STORMWATER STRATEGIC ASSET MANAGEMENT PLAN

JOHNSON COUNTY KANSAS

JOHNSON COUNTY STORMWATER MANAGEMENT PROGRAM | JANUARY 2019

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Acronyms

AIMS	Johnson County Automated Information Mapping System
APWA	American Public Works Association
CDM Smith	CDM Smith, Inc
CIP	capital improvement program
CMP	corrugated metal pipe
CoF	consequence of failure
DEMs	digital elevation models
ENR	Engineering News-Record
FEMA	Federal Emergency Management Agency
KDA	Kansas Department of Agriculture
KDOT	Kansas Department of Transportation
KPIs	key performance indicators
LiDAR	Light Detection and Ranging
LoF	likelihood of failure
MACP	Manhole Assessment and Certification Program
MDOT	Missouri Department of Transportation
NAD	North American Datum
NASSCO	National Association of Sewer Service Companies
NWI	National Wetland Inventory
O&M	Operational and Maintenance
OPC	opinion of probable cost
PACP	Pipeline Assessment Certification Program
PI	performance indicator
PWK	Johnson County Public Works
SAMP	strategic asset management plan
SMAC	Stormwater Advisory Council
SMP	Stormwater Management Program
SQL	Structured Query Language
TMDL	Total Maximum Daily Load
WAMP	Watershed Asset Management Plan

Executive Summary

ES-1 Introduction

This report outlines a strategic asset management plan (SAMP) for Johnson County Stormwater Management Program (SMP). The SMP is a County program which partners with the 20 cities in Johnson County to manage stormwater and is funded by a 1/10th of one percent, County-wide sales tax. It administers these funds on behalf of the Cities, historically by providing matching funds to Cities for eligible projects, including study, design, and construction projects. As the SMP is currently structured, Cities apply for these funds for individual projects, which are then approved and prioritized based on SMP policies and procedures. This process is overseen by a Stormwater Management Advisory Council (SMAC) comprised of City representatives, and the SMAC is responsible to review the recommendations of SMP on projects and to then make recommendations to the Board of County Commissioners.

The SMP, as part of a strategic planning initiative completed in 2016, intends to begin funding projects which renew deteriorated stormwater infrastructure under a new 'System Management' program. The purpose of this document is to serve as a foundational plan for the System Management program. This program is intended to fund planned projects to inspect, rehabilitate, and replace stormwater infrastructure and natural elements. The program follows a traditional asset management approach wherein individual structures, lines, and natural elements are treated as individual assets which are assigned scores to prioritize their renewal or replacement.

This report describes the framework developed to consolidate stormwater system data on a County-wide basis, assign prioritization scores to each asset, and create guidelines for development of projects which can be funded by the SMP.

ES-1.1 Background

The System Management program is outlined in the SMP's 2016 Strategic Plan (Black & Veatch 2016) and its goals include:

- Promoting proactive management of stormwater infrastructure throughout the County;
- Reducing the number of emergency failures and associated interruptions of basic County services, disruption of transportation routes, and economic impacts; and,
- Advancing public safety and overall quality of life for County residents.

The Strategic Plan also recommended broader changes to the SMP, including the reorganization of the existing SMAC into Watershed Organizations that are arranged according to watershed boundaries which would "manage and develop projects, as well as represent the watershed's interests with respect to the overall program" (p. 29). Watershed groupings will define the boundaries of the Watershed Organizations and are comprised of multiple watersheds. These Organizations are anticipated to be comprised of representatives from each City within their representative watersheds. The boundaries of the proposed Watershed Organizations are shown in **Figure ES-1**.

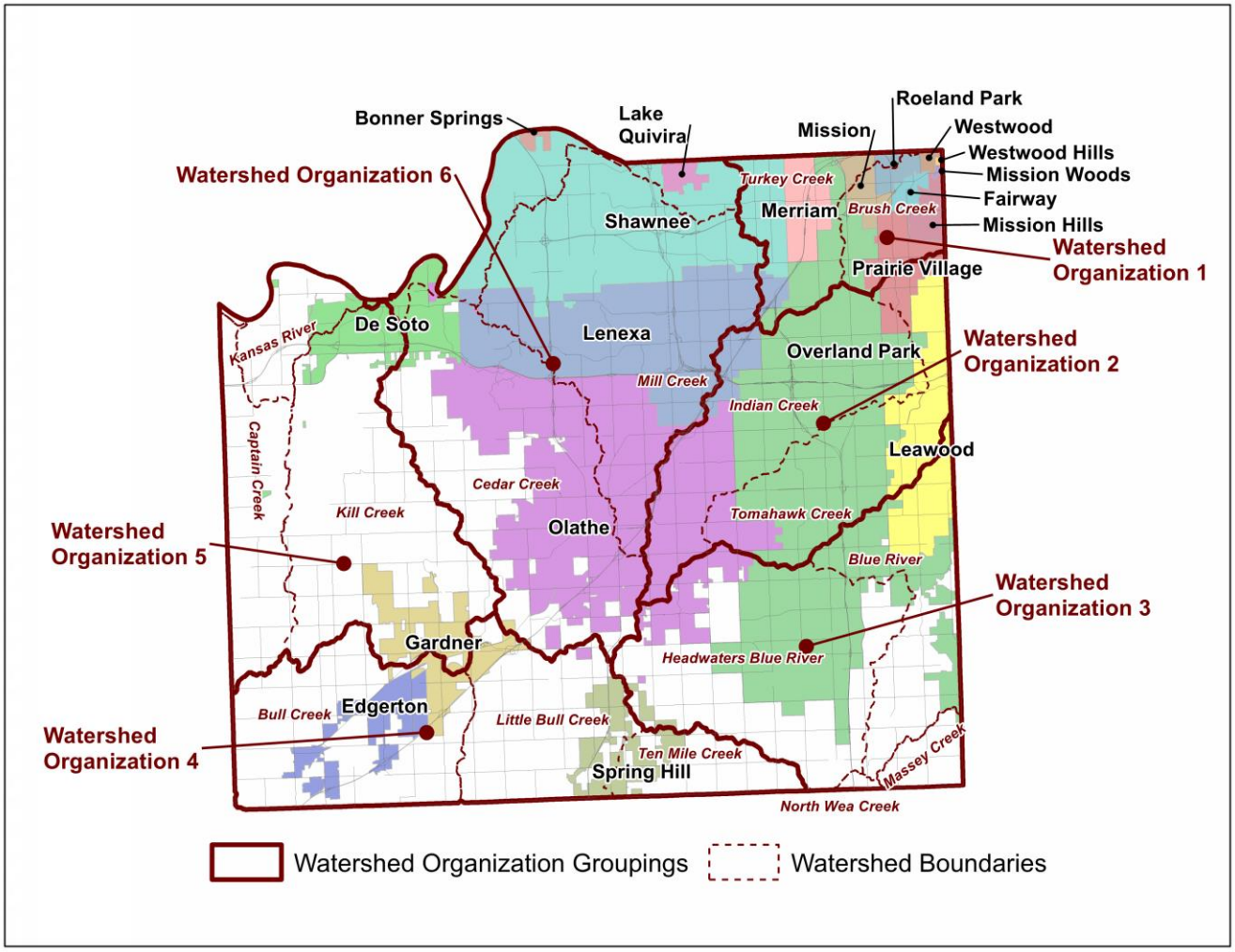

Figure ES-1 Watershed Organization Groupings

The SAMP has been developed to build upon the recommendations of the Strategic Plan and provide guidance to the Watershed Organizations such that project development can be completed by the Organizations in conversation with their City membership. The SAMP has also been informed based on feedback received over the course of five subcommittee meetings in 2017 which were convened to discuss and provide guidance to the System Management program. The subcommittee decided that the SAMP should accomplish at least the following:

- Compile an asset registry for all stormwater assets in the County, to include:
  - Publicly and Privately-Owned Assets
  - Natural Features
    - Natural Wetlands
    - Streams and Riparian Areas
  - Engineered Features
    - Lines, including pipes, culverts, and bridges, starting at the first inlet
    - Structures, including inlets, manholes, junction boxes, and other pertinent structures
    - Detention Basins
- Prioritize assets for replacement using the following criteria:
  - Safety
  - Service Life
  - Economic Impact
  - Quality of Life

ES-1.2 SAMP Development

Development of the SAMP was completed in collaboration with SMP staff as well as a subcommittee comprised of County staff from SMP, Johnson County Public Works (PWK), and Johnson County Automated Information Mapping System (AIMS), City representatives, and local engineering consultants.

Overall, the SAMP development process included the following:

- **Data collection and asset prioritization**. A key component of the SAMP was the creation of a tool to prioritize stormwater assets based on the risk associated with their failure. This tool took the form of a Structured Query Language (SQL) computer script which is used to assign a prioritization score to all eligible assets contained in a County-wide asset database. Inputs to this script included a County-wide asset registry that was compiled for this project and a framework to prioritize individual assets and System Management projects.

- **New System Management Policies and Procedures**. Following creation of the prioritization tool, policies and procedures were formed around it which enable it to be used in a practical way. These included eligibility requirements, program activities, and procedures for System Management project development and submittal.
- **Ongoing Program Activities**. The prioritization tool and associated policies and procedures will require upkeep and evaluation for the System Management to be successful.

ES-1.3 Use of SAMP Report

The SAMP report is intended to serve as a foundational document for the SMP's new System Management program. It represents an understanding of available data, SMP funding and priorities, stakeholder input, and various other factors that can influence and shape the System Management program for a snapshot in time. As such, as the program progresses, some aspects may evolve from the initial recommendations of this report. The SAMP was structured to provide an adaptive management approach to program management.

As such, it is intended to serve as both a foundation for creation of new policies and procedures for the System Management program as well as a reference which provides alternative approaches for various aspects of the program should the policies and procedures need to be modified in the future to address unforeseen circumstances.

This SAMP report does not represent a final summary of policies and procedures adopted by the SMP for the System Management program, though it is intended to inform the policies and procedures which will be adopted. As such, readers of this document should always refer to the latest version of the adopted Policies and Procedures document to determine policies and procedures.

ES-2 Asset Prioritization

The System Management program focuses on the planned repair or replacement of City- or County-owned stormwater assets which are structurally deteriorated. Program funds will be not be used to address emergency repairs or replacements, nor will they be used to address operations or maintenance challenges (e.g., frequent cleaning required, roots, etc.). Assets which have operational issues may be eligible to receive funding under the SMP's Flood Reduction program if they meet the criteria of that program.

ES-2.1 Eligible Asset Types

Stormwater assets which are eligible for SMP inspection, repair, and replacement funding include the following:

- Structures
  - Inlets (all kinds)
  - Manholes
  - Junction boxes
  - Outfalls
- Lines
  - Enclosed system pipes (where one asset is comprised of all pipe lengths between two structures)
  - Culverts
- Streams (stabilization projects where erosion is threatening buildings or major infrastructure)
- Reservoirs/Dams registered with the Kansas Department of Agriculture (eligible for funding to repair only)
- Levees (eligible for funding to repair)

Other stormwater system elements, such as privately owned assets, detention basins, wetlands, and structure types not included in the above categories will be inventoried by AIMS in the asset registry but will not receive program funding.

ES-2.2 Data Requirements

All Cities that request program funding must maintain an accurate inventory of their stormwater infrastructure for incorporation into the AIMS asset registry. The minimum requirement is for Cities to accurately maintain stormwater GIS data and provide AIMS access to it. This will allow the SMP the ability to incorporate the data in a timely manner so that the Cities and Watershed Organizations can review the results and submit projects before the deadline.

ES-3 Unified Condition Assessment Scale

For years many Cities have been assessing and recording the condition of their stormwater assets. While different assessment methods and rating scales have been utilized across the County, the existing information will be standardized and used to support the prioritization of repair and replacement projects. The different rating scales that Cities have utilized were reviewed and a standardized rating scale that enables direct comparisons across asset types and City boundaries was developed. All condition ratings will be converted to this standardized scale.

The standard condition assessment scale that applies to all asset types is shown in **Table ES-1**.

Table ES-1 Unified Condition Scale

Condition		Definition
1	Excellent	No noticeable defects. Some aging or wear may be visible. Fully functional.
2	Good	Only minor deterioration or defects are evident. Noticeable wear or aging is visible. Fully functional. Minor maintenance may be required.
3	Fair	Moderate deterioration or defects are evident. Function is not significantly affected. Minor repairs may be required.
4	Poor	Serious deterioration or defects are evident. Function may be significantly affected. Repairs or replacement are required.
5	Near Failure or Failed	Asset has failed or will likely fail within the next five years. Require immediate attention

ES-3.1 Asset Risk Scores

Risk and prioritization criteria were developed with the end goal of assigning a single score to each stormwater asset contained in the AIMS stormwater database. These criteria were generally defined in broad categories by the System Management subcommittee as:

- Service Life
- Quality of Life
- Safety
- Economic Impact

These categories were used to guide development of risk and prioritization criteria for the SAMP. Specifically, the categories were compared to base spatial data available to assign a numerical value to each and then combine these scores into an aggregate prioritization score for each asset.

To accomplish this, a traditional risk-based asset management framework was developed that considers each asset's likelihood of failure (LoF) and consequence of failure (CoF). LoF is a measure of an asset's risk to fail and is the measure used to evaluate the subcommittee category 'Service Life'. The remaining categories, 'Quality of Life', 'Safety', and 'Economic Impact' fit within the CoF concept, which is a measure of the impact should an asset fail.

Systems to assign numeric ratings to both of these factors were developed. LoF was made equivalent to the 1 through 5 condition rating described in **Table ES-1**. Existing field-assessed conditions were directly translated to the 1 through 5 rating scale, and where field-assessed condition was not available it was estimated using a linear degradation model.

CoF was assigned a numeric criteria calculated based on the importance of the assets to the overall stormwater system as well as proximity to important infrastructure and facilities.

LoF and CoF scores are calculated by a computer script which combines these factors into a single risk score for each asset. The risk score is calculated as a weighted average where LoF is weighted as 65% and CoF is weighted as 35% of the risk score. Risk scores are rated on a 1 through 5 scale.

The prioritization computer script which completes these calculations was developed specifically to support the System Management program. When run, this script does the following:

- Reads the latest version of the stormwater asset database and standardizes data as necessary
- Calculates scores for LoF, CoF, and risk
- Outputs an ESRI ArcGIS stormwater geodatabase with the results of the script.

Risk scores are a key factor which will be used to prioritize individual assets for funding in the System Management program.

ES-4 Project Formulation and Program Outlook

The System Management program will fund two types of projects: inspection projects and renewal projects. Renewal projects can involve repair or replacement of assets, as appropriate, and for an asset to be eligible for a renewal project it is required that field inspection of the asset to determine its condition be completed.

Because of this eligibility requirement, the System Management Program will also fund field inspections of assets. Assets without inspection data will be prioritized using a linear degradation model which estimates condition based on the age of the asset and its material.

Watershed Organizations are entitled to submit projects for matching funding under the System Management program. To ensure fairness and the consistency of project evaluations, only assets that have been assigned a risk score by the computer prioritization script may receive program funding. Assets with high risk scores can be addressed individually or multiple assets may be grouped into a project.

There are no restrictions on the assets that can be included in a project; however, the only assets that will factor into the project prioritization and that will receive funding are those that meet the eligibility criteria and that have a sufficiently high risk score. This allows Cities to assemble projects based on any logic or criteria that are important to them (e.g., paving schedules, including adjacent assets that are not yet in poor condition) and allows the SMP to make direct comparisons of the projects and direct the limited program funds towards the highest risk assets in the County. The initial minimum risk scores recommended for program funding are as follows:

- Asset renewal funding risk score threshold: **3.2**
- Asset inspection funding risk score threshold**: 3.2**

The number of eligible assets meeting these thresholds in the latest available version of the AIMS stormwater geodatabase (dated October 26, 2018) are summarized below in **Table ES-2**. In each cell, the number of assets with risk scores at or greater than 3.2 are totaled and then followed by a percentage in parenthesis which is the number of assets with risk scores at or greater than 3.2 divided by total assets in the database.

Table ES-2. Assets with Risk Score Greater than or Equal to 3.2 by City

City	Total Eligible Assets in Database Received (October 26, 2018)		Assets Eligible for Inspection (Risk > 3.2)		Assets Eligible for Replacement (Risk > 3.2)	
	Lines	Structures	Lines	Structures	Lines	Structures
Bonner Springs	18	20	0 (0%)	0 (0%)	0 (0%)	0 (0%)
De Soto	566	719	117 (2%)	45 (1%)	0 (0%)	1 (%)
Edgerton	1,025	1,246	22 (%)	8 (%)	0 (0%)	0 (0%)
Fairway	302	334	0 (0%)	5 (%)	0 (0%)	0 (0%)
Gardner	3,257	3,627	263 (4%)	199 (3%)	0 (0%)	0 (0%)
Unincorporated Johnson County	2,245	1,359	91 (1%)	23 (%)	0 (0%)	0 (0%)
Lake Quivira	94	110	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Leawood	8,897	9,653	332 (5%)	139 (2%)	622 (10%)	426 (7%)
Lenexa	15,722	17,692	828 (13%)	287 (5%)	1,029 (17%)	344 (6%)
Merriam	2,421	2,730	63 (1%)	135 (2%)	135 (3%)	73 (1%)
Mission	1,329	1,404	0 (0%)	49 (1%)	0 (0%)	0 (0%)
Mission Hills	784	905	80 (1%)	106 (2%)	0 (0%)	17 (%)
Olathe	17,154	19,045	669 (11%)	1,011 (16%)	1,747 (28%)	57 (1%)
Overland Park	34,156	37,253	1,926 (31%)	2,393 (39%)	184 (3%)	0 (0%)
Prairie Village	3,544	3,312	201 (3%)	288 (5%)	16 (%)	9 (%)
Roeland Park	660	862	268 (4%)	364 (6%)	21 (%)	0 (0%)
Shawnee	12,124	13,849	1,055 (17%)	286 (5%)	628 (10%)	843 (14%)
Spring Hill	1,278	1,473	1 (%)	0 (0%)	37 (1%)	30 (%)
Westwood	338	407	254 (4%)	116 (2%)	0 (0%)	28 (%)
Totals:	105,914	116,000	6,170 (6%)	5,454 (5%)	4,469 (4%)	1,828 (2%)

Risk score thresholds for projects are anticipated to be adjusted in the future to maintain focus on replacing the highest risk assets in the stormwater system while considering the availability of condition data and distribution of risk scores.

Each asset that is included in a project will have its own risk score. The risk scores for assets that are eligible for funding will be aggregated to establish a project-level risk score which will be used for project ranking. The project level risk score is the cost-weighted average of the asset-level risk scores, as shown below.

$$\text{Project Risk} =$$

$$\frac{(\text{Asset1 Risk}) * (\text{Asset1 Cost}) + (\text{Asset2 Risk}) * (\text{Asset2 Cost}) + \cdots + (\text{AssetN Risk} * \text{AssetN Cost})}{(\text{Asset1 Cost}) + (\text{Asset2 Cost}) + \cdots + (\text{AssetN Cost})}$$

Cost-weighted averaging is used to develop the project risk score so that the scores associated with the most expensive items are weighed more heavily than the scores for the least expensive items. The costs noted in the equation above are the estimated renewal or inspection costs (as applicable).

ES-4.1 Project Prioritization

The SMP ultimately retains the ability to choose any submitted projects with eligible assets defined by the program as high risk (i.e. have a risk score above the project funding risk score threshold) for inclusion in its 5-year CIP. The prioritization tool and project formulation guidelines create a pool of projects for inspection or renewal of high risk assets, and the risk scores provide a means of prioritizing projects. As such, it is recommended that the SMP follow the risk score rankings to prioritize projects in most cases such that the projects with the highest risk scores are the highest priority to receive funding. Consistent use of this approach is anticipated to encourage Cities to address the highest risk assets, as doing so will make their projects most competitive for funding.

However, because the SMP is dependent upon Cities providing a local match to be able to fund projects, and because this funding is outside of the control of the SMP, operational flexibility will be key to success of the program and allowing the SMP to choose from the pool of eligible, high risk projects will help to provide it. This will also allow the SMP opportunities to take advantage of opportunities as they arise, such as speeding up implementation of a project where a road replacement project coincides with a proposed project area. This scenario would help cover demolition and restoration costs associated with stormwater asset replacement, effectively increase the level of funding provided by a City, benefitting the SMP as a whole.

The base factors which will be considered when choosing projects are:

- Project risk score
- Availability of funding (both City and SMP matches)
- Percentage of City match, if higher than base 50-percent

Additional factors will also be considered, especially when two or more projects are nearly identical in terms of the base prioritization factors. These include:

- Effect of project on water quality and flood control
- Age of assessment dates, where the condition of assets with older assessments are presumed to have a higher level of deterioration
- Potential for impacts on gas and electric utilities should project assets fail

ES-4.2 SMP Matching Funding

The SMP will fund inspections of stormwater assets which have a risk score above the threshold in place at the time of the funding request. These inspections are anticipated to be completed either by a contractor, in which case the SMP will provide 50-percent matching funds for eligible assets based on the inspection prices set with that contractor, or by City staff, in which case the SMP will reimburse 50-percent of inspection of eligible assets based on submitted City expenses.

The SMP will also fund renewal projects which repair or replace eligible stormwater assets which have a risk score above the threshold in place at the time of the funding request. When a project is approved, the upper limit for matching funds will be set at a rate of 50-percent of the project budget.

Project budgets will be determined using one of the following approaches:

- A project budget can be set using the costs assigned to each asset being replaced by the prioritization script. These costs represent estimated costs to completely replace assets and include demolition, material, labor, and restoration costs associated with each eligible asset as well as some portion of project mobilization.
- Alternatively, Cities can submit an engineer's opinion of probable cost (OPC) to be used as the project budget.

These approaches allow flexibility for Cities with both high and low funding capacities. If a City has a low funding capacity, then it may seek renewal projects comprised of mostly repairs with a lower budget to achieve a lower cost share. Alternatively, Cities with a higher funding capacity may seek larger projects to replace assets.

Ultimately, the matching funds provided by the SMP will be based on actual project costs as determined at the end of the project. To provide a basis for cost sharing on an asset-by-asset basis, all System Management projects must be bid as unit cost projects.

ES-4.3 Watershed Organizations Requirements and Responsibilities

At the time of the writing of this report, the Watershed Organizations called for in the SMP's Strategic Plan (Black & Veatch 2016) have not yet been formed. It is anticipated that all System Management projects will be submitted to the SMP by Watershed Organizations, and therefore they play a key role in the success of the program. As such, this section outlines general requirements of Watershed Organizations to secure eligibility for System Management funds for their constituent Cities.

The basic requirement for Watershed Organizations will be to complete and maintain a Watershed Asset Management Plan (WAMP) to establish priorities for System Management projects within the watershed. The major components of a WAMP will address:

- The current state of the stormwater asset inventory across the watershed and the plan for addressing data gaps.
- The development of watershed-scale strategies to address high risk assets.
- The system repair, and replacement projects that are planned, whether they receive SMP matching funds or not.
- The inspections that should be prioritized to achieve a better understanding of condition across the watershed.
- The development of a 5-year Watershed Capital Improvement Program (CIP)

A template WAMP has been developed to assist Watershed Organizations in walking through this process and is included as **Appendix C** of this report.

ES-4.4 Future Program Activities and Outlook

Planned Policy and Procedure Modifications

As described in **Section ES-1.3**, planned modifications to the System Management program represent incremental changes which have been identified before larger modifications are needed and represent factors which can be used to fine-tune the program as necessary. The following list outlines factors to be evaluated on an annual basis which can be adjusted to fine-tune the System Management program's performance:

- **High Priority Risk Score Thresholds -** An initial funding risk score threshold of 3.2 is recommended to delineate assets eligible for System Management funding for both inspection and replacement projects. This threshold was selected by considering the availability of condition data and distribution of risk scores, and it is anticipated that as additional stormwater system data is collected, especially condition data, these project risk score thresholds will need to be adjusted.

- **SMP Matching Funding Level** - The System Management program is anticipated to start with approximately 30-percent of the SMP budget being used as project matching funds, and approved projects will be funded 50-percent by SMP funds. Both of these variables, the System Management budget and matching funding level, should be evaluated on an annual basis

  These evaluations may indicate one of two scenarios: 1) the System Management budget is overutilized, and the SMP can either increase the program's budget or restrict project requirements by increasing the risk score thresholds for eligible assets; or 2) the System Management budget is underutilized, either because project applications do not deplete the program's budget or because Cities with the highest funding capacities dominate project applications and high risk assets in Cities with low funding capacities go unaddressed. If the program budget is underutilized, the SMP could:

  - Decrease the local match required for projects
  - Create a tiered approach to determining matching funds where the highest risk assets are provided a higher program match.

- **Unit Cost Model -** Because replacement costs assigned by the prioritization script can be used to set project budgets, it will be important to continually evaluate the unit costs used by the script against actual costs for projects funded by the SMP. It will be important to the SMP's budgeting process to set project upper limits using up-to-date unit costs. If project budgets are regularly too low, then the program may not fund the repair/replacement of eligible assets at its intended 50-percent level, and if project budgets are regularly too high, then unspent funds will continuously carry over year after year. Fine-tuning the unit cost model will help to mitigate these two scenarios.

- **Condition Data Quality Control -** In order to maintain consistency in condition data being entered to the stormwater geodatabase across Cities, it is recommended for the SMP to complete reinspection of a subset of assets inspected by Cities on at least an annual basis. Specifically, reinspections are recommended where condition scores have been received with a rating of 4 or worse so that the uniformity of scores received can be evaluated. Where a contractor has previously completed the original inspection, an independent contractor should complete the reinspection. Where deviation from inspection requirements are indicated, submitted scores should be adjusted.

Recommended Schedule of Activities

The SMP currently plans to implement a 5-year CIP planning cycle which will include all projects funded by the program. The details of the CIP, including fiscal year dates, deadlines for project selection and placement CIP, and other aspects have not yet been determined. As a result, a theoretical fiscal year which coincides with the calendar year was assumed and anticipated program activities placed on a quarterly schedule, and this is shown in **Table ES-3**. This was done to illustrate the relative timeframe to complete these activities and serve as a tool to help create the System Management CIP cycle.

Table ES-3 Timing of Activities for Hypothetical Fiscal Year (Concurrent with Calendar Year)

Quarter (Calendar and Fiscal)	Activity	Explanation
1st	SMP notifies Watershed Organizations and Cities of risk score thresholds to determine assets eligible for funding as well as any changes to the total System Management budget or the level of SMP matching	Establishing the criteria by which projects will be chosen for funding early in the year provides between 3 and 6 months for Cities and Watershed Organizations to develop projects. Sufficient lead time will be necessary for this as project prioritization will need to be negotiated within the Watershed Organizations.
2nd	Cities and Watershed Organizations create projects for submittal	Using the latest available prioritization script results, Cities and Watershed Organizations will develop projects which meet project criteria for the year.
3rd	Deadline for project submittal	Requiring projects to be submitted in the 3rd quarter will provide around 3 months for the SMP to choose projects.
4th	SMP chooses projects for funding and determines any changes in project timing	Projects will need to be chosen and communicated to Cities on a regular basis, and because new projects will theoretically be placed in the fifth year of the CIP, it is important that communication of project approval be done regularly so that Cities can allocate funding in their CIPs. When implementation is either accelerated or delayed within the CIP, it will be important for the SMP to communicate these changes as early as possible to Cities.
Continuous	AIMS executes the prioritization script and makes results available to Cities and Watershed Organizations on at least a monthly basis	The prioritization script should be run frequently throughout the year, as Cities may flexibility need updated results to assemble projects as new data are added to the AIMS stormwater geodatabase.
Continuous	Cities continually complete field assessments and inventories of stormwater assets and submit new data to AIMS to add to the stormwater geodatabase	It will be in the best interest of Cities to continually obtain and provide field assessments of stormwater assets, as this increases the pool of assets they have available to request SMP funding to repair/replace, and the SMP should support ongoing collection and maintenance of this data.

Formulation of the initial 5-year CIP can follow this schedule; however, projects chosen for funding in the 4th quarter may span the entire 5-year timeframe of the CIP, and will most likely include projects to be funded the following year. Cities with projects approved for funding in the first year of the CIP should be notified as soon as possible so that City matching funds can be allocated.

System Management Program Performance Indicator Calculations

The following Performance Indicator (PI) calculations are recommended to be completed on at least an annual basis to measure the performance of the System Management program. These PIs are intended to numerically summarize whether the program is meeting its goal of improving stormwater asset condition throughout the County. The results of tracking these PIs could serve as a communication tool with the Board of County Commissioners and guide any planned modifications.

- **PI #1: Geographical Distribution of Project Funding**
  - The goal of this PI is to capture the overall reach of the System Management program to track that funds are distributed across the County. Should this not be the case, the policies and procedures associated with the System Management program should be evaluated and potentially adjusted to achieve a desired distribution of funds.
- **PI #2: Overall County Risk Score**
  - The goal of this PI is to simply track the County's overall risk score. This calculation should be done on the basis of the assets contained in the geodatabase maintained by AIMS at the start of the period of interest such that any field condition assessments completed during the period of interest are not included.
- **PI #3: Benefit-Cost Analyses**
  - The goal of this PI is to measure the return on investment being made by the SMP under the System Management program. For renewal projects, benefit is defined as reduction in overall risk and inspection project benefits are measured by their success in documenting new assets in deteriorated condition.
- **PI #4: Budgeted Versus Actual Costs**
  - The goal of this PI is to capture how well the use of the unit cost model for replacement of assets matches with actual project costs by calculating the percentage of total costs provided by SMP matching funds provided for renewal of eligible assets and the amount of budget assigned to projects that is carried over to the next year.

ES-4.5 Estimated Program Staffing

In order to maintain and execute the System Management program, additional labor beyond existing levels from the SMP, AIMS, and PWK will be required. This will include both regular, ongoing tasks to be performed annually, as well as startup activities to implement the program at its inception. **Table ES-4** below summarizes the level of effort (LOE) required for ongoing, annual tasks for each department. The LOEs in this table are summarized by both annual hours required and annual full-time equivalents (FTEs). The annual FTEs represent the percentage of a working year a full-time employee would work to complete a task, divided by 100. A working year was assumed to be a total of 1,880 working hours, based on a full-time employee receiving 10 holidays and 3 combined weeks of vacation and sick leave each year. For example, a task requiring 0.5 FTEs would take half of an employees working year to complete, equivalent to 940 hours.

Each department has been provided a range of potential LOEs, and this was done because the effort required to execute the System Management Program is anticipated to be largely dependent on the level of participation by Cities. Accordingly, a lower LOE has been provided in the columns labeled 'Low Estimate' based on an assumption of low City participation, and a higher LOE has been provided in the columns labeled 'High Estimate' based on an assumption of high City participation.

Table ES-4 Summary of Required LOEs for System Management Program

Entity	Low Estimate Hours per Year	High Estimate Hours per Year	Low Estimate Annual FTEs	High Estimate Annual FTEs
SMP*	1,390-1,734	2,586-3,274	0.7-0.9	1.4-1.8
AIMS	196	392	0.1	0.2
PWK	276	552	0.1	0.3

* - A range of estimates is provided as the number of hours for low and high estimates for SMP base tasks to represent the increased hours required if two separate employees execute the base tasks

SMP Staffing for Ongoing Activities

SMP staff will assume the primary responsibilities to execute and maintain the System Management program, and as such have the highest estimated workload among the three departments. At a minimum, the SMP is estimated to require at least one additional annual FTE for the program and may require as many as 2 annual FTEs.

To date, public meetings on the System Management program have received widespread engagement from multiple Cities, indicating a high level of interest in program participation. This engagement has been continuous starting with the Strategic Plan's steering committee and has continued with the System Management subcommittee in 2017 and the SAMP subcommittee in 2018. As a result, the LOE for SMP is anticipated to be more consistent with the 'High Estimate Annual FTEs' shown in **Table ES-4**.

Additionally, it is anticipated that there will be a need for two distinct skillsets within the SMP to execute inward- and outward-facing tasks. Inward-facing tasks are anticipated to be more technical in nature and would require some technical knowledge specific to asset management principles, a working knowledge of, and ability to manipulate data in, ArcGIS, and the ability to exercise engineering judgement to develop projects, while the outward-facing tasks are anticipated to require project management and coordination skills.

If a single new employee is retained to execute the program, then they would need to possess both skillsets, but if at least two new employees are retained, then each could possess only one of the required skillsets and the program activities split appropriately. The SMP LOEs estimated in **Table ES-4** include a range of estimates to account for the potential to retain one or two employees, and the higher LOEs include additional time for weekly coordination between two employees.

AIMS Staffing for Ongoing Activities

The SMP will be reliant upon AIMS to assist with some elements of the System Management program. These activities are nearly all maintenance related and involve incorporating feedback received by AIMS to update the System Management program's digital tools and providing technical assistance to Cities. Overall, it is anticipated that the LOE for AIMS staff would be between 196 to 392 hours annually, or 0.1 to 0.2 annual FTEs.

PWK Staffing for Ongoing Activities

Unincorporated Johnson County is anticipated to be a participant in four of the six Watershed Organizations with PWK staff as its representatives. Overall, it is anticipated that the LOE for PWK staff would be between 276 and 552 hours annually, or 0.1 to 0.3 annual FTEs.

Startup Activities

The following start-up activities are anticipated to be required and represent initial tasks to be completed at the start of the System Management program. They do not represent ongoing activities to maintain and execute it and are anticipated to be additional effort beyond the LOEs listed in **Table ES-4**.

- Develop System Management policies and procedures and establish Watershed Organizations. SMP staff will need to develop policy and procedures documents which formally outline how Cities and Watershed Organizations will be required participate in the System Management program. This is anticipated to be done using this SAMP report as a guide, and it is anticipated that the template WAMP will serve as an attachment to the procedures document. In addition, Watershed Organizations will need to be established according to the policy and procedures documents and their participants engaged and convened.

- Participate in and manage creation of initial WAMPs. WAMPs for each watershed will need to be created for each Watershed Organization, and their initial formulation will require significantly more effort than their future annual upkeep. It is anticipated that the SMP will fund the creation of the initial WAMPs, and thus SMP staff effort will be required to manage this work. In addition, PWK staff are anticipated to be involved in WAMP creation due to their status as participants in four of the Watershed Organizations.
- Develop 5 years of projects for initial funded 5-year CIP. The WAMPs will create an initial 5-year CIP for each Watershed Organization which will be submitted to SMP for funding consideration. It is unclear how many projects will be included in each Watershed Organization CIP, however, it is anticipated that there will be a large number of projects to review, rank, and select in the first year of the System Management program, requiring a significant effort beyond what will be required in following years.

Section 1
Introduction

This report outlines a strategic asset management plan (SAMP) for Johnson County Stormwater Management Program (SMP). The SMP is a County program which partners with the 20 cities in Johnson County to manage stormwater and is funded by a 1/10th of one percent, County-wide sales tax. It administers these funds on behalf of the Cities, historically by providing matching funds to Cities for eligible projects, including study, design, and construction projects. As the SMP is currently structured, Cities apply for these funds for individual projects, which are then approved and prioritized based on SMP policies and procedures. This process is overseen by a Stormwater Management Advisory Council (SMAC) comprised of City representatives, and the SMAC is responsible to review the recommendations of SMP on projects and to then make recommendations to the Board of County Commissioners.

The SMP, as part of a strategic planning initiative completed in 2016, intends to begin funding projects which renew deteriorated stormwater infrastructure under a new 'System Management' program. The purpose of this document is to serve as a foundational plan for the System Management program. This program is intended to fund planned projects to inspect, rehabilitate, and replace stormwater infrastructure and natural elements. The program follows a traditional asset management approach wherein individual structures, lines, and natural elements are treated as individual assets which are assigned scores to prioritize their renewal or replacement.

This report describes the framework developed to consolidate stormwater system data on a County-wide basis, assign prioritization scores to each asset, and create guidelines for development of projects which can be funded by the SMP.

1.1 Background

The System Management program is outlined in the SMP's 2016 Strategic Plan (Black & Veatch 2016) and its goals include:

- Promoting proactive management of stormwater infrastructure throughout the County;
- Reducing the number of emergency failures and associated interruptions of basic County services, disruption of transportation routes, and economic impacts; and,
- Advancing public safety and overall quality of life for County residents.

The Strategic Plan also recommended broader changes to the SMP, including the reorganization of the existing SMAC into Watershed Organizations that are arranged according to watershed boundaries which would "manage and develop projects, as well as represent the watershed's interests with respect to the overall program" (p. 29). Watershed groupings will define the boundaries of the Watershed Organizations and are comprised of multiple watersheds.

These organizations are anticipated to be comprised of representatives from each City within their representative watersheds. The boundaries of the proposed Watershed Organizations are shown in **Figure 1-1**.

