ARLINGTON℠

Comprehensive **STORMWATER PLAN**

Prepared by
Public Works and Transportation
Stormwater Management
April 2021

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Executive Summary

The City of Arlington's Public Works and Transportation Department manages the public stormwater system that collects and conveys rainwater runoff from developed and undeveloped properties inside the City. The public stormwater system consists of manmade channels, detention ponds, underground storm drain pipes, curb inlets, flumes, roadside ditches and culverts. The City experiences a wide range of challenges which stem from a variety of terrain and soil conditions, intense rainfall, an aging stormwater system and fully developed watersheds. Management of this system requires a coordinated effort to ensure the stormwater system can effectively convey runoff when flood conditions occur.

The City of Arlington's Stormwater Management Program's primary goal is to increase the City's resilience to flooding. This is achieved through the application of building design criteria and codes, routine system maintenance, construction of mitigation projects, stormwater quality regulatory compliance, effective floodplain management and comprehensive education for residents and property owners about stormwater best management practices for flood risk reduction and stormwater pollution prevention. By utilizing these tools to reduce the potential loss of life and property due to the impacts of flooding while also enhancing the natural and beneficial functions of the floodplain along our local waterways, the City can continue to strengthen its flood resilience.

Comprehensive Stormwater Plan Goals

The purpose of the Comprehensive Stormwater Plan (CSP) is to provide a document that includes the guidance necessary for effective management of the City's stormwater system. The CSP combines all Watershed Master Plans, the Localized Flooding Analysis, reported drainage issues, known maintenance issues, and the City's stormwater regulatory requirements to provide a data-driven prioritization framework for future mitigation projects and maintenance activities. The CSP is a dynamic and proactive strategic plan that will aid in identifying, planning and prioritizing future stormwater projects on a worst-first basis to prevent and mitigate the impacts from flooding.

The Comprehensive Stormwater Plan goals to address identified Stormwater Management needs:

- Reduce the existing potential for stormwater damage to public health, safety, life, property and environment through mitigation projects.
- Protect and enhance the quality, quantity and availability of Arlington's waterways.
- Preserve and enhance existing aquatic and riparian environments and encourage restoration of degraded areas.
- Establish comprehensive data-driven prioritization framework for all maintenance activities and mitigation projects.
- Promote equitable, acceptable and legal measures for Stormwater Management.

Asset Management Recommendations

Stormwater infrastructure includes constructed and natural assets necessary to contain and convey stormwater runoff throughout the City. Maintaining an inventory of these assets and tracking the condition are necessary to forecast future maintenance and capital improvement needs.

The City has reviewed current stormwater asset management procedures and practices and offers the following recommendations:

- Prepare and adopt a Stormwater Asset Management Plan that includes standard operating procedures for updating the asset inventory as needed and a schedule for routine condition inspections.
- Perform Closed Circuit Television Inspections on all storm drain systems in five years to establish baseline conditions of all public storm drain lines, manholes and inlets for a probability of failure analysis.
- Inspect all City-owned ponds annually and document identified maintenance needs for incorporation into the stormwater capital maintenance program.
- Update the City's Bank Erosion Hazard Index Ratings for all creeks and streams every five years.
- Update asset inspection and maintenance reporting parameters in Cartegraph OMS so that records can be used to develop asset probability of failure.
- Implement routine engineering analysis to assess the consequence of failure for each stormwater system located within the City. Complete 50% of consequence of failure assessments in five years.
- Refine and utilize a Stormwater Overall Condition Index (OCI) for all public stormwater asset types.

Operations and Maintenance Recommendations

A comprehensive stormwater management program is not only made up of capital improvements, but also a well-planned operations and maintenance program for existing infrastructure. The City has reviewed current operations and maintenance data and practices and offers the following recommendations:

- Continue funding the Street Sweeping Program.
- Maintain as needed all concrete channels.
- Clean as needed all public storm drain inlets.
- Continue dredging as needed City-owned ponds to ensure flood storage capacity is maintained.
- Continue performing small-scale drainage improvements and stormwater system repairs using internal stormwater Field Operations staff to reduce funding impacts to the Stormwater Capital Improvement Program.
- Continue placing "No Dumping Drains to Creek" stormwater inlet decals annually for public education purposes.

Regulatory Recommendations

The City of Arlington has regulatory obligations it must meet to stay in compliance with State and Federal law related to the management of stormwater quality and floodplain management. Each regulatory aspect of the Stormwater Program is critical in preventing flood risks from stormwater quality and quantity issues.

Texas Commission on Environmental Quality

The City is subject to the requirements of the Texas Pollutant Discharge Elimination System (TPDES) Municipal Separate Storm Sewer System (MS4) Permit as administered by the Texas Commission of

Environmental Quality (TCEQ). As required by the MS4 Permit, a Stormwater Management Program (SWMP) has been developed to meet the requirements set for by the TCEQ and to guide the City's Stormwater Management Program over the MS4 Permit term of five years. The goal of the SWMP is to assist in the effort to reduce pollutants in stormwater runoff to the maximum extent practicable and ultimately from entering waterways within the City. The SWMP is separate from the CSP because it is reviewed and approved by the TCEQ for compliance with all aspects of the TPDES MS4 requirements.

The SWMP is a major component of the City's Stormwater Management Program as it is the City's implementation plan to monitor and manage stormwater quality. It provides the guidance necessary to reduce risks associated with exposure to harmful pollutants in stormwater runoff and facilitate inspection of privately owned stormwater control measures, such as detention ponds. The City offers the following recommendations to incorporate into the CSP as it relates to stormwater quality:

- Maintain the City's compliance with the TCEQ TPDES regulations, including administering the requirements of Stormwater Pollution Prevention Chapter of the Arlington City Code of Ordinances.
- Inspect Post Construction Stormwater Control Measures.
- Continue to implement illicit discharge detection and elimination hot spot monitoring.
- Establish a Total Maximum Daily Load Program.
- Continue to provide public education and outreach for stormwater pollution prevention best practices.

National Flood Insurance Program

It is recommended that the City:

- Maintain the City's good standing in the National Flood Insurance Program by remaining in compliance with the NFIP regulations, including administering the requirements of the Flood Damage Prevention Chapter of the Arlington City Code of Ordinances.
- Identify upstream and downstream impacts in accordance Federal Emergency Management Agency (FEMA) regulatory requirements during project identification and prioritization.
- Achieve and maintain a Class 5 Rating in the Community Rating System Program which will allow property owners located within a FEMA-designated floodplain to receive a 25% discount on flood insurance premiums while all others receive a 10% discount.
- Implement a Substantial Damage Property Management Plan in accordance with FEMA policy.
- Provide public education and outreach on the importance of purchasing a flood insurance policy.
- Update and implement public outreach based upon the City's adopted Floodplain Program for Public Information Plan.
- Upgrade and expand the Flood Monitoring System to allow first responders and the public access to the City's stream and rain gauge data.

United States Army Corps of Engineers

It is recommended that the City:

- Identify United States Army Corps of Engineers Permitting needs during project identification and prioritization.
- Keep maintenance activities under the thresholds to the maximum extent practicable.

Project Identification

Potential projects to include in the CSP have been identified through multiple sources including the Watershed Study Program, Localized Drainage Analysis, maintenance inspections and work order data, drainage concerns, Repetitive Loss Area Analysis Plan and flood insurance claims data. It is recommended that the City:

- Perform a basic level of service assessment on all storm drain systems that do not have reported flooding and assess criticality and flood hazards based upon results.
- Review and update as needed the Watershed Master Plans on a five-year cycle.
- Review Flood Insurance Claims data annually and update Repetitive Loss Area Analysis (RLAA) Plan as needed.
- Review Overall Condition Index for stormwater assets and identify appropriate maintenance needs.

Data-Driven Prioritization Framework Recommendations

The prioritization of eligible projects is completed by City staff. Project type categories include watershed, localized drainage, erosion, voluntary buyouts and maintenance. Projects will be evaluated and scheduled on a worst-first approach with an emphasis on making downstream improvements prior to upstream improvements.

In general, it is recommended each project must meet the following criteria:

- Address public health, safety and welfare.
- Reduce frequency of flooding and other associated flood hazards.
- Meet City, state and federal stormwater regulations.
- Benefit the local watersheds and stormwater assets.
- Gain neighborhood support.
- Generate opportunities to improve the overall stormwater system.

Chapters 5 and 6 of this report contains a summary of project-type categories and the prioritization framework for each project category.

Capital Improvement Program Recommendations

An essential component of a stormwater management program is the development of a Stormwater Capital Improvement Program (CIP) based upon the City's short- and long-term stormwater capital needs. The City recommends the following based upon the project prioritization framework:

- Program capital projects into yearly plans based on project prioritization and areas of emphasis, such as the Roadway, Water and Drainage coordinated projects.

- Establish a proactive annual stormwater capital maintenance program to identify and plan for drainage improvements and infrastructure repairs that are too large for the City's field operations staff to complete.
- Establish a proactive storm drain system rehabilitation program focused on identifying and repairing storm drains that have adequate stormwater conveyance capacity but are reaching the end-of-life cycle.

Funding Recommendations

The current Stormwater Utility Fee rate of $7.50 per Equivalent Residential Unit (ERU) currently produces an estimated annual revenue of $20M. The total operations budget averages $10.4M. This allows approximately $9.6 M for "pay as you go" funding of capital projects annually. The Stormwater Program will need to continue to utilize revenue bonds at the current level to average a $15 to $18M capital program annually.

Chapter 1: Introduction

1.1 Background

The City of Arlington was founded in 1876 as a station on the Texas and Pacific Railroad in the vicinity of Bird's Fort. By 1900, the town's population had grown to 1,800, and the first decade of the 20th century was full of firsts for Arlington: a new electric plant, telephones, a public school system, natural gas lines and a municipal water system. The City continued to steadily grow and develop reaching a population of 7,692 in 1950.

Large-scale industrialization began in 1954 with the arrival of the General Motors assembly plant, and Arlington became one of the fastest growing cities. Over a single decade from 1950 to 1960, the population grew from 7,692 to 44,775. The first subdivision regulations in Arlington were enacted in 1951 prior to the start of this building boom. These guidelines were in place to help guide this growth with platting and zoning regulations. These regulations did not include modern drainage requirements, and the subdivisions were largely constructed with minimal drainage infrastructure. When drainage infrastructure was constructed, often the primary focus was to move the stormwater runoff downstream as quickly as possible, without evaluation of the downstream flooding impacts. It was also a common engineering practice at the time to "straighten out" creeks, such as Johnson Creek and Cottonwood Creek, and hard armor them with concrete to be able to maximize the developable space.

By 1970, the population had doubled again to 90,229. The City of Arlington adopted floodplain development standards in 1971 for entry into the newly formed National Flood Insurance Program which allowed all residents to become eligible to purchase a flood insurance policy. These standards regulated development only in areas that had been identified as Flood Hazard Zones by the Flood Insurance Administration and did not require new developments to evaluate downstream impacts from new construction. In 1977, Arlington adopted its first modern drainage requirements for areas located outside of the floodplain in the City's Subdivision Rules and Regulations. These new drainage requirements introduced design criteria on how to size permanent improvements of drainage features and created an option to leave larger natural channels such as Rush Creek in existing states while smaller tributaries were required to be concrete lined. The population at that time was almost 160,000 people.

The Stormwater Utility Fee was established in 1990 to address the City's need for improved maintenance of existing stormwater system, ongoing repair of deteriorated infrastructure, enhancement of the stormwater system and compliance with the Environmental Protection Agency (EPA) Clean Water Act requirements. Establishing the stormwater utility fund was a step toward proactively managing the City's stormwater challenges, but it was not envisioned to provide a comprehensive stormwater plan or program.

