LAKE LUCILE: LAKE MANAGEMENT PLAN

Wasilla, Alaska

Prepared For:
The City of Wasilla

Prepared By:
AWR Engineering, LLC

June 2020

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Definitions for Common Terms and Acronyms Used in this Plan

ACWA – Alaska Clean Water Actions Program

ACWF – Alaska Clean Water Fund

ADEC – Alaska Department of Environmental Conservation

ADF&G – Alaska Department of Fish and Game

ADOT&PF or DOT&PF – Alaska Department of Transportation and Public Facilities

ADWF – Alaska Drinking Water Fund

Bioretention – A soil and plant-based stormwater facility that captures, treats, and either infiltrates stormwater or filters it and sends it downstream to a receiving system.

BMP – Best Management Practice. BMPs are structural, vegetative, or managerial practices used to treat, prevent, or reduce stormwater pollution.

Drainage Area or Drainage Basin – The surface area that contributes stormwater runoff to a specified point of interest.

EPA – Environmental Protection Agency

First Flush -- A small, common rain event or the first portion of a large rain event. These events cleanse the ground surface, moving pollutants into the stormwater system.

GIS – Geographic Information Systems

Heavy Metals – In this Plan, heavy metals refers to lead, copper, and zinc.

Impervious Surface – A hard surface such as asphalt or concrete that prevents the infiltration of stormwater into the soil.

Infiltration – The percolation of water from the land surface into the ground.

MSB – Matanuska Susitna Borough

OGS – Oil and Grit Separator

Outfall – A point where piped stormwater flows into a receiving water body.

PAHs – Polycyclic Aromatic Hydrocarbons

Remedial Action Facility – A facility intended to reduce pollutants entering Lake Lucile.

Storm Drain – A subsurface pipe that collects excess stormwater and usually conveys it to a receiving water body.

Stormwater – Surface water runoff from rainfall and snowmelt.

1. Introduction and Background

Lake Lucile is a freshwater lake located in the heart of Wasilla, Alaska within the Matanuska-Susitna Borough (MSB). This valuable aquatic resource occupies approximately 365 acres and is fairly shallow with depths ranging from five to 20 feet. The lake is primarily groundwater fed and does not have a natural surface water inflow source such as a creek or stream. The lake is the headwaters of Lucile Creek, which flows out of the lake on the western side. The water surface elevation of the lake is controlled by a small dam with an overflow weir. Lake Lucile is regularly stocked with rainbow trout and coho salmon for sport fishing, and is used for other recreational activities such as canoeing and swimming.

Lake Lucile also receives stormwater runoff from surrounding areas. The Lake Lucile drainage basin is approximately 3,000 acres and consists of a mixture of commercial, industrial, and residential land uses. Much of the basin's land cover is low density residential land, characterized by disconnected impervious areas with substantial vegetation remaining. The most densely developed portion of the Lake Lucile basin is the approximately 235 acres located north of the lake along the Parks Highway. This area includes approximately two miles of the Parks Highway, the commercial developments that abut the Parks Highway, and downtown Wasilla. Stormwater runoff from this area enters Lake Lucile via two stormwater outfalls that discharge into the lake, known as the east outfall and the west outfall.

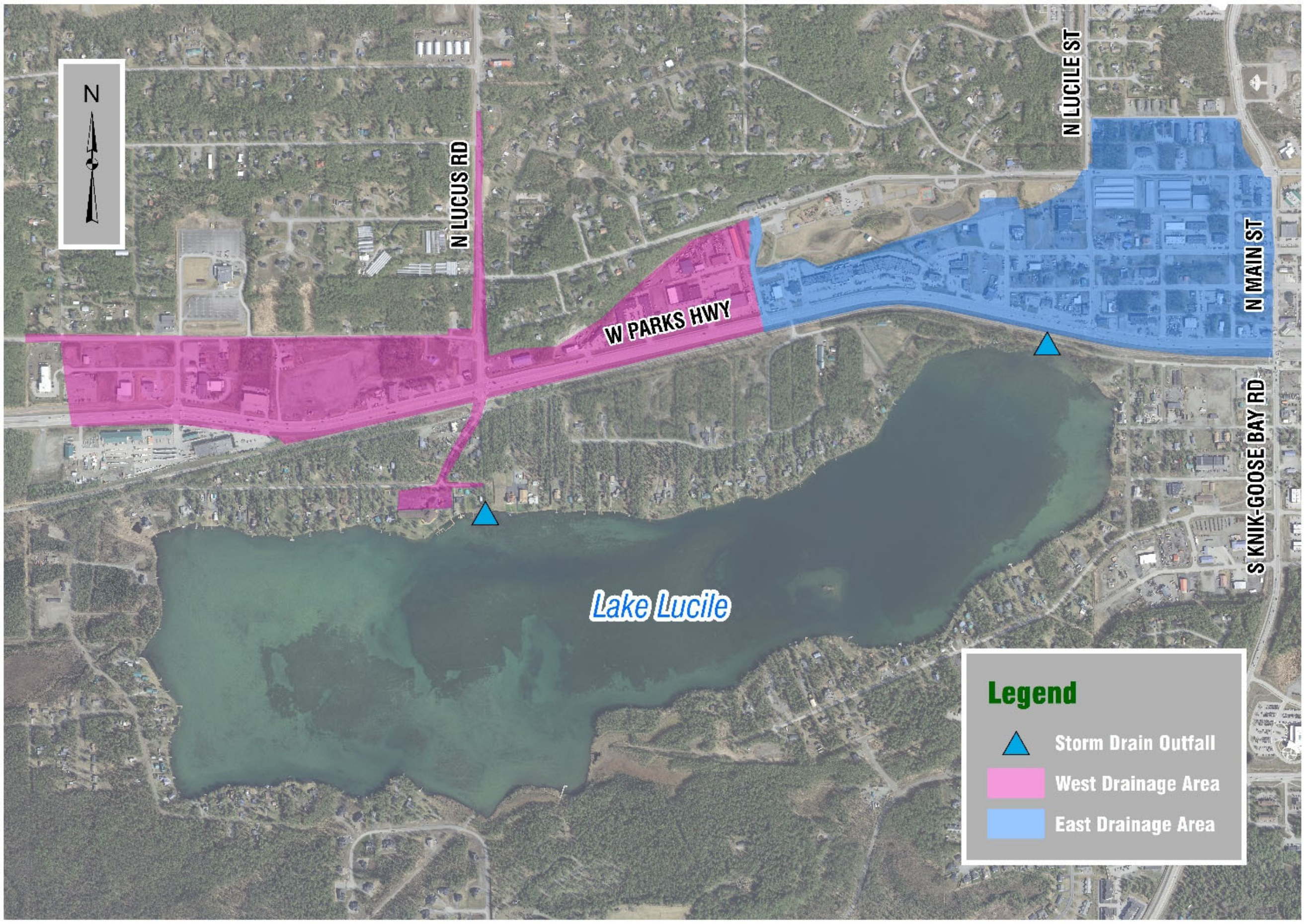
The location of the lake, the two outfalls, and the more densely populated 235 acres around the Lake are shown in Figure 1.

1.1. Project Purpose and Objectives

The water quality of Lake Lucile has been an ongoing concern for many years. The Alaska Department of Environmental Conservation (ADEC) completed sediment sampling around the two stormwater outfalls and determined that the lake bed sediments contain high amounts of heavy metals (lead, copper, and zinc) and polycyclic aromatic hydrocarbons (PAHs). As is common for urban pollutants, the pollutants in the lake were found to be bound to sediment particles. The pollutant concentrations were observed to be highest in the immediate vicinity of the outfalls, indicating that sediments associated with stormwater runoff are bringing pollutants into Lake Lucile.

This Lake Management Plan (Plan) was developed as part of a joint effort between the City of Wasilla (City) and ADEC. The purpose of this Plan is to identify opportunities to improve the quality of Lake Lucile by removing pollutants from stormwater before stormwater is discharged into the lake.

Figure 1: Project Vicinity and Primary Drainage Areas



1.2. Pollutant Sources and Mobilization

The pollutants of concern for this Plan are primarily sediment-bound lead, copper, zinc, and PAHs. These pollutants can come from a variety of sources associated with urban activity including the following:

- Corrosion of metals such as steel and aluminum (zinc)
- Corrosion of galvanized surfaces such as roofing, gutters, fencing, tanks, etc. (zinc)
- Hydraulic fluids (zinc)
- Particulates from wear on brake pads and other vehicle components (lead, copper)
- Tire wear and material breakdown (PAHs, zinc)
- Vehicle exhaust from some vehicles (PAHs)
- Deteriorating asphalt (PAHs)
- Asphalt sealants (PAHs, zinc, copper)
- Motor oils (PAHs)
- Use or disposal of pressure-treated wood (copper)
- Breakdown of stored materials such as tires, paints, scrap metal, etc.

In most cases, heavy metals and PAHs in stormwater runoff are generated from impervious surfaces, especially runoff from commercial and industrial surfaces that are directly connected to the piped stormwater system. Pollutants from these surfaces are usually mobilized by a rainfall “first flush” which is either a small, common rain event or the first portion of a large rain event. These small rain events cleanse the ground surface, moving pollutants into the stormwater system.

Based on this understanding of how stormwater pollutants are generated and mobilized, stormwater pollutants entering Lake Lucile are expected to be primarily linked to the 230 acres of dense development in close proximity to the lake. These surfaces are readily contributing stormwater runoff to the lake, and opportunities for remedial action facilities were focused in these areas. (See Figure 1.)

The further reaches of the drainage area, such as the low density residential areas, are not expected to be contributing notable quantities of pollutants to the lake because 1) these areas are not likely to contribute stormwater to the outfalls under smaller rain events that mobilize most pollutants and 2) features such as yards and roadside channels minimize amount of directly connected impervious surfaces.

1.3. Pollutant Impacts

High concentrations of heavy metals and PAHs degrade the quality of Lake Lucile and can cause many types of adverse biological effects to fish including reduced abundance, increased mortality, increased genetic defects, and behavioral changes, such as delayed response to avoid predators. These pollutants also impair the water clarity of the lake and reduce the lake’s level of dissolved oxygen. Reducing the concentrations of heavy metals and PAHs through stormwater treatment is expected to lessen these adverse impacts and promote a healthy water quality of the lake.

2. Data Sources and Limitations

Information and recommendations in this Plan were developed based on observations from site visits and on available information regarding stormwater system configuration, area topography and drainage patterns, location of utilities, future projects in the drainage area, and land availability. Several of these data sources and their associated limitations are discussed below.

- Topography and Aerial Imagery. Area topography and aerial imagery was obtained from the 2011 MSB LIDAR data. This information was used to determine surface drainage patterns and characterize area land use.
- Existing Stormwater Systems. Information regarding the location and connectivity of existing stormwater systems was obtained from a combination of as-built drawings, local knowledge from the City, observations based on site visits, and Google Street View imagery.
- Utilities. Information regarding the type and location of existing utilities was not readily available for the sites discussed in this project. Limited information was obtained from as-built drawings, local knowledge from the City, visual observations from site visits, and Google Street View imagery.

- Future Projects. Information regarding future projects in the area, specifically the Wasilla Main Street project, was obtained from the project website and from information provided to the design team by the Alaska Department of Transportation and Public Facilities (DOT&PF).

- Land Availability. Land ownership and availability was based on local knowledge from the City and on the MSB parcel lines, obtained through the MSB Geographic Information System (GIS) server.

- EPA National BMP Database. This database provides information regarding the performance of many types of stormwater treatment facilities in removing various types of pollutants. This database was used to characterize the potential pollutant removal performance of the facilities presented in this Plan.

3. Area Drainage Patterns

The primary focus area for this project is divided into the east and west drainage areas based on locations contributing stormwater runoff to the east and west stormwater outfalls, respectively. Existing drainage patterns in these areas are shown in Figures 2 and 3 and are described below.

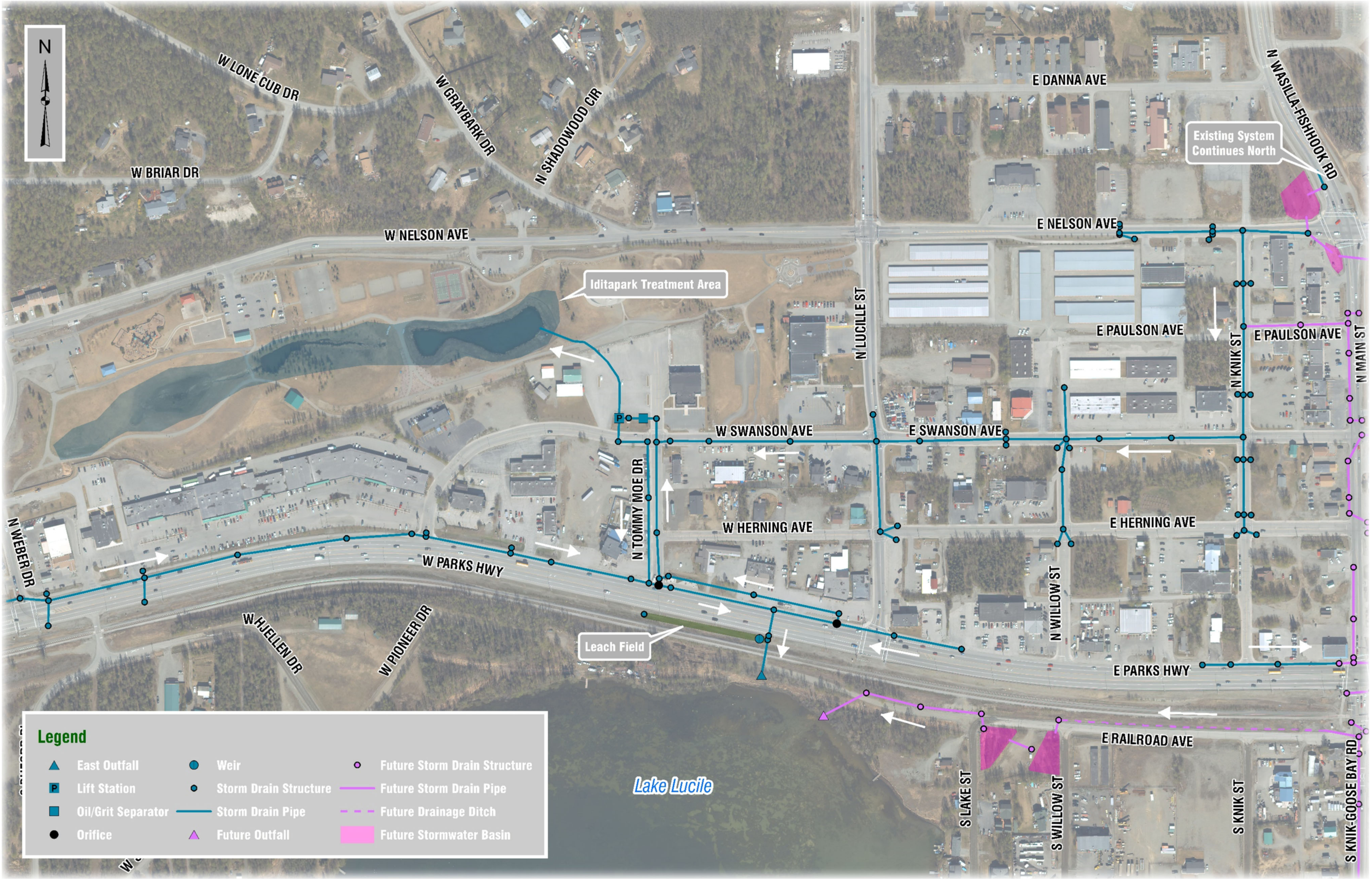
3.1. East Drainage Area

The east drainage area is approximately 125 acres, and drainage patterns in this area are shown in Figure 2. The east outfall area includes downtown Wasilla and the industrial development along the Parks Highway to Weber Drive.

Downtown Drainage and Iditapark System. In the downtown Wasilla area, surface water runoff from local streets and surrounding properties is collected in storm drain pipes and directed to the west toward Tommy Moe Drive. An existing pump station at the corner of Tommy Moe Drive and Swanson Avenue collects this stormwater, provides primary treatment through several oil and grit separators, and then pumps the stormwater to an existing treatment and retention area referred to throughout this plan as the Iditapark stormwater system. This system consists of several treatment facilities operating in series. Water is discharged from the storm drain force main into a lined detention and settling pond for initial treatment and sediment removal. The pond then discharges water into a large bioretention area that provides opportunity for additional settling of sediment, infiltration of water, and detention of peak flows. The bioretention area is connected to a second pond that provides additional storage and infiltration opportunities. Under very high stormwater flows, the Iditapark system is allowed to safely overflow onto Weber Drive where water enters a storm drain inlet and directed toward the Parks Highway.

Parks Highway Drainage. Surface water runoff from the parks Highway and surrounding developed areas is collected in a storm drain system in the Parks Highway right-of-way and directed generally toward Tommy Moe Drive. Near Tommy Moe Drive, there are two flow control manholes with internal orifices that are intended to direct low flows from smaller rain events into the storm drain on Tommy Moe Drive and eventually into the Iditapark treatment system while allowing higher flows to bypass the Tommy Moe system and continue directly to Lake Lucile.

Figure 2: Drainage Patterns in the East Drainage Area



3.2. West Drainage Area

The west drainage area is approximately 110 acres, and drainage patterns in this area are shown in Figure 3. The west drainage area generally includes the Parks Highway from Weber Drive to just west of Deskas Street as well as developments adjacent to the highway on the north side. The area also includes a portion of Lucus Road and Deskas Street.

There is an existing storm drain system along the Parks Highway near Lucus Road and along Lucus Road itself. This system collects stormwater runoff from the area and directs it south toward the west outfall. Some of the stormwater is collected in grass-lined ditches prior to entering the storm drain system, which may allow for some treatment opportunities. There is an existing oil and grit separator located downstream (south) of the Parks Highway that may also be providing treatment of stormwater before stormwater enters Lake Lucile. However, the unit is relatively old and is understood to be unmaintained, so its treatment effectiveness is not known.

3.3. Future Wasilla Main Street Project

DOT&PF is currently planning to reconstruct Main Street in Wasilla and change the local the traffic pattern to be a one-way couplet to improve area traffic congestion. Southbound traffic will utilize Main Street and Knik-Goose Bay Road, and northbound traffic will utilize new extensions of Talkeetna Street and Yenlo Streets. The project is also proposing changes to area drainage patterns and installing new drainage infrastructure, including new storm drains both north and south of the Parks Highway. The proposed storm drain along Talkeetna Street is planning to discharge stormwater into nearby Wasilla Lake, and stormwater collected along Main Street is proposed to discharge into new stormwater infiltration ponds near Bogard Road. The proposed storm drain along Knik-Goose Bay Road is planned to discharge into a new stormwater infiltration basin close to Lake Lucile. This basin is expected to capture and infiltrate flows up to the 50-year event. Higher stormwater flows will be discharged into Lake Lucile via a new outfall to be constructed near the existing east outfall.

The improvements associated with the Wasilla Main Street project are not expected to notably increase the stormwater discharge into Lake Lucile and do not impact the recommendations associated with this Plan.

Figure 3: Drainage Patterns in the West Drainage Area

4. Stormwater Treatment Facilities

This Plan has identified several types stormwater treatment facilities that are expected to work well for removing the pollutants of concern in the Lake Lucile drainage area. Section 4 of this Plan introduces the proposed new facilities, discusses how they work to remove pollutants, and discusses their pollutant removal effectiveness. Section 5 of this plan discusses specific locations where these facilities are proposed to be used in the Lake Lucile drainage area.

Because the pollutants of concern in Lake Lucile are bound to sediment particles, recommendations presented in this Plan are focused on facilities that can remove sediment from stormwater runoff.

4.1. Bioretention Swales

Biorientation swales are landscaped areas of topsoil and vegetation that are designed to capture, treat, and either infiltrate stormwater or filter it and send it downstream to a receiving system. Bioretention is sometimes called “biofiltration” or “rain gardens” depending on the facility configuration and features. Bioretention facilities are one of the most versatile and adaptable stormwater treatment tools available. They can take almost any shape and can be adapted to a wide range of environmental conditions through selection of site-appropriate vegetation and drainage features. A bioretention swale typical section is provided in Figure 4.

Bioretention facilities can also be configured for site-specific needs, such as allowing water to enter the facility below grade to maximize the infiltration and treatment potential. This concept is utilized for two sites discussed in Section 5. A combination bioretention/infiltration swale typical section is shown in Figure 5.

4.1.1. Functionality

Stormwater runoff can enter a bioretention swale either via overland flow from adjacent surfaces or via a curb cut or other opening along an urban street. Once in the facility, stormwater percolates through a layer of engineered top soil, which is a combination of sand and organic material, to filter the stormwater and remove sediments and associated pollutants. Depending on the infiltrative capacity of the native soils, excess water can then infiltrate into the existing subgrade, or it can be collected in a subdrain pipe and returned to the stormwater collection system.

The primary treatment mechanism of bioretention is sediment removal through filtration and infiltration. However, stormwater captured in the pores of the engineered soil is also utilized by the facility vegetation, providing additional disposal of soluble pollutants through plant uptake.

Bioretention facilities are usually designed to capture and treat flows from small, frequent rain events that mobilize the most pollutants. As such, they should be designed with a safe bypass or overflow for larger rain events.

4.1.2. Pollutant Removal Performance

Pollutant removal data presented in this Plan is based on data from the EPA’s National BMP Database. This database provides performance data for stormwater treatment facilities based on the results of site-specific testing. The database was used to generate a list of bioretention sites that were tested for their ability to remove total suspended solids, lead, copper, and Zinc. The results are compiled and summarized in Table 1 below. Additional details including a list of the sites used to create this table are provided in Appendix A.

Table 1: Pollutant Removal Performance for Bioretention Swales

TSS			Lead			Copper			Zinc		
Min	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**
41%	84%	100%	26%	69%	94%	26%	53%	82%	36%	72%	94%

It should be noted that actual facility performance will vary based on a number of factors including facility size, design rain event, the size of the contributing basin, and the incoming pollutant concentrations. The information presented in Table 1 is expected to be a good average representation of bioretention performance. To maximize performance, bioretention facilities should be designed in accordance with reliable engineering design criteria. To avoid overloading the facility, it is important to ensure that the facility is not too small for the contributing drainage basin. This will also help minimize the frequency of required maintenance.

The EPA database did not provide specific information about the performance of bioretention swales related to the removal of general PAHs. However, PAHs in stormwater adhere readily to sediment particles, and a strong facility performance for sediment removal is expected to also result in PAH removal.