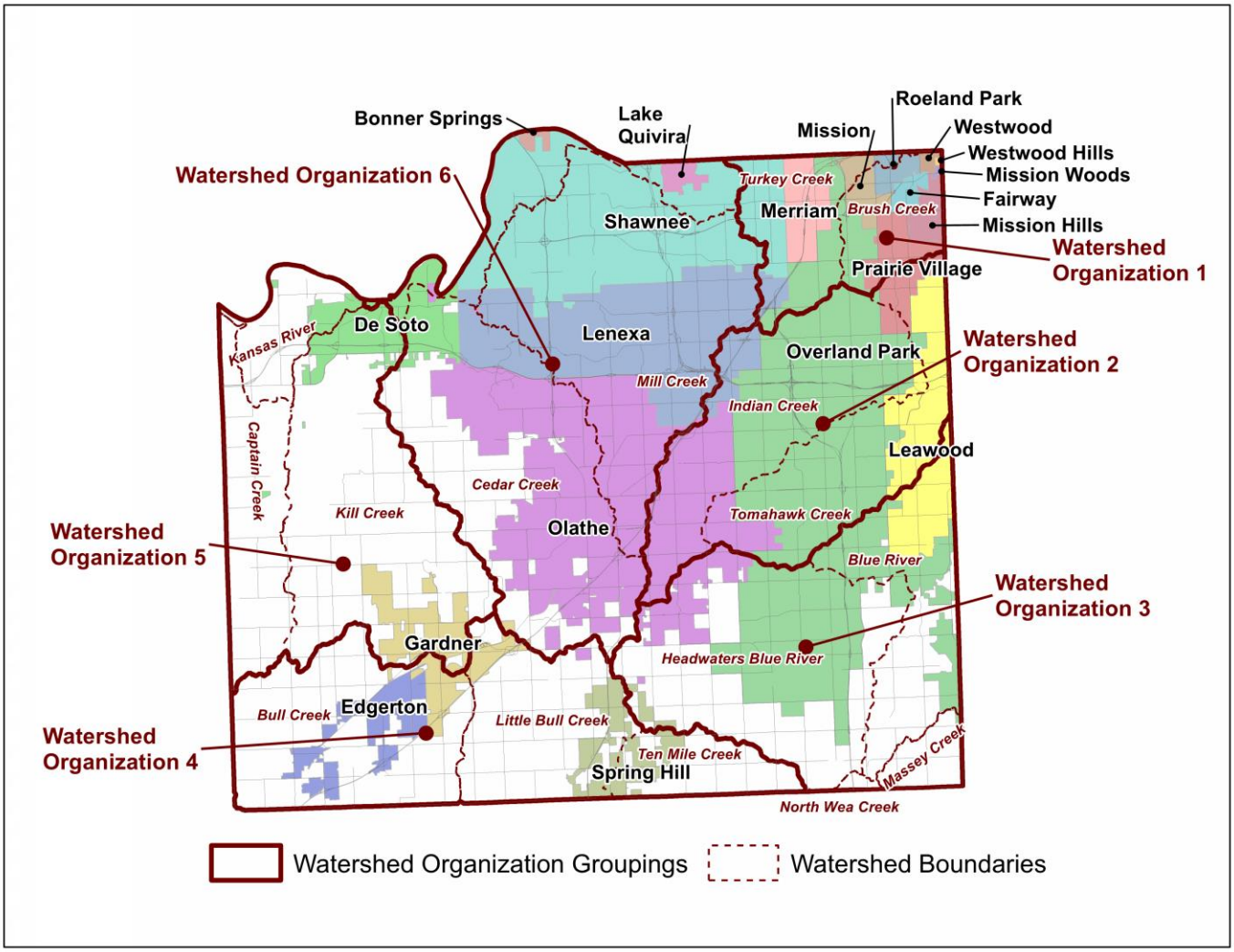

Figure 1-1 Watershed Organization Groupings

The SAMP has been developed to build upon the recommendations of the Strategic Plan and provide guidance to the Watershed Organizations such that project development can be completed by the organizations in conversation with their City membership. The SAMP has also been informed based on feedback received over the course of five subcommittee meetings in 2017 which were convened to discuss and provide guidance to the System Management program. The subcommittee decided that the SAMP should accomplish at least the following:

- Compile an asset registry for all stormwater assets in the County, to include:
  - Publicly and Privately-Owned Assets
  - Natural Features
    - Natural Wetlands
    - Streams and Riparian Areas
  - Engineered Features
    - Lines, including pipes, culverts, and bridges, starting at the first inlet
    - Structures, including inlets, manholes, junction boxes, and other pertinent structures
    - Detention Basins
- Prioritize assets for replacement using the following criteria:
  - Safety
  - Service Life
  - Economic Impact
  - Quality of Life

These two tasks were completed, and are described in **Sections 3.1** and **3.2**, respectively.

1.2 SAMP Development

Development of the SAMP was completed in collaboration with SMP staff as well as a subcommittee comprised of County staff from SMP, Johnson County Public Works (PWK), and Johnson County Automated Information Mapping System (AIMS), City representatives, and local engineering consultants.

Overall, the SAMP development process included the following:

- **Data collection and asset prioritization**. A key component of the SAMP was the creation of a tool to prioritize stormwater assets based on the risk associated with their failure. This tool took the form of a Structured Query Language (SQL) computer script which is used to assign a prioritization score to all eligible assets contained in a County-wide asset database. Inputs to this script included a County-wide asset registry that was compiled for this project and a framework to prioritize individual assets and System Management projects. The framework developed to guide this activity is described in **Section 2**.

- **New System Management Policies and Procedures**. Following creation of the prioritization tool, policies and procedures were formed around it which enable it to be used in a practical way. These included eligibility requirements, program activities, and procedures for System Management project development and submittal. These new policies and procedures are described in **Section 3**.
- **Ongoing Program Activities**. The prioritization tool and associated policies and procedures will require upkeep and evaluation for the System Management to be successful. **Section 4** of this report provides recommendations for these ongoing activities.

1.2.2 Use of SAMP Report

The SAMP report is intended to serve as a foundational document for the SMP's new System Management program. It represents an understanding of available data, SMP funding and priorities, stakeholder input, and various other factors that can influence and shape the System Management program for a snapshot in time. As such, as the program progresses, some aspects may evolve from the initial recommendations of this report. The SAMP was structured to provide an adaptive management approach to program management. As such, it is intended to serve as both a foundation for creation of new policies and procedures for the System Management program as well as a reference which provides alternative approaches for various aspects of the program should the policies and procedures need to be modified in the future to address unforeseen circumstances. The following subsections elaborate on this adaptive management approach.

Planned and Unplanned Policy and Procedure Modifications

The report sections with recommendations for policies which may be adjusted in the future are contained in **Sections 3** and **4**. All stormwater programs must adjust to maintain performance over time, as both internal factors and outside influences shift priorities, goals, and success factors. These changes consist of two types: planned changes and unplanned changes. Because the SMP is establishing initial System Management policies and procedures, it is anticipated that they may be subject to these two types of changes and would therefore require some modification in the future.

Planned modifications represent incremental changes to the System Management program which have been identified and represent factors which can be used to fine-tune the program as necessary. An example of a planned modification would be adjusting the threshold to determine which assets are eligible for System Management funding. Planned modifications are clearly summarized in **Section 4.4.1**.

Unplanned modifications are those changes which would be made in reaction to unforeseen circumstances and would represent a larger change to the program than a planned modification. An example of an unplanned modification would be to change the eligibility of private assets for System Management funding because SMP funds are not being used efficiently. Because of their nature, unplanned modifications cannot be readily identified in this report; however, where it is feasible, policy alternatives to address unplanned modifications are presented as 'Tier 2' recommendations in **Sections 3** and **4** for SMP staff to reference in the future. Tiered recommendations are described in the following subsection.

Base and Secondary Policy and Procedure Recommendations

Section 3 contains policy recommendations which define interactions between the SMP, Watershed Organizations, and Cities, and because the SMP's ability to implement projects depends on active participation of Cities in the program, they are partially dependent on the actions and buy-in of entities outside the SMP. **Section 3** includes two tiers of recommendations:

- Tier 1: Program standards for base policies and procedures which were developed in conjunction with SMP staff. These represent core items which are not anticipated to change significantly in the future.
- Tier 2: Considerations which were developed by the CDM Smith, Inc (CDM Smith) team based on the firm's experience working with stormwater and asset management programs. These recommendations include alternatives for implementation where practical and therefore represent opportunities for flexibility in the program in the future to make adjustments representing unplanned changes. Tier 2 recommendations were presented to a group of stakeholders on October 20, 2018, and the feedback received at this meeting is documented in **Section 2.2.6**.

Recommendations included in each tier are clearly identified in **Section 3**. This approach allows the SMP some flexibility in implementing the System Management program. Because options for policies and procedures are documented in this report, if program adjustments become necessary due to unforeseen factors, this report can serve to provide alternatives which may better fit SMP needs at some future point.

Section 4 includes recommendations for activities which will be completed by the SMP and are fully within their control. Examples of these recommendations include data standards, staffing levels, and System Management program quality control activities. As in **Section 3**, Tier 1 and 2 recommendations were included where feasible to provide flexibility for future program adjustment.

Final Policies and Procedures

This SAMP report does not represent a final summary of policies and procedures adopted by the SMP for the System Management program, though it is intended to inform the policies and procedures which will be adopted. As such, readers of this document should always refer to the latest version of the adopted Policies and Procedures document to determine policies and procedures.

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Section 2

Program Startup Activities

2.1 Existing Data Analysis

2.1.1 Data Gathering

Lines (Pipes) and Structures

The majority of the stormwater asset data used in this report was provided by Johnson County Automated Information Mapping System (AIMS) in ESRI ArcGIS geodatabase format and included the following feature classes, which were compiled from data previously provided by Cities to AIMS:

- Stormwater_LN – stormwater line assets, comprised of pipe assets as well as bridges
- Stormwater_PT – stormwater structure assets, comprised of structures associated with the enclosed sewer system such as inlets, manholes, and junction boxes

These databases represent compilations of stormwater asset data submitted by Cities to AIMS, and it is anticipated that AIMS will continue to serve as the collector and compiler of data submitted by Cities. The final version of the Stormwater_LN and Stormwater_PT geodatabases used in the SAMP were received from AIMS on October 26, 2018.

In addition, stormwater line and structure data were provided by Mission Hills and Fairway and to the project team directly, and these are included in **Appendix B**. Data from these Cities were digitized in ArcGIS as needed and appended to the appropriate feature classes, replacing existing records as appropriate to avoid duplicating assets, and submitted to AIMS.

The projection system used for the compiled geodatabases was NAD 1983 Kansas State Plane – FIPS 1501_feet.

Reservoirs/Dams

Spatial data for reservoirs and dams in Johnson County were obtained from AIMS and the Kansas Department of Agriculture (KDA), as are shown in **Figure 2-1**, and these were appended to the Stormwater_PT geodatabase as structures located at the dam site. Ownership data was also obtained from Kansas Department of Agriculture (KDA) to establish all publicly owned dams appended to the geodatabase.

Levees and Floodwalls

Data indicating the location and alignment of levees were obtained from the Federal Emergency Management Agency (FEMA) for accredited levees in the County and from the SMP for the levee in Leawood, and these are shown in **Figure 2-1**. These were appended to the Stormwater_LN geodatabase as lines which follow the levee alignment.

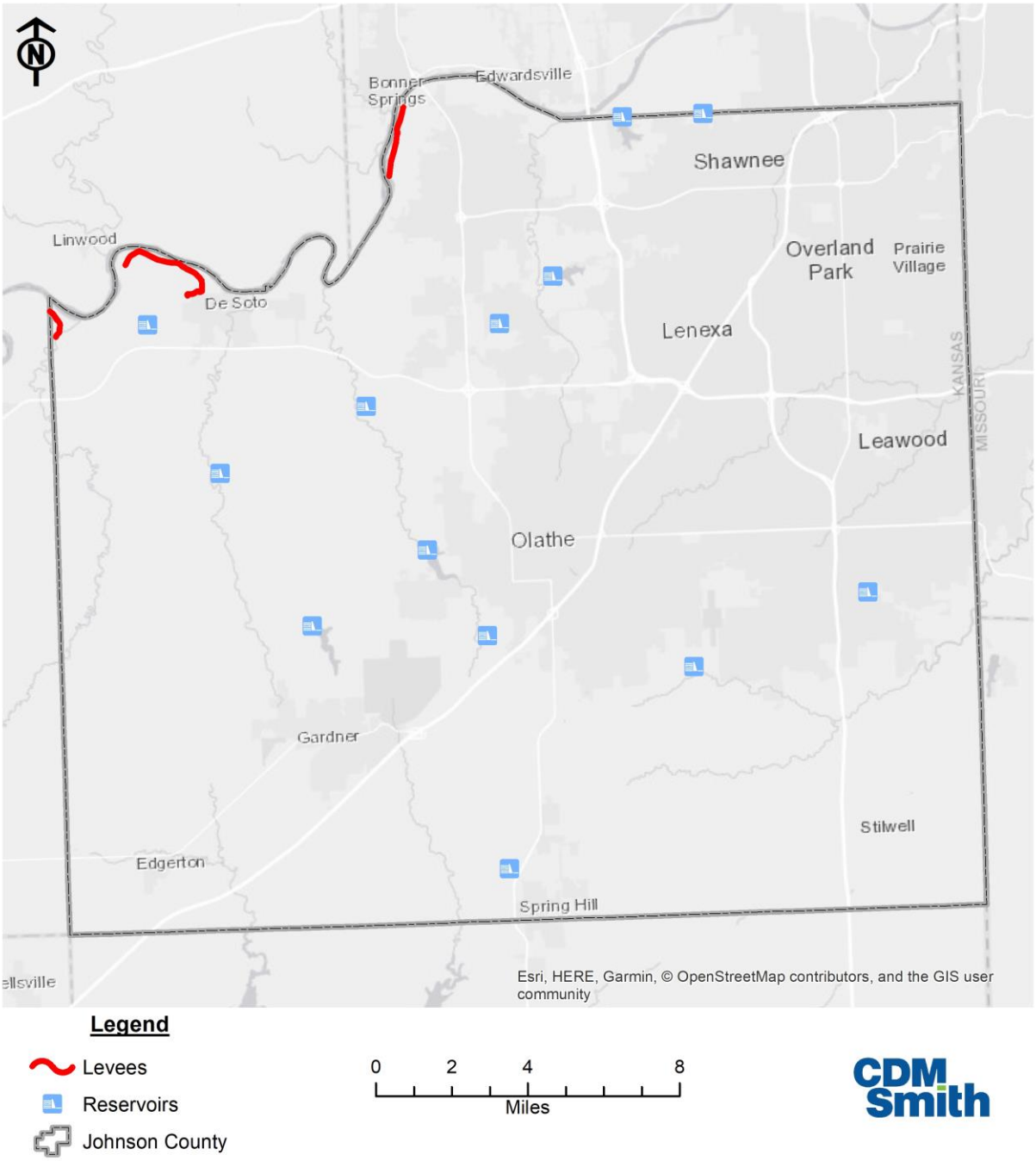

Figure 2-1 Reservoirs and Levees in Asset Registry within Johnson County

Detention Basins

Spatial data on detention basins located in Leawood, Lenexa, Olathe, Overland Park, and Shawnee, Kansas were gathered and appended to the Stormwater_PT feature class, and these are summarized in **Table 2-1**. Detention basins are not assets eligible for funding as the majority are privately owned; however, they were incorporated into the AIMS geodatabase to inventory and track them. Note that **Table 2-1** summarizes information available to include in the asset registry provided by Cities and may not represent the actual number of detention basins within each City.

Table 2-1 Inventoried Detention Basins in Asset Registry

City	Number of Detention Basins Inventoried
Leawood	24
Lenexa	661
Olathe	16
Overland Park	15
Shawnee	284

Streams

As shown in **Figure 2-2**, there are over 1,800 miles of delineated streams in Johnson County. These were provided by AIMS in the feature class StormwaterNatrl_LN.

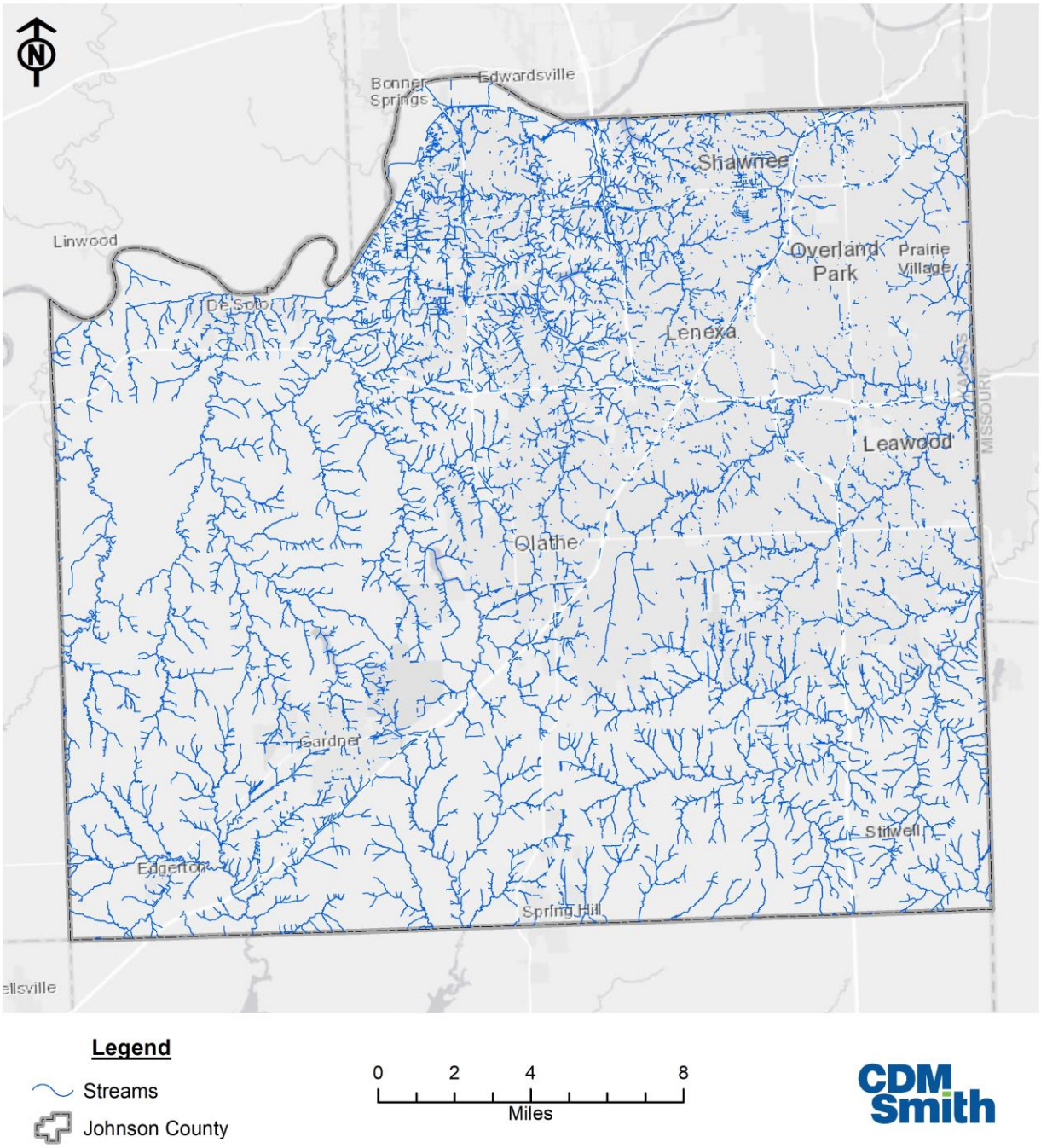

Figure 2-2 Johnson County Streams in Asset Registry

Natural Wetland Areas

CDM Smith used the National Wetland Inventory (NWI) database to locate and analyze the wetlands located in Johnson County. Only 'freshwater forested/shrub wetlands' and 'freshwater emergent wetlands' 1-acre or larger in size were identified to inventory as these capture the wetlands independent of other water features that are inundated over a prolonged period. The other two types that were not inventoried were 'freshwater ponds' that are seasonal and 'riverine wetlands'. Ultimately, because the majority of wetlands are privately owned, it was decided by the SMP and SAMP Subcommittee that these are best to be inventoried and located, as shown in **Figure 2-3**, but not eligible for System Management project funding.

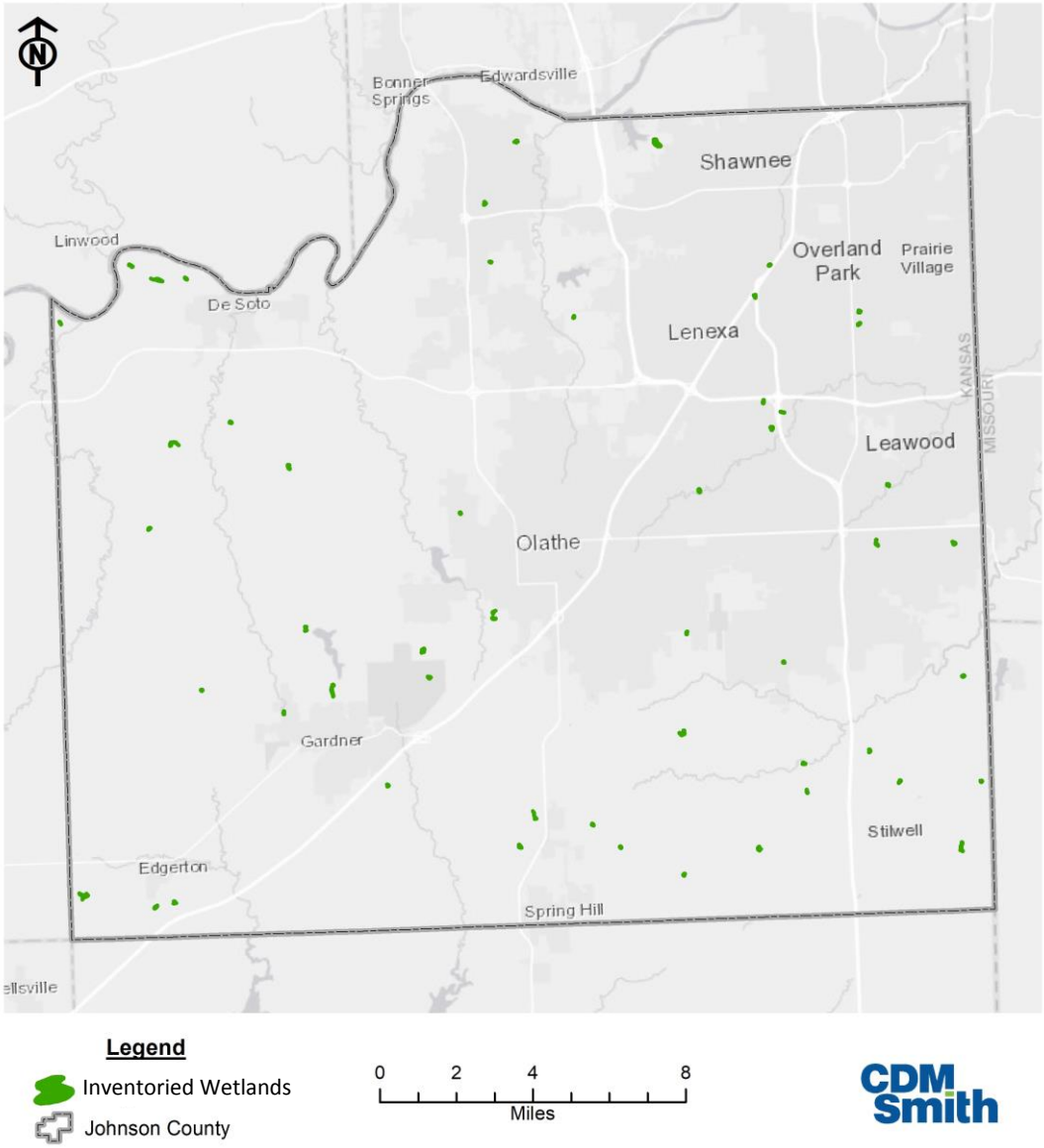

Figure 2-3 Inventoried Wetlands in Asset Registry

Base Data

All base data were obtained from AIMS and included datasets such as street centerlines, locations of critical facilities, and sewer lines. These were used by the prioritization script as described in **Appendix A.1**.

2.1.2 Data Cleanup Activities and Gaps

Data required to prioritize assets are summarized in **Table 2-2** below. Because the stormwater geodatabase represents a compilation of data from most of the Cities in the County, they were reviewed to identify required data and to formulate data standardization procedures and standard values in the prioritization script. These standard values will be required for new data submitted to AIMS as outlined in **Section 4.1**.

Table 2-2 Stormwater Asset Data Required for System Management Projects

	Inspection Project (Data Required to Estimate Condition)	Renewal Project
Lines	▪ Asset ID ▪ Owner ▪ Dimensions ▪ Number of Barrels ▪ Upstream and Downstream Node IDs ▪ Shape ▪ Year Constructed (or Rehabilitated) ▪ Material	▪ Asset ID ▪ Owner ▪ Cross section dimensions (i.e. diameter) ▪ Dimensions ▪ Number of Barrels ▪ Upstream and Downstream Node IDs ▪ Shape ▪ Field-Inspected Condition
Structures	▪ Asset ID ▪ Owner ▪ Structure Type ▪ Year Constructed (or Rehabilitated) ▪ Material	▪ Asset ID ▪ Owner ▪ Structure Type ▪ Field-Inspected Condition
Streams	▪ Owner ▪ Estimated Condition	▪ Owner ▪ Field-Inspected Condition
Reservoirs/ Dams	▪ N/A (Not eligible for field inspection funding)	▪ Owner ▪ Field-Inspected Condition
Levees/ Floodwalls	▪ N/A (Not eligible for field inspection funding)	▪ Owner ▪ Field-Inspected Condition

Table 2-3 summarizes the data provided for Stormwater_LN for lines for each of these required fields, and **Table 2-4** summarizes them for Stormwater_PT for structures for the October 26, 2018 database. Only eligible assets are summarized in these tables, where eligible assets are those listed in **Section 3.1.1**, and ineligible assets are those not included in this list. Ineligible assets will not receive System Management funding for projects.

In each cell, the number of assets falling into each column are totaled and then followed by a percentage in parenthesis which represents to number of assets in the column data category divided by total assets from the provider (listed in the first column).

Table 2-3 Data Available for Required Fields in Lines Data (Stormwater_LN)

Data Provider	Total Eligible Assets in Stormwater_LN Feature Class	Eligible Assets with Material Data*	Eligible Assets with Year Constructed*	Eligible Assets with Owner*,**	Eligible Assets with Cross Section Dimension(s)**	Eligible Assets with Field-Inspected Condition Data Mapped to Unified Scale**
Bonner Springs	18	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
De Soto	566	467 (83%)	392 (69%)	0 (0%)	473 (84%)	0 (0%)
Edgerton	1,025	377 (37%)	977 (95%)	0 (0%)	373 (36%)	0 (0%)
Fairway	302	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Gardner	3,180	2,869 (90%)	1,987 (62%)	0 (0%)	2,966 (93%)	0 (0%)
Unincorporated Johnson County	2,210	1,983 (90%)	0 (0%)	2,210 (100%)	1,226 (55%)	0 (0%)
Lake Quivira	94	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Leawood	8,897	8,896 (100%)	8,894 (100%)	8,897 (100%)	8,828 (99%)	5,697 (64%)
Lenexa	14,615	14,221 (97%)	3,591 (25%)	14,615 (100%)	12,695 (87%)	6,976 (48%)
Merriam	2,421	2,421 (100%)	0 (0%)	1,900 (78%)	1,804 (75%)	1,705 (70%)
Mission	1,329	807 (61%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Mission Hills	784	716 (91%)	0 (0%)	774 (99%)	106 (14%)	0 (0%)
Olathe	17,154	14,911 (87%)	15,785 (92%)	17,083 (100%)	16,122 (94%)	6,232 (36%)
Overland Park	33,949	33,771 (99%)	33,946 (100%)	33,916 (100%)	33,566 (99%)	14,291 (42%)
Prairie Village	3,219	2,945 (91%)	2,538 (79%)	3,011 (94%)	2,703 (84%)	312 (10%)
Roeland Park	659	625 (95%)	239 (36%)	246 (37%)	554 (84%)	186 (28%)
Shawnee	12,124	11,947 (99%)	11,532 (95%)	12,110 (100%)	11,840 (98%)	4,883 (40%)
Spring Hill	1,278	995 (78%)	649 (51%)	1,278 (100%)	788 (62%)	191 (15%)
Westwood	338	327 (97%)	0 (0%)	337 (100%)	329 (97%)	4 (1%)
Totals	104,162	98,278 (94%)	80,530 (77%)	96,377 (93%)	94,373 (91%)	40,477 (39%)

* - Data required for inspection project

** - Data required for replacement project

Table 2-4 Data Available for Required Fields in Structures Data (Stormwater_PT)

Data Provider	Total Eligible Assets in Stormwater_PT Feature Class	Eligible Assets with Material Data*	Eligible Assets with Year Constructed*	Eligible Assets with Owner*, **	Eligible Assets with Field-Inspected Condition Data Mapped to Unified Scale**
Bonner Springs	20	0 (0%)	0 (0%)	0 (0%)	0 (0%)
De Soto	719	0 (0%)	0 (0%)	0 (0%)	47 (7%)
Edgerton	1,246	0 (0%)	1,175 (94%)	0 (0%)	0 (0%)
Fairway	334	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Gardner	3,627	0 (0%)	2,514 (69%)	0 (0%)	0 (0%)
Unincorporated Johnson County	1,359	94 (7%)	0 (0%)	1,359 (100%)	0 (0%)
Lake Quivira	110	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Leawood	9,653	8,827 (91%)	9,648 (100%)	9,653 (100%)	5,707 (59%)
Lenexa	17,692	2,968 (17%)	2,964 (17%)	17,690 (100%)	8,258 (47%)
Merriam	2,730	1,538 (56%)	0 (0%)	2,496 (91%)	1,589 (58%)
Mission	1,404	1,150 (82%)	0 (0%)	0 (0%)	0 (0%)
Mission Hills	905	522 (58%)	0 (0%)	700 (77%)	583 (64%)
Olathe	19,045	15,366 (81%)	17,103 (90%)	18,931 (99%)	11,026 (58%)
Overland Park	37,252	29,221 (78%)	37,251 (100%)	37,191 (100%)	0 (0%)
Prairie Village	3,312	3,263 (99%)	2,686 (81%)	3,312 (100%)	83 (3%)
Roeland Park	862	24 (3%)	257 (30%)	858 (100%)	0 (0%)
Shawnee	13,844	5,652 (41%)	11,502 (83%)	13,813 (100%)	8,866 (64%)
Spring Hill	1,473	0 (0%)	737 (50%)	1,473 (100%)	293 (20%)
Westwood	407	0 (0%)	0 (0%)	407 (100%)	243 (60%)
Totals	115,994	68,625 (59%)	85,837 (74%)	107,883 (93%)	36,695 (32%)

* - Data required for inspection project

** - Data required for replacement project

Condition Data Standardization

A total of 12 Cities submitted assets with valid field-inspected condition ratings, and these were standardized to a 1 through 5 rating system based on the Pipeline Assessment Certification Program (PACP) condition rating system as shown in **Table 2-5** below. This scale was formulated to be consistent with the National Association of Sewer Service Companies (NASSCO) condition rating system, with 1 being the highest score (asset is in excellent condition) and 5 being the lowest score (asset is failed or near failure).

Table 2-5 Unified Condition Scoring System

Condition		Description
1	Excellent	No noticeable defects. Some aging or wear may be visible. Fully functional.
2	Good	Only minor deterioration or defects are evident. Noticeable wear or aging is visible. Fully functional. Minor maintenance may be required.
3	Fair	Moderate deterioration or defects are evident. Function is not significantly affected. Minor repairs may be required.
4	Poor	Serious deterioration or defects are evident. Function may be significantly affected. Repairs or replacement are required.
5	Near Failure or Failed	Asset has failed or will likely fail within the next five years. Require immediate attention.

Standardization to this scale was done on a City-by-City basis, as approaches to rating asset condition varied by City. The conversion of each City's condition to the unified condition scoring system is shown in **Table 2-6**.

Where condition data was missing, the condition was estimated where the data required for prioritization projects listed in **Table 2-2** were available.

Table 2-6 Mapping of Existing Condition Data to the Unified Condition Scoring System

	Unified Scale	De Soto	Leawood	Lenexa	Merriam	Mission Hills	Olathe	Overland Park	Prairie Village	Roeland Park	Shawnee	Spring Hill	Westwood
Points	1	-	-	Excellent	Excellent	-	>75	-	Excellent Very Good	-	No Deterioration	Excellent	-
	2	Good	Good Rehab Project Complete	Good	Good	Good	>50 and <=75	-	Good	-	-	Good	Good
	3	Fair	Fair	Fair	Fair	Fair	>25 and <=50	-	Fair	-	Minor Deterioration	Fair	Fair
	4	Poor	Poor	Poor	Poor	Poor	>10 and <=25	-	Poor	-	Repair Needed	Poor	Poor
	5	-	Needs Repair	-	-	-	>=0 and <=10	-	Immediate Repair	-	-	-	-
Lines	1	-	-	Excellent	Excellent	-	>75	Excellent	Excellent	Excellent	-	Excellent	-
	2	-	Good	Good	Good	-	>50 and <=75	Good	Good	Good	No Action Needed	-	Good
	3	-	Fair	Fair	Fair	-	>25 and <=50	Fair	Fair	Fair	Monitor	Fair	-
	4	-	Poor	Poor	Poor	-	>10 and <=25	Poor	Poor	Poor	Work Needed	Poor	-
	5	-	Very Poor		-	-	>=0 and <=10	-	-	-	-	-	-

Notes: Cities not listed in this table did not have condition data in the Stormwater_PT or Stormwater_LN geodatabase feature classes.
Blank entries in this table indicate that not suitable existing condition rating was found to convert to the Unified Condition Scale

Material Data Standardization

The material field for both the lines and structures were consolidated into a list of standard materials for the prioritization tool and used to estimate useful life for each asset. The list of standard materials used were taken from NASSCO PACP standard codes for materials of pipes.

A total of 79 different line materials and 119 structure materials were input for material data in the Stomwater_LN and Stormwater_PT feature classes. These were consolidated into 13 materials for lines and 14 materials for structures as documented in **Table 'Lucity.dbo.PWK_MaterialTypeDecode'** in **Appendix A.1**. Where material data was missing for pipes or structures (either left blank or marked as "Unknown", "N/A" or "null"), the asset was assigned a material of 'ZZZ', which is the designation used by NASSCO for pipe material that is unknown and was assigned an assumed useful life.

Structure Type Standardization

The Stormwater_PT feature class included 135 different structure types, and these were converted into a list of 23 standardized structure types, which included an 'Ineligible' category for those structures not eligible for funding. Structure type standardization is documented in **Table 'Lucity.dbo.PWK_StructureTypeDecode'** in **Appendix A.1**.

Pipe Dimensions

The dimensions of the cross sections of pipes included in Stormwater_LN necessary to determine the flow area of the pipes are required data for both inspection and replacement projects as the prioritization script calculates flow area based on these dimensions to determine the 'Impact Potential' component of the consequence of failure (CoF) for each pipe. For circular pipes, which are the most common pipe shape, only the pipe diameter is required to calculate flow area, and where no material data was provided and only one cross section dimension was provided, a circular pipe was assumed. Two dimensions are required for all other shapes, which include elliptical, arch, or rectangular pipes. **Table 2-3** lists the number of lines for each City with at least one pipe dimension listed.

Construction Year Data

A total of 25,394 pipes and 38,071 structures were missing a construction year. Where possible construction year was estimated by the prioritization script using a spatial database of County plats. Assets missing a construction date were assigned the year the plat was established that the asset was located in, if it was located within a plat established 1900 or after. This was based on an assumption that the asset would have been constructed within a reasonable timeframe after the plat was established. Estimated construction years were assigned to 11,443 structures and 10,487 lines using this process.

2.2 Development of Project Prioritization Framework

2.2.1 Risk and Prioritization Criteria

Risk and prioritization criteria were developed with the end goal of assigning a single score to each stormwater asset contained in the AIMS stormwater database. These criteria were generally defined in broad categories by the System Management subcommittee as:

- Service Life
- Quality of Life
- Safety
- Economic Impact

These categories were used to guide development of risk and prioritization criteria for the SAMP. Specifically, the categories were compared to base spatial data available to assign a numerical value to each and then combine these scores into an aggregate prioritization score for each asset.

To accomplish this, a traditional risk-based asset management framework was developed that considers each asset's likelihood of failure (LoF) and Consequence of Failure (CoF). LoF is a measure of an asset's risk to fail and is the measure used to evaluate the subcommittee category 'Service Life'. The remaining categories, 'Quality of Life', 'Safety', and 'Economic Impact' fit within the CoF concept, which is a measure of the impact should an asset fail.

The development of numerical ratings for LoF and CoF are described in the following subsections.

2.2.2 Likelihood of Failure

In a traditional asset management framework, failure is defined as either a structural inadequacy or an inability to provide a required level of service (e.g., as a result of insufficient capacity or improper design). The ability of an asset to meet level of service requirements was not included as a LoF factor. This was done for two reasons:

- First, there is not a County-wide tool (such as a computer model) which can be used to evaluate the level of service of the County's enclosed system.
- Second, projects which reduce flood risk caused by existing stormwater infrastructure not providing an adequate level of service are already funded by the SMP through its Flood Reduction projects, and therefore flood risk is addressed outside of the System Management program.

