CITY OF DUPONT

PIERCE COUNTY **WASHINGTON**

STORMWATER MANAGEMENT ACTION PLAN

G&O #23240
OCTOBER 2023

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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CHAPTER 1

INTRODUCTION

As a Phase II NPDES permittee, the City of DuPont is required to prepare a Stormwater Management Action Plan (SMAP). The NPDES Phase II requirement to complete watershed-scale stormwater management is based upon a 2008 Pollution Control Hearings Board Phase I ruling that recognized it would not be possible to maintain water quality and aquatic habitat in lowland streams without focusing on a broader scale than individual site and development projects. Ecology recognizes that stormwater programs must include planning and development of policies that address receiving water needs and retrofit provisions.

The following SMAP is intended to address the water quality of runoff within the jurisdiction so that a plan can then be created to protect runoff in a certain concentrated area within a prioritized watershed. The Plan provides a watershed assessment, prioritization of a primary area to focus future restoration efforts on as well as a description of these efforts. In addition, this Plan provides a schedule and estimated costs necessary to implement these efforts.

Compilation of this Plan was aided by tools developed by the Department of Ecology and the Department of Commerce. These tools were used in the receiving water assessment and prioritization of watersheds with the purpose of choosing effective stormwater management strategies that will provide the most benefit within a chosen watershed.

- The NPDES Phase II Fact Sheet (Ecology 2018)
- Building Cities in the Rain (Commerce, 2016)
- Ecology Puget Sound Characterization Project Interactive Map (*https://fortress.wa.gov/ecy/coastalatlas/wc/landingpage.html*)

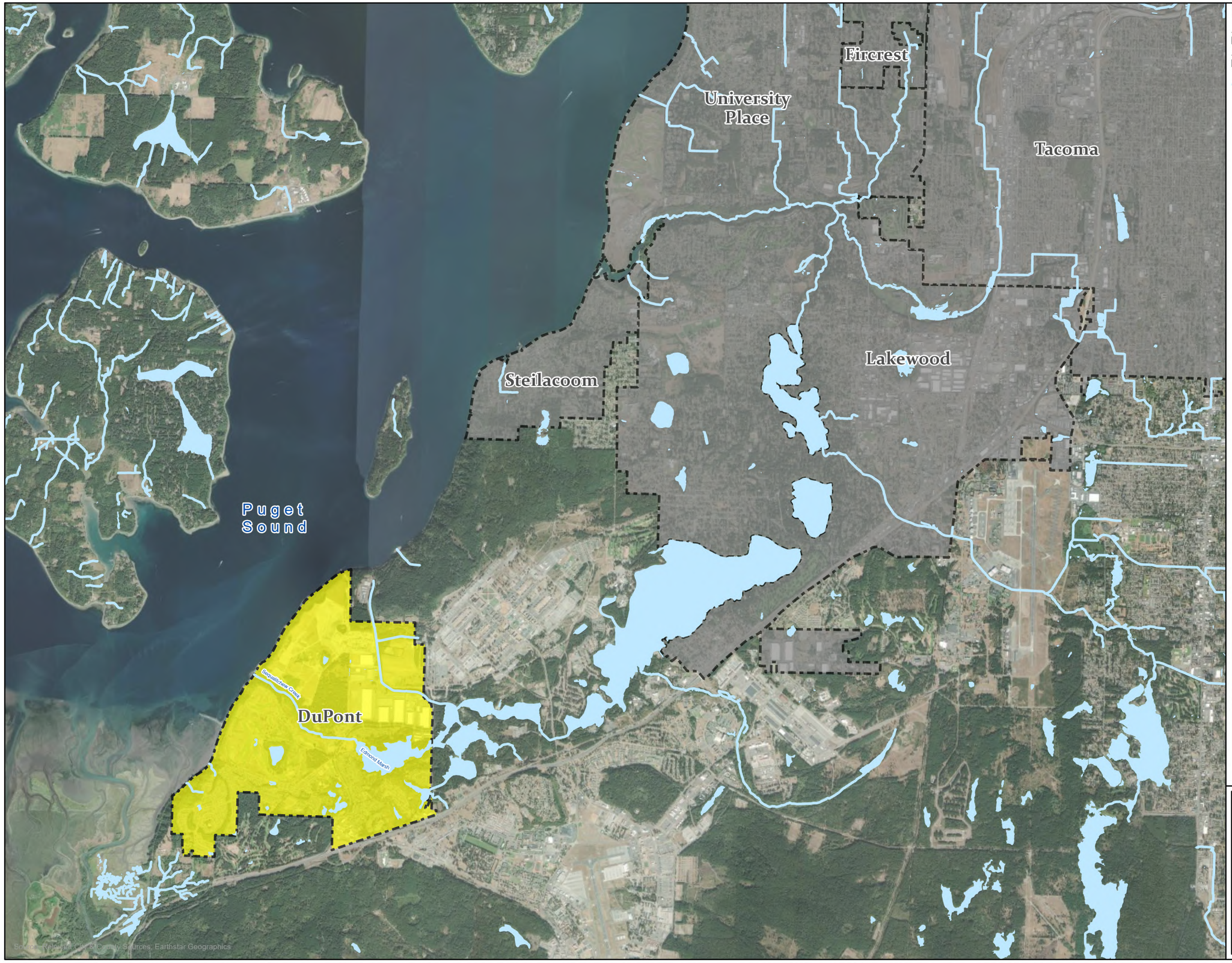
RECEIVING WATERS CONDITION ASSESSMENT

BASIN DELINEATION AND RECEIVING WATERS

The first step to understanding the water quality within a region is to delineate drainage basins and recognize the receiving waters downstream. The immediate receiving waters in DuPont are primarily the Sequalitchew Creek and the Puget Sound (see Figure 1-1). The Sequalitchew Creek flows to the west, eventually flowing into the Puget Sound.

Utilizing Ecology's Watershed Assessment Units as a guide for delineation, the basins shown in Figure 1-2 were identified. The majority of the City infiltrates stormwater and does not convey any stormwater to receiving waters. The exception to this is the Civic Center Basin and the Edmond Marsh Basin. Center Drive within the Civic Center Basin conveys flow to the Sequalitchew Creek. The remaining area in the Civic Center Basin is

conveyed to the Civic Drive Storm Pond that treats and infiltrates runoff. Stormwater in the Edmond Marsh Basin is conveyed by ditches and stormwater pipes to Edmond Marsh which conveys stormwater to Sequalitchew Creek. The creek meanders westward for 1.5 miles where it then discharges into the Puget Sound. The contributing areas for each watershed are listed in Table 1-1.



Legend

- DuPont City Limits
- Other City Limits
- Streams

N

0 3,000 6,000 12,000 Feet

CITY OF DUPONT

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FIGURE 1-1

VICINITY MAP

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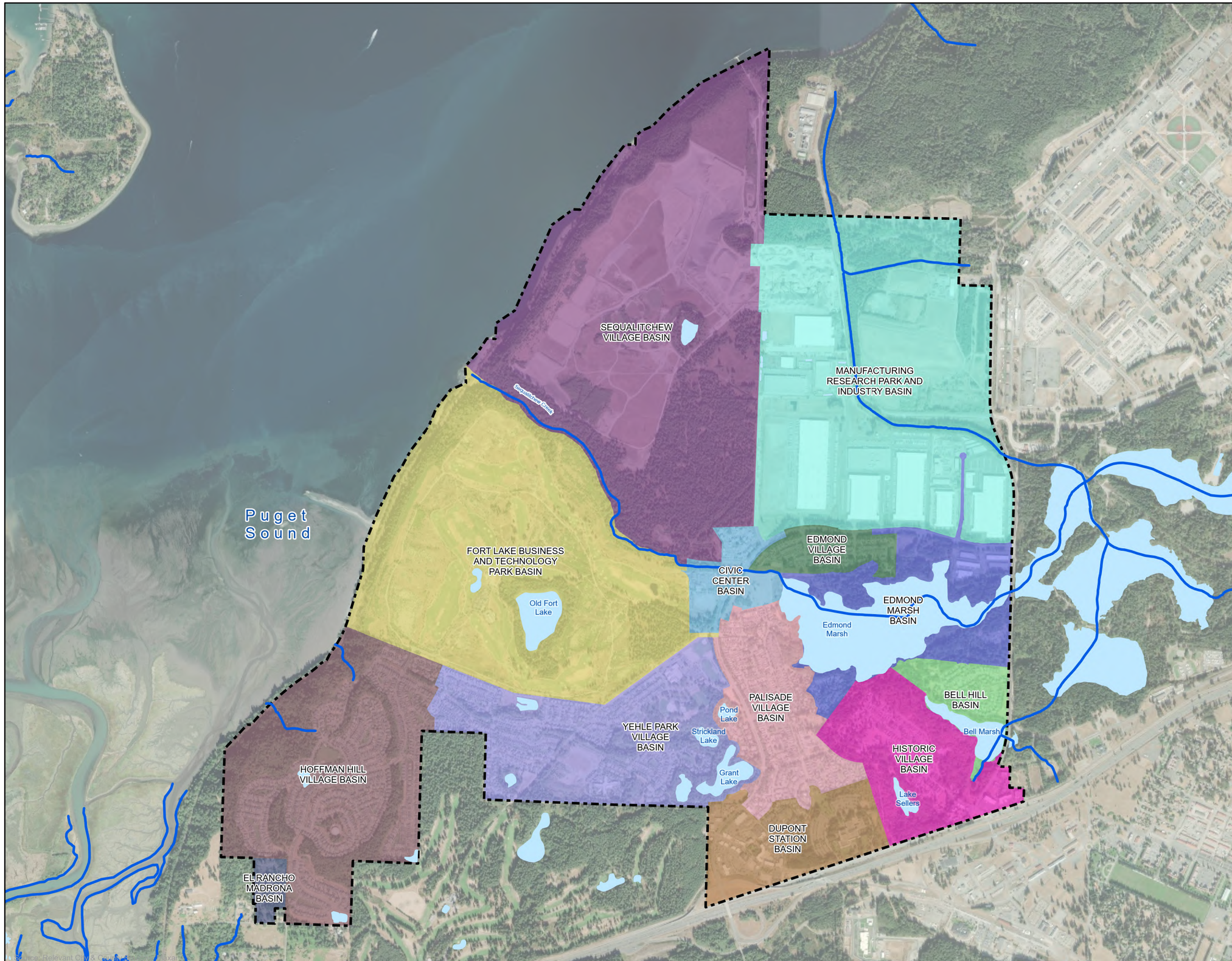

Legend

- City Limits
- Streams
- Bell Hill Basin
- Civic Center Basin
- DuPont Station Basin
- Edmond Marsh Basin
- Edmond Village Basin
- El Rancho Madrona Basin
- Fort Lake Business and Technology Park Basin
- Historic Village Basin
- Hoffman Hill Village Basin
- Manufacturing Research Park and Industry Basin
- Palisade Village
- Sequalitchew Village Basin
- Yehle Park Village Basin

N

0 1,000 2,000 4,000 Feet

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FIGURE 1-2

DRAINAGE BASINS

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TABLE 1-1

Watershed Areas

	Bell Hill Basin	Civic Center Basin	DuPont Station Basin	Edmond Marsh Basin	Edmond Village Basin	El Rancho Madrona Basin	Fort Lake Business and Technology Park Basin	Historic Village Basin	Hoffman Hill Village Basin	Manufacturing Research Park and Industry Basin	Palisade Village Basin	Sequalitchew Village Basin	Yehle Park Village Basin
Watershed Area w/in City UGA (ac)	63	59	131	248	52	18	656	172	391	677	165	833	309
Total Watershed Area (ac) to a Flow-Control Exempt Water Body	0	12	0	248	0	0	0	0	0	0	0	0	0
% Within City UGA	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Desired Water Quality Benefit

Generally, the allowable quality of stormwater runoff is guided by the Washington State water quality standards (WAC 173-201A) where the standards are intended to be consistent with the public health and enjoyment of the waters while they also propagate protection of fish, shellfish and wildlife. The standards are based upon use for aquatic life. Table 1-2 lists the known fisheries in the Sequalitchew Creek and Puget Sound.

TABLE 1-2

Fisheries Present in Downstream Receiving Waters

	Puget Sound	Sequalitchew Creek
Sockeye Salmon	✓	
Dolly Varden/Bull Trout	✓	
Steelhead	✓	
Kokanee	✓	
Pink Salmon	✓	
Chum	✓	✓
Coho Salmon	✓	✓
Chinook Salmon	✓	
Cutthroat Trout	✓	✓

The water quality standards are based upon the presence of these fish as noted in Table 1-3.

TABLE 1-3

Freshwater Aquatic Life Criteria (WAC 173-201A-200)

Category	Criteria
Temperature	• Salmonid Spawning, Rearing, and Migration ○ 17.5 degrees C
Dissolved Oxygen	• Salmonid Spawning, Rearing, and Migration ○ 10 mg/L
Turbidity	• Salmonid Spawning, Rearing, and Migration ○ Turbidity shall not exceed: 5 NTU over background when the background is 50 NTU or less; or a 10 percent increase in turbidity when the background turbidity is more than 50 NTU.

TABLE 1-3 – (continued)

Freshwater Aquatic Life Criteria (WAC 173-201A-200)

Category	Criteria
Total Dissolved Gas	• Salmonid Spawning, Rearing, and Migration ○ Total dissolved gas shall not exceed 110 percent of saturation at any point of sample.
pH	• Salmonid Spawning, Rearing, and Migration ○ pH shall be within the range of 6.5 to 8.5 with a human-caused variation within the above range of less than 0.5 units.

The receiving water is listed as primary contact uses (per WAC 173-201A-602). The primary contact uses are subject to bacteria criteria as shown in Table 1-4.

TABLE 1-4

Freshwater Primary Contact Bacteria Criteria (WAC 173-201A-200)

Category	Criteria
E. coli	E. coli organism levels within an averaging period must not exceed a geometric mean value of 100 CFU or MPN per 100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample values exist) obtained within the averaging period exceeding 320 CFU or MPN per 100 mL.

CFU – colony forming units
MPN – most probable number

CHAPTER 2

RECEIVING WATER CONDITIONS ASSESSMENT BACKGROUND

For each of the 13 basins, only the Edmond Marsh Basin and Civic Center Basin convey any flow to receiving waters. The remaining 11 basins detain and infiltrate all stormwater flows. These remaining basins do not warrant an evaluation within this SMAP since their stormwater management influence will be negligible. As such, the following presents available data on fish, water flow, water quality and land use opportunities for the Edmond Marsh Basin and Civic Center Basin. No new information was obtained for this Plan. All data was obtained from readily available sources such as government websites. With each category, the potential to make an impact via stormwater management is listed in terms of low (i.e., little chance to protect or restore the area) or high (i.e., greater chance to protect or restore the area). Stormwater management can be used to either retrofit or protect an area using such means as policy, structural retrofits or operation principles. The background data discussed herein will be utilized to prioritize the two basins in terms of their need to be protected and/or restored. By reviewing the potential for stormwater management impacts, the City is able to prioritize a single basin to focus on for protection and/or restoration efforts.

FISH RELATED DATA

Aquatic life and its associated habitat are important metrics to measuring the overall health of a watershed. The known fish species within the area are provided in Table 1-2 in Chapter 1. The following provides an assessment of fish barriers and stream habitat for these species within the local watershed. In addition, a discussion of the presence of benthic invertebrate is provided as this is typically a useful measure in evaluating the current health of a stream.

FISH BARRIERS

In review of the Washington State Department of Fish and Wildlife's (WDFW) SalmonScape site (https://apps.wdfw.wa.gov/salmonscape/), fish passage blockages exist within the basins as shown in more detail in Table 2-1 and Figure 2-1. According to the database, Civic Center Basin has two partial blockages and a blockage with an unknown status. The Edmond Marsh Basin has one total blockage, one blockage listed as "unknown percent passable," and another blockage with an "unknown" status. Due to the retrofit opportunities in the Civic Center and Edmond Marsh Basin, these two basins were listed as "high" for stormwater management influence purposes.