Figure 4: Bioretention Swale Typical Section

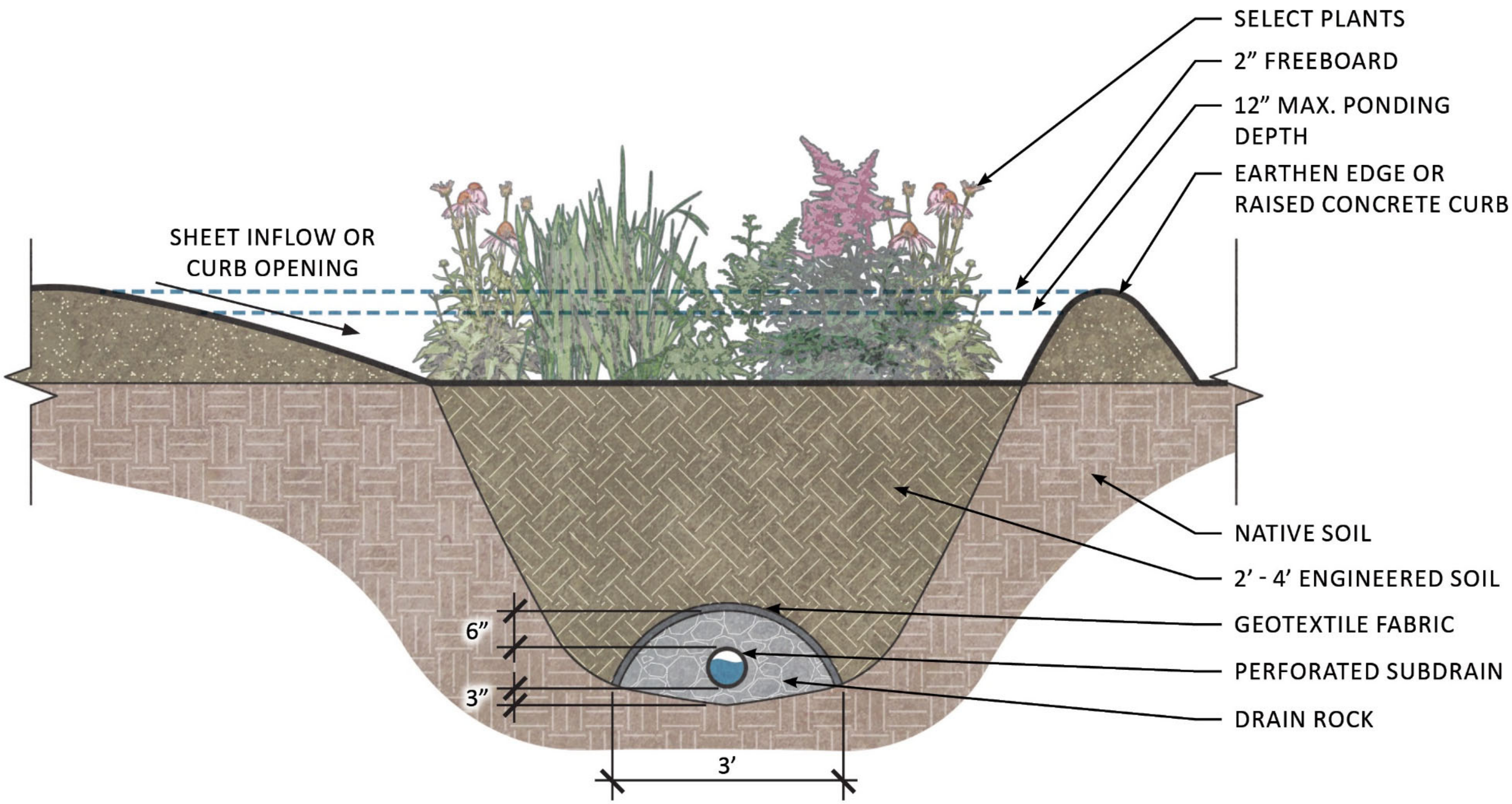
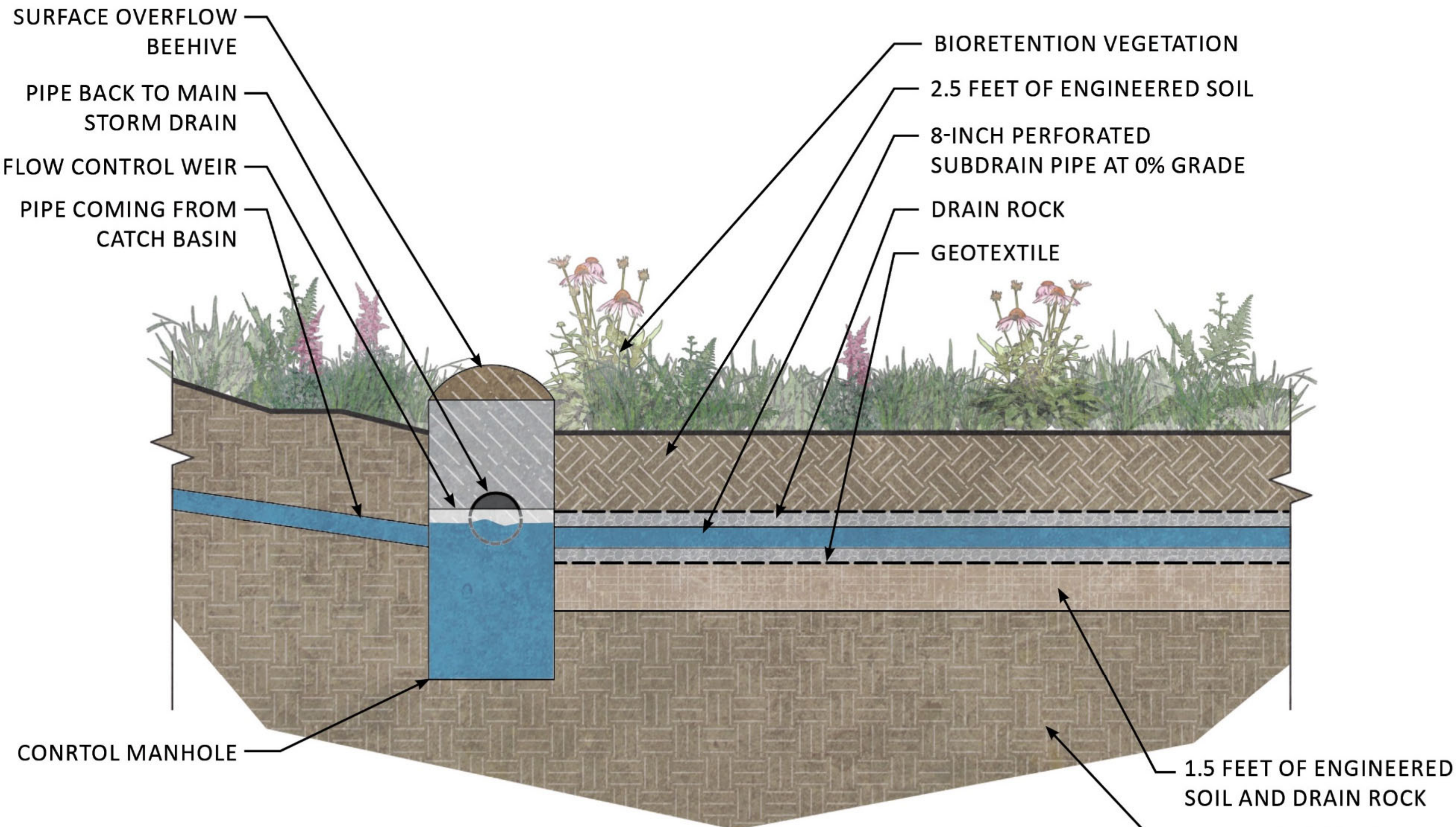


Figure 5: Bioretention/Infiltration Swale Typical Section



NOTES:

1. PERFORATED SUBDRAIN WILL DISTRIBUTE INCOMING FLOWS TO THE FACILITY DURING LOW FLOW EVENTS. DURING HIGH FLOW EVENTS, THE SUBDRAIN WILL ALLOW WATER TO FLOW BACK TO THE CONTROL MANHOLE IF THE LOWER PORTION OF THE FACILITY BECOMES SATURATED.
2. THE CONTROL WEIR WILL ALLOW WATER TO RETURN TO THE STORM DRAIN SYSTEM DURING HIGHER FLOW EVENTS. THE ELEVATION OF THE CONTROL WEIR TO BE SET DURING DETAILED DESIGN.

4.2. Enhanced Vegetated Ditches

Enhanced vegetated ditches, also known as grass swales, are intended to provide both stormwater treatment and conveyance. While there are many characteristics that are similar to bioretention swales, the primary difference is the ability of the vegetated ditch to also provide conveyance for large storm events. Vegetated ditches are often utilized for roadways with rural cross sections where stormwater is collected in roadside ditches instead of in curbs and gutters. An enhanced vegetated ditch typical section is shown in Figure 6.

4.2.1. Functionality

Stormwater generally enters a vegetated ditch through direct runoff from an adjacent surface, usually a roadway. Vegetated ditches are a type of bioretention facility, and they have many of the same features. The bottom of the facility is comprised of engineered soil and the facility is vegetated, usually with type of grass or other seed mix that will not require mowing. Water that enters the ditch is conveyed slowly along the ditch flow line, allowing time for water to percolate into the engineered soil and into the subgrade below. Earthen check dams are often used in vegetated ditches to help slow the flow from small rain events while allowing heavier flows to overtop and continue safely downstream. A subdrain is optional based on site characteristics.

Similar to bioretention swales, vegetated ditches provide stormwater treatment primarily through settling, filtration, and infiltration.

4.2.2. Pollutant Removal Performance

Table 2 presents the pollutant removal data from the EPA's National BMP Database for grass swales. (The database is discussed in more detail in Section 4.1.2.) Additional details including a list of the sites used to generate this table is provided in Appendix A.

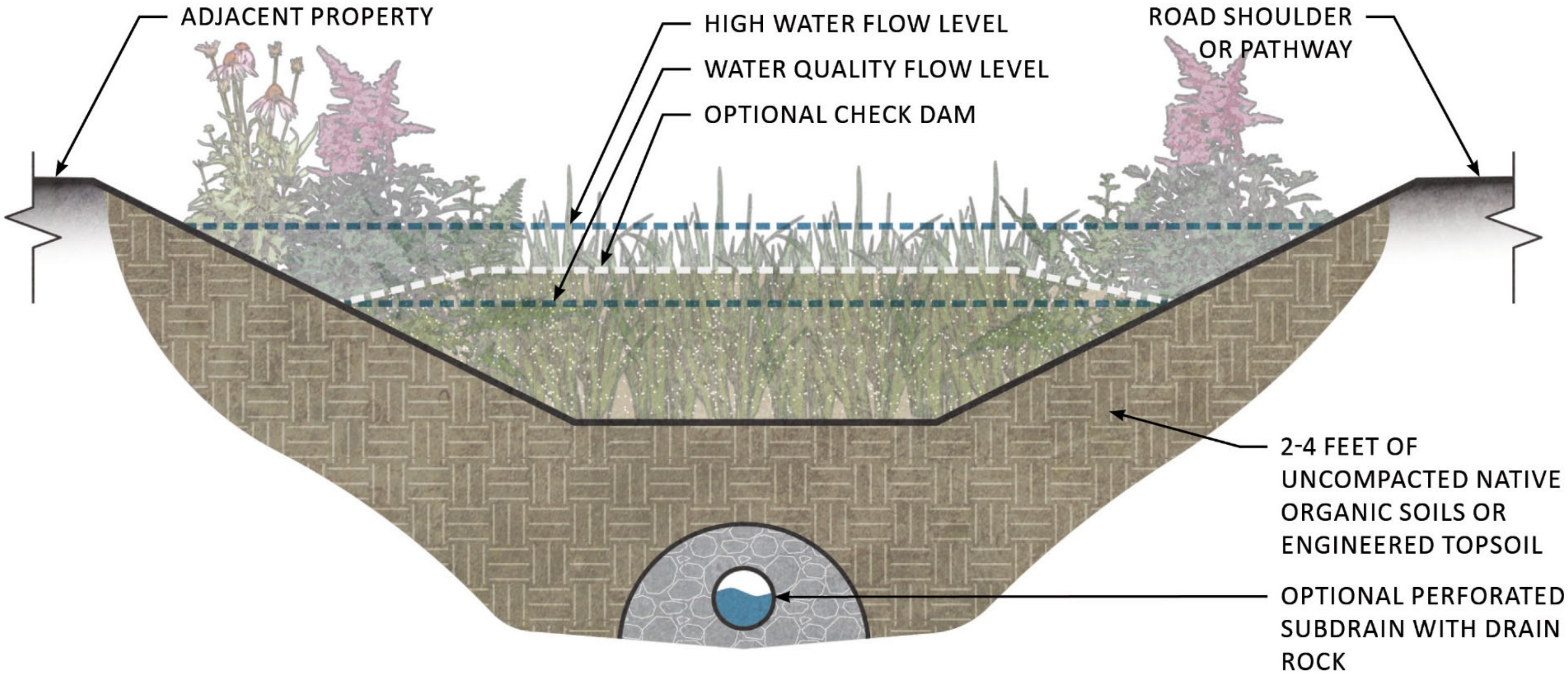
Table 2: Pollutant Removal Performance for Vegetated Ditches (Grass Swales)

TSS			Lead			Copper			Zinc		
Min	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**
18%	**47%**	**70%**	26%	51%	74%	13%	43%	65%	11%	48%	87%

The performance of vegetated ditches can be maximized by ensuring the facility is well-designed and not overloaded. Utilizing features like check dams to maintain slow flow velocities is important for stormwater treatment.

The EPA database does not provide information about the performance of vegetated ditches related to removal of general PAHs. However, PAHs in stormwater adhere readily to sediment particles, and a strong facility performance for sediment removal is expected to also result in PAH removal.

Figure 6: Enhanced Vegetated Ditch Typical Section



4.3. Constructed Wetland

Constructed wetlands are designed to treat stormwater runoff by mimicking the conditions of natural wetlands. Constructed wetlands generally include a low marsh area that remains permanently inundated as well as a high marsh area that is inundated intermittently as water levels fluctuate. There are many types of constructed wetlands, and the wetland proposed for the Lake Lucile drainage area is called a pocket wetland. It provides low marsh in the form of sinuous channel and high marsh surrounding the channel. A typical section for the constructed wetland is provided in Figure 7.

4.3.1. Functionality

The pocket wetland is intended to be an end-of-pipe treatment facility, and water enters the wetland via a pipe or open channel. The primary treatment mechanism is sedimentation through settling, but additional treatment may be provided through decomposition and chemical transformation in the wetland environment. The facility is generally only practical in locations where the groundwater is close to the surface such that the wetland can contain a permanent pool of water. The pocket wetland is not typically able to treat or attenuate large volumes of stormwater, so heavy flows are designed to safely overflow or bypass the wetland.

4.3.2. Pollutant Removal Performance

The EPA's National BMP Database provides performance information for various types of constructed stormwater wetlands. Table 3 presents the pollutant removal data for wetland channels, as it was closest type of wetland to the proposed pocket wetland. (The EPA database is discussed in more detail in Section 4.1.2.) Additional Details including a list of the sites used to generate this table is provided in Appendix A.

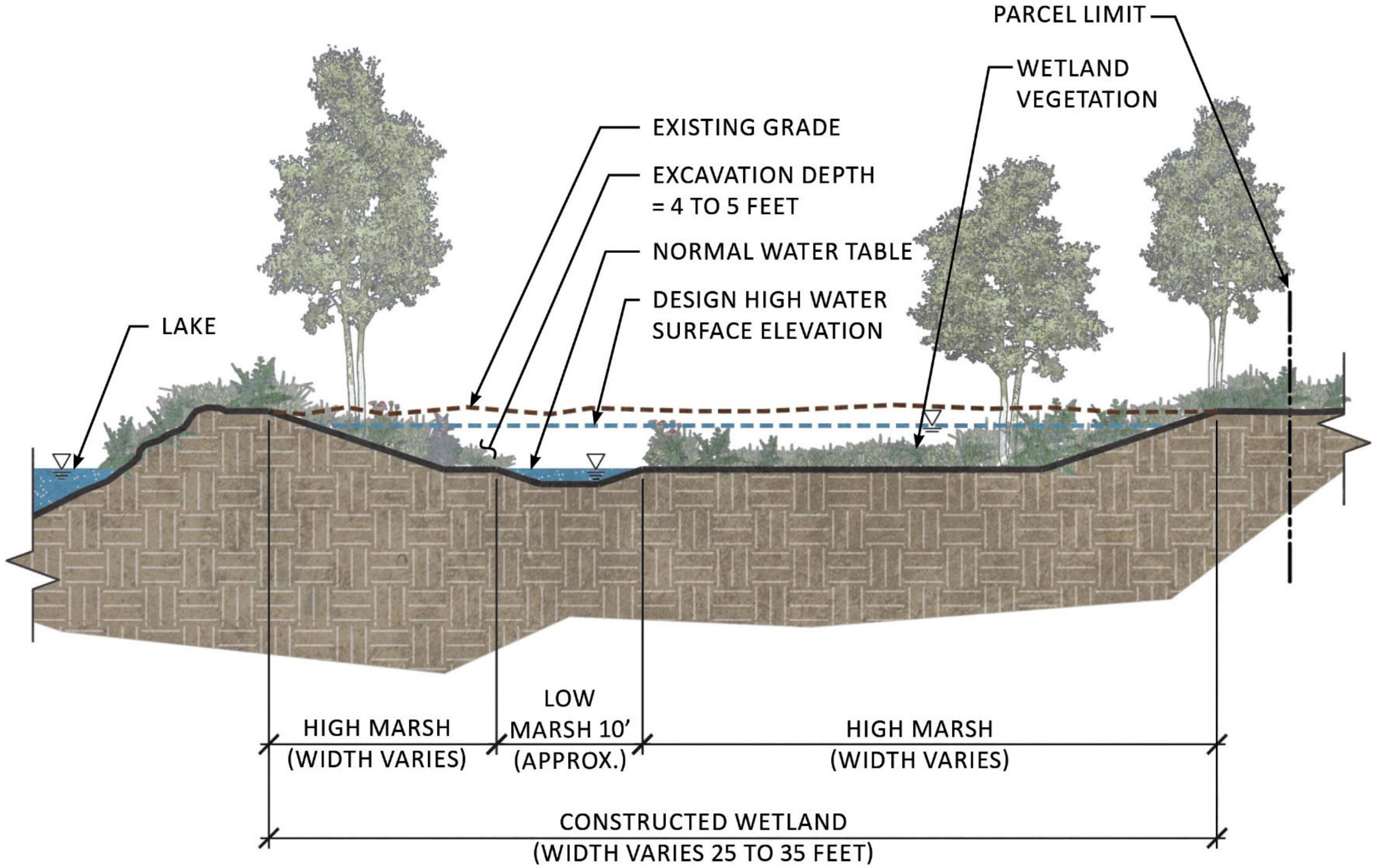
Table 3: Pollutant Removal Performance for Pocket Wetland (Wetland Channel)

TSS			Lead			Copper			Zinc		
Min	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**
21%	50%	79%	19%	47%	70%	13%	32%	53%	33%	46%	60%

The performance of the constructed wetland can be maximized by following good design practices. These include providing a variety of wetland-appropriate vegetation, configuring the wetland geometry to maximize treatment opportunities, utilizing forebays at the facility entrance to capture the initial sediment load and allow for easy sediment removal, following appropriate sizing techniques, and minimizing opportunities for public access to the facility to avoid damage to the vegetation.

The EPA database does not provide information about the performance of constructed wetlands related to removal of general PAHs. However, PAHs in stormwater adhere readily to sediment particles, and a strong facility performance for sediment removal is expected to also result in PAH removal.

Figure 7: Constructed Wetland Typical Section



4.4. Oil and Grit Separators

Oil and Grit separators (OGS) remove stormwater pollutants through mechanical removal of sediment and suspended oils. There are many OGS manufacturers that provide a wide range of facility types, sizes, and performance capabilities.

4.4.1. Functionality

OGS units are typically designed as part of a piped storm drain system, and they are housed in a manhole structure. The structure size varies depending on the unit selected, the required treatment flow rate, and the necessary sediment storage capacity. OGS units are typically designed to treat runoff from smaller events and allow larger flows to bypass the unit without resuspending the collected sediments.

4.4.2. Pollutant Removal Performance

The EPA's National BMP Database provides performance information for OGS units. This information is summarized in Table 4 . Additional Details including a list of the sites used to generate this table is provided in Appendix A. It should be noted that performance information may also be available from the manufacturer once a specific unit has been selected to meet the needs of the site.

Table 4: Pollutant Removal Performance for Pocket Wetland (Wetland Channel)

TSS			Lead			Copper			Zinc		
Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
24%	49%	88%	20%	45%	94%	13%	39%	67%	22%	37%	55%

The EPA database does not provide information about the performance of OGS units related to removal of general PAHs. However, PAHs in stormwater adhere readily to sediment particles, and a strong facility performance for sediment removal is expected to also result in PAH removal.

5. Proposed Remedial Actions

This project has identified 10 locations for remedial actions/facilities in the Lake Lucile drainage area that are expected to improve the quality of stormwater entering Lake Lucile. An overview of the proposed facilities is provided in Figure 8, and each site is discussed in the following subsections.

For each site discussed in this Plan, preliminary facility sizing was completed using sizing equations (where applicable) and available site information. Where site information was not available, such as infiltration capacity of the native soils or the area groundwater elevation, preliminary assumptions were made to approximate facility footprints. In many cases, the footprints were maximized based on available land space to promote treatment capacity and minimize the frequency of facility maintenance. Adjustments to the final design sizes of the facilities may be needed based on site-specific data.

Figure 8: Overview of Proposed Remedial Action Facilities

5.1. Retrofit Manholes on the Parks Highway

5.1.1. Overview

This improvement would retrofit the two existing control manholes on the Parks Highway to either remove the control orifices completely or provide larger orifices to allow higher volumes of stormwater to be treated by the existing Iditapark system instead of bypassing and flowing directly to Lake Lucile. (These manholes are discussed in Section 3.1.) This proposed remedial action is shown in Figure 9 and facility information is summarized in Table 5.

Table 5: Retrofit Manholes on the Parks Highway

Location	Parks Highway and Tommy Moe Drive
Land Ownership	DOT&PF right-of-way
Facility Type	Retrofit of existing structures
Drainage Area Size	N/A
Estimated Cost	$2,500
Recommended Maintenance Activities	None required. Optional visual monitoring of existing Tommy Moe storm drain and Iditapark system.

5.1.2. Details and Key Considerations

The surface of the Parks Highway supports significant volumes of vehicular traffic and is expected to be a primary contributor of stormwater pollutants into Lake Lucile. This retrofit would utilize existing stormwater treatment facilities to provide treatment for higher quantities of stormwater runoff from the Parks Highway surface. This is a low cost remedial action that has the potential to notably improve stormwater quality.

Based on as-built information, the two control manholes restrict flow to the Tommy Moe system via a 4-inch orifice (eastern manhole) and a 6-inch orifice (western manhole). Depending on the City's preference, these orifices could be completely removed or they could be increased to a larger diameter. The pipes downstream of the orifices are both 18-inch diameter. At the eastern manhole, the main flow pipe along the Parks Highway is also an 18-inch diameter pipe. At the western manhole, the main flow pipe on the Parks Highway is a 54-inch diameter pipe. It is recommended that a visual inspection of the manholes be completed to confirm the pipe and orifice sizes prior to removing the orifice plates.

This remedial action would send more stormwater into the Tommy Moe storm drain system, into the existing pump station and associated oil grit separators, and into the existing Iditapark stormwater system. (This system is discussed in Section 3.1.) A capacity analysis of these facilities has not been completed, but the City owns and maintains the facilities and has expressed support for utilizing them to a higher degree. This City noted that the oil grit separators are expected to be under-utilized, and the Iditapark system has only been known to overflow only once during a very heavy rainfall.

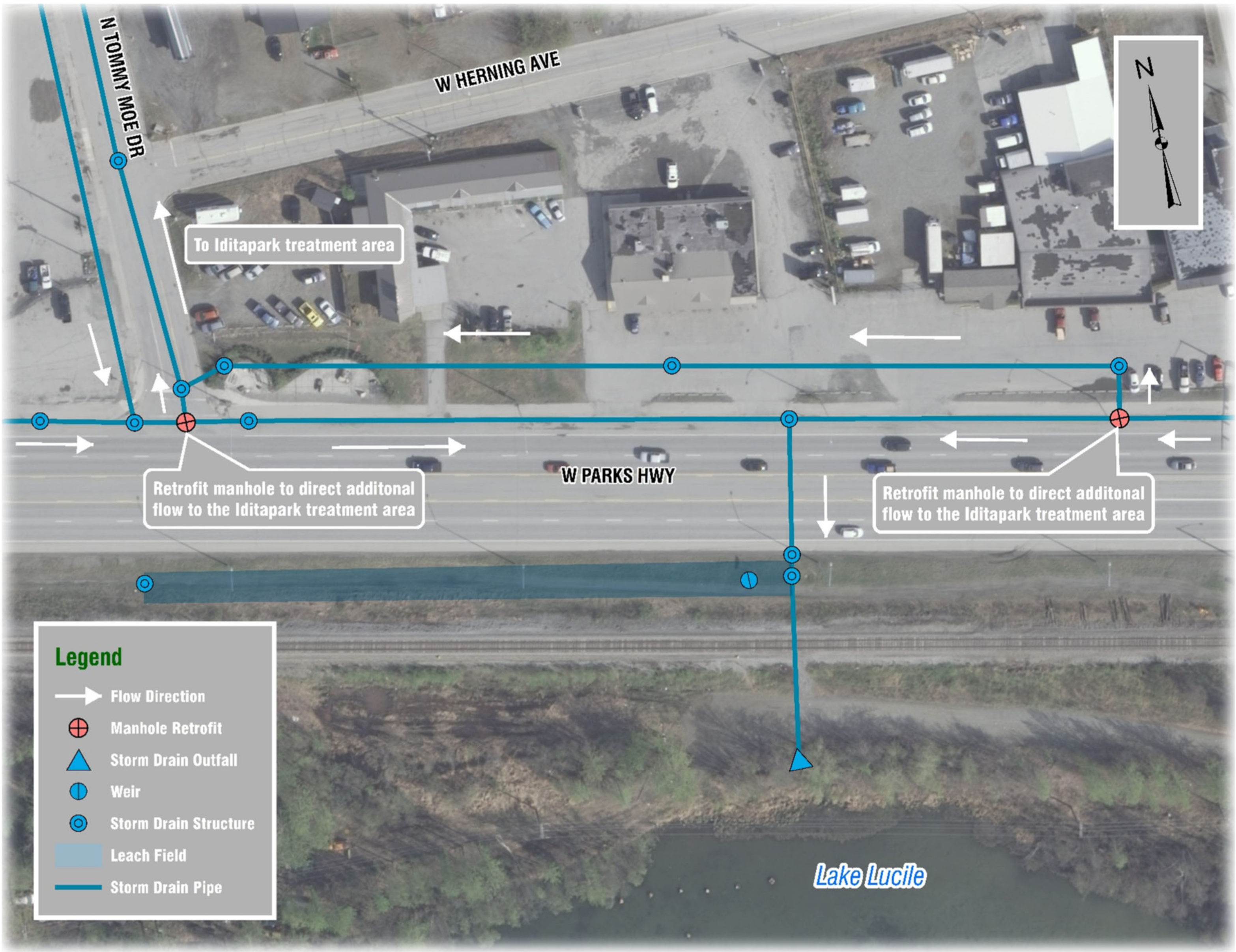
Both manholes are owned by DOT&PF. Approval and access coordination will be needed prior to implementation.

<u>Facility Cost</u>. If City maintenance crews do the work for this action, the overall cost would be negligible.

Timeline: Planned project timelines are discussed in Section 7.

Recommended Maintenance Activities. This proposed remedial action would not require any direct maintenance. Increased or more frequent maintenance of the Iditapark system may be required. The City could consider visual monitoring of the Tommy Moe and Iditapark systems to ensure that those facilities do not become overloaded. If capacity proves to be a concern, the orifice size could be adjusted accordingly.

