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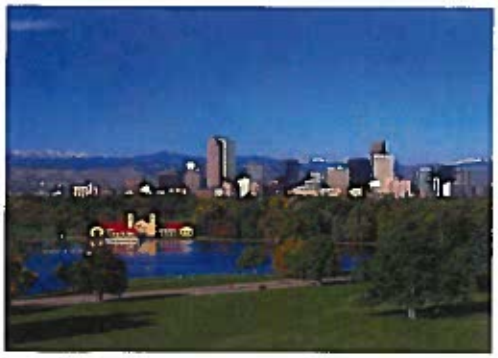

DRAFT

# City and County of Denver Storm Metrics Analysis

DENVER
THE MILE HIGH CITY

January 2016

Matrix DESIGN GROUP

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## Acknowledgements

The following members of the consultant project team contributed significant time and effort to the preparation of this report:

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The project team wishes to acknowledge the various individuals at the City and County of Denver who initiated and assisted in the preparation of this study:

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# 1 Introduction

## 1.1 Authorization

Matrix Design Group, Inc. (Matrix) was retained by the City and County of Denver (Denver) to complete a Storm Metrics Analysis Plan. The Agreement regarding the Storm Metrics Analysis was executed on June 8, 2015 (Master On-Call Professional Engineering Services Contract Number OC11007, Task Order #12, Contract Control Number 201522533).

## 1.2 Purpose and Scope

The recently completed 2014 City and County of Denver - *Storm Drainage Master Plan* (SDMP) identifies over $1 billion in capital improvements throughout the City's 117 square miles, excluding Denver International Airport (DIA) property located generally east of North Dunkirk Street (projected). The SDMP identifies where existing storm drain pipes do not meet current drainage criteria, where new storm drains are needed, and identifies storm drainage capital improvements needed in order to meet Denver's drainage criteria.

Based upon current fiscally-constrained capital improvement budgets, it will take many years to build out the SDMP; therefore, there is a need to define high-priority projects identified in the SDMP based upon a number of deciding factors in order to create a metrics-based Capital Improvement Program.

This analysis defines those factors in addition to identifying areas of the City which have the greatest need for improved drainage. Prioritizing these capital improvements and the areas that they serve has not been part of previous storm drainage master planning efforts. This analysis assesses Denver's needs and develops quantitative measurement tools to assist with prioritization.

Denver is mostly fully developed urban land with uses varying from open space, residential, commercial, and industrial areas. The target level of service is defined by City's Storm Drainage Design and Technical Criteria (Revised January 2006 & Amended November 2013). The current standard level of service in the City and County of Denver is to allow the streets to convey storm runoff during the minor storm event (defined as the 2-year storm for residential areas and 5-year storm for commercial and industrial areas) up to the top of curb or 10 cubic feet per second, whichever is less. At that point, storm drainage improvements are warranted and are designed to convey, at a minimum, the minor storm. Storm runoff produced in larger storm events which exceeds the storm drain's capacity is then carried in the street at a depth of up to 12 inches in the gutter for the 100-year storm.

Much of Denver's storm infrastructure was constructed prior to current drainage criteria and can only convey a 1-year storm event; in some cases even less. Therefore, some areas experience ponding

and street flooding which exceeds Denver's drainage criteria even during frequent minor storm rainfall events.

Capital improvements have been programmed in the past based upon the City's knowledge of drainage needs and other catalytic developments such as TREX, FasTracks, I-70 reconstruction and redevelopment opportunities. These catalytic drivers are continually evolving and thus may not be the most efficient way to prioritize drainage improvement projects and address the most critical needs.

This analysis develops a GIS-based scorecard for both the storm drainage basins and the associated storm drain infrastructure and includes the preparation of this "Storm Metrics" analysis report which describes the prioritization results and associated metrics and approach. The ultimate goal is to establish a current state baseline and establish a Decision Support System (DSS) to assist in prioritization, and potentially an eventual asset management system.