In 1992 when the population was 273,399, a series of building setbacks along natural creeks were adopted in the Subdivision Rules and Regulations. These setbacks restricted development in the immediate vicinity of the creek and was based upon the depth of the creek. This requirement eventually became known as the Erosion Clear Zone. Prior to this regulation, buildings were often constructed near the edge of creeks which increased the erosion and flood risks.

In 2003, all engineering design standards were removed from various ordinances and combined into one Design Criteria Manual. These regulations no longer recommended the construction of concrete-lined

channels in subdivisions and provided design criteria for stormwater best management practices (BMP) such as detention ponds.

In response to the July 2004 flood event, City Council appointed a Citizen Policy Review Committee (CPRC) in March 2005. The CPRC was tasked with completing a comprehensive review of the City's stormwater programs and policies at the time. The CPRC reviewed drainage issues, programs, fee structure, design criteria, ordinances and policies, and took a tour of the City and collected public comments. The CPRC developed a list of short- and long-term recommendations and provided a final report to City Council in August 2005 based upon the findings.

The Stormwater Utility Fee was restructured in 2007 in response to the CPRC's recommendation to ensure equity between residential and commercial properties. The Stormwater Management division within the Public Works and Transportation Department was also formed in 2008 in response to the CPRC's recommendations that the City ensure consistent oversight of the Stormwater Program.

The Stormwater Management division implemented the CPRC's short- and long-term recommendations which included, but is not limited to, constructing flood-mitigation projects, expanding the preventative maintenance program to include monitoring and evaluating the condition of stormwater pipes, developing a buyout policy, expanding the environmental management program to include construction site inspections, and developing a comprehensive stormwater plan.

The City contracted with Jacobs Engineering to begin the initial work to develop a comprehensive stormwater plan. Jacobs Engineering conducted an assessment and inventory of the natural stream system, reviewed the current development requirements, and provided recommendations for addressing erosion damages in the City. The contract was broken into three phases. The first phase included reviewing the City's stormwater regulations and design criteria and identifying "quick fixes" that would address current issues as well as initiating a pilot stormwater system condition inventory. The second phase involved an inventory of the current natural stream system and identification of critical issues. The third phase was originally planned to include the stream inventory assessment and provide design and financial recommendations for correcting existing problems. During Phase I and Phase II, the City amended the contract to include parts of Phase III in the contract.

The Jacobs Engineering study was completed in August 2011. The results of the assessment and inventory of infrastructure demonstrated the City needed to evaluate each stream on a watershed basis using up-to-date engineering information and technology. The floodplain maps at the time the Jacobs study was completed were based upon data that had been developed on average 20-30 years prior to the start of the study. Project alternatives were not developed, and a prioritization strategy and costs associated with correcting existing problems were not finalized at that time because the City recognized the need to update the watershed information with current conditions to identify projects and establish priorities for the Stormwater Program. The City started the Watershed Study Program in 2011 and began to systematically study each of the major watersheds as funding was available.

The Watershed Study Program included updating all hydraulic and hydrologic models for each watershed using both current land use and fully urbanized land use conditions and re-evaluating stream reaches for erosion issues. This information serves as a base for all engineering analysis for the Stormwater Program. Each watershed plan identified flood and erosion mitigation projects as well as buyout locations.

In September and October 2018, the City experienced a record 32 inches of rain that resulted in flooding citywide. Most of the flooding that occurred was within neighborhoods along storm drain lines. The City began the Localized Drainage Analysis to determine the source of the reported flooding and prioritize each location.

The Watershed Study Program and the Localized Drainage Analysis identified 38 Watershed Projects, 63 Localized Drainage Projects of varying size and 367 Voluntary Buyouts. The City cannot support the repair of all of these stormwater issues at one time due to a limited number of funds available, limited staff resources and the public inconvenience it would cause. The identified projects were prioritized to give the City a strategic approach to the capital improvements and identify funding needs to continue to maintain normal operations and construct capital improvements.

1.2 Purpose and Intent

The City of Arlington acknowledges the need for a more proactive and comprehensive approach to manage stormwater runoff. The City also understands the integrated nature of the watershed system and the need to consider stormwater management planning on a watershed basis. Therefore, the Comprehensive Stormwater Plan (CSP) has been created to establish goals and policies to guide Stormwater Management decision making for the City. The CSP combines all Watershed Master Plans, the Localized Flooding Analysis, reported drainage issues, known maintenance issues and the City's stormwater regulatory requirements into one document that covers the entire City. The CSP identifies Stormwater Management program components, discusses the implementation of those components, and contains management objectives and policies. The CSP provides the City with an effective framework to prioritize capital projects, identify maintenance activities, identify regulatory needs, and enhance public education and outreach. The CSP recognizes the critical need to reduce the potential for recurring flood damage and the responsibility for protecting life, public health, safety, and the environment within the City. The CSP will be updated on a five-year cycle.

1.3 Goals

The Comprehensive Stormwater Plan defines goals to address identified Stormwater Management needs:

- Reduce the existing potential for stormwater damage to public health, safety, life, property and environment through mitigation projects.
- Protect and enhance the quality, quantity and availability of Arlington's waterways.
- Preserve and enhance existing aquatic and riparian environments and encourage restoration of degraded areas.
- Establish comprehensive data-driven prioritization framework for all maintenance activities and mitigation projects.
- Promote equitable, acceptable and legal measures for Stormwater Management.

Chapter 2: Stormwater Asset Management

The basic function of a stormwater drainage system is to convey collected stormwater runoff. Stormwater assets include all infrastructure within a drainage network such as channels, pipes, bridges and inlets. These assets can be either natural or engineered to carry a specific amount of stormwater runoff. Stormwater asset management includes documenting drainage system information, inspecting assets and forecasting system maintenance needs.

The City of Arlington is faced with the challenge of addressing issues related to an aging stormwater system. A comprehensive understanding of the condition and location of all stormwater assets is necessary for a proactive asset-management program. Steps for an effective stormwater asset-management program include:

1. Develop an Asset Inventory and Gather Data
2. Identify Asset Condition and Criticality Scoring
3. Identify Levels of Service
4. Set Program Priorities
5. Prepare an Asset-Management Plan

This chapter includes a summary of the City's current stormwater asset management program. It also includes recommendations to better incorporate this program into the data-driven prioritization strategy being adopted with the overall Comprehensive Stormwater Plan.

2.1 Stormwater Asset Inventory and Data Gathering

Complete and accurate information regarding the City's stormwater assets serve as the foundation for asset management. Asset inventory efforts are performed for the purpose of presenting a complete picture of all assets and, when necessary, closing information and data gaps. The City utilizes ESRI Geographical Information System (GIS) to map all stormwater assets.

2.1.1 Stormwater Asset Types

The City has identified eight unique categories of assets within the stormwater system. In general, the stormwater asset types include:

- Inlets
- Manholes/Junctions
- Outfalls
- Culverts
- Bridges
- Pipes
- Open Channels
- Ponds

The information presented in Table 2.1 Stormwater Asset Inventory (October 2019) is inventory data known to the City of Arlington as of October 2019. It is estimated to represent approximately 90 percent of the public stormwater infrastructure system for which the City is responsible. This table does not include stormwater assets within the TxDOT Right of Way or within the boundaries of the University of Texas at Arlington. Stormwater infrastructure located in those areas is maintained by the respective state entities.

Table 2.1 Stormwater Asset Inventory (October 2019)

Asset Type	Quantity
Channels	1,931
Culverts	711
Inlets	19,323
Manholes	1,198
Outfalls	3,589
Pipes	35,718
Ponds	28

2.1.3 Stormwater Asset Attribute Tracking

Within the Geographic Information System (GIS), the City tracks stormwater asset information such as asset unique identifiers, custodian information, location, size, invert elevation, slope, length, construction date and source plan data. Assets such as outfalls, manholes and inlets are geospatially located utilizing GPS location data so they can be located during an emergency and pipe assets are connected to them as appropriate. A GIS Data Dictionary provides detailed information about the type of information that should be included in each asset type within GIS.

Figure 2.1 Example of Stormwater Assets Mapped in GIS

The City reviewed its current stormwater asset attribute data within GIS and found some attributes were missing from the GIS data. Some examples of data gaps in the asset layers include 65% of all pipe installed dates, 11% of plan information, unverified flowline elevation data, etc.

Plan research, inspection data and topographical survey data can help fill these data gaps to ensure the stormwater system is fully mapped and documented to facilitate the data-driven prioritization for maintenance related operational tasks and capital projects.

2.1.4 Other Stormwater Data

The City maintains other data pertaining to stormwater including drainage concerns, natural stream location and stability ratings, stormwater asset inspection and maintenance records, and regulatory floodplain information such as repetitive loss areas, drainage basins and identified flood zones.

2.2 Stormwater Asset Condition Inspections

Figure 2.2 Channel Wall Failure and Debris Blockage

Asset inspections are critical for establishing the current condition of each asset and performing routine maintenance when needed to ensure the system functions properly. Stormwater asset inspections are primarily managed by the Field Operations and Information Services Division of the Public Works and Transportation Department. The Stormwater Operations group within this division conduct annual inspections of all City-owned and maintained inlets, flumes, channels and culverts.

All inspection and maintenance activities are tracked within the Cartegraph Operations Management Software (OMS) work order system that pulls asset information from the Stormwater GIS data described in Section 2.1.3. Inspections document obstruction such as sediments, trash and debris as well as any structural issues that may lead to a loss in the infrastructure capacity or structural integrity. Certain locations receive more frequent inspection either because they are known problem areas or because they have a high consequence of failure (i.e., structural flooding or unsafe roadway conditions). This section includes a summary of the inspection activities of all public stormwater asset types.

2.2.1 Closed Circuit Television Inspection

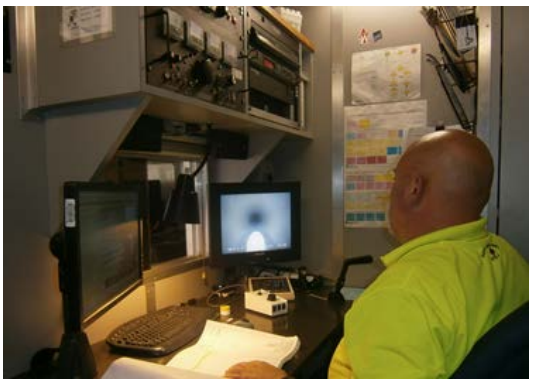

Figure 2.2.1 CCTV Inspection

Televising underground stormwater infrastructure such as inlets, laterals, manholes and storm drain pipes aids in determining the condition of each of those asset types. This type of inspection typically utilizes Closed Circuit Television (CCTV) camera equipment. A visual inspection of the video is used to determine a condition score for pipes and culverts. This type of inspection can identify if an asset is showing signs of deterioration where preventative maintenance should be performed. If parts of a pipe are in the early stages of failure, it can be scheduled to be repaired or rehabilitated. These inspections can also be used to determine if an underground asset has failed or collapsed and needs to be replaced either through an emergency repair or a capital improvement project.

The City currently has one vehicle equipped with CCTV inspection equipment to inspect underground stormwater infrastructure. This vehicle is operated by the Field Operations and Information Services Division of the Public Works and Transportation Department. City inspections are recorded and linked to specific assets through specialized software to the Cartegraph OMS work order system.

