VRWJPO XP-SWMM Model Update:

City of Rosemount Addition

Prepared for
Vermillion River Watershed Joint Powers Organization

February 2016

4700 West 77th Street
Minneapolis, MN 55435-4803
Phone: 952.832.2600
Fax: 952.832.2601

VRWJPO XP-SWMM Model Update: City of Rosemount Addition

February 2016

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Certifications

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly License Professional Engineer under the laws of the State of Minnesota.

February 18, 2016

Brandon Barnes

Date

PE #: 49540

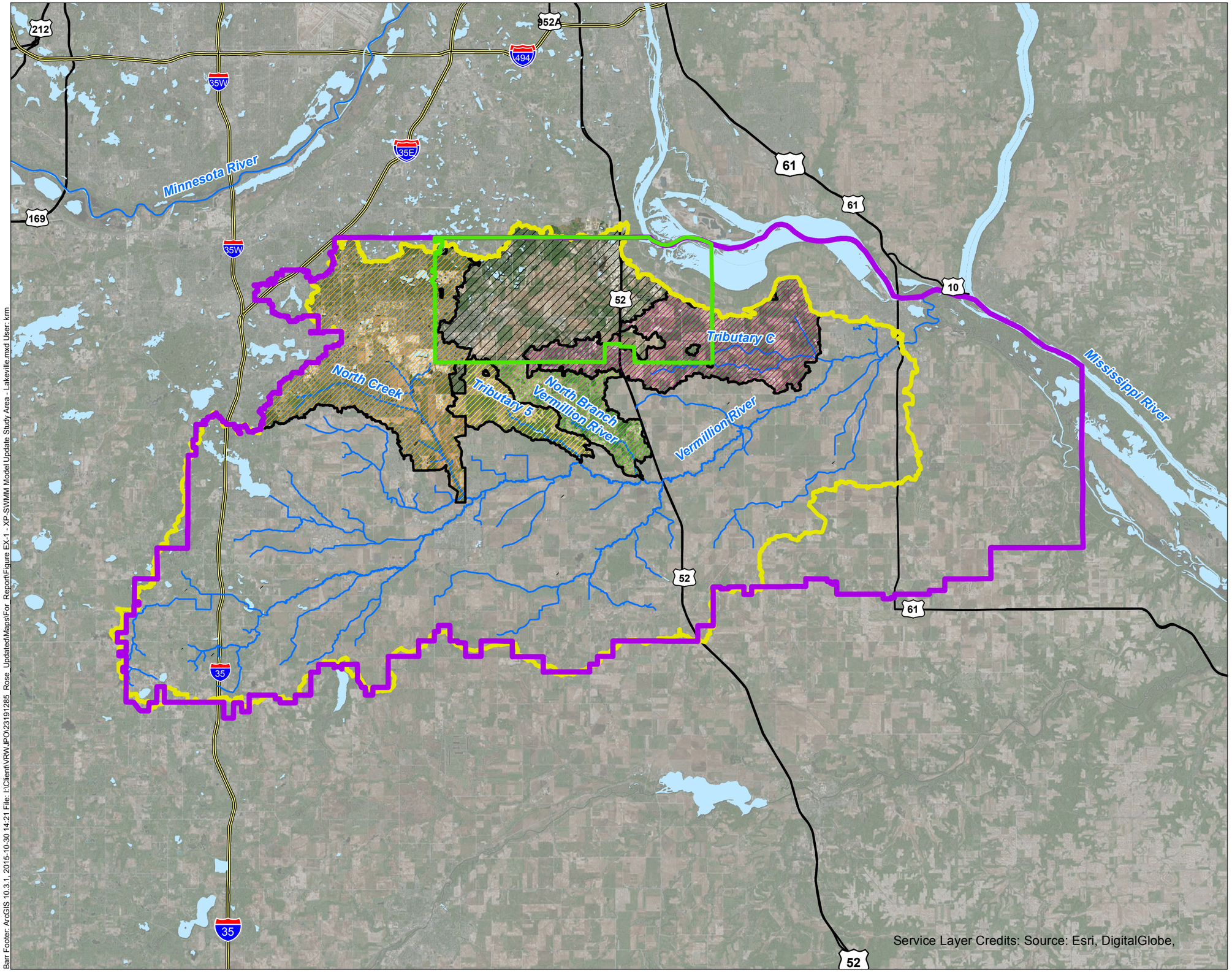
Executive Summary

This report describes the methodology and results of hydrologic and hydraulic modeling for area within the City of Rosemount that is tributary to the Vermillion River. The Vermillion River begins in the southwestern portion of Scott County and flows east through the central portion of Dakota County towards the Mississippi River near Hastings, Minnesota. The study area near the City of Rosemount is, roughly 35 square miles, includes the majority of the City as well as area outside the municipal boundary that is tributary to the City's creeks and streams as shown in Figure EX-1.

Previous modeling analyses of the Vermillion River watershed were completed in 2009 and 2010 for the Vermillion River Watershed Joint Powers Organization (VRWJPO). These analyses used subwatersheds that were generally 160 to 640 acres in area. The resulting calibrated XP-SWMM model was primarily a single-tiered network (i.e., flow was primarily routed through an overland network of drainage ways, natural stream sections, and roadway culverts and generally excluded detailed storm sewer networks). The model was modified in 2014 to provide more detail in the Cities of Lakeville and Farmington by including smaller subwatersheds, regional stormwater ponds, storm sewer connections between stormwater ponds, and storm sewer outlets to Vermillion River tributary creeks. The updated portion of the XP-SWMM model now includes sections of two-tiered network (i.e., flows are simultaneously routed through detailed storm sewer and overland networks). The VRWJPO used the peak flows and runoff volumes from the 2014 analysis to set flow and volume standards at the community standard locations defined in the 2009 study.

This study added the City of Rosemount to the VRWJPO model. The model development process is shown in Figure EX-2. The updated XP-SWMM model was used to simulate the 1-, 2-, 10-, 50-, and 100-year 4-day events based on rainfall depths published in Atlas 14 without further calibration. The resulting flow rates and runoff volumes are reported at the new and established community standard locations. Figure EX-3 shows the 100-year peak flow rates for the updated XP-SWMM model using Atlas 14 rainfall depths.

When using the model to assess development impacts to flow-rate standards it is important to consider the hydrologic and hydraulic scale for which the model was originally developed and calibrated. It is also necessary to recognize that the model should be used as a tool to assess the relative impacts of development rather than to establish absolute values, because a detailed recalibration was not completed as part of this current update effort. Future model updates should include verification of simulation results using post-2005 storm events to improve the model's representation of real-world conditions.



City of Rosemount

VRWJPO Boundary

Vermillion River Drainage Area

Lakes & Ponds

Rivers and Streams

Major Subwatersheds

North Branch Vermillion River

North Creek

Tributary 5

Tributary C

Land Locked Subwatersheds*

*Land locked area for 100-year, 4-day event. Other areas may be land locked during smaller events.

Miles

3 0 3

BARR

Figure EX-1

XP-SWMM MODEL UPDATE
STUDY AREA

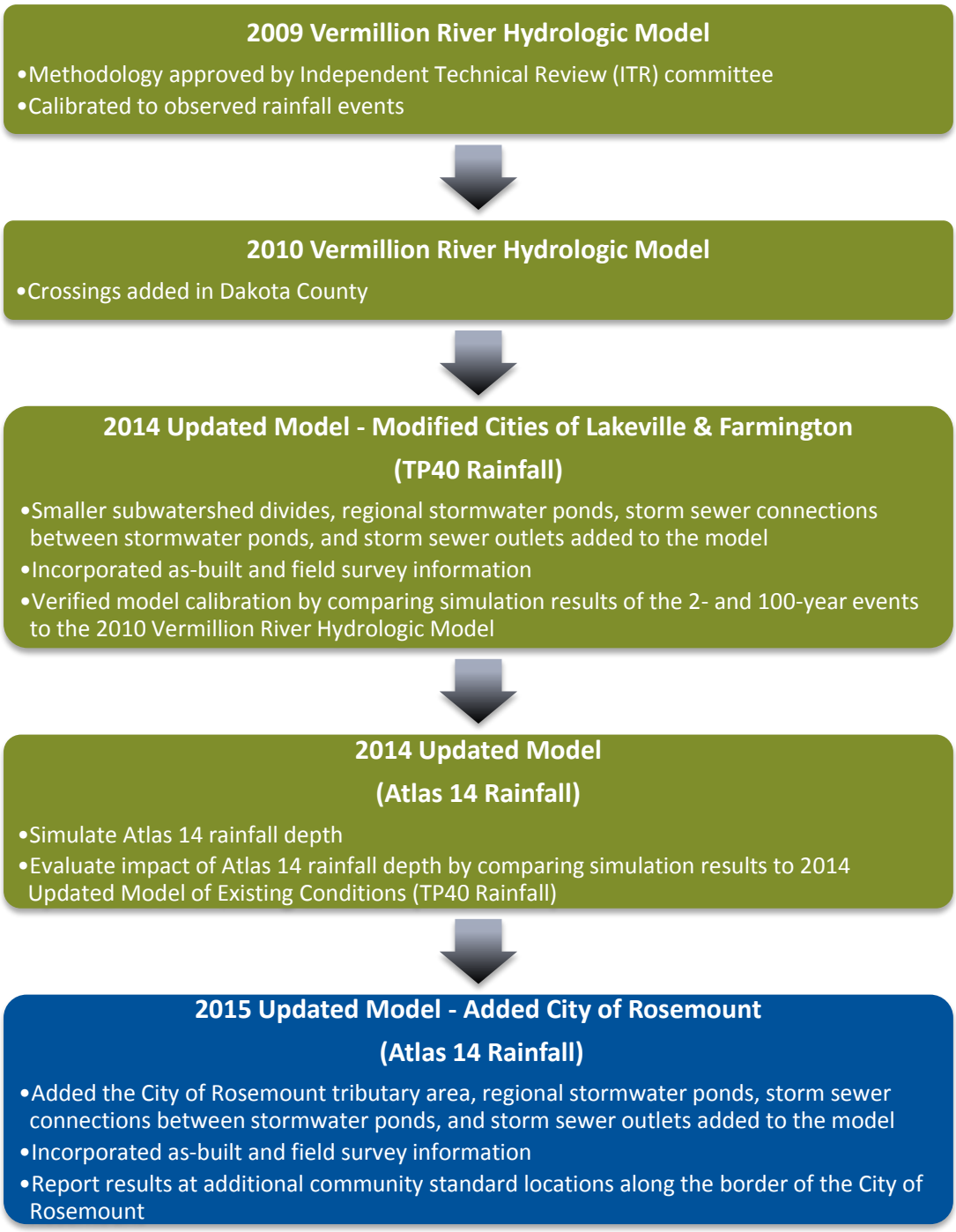
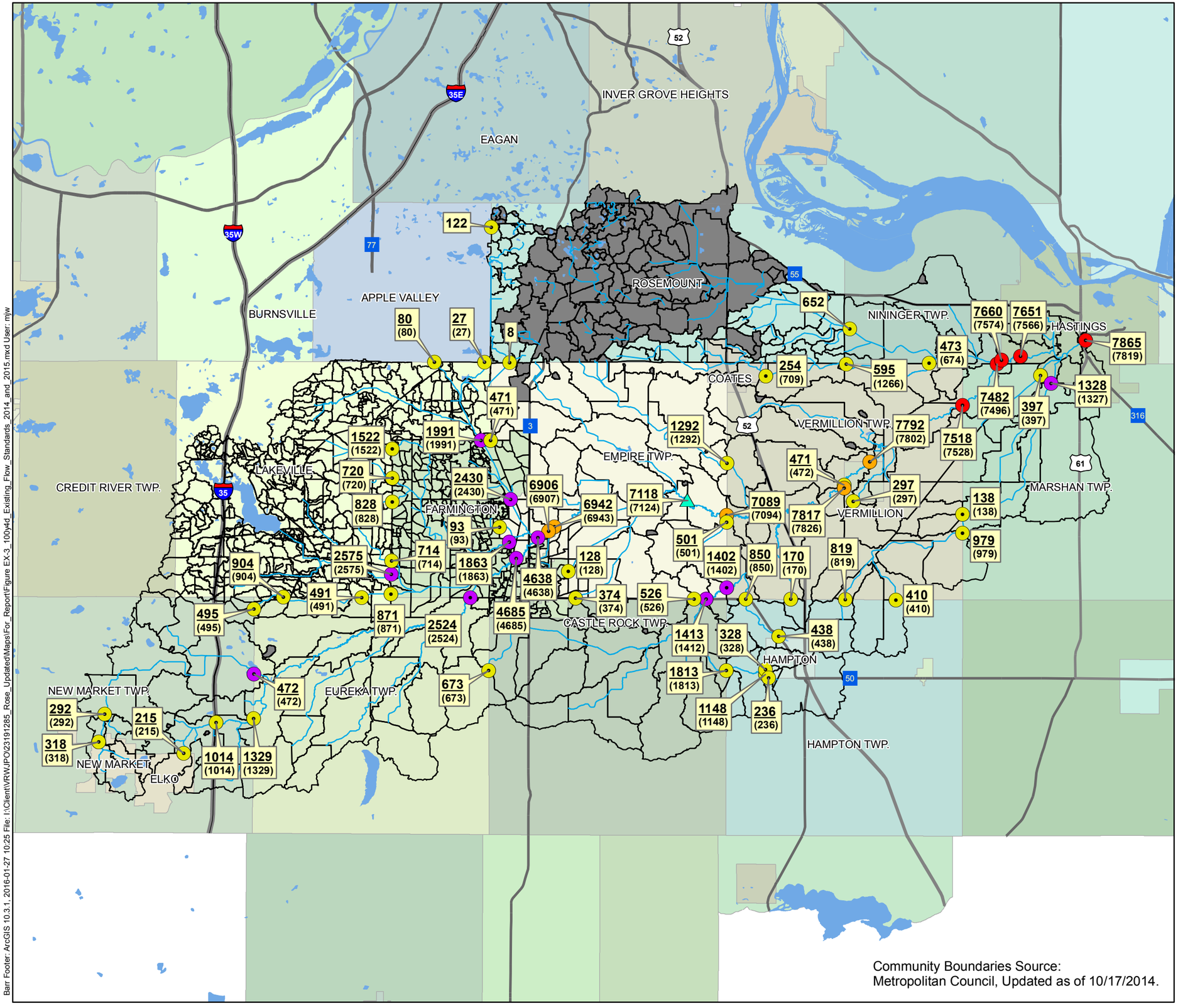


Figure EX-2 Hydrologic Model Update Process



Community Boundaries Source:
Metropolitan Council, Updated as of 10/17/2014.

Legend

Standard Locations

Tributary Drainage Area

- 0-10 square miles
- 10-67.5 square miles
- 67.5-170 square miles
- 170-225 square miles
- USGS Station
- SWMM Links
- Subwatersheds
- Lakes
- Land Locked Subwatersheds*

100-Year, 4-Day Peak Flow Rate (CFS)

7660 (7674) — 2015 Model with Rosemount / 2014 Model Update

*Land locked area for 100-year, 4-day event. Other areas may be land locked during smaller events.