Matrix and the Technical Advisory Group considered over 30 different rating categories including undersized storm pipes, known flooding problems, Significant Flooding Locations (Red Stars), Potential Inundation Areas (PIAs), social justice, transportation impacts, critical facilities, partnerships , as well as known catalysts such as "Areas of Change" identified in Blueprint Denver, which anticipates redevelopment projects.

## 1.3 Data Collection

Mapping and planning information for this project was obtained from several sources. Given the multi-disciplinary makeup of the analysis, every attempt was made to use the best available data. The previous Denver Water Quality Inventory and Mapping Project (2013), the Storm Drainage Master Plan (2014), and the Stormwater Quality Prioritization and BMP Opportunity Analysis (2015) all completed by Matrix, are the backbone of this analysis. The inventory assembled Geographic Information System (GIS) data for storm drain infrastructure, proposed storm drainage improvements, and other data sources. Table 1-1 summarizes the GIS data obtained and utilized as a part of this analysis.

**Table 1-1 GIS data descriptions and sources**

| Data Description | Source | Date |
|---|---|---|
| Blueprint Denver Areas of Change | CPD and DenverGIS | 6/30/2011 |
| CCD Rights-of-Way | Denver | 9/28/2010 |
| Existing Land Use | Denver GIS | 2015 |
| Floodplain | CCD 2014 Storm Drainage Master Plan | 2014 |
| HUD Income Levels by Block Group | Denver Office of Economic Development | 5/25/2011 |
| Impervious Area | Denver | 3/1/2004 |
| MS4 Basins | Denver Department of Public Works | 2013 |
| MS4 Outfalls | Denver Department of Public Works | 2013 |
| Parcels | Denver Assessor's Office | 1/1/2015 |
| Population | U.S. Census | 2010 |
| Existing Storm Drains | Denver Department of Public Works - Wastewater Management Division | 2/12/2014 |
| Stormwater Proposed Improvements | CCD 2014 Storm Drainage Master Plan | 2014 |
| Collection System Drainage Basins | CCD 2014 Storm Drainage Master Plan | 2014 |
| Sub Collection System Boundaries | CCD 2014 Storm Drainage Master Plan | 2014 |
| Water Quality Map Units | CCD Water Quality Inventory and Mapping Project | 2013 |
| Potential Inundation Areas (PIAs) | CCD 2014 Storm Drainage Master Plan | 2014 |
| Significant Flooding Locations | CCD 2014 Storm Drainage Master Plan | 2014 |
| Detention Opportunities | CCD 2014 Storm Drainage Master Plan | 2014 |
| Existing Roadway Classification | Denver GIS - Roadway Centerlines | 2014 |
| Critical Facilities (hospitals, fire stations) | Denver GIS | 2014 |

# 2 Study Area

## 2.1 South Platte River through Denver

The South Platte River is the largest receiving waterway in the Denver Metropolitan area and flows from south to north through the City. Within the City limits, the South Platte River meanders 11.7 miles from Dartmouth Avenue to Franklin Street.

Major tributaries and receiving water bodies in the South Platte River Basin within the City limits include: Second Creek, First Creek, Clear Creek, Irondale Gulch, Harvard Gulch, Goldsmith Gulch, Cherry Creek, Bear Creek, Sanderson Gulch, Dry Gulch, Weir Gulch, Lakewood Gulch, Westerly Creek, Sand Creek, West Harvard, Sloan's Lake, and Marston Lake in addition to numerous localized drainage basins. The SDMP breaks up the City into a total of 67 drainage basins defined by the existing storm drain networks. Many of the basins are defined by the tributary area of the gulches within the City, while others are dominated by extensive and multiple storm drain networks which discharge urban runoff into the South Platte River.