As the SMP continues to move forward addressing both flooding issues and replacement of deteriorated assets through their respective programs, it may be desirable to provide a single framework for prioritizing projects on the same basis regardless of the need it addresses. Use of the asset management framework developed in this SAMP could provide this consistent basis by incorporating a level of service evaluation into the LoF factor. This would require creation of an enclosed system stormwater model to provide a consistent, County-wide measure of each asset's level of service.

The following subsections generally describe how condition scores will be developed, either by estimating condition for inspection projects or field inspections for replacement projects. Field inspection requirements are expanded upon with more specific requirements in **Section 4.2**.

Estimated Condition Calculation (Inspection Projects)

Estimated condition is required for assets to be eligible for matching funding for inspection projects. The following subsections describe the process for estimating condition using the required data documented in **Table 2-2**.

Lines (Pipes) and Structures

Lines and structures which have the data listed in **Table 2-2** as required for inspection projects will have an estimated condition calculated by the prioritization tool each time the script is run according to the following formula, which is illustrated in **Figure 2-4**:

$$\text{Estimated Condition} = 5 - 4 * \left(\frac{\text{Remaining Useful Life}}{\text{Service Life}}\right)$$

where:

- $\text{Remaining Useful Life} = (\text{Current Year}) - (\text{Year of Asset Construction})$
- Service Life is assigned to each asset based on its material per **Table 'Lucity.dbo.PWK_StructureTypeDecode'** in **Appendix A.1** for structures based on structure type and **Table 'Lucity.dbo.PWK_ServiceLifeLookup'** in **Appendix A.1** for structures and pipes based on likelihood of heavy salt loadings. Service life was reduced by 15 years where metal structures and pipes are assumed to have a heavy salt load. Those metal assets located near critical facilities, which are presumed to contribute a high salt load in winter, were assigned this service life reduction.

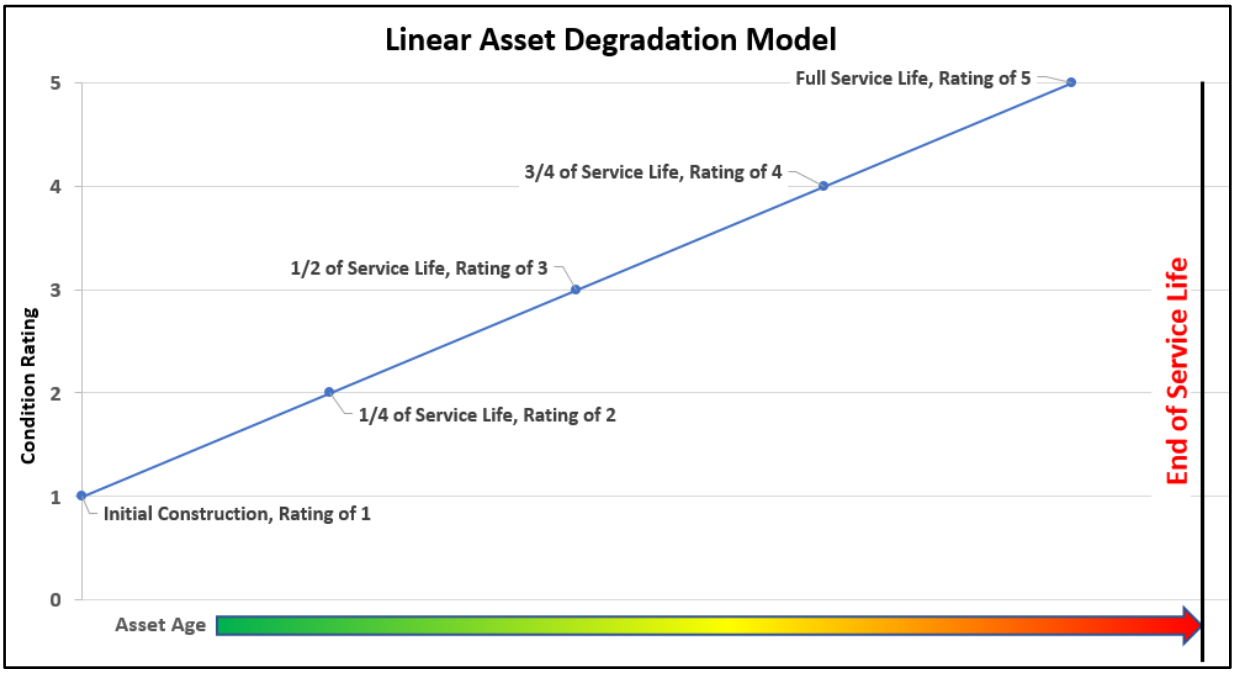

Figure 2-4 Estimated Condition Degradation Model

The degradation of asset condition is modeled linearly because there is no consensus in the industry on how different stormwater asset types (e.g., pipes/structures, materials, site conditions) normally degrade over their service lives or even what their service lives should be. Linear degradation provides a reasonable estimate and it can be easily applied to all asset types with only minimal information required. Initially, the service lives assigned to assets will be based only on the asset type and material. Over time, the SMP may benefit from comparing the estimated scores to the evaluated scores and adjusting the degradation curve and/or the service lives.

Streams

Stream condition will be estimated using a spatial analysis of digital elevation models (DEMs) to identify areas of stream erosion is threatening buildings and major infrastructure. This process is described further in **Section 4.1.2**.

Reservoirs/Dams

KDA requires that owners inspect their dams on a regular basis as part of their normal operations and maintenance, and as such will not be eligible for inspection funding under the System Management funding.

Levees and Floodwalls

Due to their importance to community flood protection, levees and floodwalls are anticipated to be inspected by their owners on a regular schedule as part of their normal operations and maintenance, and as such will not be eligible for inspection funding under the System Management funding.

General Field Inspection Requirements (Replacement Projects)

Field-inspected condition is required for assets to be eligible for matching funding for asset renewal projects. The following subsections summarize the requirements to assess the condition of eligible assets.

Lines (Pipes) and Structures

Lines comprised of enclosed piped system and structures associated with the enclosed system will be evaluated by a standard field inspection. Their condition will be estimated as data required to calculate an estimated condition (shown in **Table 2-2**) is available.

Streams

Streams will be field assessed for condition using the guidance in Section 5606.5 of the Kansas City American Public Works Association (APWA) Stormwater Specifications (APWA 2011).

Reservoirs/Dams

Reservoir dams are eligible for funding to complete repairs, and those eligible for SMP funding are those classified as high-hazard by the KDA. All high hazard dams must be inspected on a periodic basis per state law using a standard inspection form. Scores on this standard form will be converted to a condition rating between 1 and 5.

Levees and Floodwalls

There are 3 known levee and 1 known floodwall systems in the County, and three of the levee systems are accredited with the FEMA. There is not a set standard for inspection of these assets, though the FEMA-accredited levees are required to be inspected on a routine basis. Inspections specific to each of these systems can be submitted to the SMP for a condition rating, and the assignment of a condition rating between 1 and 5 will be done on a case-by-case basis.

2.2.3 Consequence of Failure

The CoF measure attempts to relatively rank, on a 1-5 scale, how the failure of each asset would affect the quality of life, economy, and safety of the community. Because many assets across the County could be in very poor condition, the CoF scores enable the SMP to identify where action is most urgently needed. For instance, the CoF score will prioritize a pipe that is in poor condition which runs beneath an arterial roadway over a pipe in the same condition that runs through an undeveloped field.

Every program-eligible asset that meets the data requirements in **Section 4.1** will be assigned a CoF score by the prioritization script. Unlike the condition, the CoF scores will generally not change over time but they may change as the base data used in the evaluation is updated over time (e.g., road data, utility data, critical facility data).

The CoF for each asset is determined by averaging 2 different scores: Impact Potential and Impact Severity. The 'Impact Potential' score attempts to relatively rank each asset's significance to the stormwater system. For a stormwater system this would typically be done using a stormwater model, which can calculate the magnitude of flows conveyed by stormwater lines. Because such a model does not exist on a County-wide basis, the cross-sectional area of pipes was used as a proxy to quantify 'Impact Potential'. The flow area is calculated from the line shape and dimension data provided by the cities. Stormwater structures are assumed to be sized based on the sizes of incoming and outgoing pipes and so they receive the Impact Potential score of the highest-rated adjacent line. **Table 2-7** shows the flow area ranges and equivalent pipe sizes that correspond to the 1-5 Impact Potential scores.

'Impact Potential' was assigned to structures by assigning the highest pipe 'Impact Potential' score of all pipes which are connected to the structure.

The other half of the CoF evaluation is the 'Impact Severity' score. It attempts to relatively rank the impact of failure caused by individual assets. 'Impact Severity' is scored by evaluating all the different potentially significant impacts that can be measured using the base spatial data that is available. **Table 2-7** lists the six different 'Impact Severity' factors that are scored for each asset on a 1 through 5 scale and describes how they are evaluated. The maximum value from the six factors becomes the Impact Severity score that is then averaged with the Impact Potential score to produce the CoF score.

The six 'Impact Severity' factors, summarized below in **Table 2-7**, include:

- **Public Safety** – this factor is applicable only to Reservoirs/Dams and Levees/Floodwalls, which are assigned a score of 5 by default. This was done intentionally because failure of these assets would likely result in widespread flooding and impacts beyond what is quantifiable using available base data.
- **Impact to Transportation** – scores are assigned to lines and structures where they are in proximity to streets and railroads.
- **Impact to Critical and Non-Critical Facilities** – scores are assigned to lines and structures where they are in proximity to critical and non-critical facilities, Critical facilities were those included in the critical facilities dataset created and maintained by AIMS.
- **Impact to Utilities** - scores are assigned to lines and structures where they are in proximity to electric, drinking water, and sewer lines, as well as major pipelines.
- **Erosion** – this factor only applies to streams and will be assigned a rating of 5 by default where stream erosion is indicated within 25 feet of buildings or major infrastructure by the analysis for estimating stream condition described in **Section 2.2.2 – Estimated Condition Calculation (Inspection Projects)**. This was done to reflect the severity of further stream erosion causing failure of adjacent buildings or infrastructure.
- **TMDL Contribution** – this factor has a maximum score of 3 and is assigned to any metal pipe which is located within a watershed with an impaired waterway assigned a Total Maximum Daily Load (TMDL).

Where these factors are determined based on spatial data, these are calculated by the prioritization script using base data owned and maintained by AIMS. The processes used by the script to determine these factors and the data used are described in detail in **Appendix A.1**.

Table 2-7 Consequence of Failure Factors

Consequence of Failure (CoF) Factors		1	2	3	4	5
Impact Potential (50% of CoF Score)	Significance to the System	**Lines**: 18" or smaller diameter **Structures**: Largest connected pipe 18" or smaller diameter **All Others**: N/A	**Lines**: Between 18" and 36" diameter **Structures**: Largest connected pipe between 18" and 36" diameter **All Others**: N/A	**Lines**: Between 36" and 60" diameter **Structures**: Largest connected pipe between 36" and 60" diameter **All Others**: N/A	**Lines**: Between 60" and 84" diameter **Structures**: Largest connected pipe between 60" and 84" diameter **All Others**: N/A	**All Reservoirs/Dams and Levees/Floodwalls** (by default) **Lines**: Greater than 84" diameter **Structures**: Largest connected pipe greater than 84" diameter **Streams**: Buildings/important infrastructure located within 25 feet of eroded stream
Impact Severity - Maximum of all Impact Severity Scores (50% of CoF Score)	Public Safety	**All:** N/A	**All:** N/A	**All:** N/A	**All:** N/A	**Reservoirs/Dams and Levees/Floodwalls** (by default) **All Others**: N/A
	Impact to Transportation	**Lines and Structures**: Not within 50 feet to a street **All Others**: N/A	**Lines and Structures**: Intersects or within 50 feet of local streets **All Others**: N/A	**All:** N/A	**Lines and Structures**: Intersects or within 50 feet of collector streets **All Others**: N/A	**Lines and Structures**: Intersects or within 50 feet of railroad, highway, or major thoroughfare **All Others**: N/A
	Impact to Critical and Non-Critical Facilities	**Lines and Structures**: Is not under a property associated with a facility **All Others**: N/A	**All:** N/A	**Lines and Structures**: Is under a property associated with a sports facility or cemetery **All Others**: N/A	**Lines and Structures**: Is under a property associated with government offices **All Others**: N/A	**Lines and Structures**: Is under a property associated with critical facilities, hospitals, schools, police, fire, historic sites, landfills, airports, gas stations **All Others**: N/A
		Lines and Structures: Not within 25 feet of a property associated with a facility **All Others**: N/A	**Lines and Structures**: Within 25 feet of a property associated with a cemetery **All Others**: N/A	**Lines and Structures**: Within 25 feet of a property associated with a government office **All Others**: N/A	**Lines and Structures**: Within 25 feet of a property associated with a critical facilities, hospitals, schools, police, fire, historic sites, landfills, airports, or gas stations **All Others**: N/A	**All:** N/A

Table 2-7 Consequence of Failure Factors (continued)

Consequence of Failure (CoF) Factors		1	2	3	4	5
Impact Severity - Maximum of all Impact Severity Scores - (50% of CoF Score)	Impact to Utilities	**Lines and Structures**: No proximity or crossings **All Others**: N/A	**Lines and Structures**: Towers/Poles **All Others**: N/A	**All:** N/A	**Lines and Structures**: Drinking Water/Sewer **All Others**: N/A	**Lines and Structures**: Major Pipelines **All Others**: N/A
	Erosion	**Streams**: Not within an area of high erosion potential **All Others**: N/A	**All:** N/A	**All:** N/A	**All:** N/A	**Streams**: Buildings/important infrastructure located within 25 feet of eroded stream **All Others**: N/A
	TMDL Contribution	**Lines**: Not CMP or CMP Pipe not within EPA 303(d) stream watershed **All Others**: N/A	**Lines**: Any CMP pipe **All Others**: N/A	**Lines**: CMP pipe within watershed within an EPA 303(d) impaired stream **All Others**: N/A	**All:** N/A	**All:** N/A

2.2.4 Stormwater Asset Risk Scoring

All eligible stormwater assets with sufficient data will be given a risk score by the prioritization script, and assets without sufficient data will not receive a risk score. Risk is a relative measure formulated as a weighted combination of the LoF and CoF scores and ranges from 1 through 5:

$$\text{Individual Asset Risk} = 0.65 * \text{LoF} + 0.35 * \text{CoF}$$

Risk scores should guide the Cities and Watershed Organizations in the creation of projects and they will be the primary basis by which inspection and replacement projects are formulated and prioritized.

This formula more heavily weights LoF with a 65% weight and assigns CoF a 35% weight. The weightings were developed by considering the relative importance of each unique combination of LoF and CoF. Color-coded risk bands, shown in **Figure 2-5** below, were developed to identify when action should be taken, and how critical action has become for an asset, and then the weightings that produced numeric results consistent with the risk bands were identified. The goal was to develop risk bands that can be used to communicate different levels of urgency and drive appropriate actions. The resulting risk levels are shown in **Figure 2-5** below.

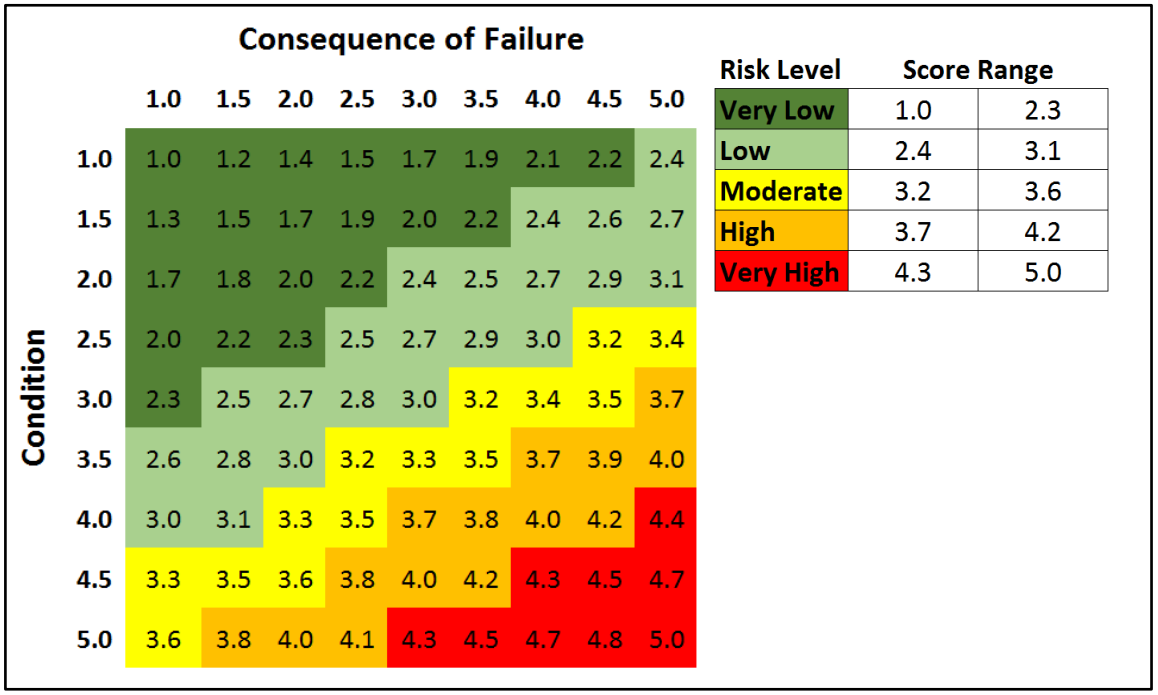

Figure 2-5 Risk Level Bands

Figure 2-5 illustrates risk levels for many different combinations of LoF and CoF and the effect of the weighted risk score. Assets that are with a high LoF and low CoF are higher risk than assets with low LoF and high CoF. **Table 2-8** below summarizes the number of assets falling within each risk level category for the asset database received on October 26, 2018 for eligible, City and County-owned assets with both field-inspected condition provided by Cities and estimated condition calculated by the prioritization script.

Table 2-8 Number of Assets within Each Risk Band

		Estimated Condition Calculated by Prioritization Script		Field-Inspected Condition Provided by Cities	
Risk Level	Risk Score Range	Number of Eligible Structures	Number of Eligible Lines	Number of Eligible Structures	Number of Eligible Lines
Very Low	1.0 – 2.3	26,548	29,119	24,148	19,731
Low	2.4 – 3.1	14,721	14,504	9,236	15,068
Moderate	3.2 – 3.6	3,471	3,619	1,206	2,497
High	3.7 – 4.2	1,546	1,923	606	1,760
Very High	4.3 – 5.0	475	666	16	212

Note: The sum of all assets listed in this table do not equal the sums of assets in Tables 2-3 and 2-4, and this is because of data gaps which prevented either estimation of LoF (such as missing year constructed) or calculation of CoF (such as missing pipe dimensions).

2.2.5 Prioritization Computer Script

The LoF, CoF, and risk score calculations will all be calculated by a prioritization computer script. This script was coded in SQL, as this language has robust database manipulation and spatial capabilities. When run, this script does the following:

- Reads the latest version of the stormwater asset database and standardizes data as necessary (for data received prior to January 1st, 2020 not complying with the standards set forth in **Section 4.1**)
- Using the standardized data, calculates scores for both LoF and CoF
- Calculates the risk score for each asset based on the LoF and CoF scores, using the weighting described in **Section 2.2.4**
- Output ESRI ArcGIS feature classes with the results of the script

The development of the script and its procedures and functionality are described in detail in **Appendix A.1**, and a final digital version of the script is included in **Appendix B**. It is anticipated that AIMS will own and maintain this script. The script relies on multiple lookup and decoding tables, and these should be checked periodically for their continued appropriateness. These tables were developed based on the best available information as part of the SAMP, but as the System Management program progresses, it may become necessary to modify these tables. Any modifications to these tables should be initiated by SMP and the revised script outputs checked for appropriateness. **Section A.1.3** in **Appendix A** defines how these tables should be edited.

2.2.6 Stakeholder Coordination and Scoring Validation

Two stakeholder meetings were conducted on September 6, 2018 and October 30, 2018 to solicit feedback and discuss the formation of the SAMP. These meetings convened the SAMP subcommittee, whose membership was comprised of City representatives, engineering consultants, and County staff from SMP, PWK, and AIMS. Meeting minutes from each are included in **Appendix B**, and below are brief overviews of topics discussed and key takeaways from each of the meetings:

Meeting 1 – September 6, 2018

The first SAMP subcommittee meeting generally covered more technical topics, including data collection and gaps, condition ratings, and the prioritization framework. The following were presented for feedback:

- **Summary of SAMP Progress**
  - Existing data in the AIMS stormwater geodatabase and that data collected and compiled from Cities were summarized, and data gaps presented.
  - Preliminary concepts on how natural stormwater elements would be incorporated into the System Management program were presented. These elements included streams, riparian areas, and wetlands, as well as non-natural detention basins and reservoirs assets, were described.

Wetland and detention basin assets were described as assets which would be inventoried in the AIMS geodatabase but not eligible for inspection or renewal project funding.

Streams and riparian areas were proposed to be grouped together, and strategies for prioritizing these combined stream assets, as well as reservoirs, were presented.

- Feedback from Subcommittee: The subcommittee asked that levees be included in the asset registry.
  - Action taken: Levees have been incorporated into the stormwater geodatabase.
- Feedback from Subcommittee: The subcommittee asked that reservoirs and levees be prioritized using the same framework and factors as all other stormwater assets.
  - Action taken: Reservoirs and levees were included in the overall prioritization framework consistently with other assets, with an LoF score assigned as described in **Section 4.1.3** and a CoF score assigned as shown in **Table 2-7**.

- A draft of the unified condition assessment table was also presented.
  - Feedback from Subcommittee: The subcommittee asked that a rating of 5 not be called "failed", but that a term like "Near failure" or "At failure" be used.
    - Action taken: As shown in **Table 2-5**, the condition description for a rating of 5 was changed to "Near Failure or Failed".
  - Feedback from Subcommittee: Cities struggle to achieve consistency in their condition ratings, and it was requested that the SAMP document clearly outline requirements for inspections to promote consistency in condition ratings.
    - Action taken: Specific requirements for field inspections were developed and are provided in **Section 4.1.3** to help address this issue. Specifically, this section requires NASSCO inspection criteria for the enclosed system, and this provides a nationally-recognized standard for the storm sewer system. Additionally, Kansas City APWA 5600 criteria, which were created and are used by local experts, are required for stream inspections, and dam inspections already being completed to fulfill state inspection requirements are used for Reservoir/Dam assets. Together, these inspection requirements are anticipated to promote County-wide consistency in condition ratings.

- **Asset Prioritization**
  - A draft of the asset prioritization framework, including the process to calculate LoF, CoF, and overall risk score was presented for feedback. Following the meeting, draft results from the prioritization script which employed this draft framework were provided as digital geodatabase files as well as PDF maps.
    - Feedback from Subcommittee: No feedback was received on the draft framework or the draft prioritization results.

Meeting 2 – October 30, 2018

The second SAMP subcommittee meeting generally covered topics related to policies and procedures for the System Management subcommittee, as described below:

- **Basic Program Details**
  - A definition for the System Management program was given, and eligible assets presented.
    - Feedback from Subcommittee: The subcommittee requested that all publicly-owned reservoirs, regardless of size, be included as eligible for projects.
      - Action taken: All reservoirs registered with KDA in the County were added to the stormwater geodatabase, which is included in **Appendix B**.
  - Inspection requirements for all eligible assets were discussed. For the enclosed system, NASSCO standards were proposed, and standards for the other assets using existing protocols were presented.
    - Feedback from Subcommittee: The subcommittee expressed concern with requiring MACP standards be used for stormwater structures. Patrick Beane stated that JCW does not require MACP inspections as it was felt that the standard requires a more comprehensive inspection than they felt was necessary.
      - Action taken: The requirements for structure inspections were reduced from full MACP compliance to simply requiring that all elements of, and defects in, a structure be inspected, documented with photos, coded using MACP procedures, and assigned a condition score. These requirements are described more fully in **Section 4.1.3**.
    - Feedback from Subcommittee: The subcommittee asked for clarification if matching funds will be provided for inspections of eligible assets by City staff.
      - Action taken: Inspections performed by City staff are recommended to be reimbursed at a 50-percent rate based on submitted City inspections as described in **Section 3.1.3**.

- **Project Eligibility, Formulation, Submittal, and Funding**

  - Project eligibility, formulation, submittal, and funding procedures were presented. Eligible assets were described as those which meet a minimum risk score, which was proposed to be initially set at 3.2 for both inspection and renewal projects. Two options were then outlined for submittal requirements: one which requires an engineering study to set a project budget, and one which does not require such as study but sets the budget based on the unit cost model (described in **Section 3.2** below).

    - Feedback from Subcommittee: The subcommittee expressed a desire to set project budgets and determine SMP and City funding based on the prioritization script's implementation of the unit cost model.

  - Projects were described as being submitted by Watershed Organizations, and not Cities themselves, and approved projects may be dropped from the SMP's CIP if the City does not maintain communication about it for a period of 12 months.

    Three funding options were also presented for subcommittee consideration. The first was to fund some projects deemed to be of County importance fully with System Management funds. Second, a procedure for funding projects with multiple benefits (i.e. that both replace deteriorated assets and provide flood reduction) was outlined. Finally, funding of private assets was brought up for consideration.

    - Feedback from Subcommittee: The subcommittee did not want to pursue funding renewal of private assets, nor did it want to allow funding of projects with multiple benefits under the System Management program and felt that asset replacement projects which address flooding are more appropriately funded by the SMP's Flood Reduction Program. Finally, the subcommittee did not want to pursue full funding of projects deemed to be of County importance.

2.3 Unit Cost Model Development

A unit cost model was developed to provide a high-level estimate of the cost to replace eligible assets. Only replacement costs were developed for this model. Unit costs developed included the following:

- Surface Demolition and Restoration (turf or asphalt pavement)
- Excavation (for the asset being replaced only)
- Asset Material
- Labor
- A 40-percent contingency
- A 15-percent engineering fee

This model was created based on unit costs provided in bid tabs from Kansas Department of Transportation (KDOT) and Missouri Department of Transportation (MODOT) bid tabs from 2013 through 2018 as well as bid tabs from two SMP-funded projects in 2018. The SMP-funded projects included the Lamar Avenue (95th Street to 92nd Street) Major Storm Sewer Repair and the 89th Terrace and Outlook Drive to Reeds Road Storm Sewer Repair. The relevant items from these bid tabs are included in in **Appendix A.2**.

Quantities for surface demolition and restoration and excavation for pipes were developed based on the size of the pipe. The excavation volume for each asset type was estimated in cubic yards. Excavation of the assets was assumed to be a trapezoidal shape with 2:1 side slope (ratio of 2 units horizontal to 1 unit vertical). A depth of one foot was also assumed to be under the asset with the same width of the asset for bedding aggregate material. The crown of pipes were assumed to be buried two feet beneath the ground surface.

The square yardage of pavement needed to replace the pavement demolished for assets located under roadways was also estimated based on the size of the asset using the area of the top of the pipe excavation times the length of the pipe. Prices from years prior to 2018 were inflated to 2018 costs based on Engineering News-Record (ENR) Cost Index for Kansas City, Missouri, as shown in **Table 2-9**. These quantities were given a standard value for structures.

Table 2-9 Historical ENR Cost Indices – Kansas City, Missouri

Year	Construction Cost Index (CCI)
2018	11,415.62
2017	11,372.83
2016	11,262.49
2015	10,965.06
2014	10,882.57
2013	10,691.12

Using these prices, unit costs were developed for three cases:

- Assets located under paved roadways
- Assets located under turf (i.e. all assets not beneath paved roadways)
- Assets located near railroads

Excavation costs for pipes near railroads were estimated based on the cost of jack and bore excavation. These costs were only available in the bid tabs referenced for some of the pipe sizes, so to estimate a full range of pipes, linear interpolation was used to generate an equation based on the pipe diameter to determine the cost of any size diameter pipe.

Prices for larger stormwater pipes (greater than 48-inches) and for very large end sections (larger than 72-inches) were not included in the available bid tabs. To get a better estimate of prices for these assets, CostWorks and other applicable databases were used to obtain unit prices.

Unit cost tables were developed for stormwater pipe sizes ranging from 12-inch diameter to 84-inch diameter, five different structures, and 15 different sizes of reinforced concrete boxes. Bridges were not included since they would be very case specific and there could not be one estimated unit cost associated with all bridges. A summary of unit costs for each of these assets can be seen in **Tables 2-10** through **2-12**. Outfalls (end sections) were broken down based on the Impact Potential (flow area size) associated with the end section. These prices can also be seen in **Table 2-13**.

The Stormwater_LN database includes pipes with dimensions which are not exact matches with the dimensions listed in **Tables 2-10** and **2-11**, and in such cases the unit costs were applied for a range of flow areas as specified in the column 'Applicable Flow Area Range'.

The prioritization script then uses these tables to calculate a replacement cost for eligible assets and outputs it to the field 'ReplCost' as described in **Section 4.1.4**. This cost is not rounded by the script, and this was done so that any rounding can be completed by SMP staff as appropriate for individual projects.

Table 2-10 Summary of Circular Pipe Costs

Line Diameter (Storm Sewer or Culvert)	Flow Area, square inches	Applicable Flow Area Range, square inches	Cost per Linear Foot Under Pavement	Cost per Linear Foot Not Under Pavement	Cost per Linear Foot near Railroad
12	113.1	<=113.1	$400	$300	$800
15	176.7	>113.1 and <=176.7	$400	$300	$900
18	254.5	>176.7 and <=254.5	$500	$400	$1,000
21	346.4	>254.5 and <=346.4	$500	$400	$1,100
24	452.4	>346.4 and <=452.4	$500	$400	$1,100
30	706.9	>452.4 and <=706.9	$600	$400	$1,200
36	1,017.9	>706.9 and <=1,017.9	$800	$500	$1,400
42	1,385.4	>1,017.9 and <=1,385.4	$900	$600	$1,600
48	1,809.6	>1,385.4 and <=1,809.6	$1,100	$800	$1,800
60	2,827.4	>1,809.6 and <=2,827.4	$1,600	$1,100	$2,700
66	3,421.2	>2,827.4 and <=3,421.2	$1,800	$1,300	$3,000
72	4,071.5	>3,421.2 and <=4,071.5	$2,100	$1,500	$3,300
84	5,541.8	>4,071.5 and <=5,541.8	$2,800	$2,100	$4,100
96	7,238.2	>5,541.8 and <=7,238.2	$3,800	$2,900	$5,200

Table 2-11 Reinforced Concrete Box Unit Costs

RCB Description	Flow Area, square inches	Applicable Flow Area Range, square inches	Cost per Linear Foot Under Pavement	Cost per Linear Foot Not Under Pavement
Reinforced Concrete Box (4' X 3') (Precast)	1,728	<=1728	$1,200	$900
Reinforced Concrete Box (5' X 3') (Precast)	2,160	>1,728 and <=2,160	$1,600	$1,200
Reinforced Concrete Box (6' X 3') (Precast)	2,592	>2,160 and <=2,592	$1,200	$900
Reinforced Concrete Box (7' X 3') (Precast)	3,024	>2,592 and <=3,024	$1,700	$1,300
Reinforced Concrete Box (8' X 3') (Precast)	3,456	>3,024 and <=3,456	$1,700	$1,200
Reinforced Concrete Box (9' X 3') (Precast)	3,888	>3,456 and <=3,888	$1,900	$1,400
Reinforced Concrete Box (10' X 3') (Precast)	4,320	>3,888 and <=4,320	$1,900	$1,400
Reinforced Concrete Box (4' X 8') (Precast)	4,608	>4,320 and <=4,608	$2,000	$1,500
Reinforced Concrete Box (12' X 3') (Precast)	5,184	>4,608 and <=5,184	$3,000	$2,300
Reinforced Concrete Box (7' X 6') (Precast)	6,048	>5,184 and <=6,048	$2,800	$2,100
Reinforced Concrete Box (7' X 7') (Precast)	7,056	>6,048 and <=7,056	$3,200	$2,400
Reinforced Concrete Box (10' X 5') (Precast)	7,200	>7,056 and <=7,200	$3,000	$2,200
Reinforced Concrete Box (8' X 8') (Precast)	9,216	>7,200 and <=9,216	$3,300	$2,400
Reinforced Concrete Box (8' X 10') (Precast)	11,520	>9,216 and <=11,520	$4,300	$3,200
Reinforced Concrete Box (8' X 12') (Precast)	13,824	>11,520 and <=13,824	$7,000	$5,800

Table 2-12 Structure Eligibility and Unit Costs

Script Structure	Unit Cost Name	Unit Cost Under Pavement	Unit Cost Not Under Pavement
Area Inlet	Area Inlet	$8,400	$8,400
Curb Inlet	Curb Inlet	$7,000	$7,000
Drop Inlet	Drop Inlet	$5,300	$5,300
Inlet	Curb Inlet	$7,000	$7,000
Junction Box/Manhole	Junction Box	$9,200	$9,200
Outfall	End Section (dependent on pipe flow area)	N/A	N/A
Simple Junction	Junction Box	$9,200	$9,200

Table 2-13 Structure Outfall Unit Costs Based on Impact Potential Rating

Outfall Pipe Size	Unit Cost
18-inches or Less	$1,300
18- to 36-inch	$1,900
36- to 60-inch	$4,300
60- to 84-inch	$8,500
Greater than 84 inch	$11,500

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Section 3

System Management Program Policies and Procedures Overview

3.1 Program Structure

3.1.1 Eligibility Requirements and Funding

Tier 1: Program Standards

Stormwater assets which are eligible for SMP inspection and replacement funding generally include all *City- and County-owned* engineered assets:

- Structures
  - Inlets (all kinds)
  - Manholes
  - Junction boxes
  - Outfalls
- Lines
  - Enclosed system pipes (where one asset is comprised of all pipe lengths between two structures)
  - Culverts
- Streams (stabilization projects where erosion is threatening buildings or major infrastructure)
- Reservoirs/Dams classified as 'High Hazard' by the Kansas Department of Agriculture (eligible for funding to repair only)
- Levees and floodwalls (eligible for funding to repair)

Assets which are submitted for repair or replacement funding will be eligible only if they have been field inspected. The System Management program will only replace assets which are structurally deteriorated, and assets with issues related to deficient operations and maintenance or issues which are distinctly operational are not eligible for System Management funding.

Other stormwater system elements, such as detention basins, wetlands, structure types not included in the above categories, and privately-owned assets will be inventoried in the AIMS dataset but will not receive program funding.

Tier 2: Considerations

At the inception of the System Management program, private assets will not be eligible for inspection or renewal funding. However, should the SMP desire to make them eligible in the future, it is recommended to only include only those private assets which are significant to the stormwater system. Assets which are significant to the system would be recommended to be defined as those which receive runoff from at least 2 acres of drainage area. Because the SMP and the partnering City would be managing construction on private property, consideration should be given to limit the County's liability and potential presumed ownership of stormwater assets due to its involvement in construction of assets on private property. Potential strategies could include:

- Requiring Cities to acquire easements for the new stormwater assets and take ownership of the assets
- Requiring that all new stormwater assets be constructed in City-owned land such that private assets are 'replaced' by routing stormwater around private property
- Creation of public-private partnerships which legally define future ownership, roles, and responsibility with private asset owners

3.1.2 Project Formulation (Inspection and Replacement) and Submittal Process

Tier 1: Program Standards

The System Management program will fund two types of projects: inspection projects and renewal projects. Renewal projects can involve repair or replacement of assets, as appropriate, and for an asset to be eligible for a renewal project it is required that field inspection of the asset to determine its condition be completed.

Because of this eligibility requirement, the System Management Program will also fund field inspections of assets. Assets without inspection data will be prioritized using a linear degradation model which estimates condition based on the age of the asset and its material. The following data is required to estimate condition:

- Year of Construction
- Material

Watershed Organizations are entitled to submit projects for matching funding under the System Management program. To ensure fairness and the consistency of project evaluations, only assets that have been assigned a risk score by the SMP using the prioritization approach described in **Section 2.2** may receive program funding. Assets with high risk scores can be addressed individually or multiple assets may be grouped into a project.

There are no restrictions on the assets that can be included in a project; however, the only assets that will factor into the project prioritization and that will receive funding are those that meet the eligibility criteria and that have a sufficiently high risk score. This allows Cities to assemble projects based on any logic or criteria that are important to them (e.g., paving schedules, including adjacent assets that are not yet in poor condition) and allows the SMP to make direct comparisons of the projects and direct the limited program funds towards the highest risk assets in the County. The initial minimum risk scores recommended for program funding are as follows:

- Asset renewal funding risk score threshold: **3.2**
- Asset inspection funding risk score threshold**: 3.2**

The number of eligible assets meeting these thresholds in the October 26, 2018 version of the AIMS stormwater geodatabase within each City are summarized below in **Table 3-1**. In each cell, the number of assets with risk scores at or greater than 3.2 are totaled and then followed by a percentage in parenthesis which is the number of assets with risk scores at or greater than 3.2 divided by total assets in the database.