TABLE 2-1

Fish Passage Blockages

	Civic Center Basin	Edmond Marsh Basin
Culverts		
Partial Blockage	2	1
Total Blockage	0	1
Unknown Blockage	1	1
Dams		
Total Blockage	0	0
Total Blockages Per Basin	**3**	**3**
Stormwater Management Influence	**High**	**High**

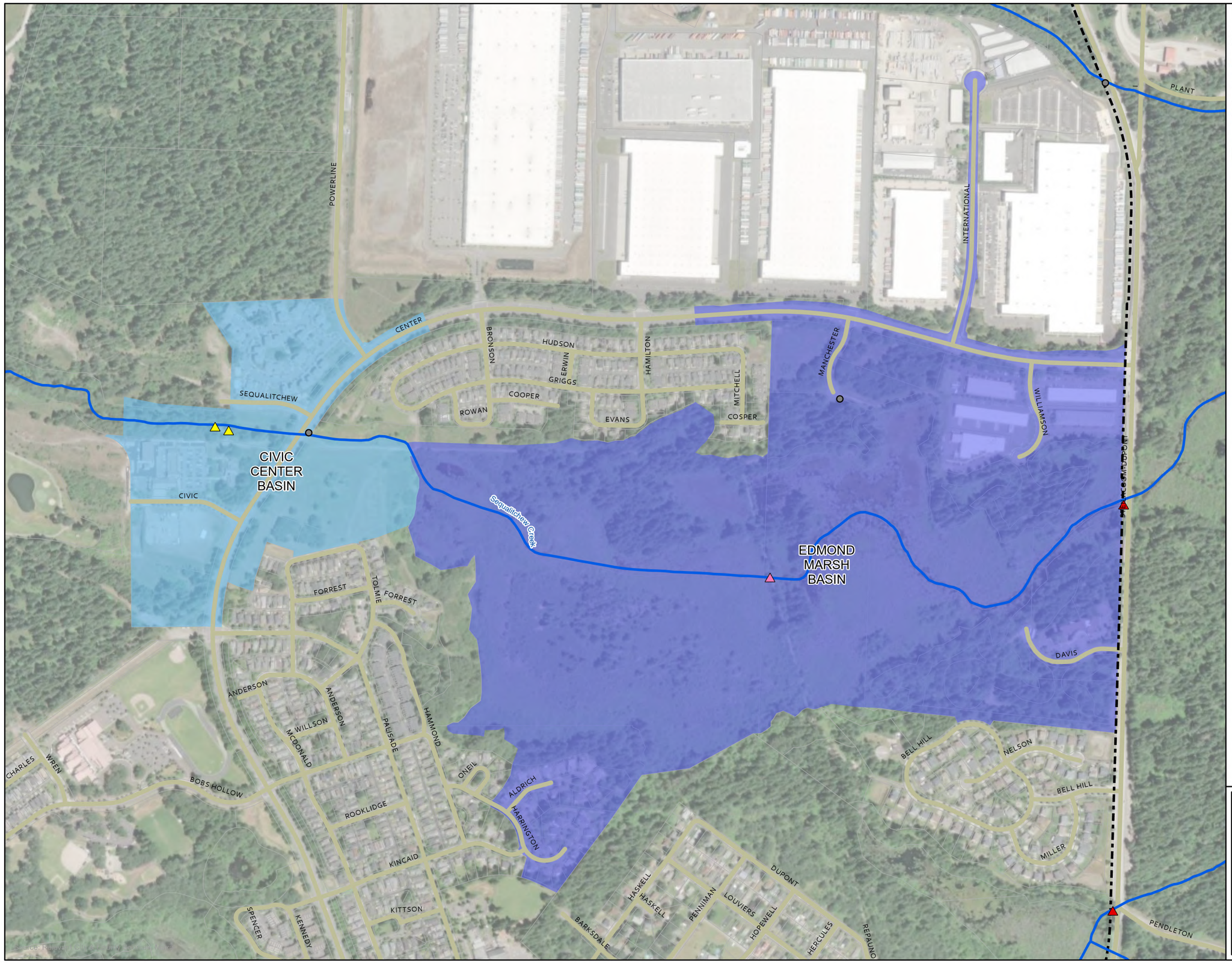
FISH HABITAT

Stream Typing

A number of resources are available to assess fish habitat. One of these resources includes stream typing. The stream typing defined by the Washington State Department of Natural Resources includes:

- **Type S** (Shoreline) – Streams and waterbodies designated as "shorelines of the state."
- **Type F** (Fish) – Known to be used by fish or meet the physical criteria to be potentially used by fish. May not flow all year.
- **Type Np** (Non-fish) – Have flow year round and may have intermittent dry reaches downstream. Do not meet physical criteria of a Type F stream. Also proven not to contain fish.
- **Type Ns** (Non-fish Seasonal) – Do not have surface flow for at least some portion of the year and do not meet the physical criteria of a Type F stream.

Figure 2-2 displays the stream typing of tributaries to the Civic Center and Edmond Marsh Basin as provided by Wild Fish Conservancy Northwest. This figure indicates that both the Civic Center and Edmond Marsh Basin include fish bearing streams.



Legend

- City Limits
- Streams
- Roads
- Parcels
- Civic Center Basin
- Edmond Marsh Basin
- Partial Fish Passage Blockage
- Barrier, Unknown Percent Passable
- Total Fish Passage Blockage
- Barrier, Unknown Status, Unknown Percent Passable

N

0 300 600 1,200 Feet

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FIGURE 2-1

FISH BLOCKAGES

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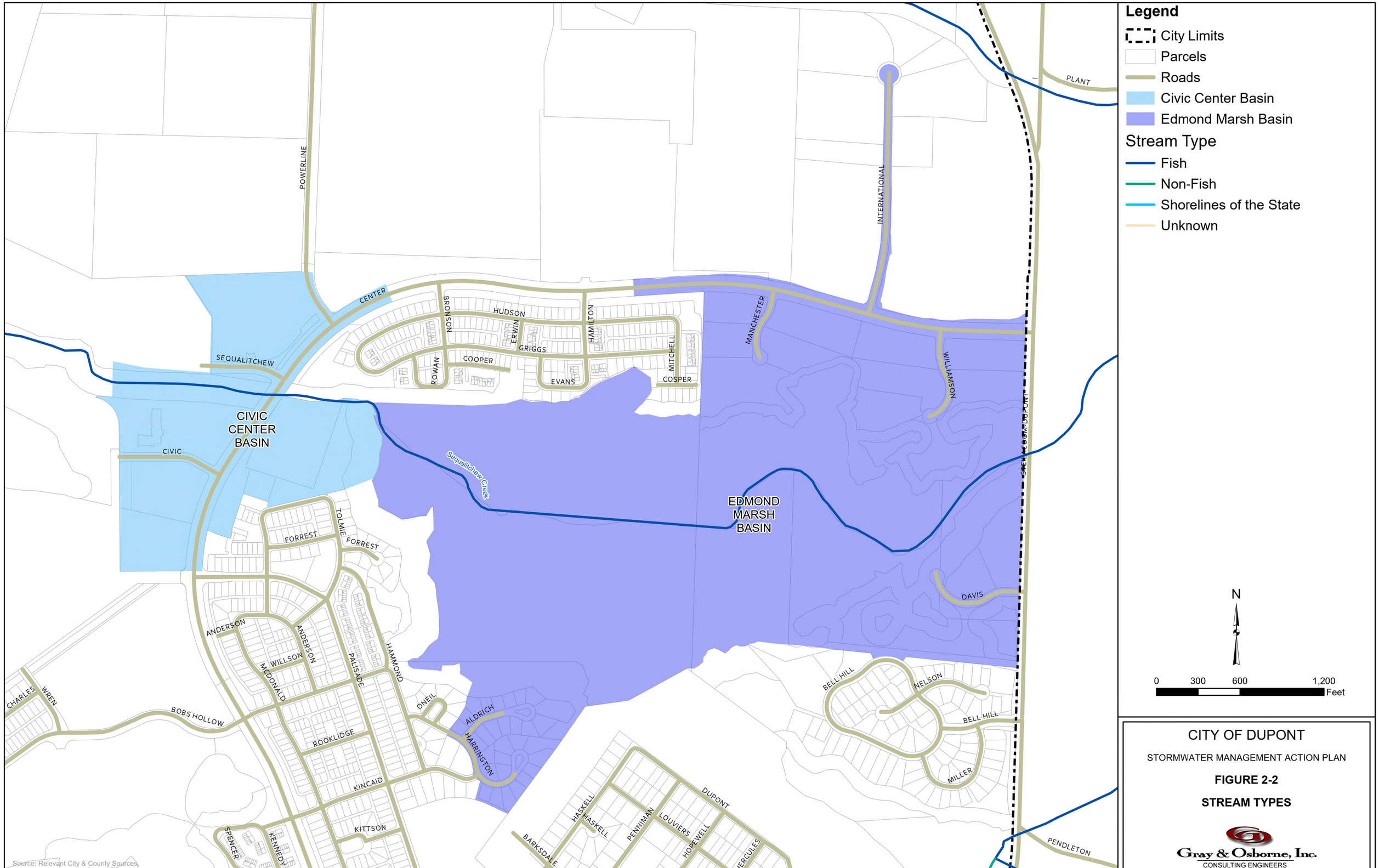

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STORMWATER MANAGEMENT ACTION PLAN

FIGURE 2-2

STREAM TYPES

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Puget Sound Habitat Characterization

The Puget Sound Characterization Project is a project developed in part by the Department of Ecology which provides a tool that highlights the most important areas to protect and restore throughout the Puget Sound region while also highlighting areas most suitable for development. The project resulted in a web-based interactive map which divides the region into assessment units (or "AU"s). For each AU, the map shows watershed assessments related to:

- Water Flow (delivery, surface storage, recharge, and discharge);
- Water quality (sediment, nutrients, pathogens, and metals);
- Landscape assessments of fish and wildlife habitat in their environments:
    - Terrestrial
    - Freshwater
    - Marine Shorelines

The Civic Center Basin includes AU 12027. The Edmond Marsh Basin includes AU 12021 and 12031. Figure 2-3 depicts the location of the correlated assessment units in DuPont.

The Fish and Wildlife Habitat module assesses the relative value of an AU as freshwater, terrestrial, or marine habitat. The two basins delineated as part of this Plan do not include marine habitat. The following describes each of the freshwater and terrestrial elements.

- Freshwater – The Freshwater indices assess the relative conservation value for habitats as a function of the number of salmonids that are present both within the AU and downstream of it as well as consideration of other features such as the presence of wetlands and undeveloped floodplains present within the AU.
- Terrestrial – The Terrestrial index assesses the relative conservation value for land based habitats (forests, open space, etc.) as a function of landscape integrity and the locations of priority habitats and species.

Table 2-2 displays the results of the habitat related characteristics of the watershed basins within the City.

TABLE 2-2

Puget Sound Characterization Project Habitat Results

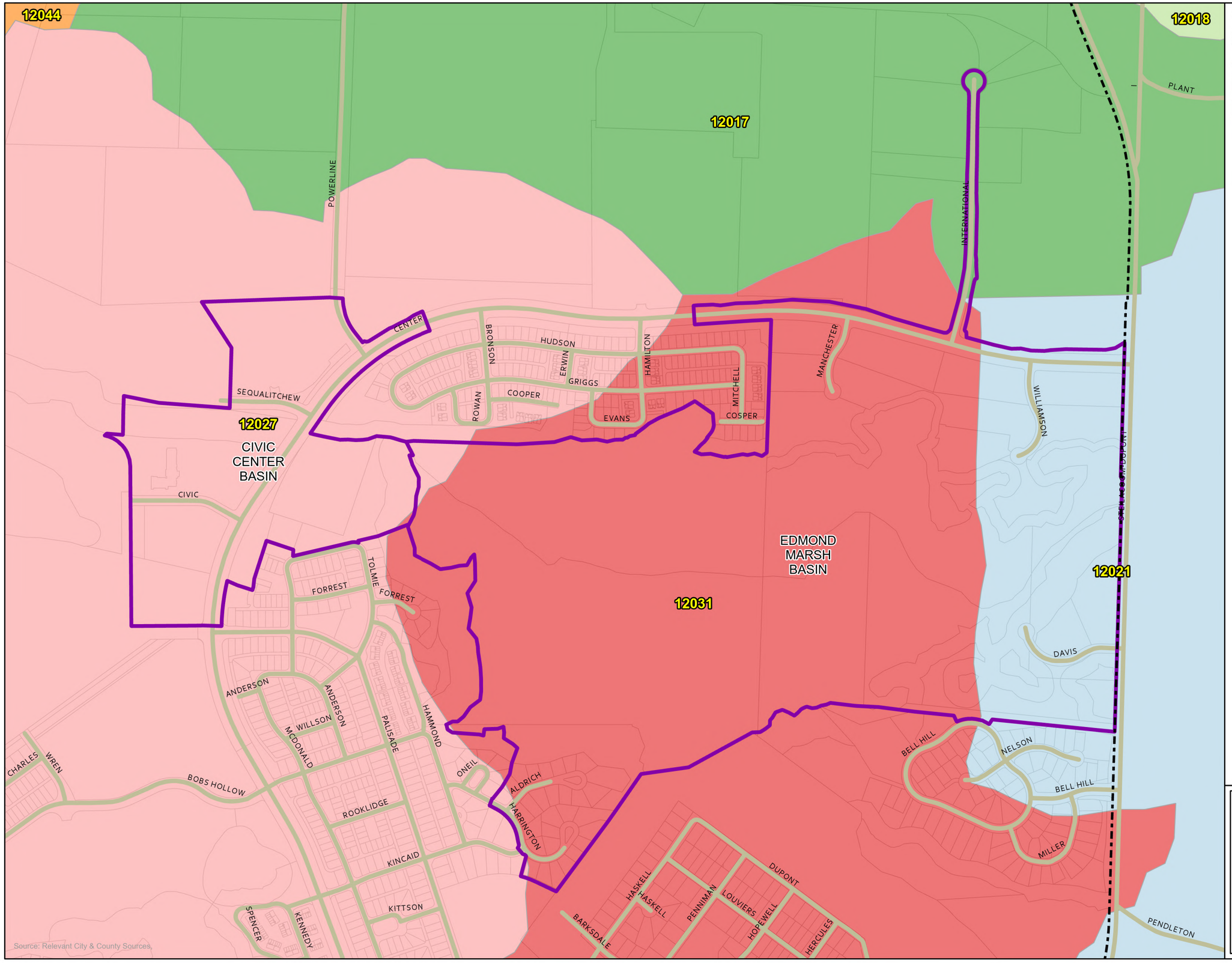
	Civic Center Basin	Edmond Marsh Basin(7)
Freshwater		
Sum Freshwater Index Components(1)	17	20/NA
Max Freshwater Index Components(1)	20	20/NA
Hydrogeomorphic Features(2)	7.6 – 8.0	9.6 – 10.0/NA
Salmonid Habitat		
Downstream Habitats Index(1)	6	7/NA
Local Salmonid Habitats Index(3)	10	10/NA
Aquatic Ecological Integrity(4)	21 – 30	31 – 40/NA
Terrestrial		
Habitats Index(5)	34.82 – 42.85	51.51 – 60.21/NA
Open Space Blocks(6)	0.81 – 0.90	0.81 – 0.90/0.71 – 0.80
Stormwater Management Influence	**High**	**High**

(1) Scores range from 1 to 20 (lowest to highest).
(2) Scores range from 1 to 10 (lowest density to highest density for environmental features).
(3) Scores range from 0 (No freshwater local Salmonid Habitat) to 10 (highest value of Salmonid Habitats).
(4) Scores range from 1 to 100 (lowest to highest based on the ecological ability to support and maintain a biological community).
(5) Scores range from 1 to 100 (lowest to highest based on the integrity of the landscape and locations of priority).
(6) Scores range from 0.00 to 1.0 (lowest to highest based on the amount of area that supports natural habitats, semi-natural habitats, or serve as actual habitats for wildlife).
(7) Edmond Marsh Basin includes multiple assessment units. The first value recorded in the table is for AU 12021. The second value is for AU 12031.

Table 2-2 indicates that both basins have low habitat value scores. Each basin is considered to be in poor condition which results in each basin having a high potential stormwater management influence, meaning that stormwater management projects may have a high impact on downstream water quality. In summation, the basins will have the same Stormwater Management Influence.

Vegetation Buffers

The presence of vegetated buffers that overhang a stream correlate well with the potential for fish recovery. Utilizing GIS stream information and aerial photography, an approximate percentage of a vegetated buffer within 100 feet and 300 feet of the stream was estimated (see Figure 2-4). Table 2-3 presents the buffer related data.



Legend

- City Limits
- Roads
- Parcels
- Basin

N

0 300 600 1,200 Feet

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FIGURE 2-3

ASSESSMENT UNITS

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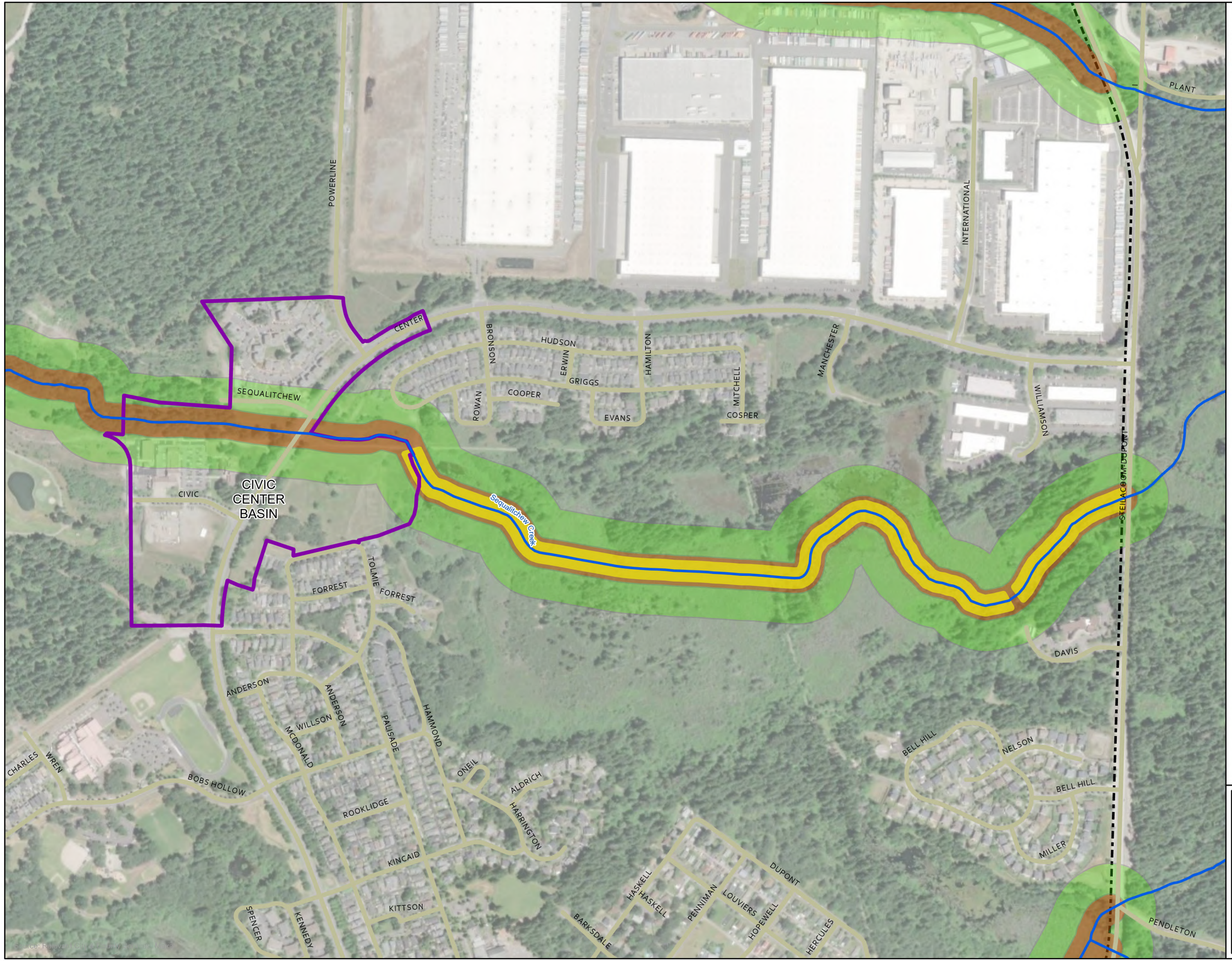

Legend

- City Limits
- Streams
- Roads
- Basin
- 100ft Stream Buffer
- 300ft Stream Buffer
- Area of Stream with both 100' and 300' Vegetated Buffer (Within Prioritized Basins)

N

0 300 600 1,200 Feet

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FIGURE 2-4

VEGETATION BUFFER

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TABLE 2-3

Estimated Vegetative Stream Coverage

	Civic Center Basin		Edmond Marsh Basin	
	100 ft Buffer	**300 ft Buffer**	**100 ft Buffer**	**300 ft Buffer**
Linear Feet of Stream with Vegetative Buffer	1,085	0	5,700	5,570
Total Linear Feet of Stream	1,865	1,865	5,700	5,700
Percent of Stream w/a Vegetative Buffer	58%	0%	100%	98%
Stormwater Management Influence	**High**	**High**	**High**	**High**

As seen in Table 2-3, the Edmond Marsh Basin has almost complete vegetative buffer coverage. The Civic Center Basin only has a portion of their 100-foot buffers vegetated. Due to this, the Civic Center Basin presents a higher opportunity to be restored for the purposes of enhancing habitat for aquatic life.