## 2.2 Denver Storm Drainage Master Plan

The Denver Storm Drainage Master Plan (SDMP) is updated every five years and its goal is to identify where existing storm drains do not meet the City's current drainage criteria, where new storm drains are needed, and possible solutions to alleviate drainage problems in Denver. The SDMP updates and refines the previous SDMP to incorporate recently-constructed storm drainage facilities and the findings and recommendations of various studies conducted in the years following publication of the last SDMP. In addition, the latest SDMP update adopted by Denver City Council on September 22, 2014 identifies topographic drainage basin boundaries and thalwegs, Potential Inundation Areas (PIAs) where stormwater has or could exceed 12 inches deep in the gutter, and Significant Flooding Locations reported since the year 2000 which are marked with Red Stars. The update also identifies locations of flood control improvements needed along drainageways in studies conducted by the Urban Drainage and Flood Control District (UDFCD) in partnership with the City and County of Denver. The total project cost to upgrade the City's storm drainage infrastructure to meet minimum current drainage criteria in the Recommended Plan for the entire City is estimated to be approximately $1.5 billion dollars. However, the SDMP does not attempt to prioritize any of the 258 individual projects.

## 2.3 Denver Stormwater Quality Prioritization & BMP Opportunity Analysis

Matrix recently completed the Stormwater Quality Prioritization & BMP Opportunity Analysis (also referred to as the Water Quality Scorecard). It established a methodology to identify areas of Denver which have the greatest need for water quality improvement along with the ancillary benefits of prioritizing drainage basins in Denver according to numeric criteria. The next step identified where potential Best Management Practices (BMPs) could be constructed to improve water quality using similar numeric criteria. The two were then intersected to prioritize areas which have the largest need to improve water quality and offer the greatest potential to implement BMP projects. A driving force for the project was fully utilizing Denver's existing GIS data such that basin needs and priorities are dictated by data, not opinions or anecdotal stories in order to create a defensible list of Capital Improvement Program (CIP) projects.

# 3 Storm Metrics

Denver Public Works management and staff were very pleased with the methodology established in the Water Quality Scorecard and wanted to generate a similar methodology for the City's drainage system. Thus, this Storm Metrics analysis aims to prioritize areas of the City which have the greatest need for drainage system improvements and to prioritize the projects identified in the SDMP. The Water Quality Scorecard was slightly different in that it needed to identify projects, whereas this Storm Metrics analysis already has projects identified in the City's SDMP. The intent is to create an

objective and defensible framework for identifying and promoting projects that demonstrate the most value to people in Denver.

## 3.1 Overview and Methodology

The overall purpose of this methodology is to prioritize areas which have a large need for storm drainage improvement as well as the secondary benefits that improving the overall drainage provides. Since Denver contains over 100 square miles, 180,000 parcels, and 600,000 residents, GIS plays an important role in efficiently identifying where storm drainage projects are most needed. The overall approach follows four basic steps:

1. Prioritize SDMP drainage basins – identify the drainage basins with the greatest need
2. Identify storm drainage projects – the SDMP has already completed this step. This analysis does not propose any additional storm drainage projects.
3. Quantify the benefits of each proposed storm drainage project identified in the SDMP and prioritize these projects based on their benefits
4. Overlay high priority basins with identified storm drainage projects

The focus of this analysis is on projects that were identified in the 2014 SDMP update. However, this prioritization could be re-calculated immediately following each subsequent SDMP update. Each step uses a multi-objective approach to consider the multiple benefits that storm drainage projects provide. In order to capture this approach, a scorecard was established for prioritizing basins and projects. The sections below outline each separate scorecard and the categories contained in it.

The project team had extensive deliberations on the criteria to be included as well as the scoring weights. Meeting minutes can be found in Appendix A.

### 3.1.1 Basin Prioritization

The basin prioritization is the first step to identify those areas of Denver which have the greatest need for drainage improvements as well as the secondary benefits which storm drainage projects provide. The 67 drainage basins used for this analysis where defined based on the existing storm drain networks and are consistent with catchments outlined in the SDMP. The drainage basins mostly have similar areas (average 1,500 acres). This relatively consistent size for each drainage basin is important so that comparisons can be made on a similar scale.