Figure 9: Retrofit Manholes ON the Parks Highway



5.2. Herning and Knik Bioretention

5.2.1. Overview

This proposed remedial action facility is a combination bioretention/infiltration swale that would provide treatment for runoff from portions of both Herning Avenue and Knik Street as well as from surrounding properties that contribute runoff toward the road. A graphic of this proposed facility is provided in Figure 10 and facility information is summarized in Table 6.

Table 6: Herning and Knik Bioretention/Infiltration

Location	Southeast corner of Herning Avenue and Knik Street
Land Ownership	City-owned parcel and City right-of-way
Facility Type	Combination bioretention swale and infiltration facility
Drainage Area Size	3.2 acres
Estimated Cost	$210,000
Recommended Maintenance Activities	See Table 15 in Section 6.

5.2.2. Details and Key Considerations:

<u>Functionality.</u> This swale would accept stormwater inflow via curb openings along both Herning Avenue and Knik Street. The engineered soil at the swale surface should be graded to promote distribution of surface flows throughout the facility.

To maximize the treatment potential of the facility, water would also enter the swale below grade from an existing storm drain structure at the southwest corner of the Herning-Knik intersection. The storm drain structure would be connected a new control manhole located at the upstream end of the swale. This control manhole would direct regular, low flows into a subdrain to distribute the subsurface flows throughout the facility. Under high flows or if the facility becomes fully saturated, incoming water would bypass the swale and exit the control manhole to the north, returning to the storm drain on Herning Avenue. Inside the control manhole, a weir would separate the subdrain from the storm drain return piping. The elevation of the weir should be set to maximize the treatment potential of the facility while still allowing for safe bypass when needed. (See Figure 10.)

The facility subdrain would also prevent water from pooling at the surface, as excess water in the bioretention layers would be collected in the subdrain and returned to the control manhole. The control manhole should be configured with a beehive inlet to prevent excess surface ponding when the ground is frozen or in the event that the subdrain becomes clogged.

<u>Vegetation.</u> Many types of vegetation would work well in this facility, though vegetation should be able to accommodate intermittent wet and dry periods. Vegetation selection should also consider available/desired maintenance frequency, aesthetic preference, and available funds.

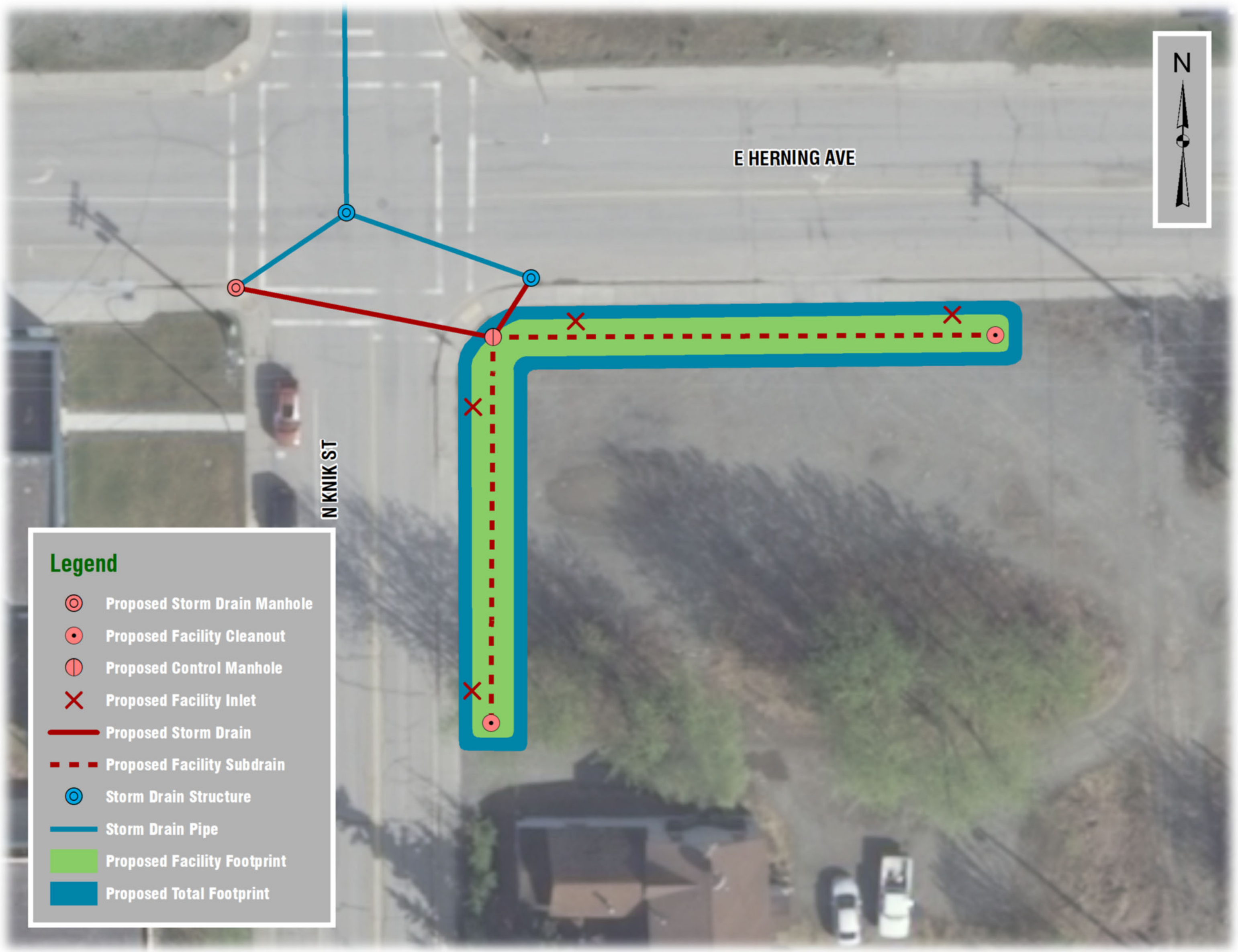
<u>Utility Conflicts.</u> Detailed utility conflict analysis was not completed as part of this work, and information regarding the location of existing utilities was obtained through available as-builts and mapping.

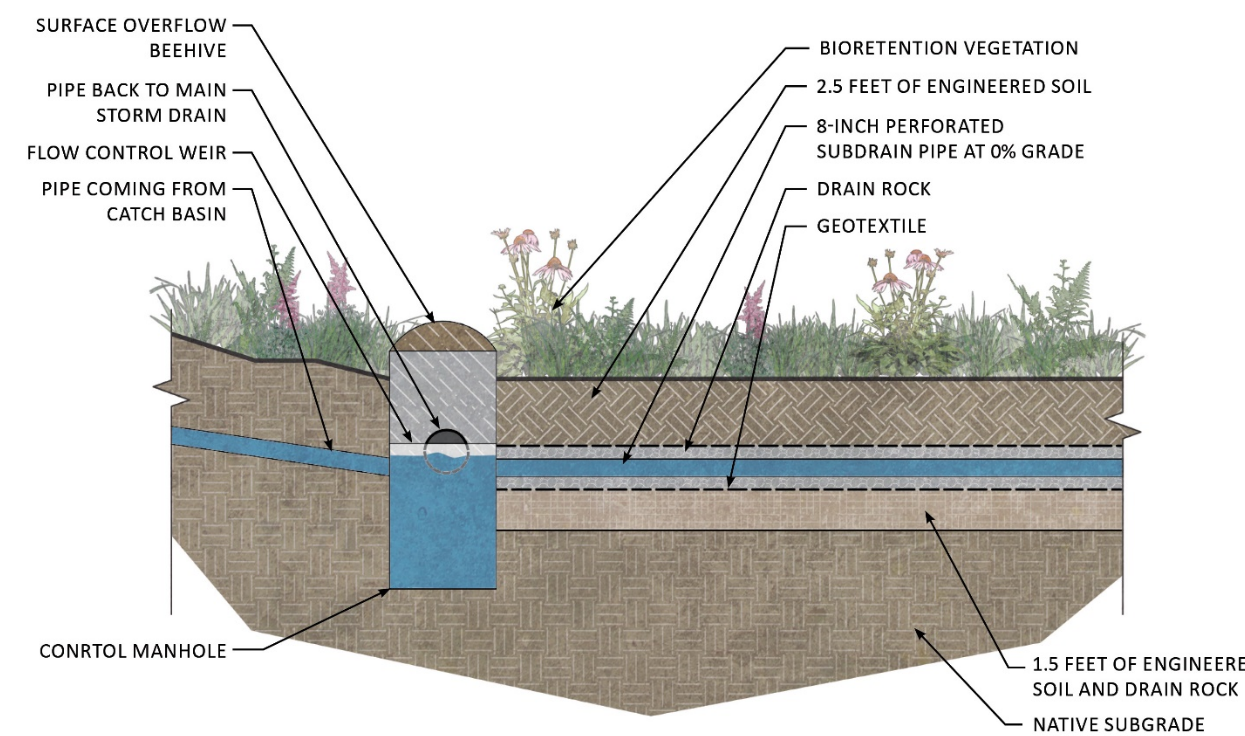
There is an existing gas line that runs along the west side of the parcel and may conflict with the proposed swale alignment. There is an existing electrical junction box and power pole at the southwest corner of the intersection that will need to be supported or temporarily relocated during construction.

Facility Cost. The estimated cost of this facility is $210,000. A detailed breakdown of this cost along with relevant assumptions are presented in Appendix B. It should be noted that utility costs are generally a placeholder as more detailed information on area utilities is needed to estimate a price.

Timeline. The timeline for implementing this remedial action is largely dependent on the funding source for the project. If funding were readily available, the project could be designed and constructed in a single year. Vegetation maintenance would be ongoing after construction is complete. Maintenance is discussed further in Section 6, and planned project timelines are discussed in Section 7.

Figure 10: Herning and Knik Bioretention





NOTES:
1. PERFORATED SUBDRAIN WILL DISTRIBUTE INCOMING FLOWS TO THE FACILITY DURING LOW FLOW EVENTS. DURING HIGH FLOW EVENTS, THE SUBDRAIN WILL ALLOW WATER TO FLOW BACK TO THE CONTROL MANHOLE IF THE LOWER PORTION OF THE FACILITY BECOMES SATURATED.
2. THE CONTROL WEIR WILL ALLOW WATER TO RETURN TO THE STORM DRAIN SYSTEM DURING HIGHER FLOW EVENTS. THE ELEVATION OF THE CONTROL WEIR TO BE SET DURING DETAILED DESIGN.

Facility Plan View

Facility Typical Section

5.3. Swanson and Willow Bioretention

5.3.1. Overview

This proposed remedial action facility is a bioretention swale that would provide treatment for runoff from a significant portion of Swanson Avenue and Willow Street, from surrounding parcels that contribute runoff toward the road, and from the adjacent Nunley Park parking lot. A graphic of this proposed facility is provided in Figure 11 and facility information is summarized in Table 7.

Table 7: Swanson and Willow Bioretention

Location	Southeast corner of Swanson Avenue and Willow Street (Nunley Park)
Land Ownership	City-owned park and City right-of-way
Facility Type	Bioretention swale
Drainage Area Size	7.5 acres
Estimated Cost	$90,000
Recommended Maintenance Activities	See Table 16 in Section 6.

5.3.2. Details and Key Considerations

Functionality. The proposed layout of this swale would require removal of two existing parking spaces from the adjacent parking lot. This facility would function as a traditional bioretention swale and would receive stormwater runoff via curb openings along Swanson Avenue and Willow Street. The engineered soil at the swale surface should be graded to promote distribution of surface flows throughout the facility. Depending on the infiltrative capacity of the native soils, a subdrain may be needed to collect excess stormwater and return it to the storm drain. An overflow manhole with a raised beehive is also proposed at the south end of the facility to allow stormwater from heavy rain events safely exit the swale and return to the main storm drain on Willow Street. This overflow will also prevent excess surface ponding when the ground is frozen or if the facility subdrain becomes clogged. (See Figure 11.)

Vegetation. Many types of vegetation would work well in this facility, though vegetation should be able to accommodate intermittent wet and dry periods. Vegetation selection should also consider available/desired maintenance frequency, aesthetic preference, and available funds.

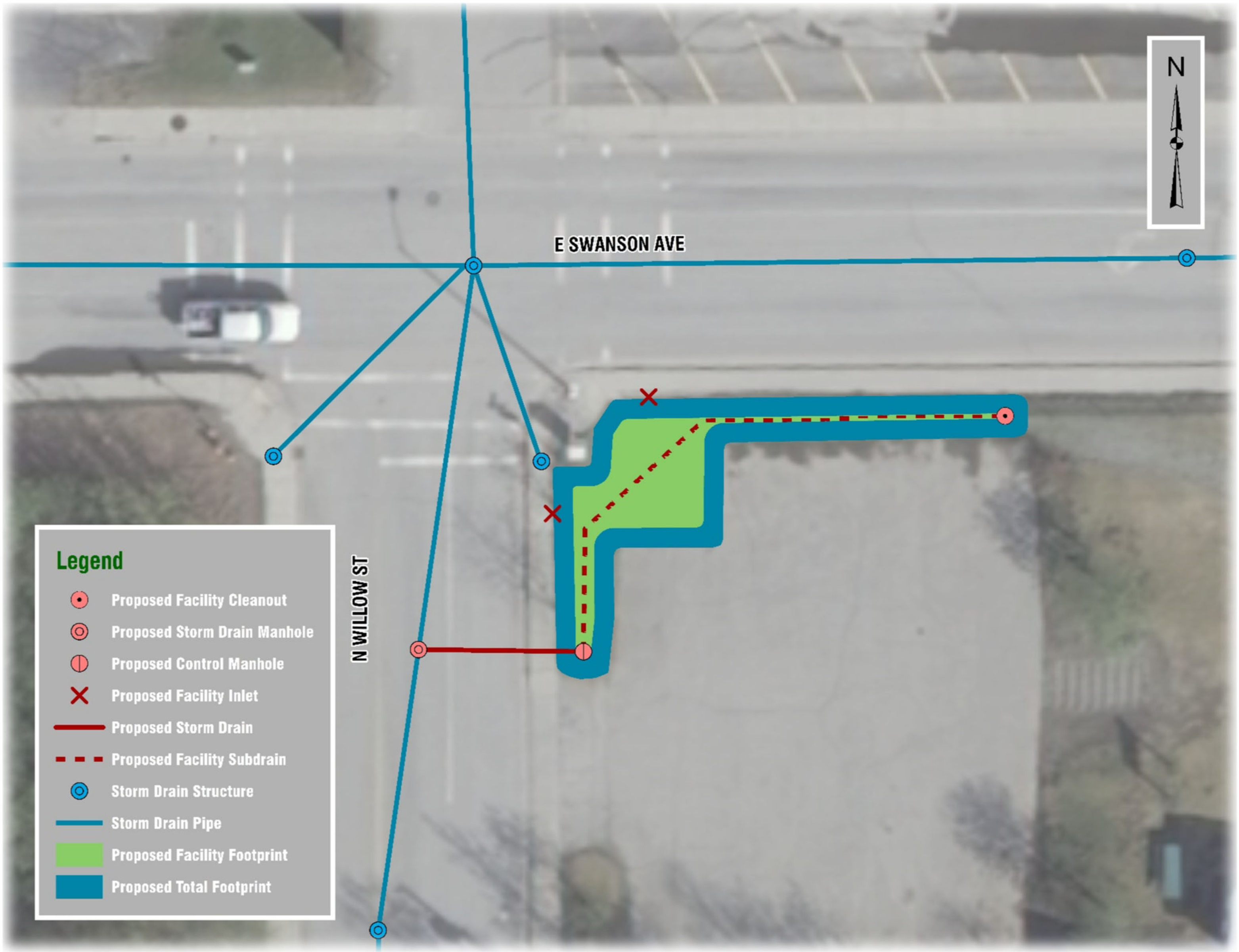
Utility Conflicts. Detailed utility conflict analysis was not completed as part of this work, and information regarding the location of existing utilities was obtained through available as-builts and mapping.

There is an existing electric line on the west side of the proposed swale that would require support during construction. There is an existing junction box and light pole at the southeast corner of the Swanson-Willow intersection that will need to be avoided during construction.

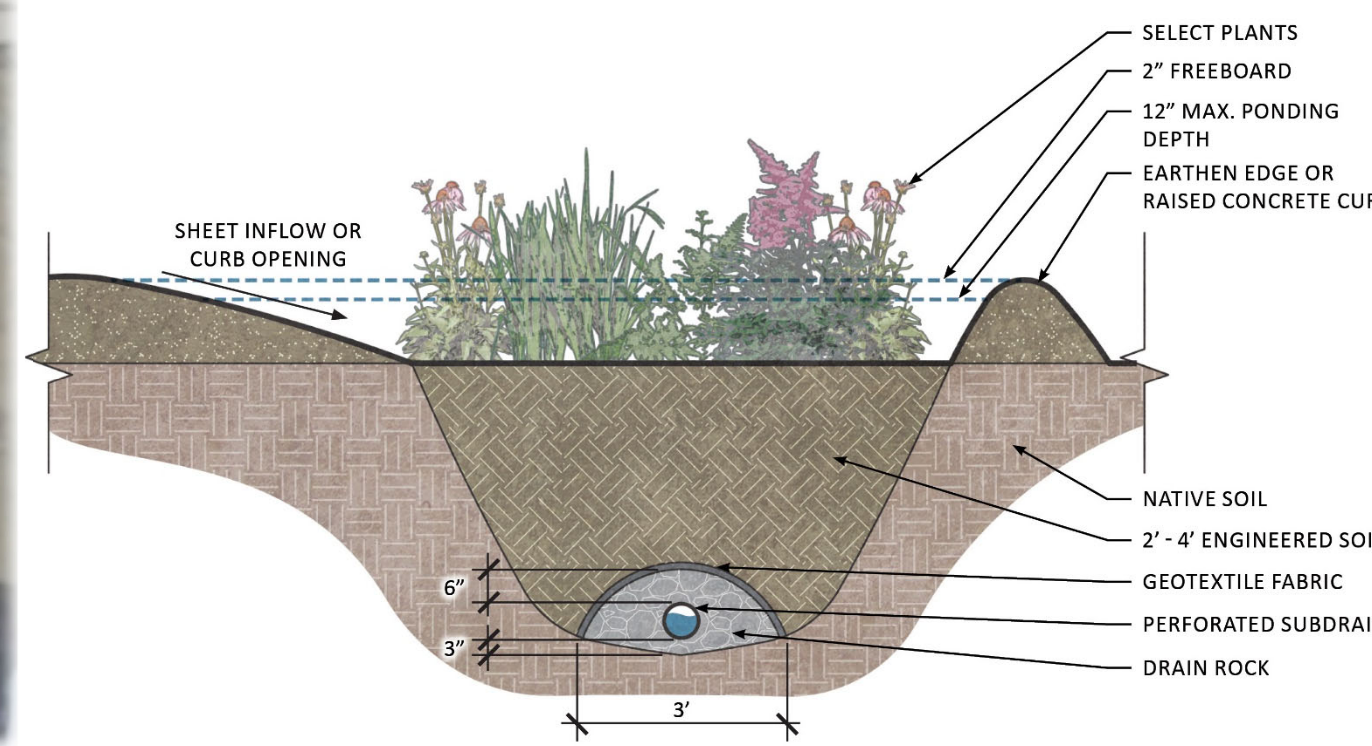
Facility Cost. The estimated cost of this facility is $90,000. A detailed breakdown of this cost along with relevant assumptions are presented in Appendix B. It should be noted that utility costs are generally a placeholder as more detailed information on area utilities is needed to estimate a price.

Timeline: The timeline for implementing this remedial action is largely dependent on the funding source for the project. If funding were readily available, the project could be designed and constructed in a single year. Vegetation maintenance would be ongoing after construction is complete. Maintenance is discussed further in Section 6, and planned project timelines are discussed in Section 7.

Figure 11: Swanson and Willow Bioretention



Facility Plan View



Facility Typical Section

5.4. Nelson Avenue Bioretention

5.4.1. Overview

This proposed remedial action facility is a combination bioretention/infiltration swale that would provide treatment for runoff from Nelson Avenue and surrounding properties that contribute runoff toward the road. A graphic of this proposed facility is provided in Figure 12 and facility information is summarized in Table 8.

Table 8: Nelson Avenue Bioretention/Infiltration

Location	South side of Nelson Avenue, west of Knik Street
Land Ownership	City right-of-way
Facility Type	Combination bioretention swale and infiltration facility
Drainage Area Size	18.1 acres
Estimated Cost	$520,000
Recommended Maintenance Activities	See Table 15 in Section 6.

5.4.2. Details and Key Considerations:

Functionality. This bioretention swale would accept stormwater inflow via curb openings along the south side of Nelson Avenue. The swale would be separated into segments by necessary driveway crossings, but strategic placement of inlets along with the use of subdrains would ensure that the entire facility can be utilized for stormwater treatment.

To maximize the treatment potential of the swale, water would also be directed to the facility from two existing storm drain inlet structures along Nelson Avenue. This allows water from both sides of the road surface to enter the swale. This is concept is particularly helpful at this location because much of the impervious surface on the north side of Nelson Avenue drains toward the road. Similar to the Herning/Knik facility, water from the storm drain structures would enter the facility at an upstream control manhole. The control manhole would be designed to direct regular, low flows into a subdrain to distribute the subsurface flows throughout the facility. Under high flows or if the facility becomes fully saturated, incoming water would bypass the swale and return to the storm drain on Nelson Avenue.

The facility subdrain also prevents water from pooling at the surface, as excess water in the bioretention layers would be collected in the subdrain and returned to the control manhole to be routed back to the main storm drain. (See Figure 12.) A beehive inlet inside the facility is recommended to prevent excess ponding when the ground is frozen or if the facility subdrain becomes clogged.

Vegetation. Many types of vegetation would work well in this facility, though vegetation should be able to accommodate intermittent wet and dry periods. Vegetation selection should also consider available/desired maintenance frequency, aesthetic preference, and available funds.

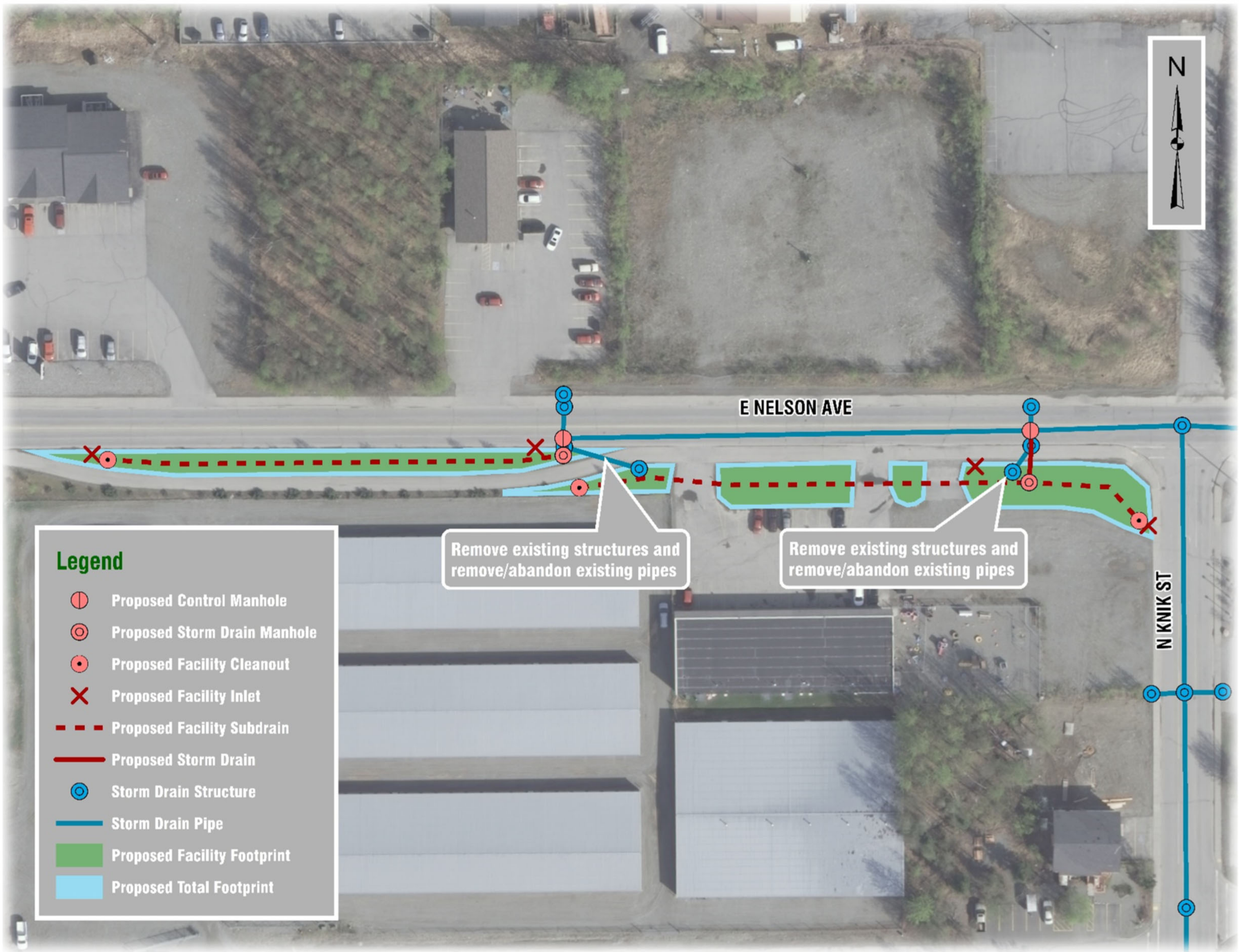
Utility Conflicts. Detailed utility conflict analysis was not completed as part of this work, and information regarding the location of existing utilities was obtained through available as-builts and mapping.

