Urban Drainage and Flood Control District

Community Rating System Assessment

October 22, 2015

French & Associates, Ltd.
Steilacoom, Washington

LeonardRice ENGINEERS, INC.

Urban Drainage and Flood Control District

Community Rating System Assessment

Urban Drainage and Flood Control District
Community Rating System Assessment

1. Introduction

The CRS: The Community Rating System (CRS) is part of the National Flood Insurance Program (NFIP) administered by the Federal Emergency Management Agency. It provides a reduction in flood insurance premiums in those communities that implement activities above and beyond the NFIP's minimum criteria. It is administered by ISO, the Insurance Services Office.

The CRS has been shown to effectively measure and promote improved floodplain management practices. Communities that already have good programs have an added incentive to keep them during the dry years and when challenged by floodplain developers or budget cuts.

Most of the CRS credited practices are implemented by the cities and counties participating in the NFIP. Because CRS credit is for non-Federal activities that have an *impact* in a community, credit is also provided for activities implemented by others, such as the State and the Urban Drainage and Flood Control District. The State and the District can also play an important role by assisting CRS communities.

The District: This assessment reviews how the Urban Drainage and Flood Control District can implement or support activities that provide CRS credit to its communities. In so doing, the District can strengthen local programs and reduce the cost of flood insurance to its constituency.

The Urban Drainage and Flood Control District serves all or portions of seven counties, including 34 cities and towns, in the Denver metropolitan area. Twenty District communities are in the CRS. They are listed in Table 1 on the next page. Under the 2007 *CRS Coordinator's Manual*, they averaged 1,716 CRS points, compared to the national average of 1,546 and the average 1,375 points for the rest of Colorado. One major reason for this difference is likely to be the extra services provided by the District.

As seen in Table 1, the District's 20 CRS communities have over 9,000 flood insurance policies. The total savings to District policy holders is over $1.3 million, every year. This savings will go up as premiums increase due to the recently enacted Biggert-Waters and Homeowner Flood Insurance Affordability Acts and to communities improving their CRS classifications.

This Report: This report reviews the District's floodplain management activities and assesses how they currently support or could support community CRS efforts. It is organized by office and program. The District's programs are not explained because the reader is already familiar with them. Instead, the report focuses on how those programs meet the credit criteria of one or more CRS activities and elements.

This report has a series of tables showing the credits that the 20 CRS communities have been getting. It is important to note that the information in the tables is as of May 1, 2014, the latest data available. All of the credits reported as of May 1, 2014, are based on visits to communities under the 2007 *CRS Coordinator's Manual*.

This report is based on the 2013 *CRS Coordinator's Manual*, which made many changes to the program. Credits reported in the tables provided under the earlier *Manual* will probably be different after the next ISO verification visit to a community. In most cases, a check mark ("✓") is used to show who has been receiving a credit instead of points because the points will change.

Table 1. District CRS Communities

Community	County	Points	Class	PIF *	CRS Discount
Arapahoe County	Arapahoe	1,368	8	192	$2,831
Arvada	Jefferson	2,510	5	509	$179,631
Aurora	Arapahoe	1,725	8	392	$13,193
Boulder	Boulder	2,555	5	3,831	$637,666
Boulder County	Boulder	1,767	7	759	$94,241
Centennial	Arapahoe	1,626	8	128	$1,267
Cherry Hills Village	Arapahoe	1,013	8	44	$2,382
Denver	Denver	1,032	8	1,361	$126,927
Douglas County	Douglas	1,371	8	254	$2,851
Englewood	Arapahoe	1,531	7	38	$2,886
Golden	Jefferson	1,545	7	86	$16,039
Jefferson County	Jefferson	2,140	6	553	$74,156
Lakewood	Jefferson	2,197	6	475	$88,586
Littleton	Arapahoe	1,794	7	144	$14,075
Louisville	Boulder	1,296	8	62	$3,853
Morrison	Jefferson	650	9	12	$1,309
Parker	Douglas	2,256	6	72	$1,649
Thornton	Adams	1,684	7	95	$2,893
Westminster	Jefferson	2,286	6	117	$6,440
Wheat Ridge	Jefferson	2,021	6	193	$36,120
Total				9,317	$ 1,308,993

Points are under the 2007 *CRS Coordinator's Manual* and will be different after the community is visited under the 2013 *Manual*
* PIF = flood insurance policies in force
County CRS participation and benefits are for unincorporated areas only

More information on the Community Rating System can be found at www.floodsmart.gov/floodsmart/pages/crs/community_rating_system.jsp. Copies of the *CRS Coordinator's Manual* and the other publications referenced in this report can be downloaded from www.CRSResources.org.

2. Floodplain Management Program

2.1. Flood Hazard Area Delineations

Flood Hazard Area Delineation (FHAD) studies are prepared in conjunction with watershed and major drainageway master plans. They are published independently from the plans, but in close coordination with the affected communities. They are considered "best available data" by the NFIP. If a community adopts a FHAD by amending its floodplain management ordinance, it can receive credit for up to four of the first five elements in Activity 410 (Floodplain Mapping):

New study (NS)
Leverage (LEV)
Higher study standards (HSS)
More restrictive floodway standard (FWS)
Cooperating Technical Partner (CTP)

2.1.1. Activity 410 credit criteria

The following criteria must be met in order to receive credit for the elements under Activity 410. They are listed in more detail on pages 410-7 – 410-8 of the 2013 *CRS Coordinator's Manual*.

1. All studies and data that the community requests for credit must be displayed on a map. This map may be either digital or paper.

   Status: FHADs meet this criterion.

2. The community must use the floodplain map or data for which credit is requested in its floodplain development regulations. A study that has no impact on floodplain development is not credited. The CRS does not credit studies conducted for drainage improvements or the design of a flood control project if they are not used for regulatory purposes. The community either must have (either)

   a. Amended its floodplain regulations to adopt the new floodplain map or data, or

   b. Authorized a local official, such as the community's engineer, to approve new maps or data in unstudied areas. There must be a record showing that the new study has been approved and utilized by the official.

   Status: The credit is dependent on the community's actions. Some communities automatically adopt new FHADs in their regulations once they have been adopted by the Colorado Water Conservation Board. Others may not have done this.

3. The study must be based on a FEMA-approved technique or specifically approved by the ISO/CRS Technical Reviewer.

   Status: The District's mapping techniques should meet FEMA criteria. Individual studies that varied from normal practices should be reviewed to verify that they qualify.

4. If the study affects a length of stream or shoreline, it must be submitted to FEMA to revise the community's FIRM. This criterion can be met even if FEMA does not immediately publish the map revision.

   Status: This has been the District's practice. It has been formalized recently as a physical map revision process where the District's data are dovetailed into FIRM revisions by FEMA's mapping contractor.

   However, some communities are hesitant to ask FEMA to make their SFHA larger or to add unstudied streams to their FIRM. They prefer to avoid the insurance purchase requirement and higher A Zone premium rates that come with a map revision. This has been found to be a deterrent to applying for 410 credit for some communities who may not have understood the District's policy that newly mapped or revised floodplains will eventually be incorporated into their FIRMs. In some FEMA Regions, it is sufficient for the Region to know that the study exists. Often they will not revise the FIRM, especially if the study does not meet their mapping criterion of having a watershed of one square mile or larger.

2.1.2. New study (NS)

This CRS element credits adopting flood data above and beyond what is provided by FEMA on the community's Flood Insurance Rate Map. Credit is dependent upon meeting three credit criteria, found on page 410-10 of the *CRS Coordinator's Manual*:

(1) The activity credit criteria must be met

Status: All activity credit criteria are met if the community adopts the map and data into its regulatory program.

(2) This credit criterion relates to studies for a single parcel and is not applicable to FHADs.

(3) In order to receive NS credit, studies must [either]

(a) Produce a base flood elevation in a B, C, D, X, or approximate A Zone where there was no elevation shown on the FIRM at the time of the study; or

(b) In AE and numbered A Zones, produce a base flood elevation higher than that shown on the FIRM in effect at the time of the study.

Status: Some parts of a FHAD may meet this criterion and some may not. There may be some older FHADs in areas that have had a more recent Flood Insurance Study that provided higher base flood elevations. Each map will need to be reviewed to determine what mapped areas meet this criterion. Credit can be adjusted to reflect how much of the community's SFHA benefits from the FHAD.

2.1.3. Leverage (LEV)

This element adjusts the credit points for NS to reflect the non-FEMA cost share for a new study credited under NS. Non-FEMA cost share applies to study costs borne by the District, a community, the state, or a private entity, such as a developer. The actions by FEMA's mapping contractor to convert a study to FEMA's FIRM format is not considered part of the cost of a study.

Where a study is 100% funded by a non-FEMA entity, such as the District, the value for LEV is 1.0. This means that 100% of the credit for NS will accrue to the impacted CRS community.

Status: All FHADs should receive full credit (1.0) for LEV.

2.1.4. Higher study standards (HSS)
HSS is for studies done to one or more standards higher than the FEMA mapping criteria, which are now found at www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping.

Status: Most FHADs should get credit for two higher standards:

(1) Basing hydrology on future conditions. Where there are local land use plans, the FHAD hydrology is based on runoff conditions based on the planned future land use. These are generally 20 to 30 years in the future from the date of the plan. Where the future conditions Q_{100} is less than 30% of the current conditions Q_{100}, FEMA has agreed to incorporate the FHAD into a FIRM revision and HSS credit can be provided.

Where the future conditions Q_{100} is greater than 30% of the current conditions Q_{100}, the District prepares two maps, one for the FIRM revision based on current conditions and one based on future conditions for the community to use. HSS credit is provided only if the community adopts the future conditions map in its regulations.

(2) Using a base map that is more accurate (i.e., has a smaller contour interval) than US Geological Service quadrangle maps. The District currently uses two foot LIDAR for the topographic base map and has not used USGS maps for 20 years.

The credit for each FHAD will depend on the standards used when it was prepared. Each study would have to be reviewed to verify the credit.

2.1.5. More restrictive floodway standard (FWS)
This credit is for delineating the floodway using a lower encroachment threshold than FEMA's one foot criterion.

Status: Some FHADs used a 0.5 foot criterion before it became a state requirement in 2012. Since 2012, all of them use this lower encroachment threshold. In 2010, it was noted that seven District CRS communities were receiving credit for 0.5 foot floodways.

2.1.6. Cooperating Technical Partner (CTP)
CTP1 credit is for a community being a Cooperating Technical Partner or being within an area covered by a Cooperating Technical Partner agreement. The agreement must identify a specific study that will be done that impacts the community wanting the credit.

CTP2 credit provides bonus points on top of the new study score (NS) for the CTP-designated study, after it is completed and adopted for regulatory purposes.

Status: The District is a CTP. ISO's master list of CTP1 credits includes all of the District communities. However, only half were getting the credit as of May 1, 2014, probably because the cycle verification visits had not caught up with the ISO master list. Every community deserves the ten points, even if they do not receive any other credit under Activity 410.

2.1.7. Activity 410 credit points

Table 2 shows the credits as of May 1, 2014, for the elements in Activity 410 discussed here. The actual points for each element are aggregated with other credits and then calculated with an impact adjustment. As a result meaningful separate scores are not provided. They would not be the same under the 2013 *CRS Coordinator's Manual*, anyway.

The database does not differentiate between credit for a FHAD and credit for another study. Table 2 does show which communities are not receiving any 410 credit. If any of them have received a FHAD, they are likely missing out on credit.

2.1.8. Activity 410 Documentation

CRS communities must provide documentation to verify a credit or to help calculate the credit points. The documentation needed for all five elements are summarized here:

1. A copy of the study and the study's floodplain map, if not available online. The sections describing the funding source(s), the higher study standard, and the floodway standards need to be identified.
2. The local law or ordinance that adopts the flood study for regulatory purposes.
3. Development permit records showing how the new data are used. This is not needed if FEMA revised the FIRM to incorporate the FHAD.

Table 2. District Communities' 410 Credits

Community	NS	LEV	HSS	FWS	CTP	c410*
Arapahoe County	✓	1.0	✓	✓	✓	235
Arvada	✓	1.0	✓		✓	305
Aurora	✓	1.0	✓			100
Boulder	✓	1.0	✓	✓	✓	70
Boulder County	✓	1.0	✓		✓	287
Centennial						0
Cherry Hills Village						0
Denver						0
Douglas County						0
Englewood						0
Golden	✓	1.0	✓		✓	90
Jefferson County	✓	1.0	✓		✓	110
Lakewood	✓	1.0	✓	✓	✓	619
Littleton	✓	1.0	✓			50
Louisville					✓	10
Morrison						0
Parker						0
Thornton				✓	✓	110
Westminster	✓	1.0	✓		✓	398
Wheat Ridge	✓	1.0	✓		✓	170

* c410 = the total credit for Activity 410, before the growth adjustment.
This may include credit for elements not listed in this table.

4. An impact adjustment map showing the area covered by each credited study, along with calculations showing the acreage of the SFHA at the time of adoption of the study and the acreages of the areas affected by the credited studies. Impact adjustment maps are discussed in Section 3.1.3 of this report.
5. Evidence that the study has been submitted to FEMA or FEMA is aware that the study is available. This is discussed under credit criterion 4 on page 4.