The basin prioritization scorecard is broken into primary and secondary categories (Table 3-1). Those attributes which are associated with reducing the flooding impacts of frequent storms are of primary concern, whereas the secondary categories include parameters such as major storm impacts, detention opportunities, critical facilities impacted, etc. In addition, social justice is considered by incorporating economics as a secondary category. There are five primary categories with a total possible score of 55, and seven secondary categories with a total possible score of 45. Thus, the maximum total score is 100. The complete scorecard and category descriptions are in Appendix B.

**Table 3-1 Basin Prioritization Scorecard Categories**

| Primary Category (5 total) | Max Score | Secondary Category (7 total) | Max Score |
|---|---|---|---|
| Significant Flooding Locations (aka Red Stars) | 15 | Major Storm Effectiveness | 5 |
| Minor Storm Effectiveness | 10 | Areas of Change | 5 |
| Hydraulic Capacity | 10 | Social Justice | 5 |
| Potential Inundation Areas (PIAs) | 10 | Detention Opportunities | 5 |
| Population Impacted/ Population Density | 10 | Critical facilities (hospitals, fire stations) | 5 |
| **SubTotal** | **55** | Roadway Classification - arterial | 5 |
| | | - collector | 3 |
| | | - local | 2 |
| | | Land Use Classification - residential | 5 |
| | | - commercial | 3 |
| | | - industrial | 2 |
| | | **SubTotal** | **45** |
| | | **Total** | **100** |

### 3.1.2 Basin Prioritization – Primary Categories

The primary goal of this analysis is to prioritize proposed storm drainage improvements identified in the SDMP which improve local drainage during frequent storm events. The SDMP defines the minor storm (aka frequent storm events) as the 2-yr storm for residential areas and the 5-yr storm for commercial/industrial areas. The major storm is defined as the 100-yr event, but is not the primary focus of this analysis. The larger drainage basins in which the SDMP projects are located were also considered based on their individual characteristics and are also included in the criteria categories. The score break downs in each category were determined using the Jenks Method (see call out box to the right).

**Jenks Method**

The Jenks Method, also known as a natural breaks method, is a widely used data clustering method which aims to optimally place each value in a bin, or class, in an iterative process. The method seeks to minimize the class's average deviation from the class mean, while maximizing each class's deviation from the means of the other groups, until the optimal solution is achieved. This is commonly referred to as reducing the variance within classes and maximizing the variance between classes (Jenks, 1967).

### Table 3-2 Significant Flooding Location Scores

| Number of Red Stars | Score |
|---|---|
| 9 to 12 | 15 |
| 6 to 8 | 10 |
| 3 to 5 | 6 |
| 2 | 4 |
| 1 | 2 |
| 0 | 0 |

The SDMP defines Significant Flooding Locations as locations where significant flooding and/or property damage have been reported since the year 2000 to the City and County Department of Public Works-Storm Drainage Planning, and have not yet been mitigated with storm drainage improvements. They do not reflect all reports received, only the most severe. Furthermore, even the most severe reports may not necessarily be related to an undersized storm drain system. Basins have as few as zero Red Stars and as many as twelve Red Stars. Using the method described above each basin's score was determined based on its number of Red Stars (Table 3-2). With the goal of addressing flooding associated with minor storms in mind the project team determined that the Significant Flooding Locations (aka Red Stars) was the most important criteria and received the most possible points for any single category.

### Table 3-3 Minor Storm Effectiveness Scores

| Minor Storm Effectiveness (% of existing storm drain network that meets Denver criteria) | Score |
|---|---|
| <48% | 10 |
| 48% - 60% | 8 |
| 60% - 77% | 6 |
| 77% - 93% | 4 |
| 93% - 100% | 2 |
| 100% | 0 |

The minor storm effectiveness category aims to prioritize basins whose existing storm drainage systems are the most undersized. Since the primary goal of this analysis is to address flooding problems associated with the minor storm the team agreed a maximum score of 10 was appropriate. Basins with a high percentage of their existing storm drainage network that meet current Denver drainage criteria scored lower than basins which have a low percentage of existing storm drains that meet current criteria (Table 3-3). Break points for scores were established using the Jenks Method.