There is an existing sanitary sewer force main in the same alignment as the new facility. The force main is expected to be deeper than the proposed swale, but this will need to be confirmed and accommodated during design. If necessary, the facility depth can be reduced by reducing the engineered soil thickness. The depth will also be dictated by the existing storm drain depths and the configuration of the control manholes.

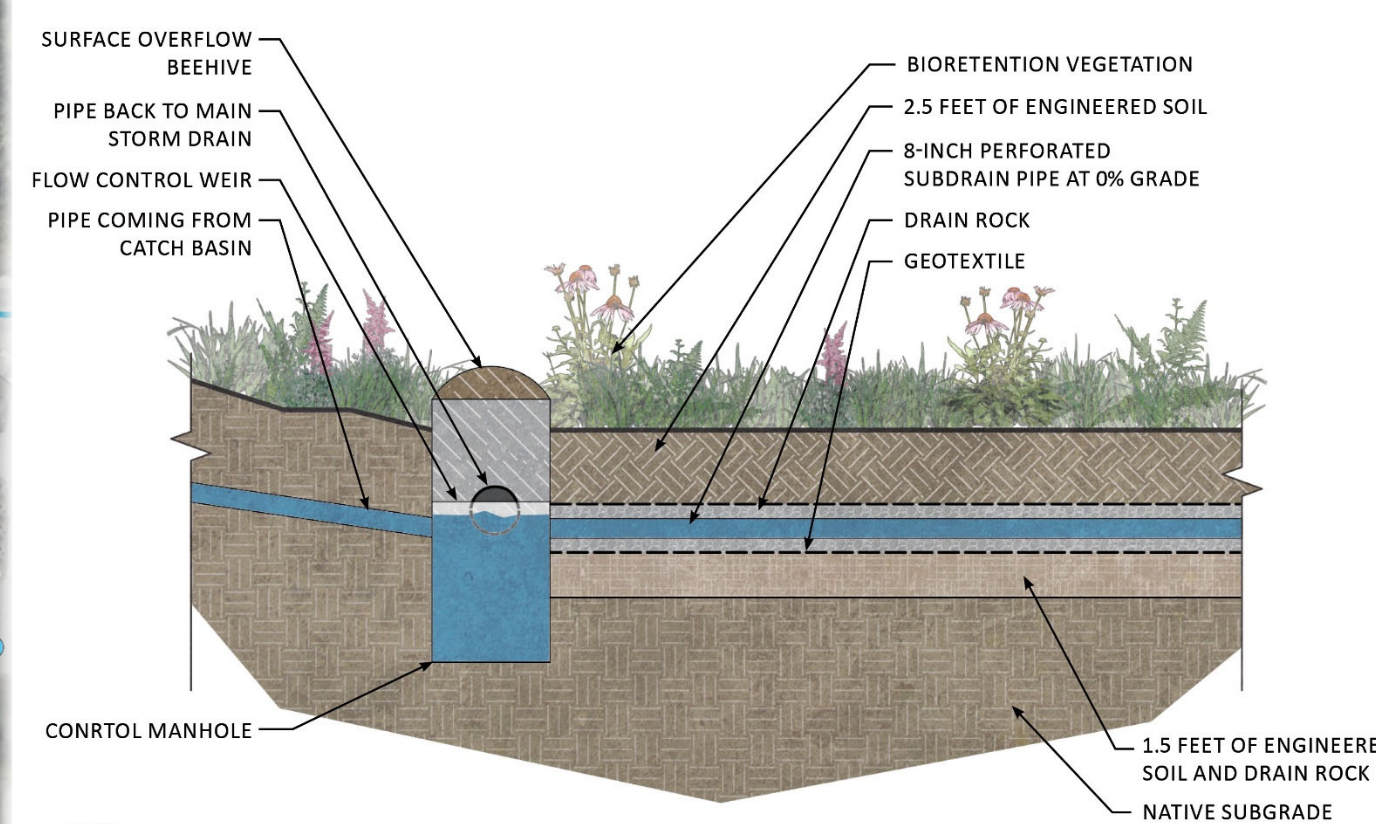
Facility Cost. The estimated cost of this facility is $520,000. A detailed breakdown of this cost along with relevant assumptions are presented in Appendix B. It should be noted that utility costs are generally a placeholder as more detailed information on area utilities is needed to estimate a price.

Timeline. The timeline for implementing this remedial action is largely dependent on the funding source for the project. If funding were readily available, the project could be designed and constructed in a single year. Vegetation maintenance would be ongoing after construction is complete. Maintenance is discussed further in Section 6, and planned project timelines are discussed in Section 7.

Figure 12: Nelson Avenue Bioretention



<u>**Facility Plan View**</u>



NOTES:
1. PERFORATED SUBDRAIN WILL DISTRIBUTE INCOMING FLOWS TO THE FACILITY DURING LOW FLOW EVENTS. DURING HIGH FLOW EVENTS, THE SUBDRAIN WILL ALLOW WATER TO FLOW BACK TO THE CONTROL MANHOLE IF THE LOWER PORTION OF THE FACILITY BECOMES SATURATED.
2. THE CONTROL WEIR WILL ALLOW WATER TO RETURN TO THE STORM DRAIN SYSTEM DURING HIGHER FLOW EVENTS. THE ELEVATION OF THE CONTROL WEIR TO BE SET DURING DETAILED DESIGN.

<u>**Facility Typical Section (Conceptual)**</u>

(See Appendix C for detailed facility section.)

5.5. Parks Highway at Swanson Avenue Bioretention

5.5.1. Overview

This proposed remedial action would convert an existing stormwater collection ditch into an enhanced vegetated ditch that would treat stormwater runoff from portions of Swanson Avenue and the Parks Highway as well from adjacent developments. A graphic of this proposed facility is provided in Figure 13 and facility information is summarized in Table 9.

Table 9: Parks Highway at Swanson Avenue Bioretention

Location	North side of the Parks Hwy, east of Swanson Ave
Land Ownership	DOT&PF right-of-way
Facility Type	Enhanced vegetated ditches
Drainage Area Size	7.7 acres
Estimated Cost	$160,000
Recommended Maintenance Activities	See Table 17 in Section 6.

5.5.2. Details and Key Considerations:

<u>Functionality.</u> Water would enter this facility several ways. Water from Swanson Avenue and a portion of the Parks Highway surface would enter the facility at the west end near the location of an existing storm drain inlet. The storm drain inlet would be replaced/reconfigured to direct water into the swale. Water could also be configured to enter the east end of the facility by redirecting flow from an existing storm drain curb inlet into the facility instead of directly into the storm drain. Water would also continue to enter the facility via overland from adjacent parcels.

The existing ditch slope is fairly flat, and high velocity flow is not expected to be problematic. Under existing conditions, the water in the ditch is directed to a surface inlet and flows into the storm drain. The elevation of that inlet would be raised to allow runoff from low flows to percolate into the engineered soil, while allowing large flows to safely enter the storm drain.

<u>Vegetation.</u> DOT&PF has expressed the need for low maintenance and easy-to-replace vegetation in this area. Based on these needs, the recommended vegetation for this facility is a grass or wildflower mix that will not be mowed. Facility performance will be enhanced by unmowed grass with mature roots to promote infiltration and taller blades to promote water uptake and transpiration.

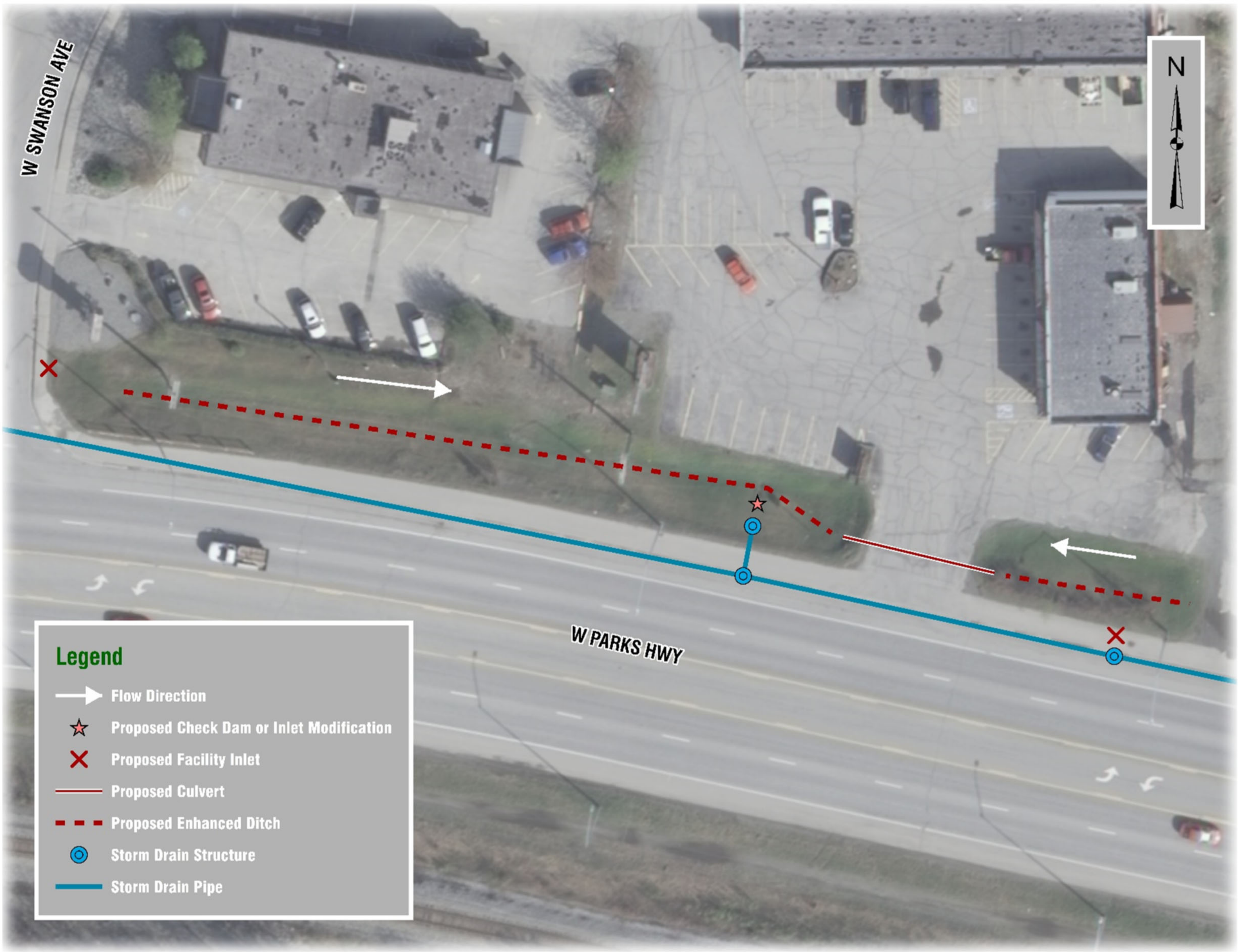
<u>Utility Conflicts.</u> Detailed utility conflict analysis was not completed as part of this work, and information regarding the location of existing utilities was obtained through available as-builts and mapping.

Information about existing utilities in this location was not readily available. Generally, electric, gas, and fiberoptic utilities that may be present below the existing ditch could remain in their existing alignment. Much of the existing ditch is fairly deep (approximately 3 to 4 feet), which could potentially allow the flow line to be raised to accommodate the engineered soil thickness, if needed. If needed, a subdrain could also be incorporated to ensure that any utilities do not become overly saturated.

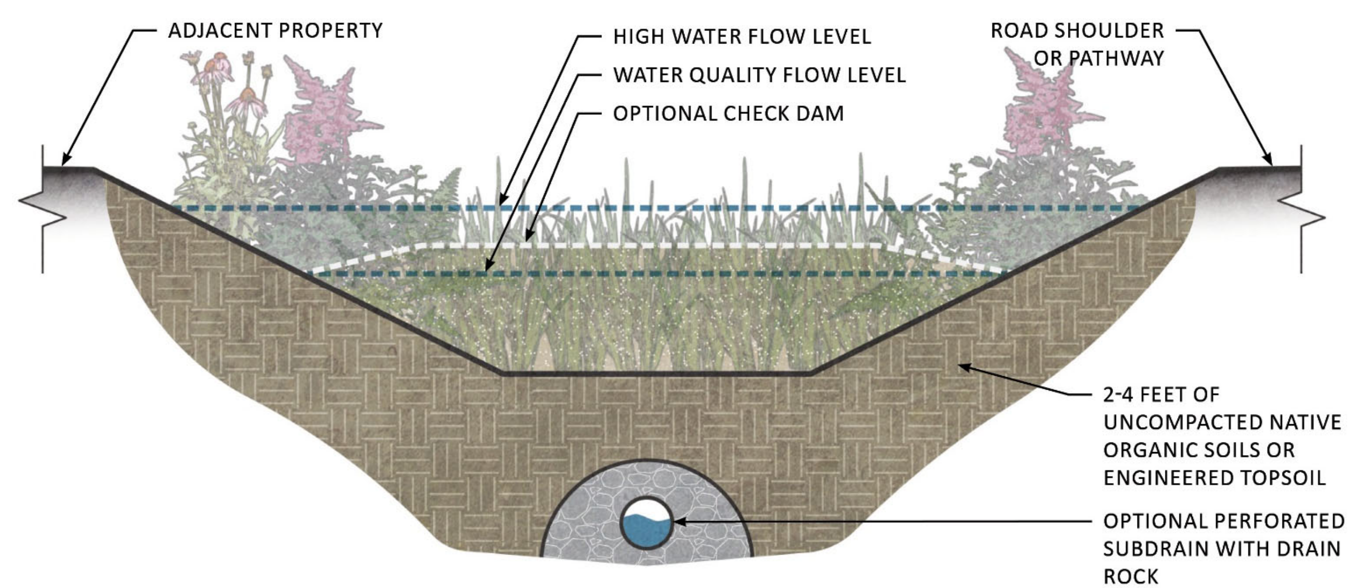
Facility Cost. The estimated cost of this facility is $160,000. A detailed breakdown of this cost along with relevant assumptions are presented in Appendix B. It should be noted that utility costs are generally a placeholder as more detailed information on area utilities is needed to estimate a price.

Timeline. The timeline for implementing this remedial action is largely dependent on the funding source for the project and on coordination with DOT&PF for the proposed improvements. Planned project timelines are discussed in Section 7.

Figure 13: Parks Highway at Swanson Avenue Bioretention



Facility Plan View



Facility Typical Section

5.6. Constructed Wetlands at East Outfall

5.6.1. Overview

This proposed remedial action facility is a constructed wetland located just upstream of the east outfall. This wetland would provide a final cleaning opportunity before stormwater enters Lake Lucile. A graphic of this proposed facility is provided in Figure 14 and facility information is summarized in Table 10.

Table 10: Constructed Wetlands at East Outfall

Location	At the east stormwater outfall into Lake Lucile
Land Ownership	City-owned parcel
Facility Type	Constructed pocket wetland
Drainage Area Size	N/A
Estimated Cost	$300,000
Recommended Maintenance Activities	See Table 18 in Section 6.

5.6.2. Details and Key Considerations:

<u>Functionality.</u> This proposed wetland would require disconnecting the existing east outfall and redirecting water into the proposed wetland. Because the wetland would be constructed immediately adjacent to the lake, high groundwater is expected and would provide an ideal environment to maintain a permanent pool in the wetland. The proposed wetland would provide treatment for low flows and allow larger flows to safely overtop the wetland into the lake, as shown on Figure 14. A small forebay could be constructed at the wetland entrance to capture larger sediment particles in an area that can be accessed for cleaning. A trash rack is also recommended at the entrance to the constructed wetland, where it transitions from the piped storm drain to an open channel. The trash rack would capture large pieces of trash and debris for easy removal.

The design high water elevation for the wetland should be set such that it does not cause backwater of the storm drain that directs water to the wetland.

<u>Vegetation.</u> The low marsh areas should be vegetated with plants that can sustain permanent inundation, and the high marsh area requires vegetation that can be intermittently wet and dry. A diverse plant species is recommended for longevity of the wetland, and guidance from a qualified landscape architect or plant species specialist may be beneficial.

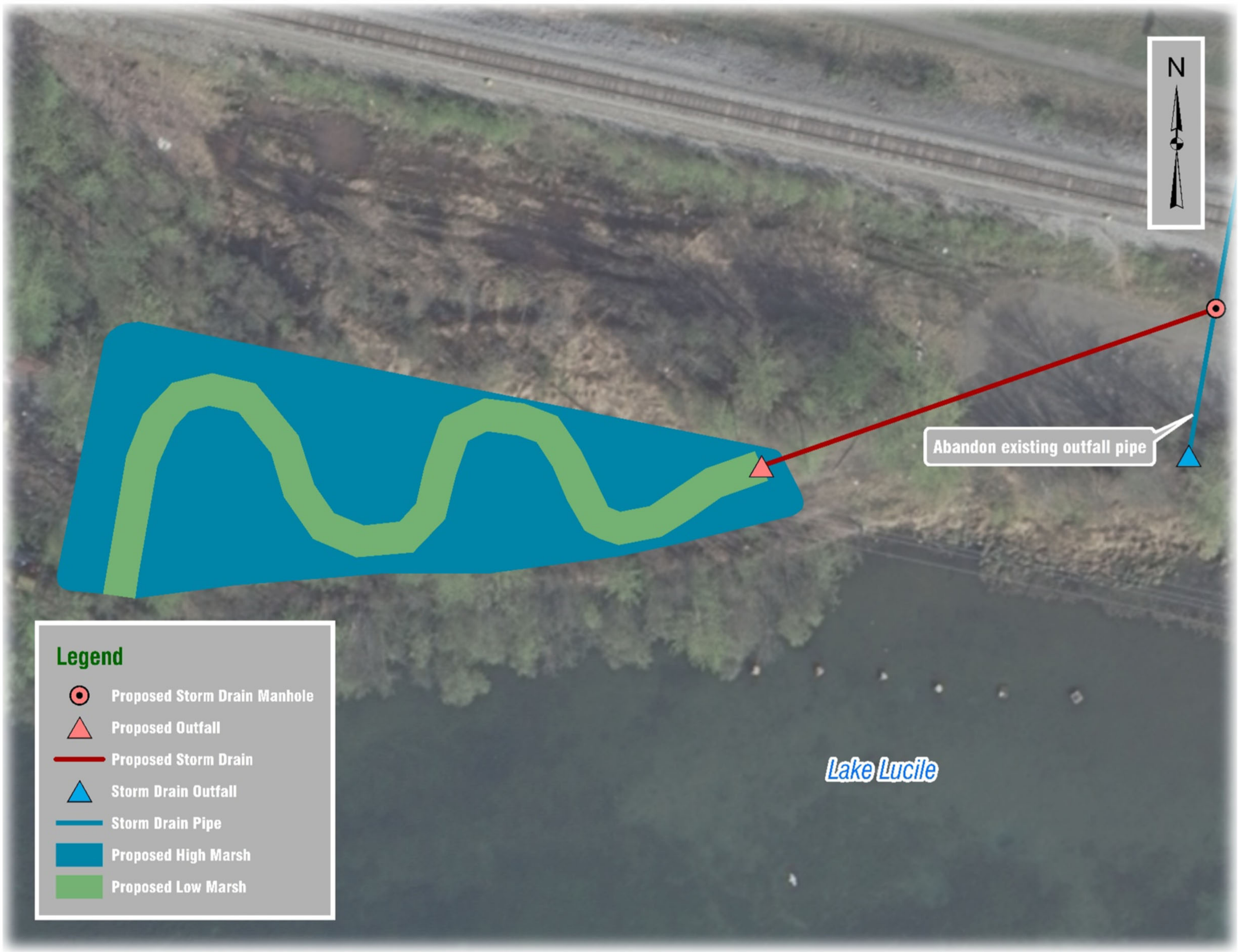
<u>Utility Conflicts.</u> Detailed utility conflict analysis was not completed as part of this work, and information regarding the location of existing utilities was obtained through available as-builts and mapping.

There are no known utility conflicts in this area. There is an existing power pole near the outfall that may require support during construction.

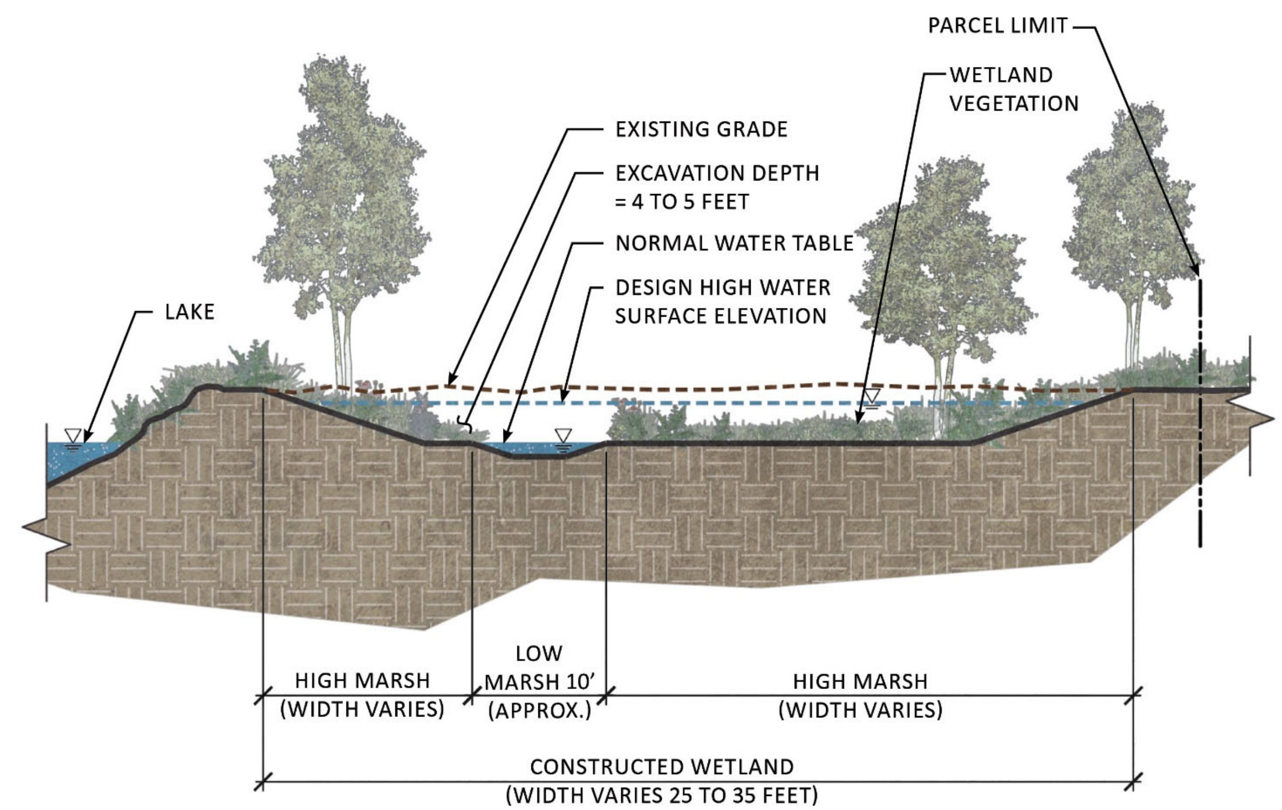
Facility Cost. The estimated cost of this facility is $300,000. A detailed breakdown of this cost along with relevant assumptions are presented in Appendix B. It should be noted that utility costs are generally a placeholder as more detailed information on area utilities is needed to estimate a price.

Timeline. The timeline for implementing this remedial action is largely dependent on the funding source for the project. Once a funding source is in place, the project can be designed and constructed in a single year. Vegetation maintenance would be ongoing after construction is complete. Maintenance is discussed further in Section 6, and planned project timelines are discussed in Section 7.

Figure 14: Constructed Wetland at East Outfall



Facility Plan View



Facility Typical Section

5.7. Parks Highway Deskas to Lucus Bioretention

5.7.1. Overview

This proposed remedial action would convert existing stormwater collection ditches on the north side of the Parks Highway into enhanced vegetated ditches that would treat stormwater runoff from portions of the Parks Highway and from adjacent developments that drain toward the highway. A graphic of this proposed facility is provided in Figure 15 and facility information is summarized in Table 11.

Table 11: Parks Highway Deskas to Lucus Bioretention

Location	North side of the Parks Hwy from east of Deskas Street to Lucus Road
Land Ownership	DOT&PF right-of-way
Facility Type	Enhanced vegetated ditches
Drainage Area Size	57.5 acres
Estimated Cost	$440,000
Recommended Maintenance Activities	See Table 17 in Section 6.