No documentation is needed from the community for the CTP credit as that is verified by checking the online database of CTP agreements.

2.1.9. Conclusions and Recommendations

1. Flood Hazard Area Delineation maps and studies should provide communities with credit points under several elements of Activity 410 (Floodplain Mapping). Each report needs to be checked to verify and identify the credit for each element.

2. It appears that some communities that are likely to have one or more FHADs in their corporate limits are not receiving the credit.

3. District staff should work with the ISO/CRS Specialist and ISO's 410 technical reviewer to clarify if CTP credit will continue. Communities do not appreciate being told there is credit and then told that they're losing it.

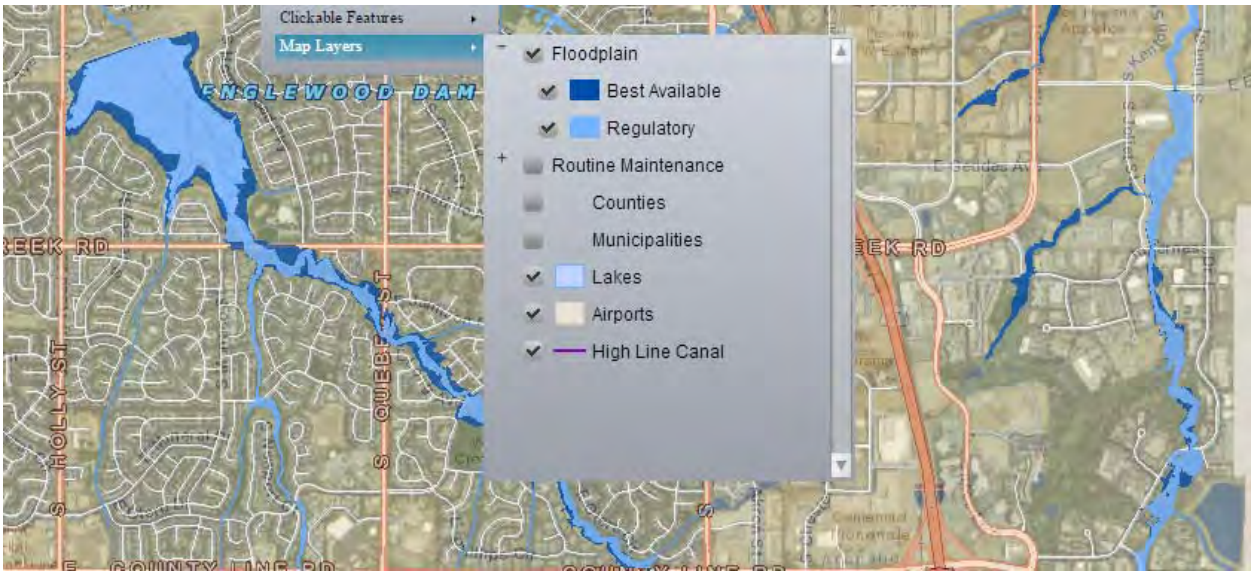
4. The District can help all communities that deserve 410 credits by doing the following:

   a. Talk to FEMA Region VIII about 410 credit criterion 4, discussed on page 4. For credit, a study needs to be submitted to FEMA and some communities are hesitant to do this. Regional staff can clarify how this credit criterion will be handled.

   b. Advise the communities to utilize the electronic data management system on the District's website and review each stream to determine if there is a FHAD. FHADs not incorporated in a FIRM are shown as the dark blue "Best Available" floodplain delineations. An example is shown below. Over the next year, the District will have a GIS layer with source data that will identify where an FHAD is in a FIRM.

      Where there are FHADs, the community could research its ordinance and Flood Insurance Study to verify the FHAD is being used for regulations and if it meets the credit criteria. If so, it can apply for 410 credit for NS and, possibly, HSS and FWS.

   c. Offer District GIS capabilities to prepare impact adjustment maps and calculate acreage data for requesting communities. While many communities may have in-house GIS capabilities, they are usually not familiar with the mechanics of preparing an impact adjustment map. Having that expertise at the District level will help many communities. See Section 3.1.3.



2.2. Model Ordinance

The District has had a model floodplain ordinance since 1970. However, its primary purpose was to set criteria to be used if the District had to directly regulate land development, something it has not had to do. Most communities used FEMA's model ordinance instead. With the adoption of new state standards, communities have recently used the Colorado Water Conservation Board's (CWCB) model.

In 2013, the District's model ordinance was updated for the first time since 1980. The update relied heavily on the CWCB model. Because communities have already brought their regulations up to the current standards, there may not be much need for the model ordinance. However, if adopted verbatim, six provisions would receive credit under the elements of Activity 430 (Higher Regulatory Standards) listed in Table 3 on the next page. Note that the exact credit is dependent on the community's impact adjustment ratio for Activity 430 and, in some cases, submittal of the provision to ISO for prorating.

Recommendation: If communities are interested in other higher regulatory standards or higher credit for the provisions listed in Table 3, the District should prepare model ordinance language and submit it to ISO for a courtesy review.

2.3. Public Information Activities

The 300-series of CRS activities credits local programs that advise people about the flood hazard, flood insurance, and flood protection measures. The activities can be directed toward floodplain residents, property owners, insurance agents, real estate agents, or other segments of the local populace.

The District can directly assist its communities under three of the seven 300 series activities:

Activity 320 (Map Information Service)
Activity 330 (Outreach Projects)
Activity 350 (Flood Protection Information)

The District's support for Activity 320 would be through its GIS services, so it is covered in Section 3.1.1. under Information Services & Flood Warning.

2.3.1. Outreach projects (OP)

The objective of Activity 330 is to provide the public with information needed to increase flood hazard awareness and to motivate actions to reduce flood damage, encourage flood insurance coverage, and protect the natural functions of floodplains.

The element Outreach Projects (OP) is the basic credit for using various media to disseminate floodplain management messages. To receive credit, projects must be disseminated at least annually. At least one project must convey a message on the topic of flood insurance. Points are based on the type of project and the messages covered.

Table 3. CRS Credits in the District's Model Ordinance	
Model Ordinance Provision	**CRS Credit in Activity 430 (2013 *Manual*)**
SECTION 4.0 FLOOD REGULATORY DISTRICT 4.55 The storage or processing of materials that are buoyant, flammable, toxic, explosive, or in times of flooding, could be injurious to human, animal, or plant life, shall be at or above the flood protection elevation for the particular area.	432.a. Development Limitations (DL) DL(3) Storage of hazardous materials (DL3c): Credit is provided if hazardous materials are allowed to be stored indoors in the floodplain, but must be elevated above the base flood elevation. Max: 10 points
SECTION 5.0 FLOODWAY DISTRICT 5.32 No mobile homes or recreational vehicles shall be placed in the Floodway District.	432.a. Development Limitations (DL) DL(2) (2) Prohibition of buildings (DL2) (maximum credit: 1,000 points). If the regulations prohibit only certain types of buildings, such as residences, the points can be prorated. Credit for prohibiting mobile homes: 10 points, more if the community can show what percentage of the regulatory floodplain is zoned for mobile homes or mobile home parks.
5.33 No building designed for human occupancy shall be placed in the Floodway District	432.a. Development Limitations (DL) DL(2) (2) Prohibition of buildings (DL2) (maximum credit: 1,000 points). If the regulations prohibit only certain types of buildings, such as residences, the points can be prorated. Credit for prohibiting residential buildings: 25 points, more if the community can show what percentage of the regulatory floodplain is zoned for residential development.
SECTION 6.0 FLOOD STORAGE DISTRICT 6.34 All new and substantially improved critical facilities and new additions to critical facilities in the Flood Storage District shall be elevated or floodproofed to at least one foot above the flood protection elevation.	432.f. Protection of critical facilities (PCF) PCF credit is provided for regulations that either prohibit critical facilities or set higher standards for protecting them from flood damage. While this is a higher standard, there is no credit for protecting a critical facility to less than the 500-year flood level. Credit could be provided where one foot above the flood protection elevation (i.e., two feet above the base flood elevation) is at or above the 500-year flood elevation.
6.35 New critical facilities shall, when practicable, have continuous noninundated access (ingress and egress for evacuation and emergency services) during a 100-year flood event.	If credit can be provided for PCF (above), additional credit is provided for dry land access during a flood.
SECTION 11.0 DEFINITIONS 11.11 Flood Protection Elevation - an elevation one foot above the elevation or "flood profile" of the 100-year flood under existing channel and floodplain conditions. It is one foot above the elevation of the flood for the Flood Regulatory District, as shown on the Floodplain maps in the office of the Urban Drainage and Flood Control District.	432.b. Freeboard (FRB) Freeboard credit is for requiring new buildings to be protected to a level higher than the 100-year flood. The credit points vary depending on whether fill is allowed and whether ductwork and all mechanical equipment are protected to the flood protection elevation.

Messages must be action-oriented, not simply descriptive. For example "flood insurance is available in Aurora" would not be credited while "Make sure you have flood insurance on your contents" would. Messages are scored under the six general topics in Table 4.

Table 4. Outreach Project Topics and Messages	
Topics	**Example Messages**
1. Know your flood hazard	Find out the flood hazard for your property
2. Insure your property for your flood hazard	Take advantage of a low-cost Preferred Risk Policy
3. Protect people from the hazard	Turn around, don't drown
4. Protect your property from the hazard	We can help you get a grant to elevate your home. Call us at __
5. Build responsibly	Get a permit before you build from ….
6. Protect natural floodplain functions	Report broken silt fences: they help keep our streams clean

Status: The District has several publications, such as planning and design reports, "Flood Hazard News," and semi-annual activity reports. These discuss District programs. They are short on the kinds of messages that tell people what to do to protect themselves. It would take some revising for them to be creditable, i.e., to do something they are not intended for.

The District's floodplain preservation brochure and mini CD would qualify as an OP project for communities. The District should not promote this unless it can assure communities that it will provide adequate copies every year.

Other publications, such as "September to Remember," are too large to be used efficiently as annual outreach projects.

2.3.2. Annual floodplain notification (OPF)

Every year, the Floodplain Management Program distributes its "official notice" annual notification to over 20,000 floodplain properties. This has been scored in the past as an outreach project to floodplain properties (OPF). It is sent out directly by the District, so all impacted communities get the credit if they bring it to ISO's attention at the verification visit.

As seen in Table 5, in the "OPF" column, 17 communities are receiving credit under the 2007 *CRS Coordinator's Manual* for such an annual mailing. For five of the communities, OPF is their only outreach project credit. Most, if not all, of the OPF credits are most

Table 5. District Communities' Public Info Credits

Community	330			350		
	OP	OPF	PPI	LIB	LPD	WEB
Arapahoe County		38	*			
Arvada	38	29		20	5	34
Aurora		32	*			
Boulder	16	38	**	18	3	17
Boulder County	74	48	**	22	5	42
Centennial	4	38	*			
Cherry Hills Village	10	32	*			7
Denver		32	*			
Douglas County		32				
Englewood		42		18	2	
Golden	16	114				35
Jefferson County	40	31		20	2	36
Lakewood	16	30		20	3	2
Littleton						
Louisville						
Morrison	6	46				
Parker	13					12
Thornton	13	40		4		3
Westminster	21	36	*	7	5	11
Wheat Ridge	11	42		23	3	17

Maximum credit for OPF and LIB is lower in the 2013 *Manual*. Maximum credit for LPD and WEB is higher.

* – Community is part of the District facilitated PPI. Commercial City, though not in the CRS yet, is also participating.

** – Boulder and Boulder County are preparing a joint PPI

FRP credit is new in the 2013 *Manual*, so it is not included.

likely for the District's mailing. Under the 2013 *CRS Coordinator's Manual*, the maximum points are reduced from 120 points to 36.

A draft of the 2015 version has been reviewed for credit. It should receive the maximum 36 points for a targeted project with messages under all six topics in Table 4 (page 10). Next year's notification will likely be designed with maximizing OP credit.

2.3.3. Flood response projects (FRP)

While OP credits projects that are repeated each year, FRP credit is for preparing projects that will only be used before, during, and/or after the next flood. An FRP package is a collection of outreach projects prepared in advance, but not delivered until a flood occurs. These materials may include templates and masters of handouts, mailers, press releases, etc. that cover key

messages that need to be disseminated before, during, and after a flood. The package must include both the materials that will be needed and the procedures for how they will be used.

Status: Before, during and after a flood, the District disseminates messages through a variety of media. Individual communities do, too. These would need to be organized and scripted for different flood threat possibilities to be credited. They would also have to be used during and after floods.

2.3.4. Program for Public Information (PPI)

A third element under Activity 330 (Outreach Projects) is the Program for Public Information. A PPI is an ongoing public information effort to design and transmit the messages that the community determines are most important to its flood situation and the protection of its floodplains' natural functions. Preparation of the program follows a seven step planning process, with support from a committee of local staff, stakeholders, and members of the public.

Status: The Floodplain Management Program has taken on the role of facilitator to assist seven communities prepare a multi-jurisdictional PPI. This effort has just begun, but it is on the right track. The City of Boulder's "2013 Flood Education Communication Plan" is similar to a PPI. The group that prepared it should be the cadre for a PPI that meets the credit criteria of Activity 330.

