National Flood Insurance Program

Community Rating System

CRS Credit for Stormwater Management

2007

FEMA

Note on this edition: This document was revised to reflect the following changes in the 2007 *CRS Coordinator's Manual*:

- A change in terminology from "Stormwater Master Plan (SMP)" to "Watershed Master Plan (WMP)" and changes in the commentary to better describe the requirements and the objectives of this credit.

A community interested in more information on obtaining flood insurance premium credits through the Community Rating System (CRS) should have the *CRS Application*. This and other publications on the CRS are available at no cost from

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They can also be viewed and downloaded from FEMA's CRS website,
http://training.fema.gov/EMIWeb/CRS/index.htm

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Introduction

Objective

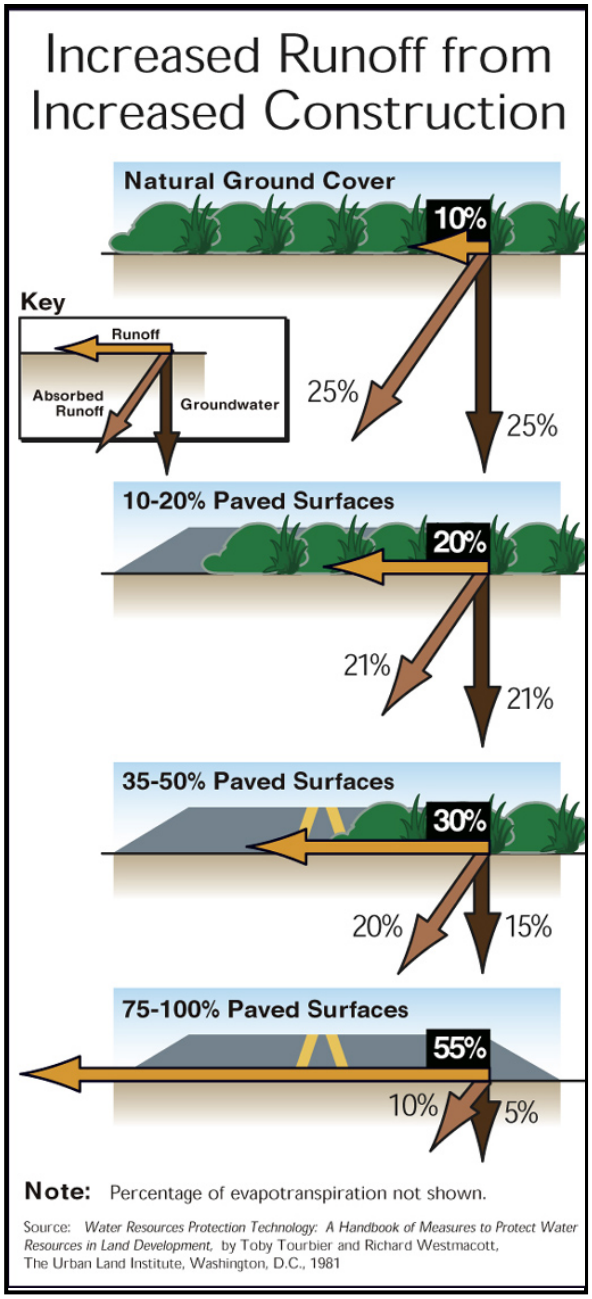
One of the biggest problems of floodplain management in urbanizing areas is the increase in peak flow caused by development within a watershed. As forests, fields, and farms are covered by impermeable surfaces like streets, rooftops, and parking lots, more rain runs off at a faster rate. When an area is urbanized, the rate of runoff can increase five-fold or more.

This problem is compounded by changes in the surface drainage system. Stormwater runoff travels faster on streets and in storm drains than it did under pre-development conditions. As a result, flooding is more frequent and more severe.

Efforts to reduce the impact of increased runoff that results from new development in a watershed are known as stormwater management. Stormwater management also encompasses many aspects of water quality, and includes efforts to reduce erosion and the entry of sediment and pollutants into receiving streams.

Finally, it is recognized that many buildings outside the floodplain are flooded because of local drainage problems. Elevating new buildings outside the floodplain or providing positive drainage away from new development reduces much of this damage.

Among the objectives of the Community Rating System (CRS) are flood damage reduction and water quality protection. These objectives are addressed by the elements in this CRS activity.



The CRS

The Community Rating System (CRS) is a part of the National Flood Insurance Program (NFIP). When communities go beyond the minimum standards for floodplain management, the CRS can provide discounts up to 45% off flood insurance premiums.

Communities apply for a CRS classification and are given credit points that reflect the impact of their activities on reducing flood losses, insurance rating, and promoting the awareness of flood insurance. The Insurance Services Office's ISO/CRS Specialist reviews the community's program and verifies the CRS credit. This includes a review of the written procedures and records of an activity and, in some cases, a visit to sites in the field.

A community applies using the *CRS Application*. CRS credit criteria, scoring, and documentation requirements are explained in the *CRS Coordinator's Manual*. Copies of both are available free from the office listed on the inside front cover of this publication.

Regulations Recognized in Activity 450

The CRS credit for watershed management regulations, watershed planning, and water quality management is provided under Activity 450 (Stormwater Management) in the *Coordinator's Manual*. This publication explains the CRS credit criteria and gives examples.

This activity recognizes five approaches to managing surface water outside of the floodplain. They are detailed in Sections 451.a through 451.e of the *Coordinator's Manual*.

a. **Stormwater management regulations** require that, in new developments, the increase in peak flows that normally results from development be prevented. The acronym used in the credit calculation formulae is "SMR." The credit criteria are explained in Section 451.a of the *Coordinator's Manual.*

b. Even with regulation of new development, the combined flows from a number of developments can still increase downstream peak flows. **Watershed master planning** (WMP) can modify the regulatory standards and/or add structural measures to further reduce flood damage throughout the watershed. A master plan may also include elements to improve water quality and preserve the natural and beneficial functions of watersheds. The credit criteria for WMP are explained in Section 451.b of the *Coordinator's Manual.*

c. Much of the nation's flood damage occurs in B, C, and X Zones. A large portion of this damage can be prevented by requiring all new development to be elevated. Requiring **freeboard for new buildings in C, D and X Zones** (FRX) is discussed in Section 451.c of the *Coordinator's Manual.*

d. Sediment control is especially important in watersheds where land is being disturbed by construction or farming. Drainage systems cannot operate as designed if they are choked with sediment washed in from construction sites. **Erosion and sediment control regulations** (ESC) are discussed in Section 451.d of the *Coordinator's Manual.*

e. Stormwater runoff picks up dirt, road oil, salt, farm chemicals, and other substances. Regulations that require developers to install or implement measures that permanently improve the quality of stormwater are credited under the CRS. **Water quality regulations** (WQ) are discussed in Section 451.e of the *Coordinator's Manual.*

This publication reviews the first two elements of this activity, SMR and WMP, and explains the requirements for recognition by the CRS.

Stormwater Management (Activity 450) can be made more effective through a comprehensive program of channel maintenance and debris removal (Activity 540 under the CRS). These two activities work together to reduce flood damage to development outside the floodplain. Activity 540 (Drainage System Maintenance) explains the credit points for channel maintenance and debris removal. It is strongly recommended that a community delineate these procedures in the same document, especially because the two maintenance programs are often conducted by the same personnel.

A comprehensive community drainage program should include elements from both Activities 540 (Drainage System Maintenance) and 450 (Stormwater Management).

Regulations Recognized Elsewhere

The regulations credited in Activity 450 are related to reducing flood damage in and originating in watersheds, and protecting water quality. Communities may have other regulations related to flooding or water resources protection. Many of these are credited under other CRS activities, such as those listed below.

- Requirements that developers or sellers publicize or disclose the flood hazard on their properties are credited under Activity 340 (Flood Hazard Disclosure).
- Requiring permit applicants to develop base flood elevations or study the impact of their projects on flood heights or velocities in floodplains where such data are not provided by the NFIP is credited under Activity 410 (Additional Flood Data).
- More restrictive floodway mapping, "zero rise floodway," and "full urbanization hydrology" requirements are also covered under Activity 410.
- Prohibiting new buildings in the floodway, V Zone, or other part of the floodplain is credited under Activity 420 (Open Space Preservation). A community can receive credit for a prohibitory regulation under either Activity 420 or Activity 430, but not under both. Activity 420 provides more credit points than does Activity 430 because new buildings are better protected from flooding if they are kept out of the floodplain in the first place. Therefore, most communities opt to credit prohibitory regulations under Activity 420.
- Activity 430 provides CRS credit for numerous regulatory standards that reduce flood damage, otherwise protect buildings, and generally improve floodplain management.
- Regulations on dumping or placing debris in stream channels are credited under Activity 540 (Drainage System Maintenance).

Legal Aspects

For the purposes of this activity, creditable regulations must be legally enforceable requirements placed on watershed development. They do not have to be enforced by the community but they do have to be legally enforceable by a government agency. For example, state regulations or requirements from a county or regional drainage or flood control district may be credited if those entities have jurisdiction in the community.

In most states, regulations are in the form of state statutes, codes, or regulations or local ordinances or bylaws. Plans, such as land use plans and comprehensive plans, are usually recommendations, not regulations. A community that submits a plan for credit under this activity must also submit its attorney's opinion that the plan has the force of law and is enforced by a regulatory office, such as a building or zoning department.

Most stormwater management regulations appear in a subdivision ordinance or separate stormwater management ordinance. They either cover construction projects throughout the community or in subdivisions and other developments that require special plan approval.

In some cases, an ordinance, especially a subdivision ordinance, will refer to state or local policies, specifications, a design manual, or other separate document. Many local officials have said, "developers don't argue, they follow this manual because we tell them to." Unless the separate policy document is specifically adopted by reference in the ordinance, the community will have to include a statement from its legal counsel that its policies and design standards have the force of law.

Similarly, some regulations state that something "may be required" or that a permit applicant "should" do something. The CRS only credits clear and explicit regulations that require specific actions or standards from a floodplain developer. Generally the word "shall" indicates such a requirement.

For example, the following language would NOT be credited.

> *If, in the opinion of the building official, the soils are not suitable for construction, appropriate fill and compaction may be required.*

The following language WOULD be credited.

> *The applicant shall provide a soils engineering report based on the results of one soil boring for each acre where the following soil types are present . . .*

In general, statements in the purpose or objective section of an ordinance are not acceptable. The CRS credits the specific requirement, not a statement about a reason for adopting the ordinance. For example, many communities have language that says one of the objectives of the ordinance is "To prevent fraud and victimization of unwary land and home buyers." Nowhere else in the ordinance is there a reference to fraud or a specific disclosure requirement. Therefore, credit under Activity 340 (Flood Hazard Disclosure) has not been provided for that language.

In some cases, state laws provide the authority for a state agency or a community to do something. Usually a state agency will implement regulations or a community will enact an

ordinance pursuant to the law. It is the subsequent regulations or local ordinance that must be submitted for CRS credit, not the authorizing or enabling legislation.

Sometimes a requirement is meaningless without the definition section of the ordinance or regulation. Instead of requiring buildings to be elevated 1 foot above the base flood elevation, some communities require them to be elevated above a "flood protection elevation." In these cases, the community also needs to submit the ordinance section that defines the "flood protection elevation."

As with all regulatory issues, the opinion of the community's attorney or corporation counsel is most important. If language is not accepted by the ISO/CRS Specialist because it does not appear to be clear, explicit, or consistently enforceable, then the community may submit a letter on its attorney's letterhead stating that the debated item has the force of law.

COMMUNITIES SHOULD BE CAREFUL WHEN USING MODEL ORDINANCES AND THE EXAMPLES IN THIS PUBLICATION. A community should not amend its ordinances solely to earn CRS credit points, nor should it adopt these examples verbatim. Ordinance language should be carefully written to support the community's goals and the purposes of its regulatory program, to sufficiently respond to the watershed situation facing the community, and to conform with state law. ALL SUCH LANGUAGE SHOULD BE REVIEWED BY THE COMMUNITY'S LEGAL COUNSEL BEFORE ADOPTION.

Verification Visit

During the verification visit, the ISO/CRS Specialist will check records such as building permit files and subdivision plats to verify enforcement of the community's ordinance. For Activity 450, a 5-5-5 sampling method, described below, is used. If the verified credit for an element is less than 50%, no credit is given for that element.

Under the 5-5-5 sampling method, the ISO/CRS Specialist selects a sample of five (e.g., five building permit files and/or subdivision plats). If all of the first five developments comply with the stormwater regulations, full credit is given for SMR. If one or more items in the sample does not qualify for credit, the ISO/CRS Specialist will look at five more examples.

If the review finds six or more of the sample of 10 to be deficient (less than 50% compliance) then five more permits will be reviewed. The final score is based on the sample of 15, provided at least eight of them (53% of 15) qualify for the credit.

Example: A community has stormwater management regulations that require detention of the 100-year storm for all new developments that increase the impervious area by more than 5,000 square feet. There is no procedure to inspect stormwater facilities. The community is applying for the following credit:

SZ = 20
DS = 60
SMR = 80

The ISO/CRS Specialist asks to see building/development permits for a convenience store, a neighborhood shopping center, and three residential subdivisions. Although the convenience store created more than 5,000 square feet of new impervious area, it was granted a variance to the detention requirement because the lot was crowded with the proposed development.

Because the detention requirement was not included in all of the first five developments, the ISO/CRS Specialist takes an additional sample of five developments. All of these are compliant.

Altogether, nine of the ten developments met the requirements of the stormwater regulation. The community's credit for SMR is reduced to 90% of the credit earned by the regulation. The verified score for SMR is

80 x 0.9 = 72

This credit is adjusted by the impact adjustment as explained in Section 452.

451 Credit Points

This section discusses two of the five elements (stormwater management regulation and stormwater master plans) and the corresponding CRS credit points under Activity 450. As in the *Coordinator's Manual*, the credit criteria of the *CRS Schedule* are shown in shaded boxes with double line borders. Examples of regulatory language are shown as block quotations *in this italicized typeface.* Scoring examples are shown in this typeface.