5.7.2. Details and Key Considerations:

Functionality. Under existing conditions, water from the Parks Highway is collected in curbs and directed to curb inlets. On the western portion of the project area, there is no storm drain pipe, and these curb inlets discharge water into the existing ditch, which flows to the east. On the eastern portion of the project area, there is a storm drain pipe, and the curb inlets direct water into the storm drain. There are additional pipes that collect water from the ditch and also direct that into the storm drain.

Under proposed conditions, the drainage pattern on the western portion of the site would not change. Water from the Parks Highway surface would be directed into the new enhanced vegetated ditch where it would be treated and slowly flow to the east. On the eastern portion of the project area, two modification would be made to the existing drainage patterns. First, new inlets would be installed just upstream of the existing inlets to collect water from the Parks Highway and send it under the sidewalk and into the enhanced vegetated ditch. The inlets would be small opening intended to capture only small flows and allow larger flows to bypass to the existing inlets. Additionally, earthen check dams would be constructed in the ditches upstream of the pipes that direct water from the ditch back to the storm drain. The check dams would be set to allow for infiltration of low flows, while allowing higher flows to enter the storm drain.

Vegetation. DOT&PF has expressed the need for low maintenance and easy-to-replace vegetation in this area. Based on these needs, the recommended vegetation for this facility is a grass or wildflower mix that will not be mowed. Facility performance will be enhanced by unmowed grass with mature roots to promote infiltration and taller blades to promote water uptake and transpiration.

Utility Conflicts. Detailed utility conflict analysis was not completed as part of this work, and information regarding the location of existing utilities was obtained through available as-builts and mapping.

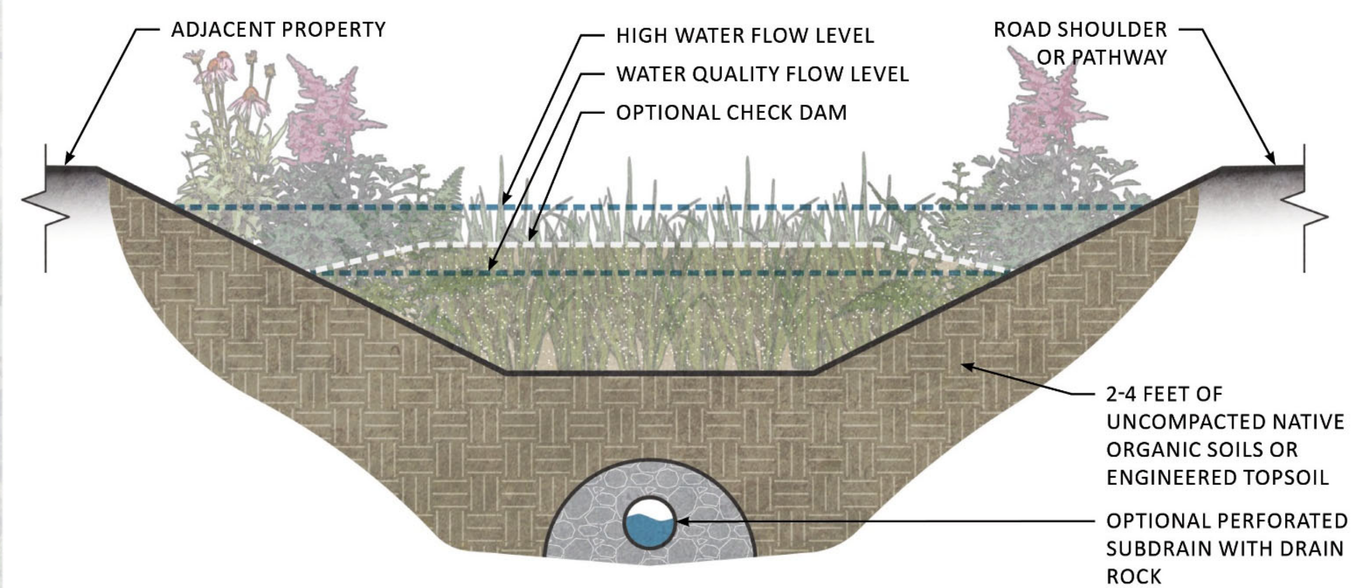
There may be an abandoned storm drain pipe in the ditch line near Lucus Avenue. If that pipe has not been removed or is less than 3-4 feet deep, it will require removal to facilitate placement of the enhanced ditch features. There is existing lighting along this corridor adjacent to the ditch. Light poles and associated power lines will need to be accommodated and protected during construction.

Facility Cost. The estimated cost of this facility is $440,000. A detailed breakdown of this cost along with relevant assumptions are presented in Appendix B. It should be noted that utility costs are generally a placeholder as more detailed information on area utilities is needed to estimate a price.

Timeline. The timeline for implementing this remedial action is largely dependent on the funding source for the project and on coordination with DOT&PF for the proposed improvements. Planned project timelines are discussed in Section 7.

Figure 15: Parks Highway Deskas to Lucus Bioretention

Facility Plan View



Facility Typical Section

5.8. Commercial Drive Bioretention

5.8.1. Overview

This proposed remedial action would convert an existing stormwater collection ditch and landscaped area adjacent to Commercial Drive into an enhanced vegetated ditch that would treat stormwater runoff from portions of the Parks Highway, Commercial Drive, and adjacent developments. A graphic of this proposed facility is provided in Figure 16 and facility information is summarized in Table 12.

Table 12: Commercial Drive Bioretention

Location	North of the Parks Hwy adjacent to Commercial Drive
Land Ownership	DOT&PF and City right-of-way
Facility Type	Enhanced vegetated ditches
Drainage Area Size	24.9 acres
Estimated Cost	$690,000
Recommended Maintenance Activities	See Table 17 in Section 6.

5.8.2. Details and Key Considerations

<u>Functionality.</u> Under existing conditions, water flows toward the ditch/landscaped area via overland flow from adjacent surfaces, and this drainage pattern would be maintained. Currently, excess water is collected at both the east and west ends of the swale and directed into adjacent storm drain systems. Flow into the storm drains would be limited by modifying the elevations of the storm drain inlets or constructing earthen dams near the intake, depending on the inlet configurations. The inlets would be configured to promote infiltration of small, frequent rain events while allowing larger events to bypass into the storm drain. The inlet elevations should be set such that ponded water does not impact adjacent areas.

<u>Vegetation.</u> If this area will be maintained by DOT&PF, the recommended vegetation is a grass or wildflower mix that will not be mowed similar to other proposed vegetated ditches in the DOT&PF right-of-way. If the facility will be maintained by the City, the vegetation could be a wide variety of plantings that would tolerate intermittent wet and dry periods. The vegetation could also be designed to enhance the aesthetics of this area, based on visual preference. Available funding and desired maintenance frequency should also be considered.

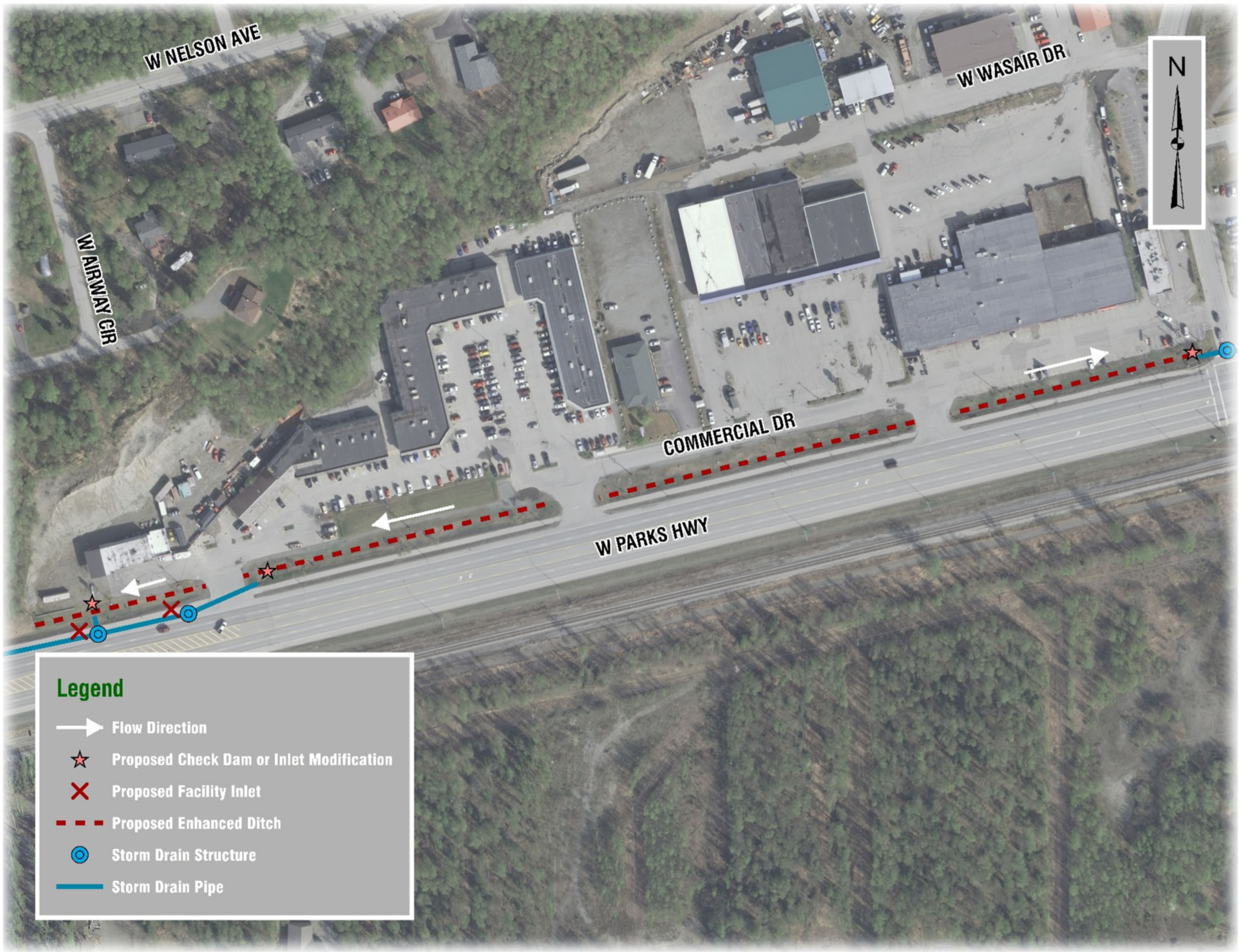
<u>Utility Conflicts.</u> Detailed utility conflict analysis was not completed as part of this work, and information regarding the location of existing utilities was obtained through available as-builts and mapping.

There is an existing water line in the vicinity of the proposed vegetated ditch. The water line is expected to be sufficiently deep to not conflict with the proposed improvements.

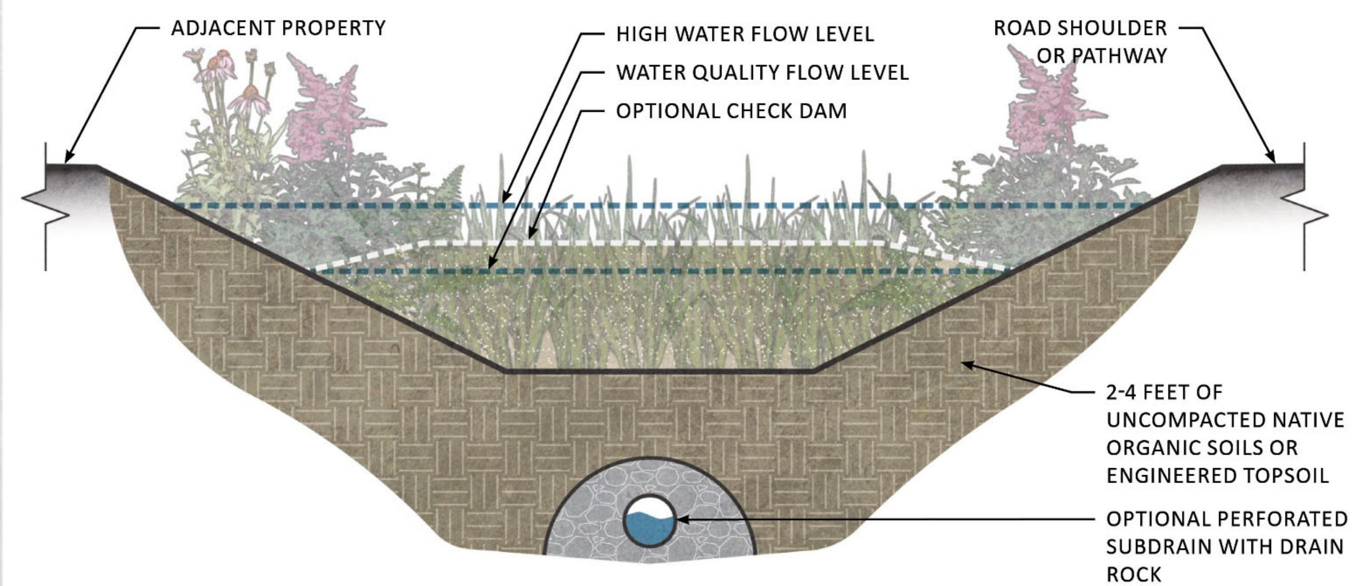
<u>Facility Cost.</u> The estimated cost of this facility is $690,000. A detailed breakdown of this cost along with relevant assumptions are presented in Appendix B. It should be noted that utility costs are generally a placeholder as more detailed information on area utilities is needed to estimate a price.

Timeline. The timeline for implementing this remedial action is largely dependent on the funding source for the project and on coordination with DOT&PF for the proposed improvements. Planned project timelines are discussed in Section 7.

Figure 16: Commercial Drive Bioretention



Facility Plan View



Facility Typical Section

5.9. Burchell High School Bioretention

5.9.1. Overview

This proposed remedial action facility is a bioretention swale/rain garden that would provide treatment for runoff the Burchell Highschool building, access drives, and other area surfaces. (When placed on a site like this one, a bioretention swale is commonly called a rain garden.) A graphic of this proposed facility is provided in Figure 17 and facility information is summarized in Table 13.

Table 13: Burchell High School Bioretention

Location	Burchell Highschool at Deskas Street and the Parks Hwy
Land Ownership	Matanuska Susitna Borough
Facility Type	Bioretention Swale/Rain Garden
Drainage Area Size	6.2 acres
Estimated Cost	$60,000
Recommended Maintenance Activities	See Table 16 in Section 6.

5.9.2. Details and Key Considerations

Functionality. This bioretention swale would utilize an existing topographic low area on the Burchell School site to collect and treat stormwater from adjacent surfaces. Some ditching is expected to be required to help direct stormwater into the facility. If there is existing curb along the perimeter of the access drive and parking areas, curb cuts would also be needed.

Vegetation. Many types of vegetation would work well in this facility, though vegetation should be able to accommodate intermittent wet and dry periods. Vegetation selection should also consider available/desired maintenance frequency, aesthetic preference, and available funds.

Utility Conflicts. Detailed utility conflict analysis was not completed as part of this work, and information regarding the location of existing utilities was obtained through available as-builts and mapping.

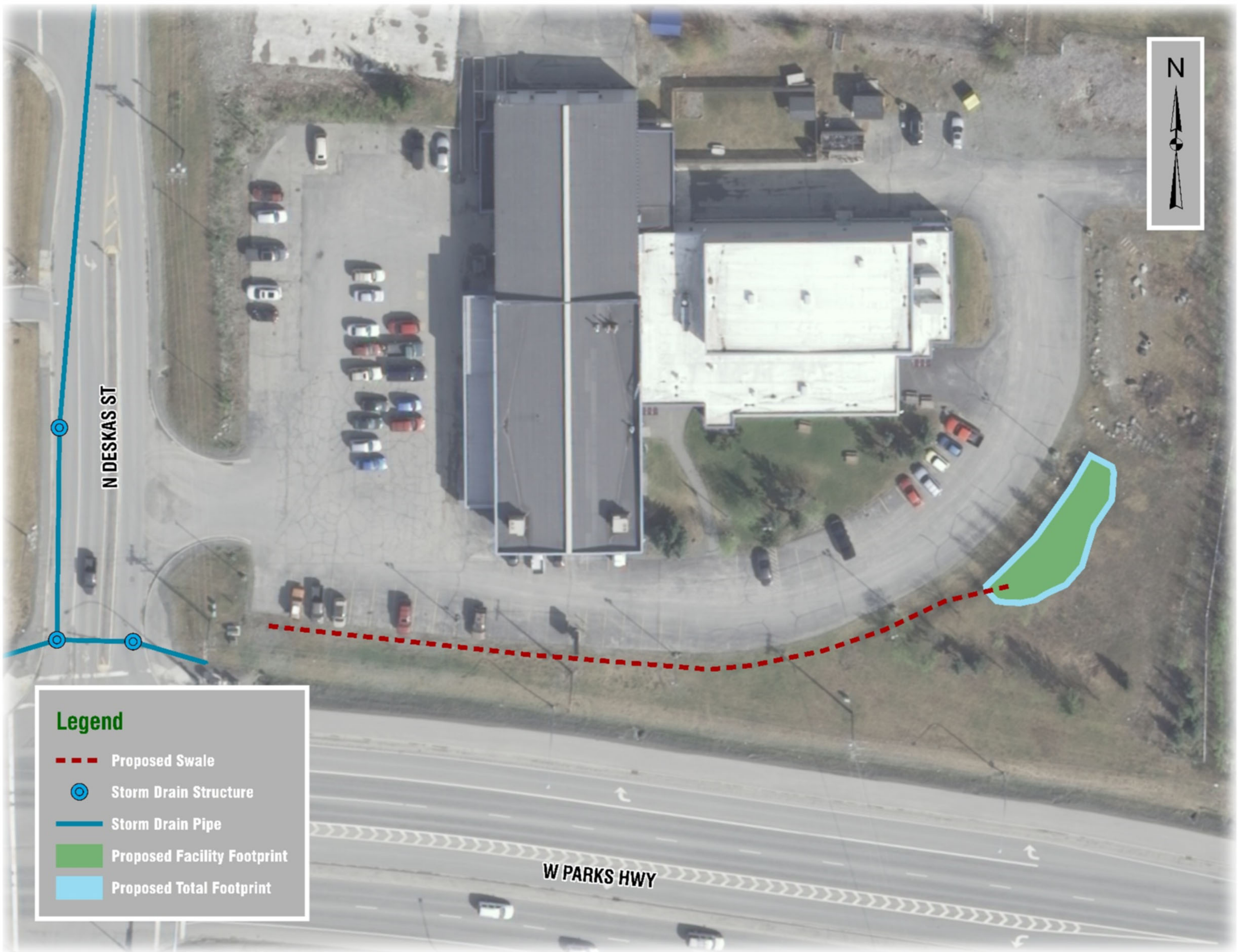
There are no known utility conflicts.

Facility Cost. The estimated cost of this facility is $60,000. A detailed breakdown of this cost along with relevant assumptions are presented in Appendix B.

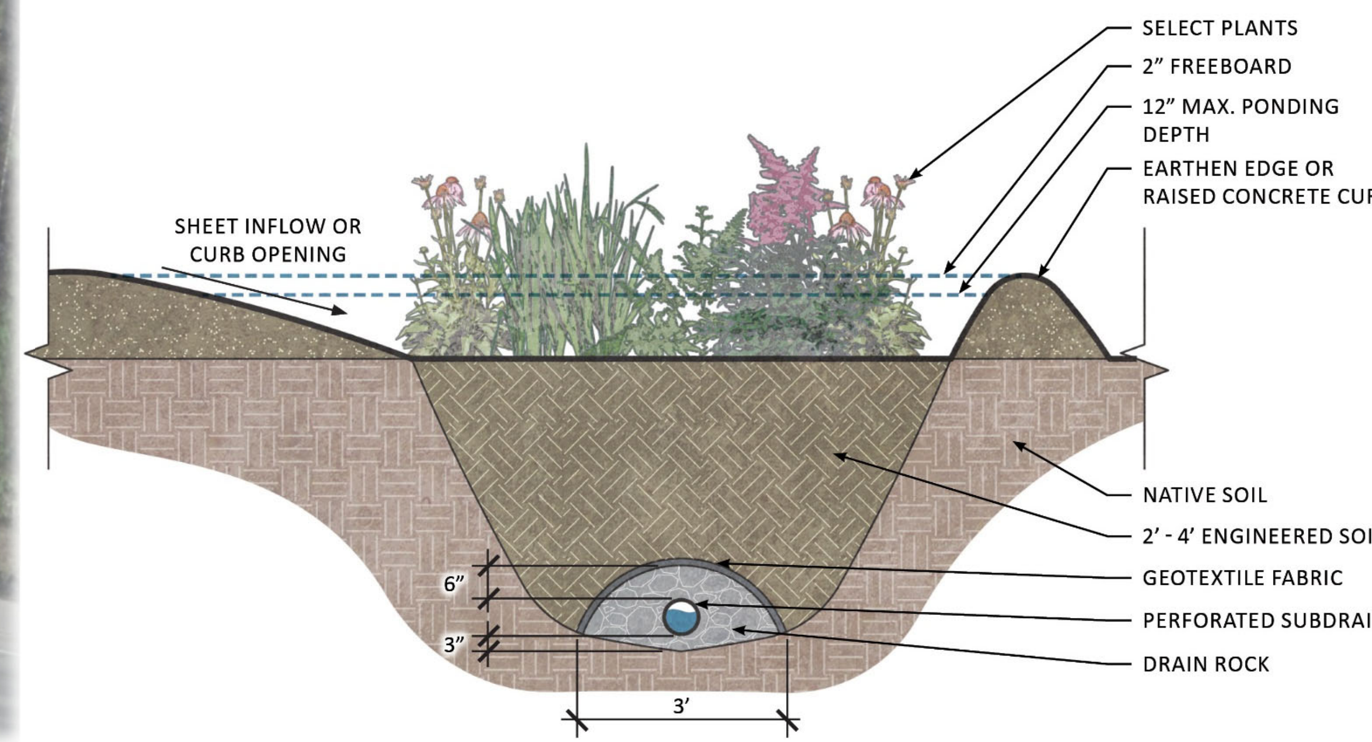
However, this site may present opportunities for student and teacher volunteers to be involved in the facility design and construction, which would reduce the cost.

Timeline: The timeline for implementing this remedial action is largely dependent on the funding source for the project. If funding were readily available, the project could be designed and constructed in a single year. Vegetation maintenance would be ongoing after construction is complete. Maintenance is discussed further in Section 6, and planned project timelines are discussed in Section 7.

Figure 17: Burchell High School Bioretention



Facility Plan View



Facility Typical Section

5.10. Oil and Grit Separator at West Outfall

5.10.1. Overview

This proposed remedial action would install an OGS upstream of the existing west stormwater outfall. This OGS would provide a final cleaning opportunity before stormwater enters Lake Lucile. A graphic of this proposed facility is provided in Figure 18 and facility information is summarized in Table 14.

Table 14: Oil and Grit Separator at West Outfall

Location	South of the Parks Hwy at Hallea Lane
Land Ownership	City right-of-way
Facility Type	Mechanical treatment (oil grit separator)
Drainage Area Size	N/A
Estimated Cost	$130,000
Recommended Maintenance Activities	Follow manufacturer guidelines.

5.10.2. Details and Key Considerations

Functionality. The proposed OGS would be constructed generally in line with the existing storm drain in this area, and would provide in-line treatment of small, frequent flows. Larger flows from heavy rains would bypass through the facility without treatment.

It is understood that there is an existing OGS located south of the intersection of the Parks Highway and Lucus Drive. The condition of that unit is not known, and it is understood to be unmaintained. A new OGS in this vicinity would offer treatment for stormwater in a location where green infrastructure treatment options are limited. The proposed location of this OGS is outside of DOT&PF right-of-way, but within City right-of-way. This location was selected to minimize utility conflicts and keep the installation costs as low as possible.

The existing storm drain pipe in this area has been sliplined, and the proposed configuration of the OGS unit assumes that the slip lined storm drain can be connected to a single new manhole structure. If this is not possible, additional manholes may be needed to make the connection.