While CCTV inspections are the most effective means of inspecting underground assets, these inspections are time consuming and costly. Pipes are only inspected at the time of installation to confirm the asset was installed correctly, within designated capital improvement project areas or when an underground asset exhibits signs that it may not be functioning properly. Future determination of scheduled CCTV inspections may be determined based on the estimated pipe overall condition index (OCI) rating.

2.2.2 TxDOT Bridge and Culvert Inspections

Bridges and culverts over 20-feet in length are inspected by the Texas Department of Transportation (TxDOT) on a two-year cycle. There are approximately 180 of these bridges owned and maintained by Arlington. TxDOT provides the Public Works and Transportation Department with a list of bridge inspection reports and identified maintenance needs at the end of each inspection cycle. Based upon the needs that are identified by TxDOT, the minor maintenance repairs are performed by the PWT Field Operations division. This can include work such as minor concrete repair, rock rip rap placement, etc. Major maintenance work that includes bearing pad replacement or bridge deck repair is too large for the PWT Field Operations division and is incorporated into PWT's Stormwater Capital Improvement Program.

Figure 2.2.2 Photo from Bridge Inspection

Bridges and culverts under 20 feet in length are inspected by Field Operations on an annual basis.

2.2.3 Priority Inspection for Barricade Locations

Locations that have frequently overtopped during a flood event and require barricading are inspected before and after rain events to remove any debris blockages and ensure each site is able to convey stormwater runoff as efficiently as possible.

These locations include:

- 5857 Silo Road
- 1300 E. Abram Street
- 1100 S Center Street
- 500 S. Collins Street
- 100 W. Park Row Drive
- 800 E. Mitchell Street
- 1200 Pennant Drive
- 2500 Copeland Road
- 1000 E. Mitchell Street
- 1400 E. Randol Mill Road
- 1500 E. Division Street
- 1500 E. Sanford Street
- 3400 Indian Trail
- 3600 Woodside Drive
- 4200 Woodland Park
- 3100 Park Springs Boulevard
- 3600 Forest Edge Drive
- 3600 W. Division Street
- 2300 Park Hill Drive
- 2900 N. Collins Street
- 2500 N. Fielder
- 2900 Pitkin Drive
- 200 S. Center Street
- 1900 S. Davis Street
- 2300 Southcrest Drive
- 300 S. Pecan
- 6600 Silo Road
- 6406 Redstone Drive
- 100 N. West Street
- Mossy Oak Street at Lamar Boulevard

2.2.4 Earthen Channel Inspection

Maintenance and mowing of earthen channels within a drainage easement that are not covered by a maintenance agreement are the responsibility of the Stormwater Maintenance group. At a minimum, these channels are mowed three times per year.

2.2.5 Improved Channel and Flume Inspection

Concrete channels and flumes that are located within drainage easements are inspected by the Stormwater Maintenance group on an annual basis. These visual inspections are used to determine maintenance needs in the channel. Channel segments are assigned scores that are documented in Cartegraph OMS. Cleaning sediment and debris as well as minor concrete repairs are completed by the Stormwater Maintenance group. Larger repairs or replacement of channels are performed as capital improvements projects. Replacement of improved channels is typically conducted in association with flood mitigation and can include extensive flood studies and permitting.

Figure 2.2.4 Headwall Cracks Identified During Channel Inspection

2.2.6 Natural Creek Inspection

Natural creeks and streams located within the City of Arlington are considered private property and are the responsibility of the private property owner to maintain. To track the progress of erosion and identify erosion threats to public infrastructure, the Stormwater Management and Business Services division is responsible for updating the Bank Erosion Hazard Index (BEHI) Assessment on all streams and creeks within the City.

2.2.7 Roadside Ditches Inspections

Roadside ditches are inspected by the Stormwater Maintenance group on an as needed basis.

2.2.8 Stormwater Storage Facilities and City-Owned Pond Inspections

The Stormwater Maintenance Group inspects stormwater storage facilities not located on Parks and Recreation property each quarter.

The Floodplain Management group is responsible for inspecting all City-Owned Ponds that permanently detain water on an annual basis. Each inspection of the City-Owned Ponds includes an assessment of accumulated sediment to determine any impacts to the pond's flood operational capacity and prioritized for capital maintenance based upon flood risks.

2.2.9 Inlet Inspections

All public stormwater inlets are inspected on an annual basis by the Stormwater Maintenance group. At this time, that includes the inspection of all public inlets. Inlets are assessed for structural deficiencies at that time and are cleaned as needed.

2.2.10 Outfall Inspections

Outfalls for stormwater systems are both inspected by the Environmental Management group and the Stormwater Field Operations group. Environmental Management tests the stormwater quality of discharges from stormwater outfalls as needed when suspected illicit discharges are identified or reported to the City. Stormwater Field Operations will inspect outfalls on an as-needed basis when drainage concerns about creek erosion or creek blockages are reported to the City. Stormwater Field Operations will perform maintenance work to remove blockages and perform minor structural repairs to ensure the operation of the system.

2.3 Levels of Service

The operational level of service (LOS) defines the frequency and types of action desired to maintain the stormwater asset system and asset operations at an acceptable level. There are two primary levels of service: 1) Short-Term LOS and 2) Desired LOS.

It should be noted that large storm events play a part in the City's ability to achieve a goal. The intent of each identified LOS is to provide direction for the program, assist in budgeting and business planning, and to create a common understanding of program expectations.

2.3.1 Short-Term Level of Service

The short-term LOS is established to move the City from a reactive approach to a proactive approach. The short-term LOS uses currently available information regarding the system's probability of failure and consequence of failure to determine priorities and appropriate corrective actions. Therefore, the focus is to improve the City's stormwater asset inventory and condition assessment of assets while extending the effective life of assets through repair and replacement activities.

The goal is to complete the inventory and condition assessment of stormwater assets within five years and to increase the effective life of assets prior to replacement. The short-term LOS places an emphasis on gathering and verifying individual asset data to further refine and enhance the decision-making process while achieving regulatory compliance, advancing program goals and meeting resident expectations.

2.3.2 Desired Level of Service

The City desires to achieve a level of service that manages stormwater assets proactively and substantially extends the life of the stormwater system, thereby, improving the fiscal responsibility of the system operations. The desired LOS is the preferred level of service for the City's Stormwater Program, which is a proactive approach that will achieve regulatory compliance, program goals and citizen expectations while optimizing system functionality and minimizing repair and replacement costs. It should be noted that this LOS may require additional funding and resources beyond the short-term LOS to achieve. The desired LOS is focused on using risk evaluation and condition assessment data to make stormwater asset management decisions. Stormwater assets will continue to be added to the inventory as constructed, and condition assessments will be conducted based upon an asset's previous condition and probability and consequence of failure score.

2.3.3 Service Components

The level of service is met through two primary components for any stormwater asset. These are Operations and Maintenance activities and Structural activities.

Operations and Maintenance includes the LOS categories such as:

1. Routine infrastructure inspections.
2. Maintenance operations primarily through cleaning, mowing, tree removal and other tasks associated with routine maintenance activities.
3. Minor repairs that return the functionality of the asset.

Structural Activities include the LOS categories covered by the Stormwater Capital Program:

1. Rehabilitation that returns the stormwater asset to its original condition.
2. Stormwater system replacement.

2.4 Stormwater Asset Priorities

Stormwater asset priorities should be based on not only the condition of the pipe, but its ability to adequately convey stormwater flows. The Stormwater Overall Condition Index (OCI) for channel, flume, inlet, pipe, culvert and bridge assets are completed in Cartegraph OMS based on parameters set by the City. Current OCI parameters need to be refined so these scores can be used to move to a more predictive Stormwater Asset Management program by incorporating engineering analysis data about each stormwater system's ability to convey stormwater flows. The OCIs will be based on two major categories: probability of failure and consequence of failure.

2.4.1 Probability of Failure

Probability of failure for assets is based on inspections, maintenance records, age, and material when applicable. For assets that are regularly inspected, inspection results are a larger percentage of the OCI. For assets that cannot be regularly inspected age and material types are a larger percentage of the OCI.

2.4.2 Consequence of Failure

Not all assets within the stormwater system are equally critical to the system's overall function, it is necessary to identify the assets that are more critical and will therefore require more attention. Assets whose failure would have a significant impact to public safety are given a higher criticality rating. The impact of an asset's failure is determined by the:

- Asset Level of Service – A higher capacity would mean a larger impact if that asset was no longer functional.
- Asset Criticality – Assets such as culverts, channels, or pipes that are downstream from multiple pipes and inlets is more critical to the overall system than a pipe that carries from a single inlet.
- Asset Redundancy – If an inlet on a slope fails then runoff will continue to flow to the next inlet, but an inlet in a low point in the system and the pipe connected to that inlet may cause structural flooding and safety issues if they are no longer functioning.

2.5 Stormwater Asset Management Program Recommendations

The City has reviewed current stormwater asset management procedures and practices and offers the following recommendations:

- Prepare and adopt a Stormwater Asset Management Plan that includes standard operating procedures for updating the asset inventory as needed and a schedule for routine condition inspections.
- Perform Closed Circuit Television Inspections on all storm drain systems in five years to establish baseline conditions of all public storm drain lines, manholes and inlets for a probability of failure analysis.
- Inspect all City-Owned ponds annually and document identified maintenance needs for incorporation into the stormwater capital maintenance program.
- Update the City's Bank Erosion Hazard Index Ratings for all creeks and streams every five years.
- Update asset inspection and maintenance reporting parameters in Cartegraph OMS so records can be used to develop asset probability of failure.
- Implement routine engineering analysis to assess the consequence of failure for each stormwater system located within the City. Complete 50% of consequence of failure assessments in five years.
- Refine and utilize a Stormwater Overall Condition Index (OCI) for all public stormwater asset types.

Chapter 3: Operations and Maintenance

A comprehensive stormwater program is not only made up of capital improvements, but also includes a well-planned operations and maintenance (O&M) program for existing infrastructure. O&M consists of tasks that should be done to the existing stormwater infrastructure system (maintenance) and how it should be done (operation) to achieve its flood carrying capacity and reduce negative impacts to stormwater quality when the system conveys stormwater runoff. The goal of a stormwater program with well-planned O&M will transition from reactive tasks to proactive tasks and begin to see fewer occurrences of emergency work orders and decrease potential stormwater quality impacts.

The City maintains and operates approximately 604 miles of storm drain systems with 1,224 manholes and 19,307 inlets. Maintaining the current stormwater infrastructure system throughout the City is an important part of an effective drainage program. All infrastructure has a finite lifespan that can be either cut short or extended by the quality of the maintenance performed on it. Maintenance within the public stormwater system also effects how the overall system performs during a storm event.

Many of the identified problem areas and project locations have a need for additional capacity in inlets, storm drains, flumes or drainage channels. The current state of the maintenance of the system should be evaluated before any improvements are made to increase the capacity of the system.

A summary of the frequency of inspections for all stormwater infrastructure is included in Chapter 2 Asset Management.

3.1 Department Structure and Responsibility

Figure 3.1 Removing a Broken Storm Drain Pipe From a Creek

The Stormwater Field Operations group within the Field Operations and Information Services Division of the Public Works and Transportation Department is responsible for the routine maintenance and functionality of the public stormwater infrastructure throughout the City. The Stormwater Field Operations group is comprised of 13 individuals who are responsible for performing tasks such as removing debris blocking flow, minor concrete repairs, repairing small sinkholes along stormwater infrastructure and maintaining vegetation.