Table 3-1. Assets with Risk Score Greater than or Equal to 3.2 by City

City	Total Eligible Assets in Database Received (October 26, 2018)		Assets Eligible for Inspection (Risk > 3.2)		Assets Eligible for Replacement (Risk > 3.2)	
	Lines	Structures	Lines	Structures	Lines	Structures
Bonner Springs	18	20	0 (0%)	0 (0%)	0 (0%)	0 (0%)
De Soto	566	719	117 (2%)	45 (1%)	0 (0%)	1 (%)
Edgerton	1,025	1,246	22 (%)	8 (%)	0 (0%)	0 (0%)
Fairway	302	334	0 (0%)	5 (%)	0 (0%)	0 (0%)
Gardner	3,257	3,627	263 (4%)	199 (3%)	0 (0%)	0 (0%)
Unincorporated Johnson County	2,245	1,359	91 (1%)	23 (%)	0 (0%)	0 (0%)
Lake Quivira	94	110	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Leawood	8,897	9,653	332 (5%)	139 (2%)	622 (10%)	426 (7%)
Lenexa	15,722	17,692	828 (13%)	287 (5%)	1,029 (17%)	344 (6%)
Merriam	2,421	2,730	63 (1%)	135 (2%)	135 (3%)	73 (1%)
Mission	1,329	1,404	0 (0%)	49 (1%)	0 (0%)	0 (0%)
Mission Hills	784	905	80 (1%)	106 (2%)	0 (0%)	17 (%)
Olathe	17,154	19,045	669 (11%)	1,011 (16%)	1,747 (28%)	57 (1%)
Overland Park	34,156	37,253	1,926 (31%)	2,393 (39%)	184 (3%)	0 (0%)
Prairie Village	3,544	3,312	201 (3%)	288 (5%)	16 (%)	9 (%)
Roeland Park	660	862	268 (4%)	364 (6%)	21 (%)	0 (0%)
Shawnee	12,124	13,849	1,055 (17%)	286 (5%)	628 (10%)	843 (14%)
Spring Hill	1,278	1,473	1 (%)	0 (0%)	37 (1%)	30 (%)
Westwood	338	407	254 (4%)	116 (2%)	0 (0%)	28 (%)
Totals:	105,914	116,000	6,170 (6%)	5,454 (5%)	4,469 (4%)	1,828 (2%)

Risk score thresholds for projects are anticipated to be adjusted in the future to maintain focus on replacing the highest risk assets in the stormwater system while considering the availability of condition data and distribution of risk scores. The initial threshold risk scores of 3.2 represent a lower barrier for obtaining asset inspection funding and reflect uncertainty due to:

- Lack of condition data from field inspections, as only 35-percent of inventoried stormwater assets have valid condition data which could be mapped to the 1 through 5 condition rating scale shown in **Table 2-6**, and
- Uncertainty in the risk scores calculated for assets without field condition data, as their overall risk score is based on estimated condition as described in **Section 2.2.2**.

These thresholds may be adjusted over time depending on the budgets for inspection and replacement work and the changing number of inspected and uninspected assets above these risk levels across the County.

To request program funds for either replacements or inspections, the asset data and prioritization script results provided by the SMP must be used. Program participants should review the risk score results and consider the threshold values above when selecting assets for replacement and inspection funding. All System Management projects will be coordinated by the Cities through the Watershed Organizations to formulate a watershed-based prioritization, and requests for funding will be submitted to the SMP by the Watershed Organizations.

The program-eligible portion of each project will be calculated in the project template by totaling the replacement or inspection cost of all assets with a risk score above the thresholds noted above. This project template, which is in Excel workbook format, is described in detail and included in **Appendix C**. The SMP will compile and review the proposed projects, will consider their budget for inspection and replacement projects and will select projects according to the process described below.

The project template workbook is password protected so that calculation fields and the risk threshold cannot be modified. The SMP should maintain the project template by updating the risk threshold, should it change, on the ***Renewal Project Assets*** and the ***Inspection Project Assets*** tabs. The password for each sheet has been set to "2018risk".

Project Risk Score

Tier 1: Program Standards

Risk, as defined in **Section 2.2.1**, is the prioritization factor the SMP will use to evaluate projects and award inspection and replacement funding. Each asset that is included in a project will have its own risk score. The risk scores for assets that are eligible for funding will be aggregated to establish a project-level risk score which will be used for project ranking. The project level risk score is the cost-weighted average of the asset-level risk scores, as shown below.

$$\text{Project Risk} = \frac{(\text{Asset1 Risk}) * (\text{Asset1 Cost}) + (\text{Asset2 Risk}) * (\text{Asset2 Cost}) + \cdots + (\text{AssetN Risk} * \text{AssetN Cost})}{(\text{Asset1 Cost}) + (\text{Asset2 Cost}) + \cdots + (\text{AssetN Cost})}$$

Cost-weighted averaging is used to develop the project risk score so that the scores associated with the most expensive items are weighed more heavily than the scores for the least expensive items. The costs noted in the equation above are the estimated renewal or inspection costs (as applicable). The prioritization script will assign costs to each asset based on attribute data provided by Cities (e.g., size, length) and a unit cost model, which is described in **Section 2.4**.

An example of a hypothetical project formulated using the weighted project risk calculation is shown below in **Figure 3-1** and **Table 3-2**. For this example project, an area was chosen where multiple assets were presumed to have been inspected and prioritized using the Asset Prioritization SQL Script (**Appendix A.1**). The script was used to assign the estimated total cost and risk scores for each asset in **Table 3-2**, and assets were grouped by type and size, per the 'Description' column, and risk score such that there can be multiple entries in the table for the same type and size of stormwater asset. This was done to illustrate the project risk score calculation. For example, the aggregate risk score for 15-inch stormwater pipes in the example projects would be calculated as:

$$\text{Example Project Risk, 15 inch RCP only} =$$

$$\frac{(\$8{,}107 * 3.3) + (\$16{,}556 * 3.5) + (\$86{,}397 * 4.0)}{\$8{,}107 + \$16{,}556 + \$86{,}397} = 3.9$$

This same calculation was completed for each group of eligible assets and a final project score for assets with risk scores of 3.2 or higher was calculated to be 3.8. The System Management program would then fund 50-percent of the costs to replace the eligible assets within the project at $1,338,011. Because in this example the City has elected to include assets which do not meet the risk score of 3.2, and because the City would be responsible to fund replacement of these assets at their own cost, this match represents funding of 33-percent of the entire project.

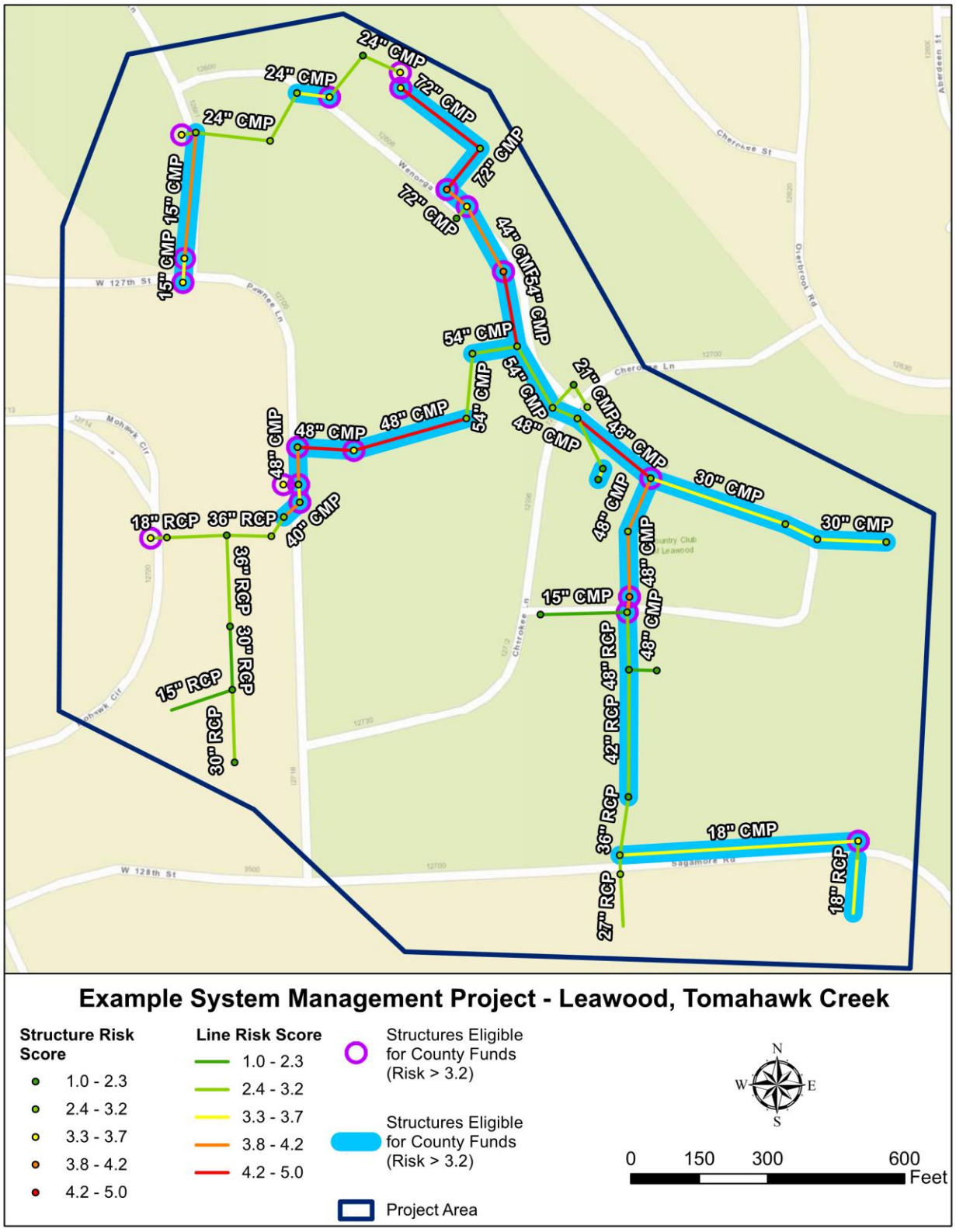

Figure 3-1 Example System Management Project

Table 3-2 Example System Management Table Cost-weighted Score

Description	Unit	Quantity	Estimated Total Cost to Replace	Risk Score
Eligible Assets				
Lines				
15" Stormwater Pipe (RCP)	LF	26	$8,107	3.3
15" Stormwater Pipe (RCP)	LF	53	$16,556	3.5
15" Stormwater Pipe (RCP)	LF	277	$86,397	4.0
18" Stormwater Pipe (RCP)	LF	682	$253,815	3.7
24" Stormwater Pipe (RCP)	LF	72	$31,095	3.7
30" Stormwater Pipe (RCP)	LF	540	$282,088	3.7
42" Stormwater Pipe (RCP)	LF	211	$152,054	3.8
42" Stormwater Pipe (RCP)	LF	279	$200,772	3.2
42" Stormwater Pipe (RCP)	LF	164	$117,945	3.8
48" Stormwater Pipe (RCP)	LF	185	$167,292	3.2
48" Stormwater Pipe (RCP)	LF	387	$349,973	3.8
54" Stormwater Pipe (RCP)	LF	255	$231,022	3.2
54" Stormwater Pipe (RCP)	LF	167	$174,665	4.5
72" Stormwater Pipe (RCP)	LF	58	$71,622	4.0
72" Stormwater Pipe (RCP)	LF	219	$272,787	4.5
72" Stormwater Pipe (RCP)	LF	116	$144,365	4.7
Structures				
Area Inlet	Each	1	$7,242	3.5
Curb Inlet	Each	5	$30,054	3.2
Curb Inlet	Each	1	$6,011	3.3
Curb Inlet	Each	1	$6,011	3.4
Curb Inlet	Each	3	$18,032	3.5
Curb Inlet	Each	3	$18,032	3.7
Curb Inlet	Each	2	$12,022	3.8
Curb Inlet	Each	1	$6,011	4.0
Outfall	Each	1	$6,026	4.0
Outfall	Each	1	$6,026	4.0
Total Eligible Costs			**$2,676,022**	-
Potential SMP Match (50% of Costs to Replace Eligible Assets)			**$1,338,011**	-
Cost Weighted Project Risk Score				**3.8**

Table 3-2 Example System Management Table Cost-weighted Score (cont.)

Description	Unit	Quantity	Estimated Total Cost to Replace	Risk Score
Non-Eligible Assets				
Lines				
15" Stormwater Pipe (RCP)	LF	490	$152,653	N/A
18" Stormwater Pipe (RCP)	LF	235	$87,532	N/A
21" Stormwater Pipe (RCP)	LF	58	$24,177	N/A
24" Stormwater Pipe (RCP)	LF	621	$269,608	N/A
30" Stormwater Pipe (RCP)	LF	454	$237,075	N/A
36" Stormwater Pipe (RCP)	LF	477	$301,278	N/A
54" Stormwater Pipe (RCP)	LF	143	$149,414	N/A
Structures				
Area Inlet	Each	14	$101,388	N/A
Curb Inlet	Each	15	$90,161	N/A
Junction Box	Each	3	$23,983	N/A
Total Ineligible Costs (100% City-funded)			**$1,437,268**	-
Total Project Cost			**$4,113,290**	-
Potential SMP Match			**$1,338,011**	-
Potential SMP Match Overall Percentage			**33%**	-

*Contingency assumed to be 40%

**Subtotal and total costs have been rounded.

***Assets with a score of 3.2 or higher are assumed eligible in this example

****Legal, Administrative, and other overhead costs are not included

A similar process for inspection projects will be employed, where the cost to inspect each asset is substituted for its replacement cost in the project risk score calculation. For structures, the recommended average cost to inspected is $150, and for lines the recommended average cost to inspect is $550.

Project Prioritization

Tier 1: Program Standards

The SMP ultimately retains the ability to choose any submitted projects with eligible assets defined by the program as high risk (i.e. have a risk score above the project funding risk score threshold) for inclusion in its 5-year CIP. The prioritization tool and project formulation guidelines create a pool of projects for inspection or renewal of high risk assets, and the risk scores provide a means of prioritizing projects. As such, it is recommended that the SMP follow the risk score rankings to prioritize projects in most cases such that the projects with the highest risk scores are the highest priority to receive funding. Consistent use of this approach is anticipated to encourage Cities to address the highest risk assets, as doing so will make their projects most competitive for funding.

However, because the SMP is dependent upon Cities providing a local match to be able to fund projects, and because this funding is outside of the control of the SMP, operational flexibility will be key to success of the program and allowing the SMP to choose from the pool of eligible, high risk projects will help to provide it. This will also allow the SMP to take advantage of opportunities as they arise, such as speeding up implementation of a project where a road replacement project coincides with a proposed project area. This scenario would help cover demolition and restoration costs associated with stormwater asset replacement, effectively increase the level of funding provided by a City, benefitting the SMP as a whole.

The base factors which will be considered when choosing projects are:

- Project risk score
- Availability of funding (both City and SMP matches)
- Percentage of City match, if higher than base 50-percent

Additional factors will also be considered, especially when two or more projects are nearly identical in terms of the base prioritization factors. These include:

- Effect of project on water quality and flood control
- Age of assessment dates, where the condition of assets with older assessments are presumed to have a higher level of deterioration
- Potential for impacts on gas and electric utilities should project assets fail

PWK may also submit its own projects to address high risks for assets owned by the County.

Tier 2: Considerations

Because System Replacement projects may replace assets which are not only deteriorating but also do not provide an acceptable level of service, it may be desirable to consider allowing for an increase in capacity of the stormwater system when replacing assets. This approach would promote overall resiliency by decreasing risk of structural failure while also reducing flood risk. Because the System Management program intends to fund only in-kind asset replacements, the SMP could incentive projects which reduce flood risk using one of the following approaches:

- Providing additional matching funds to cover the incremental cost of increasing the system's capacity
- Adding additional points to the overall project risk score
- A combination of both approaches

It is also recommended that any project which has the potential to increase downstream flows would require a study to determine any potential downstream effects as well as any measures required to mitigate increased downstream flood risk.

Project Design Standards

Tier 1: Program Standards

All projects funded by the SMP will be required to use relevant specifications and design criteria from the Kansas City Metropolitan Chapter APWA Standard Specifications & Design Criteria. All replacement projects must construct either reinforced concrete or high-density polyethylene (HDPE) pipes and structures. The use of corrugated metal pipe will not be allowed for a System Management-funded project. Exceptions to these specifications will be necessary to meet material requirements and allow for in-kind replacement of stormwater assets, including:

- Section 2600 - Storm Sewers (dated February 15, 2017)
  - Exclude:
    - 2602.2 B – Corrugated Metal Pipe
    - 2602.2 C – Structural Plate Pipe and Pipe Arches
    - 2605.2 D & 2605.3 E – Gabion Baskets
- Section 5600 - Storm Drainage Systems & Facilities (dated February 16, 2011)
  - Exclude:
    - 5601.8 A – Protection of Property
    - 5601.8 B – Protection for Streets

Should the SMP decide to incorporate performance of the stormwater system as a Likelihood of Failure factor in the future, these exceptions may need to be revisited to determine if they are still appropriate. Considerations related to incorporating system performance as a Likelihood of Failure factor are discussed in **Section 4.4**.

3.1.3 SMP Matching Funding

Tier 1: Program Standards

The SMP will fund inspections of stormwater assets which have a risk score above the threshold in place at the time of the funding request. These inspections are anticipated to be completed either by a contractor, in which case the SMP will provide 50-percent matching funds for eligible assets based on the inspection prices set with that contractor, or by City staff, in which case the SMP will reimburse 50-percent of inspection of eligible assets based on submitted City expenses.

The SMP will also fund renewal projects which repair or replace eligible stormwater assets which have a risk score above the threshold in place at the time of the funding request. When a project is approved, the upper limit for matching funds will be set at a rate of 50-percent of the project budget.

Project budgets will be determined using one of the following approaches:

- A project budget can be set using the costs assigned to each asset being replaced by the prioritization script as described in **Section B.2 – Replacement Cost**. These costs represent estimated costs to completely replace assets and include demolition, material, labor, and restoration costs associated with each eligible asset as well as some portion of project mobilization.
- Alternatively, Cities can submit an engineer's opinion of probable cost (OPC) to be used as the project budget.

These approaches allow flexibility for Cities with both high and low funding capacities. If a City has a low funding capacity, then it may seek renewal projects comprised of mostly repairs with a lower budget to achieve a lower cost share. Alternatively, Cities with a higher funding capacity may seek larger projects to replace assets.

Ultimately, the matching funds provided by the SMP will be based on actual project costs as determined at the end of the project. To provide a basis for cost sharing on an asset-by-asset basis, all System Management projects must be bid as unit cost projects.

Tier 2: Considerations

Because the SMP will determine its upper limit match as 50-percent of replacement costs determined using a unit cost model, variance in the actual match that the SMP would provide when compared to actual project costs is anticipated. It is recommended to evaluate actual matches being provided against actual project costs on at least an annual basis so adjustments can be made as necessary. If such adjustments become necessary, the following actions could be taken:

- Adjust the SMP match provided upwards or downwards, as appropriate
- Modify the unit cost model, should modeled costs for certain asset types be found to not match well with actual costs
- Require development of an engineer's OPC to refine project costs before the SMP match is determined

Requiring an engineer's OPC is an alternative to relying on the unit cost model to determine project costs and SMP matching funds. In the past, the SMP has required preliminary engineering studies to be completed prior to projects being considered for matching funds. A similar approach could be used in the System Management program to refine the project cost estimate and SMP funding request amount. The study required to develop the OPC would provide an opportunity to investigate factors which could significantly affect costs that the unit cost model did not take into account, such as major utility crossings, burial depths, and any other unforeseen factors.

Should the SMP decide to require additional study, it could provide matching funds for the studies, especially those projects which have been developed by a Watershed Organization.

Additionally, because the obligation of matching funds by both the Cities and the SMP represents a large administrative effort, the SMP should consider ways in which funds which exceed actual project costs that have been allocated to a project can be used within the project. One way in which this could be done would be to allow bid alternatives to expand a project where actual project costs are anticipated to be lower than the initial project budget on which the SMP match was originally determined.

3.1.4 Watershed Organization Requirements and Responsibilities

Tier 1: Program Standards

At the time of the writing of this report, the Watershed Organizations called for in the SMP's Strategic Plan (Black & Veatch 2016) have not yet been formed. It is anticipated that all System Management projects will be submitted to the SMP by Watershed Organizations, and therefore they play a key role in the success of the program. As such, this section outlines general requirements of Watershed Organizations to secure eligibility for System Management funds for their constituent Cities.

The basic requirement for Watershed Organizations will be to complete and maintain a Watershed Asset Management Plan (WAMP) to establish priorities for System Management projects within the watershed. The major components of a WAMP will include:

- The current state of the stormwater asset inventory across the watershed and the plan for addressing data gaps.
- The development of watershed-scale strategies to address high risk assets.
- The system repair, and replacement projects that are planned, whether they receive SMP matching funds or not.
- The inspections that should be prioritized to achieve a better understanding of condition across the watershed.
- The development of a 5-year Watershed Capital Improvement Program (CIP)

A template WAMP has been developed to assist Watershed Organizations in walking through this process and is included as **Appendix C**.

3.1.5 City Requirements and Responsibilities

Tier 1: Program Standards

The following City activities will be necessary to help promote the success of the System Management program:

- Ongoing field inspection of eligible stormwater assets in accordance with the inspection requirements set forth in **Section 4.2** and submittal of new asset data to AIMS on a consistent basis.

- Because Watershed Organizations will ultimately submit all System Management projects to the SMP for funding requests, active participation in Watershed Organization meetings by Cities will be key to organizing and prioritizing projects. Cities should also participate in the formation of the Watershed Asset Management Plans as described in **Appendix C**.

In addition, Cities will also be required to sign an agreement for all aspects of projects funded by the SMP to guarantee that standard, routine maintenance will be performed. This requirement is intended to advance the main goal of the System Management program, which is to promote the overall condition of the stormwater system in the SMP.

Tier 2: Considerations

In order to assist with Cities with inspection requirements, the SMP could consider providing assistance by:

- Providing NASSCO training to City staff for those Cities which plan to self-perform field inspections
- Providing SMP NASSCO certified crews to complete inspections for Cities
- Removing obstacles to hiring contractors to perform field inspections by retaining a list of qualified on-call contractors with pre-negotiation field rates.

Section 4

Stormwater Management Program Recommendations

4.1 Data and Field Inspection Standards

Tier 1: Program Standards

Each City within Johnson County that desires program funding will be responsible to maintain a current inventory of the stormwater assets they own and a minimum set of attributes for each asset that are required for the prioritization script. This section describes the asset data and data standards that Cities must provide to the SMP and AIMS to support the prioritization of stormwater infrastructure projects and ultimately obtain program funding. These represent base requirements, and Cities are free to collect and maintain additional data as appropriate for their stormwater program. They are also free to collect data in whatever format or structure works best for their program, but ultimately data submitted to the SMP and AIMS must adhere to the standards outlined in this section.

Summarized in the following subsection below are:

- Base data requirements, required for both inspection and renewal projects, in **Section 4.1.1**,
- Data requirements for inspection projects, in **Section 4.1.2**, and
- Data requirements for renewal projects, in **Section 4.1.3**.

Data requirements for inspection and renewal projects are summarized in **Table 2-2**. Where a limited set of accepted values for a field are required, these are defined below. Cities may still utilize their own naming conventions for different structures types for their own use, however, these must not be the structure values submitted. The required data for wetlands, detention basins, and reservoirs/dams will be maintained by AIMS.

4.1.1 Base Data Requirements for All Projects

Asset ID [Points and Lines]

All stormwater structures must be assigned a unique Asset ID.

Ownership [All Eligible Assets]

Eligibility for program funds is driven in part by who owns the asset. The SMP will only fund assets which are City- or County-owned.

Structure Type [Points]

Cities must use the standard types listed in **Table 4-1**.

Table 4-1 Acceptable Structure Type Values

Acceptable Structure Types	
Area Inlet	Pipe Bend
Bend Point	Point of Inflection
Bridge	Simple Junction
Catch Basin	Slot Drain
Culvert	Stormwater Treatment Unit
Curb Inlet	Sump Box
Drop Inlet	Transition
Ineligible	Treatment Unit
Inlet	Trench Drain
Junction Box/Manhole	Underground Connection
Outfall	

Dimensions [Lines]

All line lengths should be provided to AIMS in feet. All height, width, and diameter information should be provided in inches. The stormwater system across the County has been assumed to have virtually no assets that are less than 12-inches in size. A, any height, width, or diameter data provided by a city that is less than 12 will be assumed to be in feet and will be converted to inches.

4.1.2 Data Requirements for Inspection Projects

Construction (or Rehabilitation) Year [Points and Lines]

Construction/installation and rehabilitation dates must be provided so that the prioritization script can estimate condition for uninspected assets. For an activity to count as a rehabilitation, it should significantly lengthen the expected life of the asset by improving its structural condition. Structural pipe lining is considered a rehabilitation, but a rehabilitation date should not be set for assets where only spot repairs have been performed since the condition of the remainder of the pipe should be modeled based on the original installation date.

Material [Points and Lines]

Cities must submit material data for points and lines according to the standard material values listed in **Table 4-2**.

Table 4-2 Acceptable Material Values

Acceptable Structure Materials	Acceptable Pipe Materials*	Pipe Material Code Explanation
Block	Clay	-
Brick	CMP	Corrugated Metal Pipe
Clay	CP	Concrete Pipe
Concrete	DIP	Ductile Iron Pipe
Concrete Block	PE	Polyethylene (plastic) Pipe
Corrugated Metal	PP	Polypropylene (plastic) Pipe
Ineligible	PVC	Polyvinyl Chloride (Plastic) Pipe
Iron	RCB	Reinforced Concrete Box Pipe
Metal	RCP	Reinforced Concrete Pipe (Circular)
PE	SP	Steel Pipe
PVC	VCP	Vitrified Clay Pipe
Rehab Block		
Rehab Brick		
Steel		
Stone		

* - NASSCO codes are used for pipe materials.

Shape [Lines]

Cities must submit shape data for lines according to the standard material values listed in **Table 4-3**. If a pipe shape is not adequately described by any of the values in **Table 4-3**, the closest applicable value should be used, a comment made in a clearly labeled 'Comments' field, and upon submission of the asset data in question AIMS should be notified of the line shape value approximation.

Table 4-3 Acceptable Line Shape Values

Acceptable Line Shapes
Arch
Bridge
Circular
Elliptical
Oval
Rectangular
Squash Pipe

Number of Barrels [Lines]

Where a line in the database represents more than one barrel of pipe, the number of barrels represented by the line should be provided. If no value is entered in this field the prioritization script will assume that there is one barrel.

Upstream and Downstream Node IDs [Lines]

All stormwater line segments should include fields which indicate the Asset IDs of the upstream and downstream structures.

Estimated Condition [Streams Only]

Stream condition can be estimated using a process whereby historical DEMs created using Light Detection and Ranging (LiDAR) data are compared to identify areas of stream erosion. The most recent LiDAR data was collected in 2018, and a DEM created from this data can then be compared to existing DEMs created from 2012 and 1998 LiDAR data to identify decreases in ground elevation.

A pilot project was recently completed which used this approach in the Indian Creek watershed. For this pilot, the 2012 and 1998 DEMs were compared and structures within 25 feet of stream erosion were identified. It is recommended to expand this pilot project to a County-wide analysis such that all areas of stream erosion can be identified and where structures and major infrastructure are within 25 feet of stream erosion, an estimated condition rating of 5 be assigned. This estimated condition rating can then be used to prioritize streams for inspection projects.

4.1.3 Data Requirements for Renewal Projects

Field-Inspected Condition [All Eligible Assets]

Field inspection requirements are listed below in **Table 4-4**. These requirements are intended to provide a comprehensive inspection standard which produces consistent inspection results across all participating Cities. They have been formulated to be broad, both because many different types of assets are included, but also to allow for some flexibility in implementation to participating Cities.

Full compliance with these inspection standards will not be required until January 1, 2020. Condition assessments prior to this deadline which are performed according to the standard which Cities have been using and are based on structural evaluations will be accepted and used to prioritize replacement projects, provided the scores provided are consistent with those which have been previously used so that they can be accurately related to the standard 1 to 5 condition scale per **Table 2-6** in **Section 2.1.2**.

If a City requires a condition score definition prior to January 1, 2020 that deviates from **Table 2-6**, they must coordinate this with the SMP and provide an explanation of how their scores relate to the scores and definitions in this table. If City data are not related to the standard condition scale the assets will not be eligible for replacement funding and the script will instead attempt to estimate the condition score.

The requirements for how field condition assessments must be performed for different asset types are described below:

- All condition ratings input must be the result of field inspections which rate only the structural condition of the asset. Since the program is not intended to address Operational and Maintenance (O&M) defects (e.g., debris, deposits, roots, etc), O&M considerations should not factor into the condition scores provided to the SMP.

- All condition ratings provided to the SMP must be the result of a physical inspection and may not be estimated. Estimated condition ratings should not be provided for inclusion in AIMS to minimize confusion and to ensure a consistent methodology is used for estimating condition across the SMP.
- All eligible assets must be evaluated and assigned a rating between 1 and 5 (per **Table 2-5** in **Section 2.1.2**) using the guidance in **Table 4-4** below.

Table 4-4. Required Field Inspection Standards

Asset Type	Field Inspection Standard	Conversion to Unified Condition Rating
Lines (Storm Sewer)	Lines Greater than 100-feet in length: ▪ NASSCO PACP Inspection Standard ▪ Structural rating only Lines 100-feet in length or less: ▪ Inspections may be performed by means other than internal video inspection ▪ All defects must be coded using NASSCO PACP standard ▪ Structural ratings only	Step 1) Base condition score is equivalent to the highest structural defect rating Step 2) If a base condition score is a 4, sum all defects rated 4, divide by 16, and add to base condition score up to calculate a final condition score. Final condition score cannot be greater than 5.0.
Structures	▪ Full structure inspection such that all components of the structure are photographed ▪ All defects must be coded using NASSCO MACP standard ▪ Structural rating only	Asset condition score is the highest structural defect rating for any noted defects
Streams	APWA 5605.5 Stream Assessment (APWA, 2011)	Convert APWA 5600 Table 5405-4 scores to a rating between 1 and 5 per the following guidance: ▪ Rating 12 or less – Condition score of 1 ▪ Rating between 12 and 18 – Condition score of 3 ▪ Rating greater than 18 – Condition score of 5
Reservoirs/Dams	State Inspection Form	Step 1) Asset condition score is the highest defect rating per **Table 4-5** Step 2) If a condition score is a 4, sum all defects rated 4, divide by 16, and add to score up to a total score of 5
Levee/Floodwall	Owner Inspection Form	Levee and floodwall conversion to be determined when a City provides inspection forms to the SMP

These are discussed further in the following subsections.

Lines (Storm Sewer)

Storm sewer lines are required to be inspected according to PACP inspection standards, which require internal video inspection, for all pipes which are greater than 100-feet in length as measured in the stormwater geodatabase. Pipes are defined as the underground conduits which span from an upstream access point to a downstream access point. In addition, pipes less than

100-feet which cannot be fully inspected without internal video inspection must also be inspected according to PACP inspection standards.

Pipes which are 100-feet in length or less as measured in the stormwater geodatabase may be inspected from an upstream or downstream access point using equipment which is of sufficient resolution and quality that defects within the pipe can be identified. Any defects noted by such a method must be coded and rated using PACP standards.

The base condition score for each asset is calculated as the maximum score assigned to any of the defects noted during the inspection. If this score is 3 or less, or 5, then the base condition score is the final condition score. The final condition score is the rating which should be submitted to SMP for inclusion in the stormwater geodatabase maintained by AIMS.

If the base condition score is 4, and if there are more than one defects assigned a score of 4, then the final condition score is determined by:

- Summing the number of defects assigned a score of 4,
- Dividing this number by 16, and
- Adding this to the base condition score.

Structures

A full inspection of structures must be completed such that all components, both internal and above ground, of the structure are visually inspected and photographed. Structural defects must be photographed separately from standard structure photographs and assigned a MACP defect code and rating. The condition score assigned to a structure shall be the maximum score assigned to any structural defect.

Reservoir/Dam Inspections

For Reservoir/Dam inspections, only the fields highlighted in the state dam inspection form, included in **Attachment B** and modified to require only inspect and rate structural elements of the dam, shall be used for reservoir/dam condition ratings, and state deficiency codes shall be converted to a condition rating per **Table 4-5**. The score assigned to the reservoir/dam shall be the highest condition rating assigned to any individual dam component structural defect.

Table 4-5. Reservoir/Dam State Deficiency Codes – SAMP Condition Rating Mapping

State Deficiency Code	SAMP Condition Rating
0	1
1	3
2	4
4	5

Note: State deficiency code 3 indicates a maintenance issue.

Levee/Floodwall Inspections

Because levees and floodwalls do not currently have a standard inspection form required by any federal or local authorities, and because forms used to assess these systems were not available for this report, it was not practical to develop a system to convert condition ratings to a condition score between 1 and 5 per **Table 2-5** in **Section 2.1.1**. Should a City submit a levee or floodwall condition score in the future, it is recommended that an approach to converting inspection data to a score between 1 and 5 similar to the other assets be taken, specifically:

- The City's inspection protocol should be evaluated to identify relevant condition scores related to structural failures (such as erosion, embankment settlement, etc.).
- The scoring system used should be converted to a 1 to 5 scale consistent with **Table 2-5** in **Section 2.1.2.** For example, a scoring system of 1 through 10 should be mathematically scaled to the 1 through 5 scale, or written descriptions of condition should be converted to the 1 to 5 scale as was done for the Unified Condition Scale as shown in **Table 2-6** in **Section 2.1.2**.
- The condition score should be taken as the worst score assigned to an individual structural defect.

Streams (Field Inspection)

For streams, field inspections must be completed according to Section 5605.5 'Stream Assessment' of the Kansas City APWA Stormwater Specifications (APWA, 2011) and all fields in Table 5405-4 of the specifications must be completed. A condition score should be assigned as follows:

- APWA rating 12 or less – SAMP condition score of 1
- APWA rating between 12 and 18 – SAMP condition score of 3
- APWA rating greater than 18 – SAMP condition score of 5

4.1.4 Prioritization Script Geodatabase Output Fields and User's Guide

The prioritization script output includes two geodatabase feature classes for the engineered stormwater system, 'Stormwater_LN_FailureAnalysis' and 'Stormwater_PT_FailureAnalysis'. **Table 4-6** below summarizes key fields produced in both of these feature classes, and these are discussed briefly below.

Table 4-6 Key Prioritization Script Output Geodatabase Fields – Feature Classes 'Stormwater_LN_FailureAnalysis' and 'Stormwater_PT_FailureAnalysis'

Column	Definition
IsIneligible	Bit indicating if the pipe is ineligible for a rating (1 = yes, 0 = no)
IsCondEst	Bit indicating if the condition is estimated (1 = estimated, 0 = decoded using unified condition conversion)
StndYearConst	Standardized year constructed
IsYearEst	Bit indicating if the year is estimated (1 = estimated, 0 = provided by City)
PACPCond	1-5 rating for asset condition (either decoded or estimated)
InvalidCond	Bit indicating if the condition decoded is invalid (1 = invalid, 0 = valid)
ConsqOfFail	1-5 rating for the consequence of asset failure
Risk	1-5 rating for the risk that the asset failure poses to the system
NearGas	Bit indicating if the pipe is within 5 feet of a gas utility (1 = yes, 0 = no)
NearElec	Bit indicating if the pipe is within 5 feet of an electrical utility (1 = yes, 0 = no)
ReplCost	Unit cost of replacing the pipe, calculated using cost per linear foot and the pipe length.

When working with geodatabase results, it will be important to first filter field 'IsIneligible' so that only entries equal to 1 are shown. This will remove extraneous assets such as concrete-lined open channels, and only eligible assets are being displayed.

The field 'IsCondEst' indicates if an asset's condition is estimated by the prioritization script (field will equal 1) or if its condition was provided by the submitting City (field will equal 0). For assets with estimated conditions, 'StndYearConst' provides the year used to calculate each asset's age, and 'IsYearEst' indicates if the construction year was estimated based on plat age. If the 'StndYearConst' field is <null> and no condition was provided by the submitting City, then the asset did not intersect a plat in the AIMS plat feature class and the prioritization script could not estimate its age or condition.

The field 'PACPCond' provides asset condition on the 1 through 5 condition rating scale documented in **Table 2-5**, whether the condition was estimated or provided by the submitting City. This is also the LoF score for the asset. 'InvalidCond' indicates that a condition was provided by the submitting City that could not be mapped to the 1 through 5 condition rating scale using the conversions developed in **Table 2-6**.

The field 'ConqOfFail' is the CoF score for the asset, and the 'Risk' field is the overall risk score for the asset. The fields 'NearGas' and 'NearElec' indicate proximity to a gas or electric utility, respectively, which failure of the asset could damage.

