastate gas and all liquid lines)

A case in the U. S. Court Of Appeals, Fourth Circuit, illustrates that local zoning is not preempted by the pipeline safety statutes[31]. On March 25, 2013, the Court issued a unanimous decision upholding a Federal district court decision that the Federal Pipeline Safety Act does not preempt a county's zoning laws from applying to an intrastate gas pipeline and storage project that was not consistent with the County's zoning for transit-oriented residential development on a site.

More zoning

In July 2013, Adams County, Colorado, denied a conditional use permit to Front Range Pipeline for a new natural gas liquids pipeline construction project. County commissioners denied the proposed route of the pipeline, citing concerns that the pipeline would interfere with future development plans, especially around Denver International Airport, and interfere with future growth and economic development of the County. Adams County has other pipeline applications on its docket, indicating that pipeline operators are cognizant of the need to obtain county zoning approval for certain projects.[32]

Eminent Domain

The laws governing the ability of a pipeline company to use eminent domain[33] authority are complex and vary widely from state to state. In some, the controlling language is in the State constitution; in others, it is a statute. Some states allow the use of eminent domain by a pipeline company, or not, depending on the commodity being moved. In others, usage is available only to pipelines and other utilities regulated by the State regulatory agency, but not to other pipelines, like gathering pipeline companies. Some states extend usage of eminent domain only to common carriers, but not to pipelines carrying only the operator's product.

Local governments faced with a pipeline operator claiming the power of eminent domain should learn about the limitations imposed by their State laws. Eminent domain could be a factor affecting existing transmission pipelines if, for example, the pipeline had to be rerouted and

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[31] Washington Gas Light Co. v. The Prince George's County Council Sitting as the District Council, et al., No. 12-1443, 4th Cir.

[32] Source: Denver Post, http://www.denverpost.com/breakingnews/ci_23760379/adams-county-sends-leg-cross-country-gas-pipeline

[33] Generally speaking, "eminent domain" is the power to take private property for public use by a state. However, it can be legislatively delegated by the state to municipalities, government subdivisions, or even private persons or corporations when they are authorized to exercise functions of public character. http://en.wikipedia.org/wiki/Eminent_domain - cite_note-1

moved for some reason, or, perhaps, if the pipeline company wanted to expand an existing ROW to replace an existing line with a larger diameter line.

Safety Rules Preempted

Certain attempts by local governments, like the City of Seattle as noted above, to require additional tests or impose safety regulations on pipelines, have been ruled by the courts to be preempted.[34] Local governments attempting to require more of something that Federal regulations already require may run afoul of the preemption doctrine.

[34] Olympic Pipeline Company v. City of Seattle (9th Cir. 2006)