The Stormwater Management and Business Services Division of the Public Works and Transportation Department is responsible for providing engineering support to Field Operations staff as needed. Stormwater Management will receive stormwater infrastructure condition information from Field Operations and incorporate large-scale maintenance needs into the capital program.

The City-Owned pond maintenance program is managed by the Stormwater Management and Business Services team.

3.2 Drainage Channel Maintenance

The Stormwater Field Operations group is responsible for the maintenance of City's concrete-lined channels and the contract administration to mow grass-lined engineered channels. Maintenance activities performed by Stormwater Field Operations include, but are not limited to:

Figure 3.2 Vegetation and Debris Removal From Channel

- Removal of fallen trees, trash and debris that could block the safe flow of stormwater.
- Stabilizing areas around storm drain pipes and outfalls.
- Performing minor concrete repairs to headwalls, drop structures and channel walls.
- Graffiti Abatement on stormwater infrastructure.

The City does not maintain natural creeks located on private property. Stormwater Field Operations will investigate drainage concerns related to fallen trees or debris jams that block the flow of water and remove them to prevent flooding.

3.3 Storm Drain and Inlet Maintenance

Storm drains and inlets accept runoff from surface drainage and can be prone to collecting elements from the surface carried by the stormwater runoff. This can include silt, sand, garbage and other debris. This debris can build up in the storm drain and inlets and over time reduce their ability to fully convey stormwater runoff which can increase the risk of flooding and possibly cause property damage. The Stormwater Field Operations group inspects every public inlet on an annual basis and performs any cleaning activities that are needed. The cleaning activities for the public storm drains and inlets are performed utilizing one vactor truck that uses suction to clean out debris from inlets and storm drains. This group will also investigate reports of slow draining inlets and storm drain systems and remove any blockages if found.

Figure 3.3 Removing a Root Wad From a Storm Drain Pipe

3.4 Street Sweeping

Street sweeping activities remove debris from public roadways and gutters to prevent the debris from entering the stormwater system. The debris can not only block the flow of water to inlets during a storm event, but can also cause harmful pollutants to enter Arlington's waterways. The City's street sweeping program is responsible for routinely and systematically sweeping public streets on an as-needed basis as well as on an annual-routine schedule.

The in-house staff and the contractor do not sweep private streets not maintained by the City of Arlington. The in-house staff and the contractor do not make numerous sweeping passes to remove an abundance of fallen leaves.

3.4.1 In-House Street Sweeping

Stormwater Field Operations is responsible for the in-house, street sweeping efforts which includes one dedicated employee and a street sweeper truck. The street sweeper is responsible for performing specific sections of major thoroughfares 40 hours per week. Sweeping is also available upon request for citywide events such as the annual Fourth of July Parade.

Figure 3.4 City Street Sweeper

Three sweeping zones have been established north, central and south. Sweeping operations at each location identified within each zone shall be completed twice each year. In-house sweeping activities are performed daily unless the equipment fails.

3.4.2 Contract Street Sweeping

Stormwater Field Operations Supervisor oversees the contract for the contractor-provided mechanical sweeping efforts. Stormwater Field Operations staff spot check the work completed by the contractor. Streets predominately used as commercial and/or industrial are not included in this contract. The contracted street sweeping schedule is:

- Every public residential street oncer per year
- The Entertainment District once per week
- Major intersections three times per year
- Emergency cleanup as needed.

The contractor also performs the following for residential street sweeping:

- Performing sweeping activities on all public owned streets within one of the 12 established residential sweeping zones during each month of the contract; and,
- Removing loose debris from the gutter line and concrete valley gutters.

3.5 City-Owned Pond Maintenance

There are 29 City-Owned ponds located primarily on Parks property. The City-Owned ponds shown in Figure 3.6 range in size from 4,000 square feet to 420,000 square feet. This does not include Lake Arlington because it is maintained and operated by Water Utilities.

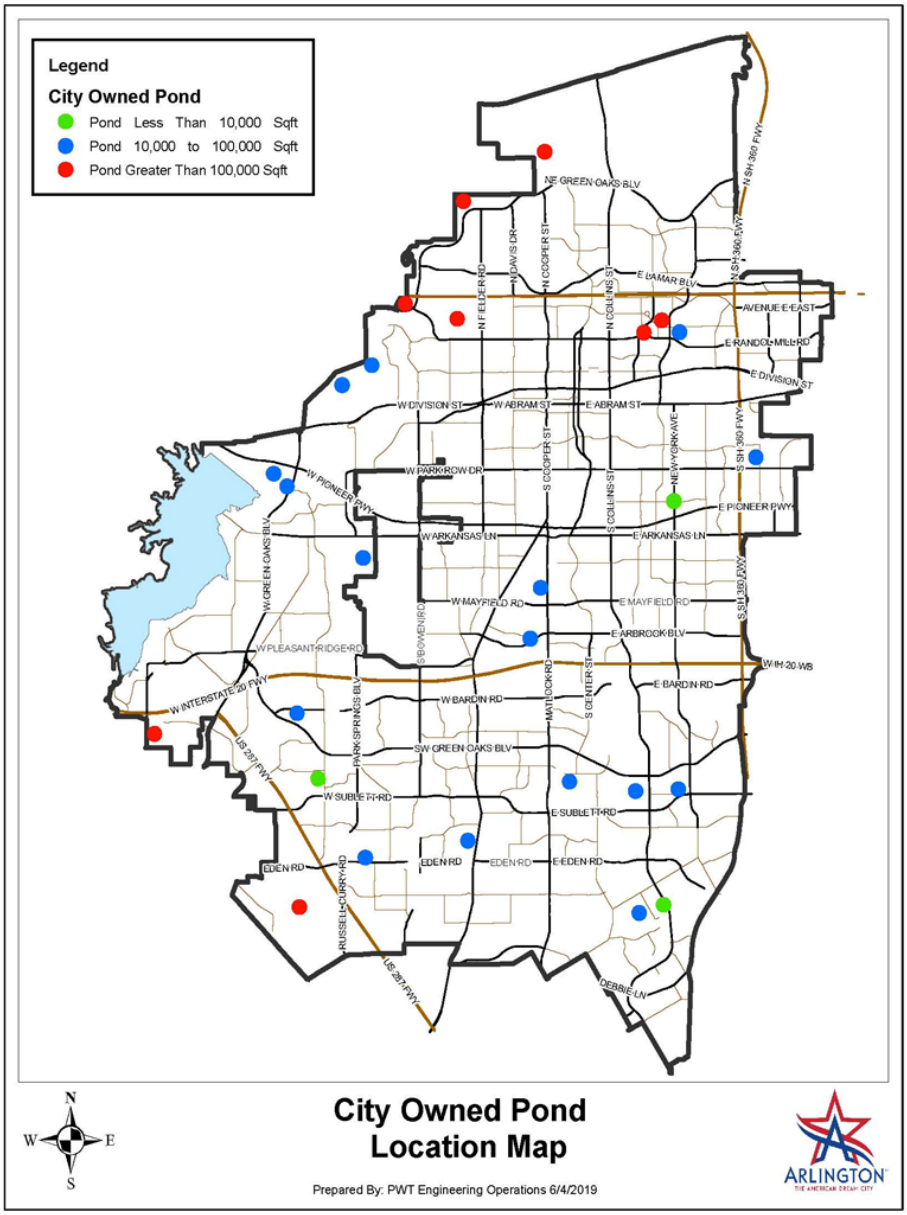

Figure 3.5 City-Owned Pond Location Map

The Stormwater Management and Business Services division is responsible for annual inspection and management of the contracts to perform dredging operations on these ponds. Maintenance and dredging activities of each pond is prioritized based upon the impact to the overall watershed. High sedimentation levels in certain ponds could increase flood hazards to the surrounding areas due to a

reduction in the available floodplain storage volume. Heavily sedimented locations can also alter flow patterns resulting in an increase in erosion.

Dredging projects are highly specialized and require unique equipment, such as dredging barges and belt filter presses to perform the work. The City does not have this equipment or equipment operator staff with dredging expertise and includes dredging projects with the Stormwater Capital Program as needed.

3.6 Operations and Maintenance Recommendations

Routine cleaning of the public stormwater system is recommended. It is recommended that the City:

- Continue funding Street Sweeping Program.
- Maintain as needed all concrete channels.
- Clean as needed all public storm drain inlets.
- Continue dredging as needed City-Owned ponds to ensure flood storage capacity is maintained.
- Continue performing small-scale drainage improvements and stormwater system repairs using internal stormwater Field Operations staff to reduce funding impacts to the Stormwater Capital Improvement Program.
- Place 360 stormwater “No Dumping Drains to Creek” inlet decals annually.

Chapter 4: Regulatory Requirements

The City of Arlington has regulatory obligations must meet to stay in compliance with State and Federal law. In addition, the City regulates activities within the stormwater system and has adopted higher standards for activities in the FEMA-mapped floodplain to protect public health, safety and welfare.

4.1 Texas Commission for Environmental Quality

The City is subject to the requirements of the Texas Pollutant Discharge Elimination System (TPDES) Municipal Separate Storm Sewer System (MS4) Permit as administered by the Texas Commission of Environmental Quality (TCEQ). Since 1998 the City has implemented a Stormwater Management Program (SWMP) to address stormwater quality. The United States Environmental Protection Agency (EPA) originally issued National Pollutant Discharge Elimination System (NPDES) Permit No. TXS000301 on August 28, 1998. The current permit was renewed through the TPDES on August 19, 2019. The City is co-permittee with the University of Texas at Arlington.

The goal of the SWMP is to reduce discharge pollutants to the maximum extent practicable to assist in the effort to reduce pollutants in stormwater runoff to the maximum extent practicable and ultimately from entering waterways within the City. The SWMP is a major component of the City's Stormwater Management Program as it is the City's implementation plan to monitor and manage stormwater quality. It provides the guidance necessary to reduce risks associated with exposure to harmful pollutants in stormwater runoff and facilitate inspection of privately owned stormwater control measures, such as detention ponds. The City SWMP contains eight Minimum Control Measures (MCM) that must be addressed:

1. MS4 Maintenance Activities
2. Post-Construction Stormwater Control Measures
3. Illicit Discharge Detection and Elimination
4. Pollution Prevention & Good Housekeeping for Municipal Operations
5. Industrial & High-Risk Runoff
6. Construction Site Runoff
7. Public Education, Outreach, Involvement & Participation
8. Monitoring, Evaluating & Reporting

The SWMP is separate from the CSP because it is reviewed and approved by the TCEQ for compliance with all aspects of the TPDES MS4 requirements. A copy of the SWMP is included in Appendix B. Many of the minimum control measures the City has included within the SWMP are shared goals with the Comprehensive Stormwater Plan. Each minimum control measure does require staffing levels that are reflected in the overall operating budget of the Stormwater Program.

4.2 Federal Emergency Management Agency

The City is subject to the requirements of the National Flood Insurance Program (NFIP) as administered by the Federal Emergency Management Agency (FEMA). The City's participation in the NFIP is required for all residents and property owners to be eligible to purchase a flood insurance policy. The City participates in the NFIP's Community Ratings System (CRS) Program and has adopted higher standards within the City's Flood Damage Prevention Chapter of the Arlington City Code of Ordinances to reduce flood damage to insurable property, strengthen and support the insurance aspects of the NFIP, and encourage a comprehensive approach to floodplain management. The City is currently a Class 6 CRS

Community which allows residents within the floodplain to obtain a 25% discount on their flood insurance premium while others receive a 10% discount.

All stormwater projects and maintenance activities must be evaluated for upstream and downstream impacts to remain in compliance with the NFIP regulations and no-rise criteria. The City must mitigate any impacts in accordance with these Federal guidelines and must submit floodplain mapping to FEMA for review as projects are proposed and then constructed.