This section also covers how the elements are scored, provides example ordinance language, and identifies some of the more common problems and misunderstandings found in community CRS applications.

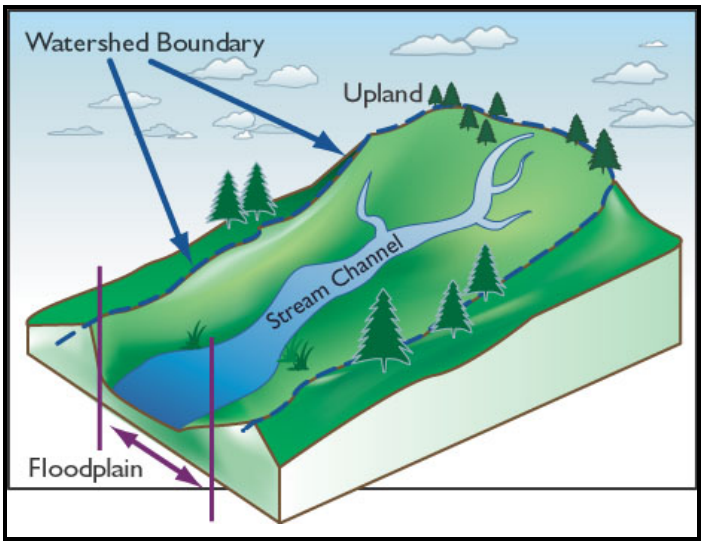
Stormwater Management Regulations (SMR)

Why do we need stormwater management regulations?

The NFIP is based on regulation of floodplain development to reduce future flood damage. However, 23% of all NFIP policies are written on buildings outside the floodplains, and these buildings have had almost 25% of the flood insurance claims. Some of these buildings are adjacent to mapped floodplains, but many are far removed from identified flood hazards.

Floods are generated from watersheds. Whether precipitation falls as water, ice, or snow, it either evaporates, infiltrates into the ground, or runs off of the watershed toward a river, lake, playa, or ocean. The proportion that evaporates and infiltrates is dependent on a number of things. For rainfall, the primary factor is the intensity of the rainfall. The harder it rains, the less water evaporates and infiltrates, and the more runs off over the surface. For snow, the primary factor is how fast it melts. This discussion will focus on rainfall and runoff, but it is equally applicable to snowmelt. It will also talk about runoff into a river, but most of the discussion applies equally to lakes, playas, and oceans.

A watershed, also called a drainage basin or catchment area, is the geographic area where the water for a river or lake originates (see figure). All lands in a watershed drain downhill toward a stream, lake, bay, or other body of water. The boundary of a watershed is also called a divide. Stormwater runoff on one side of the divide drains to one body of water and runoff on the other side drains elsewhere.



As a watershed receives rainfall, water starts to flow on the surface. Water that falls next to the river enters the river immediately. Water from the top of the watershed does not reach the river until it has made its way down the slopes of the watershed. As the rain continues, more and more of the watershed is contributing flow to the river, and the river level rises. If the rainfall intensity is steady, and the storm lasts long enough for water from the farthest point in the watershed to flow to the river, the river flow will quit rising.

When the rainfall ends, the river will gradually recede as the areas closest to the river quit contributing flow. The river will get back to its “normal” level when the upper parts of the watershed quit flowing.

This process is the same for a quarter-acre city lot with a house and for the Mississippi River where it enters the Gulf of Mexico. In the case of the city lot, the time from the start of the storm to the maximum rate of runoff is just a few minutes. For the Mississippi River, the time is several months.

Other factors affect runoff. On larger rivers, there are dams that regulate the flow. Much of the water that infiltrates during a rainstorm reaches the river as groundwater hours, days, or years after the rainfall ends. However, in most cases of flooding, there is a direct and immediate connection between precipitation and flooding.

What we think of as a flood is the event during which a larger-than-normal amount of water is flowing in the river. It is the “peak flow” that causes the most flood damage.

A flood peak usually occurs when the watershed above the point of flooding receives rainfall for a long enough period that the entire watershed is contributing to the flow. At that point, the size of the peak flow is directly related to the intensity of the rainfall.

However, the peak flow at a point on a river is very much dependent on the nature of the watershed. In a mountainous area, a one-square-mile watershed might be fully contributing after a few minutes, while a one-square-mile watershed on the Great Plains might take several hours. The time it takes for the farthest point in a watershed to reach the river is called the “time of

concentration." If the duration of a storm is equal to or longer than the time of concentration, the watershed will produce its highest peak flows for the intensity of that storm.

Storms have different intensities, but the highest intensities cover the smallest area. If a storm is five miles across, there will be some smaller areas where the rain is heavier than in others. The same is true for a tropical storm or hurricane that is 100 miles or more in diameter. Everyone has seen the radar images on television that show a broad area of rainfall with a few local centers of intense rainfall.

> Stormwater facilities do not have to be "wasted" space in a development or in the community. The City of Las Vegas has nearly 300 soccer fields, many of them in city-owned detention basins. In a recently opened complex, there are five soccer fields at different levels, so that they are not all flooded frequently. Only one field is below the 10-year flood elevation in the detention basin.

Another factor in the peak flow from a watershed is the condition of the surface of the watershed. Imagine a 10-square-mile watershed (that is, about 2 ½ miles wide and four miles long) covered by dense forest. Much of the rainfall is absorbed by the organic litter under the trees. There is a relatively small amount of runoff. Then the forest is cleared and the watershed is planted in wheat. The runoff increases significantly. After a time, the wheat fields are converted to row crops, and the watershed is contour plowed. The runoff decreases dramatically because the furrows store the runoff and increase the amount of infiltration. Then, the fields are subdivided for residential development. About half of the watershed area is covered by roofs and streets. These impervious surfaces allow almost no infiltration, so the amount of runoff increases dramatically. Not only does the amount of runoff increase, but the water runs off of roofs, into the streets, and into drainage ditches that carry it straight to the river. The time of concentration has been decreased significantly.

When the watershed was forested, the time of concentration was perhaps four hours. When it is developed, the time of concentration might be one hour. Now the watershed produces five times the amount of runoff, and it arrives at the river four times as fast. The result is a much higher peak flow. In the forest, if a ten-square-mile cell of intense rainfall hit the watershed for an hour, only a portion of the watershed contributed to the peak flow during that hour. Developed, the entire watershed contributes to the peak.

Stormwater management regulations require that each developer in the watershed ensures that the increased runoff from his or her development does not increase the peak flow downstream.

Scoring SMR

SMR credit is provided if new developments are required to prevent or reduce the increase in runoff that results from urbanization of the watershed. To receive SMR credit, the watershed must be subject to a regulation that requires the peak runoff from new developments to be no greater than the runoff from the site in its pre-development condition. Credit may be provided for other approaches to managing the impact of development on runoff where the community can show that there is no increase in flood damage downstream.

SMR credit is the sum of the credit for three sub-elements:

SMR = SZ + DS + PUB.

If SZ = 0, then SMR = 0.

The basic requirement is that the peak flow after development must not be increased as a result of the development. Picturing the change from farmland to subdivision, how is this done? Generally, the developer builds a storage basin at the lower end of the development to store the extra water that runs off. Usually, the developer is allowed to release the water from this storage basin at the peak flow rate before development. In most cases, these storage basins will empty in a few hours and be ready for the next storm.

There are other ways to accomplish the desired result of preventing downstream flooding. These generally require watershed master planning and are discussed beginning on page 16.

Example Regulatory Language for SMR

From the Subdivision Rules and Regulations for Marshfield, Massachusetts:

> *. . . the Planning Board shall require an on-site storm drainage analysis for all proposed developments that mitigates the 10, 25 and 100 year storm event in accordance with the standards contained herein.*
>
> *The following information shall be required:*
>
> *(x) Demonstration of no increase in the rate of discharge from pre-development to post-development conditions.*

The Drainage Regulations for Maricopa County [Arizona] state:

> *The entire drainage retention and conveyance system shall be designed to eliminate or minimize storm water runoff and convey the runoff through the development with minimum detrimental effects to the development or to any other property. No system shall be approved if the effect may cause an increase in the peak discharge, volume or velocity or change the point of entry of drainage onto another property during the runoff event.*

Size of Development (SZ)

SZ credit has a range of from 25 points (all projects are regulated) to 5 points (only projects 5 acres or larger are regulated). There is no credit if the regulations only affect developments larger than 5 acres or with more than 20,000 square feet of impervious surface. The CRS does not credit regulations that apply only to these large developments because the cumulative effect of a number of small, unregulated developments could have a significant impact on runoff in the watershed.

This sub-element recognizes that many communities do not want to impose the complexity of stormwater management on the owner of a small parcel.

1. Size of development (SZ) (Maximum credit: 25 points)

   SZ is based upon the minimum size of areas regulated. Use either:

   (a) 25, if all development is regulated, regardless of size;

   (b) 20, if all development is regulated except single-family residences or increases in impervious area of 5,000 square feet or less;

   (c) 15, if all development is regulated except for parcels of 1/2 acre or less or increases in impervious area of 10,000 square feet or less;

   (d) 5, if all development is regulated except for parcels of 5 acres or less or increases in impervious area of 20,000 square feet or less; or

   (e) 0, if the regulations only apply to development of parcels larger than 5 acres or increases in impervious area of more than 20,000 square feet. If the regulations only cover such large development projects, there is no credit for SZ or SMR.

During verification, SZ is adjusted, if necessary, to reflect different thresholds for different types of development. For example, if a community regulates commercial developments larger than 2 acres and residential developments larger than 5 acres, SZ is pro-rated according to the percentage of current land use in each category.

Example Regulatory Language for SZ

Maricopa County, Arizona, regulates "all commercial, industrial, and multi-family residential developments and all subdivisions." This regulatory language receives 20 points for SZ because single-family residences are exempt.

The Village Code of Downers Grove, Illinois, states that all development shall meet the stormwater requirements if

> *The parcels being developed total three acres or greater for single or two family residential land uses, or . . . the parcels being developed total one acre or greater for multiple family or nonresidential land uses, . . .*

This regulatory language provides 5 points for SZ, because it exempts up to 3 acres of development.

The Riverdale, New Jersey, code requires a site plan for any building in any business, commercial recreation or industrial zone, and for residential subdivisions. Subdivisions and site plans require that the post-development rate of stormwater runoff not exceed the pre-development rate. Because single-family residences are not required to regulate stormwater runoff, the credit for SZ is 20.

The New Hanover County [North Carolina] Storm Water Management Ordinance regulates "any development activity that will result in the accumulation of ten thousand (10,000) square feet of impervious area on any site." Such development is required to provide stormwater management. This language is worth 15 points for SZ.

Documentation Needed for Verification

The only acceptable documentation for SZ is the ordinance language requiring development to keep post-development peak flows at or below the pre-development peaks. The section of the regulation that provides exemptions to the requirement must be included.

Common Problems

- The most common problem communities have with this element is not having the right community staff member available during the verification visit. Frequently, the CRS Coordinator is not familiar with the specifics of the stormwater management regulation.
- Communities fail to understand that regulation of, for example, all subdivisions, is management of all development. To be eligible for full credit (25 points) for SZ, a community must regulate all development, including single-family residences in existing subdivisions, to ensure that pre-development runoff is not increased.

Design Storms (DS)

DS credit is provided based on the design sizing of the runoff control facilities. For DS credit, the community's regulations generally must require pre- and post-development hydrology calculations and post-development runoff must be limited to pre-development levels. The standard used may be peak flow, volume, or a combination of the two.

> DS is the total of the following points based on the design storms used in the regulations (i.e., the storms used to measure the impact of new developments). For DS credit, the community's regulations must require pre- and post-development hydrology calculations and post-development runoff must be limited to pre-development levels. The standard used may be peak flow, volume, or a combination of the two.
>
> (a) 60, if detention/retention is designed for the 100-year storm;
>
> (b) 20, if detention/retention is designed for a storm larger than the 10-year but smaller than the 100-year storm; and
>
> (c) 10, if detention/retention is designed for a 10-year storm.

Although the 100-year flood is the basis for floodplain management, communities are also encouraged to look at the effects of stormwater management on smaller, more frequent storms. A design that maintains or reduces the peak flow from only the 100-year storm may increase peaks from smaller storms, increasing flood damage.

Full credit (90 points) can be obtained in the following situations:

- If developers account for the runoff from three storms: the 100-year storm, another storm larger than the 10-year, and the 10-year storm;
- If the design storms include all storms up to and including the 100-year;
- If 100-year retention is required. For CRS purposes, retention (as opposed to detention) means that a basin has no outlet and stored runoff must be infiltrated into the soil, pumped out for irrigation, or otherwise disposed of on site; or
- If 100-year detention is required with a release rate based on the pre-development 10-year runoff.

The following examples should help explain the formula for DS:

Design storms used	DS
2, 5, and 10	10
25	20
10 and 25	30
100	60
25 and 100	80
10, 25, and 100	90

If the regulations are based on inches of rainfall, the value must be converted to a storm recurrence interval. One source that can help do this is the *Rainfall Frequency Atlas of the United States* (the National Weather Service's Technical Paper 40; accessible at http://www.ncdc.noaa.gov/oa/documentlibrary/rainfall.html).

Stormwater regulations that focus on water quality are generally not adequate for SMR credit because they have little or no impact on flood flows. For example, some communities require detention of the first 1 inch of rainfall to reduce non-point sources of water pollution. In some areas this is less than a 1-year storm, so there is no credit provided under SMR, but it could qualify as a water quality measure (WQ) for credit under Section 451.e.

Example Regulatory Language

The Maricopa County, Arizona, regulation states that

> *The retention system shall be designed to receive and retain the volume generated from the 2-hour 100-year run-off event falling over the entire development including all rights-of-way, excluding off-site flows.*

Because the stormwater is RETAINED on the development, rather than being DETAINED, this language earns 90 points for DS. If the 100-year runoff is retained, all smaller storms are also retained. Water that is retained must generally be disposed of on the property, so there is no runoff.