Finally, the field 'ReplCost' lists the cost to fully replace the asset based on the unit cost model. This cost is not rounded by the script, and this was done so that any rounding can be completed by SMP staff as appropriate for individual projects.

The prioritization script also outputs a feature class 'StormwaterNatrl_LN_FailureAnalysis' for prioritization of streams, and its key fields are explained below in **Table 4-7**.

Table 4-7 Key Prioritization Script Output Geodatabase Fields – Feature Class 'StormwaterNatrl_LN_FailureAnalysis'

Condition	Definition
NearBuilding	Bit indicating if the open channel is near a building (1 = yes, 0 = no)
IsEroded	Bit indicating if the open channel is eroded (1 = yes, 0 = no)
IsCondEst	Bit indicating if the condition was estimated or from inspection (1 = estimated, 0 = inspection)

Tier 2: Considerations

4.1.5 Refinement of NASSCO Inspection Standards

NASSCO inspection standards are a well-accepted industry standard for sewer inspection, and the requirement to use them creates a consistent basis for evaluating stormwater infrastructure necessary to the success of the System Management program. The standards themselves are very broad and were developed to be applicable to all sewer systems, and as such include defect codes and inspection items that are not applicable to a storm sewer system. The requirement to use NASSCO inspection standards can be a stand-alone requirement as stated in **Section 4.1.3** and this would result in Cities which use their own staff to complete inspections developing their own implementations of the standard.

While this approach is anticipated to result in a consistent County-wide field assessment standard, consideration should be given to developing guidance for application of NASSCO standards. This would require additional study, however, because the requirement to comply with NASSCO standards is delayed until 2020, there is sufficient time to develop this guidance. In addition, if the SMP plans to offer NASSCO training to City staffs, then tailoring that training to storm sewer inspections would be an incremental increase in the upfront training development costs that would result in a reduced effort on the parts of Cities to comply with the NASSCO standard.

Currently, AIMS maintains a collector application which is used by a limited number of smaller Cities. It is recommended that this application be reviewed following development of any refined NASSCO standard to evaluate if it should be modified to facilitate collection of inspection data.

4.1.6 Refinement of Estimated Condition

Consideration should also be given to allowing Cities to provide an estimated condition for assets where multiple maintenance activities related to structural failure have been performed on the same asset. Cities could appeal the estimated condition assigned to individual assets by the prioritization script by submitting their maintenance records to SMP for review. Where two or more structural repairs have been made on an asset, it is recommended to assign that asset an estimated condition of 5. This will ensure that the asset is assigned at least a risk score of 3.2, enabling the SMP to provide matching funding for inspection of the asset under the initial recommended inspection project risk score threshold.

4.2 Staffing and Resources

In order to maintain and execute the System Management program, additional labor beyond existing levels from the SMP, AIMS, and PWK will be required. This will include both regular, ongoing tasks to be performed annually, as well as startup activities to implement the program at its inception. Anticipated ongoing SMP tasks include:

- Task 1) Selection and Oversight of System Management Projects
- Task 2) Technical Assistance to Cities
- Task 3) Watershed Organization Meeting Participation
- Task 4) City Meetings Attendance
- Task 5) System Management Program Maintenance

These tasks represent basic required activities, and do not include time to implement the Tier 2 considerations listed in this report. The following activities would be required in addition to the basic tasks to implement Tier 2 considerations:

- Task 6) Condition Assessment Activities, per **Section 4.1.5**
- Task 7) Coordinate Refined Estimated Condition, per **Section 4.1.6**
- Task 8) Maintain Web Application, per **Section 4.3.5**

Other tasks for AIMS and PWK are defined in the following subsections. The level of effort (LOE) required to execute ongoing tasks has been estimated as described below in **Section 4.2.1** for the SMP, **Section 4.2.2** for AIMS, and **Section 4.2.3** for PWK. **Section 4.2.4** outlines startup activities anticipated to be required at the inception of the System Management program. These sections all outline the requirements of these tasks by breaking them into subtasks, as appropriate, which are explained in detail.

Each task has been provided a range of potential LOEs, and this was done because the effort required to execute the System Management Program is anticipated to be largely dependent on the level of participation by Cities. Accordingly, a lower LOE has been provided for each ongoing task based on an assumption that 6 Cities will participate in the program annually, and a higher LOE has been provided based on an assumption that 15 Cities will participate and receive funding from the program annually.

Tasks 1, 2, 3, and 4 will be most influenced by the level of City participation, as they involve management of projects and coordination with Cities. Additionally, although Tasks 3 and 6 deal with developing projects for the Unincorporated County and performing basic program maintenance activities, and as such are anticipated to be more independent of City participation, they have also been provided a range of LOE estimates to represent that they are new tasks and their true LOE is relatively unknown.

The LOE for each task is expressed in the following subsections in terms of both hours and annual full-time equivalents (FTEs). Annual FTEs were calculated to represent the percentage of a working year a full-time employee would work to complete a task, divided by 100. A working year was assumed to be a total of 1,880 working hours, based on a full-time employee receiving 10 holidays and 3 combined weeks of vacation and sick leave each year. For example, a task requiring 0.5 FTEs would take half of an employees working year to complete, equivalent to 940 hours.

4.2.1 SMP Staffing for Ongoing Tasks

The following activities, summarized in **Table 4-8** and explained further below, are anticipated to be required for the SMP to maintain and execute the System Management program.

For the SMP, the level of additional effort required to maintain the System Management program is anticipated to require additional staff beyond those currently available, as the additional annual workload is estimated to require a little less than one, and as many as two, additional FTEs. The addition of two new FTEs to SMP staff would require additional time beyond that shown in **Table 4-8**, and the implications of this are discussed further in the subsection **SMP Recommended Roles**.

Table 4-8 Summary of SMP Hours Required of System Management Program

Task / Subtask	Subtask Hours	Subtask Rate	Low Estimate Hours per Year	High Estimate Hours per Year	Low Estimate Annual FTEs	High Estimate Annual FTEs
Task 1) Selection and Oversight of System Management Projects			**632**	**1,254**	**0.34**	**0.67**
Review all applications for funding received from Watershed Organizations	4-8	per project	144	288	0.08	0.15
Rank and select projects and create 5-year CIP	20-30	annually	20	30	0.01	0.02
Execute project startup activities	20	per project	180	360	0.10	0.19
Monitor project progress	20	per project	180	360	0.10	0.19
Execute project closeout activities	12	per project	108	216	0.06	0.11
Task 2) Technical Assistance to Cities			**160**	**300**	**0.09**	**0.16**
Field requests for technical assistance	20	per City	120	240	0.06	0.13
Coordination with AIMS	40-60	annually	40	60	0.02	0.03
Task 3) Watershed Organization Meeting Participation			**384**	**624**	**0.20**	**0.33**
Organize meeting logistics and prepare agenda and meeting materials	4-6	per meeting	96	144	0.05	0.08
Prepare meeting content	8-12	per meeting	192	288	0.10	0.15
Attend meetings and coordinate follow-up	4-8	per meeting	96	192	0.05	0.10
Task 4) City Meetings Attendance	**8**	**per meeting**	**96**	**192**	**0.05**	**0.10**
Provide support to City meetings	8	per meeting	96	192	0.05	0.10
Task 5) System Management Program Maintenance			**118**	**216**	**0.06**	**0.11**
Calculate Performance Indicators (Section 4.3.3)	20-40	annually	20	40	0.01	0.02
Complete planned policy and procedure modifications (Section 4.3.1)	40-80	annually	40	80	0.02	0.04
Report on System Management program Progress to Board of County Commissioners	18-36	annually	18	36	0.01	0.02
Maintain asset registry	40-60	annually	40	60	0.02	0.03
		Totals:	**1,390**	**2,586**	**0.7**	**1.4**

- **Task 1) Selection and Oversight of System Management Projects**

  Activities related to project selection and oversight are anticipated to comprise the majority of the effort required to maintain the System Management program, with total estimated hours to be between 632 and 1,254 hours each year. These hours were, in part, based on the assumption that there will be between 9 larger and 18 smaller projects funded each year. This would correlate to an average total project budget of $1,000,000 (for 9 projects) and $500,000 (for 18 projects) for a projected annual System Management budget of $4.5 million.

  The SMP's oversight of selected System Management projects is anticipated to span a project's lifecycle and is not anticipated to vary based on project size. The subtasks comprising this activity will include:

  - Review all applications for funding received from Watershed Organizations. The number of applications to review was estimated as 36 per year, based on an assumption that each Watershed Organization will submit 6 projects each year. Activities in this subtask include reviewing for compliance with eligibility and procedures requirements, determining City and SMP matches, and requesting more information from the applicant as necessary.

  - Rank and select projects and create 5-year CIP. This activity is anticipated to be completed in coordination with all other SMP staff and will result in the ranking and selection of projects for funding, as described in **Section 3.1.2 – Project Prioritization**. Additionally, a 5-year CIP for the System Management program is assumed to be created under this subtask.

  - Execute project startup activities. These activities are anticipated to include creation and coordination of inter-local agreements as well as other internal SMP procedures required to initiate a project.

  - Monitor project progress. This LOE for this subtask was estimated to include efforts to occasionally check in with Cities on specific projects and completion of administrative activities associated with project oversight.

  - Execute project closeout activities. This subtask was assumed to include archiving of project files, coordination to update stormwater asset data from Cities for assets inspected or renewed and updating of a database of complete projects to be displayed on the AIMS website.

- **Task 2) Technical Assistance to Cities**

  The requirements and processes associated with the System Management program will require an understanding of asset management concepts and the ability to use the tools provided by the SMP to participate in the Watershed Organizations and receive funding for projects. Because these concepts will be new to some Cities, and because there is continual turnover of City staffs, it is anticipated that the SMP will provide regular technical assistance to Cities to promote participation in the System Management Program.

- Field requests for technical assistance. As Cities formulate projects, it is anticipated that they will require technical assistance to provide guidance in manipulating the prioritization script output geodatabase and complying with System Management program policies and procedures. The level of effort required for this was assumed to be between 8 and 12 hours for each City.

- Coordination with AIMS. It is anticipated that the SMP will need to proactively review the prioritization script output on behalf of the Cities and coordinate with AIMS on any issues encountered. These issues may require review of input data to the script as well as its continued implementation such that the script continues to provide accurate and reasonable results.

- **Task 3) Watershed Organization Meeting Participation**

  It is anticipated that SMP staff will not only participate in, but also organize and lead Watershed Organization meetings. Because there are 6 Watershed Organizations that will meet multiple times every year, this represents a significant time commitment that is second only to the 'Selection and Oversight of System Management Projects' task.

  - Organize meeting logistics and prepare agenda and meeting materials. To develop estimates of hours, it was assumed that each Watershed Organization will meet quarterly, and SMP staff will organize these meetings and prepare basic meeting materials for it.

  - Prepare meeting content. SMP staff is also anticipated to generate SAMP-related meeting content for each meeting related to each Watershed Organization's WAMP, including summarizing data gaps and prioritization script results, assisting in formulating watershed strategies, and providing assistance in applying those strategies to formulate projects.

  - Attend meetings and coordinate follow-up. This subtask was assumed to include time to travel to and attend Watershed Organization meetings, prepare meeting minutes, and document and coordinate action items.

- **Task 4) City Meetings Attendance**

  Because City executive roles, council memberships, and staffs experience turnover, some level of ongoing education by SMP staff about the System Management program will likely be necessary to maintain a high level of City participation. This task includes a single subtask comprised of estimates of time to meet with Cities and assumes that SMP staff will meet with each City twice each year.

- **Task 5) System Management Program Maintenance**

  This task includes time for SMP staff to maintain the System Management program, and as such are internally-focused. Specifically, this task is technical in nature and primarily involves updating information in the prioritization script, calculating program Performance Indicators, and maintaining the County-wide asset registry. In addition, there is time included to prepare an annual report to present on the program to the Board of County Commissioners annually.

  - Calculate PIs. It is recommended that SMP staff calculate program Performance Indicators on at least an annual basis, as described in **Section 4.3.3**, and this task includes time to prepare these calculations. These should be calculated before completing the next subtask, as the results will inform the direction policy and procedure modifications may take.

  - Complete planned policy and procedure modifications (**Section 4.3.1**). This subtask includes time to complete the policy and procedure modifications described in **Section 4.3.1**. These include managing high priority risk score thresholds, evaluating the SMP matching funding level, updating the unit cost model based on bid tabs as they are received, and completing condition data quality control activities.

  - Report on System Management program progress to the Board of County Commissioners. This subtask includes time to prepare a summary report to the Board of County Commissioners which will be based on the results of the Performance Indicator calculations proposed policy and procedure modifications. This report is anticipated to provide a consistent opportunity to inform the County's decision makers as to the status of the program and continue to show its impact in improving the stormwater system in Johnson County.

  - Maintain asset registry. It is anticipated that SMP staff will be involved in maintaining the AIMS stormwater asset geodatabases. Time has been included in this subtask to complete a regular quality control check of the geodatabases and make adjustments to it as necessary. Adjustments would likely require some level of coordination with the submitting Cities, as they are the originator of all data compiled into the geodatabases.

Tasks for Tier 2 (Considerations) Activities

The Tier 2 considerations described in Sections **3.1.5**, **4.1.5**, **4.1.6**, and **4.3.5** would all require additional effort from SMP staff in addition to the tasks shown in **Table 4-8**. These tasks are summarized below in **Table 4-9** and are estimated to require between 112 and 264 additional hours, or 0.06 and 0.14 additional annual FTEs.

Table 4-9 Tier 2 Considerations Tasks – SMP Hours Required

Task / Subtask	Subtask Hours	Subtask Rate	Low Estimate Hours per Year	High Estimate Hours per Year	Low Estimate Annual FTEs	High Estimate Annual FTEs
Task 6) Condition Assessment Activities (Sections 3.1.5 & 4.1.5)			**60**	**160**	**0.03**	**0.09**
Coordinate and/or conduct NASSCO trainings for City staffs	40-120	annually	40	120	0.02	0.06
Develop Vendor Shortlist for NASSCO-certified Inspection Services & manage projects	20-40	annually	20	40	0.01	0.02
Task 7) Coordinate Refined Estimated Condition (Section 4.1.6)			**40**	**80**	**0.02**	**0.04**
Receive work order data from Cities and adjust estimated condition outputs from prioritization script	40-80	annually	40	80	0.02	0.04
Task 8) Maintain Web Application (Section 4.3.5)			**12**	**24**	**0.006**	**0.013**
Coordinate with AIMS to host and maintain System Management web application	12-24	annually	12	24	0.006	0.013
		Totals:	**112**	**264**	**0.06**	**0.14**

- **Task 6) Condition Assessment Activities (Sections 3.1.5 & 4.1.5)**

  Sections 3.1.5 and **4.1.5** both recommend further actions by the SMP to assist Cities with condition assessment activities. These actions are proactive and are intended to make the inspection process more efficient for Cities. They include the following subtasks.

  - Coordinate and/or conduct NASSCO trainings for City Staffs. The goal of this task would be to devise an implementation of the NASSCO standard as described in **Section 4.1.5** and then provide an annual training session for interested Cities. This would give Cities an option for complying with the inspection requirements of the System Management program using their own inspection staff which is free to them and removes the requirement to develop their own implementation of the standard. NASSCO trainings are costly and the SMP would be providing significant cost savings to the Cities, and to accomplish this would need to either maintain certification for at least one their staff to be qualified to complete the City NASSCO trainings, or hire a contractor to complete this task.

  - Develop vendor shortlist for NASSCO-certified inspection services. Because some Cities do not have sufficient staff to devote to inspection of the stormwater system, inspections for these Cities would need to be completed by contractors. The SMP could facilitate contractor inspections by creating a shortlist of qualified contractors with negotiated unit prices, and time to do so was included in this subtask.

- Coordinate collector application maintenance with AIMS. This subtask includes time to coordinate maintenance of an inspection data collector application with AIMS. This task only includes time to maintain a collector application which has been previously developed and is being used by Cities to collect and submit asset data on their stormwater system to AIMS. Typical activities would include quality control checking of the data, testing of the application, and coordinating with AIMS to make any necessary changes or improvements to the application.

- **Task 7) Coordinate Refined Estimated Condition (Section 4.1.6)**

  This task includes time to review submittals of work orders by Cities and adjust conditions estimated by the prioritization script for uninspected assets.

- **Task 8) Maintain Web Application (Section 4.3.5)**

  This task includes time to coordinate maintenance of the web application described in **Section 4.3.5** with AIMS. This task only includes time to maintain the application and assumes it has been previously developed. Typical activities would include testing of the application, registering any errors encountered by Cities, completing internal testing, and coordinating with AIMS to make any necessary changes or improvements to the application.

Recommended SMP Roles

Ongoing activities for the SMP program shown in **Table 4-8** can be categorized as either inward-facing or outward-facing to define roles for potential new hires. The inward-facing tasks are more technical in nature and would require some technical knowledge specific to asset management principles, a working knowledge of, and ability to manipulate data in, ArcGIS, and the ability to exercise engineering judgement to develop projects, while the outward-facing tasks require project management and coordination skills. **Table 4-10** delineates tasks into these two categories.

This table assumes that these two roles would be fulfilled by two separate employees, and as such workload is shared for tasks where this could be reasonably expected, such as reviewing applications for project funding and creating a 5-year CIP. Where tasks can be split, this is indicated in the table by listing the same subtask under both roles and the total hours for each subtask were split between the two roles. The only exception to this is the subtask to attend Watershed Organization meetings, where it was assumed that both employees would attend all Watershed Organization meetings, and as a result the total hours for this subtask are doubled compared to **Table 4-8**.

Table 4-10 Summary of SMP Hours Required for System Management Program, Subdivided by Role

Subtask	LOE Range (hours)		Subtask	LOE Range (hours)	
Inward-Facing; Technical Role			**Outward-Facing; Project Management Role**		
Task 1) Selection and Oversight of System Management Projects					
Review all applications for funding received from Watershed Organizations	72	144	Review all applications for funding received from Watershed Organizations	72	144
Rank and select projects and create 5-year CIP	10	15	Rank and select projects and create 5-year CIP	10	15
-			Execute project startup activities	180	360
-			Monitor project progress	180	360
-			Execute project closeout activities	108	216
Task 2) Technical Assistance to Cities					
Field requests for technical assistance	120	240	-		
Coordinate with AIMS / Manipulate prioritization script geodatabase output	40	60	-		
Task 4) Watershed Organization Meeting Participation					
-			Organize meeting logistics and prepare agenda and meeting materials	96	144
Prepare meeting content	192	288	-		
Attend meetings and coordinate follow-up*	96	192	Attend meetings and coordinate follow-up*	96	192
Task 5) City Meetings Attendance					
Attend City meetings	24	48	Attend City meetings	72	144
Task 6) System Management Program Maintenance					
Calculate Performance Indicators (**Section 4.3.3**)	20	40	-		
Complete planned policy and procedure modifications (**Section 4.3.1**)	40	80	-		
-			Report on System Management program Progress to Board of County Commissioners	18	36
Maintain asset registry	40	60	-		
Task: Weekly Coordination**					
Coordination with Project Manager	184	368	Coordination with Technical Staff	184	368
Total Inward-Facing; Technical Role (hours):	**718**	**1,295**	**Total Inward-Facing; Technical Role (hours):**	**1,016**	**1,979**
Total Inward-Facing; Technical Role (FTEs):	**0.4**	**0.7**	**Total Inward-Facing; Technical Role (FTEs):**	**0.6**	**1.1**

* - Both roles are anticipated to participate in the same number of Watershed Organization meetings and share responsibilities to coordinate follow-up

** - Weekly coordination activities account for coordination of two employees supporting the System Management program and are only applicable if the SMP employs two System Management staff

An additional task was added to account for coordination between the two employees, as consistent communication and transfer of information and their supervisors would be key to the program's success. This was assumed to be between 4 and 8 hours each week for each employee.

The total FTEs required to execute and maintain the System Management program, rounded to the nearest tenth, is estimated to be between 0.7 and 1.8 FTEs. This indicates the following:

- If City participation in the program is low, then a single employee possessing the skills to execute both the inward- and outward-facing tasks may be able to complete all ongoing tasks necessary for the System Management Program. This individual would need to have a solid technical background in engineering and be familiar with asset management principles and would need to also possess the ability to coordinate with Cities and perform project management duties. This particular skillset could potentially be unique, and it may prove difficult to find a single employee who could fulfill both skillsets completely.

- If City participation in the program is high, then two employees executing the inward- and outward-facing tasks separately appears to be appropriate to fulfill the estimated total LOE. A high level of City participation implies a high level of coordination between the SMP and Cities, and the SMP may choose to initiate this coordination to drive participation in the program. Such an initiative would be consistent with the Strategic Plan, which states that there is a concern among stakeholders that small Cities have not participated in the SMP at a high level in the past (Black and Veatch, 17). Initiating coordination would also be following the Strategic Plan's Steering Committee guidance to begin "pro-actively preventing problems." (Black and Veatch, Appendix C).

4.2.2 AIMS Staffing for Ongoing Tasks

The SMP will be reliant upon AIMS to assist with some elements of the System Management program. The program activities and LOEs for AIMS are estimated in **Table 4-11** for both Tier 1 and Tier 2 activities, and the activities are explained further below. These activities are nearly all maintenance related and involve incorporating feedback received by AIMS to update the System Management program's digital tools and providing technical assistance to Cities. Overall, it is anticipated that the LOE for AIMS staff would be between 196 to 392 hours annually, or 0.1 to 0.2 annual FTEs. If all Tier 2 (Considerations) activities are included in this estimate, the LOE estimates for AIMS staff time are between 244 and 484 hours annually, or 0.1 to 0.3 annual FTEs.

Table 4-11 Summary of AIMS Hours for System Management Program

Task/Subtask	Subtask Hours	Subtask Rate	Low Estimate Hours per Year	High Estimate Hours per Year	Low Estimate Annual FTEs	High Estimate Annual FTEs
Assistance to Manage System Management Projects			**18**	**36**	**0.01**	**0.02**
Maintain AIMS list of completed projects	2	per project	18	36	0.01	0.02
Technical Assistance to Cities			**80**	**160**	**0.04**	**0.09**
Coordinate with SMP to provide technical assistance to Cities	80-160	annually	80	160	0.04	0.09
System Management Program Maintenance			**98**	**196**	**0.05**	**0.10**
Update prioritization script unit cost model per input from SMP	40-80	annually	40	80	0.02	0.04
Maintain asset registry ArcGIS geodatabase and output	12-24	annually	12	24	0.006	0.013
Complete script maintenance activities	46-92	annually	46	92	0.02	0.05
		Totals:	**196**	**392**	**0.1**	**0.2**
Tier 2: Considerations Activities						
Coordinate Refined Estimated Condition (Section 4.1.6)			**8**	**12**	**0.004**	**0.006**
Adjust estimated condition outputs from prioritization script based on SMP input	8-12	annually	8	12	0.004	0.006
Maintain Web Application (Section 4.3.5)			**40**	**80**	**0.02**	**0.04**
Perform maintenance of web application	40-80	annually	40	80	0.02	0.04
		Totals:	**48**	**92**	**0.03**	**0.05**

- **Assistance to Manage System Management Projects**

  AIMS assistance for managing System Management projects is anticipated to extend to closeout activities only and was assumed to consist of creating and maintaining a database of projects completed by the program and showing this list spatially on the existing AIMS web map portal. Maintaining this list online will provide a tool that SMP staff can use to promote the program to communicate its effectiveness and ability to help Cities.

- **Technical Assistance to Cities**

  This task involves providing technical assistance to Cities reaching out to the SMP for help with the System Management program and has been included because it is anticipated that some of these requests for assistance will involve some of the program elements owned and maintained by AIMS, such as the stormwater asset registry geodatabase and the prioritization script results. Overall technical assistance is anticipated to be primarily conducted by SMP staff, with minimal time required of AIMS staff.

- **System Management Program Maintenance**

  AIMS involvement in maintaining the program extends to technical assistance to update the unit cost model used by the prioritization script, maintaining the stormwater asset registry geodatabase, and maintaining the prioritization script.

  - Update prioritization script unit cost model per input from SMP. The unit cost model is anticipated to be updated on a regular basis, and this task involves modifying the appropriate script input table to reflect changes requested by SMP staff.
  - Maintain asset registry ArcGIS geodatabase. This task involves hosting and annual checking of the asset registry geodatabase and any actions required to correct issues which may be encountered. This task is only anticipated to require an annual effort to evaluate
  - Execute and maintain prioritization script. This task involves running the prioritization script and completing annual checking and maintenance of the script. Executing the script was estimated to require between 0.5 and 1 hours per week, as the process to run it was assumed to be automated. Maintenance activities are anticipated to require only an annual effort to check for continued accuracy, functionality, and performance, and 20 to 40 hours has been included to complete any actions required to correct issues which may be encountered.

The following tasks and subtasks are Tier 2 (Considerations) activities and will only be required if the SMP decides to execute the activities described in **Sections 4.1.5**, **4.1.6**, or **4.3.5**.

- **Coordinate Refined Estimated Condition (Section 4.1.6)**

  This task includes time to adjust conditions estimated by the prioritization script by directly editing the prioritization script output for uninspected assets based on input from SMP staff.

- **Maintain Web Application (Section 4.3.5)**

  This task includes time to maintain the web application described in **Section 4.3.5** with AIMS. This task only includes time to maintain the application and assumes it has been previously developed. As with the collector application, it is anticipated that SMP staff would test and identify any issues with the application and AIMS involvement would include activities to resolve these issues.

4.2.3 PWK Staffing for Ongoing Tasks

Unincorporated Johnson County is anticipated to be a participant in four of the six Watershed Organizations with PWK staff as its representatives, and **Table 4-12** summarizes these activities and their estimated LOEs for this participation. Overall, it is anticipated that the LOE for PWK staff to participate in the System Management program would be between 276 and 552 hours annually, or 0.1 to 0.3 annual FTEs.

Table 4-12 Summary of PWK Hours for System Management Program

Task/Subtask	Subtask Hours	Subtask Rate	Low Estimate Hours per Year	High Estimate Hours per Year	Low Estimate Annual FTEs	High Estimate Annual FTEs
Develop and Manage projects for Unincorporated Johnson County			**192**	**384**	**0.10**	**0.20**
Develop and submit funding requests for System Management projects	4-8	per project	32	64	0.02	0.03
Manage System Management projects	40-80	per project	160	320	0.09	0.17
Watershed Organization Meeting Participation			**84**	**168**	**0.04**	**0.09**
Participate in meetings	4-8	per meeting	64	128	0.03	0.07
Manage and update County-owned stormwater asset data to AIMS	20-40	annually	20	40	0.01	0.02
		Totals:	**276**	**552**	**0.1**	**0.3**

These activities and their associated subtasks are described further below.

- **Develop and Manage projects for Unincorporated Johnson County**

  PWK staff are anticipated to prioritize assets with high risk and coordinate with SMP staff to develop projects to inspect or renew these assets. PWK staff will also manage implementation of projects approved for System Management funding. For this LOE estimate, it was assumed that two projects would be developed annually for each of the four Watershed Organizations.

  - Develop and submit funding requests for System Management projects. This subtask includes time to prioritize high risk assets for inspection or renewal projects and assumes that projects to be submitted to Watershed Organizations will be developed by SMP staff.

  - Manage System Management projects. This subtask includes time to manage projects selected for System Management funding, and a total of four projects were assumed to be selected annually. These hourly estimates include time to oversee design, permitting, and construction of projects.

- **Watershed Organization Meeting Participation**

  PWK staff will need to participate in Watershed Organization meetings in order to submit projects for System Management funding, and this task includes time for this participation.

  - Participate in meetings. This subtask includes time to participate in an assumed four Watershed Organization meetings each year for four Watershed Organizations.

- Manage and update County-owned stormwater asset data to AIMS. This task includes time to provide asset data updates to AIMS, which could include data from the results of inspections as well as updates to provide any of the required data to meet eligibility requirements.

4.2.4 Additional Activities for Program Startup

The following start-up activities are anticipated to be required in addition to those listed in **Sections 4.2.1** through **4.2.3**, as they represent initial tasks required to begin the System Management program and not ongoing activities to maintain and execute it.

- Develop System Management policies and procedures and establish Watershed Organizations. SMP staff will need to develop policy and procedures documents which formally outline how Cities and Watershed Organizations will be required participate in the System Management program. This is anticipated to be done using this SAMP report as a guide, and it is anticipated that the template WAMP will serve as an attachment to the procedures document. In addition, Watershed Organizations will need to be established according to the policy and procedures documents and their participants engaged and convened.

- Participate in and manage creation of initial WAMPs. WAMPs for each watershed will need to be created for each Watershed Organization, and their initial formulation will require significantly more effort than their future annual upkeep. It is anticipated that the SMP will fund the creation of the initial WAMPs, and thus SMP staff effort will be required to manage this work. In addition, PWK staff are anticipated to be involved in WAMP creation due to their status as participants in four of the Watershed Organizations.

- Develop 5 years of projects for initial funded 5-year CIP. The WAMPs will create an initial 5-year CIP for each Watershed Organization which will be submitted to SMP for funding consideration. It is unclear how many projects will be included in each Watershed Organization CIP, however, it is anticipated that there will be a large number of projects to review, rank, and select in the first year of the System Management program, requiring a significant effort beyond what will be required in following years.

In addition to these activities, an organizational conflict of interest (COI) exists in the current program formulation that requires resolution at the start of the System Management program. This COI is related to ranking of Unincorporated Johnson County projects alongside those submitted by Cities. Specifically, this COI arises because Unincorporated Johnson County projects will be developed by SMP staff and the same SMP staff will then be tasked with prioritizing projects for funding. A solution to this COI should be developed by the SMP, approved by all interested stakeholders, and implemented before Unincorporated Johnson County projects are considered for System Management funding.

The following Tier 2 (Considerations) activities would also require some initial upfront effort by SMP staff:

- Oversee creation of web applications per **Section 4.3.5.** Should the SMP decide to develop the web application described in **Section 4.3.5**, some effort from SMP will be required to oversee the development of it. Additional effort from AIMS will be required to have the application developed by them, or to help to oversee development should the work be completed by an outside contractor.

- Develop NASSCO implementation and training. If the SMP decides to provide annual NASSCO trainings to City inspection staffs, then an implementation of the NASSCO standard would need to be developed. If the SMP plans to self-perform the trainings, then a County employee, likely either staff from SMP or PWK, would need to be certified to complete NASSCO trainings, and would then have to work to develop trainings for City staffs. If the SMP plans to contract this work out, then they would need to engage and manage a contractor to implement the NASSCO standard and conduct the trainings.

  Additionally, if a collector application were to be developed, then this implementation would need to be completed first to guide development of the application.

4.2.5 Conclusions

Overall, the implementation, execution, and maintenance of the System Management program is anticipated to be a large undertaking for County staff across the SMP, PWK, and AIMS departments that will require dedication of staffing resources beyond current levels. For SMP staff, the total level of commitment is anticipated to require the addition of at least 1 new FTE and as many as 2 FTEs, and the estimated LOE required for the program is anticipated to be highly dependent upon participation by Cities and the number of projects funded by the program each year.

To date, the System Management program has received widespread interest from multiple Cities. This interest started with the Strategic Plan, where a diverse steering committee identified system replacement funding as a gap in the existing SMP and recommended that a program be developed which provided matching funds to renew high risk stormwater assets.

The Strategic Plan was followed by the System Management subcommittee, which convened five times over the course of 2017 and included representatives from multiple Cities. This subcommittee planned the direction the System Management program should take, and outlined the SAMP process. This subcommittee was then followed by the SAMP subcommittee, which also engaged City stakeholders and met twice in 2018 as summarized in **Section 2.2.6**.

As a result of these outreach efforts, it is anticipated that there will be a high level of engagement with the program, and that the six Watershed Organizations will be submitting multiple projects on an annual basis. As a result, the anticipated LOE required to execute and maintain the System Management program is anticipated to trend toward the 'high estimates' described in previous subsections and summarized in **Table 4-13** below.

Table 4-13 Summary of Required LOEs for System Management Program

Entity	Low Estimate Hours per Year	High Estimate Hours per Year	Low Estimate Annual FTEs	High Estimate Annual FTEs
Base Tasks				
SMP*	1,390-1,734	2,586-3,274	0.7-0.9	1.4-1.8
AIMS	196	392	0.1	0.2
PWK	276	552	0.1	0.3
Tier 2 Considerations Tasks				
SMP	112	264	0.06	0.14
AIMS	48	92	0.03	0.05
PWK	0	0	0.0	0.0
Totals (Base and Tier 2 Considerations Tasks)				
SMP*	1,502-1,846	2,850-3,538	0.8-1.0	1.5-1.9
AIMS	244	484	0.1	0.3
PWK	276	552	0.1	0.3

* - A range of estimates is provided as the number of hours for low and high estimates for SMP base tasks to represent the increased hours required if two separate employees execute the base tasks.

It should also be noted that should SMP decide to implement some, or all, of Tier 2 (Considerations) activities, this would require additional time beyond the anticipated base FTEs. Therefore, it is recommended that if the SMP plans to implement any Tier 2 considerations, they should devise a strategy to gage the actual LOE required to execute and maintain the program before implementing any considerations. Such strategies could include delaying the implementation of any major Tier 2 considerations, or if this is not feasible, maintaining a contractor (or contractors) on an on-call basis to cover any additional workload requirements that Tier 2 considerations may incur.

4.3 Future Program Activities and Outlook

Tier 1: Program Standards

4.3.1 Planned Policy and Procedure Modifications

As described in **Section 1.2.1**, planned modifications to the System Management program represent incremental changes which have been identified before larger modifications are needed and represent factors which can be used to fine-tune the program as necessary. The following list outlines factors to be evaluated on an annual basis which can be adjusted to fine-tune the System Management program's performance:

- **High Priority Risk Score Thresholds**
  - **Evaluation timeline**: Once annually

- **Description**:
  - As described in **Section 3.1.2**, an initial funding risk score threshold of 3.2 is recommended to delineate assets eligible for System Management funding for both inspection and replacement projects. This threshold was selected by considering the availability of condition data and distribution of risk scores, and it is anticipated that as additional stormwater system data is collected, especially condition data, these project risk score thresholds will need to be adjusted. The need for adjustments can be determined by:
    - Evaluating the composition of projects being submitted by Watershed Organizations for alignment with System Management program goals
    - Calculating the number of assets with risk scores meeting the threshold and determining if the current threshold provides a sufficient number of assets to formulate projects such that a wide distribution of Cities are able to participate in the program.

  As field inspections are completed, it is anticipated that the number of deteriorated assets inventoried will increase, and the risk score threshold will likely need to be increased to continue to target high priority assets with SMP funding. Further in the future, as a majority of the County's deteriorated assets are identified and replaced, the risk score threshold will likely be reduced, although this is not anticipated until the program has been in place for multiple decades.

- **SMP Matching Funding Level**
  - **Evaluation timeline**: Once annually
  - **Description**:
    - The System Management program is anticipated to start with approximately 30-percent of the SMP budget being used as project matching funds, and approved projects will be funded 50-percent by SMP funds. Both of these variables, the System Management budget and matching funding level, should be evaluated on an annual basis by:
      - Evaluating if the entire System Management budget is being used, or if a portion of the budget is consistently left unused
      - Determining if Cities are able to secure matching funds, or if the requirement to fund 50-percent of a project discourages participation in the program
      - Tracking the Cities which are most active in the System Management program and evaluating if assets with high risk scores located in Cities with lower project funding capacities continue to be unaddressed by the program.

These evaluations may indicate one of two scenarios: 1) the System Management budget is overutilized, and the SMP can either increase the program's budget or restrict project requirements by increasing the risk score thresholds for eligible assets; or 2) the System Management budget is underutilized, either because project applications do not deplete the program's budget or because Cities with the highest funding capacities dominate project applications and high risk assets in Cities with low funding capacities go unaddressed. If the program budget is underutilized, the SMP could:

- Decrease the local match required for projects
- Create a tiered approach to determining matching funds where the highest risk assets are provided a higher SMP match.

- **Unit Cost Model**
  - **Evaluation timeline**: Continuous as project bid tabs are received
  - **Description**:
    - Because replacement costs assigned by the prioritization script can be used to set project budgets, it will be important to continually evaluate the unit costs used by the script against actual costs for projects funded by the SMP. It will be important to the SMP's budgeting process to set project upper limits using up-to-date unit costs. If project budgets are regularly too low, then the program may not fund the repair/replacement of eligible assets at its intended 50-percent level, and if project budgets are regularly too high, then unspent funds will continuously carry over year after year. Fine-tuning the unit cost model will help to mitigate these two scenarios.
- **Condition Data Quality Control**
  - **Evaluation timeline**: At least once annually, more as needed
  - **Description:**
    - In order to maintain consistency in condition data being entered to the stormwater geodatabase across Cities, it is recommended for the SMP to complete reinspection of a subset of assets inspected by Cities on at least an annual basis. Specifically, reinspections are recommended where condition scores have been received with a rating of 4 or worse so that the uniformity of scores received can be evaluated. Where a contractor has previously completed the original inspection, an independent contractor should complete the reinspection. Where deviation from inspection requirements are indicated, submitted scores should be adjusted.