### Table 3-4 Hydraulic Capacity Improvement Scores

| Hydraulic Capacity Improvement (% of existing storm drain capacity increased) | Score |
|---|---|
| >326% | 10 |
| 180% - 326% | 8 |
| 108% - 108% | 6 |
| 59% - 108% | 4 |
| 18% - 59% | 2 |
| No upsizing | 0 |

The hydraulic capacity category further emphasizes the minor storm effectiveness but instead of simply scoring a basin on whether it meets criteria, it scores basins based on exactly how much the system is undersized. This category is scored on a relative basis, by considering the average existing storm drain pipe diameter on a length weighted basis versus the average proposed storm drain pipe diameter on a length weighted basis. In other words, it does not compare a single existing pipe to a single proposed pipe; rather it aggregates all of the drains in the basin. The percentage increases should not be considered real values but allow us to compare basins on a relative basis in order to identify

which basins have the greatest need. Break points for scores were established using the Jenks Method. Scores are shown in Table 3-4.

### Table 3-5 Potential Inundation Area Scores

| Potential Inundation Areas (PIAs) (% of total basin area within a PIA) | Score |
|---|---|
| >8% | 10 |
| 5% - 8% | 8 |
| 3% - 5% | 6 |
| 1% - 3% | 4 |
| 0% - 1% | 2 |
| None | 0 |

Potential Inundation Areas (PIAs) shown in the SDMP are areas where stormwater has been reported to collect in depths exceeding 12" during storm events and where various studies have identified the potential for water depths greater than 12" in a major storm event. The areas depicted as PIAs in the SDMP represent current best-available information of these hazards and are shown in the SDMP so that this information is available to Denver residents and property owners. PIAs are not to be confused with floodplains mapped in accordance with Federal Emergency Management Agency (FEMA) guidelines for the National Flood Insurance Program (NFIP). These areas do not reflect all localized flood hazards throughout Denver but represent the best available information based on flooding reports and drainage studies. To date, studies have identified PIAs in 26 of the City's 67 drainage basins. Other areas may be identified in the course of additional more detailed studies and storm events. Although this Storm Metrics analysis is focused on minor storms, and PIAs are associated with major storm events, the team agreed that the PIAs are an additional tool which indicates system deficiencies and areas that are most likely to be impacted by localized flooding. Basins were scored based on the percentage of the total basin area that is covered by PIAs (Table 3-5). Break points for scores were established using the Jenks Method.

The project team discussed, at length, whether the analysis should prioritize based only on where people live rather than on where people work. The team discussed whether functional population which accounts for local work forces was more appropriate. However, it was agreed that standard census population which only accounts for where people live was more appropriate since citizens would be more drastically and immediately impacted by a flood where they live versus a flood where they work. Census data aggregated by Denver was utilized to calculate the population for each basin. Each basin was then normalized by the highest population and multiplied by the maximum score of 10 (Table 3-6).

### Table 3-6 Population Impacted Scores

| Population Impacted (scores are normalized by the most populated basin) | Score |
|---|---|
| >27,000 | 10 |
| 26,000 - 27,000 | 8 |
| 24,000 - 26,000 | 7 |
| 19,000 - 22,000 | 6 |
| 16,000 - 19,000 | 5 |
| 12,000 - 16,000 | 4 |
| 8,500 - 12,000 | 3 |
| 3,600 - 8,500 | 2 |
| 1,600 - 3,600 | 1 |
| <1,600 | 0 |

### 3.1.3 Basin Prioritization – Secondary Categories

**Table 3-7 Major Storm Effectiveness Score**

| Major Storm Effectiveness (% of existing storm drain network that meets Denver criteria) | Score |
|---|---|
| <86% | 5 |
| 86% - 91% | 4 |
| 91% - 96% | 3 |
| 96% - 99% | 2 |
| 99% - 100% | 1 |
| 100% | 0 |

Denver criteria state that the major storm (100-yr event) should have a depth in the street gutter of 12" or less. Though this analysis does not focus on the major storm event, it is acknowledged that if the minor storm ineffectiveness is addressed, then the major storm event effectiveness will also see an improvement (albeit very small). Thus, the major storm effectiveness category was scored in the same manner as the minor storm effectiveness category but with a maximum score of 5 (Table 3-7).