The Delaware Sediment and Stormwater Regulations require that

> *Projects in New Castle County that are located north of the Chesapeake and Delaware Canal shall not exceed the post-development peak discharge for the 2, 10 and 100 year frequency storm events at the pre-development peak discharge rates for the 2, 10 and 100 year frequency storm events.*

This language is worth 70 points for DS. Runoff from the 10- and 100-year storms is regulated.

Hoffman Estates, Illinois, requires that the 100-year storm runoff be detained.

> *The District will accept the release rate of not greater than that calculated from a storm of three (3) year frequency . . .*

By detaining the 100-year storm and releasing it at a rate lower than the 10-year pre-development rate, this regulation earns 90 points for DS.

Documentation Needed for Verification

The only acceptable documentation for DS is the ordinance language that specifies the design storms used to size detention basins. In some cases, the regulation adopts the standards specified in a design manual. In this case, appropriate pages from both the regulation and the design manual are needed for verification.

Common Problems

- The most common problem communities have with this element is determining which design storms are used for detention/retention. This problem almost always occurs when someone other than the community staff person responsible for stormwater management tries to assemble the documentation.
- Another, less frequent problem arises when a parameter other than the recurrence interval for the design storm is used to determine either the required storage volume or the allowable discharge rate. For example, the regulation may say, "Detention must be provided for the first 1.0 inch of rainfall," or "the discharge cannot exceed 0.15 cubic foot per second per acre." In these cases, the community must provide documentation that relates the parameter in its regulation to the recurrence interval of a storm in its area.
- Some communities use different design storms for different aspects of development. A community's standards might say that underground storm drains must be designed for the 10-year storm, runoff from the 25-year storm must be contained within drainage easements, and buildings must be protected from runoff from the 100-year storm. CRS credit for DS is based entirely on the storm used to design detention/retention facilities.

Public Maintenance (PUB)

Frequently, stormwater management regulations leave it up to the developer, the owner, or a homeowners' association to assume responsibility for maintenance of the required facilities. Because experience has shown that private maintenance of stormwater management facilities is

not as reliable as public maintenance in the long run, CRS credit is provided to encourage these facilities to be maintained by a public agency. This credit is also provided if the community inspects all private stormwater facilities at least annually and has the authority to require the owners to perform appropriate maintenance.

> PUB = 110, for public maintenance of all stormwater facilities.
>
> PUB is determined by the nature of public maintenance of stormwater facilities. Credit is provided if the community assumes maintenance responsibility for all private facilities or if the community inspects all private stormwater facilities at least annually and has regulatory authority to require the owners to perform appropriate maintenance.

A community can receive PUB credit through any one or combination of three ways:

1. The community inspects all new stormwater management facilities at least annually and orders maintenance when needed. If the owner fails to perform the maintenance, the community does the job and bills the owner;
2. The owners of all new stormwater management facilities perform the maintenance and their engineers certify at least annually to the community that it has been done; or
3. All new stormwater management facilities (including basins built by private developers) are required to be deeded to the community, and the community inspects the facilities at least annually and provides maintenance as needed.

Whichever approach is used, it must be supported by an ordinance or other regulatory authority. For example, holding the owner responsible for maintenance must be based on clear legal authority, such as the subdivision ordinance, that was known to the developer at the time of construction of the stormwater facility. Credit is not provided for a policy or a statement with which the community has been able to get compliance in the past.

If inspection is performed by the community, the community must document its inspection program with all documentation required for channel debris removal (CDR) in Section 544.

Example Regulatory Language

The drainage regulations for Maricopa County, Arizona, state that

> *It is a violation of this Regulation . . . for failure to maintain any natural drainage system or any drainage easement, tract or channel or common area created pursuant to this Regulation . . .*
>
> *Violation of this Regulation is a public nuisance, per se, and subject to all remedies as provided by law . . .*
>
> *If the property owner fails to remove fill material, rubbish, trash, weeds, filth, debris or any obstruction that . . . the Drainage Administrator determines obstructs, retards or diverts a natural or improved drainage system, . . . the*

> *Drainage Administrator may remove or cause the removal of the fill material, rubbish, trash, weeds, filth or debris upon his determination that failure to remove or abate the condition constitutes a threat to the public health, safety or welfare.*

If it is verified that the county inspects all detention facilities at least annually, and all necessary maintenance is performed, this regulatory language earns 110 points for PUB.

The Land Development Code for Austin, Texas, states that

> *At least once each year, the Transportation and Public Services Department shall inspect each water quality basin required to be maintained by the owner . . .*

The ordinance also specifies that the developer must provide a maintenance plan. The city has regulatory authority to repair facilities if needed. After verification of the inspection procedures and a field visit to a sample of stormwater facilities, PUB was verified at 110 points.

Documentation Needed for Verification

Documentation for PUB must include the regulatory language and the same inspection procedures and documentation that are required for channel debris removal (CDR) in Activity 540 as it applies to SMR stormwater facilities.

- If the community performs inspections of private facilities, the regulatory language must show that the community has the right to enter the property for inspections, and that the community has the authority to perform maintenance if the owner fails to do so.
- If the private owner of the drainage facilities is required to have an inspection performed, the regulatory language must include this provision.
- If all stormwater facilities are deeded to the community, this must be reflected in the regulatory language, and these facilities must be included in the community's drainage system for CDR credit in Activity 540.

Common Problems

The most common problem with PUB credit is that communities do not understand that inspection of new stormwater facilities is their responsibility. A regulation that requires stormwater facilities to be maintained by the owner is not adequate for PUB credit.

Alternative Approaches

As noted above, there are other ways to accomplish the desired result of preventing downstream flooding. These alternative approaches require a stormwater master plan:

- If a community is next to the ocean, a large river, or a lake or playa, it may choose to get the water out of town as quickly as possible. In this case, the community may choose to develop a large drainage system based on anticipated development.

Credit will be verified for this approach only where the community drains to a large receiving body of water, and where the entire watershed affecting the community is almost entirely developed.

- With advance planning, a community may design a combination of storage facilities and drains to accommodate all future development. These facilities may be built as the development occurs. They are frequently funded by the developers. This approach can be eligible for both SMR credit and credit for stormwater master planning (WMP).

  Verification of this approach will depend upon the planned discharge at the downstream end of the system. If it is apparent that the intention of the plan is to limit downstream peak flows, it can receive SMR credit. If not, it may be eligible for credit for structural flood control projects under Activity 530.

- As an alternative to using a uniform standard for all areas, some communities regulate development according to a master plan that analyzes the combined effects of existing and expected development on stormwater and flood flows in the watershed. Such watershed-specific regulations may allow different amounts of runoff for different areas in order to control the timing of increased flows into the receiving streams. A watershed master plan may also be used to preserve wetlands, riparian areas, or other important habitats. This approach can also be eligible for both SMR credit and credit for stormwater master planning (WMP).

  Verification of SMR credit for this approach generally requires credit for channel debris removal (CDR) in Activity 540. This approach may lead to rapid drainage of the lower part of the watershed so that it will not be contributing to the runoff from the upper parts of the watershed. In this case, maintenance of the channels all the way down to the receiving stream is critical to the success of the master plan.

Watershed Management Master Plan (WMP)

Why do we need watershed management plans?

Even if each developer controls the runoff from his or her development so that peak flows are not increased, downstream peaks still will increase. In regulating the peak flow, when the volume of runoff increases, the duration of high flows from the development increases. As these high flows move down the watershed and combine with the releases from other developments, the combined peaks are higher than the pre-development flow.

This can be avoided through watershed management master planning. A watershed master plan estimates the runoff from different parts of the watershed based on fully developed conditions. The regulations are adjusted. Perhaps developments in the lowest part of the watershed are allowed to pass their runoff into the system immediately, so that it is gone when the runoff from farther up the watershed arrives. Perhaps the development from the middle of the watershed is only allowed to release at a rate equal to 50% of the pre-development peaks, and the upper-most developments must wait a specified time before they can release runoff. Many other options can be developed through watershed master planning.

A watershed master plan is the result of a hydrologic and hydraulic study of the watershed, usually under both existing conditions and future development conditions, with different management scenarios. It usually includes recommendations for a set of management controls and/or construction projects to solve existing flooding problems and to prevent new problems.

Credit is provided if the community develops and implements surface water runoff regulations through a watershed master plan that ensures that flood damage within and downstream from the watershed is not increased by future development. In general, the plan must

- Have been adopted in the community's regulatory program,
- Require that the peak flows of runoff from future development will not increase beyond the present peak flows, and
- Manage all storms up to and including the 25-year storm (no credit is provided for WMP for management of storms smaller than the 25-year storm).

A watershed master plan can work with other planning tools used by the community to help accomplish other community objectives. Knowing the present and future conditions of runoff from streams too small to be included on the community's Flood Insurance Rate Map (FIRM) allows for protection of many buildings in the watershed. The community can also use this to preserve open space corridors, protect wetlands and other habitats, and for other actions that generally improve the quality of life throughout the community. Additional CRS credit is provided for some of these planning aspects.

CRS Credit for Watershed Management Master Plans

Watershed master plans must meet four prerequisites to be eligible for CRS credit. If these four prerequisites are met, the community receives a basic credit of 80 points. The community can receive additional points for other standards in the plan.

1. Prerequisites:

   (a) The community must have adopted a watershed management master plan for one or more of the watersheds that drain into the community.

To receive WMP credit the community's governing board must have adopted the plan(s). Even if the plan does not have the authority of a regulation, adoption indicates that the community accepts the standards and other provisions included in the plan and intends to implement them.

(b) The community has adopted regulatory standards for new construction in the watershed based on the plan.

In general, there must be a connection between the watershed master plan and the community's stormwater management regulation. There are two ways CRS communities have met this requirement:

1. A community recognizes that ongoing development is increasing downstream flooding. It adopts a stormwater management regulation requiring that all new development detain or retain increased runoff so that the peak flow from the development is not increased. After some time, the community sees that downstream flooding is still increasing as development proceeds. It develops a watershed master plan. This plan recommends more stringent detention/retention requirements or different requirements for different parts of the watershed. The plan usually also recommends certain structural measures to solve existing problems.

2. A community is experiencing increased runoff from ongoing development. It develops a watershed master plan to figure out what to do. This plan recommends detention/retention requirements throughout the community, or different requirements for different parts of the watershed. The plan usually also recommends certain structural measures to solve existing problems. In this case, WMP credit is provided only if the community has adopted the recommended stormwater management regulation.

Regardless of how the community got started on master planning, the plan usually must include studies of current- and future-conditions hydrology and hydraulic studies of current- and future-conditions runoff. Current conditions are generally studied to show the existing problems and to justify regulation of new development and expenditures on structural elements of the plan.

(c) The plan's regulatory standards manage future peak flows so that they do not increase over present values.

Many documents called watershed master plans have been developed to guide the construction of storm drain systems. These documents are usually comprehensive reviews of a watershed's or basin's hydrology. However, they are not eligible for WMP credit if they are only used to design drainage facilities and do not include regulations or set regulatory standards to prevent new developments from aggravating stormwater problems.

"Manage future peak flows" means management of runoff from the entire watershed so that increased flows are controlled throughout the watershed. Stormwater management regulations generally control peak flows from individual developments, but they do not control the timing of flows through the watershed. A watershed master plan examines the cumulative effects of watershed development and provides information needed to control the timing of peak flows to prevent or minimize problems.

(d) The plan's regulatory standards require management of runoff from all storms up to and including the 25-year event.

The purpose of CRS credit for watershed master planning and stormwater management regulation are to reduce flood damage resulting from development in watersheds. Regulation and

planning for smaller storms is effective in improving water quality, but does little or nothing to reduce flood damage.

> (e) In order to maintain WMP credit for any plan that is more than five years old, the community must evaluate the plan to ensure that it remains applicable to current conditions. The evaluation must address whether the dates used for the plan are still appropriate and whether the plan effectively manages stormwater runoff from the watershed. If a watershed management master plan is obsolete, the community must update the plan or the WMP credit will be revised accordingly.

Like other plans, watershed master plans become obsolete. This can happen for several reasons:

- Rainfall data added to an old record can change the design storm(s) that is used to generate runoff data;
- Changes such as channel improvements and new detention basins alter downstream flows;
- Watershed master plans are often based on projected land use. As time goes by, it is necessary to compare actual land use with the projections used; or
- Over time, new methods are developed for the hydrology and hydraulics used in stormwater projections.

There may be other considerations when deciding if a watershed plan is obsolete.

If a watershed master plan is more than five years old, the community must certify that the plan is still applicable and not obsolete. The certification must address the issues included in the documentation requirement, Section 454.j, on pages 35 and 36.

> 2. WMP = the total of the following points. Credit must be received for item (a).
>
> (a) 80, if the watershed management plan meets all of the prerequisites listed in Section 451.b.1.

After a watershed master plan meets the four prerequisites, additional WMP credit is awarded for seven aspects of planning ((b) through (h), below):

> (b) 25, if the plan manages the runoff from all storms up to and including the 100-year event.

Additional credit is provided if the community's regulations manage all storms up to and including the 100-year storm. "All storms" includes specifically listed storms, such as the 2-, 10-,

25-, 50-, and 100-year storms. Almost all communities with CRS credit for watershed master planning have used the 100-year storm, so they get this credit.

> (c) 40, if the plan provides management of future peak flows AND VOLUMES so that they do not increase over present values. If the community can demonstrate that its watershed management plan prevents damaging increases in peak flows at all points within its watershed(s) and downstream, it will receive this credit.

The more common approaches are when a community disposes of its increased volume of stormwater to an aquifer through groundwater recharge, or uses the water for irrigation or other purposes. For this credit, the community must retain the increased runoff due to development, although it may be allowed to detain and discharge an amount of water equal to the pre-development runoff. As with any retention system, sufficient storage must be created to handle a later storm that occurs before the retained water is disposed of.

Communities that discharge directly into an ocean or a Great Lake may receive this credit if they have adopted a watershed master plan that models their watershed(s) and prevents increased peak flows within those watershed(s). Communities with watersheds that discharge into other large lakes or rivers must demonstrate that their discharges will not increase flood elevations in the lake or anywhere downstream on the receiving river.