2.3.5. Library (LIB)

This is the first of the elements under Activity 350 (Flood Protection Information). The objective of Activity 350 is to provide the public with information about flood protection that is more detailed than that provided through outreach projects.

LIB credit is provided for having the latest versions of nine specific FEMA publications cataloged and available in the community's public library. Only seven of the nine are relevant to Colorado. They are listed in the box to the right. All of them are available free, singly or in quantity.

Publications credited under element LIB

1. Above the Flood: Elevating Your Floodprone House, FEMA-347 (2000)
2. Answers to Questions About the National Flood Insurance Program, F-084 (2011)
3. Elevated Residential Structures, FEMA-54 (1984)
4. Protecting Manufactured Homes from Floods and Other Hazards, FEMA P-85 (2009)
5. Protecting Building Utilities From Flood Damage, FEMA-P-348 (1999)
6. Protecting Floodplain Resources, FEMA-268 (1996)
7. Reducing Damage from Localized Flooding, FEMA 511 (2005)

Status: Two library systems were selected for review. The Jefferson County Public Library's online catalog has hundreds of books using "flood" as the search word. Most of them were not related to local flooding. Only one on the LIB list, "Answers to Questions About the National Flood Insurance Program," was present and it was dated 1989. The Denver library system only has the first two of the seven publications.

It could be that all seven documents are in both libraries, but have not been entered into the online catalog. If the ISO/CRS Specialist cannot readily verify that they are in the local public libraries, the communities would not receive this credit.

2.3.6. Locally Pertinent Documents (LPD)

LPD credit is provided for having documents in the local public library that cover flood hazards, flood protection, and natural floodplain functions and also are keyed to local conditions. These can include the community's FIRM, flood hazard area regulations, mitigation plan, and other reports.

Status: The review of the Jefferson County and Denver Public Libraries' online catalogs found a variety of references that would qualify. These include local Flood Insurance Rate Maps and Flood Insurance Studies, floodplain delineations, post-flood mitigation reports, and Arvada's very local "Flood Protection Handbook." These library systems would receive credit for LPD, possibly the maximum 10 points for 10 different references.

2.3.7. Conclusions and recommendations

1. There are several projects currently underway that could be credited as outreach projects and flood response projects. The District would only need to collect and review them for credit and then make them available to interested communities.

2. The annual notification to floodplain residents is a valuable activity and all communities with affected floodplains benefit from it. The District should stay on top of how such projects are scored to ensure maximum credit. Next year's draft should be submitted for review by ISO to be rated as uniform minimum credit for District communities. It could also be revised to receive more credit by incorporating new messages called for by the multi-jurisdictional Program for Public Information (see Section 2.3.4)

3. The multi-jurisdictional Program for Public Information should continue. The materials developed for this effort and the lessons learned should be shared with other communities considering joining or doing their own PPI.

4. The District should talk to each library system in the District to determine if the seven LIB documents are indeed in their libraries. If so, they should be entered into their online catalogs. If not, the District should obtain copies from FEMA at no cost and provide them to the libraries.

5. The District should provide each library system with state and District publications and verify that each has at least ten publications that would qualify for LPD credit listed in their online catalogs.

3. Information Services & Flood Warning Program

3.1. Geographic Information System

The District has an extensive geographic information system, some of which can be accessed by the general public via the District's website. This GIS resource can support CRS communities in four ways:

1. By providing floodplain information to the public that qualifies for credit under Activity 320 (Map Information Service) – Section 3.1.1,
2. By providing floodplain data to local regulatory staffs that qualify for credit under Activity 440 (Flood Data Maintenance) – Section 3.1.2,
3. By providing impact adjustment data and guidance needed for CRS credit calculations – Section 3.1.3, and
4. By helping prepare inundation maps for Activity 610 (Flood Warning and Response) – Section 3.3.

Table 6 shows which communities are already receiving 320 and 440 credit.

Table 6. District Communities' GIS Based Credits

Community	320	440 AMD
Arapahoe County	✓	60%
Arvada	✓	80%
Aurora	✓	80%
Boulder	✓	52%
Boulder County	✓	93%
Centennial	✓	87%
Cherry Hills Village	✓	87%
Denver		
Douglas County	✓	80%
Englewood	✓	62%
Golden	✓	62%
Jefferson County	✓	59%
Lakewood	✓	64%
Littleton	✓	39%
Louisville	✓	44%
Morrison	✓	
Parker	✓	39%
Thornton	✓	67%
Westminster	✓	80%
Wheat Ridge	✓	80%

Credits are as of 2013. The points are not applicable for the 2013 *CRS Coordinator's Manual*. The AMD column shows the percent of the maximum possible credit received by the community. Most communities have room for improvement.

3.1.1. Activity 320 (Map Information Service)

This activity credits providing inquirers with information about the local flood hazard and about flood-prone areas that need special protection because of their natural functions. It can be seen in Table 6 that every CRS community except Denver is receiving this credit.

Every community with 320 credit also received the maximum credit of 140 points under the old *CRS Coordinator's Manual.* That credit was for providing basic information from the community's Flood Insurance Rate Map.

The scoring changed substantially with the 2013 *CRS Coordinator's Manual*. The maximum credit dropped from 140 to 90 points. Instead of full credit for reading one map, there are now seven elements, MI1 – MI7, that have points for different types of map information:

→ MI1 Basic FIRM information: basic information found on a Flood Insurance Rate Map (FIRM) that is needed to accurately rate a flood insurance policy. This is effectively what the old credit was for.

→ MI2 Additional FIRM information: for inland communities, this is essentially identifying if a property is in the floodway.

→ MI3 Problems not shown on the FIRM: providing information about flood problems other than those shown on the FIRM.

→ MI4 Flood depth data: information about flood depths.

→ MI5 Special flood-related hazards: information about special flood-related hazards, such as alluvial fans, migrating channels, or ice jams.

→ MI6 Historical flood information: information about past flooding at or near the site in question.

→ MI7 Natural floodplain functions: information about areas that should be protected because of their natural floodplain functions.

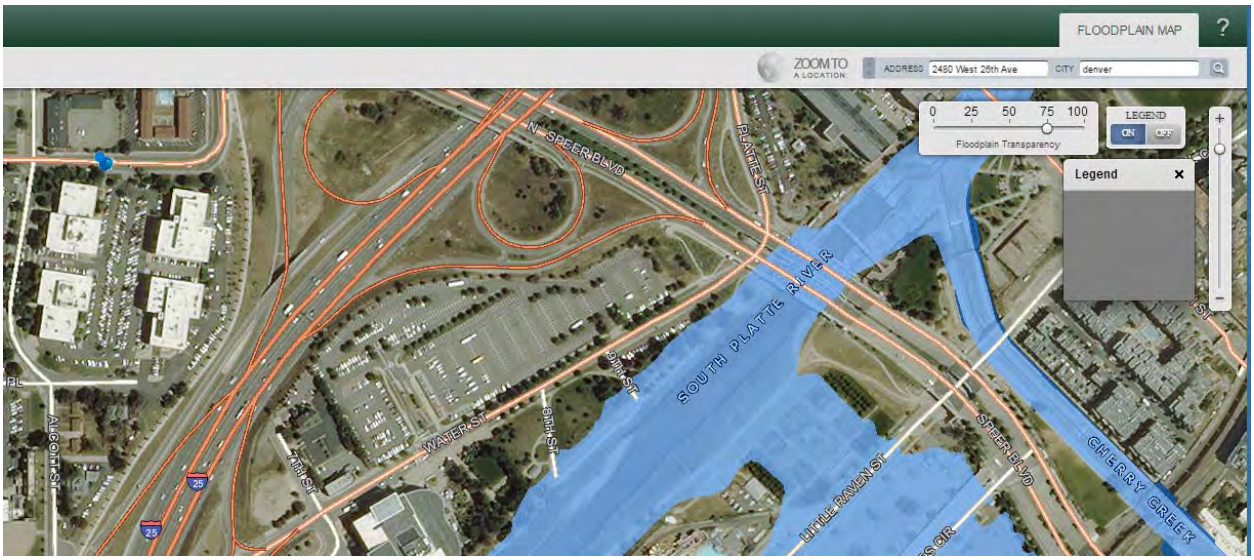
MI1, the prerequisite for any credit, is worth 30 points. The rest are worth 20 points each. A community could max out with 90 points for MI1, MI2, and any two of the rest of the elements.

Status: As seen in Table 5 (page 10), all of the District's CRS communities except Denver are receiving this credit. These communities should receive the lower credit for MI1 and MI2 using their current Flood Insurance Rate Maps.

The Information Services & Flood Warning Program staff could assist communities by coordinating its online GIS with this activity. The floodplain map tool on the District's website (see below) provides a map information service, but does not meet all the credit criteria for Activity 320. If additional information were provided when a parcel is searched, the GIS map could perform 90% of the work for communities that want the MI1 and MI2 credit. This would take some programming, but would be doable. This may be a moot point if the communities are already doing this.

It could be particularly useful for the District's GIS staff to help with the new credits for MI3 – MI7 if communities don't have such information or GIS layers. Without at least one of those layers, their programs will be reduced from 140 to 50 points.

Recommendation: The District office should poll the CRS communities to determine if they would like help with this activity. If so, a scope of work should be prepared to outline needed GIS and website changes and the District can decide if the benefits would be worth the effort.



3.1.2. Activity 440 (Flood Data Maintenance)

This activity has a GIS element, additional map data (AMD). AMD credits systems that improve access, quality, and/or ease of updating flood and FIRM data. Here are the key credit criteria:

1. The map or database must be used regularly by the community's regulatory staff. Using the system to provide map determinations for the permit office is considered a regulatory purpose.

2. The system must be updated at least annually to reflect new data, annexations, new subdivisions, flood insurance restudies, letters of map change, etc.

If a system meets these credit criteria, then the credit is based the following attributes or GIS layers. The first one is a prerequisite for any credit.

AMD1 = 20 points, for showing the SFHA boundaries, corporate limits, streets, and parcel or lot boundaries

AMD2 = 26 points, for buildings, building outlines, or building footprints

AMD3 = 12 points, for showing floodways

AMD4 = 12 points, for showing base flood elevations

AMD5 = 10 points, for including FIRM zone attributes (e.g., AE, X, etc.)

AMD6 = 10 points, for showing the 500-year floodplain elevations or boundaries

AMD7 = 12 points, for showing areas of the community subject to other natural hazards, such as landslides, channel migration, and soils unsuitable for septic fields

AMD8 = up to 10 points for topographic contour lines

AMD9 = 6 points, for including updated floodplain data in the tax assessment database

AMD10 = 6 points, for including overlays or layers for all FIRMs in effect after the date of the community's application to the CRS

AMD11 = 8 points, for other overlays or databases used for regulation or mitigation programs,

AMD12 = 14 points, for areas with natural floodplain functions (e.g., wetlands, designated riparian habitat, flood water storage areas)

AMD13 = 14 points, for including building elevation data.

Status: The District's online system would receive credit for AMD1 and AMD2. It would not be hard to add others, but, as with 320, Table 6 (page 13) shows that most communities are already receiving this credit.

3.1.3. Impact adjustment support

The third way District GIS staff could help CRS communities is with the impact adjustment. This is a step needed to determine the final score for several activities, including the high point getters like Activity 420 (Open Space Preservation) and Activity 430 (Higher Regulatory Standards).

Activities that are not implemented the same way throughout the floodplain need their credit points adjusted to reflect how much of the floodplain they do cover. Some activities are adjusted based on the number of buildings that are affected and some are adjusted based on the size of the area affected.

The simplest example is Activity 420 (Open Space Preservation). A community with 20% of its floodplain preserved as open space should receive more credit than a community that preserves only 10%. The impact adjustment step calculates the number of buildings or acreage affected and produces an impact adjustment ratio. Under the previous *CRS Coordinator's Manuals*, communities could avoid doing an impact adjustment for Activity 420 by accepting an optional minimum credit of 5% of the maximum score. That is not possible under the 2013 *Manual*. ISO reports that many communities are having problems with this new requirement.

Table 403-1 from the *CRS Coordinator's Manual* shows the various activities and elements that have an impact adjustment that is based on area. The best way to mark and calculate the affected areas is with GIS.

Table 403-1. Impact adjustment maps.

Activity	Affected Elements	Denominator	Optional Minimum
410 (Floodplain Mapping)	NS, SR, HSS, FWS	aSFT	0.10
420 (Open Space Preservation)	OSP, DR, NFOS, LZ	aSFHA	none
	OSI	aSFHA	0.10
	NSP	total length of shoreline	0.10
430 (Higher Regulatory Standards)	DL, FRB, FDN, CSI, LSI, PCF, ENL, OHS	aSFHA	0.10
	CAZ	aSFHA	0.5 / 0.1
440 (Flood Data Maintenance)	AMD	aSFHA	0.10
450 (Stormwater Management)	SMR, WMP	area of the watershed	0.15
540 (Drainage System Maintenance)	CDR, PSM, CIP	number of drainage components	0.10
	SBM	number of storage basins	0.10
610 (Flood Warning and Response)	FTR, EWD, FRO	number of buildings in the SFHA (bSF)	none
620 (Levees)	LM, LFR, LFW, LFO	number of buildings affected by a levee failure (bLF)	none
630 (Dams)	DFR, DFW, DFO	number of buildings affected by a dam failure (bDF)	none

3.1.4. Conclusions and recommendations

1. District GIS staff can provide valuable assistance to communities seeking CRS credit for a variety of activities.

2. District GIS staff should learn about the credits and discuss them with community GIS staff to determine if they would need any assistance. If so, the District could become a resource for both guidance and GIS layers to help communities receive some of the new credits.