**Table 3-8 Area of Change Score**

| Denver Area of Change (% of total basin area within an area of change) | Score |
|---|---|
| >65% | 5 |
| 28% - 65% | 4 |
| 16% - 28% | 3 |
| 6% - 16% | 2 |
| 0% - 6% | 1 |
| 0% | 0 |

The Areas of Change (from Blueprint Denver) category captures a basin's likelihood to redevelop in the near future. The project team agreed that basins which will undergo more redevelopment may need more investment in order to "set the stage" for development. Thus, areas of Denver which are anticipated to redevelop received higher scores. The total area identified as an Area of Change in Blueprint Denver was summed for each basin. Basins were scored based on the total percentage of the basin area defined as an Area of Change (Table 3-8). Break points for scores were established using the Jenks Method. It is acknowledged that Blueprint Denver was adopted in 2002 and Community Planning and Development will soon begin an update. This Storm Metrics analysis allows for reprioritization based on the Areas of Change that may emerge from the update, just as it allows for reprioritization with updates to the SDMP.

**Table 3-9 Social Justice Score**

| Social Justice (percentage of persons in the low/moderate income level per HUD) | Score |
|---|---|
| >67% | 5 |
| 56% - 67% | 4 |
| 43% - 56% | 3 |
| 23% - 43% | 2 |
| 12% - 23% | 1 |
| 0% - 12% | 0 |

Flood proofing of buildings and minor structures are often difficult for stakeholders in low to moderate income areas to privately install. Thus, these low to moderate income level areas, as defined by the United States Department of Housing and Urban Development (HUD), scored higher. The census and HUD report poverty as "a percentage of persons within the low to moderate income category". Therefore, each basin's HUD percentage was normalized by the highest

percentage and multiplied by the maximum score of 5 (Table 3-9). A high score indicates a high percentage of low to moderate income households while a low score indicates a low percentage of low to moderate income households. The intent is to prioritize these low to moderate income areas to promote environmental and social justice together.

**Table 3-10 Detention opportunities Score**

| Detention Opportunities (possible detention basin idetnified in the SDMP) | Score |
|---|---|
| Yes | 5 |
| No | 0 |

The Detention Opportunities category prioritizes a drainage basin if a potential detention basin was identified in the SDMP. Detention basins can be economical to the overall impact to the storm drain system depending on their location in addition to providing ancillary benefits to a community such as passive green space. If a drainage basin contains a potential future detention basin it scored 5, while if detention opportunities have not been identified the drainage basin scored zero (Table 3-10).

**Table 3-11 Critical Facilities Score**

| Critical Facilities (number of fire stations, hospitals, and police stations) | Score |
|---|---|
| >5 | 5 |
| 4 | 4 |
| 3 | 3 |
| 2 | 2 |
| 1 | 1 |
| 0 | 0 |

Critical facilities, such as fire stations, hospitals, and police stations need to remain open and accessible during and immediately after flood events. If these facilities are impacted by frequent flooding then public safety could be jeopardized. Thus, drainage basins with a large number of critical facilities were prioritized higher than those with few critical facilities. Scores are directly related to the number of critical facilities up to a maximum of 5 (Table 3-11).

Denver roadways are generally categorized as arterial, collector, and local. Arterial streets are crucial to remain open and passable during and immediately after storm events to allow for emergency personnel to operate and potentially evacuate if necessary. Furthermore, arterial streets convey the highest volume of traffic; thus the largest number of citizens could be impacted during transit. Collectors are the next heavily traveled with locals being the least heavily travelled. The Storm Metrics scorecard aims to improve public safety by prioritizing arterial streets (up to 5 points) and collector streets (up to 3 points) that could be potentially affected by PIAs. Local street flooding is a nuisance but is also slightly prioritized (up to 2 points) over streets that are not flooded. For each sub-category the total length of each roadway class that is impacted by a PIA is summed. Basins are then normalized by the basin with the longest roadway length impacted and multiplied by the maximum score (Table 3-12).