> (d) 25, if the plan manages the runoff from all storms up to and including the 5-day event. If a community can demonstrate that an event shorter than five days is the locally appropriate “worst-case” runoff event for stormwater management, it may receive the credit if it uses that event for its regulatory standard.

There are usually at least three “worst-case” runoff events for a particular recurrence interval storm: one that causes the highest peak discharge from the development; one that causes the highest peak discharge from the watershed; and one for the stream into which the watershed discharges. Most communities plan for the first two, which may range from a few minutes to a few days. Fewer plan for the third, which may range from a few days to several weeks.

This credit is provided for assuring that the most appropriate modeling techniques are used for the location. This is assumed to be a 5-day event unless the community can show that a shorter event is more appropriate for local conditions. In some areas this may require continuous-simulation modeling. If a community, regional, state, or federal agency can demonstrate that, say, the 72-hour event provides the “worst case” runoff for a watershed, the 72-hour event would be credited for communities in that area. Generally, the “worst case” runoff will occur when the time of concentration for the watershed is about equal to the duration of the storm event used for modeling.

In many locations, a state or federal agency or a regional stormwater management or flood control agency has determined the storm duration that causes "worst-case" flooding, including flooding on larger rivers. If that agency states that a certain storm duration is appropriate for the large rivers within its jurisdiction, the community may receive credit for using that storm duration. Using continuous simulation modeling is also credited.

(e) 15, if the plan identifies existing wetlands or other natural open space areas to be preserved from development to provide natural attenuation, retention, or detention of runoff.

Preservation of these areas reduces runoff and flood damage and provides other floodplain management benefits as well.

(f) 10, if the plan prohibits development, alteration, or modification of existing natural channels.

Where the watershed master plan includes undeveloped areas, preservation of the natural channels may reduce maintenance costs and provide many amenities to the community.

(g) 10, if the plan requires that channel improvement projects use natural or "soft" approaches rather than gabions, rip rap, concrete, or other "hard" techniques.

Even where communities are preserving existing natural drainageways, they may not have the needed capacity for a large storm. In these cases, the community may choose to use vegetation for erosion control or along the improved channel. Excavated channels may be landscaped as natural streams, golf courses, or parks.

(h) 20, if the plan was prepared in coordination with or as a part of the community's floodplain management plan credited under Activity 510.

In many cases, a community's floodplain management plan points out the need for watershed management, and therefore recommends the development and implementation of watershed master plans for some or all of its watersheds. In other cases, a watershed master plan can only solve part of the community's flood problems, and its results are input to a floodplain management plan.

This credit is dependent upon the community's receiving credit for a floodplain management plan under Activity 510 (Floodplain Management Planning). A floodplain management plan

developed for Activity 510 usually does not qualify for WMP credit, but a watershed plan may qualify for credit under Activity 510. A community may receive these 20 points if

- The floodplain management plan is mentioned prominently in the watershed master plan, and if references in the watershed plan demonstrate that it is intended to help implement the floodplain management plan; and/or
- Hydrologic output from the watershed master plan is used as input for the floodplain management plan.

Example Programs

The City of Cheyenne and Laramie County, Wyoming, have developed a common stormwater management policy. It is included in the development regulation adopted by both communities:

> *It is recognized that surface water drainage problems are primarily defined by the natural topography of the land, without regard for legal boundaries, existing improvements or proposed improvements to the land. The City and County therefore will provide for the necessary control, coordination and implementation measures required to achieve the general objectives as well as the specific improvements which may be required in order to satisfy the regulations as established herein. The City and County shall prepare a Drainage Plan or Plans for the entire area, which shall serve as a guide for the development of drainage improvements within the City and County . . . The City/County Drainage Plan shall be prepared based upon the anticipated land uses as established by the official land use plans of the City and County, the measured and recorded historic precipitation data, and the expressed objective of minimizing increases in surface water run-off and reduction in water quality caused by land development. The Drainage Plan may be prepared in several parts and such sections that are complete shall be utilized upon formal adoption.*

The City/County Drainage Plan discussed in this regulation was completed in eight sections (one for each of the eight watersheds that affect the greater Cheyenne area) and adopted.

Thurston County, Washington, adopted the Green Cove Creek Comprehensive Drainage Basin Plan. The goals of comprehensive drainage planning in Thurston County are

1. *Preserve and/or enhance water quality, stream morphology, wetlands, groundwater, fisheries/wildlife habitat, and aesthetic amenities.*
2. *Promote sustainable development within each basin (i.e. minimum impact on water resources and habitat).*
3. *Promote public interest and involvement in water resource management.*
4. *Establish short-term and long-term solutions to existing and future stormwater quality and quantity problems.*
5. *Promote a regional approach for financing, ownership and operations/ maintenance of regional facilities and programs.*

Although “solutions to . . . stormwater . . . quantity problems” is only part of one of these goals, the Green Cove Creek plan names flooding as the first problem, and solutions to flood problems as the highest priority. The plan recommends measures to deal with increased runoff due to urbanization, undersized culverts, sedimentation, inadequate design of existing facilities, and areas with high water tables.

Documentation Needed for Verification

The documentation for WMP must include documentation that the plan was adopted and those pages from the plan that support the credit requested. There should be language in a “hydrology” or “study methods” section of the plan to define the design storm(s) used to develop the plan, as well as a comparison of current- and future-conditions runoff. This language, along with language from the “introduction” or “executive summary” relating the plan to stormwater management regulations, should meet the prerequisites for CRS credit in Section 451.b.1.

The “hydrology” or “study methods” section of the plan should qualify for credit under Sections 451.b.2(b), (c), and (d) if the plan is based on the 100-year storm, manages peak flows and volumes, and/or is based on a 5-day or “worst case” storm event. A “recommended plan” or similar section should provide the documentation for credit under Sections 451.b.2(e), (f), (g), and (h).

Common Problems

A common problem with WMP credit is that the community’s “stormwater master plan” or “watershed master plan” is a drainage capital improvement plan with no stormwater management features in it. Such plans do not receive CRS credit.

452 Impact Adjustment

The CRS measures the impact of an activity on the community. It does not matter if the stormwater management program is administered by the community or by a regional district. What counts is whether the buildings in the community are being protected from increased runoff that results from development in the watershed.

Most communities are in several watersheds. These may include a large watershed that drains to a large stream and a number of small watersheds that drain into creeks or ditches that enter the community from other locations.

A community that can regulate all development in all of the watersheds that drain into it should receive full credit for this activity. This is not the case for most communities since corporate boundaries rarely follow watershed boundaries. Most communities do not have jurisdiction over new development outside their corporate limits or outside an extraterritorial limit. Because these communities cannot regulate all of the watersheds that drain into them, their CRS credit points are adjusted to reflect the limits of their stormwater management programs.

To do this, Activity 450 has impact adjustments for SMR and WMP that factor in the area of the watersheds affected. Impact adjustments for Activity 450 are different than for other CRS activities because the effectiveness of stormwater management depends on how much of the

watershed is affected by the community's program. The impact of other activities is based on how much of the floodplain is affected. While floodplains are mapped on readily available FIRMs, most communities will have to delineate their own watersheds.

The impact adjustments for SMR and WMP are ratios that are multiplied by the elements' credit points. The ratio for SMR is rSMR and the ratio for WMP is rWMP. There are three ways that an applicant can obtain the values for rWMP and rSMR: Options 1, 2, and 3.

The Impact Adjustment Map

An Impact Adjustment Map must be developed for Options 1 and 3.

The stormwater Impact Adjustment Map shows the community and all watersheds that drain into it. Watersheds larger than 50 square miles (as measured where the stream enters the area under the community's jurisdiction) do not need to be shown. Although the purpose of this map is similar to the Impact Adjustment Map discussed in Section 403 of the *Coordinator's Manual*, it may be quite different in appearance. The community will likely be only a small part of the total watershed.

Areas may be measured in acres or square miles. The area subject to the stormwater management regulations is shown as aSMR and the total area of the watershed is aW. aSMR is typically the area of the community plus any area subject to its extraterritorial jurisdiction. The area covered by the watershed management plan is aWMP.

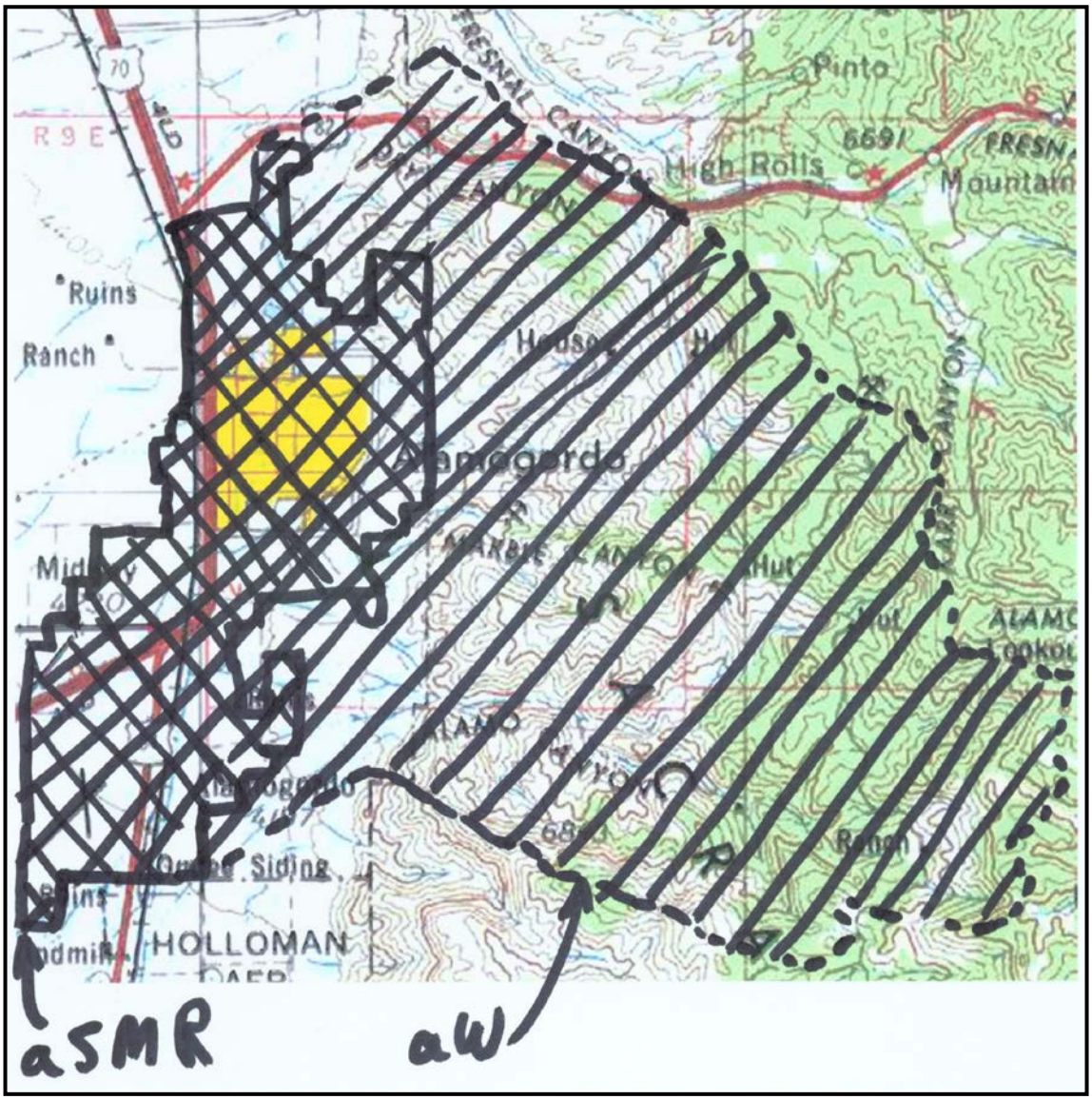
An Impact Adjustment Map is shown on the next page. It shows the approximate corporate limits for the City of Alamogordo, New Mexico, (aSMR) and the boundaries of the watersheds that affect the city (aW). Based on this map and information provided by the city, the corporate limits of Alamogordo (aSMR) include about 19.5 square miles, while the drainage area (including the incorporated areas) is about 75 square miles.

It is typical for an Impact Adjustment Map to be a large map. Although this activity is reviewed by a technical reviewer for all CRS communities, in most cases the ISO/CRS Specialist examines the Impact Adjustment Map during the community visit and verifies the impact adjustments rSMR and rWMP.

Many communities use Option 2 rather than calculate aSMR, aWMP, and aW for Option 3. However, the CRS encourages communities to calculate their points to accurately reflect their programs. Here are some ways to make it easier.

1. Watershed area data are often found in the community's Flood Insurance Study and other stormwater reports, such as "205" studies.

2. If a community can demonstrate that upstream communities have similar stormwater management regulations for the upper portions of their watersheds, it can increase the size of aSMR and aWMP. A community in a regional district that regulates all watersheds may be able to use Option 1.



3. The following areas may be excluded from the calculations for aSMR, aWMP, and aW:

   a. Watersheds larger than 50 square miles (as measured where the stream enters the area under the community's jurisdiction) may be excluded. The area of the watershed within the community remains in the impact adjustment calculation.

Impact Adjustment Map for Alamogordo, New Mexico

   If such large watersheds are outside the community's jurisdiction, or are not regulated, the community will receive more credit by excluding them. If they are regulated, the community will receive more credit by including them.

   b. If watersheds upstream of the community are effectively reduced by flood control structures that control the base flood, the size of the areas affected is reduced accordingly. Only dams designed to control the base flood can be used for this type of adjustment to aW.

c. If parts of the watersheds are unlikely to be developed due to their ownership, those portions of the watershed may be excluded. Areas that might be excluded are nature preserves, state parks, or privately owned land that is dedicated to open space use.