Benthic Index of Biotic Integrity (B-IBI)

B-IBI scores are created from a standardized scoring system which represent the diversity and abundance of macroinvertebrates in a stream. This in turn, is one indication of the biological health of the stream. This information has also been found to be a good correlation between impervious surface and flow metrics. Unfortunately, no B-IBI data appears to have been conducted amongst the two basins that are a part of this Plan. This is based upon the information provided by the Puget Sound Stream Benthos site (https://pugetsoundstreambenthos.org/SiteMap.aspx) which represents a collaboration of data from many cities, counties and tribes throughout the Puget Sound Region.

It should be noted that typically the more developed a basin is, the poorer the B-IBI score is. This is further supported by the May 2018 King County Report entitled *Stormwater Action Monitoring Status and Trends Study of Puget Lowland Ecoregion Streams: Evaluation of the first Year (2015) of Monitoring Data* that revealed 46 percent of the local Puget Sound stream miles studied outside of an Urban Growth Area (UGA) resulted in good B-IBI scores whereas only 18 percent of the stream miles that were located within a UGA resulted in good B-IBI scores. Water quality retrofits within the UGA would likely result in treatment of impaired surface waters and therefore, improve B-IBI scores.

FLOW RELATED DATA

EXISTING FLOW CONTROL FACILITIES

A number of flow control facilities have been constructed as part of land development projects in each of the two basins, most of which are infiltration trenches. Table 2-4 lists the number of known flow control facilities that are within each basin.

TABLE 2-4

Existing Flow Control Facilities

	Civic Center Basin	Edmond Marsh Basin
Total Flow Control Facilities	9	17
Stormwater Management Influence	**Low**	**Low**

The location of each flow control facility is displayed in Figure 2-5. Both basins are sufficiently covered with flow control facilities on private property thereby, assuming that private property is adequately being served from a stormwater management perspective; however, within the rights-of-way it is assumed each basin has the same level of retrofit opportunity.

PUGET SOUND FLOW CHARACTERIZATION

The Puget Sound Characterization Project included assessments based upon flow in the various AUs mentioned previously. The water flow assessment model results indicate the relative importance of the AU in its "unaltered" state and in its "altered" state in terms of water flow processes. The water flow processes within the model include:

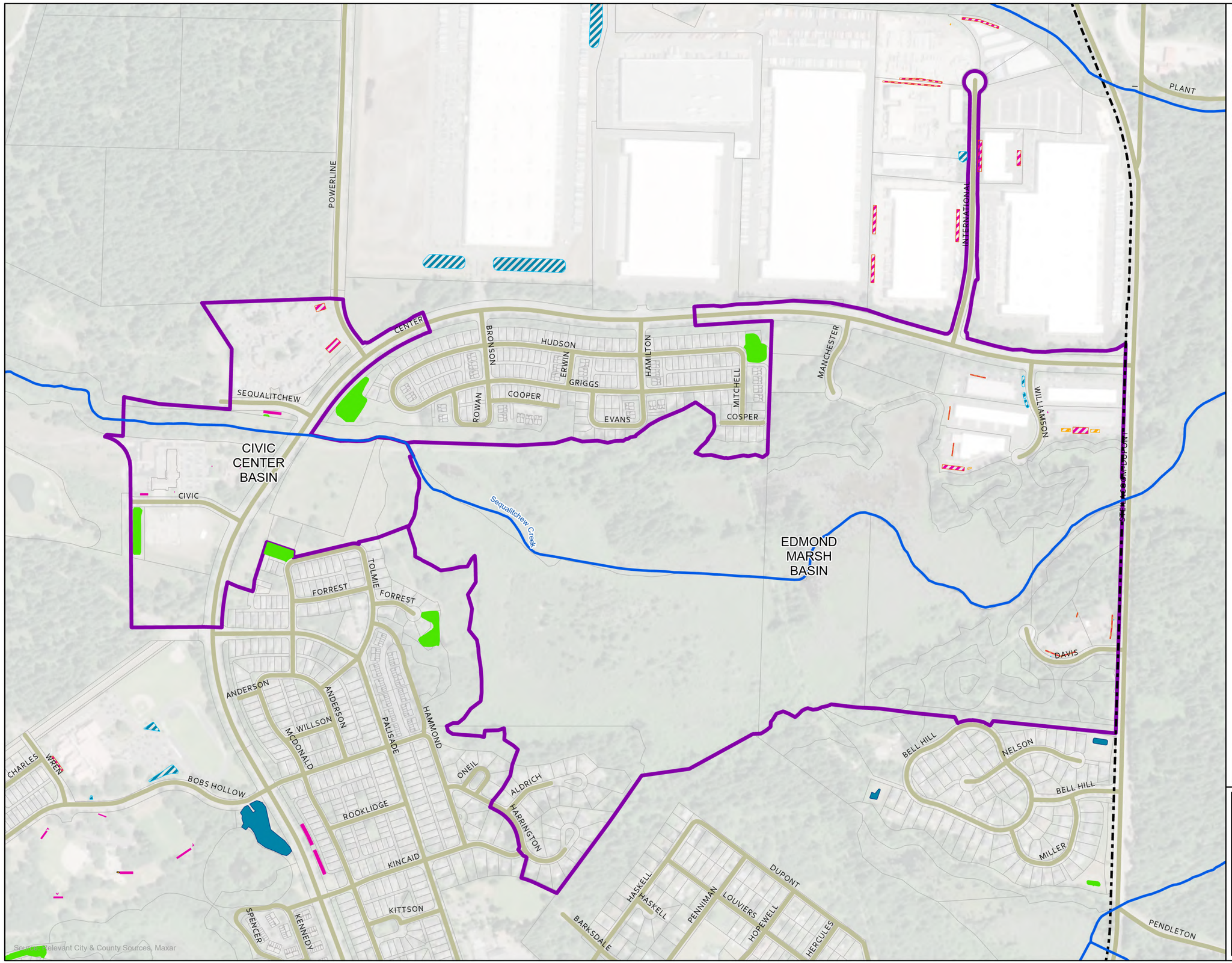
- Delivery – the physical features that control how precipitation is delivered to the landscape. Includes quantity of precipitation, forest cover, and potential for snow events.

- Surface Storage – features that control the movement of water at the surface, including depressional wetlands and floodplains.

- Recharge – the potential for infiltration and percolation of precipitation into groundwater.

- Discharge – the movement of groundwater back to the surface via wetlands, floodplains or permeable deposits.

The characterization model first looks at whether or not features that are of high **importance** to the watershed process (either via delivery, surface storage, recharge or



Legend

- City Limits
- Streams
- Roads
- Parcels
- Basin

Detention Pond
- Public
- Private

Detention Vault
- Public
- Private

Infiltration Pond
- Public
- Private

Infiltration Trench
- Public
- Private

N

0 300 600 1,200 Feet

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FIGURE 2-5

FLOW CONTROL FACILITIES

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discharge) are present. For instance, a watershed that receives a lot of rain, has a number of wetlands or floodplains, has infiltrative soils, or has steeped wetlands or permeable types of floodplains would rank as high importance compared to those watersheds that are missing these components deemed critical for moving water through a basin.

The second part of the model includes reviewing human-based **degraded** areas within the watershed that likely impair the critical features reviewed in the importance model (i.e., delivery, surface storage, recharge or discharge). For instance, the clearing of forests affects delivery of precipitation, and the construction of impervious surfaces impedes recharge of groundwater. Wells can impact the watershed by withdrawing groundwater that would be available to streams and wetlands. Likewise, filling in wetlands would decrease the amount of natural storage that would exist within the watershed.

Table 2-5 presents the results of the flow characterization for the AUs in the subject basins. It should be noted that higher rankings in the importance category indicate the presence of natural features in the basin that are important to the conveyance of water through the watershed. In the degradation category, the higher the ranking, the more degraded the area is and the more likely that its natural watershed processes are being disturbed. The characterization project combined the results of the importance and degradation models to reflect a priority level suggesting how a jurisdiction can move forward. These priority levels are illustrated visually in the Watershed Management Matrix shown in Figure 2-6 which shows that, for areas with high importance but little degradation, a city should focus on protecting these areas (i.e., through planning efforts). For areas of high importance but severe degradation, a city should focus on restoration efforts (i.e., mitigating for past damage). For areas of low importance and low degradation, little planning is needed. The City would be in conservation mode for these regions. For areas that have low importance (i.e., few features to transmit water) but high degradation, development is most appropriate.

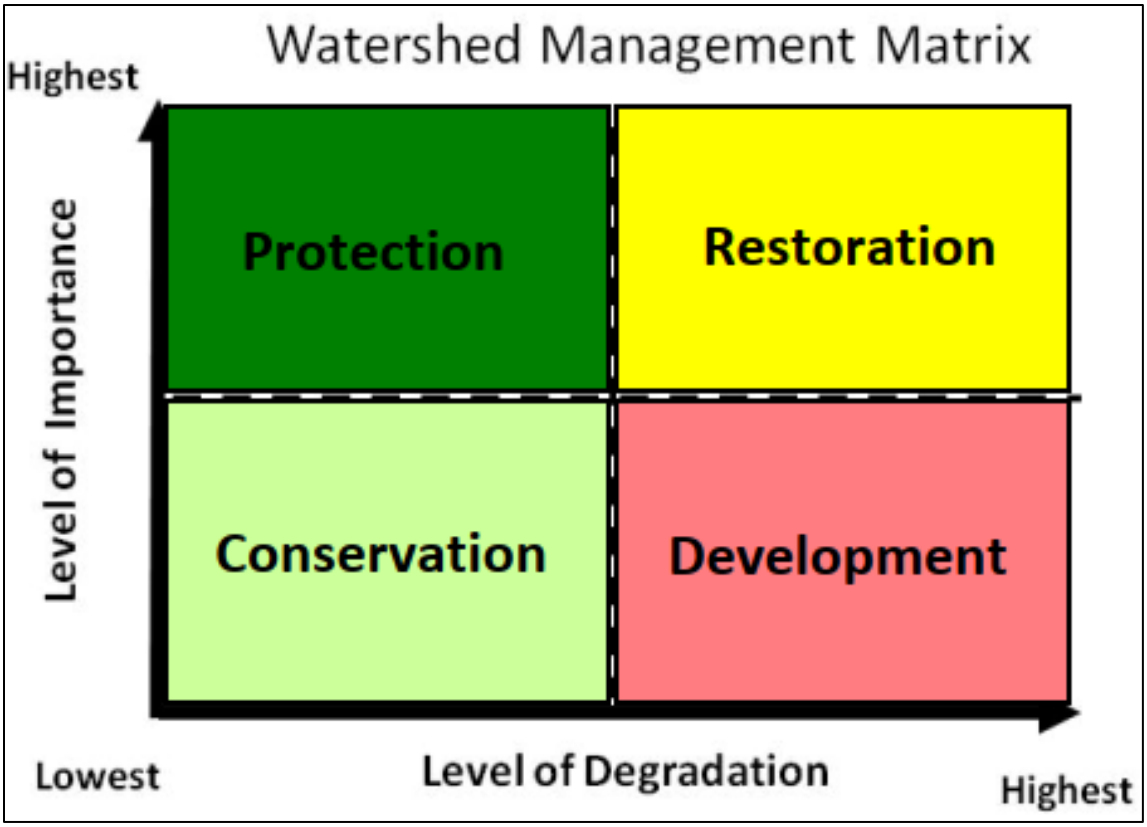


FIGURE 2-6

Characterization Project Matrix Describing Protection or Restoration Efforts Based on Flow

TABLE 2-5

Puget Sound Characterization Project Flow Results

	Civic Center Basin	Edmond Marsh Basin[1]
Overall		
Importance *(Presence of Natural Features)*	High	High
Amount of Degradation *(Based on Current Land Use)*	Moderate	Moderate/Low
Protection and Restoration	Highest Protection	Highest Protection
Delivery		
Importance *(Presence of Natural Features)*	Moderate	Moderate
Amount of Degradation *(Based on Current Land Use)*	Moderate	Moderate/Low
Protection and Restoration	Protection/Conservation	Protection/Conservation

TABLE 2-5 – (continued)

Puget Sound Characterization Project Flow Results

	Civic Center Basin	Edmond Marsh Basin(1)
Surface Storage		
Importance *(Presence of Natural Features)*	Moderate High	High
Amount of Degradation *(Based on Current Land Use)*	High	High/Moderate High
Protection and Restoration	Restoration	Highest Restoration
Recharge		
Importance *(Presence of Natural Features)*	High **(High = Very infiltrative)*	Moderate High/High **(High = Very infiltrative)*
Amount of Degradation *(Based on Current Land Use)*	Moderate	Low
Protection and Restoration	Highest Protection	Protection/Highest Protection
Discharge		
Importance *(Presence of Natural Features)*	High **(High = More sloped wetlands/floodplains; allows groundwater to resurface)*	High **(High = More sloped wetlands/floodplains; allows groundwater to resurface)*
Amount of Degradation *(Based on Current Land Use)*	Moderate	Moderate High
Protection and Restoration	Highest Restoration	Highest Restoration
Stormwater Management Influence	**High**	**High**

(1) Edmond Marsh Basin includes multiple assessment units. The first value recorded in the table is for AU 12021. The second value is for AU 12031.

As seen in Table 2-5, all basins show restoration or protection as measures that should be taken for flow purposes. In general, these basins appear to be of high importance, evidently having many features vital for water conveyance. Only in delivery is the importance of each basin moderate, though lower degradation suggests that development is not appropriate in such cases per the matrix in Figure 2-6.

WATER QUALITY RELATED DATA

EXISTING WATER QUALITY TREATMENT

A portion of the prioritized basins, as Figure 2-7 illustrates, does not have any known treatment facilities. The Civic Center Basin has approximately 70 percent of its area being treated. The Edmond Marsh Basin only has 14 percent of its basin being treated. Underground treatment systems that utilize filters, proprietary media, or similar features

can be installed so as to collect pollutants in each basin. Stormwater facilities that offer basic treatment can be retrofitted to provide enhanced treatment. Edmond Marsh is considered to be a higher priority for water treatment.