### Table 3-12 Roadway Classification Scores

| Arterial Roadways (length of arterial roadway affected by a PIA, normalized by the highest) | Score | Collector Roadways (length of arterial roadway affected by a PIA, normalized by the highest) | Score | Local Roadways (length of arterial roadway affected by a PIA, normalized by the highest) | Score |
|---|---|---|---|---|---|
| >10,500' | 5 | | | | |
| 8,500' - 10,500' | 4 | | | | |
| 5,500' - 8,500' | 3 | >8,000' | 3 | | |
| 3,500' - 5,500' | 2 | 4,500' - 8,000' | 2 | >40,000' | 2 |
| 1,000' - 3,500' | 1 | 1,500' - 4,500' | 1 | 15,000' - 40,000' | 1 |
| 0 - 1,000' | 0 | <1,500' | 0 | <15,000' | 0 |

Land use types that are impacted by localized flooding are also an important category. Similar to the roadway category, it is broken into three sub-categories: residential, commercial, and industrial[1]. The project team agreed that protecting residential land uses should be the top priority because of the potential impacts on individuals versus collective individuals in commercial and industrial land uses. The land use category used a 5, 3, and 2 score breakdown for residential, commercial, and industrial, respectively; thus paralleling the roadway classification category (Table 3-13). Land use scores were also normalized by the maximum area of each land use in each basin and multiplied by the respective maximum score.

### Table 3-13 Land Use Classification Scores

| Residential land use (total acreage, normalized by the largest basin) | Score | Commercial land use (total acreage, normalized by the largest basin) | Score | Industrial land use (total acreage, normalized by the largest basin) | Score |
|---|---|---|---|---|---|
| >1,500ac | 5 | | | | |
| 1,100ac - 1,500ac | 4 | | | | |
| 775ac - 1,100ac | 3 | >550ac | 3 | | |
| 450ac - 775ac | 2 | 450ac - 550ac | 2 | >550ac | 2 |
| 450ac - 150ac | 1 | 150ac - 450ac | 1 | 250ac - 550ac | 1 |
| <150ac | 0 | <150ac | 0 | <250ac | 0 |

Each category is scored for each basin and summed to arrive at a Storm Metrics Basin Priority score. Using the Jenks Method, each basin is represented as a high priority (red), high-medium priority (orange), medium priority (yellow), medium-low priority (blue), and low priority (green) (Figure 3-1). In general, the map shows the older areas of Denver as priority areas while newer areas (i.e. Stapleton, Lowry, Montbello, SW Denver, etc.) are lower priorities. Furthermore, even though new development is expected in currently undeveloped areas of the City such as the Gateway area, developers are required to construct facilities to current city criteria and thus would not need to be prioritized into a CIP program. Maps of each individual scoring category can be found in Appendix B.

[1] Open space and parks was also included as a land use type so that total basin area could be calculated as a check. However, flooding in open spaces and parks is not a priority and thus was not scored.

Note: This map has been revised from the original January 2016 draft to reflect minor corrections to the basins scoring. Three basins changed color: 4400-01 from Blue to Green, 4300-03 from Green to Blue, 4801-01 from Yellow to Blue.