Miles
1 0 1 2

Kilometers
1 0 1 2 3 4

Figure EX-3

COMMUNITY FLOW STANDARD LOCATIONS
2014 MODEL AND 2015 MODEL COMPARISON
100-YEAR, 4-DAY PEAK FLOW

Barr Footer: ArcGIS 10.3.1, 2016-01-27 10:25 File: I:\Client\VRW\JPO\23191285_Rose_Updated\Maps\For_Report\Figure EX-3_100y4d_Existing_Flow_Standards_2014_and_2015.mxd User: mjw

1.0 Methodology

1.1 Model Development

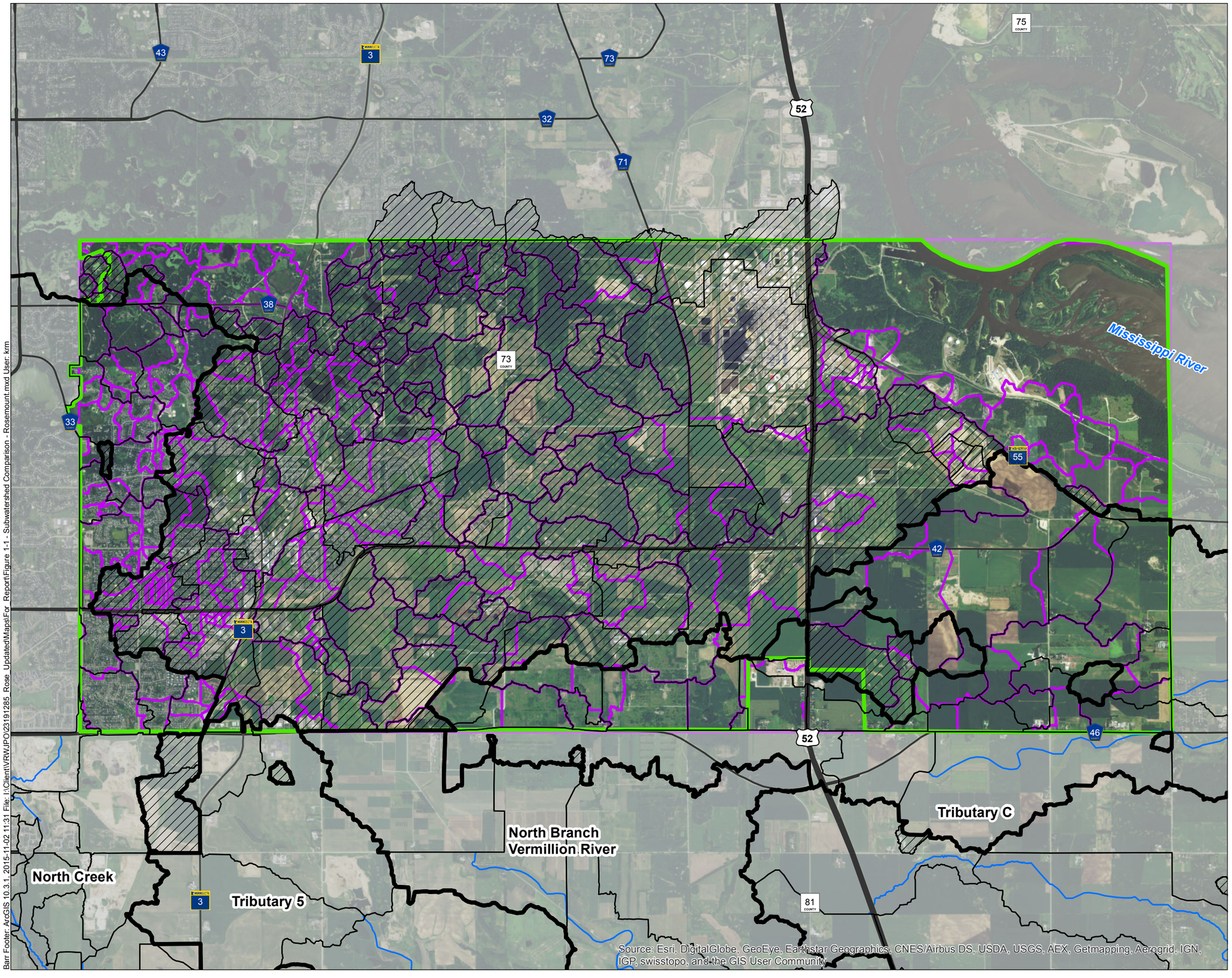
Development of the XP-SWMM model began in 2007 and was completed in 2009. At that time, 2005 land cover was the best available information to characterize conditions within the watershed and was used to define existing conditions. In 2010 the XP-SWMM model was updated to include additional crossings in Dakota County. In 2014, hydrologic and hydraulic detail was added to the 2010 VRWJPO XP-SWMM model to revise the existing conditions modeling within the Cities of Farmington and Lakeville. As part of this analysis, area within the City of Rosemount was added to the model (Figure EX-1). Hydrologic and hydraulic model inputs were based on the methodology presented in *Vermillion River Watershed Hydrologic Study of Existing Conditions* (Barr, 2009) and information provided by the City of Rosemount. For consistent application of model results, existing conditions represents 2005 land use and storm sewer conditions in the original model and subsequent revisions.

1.1.1 Hydrologic Model Parameters

Hydrologic model parameters were calculated using the calibrated values and methodology defined in *Vermillion River Watershed Hydrologic Study of Existing Conditions* (Barr 2009). The following sections summarize how individual model parameters were calculated.

1.1.1.1 Subwatershed Divides

The subwatersheds provided by the City of Rosemont were modified using 2011 Dakota County LiDAR and the City's storm sewer database to delineate subwatersheds to pond outlets within the study area. Subwatershed divides were also modified to include contributing drainage areas outside the Rosemount municipal boundary. Subwatersheds used in the model were reviewed by City of Rosemount and VRWJPO staff. Figure 1-1 shows a comparison of the subwatershed divisions provided by the City and the revised subwatershed divisions used in the updated XP-SWMM model.



City of Rosemount

Major Subwatersheds

Subwatersheds from 2015 XP-SWMM Model Update

Land Locked Subwatersheds*

Subwatersheds Provided by Rosemount

Rivers and Streams

*Land locked subwatershed areas are for 100-year, 4-day event. Other areas may be land locked during smaller events.

Feet

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BARR

Figure 1-1

SUBWATERSHED COMPARISON

Barr Footer: ArcGIS 10.3.1, 2015-11-02 11:31 File: I:\Client\VRWJPO\23191285_Rose_Updated\Maps\For_Report\Figure 1-1 - Subwatershed Comparison - Rosemount.mxd User: kmm

1.1.1.2 Impervious Area

Land-cover within a watershed affects the quantity and timing of runoff. Each land use generates a different quantity of runoff due, primarily, to the amount of impervious area within that land-cover. The impervious area input into the XP-SWMM model is, by definition, hydraulically connected to the drainage systems being analyzed. This directly connected impervious percentage includes driveways, rooftops, and parking areas that are directly connected to the stormwater collection system. Runoff from the portion of a rooftop draining onto adjacent pervious areas was not treated as connected impervious area.

The percent of directly connected impervious area associated with each land-use type was calculated using 2005 land-cover data developed by Applied Ecological Services (AES) and based on the Minnesota Land-Cover Classification System (MLCCS) for the western portion of the Vermillion River watershed and the 2005 Metropolitan Council land-use classifications. The AES land-cover data set is shown relative to the City of Rosemount in Figure 1-2, and the impervious percentages assigned to each land-cover classification are listed in Table 1-1.

Table 1-1 Land-Cover, Percent Impervious

AES Land-Cover Classification [1]	Total Percent Impervious (%)	Directly Connected Percent Impervious (%)
Asphalt	100%	100% or 0%[2]
Concrete	100%	100% or 0%[2]
Commercial Roof	100%	86% or 0%[3]
Residential Roof	100%	33% or 0%[4]
Forest	0%	0%
Corn	0%	0%
Tall Grass	0%	0%
Lawn	0%	0%
Bare Soil	0%	0%
Pond	100%	100%
Reservoir	100%	100%
Wetland	6%	6%

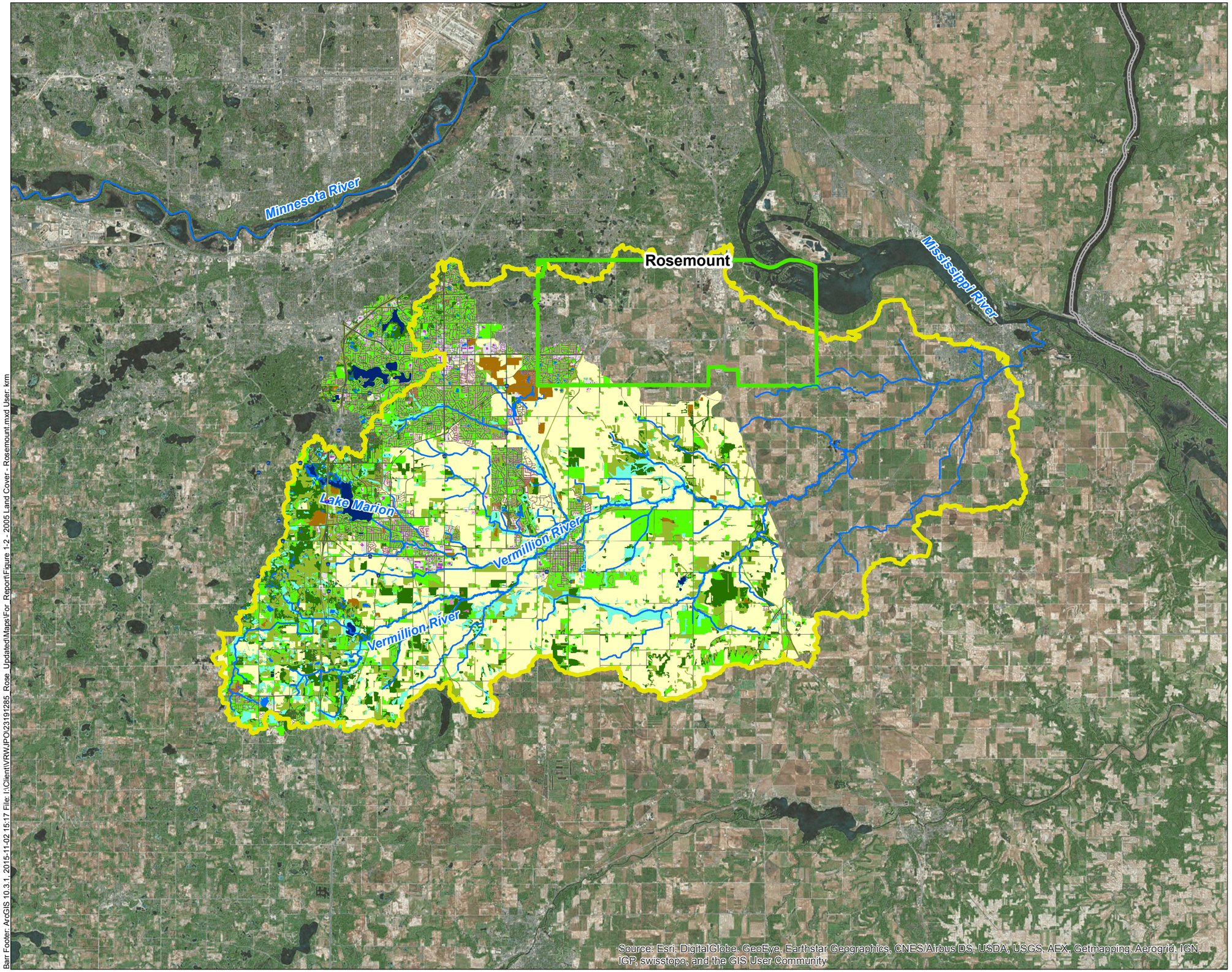
[1] 2005 land-cover classifications from Applied Ecological Services. Dataset provided in 2007

[2] Assumed to be 100 percent directly connected. In agricultural, airport, and farmstead Metropolitan Council land-use classifications assumed to be 0 percent impervious.

[3] Assumed to be 86 percent directly connected. In airport Metropolitan Council land-use classification assumed to be 0 percent.

[4] Assumed to be 33 percent directly connected. In agricultural, airport, and farmstead Metropolitan Council land-use classifications assumed to be 0 percent impervious.

The percentages from Table 1-1 were used to calculate the percentage of directly connected impervious area for each 2005 Met Council land-use classification based on the land-cover types within each area. The 2005 Met Council land-use dataset is shown in Figure 1-3, and the percent impervious assigned to land-use classifications are listed in Table 1-2.



Vermillion River Drainage Area
City of Rosemount
Rivers and Streams

Land Cover Classification (AES, 2005)

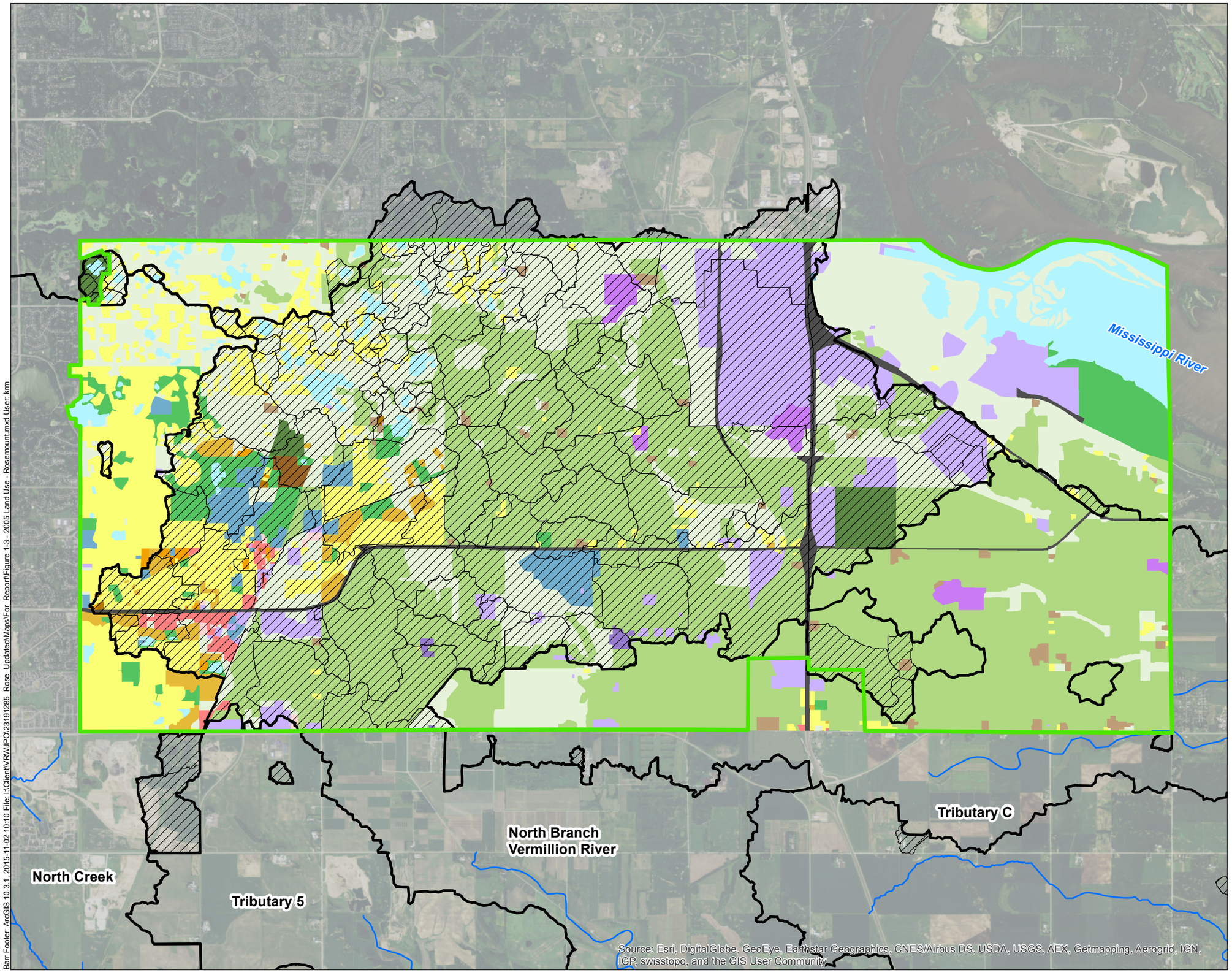
- Asphalt
- Bare Soil
- Commercial Roof
- Concrete
- Corn
- Forest
- Lawn
- Pond
- Reservoir
- Residential Roof
- Tall Grass
- Veg Pond

Miles
3 0 3

BARR

Figure 1-2

2005 LAND COVER



City of Rosemount
Major Subwatersheds
Land Locked Subwatersheds*
Rivers and Streams

Existing Land Use (Met Council, 2005)

- Agricultural
- Airport
- Extractive
- Farmstead
- Golf Course
- Industrial and Utility
- Institutional
- Major Highway and Rail
- Manufactured Housing Park
- Mixed Use Commercial and Other
- Mixed Use Industrial
- Office
- Park, Recreational or Preserve
- Retail and Other Commercial
- Seasonal/Vacation
- Single Family Residential Attached
- Single Family Residential Detached
- Mixed Use Residential
- Multifamily Residential
- Undeveloped
- Water

*Land locked subwatershed areas are for 100-year, 4-day event. Other areas may be land locked during smaller events.