TABLE 2-6

Water Quality Treatment Areas

	Civic Center Basin	**Edmond Marsh Basin**
WQ Treatment Area (ac)	41.5	35.9
Total Acreage (Within City Limits, ac)	59	248
Percent With WQ Treatment %	47%	14%
Stormwater Management Influence	**High**	**High**

PUGET SOUND WATER QUALITY CHARACTERIZATION

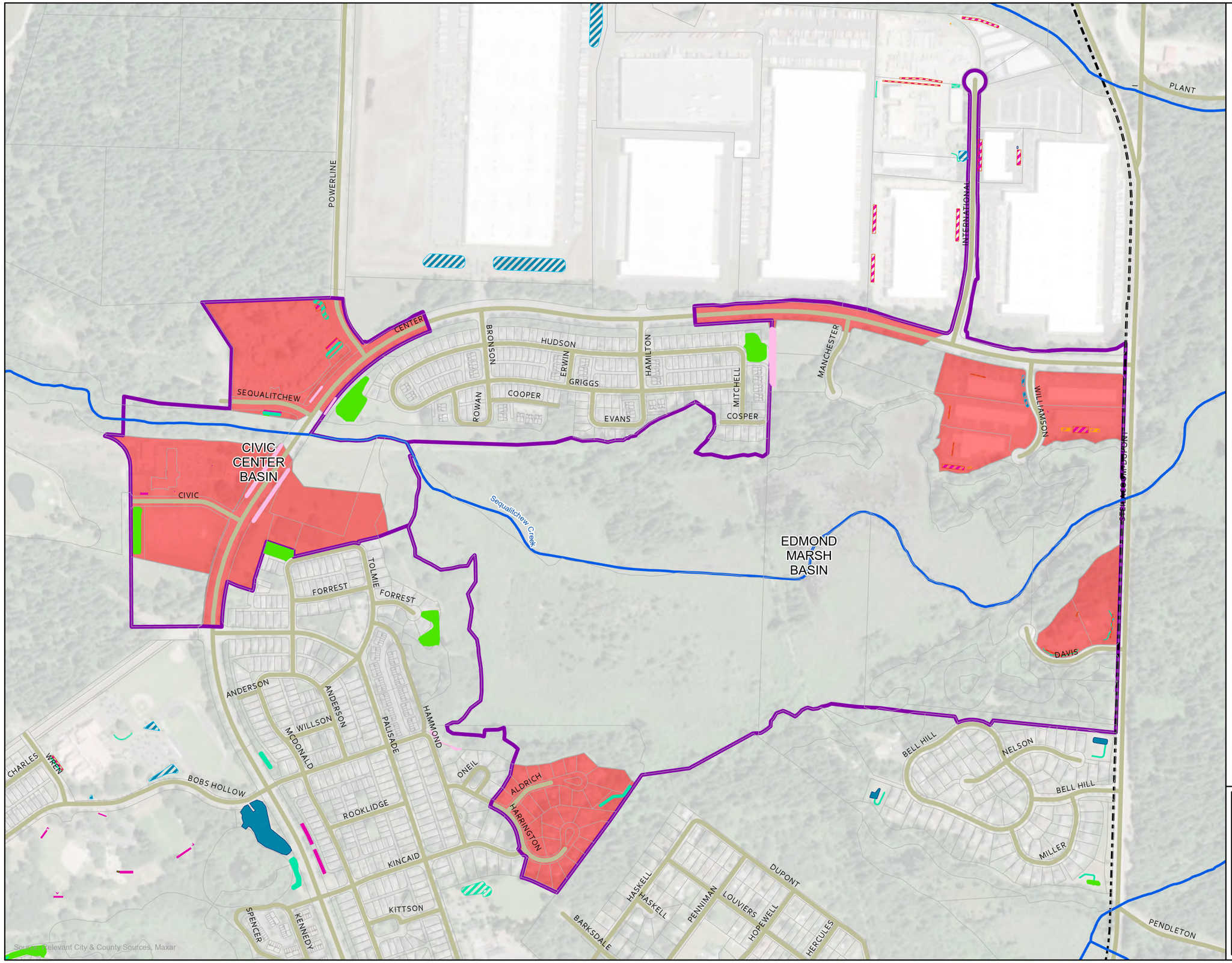
Similar to the flow assessments, the Puget Sound Characterization Project included a water quality assessment model. The water quality assessment model includes five water quality models. Within each model the "export potential" submodel evaluates the system under natural conditions and the "degradation" submodel evaluates the system based on current land cover. The water quality models are as follows:

- Sediment Model – The export potential submodel assesses the relative capacity of an AU under natural conditions to transport soils particles downstream. The degradation submodel assesses the relative sediment load based on current land cover.

- Phosphorous Model – The export potential submodel assesses the relative capacity of an AU under natural conditions to transport phosphorous downstream based on areas that act as sources and sinks of phosphorous. The degradation submodel assesses the relative capacity to generate and load phosphorous into aquatic system during a storm based on current land cover.

- Nitrogen Model – The export potential submodel assesses the relative capacity of the AU to transport nitrogen downstream based on evaluation of areas that act as sinks which facilitate denitrification. The degradation submodel assesses the relative capacity of an AU to generate and load nitrogen into aquatic systems during a storm based on current land use.

- Pathogens Model – The export potential submodel assesses the relative capacity of the AU under natural conditions to generate and transport pathogens downstream. The degradation submodel assesses the relative



Legend

- City Limits
- Streams
- Roads
- Parcels
- Basin
- Treatment Area

Bioswale
- Public
- Private

Bioretention
- Public

Cartridge Filter
- Public
- Private

Detention Vault
- Public
- Private

Detention Pond
- Public
- Private

Infiltration Pond
- Public
- Private

Infiltration Trench
- Public
- Private

N

0 300 600 1,200 Feet

CITY OF DUPONT

STORMWATER MANAGEMENT ACTION PLAN

FIGURE 2-7

TREATMENT AREAS

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capacity under the current land cover to generate and load pathogens into the aquatic systems during a storm.

- Metals Model – The export potential submodel assesses the relative capacity of an AU to generate and transport toxic metals downstream based on an evaluation of areas that act as sinks which can trap metals. The degradation submodel assesses the relative capacity to generate and load toxic metals into aquatic systems during a storm.

Similar to the flow model, results can be interpreted via a prioritization matrix (see Figure 2-8). Greater "sources" represent more ways to transport soil (i.e., higher chance of soil erosion, less features like wetland to keep soil stationary). Conversely, "sinks" represent locations where soil is to remain trapped such as in wetlands or floodplains or in places with fewer streams. As seen in Figure 2-8, if a basin has low degradation, a jurisdiction may want to focus on "protecting" the area (i.e., through planning/land use actions) as opposed to restoring (i.e., vegetate/control high erosion areas and/or enhance wetlands). Table 2-7 presents the results of the water quality characterization for the AUs in the subject basins.

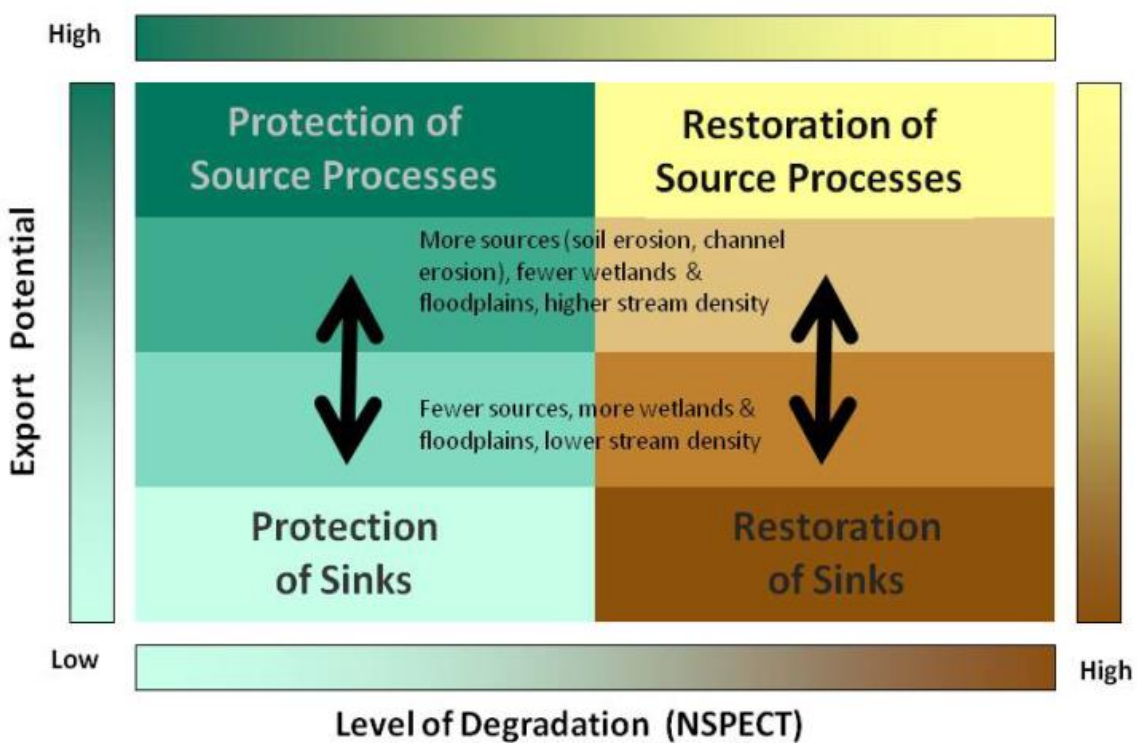


FIGURE 2-8

Characterization Project Matrix Describing Protection or Restoration Efforts Based on Water Quality

TABLE 2-7

Puget Sound Characterization Project Water Quality Results

	Civic Center Basin	Edmond Marsh Basin(1)
Sediment		
Export Potential	High	Low
Amount of Degradation *(Based on Current Land Use)*	High	Moderate High/Low
Protection and Restoration	Restoration of Source Processes	Restoration of Sinks/Protection of Sinks
Phosphorus		
Export Potential	High	Moderate High/Low
Amount of Degradation *(Based on Current Land Use)*	Moderate	Moderate/Low
Protection and Restoration	Protection of Source Processes	Protection of Source Processes/Protection of Sinks
Metals		
Export Potential	Moderate	Moderate High/Low
Amount of Degradation *(Based on Current Land Use)*	Low	Moderate/Low
Protection and Restoration	Protection of Sinks	Protection of Source Processes/Protection of Sinks
Nitrogen		
Export Potential	Moderate	Low
Amount of Degradation *(Based on Current Land Use)*	Low	Moderate/Low
Protection and Restoration	Protection of Sinks	Protection of Sinks
Pathogens		
Export Potential	Low	Low
Amount of Degradation *(Based on Current Land Use)*	Low	Moderate/Low
Protection and Restoration	Protection of Sinks	Protection of Sinks
Stormwater Management Influence	**High**	**High**

(1) Edmond Marsh Basin includes multiple assessment units. The first value recorded in the table is for AU 12021. The second value is for AU 12031.

Per Table 2-7, conditions in both basins for each of the five models necessitate protection of either sinks or source processes. This may be accomplished through the use of land use planning and/or more stringent water quality codes where any new development would require more rigorous treatment to address these water quality related concerns.

303D LISTING RELATED DATA FOR SEQUALITCHEW CREEK

Sequalitchew Creek has been placed on a 303d Category 2 listing for Dissolved Oxygen on the 2004, 2008, 2012, and 2018 assessments. This Category 2 listing means that the Creek is considered a "water of concern" but does not have enough evidence for the implementation of a Water Quality Improvement Project. All other wetlands, creeks and lakes in the City are not identified as having any particular water quality problems or have not been assessed.

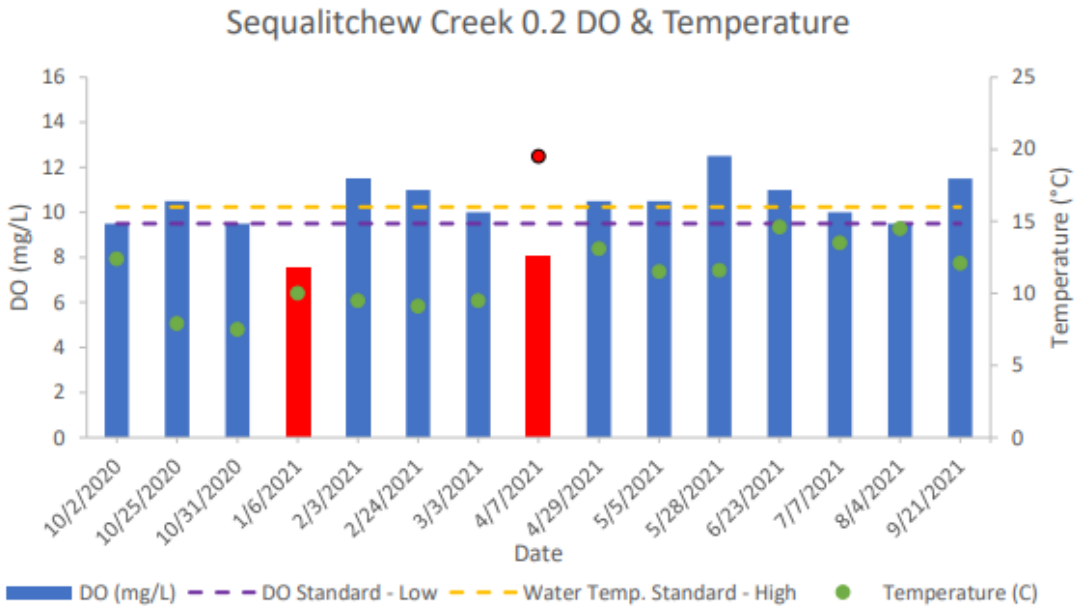
The Pierce Conservation District Stream Team conducts various water quality tests on a number of water bodies within Pierce County. These water quality tests include information dissolved oxygen, temperature, pH, nitrates, and turbidity. The Pierce Conservation District Stream Team testing site is provided in Figure 2-9.

FIGURE 2-9

Sequalitchew Creek Testing Location

When testing for each of the water quality parameters, dissolved oxygen and temperature was the only constituent that was above the state standard. Dissolved oxygen was above state standard in January 2021 and April 2021. Temperature was above state standard in April 2021. The results for dissolved oxygen and temperature are reported in Figure 2-10. The Pierce Conservation District Stream Team evaluated the Sequalitchew Creek as a whole and considered the stream to be moderately healthy with a rating of

70/100. This evaluation depended upon a combined water quality index for each water quality parameter measured in the field (i.e., dissolved oxygen, temperature, pH, nitrates, and turbidity). Taking action now to improve stormwater management in the vicinity of Sequalitchew Creek based on the other metrics outlined in this Action Plan could prevent the necessity of a Water Quality Improvement Project in the future.



Source: (https://www.piercecd.org/DocumentCenter/View/3170/Pierce-Conservation-District-Annual-Stream-Team-Report_2021)

FIGURE 2-10

Dissolved Oxygen and Temperature Levels, 2021

LAND USE OPPORTUNITY

Land use can have a profound impact on the water quality in the region. Greater unmitigated amounts of impervious surface would result in higher amounts of stormwater runoff which may erode local creeks and threaten aquatic habitat downstream. Likewise, pollution generating impervious surfaces such as roads have the opportunity to transport pollutants downstream which also endangers aquatic habitat.

EXISTING LAND USE

To understand the state of the watershed, it is important to view land use as it exists today and what land use is anticipated for the future. Table 2-8 shows the amount of impervious surface that exists within the city limits for the Civic Center and Edmond Marsh Basin in 2023. The highest percentage of impervious surface is located in the

Civic Center Basin. The current land use for both basins in DuPont is displayed in Figure 2-11.

TABLE 2-8

2023 Impervious Surface Acreage Within City Limits

	Civic Center Basin	**Edmond Marsh Basin**
Impervious Acreage (ac)	29	27
Total Acreage (Within City Limits, ac)	59	248
Percent Impervious	49%	11%
Stormwater Management Influence	**High**	**High**

Both basins are considered to have the same priority for Stormwater Management Influence because the total impervious area is almost the same for each basin.

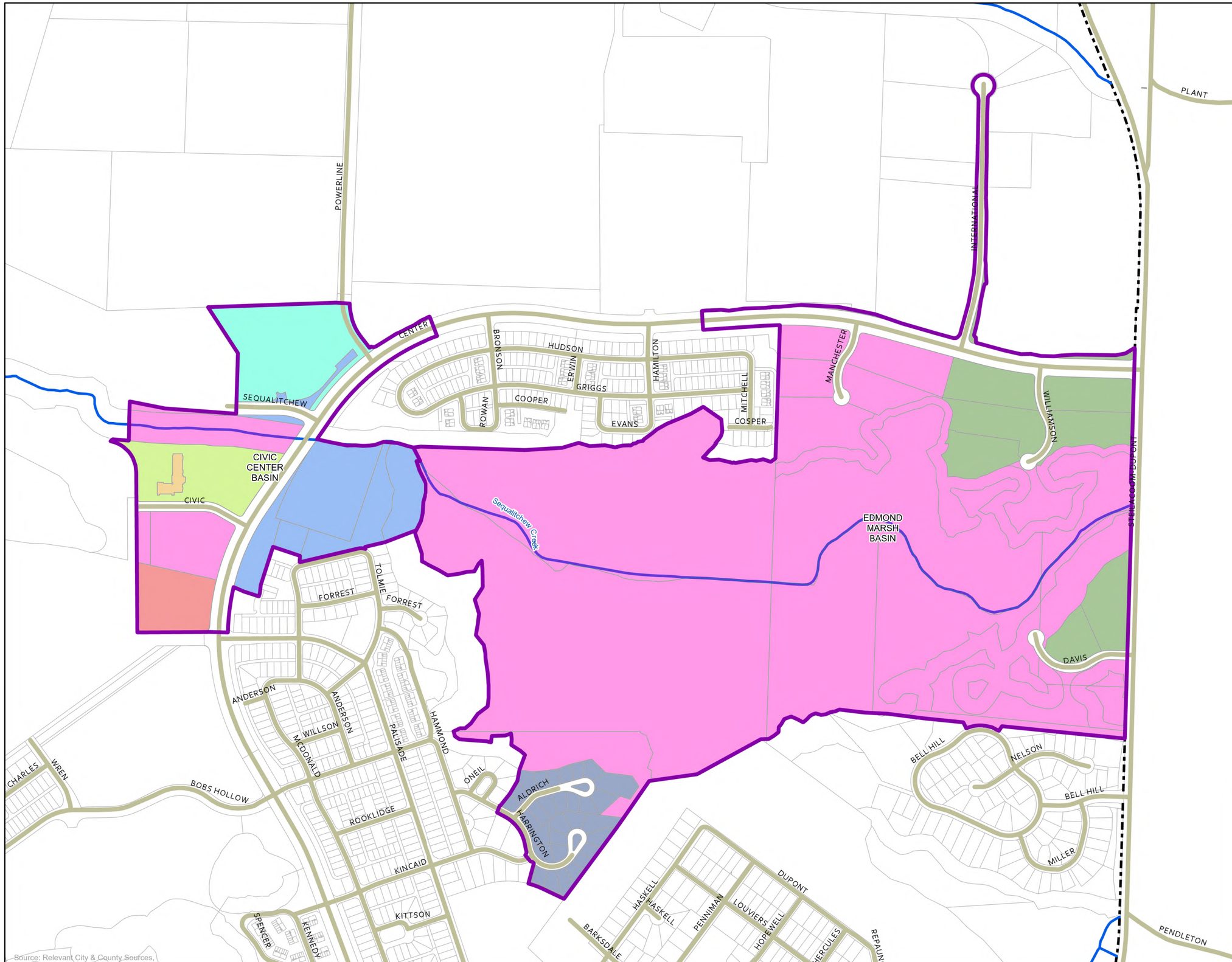
DESIGNATED FUTURE LAND USE

The buildout conditions for DuPont are provided in Table 2-9 and Figure 2-12 based on the zoning designations in the City. This illustrates the designated land use and the potential impervious surfaces that could result in each basin should all of the land be built out to its maximum lot coverage as allowed by current City code. Table 2-9 indicates that the Civic Center Basin will have a higher concentration of impervious area than the Edmond Marsh Basin. The predicted impervious area in the Edmond Marsh Basin is 43 acres and 22 acres in the Civic Center Basin. As the quantity of impervious area is greater in the Edmond Marsh Basin and only road runoff from the Civic Center feeds a receiving water, the Edmond Marsh Basin is considered to have the highest retrofit opportunity.