3. Staff could also become the area's experts in impact adjustments, which can be a complicated and confusing step in calculating a community's scores.

4. The District should consider doing the impact adjustment work for small communities with no in-house GIS capability.

3.2. Website (WEB)

WEB credit is provided under Activity 350 (Flood Protection Information). Like the library credit (LIB), it is intended to complement a public information program by providing more detailed information than outreach projects.

As seen in Table 5 (page 10), half of the District's CRS communities are receiving WEB credit, but some are not getting very many points. Under the 2013 *CRS Coordinator's Manual*, the credit has been increased to a maximum of 76 points. More points are provided if the website is included in the community's Program for Public Information, which is covered in Section 2.3.4.

3.2.1. Website credit criteria

WEB credit is for providing flood protection information on the community's website. Much of the credit can be obtained through links to other sites, such as the District's. The following key credit criteria would need to be met.

1. There must be a flood information home page that is readily found by either (1) having it listed and linked on the community website's home page or (2) using the website's search feature.
2. The flood information home page must have a directory of the flood protection information provided, along with links to the appropriate pages. The links can be to other agencies' or organizations' websites, provided they have information pertinent to the community's flood conditions.
3. If a page discusses a topic and the community provides a service related to that topic that is credited by the CRS, the website must inform the readers about the service the community offers.
4. There must be a link to FloodSmart (www.floodsmart.gov) or to FEMA's flood insurance page at www.fema.gov/business/nfip.
5. The community must check the website's links at least monthly and fix those that are no longer accurate. The community must review the content to ensure that it is still current and pertinent at least annually.

Status: WEB credit is for a community's website, so the communities must ensure that these credit criteria are met. They are new with the 2013 *CRS Coordinator's Manual*, so even those communities currently getting WEB credit may be challenged.

3.2.2. WEB sub-elements

There are four sub-elements for WEB:

WEB1: Providing detailed information on the flood protection messages conveyed in outreach projects that are credited under Activity 330 (Outreach Projects). These are listed in Table 4 (page 10). There are bonus points if the website is covered under the Program for Public Information (PPI) discussed in Section 2.3.4.

WEB2: Providing information on warning, safety, evacuation, and other topics of immediate concern when a flood threatens. There are bonus points if the website is covered under the PPI.

WEB3: Posting real-time gage information so users can see current water levels and, where available, flood height predictions.

WEB4: Posting Elevation Certificates or data from Elevation Certificates.

Status: The District's website, www.udfcd.org/, has some information that would be credited under WEB1 and WEB2. However, more information would provide more points for communities that link to the appropriate pages.

The ALERT system and F2P2 flood predictions pages at https://udfcd.onerain.com/home.php and http://alert5.udfcd.org/wp/?page_id=98 are exactly what WEB3 is designed to credit.

3.2.3. Conclusions and recommendations

1. Only half the CRS communities are getting website (WEB) credit. They are not getting very many points. More points are possible under the 2013 *CRS Coordinator's Manual*, but there are new prerequisites that must be met.

2. While credit is based on the community's web pages, the District can provide technical support on CRS credit to local webmasters.

3. The District could also review its pages to identify where it could add more information that would give linking communities more credit under WEB1 and WEB2.

3.3. Flood Warning

The central flood warning credit in the CRS is Activity 610 (Flood Warning and Response), which credits a program that addresses "normal" riverine flooding. There are other credits for warning and response plans for levee failure and dam failure, but if a community does not have a creditable program under the credit criteria for 610, it won't qualify for the other credits.

There are six elements in Activity 610:

1. Flood threat recognition system (FTR) credits a system that predicts flood elevations and arrival times at specific locations within the community.
2. Emergency warning dissemination (EWD) credits disseminating flood warnings to the public.
3. Flood response operations (FRO) credits implementation of specific tasks to reduce or prevent threats to health, safety, and property.
4. Critical facilities planning (CFP) recognizes coordinating with operators of critical facilities.
5. StormReady community (SRC) credits designation by the National Weather Service as a StormReady community.
6. TsunamiReady community (TRC): credits designation by the National Weather Service as a TsunamiReady community. As there is no tsunami threat to Colorado, TRC is not covered in this report.

3.3.1. Activity credit criteria

To receive any credit under Activity 610, a community's program must meet the following six prerequisites.

1. The community must obtain some credit in the first four flood warning and response elements (FTR, EWD, FRO, and CFP) to receive any credit under this activity.

   Status: This is a new requirement in the 2013 *CRS Coordinator's Manual*. Under the 2007 *Manual*, a community could receive credit under FTR and none of the rest of the elements. Under the 2013 *Manual*, credit is provided only if the community receives credit under *all* of the first four elements.

   As seen in Table 7, only Jefferson County met this criterion before the 2013 *Manual*. The other communities will

Table 7. District Communities' Warning Credits

Community	FTR	EWD	FRO	CFP	SRC
Arapahoe County					
Arvada	✓	✓	✓		
Aurora	✓	✓	✓		
Boulder	✓	✓	✓		
Boulder County					
Centennial					
Cherry Hills Village					
Denver					
Douglas County	✓	✓	✓		✓
Englewood					
Golden					
Jefferson County	✓	✓	✓	✓	
Lakewood	✓	✓	✓		
Littleton					
Louisville					
Morrison	✓	✓	✓		
Parker					
Thornton					
Westminster					
Wheat Ridge	✓	✓	✓		

Credits are as of 2013. The points are not applicable for the 2013 *CRS Coordinator's Manual*.

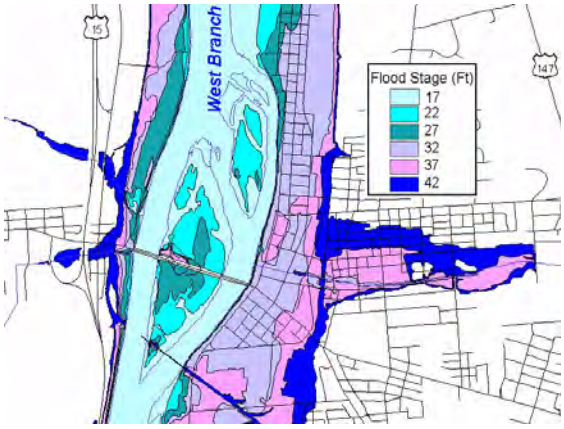
need to receive credit for critical facilities planning (CFP) in order to receive any credit in 610. Douglas County will lose its StormReady (SRC) credit if it does not receive credit for the first four.

2. The community must provide a description of its flood situation that includes information about the nature of its flood hazard, the development exposed to flooding, and the expected impacts of flooding.

   Status: This is not a new prerequisite. It is usually met by providing an excerpt from the local hazard mitigation plan.

3. The community must have a flood inundation map(s), also known as a flood stage forecast map. The map must show areas that are inundated by at least three different flood levels (see example, right).

   Status: The flood inundation map is a new prerequisite. However, it would have been difficult for communities to receive credit for flood response operations (FRO) under the old manuals without such a map. There has always been a requirement that flood response operations (other than warning) be keyed to different flood levels.



This is a basic inundation map. It shows the areas under water at six different flood levels. The levels are keyed to stage levels on a river gage.

   However, most of the current flood response plans do not have a map that matches what is needed for credit. This is discussed further in Section 3.3.4.

4. The community must have a flood warning and response plan. A "flood warning and response plan" or a similar plan with a different name must:
   (a) Describe the methods and warning devices used to disseminate emergency warnings to the general public that are credited under EWD,
   (b) Include specific flood response actions that are taken for the different flood levels that are credited under FRO, and
   (c) Be adopted by the community's governing body.

   Status: This is essentially the same credit as in previous *CRS Coordinator's Manuals*. Those communities listed as receiving credit in the past in Table 7 (page 19) should still meet this criterion.

5. The community must implement one or more outreach projects that tells its residents and businesses how they will be warned and the safety measures they should take during a flood.

   Status: This also did not change from previous *Manuals*. The District's annual notice to floodplain residents can be used to meet this requirement. However, the statement in the 2015 notice, "During heavy rainfall, stay alert for possible flood warnings (TV, radio,

websites, and social media)," would likely not qualify as telling people how they will be warned.

6. There must be at least one exercise and evaluation of the flood warning and response plan each year. The exercise can be for a flood, levee failure, or dam failure. This criterion can be met if the plan is implemented in response to an actual flood or threat of a levee or dam failure. In either case, there must be an evaluation of the performance of the plan and recommended changes that may be needed, usually done in an after-action report.

Status: This was a credit criterion under previous *Manuals*, but wasn't always monitored closely by ISO. It is expected that the after-action report will be required with each annual recertification.

An example 2013 "Boulder EOC Drill" for a flood on Boulder Creek was reviewed. It calls for the right kind of exercise, but there was no written report on how the drill went or lessons learned. The District hosts an exercise that could also qualify, but each community that wants 610 credit would need to participate in either the District's exercise or one of their own.

3.3.2. Flood threat recognition (FTR)

A flood threat recognition system provides the community with the earliest possible notification that a flood is imminent. The most credit is for a "Level 3" system that provides the timing and crest of an impending flood.

The system must meet two criteria in addition to the six activity credit criteria:

1. The system must be able to receive or provide flood notifications 24 hours a day, 7 days a week.
2. The flood threat recognition system must be correlated to the flood inundation map, so that the emergency manager can see what areas will be affected by the predicted flood. An example of this is the inundation riverine map on page 20, which is keyed to the river stages reported by the river gage.

Status: Because of the high potential for deaths from flash floods along the front range, the District has established a network of gages and a monitoring program that meets the credit criteria for a Level 3 flood threat recognition system for the larger streams in the area. Local warning and response plans on these streams should receive the maximum credit, provided they have a flood inundation map keyed to the gages.

Owners of non-federal gages need to demonstrate that their systems are maintained, so the District may be called on to document its system maintenance.

3.3.3. Emergency warning dissemination (EWD)

EWD credit is provided for emergency warning alerts and messages that are disseminated to the public when a flood is imminent. The credit is based on the different ways to get the warnings out – there are more points for having more approaches, such as sirens, reverse 911, and the Emergency Alert System used to disseminate messages through radio and television stations.

Status: As with FTR, the District's program can help most communities receive this credit. Local plans need to identify what approaches are used.

3.3.4. Flood response operations (FRO)

FRO credit is based on the extent of coverage and level of detail that the community's flood warning and response plan provides for the flood response operations. Such operations should include steps such as:

- → Activating the emergency operations center,
- → Closing identified streets or bridges,
- → Relocating threatened equipment or supplies,
- → Ordering an evacuation,
- → Opening evacuation shelters, and
- → Securing the flooded area after it is evacuated.

Different actions need to be tied to different flood levels. For example, the flood inundation map would show what level inundates certain streets or bridges. For safety reasons, they would need to be closed before they flood. The map would show the extent of a predicted flood, which would tell the emergency manager how many sandbags and shelters would be needed.

The flood warning and response plan must include appropriate actions to be implemented at the different flood levels shown on the flood inundation map. The plan must assign a person or office to be responsible for each action that needs to be taken.

Status: Most communities probably do not have the level of detail needed to itemize actions needed for full credit. Most probably do not tie the actions to an inundation map. Some have a "staged response plan" or a "severe weather protocol" that may be creditable, but each would have to be reviewed closely.

The District reports that Boulder County would be the community most likely to have a creditable FRO plan. A quick review of the County's 2012 Incident Action Plan shows that it has a different set of instructions for five different response levels, which is akin to what the CRS credits. The responses are keyed to weather conditions rather than flood levels. However, the plan relates inches of rain to the number of affected properties, something that must have been prepared from a map. An excerpt is shown on the next page.

Another example is the "Flood Standard Operating Procedures" for the Denver Department of Public Works. It, too, shows different actions at different "modes," as seen in the excerpt on page 24. There are two concerns with this document:

- → It is not clear what triggers the different modes or whether they are based on predicted flood levels.
- → The level of detail may not be sufficient for CRS credit. "Respond to problem areas and flooding complaints" and "Communicate with Division operations" are not specific actions based on different flood levels.