Alternatively, counties may use anticipated population growth to determine rWMP using Option 3. In many counties, a large portion of the projected population growth may be concentrated in a few relatively small areas of the county. Because watershed master plans are usually done where a community expects growth, an impact adjustment based solely on area does not reflect the value of master planning in these cases.

If a county uses anticipated population growth to determine rWMP, it is the responsibility of the county to document that anticipated population growth in the watershed with WMP credit and the anticipated population growth for the entire county. This must be done at the census tract level. The community must also provide documentation that shows that its projected population estimates are reasonable.

Example: Big County covers 1,000 square miles. Drainage into the county, excluding watercourses with watersheds larger than 50 mi^2, is 100 mi^2. aW for Big County = 1,100 mi^2.

Big County has one large city, Central City, and two small communities that are in other parts of the county. Central City and adjacent areas have 80% of the county's population. Big County and Central City have jointly completed watershed master plans for all watersheds that drain through Central City. These watersheds total 330 mi^2.

Based on area, $rWMP = \frac{330\ mi^2}{1{,}100\ mi^2} = 0.30$

Big County uses its Comprehensive Land Use Plan 2000–2025 data from the 2000 census and its GIS system to estimate population growth in the watersheds with master plans. The GIS operator overlays the census tracts and the watershed boundaries. If a census tract is at least 50% within a watershed, it is counted as being in that watershed. The population within the watersheds with master plans is expected to increase by 20,000 between 2000 and 2025. The population of the entire county is expected to increase by 25,000. Big County uses rSMR = 0.80 based on anticipated population growth.

Big County provides the methodology in the comprehensive plan as documentation to support the projected populations.

Options for Impact Adjustment

Option 1

Option 1 is used by communities with stormwater management regulations that cover all of their watersheds.

The CRS has a procedure for communities in a metropolitan area, region, or state that are subject to the same regulations or regulatory requirements. A "uniform minimum credit" can be developed for these communities based on the minimum requirements. All communities in the affected area receive the same credit and usually do not have to submit as much documentation. Documentation would be needed if the community's program exceeds the minimum requirements and it wanted more credit points.

For example, most communities in Delaware and South Carolina, along with many communities in Colorado, Florida, Illinois, and Washington, receive up to 90 points for stormwater management regulations (SMR) and additional credit for ESC and WQ regulations. Generally, these communities receive the credit automatically. They do not have to apply unless they implement their own programs with more restrictive standards. Many of these communities use Option 1 because all of their watersheds are covered by the regional or statewide regulatory programs.

It is possible that many other state and regional agencies have regulatory programs that would qualify their communities for uniform minimum CRS credit. These agencies and/or the communities affected should contact their ISO/CRS Specialist for more information on uniform minimum credits.

1. Stormwater Management Regulations (SMR): If the community, separately or along with upstream communities, regulates development within all of the watersheds that affect it, rSMR = 1.0.

2. Watershed Management Master Plan (WMP): If the stormwater management master plan regulates all development within all of the watersheds that affect the community, rWMP = 1.0.

An Impact Adjustment Map usually is required for Option 1. The Impact Adjustment Map for this activity is discussed above.

There are two cases in which Option 1 is most often used. The first is where the community actually has jurisdiction over all of its watersheds. An island community is one example of this. If an island were covered by a single community, and it regulated all development on the island, it would have rSMR = 1.0. If a watershed master plan had been done for the entire island, it would also have rWMP = 1.0. This is because the entire island, i.e., the entire watershed, is under the community's jurisdiction.

This can also happen where the community has its corporate boundaries formed entirely by watershed divides (ridges) or bodies of water. Such a community can regulate all developments that will affect the water that drains into it.

The second case is where a regional agency either enforces stormwater management regulations or sets minimum standards for local regulations. These are county-wide or multi-county organizations, like urban drainage districts or water management districts. Development in watersheds subject to these agencies must meet the same stormwater management standards, regardless of the community within which they lie.

Communities are encouraged to manage stormwater in cooperation with adjacent communities. If a community only has regulatory jurisdiction over a portion of its watersheds, then it does not receive the full benefits of stormwater management. However, if upstream communities also manage future development, either independently or through a state or regional agency, all communities can benefit. Therefore, if a community can demonstrate that all upstream communities in its watershed have similar stormwater management programs, it can use Option 1.

Option 2

If a community only manages a part of a watershed, it cannot prevent future increases in runoff from all of the watershed's development. The impact adjustment reduces the score to account for the fact that the community cannot do 100% of the job. Under Option 2, a default value of 25% is used for the impact adjustment ratio.

1. Stormwater Management Regulation (SMR): If the community does not regulate development within all of the watersheds that affect it, it may use the default value rSMR = 0.25.
2. Watershed Management Master Plan (WMP): If the watershed management master plan does not regulate all development within all of the watersheds that affect the community, it may use the default value rWMP = 0.25.

The default value means that communities will always get at least 25% of the credit for their watershed management regulations no matter how little of the watershed they can actually regulate. This default value also helps communities that find it difficult to use Option 3.

Option 3

An Impact Adjustment Map is required for Option 3. The Impact Adjustment Map for this activity is discussed above.

Under Option 3, the impact adjustment adjusts the credit for SMR and WMP in accordance with the portion of the watershed regulated.

1. Stormwater Management Regulation (SMR): A community must develop a stormwater Impact Adjustment Map to determine the impact of its stormwater regulations (rSMR):

   $$rSMR = \frac{aSMR}{aW}$$

   aSMR = the area subject to stormwater management regulations, and aW = the area of all watersheds affecting the community.

   It is necessary to show the entire drainage area that affects the community (aW) and the community boundary on the Impact Adjustment Map. The area regulated by the community (aSMR) is usually the same as the area of the community.

2. Watershed Management Master Plan (WMP): A community must develop an Impact Adjustment Map to determine the impact of its watershed master plan (rWMP):

   $$rWMP = \frac{aWMP}{aW}$$

   aWMP = the area regulated in accordance with the watershed plan, and aW = the area of all watersheds affecting the community.

The Option 2 impact adjustment favors communities in larger watersheds that have jurisdiction over less than 25% of the watersheds that drain into them. The Option 3 adjustment favors communities with smaller watersheds that are mostly within the community's jurisdictional area.

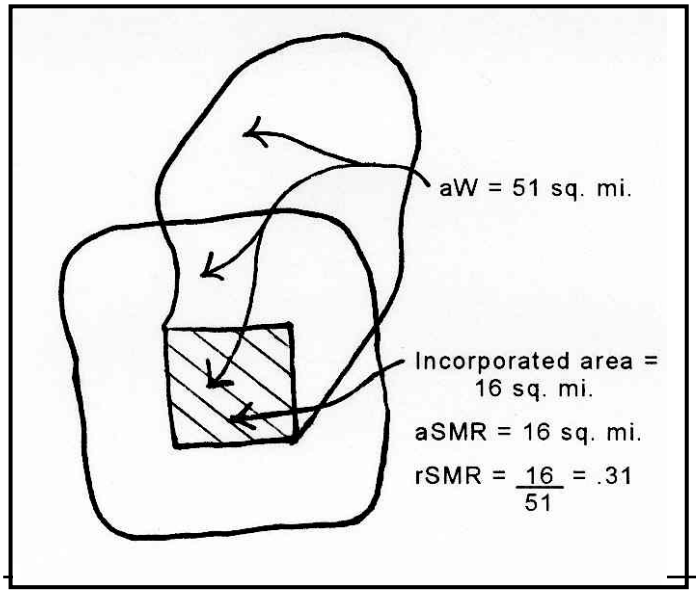
Option 2 is also used to estimate the community's credit in an initial application for the CRS. A community may prepare an Impact Adjustment Map later with the assistance of the ISO/CRS Specialist. If the map has been completed during or immediately after the ISO/CRS Specialist's verification visit, the additional credit points provided by using Option 3 will be added then.

Impact Adjustment for Extraterritorial Jurisdiction

Many incorporated communities have full review and permitting authority outside their corporate limits. This authority allows them to impose their land use standards on new developments adjacent to the community. This is usually called "extraterritorial jurisdiction," or ETJ.

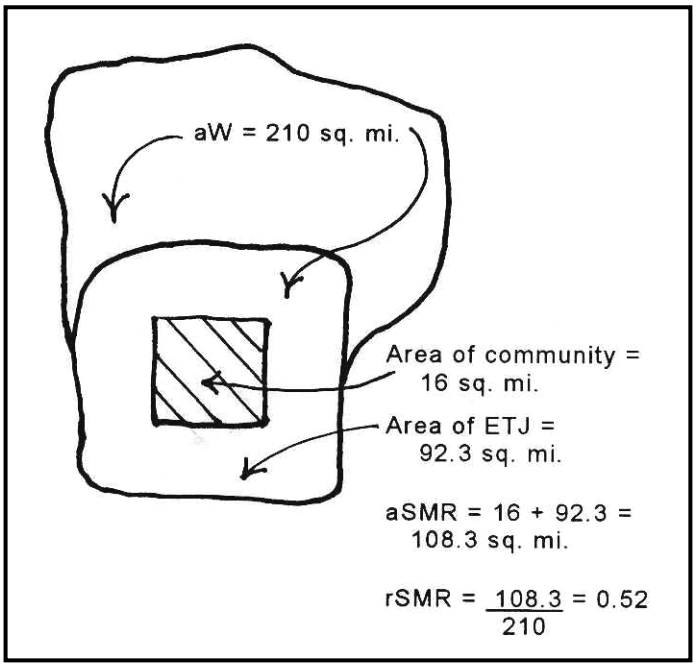
The impact adjustment for stormwater management regulation and stormwater master plans depends on how the extraterritorial jurisdiction is treated by the Federal Emergency Management Agency on the community's FIRM.

1. **ETJ not shown on the FIRM.** If a community regulates new development in its extraterritorial jurisdiction according to its stormwater management regulation, and the extraterritorial jurisdiction is NOT shown as part of the community on its FIRM, then the portion of the extraterritorial jurisdiction upstream from the community is included in aSMR. This area is regulated, and the community benefits from its regulation of runoff from future development.
    a. The area regulated (aSMR) includes the area of the community plus the portion of the extraterritorial jurisdiction that is in the watershed affecting the community.
    b. The area of the watershed affecting the community (aW) is the area of the community plus that portion of the watershed that drains into the community.



In this example, because the extraterritorial jurisdiction is not shown on the community's FIRM, only the incorporated area and the portion of the extraterritorial jurisdiction that drains into the incorporated area are counted as aSMR. Regulation of the rest of the extraterritorial jurisdiction benefits property downstream from the community. The county or a downstream community could receive credit for stormwater management in this area.

2. **ETJ shown on the FIRM.** If the extraterritorial jurisdiction is included on the community's FIRM, the area of the watersheds affecting the community (aW) is based on the extraterritorial jurisdiction. This increases aW and usually decreases rSMR and rWMP.



In this example, the area of the extraterritorial jurisdiction is considered by the NFIP to be part of the community, and NFIP policies on buildings in the extraterritorial jurisdiction are eligible for the CRS premium discount provided to the community. Therefore, the boundary of the extraterritorial jurisdiction is used just like corporate limits for most communities when determining aW and aSMR.

In this case, the county in which the community is located cannot receive credit for stormwater regulation in the extraterritorial jurisdiction, because buildings in the extraterritorial jurisdiction are within the community for CRS purposes.

Common Problems

Communities often fail to understand that the impact adjustment for this activity usually includes drainage areas outside of the community. The impact adjustment gives the community credit for stormwater management based on the portion of the watershed affecting the community that is managed. The area with stormwater management regulation, aSMR, is divided by the total watershed that produces runoff through the community, aW. aW usually extends beyond the area of the community's jurisdiction.

The same calculation is done for areas with stormwater master plans. aW is the same for both calculations.

453 Credit Calculation

In this section, the credit for stormwater management regulation (SMR) is multiplied by the impact adjustment (rSMR). The credit for stormwater master planning (WMP) also is multiplied by the impact adjustment (rWMP). The results are the total credit points for each element, cSMR and cWMP.

a. cSMR = SMR x rSMR

b. cWMP = WMP x rWMP

For example, if the community uses Option 1 for the impact adjustment for its stormwater management regulations, SMR is multiplied by 1.0. If the community chooses Option 2, SMR is multiplied by 0.25. Under Option 3, SMR is modified by the value of rSMR as calculated using the stormwater Impact Adjustment Map.

454 Credit Documentation

For a community's first application for a CRS classification, worksheet page 32 of the *CRS Application* is submitted along with the documentation described below.

Subsequent requests for credit are called modifications. Modifications include activity worksheet AW-450, along with the documentation described below. These worksheets are also used by the ISO/CRS Specialist to calculate the community's verified credit. Examples of how the credit is calculated are provided on pages 37–52.

Section 454 on worksheet page 32 of the *CRS Application* and on AW-450 is a checklist for the documentation listed below. These items are needed to confirm that the community's program meets the CRS credit criteria. If there is more than one item, each should be labeled as "Attachment 1," etc., for easy reference.

Several of the documentation requirements are for ordinance or law language. A copy of the appropriate pages of the ordinance, statute, and/or plan is sufficient and should be attached to the worksheet. The Chief Executive Officer's certification that accompanies the application or modification is considered to include a certification that the ordinance or statute has been enacted into law and is being enforced (see Section 212 of the *CRS Application*).

Regulatory Language for SMR

The community must submit the following:

a. [Required if the community is applying for credit for SMR under Section 451.a]: A copy of the ordinance or law language regulating surface water runoff from new developments in the watershed. For SMR credit, the language must require that peak runoff from new developments be no greater than the runoff from the

site in its pre-development condition. The margin next to where this appears in the ordinance must be marked "SMR."

The language submitted must include those factors that are credited: size of developments regulated, design storms to be used, and how the maintenance of drainage and retention facilities is handled. The appropriate acronym(s) (SZ, DS, and PUB) must be marked in the margin of the ordinance sections that pertain to each element.

The community may also be asked to complete an Activity Worksheet that helps identify where the credits are due.

The community must provide a copy of the ordinance or law language that regulates surface water runoff from new developments in the watershed. Generally this will be in the form of pages excerpted from the local ordinance, statute, or bylaw.