TABLE 2-9

Buildout Conditions

	Maximum Lot Coverage Allowed Per City Code	Civic Center Basin (ac)		Edmond Marsh Basin (ac)	
		Designated Acres	Potential Impervious acres	Designated Acres	Potential Impervious Acres
Residential 3 (R3)	45%	0	0	0	0
Residential 4 (R4)	45%	0	0	0.01	0
Residential 5 (R5)	45%	4	2	12	6
Residential Reserve (RR)	45%	0	0	0	0
Residential 12 (R12)	45%	13	6	0	0
Commercial (COM)	80%	0	0	0	0
Office (OFF)	80%	0	0	0	0
Mixed Use (MXD)	80%	18	15	0	0
Business Tech Park (BTP)	80%	0	0	0	0
Manufacturing and Research (MRP)	80%	0	0	43	34
Industrial (IND)	80%	0	0	3	3
Open Space/Sensitive Areas (OS)	0%	21	0	189	0
Community Park (CP)	0%	3	0	0	0
Neighborhood Park (NP)	0%	0	0	0	0
Military (MIL)	Unknown. Not Governed by City.	0	0	0	0
Total		**59**	**22**	**248**	**43**
			37%		**17%**
Stormwater Management Influence			**High**		**High**



Source: Relevant City & County Sources.

Legend

- City Limits
- Streams
- Roads
- Parcels
- Basin

Existing Land Use

- Cemeteries
- Fire Stations
- Gen Warehousing Storage
- Govermental Services
- Manufacturing and Researching
- Multi Fam Apts 5 Units or More
- Open Space
- Single Family Dwelling
- Vacant

N

0 300 600 1,200 Feet

CITY OF DUPONT

STORMWATER MANAGEMENT ACTION PLAN

FIGURE 2-11

EXISTING LAND USE

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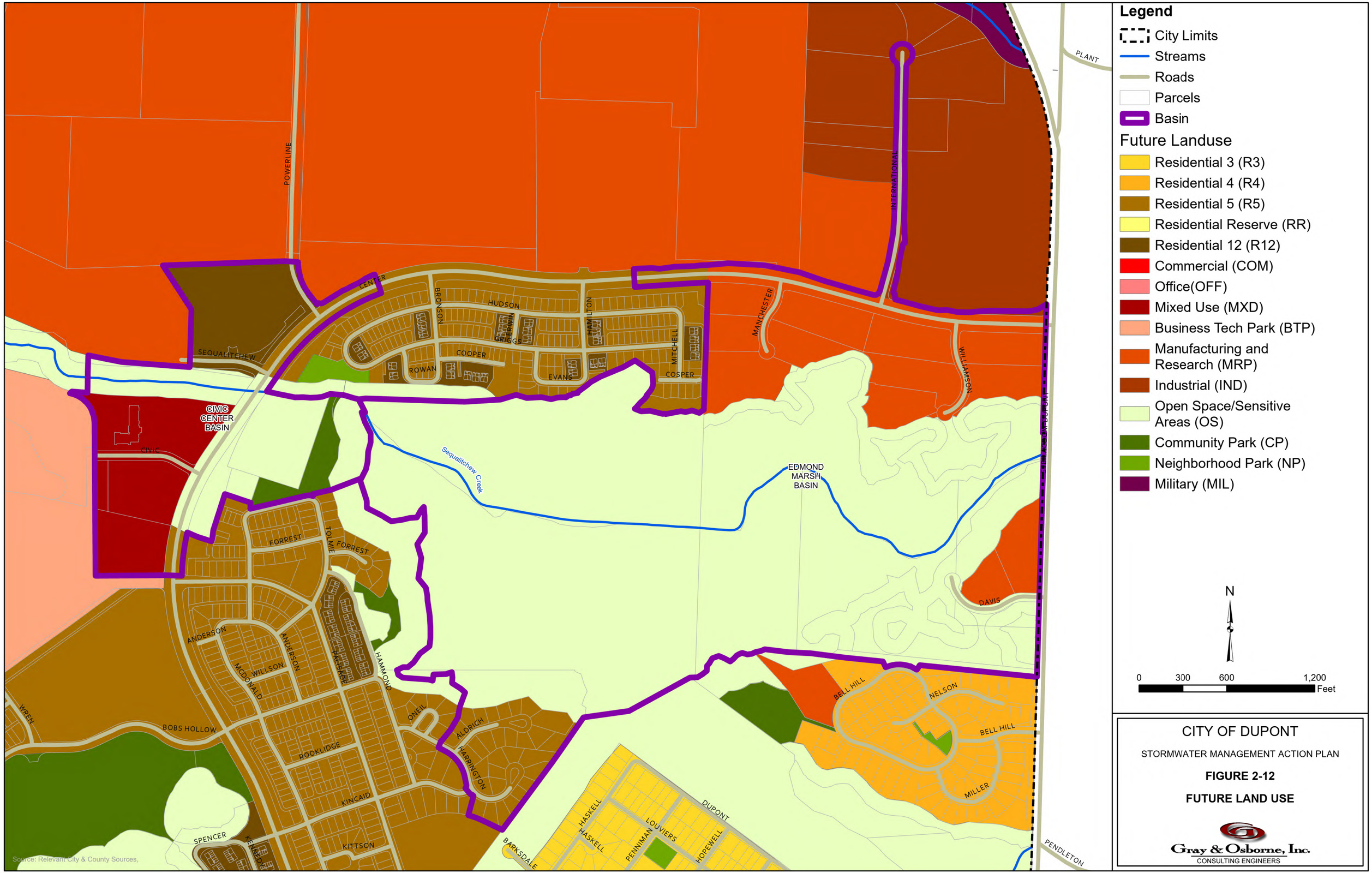

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ENVIRONMENTAL JUSTICE

As established by the Department of Ecology, pollution and environmental contamination impacts all residents in the state. However, studies have shown that people of color, low-income people, and indigenous people are impacted the most by environmental pollution. Higher levels of exposure cause negative impacts on the lives of those afflicted. In many cases, this results in higher rates of illness, disease, and hospitalization, causing lower life expectancy for impacted groups. Therefore, the State of Washington is committed to addressing the disproportionate impacts that pollution has on disadvantaged communities and aims to remediate some of the long-standing issues affecting these communities.

An emphasis on environmental justice allows the City to focus its efforts on measures that can aid historically disadvantaged communities. In developing a prioritized list of projects, the City should evaluate the impact that a given project may have on communities with low wages, and/or higher proportions of people of color or indigenous people. Projects with the highest benefit on water quality should be prioritized, especially those that have the potential to provide benefits to these communities.

DEMOGRAPHIC

There are three major ethnic groups that reside in DuPont: White (Non-Hispanic), Black or African American (Non-Hispanic), and Asian (Non-Hispanic). The breakdown of these groups is presented in Table 2-10. As noted, the predominant ethnic group in DuPont is Non-Hispanic White. A specific geographic distribution of the demographic groups is not provided, so it is assumed that each group is distributed uniformly throughout the City.

TABLE 2-10

Ethnic Group Distribution

Ethnic Group	% of DuPont's Population
White (Non Hispanic)	63.40%
Black or African American (Non-Hispanic)	8.24%
Asian (Non-Hispanic)	7.37%
White (Hispanic)	6.39%
Multiracial (Non-Hispanic)	5.58%
Multiracial (Hispanic)	2.38%
Other (Hispanic)	1.79%
Native Hawaiian and Other Pacific Islander (Hispanic)	1.63%
Native Hawaiian and Other Pacific Islander (Non-Hispanic)	1.38%
Black or African American (Hispanic)	0.76%

Source: https://datausa.io/profile/geo/DuPont-wa

WAGE DIVIDE

The entire city is under Census Tract 728. The median household income for DuPont in 2021 according to the U.S. Census Bureau is $98,409. Since there is only one Census Tract for DuPont, there is no indication of portions of the City being at a greater disadvantage.

Based on the demographic distribution and Median Household income in the City, there are no high priority basins to target for environmental justice improvements.

WATERSHED INVENTORY SUMMARY

Table 2-11 includes a summary of all of the various parameters and associated stormwater management influence considered within this Chapter.

TABLE 2-11

Stormwater Management Influence Summary

	Civic Center Basin (ac)	Edmond Marsh Basin (ac)
Watershed Area w/in City UGA (ac)	59	248
Total Watershed Area (ac) to a Flow-Control Exempt Water Body	12	248
% within City UGA	100%	100%
Fish Barriers	High	High
Fish Habitat – Stream Typing	High	High
Fish Habitat – Puget Sound Habitat Characterization	High	High
Stream Vegetation Buffer	High	High
B-IBI	-	-
Existing Flow Control Facilities	Low	Low
Flow Control – Puget Sound Habitat Characterization	High	High
Existing Water Quality Treatment	High	High
Water Quality – Puget Sound Habitat Characterization	High	High
303d Listing Parameters	High	High
Existing/Future Land Use	High	High
Demographic	Low	Low
Wage Divide	Low	Low

Table 2-11 illustrates that the two basins analyzed in this chapter have a high influence on stormwater management according to several metrics, which will be considered in the watershed prioritization process in the next chapter.

CHAPTER 3

RECEIVING WATER PRIORITIZATION

The previous chapter demonstrated that each of the two basins have the potential to be influenced by stormwater management efforts. The following will prioritize these basins and narrow the list to a single basin to focus future recovery efforts.

PRIORITIZATION METHOD

In selecting a high priority basin, it is imperative to review which basin will receive the most benefit from implementation of stormwater facility retrofits, tailored implementation of stormwater related actions and other land/development management actions.

Table 3-1 presents a relative score of each of the parameters assessed in Chapter 2 (fish habitat, flow, water quality, land use and environmental justice). For each category, the basins were scored on a scale from “1” to “2” with “2” being the most negatively affected of each of the two basins. For instance, the Edmond Marsh Basin has the largest amount of impervious area in buildout conditions and; therefore, receives a score of “2” whereas the Civic Center Basin has a smaller impervious area in buildout conditions and; therefore, receives a score of “1.”

TABLE 3-1

Basin Prioritization Summary

	Civic Center Basin (ac)	**Edmond Marsh Basin (ac)**
Watershed Area w/in City UGA (ac)	59	248
Total Watershed Area (ac) to a Flow-Control Exempt Water Body	59	248
% Within City UGA	100%	100%
	Topography flows to the west. The final destination of flow conveyed into the Sequalitchew Creek is the Puget Sound. The Sequalitchew Creek is considered to have good stream health. Land use is either open space, single family homes, or government buildings. Flow control exists throughout the basin.	Topography flows to the west. The final destination of flow conveyed from the Edmond Marsh to the Sequalitchew Creek which flows to the Puget Sound. Land use is either open space, single family homes, or manufacturing and researching areas. Flow control exists throughout the basin.
Fish Barriers	2	2
Fish Habitat – Stream Typing	2	2
Fish Habitat – Puget Sound Habitat Characterization	2	2
Stream Vegetation Buffer	2	1
B-IBI	-	--
Existing Flow Control Facilities	2	1
Flow Control – Puget Sound Habitat Characterization	2	2
Existing Water Quality Treatment	1	2
Water Quality – Puget Sound Habitat Characterization	2	2
303d Listing Parameters	1	1
Existing Land Use	2	2
Future Development	1	2
Demographic	1	1
Wage Divide	1	1
Total Score	**21**	**22**

(1) A score of 1 represents the relative best condition compared to a score of 2 which is the relative worst condition of each of the basins.

HIGH PRIORITY BASIN/CATCHMENT AREA

Figure 3-1 shows an overview of the basins and how well each basin scored per Table 3-1. As shown, the Edmond Marsh Basin had the highest score, revealing it as the most probable location to focus retrofit efforts on. The motivation behind selecting the Edmond Marsh Basin as the high priority basin includes:

- Largest area with minimal water quality treatment
- Largest amount of impervious surface in built out conditions
- Highest percentage of land within the City

Due to the listed reasons above, the City will focus stormwater restoration related efforts on the Edmond Marsh Basin.

PREDICTED POLLUTANT LOADING IMPACTS

As a base measurement to improvement, Table 3-2 and 3-3 predicts the current and future pollutant loading impacts within the Edmond Marsh Basin.

TABLE 3-2

Anticipated Annual Loadings for Existing Land Use Within the Edmond Marsh Basin

	Unit Loading (per kg ha^{-1})(2)			Total Loading (lbs/ac)(1)			Total
	Residential	Commercial	Industrial	Residential	Commercial	Industrial	Loading
Acreage				8.4	20.7	0.0	
TSS	0.05	0.28	0.71	0.38	5.19	0.00	5.56
Dissolved Phosphorus	0.00011	0.00011	0.00015	0.00	0.00	0.00	0.00
Nitrogen	0.0043	0.0043	0.0043	0.03	0.08	0.00	0.11
Copper	5.1E-05	5.1E-05	5.1E-05	0.00	0.00	0.00	0.00
Lead	2.7E-05	2.7E-05	2.7E-05	0.00	0.00	0.00	0.00
Zinc	0.00031	0.00031	0.00031	0.00	0.01	0.00	0.01
PAHs	6.70E-07	6.70E-07	6.70E-07	0.00001	0.000012	0.000000	0.0000

(1) 0.893 lbs/ac = 1 kg ha^{-1}.

(2) Data provided from the Western Washington NPDES Ph. I Stormwater Permit, Final S8.D Data Characterization 2009-2013 by Hobbs, W., B. Lubliiner, N. Kale, and E. Newell, 2015. If specific land uses were not specified, the median value was chosen.

TABLE 3-3

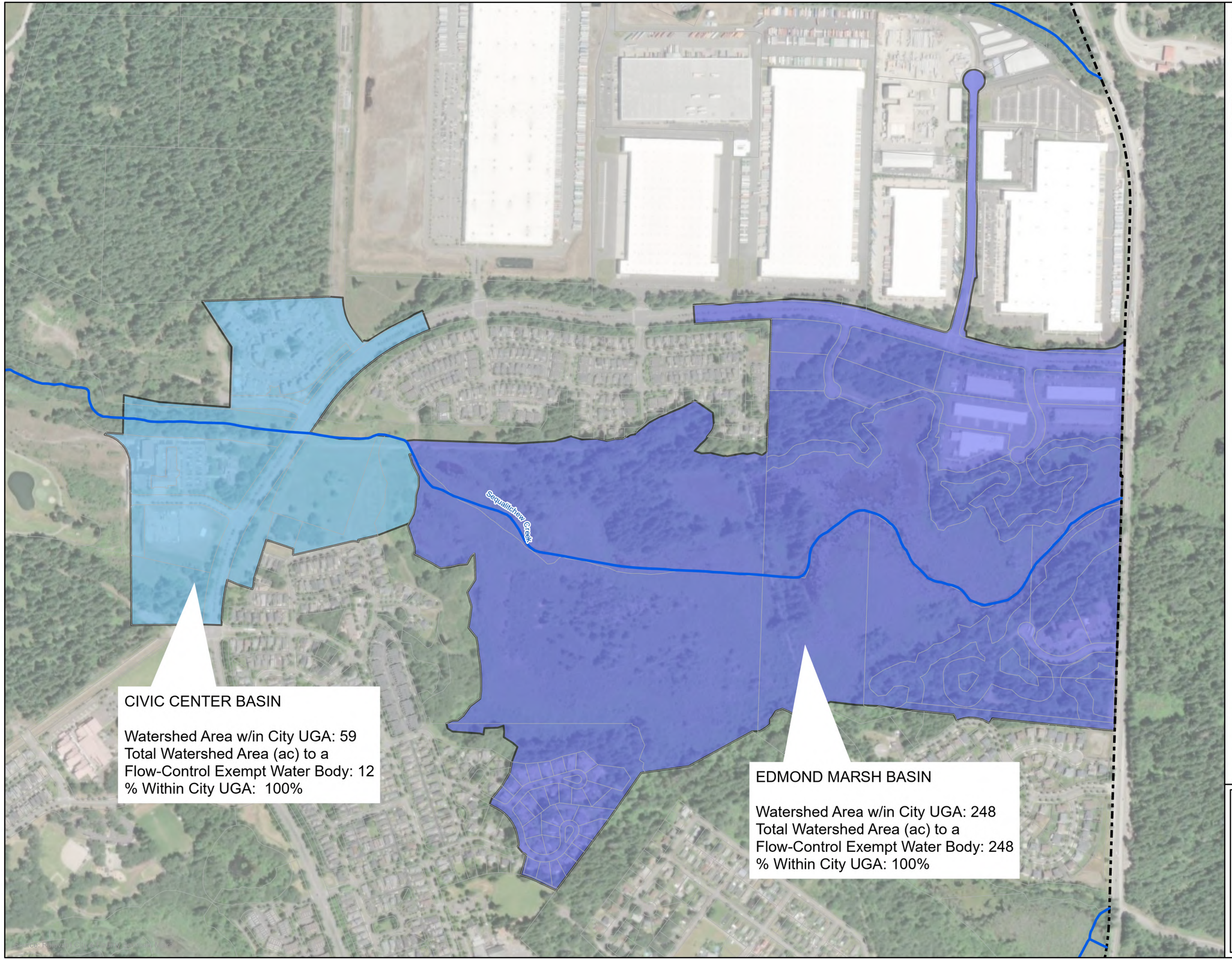
Anticipated Annual Loadings for Future Land Use within the Edmond Marsh Basin

	Unit Loading (per kg ha^{-1})(2)			Total Loading (lbs/ac)(1)			Total
	Residential	**Commercial**	**Industrial**	**Residential**	**Commercial**	**Industrial**	**Loading**
Acreage				12.4	43	3	
TSS	0.05	0.28	0.71	0.55	10.73	2.13	13.41
Dissolved Phosphorus	0.00011	0.00011	0.00015	0.00	0.00	0.00	0.01
Nitrogen	0.0043	0.0043	0.0043	0.05	0.16	0.01	0.23
Copper	5.1E-05	5.1E-05	5.1E-05	0.00	0.00	0.00	0.00
Lead	2.7E-05	2.7E-05	2.7E-05	0.00	0.00	0.00	0.00
Zinc	0.00031	0.00031	0.00031	0.00	0.01	0.00	0.02
PAHs	6.70E-07	6.70E-07	6.70E-07	0.0000	0.0000	0.0000	0.0000

(1) 0.893 lbs/ac = 1 kg ha^{-1}.