4.3.2 Recommended Schedule of Activities

The SMP currently plans to implement a 5-year CIP planning cycle which will include all projects funded by the program. The details of the CIP, including fiscal year dates, deadlines for project selection and placement CIP, and other aspects have not yet been determined. As a result, a theoretical fiscal year which coincides with the calendar year was assumed and anticipated program activities placed on a quarterly schedule, and this is shown in **Table 4-14**. This was done to illustrate the relative timeframe to complete these activities and serve as a tool to help create the System Management CIP cycle.

Table 4-14 Timing of Activities for Hypothetical Fiscal Year (Concurrent with Calendar Year)

Quarter (Calendar and Fiscal)	Activity	Explanation
1st	SMP notifies Watershed Organizations and Cities of risk score thresholds to determine assets eligible for funding as well as any changes to the total System Management budget or the level of SMP matching	Establishing the criteria by which projects will be chosen for funding early in the year provides between 3 and 6 months for Cities and Watershed Organizations to develop projects. Sufficient lead time will be necessary for this as project prioritization will need to be negotiated within the Watershed Organizations.
2nd	Cities and Watershed Organizations create projects for submittal	Using the latest available prioritization script results, Cities and Watershed Organizations will develop projects which meet project criteria for the year.
3rd	Deadline for project submittal	Requiring projects to be submitted in the 3rd quarter will provide around 3 months for the SMP to choose projects.
4th	SMP chooses projects for funding and determines any changes in project timing	Projects will need to be chosen and communicated to Cities on a regular basis, and because new projects will theoretically be placed in the fifth year of the CIP, it is important that communication of project approval be done regularly so that Cities can allocate funding in their CIPs. When implementation is either accelerated or delayed within the CIP, it will be important for the SMP to communicate these changes as early as possible to Cities.
Continuous	AIMS executes the prioritization script and makes results available to Cities and Watershed Organizations on at least a monthly basis	The prioritization script should be run frequently throughout the year, as Cities may flexibility need updated results to assemble projects as new data are added to the AIMS stormwater geodatabase.
Continuous	Cities continually complete field assessments and inventories of stormwater assets and submit new data to AIMS to add to the stormwater geodatabase	It will be in the best interest of Cities to continually obtain and provide field assessments of stormwater assets, as this increases the pool of assets they have available to request SMP funding to repair/replace, and the SMP should support ongoing collection and maintenance of this data.

Formulation of the initial 5-year CIP can follow this schedule; however, projects chosen for funding in the 4th quarter may span the entire 5-year timeframe of the CIP and will most likely include projects to be funded the following year. Cities with projects approved for funding in the first year of the CIP should be notified as soon as possible so that City matching funds can be allocated.

When the available budgets have been allocated to projects, the SMP should communicate the results with all entities that submitted projects of the results. The SMP should also submit the funded project list and the list of associated assets to AIMS for inclusion in its online GIS interface. The projects selected each year and their associated assets should be viewable in AIMS to illustrate where program funds are being spent and to illustrate the risk-based approach to managing stormwater infrastructure across the County.

4.3.3 System Management Program Performance Indicator Calculations

The following Performance Indicator (PI) calculations are recommended to be completed on at least an annual basis to measure the performance of the System Management program. These PIs are intended to numerically summarize whether the program is meeting its goal of improving stormwater asset condition throughout the County. The results of tracking these PIs could serve as a communication tool with the Board of County Commissioners and guide the planned modifications described in **Section 4.4.1**.

To track the progress of the program, it will be vital that the SMP keep a record of the results of the prioritization script on a consistent timeframe every year. For instance, the SMP could retain an active copy of the prioritization results geodatabase from the first week of every January. These copies should be easily accessible and kept from being modified in any way, and PI calculations should be completed in a separate file.

- **PI #1: Geographical Distribution of Project Funding**
  - The goal of this PI is to capture the overall reach of the System Management program to track that funds are distributed across the County. Should this not be the case, the policies and procedures associated with the System Management program should be evaluated and potentially adjusted to achieve a desired distribution of funds.
  - The following calculations are recommended to be completed under **PI #1**:
    - **PI #1.1**: Number of projects funded within each Watershed Organization
    - **PI #1.2**: Total funds distributed within each Watershed Organization
    - **PI #1.3**: Number of projects within each City
    - **PI #1.4**: Total funds distributed within each City
- **PI #2: Overall County Risk Score**
  - The goal of this PI is to simply track the County's overall risk score. This calculation should be done on the basis of the assets contained in the geodatabase maintained by AIMS at the start of the period of interest such that any field condition assessments completed during the period of interest are not included. If new field assessments were included in the calculation, the results would be skewed and could result in an increase in overall County risk score if 'very poor' condition ratings were assigned to many assets, despite renewal projects having been completed within the period of interest.

Conversely, if 'good' condition ratings were assigned to many assets, this could results in a decrease in risk score that is not the result of renewal projects.

Renewal projects should only be evaluated against the information available at the time they were formulated and using the geodatabase at the start of the period of interest will maintain a consistent evaluation.

- The following calculations are recommended to be completed under **PI #2**:
  - **PI #2.1**: Average risk scores for all structures and lines in the County, using a straight mathematical mean
  - **PI #2.2**: Cost-weighted risk scores for both structures and lines, where the cost used is the replacement cost for individual assets calculated by the prioritization script.

- **PI #3: Benefit-Cost Analyses**
  - The goal of this PI is to measure the return on investment being made by the SMP under the System Management program. For renewal projects, benefit is defined as reduction in overall risk and inspection project benefits are measured by their success in documenting new assets in deteriorated condition.
  - The following calculations are recommended to be completed under **PI #3**:
    - **PI #3.1**: Dollars spent per 0.1 points in County risk reduction, per the following formula:

$$\frac{\text{Annual Amount Spent on Renewal Projects (\$)}}{(\text{Overall County Risk Score})_1 - (\text{Overall County Risk Score})_2} * 0.1$$

where:

$(\text{Overall County Risk Score})_1$ = Overall County Risk Score at the beginning of the time period of interest (likely annual)

$(\text{Overall County Risk Score})_2$ = Overall County Risk Score at the end of the time period of interest (likely annual) for the same subset of assets which had field-assessed condition data provided by Cities at the beginning of the period of interest

This formula captures the rate of System Management funds spent to attain an increase asset integrity on a County-wide basis corresponding to a small, incremental decrease of 0.1 in risk score.

    - **PI #3.2**: Average condition scores for all inspection projects, where the conditions being averaged are the resulting field-assessed conditions for each asset.

- **PI #4: Budgeted Versus Actual Costs**
  - The goal of this PI is to capture how well the use of the unit cost model for replacement of assets matches with actual project costs by calculating the percentage of total costs provided by SMP matching funds provided for renewal of eligible assets and the amount of budget assigned to projects that is carried over to the next year.
    - **PI #4.1**: Actual percent matching funds, where the amount of matching funds provided by the SMP are divided by the total cost of all eligible asset renewals funded during the period of interest.
    - **PI #4.2**: Carryover funds not spent within the period of interest. This will be a non-zero number if the budgeted SMP match exceeds the total of at least one project budget within the period of interest and indicates that the unit cost model overestimated project budgets.

Tier 2: Considerations

4.3.4 Enclosed System Hydrologic and Hydraulic Modeling

Over time, aspects of the program may need to be modified to account for new or better data sources, and one new data source that could have a significant benefit to the program is a County-wide hydrologic and hydraulic model of the enclosed stormwater system. Currently, the risk-based prioritization scheme for all stormwater assets includes an evaluation of both the LoF and the CoF, but the LoF score is simply equivalent to the asset's condition. The condition score represents the structural integrity of the asset and does not consider if it provides an appropriate level of service. If an enclosed system stormwater model were to be developed, it could be used, alongside the existing County-wide open channel stormwater models, to support the expansion of the LoF factor to include performance characteristics.

Adding performance to the prioritization framework would require scores to be defined based on the model results. The prioritization script would need to be modified to read the model outputs, score the performance factor, and combine it with the condition score to determine the LoF and risk. Traditionally, asset management programs consider the performance of an asset as a separate failure mode that is weighted the same as the structural (i.e., condition-based) failure mode. If the program does eventually incorporate performance-based risks, it is recommended to:

- Score performance on a 1-5 basis using stormwater model results
- Set the LoF to the maximum of the condition and performance scores

The creation of a County-wide enclosed system model would enable SMP to prioritize both flooding and asset replacement projects on the same basis and would reduce or eliminate the need to carry two separate programs with two separate budgets.

4.3.5 Web-Based Project Formulation Application

To streamline the processes used to create, select, and communicate projects, a web-based application could be built on top of the AIMS data and the prioritization script results. The application could allow interested parties (i.e., cities, Watershed Organizations, the SMP, and the public) to spatially view the condition, performance, consequence, and risk scores, attribute data, and estimated asset-level inspection and replacement costs. Users with sufficient permissions could select segments and structures they would like to group into a project, and then could specify project level information (e.g., Project ID, Project Description, Project Justification). The application could automatically total the estimated project cost for the program-eligible assets selected and it could calculate the cost-weighted average project risk.

Projects could be created in a draft status and Watershed Organizations could review the draft projects in the website and formally submit selected ones for SMP consideration that year. Draft projects and projects that don't receive SMP funds could be retained in the system for review and resubmittal the following year. The SMP could access the site to review the submitted projects and spatially view the assets included in the projects and how they scored. The SMP could also enter program budgets by year and as projects are selected, the unallocated budget could be shown to help guide the selection of projects that will get matching funds from the SMP. This website could improve communication and transparency and could simplify the workflows used by the cities, Watershed Organizations and the SMP to create, select, and communicate projects.

Section 5
References

American Public Works Association. (2011). Kansas City Metropolitan Chapter, Kansas City Metropolitan Chapter.

Black & Veatch (2016). 2016 Strategic Plan – Stormwater Management Program Johnson County, Kansas.

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Appendix A

Asset Prioritization Script Technical Documentation

A.1 Asset Prioritization SQL Script

The asset prioritization SQL script is written based on tables and base data supplied by AIMS. The target environment for execution of the script is SQL Server 2016. The logic of the script has been divided into two separate files. The first file is a setup script, intended to be run once upon delivery and yearly following that. The primary file is the prioritization script, which should be rerun as updated asset prioritization is desired. (e.g. when new or revised asset data becomes available).

All tables created for this script are placed in the database Lucity.dbo and begin with the prefix "PWK_" followed by the table name, and in the future the location of these tables, and the overall script, can be adjusted as necessary. These tables are documented following the body of this appendix.

A.1.1 Setup Script

The setup script is a short script which will create the tables necessary for the run of the prioritization script. The tables that will be created is STORMWATER_LN_FailureAnalysis, STORMWATER_PT_FailureAnalysis, and STORMWATERNATRL_LN_FailureAnalysis which are all found in the Lucity database under the dbo user. The STORMWATER_LN_FailureAnalysis table is similar in structure to the jocoPub.DLSEC. STORMWATER_LN table with some added columns, which hold data about the pipe prioritization. Likewise, the STORMWATER_PT_FailureAnalysis table structure is based off of the jocoPub.DLSEC. STORMWATER_PT table structure, with columns added to hold data about the structure prioritization. The STORMWATERNATRL_LN_FailureAnalysis table is based off of the jocoPub.DLSEC.STORMWATERNATRL_LN_FailureAnalysis table. The script also creates spatial indices for these tables, which improves performance of the script. The definition of each new column for these tables is described in the tables below.

Table A.1-1 Column Definitions for STORMWATER_PT_FailureAnalysis

Column	Definition
StndStruct	Standardized structure name
StndMater	Standardized material name
StndYearConst	Standardized year constructed
PACPCond	Asset condition (either decoded or estimated)
InvalidMater	Bit indicating if the material is invalid (1 = invalid)
InvalidCond	Bit indicating if the condition decoded is invalid (1 = invalid)
InvalidStruct	Bit indicating if the structure type is invalid (1 = invalid)
IsCondEst	Bit indicating if the condition is estimated (1 = estimated, 0 = decoded)
IsYearEst	Bit indicating if the year is estimated (1 = estimated)
ServiceLife	Unadjusted service life in years
EffectiveAge	Asset's life in years
ServLifeAdj	Adjustment to the service life for the asset
RemUseLife	Remaining use life
ImpactPotential	1-5 rating for the impact potential given this asset fails (5 = high, 1 = low)
TransportationImpact	1-5 rating for the impact to transportation given this asset fails (5 = high, 1 = low)
FacilityImpact	1-5 rating for the impact to facilities given this asset fails (5 = high, 1 = low)
UtilityImpact	1-5 rating for the impact to utilities given this asset fails (5 = high, 1 = low)
TMDLViolation	1-5 rating for the impact to streams if this asset fails (5 = high, 1 = low)
ErosionImpact	1-5 rating for the impact to erosion given this asset fails (5 = high, 1 = low)
ImpactSeverity	1-5 rating calculated by the max of TransportationImpact, FacilityImpact, UtilityImpact, TMDLViolation, and ErosionImpact
ConsqOfFail	1-5 rating for the consequence of asset failure
Risk	1-5 rating for the risk that the asset failure poses to the system
ImpactPotential	1-5 rating for the impact potential given this asset fails (5 = high, 1 = low)
IsIneligible	Bit indicating if the structure is ineligible for a rating (1 = yes, 0 = no)
NearGas	Bit indicating if the structure is within 5 feet of a gas utility (1 = yes, 0 = no)
NearElec	Bit indicating if the structure is within 5 feet of an electrical utility (1 = yes, 0 = no)
NearRail	Bit indicating if the structure is within 50 feet of a rail road (1 = yes, 0 = no)
NearRoad	Bit indicating if the structure is within 50 feet of a road, if it is not within 50 feet of a rail road (1 = yes, 0 = no)
ReplCost	Unit cost of replacing the structure.

Table A.1-2 Column Definitions for STORMWATER_LN_FailureAnalysis

Column	Definition
StndMater	Standardized material name
StndYearConst	Standardized year constructed
PACPCond	Asset condition (either decoded or estimated)
InvalidMater	Bit indicating if the material is invalid (1 = invalid)
InvalidCond	Bit indicating if the condition decoded is invalid (1 = invalid)
IsCondEst	Bit indicating if the condition is estimated (1 = estimated, 0 = decoded)
IsYearEst	Bit indicating if the year is estimated (1 = estimated)
ServiceLife	Unadjusted service life in years
EffectiveAge	Asset's life in years
ServLifeAdj	Adjustment to the service life for the asset
RemUseLife	Remaining useful life
FlowArea	Flow area in square inches for the pipe
ImpactPotential	1-5 rating for the impact potential given this asset fails (5 = high, 1 = low)
TransportationImpact	1-5 rating for the impact to transportation given this asset fails (5 = high, 1 = low)
FacilityImpact	1-5 rating for the impact to facilities given this asset fails (5 = high, 1 = low)
UtilityImpact	1-5 rating for the impact to utilities given this asset fails (5 = high, 1 = low)
TMDLViolation	1-5 rating for the impact to streams if this asset fails (5 = high, 1 = low)
ErosionImpact	1-5 rating for the impact to erosion given this asset fails (5 = high, 1 = low)
ImpactSeverity	1-5 rating calculated by the max of TransportationImpact, FacilityImpact, UtilityImpact, TMDLViolation, and ErosionImpact
ConsqOfFail	1-5 rating for the consequence of asset failure
Risk	1-5 rating for the risk that the asset failure poses to the system
IsIneligible	Bit indicating if the pipe is ineligible for a rating (1 = yes, 0 = no)
NearGas	Bit indicating if the pipe is within 5 feet of a gas utility (1 = yes, 0 = no)
NearElec	Bit indicating if the pipe is within 5 feet of an electrical utility (1 = yes, 0 = no)
NearRail	Bit indicating if the pipe is within 50 feet of a rail road (1 = yes, 0 = no)
NearRoad	Bit indicating if the pipe is within 50 feet of a road, if it is not near a rail road (1 = yes, 0 = no)
ReplCost	Unit cost of replacing the pipe, calculated using cost per linear foot and the pipe length.

Table 1 Column Definitions for STORMWATERNATRL_LN_FailureAnalysis

ConsqOfFail	1-5 rating for the consequence of asset failure
Risk	1-5 rating for the risk that the asset failure poses to the system

In addition to creating these tables, the setup script also adds four fields to the existing STORMWATERNATRL_LN_FailureAnalysis table. These fields hold condition information for the open channels and are described below.

Table 2 Column Definitions for added fields to STORMWATERNATRL_LN

Condition	1-5 integer condition rating for the asset
NearBuilding	Bit indicating if the open channel is near a building (1 = yes, 0 = no)
IsEroded	Bit indicating if the open channel is eroded (1 = yes, 0 = no)
IsCondEst	Bit indicating if the condition was estimated or from inspection (1 = estimated, 0 = inspection)

This script is intended to be run a single time upon delivery to create the necessary tables. It *will not* need to be run before each prioritization script run.

A.1.2 Prioritization Script

The goal of the prioritization script is to fill the fields listed in the tables above such that the individual assets' risk to the overall system can be calculated. This section will describe in detail the steps taken in the prioritization script to achieve this. As the first step, the STORMWATER_PT_FailureAnalysis and STORMWATER_LN_FailureAnalysis tables are truncated and refilled with fresh data from the STORMWATER_PT and STORMWATER_LN tables.

Structure Type Decoding

The next step is to use the StructureType fields from STORMWATER_PT to match with a CityCode value from the Lucity.dbo.PWK_StructureTypeDecode table. If there is a match, then the StndStruct value is set to the CountyCode from the corresponding entry in the StructureTypeDecode entry and the ServLifeAdj value is set to the ServLifeAdj value from the StructureTypeDecode entry.

If there was no match but there was an entry in StructureType, then the InvalidStruct bit is set to 1. All structure types that have not been coded are then marked as "Unknown" and given a ServLifeAdj of 0.

Material Type Decoding

The material type decoding is done depending on the asset type (pipe or structure) and using the table Lucity.dbo.PWK_MaterialTypeDecode. For decoding the structures, we match the Material value in the STORMWATER_PT_FailureAnalysis table with a CityCode in the MaterialTypeDecode table where the AssetType is "Structure". If there is a match, then the StndMater is set using the CountyCode from the MaterialTypeDecode table. For decoding the pipes, we match the Material value in the STORMWATER_LN_FailureAnalysis table with a CityCode in the MaterialTypeDecode table where the AssetType is "Pipe". If there is a match, then the StndMater is set using the CountyCode from the MaterialTypeDecode table.

Any structures that did not have a match for the Material but have a non-null Material get InvalidMater set to 1. Any structures that have not had a material decoded are set to "ZZZ". Any pipes that did not have a match for the Material but have a non-null Material get InvalidMater set to 1. Any pipes that have not had a material decoded are set to "ZZZ".

Eligibility

At this point in the script, there are some structures and pipes that we are not interested in calculating any ratings or a consequence of failure score for. For structures, these ineligible assets are identified by a "Ineligible" value in the StndMater or StndStruct field.

In general, eligible pipes were determined based on the line's material, where acceptable materials were clay, CMP, CP, DIP, PE, PP, PVC, RCB, RCP, SP, VCP, and ZZZ per the data cleanup activities described in **Section 2.1.1**. For pipes, the ineligible assets were identified by manual inspection of the asset data provided by Cities and AIMS and identified markers of open channels. This was done because open channel projects will be prioritized using a different methodology than engineered lines.

For pipes, the ineligible assets are identified by markers of open channels including:

- LINETYPE as:
  - Channel
  - Concrete Channel
  - Ditch
  - Improved Ditch
  - Natural stream
  - Pond-Lake Channel
  - Rectangular Lined Channel
  - Stream Channel
  - Swale
  - Trapezoidal Lined Channel
- LINESHAPE as:
  - Natural Channel
  - Rectangular Channel
  - Rectangular Lined Channel
  - Trapezoidal Channel
  - U-shaped Channel

- MATERIAL as:
  - "V" Bottom Ditch
  - 14" Concrete Paved Ditch
  - Channel
  - concrete channel
  - Concrete Channel
  - Concrete Channnel
  - Concrete Ditch
  - Concrete Ditch Liner
  - concrete flume
  - Concrete Flume
  - Concrete Paved Ditch
  - Concrete Trapezold
  - Drainage Channel
  - Gabion Lined
  - Precast concrete block
  - Rip Rap
  - Stacked Stone
  - Stone
  - Stone Masonry
  - Stream Bed

Condition Assignment

Depending on the source and the condition entry, the condition can be either decoded or estimated.

Dam, Reservoir, Levee, and Floodwall Conditions

For these special asset types, the STORMWATER_PT_FailureAnalysis table will be checked for STRUCTURETYPE 'Reservoir/Dam' and the STORMWATER_LN_FailureAnalysis table will be checked for LINETYPE 'Levee'. If there is a match, then the condition (PACPCond) will be retrieved directly from the CONDITION column. Valid entries will be an integer from one to five.

Text Condition Decoding

For decoded conditions, there are two ways to decode depending on the city: either by numeric range or by text decoding. For the text decoding, if the DoRating bit is equal to 1 then the Lucity.dbo.PWK_TextConditionDecode table is used to decode. We try to find an entry where the Condition in the STORMWATER_PT_FailureAnalysis table matches the CityCode in the TextConditionDecode table, the AssetType in the TextConditionDecode is "Structure", and the City in the TextConditionDecode table matches the CUEPROVIDER for the STORMWATER_PT_FailureAnalysis table. If there is a match, then the CountyCode from the corresponding entry in the TextConditionDecode table is used to set PACPCond.

The condition decoding for pipes is similar. For the text decoding, the Lucity.dbo.PWK_TextConditionDecode table is used. We try to find an entry where the Condition in the STORMWATER_LN_FailureAnalysis table matches the CityCode in the TextConditionDecode table, the AssetType in the TextConditionDecode is "Pipe", and the City in the TextConditionDecode table matches the CUEPROVIDER for the STORMWATER_LN_FailureAnalysis table. If there is a match, then the CountyCode from the corresponding entry in the TextConditionDecode table is used to set PACPCond.

Numeric Condition Decoding

Some cities use a numeric scale for ranking condition of assets. These decoding tables can be found in Lucity.dbo.PWK_NumericConditionDecode. If an eligible asset's CUEPROVIDER is found in the NumericConditionDecode table, the asset has a numeric CONDITION, and there is a record in the NumericConditionDecode table for which the CONDITION is less than or equal to the city's upper bound and greater than the city's lower bound (or equal to the lower bound in the case of 0), then the associated rating is assigned to the PACPCond field.

Error Logging for Conditions

For any asset and CUEPROVIDER found in the TextConditionDecode or NumericConditionDecode tables with a non-null CONDITION, if the condition was not decoded successfully using the specified tables, the condition is marked as invalid using the InvalidCond field and setting it to 1.

Condition Estimation

Any eligible pipe or structure ratings that were not assigned a decoded PACPCond value are marked with a 1 in the IsCondEst column. Those records are then assigned a year (StndYearConst) from the YEARCONST column if the year is greater than 1000, is numeric, and is before the current date. If the records don't fit those requirements to be assigned the YEARCONST, then the year is estimated and assigned to StndYearConst. Years are estimated by using the plat from jocoPub.DL.PLAT_PL where the year is on or after 1900. In order to have a plat, the asset must have a spatial component associated with it and must be within a plat polygon.

The effective age is calculated by subtracting the StndYearConst from the current year for pipes and structures.

The service life for condition estimated assets is then assigned by using the Lucity.dbo.PWK_ServiceLifeLookup table using the StndMater and asset type (pipe or structure). ServiceLife is assigned using the ServiceLife column and ServLifeAdj is assigned using the existing

service life adjustment from the structure decoding. If the asset has facility impact > 1 then an additional -15 years is added to ServLifeAdj if the material is marked IsSteel in the Lucity.dbo.PWK_ServiceLifeLookup table.

The remaining useful life is assigned by subtracting the effective age from the sum of the service life and the service life adjustment, but if that value is negative then it is set to zero. The PACPCond is then estimated by the formula:

$$\text{PACPCond (Estimated Condition)} = 5 - 4 * \left(\frac{\text{RemUseLife}}{\text{ServiceLife}}\right)$$

The resulting condition is then rounded to one decimal place.

Impact Potential

The Impact Potential measures the scale of the impact of an asset failure. For pipes, this is assigned by a flow area calculation. For structures, this is assigned using two methods of pairing pipes and structures, and the ImpactPotential from paired pipes is used to calculate the structure ImpactPotential.

Pipes

The Impact Potential of eligible pipes is calculated by finding the flow area of the pipe and then looking up the rating according to this flow area. Flow area is calculated using DIM1 and DIM2, which is then converted to inches. In the cases of DIM1 or DIM2 greater than zero and less than twelve, DIM1_IN is calculated by multiplying DIM1 by twelve and DIM2_IN is calculated by multiplying DIM2 by twelve. In all other cases, DIM1 and DIM2 are assumed to already be in inches and are assigned directly to DIM1_IN and DIM2_IN.

In the cases of DIM1_IN as null or zero and DIM2_IN as non-null or zero, DIM2_IN is used for both dimensions to calculate flow area. The opposite is also true. In the cases of both non-null and non-zero DIM1_IN and DIM2_IN, both dimensions are used to calculate flow area. In the case of both null or zero DIM1_IN and DIM2_IN, the flow area and Impact Potential cannot be calculated.

The formula used to calculate the flow area is an elliptical formula (DIM1_IN * DIM2_IN)/4*pi, DIM1_IN * DIM1_IN)/4*pi, or DIM2_IN * DIM2_IN)/4*pi) in the cases defined in the Lucity.dbo.PWK_FlowAreaFormulaLookup table. These are cases of the following LINESHAPE: Arch Pipe, Arch, Elliptical, Elliptical Pipe, Oval, Squash Pipe, Culvert Pipe Single, Round, Round Pipe, and Circular. In the case of Culvert Pipe Multiple, the elliptical formula is used and multiplied by two.

The formula used to calculate the flow area is a rectangular formula (DIM1_IN * DIM2_IN, DIM1_IN * DIM1_IN, or DIM2_IN * DIM2_IN) in the cases of LINESHAPE: Box, Box Culvert, Rectangular, or Square. In the cases of Double Box or Triple Box, the rectangular formula is used and multiplied by two or three.

If the formula was not able to be found by using the LINESHAPE, the StndMater field can also be used to lookup the formula. The formula is elliptical in cases of Clay, CMP, CP, DIP, PE, PP, PVC, RCP, SP, VCP, and ZZZ. It is rectangular in the cases of RCB.

These calculated flow areas are used with the Lucity.dbo.PWK_ImpactPotentialLookup table to calculate the Impact Potential rating. To match with a rating in the table, the flow area must be larger than FlowAreaMin and less than or equal to FlowAreaMax (except in the case of the highest rating, where FlowAreaMax should be null and won't be tested). That rating is then assigned to ImpactPotential for the pipe.

Structures

The Impact Potential of eligible structures is calculated using two different methods. The first method attempted is by trying to match a structure's PROVIDERKEY with a pipe's USNODEID or DSNODEID and ensuring that the pipe and structure have the same CUEPROVIDER. There can be many matches for a single structure. In the case of multiple matches, the largest of the matching pipe's ImpactPotential is assigned to the structure.

For the eligible structures that are not assigned an Impact Potential using the method described above, a buffer is used to find all pipes within five feet of the structure. The structure is then assigned the maximum ImpactPotential of the matching pipes.

Transportation Impact

Transportation Impact is calculated for all eligible pipes and structures. Pipe and structure proximity to specified rail and roadways is calculated and assigned a rating per the table below. The maximum qualifying value is assigned for each pipe or structure. Assets that are not within 50 feet of any of these rail or roadways are assigned TransportationImpact of 1.

Table A.1-3 Transportation Impact Ratings

Transportation Type	Source Table	Within 50 Feet Rating
Rail	jocoPub.DL.RAIL_LN	5
State Highway	jocoPub.DL.CENTERLINE_LN where SUBCLASDSC is State Highway	5
Highway Ramp	jocoPub.DL.CENTERLINE_LN where SUBCLASDSC is Highway Ramp	5
Interstate Highway	jocoPub.DL.CENTERLINE_LN where SUBCLASDSC is Interstate Highway	5
US Highway	jocoPub.DL.CENTERLINE_LN where SUBCLASDSC is US Highway	5
Thoroughfare-Major	jocoPub.DL.CENTERLINE_LN where SUBCLASDSC is Thoroughfare-Major	4
Thoroughfare-Minor	jocoPub.DL.CENTERLINE_LN where SUBCLASDSC is Thoroughfare-Minor	4
Thoroughfare-Ramp	jocoPub.DL.CENTERLINE_LN where SUBCLASDSC is Thoroughfare-Ramp	4
Thoroughfare-Unclassified	jocoPub.DL.CENTERLINE_LN where SUBCLASDSC is Thoroughfare-Unclassified	4
Collector-Major	jocoPub.DL.CENTERLINE_LN where SUBCLASDSC is Collector-Major	3
Collector-Minor	jocoPub.DL.CENTERLINE_LN where SUBCLASDSC is Collector-Minor	3
Collector-Unclassified	jocoPub.DL.CENTERLINE_LN where SUBCLASDSC is Collector-Unclassified	3
Local-Private	jocoPub.DL.CENTERLINE_LN where SUBCLASDSC is Local-Private	2
Local-Public	jocoPub.DL.CENTERLINE_LN where SUBCLASDSC is Local-Public	2
Local-Access	jocoPub.DL.CENTERLINE_LN where SUBCLASDSC is Local-Access	1
Local-Mono Parity	jocoPub.DL.CENTERLINE_LN where SUBCLASDSC is Local-Mono Parity	1

Facility Impact

Facility Impact is calculated for all eligible pipes and structures. Pipe and structure proximity to specified facilities is calculated and assigned a rating per the table below. The maximum qualifying value is assigned for each pipe or structure. Assets that are not within 25 feet of any of these facilities are assigned FacilityImpact of 1.

Table A.1-4 Facility Impact Ratings

Facility Type	Source Table	Underneath Rating	Within 25 Feet Rating
Critical Facilities	jocoPub.dbo.CRITICALFACILITIES	5	4
Historic Sites	jocoPub.DL.HISTORICSITES_PT	5	4
Gas Stations	jocoPub.DL.GASSTATION_PT	5	4
Airports	jocoPub.DL.AIRPORT_PL	5	4
Landfills	jocoPub.DL.LANDFILLS_PT	5	4
Parks	jocoPub.DL.PARK_PL	3	2
Golf Courses	jocoPub.DL.GOLF_PL	3	2
Cemeteries	jocoPub.DL.CEMETERY_PL	3	2

Utility Impact

Utility Impact is calculated for all eligible pipes and structures. Pipe and structure proximity to specified utilities is calculated and assigned a rating per the table below. The maximum qualifying value is assigned for each pipe or structure. Assets that are not within 25 feet of any of these utilities are assigned UtilityImpact of 1.

Table A.1-5 Utility Impact Ratings

Utility Type	Source Table	Within 5 Feet Rating
NPMS Pipe	jocoPub.DLSEC.NPMSPIPE_LN	5
Sewer Mains	jocoPub.DLSEC.SEWERMAINS_LN	4
Sewer Points	jocoPub.DLSEC.SEWERPOINTS_PT	4
Sewer Structures	jocoPub.DLSEC.SEWERSTRUCTURES_PT	4
Water Hydrants	jocoPub.DLSEC.WATERHYDRANTS_PT	4
Water Mains	jocoPub.DLSEC.WATERMAINS_LN	4
Water Meters	jocoPub.DLSEC.WATERMETERS_PT	4
Water Valves	jocoPub.DLSEC.WATERVALVES	4

Because the spatial files for electric and gas do not cover the whole of Johnson County, electric and gas are not included in the above ratings. Instead there are flags called NearGas and NearElec that are set to identify eligible pipes and structures within five feet of gas and electric utilities. The table used to measure proximity to gas is jocoPub.DLSEC.GASMAINS_LN. The tables used to measure proximity to electric are:

- jocoPub.DLSEC.ELECBELOWGRNDSTR_PT
- jocoPub.DLSEC.ELECDUCTBANK_LN

- jocoPub.DLSEC.ELECPAD_PT
- jocoPub.DLSEC.ELECSUBSTATION_PL
- jocoPub.DLSEC.ELECSWITCH_PT
- jocoPub.DLSEC.ELECTRANSFORMER_PT
- jocoPub.DLSEC.ELECUNDERGROUND_LN
- jocoPub.DLSEC.ELECMULTIPOLE_PT
- jocoPub.DLSEC.ELECSINGLEPOLE_PT

TMDL Contribution

TMDL Contribution is only calculated for eligible CMP pipes within a stream's watershed. If a CMP pipe is in the same watershed as a 303D stream, then it is rated 3. If a CMP pipe is in the same watershed as any other stream, then it is rated 2. Everything else is rated as 1.

Erosion Impact

Erosion is rated in the STORMWATERNATRL_LN table. In this table, there should be an integer 1-5 rating in the condition column. There is a Boolean called IsCondEst that is 1 if the condition is estimated and 0 if the condition is based on field inspection. There should also be a Boolean marking if the open channel is near a building or has erosion. If both of these cases are satisfied, determined by a 1 in the NearBuilding column and a 1 in the IsErosive column, then the consequence of failure is recorded as a 5. Consequence of failure is 1 otherwise. The risk is then calculated by weighing the consequence of failure at 35% and the condition at 65%.

Replacement Cost

Replacement costs are assigned to each asset based on the unit cost modeled described in **Section 3.4**. There is a variable @CostInflator found in the script that is designed to apply inflation costs to the structure/pipe replacement costs without requiring changes to the associated tables. This variable is defaulted to 1 but can be changed by the user before running the script.

Pipes

For pipes that have material type RCB, the replacement cost (ReplCost) will be calculated by checking if the structure is within fifty feet of a rail line. If it is, then use the LnftCostNearRail column of the Lucity.dbo.PWK_RCBPipeCostLookup table for the pipe's appropriate flow area range to multiply by the pipe's Length column. If it is not near a rail line but is near a road then use the LnftCostUnderPavement column multiplied by the pipe's Length column. Otherwise use the LnftCostNotUnderPavement column multiplied by the pipe's Length column. All costs are adjusted depending on the user-set cost inflator variable, described above.

For all other pipes, use the same approach but look up the linear foot costs in the Lucity.dbo.PWK_PipeCostLookup table.

Structures

For structures that are of type Outfall, the replacement cost (ReplCost) will be calculated by checking if the structure is within fifty feet of a road. If it is, then the UnitCostUnderPavement will be used for the structure's corresponding ImpactPotential as looked up in Lucity.dbo.PWK_OutfallReplacementCostLookup. If it is not within fifty feet of a road, then the UnitCostNotUnderPavement will be used for the structure's corresponding ImpactPotential as looked up in the PWK_OutfallReplacementCostLookup table. All costs are adjusted depending on the user-set cost inflator variable, described above.

For structures that are not of type Outfall, the replacement cost will be calculated by checking if the structure is within fifty feet of a road. If it is, then the ReplacementUnitName will be looked up from Lucity.dbo.PWK_StructureReplacmentUnitLookup using the structure type. The cost of replacing that unit will be looked up in the Lucity.dbo.PWK_StrucutreUnitCostLookup table using the UnitCostUnderPavement column. If the structure is not near a road, then the UnitCostNotUnderPavement column will be used. All costs are adjusted depending on the user-set cost inflator variable, described above.

Impact Severity

The impact severity for each asset is calculated by taking the maximum value from the following fields for that asset: TransportationImpact, FacilityImpact, UtilityImpact, TMDLViolation, and ErosionImpact.

Consequence of Failure

The consequence of failure rating (ConsqOfFail) for each asset is calculated by averaging the ImpactSeverity and the ImpactPotential and rounding to one decimal place, except in the cases of dams, reservoirs, levees, and floodwalls, which receive a consequence of failure rating of five.

Risk Rating

The risk rating (Risk) uses a weighted average of 35% ConsqOfFail and 65% PACPCond, which is rounded to one decimal place.

A.1.3 Prioritization Script Details for Maintenance and Use

The following tables described below can be added to as needed, but it is not recommended to delete or edit records in them. Existing records included in these tables delivered in this report in **Appendix C** were formulated to be consistent with the conversions and prioritization processes described in **Sections 2** and **3** of this report, and any changes to them other than to add records will cause the script to deviate from this report.

Flow Area Formula Lookup

Items can be deleted from this table without script changes. Items can be added to this table without script changes as long as an existing FormulaName and CharacteristicType is used. The CharacteristicType and Characteristic set must be unique.

Impact Potential Lookup

FlowAreaMin and FlowAreaMax can be edited for the existing ratings. It is recommended that no ratings outside the current 1-5 scale be added, as this could produce unexpected results. The rating must be unique.

Material Type Decode

This table is intended to be added to over time. After each script run, the InvalidMater column signifies materials not found in this table. It is recommended that after each run, this table be updated with any new CityCode values found in the MATERIAL column of records with InvalidMater. The AssetType (structure or pipe) is required. The CityCode and AssetType set must be unique.

Numeric Condition Decode

Existing records in this table can be modified or deleted. New records can be added, given that the City, AssetType, and CountyCode set is unique. All CountyCode values should be integers from one to five.