A local "policy," drainage design manual, or other document is not acceptable unless the community can document that it has the force of law. When there is doubt, the community should provide a letter from its attorney that the documentation submitted has been adopted by the governing board and is legally binding on all new development.

The regulatory language submitted must include those factors for which the community is seeking credit. Each appropriate acronym must be marked in the margins. The acronyms are as follows:

SMR identifies the regulatory language that requires that peak runoff from new development be no greater than the runoff from the site in its pre-development condition. SMR regulations are usually part of a subdivision ordinance, public works design standard regulation, or other regulation that sets drainage design standards for new developments. Examples of this language as used by the example communities are presented on pages 37–52.

NOTE: *This publication contains examples of certifications and ordinance language. Communities are advised to have all certifications and proposed ordinances reviewed by their attorneys or corporation counsels.*

SZ is put in the margin of the section of the regulations that identifies the size of development that is regulated. Usually this language is found at the beginning of the regulation in a section that discusses jurisdiction, applicability, and/or exceptions. Examples of SZ language for the example communities can be found on pages 37–52.

DS shows the regulatory language that prescribes the design storm(s) used to set the release rate from new development. It is usually in the section that discusses the design standards for retention or detention basins. It is important to note that DS is not the same as the design size for storm sewers. It is the recurrence interval of the storms that are regulated at the outfall from the development. Examples of regulations' design storms for the example communities appear on pages 37–52.

PUB is used to mark the section of the regulations that describes if and when stormwater management facilities built by the developer are maintained by a public agency. PUB language must cover retention or detention basins, not just the sewer lines on public rights of way.

Two types of documents can suffice as documentation for this element. The first is a subdivision ordinance or other regulatory document that states that stormwater management facilities are turned over to a public agency for ownership or maintenance. The other is a regulation that states that a public agency may enter the property and perform the maintenance if the owner fails to properly maintain the facility. An example of the latter approach is found on pages 38–39. The community will also need to provide a copy of the procedures used to inspect and maintain the facilities (see Section 454.h). These procedures are the same as those required for CRS credit for channel debris removal (CDR) in Activity 540.

Watershed Master Plan

b. [Required if the community is applying for WMP credit under Section 451.b] Copies of the pages of the watershed master plan that show the following:

1. Management of peak flows and volumes so that they do not exceed present values. The plan must either include regulations that meet these criteria or be based on a rainfall/runoff model that achieves these results;

2. The recurrence interval of the storm used for the regulations and/or model;

3. The duration of the storm used for the regulations and/or model;

4. [Required if the community is applying for credit for Section 451.b.2(d)—(f)] How the plan utilizes or protects the existing natural stormwater features within the watershed; and

5. [Required if the community is applying for credit for Section 451.b.2(g)] A statement by the community official responsible for implementation of the watershed master plan that it was prepared in coordination with or as part of the community's Floodplain Management Plan credited under Activity 510. This documentation may be provided from either plan if it is contained there.

A watershed management plan is usually a complex and bulky document. There may be an introduction or summary describing the area covered by the plan, its objectives, and the regulation of surface water runoff. The summary usually is adequate documentation for some or all of this credit. If no such summary is available, one must be developed to document this credit.

NOTE: *Sections 454.c through 454.e are not discussed in this publication. Communities that apply for CRS credit for erosion and sediment control (ESC), protection of water quality (WQ), or freeboard for buildings in the B, C, D, and X Zones (FRX) must meet the documentation requirements in Sections 454.c through 454.e in the* ***Coordinator's Manual****.*

Stormwater Impact Adjustment Map

> f. [Required if the community calculates the impact adjustment ratio for one or more elements by using Option 1 (452.a) or Option 3 (452.c)] An Impact Adjustment Map showing watershed boundaries and stormwater management jurisdiction.

If the community chooses either Option 1 or Option 3 for its impact adjustment, the documentation must include a map showing the watersheds. The stormwater Impact Adjustment Map is explained on pages 24–26. The community should also show how aSMR, aWMP, and aW were calculated. Example maps and calculations are shown for Cheyenne and Laramie County on pages 45–49.

Other Communities' Regulations

> g. [Required if the community determines the area of stormwater management regulation (aSMR) or the area covered by the watershed management plan (aWMP) to include watershed areas regulated by other communities] Documentation that watersheds outside the jurisdiction of the community are regulated to similar standards or are subject to the same plan as those within the community.

Under Option 1 and Option 3 of the impact adjustment, a community may receive more credit points if other communities in its watersheds have stormwater management regulations that are eligible for CRS credit. If the applicant wants the additional credit points, it must document the other communities' regulations. This can be in the form of copies of the other communities' regulatory language.

As an alternative to copies of many regulations, the applicant may submit a statement from the regional agency with stormwater management jurisdiction that lists the other communities in which the regulations are also in effect.

Facility Maintenance Procedures

> h. [Required if the community is applying for PUB credit under Section 451.a.3] The procedures used to inspect and maintain drainage facilities.

If the community is applying for PUB credit for stormwater facilities under Section 451.a.3, then the submittal must include a copy of the procedures used to inspect and maintain those facilities. This applies for both publicly owned and privately owned facilities. The procedures should be a part of or coordinated with the community's procedures for drainage system maintenance (see

Section 544.a of Activity 540 (Drainage System Maintenance) in the *Coordinator's Manual*). For PUB credit, all such facilities must be inspected at least annually.

If the community is applying for credit for channel and basin debris removal (CDR) under Activity 540, the documentation for that activity should meet the documentation requirements for Section 454.h.

Permit Records

The community must have the following documentation available to verify implementation of this activity:

i. Development and building permit records that demonstrate enforcement of the regulations. If the community applied for credit for public maintenance under Section 451.a.3, records that demonstrate implementation of the inspection and maintenance requirements.

To confirm that the regulations have been implemented, the community must be able to show the ISO/CRS Specialist the appropriate development and building permit records. The ISO/CRS Specialist will select a sample of recent development sites and request the records during the verification visit. Permit records are not submitted with an application or modification. The applicant should have the records ready for the verification visit.

For PUB credit, verification includes a review of inspection and maintenance records and a field verification of facilities. If the community has credit for channel and basin debris removal (CDR in Activity 540), these facilities must be included in the community's drainage system as defined for that activity. If the community does not request credit for CDR, it must still provide the same CDR documentation for stormwater facilities. See *CRS Credit for Drainage System Maintenance* for more information. This document is available free (see Appendix E of the *Coordinator's Manual*).

In the unusual case where, as a result of a stormwater master plan, the community has areas in which stormwater management does not include detention or retention, PUB will be verified based on channel maintenance to the lower edge of the community or to the receiving body of water.

WMP Evaluation

If it has received credit for a watershed management master plan (WMP) under Section 451.b, the community must provide the following documentation at the time of its cycle verification:

j. An evaluation report that addresses whether the community's watershed management plans that are more than five years old are still based on appropriate data and effectively manage stormwater runoff. In lieu of a formal

report, the community may submit a letter signed by a licensed professional engineer that addresses the following issues:

(1) The "future conditions" at the time the plan was completed: Do these conditions still reasonably reflect the actual watershed conditions today?

(2) The precipitation data used for the plan's hydrology: Does the community or agency still use the same precipitation that was used in the report?

(3) Method used for the plan(s): Is the method used to develop the plan(s) considered appropriate today by the agency?

(4) Construction: Has construction of stormwater infrastructure altered actual conditions in ways that make the plan(s) obsolete?

(5) Other factors: Are there other aspects of the plan(s) that make it obsolete or otherwise of questionable applicability?

455 For More Information

Many metropolitan areas have regional planning commissions or stormwater or sanitary districts whose staff have expertise in stormwater management. Some have model ordinances or mandatory requirements for local governments.

Example

Hilton Head Island, South Carolina

Excerpts from the Hilton Head Island stormwater management program are given on the following pages to serve as a scoring example. Examples for two other communities are shown later. The communities' programs are not meant to be models to be copied and adopted. A stormwater management program must be tailored to local conditions and developed with adequate technical input.

NOTE: *Communities are advised to have all proposed ordinance language reviewed by their attorneys or corporation counsels.*

Hilton Head Island has a fairly simple stormwater program. Its regulation requires that all new development, except single-family residences on existing lots, ensure that the flows of the 25-year storm do not exceed the flows from the site under pre-development conditions. Because the community is an island, all watersheds are regulated and the community uses Option 1 for its impact adjustment. Hilton Head Island also has credit for maintenance of all stormwater facilities.

451 Credit Points

Stormwater Management Regulations (SMR)

1. Size of Development (SZ). Hilton Head Island's ordinance is applicable to virtually all development except single-family residences, agricultural activities, and temporary work done during emergencies.

   Sec. 16-5-501. Applicability; Exceptions

   All development, with the following exceptions, shall include adequate provisions for stormwater management in compliance with this Article.

   A. All developments exempted by this Title from development plan review, unless other applicable review procedure requires compliance with provisions for stormwater management.

   B. The establishment of a single family residential structure, including a manufactured home, and its accessory structures that are part of an approved subdivision, or additions or modifications to existing single family residential structures. Such activities are, however, subject to the flood damage control standards as outlined in Title 9 of Title 15 of the Municipal Code of the Town of Hilton Head Island.

   C. Existing agricultural activity and new agricultural activity not involving the filling or drainage of land.

D. Work by agencies or property owners required to meet emergency flooding conditions. If practicable, emergency work should be approved verbally by the Administrator or other duly appointed official in charge of emergency preparedness or emergency relief. Property owners performing emergency work will be responsible for any damage or injury to persons or property caused by their unauthorized actions. Property owners will restore the site of the emergency work within 60 days following the end of the emergency period.

E. Developments that do not disturb more than 5,000 square feet of land in total, nor disrupt existing drainage patterns.

Based on this requirement, SZ = 20.

2. Design Storm (DS). Hilton Head Island's ordinance requires that the 25-year storm be accounted for in all development.

Sec. 16-5-502. General Standards for Stormwater Management

A. Each development shall incorporate stormwater management facilities sufficient to maintain pre-development peak discharge rates across adjacent property lines. In the case of redevelopment, the pre-development condition shall be defined as the natural state. This requirement may be waived where a suitable means of flow into a downstream tidal discharge point is accessible; or where the applicant provides a drainage system with adequate capacity to carry site flows to an ultimate downstream tidal discharge point. Except as noted above, discharge of runoff into tidal or freshwater wetlands shall be limited to pre-development conditions, unless otherwise approved by the OCRM.

Sec. 16-5-505. Design Standards

A. Twenty-Five Year Storm. The 25-year frequency storm shall be used in the design of all drainage systems and runoff detention/retention structures.

B. On-Site Retention. All applications for development shall provide for on-site retention (dry or wet), or percolation of stormwater sufficient to maintain pre-development 25-year frequency peak discharges after development has occurred, or as exempted in Sec. 16-5-501.

DS = 20.

3. Public Maintenance (PUB). Hilton Head Island requires owners to maintain stormwater facilities. The city has the right to enter these facilities for inspections and to perform maintenance if necessary.

Sec. 16-5-506. Drainage Easements

A. Assignment. The Administrator may require as a condition for obtaining approval of runoff control and drainage plans that the applicant record plats or covenants insuring that drainage easements and facilities are assigned to a specific entity. Specific entities may include, but are not limited to, the

developer, a Homeowner's or Landowner's Association or regime, or a public service district. If the recording of such covenants or plats is not desired by the applicant, the Administrator will then require as it deems necessary that the applicant solicit dedication to and acceptance by a specific entity of such easements and facilities to assure the provision, maintenance and operations of said facilities. All required easements or covenants shall be recorded and filed in the Beaufort County Courthouse and documented prior to the issuance of a Certificate of Compliance.

B. Maintenance Requirements. General maintenance requirements necessary to insure the long-term functions of deeded stormwater runoff controls, easements and drainage facilities shall also be described in the documents establishing the Homeowners or Landowners Association. The documents will also state that the Town or a legal entity having authority over such drainage may perform or require the Homeowners or Landowners Association to take action under the following conditions:

1. normal maintenance is not performed which results in an adverse affect on drainage flow; or

2. to alleviate flooding or other emergency drainage problems upstream, or downstream of the easement.

3. The Town will assist the developer in negotiating with the Homeowner's or Landowner's Association and other affected parties on equitable distribution of costs incurred in performing or repairing actions taken on these easements under such conditions.

In its documentation for channel debris removal (CDR in Activity 540), Hilton Head Island included annual inspection of all stormwater facilities approved under this ordinance. A review of permit records and subdivision plats confirmed the implementation of the requirements, and field inspection indicated that the maintenance is performed.

PUB = 110.

SMR Credit

The credit for SMR is the sum of the three sub-elements: SMR = SZ + DS + PUB.

SMR = 20 + 20 + 110 = 150

Watershed Management Master Plan (WMP)

Hilton Head Island has no watershed master plan, so WMP = 0.

452 Impact Adjustment

Because it is an island, the area of Hilton Head Island equals the total area of its watershed. All of its watershed is subject to its stormwater regulations. It uses Option 1 for its impact adjustment: rSMR = 1.0.

453 Credit Calculation

cSMR = SMR x rSMR

cSMR = 150 x 1.0 = 150

454 Credit Documentation

Section 454 on activity worksheet AW-450 lists the documentation needed. Hilton Head Island checks off what is included in the submittal and what it agrees to provide during the verification visit. It numbers the attachments to make the review easier.

The community also marks the margins of the documents with the appropriate acronyms to show where the credited elements appear. This is very important to assist the reviewer. If the reviewer cannot find the documented support for the credit claimed, the community may not receive the credit.

> The community must submit the following:
>
> a. [Required if the community is applying for credit for SMR under Section 451.a] A copy of the ordinance or law language regulating surface water runoff from new developments in the watershed. For SMR credit, the language must require that peak runoff from new development be no greater than the runoff from the site in its pre-development condition. The margin next to where this appears in the ordinance must be marked "SMR."
>
> The language submitted must include those factors that are credited: size of development regulated, design storms to be used, and how the maintenance of drainage and retention facilities is handled. The appropriate acronym(s) (SZ, DS, and PUB) must be marked in the margins of the sections of the ordinance that pertain to each element.