(2) Data provided from the Western Washington NPDES Ph. I Stormwater Permit, Final S8.D Data Characterization 2009-2013 by Hobbs, W., B. Lubliiner, N. Kale, and E. Newell, 2015. If specific land uses were not specified, the median value was chosen.

The largest anticipated change between today's land use and buildout conditions relates to TSS. From existing land use to the future land use, it is anticipated that TSS will increase 41 percent, an estimated 7.85 lbs/ac. Based upon this evaluation, potential retrofits should target the removal of TSS.



Legend

- City Limits
- Streams
- Parcels
- Civic Center Basin: 21
- Edmond Marsh Basin: 22

N

0 300 600 1,200 Feet

CITY OF DUPONT

STORMWATER MANAGEMENT ACTION PLAN

FIGURE 3-1

PRIORITIZATION SCORES

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CHAPTER 4

STORMWATER MANAGEMENT ACTION PLAN

Using the basin priority criteria discussed in Chapter 3, the Edmond Marsh Basin was categorized as the highest priority basin within the City. The entire basin was selected for focused stormwater improvements (see Figure 4-1). The potential for stormwater retrofits, land management/development strategies, and stormwater management actions designated for this high priority catchment area are discussed within this chapter.

PLANNED STORMWATER RETROFIT

The City of DuPont has proposed three bioretention stormwater improvement projects within the Edmond Marsh Basin. Bioretention facilities provide total suspended solids removal while having the added benefit of providing enhanced treatment which focuses on removing dissolved metals. The projects will be located at Williamson Place, International Place, and Manchester Place (see Figure 4-2).

WILLIAMSON PLACE BIORETENTION

This bioretention facility will treat runoff from 1.03 acres of Williamson Place. Dupont is required to treat 1 acre of land per the upcoming 2024 NPDES Municipal Stormwater Permit. This requirement would be satisfied by this project. Bioretention facilities provide an effective method of removing pollutants and reducing stormwater runoff. As defined by the Department of Ecology, bioretention systems are shallow, landscaped depressions with compost-amended soils and adapted plants. The details of this bioretention facility are documented in Table 4-1. A report on sizing the bioretention facility through the Western Washington Hydrology Model (WWHM) is documented in Appendix B. The construction of this project is estimated to begin in 2028 and is estimated to cost $259,000.

TABLE 4-1

Williamson Place Bioretention Facility Specifications

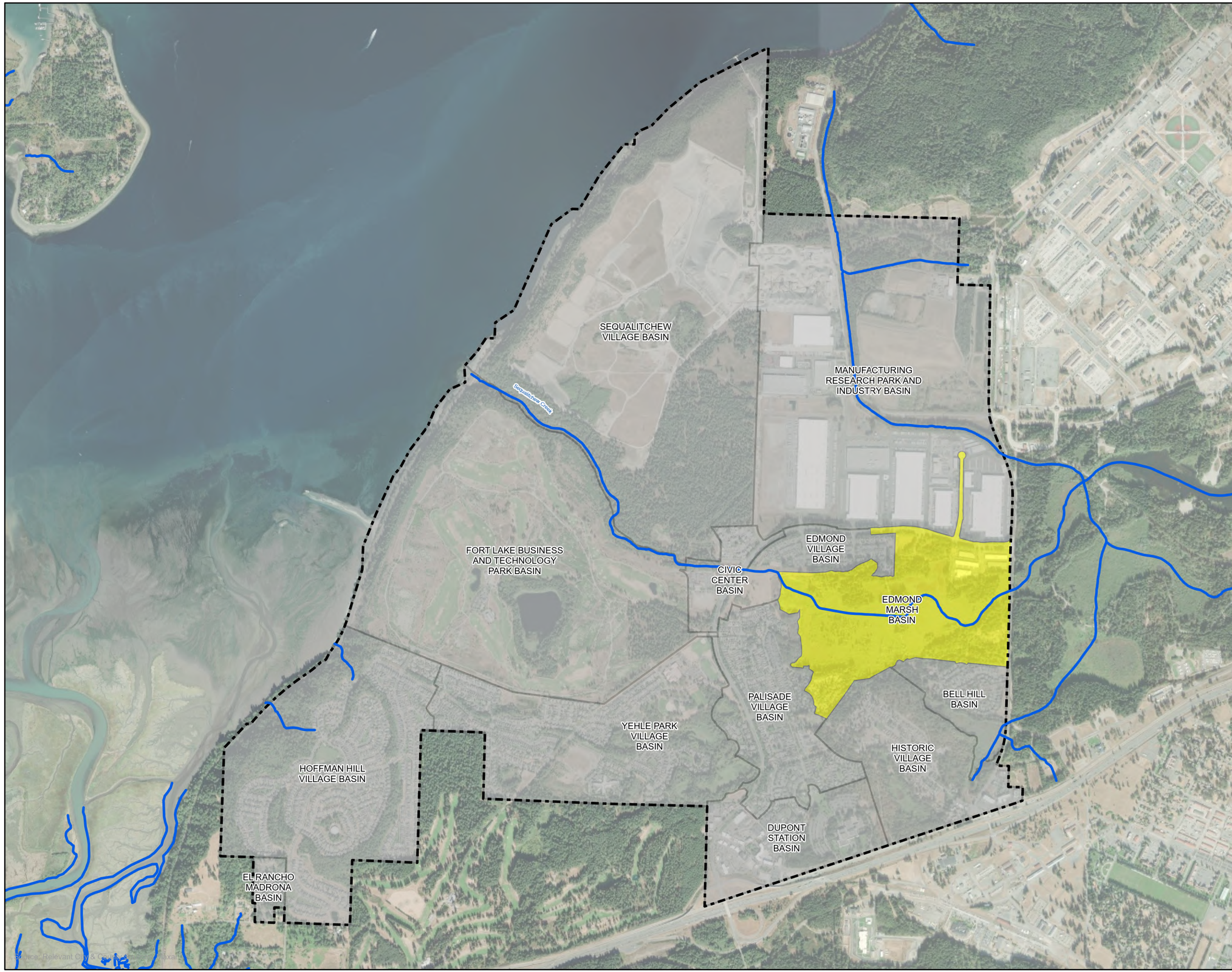
Details	
Bioretention Length (ft)	20
Bioretention Bottom Width (ft)	20
Ponding Depth (in)	12
Side Slopes (H:V)	3:1
Assumption	
KSat Safety Factor(2)	4
Target Treatment Percentage	91%
WWHM Model Pre-Developed Area Condition(1)	
Forest, Type C, Flat (acres)	1.03
WWHM Model Developed Area Condition(1)	
Roads, Flat (acres)	1.03

(1) These conditions were used to size the bioretention facility by using WWHM.

(2) Per guidelines set by the Department of Ecology, treating over 10,000 sf of impervious area or 5,000 sf of pollution generating area requires a KSat safety Factor of 4.

INTERNATIONAL PLACE BIORETENTION

This bioretention facility will treat runoff from 4.54 acres of International Place. Runoff from International Place is conveyed south of the existing road by an existing stormwater pipe. The proposed bioretention facility will be constructed within existing City right-of-way. The details of this bioretention facility are documented in Table 4-2. A report on sizing the bioretention facility through the Western Washington Hydrology Model (WWHM) is documented in Appendix B. The construction of this project is estimated to begin in 2033 and is estimated to cost $497,000.



Legend

- City Limits
- Streams
- Prioritized Basin
- Non-Prioritized Basin

N

0 1,000 2,000 4,000 Feet

CITY OF DUPONT

STORMWATER MANAGEMENT ACTION PLAN

FIGURE 4-1

HIGH PRIORITY CATCHMENT AREA

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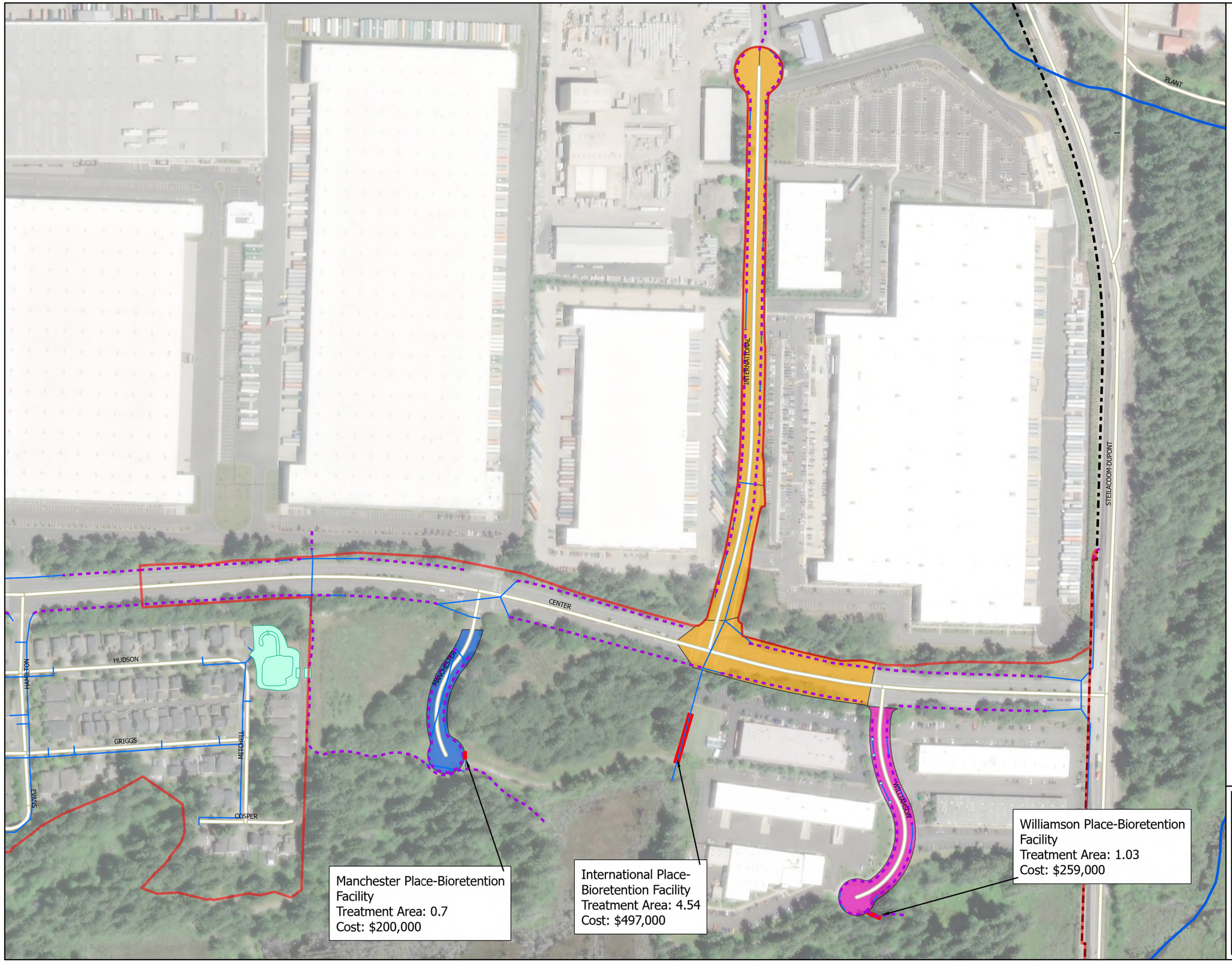

Legend

- City Limits
- Streams
- Roads
- Edmond Marsh Basin
- Public Stormwater Facility
- Retrofit Projects

Public Storm Lines

- Ditch
- Pipe

Edmond Marsh Subbasins

- International Place-Basin
- Williamson Place-Basin
- Manchester Place Basin

N

0 150 300 600 Feet

CITY OF DUPONT

STORMWATER MANAGEMENT ACTION PLAN

FIGURE 4-2

RETROFIT TREATMENT AREA

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TABLE 4-2

International Place Bioretention Facility Specifications

Details	
Bioretention Length (ft)	47
Bioretention Bottom Width (ft)	47
Ponding Depth (in)	12
Side Slopes (H:V)	3:1
Assumption	
KSat Safety Factor(2)	4
Target Treatment Percentage	91%
WWHM Model Pre-Developed Area Condition(1)	
Forest, Type A/B, Flat (acres)	4.54
WWHM Model Developed Area Condition(1)	
Roads, Flat (acres)	4.54

(1) These conditions were used to size the bioretention facility by using WWHM.

(2) Per guidelines set by the Department of Ecology, treating over 10,000 sf of impervious area or 5,000 sf of pollution generating area requires a KSat safety Factor of 4.

MANCHESTER PLACE BIORETENTION

This bioretention facility will treat runoff from 0.7 acres of Manchester Place and be constructed at the southern end of the road. The details of this bioretention facility are documented in Table 4-3. A report on sizing the bioretention facility through the Western Washington Hydrology Model (WWHM) is documented in Appendix B. The construction of this project may be timed with potential future development and is estimated to cost $200,000.

TABLE 4-3

Manchester Place-Bioretention Facility Specifications

Details	
Bioretention Length (ft)	15
Bioretention Bottom Width (ft)	15
Ponding Depth (in)	12
Side Slopes (H:V)	3:1
Assumption	
KSat Safety Factor(2)	4
Target Treatment Percentage	91%
WWHM Model Pre-Developed Area Condition(1)	
Forest, Type A/B, Flat (acres)	0.7
WWHM Model Developed Area Condition(1)	
Roads, Flat (acres)	0.7

(1) These conditions were used to size the bioretention facility by using WWHM.

(2) Per guidelines set by the Department of Ecology, treating over 10,000sf of impervious area requires a KSat safety Factor of 4.

RETROFIT AREA SUMMARY

The Williamson and International Place retrofits are the highest priority as the Manchester Place retrofit may be combined with future private development. Constructing either of these two projects will provide more than 1 acre of treatment and would satisfy the 1 acre of treatment required for the 2024 NPDES permit. Constructing only the Manchester Place retrofit will not satisfy the NPDES permit requirements and would need to be constructed with another retrofit. If all three retrofits are constructed, a total of approximately 5.64 acres of land will receive treatment as documented in Table 4-4. The planning-level cost for the retrofit is provided in Table 4-4 while Appendix A provides a detailed cost estimate.

TABLE 4-4

Retrofit Area Effect

Retrofit	Area Treated (ac)	Total Project Cost
Williamson Place-Bioretention	1.03	$259,000
International Place-Bioretention	4.54	$497,000
Manchester Place-Bioretention	0.7	$200,000
Total Area Treated	5.64	
Percent of Edmond Marsh Basin Within City UGA Treated	2.27%	

(1) Total project cost includes cost of construction, sales tax, 30 percent contingencies, and 30 percent for project administration and construction management.

LAND MANAGEMENT

There are no plans to change city code to adjust zoning or land use policies in order to protect or conserve areas within the selected priority catchment area. In an effort to not hinder development in a city such as DuPont, it has been determined that changing the City's land use code to accommodate for the protection and conservation of stormwater in this location is not feasible. However, the City is committed to providing water quality based retrofits as well as conducting stormwater management actions as noted further herein.

STORMWATER MANAGEMENT ACTIONS

General Stormwater Management actions taken in DuPont include prioritization of:

- Street sweeping and catch basin cleaning;
- Maintenance of City-owned stormwater facilities;
- Inspections of businesses for their stormwater practices;
- Illicit discharge/spill inspections;
- Public education/outreach.

These measures are required per the City's NPDES Municipal Permit; however, these actions will be prioritized within the selected catchment area over other areas within the City.

IMPLEMENTATION SCHEDULE AND COSTS

SHORT-TERM ACTIONS (6-YEAR PLAN)

Stormwater goals have been established for each year between 2023 and 2028. Table 4-5 lists the stormwater actions for each year assuming a 4 percent inflation rate. This table includes the estimated cost and a general description of the stormwater activity. The total sum of each stormwater action over the 6-year period is estimated to cost approximately $610,000. This sum includes the stormwater retrofit project planned to be constructed in 2028.