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BARR

Figure 1-3

2005 LAND USE

Table 1-2 Land Use, Percent Impervious

2005 Metropolitan Council Land-Use Classification	Directly Connected Percent Impervious (Percent)
Agricultural	0.0
Airport	0.0
Extractive (e.g., gravel pits)	5.7
Farmstead	0.0
Golf Course	4.8
Industrial and Utility	59.1
Institutional	34.3
Major Highway and Rail	54.2
Manufactured Housing Parks	32.3
Mixed-Use Commercial and Other	97.6
Mixed-Use Industrial	55.5
Mixed-Use Residential	28.4
Multifamily	47.3
Office	70.9
Park, Recreational, or Preserve	11.0
Retail and Other Commercial	75.7
Seasonal/Vacation	15.7
Single Family, Attached	30.3
Single Family, Detached	20.6
Undeveloped	6.5
Water	100.0

Land-use classifications from Metropolitan Council, June 2005.

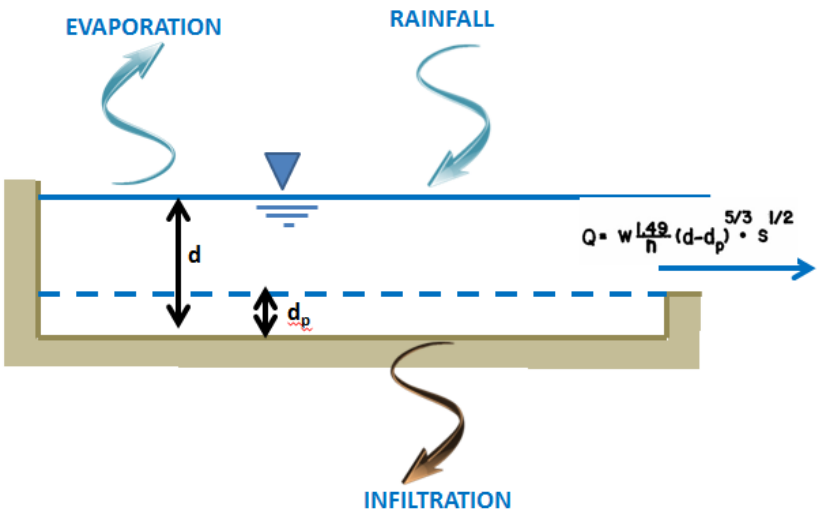
The directly connected impervious area for each subwatershed was calculated using the same methodology as detailed *Vermillion River Watershed Hydrologic Study of Existing Conditions* (Barr 2009) using the AES land-cover data and 2005 Met Council land-use dataset.

1.1.1.1 Watershed Slope

The average watershed slope was calculated in GIS. The methodology used to calculate the watershed slope for the updated areas is the same used for other watersheds within the VRWJPO XP-SWMM model. The area-weighted average watershed slope (feet/feet) for each subwatershed was estimated using GIS and a digital elevation model (DEM) created from Dakota County LiDAR data. LiDAR, which stands for light detection and ranging, is a remote sensing technology that measures the distance to the earth's surface, which can be converted to elevation. LiDAR data is typically provided in the form of a digital elevation model (DEM) which can be used to generate contour data.

1.1.1.3 Watershed Width

In XP-SWMM, surface runoff from subwatersheds is routed to the stormwater system via the nonlinear reservoir methodology. During each time-step XP-SWMM calculates the surface runoff from the subwatershed as shown in Figure 1-4.



In the equation, "Q" is the flow rate from the subwatershed (cfs), "n" is the Manning's roughness coefficient, "d" is the depth of water (ft), "d_p" is the depression storage (ft), and "s" is the slope (ft/ft).

Figure 1-4 Nonlinear Reservoir Schematic of a Subwatershed Used in XP-SWMM

The flow rate from a subwatershed is directly related to the watershed slope, overland flow surface roughness, depression storage, and width parameter. As the watershed width increases, the flow rate from the subwatershed also increases. With a higher runoff rate, less runoff is stored within the subwatershed and less infiltration occurs. This increases the runoff volume for a given rainfall event. However, as the watershed width decreases the opposite occurs; the flow rate from the subwatershed decreases, infiltration increases, and less runoff volume is generated.

The SWMM user's manual (Storm Water Management Model; Version 4 User's Manual, U.S. EPA 1988) suggests estimating the watershed width for a given subwatershed by dividing the watershed area by the longest flow path. This is the methodology described in the *Vermillion River Watershed Hydrologic Study of Existing Conditions* (Barr 2009) and used for this model update.

1.1.1.4 Infiltration Parameters

Infiltration is the movement of water into the soil surface. For a given storm event, the infiltration rate will vary with time. The infiltration rate at the beginning of the storm is the maximum rate because the soil surface is typically drier and full of air spaces. As the storm event continues, the infiltration rate will gradually decrease as the air space fills with water. For long storms, the infiltration rate will reach a

constant value—the minimum infiltration rate or the soil's hydraulic conductivity. The Horton infiltration equation was used to simulate the relationship between infiltration rate and time.

The Natural Resource Conservation Service (NRCS) soil survey geographic database (SSURGO) released in July 2006 was used to determine the hydrologic soil group classifications of the soils within the study area. Horton infiltration input parameters for each hydrologic soil group were previously calibrated for the study area as described in the *Vermillion River Watershed Hydrologic Study of Existing Conditions* (Barr 2009). Composite infiltration parameter values were estimated by computing an area-weighted average for each parameter based on the percentage of each soil type within the subwatershed, using the calibrated values from 2009.

1.1.1.5 Depression Storage and Overland Flow Roughness

Depression storage, which includes the areas that must be filled with water prior to generating runoff from both pervious and impervious areas, was set for each land-use classification based on the values described in the *Vermillion River Watershed Hydrologic Study of Existing Conditions* (Barr 2009). The methodology defined in this study was also used to assign overland flow roughness values for each land-use classification.

1.1.2 Hydraulic Model Parameters

Hydraulic information in the model consists of storm sewer, pond outlets, and natural channels. The following sections describe the sources of hydraulic information for each portion of the stormwater conveyance system.

1.1.2.1 Storm Sewer Data

Storm sewer data were entered into a GIS database. The GIS database was used to expedite data entry into the XP-SWMM model and provide a single source of information for developing the XP-SWMM model. The GIS database was populated with as-built drawings, GIS layers, and survey data provided by the City of Rosemount and the VRWJPO. Data included pipe invert elevations, lengths, diameters, shape, and material type.

1.1.2.2 Stormwater Storage Areas

Stormwater storage-area locations, such as ponds and wetlands, were identified based on information provided by the City of Rosemount, aerial photographs, and LiDAR data. Storage-elevation curves for the ponds were calculated in ArcGIS based on Dakota County LiDAR data (2011). Pond outlet structure information was taken from as-built drawings, as provided. In areas where as-built plans and survey data were not available, overflow elevations were based on LiDAR data.

1.1.2.3 Stream Cross Sections

Stream cross sections used in the XP-SWMM model were developed using GIS and a DEM created from Dakota County LiDAR data (2011). The most restrictive cross section for a given reach was selected in accordance with the methodology presented in the *Vermillion River Watershed Hydrologic Study of Existing Conditions* (Barr 2009).

1.2 Precipitation Data

The 4-day design event was identified by the VRWJPO as the critical event for the Vermillion River watershed, and used to estimate peak flows and total runoff volumes at community standard locations. The following section present the Atlas 14 rainfall depths used to develop the design events simulated with the updated XP-SWMM model.

1.2.1 Atlas 14 Rainfall Depths

In 2013, the National Oceanic and Atmospheric Administration (NOAA) released Atlas 14, Volume 8, which revised precipitation frequency estimates for 11 Midwestern states, including Minnesota. The estimates serve as an update to the U.S. Weather Bureau's *Technical Paper No. 40* (TP40), published in 1961, which was the primary source for precipitation depths used in the 2009 Vermillion River XP-SWMM model.

Atlas 14 rainfall depths from the Farmington station (NWS Cooperative Station ID 21-2737), which is centrally located within the Vermillion River watershed, were selected to develop rainfall distributions for the model. The 4-day precipitation depths from the Farmington monitoring station are included in Table 1-3.

Table 1-3 Hypothetical Rainfall Event Point Precipitation from Atlas 14 (inches)

	Return Frequency				
Duration	**1 Year**	**2 Year**	**10 Year**	**50 Year**	**100 Year**
5 minutes	0.35	0.42	0.64	0.92	1.05
10 minutes	0.52	0.62	0.94	1.35	1.54
15 minutes	0.63	0.75	1.15	1.64	1.88
30 minutes	0.89	1.06	1.64	2.37	2.72
1 hour	1.16	1.38	2.18	3.27	3.81
2 hours	1.43	1.70	2.71	4.17	4.91
3 hours	1.59	1.89	3.04	4.77	5.67
6 hours	1.86	2.20	3.55	5.60	6.68
12 hours	2.13	2.49	3.88	5.96	7.04
24 hours	2.46	2.80	4.16	6.29	7.41
2 days	2.85	3.18	4.51	6.65	7.79
3 days	3.12	3.45	4.83	6.99	8.14
4 days	3.33	3.69	5.12	7.31	8.45

The rainfall precipitation depths from the Farmington monitoring station were used to develop rainfall hyetographs following current guidance suggested by the Minnesota Department of Transportation and the Minnesota Department of Natural Resources for developing hyetographs using Atlas 14 precipitation depths. This methodology is consistent with the methodology used to develop design rainfall hyetographs for the VRWJPO XP-SWMM model.

2.0 Modeling Results

The XP-SWMM model was used to simulate 2005 development conditions. Following updates to the XP-SWMM model, the 1-, 2-, 10-, 50-, and 100-year design event peak flow rates and runoff volumes were compared to the VRWJPO standards at each community standard location. A comparison of peak flow and runoff volume results is included in Appendix A. Appendix A also includes figures illustrating peak flows and total runoff volumes at each VRWJPO community standard location.

The largest decreases in peak flow rate for the 100-year event occurred at standard locations on Tributary C. In this location additional topographic information was added upstream to better define the available storage within the watershed. As a result, there is more landlocked area for the smaller events, and lower peak discharges for the larger rainfall events. Figure 2-1 shows the peak discharge rate and runoff volume for standard locations near the Rosemount municipal boundary.

Tributary 1A to North Creek Standard Location (RL-352): This standard location is located just downstream of Shannon Pond. This pond does not have a defined outlet, and during smaller, more frequent, rainfall events the pond is landlocked. The upstream drainage area includes several ponds, and the discharge into Shannon Pond following a rainfall event is limited to the capacity of upstream pump stations. During larger rainfall events (e.g., events larger than the 10-year) model simulation indicates that the pond will fill up and County Road 46 will overtop.

Tributary C2 Standard Locations (RL-305 & L-346): The reduction in peak discharge rate at these locations was a result of adding additional detail to the stormwater system in Rosemount. The 2014 XP-SWMM model included a single subwatershed for the drainage area upstream of the Coats municipal boundary (RL-305). The 2015 model includes 15 subwatersheds, which are based on information and comments provided by the City of Rosemount. When the additional detail is incorporate, peak flow rates are reduced by the additional culverts, ponds, and topographic depressions that were added to the model. The additional detail results in lower flow rates for the larger rainfall events. The additional storage volume results in no discharge at the upper end of Tributary C2 for more frequent rainfall events (e.g., events up to the 2-year).

Tributary C Standard Location (RL-299): This is a new standard location that was added as part of the model updates. The watershed upstream of this location includes several topographic depressions, ponds, and wetlands which result in most of the area being landlocked during the 100-year event upstream of this standard location.

Unnamed Reach (OV-1341-2): There is one pond south of McAndrews Road that does not have a piped outlet. During smaller, more frequent, rainfall events this area is landlocked. However, during larger rainfall events (e.g., events larger than the 10-year), the pond may overflow into Apple Valley.

Standard Location	1-year	2-year	10-year	50-year	100-year
Unnamed Reach: Rosemount – Apple Valley (Link: OV-1341-2)					
Peak Flow Rate (cfs)	0	0	9	80	122
Total Runoff Volume (ac-ft)	0	0	2	13	18

Standard Location	1-year	2-year	10-year	50-year	100-year
Tributary C: Rosemount – Nininger Township (Link: RL-299)					
Peak Flow Rate (cfs)	15	39	200	475	652
Total Runoff Volume (ac-ft)	16	35	159	451	639

Standard Location	1-year	2-year	10-year	50-year	100-year
Tributary C2: Rosemount – Vermillion Township (Link: L-346)					
Peak Flow Rate (cfs)	30	51	167	344	595
Total Runoff Volume (ac-ft)	9	18	129	411	649

Standard Location	1-year	2-year	10-year	50-year	100-year
Tributary C2: Coats – Vermillion Township (Link: RL-305)					
Peak Flow Rate (cfs)	0	0	29	161	254
Total Runoff Volume (ac-ft)	0	0	56	232	374

Standard Location	1-year	2-year	10-year	50-year	100-year
Tributary 1A to North Creek: Rosemount – Empire Township (Link: RL-352)					
Peak Flow Rate (cfs)	0	0	4	7	8
Total Runoff Volume (ac-ft)	0	0	90	307	371

Mississippi River

52

Tributary C

North Branch
Vermillion River

North Creek

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Standard Locations

Tributary Drainage Area

- 0-10 square miles
- 10-67.5 square miles
- 67.5-170 square miles
- 170-225 square miles
- Major Subwatersheds
- Subwatersheds
- Land Locked Subwatersheds*
- City of Rosemount
- Lakes & Ponds

*Land locked subwatershed areas are for 100-year, 4-day event. Other areas may be land locked during smaller events.

Feet
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BARR

Figure 2-1

CITY OF ROSEMOUNT
STANDARD LOCATIONS
4-DAY EVENT PEAK RATE &
RUNOFF VOLUME

Barr Footer: ArcGIS 10.3.1, 2015-10-30 15:24 File: I:\Client\VRW\PO\23191285_Rose_Updated\Maps\For_Report\Figure X - Standard Flow Locations - Rosemount.mxd User: krm

3.0 Conclusions / Recommendations

This study incorporated area within the City of Rosemount in the VRWJPO XP-SWMM model to include smaller subwatersheds, existing regional stormwater ponds, existing storm sewer connections between stormwater ponds, and existing storm sewer that are tributary to the Vermillion River. During the model update, comments provided by the City of Rosemount and VRWJPO on the subwatershed divides and model parameters were incorporated into the model. The updated XP-SWMM model was used to simulate the 1-, 2-, 10-, 50-, and 100-year 4-day events without recalibration. The resulting flow rates and runoff volumes were compared to the established rates and volumes at the community standard locations, and are summarized in Appendix A.

Three additional standard locations were incorporated to report peak discharge rates and runoff volumes at the Rosemount municipal boundary.

1. Just south of McAndrews Road where overflow into Apple Valley may occur during larger rainfall events
2. Downstream of Shannon Pond where County Road 46 may overtop during larger rainfall events
3. On Tributary C where water is conveyed from Rosemount into Nininger Township

The updated model can be used to define baseline conditions for planning purposes within the watershed. When using the model to assess development impacts to flow-rate standards it is important to consider the hydrologic and hydraulic scale for which the model was originally developed and calibrated. It is also necessary to recognize that the model should be used as a tool to assess the relative impacts of development rather than to establish absolute values, because a detailed recalibration was not completed as part of this update effort, and monitoring data near the Rosemount municipal boundary was not available for model calibration. Future model updates should include a verification of the model calibration to improve the model's representation of real-world conditions. Verification could occur when additional information is available (i.e., additional gage locations are installed within the watershed).