4.3 United States Army Corps of Engineers

The United States Army Corps of Engineers (USACE) is responsible for regulating dredging and filling activities in the "Waters of the United States," which includes jurisdictional wetlands. All stormwater projects and maintenance activities must be evaluated for compliance with Section 404 of the Clean Water Act which is administered by the USACE. If a maintenance activity or stormwater project exceeds the thresholds outlined in Section 404 of the Clean Water Act, the City may be required to mitigate the impacts to the "Waters of the United States." Mitigation of these impacts can include purchasing mitigation bank credits at a mitigation bank located within the Trinity River watershed but is outside of the City of Arlington. Cost associated with mitigation bank credits can make construction of a project extremely cost prohibitive due to the lack of available mitigation credits. The City aims to plan and design all mitigation projects and maintenance activities so they are under the project limit thresholds identified in Section 404 of the Clean Water Act. In the instances when this cannot be achieved, the City attempts to design projects in such a way they are "self-mitigating" which would not require the purchase of mitigation bank credits.

4.4 Regulatory Recommendations

It is recommended the City continue to implement the following recommendations to maintain compliance with the TCEQ MS4 requirements:

- Maintain the City's compliance with the TCEQ TPDES regulations, including administering the requirements of Stormwater Pollution Prevention Chapter of the Arlington City Code of Ordinances.
- Inspect Post Construction Stormwater Control Measures.
- Continue to implement illicit discharge detection and elimination hot-spot monitoring.
- Establish a Total Maximum Daily Load Program.
- Continue to provide public education and outreach for stormwater pollution prevention best practices.

It is recommended the City continue to implement the following recommendations and to maintain compliance within FEMA's NFIP and CRS Program:

- Maintain the City's good standing in the NFIP by remaining in compliance with the NFIP regulations, including administering the requirements of the Flood Damage Prevention Chapter of the Arlington City Code of Ordinances.
- Identify upstream and downstream impacts in accordance FEMA regulatory requirements during project identification and prioritization.

- Achieve and maintain a Class 5 Rating in the CRS Program which will allow property owners located within a FEMA-designated floodplain to receive a 25% discount on their flood insurance premium while all others receive a 10% discount.
- Implement a Substantial Damage Property Management Plan in accordance with FEMA policy.
- Provide public education and outreach on the importance of purchasing a flood insurance policy.
- Update and implement public outreach based upon the City's adopted Floodplain Program for Public Information Plan.
- Upgrade and expand the Flood Monitoring System to allow first responders and the public access to the City's stream and rain gauge data.

It is recommended the City continue to implement the following initiatives to maintain compliance with the USACE Section 404 regulations:

- Identify USACE Permitting needs during project identification and prioritization.
- Keep maintenance activities under the thresholds to the maximum extent practicable.

Chapter 5: Project Identification

Flood mitigation projects reduce the risk of flooding of building and roadways through the construction of stormwater infrastructure or voluntary property buyouts. These projects can address flooding from inadequate stormwater system capacity or riverine flooding. Flood mitigation due to poor grading on private property or inadequate privately owned stormwater infrastructure is not part of the Stormwater Program because the necessary improvements must be completed by private property owners.

Past stormwater capital projects were identified through a complaint-based methodology. When drainage concerns were reported to the City, they were analyzed to determine the extent and cause of flooding. Staff would determine if the concern should become a project. Projects would be prioritized based on the number of drainage concerns in the area and the severity of flooding. Since the establishment of the Stormwater and Business Services Division of Public Works and Transportation in 2009, the City has been working toward a comprehensive stormwater program that includes data collection and analysis to help establish a data driven Stormwater CIP that is proactive rather than reactive to the City's stormwater issues.

The first step to establish a data-driven project prioritization method for the Stormwater Capital Improvement Program includes the collection of all relevant information concerning flooding, erosion, and stormwater assets to identify potential project locations. This information comes from many sources, including, but not limited to:

- Citizen Outreach and Flood Surveys
- Historical Drainage Concerns
- Flood Insurance Claims Data
- Watershed Study Data and Results
- Localized Drainage Analysis Results
- Geomorphological Studies
- Barricading and Roadway Closure Information
- Stormwater System Asset Inspections and Overall Condition Index Ratings
- Historical Maintenance Records
- Field Observations
- Stormwater System Capacity Requirements
- State and Federal Regulatory Requirements

A location map including of all reported drainage concern and flood insurance claims locations is found in Figure 5.1. Other factors beyond specific stormwater needs also play a role in project identification including, but not limited to, health and safety concerns and other capital improvement projects for streets, water utilities or development.

This chapter includes a summary of the project identification process for flood mitigation, infrastructure maintenance and erosion mitigation project types.

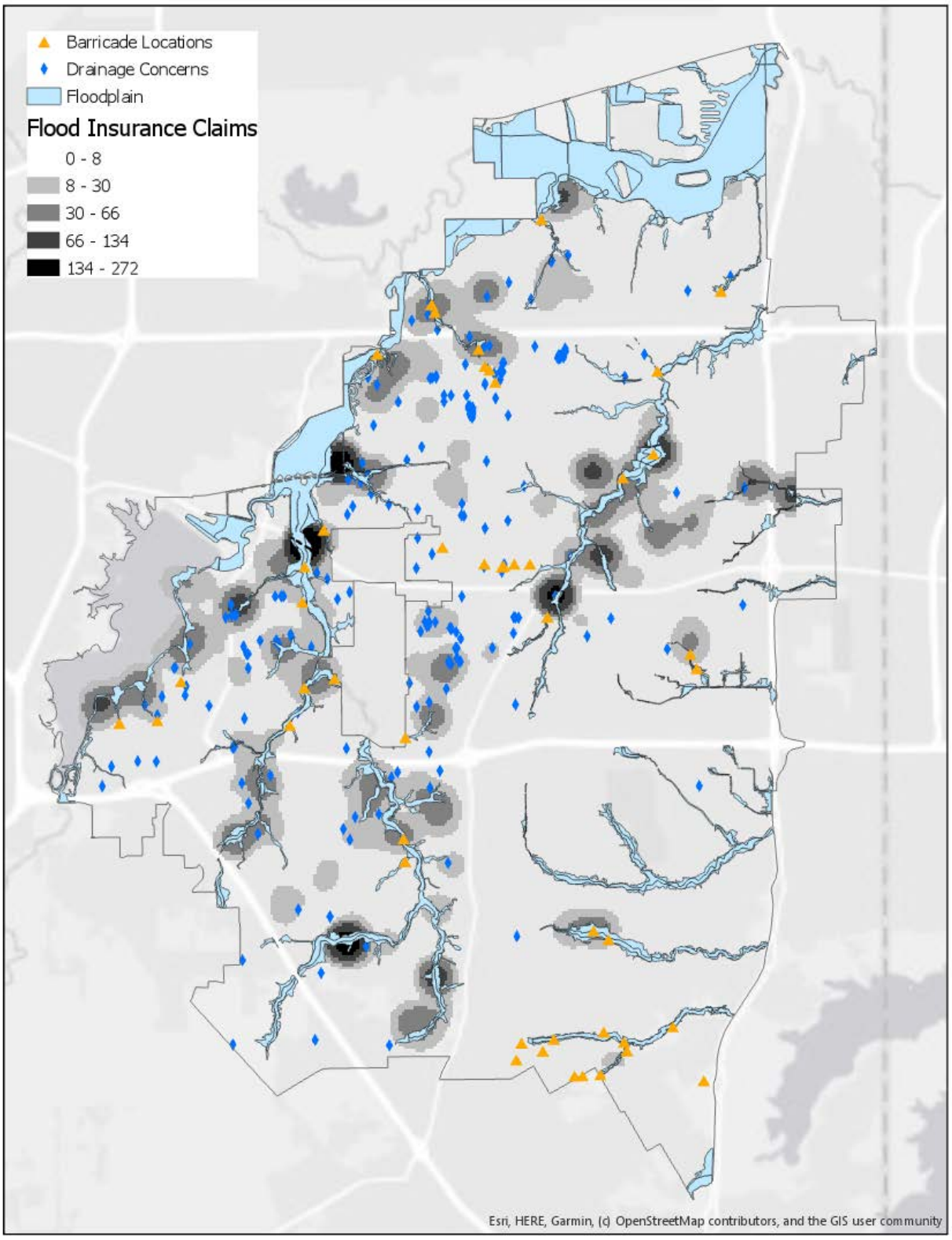

Figure 5.1 Citywide Map of Reported Drainage Concerns and Flood Insurance Claims

5.1 Project Identification Key Terms and Definitions

The following is a list of common terms and definitions utilized to define a stormwater project:

- **Structure**: Residential, commercial or industrial insurable buildings (excludes sheds, outbuildings, and other structures that are not habitable).
- **Structural Flooding:** Flooding from the public right of way which causes structures to flood. This does not include lot-to-lot flooding that is not caused by water leaving the public right of way. The limits of structural flooding are determined from reported or observed flooding, flood insurance claims and engineering analysis from the Watershed Study Program or Localized Flooding Analysis.
- **Non-Structural Flooding:** Non-Structural Flooding includes impacts to streets and roadways.
- **Critical Areas:** Critical areas include critical infrastructure such as hospitals and schools that would be severely impacted by a flood. This also includes identified Repetitive Loss Areas with substantial flood insurance loss claims and are identified in the City's adopted Repetitive Loss Area Analysis for mitigation.
- **Public Infrastructure**: Public infrastructure includes roadways located within the public right of way and the City's water, sewer and stormwater infrastructure.
- **Downstream Impacts:** The limits of projects take into consideration other reported drainage issues downstream of the project area. Drainage issues can include the structural condition of roadway and stormwater infrastructure and additional structural flooding. All downstream impacts must be mitigated prior to constructing improvements within an identified project area.
- **Upstream Impacts:** The limits of projects take into consideration reported drainage issues located upstream of the project areas to identify whether additional improvements can be incorporated into the project to mitigate flooding.

5.2 Flood Mitigation Project Identification

Flood mitigation project locations are identified with the following objectives:

- Reduce or prevent flood damages to structures and contents.
- Reduce the flood risk to human health and safety associated with inundation, high velocities and/or overtopping of roadways and bridges.
- Reduce flood damages to public facilities, such as roads, bridges, utilities and critical facilitates within the City.
- Reduce the public and private costs associated with flood fighting and recovery.
- Reduce business and commercial losses resulting from a loss of production and/or economic activity due to flooding.
- Improve the overall health, safety and quality of life of all residents of Arlington.

5.2.1 Project Size Categories

The Watershed Study Program and Localized Flooding Analysis identified and evaluated stormwater issues across the City. Each of these efforts utilized engineering analysis to determine the severity of each issue and determine potential flooding impacts and project sizes. Project size is assessed during the prioritization process so that projects with similar levels of needs can be compared with one another. This approach limits larger scale projects from taking the priority over smaller scale projects

and vice versa. It allows for the Stormwater Capital Program to simultaneously address a variety of flood mitigation needs across the City. This section includes a general description of the flood mitigation project size categories.

Small Localized Drainage Projects

Small localized drainage projects are in areas with limited stormwater infrastructure and require minor infrastructure improvements to mitigate flooding. These improvements typically do not require a downstream impact evaluation. Improvements include, but are not limited to, minor storm drain and inlet construction, roadway curb and gutter repair, and limited ditch grading.