TABLE 4-5

Short-Term Plan (2023-2028)

Project/Stormwater Action	Project Description	2023	2024	2025	2026	2027	2028
Street Sweeping	Sweep street 9 months every year	$1,879	$1,954	$2,032	$2,113	$2,198	$2,286
Catch Basin Inspection	Inspect 1/2 of catch basins each year	$200	$208	$216	$225	$234	$243
Catch Basin Cleaning	Clean 1/2 of catch basins each year	$400	$416	$433	$450	$468	$487
Business Stormwater Source Control Inspection	Inspect businesses source control measures each year	$100	$104	$108	$112	$117	$122
IDDE Inspection	Assume 4 IDDE events occur each year	$400	$416	$433	$450	$468	$487
Public Outreach/Education	Educate on stormwater best management practices and provide opportunities for the public to participate in stewardship activities	$600	$624	$649	$675	$702	$730
SMAP Evaluation	Evaluate and critique the current SMAP, revise as needed	$400	$416	$433	$450	$468	$487
Williamson Place Bioretention	Construction of Williamson Place Bioretention retrofit						$604,676
Total Annual Cost		**$3,979**	**$4,138**	**$4,303**	**$4,476**	**$4,655**	**$609,517**

Note: All activities are only for facilities located within the high priority catchment area.

LONG-TERM ACTIONS (20-YEAR PLAN)

Following the conclusion of the 6-year plan, a set of long-term actions are planned through the year 2042. These actions can range from SMAP evaluation to catch basin cleaning. Each of these actions and their occurrence is listed in Table 4-6 assuming a 4 percent inflation rate. The total for these stormwater actions over the course of 14 years is estimated at approximately $655,000.

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TABLE 4-6

Long-Term Plan (2029-2042)

Project/ Stormwater Action	Project Description	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Street Sweeping	Sweep street 9 months every year	$1,879	$1,954	$2,032	$2,113	$2,198	$2,286	$2,377	$2,472	$2,571	$2,674	$2,781	$2,892	$3,008	$3,128
Catch Basin Inspection	Inspect 1/2 of catch basins each year	$200	$208	$216	$225	$234	$243	$253	$263	$274	$285	$296	$308	$320	$333
Catch Basin Cleaning	Clean 1/2 of catch basins each year	$400	$416	$433	$450	$468	$487	$506	$526	$547	$569	$592	$616	$640	$666
Business Stormwater Source Control Inspection	Inspect businesses source control measures each year	$100	$104	$108	$112	$117	$122	$127	$132	$137	$142	$148	$154	$160	$167
IDDE Inspection	Assume 4 IDDE events occur each year	$400	$416	$433	$450	$468	$487	$506	$526	$547	$569	$592	$616	$640	$666
Public Outreach/Education	Educate on stormwater best management practices and provide opportunities for the public to participate in stewardship activities	$600	$624	$649	$675	$702	$730	$759	$790	$821	$854	$888	$924	$961	$999
SMAP Evaluation	Evaluate and critique the current SMAP, revise as needed	$400	$416	$433	$450	$468	$487	$506	$526	$547	$569	$592	$616	$640	$666
International Place Bioretention	Construction of International Place Bioretention retrofit					$581,420									
Total Annual Cost		**$3,979**	**$4,138**	**$4,303**	**$4,476**	**$586,074**	**$4,841**	**$5,034**	**$5,236**	**$5,445**	**$5,663**	**$5,890**	**$6,125**	**$6,370**	**$6,625**

Note: All activities are only for facilities located within the high priority catchment area.

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BUDGET

DuPont anticipates that the funds necessary to pay for the stormwater management actions and retrofit projects listed in this document will be acquired through either City funds or through grants obtained through the Department of Ecology. The total cost is estimated to be $1.3 million over the course of 20 years. This value is based upon the short- and long-term actions planned. The City will identify funding for the projects via its stormwater utility and will continue to monitor these funds on an annual basis to ensure they can adequately fund the plan presented herein.

PROGRAM ASSESSMENT

It is recommended that this stormwater management plan be assessed throughout the next 20 years to ensure it is being implemented as intended and that water quality treatment goals are being met. The ongoing assessment of this plan will involve recording the progress made with each of the program elements (retrofits, stormwater management actions, budget), identifying areas of improvement, and then incorporating improvements into the SMAP as needed.

DuPont plans to evaluate their SMAP on an annual basis. This review will involve a checklist of items. This includes tracking the progress against the retrofit and stormwater management action timelines as listed in the short and long-term plans provided in Tables 4-5 and 4-6.

Assessing this program will allow the City to provide ongoing progress updates to City officials, the public, and Ecology in terms of the City meeting and managing its stormwater goals.

APPENDIX A

COST ESTIMATES

CITY OF DUPONT
WILLIAMSON PLACE---BIORETNTION FACILITY
ENGINEER'S CONSTRUCTION COST ESTIMATE
UPDATED: OCTOBER 12, 2023
G &O #13591

NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1.	Minor Changes (S.P. 1-04.4(1))	1	CALC	$ 10,000	$ 10,000
2.	Survey (S.P. 1-04.5(2))	1	LS	$ 6,000	$ 6,000
3.	Record Drawings (Minimum Bid $1,000) (1-05.18)	1	LS	$ 1,000	$ 1,000
4.	SPCC Plan (1-07.15(1))	1	LS	$ 1,000	$ 1,000
5.	Mobilization, Cleanup, and Demobilization (S.P. 1-09.7)	1	LS	$ 13,000	$ 13,000
6.	Project Temporary Traffic Control (1-10.5(3))	1	LS	$ 8,000	$ 8,000
7.	Clearing and Grubbing (S.P. 2-01.5)	1	LS	$ 15,000	$ 15,000
8.	Locate Existing Utilities (S.P. 2-09.5)	1	LS	$ 5,000	$ 5,000
9.	CPEP Storm Sewer Pipe, 12 In. Diam. (Incl. Bedding) (S.P. 7-04.5)	100	LF	$ 100	$ 10,000
10.	Catch Basin Type 1 (S.P. 7-05.5)	1	EA	$ 2,000	$ 2,000
11.	Connection to Existing Storm System (S.P. 7-05.5)	1	EA	$ 1,500	$ 1,500
12.	Removal of Unsuitable Material (Trench) (S.P. 7-08.5)	10	CY	$ 20	$ 200
13.	Trench Excavation Safety Systems (S.P. 7-08.5)	1	LS	$ 5,000	$ 5,000
14.	Erosion / Water Pollution Control (S.P. 8-01.5)	1	LS	$ 5,000	$ 5,000
15.	Excavation, Compaction, and Grading for Bioretention Facilities (S.P. 8-02.5)	112	CY	$ 60	$ 6,720
16.	Bioretention Soil Mix (S.P. 8-02.5)	26	CY	$ 70	$ 1,820
17.	PSIPE (Bioretention Plantings) (S.P. 8-02.5)	1	LS	$ 30,000	$ 30,000
18.	Bark or Wood Chip Mulch (S.P. 8-02.5)	5	CY	$ 70	$ 350
19.	General Restoration (S.P. 8)	1	LS	$ 15,000	$ 15,000
20.	Project Documentation (S.P. 8)	1	LS	$ 3,000	$ 3,000
	Subtotal Construction Cost				$ 139,590
	Construction Contingency (30%)	30%			$ 41,877
					$ 181,467
	Sales Tax (9.5%)	9.5%			$ 17,239
	Total Construction Cost				$ 198,706
	Project Administration/Construction Management	30%			$ 59,612
					$ 258,318
	CONSTRUCTION COST ESTIMATE (ROUNDED)				**$ 259,000**

CITY OF DUPONT
INTERNATIONAL PLACE---BIORETNTION FACILITY
ENGINEER'S CONSTRUCTION COST ESTIMATE
UPDATED: OCTOBER 12, 2023
G &O #13591

NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1.	Minor Changes (S.P. 1-04.4(1))	1	CALC	$ 15,000	$ 15,000
2.	Survey (S.P. 1-04.5(2))	1	LS	$ 8,000	$ 8,000
3.	Record Drawings (Minimum Bid $1,000) (1-05.18)	1	LS	$ 1,000	$ 1,000
4.	SPCC Plan (1-07.15(1))	1	LS	$ 1,000	$ 1,000
5.	Mobilization, Cleanup, and Demobilization (S.P. 1-09.7)	1	LS	$ 25,000	$ 25,000
6.	Project Temporary Traffic Control (1-10.5(3))	1	LS	$ 8,000	$ 8,000
7.	Clearing and Grubbing (S.P. 2-01.5)	1	LS	$ 20,000	$ 20,000
8.	Locate Existing Utilities (S.P. 2-09.5)	1	LS	$ 5,000	$ 5,000
9.	CPEP Storm Sewer Pipe, 12 In. Diam. (Incl. Bedding) (S.P. 7-04.5)	450	LF	$ 100	$ 45,000
10.	Catch Basin Type 1 (S.P. 7-05.5)	1	EA	$ 2,000	$ 2,000
11.	Connection to Existing Storm System (S.P. 7-05.5)	1	EA	$ 1,500	$ 1,500
12.	Removal of Unsuitable Material (Trench) (S.P. 7-08.5)	10	CY	$ 20	$ 200
13.	Trench Excavation Safety Systems (S.P. 7-08.5)	1	LS	$ 5,000	$ 5,000
14.	Erosion / Water Pollution Control (S.P. 8-01.5)	1	LS	$ 5,000	$ 5,000
15.	Excavation, Compaction, and Grading for Bioretention Facilities (S.P. 8-02.5)	464	CY	$ 60	$ 27,840
16.	Bioretention Soil Mix (S.P. 8-02.5)	132	CY	$ 70	$ 9,240
17.	PSIPE (Bioretention Plantings) (S.P. 8-02.5)	1	LS	$ 70,000	$ 70,000
18.	Bark or Wood Chip Mulch (S.P. 8-02.5)	22	CY	$ 70	$ 1,540
19.	General Restoration (S.P. 8)	1	LS	$ 15,000	$ 15,000
20.	Project Documentation (S.P. 8)	1	LS	$ 3,000	$ 3,000
	Subtotal Construction Cost				$ 268,320
	Construction Contingency (30%)	30%			$ 80,496
					$ 348,816
	Sales Tax (9.5%)	9.5%			$ 33,138
	Total Construction Cost				$ 381,954
	Project Administration/Construction Management	30%			$ 114,586
					$ 496,540
	CONSTRUCTION COST ESTIMATE (ROUNDED)				**$ 497,000**

CITY OF DUPONT
MANCHESTER PLACE---BIORETNTION FACILITY
ENGINEER'S CONSTRUCTION COST ESTIMATE
UPDATED: OCTOBER 12, 2023
G &O #13591

NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1.	Minor Changes (S.P. 1-04.4(1))	1	CALC	$ 5,000	$ 5,000
2.	Survey (S.P. 1-04.5(2))	1	LS	$ 6,000	$ 6,000
3.	Record Drawings (Minimum Bid $1,000) (1-05.18)	1	LS	$ 1,000	$ 1,000
4.	SPCC Plan (1-07.15(1))	1	LS	$ 1,000	$ 1,000
5.	Mobilization, Cleanup, and Demobilization (S.P. 1-09.7)	1	LS	$ 10,000	$ 10,000
6.	Project Temporary Traffic Control (1-10.5(3))	1	LS	$ 8,000	$ 8,000
7.	Clearing and Grubbing (S.P. 2-01.5)	1	LS	$ 15,000	$ 15,000
8.	Locate Existing Utilities (S.P. 2-09.5)	1	LS	$ 2,000	$ 2,000
9.	CPEP Storm Sewer Pipe, 12 In. Diam. (Incl. Bedding) (S.P. 7-04.5)	100	LF	$ 100	$ 10,000
10.	Catch Basin Type 1 (S.P. 7-05.5)	1	EA	$ 2,000	$ 2,000
11.	Connection to Existing Storm System (S.P. 7-05.5)	1	EA	$ 1,500	$ 1,500
12.	Removal of Unsuitable Material (Trench) (S.P. 7-08.5)	10	CY	$ 20	$ 200
13.	Trench Excavation Safety Systems (S.P. 7-08.5)	1	LS	$ 5,000	$ 5,000
14.	Erosion / Water Pollution Control (S.P. 8-01.5)	1	LS	$ 4,000	$ 4,000
15.	Excavation, Compaction, and Grading for Bioretention Facilities (S.P. 8-02.5)	50	CY	$ 60	$ 3,000
16.	Bioretention Soil Mix (S.P. 8-02.5)	16	CY	$ 70	$ 1,120
17.	PSIPE (Bioretention Plantings) (S.P. 8-02.5)	1	LS	$ 20,000	$ 20,000
18.	Bark or Wood Chip Mulch (S.P. 8-02.5)	3	CY	$ 70	$ 210
19.	General Restoration (S.P. 8)	1	LS	$ 10,000	$ 10,000
20.	Project Documentation (S.P. 8)	1	LS	$ 3,000	$ 3,000
	Subtotal Construction Cost				$ 108,030
	Construction Contingency (30%)	30%			$ 32,409
					$ 140,439
	Sales Tax (9.5%)	9.5%			$ 13,342
	Total Construction Cost				$ 153,781
	Project Administration/Construction Management	30%			$ 46,134
					$ 199,915
	CONSTRUCTION COST ESTIMATE (ROUNDED)				**$ 200,000**

APPENDIX B

WWHM REPORTS

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	Williamson Pl
Site Name:	
Site Address:	
City:	
Report Date:	10/3/2023
Gage:	38 IN CENTRAL
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2019/09/03
Version:	4.2.16

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

Pre-Williamson

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Flat	1.03
Pervious Total	1.03
Impervious Land Use	acre
Impervious Total	0
Basin Total	1.03

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	1.03
Impervious Total	1.03
Basin Total	1.03

Element Flows To:

Surface	Interflow	Groundwater
Surface retention 1	Surface retention 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Bioretention 1

Bottom Length:	19.65 ft.
Bottom Width:	19.65 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW 12 in/hr
Material thickness of second layer:	1.5
Material type for second layer:	Sand
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	0.5
Orifice Diameter (in.):	6
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	388.507
Total Outflow (ac-ft.):	422.929
Percent Through Underdrain:	91.86
Discharge Structure	
Riser Height:	1 ft.
Riser Diameter:	12 in.
Element Flows To:	
Outlet 1	Outlet 2

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0325	0.0000	0.0000	0.0000
0.0549	0.0322	0.0001	0.0000	0.0000
0.1099	0.0316	0.0002	0.0000	0.0000
0.1648	0.0311	0.0004	0.0000	0.0000
0.2198	0.0305	0.0005	0.0000	0.0000
0.2747	0.0300	0.0006	0.0000	0.0000
0.3297	0.0294	0.0007	0.0001	0.0000
0.3846	0.0289	0.0009	0.0002	0.0000
0.4396	0.0283	0.0010	0.0002	0.0000
0.4945	0.0278	0.0012	0.0003	0.0000
0.5495	0.0273	0.0013	0.0004	0.0000
0.6044	0.0268	0.0015	0.0005	0.0000
0.6593	0.0263	0.0016	0.0006	0.0000
0.7143	0.0258	0.0018	0.0007	0.0000
0.7692	0.0252	0.0020	0.0008	0.0000
0.8242	0.0247	0.0021	0.0011	0.0000
0.8791	0.0243	0.0023	0.0011	0.0000
0.9341	0.0238	0.0025	0.0014	0.0000
0.9890	0.0233	0.0027	0.0014	0.0000
1.0440	0.0228	0.0029	0.0018	0.0000
1.0989	0.0223	0.0031	0.0019	0.0000
1.1538	0.0219	0.0033	0.0023	0.0000
1.2088	0.0214	0.0035	0.0024	0.0000
1.2637	0.0209	0.0037	0.0028	0.0000
1.3187	0.0205	0.0039	0.0030	0.0000
1.3736	0.0200	0.0041	0.0034	0.0000
1.4286	0.0196	0.0043	0.0037	0.0000
1.4835	0.0191	0.0046	0.0041	0.0000
1.5385	0.0187	0.0048	0.0045	0.0000

1.5934	0.0183	0.0050	0.0048	0.0000
1.6484	0.0179	0.0052	0.0053	0.0000
1.7033	0.0174	0.0054	0.0057	0.0000
1.7582	0.0170	0.0057	0.0063	0.0000
1.8132	0.0166	0.0059	0.0066	0.0000
1.8681	0.0162	0.0061	0.0073	0.0000
1.9231	0.0158	0.0064	0.0075	0.0000
1.9780	0.0154	0.0066	0.0085	0.0000
2.0330	0.0150	0.0069	0.0086	0.0000
2.0879	0.0146	0.0071	0.0098	0.0000
2.1429	0.0143	0.0074	0.0098	0.0000
2.1978	0.0139	0.0077	0.0110	0.0000
2.2527	0.0135	0.0079	0.0111	0.0000
2.3077	0.0131	0.0082	0.0123	0.0000
2.3626	0.0128	0.0085	0.0126	0.0000
2.4176	0.0124	0.0088	0.0137	0.0000
2.4725	0.0121	0.0091	0.0142	0.0000
2.5275	0.0117	0.0094	0.0152	0.0000
2.5824	0.0114	0.0097	0.0159	0.0000
2.6374	0.0111	0.0100	0.0168	0.0000
2.6923	0.0107	0.0103	0.0178	0.0000
2.7473	0.0104	0.0107	0.0185	0.0000
2.8022	0.0101	0.0110	0.0197	0.0000
2.8571	0.0098	0.0113	0.0203	0.0000
2.9121	0.0095	0.0117	0.0207	0.0000
2.9670	0.0092	0.0120	0.0207	0.0000
3.0000	0.0089	0.0122	0.0447	0.0000