4.0 References

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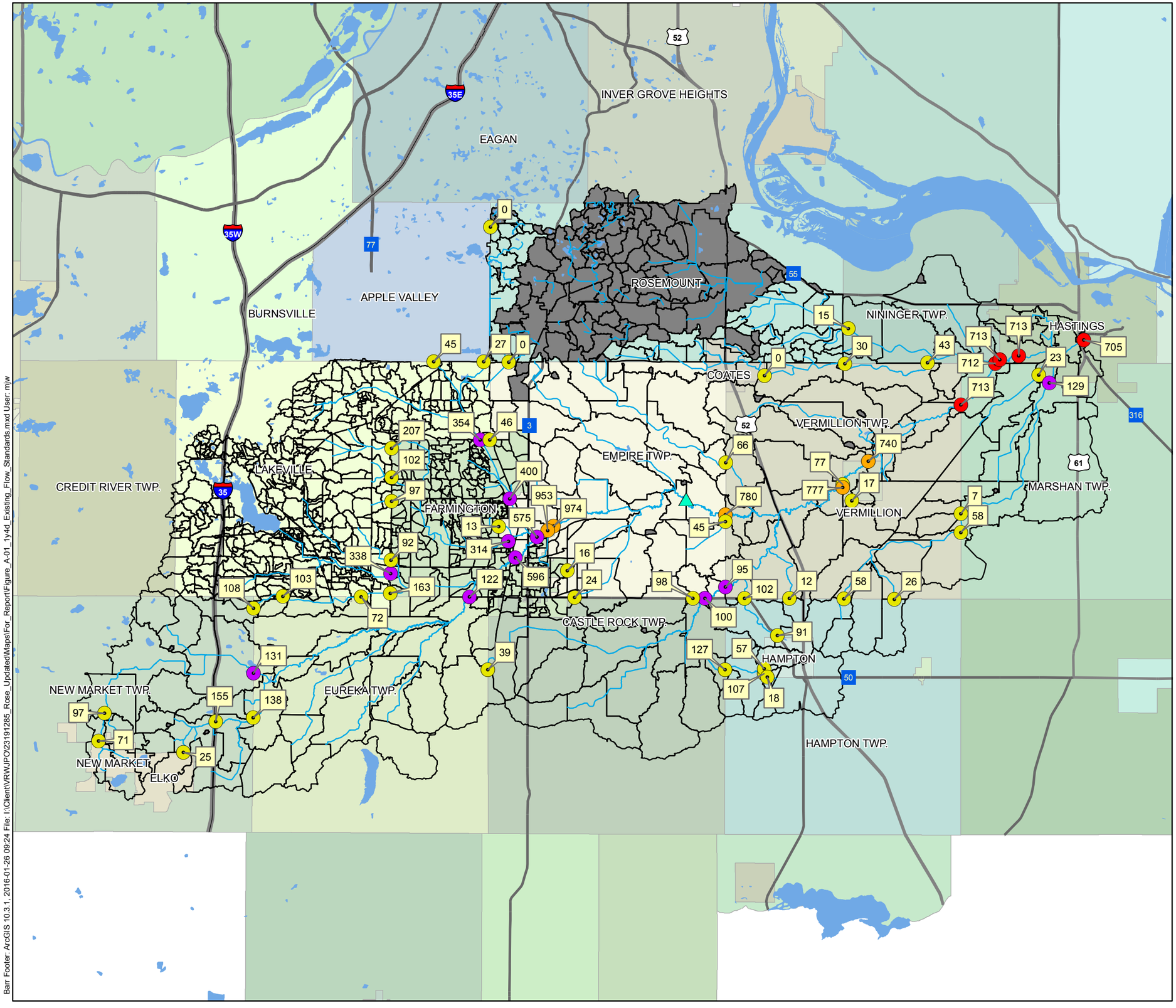
Appendix A

Community Flow and Volume Standards



Legend

Standard Locations

Tributary Drainage Area

- 0-10 square miles
- 10-67.5 square miles
- 67.5-170 square miles
- 170-225 square miles
- USGS Station (784 cfs)
- SWMM Links
- Subwatersheds
- Landlocked Subwatersheds*
- Lakes

Peak flow rates listed in units of cfs.

*Land locked area for 100-year, 4-day event. Other areas may be land locked during smaller events.

Community Boundaries Source:
Metropolitan Council, Updated as of 10/17/2014.

Miles
1 0 1 2

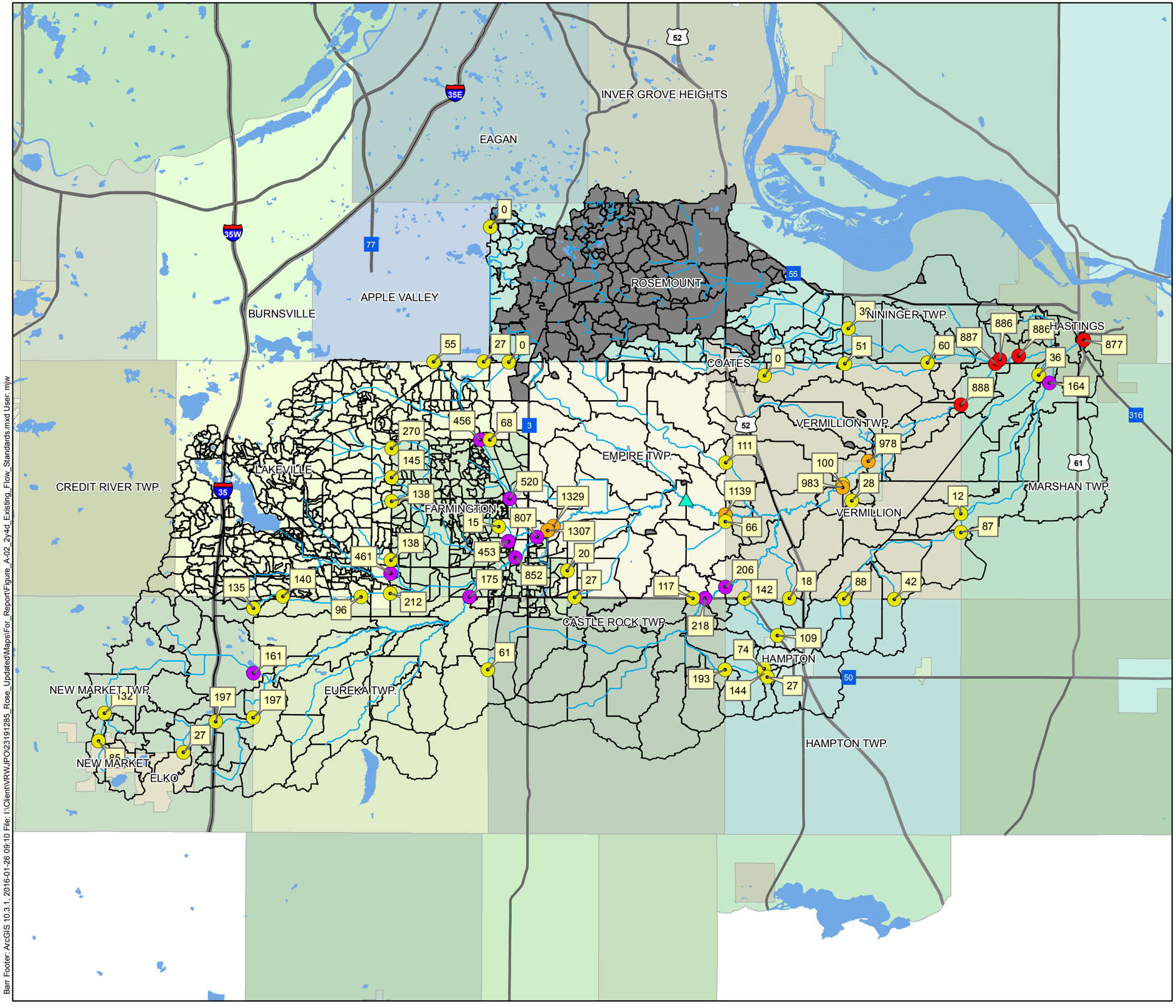
Kilometers
1 0 1 2 3 4

BARR

Figure A-1

COMMUNITY FLOW STANDARDS
1-Year, 4-Day Peak Flow
Vermillion River Watershed

Barr Footer: ArcGIS 10.3.1, 2016-01-26 09:24 File: I:\Client\VRWJPO\23191285_Rose_Updated\Maps\For_Report\Figure_A-01_1y4d_Existing_Flow_Standards.mxd User: mjw



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Standard Locations

Tributary Drainage Area

- 0-10 square miles
- 10-67.5 square miles
- 67.5-170 square miles
- 170-225 square miles
- USGS Station (1,155 cfs)
- SWMM Links
- Subwatersheds
- Landlocked Subwatersheds*
- Lakes

Peak flow rates listed in units of cfs.

*Land locked area for 100-year, 4-day event. Other areas may be land locked during smaller events.

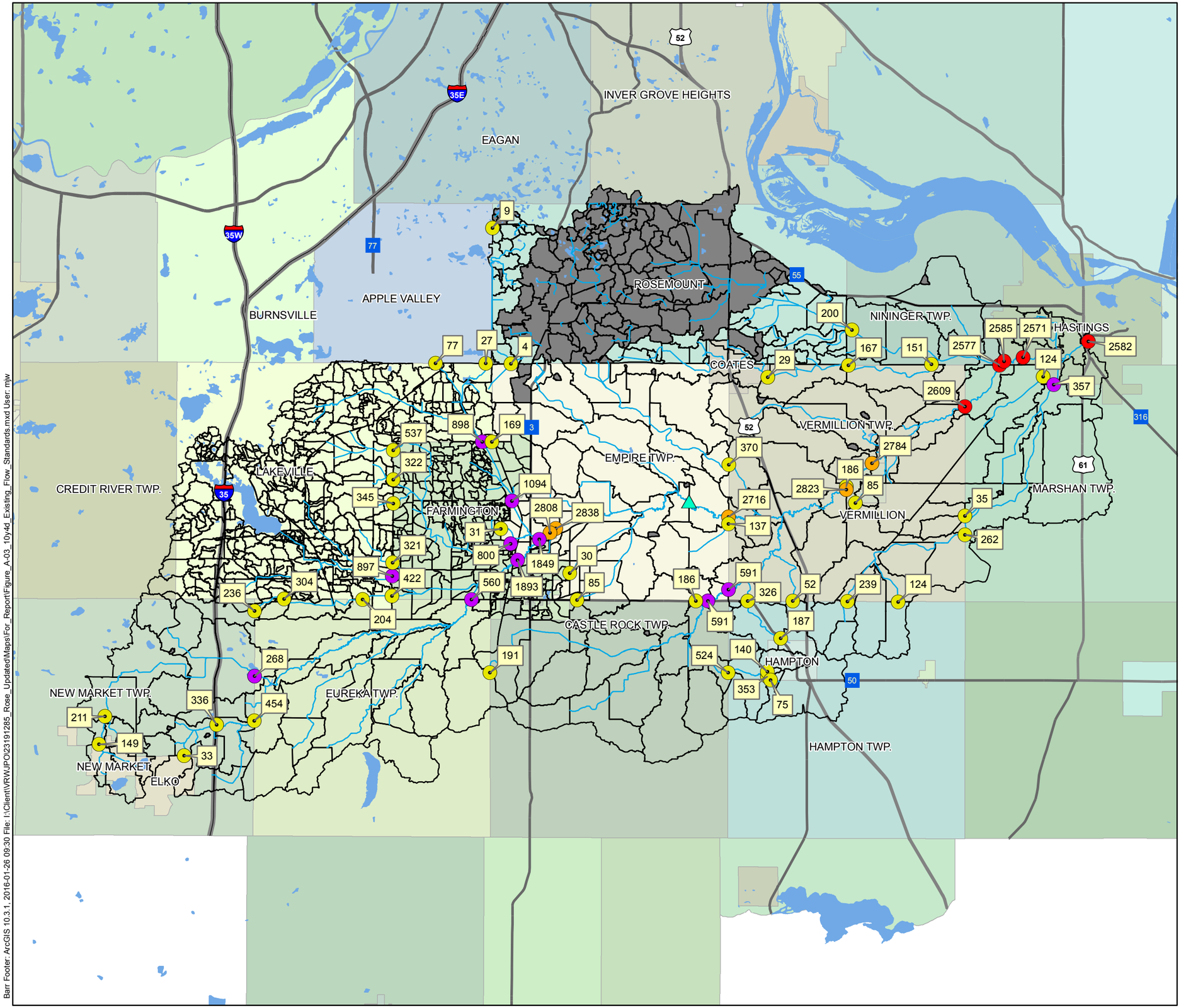
Community Boundaries Source:
Metropolitan Council, Updated as of 10/17/2014.

Miles
1 0 1 2

Kilometers
1 0 1 2 3 4

Figure A-2

COMMUNITY FLOW STANDARDS
2-Year, 4-Day Peak Flow
Vermillion River Watershed



Legend

Standard Locations

Tributary Drainage Area

- 0-10 square miles
- 10-67.5 square miles
- 67.5-170 square miles
- 170-225 square miles
- USGS Station (2,732 cfs)
- SWMM Links
- Subwatersheds
- Landlocked Subwatersheds*
- Lakes

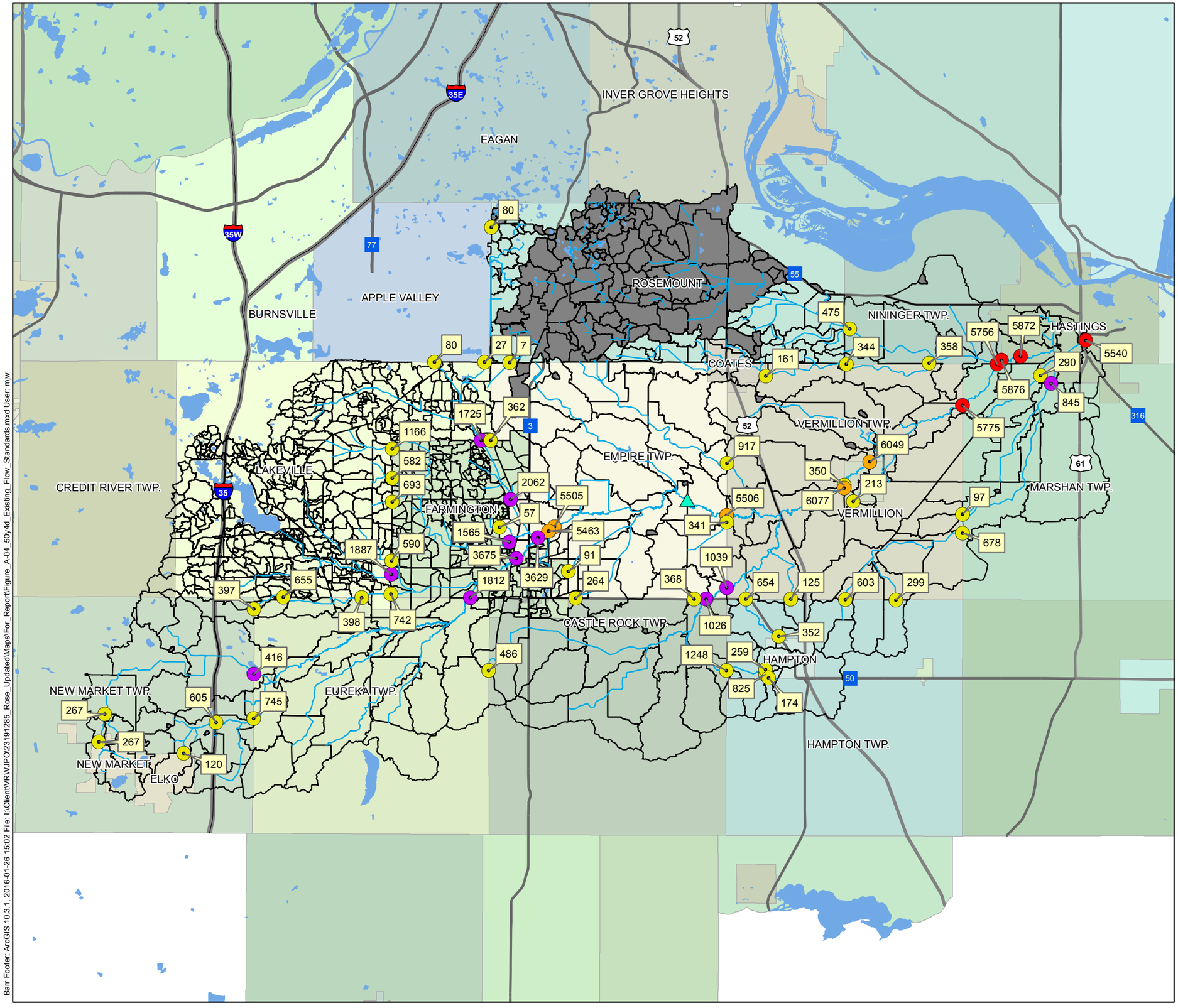
Peak flow rates listed in units of cfs.