Hilton Head Island provides copies of sections 16-5-501, 16-5-502.A, 16-5-505, and 16-5-506 of its city code with the acronyms SZ, DS, and PUB marked in the margins. The community includes a copy of the cover of the code to identify the source of the copied pages. Each page of the code has the latest revision date in the footer, so there is no need for further documentation of the adoption date of the code.

> f. [Required if the community calculates the impact adjustment ratio for one or more elements by using Option 1 (452.a) or Option 3 (452.c)] An Impact Adjustment Map showing watershed boundaries and stormwater management jurisdiction.

During the verification visit, the ISO/CRS Specialist verifies that Hilton Head Island is entirely located on a barrier island. He or she makes a note of this and sends it to the technical reviewer with Hilton Head Island's other documentation.

h. [Required if the community is applying for PUB credit under Section 451.a.3] The procedures used to inspect and maintain drainage facilities.

During the verification visit, the ISO/CRS Specialist reviews the documentation for channel and basin debris removal (CDR) under Activity 540. He or she makes a note that these procedures have been verified and sends it to the technical reviewer with Hilton Head Island's other documentation.

The community must have the following documentation available to verify implementation of this activity:

i. Development and building permit records that demonstrate enforcement of the regulations. [If the community applied for credit for public maintenance under Section 451.a.3] Records that demonstrate implementation of the inspection and maintenance requirements.

During the verification visit, the ISO/CRS Specialist asks to see several recent subdivision plats and permits for other developments that are required to provide stormwater detention under the city code. He or she verifies that the plats and plans attached to the permits show that the detention was included in the development. Some of these sites will be included in the field verification for channel and basin debris removal (CDR). The ISO/CRS Specialist further verifies that annual inspections are done for each privately owned detention facility and for the conveyance systems that drain to and from these facilities.

Example

Cheyenne and Laramie County, Wyoming

Excerpts from the stormwater management programs for the City of Cheyenne and Laramie County, Wyoming, are provided on the following pages. The communities' programs are not meant to be models to be copied and adopted. A stormwater management program must be tailored to local conditions and developed with adequate technical input.

NOTE: *Communities are advised to have all proposed ordinance language reviewed by their attorneys or corporation counsels.*

Cheyenne and Laramie County have a fairly complex stormwater management program. Their regulations require that all new subdivisions ensure that the flows of the 50- and 100-year storms do not exceed the flows under pre-development conditions. The Cheyenne area experienced a flood in 1985 that caused $65 million in damage and took 12 lives. As a result of that flood, the city and county developed and adopted a Drainage Master Plan and detailed master plans for each of the eight basins in and around Cheyenne. In addition to stormwater and floodplain management, these basin plans included $85 million in capital improvement projects. Planning is complicated to some extent by the existence of F. E. Warren Air Force Base within the urbanized area.

451 Credit Points

Stormwater Management Regulations (SMR)

The City of Cheyenne and Laramie County adopted the *Cheyenne–Laramie County Subdivision/Development Regulations 2000* in June 2000 and July 2000, respectively. Article VIII, Section 80.010(b) of these regulations states

> *Land subject to flooding, and/or within drainage areas shall be developed in accordance with the provisions of the Cheyenne Storm Water Management Manual, Design Standards and Regulations—an Amendment to the Subdivision/Development Regulations, as well as the Floodplain Management Regulations.*

1. Size of Development (SZ). The following definitions are from the *Cheyenne–Laramie County Subdivision/Development Regulations 2000*.

Subdivision. (County Only) Means the creation or division of a lot, tract, parcel or other unit of land for the immediate purpose of sale, building development or redevelopment, for residential, recreational, industrial, commercial or public uses. The word "Subdivide" or any derivative thereof shall have reference to the term subdivision, including mobile home courts, the creation of which constitutes a subdivision of land.

Subdivision/Development. (City Only) The division of a lot, tract, parcel or other unit of land into three (3) or more lots, plots, sites or other subdivisions/developments of land for the immediate or future purpose of sale, building development or redevelopment, for residential, recreational, industrial, commercial or public uses. Mobile home parks and cemeteries shall be considered subdivisions/developments. The following items are exempt from Subdivision/Development Regulations:

(a) The sale of land where the parcels involved in the sale are thirty-five (35) acres or larger.

(b) The sale of land for agricultural purposes.

(c) Railroad rights-of-way.

(d) State and County Highway rights-of-way.

Because the regulations include virtually all development except agricultural development and single family residences on existing lots, DS = 20 for both the City of Cheyenne and Laramie County. Agricultural uses usually do not increase stormwater runoff.

2. Design Storms (DS). Appendix A of the *Cheyenne–Laramie County Subdivision/ Development Regulations 2000* has separate sections for design standards in rural and urban areas, but the design storms used to size detention/retention structures are the same:

Storage—Subdivisions/Developments shall be planned and drainage facilities designed such that the peak rate of stormwater discharge that shall occur, at downstream boundary discharge points, after completion of the subdivision/development shall not exceed the peak rate of storm water discharge that would occur from the undeveloped or existing conditions at the same discharge locations, for an event equal to a 50-year frequency storm. . . . Freeboard shall be provided for storage impoundments to contain the 100-year frequency storm or pass it through spillways and outlets of sufficient capacity that the downstream flows do not exceed the predevelopment conditions.

Because discharges for the 50- and 100-year storms are controlled to the pre-development levels, SZ = 80 for both the City of Cheyenne and Laramie County.

3. Public Maintenance (PUB). From Appendix A of the *Cheyenne–Laramie County Subdivision/Development Regulations 2000*:

Maintenance—Upon satisfactory completion of the construction of a drainage improvement (ponding area, storm drain, ditch, etc,) in accordance with previously approved plans, and subject to the approval of the City and County Engineer, and after proper deeding or dedications of the land or easements

containing the improvement to the City or County, the City or County shall assume ownership of the land and the drainage facility located thereon and shall become responsible for all repairs that are required, except for such defects or repairs that are covered under warranty by the Contractor or Subdivider/Developer who constructed the facility. Such maintenance shall include periodic cleaning, weed and grass cutting, repairs to pipe and underground structures and all else which is reasonably expected of a publicly owned and operated public utility system. The design of a drainage improvement shall provide for equipment access for maintenance purposes.

Based on this regulatory language, PUB = 110. However, the community must provide documentation equivalent to that required for channel debris removal credit (CDR in Activity 540) for all channels and detention facilities approved under this regulation. These facilities will be inspected during the CRS verification process, and if it is apparent that some areas are not maintained in accordance with the credited procedures, PUB credit will be reduced accordingly.

SMR Credit

The credit for SMR is the sum of the three sub-elements: SMR = SZ + DS + PUB.

SMR = 20 + 80 + 110 = 210

Watershed Management Master Plan (WMP)

As a result of record rainfall on August 1, 1985, the Cheyenne area suffered a devastating flood. Damage was estimated at $65 million, and 12 lives were lost. The City of Cheyenne and Laramie County immediately set out to develop a master drainage plan to reduce the flood threat to lives and property. The 1988 Drainage Master Plan that resulted includes drainage master plan reports for eight watersheds that drain into and through the greater Cheyenne area.

To qualify for CRS credit for watershed master plans (WMP), a plan must meet five criteria (Section 451.b.1).

(a) The community must have adopted a watershed management master plan for one or more of the watersheds that drains into the community.

The City of Cheyenne and Laramie County have adopted watershed drainage plans for eight watersheds.

(b) The community has adopted regulatory standards for new construction in the watershed based on the plan.

The *Cheyenne–Laramie County Subdivision/Development Regulations 2000* were adopted as a result of the Surface Water Drainage Committee's review of the Drainage Master Plan.

(c) The plan's regulatory standards manage future peak flows so that they do not increase over present values.

Although the recommendations in some of the watershed master plans allow some increase in discharge, these plans do not include the detention required of new developments under the 2000 stormwater regulations. Also, in several watersheds, additional detention was recommended by the Surface Water Drainage Committee. It is expected that peak flows on Crow Creek below the confluence of the eight watersheds will be reduced as a result of implementation of the plans, as modified by the committee.

(d) The plan's regulatory standards require management of runoff from all storms up to and including the 25-year event.

All master drainage plans were based on 2-, 5-, 10-, 25-, 50-, and 100-year storm events.

(e) In order to maintain WMP credit for any plan that is more than five years old, the community must evaluate the plan to ensure that it remains applicable to current conditions.

The City and County understand that their engineers will need to evaluate the plans and sign a statement at the next cycle verification visit.

WMP.b.2(a) = 80

Additional credit for stormwater master plans is as follows (Section 451.b.2):

(b) 25, if the plan manages the runoff from all storms up to and including the 100-year event.

All master drainage plans were based on 2-, 5-, 10-, 25-, 50-, and 100-year storm events.

WMP.b.2(b) = 25

WMP = the sum of the above.

WMP = 80 + 25 = 105

452 Impact Adjustment

The impact adjustment for Cheyenne and Laramie County is the portion of the area of each community eligible for credit (aSMR and aWMP) for each element, divided by the area of watershed affecting each community (aW).

Stormwater Management Regulation—Cheyenne

The City of Cheyenne regulates all of its incorporated area, and Laramie County regulates areas adjacent to the city to the same standards (SMR = 210). The city does not regulate development on Warren Air Force Base.

> Although the city does not receive credit for SMR for the area of Warren Air Force Base because it does not regulate development there, it works actively with the base on drainage issues, and the base, the city, and the county are co-sponsoring a detention basin on the base to reduce flooding in portions of the city.

See the map on the next page. The area of the City of Cheyenne is 18.9 square miles. The area of the developed portion of Warren Air Force Base is 9.2 square miles. Since the city and the county have the same regulatory standards, the city can include the entire drainage area to the west in its calculation of aSMR. However, since a portion of the drainage area for Crow Creek is in Albany County, and is not regulated, and because the drainage area of Crow Creek where it enters the city's jurisdiction is larger than 50 square miles, the city excludes the Crow Creek drainage area from its calculations. The area of Laramie County draining into Cheyenne, exclusive of Crow Creek, is 53.6 square miles. The drainage area of Crow Creek is indicated by dashed lines on the Impact Adjustment Map on the next page.

aSMR = the area of the city and county that is regulated.

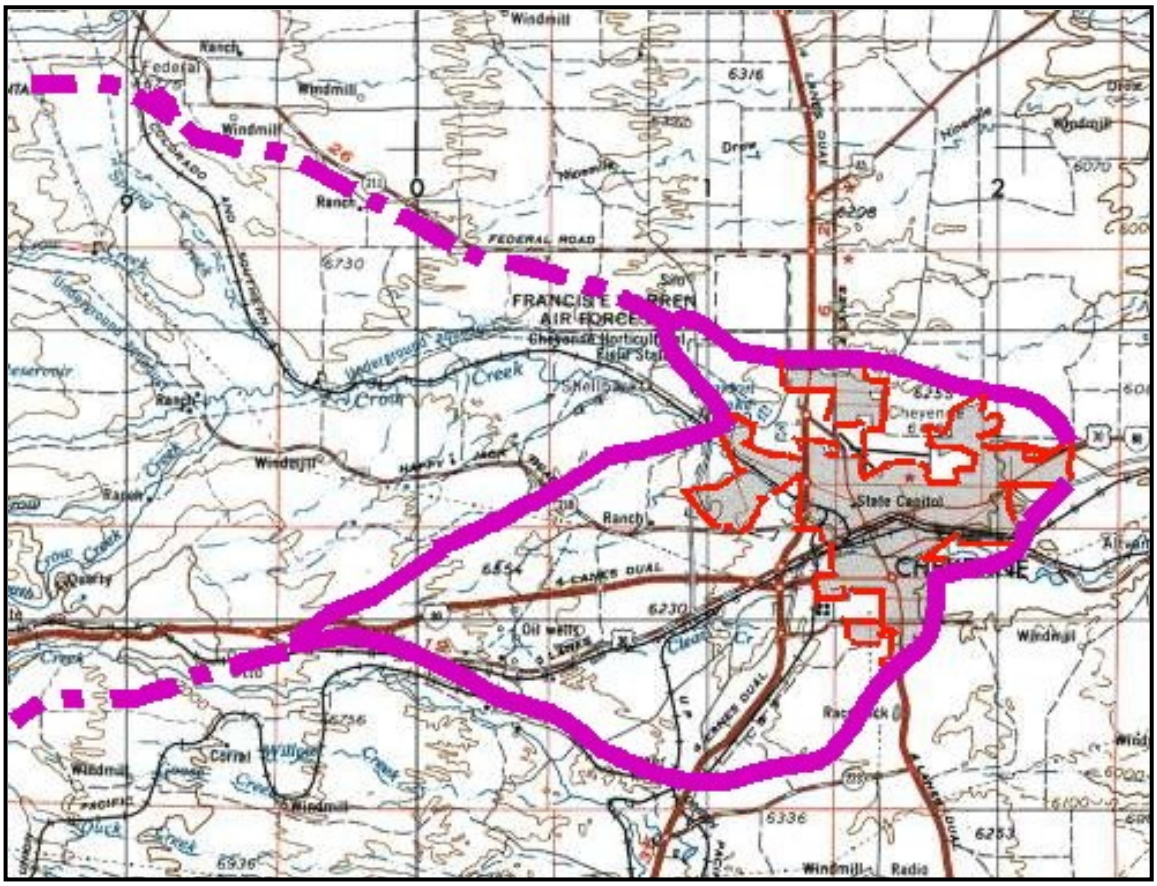
$aSMR = 18.9\ mi^2 + 53.6\ mi^2 = 72.5\ mi^2$

aW = the area of the watersheds that drain into the city, excluding the watershed for the main stem of Crow Creek, because it is greater than 50 square miles.