Location	1-Hour Rainfall Threshold (inches)	Flow Rate CFS (cubic feet/ second)	Homes at Risk	Flood Affects Bridges & Roads Affected. Life Safety Risk	AHA System Alert Level
Fourmile Creek Watershed	1/2"	< 100	0	• Most small residential bridges	Green
Fourmile Creek Watershed	3/4"	100 to 300	0	• Most small residential bridges • Life Safety risk possible.	Green
Fourmile Creek Watershed	1"	600 to 1,000	10	• Most small residential bridges, incl. Boulder Mountain Lodge. • Life Safety risk is now present.	Green
Fourmile Creek Watershed	1¼"	1,200 to 1,800	21	• Logan Mill, Crisman Rd., Private Drive upstream of Logan Mill. • Life Safety Risk is HIGH.	Green
Fourmile Creek Watershed	1½"	1,800 to 2,600	21	• Shwy119 overtops at 2,000 • Life safety risk high and life safety risk for downstream residents developing.	Green
Fourmile Creek Watershed	1¾"	2,500 to 3,500	50		Green
Fourmile Creek Watershed	2"	3,200 to 4,300	Structures along Boulder Creek possibly impacted.	• Impact in the City of Boulder along Boulder Creek possible. • Life safety risk to immediate creek bed areas.	Yellow Alert Level for CJ

– Boulder County, Incident Action Plan, Fourmile Flood Incident Response Plan, 2012, page 13

It is likely that Boulder County's and Denver's approaches are more appropriate for a flash flood situation where there is little warning time and where warning dissemination and evacuation are more important than other response actions.

3.3.5. Critical facilities planning (CFP)

Critical facilities may need special early warning. Every facility should have its own individual flood warning and response plan. CFP credits assisting critical facilities and coordinating the community's response plan with theirs.

There are two sub-elements. CFP1 is for having a list of the facilities considered critical in a flood and contact information for those facilities. The information must be updated annually. CFP1 is a prerequisite for any CFP credit. CFP2 credit is provided if individual critical facilities have developed flood warning and response plans which have been reviewed by or coordinated with the community's emergency manager.

Status: Every county emergency manager has a list of critical facilities. It is surprising that only one community in Table 7 (page 19) is receiving this credit. It is possible that (1) there has been no effort to develop a flood-specific list and keep it updated, (2) the emergency manager does not want to release what some consider classified data, or (3) the CRS coordinator is not aware of the list.

FLOOD MODE DUTIES				
Mode	**Director of WMD Operations**	**WMD Operations**	**OEM Duty Officer**	**PW Engineer on Duty**
Green	Normal Operation, Keep Monitoring the weather			
Yellow Possible threat to life and Property	• Communicate with WMD operations.	• Monitor weather using: • PMS, NWS and UDFCD ALERT System • Internet (radar, satellite, forecasts, river level and weather data)		
	• Put additional staff on Stand-by	• Communicate with Director of WMD Operations and OEM	• Communicate with WMD operations	• Communicate with WMD Operations and OEM. See PW Engineer Duties on Page 11
Orange Increased threat to life and property	• Communicate with WMD operations	• Communicate with Director of WMD Operations, OEM and PW Engineering	• Communicate with WMD Operations and PW Engineering	• Communicate with WMD Operations and OEM
	• Keep additional staff after hours	• Respond to problem areas and flooding complaints	• Make notification per duty book	• Report to EOC if requested
	• Open EOC Y/N	• Traffic control	• Open EOC Y/N	• See PW Engineer Duties on page 11
			• Activate public warning systems if needed	
Red Serious threat to life and property is imminent or in progress.	• Open EOC	• Continue responding to problem areas and flooding complaints	• Open EOC	• Report to EOC
	• Report to EOC	• Traffic control	• Coordinate EOC activities with other agencies	• See "PW Engineer Duties on page 11
	• Contact Manager of PW and PWPIO	• If needed respond to storm and sanitary lift stations	• Report observations to PMS and NWS	
	• Manage flood response		• Activate public warning systems and notify NWS and PMS	
	• If needed relocate WMD vehicle / equipment out of flooded area		• Consider recommendation for disaster declaration per City protocol	Revised April 2014

– City and County of Denver, Department of Public Works, Wastewater Management Division, Flood Standard Operating Procedures, 2015, page 11

3.3.6. StormReady community (SRC)

StormReady is a National Weather Service program to help communities develop plans to handle all types of severe weather, including floods. The Weather Service sets the recognition criteria and reviews and designates local programs. FEMA encourages communities to become StormReady and provides CRS credit for the designation. However, the designation is dependent on the community receiving credit for the first four elements of Activity 610.

Status: According to the National Weather Service's website, there are only four StormReady communities in the District: Boulder, Englewood, Boulder County, and Douglas County. There are two "StormReady Supporters" in the area: Cherry Creek Shopping Center and Coors Field.

3.3.7. Conclusions and recommendations

1. The Denver area, and the District in particular, are known as having one of the best flood warning programs in the country. Under the former *CRS Coordinator's Manual*s, less than half of the communities in the District received credit for Activity 610 (Flood Warning and Response). Some part of their credit is likely due to the District's efforts, but the District can only do so much to help local flood warning and response planning.

2. The 2013 *CRS Coordinator's Manual* has raised the bar on the credit for local flood warning programs. If they do not submit documentation that they are doing more than they provided in the past, seven of the eight communities that have received 610 credit will lose it.

3. A key change in the credit criteria is the requirement for a flood inundation map and flood response operations keyed to the flood levels shown on the map. Some communities have flood response operations keyed to different "modes," but their plans do not include inundation maps.

4. Given the District's GIS office capability and the current flood data available to local emergency managers, it would not be hard for the District to prepare flood inundation maps. A pilot project should be tried with one or two interested CRS communities.

5. There are several examples that come close to a creditable 610 plan. They may not need much more than editing to show how the credit criteria are met. The District should select one or two. Staff should meet with the CRS flood warning technical reviewer, Al Goodman, to see what would need to be changed in the existing plans. The meeting should also review whether local approaches are effective in meeting the objectives of Activity 610, even if they don't meet the letter of the 2013 *Manual's* credit criteria.

6. The District could work with the National Weather Service's local Denver/Boulder Forecast Office to assist communities in becoming StormReady.

4. Master Planning Program

Master Planning staff conduct activities that are credited under CRS Activity 450 (Stormwater Management). The objective of Activity 450 is to prevent future development from increasing flood hazards to existing development and to maintain and improve water quality. There are four elements, which are reviewed in the order they appear in the *CRS Coordinator's Manual*.

4.1. Stormwater Management Regulations (SMR)

The first element in Activity 450 is stormwater management regulations, known by its acronym of SMR. SMR credits local regulations that manage runoff from future development in the watershed. SMR credit is provided if new developments are required to prevent or reduce the increase in runoff that results when their sites are urbanized.

Once a community meets the prerequisite, it can receive credit under four sub-elements:

→ Size of development (SZ)
→ Design storms used in regulations (DS)
→ Low-impact development (LID)
→ Public maintenance of required facilities (PUB)

A community must receive credit under the first two in order to receive any credit for SMR.

4.1.1. Prerequisite

A prerequisite for credit for SMR is that there must be land use regulations that require the peak runoff from new development to be no greater than the runoff from the site in its pre-development condition.

Status: The District does not have direct land use authority. However, it does have the updated Urban Storm Drainage Criteria Manual (USDCM), which includes policies, design criteria and federal and state requirements. If a community adopts the USDCM, its program will meet most of the criteria for SMR credit. USDCM Volumes 1 and 2 are currently being updated and draft chapters are under review. This provides an opportunity to incorporate changes or additions to help support CRS credit.

Cities and counties have the needed authority, which is usually implemented through their subdivision regulations and related ordinances for larger developments. For example, Colorado Revised Statute 30-28-133, Subdivision Regulations, Section (4) (a) (III) (b) states

> "(4) Subdivision regulations adopted by the board of county commissioners pursuant to this section shall also include, as a minimum, provisions governing the following matters:…
>
> "(b) Standard and technical procedures applicable to storm drainage plans and related designs, in order to ensure proper drainage ways, which may require, in the opinion of the board of county commissioners, detention facilities which may be dedicated to the county or the public, as are deemed necessary to control, as nearly as possible, storm water generated exclusively within a subdivision for a one hundred year storm which are in excess of the

historic runoff volume of storm water from the same land area in its undeveloped and unimproved condition;"

Neither the USDCM or its standards are required of communities, so the District's role for SMR credit is as an advisor and recommender of effective standards to be adopted by the cities and counties.

4.1.2. Size of development (SZ)

SZ is the first of the four sub-elements in SMR. Points are based on the minimum size of development subject to the stormwater management regulations. The smaller the development, the greater the credit.

To receive any credit for SZ (and therefore for SMR), the community must regulate parcels of 5 acres or more or increases in impervious area of 20,000 sq. ft. or more.

Status: The current standard in the MS4 General Permit for Colorado (CWQCD 2008) is for "new development and redevelopment projects that disturb greater than or equal to one acre including projects less than one acre that are part of a larger common plan of development or sale, that discharge into the MS4."

This standard is worth 60 out of a maximum possible 110 points. A community may receive the maximum if all developments, including single-family residences, are subject to the regulations.

4.1.3. Design storms used in regulations (DS)

Although the 100-year flood is the typical basis for floodplain management, many communities use a lesser standard for stormwater management. A lower standard may meet many community needs, but management of smaller storms does not necessarily result in reduced peak flows or volume from a major storm.

DS credit is based on the size of the storm that is managed by the community's program. More points are provided for managing larger storms. To receive any credit for DS (and therefore for SMR), the community's program must manage at least the 10-year storm. Bonus credit is provided for controlling the volume of runoff, in addition to the peak flow.

Status: The USDCM, Draft Chapter 1, Drainage Policy, Section 4.0, Technical Criteria, 4.2, Initial and Major Drainage Criteria, includes Table 1-1, below. If the CRS stormwater management technical reviewer agrees that the credit can be provided for managing only the major drainage system, DS credit of 100 points could be provided.

Table 1-1. Design Storms and Purposes of Initial and Major Drainage Systems

Drainage System	Design Storm	Purposes
Initial Drainage System	2- to 10-year floods (depends on local criteria)	Reduce the frequency of street flooding and maintenance costs, provide protection against regularly recurring damage from storm runoff, help create an orderly urban system, and provide convenience to urban residents.
Major Drainage System	100-year flood (1% probability of occurrence for any given year)	Avoid major property damage and loss of life for the storm runoff expected to occur from an urbanized watershed.

4.1.4. Low-impact development (LID)

Low-impact development practices include bioretention facilities, rain gardens, vegetated rooftops, rain barrels, and permeable pavements. The CRS encourages LID principles and practices and promotes the natural movement of water within an ecosystem or watershed.

The credit for LID is a flat 25 points if development is *required* to give preference to the use of low-impact development techniques to control the impacts of development on runoff.

Status: The District and the draft USDCM *encourage* LID practices. Colorado's Discharge Permit System Regulations (CWQCC 2009) and MS4 permits require BMPs "prior to discharges to a State Water from areas of 'New Development and Significant Redevelopment.'"

Communities that have specific requirements that developers *must* incorporate LID practices where feasible would receive the 25 points. It does not appear that the District and State language would do this.

4.1.5. Public maintenance of required facilities (PUB)

In the past, the common practice was for owners of stormwater management storage basins to be responsible for their maintenance. Often, it did not take many years of neglect or mismanagement by non-technical owners for the basins to degrade and lose their effectiveness.

PUB credit is provided if the community's regulations call for community involvement in ensuring that facilities are properly maintained. Three options are creditable:

1. Require the owners of stormwater management facilities to have the facilities inspected by a licensed professional engineer and perform any maintenance recommended by the engineer.
2. Require the owners to allow the community to inspect the facilities. If problems are found, the owners must perform the necessary maintenance.
3. Require all stormwater management facilities to be deeded to the community or other stormwater management agency.

Status: Maintenance is discussed in the USDCM Draft Chapter 1, Drainage Policy under Section 1.1 Principles, No. 10. "The stormwater management system should receive regular maintenance." This is not sufficient language for credit.

Under the District's maintenance eligibility program, new facilities must be either publicly owned or provide access for public maintenance. However, this is not a regulation that affects all new developments, as would be needed for this part of the stormwater management regulations (SMR) credit.