*Land locked area for 100-year, 4-day event. Other areas may be land locked during smaller events.

Community Boundaries Source: Metropolitan Council, Updated as of 10/17/2014.

Figure A-3

COMMUNITY FLOW STANDARDS
10-Year, 4-Day Peak Flow
Vermillion River Watershed



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Standard Locations

Tributary Drainage Area

- 0-10 square miles
- 10-67.5 square miles
- 67.5-170 square miles
- 170-225 square miles
- USGS Station (5,531)
- SWMM Links
- Subwatersheds
- Landlocked Subwatersheds*
- Lakes

Peak flow rates listed in units of cfs.

*Land locked area for 100-year, 4-day event. Other areas may be land locked during smaller events.

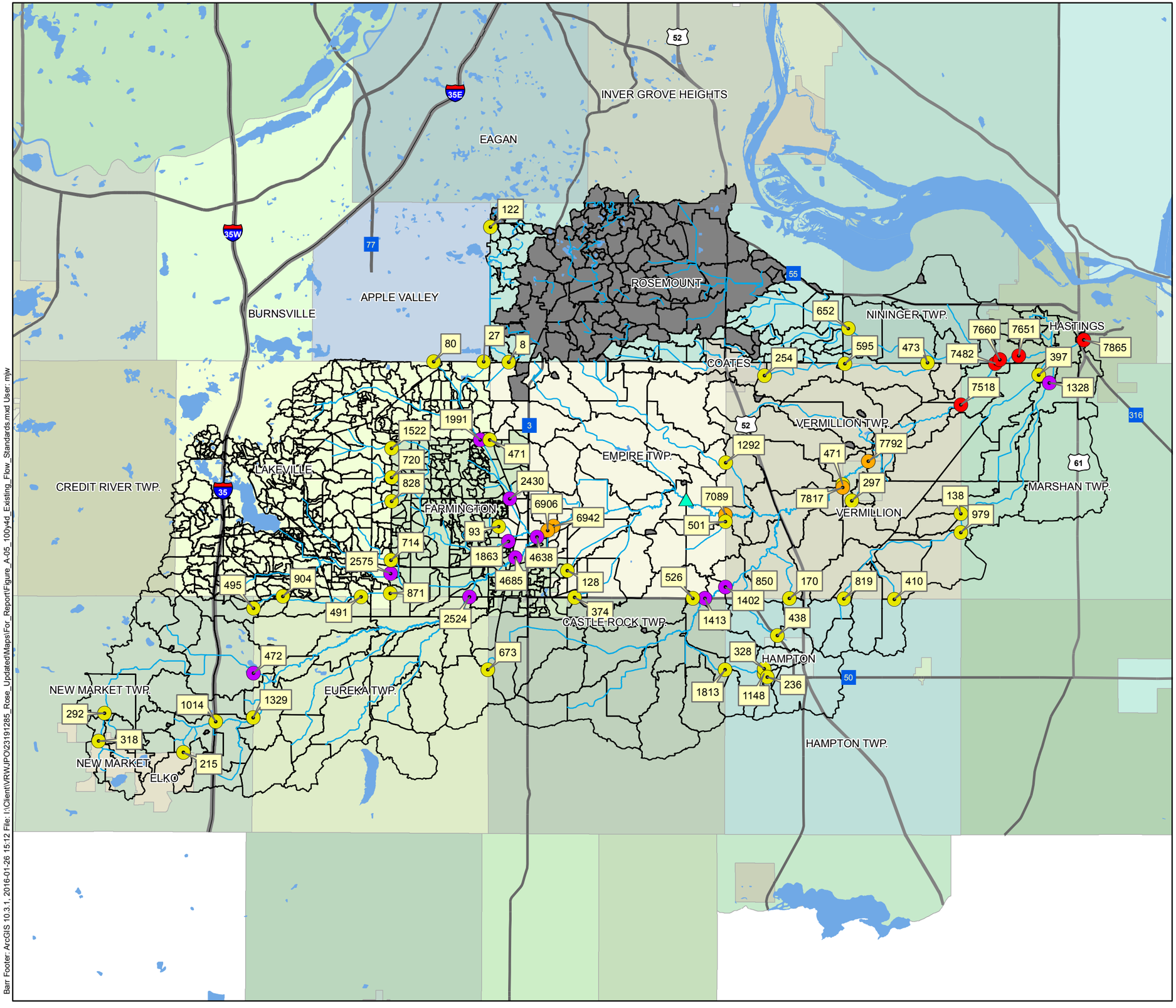
Community Boundaries Source:
Metropolitan Council, Updated as of 10/17/2014.

Miles
1 0 1 2

Kilometers
1 0 1 2 3 4

Figure A-4

COMMUNITY FLOW STANDARDS
50-Year, 4-Day Peak Flow
Vermillion River Watershed



Legend

Standard Locations

Tributary Drainage Area

- 0-10 square miles
- 10-67.5 square miles
- 67.5-170 square miles
- 170-225 square miles
- USGS Station (7,118 cfs)
- SWMM Links
- Subwatersheds
- Landlocked Subwatersheds
- Lakes

Peak flow rates listed in units of cfs.

*Land locked area for 100-year, 4-day event. Other areas may be land locked during smaller events.

Community Boundaries Source:
Metropolitan Council, Updated as of 10/17/2014.

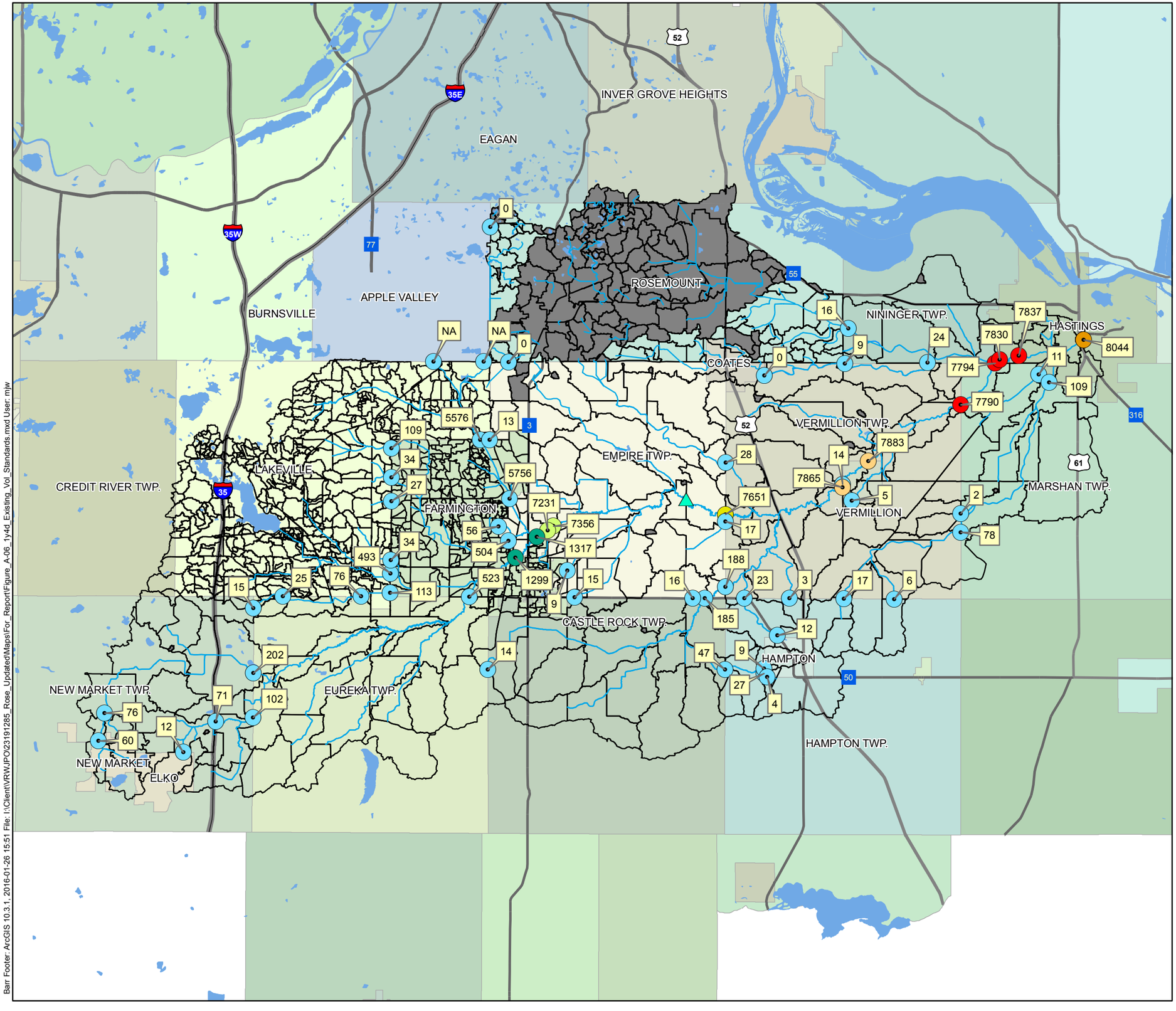
Miles

Kilometers

Figure A-5

COMMUNITY FLOW STANDARDS
100-Year, 4-Day Peak Flow
Vermillion River Watershed

Barr Footer: ArcGIS 10.3.1, 2016-01-26 15:12 File: I:\Client\VRWJPO\23191285_Rose_Updated\Maps\For_Report\Figure_A-05_100y4d_Existing_Flow_Standards.mxd User: mjw



Legend

Standard Locations

Baseflow

- 0 cfs
- 1 cfs
- 10 cfs
- 16 cfs
- 30 cfs
- 39 cfs
- 50 cfs
- 58 cfs
- USGS Station (1,746 ac-ft)

SWMM Links

Subwatersheds

Landlocked Subwatersheds*

Lakes

Runoff volumes listed in units of ac-ft.

*Land locked area for 100-year, 4-day event. Other areas may be land locked during smaller events.

Community Boundaries Source:
Metropolitan Council, Updated as of 10/17/2014.

N

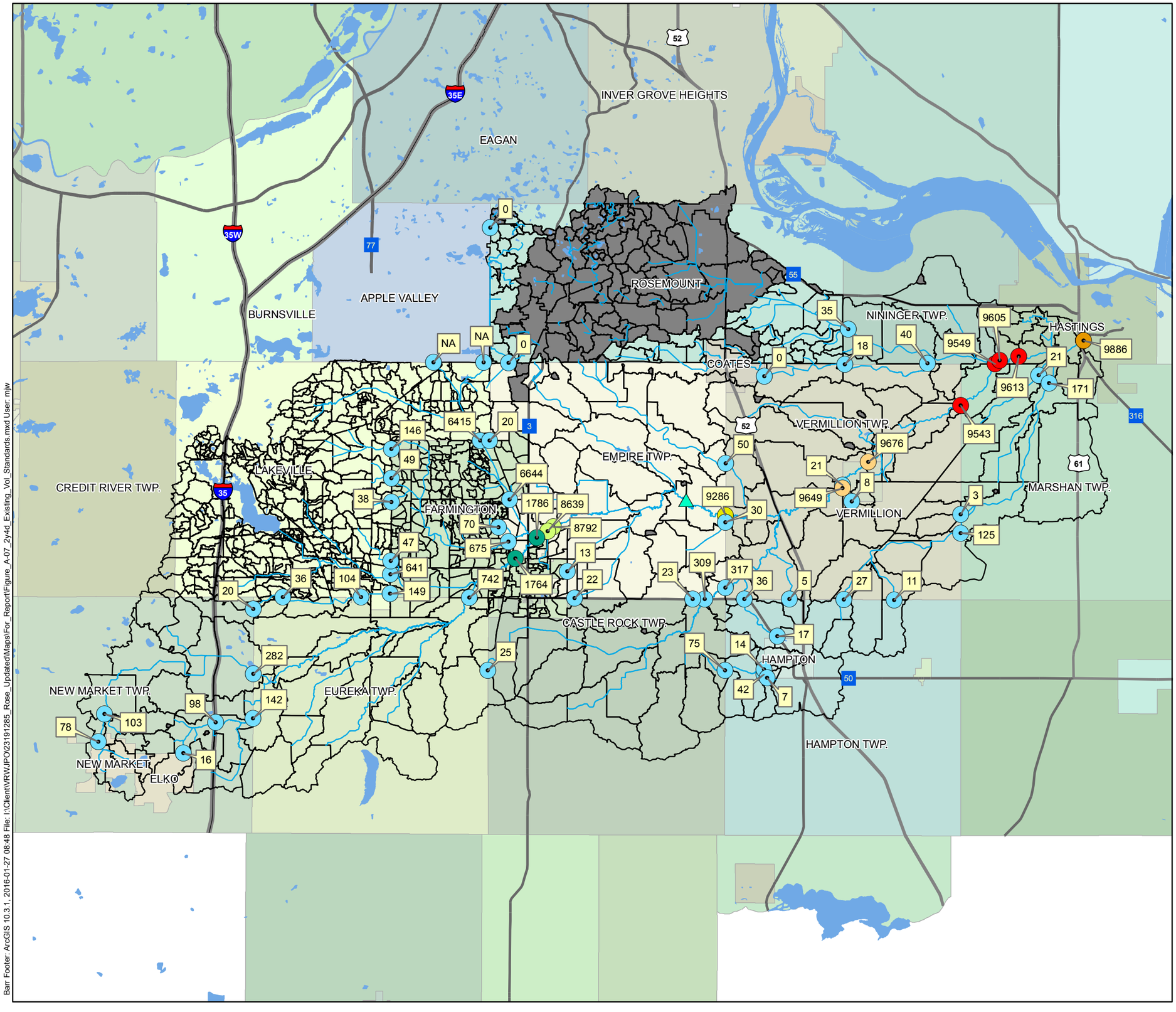
Miles
1 0 1 2

Kilometers
1 0 1 2 3 4

Figure A-6

COMMUNITY VOLUME STANDARDS
1-Year, 4-Day Runoff Volume
Vermillion River Watershed

Barr Footer: ArcGIS 10.3.1, 2016-01-26 15:51 File: I:\Client\VRWJPO\23191285_Rose_Updated\Maps\For_Report\Figure_A-06_1y4d_Existing_Vol_Standards.mxd User: mjw



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Legend

Standard Locations

Baseflow

- 0 cfs
- 1 cfs
- 10 cfs
- 16 cfs
- 30 cfs
- 39 cfs
- 50 cfs
- 58 cfs
- USGS Station (2,016 ac-ft)

SWMM Links

Subwatersheds

Landlocked Subwatersheds*

Lakes

Runoff volumes listed in units of ac-ft.

*Land locked area for 100-year, 4-day event. Other areas may be land locked during smaller events.