Medium Localized Drainage Projects

Medium localized drainage projects are typically located in areas with limited stormwater infrastructure. Mitigation in these areas could include, but is not limited to, extending storm drain lines, repairing existing infrastructure, performing grading within ditches and channels. These projects typically do not require extensive upstream or downstream improvements to construct the project.

Large Localized Drainage Projects

Large localized drainage projects are typically located in areas with either no stormwater infrastructure or undersized infrastructure. Mitigation in these locations could require significant improvements both upstream and downstream of the identified problem areas. These projects typically require a conceptual design phase that will evaluate several project alternatives to develop the most cost-effective solution that meets State and Federal requirements. Construction for these projects typically occurs over multiple phases.

Watershed Projects

Watershed projects are large-scale mitigation projects that are typically located along a creek or stream. These projects have been identified through the Watershed Study Program and include reach-based solutions to mitigate flooding along roadways and neighborhoods located within the FEMA-mapped floodplain. Typical improvements can include, but are not limited to, culvert and bridge upsizing, regional detention, and large channel improvements that need to be constructed before other flood mitigation projects can be constructed within the watershed.

5.2.2 Identifying Unreported Flooding Locations

The Localized Flooding Analysis also developed a simplified methodology to evaluate areas that have not reported flooding to the City but may have some level of flood risk. This methodology was tested in four locations in east Arlington are limited flooding and drainage concerns were reported to the City.

This methodology will be utilized to further investigate each area for possible infrastructure maintenance needs or public education and outreach. Locations that are identified to have a significant flood risk will be prioritized for future flood mitigation project evaluation based upon the results of the analysis.

5.3 Identified Flood Mitigation Project Areas and Voluntary Buyout Locations

Using the results of all data gathered, nearby drainage issues were grouped together to form project areas. This includes combining Watershed Projects with Localized Drainage Projects of all sizes. The Comprehensive Stormwater Plane identifies 38 Watershed Projects, 63 Localized Drainage Projects and 367 Voluntary Buyouts to help mitigate flooding across the City. Figure 5.3 shows the locations of these known project areas.

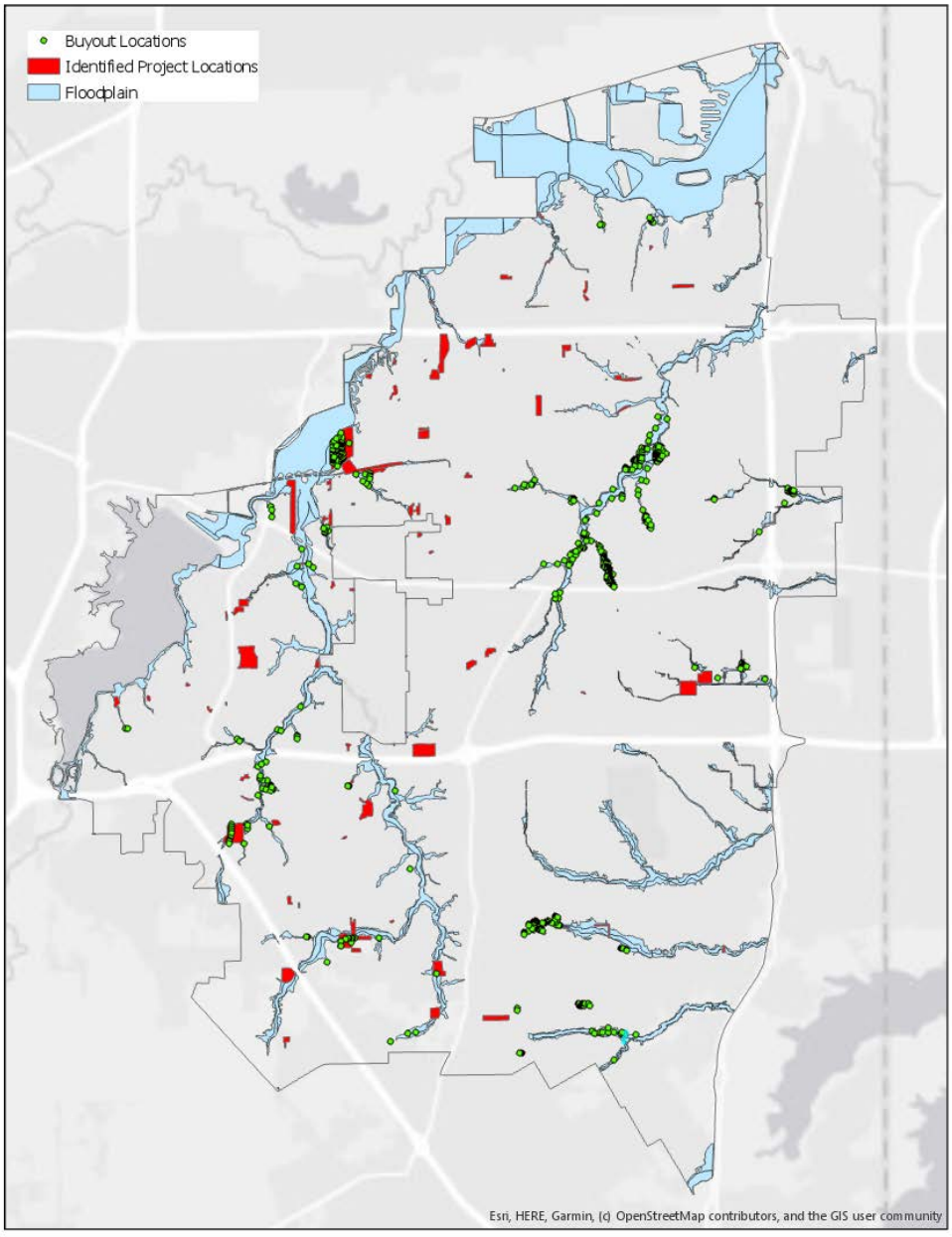

Figure 5.3 Identified Flood Mitigation Project Areas and Voluntary Buyout Locations

5.4 Infrastructure Maintenance Project Locations

Infrastructure maintenance projects address failing or inadequate stormwater infrastructure including pipes, channels, bridges, outfalls, etc. Maintenance projects that have been elevated to the capital program are either too large to be completed by Stormwater Field Operations or are necessary to mitigate a flooding or erosion issue. Typical reasons for infrastructure replacement projects include end-of-life replacement or repairs due to structural damages.

Infrastructure maintenance projects are identified through GIS analysis, routine inspections and reports from citizens. Chapter 2 Asset Management describes the GIS tracking and inspections used to determine the need to repair or replace infrastructure. The City also investigates reports of infrastructure not properly functioning to identify possible asset repair or replacement projects.

Infrastructure maintenance project locations are identified with the following objectives:

- Correct ongoing maintenance issues with stormwater system infrastructure.
- Repair structural deficiencies to stormwater system infrastructure.

5.5 Erosion Mitigation Project Locations

Erosion in streams is a natural process that is not mitigated by the City unless it is threatening public infrastructure such as bridges, roadways or utility lines. Erosion mitigation to protect private property is the responsibility of private property owners. Erosion mitigation is sometimes completed as part of flood mitigation or infrastructure maintenance projects to mitigate downstream impacts.

Streams throughout the City have undergone a desktop geomorphological assessment. Geomorphology is the study of landforms and their processes. They have been assigned Bank Erosion Hazard Index (BEHI) scores and classified and mapped in GIS as highly unstable, moderately unstable, moderately stable or highly stable. Stream stability ratings are primarily based on steepness of streambanks and vegetation coverage. Approximately 8.6% of Arlington's 129 miles of streams and channels are currently rated severely unstable.

Erosion can occur quickly, so erosion-related drainage concerns are typically identified following severe rain events when a large amount of erosion is observed or reported to the City. Erosion projects are also identified through flood mitigation and infrastructure maintenance projects.

Erosion mitigation projects locations are identified with the following objectives:

- Address immediate threat to public infrastructure adjacent to severe stream-bank instability.
- Reduce sediment erosion and improve water quality.
- Prevent future downcutting and widening of the channel to protect public infrastructure.

5.6 Project Identification Recommendations

The City offers the following recommendations to ensure the projects identified as part of the Comprehensive Stormwater Plan are up to date and reflect existing system conditions:

- Perform a basic level of service assessment on all storm drain systems that do not have reported flooding and assess criticality and flood hazards based upon results.
- Review and update as needed all Watershed Master Plans and Localized Drainage Analysis on a 5-year cycle.
- Review Flood Insurance Claims data annually and update Repetitive Loss Area Analysis (RLAA) Plan as needed.
- Assess Overall Condition Index for all stormwater asset types and identify appropriate maintenance needs.

Chapter 6: Data-Driven Prioritization Framework

The City cannot support the repair of all stormwater issues at one time due to a limited number of funds available, limited staffing resources and public inconvenience and safety considerations. For these reasons, identified projects must be prioritized to give the City a strategic approach to capital improvements. A prioritization methodology was developed to set priorities on a worst-first basis to implement the Stormwater Capital Improvement Program (CIP). The City evaluated a prioritization framework to appropriately weight each criteria. The prioritization criteria are intended to be a tool that can be used as a screening mechanism for City staff. These ranking systems were specifically developed for capital projects proposed as part of the City's ongoing Comprehensive Stormwater Plan.

6.1 Project Prioritization Key Terms and Definitions

Once a project has been identified, it is analyzed to help determine how it should be prioritized within the Stormwater Capital Program. Prioritization of projects generally depends on the probability and consequences of flooding or failure of infrastructure. Flood mitigation, infrastructure maintenance and erosion mitigation projects depend on different factors to determine the probability and consequence of flooding or failure on infrastructure. Other factors beyond stormwater can also affect project prioritization. These other factors include, but are not limited to regulatory needs, health and safety concerns, and other capital improvement projects for streets and water utilities.

The following is a list of terms and definitions utilized to prioritized stormwater projects:

- **Flood Frequency**: Flooding limits are assessed at the 5-, 25- and 100-year storm events. Flooding that occurs during a five-year storm event is classified as more frequent flooding and is assessed a higher priority while flooding.
- **Level of Service**: Level of service is defined as the maximum capacity that stormwater infrastructure can convey before structural or nonstructural flooding occurs.
- **Probability of Failure:** The probability of failure takes into consideration the physical condition of stormwater infrastructure in a project area. It is based upon routine inspections outlined in Chapter 2 Asset Management. It places a higher priority on infrastructure that has structurally failed or is nearing failure over infrastructure that is in good condition.
- **Criticality Ratings**: Not all assets within the City's stormwater system are equally critical to the system's overall ability to function. Criticality is determined based upon several criteria, including, but not limited to, quantity of flow, amount of flow leaving the right of way, transportation and business impacts, environmental impacts, public safety impacts and difficulty of repairs. An asset's criticality takes into consideration the probability of failure and what is impacted from system failure. Stormwater assets that are assessed a higher criticality require more attention to protect public health, safety and welfare.

6.2 Flood Mitigation Projects

During the process of evaluating all of the projects that have been identified in the Localized Drainage Analysis and the Watershed Study Program, the City identified four scoring categories for flood mitigation projects. These categories include Flood Rating, Infrastructure Rating, Stream Condition Rating and Other Project Rating.

6.2.1 Flood Rating Category

Flood mitigation projects are primarily prioritized based on the frequency of flooding and the extent of what is flooded. Residential and commercial structures as well as overtopped roadways receive a higher priority because of the potential impacts flooding could cause to the overall community. The scoring criteria for both Localized Drainage and Watershed project types include a consideration of the following:

- Number of structures determined to be at risk of flooding.
- Frequency of flooding.
- Capacity of the existing stormwater infrastructure.
- Amount of runoff that exceeds the stormwater infrastructure capacity.
- Depth of flooding in projects located in predominately riverine areas.
- Roadway flooding which may limit emergency access or result in unsafe driving conditions.