Outfall Replacement Cost Lookup

Existing records in this table can be modified. Impact potential should be unique and have an entry for each integer 1-5. The unit costs may be modified as necessary.

Pipe Cost Lookup

This table should include entries for all feasible flow areas. None of the MinFlowArea to MaxFlowArea ranges should overlap, therefore the MaxFlowArea from the line above should be used as the MinFlowArea on the line below. The linear costs may be altered as necessary.

Ratings Lookup

This table is the single most difficult table to modify, and great care should be taken while doing so. Ratings for utilities, facilities, transportation, TMDL violations, and erosion can be modified, as long as script changes are made by someone knowledgeable about SQL. In each ratings section (FacilityImpact, TransportationImpact, etc.) the ratings must be made in *descending* order in order to ensure that the maximum applicable value is used. If a user wanted to raise the FactilityImpact rating of an asset under a shopping center, the rating for the UnderShopCenter record would be increased, but the user would also need to move the location in the script where the under-shopping center rating is done to be with the FacilityImpact 5 ratings, rather than the current 4 ratings.

New records can be added to this table, but a knowledgeable SQL developer will have to create the script fragments and place them in the correct location in the existing script, among the other portions of the script that are accomplishing a similar functionality.

Records may be deleted from this table if necessary. Removal of the associated SQL script fragments by a knowledgeable SQL developer would help the script run more quickly after the deletion.

Service Life Lookup

The service life table may be modified or added to, but the AssetType and Material set must be unique.

Structure Replacement Unit Lookup

This table may be added to as needed. This table should only contain a single structure type one time. For each structure type it should have a non-null replacement unit name, used to look up the replacement cost of the structure in the Structure Unit Cost Lookup table. When records are deleted from this table, they should also be removed from the Structure Unit Cost Lookup table.

Structure Type Decode

This table is intended to be added to over time. After each script run, the InvalidStruct column signifies structures not found in this table. It is recommended that after each run, this table be updated with any new CityCode values found in the STRUCTURETYPE column of records with InvalidStruct. The CityCode must be unique.

Structure Unit Cost Lookup

This table is intended to be added to as needed. New replacement unit names can be added, and unit costs may be altered. All replacement unit names should also appear in the Structure Replacement Unit Lookup table with the corresponding structure types or else they will be unused. As records are deleted, they should be removed from the Structure Replacement Unit Lookup table.

Text Condition Decode

This table is intended to be added to over time. After each script run, the InvalidCond column signifies non-null conditions in cities with decodings available, which are not found in this table. It is recommended that after each run, this table be updated with any new valid values found in the CONDITION column of records with InvalidCond. This table can also be updated to include new cities as they are available. The City, AssetType, and CityCode set must be unique.

RCB Pipe Cost Lookup

This table should include entries for all feasible flow areas. None of the MinFlowArea to MaxFlowArea ranges should overlap, therefore the MaxFlowArea from the line above should be used as the MinFlowArea on the line below.

Cost Inflation

Because the unit cost model employed by the script assigns costs in 2018 dollars, a variable '@CostInflator' was defined which can be used to inflate costs in the future was included in the prioritization script. If the base unit costs in the script continue to be based in 2018 dollars, this variable should be updated using the Engineer News Record's cost index data. Alternatively, if unit costs are updated manually in the relevant tables, then cost inflation should be applied carefully such that updated unit costs are not also inflated if this is not appropriate.

A.2 Historical Bid Tabs

The following tables document the average costs from Kansas and Missouri Department of Transportation bid tabs as well as two PWK projects as described in **Section 2.3**. For the KDOT and MODOT tables, unit costs are listed for each year and encompass the average of all bids for all projects which included a particular line item constructed in that year.

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Appendix B
Technical Documentation (Digital)

B.1 Data Received from Cities

Storm Structures, City of Fairway – Project Update 4-15-2011

Description: This is a map in AutoCAD format supplied by Bill Stogsdill documenting the locations of stormwater assets within Fairway

Storm Structure Inventory – Updated 4/2011

Description: This PDF accompanies Fairway's Storm Structure Map and documents the sizes of structures and stormwater lines and materials

2016 Stormwater Pipe System Masterplan Update – Mission Hills, Kansas

Description: A report with accompanying data characterizing the conditions of pipes in Mission Hills

B.2 Prioritization Script Results – E-size PDF Maps

B.3 Prioritization Script (Digital Submittal)

B.4 Modified State Dam Inspection Form

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Appendix C

Watershed Asset Management Plan Template

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Watershed Asset Management Plan

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Section 1
Introduction

This watershed asset management plan (WAMP) provides procedural guidance to Cities and Watershed Organizations and outlines requirements and procedures for participation in the System Management program of the Johnson County, Kansas, Stormwater Management Program (SMP). This WAMP supplements the SMP's policies and procedures document and is written to more clearly specify the roles and responsibilities of the Cities and Watershed Organizations related to:

- Managing an inventory of stormwater assets in each City
- Assessing the condition of all assets that are eligible for program funding
- Creating and submitting projects to the SMP for review and funding approval

Sections 2 through **4** of this WAMP address the three subjects above. **Section 5** is the asset management plan for the watershed which addresses:

- The current state of the stormwater asset inventory across the watershed and the plan for addressing data gaps.
- The development of watershed-scale strategies to address high risk assets.
- The system repair, and replacement projects that are planned, whether they receive SMP matching funds or not.
- The inspections that should be prioritized to achieve a better understanding of condition across the watershed.
- The development of a 5-year Watershed Capital Improvement Program (CIP)

1.1 Background

The SMP has traditionally only funded flood mitigation projects but is currently restructuring its program to fund projects which replace existing, deteriorated stormwater assets under a new "System Management" program. This new program is outlined in the County's 2016 Strategic Plan and its goals include:

- Promotion of proactive management of stormwater infrastructure throughout the County;
- Reducing the number of emergency failures and associated interruptions of basic County services, disruption of transportation routes, and economic impacts; and,
- Advancing public safety and overall quality of life for County residents.

The Strategic Plan also recommended broader changes to the SMP, including the reorganization of the existing Stormwater Management Advisory Council into Watershed Organizations that are organized according to watershed groupings which would "manage and develop projects, as well as represent the watershed's interests with respect to the overall program" (p. 29). These Organizations are anticipated to be comprised of representatives from each City within their representative watersheds. The boundaries of the proposed Watershed Organizations are shown in **Figure 1-1**.

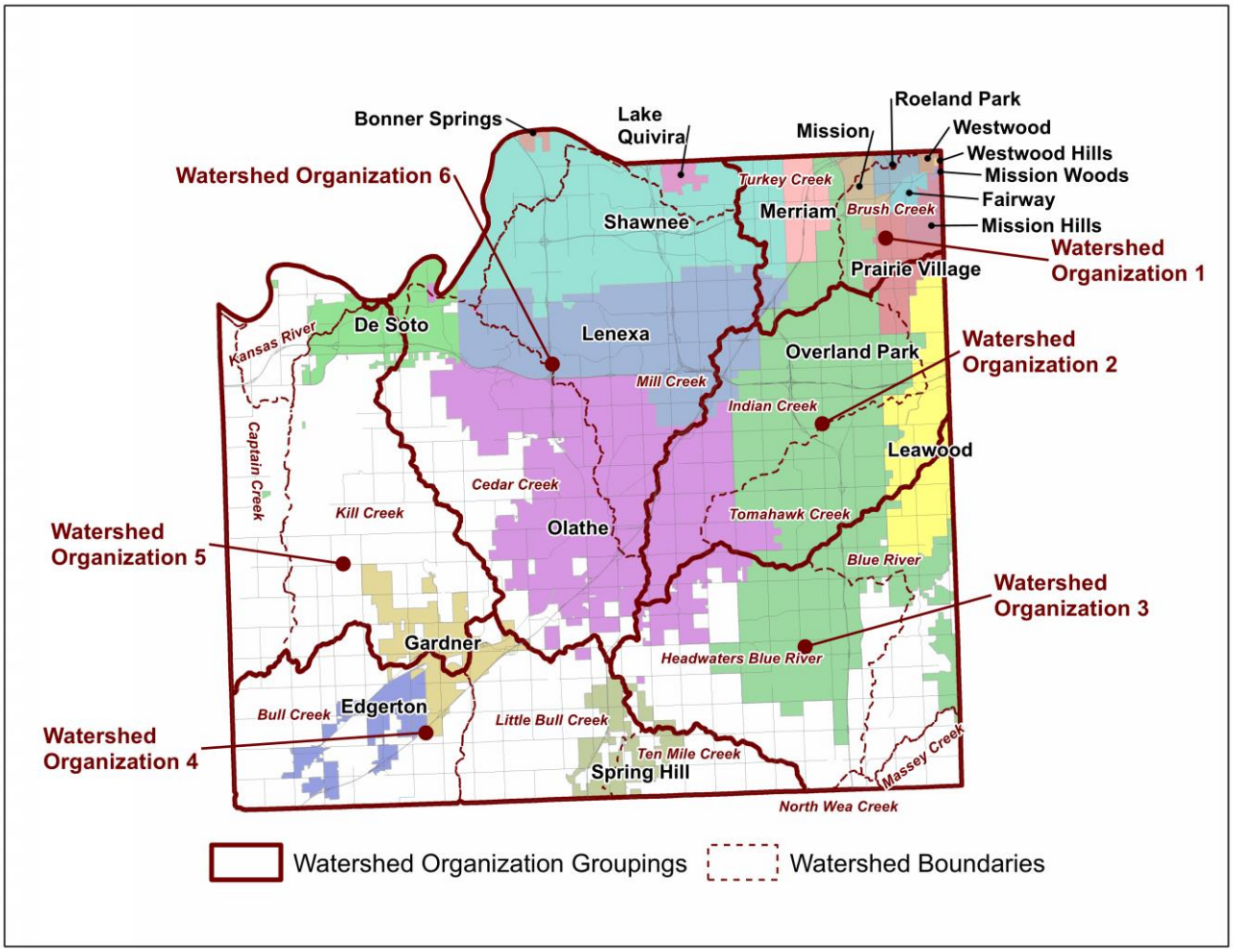

Figure 1-1 Watershed Organization Groupings

City and Watershed Organization responsibilities for the System Management Program include:

- Maintaining an accurate asset registry of stormwater assets using the best and most comprehensive available data, including:
  - Publicly and Privately-Owned Assets
  - Natural Features
    - *Natural Wetlands*
    - *Streams and Riparian Areas*
  - Engineered Features
    - *Pipes, starting at the first inlet*
    - *Structures, including inlets, manholes, junction boxes, and other pertinent structures*
    - *Detention Basins*
- Periodically reviewing planned projects and stormwater infrastructure risks and identifying the most important inspection, repair, and replacement projects that should be completed in the next five years. This includes identifying how each risk should be mitigated (e.g., point repair, full replacement, etc.) and developing project cost estimates, should the City desire to do so. The project development is explained in detail in **Section 4**.
- Securing the City's commitment to fund 50% of the cost of the program-eligible assets in each project.
- Submitting projects to the SMP for funding, for assets that meet program eligibility requirements.

SMP responsibilities include:

- Compiling and standardizing stormwater asset data requirements received from the Cities
- Maintaining and regularly executing a computer script that consistently calculates a prioritization score for all program-eligible assets across the SMP. Eligible assets are those listed in **Section 2.1**.
- Establishing and monitoring program budgets for inspection and replacement work.
- Prioritizing and funding projects to mitigate risks associated with the City- and County-owned stormwater infrastructure in Johnson County.

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Section 2

Program Eligibility and Inventory Requirements

The System Management program focuses on the planned repair or replacement of City- and County-owned stormwater assets which are structurally deteriorated. Program funds will be not be used to address emergency repairs or replacements, nor will they be used to address operations or maintenance challenges (e.g., frequent cleaning required, roots, etc.). Assets which have operational issues may be eligible to receive funding under the SMP's Flood Damage Reduction program if they meet the criteria of that program.

2.1 Eligible Asset Types

Stormwater assets which are eligible for SMP inspection, repair, and replacement funding include the following:

- Structures
  - Inlets (all kinds)
  - Manholes
  - Junction boxes
  - Outfalls
- Lines
  - Enclosed system pipes (where one asset is comprised of all pipe lengths between two structures)
  - Culverts
- Reservoirs/Dams registered with the Kansas Department of Agriculture (eligible for funding to repair only)
- Levees (eligible for funding to repair)
- Streams (stabilization projects where erosion is threatening buildings or major infrastructure)

Because projects to improve streams will also be eligible for funding as a water quality project, **Figure 2-1** below is a flowchart which illustrates the criteria for determining if a stream improvement project can be funded under the System Management program.

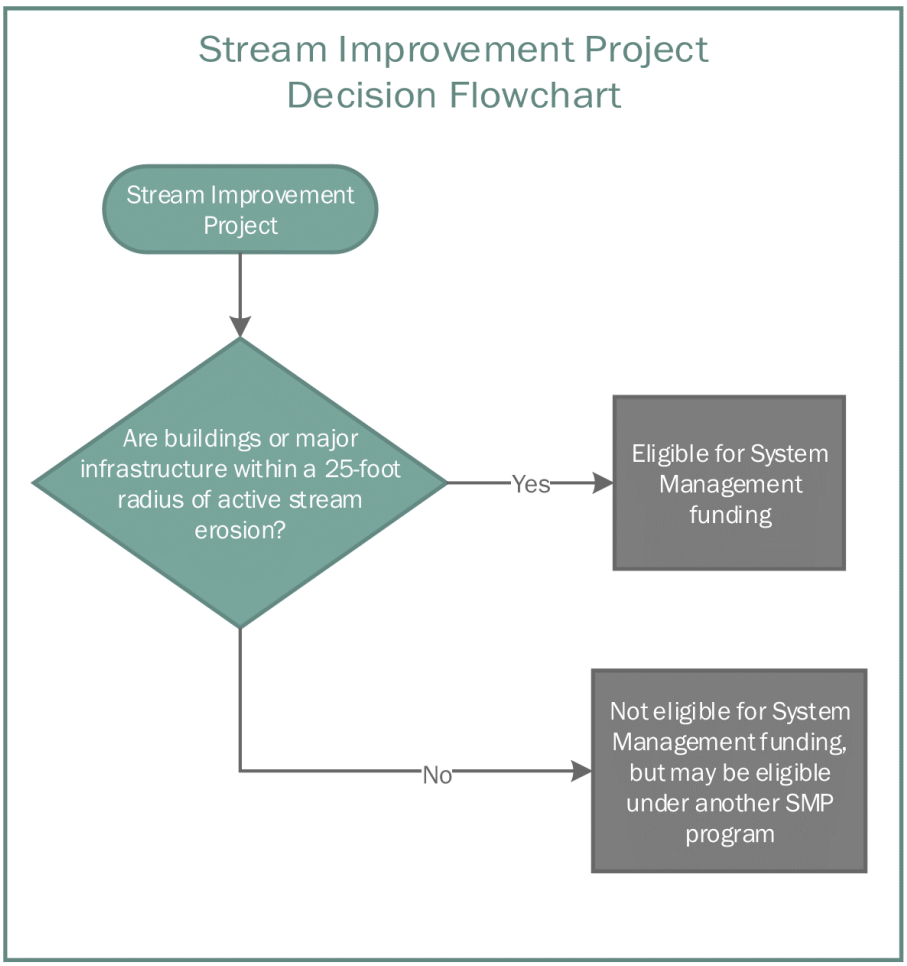

Figure 2-1 Stream Improvement Project Decision Flowchart

Other stormwater system elements, such as privately owned assets, detention basins, wetlands, and structure types not included in the above categories will be inventoried by Johnson County Automated Information Mapping System (AIMS) into a County-wide asset registry but will not receive program funding. These assets may be part of the proposed asset replacement project, but that portion of the project will not receive funding.

2.2 Asset Data Requirements

All Cities that request program funding must maintain an accurate inventory of their stormwater infrastructure for incorporation into the AIMS asset registry. The minimum requirement is for Cities to accurately maintain stormwater GIS data and provide AIMS access to it. This will allow the SMP the ability to incorporate the data in a timely manner so that the Cities and Watershed Organizations can review the results and submit projects before the deadline.

2.2.1 Required Data

City data has been compiled by AIMS for several years and the implementation of this program only requires minor changes to the data that AIMS has been capturing. The following subsections specify the minimum information that must be provided to AIMS for each asset type to support project development, and **Table 2-1** summarizes the data required for each asset type to be eligible for SMP funding. The differences in data requirements reflect that inspection projects rely on estimated condition, which is calculated by the computer prioritization script using the information specific to inspection projects, to prioritize assets, while renewal projects require field-inspection condition.

Table 2-1 Required Data for Assets

	Inspection Project (Data Required to Estimate Condition)	Renewal Project
Lines	▪ Asset ID ▪ Owner ▪ Dimensions ▪ Number of Barrels ▪ Upstream and Downstream Node IDs ▪ Shape ▪ Year Constructed (or Rehabilitated) ▪ Material	▪ Asset ID ▪ Owner ▪ Cross section dimensions (i.e. diameter) ▪ Dimensions ▪ Number of Barrels ▪ Upstream and Downstream Node IDs ▪ Shape ▪ Field-Inspected Condition
Structures	▪ Asset ID ▪ Owner ▪ Structure Type ▪ Year Constructed (or Rehabilitated) ▪ Material	▪ Asset ID ▪ Owner ▪ Structure Type ▪ Field-Inspected Condition
Streams	▪ Owner ▪ Estimated Condition	▪ Owner ▪ Field-Inspected Condition
Reservoirs/ Dams	▪ N/A (Not eligible for field inspection funding)	▪ Owner ▪ Field-Inspected Condition
Levees/ Floodwalls	▪ N/A (Not eligible for field inspection funding)	▪ Owner ▪ Field-Inspected Condition

2.2.1.1 Base Data Requirements for All Projects

Asset ID [Points and Lines]

All stormwater structures must be assigned a unique Asset ID.

Owner [All Eligible Assets]

Eligibility for program funds is driven in part by who owns the asset. The SMP will only fund assets which are City- or County-owned.

Structure Type [Points]

Cities must use the standard types listed in **Table 2-2**.

Table 2-2 Acceptable Structure Type Values

Acceptable Structure Types	
Area Inlet	Pipe Bend
Bend Point	Point of Inflection
Bridge	Simple Junction
Catch Basin	Slot Drain
Culvert	Stormwater Treatment Unit
Curb Inlet	Sump Box
Drop Inlet	Transition
Ineligible	Treatment Unit
Inlet	Trench Drain
Junction Box/Manhole	Underground Connection
Outfall	

Dimensions [Lines]

All line lengths should be provided to AIMS in feet. All height, width, and diameter information should be provided in inches. The stormwater system across the County has been assumed to have virtually no assets that are less than 12-inches in size. A, any height, width, or diameter data provided by a City that is less than 12 will be assumed to be in feet and will be converted to inches.

Number of Barrels [Lines]

Where a line in the database represents more than one barrel of pipe, the number of barrels represented by the line should be provided. If no value is entered in this field then one barrel will be assumed.

Upstream and Downstream Node IDs [Lines]

All stormwater line segments should include fields which indicate the Asset IDs of the upstream and downstream structures.

Shape [Lines]

Cities must submit shape data for lines according to the standard material values listed in **Table 2-3**. If a pipe shape is not adequately described by any of the values in **Table 2-3**, the closest applicable value should be used, a comment made in a clearly labeled 'Comments' field, and upon submission of the asset data in question AIMS should be notified of the line shape value approximation.

Table 2-3 Acceptable Line Shape Values

Acceptable Line Shapes
Arch
Bridge
Circular
Elliptical
Oval
Rectangular
Squash Pipe

2.2.1.2 Data Requirements for Inspection Projects

Construction (or Rehabilitation) Year [Points and Lines]

Construction/installation and rehabilitation dates must be provided so that condition can be estimated for uninspected assets. For an activity to count as a rehabilitation, it should significantly lengthen the expected life of the asset by improving its structural condition. Structural pipe lining is considered a rehabilitation, but a rehabilitation date should not be set for assets where only spot repairs have been performed since the condition of the remainder of the pipe should be modeled based on the original installation date.

Material [Points and Lines]

Cities must maintain standard material values listed in **Table 2-4**.

Table 2-4 Acceptable Material Values

Acceptable Structure Materials	Acceptable Pipe Materials*	Pipe Material Code Explanation
Block	Clay	-
Brick	CMP	Corrugated Metal Pipe
Clay	CP	Concrete Pipe
Concrete	DIP	Ductile Iron Pipe
Concrete Block	PE	Polyethylene (plastic) Pipe
Corrugated Metal	PP	Polypropylene (plastic) Pipe
Ineligible	PVC	Polyvinyl Chloride (Plastic) Pipe
Iron	RCB	Reinforced Concrete Box Pipe
Metal	RCP	Reinforced Concrete Pipe (Circular)
PE	SP	Steel Pipe
PVC	VCP	Vitrified Clay Pipe
Rehab Block		
Rehab Brick		
Steel		
Stone		

* - NASSCO codes are used for pipe materials

Estimated Condition [Streams Only]

Stream condition can be estimated using a process whereby historical DEMs created using Light Detection and Ranging (LiDAR) data are compared to identify areas of stream erosion. The most recent LiDAR data was collected in 2018, and a DEM created from this data can then be compared to existing DEMs created from 2012 and 1998 LiDAR data to identify decreases in ground elevation.

A pilot project was recently completed which used this approach in the Indian Creek watershed. For this pilot, the 2012 and 1998 DEMs were compared and buildings within 25 feet of stream erosion were identified. It is recommended to expand this pilot project to a County-wide analysis such that all areas of stream erosion can be identified and where buildings and major infrastructure are within 25 feet of stream erosion, an estimated condition rating of 5 be assigned. This estimated condition rating can then be used to prioritize streams for inspection projects.

2.2.1.3 Data Requirements for Renewal Projects

Field-Inspected Condition [All Eligible Assets]

Field inspection requirements are listed below in **Section 3.2**. These requirements are intended to provide a comprehensive inspection standard which produces consistent inspection results across all participating Cities. They have been formulated to be broad, both because many different types of assets are included, but also to allow for some flexibility in implementation to participating Cities.

Full compliance with these inspection standards will not be required until January 1, 2020. Condition assessments prior to this deadline which are performed according to the standard which Cities have been using and are based on structural evaluations will be accepted and used to prioritize replacement projects, provided the scores provided are consistent with those which have been previously used so that they can be accurately related to the standard 1 to 5 condition scale per **Table 2-5**.

If a City requires a condition score definition prior to January 1, 2020 that deviates from **Table 2-5**, they must coordinate this with the SMP and provide an explanation of how their scores relate to the scores and definitions in this table. If City data are not related to the standard condition scale the assets will not be eligible for replacement funding and instead condition will be estimated.

The requirements for how field condition assessments must be performed for different asset types are described in **Section 3.2**.

Table 2-5 Mapping of Existing Condition Data to the Unified Condition Scoring System

	Unified Scale	De Soto	Leawood	Lenexa	Merriam	Mission Hills	Olathe	Overland Park	Prairie Village	Roeland Park	Shawnee	Spring Hill	Westwood
Points	1	-	-	Excellent	Excellent	-	>75	-	Excellent Very Good	-	No Deterioration	Excellent	-
	2	Good	Good Rehab Project Complete	Good	Good	Good	>50 and <=75	-	Good	-	-	Good	Good
	3	Fair	Fair	Fair	Fair	Fair	>25 and <=50	-	Fair	-	Minor Deterioration	Fair	Fair
	4	Poor	Poor	Poor	Poor	Poor	>10 and <=25	-	Poor	-	Repair Needed	Poor	Poor
	5	-	Needs Repair	-	-	-	>=0 and <=10	-	Immediate Repair	-	-	-	-
Lines	1	-	-	Excellent	Excellent	-	>75	Excellent	Excellent	Excellent	-	Excellent	-
	2	-	Good	Good	Good	-	>50 and <=75	Good	Good	Good	No Action Needed	-	Good
	3	-	Fair	Fair	Fair	-	>25 and <=50	Fair	Fair	Fair	Monitor	Fair	-
	4	-	Poor	Poor	Poor	-	>10 and <=25	Poor	Poor	Poor	Work Needed	Poor	-
	5	-	Very Poor		-	-	>=0 and <=10	-	-	-	-	-	-

Notes: Cities not listed in this table did not have condition data in the Stormwater_PT or Stormwater_LN geodatabase feature classes.
Blank entries in this table indicate that not suitable existing condition rating was found to convert to the Unified Condition Scale

Section 3
Condition Assessments and Risk Scores

The standard condition assessment scale and the requirements for how condition assessments must be performed to receive program funds for repair and replacement projects are presented in this section.

3.1 Unified Condition Assessment Scale

For years many Cities have been assessing and recording the condition of their stormwater assets. While different assessment methods and rating scales have been utilized across the County, the existing information will be standardized and used to support the prioritization of repair and replacement projects. The SMP reviewed the different rating scales that Cities have utilized and developed a standardized rating scale that enables direct comparisons across asset types and City boundaries. AIMS will convert all condition ratings to this standardized scale for data submitted up to January 1, 2020.

The standard condition assessment scale that applies to all asset types is shown in **Table 3-1**. Where Cities have their own assessment program and rating scale they are not required to adopt this scale provided:

- They define the assessment framework they are using and provide the definitions to AIMS to ensure that their scores can be converted to the scale in **Table 3-1**.
- Their assessment programs adhere to all the requirements in **Section 3.2**.

Table 3-1 Unified Condition Scale

Condition		Definition
1	Excellent	No noticeable defects. Some aging or wear may be visible. Fully functional.
2	Good	Only minor deterioration or defects are evident. Noticeable wear or aging is visible. Fully functional. Minor maintenance may be required.
3	Fair	Moderate deterioration or defects are evident. Function is not significantly affected. Minor repairs may be required.
4	Poor	Serious deterioration or defects are evident. Function may be significantly affected. Repairs or replacement are required.
5	Near Failure or Failed	Asset has failed or will likely fail within the next five years. Require immediate attention

3.2 Field Condition Assessment Requirements

The requirements in this section that define how condition assessments must be performed for different stormwater asset types will go into effect in 2020. This will allow the Cities time to familiarize themselves with, and in some cases get trained on, the requirements specified below. Any assessments performed prior to 2020 that do not adhere to these requirements do not need to be redone to receive repair or replacement funding. However, if assets are assessed using a

different standard in or after 2020 they will not be eligible for inspection, repair, or replacement funding from the SMP.

- All condition ratings input must be the result of field inspections which rate only the structural condition of the asset. Since the program is not intended to address Operational and Maintenance (O&M) defects (e.g., debris, deposits, roots, etc.), O&M considerations should not factor into the condition scores provided to the SMP.
- All condition ratings provided to the SMP must be the result of a physical inspection and may not be estimated. Estimated condition ratings should not be provided to AIMS for inclusion in AIMS to minimize confusion and to ensure a consistent methodology is used for estimating condition across the SMP.
- All eligible assets must be evaluated and assigned a rating between 1 and 5 (per **Table 3-1**) using the guidance in **Table 3-2** below.

Table 3-2. Required Field Inspection Standards

Asset Type	Field Inspection Standard	Conversion to Unified Condition Rating
Lines (Storm Sewer)	Lines Greater than 100-feet in length: ▪ NASSCO PACP Inspection Standard ▪ Structural rating only Lines 100-feet in length or less: ▪ Inspections may be performed by means other than internal video inspection ▪ All defects must be coded using NASSCO PACP standard ▪ Structural ratings only	Step 1) Base condition score is equivalent to the highest structural defect rating Step 2) If a base condition score is a 4, sum all defects rated 4, divide by 16, and add to base condition score up to calculate a final condition score. Final condition score cannot be greater than 5.0.
Structures	▪ Full structure inspection such that all components of the structure are photographed ▪ All defects must be coded using NASSCO MACP standard ▪ Structural rating only	Asset condition score is the highest structural defect rating for any noted defects
Streams	APWA 5605.5 Stream Assessment (APWA, 2011)	Convert APWA 5600 Table 5405-4 scores to a rating between 1 and 5 per the following guidance: ▪ Rating 12 or less – Condition score of 1 ▪ Rating between 12 and 18 – Condition score of 3 ▪ Rating greater than 18 – Condition score of 5
Reservoirs/Dams	State Inspection Form	Step 1) Asset condition score is the highest defect rating per **Table 4-4** Step 2) If a condition score is a 4, sum all defects rated 4, divide by 16, and add to score up to a total score of 5
Levee/Floodwall	Owner Inspection Form	Levee and floodwall conversion to be determined when a City provides inspection forms to SMP

These are discussed further in the following subsections.

Lines (Storm Sewer)

Storm sewer lines are required to be inspected according to PACP inspection standards, which require internal video inspection, for all pipes which are greater than 100-feet in length as measured in the stormwater geodatabase. Pipes are defined as the underground conduits which span from an upstream access point to a downstream access point. In addition, pipes less than 100-feet which cannot be fully inspected without internal video inspection must also be inspected according to PACP inspection standards.

Pipes which are 100-feet in length or less as measured in the stormwater geodatabase may be inspected from an upstream or downstream access point using equipment which is of sufficient resolution and quality that defects within the pipe can be identified. Any defects noted by such a method must be coded and rated using PACP standards.

The base condition score for each asset is calculated as the maximum score assigned to any of the defects noted during the inspection. If this score is 3 or less, or 5, then the base condition score is the final condition score. The final condition score is the rating which should be submitted to SMP for inclusion in the stormwater geodatabase maintained by AIMS.

If the base condition score is 4, and if there are more than one defects assigned a score of 4, then the final condition score is determined by:

- Summing the number of defects assigned a score of 4,
- Dividing this number by 16, and
- Adding this to the base condition score.

Structures

A full inspection of structures must be completed such that all components, both internal and above ground, of the structure are visually inspected and photographed. Structural defects must be photographed separately from standard structure photographs and assigned a MACP defect code and rating. The condition score assigned to a structure shall be the maximum score assigned to any structural defect.

Reservoir/Dam Inspections

For Reservoir/Dam inspections, only the fields highlighted in the state dam inspection form, included in **Attachment 1** and modified to require only inspect and rate structural elements of the dam, shall be used for reservoir/dam condition ratings, and state deficiency codes shall be converted to a condition rating per **Table 3-3**. The score assigned to the reservoir/dam shall be the highest condition rating assigned to any individual dam component structural defect.

Table 3-3. Reservoir/Dam State Deficiency Codes – SAMP Condition Rating Mapping

State Deficiency Code	SAMP Condition Rating
0	1
1	3
2	4
4	5

Note: State deficiency code 3 indicates a maintenance issue

Levee/Floodwall Inspections

Because levees and floodwalls do not currently have a standard inspection form required by any federal or local authorities, and because forms used to assess these systems in the County were not available for this report, it was not practical to develop a system to convert condition ratings to a condition score between 1 and 5 per **Table 3-1**. Should a City submit a levee or floodwall condition score in the future, it is recommended that an approach to converting inspection data to a score between 1 and 5 similar to the other assets be taken, specifically:

- The City's inspection protocol should be evaluated to identify relevant condition scores related to structural failures (such as erosion, embankment settlement, etc.).
- The scoring system used should be converted to a 1 to 5 scale consistent with **Table 3-1**. For example, a scoring system of 1 through 10 should be mathematically scaled to the 1 through 5 scale, or written descriptions of condition should be converted to the 1 to 5 scale as was done for the Unified Condition Scale as shown in **Table 2-4** in **Section 2.2.1.3**.
- The condition score should be taken as the worst score assigned to an individual structural defect.

Streams (Field Inspection)

For streams, field inspections must be completed according to Section 5605.5 'Stream Assessment' of the Kansas City APWA Stormwater Specifications (APWA, 2011) and all fields in Table 5405-4 of the specifications must be completed. A condition score should be assigned as follows:

- APWA rating 12 or less – SAMP condition score of 1
- APWA rating between 12 and 18 – SAMP condition score of 3
- APWA rating greater than 18 – SAMP condition score of 5

3.3 Asset Risk Scores

Risk and prioritization criteria were developed with the end goal of assigning a single score to each stormwater asset contained in the AIMS stormwater database. These criteria were generally defined in broad categories by the System Management subcommittee as:

- Service Life
- Quality of Life

- Safety
- Economic Impact

These categories were used to guide development of risk and prioritization criteria for the SAMP. Specifically, the categories were compared to base spatial data available to assign a numerical value to each and then combine these scores into an aggregate prioritization score for each asset.

To accomplish this, a traditional risk-based asset management framework was developed that considers each asset's likelihood of failure (LoF) and consequence of failure (CoF). LoF is a measure of an asset's risk to fail and is the measure used to evaluate the subcommittee category 'Service Life'. The remaining categories, 'Quality of Life', 'Safety', and 'Economic Impact' fit within the CoF concept, which is a measure of the impact should an asset fail.

Systems to assign numeric ratings to both of these factors were developed. LoF was made equivalent to the 1 through 5 condition rating described in **Section 3.2**. Existing field-assessed conditions were directly translated to the 1 through 5 rating scale, and where field-assessed condition was not available it was estimated using a linear degradation model based on material and year constructed data. Where year constructed data were not available, it was estimated to the extent possible for individual assets within a plat included in the County's spatial database of plats. For these assets, the year constructed was assumed to be the year the plat was established.

CoF was assigned a numeric criteria calculated based on the importance of the assets to the overall stormwater system as well as proximity to important infrastructure and facilities.

LoF and CoF scores are calculated by a computer script which combines these factors into a single risk score for each asset. The risk score is calculated as a weighted average where LoF is weighted as 65% and CoF is weighted as 35% of the risk score. Risk scores are rated on a 1 through 5 scale.

The prioritization computer script which completes these calculations was developed specifically to support the System Management program. When run, this script does the following:

- Reads the latest version of the stormwater asset database and standardizes data as necessary (for data received prior to January 1st, 2020 not complying with the standards set forth in **Section 2.2.1**)
- Calculates scores for LoF, CoF, and risk
- Outputs an ESRI ArcGIS stormwater geodatabase with the results of the script.

Risk scores are a key factor which will be used to prioritize individual assets for funding in the System Management program, as described in **Sections 4.2** and **4.3**.

Section 4
Creating and Submitting Projects

4.1 Project Types

The System Management Program will fund two types of projects: inspection projects and renewal projects. For assets to be eligible for renewal project funding they must be field inspected. The System Management Program will fund field inspections to assist Cities in meeting this eligibility requirement. Provided the required data is supplied, the SMP's prioritization computer script, described further in **Section 4.2** below, will estimate the condition of all assets where no condition information is provided. This estimated condition, along with the consequence of failure, will be used to prioritize submitted inspection projects across the County.

Renewal projects are those that improve the structural condition and extend the life of the assets. In practice, renewal projects may include anything from spot repairs to full asset replacement. The Watershed Organization will consider the circumstances and define the approach to be taken. The SMP will prioritize renewal projects separately from inspection projects but they will use the same method except that the observed condition information provided by the Cities will be utilized instead of the estimated scores.

4.2 Funding Eligibility

Watershed Organizations are entitled to submit projects for matching funding under the System Management program. To ensure fairness and the consistency of project evaluations, only assets that have been assigned a risk score by the SMP using the prioritization script may receive program funding. Assets with high risk scores may be addressed individually or multiple assets may be grouped into a project.

There are no restrictions on the number or type of assets that can be included in a project. Cities and Watershed Organizations may assemble projects based on any logic or criteria that are important to them according to the strategies developed per guidance in **Section 5**. However, only assets that meet the eligibility criteria (defined in **Section 2.1**) and that have a risk score greater than or equal to the minimum risk threshold will receive program funding.

These risk scores will serve as the basis for creating and prioritizing System Management projects. The initial System Management risk threshold for both inspection and renewal projects will be 3.2. Assets with a score greater than or equal to 3.2 will be eligible for System Management funding. Assets not meeting the minimum risk threshold score may be included in projects but must be funded fully by the sponsoring City.

Setting a minimum risk threshold ensures the limited program funds go toward the highest risks across the County. Cities and the Watershed Organization have flexibility to include lower risk assets and will not be penalized for doing so since assets below the threshold are not eligible for funding and do not factor into the project risk calculations that are the primary way inspection and renewal projects are prioritized by the SMP.

4.3 Creating, Submitting, and Executing Projects

Cities are encouraged to review their stormwater asset data and the results of the prioritization script in AIMS in advance of the SMP's project submittal deadline. Cities should work with AIMS to resolve any data gaps or errors and request that the prioritization script be rerun prior to creating projects. Cities can formulate projects using either a specific web portal set up to view the script's output geodatabase, or if a City has staff proficient in ArcGIS, the output geodatabase will be available to formulate projects as well.

Once Cities are satisfied that the asset data and prioritization script results are complete and accurate they should view the risk results in AIMS, particularly assets that are in the highest risk bands. Because inspection and renewal projects are submitted and prioritized separately, Cities should view the assets that have been inspected when creating renewal projects and those that have not been inspected when creating inspection projects. Risk score and inspection status for each asset can be identified using the instructions in the guide in **Section 4.3.1** below.