$aW = 18.9\ mi^2 + 53.6\ mi^2 + 9.2\ mi^2 = 81.7\ mi^2$

$$rSMR = \frac{aSMR}{aW} = \frac{72.5}{81.7} = 0.8874$$

This is rounded to 0.89 and entered on the worksheet.



Impact Adjustment Map for Cheyenne

Stormwater Management Regulation—Laramie County

Laramie County regulates all unincorporated areas, and the City of Cheyenne regulates all of its incorporated area to the same standards (SMR = 210). Development on Warren Air Force Base is not regulated.

See the map on the next page. The total area of Laramie County is 2,660 square miles. All of this area is regulated by either the county or the City of Cheyenne, except for Warren Air Force Base. For Laramie County,

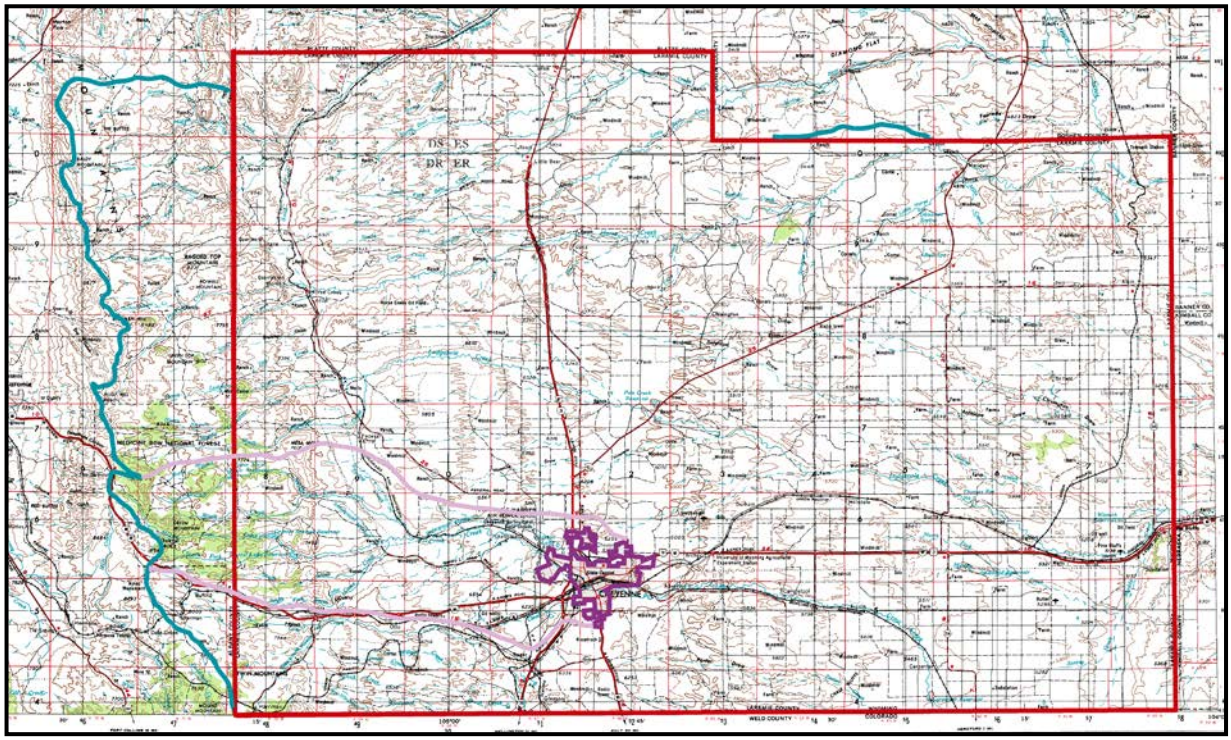
$$aSMR = 2{,}660\ mi^2 - 9.2\ mi^2 = 2{,}651\ mi^2.$$

Examination of U.S. Geological Survey quadrangle maps indicates that about 130 square miles drain into Laramie County when streams with more than 50 square miles of drainage area where they enter the county are ignored. For Laramie County,

$$aW = 2{,}660 + 130 = 2{,}790\ mi^2.$$

$$rSMR = \frac{2{,}651\ mi^2}{2{,}790\ mi^2} = 0.950$$

This is rounded to 0.95 and entered on the worksheet.



Impact Adjustment Map for Cheyenne and Laramie County

Watershed Master Plan—Cheyenne

All of the watersheds affecting the City of Cheyenne have watershed master plans. The city uses Option 1. rWMP = 1.0.

The area of Warren Air Force Base is included in aWMP because the watershed master plans included the base and determined future runoff based on future growth on the base.

Watershed Master Plan—Laramie County

See the map above. Laramie County has completed watershed master plans for 336 mi^2. aWMP = 336 mi^2.

The total area of Laramie County is 2,660 square miles. Examination of U.S. Geological Survey quadrangle maps indicates that about 130 square miles drain into Laramie County when streams with over 50 square miles of drainage area where they enter the county are ignored. For Laramie County,

$$aW = 2{,}660 + 130 = 2{,}790 \text{ mi}^{2.}$$

$$rWMP = \frac{336 \text{ mi}^2}{2{,}790 \text{ mi}^2} = 0.120$$

Laramie County uses Option 2.

$$rWMP = 0.25$$

The population of the Cheyenne metropolitan statistical area (MSA) is 73,544, compared with a total county population of 78,872. It is likely that Laramie County would have a considerably higher impact adjustment (rWMP) if it determined the projected population growth of the watersheds that have stormwater master plans. The county has a comprehensive plan and GIS capability. It can provide this documentation and receive more credit for WMP whenever it is ready to submit a modification for a higher CRS classification.

453 Credit Calculation

City of Cheyenne

cSMR = SMR x rSMR. cSMR = 210 x 1.0 = 210

cWMP = WMP x rWMP. cWMP = 105 x 1.0 = 105

Laramie County

cSMR = SMR x rSMR. cSMR = 210 x 0.95 = 199.5

cWMP = WMP x rWMP. cWMP = 105 x 0.25 = 26.25

It may seem unfair that the City of Cheyenne receives more credit for stormwater management regulation and watershed master plans than Laramie County does. However, this is the purpose of the impact adjustments for these activities.

Although both communities regulate new development to the same standards, all of the watersheds affecting Cheyenne are regulated, while there is no documentation that watershed areas outside of Laramie County are regulated.

Similarly, all watersheds that affect Cheyenne have been included in master plans, and as these plans are implemented, flood problems will be reduced. Only a small portion of the watersheds in Laramie County are afforded that protection. If Laramie County provides the documentation needed to adjust WMP based on where growth is expected, the county should receive considerably more credit.

454 Credit Documentation

Because the City of Cheyenne and Laramie County both applied for CRS credit for stormwater management at the same time, the ISO/CRS Specialist made the verification visit to both communities during the same week. When it became apparent how closely tied the two stormwater management programs were, the ISO/CRS Specialist arranged a joint meeting with the stormwater management experts in the two communities. They agreed to the documentation needs for SMR and WMP and provided the documentation for both communities in one package.

Stormwater Management Regulation

1. SMR. The *Cheyenne–Laramie County Subdivision/Development Regulations 2000* include Ordinance No. 3408, adopted by the Governing Body of the City of Cheyenne, and Resolution No. 000801-04, adopted by the Board of Commissioners of Laramie County. These are the instruments by which the city and county, respectively, adopted the subdivision regulations.

   The ordinance language that earns CRS credit for stormwater management regulation is shown on pages 42–44.

2. rSMR. Documentation for rSMR was not on an Impact Adjustment Map, but was obtained from several sources. The Drainage Master Plan documents for each of eight basins had the drainage areas of the studies. A map in *Implementing the Master Drainage Plan for the Greater Cheyenne Area* included a map showing the drainage areas and the corporate limits of the city. The areas of the city, the county, and Warren Air Force Base were found in the city's comprehensive plan on the city's website. Drainage areas entering Laramie County from other jurisdictions were estimated from U.S. Geological Survey quadrangle maps.

   If the stormwater technical reviewer had not been able to find all of this information and determine the impact adjustments, he or she would have contacted the city and/or the county and told them what was needed. If they could not provide it, they would have been verified with rSMR = 0.25 and rWMP = 0.25, the Option 2 default values.

   To maximize their credit for these elements, communities are advised to provide all documentation specified in the *Coordinator's Manual*.

Watershed Master Plan

1. WMP. The communities provided documentation showing that the eight basin Drainage Master Plans were adopted by the governing bodies of both the city and the county. The plans were based on hydrologic modeling of the 2-, 5-, 10-, 25-, 50-, and 100-year storms of a duration equal to the basin response time (2 to 24 hours).

   The relationship between the stormwater management regulation and the watershed master plans is demonstrated in the documents.

   1. From the *Cheyenne–Laramie County Subdivision/Development Regulations 2000*:

      City/County Drainage Plan—It is recognized that surface water drainage problems are primarily defined by the natural topography of the land, without regard for legal boundaries, existing improvements or proposed improvements to the land. The City and County therefore will provide for the necessary control, coordination and implementation measures required to achieve the general objectives as well as the specific improvements which may be required in order to satisfy the regulations as established herein. THE CITY AND COUNTY SHALL PREPARE A DRAINAGE PLAN OR PLANS FOR THE ENTIRE AREA, WHICH SHALL SERVE AS A GUIDE FOR THE DEVELOPMENT OF DRAINAGE IMPROVEMENTS WITHIN THE CITY AND COUNTY. The City/County Drainage Plans shall define and identify the major drainage facilities required to store and transport surface drainage run-off affecting large land areas.

This language in the regulation shows that the regulations will be implemented in coordination with structural projects from the watershed master plan.

2. From the Drainage Master Plan: Capitol and Holliday Basins*:*

   Future land use within much of Capitol and Holliday Basins is expected to remain the same as existing because these areas are nearly fully developed. Within Holliday Basin, the only area for potential change is at the Cheyenne Municipal Airport, where future development may result in an expansion of the terminal and parking facilities along an extension of Morrie Avenue. FOR HYDROLOGIC ANALYSES CONDUCTED HEREIN, IT WAS ASSUMED THAT ANY SUCH EXPANSION INTO THIS AREA WOULD BE REQUIRED TO LIMIT ITS RUNOFF TO THE PRESENT HISTORIC LEVELS.

   The last sentence in this paragraph shows that the impact of the stormwater management regulations is considered in the development of the watershed master plan.

Present and future conditions were considered in each basin, as shown in the following discussion from the Drainage Master Plan: Clear Creek Basin.

Clear Creek basin is essentially a rural basin composed of rangeland used for grazing sheep and cattle. Land cover in the basin is mainly grasses, forbs, and shrubs. About 2,100 acres of land in the basin have been issued permits for irrigation. Two reservoirs, with a combined capacity of about 320 acre-feet, store irrigation water on Clear Creek upstream of Interstate 25 (I-25) . . .

Over 85 percent of the Clear Creek Drainage Basin is located west of I-25. Except for one industrial plant and some residences, this part of the basin is essentially undeveloped. The remaining basin below I-25, containing the Clear Creek flood plain study reach, is more urbanized but still has vast open areas . . . About 12 percent of the basin below I-25 is impervious area, due to roads, residential subdivisions, and industrial and warehouse complexes.

Future land use within the basin is expected to show the conversion of much of the rural land near the City of Cheyenne into an urban use. City and county planning documents indicate that much of the area is part of a planned unit development (PUD), with areas designated for residential, commercial, and industrial uses . . . Based upon the proposed development conditions, future basin lag times and impervious areas were estimated to evaluate future basin hydrology. All other hydrologic parameters were assumed to remain the same. With the planned urbanization of the basin, the amount of impervious area will increase from the present 2.6 percent to an expected 16.2 percent.

Watershed master plans are not static documents. They should be reviewed and revised from time to time as they are implemented. This was done in Cheyenne and Laramie County.

The recommendations from the watershed master plans were not fully implemented. In 1997, the city and the county commissioned a Surface Water Drainage Committee to look into the matter. According to *Implementing the Drainage Master Plan for the Greater Cheyenne Area*, dated March 2000, this committee

- Examined progress and explored ways to implement the Drainage Master Plan;

- Developed an organizational means to coordinate city, county, and Warren Air Force Base efforts to mitigate the flood hazards;
- Identified ways to reduce the cost of implementing the master plan by proposing revisions of improvement projects using revised design criteria;
- Assessed the benefits and ramifications of establishing a drainage utility;
- Developed preliminary recommendations for implementing a comprehensive drainage management program;
- Hosted public meetings and gathered and responded to public comments; and
- Developed final recommendations for implementing a comprehensive drainage management plan.

A primary finding of the Surface Water Drainage Committee was that funding has not been provided to implement the 1988 Drainage Master Plan. The final committee recommendation was the development of a surface water drainage utility that would include the city, Warren Air Force Base, and portions of the county. This utility could be funded by fees from existing and future development.

The committee stated that "it is reasonable to expect that all developments address any drainage problems they might create," and "it is recommended that design criteria and standards for surface water be provided in a single document to be adopted by the City, County, and Warren Air Force Base." These two stormwater management elements are included, as much as possible, in the Cheyenne–Laramie County Subdivision/Development Regulations 2000. The committee noted that "Warren Air Force Base will be an important part of the surface water drainage program. Warren Air Force Base is currently developing drainage plans and a series of environmental restoration projects on the base . . . The degree that Warren Air Force Base participates will depend on the Department of the Air Force."

In reviewing the watershed master drainage plans, the committee recommended several revisions to reduce costs. These included the acquisition of some residences instead of far more costly structural projects to protect them, and the development of larger, publicly owned detention facilities in several locations. Acquisition of floodprone buildings has become a more common and more acceptable way to mitigate flood damage since the original plans were completed in 1988, and the construction of larger publicly owned detention facilities is possible if the stormwater utility is established with appropriate fees.

The preceding discussion shows several things common to stormwater master planning:

- Implementation of a watershed master plan that includes structural components can be very expensive;
- Many communities have unavoidable impediments to planning, such as the existence of large state, federal, or other development over which they have no jurisdiction; and
- Periodic review of watershed master plans is essential to their implementation.