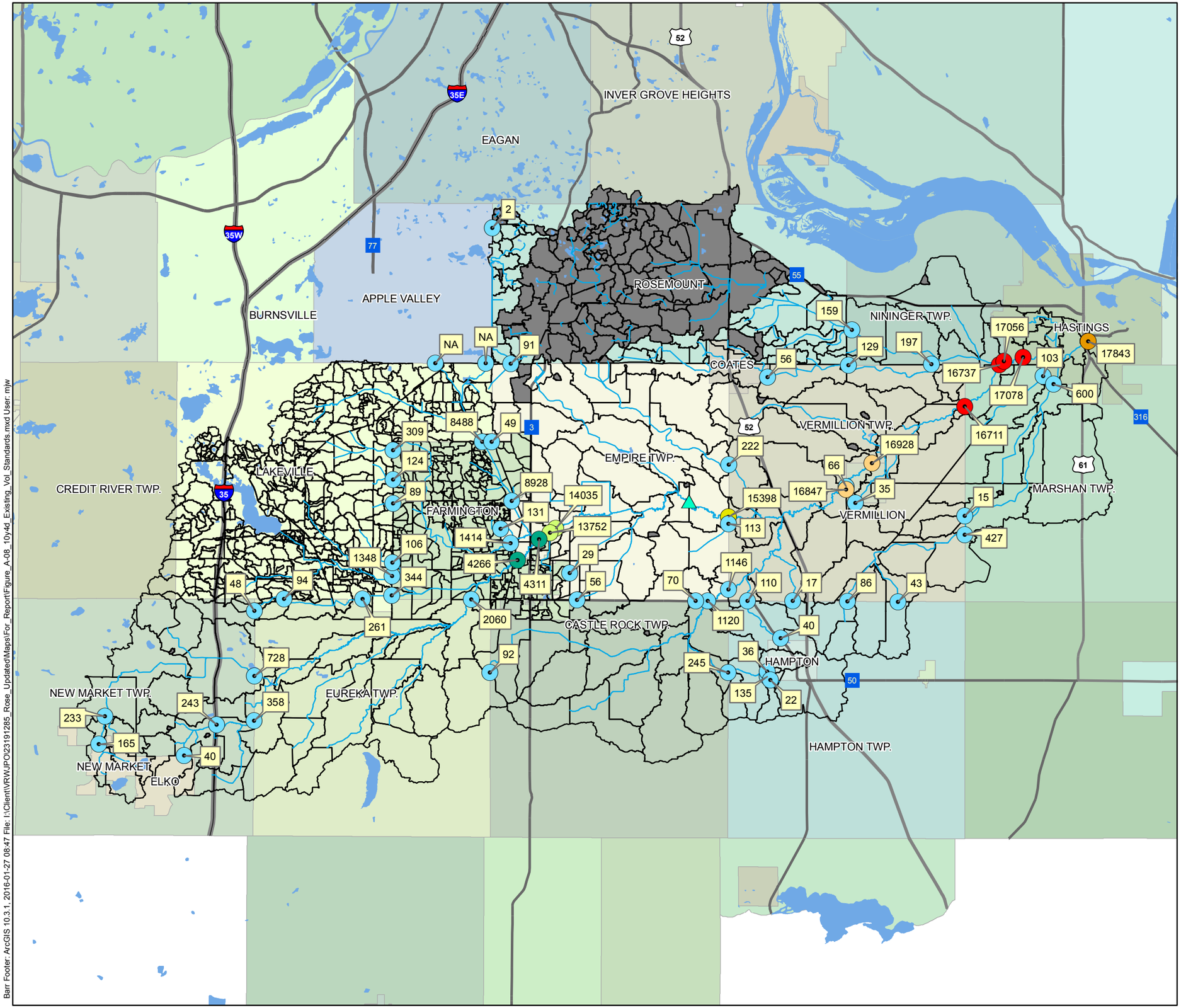
Community Boundaries Source:
Metropolitan Council, Updated as of 10/17/2014.

Miles
1 0 1 2

Kilometers
1 0 1 2 3 4

Figure A-7

COMMUNITY VOLUME STANDARDS
2-Year, 4-Day Runoff Volume
Vermillion River Watershed



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Legend

Standard Locations

Baseflow

- 0 cfs
- 1 cfs
- 10 cfs
- 16 cfs
- 30 cfs
- 39 cfs
- 50 cfs
- 58 cfs
- USGS Station (2,587 ac-ft)

SWMM Links

Subwatersheds

Landlocked Subwatersheds*

Lakes

Runoff volumes listed in units of ac-ft.

*Land locked area for 100-year, 4-day event. Other areas may be land locked during smaller events.

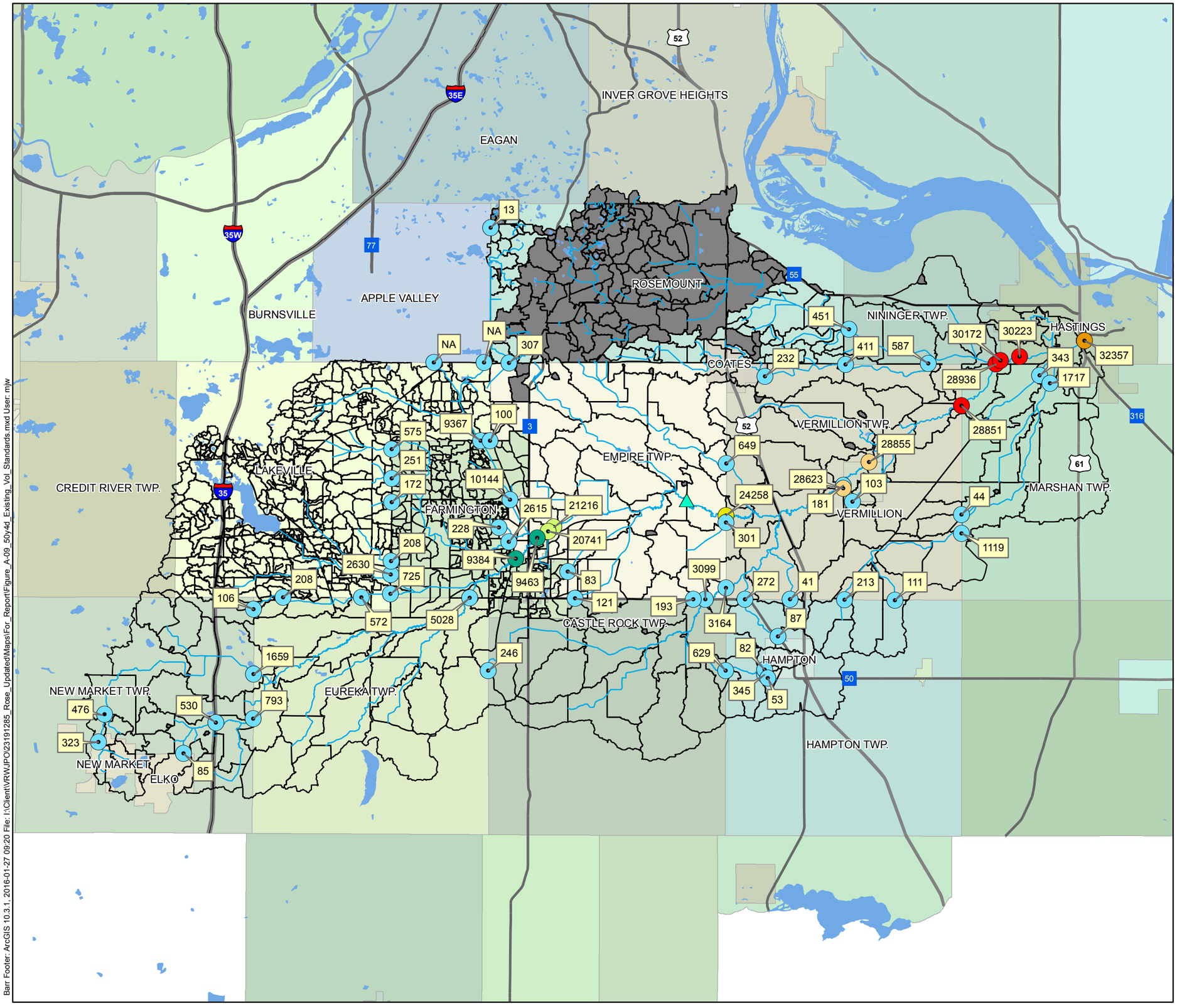
Community Boundaries Source:
Metropolitan Council, Updated as of 10/17/2014.

Miles
1 0 1 2

Kilometers
1 0 1 2 3 4

Figure A-8

COMMUNITY VOLUME STANDARDS
10-Year, 4-Day Runoff Volume
Vermillion River Watershed



Legend

Standard Locations

Baseflow

- 0 cfs
- 1 cfs
- 10 cfs
- 16 cfs
- 30 cfs
- 39 cfs
- 50 cfs
- 58 cfs
- USGS Station (2,715 ac-ft)
- SWMM Links
- Subwatersheds
- Landlocked Subwatersheds*
- Lakes

Runoff volumes listed in units of ac-ft.

*Land locked area for 100-year, 4-day event. Other areas may be land locked during smaller events.

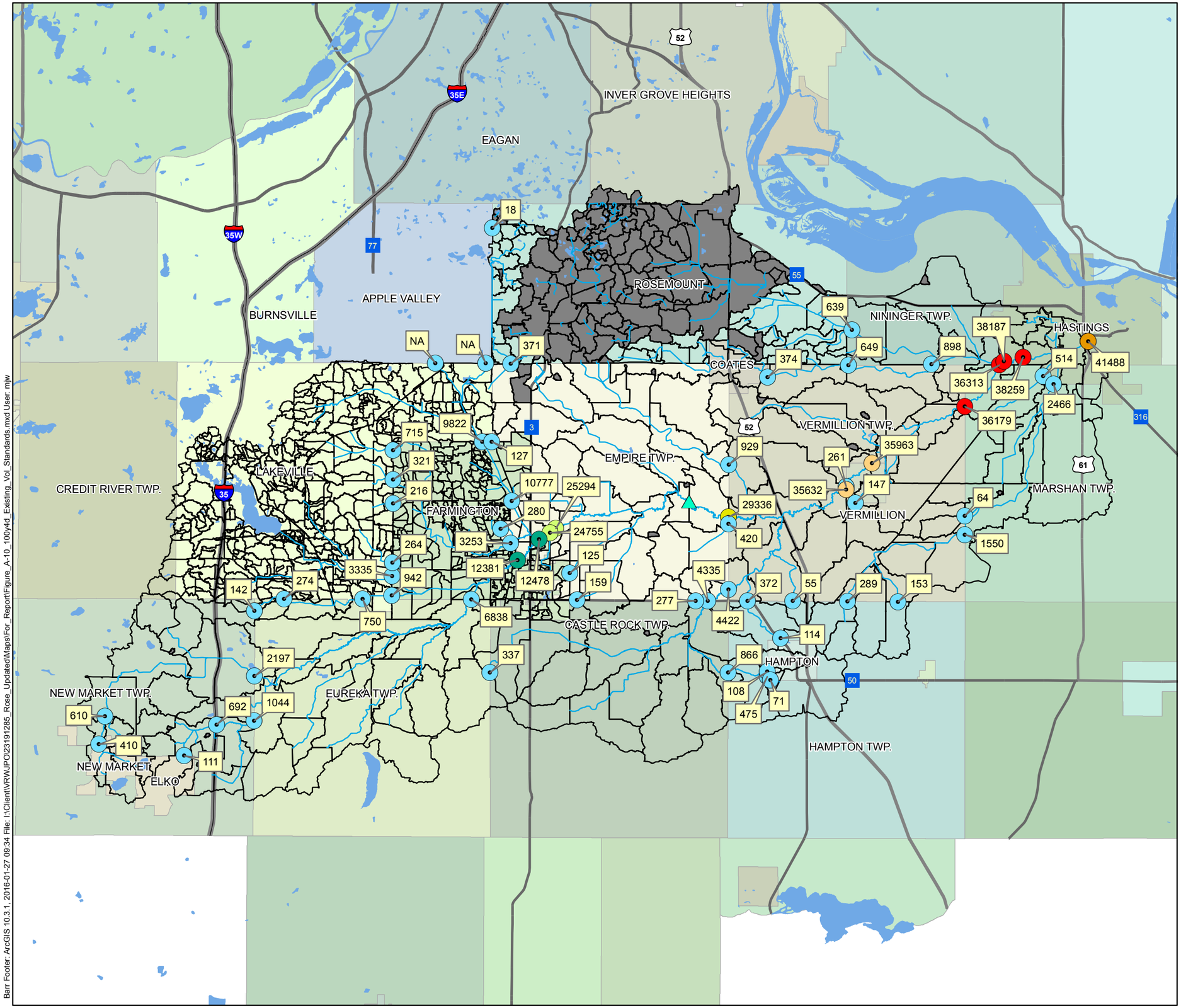
Community Boundaries Source:
Metropolitan Council, Updated as of 10/17/2014.

Miles
1 0 1 2

Kilometers
1 0 1 2 3 4

Figure A-9

COMMUNITY VOLUME STANDARDS
50-Year, 4-Day Runoff Volume
Vermillion River Watershed



Legend

Standard Locations

Baseflow

- 0 cfs
- 1 cfs
- 10 cfs
- 16 cfs
- 30 cfs
- 39 cfs
- 50 cfs
- 58 cfs
- USGS Station (2,785 ac-ft)
- SWMM Links
- Subwatersheds
- Landlocked Subwatersheds*
- Lakes

Runoff volumes listed in units of ac-ft.

*Land locked area for 100-year, 4-day event. Other areas may be land locked during smaller events.

Community Boundaries Source:
Metropolitan Council, Updated as of 10/17/2014.

Miles
1 0 1 2

Kilometers
1 0 1 2 3 4

Figure A-10

COMMUNITY VOLUME STANDARDS
100-Year, 4-Day Runoff Volume
Vermillion River Watershed

Table A-1 Peak Flow Rates at Standard Locations

XP-SWMM Node	XP-SWMM Link	Reach	Upstream Municipality	Downstream Municipality	Upstream Tributary Area (sq mi)	100-Year Peak Flow (cfs)[1]	50-Year Peak Flow (cfs)[1]	10-Year Peak Flow (cfs)[1]	2-Year Peak Flow (cfs)[1]	1-Year Peak Flow (cfs)[1]
N-1261	L-1442	County Ditch 12	New Market Twp.	Eureka Twp	12.1	472	416	268	161	131
CD12-8	L-1448	County Ditch 12	New Market	New Market Twp.	2.4	292	267	211	132	97
E SCreek-2	L-1351	East Branch South Creek	Lakeville	Farmington	0.9	714	590	321	138	92
MCreek-20	L-LMC-133	Middle Creek	Lakeville	Farmington	2.4	1,522	1,166	537	270	207
MCreek-1a	L-201	Middle Creek	Farmington	Empire Twp.	11.5	1,863	1,565	800	453	314
NBranch-2	L-1233	North Branch Vermillion River	Empire Twp.	Vermillion Twp.	6.2	1,292	917	370	111	66
NCreek-2	L-1580	North Creek	Farmington	Empire Twp.	23.3	2,430	2,062	1,094	520	400
NCreek-9	L-1584	North Creek	Lakeville	Farmington	19.7	1,991	1,725	898	456	354
SBranch-26	L-1121	South Branch Vermillion River	Erueka Twp.	Castle Rock Twp.	1.9	673	486	191	61	39
SBranch-9	L-1599	South Branch Vermillion River	Castle Rock Twp.	Empire Twp.	27.1	1,413	1,026	591	218	100
SBranch-8	L-305	South Branch Vermillion River	Empire Twp.	Vermillion Twp.	27.5	1,402	1,039	591	206	95
SCreek-2	L-830	South Creek	Lakeville	Farmington	15.5	2,575	1,887	897	461	338
Trib1-20	L-1022	Tributary 1	Hampton Twp.	Vermillion Twp.	1.5	819	603	239	88	58
Trib1-13	L-992	Tributary 1	Vermillion Twp.	Marshan Twp.	8.7	979	678	262	87	58
Trib1-3	L-979	Tributary 1	Marshan Twp.	Hastings	19.2	1,328	845	357	164	129
MCreek-3	L-202	Tributary 1 to Middle Creek	Farmington	Empire Twp.	0.8	93	57	31	15	13
NCreek-25 [3]	Link19	Tributary 1 to North Creek	Apple Valley	Lakeville	7.6	80	80	77	55	45
SBranch-5	L-1078	Tributary 1 to South Branch Vermillion River	Hampton	Hampton Twp.	0.5	438	352	187	109	91
SBranch-3	L-1072	Tributary 1 to South Branch Vermillion River	Hampton Twp.	Vermillion Twp.	2.0	850	654	326	142	102
SCreek-11	L-LSC-850	Tributary 1 to South Creek	New Market Twp.	Eureka Twp.	0.6	495	397	236	135	108
SCreek-10	L-LSC-803	Tributary 1 to South Creek	Lakeville	Eureka Twp.	1.2	904	655	304	140	103
SCreek-8	L-LSC-816	Tributary 1 to South Creek	Erueka Twp.	Lakeville	2.8	491	398	204	96	72
SCreek-6	L-1339	Tributary 1 to South Creek	Lakeville	Farmington	3.9	871	742	422	212	163
NCreek-24 [3]	L-1167	Tributary 1A to North Creek	Apple Valley	Lakeville	5.8	27	27	27	27	27
Trib1-12	L-392	Tributary 1C	Vermillion Twp.	Marshan Twp.	0.5	138	97	35	12	7
Trib1-2	L-1220	Tributary 1D	Marshan Twp.	Hastings	4.7	397	290	124	36	23
Trib1-18	L-378	Tributary 1E	Hampton Twp.	Vermillion Twp.	0.8	410	299	124	42	26
CD12-12	L-1623	Tributary 2 to County Ditch 12	New Market	New Market Twp.	1.6	318	267	149	85	71
SBranch-10	L-301	Tributary 2 to South Branch Vermillion River	Empire Twp.	Castle Rock Twp.	2.0	526	368	186	117	98
N-990	L-1103	Tributary 3 to South Branch Vermillion River	Hampton Twp.	Hampton	0.3	236	174	75	27	18
SBranch-14	L-294	Tributary 3 to South Branch Vermillion River	Hampton	Hampton Twp.	2.6	1,148	825	353	144	107
SBranch-13	L-1532	Tributary 3 to South Branch Vermillion River	Hampton Twp.	Castle Rock Twp.	4.7	1,813	1,248	524	193	127
SBranch-6	L-295	Tributary 3C to South Branch Vermillion River	Hampton	Hampton Twp.	0.5	328	259	140	74	57
NCreek-7	L-215	Tributary 4 to North Creek	Empire Twp.	Farmington	0.8	471	362	169	68	46
Trib6-6	L-1547	Tributary 6	Castle Rock Twp.	Empire Twp.	0.4	374	264	85	27	24
MCreek-18	L-LMC-119	Tributary 6 to Middle Creek	Lakeville	Farmington	1.2	720	582	322	145	102
SBranch-4	L-310	Tributary 6 to South Branch Vermillion River	Hampton Twp.	Vermillion Twp.	0.3	170	125	52	18	12