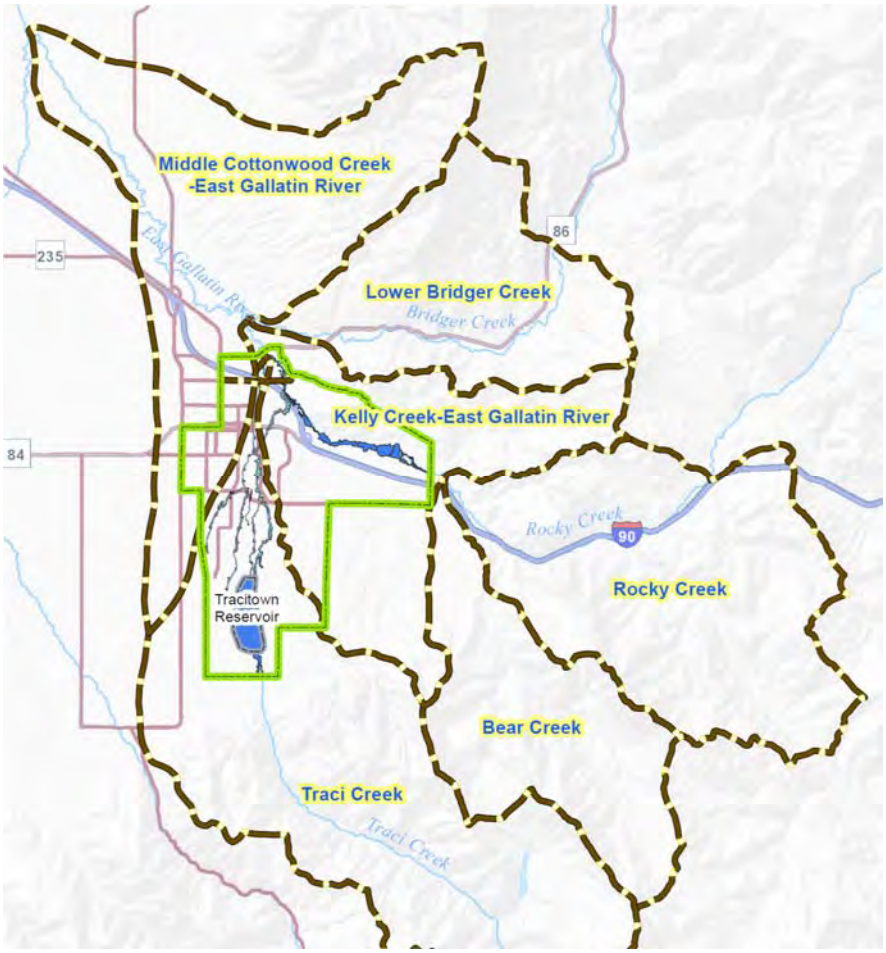
4.1.6. Impact adjustment

The impact adjustment is a step in the credit calculation process that accounts for the area affected by the element. A city that manages all watersheds that drain into it should receive more credit than one that only manages development within its city limits.

The credit for SMR has an impact adjustment that measures the area subject to the community's jurisdiction compared to the area of the watersheds that drain into the community. Watersheds larger than 50 square miles and watersheds where there will be no development can be excluded from the formulas. An example of the latter would be land in a national forest.

The CRS impact adjustment step has proven difficult for many communities. Besides being complicated, some communities do not have the GIS capabilities to map and calculate the impact of their program. They may not be aware that they can include watersheds that are regulated by neighboring communities to the same or higher standards.

Status: The District GIS system includes watershed maps. They could be used to help communities provide the documentation needed to support the SMR credits.



Example of an SMR impact adjustment map used to determine the percentage of the watersheds that drain into the community that are subject to the community's stormwater management regulations.

4.1.7. Conclusions and recommendations

Table 8 shows which District communities currently receive SMR credit.

1. All but two of the District's CRS communities are receiving SMR credit. Credit for any that are getting the new low impact development credit (LID) has not been reported. Only three are getting credit for public maintenance (PUB).

   District staff believe that more communities should be getting PUB credit. This would be worth further investigation with the communities and ISO to see why they have not been receiving PUB credit.

2. Neither the USDCM or its standards are required of communities, so the District's role for SMR credit is as an advisor and recommender of effective standards to be adopted by the cities and counties.

Table 8. District Communities' 450 Credits

Community	SMR				WMP	ESC	WQ
	SZ	DS	LID	PUB			
Arapahoe County	✓	✓		✓		✓	✓
Arvada	✓	✓				✓	✓
Aurora	✓	✓				✓	✓
Boulder	✓	✓				✓	✓
Boulder County	✓	✓				✓	✓
Centennial	✓	✓		✓		✓	✓
Cherry Hills Village						✓	✓
Denver	✓	✓			✓	✓	✓
Douglas County	✓	✓		✓		✓	✓
Englewood	✓	✓				✓	✓
Golden	✓	✓				✓	✓
Jefferson County	✓	✓				✓	✓
Lakewood	✓	✓				✓	✓
Littleton	✓	✓				✓	✓
Louisville						✓	
Morrison	✓	✓					
Parker	✓	✓				✓	✓
Thornton	✓	✓					
Westminster	✓	✓				✓	✓
Wheat Ridge	✓	✓				✓	✓

Credits are as of 2013. The points are not applicable for the 2013 *CRS Coordinator's Manual*.

LID is a new credit in the 2013 *Manual*, so no community has the credit.

3. While most communities are receiving some credit for SZ and DS, few are getting the maximum credit. The District should review the Urban Storm Drainage Criteria Manual (USDCM) and PUB-type maintenance programs and procedures with the CRS stormwater management technical reviewer to determine the credit for communities that adopt the Manual in their regulatory program.

4. The District should work with the State MS4 staff to develop model ordinance language that builds on current principles and policies. Each community can opt to revise their regulations to obtain or improve credit for their stormwater management regulations (SMR).

5. The District's GIS office currently prepares watershed layers. It would be a good service to communities to have in-house expertise and prepare watershed maps that identify areas included and excluded from the formulas in Activity 450. Staff can work with individual communities to help map and calculate the values.

4.2. Watershed Planning

The SMR level of stormwater management treats all properties the same with the same regulatory standard: ensure that the peak flow does not increase over pre-development conditions. This simple standard may not be the best approach everywhere. The CRS considers watershed master plans as a better approach.

A watershed master plan is based on a model that predicts the rainfall/runoff relationships within the watershed, examines existing problems, and identifies potential future problems. For CRS credit, a watershed master plan must address the regulatory standards for new development. The modeling may show that different standards are needed for different parts of the watershed. As a result of the modeling, communities may find that their existing stormwater management regulations are adequate or they may decide to make them more stringent to prevent development from increasing the frequency and severity of existing problems.

The District prepares two types of plans that are similar to a watershed master plan:

1. A Major Drainageway Plan (MDP) identifies the existing natural and constructed channels and improvements to them to (a) minimize or eliminate damage to the public and structures from the 100-year event, (b) improve water quality, (c) repair damage to existing systems, and (d) propose solutions for problem areas.

2. An Outfall Systems Plan (OSP) is the same as an MDP except it focuses on the tributaries to a major drainageway and does not analyze the 100-year floodplain.

4.2.1. Watershed master plan (WMP) credit criteria

Activity 450 credits a watershed master plan (WMP) that meets certain criteria. This section reviews the District's major drainageway plans (MDP) and outfall systems plans (OSP) in light of those criteria.

As noted in Table 8 (page 30), only Denver is receiving WMP credit. That credit is for the "City and County of Denver Storm Drainage Master Plan, June 2009." The ISO technical reviewer states that it is likely the 2009 plan would not receive credit again under the 2013 *CRS Coordinator's Manual*.

1. The community must have adopted a watershed master plan for one or more of the watersheds within its jurisdiction.

   Status: The District's Board adopts completed master plans by resolution. The District believes that the Funding Agreement with communities for an MDP or OSP constitutes adoption of the completed plan by the communities' governing Boards or Councils. The CRS would need an attorney's opinion that this equates to amending a city's or county's regulations.

2. The plan must identify the natural drainage system and constructed channels.

   Status: The USDCM's Draft Chapter 3, Planning, describes what is included in an MDP and an OSP. It calls for "Performance of a site investigation to identify major drainage structures,

existing problem locations and hydrologic and hydraulic parameters" and calculating peak flow rates that are used "to evaluate the sufficiency of existing drainage facilities, identify potential drainage problems and evaluate alternative drainage improvements." All master plans have a Study Area section which describes the drainage systems on a reach by reach basis, including discussion of the type of channel.

3. The community must have adopted regulatory standards that are based on the plan and that receive credit under SMR. "Based on the plan" means that different retention/detention standards would be recommended for different areas, based the area's conditions. For example, a plan might have different retention standards in different areas, depending on the receiving streams' capacities.

   Status: The regulatory criteria for SMR are reviewed in the previous section. As noted there, the District does not have regulatory authority. All master plans include language like the following:

   b) That Sponsors and any other jurisdiction having land use control powers in this watershed require new land development and significant redevelopment and publicly funded projects to provide to the maximum extent practicable runoff volume control practices (i.e., minimize directly connected impervious areas and employ infiltrating BMPs) whenever site conditions permit.

   It is not likely that generic language like this would be credited, especially if every plan says the same thing. This could be verified with a review by the CRS stormwater management technical reviewer.

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

   Status: Most MDPs and OSPs propose improvements that reduce post-development flows where feasible. However, as noted previously, it is not clear if the regulatory statements would qualify as creditable regulatory standards.

5. The Plan's regulatory standards must require management of runoff from all storms up to and including the 25-year event.

   Status: MDPs and OSPs analyze the 2-, 5-, 10-, 25-, 50-, 100-year storm events (and the 500-year, if floodplain mapping is included in the scope for the master plan). However, the plans are only required to propose improvements to manage the 100-year event. Management of the full spectrum of flows for detention is the District's recommended approach, as described in USDCM Draft Chapter 10, Section 3.0.

6. Any plan more than 5-years old must be evaluated to determine if it is still applicable.

   Status: The District relies on communities to request updates to existing plans. Either this would be left up to each community getting the credit or the District could develop procedures to meet this requirement. While funding may prevent this, there is talk of the CRS requiring evaluations every ten years instead of every five years.

4.2.2. Watershed master plan (WMP) credit points

Watershed master plans can receive up to 315 points if they have all of the following attributes and an impact adjustment of 1.0.

1. 90 points, if the watershed master plan meets all of the criteria listed in 4.2.1.
2. 30 points, if the plan and the community's regulations manage the runoff from all storms up to and including the 100-year event.
3. 55 points, if the plan provides management of future peak flows *and volumes* so that they do not increase over present values.
4. 35 points, if the plan manages the runoff from all storms up to and including the 5-day event
5. 30 points, if the plan identifies existing wetlands or other natural open space areas to be preserved from development so that natural attenuation, retention, or detention of runoff is provided
6. 25 points, if the plan prohibits development, alteration, or modification of existing natural channels
7. 25 points, if the plan requires that channel improvement projects use natural or "soft" approaches rather than gabions, rip rap, concrete, or other "hard" techniques
8. 25 points, if the community has a dedicated funding source to implement the recommendations in the plan

Status: Several of these potential credits are the norm for District plans. A careful review of each plan would be needed to determine which credits are deserved.

4.2.3. Impact adjustment

The impact adjustment criteria for WMP are the same as for SMR. There must be a map that shows all watersheds that drain into the community and those watersheds with master plans. As noted above, the maximum impact adjustment is 1.0, which is only possible if all the qualifying watersheds that drain into the community are covered by an adopted master plan. Because the District's plans tend to focus on smaller areas, ratios of 1.0 are not likely.

Where they do cover larger areas, the District GIS staff can help communities prepare impact adjustment maps showing the areas(s) impacted by their programs.

4.2.4. Conclusions and recommendations

1. The District's major drainageway and outfall systems plans have many, but not all, of the attributes that deserve credit under watershed master plan (WMP).

2. As with most watershed plans around the country, the key missing ingredient is having enforceable regulatory standards. Rather than call for an attorney's review of the District's positon, it is recommended that each community that wants WMP credit clearly adopt the plan's standards in its stormwater management regulations.

3. The District should select one or two of its plans for an in-depth review for the WMP credit points. The results would be used by both the communities and the CRS technical reviewer to facilitate crediting other plans.

4. As with SMR, the District GIS staff should help communities prepare impact adjustment maps and run the impact adjustment calculations.

4.3. Water Quality Activities

Activity 450 has two elements that credit water quality programs. Colorado communities can receive uniform minimum credit for both.

4.3.1. Erosion and sedimentation control regulations (ESC)

ESC credit is provided if a community requires that erosion and sedimentation control measures be taken on land that is disturbed during development. ESC credit is based upon the size of the areas subject to the regulation.

1. 40 points, if regulations control erosion and soil loss from any disturbed land greater than 1,000 square feet; OR
2. 30 points, if regulations control erosion and soil loss from any disturbed land greater than 0.5 acre; OR
3. 10 points, if regulations control erosion and soil loss from any disturbed land greater than one acre. This is the standard set by the USEPA for MS4 communities. It is not worth many points because it is considered a national mandate.

Status: The Colorado uniform minimum credit is based on the standards in Colorado Revised Statute 25-8 and Colorado Discharge Permit System Regulation 61.8(11)(ii)D). This is the same one acre standard as the USEPA requirement.

As seen in Table 8 (page 30), all but two communities in the District (Morrison and Thornton) receive ESC credit. The credit is for one acre with the exception of Arvada and Golden, which are getting more credit for a 0.5 acre standard.

4.3.2. Water quality regulations (WQ)

WQ credit is provided for implementing best management practices to protect water quality. Regulations that require developers to install or implement measures that improve the quality of stormwater are credited. This is usually done by adopting a state manual on best management practices (BMPs). WQ credit is not for BMPs required during the course of construction, but rather for measures that are permanently incorporated in the development's stormwater management facilities.

The credit is a flat 20 points for having the regulations.

Status: The Colorado uniform minimum credit is based on the standards in Colorado Revised Statute 25-8 and Colorado Discharge Permit System Regulation 61. All communities can receive the 20 points. For some reason Louisville, Morrison, and Thornton do not (see Table 8 (page 30)).

4.3.3. Conclusions and recommendations

1. All communities in the District should receive 10 points or ESC and 20 points for WQ.

2. District staff should talk to Louisville, Morrison, and Thornton staff to determine why they are not getting the credit.

3. If communities want to receive more than the minimum credit for ESC, they should submit documentation that their regulations apply to areas of disturbance smaller than one acre.