6.2.2 Infrastructure Rating Category

The condition of the surrounding stormwater infrastructure is also rated during prioritization to identify infrastructure criticality and probability of failure in both Localized Drainage and Watershed project types. The scoring criteria for all project types included an assessment of the following:

- Culvert, bridge and storm drain infrastructure conditions based upon inspection data and frequency of maintenance work orders. Higher priority is placed upon project areas with frequent maintenance issues or deficiencies identified during routine inspections.
- Road Overall Condition Index within the project area is averaged for a project area. Higher priority is placed on areas with a significant number of Red Streets impacted by flooding.
- Criticality of all stormwater infrastructure in the project area. Priority is placed on infrastructure where its failure could have significant impacts to public safety.
- Criticality of roadway flooding impact in the area. The highest priority is placed on project areas that would result in an area having no reasonable detour or emergency access during a flood. Priority is also placed on roadways with higher traffic volume.

6.2.3 Stream Condition Rating Category

Stream condition rating is only taken into major consideration for Watershed project types. These projects typically are constructed within areas that can directly impact a stream's overall condition and function. The Localized Drainage project categories does incorporate the immediate stream condition while determining if it is a small, medium or large project. Stream condition ratings include:

- The Overall Condition Index of concrete lined channels. Priority is placed on channels in need of repair.
- The Bank Erosion Hazard Index for natural creeks, channels and streams. Priority is placed upon reaches that are more unstable or in need of emergency repairs.
- The criticality of the concrete channel or natural creek. Higher priority is placed on reaches where there is a significant threat to public safety should failure occur.

6.2.4 Other Project Rating Category

Other project rating for Localized Drainage and Watershed project types evaluates other scheduled capital improvements such as roadway, water and sanitary sewer improvements. Project areas identified through the Roadway, Water and Drainage Committee are given a higher priority to coordinate design and construction efforts.

Downstream and upstream impacts are also considered in this category. Higher priority is given to projects that can mitigate flooding in multiple areas or projects that need to be constructed before constructing improvements in other areas.

Environmental impacts are also taken into consideration for both project types. Higher priority is given to projects that provide potential benefit to restore natural areas or help litter and debris from entering the stormwater system.

6.3 Infrastructure Maintenance Projects

Infrastructure maintenance prioritization is based on necessary preventative maintenance and safety concerns.

The probability of failure is represented as a condition score (OCI) in the City's asset management program (Cartegraph) as detailed in Chapter 2 Asset Management. That score is based on:

- Life expectancy of the overall asset.
- Life expectancy of the material components of the asset.
- Findings from inspection data when available.
- Maintenance records.

The consequence of failure for assets is based on:

- Number of structures in the area determined to be at risk of flooding.
- Roadway flooding which may limit emergency access or result in unsafe driving conditions.
- Design storm and flow capacity the asset was designed to carry.
- Criticality of asset as part of the stormwater system.

6.4 Erosion Mitigation Projects

Erosion mitigation projects protect public infrastructure that cannot be easily relocated. These projects are typically prioritized based on the immediacy of the threat.

Erosion projects are prioritized based on:

- The probability of erosion is based on stream stability ratings.
- The consequence of erosion is based on proximity of the public infrastructure within the erosion clear zone.

Projects that stabilize streams must be carefully evaluated to ensure they do not create erosive conditions or increase flooding outside of the project area. Natural streams and channels benefit the ecosystem, improve water quality and absorb runoff throughout their floodplains to mitigate flooding. Erosion mitigation that involves hard armor solutions such as retaining walls or concrete channels can

disrupt natural stream process. They can also potentially move erosive conditions or flooding to other areas upstream or downstream of the project area if not designed and constructed carefully.

Erosion mitigation is completed as part of other capital projects when necessary.

6.5 Voluntary Flood Buyout Program

The City's Voluntary Flood Buyout Program acquires and demolishes structures that have been flooded or have been identified through the Watershed Study Program to have a severe flood risk. A prioritized buyout plan was developed using the results from the City's Watershed Study Program. Each watershed study identified potential flood prone structures for the buyout program with a high flood risk. The City analyzed each identified property buyout using FEMA's HAZUS tool to determine the potential structural damage costs caused by flooding in the 25-year and 100-year storm events. Buyouts were ranked based upon the level of flood risk, total costs of structural damages and the likelihood of recovery.

The likelihood of recovery was determined based upon the total cost of structural damages compared to the market value of each structure. The City's Flood Damage Prevention Code requires any structure within the FEMA-mapped floodplain that has been damaged over 25% of the structures market value be updated so it meets the City's current Flood Damage Prevention Code requirements. In many of the identified buyout properties, this would require the property owners to elevate the buildings two feet above the ultimate base flood elevation. This is often cost prohibitive for the property owner to do and hinders the ability to recover from a flood.

A total of 72 buyouts were prioritized and incorporated into the Stormwater 10-year Capital Program Plan. Cost estimates for the capital plan included acquisition, abatement, demolition and site restoration costs.

6.6 Project Prioritization Recommendations

The prioritization of eligible projects is completed by City staff. Project type categories include riverine, localized, voluntary buyouts and maintenance. Projects will be evaluated and scheduled on a worst-first approach with an emphasis on making downstream improvements prior to upstream improvements.

In general, it is recommended that each project must meet the following criteria:

- Address public health, safety and welfare.
- Reduce frequency of flooding and other associated flood hazards.
- Meet City, State, and Federal stormwater regulations.
- Benefit the local watersheds and stormwater assets.
- Gain neighborhood support.
- Generate opportunities to improve the overall stormwater system.

Chapter 7: Capital Improvement Program

The City's Stormwater Capital Improvement Program (CIP) addresses a wide range of drainage challenges which mostly stem from an aging system built prior to modern stormwater design standards. This Stormwater CIP addresses significantly undersized and inadequate storm drainage systems throughout the City. Capital projects include flooding and erosion data collection and analysis, flood mitigation and erosion projects, flood mitigation buyouts, major infrastructure maintenance and miscellaneous additional services. The Capital Improvement Program does not include operational expenses. Operational expenses are approved in a separate budget process in October of every year.

The Long-Range CIP shown in Appendix A of this plan identifies the City's prioritized stormwater capital improvement needs for FY 2021 to FY 2031. The CIP is the primary tool for implementing the Comprehensive Stormwater Plan. By providing funding for these capital improvements, the Stormwater CIP helps ensure the level of service for stormwater infrastructure is improved or maintained in a manner consistent with Council priorities and City design standards. It is a result of the strategies outlined in the previous chapters of this plan where stormwater projects have been identified, evaluated and prioritized on a worst-first approach. A summary of Stormwater Program Funding needs is included in Chapter 8.

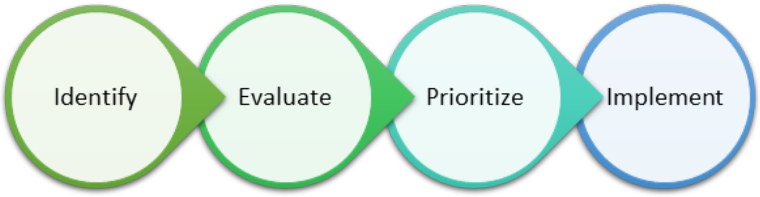

Figure 7. Capital Improvement Program Process

7.1 Capital Improvement Project Implementation

Once the Capital Improvements Program budget is approved each fiscal year, it is implemented throughout the year. New design contracts are typically negotiated prior to capital program approval so projects can begin immediately once the budget is approved. The approval of the annual program also releases capital funds for construction, right of way acquisition, buyouts and other miscellaneous capital program related expenses. Those funds are utilized when they are needed. Typical stormwater capital projects progress from conceptual design through construction.

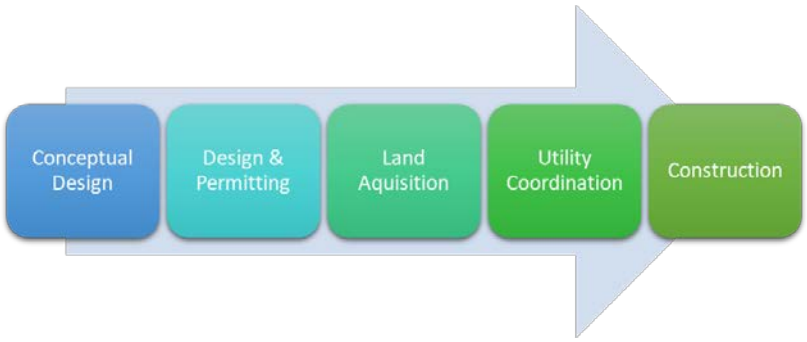

Figure 7.1 Capital Improvement Project Implementation Process

7.1.1 Conceptual Design

Conceptual Design is either completed as part of a design contract or as a standalone contract. Determination of whether conceptual design is completed prior to a final design contract depends on the complexity of the drainage problem, the potential for downstream impacts, the size of the project and whether there are multiple alternative solutions to the drainage problem. A pre-design conceptual analysis can help determine the most cost-effective solution to mitigate flooding and erosion if there are many unknowns or potential construction phases because of a project's size or downstream impacts. It can also help to determine total cost of a project or the appropriate sequencing of project phases which will help refine future capital improvement program planning.

If the conceptual design is completed as part of a larger design contract, then it is the phase where potential conflicts and new infrastructure alignments are determined. During this phase, cost estimates are refined and the need for additional right of way or easements is determined. Conceptual designs often need to consider land acquisition, future maintenance and operation costs in addition to construction costs.

This project phase also typically includes public involvement to receive feedback to ensure the project fully addresses the public drainage issue and to ensure the City understands the public concerns and project constraints. Project stakeholders can include other departments, neighborhood associations, business owners and private property owners. Public involvement can include online questionnaires, public meetings and/or mailed informational flyers.

7.1.2 Design

Design includes the development of plans for construction. Designs are completed in accordance with the City Design Criteria Manual. Often projects accomplish multiple goals across different departments within the City, so they are jointly managed and funded. Even when projects are not jointly funded, they can require coordination and review by other departments and divisions to ensure consistency for all City infrastructure. Coordination with franchise utility operators also occurs during this phase.

Design includes consideration of regulatory requirements, permitting, need for land acquisition, utility conflicts and estimated cost. Stormwater-specific design must include hydrology and hydraulic design to ensure stormwater infrastructure is properly sized as well as to ensure flood projects do not negatively affect the mapped regulatory floodplain.

Public communication during design includes updates typically sent in information flyers but can also include communication with specific property owners affected by the project such as property owners with existing easements, property owners involved in land acquisition negotiations, and property owners that have been adversely affected by the drainage issue the City is working to resolve. Communication for projects can also include the use of social media.

7.1.3 Land Acquisition

Land Acquisition typically begins halfway through design. Property owners with existing easements are notified of improvements within the easement but are not compensated for the use of that property. Portions of properties essential to construction or access a project can be acquired as right of way, permanent easements or temporary easements. Stormwater projects rarely require the acquisition of permanent public right of way. Permanent easements are acquired when the area will contain a permanent drainage feature such as a pipe or flume. Temporary easements are acquired when an area is needed for access, additional room for construction, or a staging and storage area for equipment and materials.

These areas are identified during design. Permission is obtained from private property owners to access their property to create an easement document with metes and bounds. A fair market value offer (typically determined by a property appraisal completed by a licensed professional) is made to the property owner, and a value for the land is negotiated. In rare cases, the City is forced to use eminent domain to obtain easements.