After selecting the type of assets to view (i.e., inspected or uninspected), Cities should step through **Figure 4-1** (for inspection projects) or **Figure 4-2** (for renewal projects) to create projects. Cities are responsible to create the projects because they have the best understanding of their stormwater system, how best to address problems, and what local matching funds are available to support the project.

Cities will submit the projects to the appropriate Watershed Organization so that the group is able to reconcile them with projects submitted by the other Cities against the Organization's project strategies (described in **Section 5**) to create a prioritized list of projects to submit to the SMP for funding.

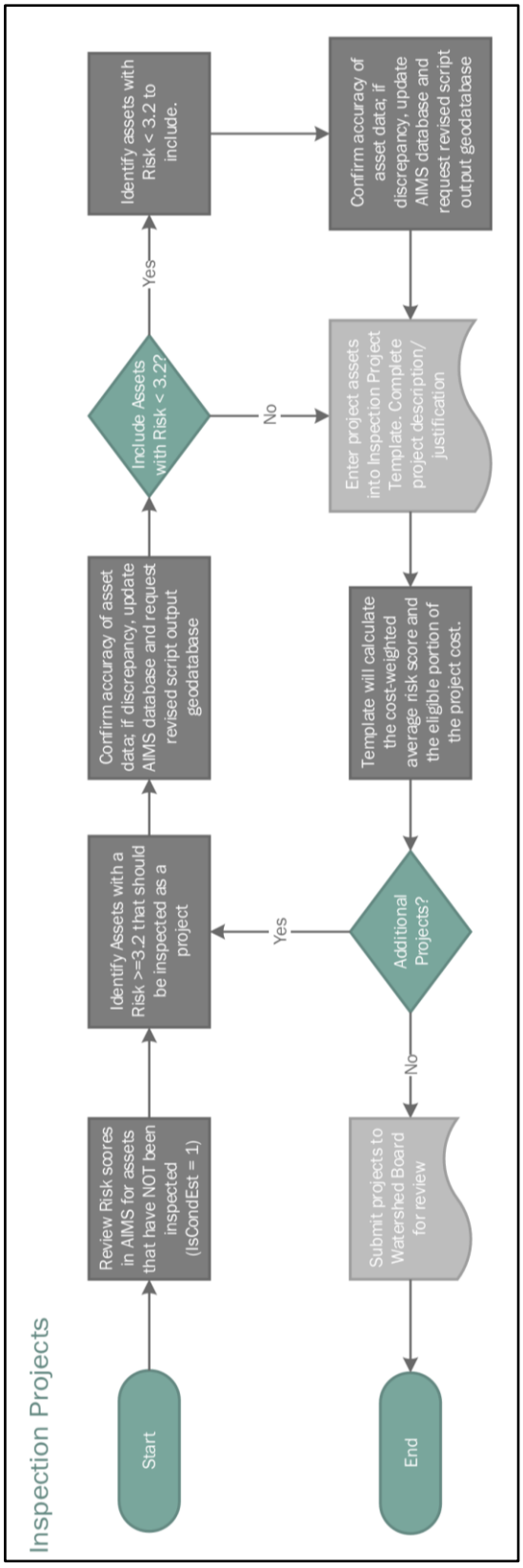

Figure 4-1 Process for Creating Inspection Projects

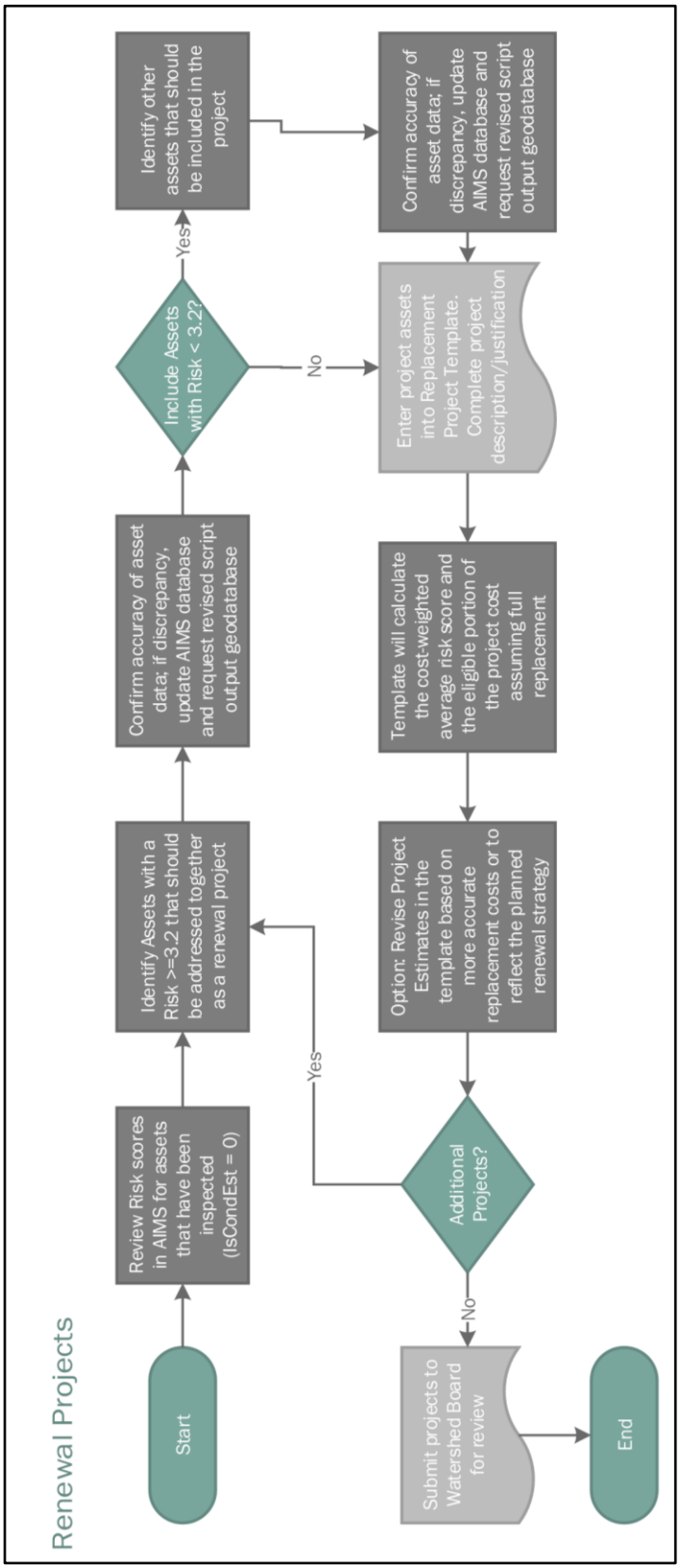

Figure 4-2 Process for Creating Renewal Projects

The Project Template that **Figures 4-1** and **4-2** refer to is a document all Watershed Organizations must use when submitting projects for the SMP consideration. The standard form allows the SMP to easily compile the submitted projects and ensures that the required information is provided. The project template is included in **Attachment 1**. Creating projects in the template involves inputting data to two of the workbook's three tabs, as described in the following steps

Step 1: Define basic project information on the ***Basic Information*** tab. This involves specifying the following information, which is highlighted yellow in the workbook and numbered to correspond to the bulleted items below:

1. **City** - Specify the City where the assets are located. This field is a dropdown menu corresponding to the table of City Standard Values, which also located on this sheet.

2. **Watershed Organization Number** – Specify the watershed where the assets are located. Projects should not span watersheds.

3. **Project Type** – Specify if the projects is a renewal or inspection project. This field is a dropdown menu corresponding to the table of Project Type Standard Values, which also located on this sheet.

4. **Year Submitted** – Specify the year the project was submitted in a 'YYYY' format.

5. **Unique Project Number** - To ensure uniqueness across a City within a Watershed Organization, a unique number should be assigned to differentiate from other projects submitted by the same City within a Watershed Organization.

   Using the fields specified in Fields 1 through 4, the project template will automatically derive a unique identifier in the format:

   Watershed Organization Number - City Abbreviation – Year – Project Type abbreviation– Unique Project Number

   For example, Overland Park's second renewal project submitted in 2019 for their assets that are in Watershed Organization 1, would be 1-OP-2019-R-2.

6. **Project Description** – Enter a brief description of the project. Example: "Replace 200ft of 18-inch CMP in Amesbury Lake neighborhood."

7. **Project Justification** – Describe why the project warrants System Management funding. Where possible, this field should be used to describe how the project supports the overall asset management plan and strategies for the watershed, which will be developed as described in **Section 5**.

   The conditions, consequences, and risk scores for the project will be apparent from the data so this field is the City and Watershed Organization's opportunity to characterize any additional information that the SMP should consider when selecting projects that will receive matching funds. Other considerations should be written in this field, for example: "This project can be very efficiently executed next year because it would coincide with a

planned paving project. Delaying the stormwater portion of the project would result in increased cost to the City and the SMP."

Following these fields are 5 calculation fields which will be automatically populated by the workbook when either of the ***Renewal Project Assets*** or ***Inspection Project Assets*** sheets are populated and include project risk, maximum individual asset risk, total project cost, SMP project share, and City project share. The results of these calculations inform the direction for the remaining input fields:

8. **City Funds Available?** – This field must be specified as 'Yes' in order to be eligible for SMP funding. Projects without City matching funds which meet the 'City Project Share' field amount should not be submitted to the SMP. Cities developing projects can either reduce the scope of the project or develop refined opinions of project cost to reduce the overall project budget from the unit costs for replacement. Reducing overall project cost may be useful especially in situations where point repairs may be sufficient to renew an asset, or where inspection costs are less than the program-specified estimates.

9. **City Funding Source** – List the funding source planned to be used for the City project share.

10. **City Funds Fiscal Year** – List the fiscal year the City project share funds are planned.

11. **City Fiscal Year Start and End Dates** – List the sponsoring City fiscal year's calendar start and end dates.

Step 2: Define project assets on either the ***Renewal Project Assets*** or ***Inspection Project Assets*** sheet. These sheets are to be populated with assets included in the submitted project and are used to calculate overall project risk, budget, and SMP and City project shares. Only one sheet should be used for each workbook corresponding to the submitted project type. The following information, which is highlighted yellow or orange in the workbook and numbered to correspond to the bulleted items below, must be provided:

1. **Project ID** – the project ID listed in the ***Basic Information*** tab should be populated for each asset listed.

2. **Asset ID** – the unique ID assigned to each asset by its owning City, and listed in the stormwater database maintained by AIMS, should be provided.

3. **Renewal/Inspection Cost** – The inspection or renewal cost for each asset must be listed in this field. Standard renewal costs may be obtained from the prioritization script output and represent replacement costs developed using a unit cost model. Standard inspection costs will be specified by the SMP and a value of $550 should be used for pipe inspections and $150 should be used for structure inspections.

4. **Cost Adjustment Explanation** – Both renewal and inspection costs for each asset may be adjusted by Cities from the standard renewal and replacement costs. For renewal projects, the starting assumption is that the renewal will involve an in-kind replacement of the asset. Therefore, the Renewal Cost and Funding Eligibility will be based on the SMP's standard unit costs for replacement. If the project won't fully replace the asset or if a more accurate

cost estimate is known, the Renewal Cost for that asset should be updated if possible. This will enable the SMP to more accurately allocate program funds and potentially increase the number of projects that can be funded. If the standard Renewal Cost is adjusted, please briefly note the circumstances in this field.

This field should also specify the basis for adjustment of the costs and refer to backup documentation, such as an opinion of probable cost provided by an engineer, or negotiated inspection rates provided by a contractor.

5. **Comments** – This field in not mandatory to be filled out but can be utilized to provide any additional relevant information.

In addition to these fields, inputs from the prioritization script geodatabase must be entered in the following lettered fields, which are highlighted green:

A. **Asset Type** – The asset type should be listed and should include a description of size and material (e.g. 18-inch CMP).

B. **Construction Date** – The date the existing asset was constructed should be listed.

C. **Risk** – The risk score calculated for the asset should be listed.

The remaining fields, SMP Match and Project Aggregate Risk, are automatically calculated by the workbook based on the input fields. Note that the automatically-derived SMP Match of the asset cost takes into account program eligibility requirements and the minimum risk threshold (3.2). If the asset is privately owned, is an ineligible asset type, or has a risk score below 3.2 the Eligible Portion will be $0 for both inspection and renewal projects. For assets that meet all requirements for SMP funding the Eligible Portion will be 50% of the Renewal or Inspection Cost for the asset.

The Watershed Organizations should compile all projects to inspect and renew stormwater infrastructure across the watershed into one populated template. That compiled project list should be reviewed by the Watershed Organization and revised if necessary so that the Organization's priorities are clear to the SMP.

When approved by the Watershed Organization, the completed project template workbook containing the projects and asset data should be sent to the SMP. The workbook name should be saved to include the unique Project ID as a file management procedure.

4.3.1 Prioritization Script Geodatabase Output Fields and User's Guide

The prioritization script output includes two geodatabase feature classes for the engineered stormwater system, 'Stormwater_LN_FailureAnalysis' and 'Stormwater_PT_FailureAnalysis'. **Table 4-1** below summarizes key fields produced in both of these feature classes, and these are discussed briefly below.

Table 4-1 Key Prioritization Script Output Geodatabase Fields – Feature Classes 'Stormwater_LN_FailureAnalysis' and 'Stormwater_PT_FailureAnalysis'

Column	Definition
IsIneligible	Bit indicating if the pipe is ineligible for a rating (1 = yes, 0 = no)
IsCondEst	Bit indicating if the condition is estimated (1 = estimated, 0 = decoded using unified condition conversion)
StndYearConst	Standardized year constructed
IsYearEst	Bit indicating if the year is estimated (1 = estimated, 0 = provided by City)
PACPCond	1-5 rating for asset condition (either decoded or estimated)
InvalidCond	Bit indicating if the condition decoded is invalid (1 = invalid, 0 = valid)
ConsqOfFail	1-5 rating for the consequence of asset failure
Risk	1-5 rating for the risk that the asset failure poses to the system
NearGas	Bit indicating if the pipe is within 5 feet of a gas utility (1 = yes, 0 = no)
NearElec	Bit indicating if the pipe is within 5 feet of an electrical utility (1 = yes, 0 = no)
ReplCost	Unit cost of replacing the pipe, calculated using cost per linear foot and the pipe length.

When working with geodatabase results, it will be important to first filter field 'IsIneligible' so that only entries equal to 1 are shown. This will remove extraneous assets such as concrete-lined open channels, and only eligible assets are being displayed.

The field 'IsCondEst' indicates if an asset's condition is estimated by the prioritization script (field will equal 1) or if its condition was provided by the submitting City (field will equal 0). For assets with estimated conditions, 'StndYearConst' provides the year used to calculate each asset's age, and 'IsYearEst' indicates if the construction year was estimated based on plat age. If the 'StndYearConst' field is <null> and no condition was provided by the submitting City, then the asset did not intersect a plat in the AIMS plat feature class and the prioritization script could not estimate its age or condition.

The field 'PACPCond' provides asset condition on the 1 through 5 condition rating scale documented in **Table 3-1**, whether the condition was estimated or provided by the submitting City. This is also the LoF score for the asset. 'InvalidCond' indicates that a condition was provided by the submitting City that could not be mapped to the 1 through 5 condition rating scale using the conversions developed in **Table 2-4**.

The field 'ConqOfFail' is the CoF score for the asset, and the 'Risk' field is the overall risk score for the asset. The fields 'NearGas' and 'NearElec' indicate proximity to a gas or electric utility, respectively, which failure of the asset could damage.

Finally, the field 'ReplCost' lists the cost to fully replace the asset based on the unit cost model. This cost is not rounded by the script, and this was done so that any rounding can be completed by SMP staff as appropriate for individual projects.

The prioritization script also outputs a feature class 'StormwaterNatrl_LN_FailureAnalysis' for prioritization of streams, and its key fields are explained below in **Table 4-2**.

Table 4-2 Key Prioritization Script Output Geodatabase Fields – Feature Class 'StormwaterNatrl_LN_FailureAnalysis'

Condition	Definition
NearBuilding	Bit indicating if the open channel is near a building (1 = yes, 0 = no)
IsEroded	Bit indicating if the open channel is eroded (1 = yes, 0 = no)
IsCondEst	Bit indicating if the condition was estimated or from inspection (1 = estimated, 0 = inspection)

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Section 5

Watershed Asset Management Plan

5.1 Watershed Organization Responsibilities

Watershed Organizations will be responsible to create a Watershed Asset Management Plan (WAMP). This plan is intended to provide specific guidance to create a WAMP. A WAMP will be comprised of, at a minimum, the following steps, which are also summarized in **Figure 5-1**:

- **Step 1)** An inventory of stormwater asset data, with data gaps identified.
- **Step 2)** A characterization of the watershed stormwater system's overall risk profile.
- **Step 3)** Summaries of strategies to fill data gaps, inspect stormwater assets without field-assessed condition data, and renew high risk assets. These strategies should be developed based on consideration of the data gap summary and the stormwater system's risk profile, as shown in **Figure 5-1**.
- **Step 4)** Planning documents, which should include 5-year Data Management Plan, Inspection Plan, and Watershed CIP. Projects on the Watershed 5-year CIP should be formulated based on the strategies developed in Step 3. As shown in **Figure 5-1**, as these plans are executed, the data inventory and characterization of the watershed's risk profile should be revisited and revised, as necessary, to reflect changes in data gaps and inspection and renewal of the stormwater system's highest risk assets.

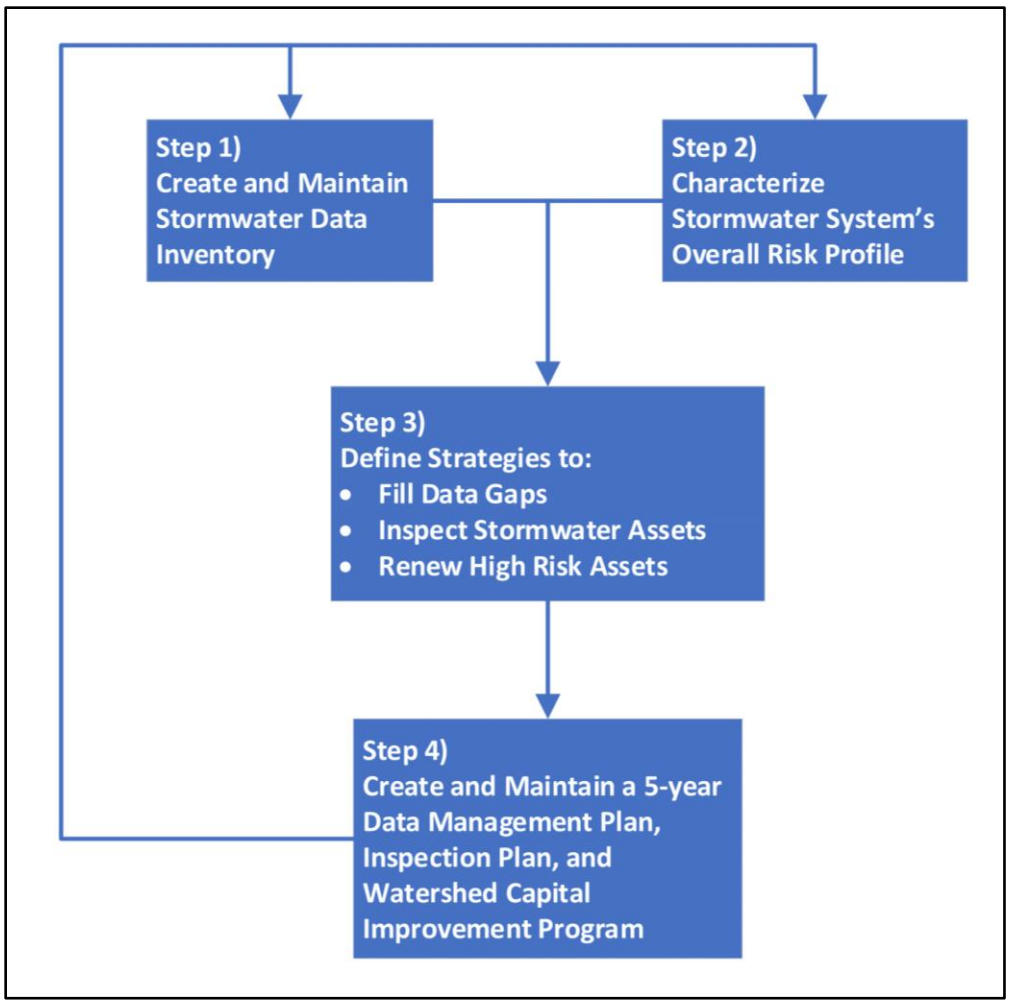

Figure 5-1 WAMP Creation and Maintenance Process

The following subsections described each of these steps, and include suggested tables for tracking data gaps, creating a watershed's risk profile, and formulating and tracking projects. These tables are included in digital form in **Attachment 1**. The information captured in these tables represent the minimum requirements for items to track and Watershed Organizations can build on and add to the minimum tracking requirements to address specific needs within the watershed as needed.

5.2 Step 1) Create and Maintain a Stormwater Asset Data Inventory

This section summarizes the scope of the stormwater infrastructure data inventory which should be created and maintained for the watershed. This inventory will help to identify, track, and prioritize efforts to address data gaps. Watershed Organizations have flexibility to decide how best to summarize these items, however, the information described below are the minimum requirements for information to be included for Step 1 in the WAMP. These tables track asset data by City, but it may also be helpful to track by subwatershed for the larger Watershed Organization groupings. Subwatersheds are shown in **Figure 1-1**.

Step 1a) Quantify the stormwater system in the watershed. The following information should be documented as part of Step 1a.

- Maps of the watershed which show stormwater infrastructure in the AIMS geodatabase (to be provided by AIMS) in sufficient detail such that all assets can be clearly seen.
- A table that summarizes the total length of line features and the number of important structure types by City and across the watershed.

Table 5-1 Watershed Organization - Stormwater Asset Summary

	City 1	City 2	City 3	Watershed Total
Miles of Pipe, Diameter less than or equal to 18-inches				
Miles of Pipe, Diameter between 18-inches and 36-inches				
Miles of Pipe, Diameter between 36-inches and 60-inches				
Miles of Pipe, Diameter between 60-inches and 84-inches				
Miles of Pipe, Diameter greater than 84-inches				
Number of Catch Basins/Inlets				
Junction Boxes/Manholes				
Number of Culverts				
Miles of Streams				
Number of Reservoirs				
Miles of Levees				

Step 1b) Summarize data gaps. The number and percentage of each City's assets that meet do not meet program data requirements should be documented. Assets missing required information, which is documented in **Table 2-1**, will not be eligible for projects. With the exception of field-assessed condition, filling existing data gaps represents an administrative exercise which would result in potentially making an asset eligible for funding. Because of this, it would be beneficial for Cities to attempt to fill data gaps as soon as possible and a data management plan which documents how data gaps will be addressed is required as part of the WAMP.

Table 5-2 could be used to summarize and track data gaps, and it is recommended to revise this table on a watershed scale on at least an annual basis.

Table 5-2 Watershed Organization – Data Gap Summary

	City 1 Number of Assets with Missing Data	City 2 Number of Assets with Missing Data	City 3 Number of Assets with Missing Data	City 4 Number of Assets with Missing Data	Total Watershed Number of Assets with Missing Data
Asset ID					
Ownership					
Material					
Asset Type					
Construction Year					
Rehabilitation Year (as applicable)					
Dimensions					
Field-Assessed Condition					

Not included in this table are unmapped stormwater assets, and this is because they cannot be quantified as there is currently no data available for these assets. It is anticipated that each City has some unmapped assets, and these should be tracked as they are added to the AIMS stormwater database as well.

Step 1c) Track field inspections. Field-assessed condition gaps will require inspection projects to fill, and because of the greater effort involved, and because System Management funding will be available to help with inspection projects, more detailed tracking of field-assessed condition should be completed.

Specifically, the number of assets inspected during a fiscal year (FY) should be tracked. To contextualize this number, the number of assets missing field-assessed condition data at the start of every FY should be documented for each City. Also, because the addition of unmapped assets may add to the number of assets missing condition data, these should be tracked so that progress can be accurately measured. Finally, assets without field-assessed condition data should be summarized for the end of the year. These four inputs should balance as shown below:

(Assets without field-assessed condition data – end of FY) = (Assets without field-assessed condition data – start of FY) - (Assets Inspected During FY) + (Previously Unmapped Assets Inventoried but not Inspected)

Table 5-3 below presents a format which could be used to track these items on a City- and Watershed-basis

Table 5-3 Watershed Organization – Detailed Field-Assessed Condition Tracking

	Populate these Fields for Each City and to Create Totals for Watershed			
	Assets without Field-Assessed Condition - Start of FY	**Assets Inspected During FY**	**Previously Unmapped Assets Inventoried but not Inspected**	**Assets without Field-Assessed Condition - End of FY**
Structures				
Lines (Pipes)				
Streams				
Reservoirs				
Levees / Floodwalls				

5.3 Step 2) Current Condition and Risk Profile

This section should be used to illustrate and summarize the current condition of the stormwater infrastructure across the watershed. It should also illustrate the risk profile across the watershed. Watershed Organizations have flexibility to decide how best to summarize these items, and the following are suggestions for implementation:

Step 2a) Develop base mapping. A color coded map, or set of maps, which show of the risk score of lines and structures across the watershed should be created at least annually. An example of this type of map is shown in **Figure 5-2** below. Any maps developed should take care to visually separate assets with field-assessed condition and those whose condition has been estimated by the prioritization script. This map, or set of maps, should be updated at least annually, or as needed to incorporate new prioritization script results. In lieu of hard copy or paper maps, Cities with staff proficient in ArcGIS may simply use ArcMap and the latest version of the prioritization script output geodatabase to accomplish this, however, the version of the geodatabase used to create or update the WAMP must be archived with the WAMP for future reference.

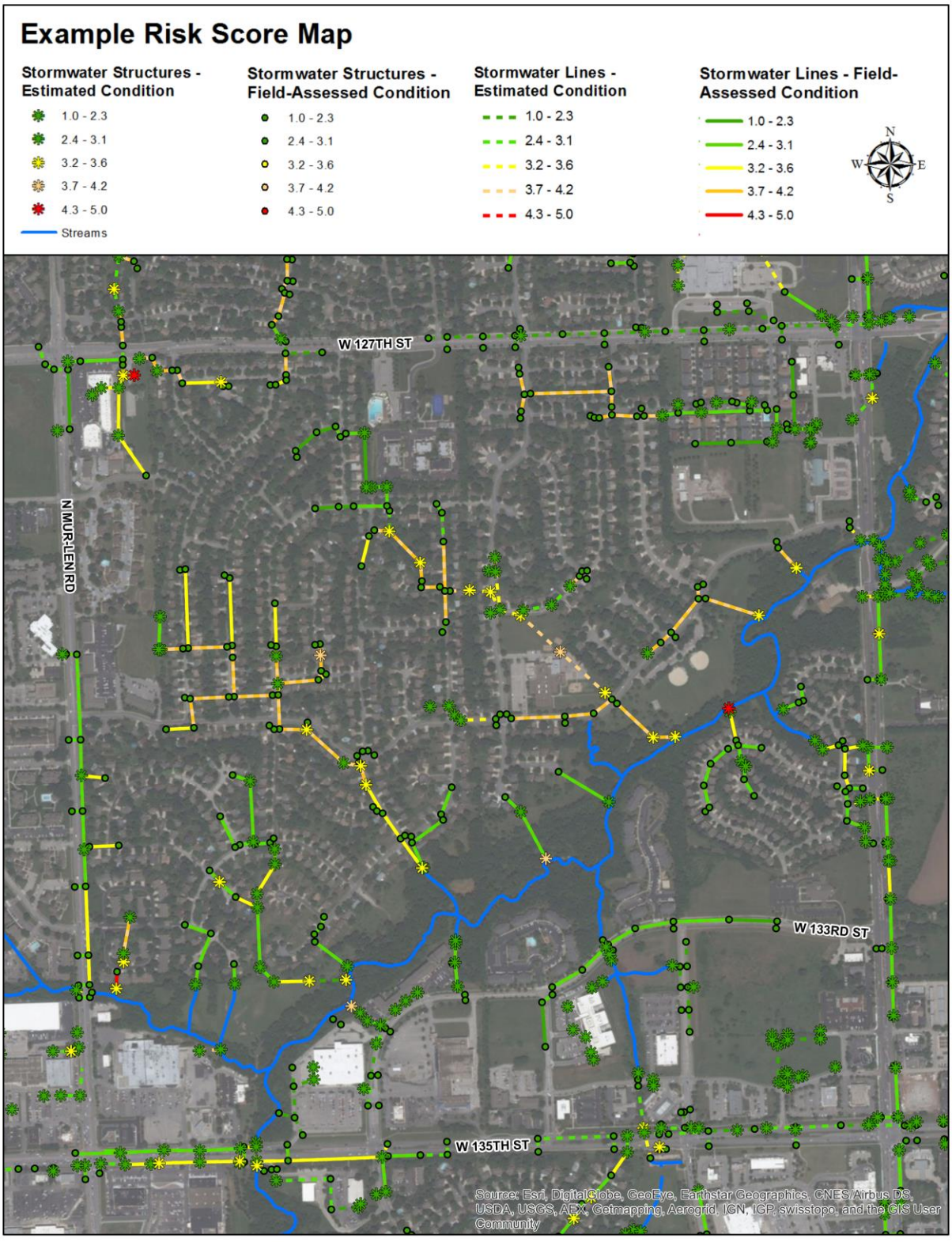

Figure 5-2 Example Risk Score Map

Step 2b) Track cost-weighted risk score for eligible assets with estimated condition. Table 5-4 below shows a format for tracking the cost-weighted average risk score of all assets. The cost-weighted average should be computed using the replacement cost for each asset assigned by the prioritization script.

Table 5-4 Watershed Organization –Risk Score Tracking for Assets with Estimated Condition

	Populate these Fields for Each City and to Create Totals for Watershed	
	Number of Assets with Estimated Condition	Cost-Weighted Average Risk Score of Assets
Structures		
Lines (Pipes)		
Streams		
Reservoirs		
Levees / Floodwalls		

Step 2c) Track cost-weighted risk score for eligible assets with field-assessed condition. Table 5-4 below shows a format for tracking the cost-weighted average risk score of all assets. The cost-weighted average should be computed using the replacement cost for each asset assigned by the prioritization script.

Table 5-5 Watershed Organization – Risk Score Tracking for Assets with Field-Assessed Condition

	Populate these Fields for Each City and to Create Totals for Watershed	
	Number of Assets with Field-Assessed Condition	Cost-Weighted Average Risk Score of Assets
Structures		
Lines (Pipes)		
Streams		
Reservoirs		
Levees / Floodwalls		

Step 2d) Maintain a table summarizing the total number, and the associated replacement cost, of assets that have been inspected and are above the current project risk threshold. An example table which could be used is shown below in **Table 5-6**.

This table tracks the number of assets within a group defined as having a risk score of at least 3.2, and contextualizes this number by accounting for assets added to and subtracted from this grouping throughout a FY. Assets are added to this grouping by completing field inspections and submitting the new condition data to AIMS. AIMS will then run the

prioritization script to assign risk scores to the assets with new condition data and provide updated results to the Watershed Organization and Cities. These are tracked in the column 'Assets Added by Inspection Projects'.

Conversely, assets are removed from this group by renewal projects, and the number removed are tracked in the column 'Assets Removed by Renewal Projects'.

Finally, assets remaining with risk scores of at least 3.2 at the end of the FY should be tracked in the column 'End of FY'. These four columns should balance as shown below:

(Number of Assets, End of FY) =

(Assets Added by Inspection Projects) **-** (Assets Removed by Renewal Projects) **+** (Number of Assets, Start of FY)

Table 5-6 Watershed Organization – Assets above Risk Score Threshold Tracking

	Populate these Fields for Each City and to Create Totals for Watershed			
	Start of FY	**Assets Added by Inspection Projects**	**Assets Removed by Renewal Projects**	**End of FY**
Structures with Risk Greater than or Equal to 3.2				
Lines with Risk Greater than or Equal to 3.2				
Streams with Risk Greater than or Equal to 3.2				
Reservoirs with Risk Greater than or Equal to 3.2				
Levees/Floodwalls with Risk Greater than or Equal to 3.2				

5.4 Step 3) Watershed Data Gap, Inspection Project, and Renewal Project Strategies

This section summarizes the development of strategies to address data gaps and to create inspection and renewal projects. Of these three items, efforts to address data gaps are anticipated to be smaller compared to efforts to develop projects. In addition, filling data gaps has a high benefit as it enables the prioritization script to assign an estimated condition to assets such that they can be eligible for SMP inspection funding. Data gap strategies should be developed as follows:

- Estimate the level of effort required to fill all data gaps.
- Determine if there is City staff availability to address data gaps, or if an outside entity will be needed.
- Determine the cost to address all data gaps.
- Create data gap areas and prioritize those which contain known deteriorated stormwater assets. For example, prioritized areas should include the oldest parts of a City.

For inspection and renewal projects, there are two factors that are anticipated to drive watershed project strategies: the location of high risk assets and available City funding. This is because where available funding and high risk assets coincide within a City, projects are more likely to be completed. The WAMP should address both strategy drivers by first formulating all feasible projects within the watershed, and then matching projects to available funds to formulate and maintain a 5-year CIP.

The first step, addressing high risk assets, should consider the asset inventories and risk profiles developed per **Sections 5.2** and **5.3**. These materials will assist in identifying high risk areas which meet the System Management program's risk score threshold for asset inspection/renewal funding. These areas should be considered for projects, and preliminary projects formulated per the instructions in **Section 4.3**. All feasible projects should be formulated as part of Step 3 and a draft project template developed for each. Draft project templates should all assets to be inspected or renewed and should populate the ***Basic Information*** tab to the extent possible.

A worksheet titled 'Watershed Organizationstormwater Asset Risk Reduction Strategy Worksheet' has been created to assist with identifying these areas and is included in **Attachment 1**. This worksheet should be completed as part of each new version of the WAMP, and a narrative response to each prompt in the worksheet should be provided. Attachments supporting these narratives, such as maps showing the locations of groupings of high risk assets and completed projects, should referenced in, and attached to, the finished worksheet.

After all feasible projects have been formulated, Cities should then summarize their financial capacity for implementing projects for the next 5 years. Estimated project costs will have been developed at this point as part of the project template, and these should be compared to the available funding. Where City matching funds are able to meet the required City contribution, the projects should be placed onto a 5-year inspection or renewal plan.

5.5 Step 4) Create 5-year Plans – Data Management, Inspection, and Renewal

Using the strategies developed in Step 3, plans spanning the next 5 years should be developed for:

- Data Management – to address data gaps
- Inspection Projects – to summarize inspection projects
- Renewal Projects – to summarize inspection projects

These plans should take into account City funding capacities based on the assumption that they will be approved for System Management funding and must be approved by the Watershed Organization. Projects submitted in the CIP are not required to follow the strategies set forth in Step 3, but those that do follow these strategies will be considered higher priority in the System Management program.

Those projects which do not receive System Management funding can then either be fully funded by the sponsoring City or assigned to another FY. Projects that were formulated in Step 3 but were not added to their respective 5-year plan either due to lack of funding or because they were ranked lower in the prioritization should still be retained as future opportunities.

The inspection and renewal projects should then be consolidated into a single 5-year CIP, which should be submitted to the SMP each time it is renewed as part of an overall package which includes finalized project templates. The format of this document is to be determined by Watershed Organizations, but should at a minimum include the following information:

- Project Name
- Project Type
- Unique Project Number (from project template)
- Project Description and Justification
- Description of Project's Tie to Watershed Strategy
- City Funding Source
- Total Project Cost
- Basis of Total Project Cost (unit cost model or other)
- SMP Match
- City Match
- SMP Fiscal Year for Funding (make note if this has changed from a previous CIP)

5.4.1 Watershed Organization Administration and WAMP Updates and Maintenance

While the details of how Watershed Organizations will be structured have not yet been determined, it is anticipated that they will need to meet at least twice a year to participate in the System Management program. The first such meeting would start at the top of the flowchart shown in **Figure 5-1**, and would take place towards the end of the program planning cycle and would be used to determine a plan to develop Steps 1 through 3 of the WAMP. Because the previous years' activities may alter the stormwater data inventory and the stormwater system's overall risk profile, these should be revisited and updated as necessary. In addition, this meeting is anticipated to set a plan to refine strategies based in Step 3 based on the updated data inventory and risk profile. If there is a large amount of work involved in completing Steps 1 and 2, the Watershed Organizationshould consider addressing Step 3 in an additional meeting.

The second meeting would take place early in the program planning cycle and would be used to complete Step 4 and finalize the list of projects to be submitted to SMP for funding as part of 5-year CIP. Note that once an initial 5-year CIP has been created, updates to the CIP will be allowed to move projects between FYs to accommodate shifting City funding availability. Such shifts should be clearly communicated to the SMP, ideally as soon as a change in FY for a given project is known.

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Attachment 1 (Digital)

Includes:

Modified State Dam Inspection Form

Project Template

WAMP Suggested Tables

Watershed Organization Stormwater Asset Risk Reduction Strategy Worksheet

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