4. While uniform minimum credit is "automatic," it can be denied if the ISO/CRS Specialist determines that it is not being enforced. It is not uncommon for communities to be in states with uniform credit for ESC to not receive the credit because the Specialist sees construction sites without erosion control measures installed. Communities that want these credits should make sure that they are being implemented, even if that is done by another agency.

5. Design, Construction & Maintenance Program

This office designs, constructs, and maintains flood protection projects throughout the District. Its work mirrors two types of CRS credit: construction of projects that reduce flood damage and maintenance of drainage systems to ensure they do their job of carrying or storing flood waters.

5.1. Flood Protection Projects

There are several CRS activities and elements that could credit a flood control, acquisition, restoration, or other type of project administered by the Design, Construction & Maintenance Program. Four are reviewed here.

5.1.1. Capital improvement program (CIP)

The first step in managing flood protection projects is usually developing a master plan or schedule of what should be addressed first. A capital improvements plan or program combines this step with an annual budget. Such a program is recognized in CRS Activity 540 (Drainage System Maintenance) under the element of capital improvement program or CIP.

CIP credit recognizes a program that makes permanent, structural changes within the drainage system to reduce flood or maintenance problems. This credit is not for a program of continuous maintenance, such as cleaning or repairing inlets and culverts (that is covered in Section 5.2).

Here are the credit criteria:

1. The activity credit criteria in Section 541.b. must be met. These are covered in Section 5.2.1 on drainage maintenance.

2. The community must be receiving credit for channel debris removal, CDR, covered in Section 5.2.2.

3. Sites that are improved through the program must be in the community's conveyance system, which is mapped as part of the CDR credit.

4. There must be a "master list" of problem sites that are planned for improvement projects. The list can be prepared from master watershed plans, complaints, or reports from maintenance crews. Projects do not have to be prioritized or listed in any order. For example, the community may determine which projects will be funded at the beginning of each fiscal year.

   If the program is administered by a county or multi-community district, then the list must be prepared from master watershed plans and not based solely on complaints or other ad hoc methods.

5. For full credit, an engineering analysis must have been completed that identifies the problem and provides a solution. It must include an estimate of the 1% annual chance (100-year) flood at the problem site and the resulting flood elevations. Having this analysis increases the credit from 30 points to 70 points.

6. The community must spend money on a regular basis on the improvement projects (a one-time-only project would not be credited). This can be documented by a multi-year capital improvements budget or line items in several years' budgets that fund drainage improvement projects.

Status: The District has a 5-year Capital Improvement Plan that is updated every year. It includes capital projects for each county within the District. The District budgets for up to half the cost of each year's projects, with the remainder funded by the city or county benefiting from the project.

Projects are identified from the major drainageway plans (MDP) and outfall systems plans (OSP) that are described in Section 4.2.1, community master plans, and complaints. The CRS technical reviewer would need to confirm that this approach satisfies credit criterion 4.

Communities that have received credit for CIP are shown in Table 9. The database does not show if the credited program was the community's or the District's.

Table 9. District Communities' Project Credits

Community	540	520	530	420		
	CIP			OSP	DR	NFOS
Arapahoe County						
Arvada		✓		✓	✓	
Aurora	✓			✓		
Boulder	✓	✓		✓	✓	✓
Boulder County				✓		
Centennial				✓		
Cherry Hills Village						
Denver				✓		
Douglas County				✓		
Englewood				✓		
Golden	✓			✓	✓	
Jefferson County	✓			✓		
Lakewood	✓			✓		
Littleton				✓	✓	✓
Louisville				✓		
Morrison						
Parker	✓			✓	✓	
Thornton				✓		
Westminster				✓		
Wheat Ridge	✓	✓		✓	✓	✓

Credits are as of 2013. The points are not applicable for the 2013 *CRS Coordinator's Manual*.

No communities are receiving credit for Activity 530 (Flood Protection).

420 NSP is a new credit in the 2013 *Manual*, so no community has the credit.

5.1.2. Activity 530 (Flood Protection)

A flood control project may qualify for CRS credit under Activity 530 (Flood Protection). Credit is provided on a project by project basis once the appropriate documentation is submitted to the ISO/CRS Specialist. Once a project is credited, the community does not have to do anything more, as long as the protected buildings are located in the Special Flood Hazard Area.

A flood control project would need to meet the following credit criteria:

1. It must protect one or more insurable buildings in the Special Flood Hazard Area. If the project reduces the 100-year flood level sufficient to result in a map revision, the buildings removed from the SFHA receive a much greater premium reduction than the CRS can provide. In these cases, there is no double insurance credit, so there is no CRS credit.
2. The project must protect the building(s) from at least the 25-year flood.
3. All required permits must have been issued for the project or the local permit officer must state in writing that the project complies with all federal, state, and local codes and regulations.

4. If the project requires human intervention, there must be at least one hour of flood warning time plus the time it takes to install the measure. "Human intervention" means that a person is needed at the site to close an opening or install or operate a protection device before flood waters reach the building.
5. Credit is not provided for a retrofitted building or flood control project that is in disrepair or does not appear to be maintained.
6. The design and construction of the flood control project must have been certified by a licensed professional engineer.
7. The responsible agency must be implementing an operations and maintenance plan that was prepared for the project by a licensed professional engineer.
8. If the flood control project lowers the base flood elevation shown on the FIRM, a Letter of Map Revision (LOMR) must be submitted to FEMA.
9. The community must ensure that the impact of future development will not adversely affect the project's flood protection level. This can be done by either
    a. Enforcing watershed-wide regulations that prevent increases in stormwater runoff. This is usually documented by receiving credit for stormwater management regulations under Activity 450 (Stormwater Management); OR
    b. Designing the project so that it will perform to its design protection level based on a watershed that is fully built out or developed in accord with an adopted long-range land use plan.
10. If the project was constructed after April 1, 2013, the community must sign a form (CC-530EHP) certifying that it complies with applicable federal environmental and historic preservation laws and executive orders.

Status: It is likely that most District projects could meet most of these credit criteria. The ones that would be hardest to meet are numbers 1 and 9.

1. Most District projects are designed for 100-year flood protection. A projects that lowers the 100-year flood, and is submitted for a map revision, would produce a flood insurance premium reduction for those properties removed from the Special Flood Hazard Area. There would not be a duplicate insurance premium credit under the CRS.

9. While almost all the District's CRS communities are getting credit for SMR stormwater management regulations, they may not address a large enough design storm to meet this criterion (see Section 4.1.3, above). Each regulation will need to be reviewed by the CRS stormwater management technical reviewer.

5.1.3. Activity 520 (Acquisition and Relocation)

Often it makes more sense to remove a building from the path of flooding instead of trying to control floodwaters. Activity 520 credits removing buildings from the floodplain. The credit is greater for some buildings, such as repetitive loss properties and critical facilities. Credit is dependent on preserving the site as open space (see next section).

Status: The District has an acquisition program that is available to communities. Candidate properties are most often identified through the master planning process. The program requires

that the property be "used for drainage and flood control purposes" as stated in the Acquisition Agreement. However, "drainage and flood control purposes" may not always mean open space.

5.1.4. Activity 420 (Open Space Preservation)

Once a property is acquired and cleared, it can qualify for one or more of the elements in Activity 420. These credits are cumulative:

1. Open space preservation (OSP): this is the basic credit for keeping land vacant through ownership or regulations. "Open space" means land without any buildings, filling, or storage. The land must be preserved by being kept in public ownership or with some regulatory restrictions.
2. Deed restrictions (DR) provides extra credit for OSP land if there is a legal restriction that ensures that the parcels will never be developed.
3. Natural functions open space (NFOS) provides extra credit for OSP credited parcels that are preserved in or restored to their natural state.
4. Natural shoreline protection (NSP) credits programs that protect natural channels and shorelines or restores a channel back to a natural condition. Often a parcel that qualifies for NFOS can also qualify for NSP.

Status: Properties are sometimes purchased by the District as part of a flood control or acquisition project. As noted above, parcels intended for "drainage and flood control purposes" may not always mean open space.

The agreement with the community specifies that the use of the site cannot be changed without District approval. This would not qualify as a deed restriction.

On District GIS maps, some parcels are shown as "natural areas." Again these parcels may or may not meet the CRS criteria for credit as a natural functions open space or natural shoreline.

5.1.5. Conclusions and recommendations

1. District flood projects could receive CRS credit under Activities 420, 520, 530, and/or 540. As seen in Table 9 (page 36), many communities are not receiving credit under these activities.

2. The District should submit its 5-year Capital Improvement Plan to the ISO technical reviewer to determine if it qualifies for credit under 540 – CIP.

3. Each flood control and acquisition project would need to be reviewed individually in light of the credit criteria.

4. The District should submit examples of each type of project – flood control, acquisition, and open space, to ISO to determine if some would be creditable.

5. The District should consider clearer and more restrictive language on the use of parcels purchased and cleared by a District project. Requiring a deed restriction would be even better.

5.2. Drainage Maintenance

The second CRS-related activity conducted by Design, Construction & Maintenance is to ensure that certain facilities are properly maintained. CRS Activity 540 (Drainage System Maintenance) provides credit for programs that keep channels and storage basins clear of debris so that their flood carrying and storage capacities are maintained.

One of 540's elements, capital improvements program, is discussed in the previous section. Three others directly relate to the District: channel debris removal (CDR), problem site maintenance (PSM), and storage basin maintenance (SBM).

Most communities are already receiving credit for CDR, as seen in Table 10. 540 SBM is a new credit in the 2013 *Manual*, so no community has the credit, but it is likely that most getting CDR credit would qualify.

Note 1 in Table 10 identifies communities not receiving full credit for their CDR programs. This issue is discussed in Section 5.2.5. Impact adjustment.

Table 10. District Communities' Maintenance Credits

Community	540		
	CDR	PSM	SBM
Arapahoe County			
Arvada	✓	2	
Aurora	✓	✓	
Boulder	✓	✓	
Boulder County			
Centennial			
Cherry Hills Village	1	2	
Denver	1		
Douglas County			
Englewood	1		
Golden	✓	✓	
Jefferson County	1	✓	
Lakewood	✓	✓	
Littleton	1		
Louisville	✓		
Morrison	1		
Parker	1	✓	
Thornton	1	2	
Westminster	1		
Wheat Ridge	1	✓	

Credits are as of 2013. The points are not applicable for the 2013 *CRS Coordinator's Manual*.

Note 1. These communities are not getting the full credit.

Note 2. These communities could be getting PSM credit. It cannot be determined in the database.

SBM is a new credit in the 2013 *Manual*, so no community has the credit.

5.2.1. Activity credit criteria

While most communities are already receiving some drainage maintenance credit, the District could help them by providing information about its maintenance program. Here are the key credit criteria that the District would need to meet. They cover all three elements:

1. The community must have a program to inspect its drainage system annually, upon receiving a complaint, and after each major storm. While responding to complaints and performing inspections after storm events are required to obtain credit, a program that only responds to complaints or inspects after storms is not eligible for this credit.

   Status: The District inspects and maintains facilities that were approved as designed and constructed in accordance with the Urban Storm Drainage Criteria Manual. These are inspected annually by student interns. Major drainage system projects are inspected after each major event and in response to complaints.

   A Maintenance Work Plan is prepared each year. Each community requests which drainageway(s) they want maintained. Maintenance includes vegetation management, debris removal, sediment and silt removal, weed control, channel restoration, bank and channel stabilization and other repairs. Several of these, such as bank stabilization, are above and beyond what is needed for credit for debris removal.

The District is implementing a "Stream Management Pilot Program" that would enhance the current maintenance program.

2. The inspections and maintenance can be provided by the community, another non-federal agency, or private property owners. The CRS community is responsible for providing all the documentation needed to verify credit, including for the District's program.

   Status: The database does not identify if a community is receiving credit for District work. It is likely that those identified with a "✓" for CDR in Table 10 (page 39) either (1) include District work or (2) have no District projects). See also the discussion in Section 5.2.5. Impact adjustment.

3. The program must have a regular source of funding. No credit is provided for projects that rely on unsecured outside funding, such as a one-time District project.

   Status: The District pays 100% of this program from its property tax levy. There is no community match required.

4. The program must be compliant with applicable Federal, State, and local environmental and historic preservation laws and executive orders. The community must complete a CC-540EHP, Certification of Compliance with Environmental and Historic Preservation Requirements for Drainage System Maintenance.

   Status: The District has not completed the CC-540EHP forms but does comply with all the requirements outlined in the form.

5.2.2. Channel debris removal (CDR)

Credit for this element is dependent upon annual inspections and regular maintenance of the channels and associated conveyance facilities in developed areas. Debris must be removed as needed after each inspection, in accordance with a written maintenance plan.

Credit criteria:

1. The activity credit criteria in Section 5.2.1. must be met.

2. The community must have a program to inspect and maintain its drainage facilities, and inspections must be conducted at least once each year, upon receiving a complaint, and after each major storm. Action must be taken after an inspection identifies a need for maintenance or cleaning.

3. The community must provide a map of the conveyance system with components of the drainage system labeled.

4. The community must provide a complete inventory of its conveyance system components.

5. There must be written procedures for inspection, maintenance, and record keeping.

6. All the inspection and maintenance activities must be recorded and the records must be maintained until the next verification visit.