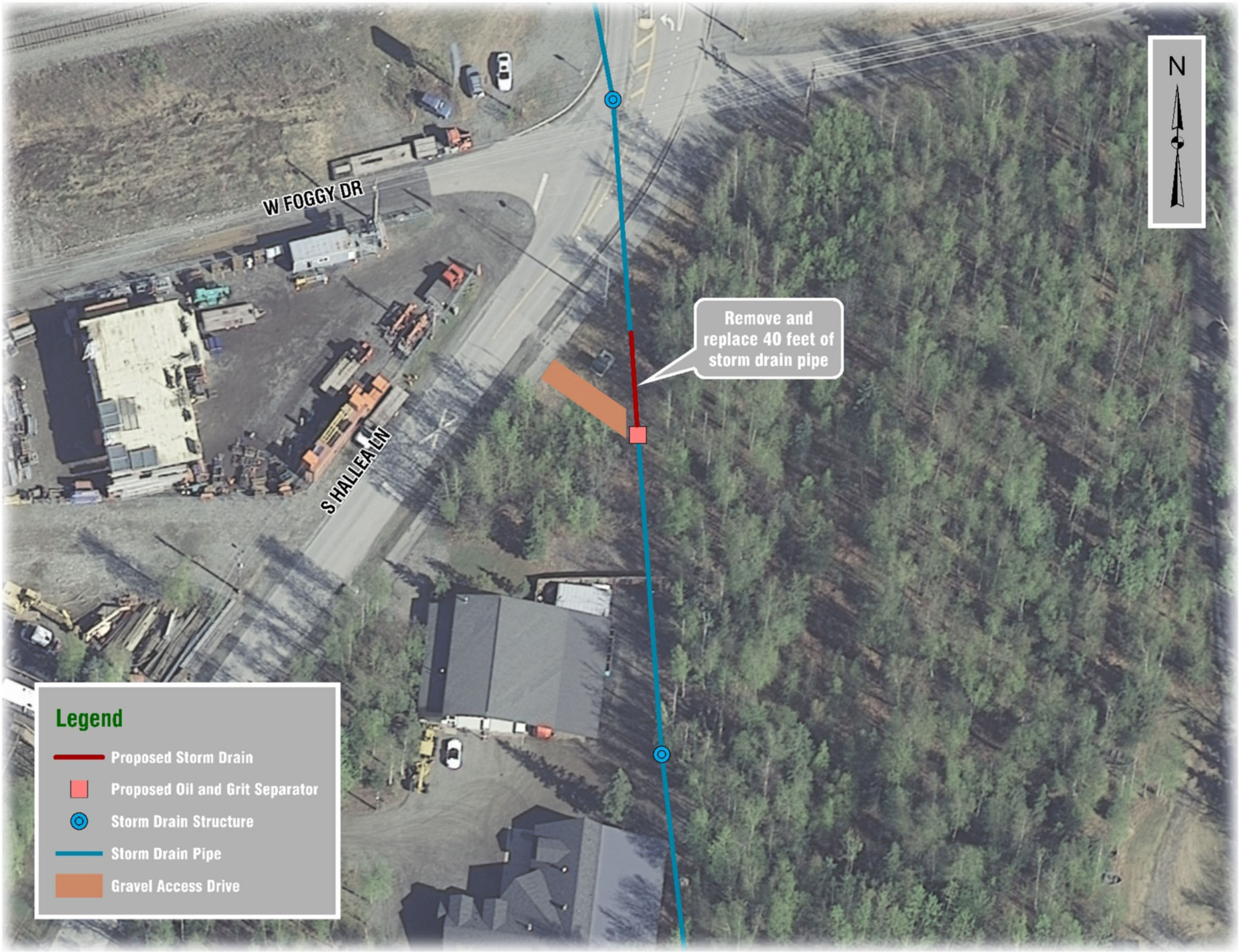
Utility Conflicts. Detailed utility conflict analysis was not completed as part of this work, and information regarding the location of existing utilities was obtained through available as-builts and mapping.

There are no known utility conflicts in the proposed location of the unit.

Facility Cost. The estimated cost of this facility is $130,000. A detailed breakdown of this cost along with relevant assumptions are presented in Appendix B.

Timeline. Planned project timelines are discussed in Section 7.

Figure 18: Oil and Grit Separator at West Outfall



6. Facility Maintenance

Maintenance of stormwater treatment facilities is important to ensure the facilities continue to provide successful removal of pollutants and do not causes local drainage issues. This section presents recommended maintenance activities for the facilities discussed in this Plan. These are general guidelines. Maintenance recommendations should be updated after final facility design to ensure proper maintenance of all facility features.

6.1. Bioretention/Infiltration Swale

The maintenance recommendations in this section apply to the proposed Herning and Knik Bioretention/Infiltration Swale and the Nelson Avenue Bioretention/Infiltration Swale.

Key notes and considerations**.**

- Required maintenance for this facility is expected to be more frequent until the vegetation becomes fully established.
- Items that should be inspected during routine inspection include the following:
    - Proper function of the facility inlets. Ensure there is no blockage or debris buildup on the downstream side of the inlets or at the inflow manhole.
    - Any sign of erosion of the engineered soil at the inlets.
    - Standing water that persists longer than the design retention time. The design retention time varies, but is commonly 48 hours.
    - General health of the vegetation.
    - Signs of vandalism or damage from moose and other wildlife.
- Using bioretention areas for snow storage is generally not recommended. It heavily loads the facility with sand when the snow melts, and it can cause compaction of the engineered soil.

Table 15: Maintenance Activities for Bioretention/Infiltration Swales

Activity	Frequency
Routine Inspections	Monthly for the first growing season. After the first growing season, perform inspections following significant rainfall events.
Inspections during rainfall events to ensure proper function	Annually
Inspect soil and repair eroded areas if needed	Monthly or following significant rainfall events
Water plants regularly	As needed during first growing season
Water during dry periods	As needed after first growing season
Maintain vegetation (pruning, tilling, weeding, adding engineering soil, etc.)	Minimum of annually or as needed
Remove litter and debris	Twice per year or as needed
Re-mulch void areas	As needed
Remove and replace engineered soil and/or mulch	As needed
Treat diseased trees and shrubs	As needed
Clean out sumps for control manhole and connected upstream inlets	Annually

6.2. Bioretention Swale

The maintenance recommendations in this section apply to the proposed Swanson and Willow Bioretention Swale and the Burchell Highschool Bioretention Swale.

Key notes and considerations.

- Required maintenance for this facility is expected to be more frequent until the vegetation becomes fully established.
- Items that should be inspected during routine inspection include the following:
  - Proper function of the facility inlets. Ensure there is no blockage or debris buildup on the downstream side of the inlets.
  - Signs of erosion of the engineered soil at the inlets.
  - Standing water that persists longer than the design retention time. The design retention time varies, but is commonly 48 hours.
  - General health of the vegetation.
  - Signs of vandalism or damage from moose and other wildlife.
- Using bioretention areas for snow storage is generally not recommended. It heavily loads the facility with sand when the snow melts, and it can cause compaction of the engineered soil.

Table 16: Maintenance Activities for Bioretention Swales

Activity	Frequency
Routine Inspections	Monthly for the first growing season. After the first growing season, annually or following significant rain events.
Inspections during rain events to ensure proper function	Annually
Inspect soil and repair eroded areas if needed	Monthly or following significant rainfall events
Water plants regularly	As needed during first growing season
Water during dry periods	As needed after first growing season
Maintain vegetation (pruning, tilling, weeding, adding engineering soil, etc.)	Minimum of annually or as needed
Remove litter and debris	Twice per year or as needed
Re-mulch void areas	As needed
Remove and replace engineered soil and/or mulch	As needed
Treat diseased trees and shrubs	As needed

6.3. Enhanced Vegetated Ditches

The maintenance recommendations in this section apply to the proposed enhanced vegetated ditches at the Parks Highway at Swanson Avenue, Parks Highway Deskas to Lucus, and Commercial Drive.

Key notes and considerations.

- Required maintenance for this facility is expected to be more frequent until the vegetation becomes fully established.
- For optimal facility function, do not mow the vegetation.
- Items that should be inspected during routine inspections include the following:
  - Proper function of the facility inlets. Ensure there is no blockage or debris buildup around the inlets or around the facility perimeter if water is entering via overland flow from adjacent surfaces.
  - Signs of erosion at the inlets, around the perimeter, or anywhere in the facility.
  - Standing water that persists longer than the design retention time. The design retention time varies, but is commonly 48 hours.
  - General health of the vegetation.
  - Signs of damage from ATVs, foot traffic, moose and other wildlife.

Table 17: Maintenance Activities for Enhanced Vegetated Ditches

Activity	Frequency
Routine inspections	Monthly for the first growing season. After the first growing season, annually or following significant rain events.
Inlet structure cleaning (as applicable)	Annually (usually following breakup)
Maintain vegetation (watering, pruning, weeding, adding engineering soil, etc.)	Minimum of annually or as needed
Reseeding and plant replacement	As needed
Remove trash and debris	Twice per year or as needed
Check proper function of facility overflow (as applicable)	Annually
Clean out accumulated sediment and replace impacted soil and vegetation	As needed

6.4. Constructed Wetlands

The maintenance recommendations in this section apply to the proposed constructed wetlands near the east outfall.

Key notes and considerations**.**

- Required maintenance for this facility is expected to be more frequent until the vegetation becomes fully established.
- Items that should be inspected during routine inspections include:
    - Proper function of the facility inlets. Ensure there is no blockage or debris buildup around the inlets.
    - Proper function of overflow areas and outlets. Ensure water can exit the facility in appropriate locations without causing backwater or short-circuiting.
    - Signs of short-circuiting or water entering lake and bypassing the treatment flow path.
    - Signs of erosion anywhere in the facility.
    - The presence of invasive plant species.
    - Areas of unvegetated standing water that should be re-vegetated.
    - General health of the vegetation and distribution of the wetland vegetation.

Table 18: Maintenance Activities for Constructed Wetlands

Activity	Frequency
Routine inspections	Monthly for the first growing season Twice a year for the first three years Annually after the first three years
Inlet structure cleaning	Annually
Remove sediment from forebay area	Every two years
Maintain vegetation (Remove invasive species, replace damaged plants, disperse plants for full coverage, etc.)	As needed
Remove trash and debris	Twice per year or as needed
Dredge sediment and replace impacted vegetation	Every 10 years or as needed

6.5. Common Maintenance Issues

This section briefly presents common maintenance activities for all kinds of green infrastructure facilities. This would apply to all facilities in the Plan other than the manhole retrofits, the constructed wetland, and the OGS.

Table 19: Common Maintenance Issues and Corrective Actions

Common Maintenance Issue	Potential Corrective Action
Soil erosion at inflow areas	Place cobbles around inlet and re-vegetate disturbed areas.
Water bypassing facility at inlets	Ensure that the area downstream of the inlet is not blocked with road sand, topsoil, or vegetation. Provide an unobstructed flow path into the facility at the inlet with proper erosion protection. Designing facilities with a small vertical drop at the inlet can help avoid this issue.
Standing water in the facility for more than the design retention time (usually 48 hours)	Ensure that vegetation is not blocking water from entering the engineered soil. If engineered soil is receiving water and staying saturated: ▪ Check the function of the subdrain (if applicable) using the facility cleanouts and ensure that the pipe is not blocked or damaged. The subdrain should be wrapped in geotextile fabric during initial facility design to prevent clogging. ▪ If the facility is aging, the engineered soil may need to be removed and replaced. Ensure that the facility overflow manhole or inlet is able to receive water at the design threshold.

7. Project Timelines

The City is planning to implement the improvements recommended in this Plan using a phased approach over the next 10 years, based on availability of funding. The current implementation plan is as follows:

- Over the next two years: Work with DOT&PF to retrofit the existing control manholes on the Parks Highway (see Section 5.1).
- Over the next five years: Construct wetlands near the East Outfall (see Section 5.6), potentially in conjunction with construction of the nearby Wasilla Main Street project.
- Over the next ten years: Implement additional facilities as funding becomes available.

8. Potential Funding Sources

There are several potential funding sources that may be available for future design and construction of the projects identified in this Plan.

1. The Alaska Clean Water Fund (ACWF) and the Alaska Drinking Water Fund (ADWF). These funds are two ADEC loan fund programs that offer low interest loans to Alaskan municipalities and other qualified entities for financing water, wastewater and water quality related projects. Loans can finance up to 100 percent of a project's eligible costs for planning, design and construction of publicly owned facilities. In addition, loans can serve as local match most other federal or state funding sources. Projects under this Plan would fall under the ACWF.
2. Alaska Clean Water Actions Program (ACWA). This program is a collaboration between the ADEC, the Department of Fish and Game, and the Department of Natural Resources to restore, protect, and conserve the quality of Alaska's aquatic resources. Projects considered for this funding should work to address nonpoint source pollution restoration, protection, or stewardship activities. These grants are smaller than the State Revolving Fund and require a nonfederal match. The program issues a Request for Proposal (RFP) every other year, and the next RFP is anticipated in fall 2020. This Plan was partially funded through an ACWA grant.
3. City of Wasilla. The City of Wasilla may have funding to contribute toward implementation of the facilities presented in this plan, depending on future budgets and funding allocations.

9. Public Involvement

During the development of this Plan, the project team coordinated with landowners, stakeholders, and project partners. Their involvement was critical to developing sustainable and feasible project solutions. Phone calls, email communications, and one-on-one meetings were held with the following project stakeholders, landowners, businesses, and partners:

1. State of Alaska DOT&PF
2. Burchell High School
3. The Alaska Railroad
4. Alaska Department of Fish & Game

5. Alaska Department of Environmental Conservation
6. Matsu Water LLC
7. Spenard Builder Supply
8. Best Western Lake Lucille

The Draft Lake Lucile Lake Management Plan was released to the public and project stakeholders for review and comment on May 12, 2020. The public comment period was open for three and a half weeks and comments were accepted until June 5, 2020. The Draft Plan was publicized in the following locations:

1. City of Wasilla Website: https://www.cityofwasilla.com/departments/public-works/projects
2. City of Wasilla eNotification (5/12/2020)
3. Project Stakeholder Email Notification (5/19/2020)

COVID-19 presented challenges to community outreach. In lieu of a public meeting, the project team developed a virtual story map to describe the project, potential solutions, and broadly educate the public about facilities that could improve the water quality of Lake Lucile. The virtual story map is available at the following website: https://huddle.maps.arcgis.com/apps/MapSeries/index.html?appid=067ae870a6a84ff19a3c249686ca06e3

A complete record of public notices and comments received are available in Appendix D. This includes the documents listed below.

1. City of Wasilla Website Notice
2. City of Wasilla eNotification (5/12/2020)
3. Project Stakeholder Email Notification (5/19/2020)
4. Comment-Response Table

10. References Used in the Development of this Plan

- Alaska Department of Environmental Conservation, Alaska Clean Water Actions web page. Accessed on June 29, 2020. https://dec.alaska.gov/water/water-actions/
- Alaska Department of Environmental Conservation, Alaska Clean Water Fund (ACWF) and the Alaska Drinking Water Fund (ADWF) web page. Accessed on June 30, 2020. https://dec.alaska.gov/water/technical-assistance-and-financing/state-revolving-fund/loan-overview
- Covich, Alan P., Margaret A. Palmer, and Todd A. Crowl. *The Role of Benthic Invertebrate Species in Freshwater Ecosystems: Zoobenthic species influence energy flows and nutrient cycling*. BioScience. 49(2), 1999.
- Davis, Jeffrey C., Gay A. Davis, and Rachel J Burns. *Lake Lucile Sediment Quality Sampling: Spatial Extent of Impaired Sediment due to Outfall Stormwater Inputs*. Aquatic Restoration and Research Institute. Prepared for Alaska Department of Environmental Conservation, 2013.
- Municipality of Anchorage. *Anchorage Stormwater Manual Volume 1*, 2017.
- Perrin, Christy. *Polycyclic Aromatic Hydrocarbons (PAHs) in Urban Waterways*. North Carolina State University Cooperative Extension Services, 2012.
- Port of Portland. *Stormwater Pollutant Factsheet*. Accessed online 2020: https://popcdn.azureedge.net/pdfs/StrmWtr-FactSheet-Pollutant-Metals.pdf

Appendix A: Water Quality Data from EPA National BMP Database

Lake Lucile Lake Management Plan
Pollutant Removal Data for Proposed Remedial Actions

Table 1: Summary of Expected Pollutant Reduction Ranges for Proposed Remedial Action Facilities

BMP Type	TSS			Lead			Copper			Zinc		
	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max
Bioretention	41%	84%	100%	26%	69%	94%	26%	53%	82%	36%	72%	94%
Grass Swale	18%	47%	70%	26%	51%	74%	13%	43%	65%	11%	48%	87%
Wetland Channel	21%	50%	79%	19%	47%	70%	13%	32%	53%	33%	46%	60%
Oil Grit Separator	24%	49%	88%	20%	45%	94%	13%	39%	67%	22%	37%	55%

Table 2A: TSS Reduction in Biorention Facilities

BMP Site Name	***No. Sample Events***	***Precip Min (in)***	***Precip Max (in)***	***Pollutant Reduction Min (%)***	***Pollutant Reduction Avg (%)***	***Pollutant Reduction Max (%)***
UDFCD Rain Garden	60	0.08	2.28	0%	92%	100%
WA Ecology Embankment at SR 167 MP 16.4	25	0.15	1.29	69%	91%	100%
Bioretention 6	25	0.12	5.35	25%	72%	92%
Bioretention Cell	24	0.35	2.09	12%	72%	100%
Hal Marshall Bioretention Cell	22	0.25	2.43	3%	59%	95%
Parks & Forestry Bioretention	22	0.20	4.41	30%	78%	98%
Small Cell	20	NA	NA	3%	41%	95%
Bioretention 3B	19	0.12	1.89	44%	78%	97%
Bioretention Cells	19	0.28	2.20	4%	52%	92%
BRC_B	16	0.16	2.61	29%	72%	94%
BRC_A	15	0.16	2.61	38%	65%	85%
Tree Filter	15	0.10	2.37	6%	78%	99%
Bioretention System (D1)	13	0.10	2.34	20%	76%	98%
UC Bioretention	10	0.20	1.26	3%	68%	97%
Parking Lot Bioretention Cell	10	0.12	0.59	0%	67%	92%
FC Bioretention Cell Retro	9	0.16	1.52	41%	66%	98%
Cub_Run_Bioretention	9	0.15	2.36	75%	88%	97%
Cell SS	8	0.08	4.06	13%	64%	98%
Traffic Island	8	0.41	4.89	33%	79%	98%
Cell CP	8	0.08	4.06	38%	81%	99%
BP1	8	NA	NA	63%	82%	92%
BP3	7	NA	NA	94%	97%	99%
BP2	7	NA	NA	96%	98%	99%
RMGC_Bioretention	7	0.16	0.84	78%	86%	90%
1222	6	NA	NA	28%	65%	96%
CHS_BioFilter	6	0.31	3.47	9%	74%	92%
Rocky Mount Grassed Bioretention Cell 2	5	0.52	1.26	0%	51%	73%
Bioretention Area	4	0.29	1.21	37%	70%	85%
Rocky Mount Grassed Bioretention Cell 1	3	1.94	2.09	35%	58%	78%

Notes:

1) Data compiled from EPA's National BMP Database.
2) Pollutant reduction is generally higher for smaller rain events and larger influent pollutant concentrations.

Table 2B: Lead Reduction in Biorention Facilities

BMP Site Name	*No. Sample Events*	*Precip Min (in)*	*Precip Max (in)*	*Pollutant Reduction Min (%)*	*Pollutant Reduction Avg (%)*	*Pollutant Reduction Max (%)*
UDFCD Rain Garden	54	0.08	2.28	7%	77%	98%
Bioretention Cell	11	0.35	2.09	50%	85%	100%
Hal Marshall Bioretention Cell	10	0.25	2.43	9%	26%	53%
UC Bioretention	9	0.20	1.26	11%	68%	95%
BP1	8	NA	NA	28%	62%	85%
BP3	7	NA	NA	81%	91%	96%
BP2	7	NA	NA	92%	94%	96%
Cell CP	4	0.08	4.06	33%	63%	85%
Cell SS	3	0.08	0.18	0%	39%	60%
Cub_Run_Bioretention	3	0.62	0.62	86%	90%	93%

Table 2C: Copper Reduction in Biorention Facilities

BMP Site Name	*No. Sample Events*	*Precip Min (in)*	*Precip Max (in)*	*Pollutant Reduction Min (%)*	*Pollutant Reduction Avg (%)*	*Pollutant Reduction Max (%)*
UDFCD Rain Garden	44	0.08	2.28	0%	52%	94%
Hal Marshall Bioretention Cell	21	0.25	2.43	8%	54%	85%
Bioretention 3B	19	0.12	1.89	7%	44%	86%
Bioretention Cell	18	0.35	2.09	5%	66%	99%
Bioretention 6	17	0.12	5.35	5%	46%	82%
WA Ecology Embankment at SR 167 MP 16.4	13	0.16	0.73	44%	80%	93%
Parks & Forestry Bioretention	12	0.20	4.41	22%	55%	86%
BP1	8	NA	NA	70%	82%	87%
Parking Lot Bioretention Cell	7	0.16	0.59	0%	42%	84%
BP3	7	NA	NA	70%	81%	90%
BP2	7	NA	NA	69%	82%	92%
Bioretention Cells	7	0.28	2.20	7%	30%	87%
Cub_Run_Bioretention	7	0.15	2.36	9%	60%	96%
Cell SS	5	0.08	4.06	0%	26%	74%
Cell CP	5	0.08	4.06	6%	30%	52%
UC Bioretention	3	0.20	1.26	8%	27%	59%

Notes:

1) Data compiled from EPA's National BMP Database.
2) Pollutant reduction is generally higher for smaller rain events and larger influent pollutant concentrations.

Table 2D: Zinc Reduction in Biorention Facilities

BMP Site Name	*No. Sample Events*	*Precip Min (in)*	*Precip Max (in)*	*Pollutant Reduction Min (%)*	*Pollutant Reduction Avg (%)*	*Pollutant Reduction Max (%)*
UDFCD Rain Garden	55	0.08	2.28	6%	77%	98%
WA Ecology Embankment at SR 167 MP 16.4	25	0.15	1.29	67%	85%	95%
Bioretention Cell	24	0.35	2.09	4%	69%	100%
Hal Marshall Bioretention Cell	22	0.25	2.43	51%	77%	95%
Parks & Forestry Bioretention	21	0.20	4.41	0%	66%	98%
Bioretention Cells	20	0.28	2.20	0%	36%	79%
Bioretention 3B	18	0.12	1.89	36%	79%	98%
Bioretention 6	17	0.12	5.35	6%	52%	81%
Bioretention System (D1)	15	0.10	2.35	33%	82%	97%
Tree Filter	12	0.10	2.37	19%	77%	99%
UC Bioretention	10	0.20	1.26	15%	53%	89%
Cell SS	8	0.08	4.06	29%	66%	89%
Cell CP	8	0.08	4.06	20%	68%	94%
BP1	8	NA	NA	77%	86%	91%
Cub_Run_Bioretention	8	0.15	2.36	47%	68%	96%
BP3	7	NA	NA	86%	93%	96%
BP2	7	NA	NA	90%	94%	96%
Small Cell	3	NA	NA	68%	75%	80%

Notes:

1) Data compiled from EPA's National BMP Database.
2) Pollutant reduction is generally higher for smaller rain events and larger influent pollutant concentrations.

Table 3A: TSS Reduction in Grass Swale Facilities

BMP Site Name	*No. Sample Events*	*Precip Min (in)*	*Precip Max (in)*	*Pollutant Reduction Min (%)*	*Pollutant Reduction Avg (%)*	*Pollutant Reduction Max (%)*
Bioswale	34	0.18	1.72	34%	66%	90%
Swale	26	0.01	3.68	13%	47%	86%
Brodie Lane Swale	16	0.35	5.98	2%	50%	97%
Alta Vista Planned Development Detention w/ swales	14	0.21	2.00	0%	30%	66%
F8 - Asphalt w/ Swale	13	0.43	2.91	8%	44%	89%
Vegetated Swale	12	0.20	2.37	8%	61%	99%
F7 - Asphalt w/ Swale	11	0.36	2.91	5%	43%	82%
Palomar Swale	9	0.33	1.83	43%	60%	74%
AlbanyNZSwale	9	0.42	2.43	22%	70%	93%
Wilson	8	0.30	1.30	27%	66%	94%
29 S Swale	7	0.70	2.15	4%	32%	62%
Dayton Biofilter - Grass Swale	6	0.20	2.32	20%	54%	89%
Bioswale Non-Native West	6	NA	NA	34%	59%	92%
Bioswale Native East	6	NA	NA	55%	68%	94%
Del Amo	6	0.30	3.47	35%	68%	93%
5/605 swale	6	0.21	2.57	30%	62%	89%
Cerritos	6	0.16	3.47	6%	37%	60%
Univ Cent FL Swale Block A	6	0.41	2.35	38%	63%	81%
Russell Pond Bioswale	5	0.24	0.68	0%	37%	71%
West Swale	4	0.01	0.32	0%	18%	44%
Melrose	4	0.58	1.78	33%	57%	77%
29 N Swale Sect 4	4	0.36	2.53	3%	27%	53%
NCDOT_Swale_A	4	0.32	3.93	0%	22%	50%
East Swale	3	0.01	0.32	0%	18%	48%
605/91 swale	3	0.83	3.47	18%	33%	51%
29 N Swale B	3	0.36	1.61	24%	36%	53%

Notes:

1) Data compiled from EPA's National BMP Database.
2) Pollutant reduction is generally higher for smaller rain events and larger influent pollutant concentrations.