Properties with easements are restored to like or better condition after construction if possible. If the project involves the acquisition of permanent easements that result in a loss of property value, then they are compensated for that loss during the negotiation process.

7.1.4 Utility Coordination

Franchise utilities obtain permits to locate facilities within the City's rights of way and easements. Franchise utilities are utilities owned and operated by private companies such as AT&T, Atmos and Oncor. At times, the construction of new stormwater infrastructure can require the relocation of these facilities. Depending on the location of the utilities, relocation is sometimes performed at the cost of the City. Utility coordination typically includes obtaining information about the location of franchise utilities, transmittal of preliminary design plans for franchise utility review and notification of the need to relocate facilities prior to construction.

7.1.5 Construction

The construction phase includes bidding, construction and a two-year warranty period. Once design, permitting, land acquisition and utility relocation are complete, a project can be advertised for bid. Stormwater projects typically are awarded to the lowest qualified bidder through a traditional bidding process. Contractors are pre-qualified through a City process to ensure that stormwater infrastructure is built by contractors with experience building the type of facilities in the project. Some of the more frequently used pre-qualification categories include stormwater pipe, concrete structures, modular block walls and stream stabilization.

Once a project has been awarded, both a City pre-construction meeting and a public meeting are held to introduce the contractor to the City and neighborhood stakeholders. The public

meeting is an opportunity to ensure the public understands the project goals and phases of construction.

After construction is complete, contractors provide a two-year warranty on work completed.

7.2 Other Capital Needs

In addition to the capital projects, there are also other capital investments the City makes to improve the City's stormwater systems.

7.2.1 Annual Stormwater Maintenance Contracts

As infrastructure continues to age, it will need to be maintained or replaced. The City currently responds to stormwater infrastructure failures as they are discovered. The reactive and urgent nature of these repairs typically have higher costs to the City. The annual stormwater maintenance contracts listed in the capital plan include work that is too large for the City's Field Operations crews to perform. These annual maintenance contracts include:

- Annual Miscellaneous Concrete
  This includes funding to repair and replace stormwater infrastructure made of concrete.

- Annual Pipe Maintenance
  This includes funding to repair and replace storm drain pipes too large for the City's Field Operations crews to perform.

- Annual Bridge Maintenance
  This includes funding for the design and construction costs to remediate the bridge deficiencies identified by TxDOT in the Bridge Deficiency List.

- Annual Channel Maintenance
  This includes funding the costs associated with remediating channel maintenance issues, such as channel embankment failures from erosion, channel access issues and repairing damages the channel has sustained from any source.

- Annual City-Owned Pond Dredging Program
  Dredging requires specialized equipment and expertise. This funding is for the survey, design and dredging activities to maintain appropriate sediment levels within the 29 City-Owned ponds. An inventory of the City-Owned ponds is included in Chapter 2 Asset Management.

- Annual Ditch Maintenance
  The capital program currently has costs associated with specific ditch construction projects identified after the Fall 2018 floods. Other ditch projects have been prioritized in the plan. In anticipation there will be future ditch repair needs, an annual ditch program is shown to begin in FY 2026 in the Stormwater Capital Improvement Program for FY 2021 to FY 2031. This is after the ditch projects currently identified in the Stormwater CIP have been constructed.

7.2.2 Annual Stormwater Infrastructure Evaluations and Storm Drain System Rehabilitation

Storm drain systems can experience deterioration throughout the length of the system. This includes longitudinal cracking or exposed reinforcement in the concrete. These deficiencies do not need immediate attention but, if left unattended, will cause future system failure. For storm drain systems that require structural rehabilitation for the entirety of the pipe, the City can rehabilitate the pipe before full failure occurs.

Rehabilitation methods vary depending on the size and material of the storm drain. The location and method of the storm drain rehabilitation work will vary based upon the results of the CCTV inspections described in Chapter 2 Asset Management. The capital program includes annual contracts to obtain CCTV inspections and Annual Pipe Maintenance.

7.2.3 Annual Stormwater Engineering and Professional Services Contracts

Annual engineering and professional services contracts provide capital program support by performing work City Staff is not able to perform due to workload or is too small a project area to include in a major capital design and construction project. These annual engineering and professional services contracts include:

- Development Review (Flood Study and Detention Analysis)
  This includes funding for a contract that supports stormwater review for proposals submitted to the Planning and Development Services Department for new development projects.

- Stormwater Review and Watershed Model Maintenance
  These contracts include the work to review engineering models the City currently does not own the software to. The watershed model maintenance includes work to perform periodic updates to the watershed models developed in the Watershed Study Program. This is to ensure the long-term quality of the data being supplied to the public for use.

- Stormwater CIP Services
  This includes funding for an engineering services contract to perform design work on small-scale capital projects that require infrastructure repair for locations needing immediate attention to ensure the system is fully restored.

- Survey and Elevation Certificates Contract
  This is to perform the stormwater related survey work not able to be handled by the City's surveying staff due to workload issues. This includes a variety tasks including but not limited to, easement preparation, field survey for small maintenance projects, obtaining elevation certificates for City properties and post-flood, high-water mark surveys.

7.2.4 Flood Monitoring System Annual Program

The Flood Monitoring System currently consists of six stream and rain gauges that were installed in 2006 in the Rush Creek and Johnson Creek watersheds. The City is

prioritizing expanding the system so all the major watersheds are monitored. This is important for emergency operations planning as well as public education for flooding issues. This capital investment includes the equipment upgrades necessary to ensure the existing gauges continue to function properly as well as the system expansion to achieve full citywide coverage.

7.2.5 Internal Charges

The Stormwater CIP includes costs to annually participate in contracts that support the construction projects administered by the Public Works and Transportation Department. The Construction Materials Testing and Geotechnical Services contract includes the third-party materials testing required to ensure construction meets City standards. The Irrigation annual contract includes work associated with the irrigation relocation, tree removal and grass replacement services in and around construction projects.

Internal charges are also included in the Stormwater CIP. This is to fund the chargebacks for the work for construction inspection, real estate services and other related work performed by other City department for any capital project.

7.2.6 Voluntary Flood Buyout Program

A total of 72 flood-prone properties have been prioritized for the voluntary acquisition and demolition for the FY 2021 to FY 2031 Stormwater CIP. The City is planning to gradually begin acquiring these prioritized properties starting in FY 2022.

7.3 Capital Improvements Program Recommendations

The City offers the following recommendations to continue to improve the development of a comprehensive Capital Improvements Program:

- Program capital projects into yearly plans based on project prioritization and areas of emphasis, such as the Roadway, Water and Drainage coordinated projects.
- Establish a proactive annual stormwater capital maintenance program to identify and plan for small drainage improvements and infrastructure repairs too large for the City's field operations staff to complete.
- Establish a proactive storm drain system rehabilitation program focused on identifying and repairing storm drains with adequate stormwater conveyance capacity but are reaching the end of their life cycle.

Chapter 8: Stormwater Program Funding

The total Stormwater Program costs addressed in the Comprehensive Stormwater plan include the cost of capital projects, cost to maintain and operate the system, and the cost to ensure the City's compliance with regulatory requirements. Table 8.1 summarizes the expected expenditures by each fiscal year based upon programming identified in this plan.

Table 8.1 Estimated Stormwater Program Costs FY 2021 to FY 2031

FISCAL YEAR	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Stormwater Utility Fee Rate	$7.50	$7.50	$7.50	$7.50	$7.50	$7.50	$7.50	$7.50	$7.50	$7.50	$7.50
Estimated Stormwater Revenue	$22,364,159	$21,055,402	$21,215,951	$21,317,407	$21,362,373	$21,529,252	$21,562,152	$21,745,016	$21,841,068	$21,936,440	$21,997,365
Estimated Program Expenditures											
Billing Service: Water & Sewer Fund	$170,122	$170,122	$170,122	$170,122	$170,122	$170,122	$170,122	$170,122	$170,122	$170,122	$170,122
Capital Reimbursement to General Fund	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
PDS Chargebacks for SW Plan Review	$88,699	$88,699	$88,699	$88,699	$88,699	$88,699	$88,699	$88,699	$88,699	$88,699	$88,699
To Debt Service Fund - TMRS Reimbursement	$140,683	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Indirect Costs to General Fund	$578,959	$578,959	$578,959	$578,959	$578,959	$578,959	$578,959	$578,959	$578,959	$578,959	$578,959
Transfer to Pay Go Capital Fund	$11,000,000	$9,300,000	$9,000,000	$8,700,000	$8,200,000	$7,800,000	$7,200,000	$6,800,000	$6,300,000	$5,800,000	$5,200,000
Estimated Programs Subtotal	$11,978,463	$10,137,780	$9,837,780	$9,537,780	$9,037,780	$8,637,780	$8,037,780	$7,637,780	$7,137,780	$6,637,780	$6,037,780
Estimated Stormwater Operating Expenses											
Administration & Engineering	$1,821,714	$1,858,148	$1,895,311	$1,933,217	$1,971,882	$2,011,319	$2,051,546	$2,092,577	$2,134,428	$2,177,117	$2,220,659
Payment In Lieu of Taxes	$661,371	$661,371	$661,371	$661,371	$661,371	$779,719	$779,719	$779,719	$779,719	$779,719	$779,719
Estimated Debt Service	$4,336,737	$4,710,447	$5,070,390	$5,426,209	$5,802,068	$6,213,872	$6,658,443	$7,138,112	$7,629,930	$8,153,754	$8,709,938
Field Operations Expenses	$1,917,393	$1,955,741	$1,994,856	$2,034,753	$2,075,448	$2,116,957	$2,159,296	$2,202,482	$2,246,531	$2,291,462	$2,337,291
Environmental Compliance Expenses	$1,112,660	$1,134,913	$1,157,611	$1,180,764	$1,204,379	$1,228,467	$1,253,036	$1,278,097	$1,303,659	$1,329,732	$1,356,326
Education & Outreach Expenses	$131,920	$134,558	$137,250	$139,995	$142,794	$145,650	$148,563	$151,535	$154,565	$157,657	$160,810
Estimated Operating Expenditures Subtotal	$9,981,795	$10,455,178	$10,916,789	$11,376,309	$11,857,942	$12,495,984	$13,050,603	$13,642,520	$14,248,833	$14,889,440	$15,564,743
Estimated Expenditures Total	$21,960,258	$20,592,958	$20,754,569	$20,914,089	$20,895,722	$21,133,764	$21,088,383	$21,280,300	$21,386,613	$21,527,220	$21,602,523
Projected End of Year Balance	$403,902	$462,443	$461,382	$403,318	$466,651	$395,488	$473,769	$464,715	$454,455	$409,220	$394,841
Estimated Pay Go Capital Funds	$11,000,000	$9,300,000	$9,000,000	$8,700,000	$8,200,000	$7,800,000	$7,200,000	$6,800,000	$6,300,000	$5,800,000	$5,200,000
Estimated Stormwater Bond Fund Needs	$8,870,000	$6,125,000	$5,825,000	$7,550,000	$9,450,000	$8,440,000	$9,145,000	$8,235,000	$8,960,000	$9,630,000	$12,445,000
Total Capital Budget	$19,870,000	$15,425,000	$14,825,000	$16,250,000	$17,650,000	$16,240,000	$16,345,000	$15,035,000	$15,260,000	$15,430,000	$17,645,000

Appendix A – Stormwater Projects List and Capital Improvement Program

Appendix B – Stormwater Management Program (Environmental Management)