Status: Items 1 and 2 are discussed in Section 5.2.1. Activity credit criteria.

Items 3 and 4 have been somewhat revised since the 2013 *CRS Coordinator's Manual* was published. ISO is requiring a map of the conveyance system, but it and the inventory can be labeled to show the community's approach to identifying parts of its system. The community does not have to use the *Manual's* format of channel segments and crossings. The District's current system would need to be reviewed by the ISO technical reviewer.

Items 5 and 6, written procedures and records are vital. The District's current system probably complies, but should be checked.

5.2.3. Problem site maintenance (PSM)

This credit is provided if the community's channel maintenance program identifies components that are "choke points," chronic dumping sites, obstructions to flows, or sites with erosion or sedimentation problems, that are inspected and maintained differently or more frequently than other parts of the system. Such inspections are in addition to those credited under CDR.

Credit criteria:

1. The activity credit criteria in Section 541.b. must be met.

2. The community must be receiving credit for CDR.

3. The community must have written procedures or guidelines that identify each problem site component, what the issues are, and what special inspection and/or maintenance is needed.

4. The problem sites are identified on the community conveyance system map developed for CDR credit and noted in the conveyance system component inventory.

5. The community's maintenance program must require that
   (a) An inspection be conducted more than once each year,
   (b) An inspection of each problem site component be conducted after each major storm, and
   (c) Action be taken after an inspection identifies a need for maintenance or cleaning.

Status: There are likely sites under the jurisdiction of the District's program that warrant inspection more than once a year. If the District's program can be adjusted to qualify for CDR credit, it could qualify for PSM. If the District won't or can't do inspections more than once a year, the problem sites would need to be inspected and maintained by the community's program.

5.2.4. Storage basin maintenance (SBM)

Channel and storage basin maintenance were made separate credits in the 2013 *CRS Coordinator's Manual*. CDR and PSM credit focus on streams, ditches and other open channels. SBM credit is dependent upon annual inspections and regular maintenance of retention, detention, infiltration, and other types of storage basins.

The maintenance work is normally done by a public works crew, usually without specialized equipment, but backhoes and trucks are frequently required. The objective of this activity is to remove accumulated sediment or debris that prevents the storage or infiltration of excess stormwater. It is important that the community's procedures spell out what can and cannot be removed.

The credit criteria are essentially the same as for CDR, i.e., annual inspections, inspections after complaints and major storms, a map and inventory of facilities, written procedures, and records.

One major difference is that the communities must be receiving credit for both size of development (SZ) and public maintenance (PUB) regulations under Activity 450 (Stormwater Management). These elements are discussed in Sections 4.1.2. and 4.1.5.

Status: Guidance for community programs is provided in Chapter 6 of the Urban Storm Drainage Criteria Manual Volume 3, Best Management Practices.

The District requires a "Maintenance Site Plan" for all basin projects as a condition of maintenance eligibility. The plan includes maintenance frequency and procedure sections. If these procedures are acceptable and the District can meet all the credit criteria, then its program to inspect and maintain basins should be creditable.

It is expected that the requirement for the 450 regulations would need to be met by the community, as discussed in Section 4.1.1. However, given the District's unique program, this could be discussed with the CRS technical reviewer.

5.2.5. Impact adjustment

To receive full credit for this activity, the program must inspect and maintain all public and private components in the developed portion of the drainage system. If all components of the drainage system cannot be inspected annually (for example, because there is no legal access to those parts of the system that lie on private property or for budgetary reasons), then credit is adjusted by the impact adjustment.

The impact adjustment involves preparing a map of the entire system in the developed portion of the community (which is usually the entire community for a city). It is marked to show those areas covered by the program. The areas are measured to calculate the ratio of the system that is credited. The final credit points are based on the ratio.

Status: If a community does not assume responsibility for areas managed by the District and it does not submit the needed documentation for those areas, the community will not receive full credit. As seen in Table 10 (page 39), there are ten communities that are not getting full credit for their channel programs (CDR). It cannot be determined if this is because they are omitting District areas or omitting areas for other reasons, such as a limited budget.

5.2.6. Conclusions and recommendations

1. Inspecting and maintaining selected drainage channels and basins is a major part of the District's flood protection program. It is expected that the current program meets most of the credit criteria for CRS credit, but some program and document revisions would be needed.

2. Most of the District's CRS communities are receiving some credit for their drainage maintenance program. The majority of them are not receiving the full credit for CDR or PSM. It is likely that those getting CDR credit could qualify for the new SBM credit.

3. If the District does not make the revisions to qualify for CRS credit in Activity 540 (Drainage System Maintenance), no community with a facility that is maintained by the District can receive the maximum score, unless it assumes responsibility for inspecting and maintaining the facility.

4. If a community has an area that is inspected and maintained by a qualifying District program, it can receive some credit, even if it does not have a maintenance program for the rest of its drainage system.

5. It is recommended that the District do the following:

    a. Submit Chapter 6 of the Urban Storm Drainage Criteria Manual Volume 3, Best Management Practices to the CRS stormwater management technical reviewer for feedback on what would be needed for SBM credit.

    b. Prepare a GIS-based map of the drainage system in the District. This would be submitted to the ISO technical reviewer for approval to be the impact adjustment map for all communities. Using a simplified method acceptable to the technical reviewer, GIS staff would calculate the total areas of the channel and basin parts of each community's system in their developed areas. The ratio of the District's share would be calculated. This would assist all communities, but especially those not getting any credit.

    c. Complete the CC-540EHP form for the District's maintenance program. One certification should suffice, unless there are certain areas where the District's program does not comply with Federal, State, and local environmental and historic preservation laws.

6. Summary

There are many ways that the Urban Drainage and Flood Control District can assist its member cities and counties with the Community Rating System. This report includes 46 conclusions and recommendations at the end of each of the sections.

To summarize these recommendations, the District should consider three general types of support:

1. "Uniform minimum credit:" whereby all the communities would receive credit for actions done entirely by the District. An example of UMC is the annual notification sent to all floodplain residents.

2. Direct support: where District programs help a community implement a creditable activity. An example is the flood threat recognition system operated by the Information Services & Flood Warning Program.

3. Coordination: work by District staff to help communities help themselves. An example is the recommendation to have the National Weather Service talk to communities about the benefits of being StormReady.

The table below recaps the recommendations for each of the four District programs and identifies what types they are.

Section	CRS Element	Recommendation	UMC	Direct Support	Coordi-nation
Floodplain Management Program					
2.1.6. 2.1.9-3	410 CTP	Verify with the ISO technical reviewer continued CTP credit			X
2.1.1. 2.1.9-4.a	410 NS, LEV	Talk with FEMA Region VIII on procedures to advise them of the availability of FHADs			X
2.1.2. 2.1.9-4.b	410 NS, LEV	Help communities identify and document FHADs that deserve credit		X	
2.2.	430	Revise the District's model ordinance			X
2.3.1. 2.3.3. 2.3.7-1	330 OP, FRP	Collect, review, and distribute materials that could qualify for outreach project credits		X	
2.3.2. 2.3.7-2	330 OP	Continue the annual notification, keep it updated over the years to maximize credit	X		
2.3.4 2.3.7-3	330 PPI	Continue to facilitate the multi-community Program for Public Information and share the lessons learned			X
2.3.5 2.3.6 2.3.7-4,5	350 LIB, LPD	Provide creditable references and reports to the various county library systems		X	

Section	CRS Element	Recommendation	UMC	Direct Support	Coordi-nation
Information Services & Flood Warning Program					
2.1.9-4.c 3.1.3 3.1.4-3,4 4.1.6 4.1.7-5 4.2.4-4 5.2.5	410 NS 450 SMR 540 CDR 540 SBM	Provide GIS support for impact adjustment maps		X	
5.2 5.2.6-5.b	540 CDR PSM SBM	Provide GIS based maps of the District's entire drainage system to be a base map for all communities' impact adjustment maps		X	
3.1.1	320	Explore direct provision of a creditable map information service using GIS and the District's website	X		
3.1.1	320	Provide GIS layers that will help communities provide map information on topics other than their FIRMs		X	
3.1.2	440 AMD	Provide GIS layers that will help communities expand their own GIS databases		X	
3.2.2 3.2.3-2	350 WEB	Provide technical support to local webmasters			X
3.2.2 3.2.3-3	350 WEB	Develop new web pages that communities can link to		X	
3.3.2 3.3.3 3.3.7-1	610 FTR, EWD	Continue the District's flood warning program		X	
3.3.1 3.3.4 3.3.7-3,4	610 FTR, EWD, FRO	Using GIS, help communities prepare flood inundation maps and flood response plans			X
3.3.1 3.3.4 3.3.7-5	610 FTR, EWD, FRO	Help communities meet the credit criteria and work with ISO to adjust the criteria for Colorado conditions			X
3.3.6 3.3.7-6	610 SRC	Work with the National Weather Service to assist communities in becoming StormReady			X
Master Planning Program					
4.1 4.1.7-3	450 SMR	Review the USDCM and maintenance programs and procedures with the CRS stormwater management technical reviewer			X
4.1 4.1.7-4	450 SMR	Work with the State MS4 staff to develop model ordinance language to improve stormwater management (SMR) scores			X
4.2 4.2.4-3	450 WMP	Have one or two major drainageway plans reviewed by the ISO technical reviewer to identify what's needed for watershed master plan credit		X	

Section	CRS Element	Recommendation	UMC	Direct Support	Coordi-nation
Design, Construction & Maintenance Program					
5.1.1 5.1.5-2	540 CIP	Submit the 5-year Capital Improvement Plan for technical review and possible credit	X		
5.1 5.1.5-4	530 520 420	Submit flood control projects to ISO for technical review and possible credit	X		
5.1.4 5.1.5-5	520 420	Revise the agreement language for projects that involve acquisition of property to ensure that the lands will remain as open space		X	
5.2 5.2.6-5.a 5.2.6-5.c	540 CDR PSM SBM	Building on the USDCM, develop written internal procedures for inspecting and maintaining District maintenance projects and have them reviewed for uniform minimum credit.	X		

Many states and regional agencies want to focus on uniform minimum credits, i.e., where credit for their communities is automatic. However, most CRS activities require a good deal of community involvement. An example is Activity 610 (Flood Warning and Response), where the District can provide direct support with a flood threat recognition system, but the community must have a creditable, locally adopted, flood warning and response plan, keyed to local conditions and local resources.

The table above shows that there are more opportunities for direct support of community activities, coordination of efforts, and training. While not "automatic credit," they are very important in building stronger local floodplain management programs and are worthy of District attention.

Acronyms

Acronym	Description	Page
AMD	additional map data	15
BMP	best management practices (for stormwater quality)	34
CDR	channel and basin debris removal	40
CFP	critical facilities planning	23
CIP	capital improvement plan	35
CRS	Community Rating System	1
CTP	Cooperating Technical Partner	5
CWCB	Colorado Water Conservation Board	
CWQCC	Colorado Water Quality Control Commission	28
CWQCD	Colorado Water Quality Control Division	27
DFIRM	digital Flood Insurance Rate Map	
DL	development limitations	9
DR	deed restrictions placed on open space properties	38
DS	design storms used in stormwater management regulations	27
EOC	emergency operations center	
ESC	erosion and sedimentation control regulations	33
EWD	emergency warning dissemination	21
FEMA	Federal Emergency Management Agency	
FHAD	Flood Hazard Area Delineation	3
FIRM	Flood Insurance Rate Map	
FRB	freeboard	9
FRO	flood response operations	22
FRP	flood response preparations	11
FTR	flood threat recognition system	21
FWS	more restrictive floodway standard	5
GIS	geographic information system	
HSS	higher study standard	5
ISO	Insurance Services Office, Inc.	1
LEV	leverage	4
LIB	flood protection library	11
LID	low-impact development	28
LOMA	Letter of Map Amendment	
LOMR	Letter of Map Revision	37
LPD	locally pertinent documents for a library	12
MDP	Major Drainageway Plan	31
MI	providing map information and Flood Insurance Rate Map data	13
MS4	Municipal Separate Storm Sewer System	
NFIP	National Flood Insurance Program	
NFOS	natural functions open space	38
NS	new flood study	4
NSP	natural shoreline protection	38
OP	outreach projects	8

Acronym	Description	Page
OPF	outreach project to floodplain properties	10
OSP	Outfall System Plan	11
OSP	open space preservation	38
PCF	regulations that protect critical facilities	9
PIF	flood insurance policies in force	2
PPI	program for public information	11
PSM	problem site maintenance	41
PUB	stormwater facilities subject to public maintenance	28
SBM	storage basin maintenance	41
SFHA	Special Flood Hazard Area	
SMR	stormwater management regulations	26
SRC	StormReady community	24
SZ	size of development subject to stormwater management	27
TRC	tsunami ready community	19
UDFCD	Urban Drainage and Flood Control District	
UMC	uniform minimum credit	44
USDCM	Urban Storm Drainage Criteria Manual	26
USEPA	United States Environmental Protection Agency	
WEB	flood protection website	17
WMP	watershed master plan	31
WQ	stormwater management regulations for water quality	34