Table 3B: Lead Reduction in Grass Swale Facilities

BMP Site Name	No. Sample Events	Precip Min (in)	Precip Max (in)	Pollutant Reduction Min (%)	Pollutant Reduction Avg (%)	Pollutant Reduction Max (%)
F7 - Asphalt w/ Swale	20	0.36	2.60	0%	26%	83%
F8 - Asphalt w/ Swale	17	0.36	2.91	0%	41%	70%
Alta Vista Planned Development Detention w/ swales	11	0.21	2.00	0%	37%	88%
West Swale	10	0.01	0.32	20%	50%	88%
East Swale	10	0.01	0.32	32%	52%	90%
Palomar Swale	8	0.33	1.83	42%	57%	67%
Cerritos	8	0.16	3.47	3%	49%	90%
Dayton Biofilter - Grass Swale	6	0.20	2.32	0%	53%	95%
Bioswale Non-Native West	6	NA	NA	20%	49%	88%
Bioswale Native East	6	NA	NA	32%	54%	90%
Del Amo	6	0.30	3.47	24%	61%	80%
5/605 swale	6	0.21	2.57	35%	64%	85%
Russell Pond Bioswale	5	0.24	0.68	20%	40%	56%
Melrose	5	0.58	1.78	40%	64%	78%
605/91 swale	3	0.83	3.47	61%	74%	84%

Table 3C: Copper Reduction in Grass Swale Facilities

BMP Site Name	No. Sample Events	Precip Min (in)	Precip Max (in)	Pollutant Reduction Min (%)	Pollutant Reduction Avg (%)	Pollutant Reduction Max (%)
Bioswale	32	0.18	1.72	6%	41%	70%
F7 - Asphalt w/ Swale	17	0.36	2.91	11%	46%	82%
F8 - Asphalt w/ Swale	16	0.36	2.91	1%	38%	97%
East Swale	10	0.01	0.32	15%	40%	82%
West Swale	9	0.01	0.32	26%	43%	80%
Palomar Swale	8	0.33	1.83	32%	49%	58%
Cerritos	8	0.16	3.47	16%	43%	80%
AlbanyNZSwale	8	0.42	2.43	45%	65%	81%
Dayton Biofilter - Grass Swale	6	0.20	2.32	11%	41%	74%
Bioswale Native East	6	NA	NA	16%	41%	82%
Del Amo	6	0.30	3.47	0%	42%	66%
5/605 swale	6	0.21	2.57	26%	55%	78%
Bioswale Non-Native West	5	NA	NA	27%	43%	80%
Melrose	5	0.58	1.78	48%	64%	86%
Swale	5	0.01	3.14	0%	25%	53%
Brodie Lane Swale	5	0.48	1.59	19%	54%	72%
Russell Pond Bioswale	4	0.24	0.68	3%	13%	25%
605/91 swale	3	0.83	3.47	29%	31%	34%

Notes:

1) Data compiled from EPA's National BMP Database.
2) Pollutant reduction is generally higher for smaller rain events and larger influent pollutant concentrations.

Table 3D: Zinc Reduction in Grass Swale Facilities

BMP Site Name	*No. Sample Events*	*Precip Min (in)*	*Precip Max (in)*	*Pollutant Reduction Min (%)*	*Pollutant Reduction Avg (%)*	*Pollutant Reduction Max (%)*
Bioswale	34	0.18	1.72	2%	44%	74%
F8 - Asphalt w/ Swale	20	0.36	2.91	0%	24%	60%
F7 - Asphalt w/ Swale	16	0.36	2.91	0%	23%	79%
Alta Vista Planned Development Detention w/ swales	14	0.21	2.00	0%	23%	77%
Vegetated Swale	13	0.20	2.37	4%	57%	96%
West Swale	10	0.01	0.32	26%	54%	87%
East Swale	10	0.01	0.32	34%	56%	90%
Palomar Swale	8	0.33	1.83	46%	63%	74%
Cerritos	8	0.16	3.47	36%	63%	86%
AlbanyNZSwale	8	0.42	2.43	77%	87%	94%
Brodie Lane Swale	7	0.35	5.98	1%	11%	47%
Bioswale Non-Native West	6	NA	NA	26%	51%	87%
Bioswale Native East	6	NA	NA	35%	57%	90%
Del Amo	6	0.30	3.47	36%	57%	73%
5/605 swale	6	0.21	2.57	67%	79%	88%
Melrose	5	0.58	1.78	71%	81%	88%
Dayton Biofilter - Grass Swale	4	0.67	2.32	35%	53%	80%
Russell Pond Bioswale	4	0.24	0.68	2%	17%	50%
605/91 swale	4	0.83	3.47	62%	70%	79%
29 S Swale	4	0.70	2.15	0%	18%	48%
29 N Swale B	4	0.36	1.61	8%	14%	23%
Swale	3	0.01	3.14	50%	57%	66%

Notes:

1) Data compiled from EPA's National BMP Database.
2) Pollutant reduction is generally higher for smaller rain events and larger influent pollutant concentrations.

Table 4A: TSS Reduction in Wetland Channel Facilities

BMP Site Name	*No. Sample Events*	*Precip Min (in)*	*Precip Max (in)*	*Pollutant Reduction Min (%)*	*Pollutant Reduction Avg (%)*	*Pollutant Reduction Max (%)*
Lake McCarrons Wetland	23	0.13	2.58	42%	79%	95%
VillaParkWetlands	17	NA	NA	20%	42%	72%
Shop Creek Wetland (90-94)	16	0.15	2.46	0%	30%	85%
Shop Creek Wetland (95-97)	15	0.10	2.11	20%	66%	93%
Megginis Ck. Marsh	12	NA	NA	25%	69%	100%
DUST Marsh System B	10	0.35	1.53	3%	32%	74%
Down3	9	NA	NA	14%	65%	92%
DUST Marsh System A	9	0.35	1.53	17%	39%	85%
NCDOT_Wet_Swale_B	9	0.28	3.92	0%	47%	84%
Down1	7	NA	NA	7%	45%	82%
Step Pool	7	0.28	1.67	30%	62%	91%
Silver Star Rd Wetland	5	0.26	2.49	0%	21%	42%
NCDOT_Wet_Swale_C	5	0.22	3.79	11%	34%	67%
Down2	4	NA	NA	28%	42%	53%
Mobile Bay Constructed Wetland	4	0.36	2.60	18%	51%	93%
Tanners Lake Wetland	4	0.18	0.50	59%	64%	74%
8-Mile Wetland	3	0.15	0.30	40%	56%	85%

Notes:

1) Data compiled from EPA's National BMP Database.
2) Pollutant reduction is generally higher for smaller rain events and larger influent pollutant concentrations.

Table 4B: Lead Reduction in Wetland Channel Facilities

BMP Site Name	*No. Sample Events*	*Precip Min (in)*	*Precip Max (in)*	*Pollutant Reduction Min (%)*	*Pollutant Reduction Avg (%)*	*Pollutant Reduction Max (%)*
Lake McCarrons Wetland	24	0.13	2.58	20%	70%	93%
VillaParkWetlands	17	NA	NA	0%	45%	83%
DUST Marsh System B	11	0.35	1.53	0%	19%	52%
DUST Marsh System A	11	0.35	1.53	0%	25%	53%
Down3	9	NA	NA	11%	62%	93%
Down1	7	NA	NA	9%	37%	78%
Step Pool	7	0.28	1.67	0%	36%	75%
Silver Star Rd Wetland	6	0.26	2.49	54%	69%	90%
Down2	4	NA	NA	22%	42%	62%
Tanners Lake Wetland	4	0.18	0.50	59%	67%	80%

Table 4C: Copper Reduction in Wetland Channel Facilities

BMP Site Name	*No. Sample Events*	*Precip Min (in)*	*Precip Max (in)*	*Pollutant Reduction Min (%)*	*Pollutant Reduction Avg (%)*	*Pollutant Reduction Max (%)*
VillaParkWetlands	17	NA	NA	7%	25%	73%
Shop Creek Wetland (90-94)	16	0.13	2.46	0%	13%	67%
DUST Marsh System B	12	0.35	1.53	0%	27%	50%
Down3	9	NA	NA	6%	53%	91%
DUST Marsh System A	8	0.35	1.53	0%	23%	50%
Step Pool	6	0.28	1.67	0%	41%	79%
Down1	5	NA	NA	12%	29%	54%
Down2	4	NA	NA	18%	49%	65%

Table 4D: Zinc Reduction in Wetland Channel Facilities

BMP Site Name	*No. Sample Events*	*Precip Min (in)*	*Precip Max (in)*	*Pollutant Reduction Min (%)*	*Pollutant Reduction Avg (%)*	*Pollutant Reduction Max (%)*
VillaParkWetlands	22	NA	NA	0%	38%	77%
Shop Creek Wetland (90-94)	20	0.13	2.46	0%	39%	86%
Shop Creek Wetland (95-97)	13	0.11	2.11	0%	53%	80%
DUST Marsh System A	11	0.35	1.53	0%	42%	96%
Down3	9	NA	NA	11%	57%	88%
DUST Marsh System B	9	0.35	1.53	0%	46%	75%
Down1	6	NA	NA	7%	33%	87%
Silver Star Rd Wetland	6	0.26	2.49	44%	60%	91%
Step Pool	6	0.28	1.67	2%	47%	85%
Down2	4	NA	NA	21%	48%	69%

Notes:

1) Data compiled from EPA's National BMP Database.
2) Pollutant reduction is generally higher for smaller rain events and larger influent pollutant concentrations.

Table 5A: TSS Reduction in Oil Grit Seperator Facilities

BMP Site Name	*No. Sample Events*	*Precip Min (in)*	*Precip Max (in)*	*Pollutant Reduction Min (%)*	*Pollutant Reduction Avg (%)*	*Pollutant Reduction Max (%)*
T30 south oil water separator	33	0.16	1.80	3%	31%	56%
Water Quality Unit	27	0.24	5.87	2%	39%	84%
TST Unit	15	NA	NA	0%	24%	65%
45th & Duval O/G seperator	11	0.04	1.12	36%	55%	80%
BMP4	10	0.06	1.08	3%	60%	92%
Willis Drive Baffle Box	7	0.27	2.90	20%	57%	90%
Addison-Wesley Incterceptor	6	0.63	1.47	49%	63%	90%
Alameda	5	0.20	1.69	66%	88%	99%
AR	5	0.46	1.88	8%	29%	69%
ARC Oil Seperator	5	0.46	1.88	8%	29%	69%
Boeing Oil/Water Separator	5	0.21	0.68	50%	68%	78%

Notes:

1) Data compiled from EPA's National BMP Database.
2) Pollutant reduction is generally higher for smaller rain events and larger influent pollutant concentrations.

Table 5B: Lead Reduction in Oil Grit Seperator Facilities

BMP Site Name	*No. Sample Events*	*Precip Min (in)*	*Precip Max (in)*	*Pollutant Reduction Min (%)*	*Pollutant Reduction Avg (%)*	*Pollutant Reduction Max (%)*
BMP4	12	0.06	1.08	0%	49%	96%
45th & Duval O/G seperator	8	0.04	1.12	13%	56%	94%
Boeing Oil/Water Separator	7	0.21	0.68	78%	94%	100%
Addison-Wesley Incterceptor	6	0.63	1.47	22%	47%	69%
AR	6	0.46	1.78	5%	20%	35%
ARC Oil Seperator	6	0.46	1.78	5%	20%	35%
WC - OG	3	1.78	2.01	8%	27%	62%

Table 5C: Copper Reduction in Oil Grit Seperator Facilities

BMP Site Name	*No. Sample Events*	*Precip Min (in)*	*Precip Max (in)*	*Pollutant Reduction Min (%)*	*Pollutant Reduction Avg (%)*	*Pollutant Reduction Max (%)*
Water Quality Unit	23	0.31	5.87	0%	26%	75%
BMP4	11	0.06	1.08	1%	43%	93%
45th & Duval O/G seperator	8	0.04	1.12	15%	43%	76%
AR	6	0.46	1.88	18%	38%	69%
ARC Oil Seperator	6	0.46	1.88	18%	38%	69%
Boeing Oil/Water Separator	6	0.21	0.68	0%	13%	23%
Addison-Wesley Incterceptor	5	0.63	1.47	2%	41%	78%
Baffle Box	3	0.34	1.66	50%	67%	80%
WC - OG	3	1.78	2.01	23%	41%	65%

Table 5D: Zinc Reduction in Oil Grit Seperator Facilities

BMP Site Name	*No. Sample Events*	*Precip Min (in)*	*Precip Max (in)*	*Pollutant Reduction Min (%)*	*Pollutant Reduction Avg (%)*	*Pollutant Reduction Max (%)*
Water Quality Unit	24	0.31	5.87	0%	36%	75%
BMP4	11	0.06	1.08	8%	55%	95%
45th & Duval O/G seperator	7	0.04	1.12	11%	43%	77%
Addison-Wesley Incterceptor	4	0.63	1.47	14%	43%	85%
AR	4	0.46	1.88	12%	22%	37%
ARC Oil Seperator	4	0.46	1.88	12%	22%	37%
WC - OG	3	0.17	2.01	19%	42%	71%

Notes:

1) Data compiled from EPA's National BMP Database.
2) Pollutant reduction is generally higher for smaller rain events and larger influent pollutant concentrations.

Appendix B: Cost Estimates

Lake Lucile Lake Management Plan

Herning Ave. and Knik St. Bioretention (Bioretention/Infiltration Swale)

Concept Level Engineer's Estimate

Item No.	MASS Section No.	Work Description	Unit	Estimated Quantity	Price	Amount
1	20.02	Storm Water Pollution Prevention Plan	LS	1	$ 2,500	$ 2,500
2	20.07	Removal of Sidewalk	SY	30	$ 45	$ 1,350
3	20.08	Removal of Curb and Gutter	LF	70	$ 8	$ 560
4	20.09	Removal of Pavement	SY	140	$ 6	$ 840
5	20.10	Unusable Excavation	CY	660	$ 22	$ 14,520
6	20.13	Trench Excavation and Backfill	LF	80	$ 22	$ 1,760
7	20.21	Classified Fill and Backfill (Type IIA)	TN	50	$ 45	$ 2,250
8	20.22	Level Course	TN	16	$ 45	$ 720
9	20.23	Cobbles	TN	4	$ 240	$ 960
10	30.02	P.C.C. Curb & Gutter (Type I)	LF	70	$ 25	$ 1,750
11	30.03/30.04	P.C.C. Sidewalk (4" Thick) (Standard Finish) / P.C.C. Curb Ramp	SY	30	$ 250	$ 7,500
12	40.06	A.C. Pavement (Class A)	TN	16	$ 170	$ 2,720
13	55.02	Furnish, Install and Televise 10" CPEP, Type S	LF	80	$ 60	$ 4,800
14	55.03	F&I Subdrain w/Geotextile (8" CPEP)	LF	220	$ 66	$ 14,520
15	55.04	Connect to Existing Catch Basin	EA	2	$ 1,000	$ 2,000
16	55.09	Construct Type 1 Catch Basin/Manhole	EA	2	$ 5,500	$ 11,000
17	55.14	Construct Storm Drain Cleanout	EA	2	$ 750	$ 1,500
18	65.02	Construction Surveying	LS	1	$ 2,500	$ 2,500
19	70.12	Traffic Maintenance	LS	1	$ 4,000	$ 4,000
20	70.11	Remove and Relocate Sign	EA	1	$ 100	$ 100
21	75.03	Topsoil, 4"	MSF	2	$ 600	$ 1,200
22	75.04	Seeding (Schedule A)	MSF	2	$ 340	$ 680
23		Construct Catch Basin Overflow Weir	EA	1	$ 500	$ 500
24		Sidewalk Drain and Curb Cut	EA	4	$ 500	$ 2,000
25		Engineered Soil	CY	340	$ 45	$ 15,300
26		Bioretention Vegetation	LS	1	$ 4,000	$ 4,000
				Construction Total		$ 101,530

Construction Contingency (30%)	$ 30,500
Design (40%)	$ 40,700
Overhead and Administration (15%)	$ 15,300
Utility Conflicts and Coordination	$ 15,000
Total Project Cost	**$ 210,000**

Lake Lucile Lake Management Plan

Herning Ave. and Knik St. Bioretention (Bioretention/Infiltration Swale)

Key Assumptions and Estimate Notes

1. The facility concept layout utilizes a 15-foot wide strip (approx.) behind the existing sidewalk. The layout maintains a single 25-foot wide driveway along Herning Ave. Additional driveways can be added if needed.
2. The estimate assumes that site conditions (such as underlying soil types, depth to bedrock/limiting strata, and groundwater levels) are appropriate for a facility without an impermeable liner.
3. Utility Notes:
    a. Utility conflict costs are generally a placeholder. More information is needed to provide accurate prices.
    b. There is a gas line that runs along the west side of the proposed parking lot. This estimate assumes the gas line will not require relocation and will need to be supported during construction.
    c. Estimate assumes an existing junction box and power pole at the SW corner of the intersection can be supported while connecting to the nearby existing catch basin.
    d. Assumes no other utility conflicts.
4. Estimate is generally based on average unit prices from the most current MOA bid tabulations (2018).

Lake Lucile Lake Management Plan

Swanson Ave. and Willow St. Bioretention (Swale)

Concept Level Engineer's Estimate

Item No.	MASS Section No.	Work Description	Unit	Estimated Quantity	Price	Amount
1	20.02	Storm Water Pollution Prevention Plan	LS	1	$ 2,500	$ 2,500
2	20.06	Tree Removal	EA	2	$ 200	$ 400
3	20.07	Removal of Sidewalk	SY	5	$ 45	$ 225
4	20.08	Removal of Curb and Gutter	LF	12	$ 8	$ 96
5	20.09	Removal of Pavement	SY	100	$ 6	$ 600
6	20.10	Unusable Excavation	CY	135	$ 25	$ 3,375
7	20.13	Trench Excavation and Backfill	LF	30	$ 22	$ 660
8	20.21	Classified Fill and Backfill (Type IIA)	TN	25	$ 45	$ 1,125
9	20.22	Level Course	TN	8	$ 45	$ 360
10	20.23	Cobbles	TN	2	$ 240	$ 480
11	30.02	P.C.C. Curb & Gutter (Type I)	LF	12	$ 25	$ 300
12	30.03	P.C.C. Sidewalk (4" Thick) (Standard Finish)	SY	5	$ 67	$ 335
13	40.06	A.C. Pavement (Class A)	TN	8	$ 170	$ 1,360
14	55.02	Furnish, Install and Televise 10" CPEP, Type S	LF	30	$ 60	$ 1,800
15	55.03	F&I Subdrain w/Geotextile (8" CPEP)	LF	100	$ 66	$ 6,600
16	55.09	Construct Type 1 Catch Basin/Manhole	EA	2	$ 5,500	$ 11,000
17	55.14	Construct Storm Drain Cleanout	EA	1	$ 750	$ 750
18	65.02	Construction Surveying	LS	1	$ 1,000	$ 1,000
19	70.08	Removal of Fence	LF	130	$ 10	$ 1,300
20	70.12	Traffic Maintenance	LS	1	$ 2,000	$ 2,000
21	70.11	Remove and Relocate Sign	EA	1	$ 100	$ 100
22	75.03	Topsoil, 4"	MSF	1	$ 600	$ 600
23	75.04	Seeding (Schedule A)	MSF	1	$ 340	$ 340
24		Support Underground Electric During Construction	LS	1	$ 1,000	$ 1,000
25		Sidewalk Drain and Curb Cut	EA	2	$ 500	$ 1,000
26		Engineered Soil	CY	55	$ 45	$ 2,475
27		Bioretention Vegetation	LS	1	$ 1,000	$ 1,000
				Construction Total		$ 42,781

Construction Contingency (30%)	$ 12,900
Design (40%)	$ 17,200
Overhead and Administration (15%)	$ 6,500
Utility Conflicts and Coordination	$ 5,000
Total Project Cost	**$ 90,000**

Lake Lucile Lake Management Plan

Swanson Ave. and Willow St. Bioretention (Swale)

Key Assumptions and Estimate Notes

1. The facility layout would utilize space behind the existing sidewalk and would remove two parking spaces from the parking lot.
2. The estimate assumes that site conditions (such as underlying soil types, depth to bedrock/limiting strata, and groundwater levels) are appropriate for a facility without an impermeable liner.
3. Utility Notes:
    a. Utility conflict costs are generally a placeholder. More information is needed to provide accurate prices.
    b. There is an electric line running along west side of the proposed facility. The estimate assumes this line can be left in place and worked around during construction.
    c. Estimate assumes the junction box and light pole at SE corner of intersection will not be impacted and can be supported during construction.
    d. Assumes no other utility conflicts.
4. Estimate is generally based on average unit prices from the most current MOA bid tabulations (2018).

Lake Lucile Lake Management Plan

Nelson Ave. Bioretention (Bioretention/Infiltration Swale)

Concept Level Engineer's Estimate

Item No.	MASS Section No.	Work Description	Unit	Estimated Quantity	Price	Amount
1	20.02	Storm Water Pollution Prevention Plan	LS	1	$ 6,000	$ 6,000
2	20.06	Tree Removal	EA	30	$ 100	$ 3,000
3	20.08	Removal of Curb and Gutter	LF	22	$ 8	$ 176
4	20.09	Removal of Pavement	SY	240	$ 6	$ 1,440
5	20.10	Unusable Excavation	CY	3,670	$ 18	$ 66,060
6	20.13	Trench Excavation and Backfill	LF	50	$ 22	$ 1,100
7	20.21	Classified Fill and Backfill (Type IIA)	TN	75	$ 45	$ 3,375
8	20.22	Level Course	TN	25	$ 45	$ 1,125
9	20.23	Cobbles	TN	4	$ 240	$ 960
10	30.02	P.C.C. Curb & Gutter (Type I)	LF	22	$ 25	$ 550
11	40.06	A.C. Pavement (Class A)	TN	30	$ 170	$ 5,100
12	55.02	Furnish, Install and Televise 10" CPEP, Type S	LF	50	$ 60	$ 3,000
13	55.03	F&I Subdrain w/Geotextile (8" CPEP)	LF	750	$ 60	$ 45,000
14	55.04	Connect to Existing Catch Basin	EA	2	$ 1,000	$ 2,000
15	55.09	Construct Type 1 Catch Basin/Manhole	EA	4	$ 5,500	$ 22,000
16	55.11	Remove Catch Basin	EA	4	$ 1,000	$ 4,000
17	5.13	Abandon Existing Catch Basin Lead	EA	2	$ 700	$ 1,400
18	55.14	Construct Storm Drain Cleanout	EA	3	$ 750	$ 2,250
19	65.02	Construction Surveying	LS	1	$ 4,000	$ 4,000
20	70.07	Remove Pipe	LF	20	$ 50	$ 1,000
21	70.12	Traffic Maintenance	LS	1	$ 4,000	$ 4,000
22	75.03	Topsoil, 4"	MSF	6	$ 600	$ 3,600
23	75.04	Seeding (Schedule A)	MSF	6	$ 340	$ 2,040
24		Construct Catch Basin Overflow Weir	EA	2	$ 500	$ 1,000
25		Sidewalk Drain and Curb Cut	EA	4	$ 500	$ 2,000
26		Engineered Soil	CY	2,000	$ 45	$ 90,000
27		Bioretention Vegetation	LS	1	$ 20,000	$ 20,000
				Construction Total		$ 296,176

Construction Contingency (30%)	$ 88,900
Design (30%)	$ 88,900
Overhead and Administration (15%)	$ 44,500
Utility Conflicts and Coordination	$ -
Total Project Cost	**$ 520,000**

Lake Lucile Lake Management Plan

Nelson Ave. Bioretention (Bioretention/Infiltration Swale)

Key Assumptions and Estimate Notes

1. Estimate assumes existing, large business sign will not require relocation and can be worked around during construction.
2. The estimate assumes that site conditions (such as underlying soil types, depth to bedrock/limiting strata, and groundwater levels) are appropriate for a facility without an impermeable liner.
3. Utility Notes
    a. Utility conflict costs are generally a placeholder. More information is needed to provide accurate prices.
    b. There is an existing force main along the same alignment as the proposed facility. This estimate assumes the force main elevation is below the bottom of the proposed facility and will not be impacted.
    c. Assumes no other utility conflicts.
4. Estimate is generally based on average unit prices from the most current MOA bid tabulations (2018).

Lake Lucile Lake Management Plan

Parks Hwy. at Swanson Ave. Bioretention (Enhanced Ditches)

Concept Level Engineer's Estimate

Item No.	MASS Section No.	Work Description	Unit	Estimated Quantity	Price	Amount
1	20.02	Storm Water Pollution Prevention Plan	LS	1	$ 3,000	$ 3,000
2	20.06	Tree Removal	EA	10	$ 100	$ 1,000
3	20.09	Removal of Pavement	SY	95	$ 6	$ 570
4	20.10	Unusable Excavation	CY	535	$ 18	$ 9,630
5	20.13	Trench Excavation and Backfill	LF	60	$ 22	$ 1,320
6	20.21	Classified Fill and Backfill (Type IIA)	TN	30	$ 45	$ 1,350
7	20.22	Level Course	TN	10	$ 45	$ 450
8	20.23	Cobbles	TN	3	$ 240	$ 720
9	55.02	Furnish, Install and Televise 18" CMP	LF	60	$ 90	$ 5,400
10	65.02	Construction Surveying	LS	1	$ 5,000	$ 5,000
11	70.12	Traffic Maintenance	LS	1	$ 2,000	$ 2,000
12	75.03	Topsoil, 4"	MSF	26	$ 530	$ 13,780
13	75.04	Seeding (Schedule B)	MSF	26	$ 350	$ 9,100
14		Check Dam and/or Inlet Modification	EA	1	$ 2,500	$ 2,500
15		Pathway Drain and Curb Cut	EA	2	$ 1,000	$ 2,000
16		Engineered Soil	CY	525	$ 45	$ 23,625
				Construction Total		$ 81,445

Construction Contingency (30%)	$ 24,500
Design (40%)	$ 32,600
Overhead and Administration (15%)	$ 12,300
Utility Conflicts and Coordination	$ -
Total Project Cost	**$ 160,000**

Lake Lucile Lake Management Plan

Parks Hwy. at Swanson Ave. Bioretention (Enhanced Ditches)

Key Assumptions and Estimate Notes

1. The estimate assumes that site conditions (such as underlying soil types, depth to bedrock/limiting strata, and groundwater levels) are appropriate for a facility without a subdrain or impermeable liner.
2. Utility Notes
    a. Utility conflict costs are generally a placeholder. More information is needed to provide accurate prices.
    b. Estimate assume the proposed facility proximity to an existing water line is not problematic for facility permitting.
    c. Assumes no other utility conflicts.
3. Estimate is generally based on average unit prices from the most current MOA bid tabulations (2018).