Table A-1 Peak Flow Rates at Standard Locations

XP-SWMM Node	XP-SWMM Link	Reach	Upstream Municipality	Downstream Municipality	Upstream Tributary Area (sq mi)	100-Year Peak Flow (cfs)[1]	50-Year Peak Flow (cfs)[1]	10-Year Peak Flow (cfs)[1]	2-Year Peak Flow (cfs)[1]	1-Year Peak Flow (cfs)[1]
Trib6-3	L-1675	Tributary 6A	Farmington	Empire Twp.	0.2	128	91	30	20	16
MCreek-15	L-LMC-135	Tributary 6A to Middle Creek	Lakeville	Farmington	0.8	828	693	345	138	97
TribC-10a	RL-305	Tributary C2	Coates	Vermillion Twp.	3.6	254	161	29	0	0
TribC-8	L-346	Tributary C2	Rosemount	Vermillion Twp.	5.6	595	344	167	51	30
TribC-5	L-352	Tributary C2	Vermillion Twp.	Nininger Twp.	3.9	473	358	151	60	43
VRTribF-14	L-322	Tributary F	Vermillion Twp.	Vermillion	1.0	297	213	85	28	17
VRTribG-16	L-320	Tributary G	Vermillion Twp.	Vermillion	1.9	471	350	186	100	77
VRTribH-22	L-257	Tributary H	Empire Twp.	Vermillion Twp.	2.5	501	341	137	66	45
VRTribR-47	L-1500	Tributary R	Elko	New Market Twp.	0.5	215	120	33	27	25
VR-45	L-1495	Vermillion River	Elko	New Market Twp.	3.0	1,014	605	336	197	155
VR-31	L-179	Vermillion River	Farmington	Empire Twp.	62.0	4,638	3,629	1,849	807	575
N-1288	L-1473	Vermillion River	New Market Twp.	Eureka Twp	4.6	1,329	745	454	197	138
VR-34	L-FVR298	Vermillion River	Eureka Twp.	Farmington	37.9	2,524	1,812	560	175	122
VR-32	L-1317	Vermillion River	Farmington	Empire Twp.	61.7	4,685	3,675	1,893	852	596
VR-30	L-225	Vermillion River	Empire Twp.	Farmington	98.5	6,906	5,463	2,808	1,307	953
VR-29	L-1302	Vermillion River	Farmington	Empire Twp.	100.7	6,942	5,505	2,838	1,329	974
VR-24	L-581	Vermillion River	Empire Twp.	Vermillion Twp.	119.2	7,089	5,506	2,716	1,139	780
VR-17	L-319	Vermillion River	Vermillion Twp.	Vermillion	166.7	7,817	6,077	2,823	983	777
VR-15	L-324	Vermillion River	Vermillion	Vermillion Twp.	169.3	7,792	6,049	2,784	978	740
VR-8	L-1039	Vermillion River	Vermillion Twp.	Marshan Twp.	178.3	7,518	5,775	2,609	888	713
VR-7	L-1034	Vermillion River	Marshan Twp.	Nininger Twp.	179.6	7,482	5,756	2,577	887	712
VR-6	L-1031	Vermillion River	Nininger Twp.	Hastings	197.5	7,660	5,876	2,585	886	713
VR-5	L-1029	Vermillion River	Nininger Twp.	Hastings	197.9	7,651	5,872	2,571	886	713
VR-1	WOMP	Vermillion River	Hastings	NA	225.3	7,865	5,540	2,582	877	705
R614	RL-352	Tributary 1A to North Creek	Rosemount	Empire Twp.	2.8	8	7	4	0	0
RN-264	RL-299	Tributary C	Rosemount	Nininger Twp.	3.3	652	475	200	39	15
R1341	OV-1341-2	Unnamed Reach	Rosemount	Apple Valley	0.1	122	80	9	0	0

[1] Calibrated flow rates are from the 4-day duration design event. Design events of shorter duration are nested within the 4-day distribution used to calculate peak flow rates.

[2] Standard location near Rosemount municipal boundary.

[3] Apple Valley flow rates are agreed on by Apple Valley, Lakeville, and the VRWJPO.

Table A-2 Peak Flow Rate Change at Standard Locations

XP-SWMM Node	XP-SWMM Link	Reach	Upstream Municipality	Downstream Municipality	Upstream Tributary Area (sq mi)	100-Year Peak Flow Change (cfs)[1,2]	50-Year Peak Flow Change (cfs)[1,2]	10-Year Peak Flow Change (cfs)[1,2]	2-Year Peak Flow Change (cfs)[1,2]	1-Year Peak Flow Change (cfs)[1,2]
N-1261	L-1442	County Ditch 12	New Market Twp.	Eureka Twp	12.1	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
CD12-8	L-1448	County Ditch 12	New Market	New Market Twp.	2.4	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
E SCreek-2	L-1351	East Branch South Creek	Lakeville	Farmington	0.9	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
MCreek-20	L-1595	Middle Creek	Lakeville	Farmington	2.4	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
MCreek-1a	L-201	Middle Creek	Farmington	Empire Twp.	11.5	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
NBranch-2	L-1233	North Branch Vermillion River	Empire Twp.	Vermillion Twp.	6.2	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
NCreek-2	L-1580	North Creek	Farmington	Empire Twp.	23.3	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
NCreek-9	L-1584	North Creek	Lakeville	Farmington	19.7	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SBranch-26	L-1121	South Branch Vermillion River	Eureka Twp.	Castle Rock Twp.	1.9	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SBranch-9	L-1599	South Branch Vermillion River	Castle Rock Twp.	Empire Twp.	27.1	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SBranch-8	L-305	South Branch Vermillion River	Empire Twp.	Vermillion Twp.	27.5	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SCreek-2	L-830	South Creek	Lakeville	Farmington	15.5	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Trib1-20	L-1022	Tributary 1	Hampton Twp.	Vermillion Twp.	1.5	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Trib1-13	L-992	Tributary 1	Vermillion Twp.	Marshan Twp.	8.7	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Trib1-3	L-979	Tributary 1	Marshan Twp.	Hastings	19.2	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
MCreek-3	L-202	Tributary 1 to Middle Creek	Farmington	Empire Twp.	0.8	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
NCreek-25 [4]	Link19	Tributary 1 to North Creek	Apple Valley	Lakeville	7.6	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SBranch-5	L-1078	Tributary 1 to South Branch Vermillion River	Hampton	Hampton Twp.	0.5	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SBranch-3	L-1072	Tributary 1 to South Branch Vermillion River	Hampton Twp.	Vermillion Twp.	2.0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SCreek-11	L-131	Tributary 1 to South Creek	New Market Twp.	Eureka Twp.	0.6	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SCreek-10	L-1345	Tributary 1 to South Creek	Lakeville	Eureka Twp.	1.2	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SCreek-8	L-1344	Tributary 1 to South Creek	Eureka Twp.	Lakeville	2.8	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SCreek-6	L-1339	Tributary 1 to South Creek	Lakeville	Farmington	3.9	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
NCreek-24 [4]	L-1167	Tributary 1A to North Creek	Apple Valley	Lakeville	5.8	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Trib1-12	L-392	Tributary 1C	Vermillion Twp.	Marshan Twp.	0.5	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Trib1-2	L-1220	Tributary 1D	Marshan Twp.	Hastings	4.7	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Trib1-18	L-378	Tributary 1E	Hampton Twp.	Vermillion Twp.	0.8	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
CD12-12	L-1623	Tributary 2 to County Ditch 12	New Market	New Market Twp.	1.6	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SBranch-10	L-301	Tributary 2 to South Branch Vermillion River	Empire Twp.	Castle Rock Twp.	2.0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
N-990	L-1103	Tributary 3 to South Branch Vermillion River	Hampton Twp.	Hampton	0.3	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SBranch-14	L-294	Tributary 3 to South Branch Vermillion River	Hampton	Hampton Twp.	2.6	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SBranch-13	L-1532	Tributary 3 to South Branch Vermillion River	Hampton Twp.	Castle Rock Twp.	4.7	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SBranch-6	L-295	Tributary 3C to South Branch Vermillion River	Hampton	Hampton Twp.	0.5	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
NCreek-7	L-215	Tributary 4 to North Creek	Empire Twp.	Farmington	0.8	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Trib6-6	L-1547	Tributary 6	Castle Rock Twp.	Empire Twp.	0.4	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
MCreek-18	L-1200	Tributary 6 to Middle Creek	Lakeville	Farmington	1.2	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SBranch-4	L-310	Tributary 6 to South Branch Vermillion River	Hampton Twp.	Vermillion Twp.	0.3	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Table A-2 Peak Flow Rate Change at Standard Locations

XP-SWMM Node	XP-SWMM Link	Reach	Upstream Municipality	Downstream Municipality	Upstream Tributary Area (sq mi)	100-Year Peak Flow Change (cfs)[1,2]	50-Year Peak Flow Change (cfs)[1,2]	10-Year Peak Flow Change (cfs)[1,2]	2-Year Peak Flow Change (cfs)[1,2]	1-Year Peak Flow Change (cfs)[1,2]
Trib6-3	L-1675	Tributary 6A	Farmington	Empire Twp.	0.2	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
MCreek-15	L-1589	Tributary 6A to Middle Creek	Lakeville	Farmington	0.8	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
TribC-10a	L-340	Tributary C2	Coates	Vermillion Twp.	3.6	-455 (-64%)	-358 (-69%)	-217 (-88%)	-128 (-100%)	-100 (-100%)
TribC-8	L-346	Tributary C2	Rosemount	Vermillion Twp.	5.6	-671 (-53%)	-538 (-61%)	-148 (-47%)	-69 (-57%)	-59 (-66%)
TribC-5	L-352	Tributary C2	Vermillion Twp.	Nininger Twp.	3.9	-200 (-30%)	-102 (-22%)	-109 (-42%)	-7 (-10%)	-6 (-13%)
VRTribF-14	L-322	Tributary F	Vermillion Twp.	Vermillion	1.0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
VRTribG-16	L-320	Tributary G	Vermillion Twp.	Vermillion	1.9	-1 (0%)	0 (0%)	1 (0%)	0 (0%)	0 (0%)
VRTribH-22	L-257	Tributary H	Empire Twp.	Vermillion Twp.	2.5	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
VRTribR-47	L-1500	Tributary R	Elko	New Market Twp.	0.5	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
VR-45	L-1495	Vermillion River	Elko	New Market Twp.	3.0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
VR-31	L-179	Vermillion River	Farmington	Empire Twp.	62.0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
N-1288	L-1473	Vermillion River	New Market Twp.	Eureka Twp	4.6	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
VR-34	L-1413	Vermillion River	Eureka Twp.	Farmington	37.9	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
VR-32	L-1317	Vermillion River	Farmington	Empire Twp.	61.7	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
VR-30	L-225	Vermillion River	Empire Twp.	Farmington	98.5	-1 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
VR-29	L-1302	Vermillion River	Farmington	Empire Twp.	100.7	-1 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
VR-24	L-581	Vermillion River	Empire Twp.	Vermillion Twp.	119.2	-6 (0%)	-2 (0%)	0 (0%)	0 (0%)	0 (0%)
VR-17	L-319	Vermillion River	Vermillion Twp.	Vermillion	166.7	-9 (0%)	-5 (0%)	-3 (0%)	-2 (0%)	0 (0%)
VR-15	L-324	Vermillion River	Vermillion	Vermillion Twp.	169.3	-10 (0%)	-5 (0%)	-3 (0%)	-1 (0%)	0 (0%)
VR-8	L-1039	Vermillion River	Vermillion Twp.	Marshan Twp.	178.3	-10 (0%)	-6 (0%)	41 (2%)	-4 (0%)	0 (0%)
VR-7	L-1034	Vermillion River	Marshan Twp.	Nininger Twp.	179.6	-13 (0%)	-6 (0%)	40 (2%)	-5 (-1%)	0 (0%)
VR-6	L-1031	Vermillion River	Nininger Twp.	Hastings	197.5	86 (1%)	77 (1%)	42 (2%)	-7 (-1%)	-2 (0%)
VR-5	L-1029	Vermillion River	Nininger Twp.	Hastings	197.9	85 (1%)	77 (1%)	29 (1%)	-7 (-1%)	-2 (0%)
VR-1	WOMP	Vermillion River	Hastings	NA	225.3	46 (1%)	-18 (0%)	16 (1%)	-7 (-1%)	-2 (0%)
R614	RL-352	Tributary 1A to North Creek	Rosemount	Empire Twp.	2.8	NA	NA	NA	NA	NA
RN-264	RL-299	Tributary C	Rosemount	Nininger Twp.	3.3	NA	NA	NA	NA	NA
R1341	OV-1341-2	Unnamed Reach	Rosemount	Apple Valley	0.1	NA	NA	NA	NA	NA

[1] Calibrated flow rates are from the 4-day duration design event. Design events of smaller duration are nested within the 4-day distribution used to calculate peak flow rates.

[2] Change in flow rate calculated as (2015 Updated Model - 2014 Model). Percent change calculated as (2015 Model - 2014 Model)/(2014 Model).

[3] Standard location near Rosemount municipal boundary.

[4] Apple Valley flow rates are agreed on by Apple Valley, Lakeville, and the VRWJPO. Inflows were not adjusted as part of the update.