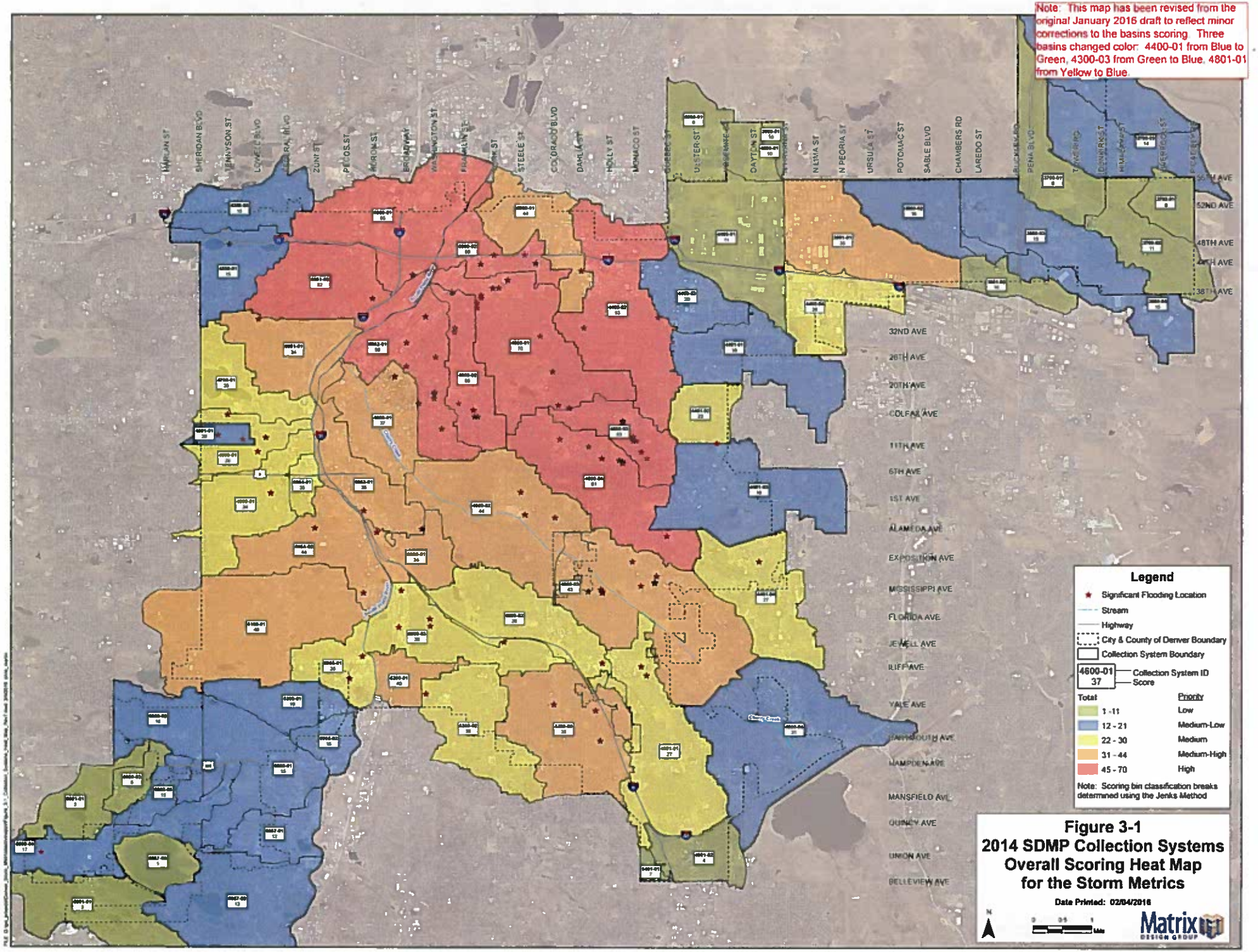


**Figure 3-1**
**2014 SDMP Collection Systems Overall Scoring Heat Map for the Storm Metrics**

Date Printed: 02/04/2016

### 3.1.4 SDMP Project Prioritization

ON-GOING

# 4 References

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Jenks, George F. *The Data model Concept in Statistical Mapping*. International Yearbook of Cartography, 1967.

# Appendices

## Appendix A – Technical Advisory Group Meeting Minutes

## Appendix B – Basin Scorecard

B.1. Basin Scoring Criteria

B.2 Basin Scoring Results

B.3 Individual Category Maps

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