Lake Lucile Lake Management Plan
Stormwater Wetlands at East Outfall
Concept Level Engineer's Estimate

Item No.	MASS Section No.	Work Description	Unit	Estimated Quantity	Price	Amount
1	20.02	Storm Water Pollution Prevention Plan	LS	1	$ 8,000	$ 8,000
2	20.04	Clearing and Grubbing	LS	1	$ 800	$ 800
3	20.10	Unusable Excavation	CY	2,600	$ 18	$ 46,800
4	20.13	Trench Excavation and Backfill	LF	155	$ 22	$ 3,410
5	20.21	Classified Fill and Backfill (Type IIA)	TN	30	$ 45	$ 1,350
6	55.02	Furnish, Install and Televise 54" CPEP, Type S	LF	155	$ 190	$ 29,450
7	55.09	Construct Type 3 120" Catch Basin/Manhole	EA	1	$ 20,000	$ 20,000
8	65.02	Construction Surveying	LS	1	$ 4,000	$ 4,000
9	70.07	Remove Pipe	LF	50	$ 75	$ 3,750
10	70.12	Traffic Maintenance	LS	1	$ 200	$ 200
11		Wetland Vegetation	LS	1	$ 25,000	$ 25,000
12		Outfall Grading and Erosion Protection	LS	1	$ 5,000	$ 5,000
				Construction Total		$ 147,760

Construction Contingency (30%)	$ 44,400
Design (50%)	$ 73,900
Overhead and Administration (15%)	$ 22,200
Utility Conflicts and Coordination	$ 5,000
Total Project Cost	**$ 300,000**

Lake Lucile Lake Management Plan

Stormwater Wetlands at East Outfall

Key Assumptions and Estimate Notes

1. The estimate assumes that site conditions will support the growth of appropriate wetland vegetation. Depth to groundwater should be verified during detailed design.
2. The estimate assumes the facility elevations can be configured without causing adverse impacts to the upstream system hydraulics.
3. Utility Notes
    a. Assumes an existing power pole in the project vicinity can be accommodated and will not require relocation.
    b. Assumes no other utility conflicts.
4. Estimate is generally based on average unit prices from the most current MOA bid tabulations (2018).

Lake Lucile Lake Management Plan

Parks Hwy. - Deskas St. to Lucus Rd. Bioretention (Enhanced Ditches)

Concept Level Engineer's Estimate

Item No.	MASS Section No.	Work Description	Unit	Estimated Quantity	Price	Amount
1	20.02	Storm Water Pollution Prevention Plan	LS	1	$ 6,000	$ 6,000
2	20.10	Unusable Excavation	CY	2,800	$ 18	$ 50,400
3	20.23	Cobbles	TN	9	$ 240	$ 2,160
4	65.02	Construction Surveying	LS	1	$ 2,500	$ 2,500
5	70.12	Traffic Maintenance	LS	1	$ 4,000	$ 4,000
6	75.03	Topsoil, 4"	MSF	40	$ 530	$ 21,200
7	75.04	Seeding (Schedule B)	MSF	40	$ 350	$ 14,000
8		Check Dam and/or Inlet Modification	EA	3	$ 1,000	$ 3,000
9		Sidewalk Drain and Curb Cut	EA	5	$ 1,000	$ 5,000
10		Engineered Soil	CY	2,800	$ 45	$ 126,000
				Construction Total		$ 234,260

Construction Contingency (30%)	$ 70,300
Design (30%)	$ 70,300
Overhead and Administration (15%)	$ 35,200
Utility Conflicts and Coordination	$ 20,000
Total Project Cost	**$ 440,000**

Lake Lucile Lake Management Plan

Parks Hwy. – Deskas St. to Lucus Rd. Bioretention (Enhanced Ditches)

Key Assumptions and Estimate Notes

1. The estimate assumes that site conditions (such as underlying soil types, depth to bedrock/limiting strata, and groundwater levels) are appropriate for a facility without a subdrain or impermeable liner.
2. Utility Notes
    a. Utility conflict costs are generally a placeholder. More information is needed to provide accurate prices.
    b. There may be an old storm drain pipe in the ditch line near Lucus Road. This estimate assumes this pipe has been removed or is below the bottom of the proposed facility.
    c. Estimate assumes existing light poles and associated underground power lines can be accommodated in place and worked around during construction.
    d. Assumes no other utility conflicts.
3. Estimate is generally based on average unit prices from the most current MOA bid tabulations (2018).

Lake Lucile Lake Management Plan

Commercial Dr. Bioretention (Enhanced Ditches)

Concept Level Engineer's Estimate

Item No.	MASS Section No.	Work Description	Unit	Estimated Quantity	Price	Amount
1	20.02	Storm Water Pollution Prevention Plan	LS	1	$ 12,000	$ 12,000
2	20.06	Tree Removal	EA	20	$ 100	$ 2,000
2	20.10	Unusable Excavation	CY	4,700	$ 18	$ 84,600
3	20.23	Cobbles	TN	3	$ 240	$ 720
4	65.02	Construction Surveying	LS	1	$ 5,000	$ 5,000
5	70.12	Traffic Maintenance	LS	1	$ 8,000	$ 8,000
6	75.03	Topsoil, 4"	MSF	54	$ 530	$ 28,620
7	75.04	Seeding (Schedule B)	MSF	54	$ 350	$ 18,900
8		Check Dam and/or Inlet Modification	EA	3	$ 1,000	$ 3,000
9		Sidewalk Drain and Curb Cut	EA	2	$ 1,000	$ 2,000
10		Engineered Soil	CY	4,700	$ 45	$ 211,500
11		Bioretention Vegetation	LS	1	$ 17,000	$ 17,000
				Construction Total		$393,340

Construction Contingency (30%)	$ 118,100
Design (30%)	$ 118,100
Overhead and Administration (15%)	$ 59,100
Utility Conflicts and Coordination	$ -
Total Project Cost	**$690,000**

Lake Lucile Lake Management Plan

Commercial Dr. Bioretention (Enhanced Ditches)

Key Assumptions and Estimate Notes

1. The estimate assumes that site conditions (such as underlying soil types, depth to bedrock/limiting strata, and groundwater levels) are appropriate for a facility without a subdrain or impermeable liner.
2. Utility Notes
    a. Utility conflict costs are generally a placeholder. More information is needed to provide accurate prices.
    b. Estimate assume the proposed facility proximity to an existing water line is not problematic for facility permitting.
    c. Assumes no other utility conflicts.
3. Estimate is generally based on average unit prices from the most current MOA bid tabulations (2018).

Lake Lucile Lake Management Plan

Burchell High School Bioretention (Swale/Rain Garden)

Concept Level Engineer's Estimate

Item No.	MASS Section No.	Work Description	Unit	Estimated Quantity	Price	Amount
1	20.02	Storm Water Pollution Prevention Plan	LS	1	$ 2,000	$ 2,000
2	20.06	Tree Removal	EA	4	$ 200	$ 800
3	20.10	Unusable Excavation	CY	300	$ 22	$ 6,600
4	20.23	Cobbles	TN	2	$ 240	$ 480
5	65.02	Construction Surveying	LS	1	$ 1,000	$ 1,000
6	70.12	Traffic Maintenance	LS	1	$ 500	$ 500
7	75.03	Topsoil, 4"	MSF	1	$ 600	$ 600
8	75.04	Seeding (Schedule A)	MSF	1	$ 340	$ 340
9		Construct Drainage Swale	LS	1	$ 6,000	$ 6,000
10		Outfall Grading and Erosion Protection	LS	1	$ 500	$ 500
11		Engineered Soil	CY	210	$ 45	$ 9,450
12		Bioretention Vegetation	LS	1	$ 3,000	$ 3,000
				Construction Total		$ 31,270

Construction Contingency (30%)	$ 9,400
Design (40%)	$ 12,600
Overhead and Administration (15%)	$ 4,700
Utility Conflicts and Coordination	$ -
Total Project Cost	**$ 60,000**

Lake Lucile Lake Management Plan

Burchell High School Bioretention (Swale/Rain Garden)

Key Assumptions and Estimate Notes

1. The estimate assumes that site conditions (such as underlying soil types, depth to bedrock/limiting strata, and groundwater levels) are appropriate for a facility without a subdrain or impermeable liner.
2. Assumes no utility conflicts.
3. Estimate is generally based on average unit prices from the most current MOA bid tabulations (2018).

Lake Lucile Lake Management Plan

Parks Hwy. Oil and Grit Separator

Concept Level Engineer's Estimate

Item No.	MASS Section No.	Work Description	Unit	Estimated Quantity	Price	Amount
1	20.02	Storm Water Pollution Prevention Plan	LS	1	$ 1,000	$ 1,000
2	20.04	Clearing and Grubbing	LS	1	$ 800	$ 800
3	20.10	Unusable Excavation	CY	30	$ 22	$ 660
4	20.13	Trench Excavation and Backfill	LF	40	$ 22	$ 880
5	20.21	Classified Fill and Backfill (Type IIA)	TN	45	$ 45	$ 2,025
6	55.02	Furnish, Install and Televise 42" CPEP, Type S	LF	30	$ 175	$ 5,250
7	65.02	Construction Surveying	LS	1	$ 1,000	$ 1,000
8	70.07	Remove Pipe	LF	40	$ 50	$ 2,000
9	70.12	Traffic Maintenance	LS	1	$ 500	$ 500
10	75.03	Topsoil, 4"	MSF	2	$ 100	$ 200
11	75.04	Seeding (Schedule A)	MSF	2	$ 340	$ 680
12		Connect New CPEP to Existing CIPP	LS	1	$ 1,000	$ 1,000
13		10' Diameter Oil/Grit Separator	EA	1	$ 60,000	$ 60,000
				Construction Total		$ 75,995

Construction Contingency (30%)	$ 22,800
Design (20%)	$ 15,200
Overhead and Administration (15%)	$ 11,400
Utility Conflicts and Coordination	$ -
Total Project Cost	**$ 130,000**

Lake Lucile Lake Management Plan

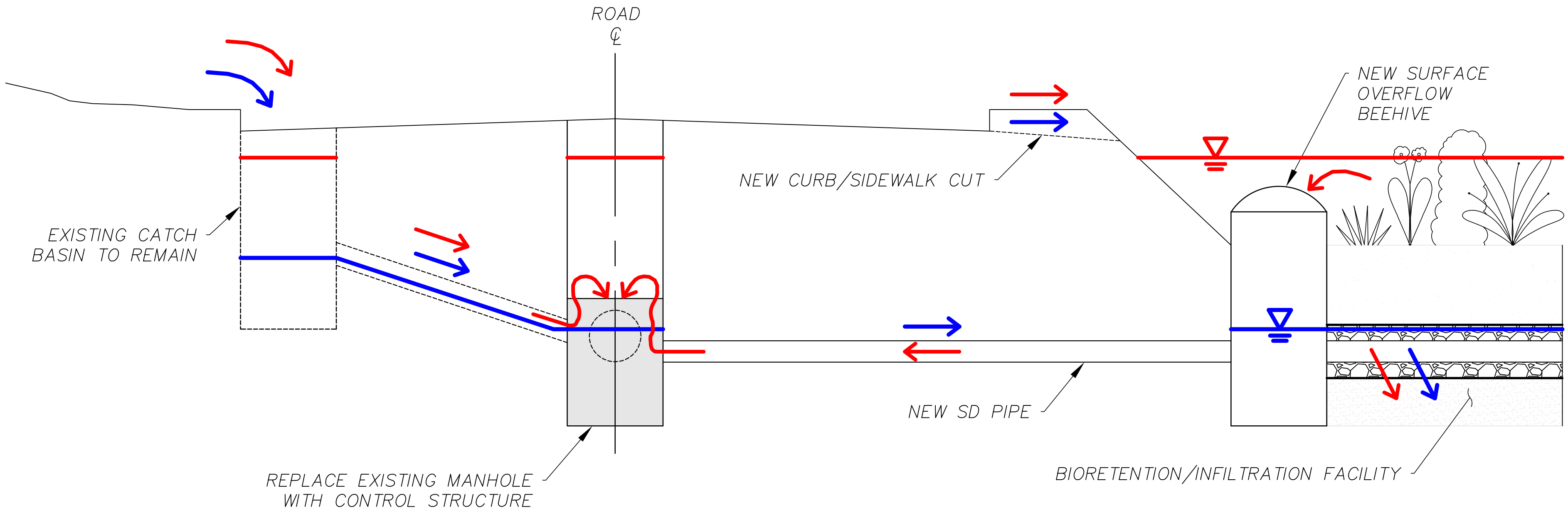
Parks Highway OGS

Key Assumptions and Estimate Notes

1. Utility Notes
    a. Facility location was selected to minimize known utility conflicts.
    b. Assumes no utility conflicts.
2. Assumes connection to existing slip-lined pipe can be made without construction of additional manholes.
3. Estimate includes a 50 foot long, 12 foot wide gravel access drive.
4. Estimate is generally based on average unit prices from the most current MOA bid tabulations (2018).

Appendix C: Additional Details

NELSON AVENUE BIORETENTION SECTION



RED ARROWS AND LINES SHOW HIGH FLOW CONDITION

BLUE ARROWS AND LINES SHOW LOW FLOW CONDITION

Appendix D: Public Involvement Documents

Projects

Lake Lucile Management Plan

Lake Lucile Management Plan

The water quality of Lake Lucile has been a concern for many years. The purpose of this Plan is to identify opportunities to improve the quality of Lake Lucile by incorporating facilities in the Lake Lucile watershed that will remove pollutants of concern from stormwater runoff before stormwater is discharged into Lake Lucile. This Lake Management Plan was developed as part of a joint effort between the City of Wasilla and the State of Alaska Department of Environmental Conservation.

Click here to see the draft Lake Lucile Management Plan

If you have questions or want to comment on the project, please send an email to the project team by Friday, June 5, 2020.

Due to COVID-19 there will not be a public open house for this project. In lieu of a public open house, please learn about the project by visiting the VIRTUAL STORY MAP.

Wasilla Police Department Construction Update

Whats New:

Ground breaking was April 25, 2019. The substantial completion is expected to be June 1, 2020 with the ribbon cutting planned for June 10, 2020.

Project Overview:

The new Wasilla Police Station will be located at 801 N Wasilla-Fishhook Road (old Iditarod Elementary School site).

The new building will be 21,078 square feet with garage space included. This project cost will be $12 million forward funded by the 1% sales tax increase which took effect January 1, 2018.

Please click here to see additional information and plans

From:	webmaster@cityofwasilla.com on behalf of City of Wasilla, AK
To:	Holly Spoth-Torres
Subject:	City of Wasilla, AK: Lake Lucile: Lake Management Plan Draft
Date:	Wednesday, May 13, 2020 4:00:43 PM

Lake Lucile: Lake Management Plan Draft

Post Date: 05/12/2020 10:00 AM

City of Wasilla, AK has sent you a News item. To view this item, please go to https://www.cityofwasilla.com/departments/public-works/projects

From:	Holly Spoth-Torres
To:	Archie Giddings; Danielle Bischoff
Cc:	Janie Dusel
Bcc:	Goentzel, Renee M (DOT); elena.fernandez@alaska.gov; jake.ciufo@alaska.gov; Eldred, Laura K (DEC); Amundsen, James (DOT); adolfaeb@akrr.com; eric@matsuwater.net; cindy.watson@sbsalaska.com; carolynyeah@yahoo.com; Miyashiro, Eric L (DOT)
Subject:	DRAFT Lake Lucile Lake Management Plan - Comments DUE June 5, 2020
Date:	Tuesday, May 19, 2020 5:04:00 PM

The Draft Lake Lucile Lake Management Plan is available for review and public comment. You can view and download the plan from the City of Wasilla's website: https://www.cityofwasilla.com/departments/public-works/projects

If you want to comment on the plan, please submit comments by email to holly@huddleak.com by Friday, June 5 2020. Also, please don't hesitate to write with questions if you have them.

Due to COVID-19 there will not be a public open house for this project. In lieu of a public open house, please learn about the project by visiting the virtual story map.

Thank you!

Holly Spoth-Torres
Huddle AK
907-223-0136
holly@huddleak.com

Lake Lucile: Lake Management Plan (Draft)
Summary of Comments and Responses

Commenter Name	Section/Page	Comment	Response
Burchell High School Principal, Shelli Lincoln	General	We are very interested in partnering with others on this project. Is there a timeline to the project so we can prepare? I have forwarded the info to our environment teacher.	We are working on timelines for all proposed projects in conjunction with potential funding sources. Currently, there is no dedicated funding for any of the projects. If a proposed timeline is developed, the project team will coordinate with Burchell High School.
ADF&G Habitat Division, Elena Fernandez, Habitat Biologist	General	The Habitat Section has reviewed the Draft Lake Lucile Management Plan. Lake Lucile is currently not cataloged for anadromous fish species in the Anadromous Waters Catalog. However, resident fish species such as ninespine stickleback are present. Because resident fish species are present, Lake Lucile is subject to Alaska Statute (AS) 16.05.841, also known as the Fishway Act. If an aspect of your project involves the installation of structures that could potentially impact fish passage (e.g., culverts, etc.), a Fish Habitat Permit from the ADF&G Habitat Section would be required.	Thank you.
State of Alaska, DOT&PF, Jake Ciufo	General	Proposed drainage improvements within or adjacent DOT&PF ROW need to be reviewed and approved by DOT&PF. Along with plans/details, hydrology and hydraulic calculations need to be provided that (at a minimum) document existing/proposed conditions as well as recommended maintenance activities. Design criteria can be found in the Alaska Highway Preconstruction Manual and the Alaska Highway Drainage Manual.	Currently, there is no dedicated funding for the proposed projects. Appropriate design computations will be completed if the projects move into a design phase.

Commenter Name	Section/Page	Comment	Response
State of Alaska, DOT&PF, Jake Ciufo	Section 5.1	Section 5.1 Retrofit Manholes on the Parks Highway: DOT&PF does not object to this recommendation. However, a capacity analysis is recommended so that both parties have a complete understanding of how the system will change. The goal would be to implement the changes once and to be prepared for the additional maintenance effort.	Maintenance of the systems downstream of the DOT&PF manholes is the responsibility of the City of Wasilla.
State of Alaska, DOT&PF, Jake Ciufo	Section 5.2	Section 5.2 Herning and Knik Bioretention, second paragraph under Functionality: Make it clear that it is critical to keep the control manhole clean so that the subdrain does not become clogged from the inside. This comment applies to all similar designs.	Recommended maintenance activities including cleaning the control manholes and other upstream inlets is addressed in Section 6.1, Table 15.
State of Alaska, DOT&PF, Jake Ciufo	Section 5.5	Section 5.5 Parks Highway at Swanson Avenue Bioretention, first paragraph under Functionality: Are there opportunities to treat runoff from adjacent parcels before it enters DOT&PF ROW?	This project focused on treatment opportunities on publicly owned land. There may be opportunities to construct treatment facilities on adjacent private land, but this is not something the City of Wasilla can facilitate or require. Under existing conditions, runoff from adjacent surfaces is flowing to the DOT&PF ROW, and the project team worked to find cost-effective treatment opportunities that maintained current drainage patterns.

Commenter Name	Section/Page	Comment	Response
State of Alaska, DOT&PF, Jake Ciufo	Section 5.5	Section 5.5 Parks Highway at Swanson Avenue Bioretention, Vegetation: What is the existing vegetation and how does it compare to what's recommended? Can existing vegetation remain?	The existing vegetation is grass that is mowed. The type of grass mix is not known. While the proposed vegetation is also a grass or wildflower mix, much of the treatment comes from the non-compacted engineered soil under the grass. Performance is also enhanced by not mowing the vegetation. If the existing vegetation is a grass mix that can be left unmowed without being unsightly, it could potentially be replaced in kind.
State of Alaska, DOT&PF, Jake Ciufo	Section 5.5	Section 5.5 Parks Highway at Swanson Avenue Bioretention, Utility Conflicts Comment A: A subdrain in the vicinity of underground cables/lines is generally not a problem from a saturation standpoint. If drainage improvements will cause water to pond around/over pedestals, vaults, etc. then it is likely not preferred, possibly damaging to the facility, or even unsafe.	This will be considered if the project becomes funded for design and construction.
State of Alaska, DOT&PF, Jake Ciufo	Section 5.5	Section 5.5 Parks Highway at Swanson Avenue Bioretention, Utility Conflicts Comment B: Provide the existing ditch depth and the depth of the structural section. Also consider how this may change the ditch capacity. This will help explain the statement, "The existing ditch is deep enough that the flow line could be raised to accommodate the engineered soil thickness."	This information was not readily available in area as-builts, but we will modify the discussion to note that raising the flowline is only a potential option. Ditch capacity will be evaluated if this project is funded for design and construction.

Commenter Name	Section/Page	Comment	Response
State of Alaska, DOT&PF, Jake Ciufo	Section 5.7	Section 5.7 Parks Highway Deskas to Lucus Bioretention: How would the recommended enhanced vegetation and check dams effect ditch capacity during the design discharge (10% AEP event)?	If this project is funded for design, a capacity analysis would be performed to ensure that capacity is maintained. If properly designed, vegetation and check dams should not impede flow at higher events like the 10% AEP.
State of Alaska, DOT&PF, Jake Ciufo	Section 5.8	Section 5.8 Commercial Drive Bioretention: Comment #7 also applies here. Are there opportunities to treat runoff from adjacent parcels before it enters DOT&PF ROW?	This project focused on treatment opportunities on publicly owned land. There may be opportunities to construct treatment facilities on adjacent private land, but this is not something the City of Wasilla can facilitate or require. Under existing conditions, runoff from adjacent surfaces is flowing to the DOT&PF ROW, and the project team worked to find cost-effective treatment opportunities that maintained current drainage patterns.
State of Alaska, DEC, Laura Strand	General	Please add an Acknowledgements section or similar and include the required grant funding language (I'll send it to you).	Will add.
State of Alaska, DEC, Laura Strand	List of Appendices	I'm wondering if it would be helpful to have a Definitions Appendix? Or at least define key terms when they appear. Examples include Stormwater, Impervious Surface, Outfall	Yes, will add.
State of Alaska, DEC, Laura Strand	Section 1.1, last sentence	While we know what a remedial action facility is, I'm wondering if there's an easier way to say this or if it needs defined	We will reword this sentence to clarify.
State of Alaska, DEC, Laura Strand	Section 1.2, first sentence page 3	This is the first time referring to Cu, Pb, Zn as heavy metals. should either just list the metals or earlier define them as heavy metals	Ok, we'll discuss that they are heavy metals on Page 1.

Commenter Name	Section/Page	Comment	Response
State of Alaska, DEC, Laura Strand	Section 1.2, first paragraph page 3	Suggest adding a sentence about snow melt.	While we agree that snow melt events can mobilize pollutants, we would not define snow melt as part of a "first flush" for a few reasons. 1) It's not usually included in a broader, nationwide definition of first flush, and 2) most of the facilities proposed in this document are not going to effectively treat snow melt, as the topsoil and other near-surface layers will be frozen. This is a challenge with nearly all green infrastructure facilities, and we make the distinction that the goal and intent of GI is to treat rainfall runoff -- not to treat snow melt. If some treatment of snow melt happens, great. But snow melt is not the design intent. This is one of the primary reasons that we recommend facility overflows.
State of Alaska, DEC, Laura Strand	Section 1.3, first paragraph.	This paragraph is scientifically correct but I'm wondering if it's speaking to our target audience or not	We agree. Will remove.
State of Alaska, DEC, Laura Strand	Figure 2	Can you add "East" to outfall in legend and also on map add labels for Tommy Moe Dr & Weber since the paragraph discusses?	Yes, will add.
State of Alaska, DEC, Laura Strand	Figure 3	Add West to Outfall in legend	Yes, will add.
State of Alaska, DEC, Laura Strand	Section 4, first paragraph	Do you want to use watershed or drainage area? I lean towards drainage area when describing the area that contributes to the piped stormwater system.	We are good with either. We will change watershed to drainage area.

Commenter Name	Section/Page	Comment	Response
State of Alaska, DEC, Laura Strand	Section 5.2.2	Do we need to address snow storage for this facility?	Snow storage is addressed broadly for bioretention facilities in the maintenance section. (It's not recommended to store snow on bioretention facilities.) The development details of this site are not currently know. When a future site plan is developed for this site, a specific location for snow storage could be added.
State of Alaska, DEC, Laura Strand	Section 5.6.2	How do we deal with all the trash that currently gets caught up in the outfall cover and can be cleaned out by maintenance staff? If all of that is removed, the trash would end up in the constructed wetland and possibly the lake. Thoughts?	We could put a new trash rack at the location where we transition from pipe to open channel. We will add this to the discussion.
State of Alaska, DEC, Laura Strand	Section 6	Should probably include trash clean out in all of them for spring/fall	Will add.
State of Alaska, DEC, Laura Strand	Section 7	Add the National Stormwater BMP database; Did you use the DEC's Stormwater Manual at all? Also other references used like MSB LiDAR.	The MSB LiDAR is referenced as Data in Section 2. I will add the BMP database to that section as well.