Table A-3 Total Runoff Volume at Standard Locations

XP-SWMM Node	XP-SWMM Link	Reach	Upstream Municipality	Downstream Municipality	Baseflow (cfs)	100-Year Volume (ac-ft)[1]	50-Year Volume (ac-ft)[1]	10-Year Volume (ac-ft)[1]	2-Year Volume (ac-ft)	1-Year Volume (ac-ft)
N-1261	L-1442	County Ditch 12	New Market Twp.	Eureka Twp	0	2,197	1,659	728	282	202
CD12-8	L-1448	County Ditch 12	New Market	New Market Twp.	0	610	476	233	103	76
E SCreek-2	L-1351	East Branch South Creek	Lakeville	Farmington	0	264	208	106	47	34
MCreek-20	L-LMC-133	Middle Creek	Lakeville	Farmington	0	715	575	309	146	109
MCreek-1a	L-201	Middle Creek	Farmington	Empire Twp.	0	3,253	2,615	1,414	675	504
NBranch-2	L-1233	North Branch Vermillion River	Empire Twp.	Vermillion Twp.	0	929	649	222	50	28
NCreek-2	L-1580	North Creek	Farmington	Empire Twp.	0	10,777	10,144	8,928	6,644	5,756
NCreek-9	L-1584	North Creek	Lakeville	Farmington	0	9,822	9,367	8,488	6,415	5,576
SBranch-26	L-1121	South Branch Vermillion River	Erueka Twp.	Castle Rock Twp.	0	337	246	92	25	14
SBranch-9	L-1599	South Branch Vermillion River	Castle Rock Twp.	Empire Twp.	0	4,335	3,099	1,120	309	185
SBranch-8	L-305	South Branch Vermillion River	Empire Twp.	Vermillion Twp.	0	4,422	3,164	1,146	317	188
SCreek-2	L-830	South Creek	Lakeville	Farmington	0	3,335	2,630	1,348	641	493
Trib1-20	L-1022	Tributary 1	Hampton Twp.	Vermillion Twp.	0	289	213	86	27	17
Trib1-13	L-992	Tributary 1	Vermillion Twp.	Marshan Twp.	0	1,550	1,119	427	125	78
Trib1-3	L-979	Tributary 1	Marshan Twp.	Hastings	0	2,466	1,717	600	171	109
MCreek-3	L-202	Tributary 1 to Middle Creek	Farmington	Empire Twp.	0	280	228	131	70	56
NCreek-25[3]	Link19	Tributary 1 to North Creek	Apple Valley	Empire Twp.	0	NA	NA	NA	NA	NA
SBranch-5	L-1078	Tributary 1 to South Branch Vermillion River	Hampton	Hampton Twp.	0	114	87	40	17	12
SBranch-3	L-1072	Tributary 1 to South Branch Vermillion River	Hampton Twp.	Vermillion Twp.	0	372	272	110	36	23
SCreek-11	L-LSC-850	Tributary 1 to South Creek	New Market Twp.	Eureka Twp.	0	142	106	48	20	15
SCreek-10	L-LSC-803	Tributary 1 to South Creek	Lakeville	Eureka Twp.	0	274	208	94	36	25
SCreek-8	L-LSC-816	Tributary 1 to South Creek	Erueka Twp.	Lakeville	0	750	572	261	104	76
SCreek-6	L-1339	Tributary 1 to South Creek	Lakeville	Farmington	0	942	725	344	149	113
NCreek-24[3]	L-1167	Tributary 1A to North Creek	Apple Valley	Lakeville	0	NA	NA	NA	NA	NA
Trib1-12	L-392	Tributary 1C	Vermillion Twp.	Marshan Twp.	0	64	44	15	3	2
Trib1-2	L-1220	Tributary 1D	Marshan Twp.	Hastings	0	514	343	103	21	11
Trib1-18	L-378	Tributary 1E	Hampton Twp.	Vermillion Twp.	0	153	111	43	11	6
CD12-12	L-1623	Tributary 2 to County Ditch 12	New Market	New Market Twp.	0	410	323	165	78	60
SBranch-10	L-301	Tributary 2 to South Branch Vermillion River	Empire Twp.	Castle Rock Twp.	0	277	193	70	23	16
N-990	L-1103	Tributary 3 to South Branch Vermillion River	Hampton Twp.	Hampton	0	71	53	22	7	4
SBranch-14	L-294	Tributary 3 to South Branch Vermillion River	Hampton	Hampton Twp.	0	475	345	135	42	27
SBranch-13	L-1532	Tributary 3 to South Branch Vermillion River	Hampton Twp.	Castle Rock Twp.	0	866	629	245	75	47
SBranch-6	L-295	Tributary 3C to South Branch Vermillion River	Hampton	Hampton Twp.	0	108	82	36	14	9
NCreek-7	L-215	Tributary 4 to North Creek	Empire Twp.	Farmington	0	127	100	49	20	13
Trib6-6	L-1547	Tributary 6	Castle Rock Twp.	Empire Twp.	0	159	121	56	22	15
MCreek-18	L-LMC-119	Tributary 6 to Middle Creek	Lakeville	Farmington	0	321	251	124	49	34
SBranch-4	L-310	Tributary 6 to South Branch Vermillion River	Hampton Twp.	Vermillion Twp.	0	55	41	17	5	3

Table A-3 Total Runoff Volume at Standard Locations

XP-SWMM Node	XP-SWMM Link	Reach	Upstream Municipality	Downstream Municipality	Baseflow (cfs)	100-Year Volume (ac-ft)[1]	50-Year Volume (ac-ft)[1]	10-Year Volume (ac-ft)[1]	2-Year Volume (ac-ft)	1-Year Volume (ac-ft)
Trib6-3	L-1675	Tributary 6A	Farmington	Empire Twp.	0	125	83	29	13	9
MCreek-15	L-LMC-135	Tributary 6A to Middle Creek	Lakeville	Farmington	0	216	172	89	38	27
TribC-10a	RL-305	Tributary C2	Coates	Vermillion Twp.	0	374	232	56	0	0
TribC-8	L-346	Tributary C2	Rosemount	Vermillion Twp.	0	649	411	129	18	9
TribC-5	L-352	Tributary C2	Vermillion Twp.	Nininger Twp.	0	898	587	197	40	24
VRTribF-14	L-322	Tributary F	Vermillion Twp.	Vermillion	0	147	103	35	8	5
VRTribG-16	L-320	Tributary G	Vermillion Twp.	Vermillion	0	261	181	66	21	14
VRTribH-22	L-257	Tributary H	Empire Twp.	Vermillion Twp.	0	420	301	113	30	17
VRTribR-47	L-1500	Tributary R	Elko	New Market Twp.	0	111	85	40	16	12
VR-45	L-1495	Vermillion River	Elko	New Market Twp.	0	692	530	243	98	71
VR-31	L-179	Vermillion River	Farmington	Empire Twp.	10	12,478	9,463	4,311	1,786	1,317
N-1288	L-1473	Vermillion River	New Market Twp.	Eureka Twp	0	1,044	793	358	142	102
VR-34	L-FVR298	Vermillion River	Eureka Twp.	Farmington	1	6,838	5,028	2,060	742	523
VR-32	L-1317	Vermillion River	Farmington	Empire Twp.	10	12,381	9,384	4,266	1,764	1,299
VR-30	L-225	Vermillion River	Empire Twp.	Farmington	16	24,755	20,741	13,752	8,639	7,231
VR-29	L-1302	Vermillion River	Farmington	Empire Twp.	16	25,294	21,216	14,035	8,792	7,356
VR-24	L-581	Vermillion River	Empire Twp.	Vermillion Twp.	30	29,336	24,258	15,398	9,286	7,651
VR-17	L-319	Vermillion River	Vermillion Twp.	Vermillion	39	35,632	28,623	16,847	9,649	7,865
VR-15	L-324	Vermillion River	Vermillion	Vermillion Twp.	39	35,963	28,855	16,928	9,676	7,883
VR-8	L-1039	Vermillion River	Vermillion Twp.	Marshan Twp.	58	36,179	28,851	16,711	9,543	7,790
VR-7	L-1034	Vermillion River	Marshan Twp.	Nininger Twp.	58	36,313	28,936	16,737	9,549	7,794
VR-6	L-1031	Vermillion River	Nininger Twp.	Hastings	58	38,187	30,172	17,056	9,605	7,830
VR-5	L-1029	Vermillion River	Nininger Twp.	Hastings	58	38,259	30,223	17,078	9,613	7,837
VR-1	WOMP	Vermillion River	Hastings	NA	58	41,488	32,357	17,843	9,886	8,044
R614	RL-352	Tributary 1A to North Creek	Rosemount	Empire Twp.	0	371	307	91	0	0
RN-264	RL-299	Tributary C	Rosemount	Nininger Twp.	0	639	451	159	35	16
R1341	OV-1341-2	Unnamed Reach	Rosemount	Apple Valley	0	18	13	2	0	0

[1] Total volume is the runoff volume generated by the design event only; base flow is not included in the total volume calculation. See the 2010 VRWJPO report (Appendix G) for further discussion of volume calculations.

[2] Standard location near Rosemount municipal boundary.

[3] Apple Valley flow rates are agreed on by Apple Valley, Lakeville, and the VRWJPO. Inflows were not adjusted as part of the update.

Table A-4 Total Runoff Volume Change at Standard Locations

XP-SWMM Node	XP-SWMM Link	Reach	Upstream Municipality	Downstream Municipality	Baseflow (cfs)	100-Year Volume Change (ac-ft)[1]	50-Year Volume Change (ac-ft)[1]	10-Year Volume Change (ac-ft)[1]	2-Year Volume Change (ac-ft)	1-Year Volume Change (ac-ft)
N-1261	L-1442	County Ditch 12	New Market Twp.	Eureka Twp	0	1 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
CD12-8	L-1448	County Ditch 12	New Market	New Market Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
E SCreek-2	L-1351	East Branch South Creek	Lakeville	Farmington	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
MCreek-20	L-LMC-133	Middle Creek	Lakeville	Farmington	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
MCreek-1a	L-201	Middle Creek	Farmington	Empire Twp.	0	0 (0%)	2 (0%)	0 (0%)	0 (0%)	0 (0%)
NBranch-2	L-1233	North Branch Vermillion River	Empire Twp.	Vermillion Twp.	0	-20 (-2%)	-17 (-3%)	-14 (-6%)	-9 (-15%)	-5 (-14%)
NCreek-2	L-1580	North Creek	Farmington	Empire Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
NCreek-9	L-1584	North Creek	Lakeville	Farmington	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SBranch-26	L-1121	South Branch Vermillion River	Erueka Twp.	Castle Rock Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SBranch-9	L-1599	South Branch Vermillion River	Castle Rock Twp.	Empire Twp.	0	1 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SBranch-8	L-305	South Branch Vermillion River	Empire Twp.	Vermillion Twp.	0	1 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SCreek-2	L-830	South Creek	Lakeville	Farmington	0	-3 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Trib1-20	L-1022	Tributary 1	Hampton Twp.	Vermillion Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Trib1-13	L-992	Tributary 1	Vermillion Twp.	Marshan Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Trib1-3	L-979	Tributary 1	Marshan Twp.	Hastings	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
MCreek-3	L-202	Tributary 1 to Middle Creek	Farmington	Empire Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
NCreek-25[4]	Link19	Tributary 1 to North Creek	Apple Valley	Empire Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SBranch-5	L-1078	Tributary 1 to South Branch Vermillion River	Hampton	Hampton Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (-1%)	0 (0%)
SBranch-3	L-1072	Tributary 1 to South Branch Vermillion River	Hampton Twp.	Vermillion Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SCreek-11	L-LSC-850	Tributary 1 to South Creek	New Market Twp.	Eureka Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SCreek-10	L-LSC-803	Tributary 1 to South Creek	Lakeville	Eureka Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SCreek-8	L-LSC-816	Tributary 1 to South Creek	Erueka Twp.	Lakeville	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SCreek-6	L-1339	Tributary 1 to South Creek	Lakeville	Farmington	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
NCreek-24[4]	L-1167	Tributary 1A to North Creek	Apple Valley	Lakeville	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Trib1-12	L-392	Tributary 1C	Vermillion Twp.	Marshan Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (1%)
Trib1-2	L-1220	Tributary 1D	Marshan Twp.	Hastings	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Trib1-18	L-378	Tributary 1E	Hampton Twp.	Vermillion Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
CD12-12	L-1623	Tributary 2 to County Ditch 12	New Market	New Market Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SBranch-10	L-301	Tributary 2 to South Branch Vermillion River	Empire Twp.	Castle Rock Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
N-990	L-1103	Tributary 3 to South Branch Vermillion River	Hampton Twp.	Hampton	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SBranch-14	L-294	Tributary 3 to South Branch Vermillion River	Hampton	Hampton Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SBranch-13	L-1532	Tributary 3 to South Branch Vermillion River	Hampton Twp.	Castle Rock Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SBranch-6	L-295	Tributary 3C to South Branch Vermillion River	Hampton	Hampton Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
NCreek-7	L-215	Tributary 4 to North Creek	Empire Twp.	Farmington	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Trib6-6	L-1547	Tributary 6	Castle Rock Twp.	Empire Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
MCreek-18	L-LMC-119	Tributary 6 to Middle Creek	Lakeville	Farmington	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
SBranch-4	L-310	Tributary 6 to South Branch Vermillion River	Hampton Twp.	Vermillion Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Table A-4 Total Runoff Volume Change at Standard Locations

XP-SWMM Node	XP-SWMM Link	Reach	Upstream Municipality	Downstream Municipality	Baseflow (cfs)	100-Year Volume Change (ac-ft)[1]	50-Year Volume Change (ac-ft)[1]	10-Year Volume Change (ac-ft)[1]	2-Year Volume Change (ac-ft)	1-Year Volume Change (ac-ft)
Trib6-3	L-1675	Tributary 6A	Farmington	Empire Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
MCreek-15	L-LMC-135	Tributary 6A to Middle Creek	Lakeville	Farmington	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
TribC-10a	RL-305	Tributary C2	Coates	Vermillion Twp.	0	-5 (-1%)	-39 (-14%)	-55 (-50%)	-46 (-100%)	-36 (-100%)
TribC-8	L-346	Tributary C2	Rosemount	Vermillion Twp.	0	-48 (-7%)	-82 (-17%)	-53 (-29%)	-45 (-72%)	-35 (-79%)
TribC-5	L-352	Tributary C2	Vermillion Twp.	Nininger Twp.	0	-50 (-5%)	-83 (-12%)	-54 (-22%)	-47 (-54%)	-38 (-61%)
VRTribF-14	L-322	Tributary F	Vermillion Twp.	Vermillion	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
VRTribG-16	L-320	Tributary G	Vermillion Twp.	Vermillion	0	0 (0%)	-2 (-1%)	-1 (-1%)	0 (-1%)	0 (0%)
VRTribH-22	L-257	Tributary H	Empire Twp.	Vermillion Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
VRTribR-47	L-1500	Tributary R	Elko	New Market Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
VR-45	L-1495	Vermillion River	Elko	New Market Twp.	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
VR-31	L-179	Vermillion River	Farmington	Empire Twp.	10	-2 (0%)	0 (0%)	0 (0%)	1 (0%)	0 (0%)
N-1288	L-1473	Vermillion River	New Market Twp.	Eureka Twp	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
VR-34	L-FVR298	Vermillion River	Eureka Twp.	Farmington	1	1 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
VR-32	L-1317	Vermillion River	Farmington	Empire Twp.	10	-2 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (0%)
VR-30	L-225	Vermillion River	Empire Twp.	Farmington	16	1 (0%)	1 (0%)	0 (0%)	-1 (0%)	0 (0%)
VR-29	L-1302	Vermillion River	Farmington	Empire Twp.	16	1 (0%)	1 (0%)	0 (0%)	-1 (0%)	0 (0%)
VR-24	L-581	Vermillion River	Empire Twp.	Vermillion Twp.	30	-19 (0%)	-10 (0%)	-2 (0%)	10 (0%)	-4 (0%)
VR-17	L-319	Vermillion River	Vermillion Twp.	Vermillion	39	-37 (0%)	-24 (0%)	-16 (0%)	6 (0%)	-7 (0%)
VR-15	L-324	Vermillion River	Vermillion	Vermillion Twp.	39	-38 (0%)	-25 (0%)	-16 (0%)	7 (0%)	-7 (0%)
VR-8	L-1039	Vermillion River	Vermillion Twp.	Marshan Twp.	58	-43 (0%)	-21 (0%)	-17 (0%)	8 (0%)	8 (0%)
VR-7	L-1034	Vermillion River	Marshan Twp.	Nininger Twp.	58	-34 (0%)	-20 (0%)	-16 (0%)	8 (0%)	8 (0%)
VR-6	L-1031	Vermillion River	Nininger Twp.	Hastings	58	-13 (0%)	-23 (0%)	-96 (-1%)	-59 (-1%)	-45 (-1%)
VR-5	L-1029	Vermillion River	Nininger Twp.	Hastings	58	-13 (0%)	-23 (0%)	-96 (-1%)	-59 (-1%)	-45 (-1%)
VR-1	WOMP	Vermillion River	Hastings	NA	58	-256 (-1%)	-235 (-1%)	-96 (-1%)	-59 (-1%)	-45 (-1%)
R614	RL-352	Tributary 1A to North Creek	Rosemount	Empire Twp.	0	NA	NA	NA	NA	NA
RN-264	RL-299	Tributary C	Rosemount	Nininger Twp.	0	NA	NA	NA	NA	NA
R1341	OV-1341-2	Unnamed Reach	Rosemount	Apple Valley	0	NA	NA	NA	NA	NA

[1] Total volume is the runoff volume generated by the design event only; base flow is not included in the total volume calculation. See the 2010 VRWJPO report (Appendix G) for further discussion of volume calculations.

[2] Change in volume calculated as (2015 Updated Model - 2014 Model). Percent change calculated as (2015 Model - 2014 Model)/(2014 Model).

[3] Standard location near Rosemount municipal boundary.

[4] Apple Valley flow rates are agreed on by Apple Valley, Lakeville, and the VRWJPO. Inflows were not adjusted as part of the update.