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.0325	0.0122	0.0000	0.0268	0.0000
3.0549	0.0331	0.0141	0.0000	0.0268	0.0000
3.1099	0.0337	0.0159	0.0000	0.0288	0.0000
3.1648	0.0343	0.0178	0.0000	0.0298	0.0000
3.2198	0.0349	0.0197	0.0000	0.0307	0.0000
3.2747	0.0354	0.0216	0.0000	0.0317	0.0000
3.3297	0.0360	0.0235	0.0000	0.0327	0.0000
3.3846	0.0366	0.0255	0.0000	0.0337	0.0000
3.4396	0.0373	0.0276	0.0000	0.0347	0.0000
3.4945	0.0379	0.0296	0.0000	0.0356	0.0000
3.5495	0.0385	0.0317	0.0000	0.0366	0.0000
3.6044	0.0391	0.0339	0.0000	0.0376	0.0000
3.6593	0.0397	0.0360	0.0000	0.0386	0.0000
3.7143	0.0404	0.0382	0.0000	0.0396	0.0000
3.7692	0.0410	0.0405	0.0000	0.0406	0.0000
3.8242	0.0416	0.0427	0.0000	0.0415	0.0000
3.8791	0.0423	0.0450	0.0000	0.0425	0.0000
3.9341	0.0429	0.0474	0.0000	0.0435	0.0000
3.9890	0.0436	0.0498	0.0000	0.0445	0.0000
4.0440	0.0443	0.0522	0.0977	0.0455	0.0000
4.0989	0.0449	0.0546	0.3281	0.0464	0.0000
4.1538	0.0456	0.0571	0.6273	0.0474	0.0000
4.2088	0.0463	0.0596	0.9624	0.0484	0.0000
4.2637	0.0470	0.0622	1.3006	0.0494	0.0000
4.3187	0.0476	0.0648	1.6096	0.0504	0.0000
4.3736	0.0483	0.0674	1.8629	0.0514	0.0000
4.4286	0.0490	0.0701	2.0472	0.0523	0.0000
4.4835	0.0497	0.0728	2.1721	0.0533	0.0000

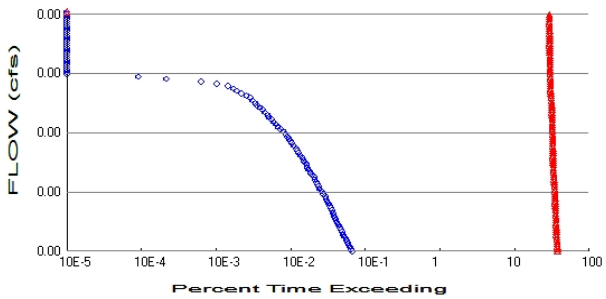
4.5385	0.0504	0.0756	2.3112	0.0543	0.0000
4.5934	0.0512	0.0784	2.4263	0.0553	0.0000
4.6484	0.0519	0.0812	2.5361	0.0563	0.0000
4.7033	0.0526	0.0841	2.6414	0.0572	0.0000
4.7582	0.0533	0.0870	2.7426	0.0582	0.0000
4.8132	0.0541	0.0899	2.8402	0.0592	0.0000
4.8681	0.0548	0.0929	2.9346	0.0602	0.0000
4.9231	0.0555	0.0960	3.0261	0.0612	0.0000
4.9780	0.0563	0.0990	3.1148	0.0622	0.0000
5.0000	0.0566	0.1003	3.2011	0.0625	0.0000

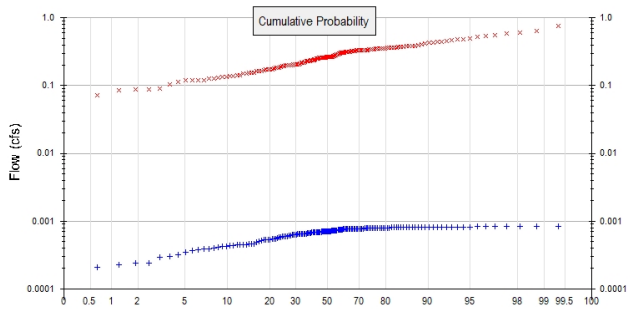
Surface retention 1

Element Flows To:

Outlet 1	Outlet 2
	Bioretention 1

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 1.03
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 1.03

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.00067
5 year	0.000827
10 year	0.0009
25 year	0.000968
50 year	0.001006
100 year	0.001036

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.259947
5 year	0.371076
10 year	0.43786
25 year	0.514663
50 year	0.566815
100 year	0.61507

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1902	0.001	0.251
1903	0.000	0.316
1904	0.001	0.413
1905	0.001	0.207
1906	0.000	0.171
1907	0.001	0.347
1908	0.001	0.242
1909	0.001	0.264
1910	0.001	0.342
1911	0.001	0.212

1912	0.001	0.636
1913	0.001	0.193
1914	0.001	0.461
1915	0.001	0.183
1916	0.001	0.426
1917	0.000	0.150
1918	0.001	0.326
1919	0.000	0.162
1920	0.001	0.164
1921	0.001	0.220
1922	0.001	0.268
1923	0.001	0.171
1924	0.000	0.119
1925	0.000	0.196
1926	0.001	0.239
1927	0.000	0.232
1928	0.001	0.259
1929	0.001	0.477
1930	0.001	0.352
1931	0.001	0.237
1932	0.001	0.279
1933	0.001	0.254
1934	0.001	0.432
1935	0.000	0.189
1936	0.001	0.204
1937	0.001	0.375
1938	0.001	0.233
1939	0.000	0.126
1940	0.001	0.398
1941	0.001	0.152
1942	0.001	0.374
1943	0.001	0.381
1944	0.001	0.548
1945	0.001	0.357
1946	0.001	0.136
1947	0.000	0.260
1948	0.001	0.302
1949	0.001	0.385
1950	0.000	0.153
1951	0.001	0.131
1952	0.001	0.543
1953	0.001	0.495
1954	0.001	0.247
1955	0.000	0.120
1956	0.000	0.072
1957	0.001	0.199
1958	0.001	0.352
1959	0.001	0.327
1960	0.001	0.162
1961	0.001	0.609
1962	0.001	0.281
1963	0.000	0.134
1964	0.000	0.329
1965	0.001	0.320
1966	0.001	0.142
1967	0.001	0.234
1968	0.001	0.219
1969	0.001	0.263

1970	0.001	0.329
1971	0.001	0.335
1972	0.001	0.758
1973	0.001	0.436
1974	0.001	0.358
1975	0.001	0.475
1976	0.001	0.355
1977	0.001	0.153
1978	0.001	0.374
1979	0.001	0.126
1980	0.001	0.260
1981	0.001	0.263
1982	0.000	0.261
1983	0.001	0.388
1984	0.001	0.271
1985	0.001	0.198
1986	0.001	0.220
1987	0.001	0.313
1988	0.001	0.206
1989	0.001	0.204
1990	0.001	0.258
1991	0.001	0.358
1992	0.001	0.333
1993	0.001	0.293
1994	0.001	0.315
1995	0.001	0.087
1996	0.001	0.272
1997	0.001	0.175
1998	0.001	0.330
1999	0.001	0.113
2000	0.001	0.338
2001	0.000	0.230
2002	0.001	0.328
2003	0.001	0.266
2004	0.001	0.268
2005	0.001	0.301
2006	0.001	0.118
2007	0.001	0.411
2008	0.001	0.206
2009	0.001	0.171
2010	0.001	0.353
2011	0.000	0.085
2012	0.001	0.337
2013	0.001	0.174
2014	0.001	0.088
2015	0.001	0.302
2016	0.000	0.105
2017	0.001	0.521
2018	0.001	0.314
2019	0.001	0.438
2020	0.001	0.198
2021	0.001	0.326
2022	0.000	0.156
2023	0.001	0.303
2024	0.001	0.594
2025	0.000	0.177
2026	0.001	0.256
2027	0.001	0.258

2028	0.000	0.091
2029	0.001	0.253
2030	0.001	0.330
2031	0.000	0.140
2032	0.000	0.050
2033	0.000	0.120
2034	0.001	0.257
2035	0.001	0.344
2036	0.000	0.237
2037	0.001	0.198
2038	0.001	0.352
2039	0.001	0.134
2040	0.001	0.290
2041	0.001	0.308
2042	0.001	0.383
2043	0.001	0.348
2044	0.001	0.310
2045	0.001	0.181
2046	0.001	0.241
2047	0.001	0.232
2048	0.001	0.298
2049	0.001	0.335
2050	0.001	0.262
2051	0.001	0.456
2052	0.001	0.200
2053	0.001	0.293
2054	0.001	0.366
2055	0.001	0.138
2056	0.000	0.264
2057	0.001	0.225
2058	0.001	0.183
2059	0.001	0.358

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0008	0.7577
2	0.0008	0.6359
3	0.0008	0.6091
4	0.0008	0.5943
5	0.0008	0.5481
6	0.0008	0.5428
7	0.0008	0.5208
8	0.0008	0.4955
9	0.0008	0.4774
10	0.0008	0.4746
11	0.0008	0.4610
12	0.0008	0.4555
13	0.0008	0.4382
14	0.0008	0.4364
15	0.0008	0.4319
16	0.0008	0.4263
17	0.0008	0.4133
18	0.0008	0.4112
19	0.0008	0.3982
20	0.0008	0.3875
21	0.0008	0.3847
22	0.0008	0.3832

23	0.0008	0.3808
24	0.0008	0.3746
25	0.0008	0.3744
26	0.0008	0.3743
27	0.0008	0.3656
28	0.0008	0.3582
29	0.0008	0.3578
30	0.0008	0.3575
31	0.0008	0.3572
32	0.0008	0.3549
33	0.0008	0.3532
34	0.0008	0.3520
35	0.0008	0.3519
36	0.0008	0.3516
37	0.0008	0.3478
38	0.0008	0.3468
39	0.0008	0.3437
40	0.0008	0.3425
41	0.0008	0.3376
42	0.0008	0.3373
43	0.0008	0.3350
44	0.0008	0.3348
45	0.0008	0.3330
46	0.0008	0.3304
47	0.0008	0.3302
48	0.0008	0.3292
49	0.0008	0.3289
50	0.0008	0.3282
51	0.0008	0.3274
52	0.0008	0.3261
53	0.0008	0.3256
54	0.0008	0.3197
55	0.0008	0.3164
56	0.0008	0.3149
57	0.0008	0.3140
58	0.0008	0.3132
59	0.0008	0.3103
60	0.0008	0.3077
61	0.0008	0.3034
62	0.0008	0.3022
63	0.0008	0.3021
64	0.0007	0.3014
65	0.0007	0.2979
66	0.0007	0.2932
67	0.0007	0.2928
68	0.0007	0.2897
69	0.0007	0.2805
70	0.0007	0.2791
71	0.0007	0.2718
72	0.0007	0.2711
73	0.0007	0.2680
74	0.0007	0.2679
75	0.0007	0.2662
76	0.0007	0.2643
77	0.0007	0.2639
78	0.0007	0.2630
79	0.0007	0.2629
80	0.0007	0.2622

81	0.0007	0.2606
82	0.0007	0.2601
83	0.0007	0.2597
84	0.0007	0.2585
85	0.0007	0.2584
86	0.0007	0.2582
87	0.0007	0.2565
88	0.0007	0.2559
89	0.0007	0.2543
90	0.0007	0.2532
91	0.0007	0.2512
92	0.0007	0.2471
93	0.0007	0.2425
94	0.0007	0.2408
95	0.0007	0.2392
96	0.0007	0.2374
97	0.0007	0.2367
98	0.0007	0.2336
99	0.0007	0.2326
100	0.0007	0.2323
101	0.0007	0.2321
102	0.0007	0.2295
103	0.0007	0.2250
104	0.0007	0.2201
105	0.0007	0.2200
106	0.0006	0.2190
107	0.0006	0.2115
108	0.0006	0.2068
109	0.0006	0.2058
110	0.0006	0.2057
111	0.0006	0.2044
112	0.0006	0.2039
113	0.0006	0.1999
114	0.0006	0.1987
115	0.0006	0.1983
116	0.0006	0.1980
117	0.0006	0.1976
118	0.0006	0.1956
119	0.0006	0.1931
120	0.0006	0.1891
121	0.0006	0.1830
122	0.0006	0.1828
123	0.0006	0.1808
124	0.0005	0.1766
125	0.0005	0.1751
126	0.0005	0.1742
127	0.0005	0.1713
128	0.0005	0.1712
129	0.0005	0.1708
130	0.0005	0.1639
131	0.0005	0.1624
132	0.0005	0.1619
133	0.0005	0.1556
134	0.0005	0.1529
135	0.0005	0.1525
136	0.0005	0.1519
137	0.0005	0.1504
138	0.0005	0.1422

139	0.0004	0.1405
140	0.0004	0.1381
141	0.0004	0.1364
142	0.0004	0.1344
143	0.0004	0.1338
144	0.0004	0.1313
145	0.0004	0.1263
146	0.0004	0.1261
147	0.0004	0.1201
148	0.0004	0.1196
149	0.0004	0.1191
150	0.0003	0.1183
151	0.0003	0.1129
152	0.0003	0.1047
153	0.0003	0.0914
154	0.0002	0.0882
155	0.0002	0.0870
156	0.0002	0.0845
157	0.0002	0.0718
158	0.0002	0.0500

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0003	3719	2093590	56294	Fail
0.0003	3569	2083064	58365	Fail
0.0003	3412	2070876	60693	Fail
0.0004	3261	2058688	63130	Fail
0.0004	3134	2047054	65317	Fail
0.0004	3028	2036528	67256	Fail
0.0004	2905	2024893	69703	Fail
0.0004	2791	2016583	72253	Fail
0.0004	2689	2010489	74767	Fail
0.0004	2595	2004949	77262	Fail
0.0004	2500	1999963	79998	Fail
0.0004	2418	1994423	82482	Fail
0.0004	2319	1988329	85740	Fail
0.0004	2231	1982789	88874	Fail
0.0004	2161	1978357	91548	Fail
0.0004	2087	1972817	94528	Fail
0.0004	2024	1967277	97197	Fail
0.0005	1956	1962291	100321	Fail
0.0005	1892	1956751	103422	Fail
0.0005	1840	1952319	106104	Fail
0.0005	1767	1946778	110174	Fail
0.0005	1698	1941792	114357	Fail
0.0005	1637	1936252	118280	Fail
0.0005	1589	1931820	121574	Fail
0.0005	1504	1926834	128113	Fail
0.0005	1449	1921294	132594	Fail
0.0005	1354	1910768	141120	Fail
0.0005	1303	1900796	145878	Fail
0.0005	1259	1891932	150272	Fail
0.0005	1210	1881960	155533	Fail
0.0005	1164	1871988	160823	Fail
0.0005	1127	1861462	165169	Fail
0.0006	1063	1853151	174332	Fail
0.0006	1010	1843179	182492	Fail
0.0006	966	1833207	189772	Fail
0.0006	923	1829883	198253	Fail
0.0006	904	1826005	201991	Fail
0.0006	871	1823235	209326	Fail
0.0006	817	1819357	222687	Fail
0.0006	792	1816033	229297	Fail
0.0006	751	1812709	241372	Fail
0.0006	704	1809939	257093	Fail
0.0006	679	1806615	266069	Fail
0.0006	653	1803291	276154	Fail
0.0006	618	1799967	291256	Fail
0.0006	567	1796643	316868	Fail
0.0006	548	1793873	327349	Fail
0.0007	522	1790549	343017	Fail
0.0007	496	1787779	360439	Fail
0.0007	473	1784455	377263	Fail
0.0007	441	1781685	404010	Fail
0.0007	400	1778361	444590	Fail
0.0007	371	1775591	478595	Fail
0.0007	349	1772266	507812	Fail

0.0007	331	1769496	534590	Fail
0.0007	304	1766726	581159	Fail
0.0007	281	1763402	627545	Fail
0.0007	270	1760632	652085	Fail
0.0007	247	1757862	711685	Fail
0.0007	232	1755092	756505	Fail
0.0007	214	1752322	818842	Fail
0.0007	197	1747336	886972	Fail
0.0008	186	1737364	934066	Fail
0.0008	171	1727392	1010170	Fail
0.0008	158	1719082	1088026	Fail
0.0008	141	1709110	1212134	Fail
0.0008	121	1699692	1404704	Fail
0.0008	106	1689720	1594075	Fail
0.0008	94	1681409	1788732	Fail
0.0008	80	1672545	2090681	Fail
0.0008	57	1670329	2930401	Fail
0.0008	35	1668113	4766037	Fail
0.0008	12	1665897	13882475	Fail
0.0008	5	1664235	33284700	Fail
0.0008	0	1662019	n/a	Fail
0.0008	0	1659803	n/a	Fail
0.0009	0	1657587	n/a	Fail
0.0009	0	1655371	n/a	Fail
0.0009	0	1653709	n/a	Fail
0.0009	0	1651493	n/a	Fail
0.0009	0	1649277	n/a	Fail
0.0009	0	1647061	n/a	Fail
0.0009	0	1645399	n/a	Fail
0.0009	0	1643183	n/a	Fail
0.0009	0	1641521	n/a	Fail
0.0009	0	1639305	n/a	Fail
0.0009	0	1637643	n/a	Fail
0.0009	0	1635427	n/a	Fail
0.0009	0	1633211	n/a	Fail
0.0009	0	1631549	n/a	Fail
0.0009	0	1629333	n/a	Fail
0.0010	0	1627671	n/a	Fail
0.0010	0	1626009	n/a	Fail
0.0010	0	1623793	n/a	Fail
0.0010	0	1622131	n/a	Fail
0.0010	0	1620469	n/a	Fail
0.0010	0	1618253	n/a	Fail
0.0010	0	1616591	n/a	Fail
0.0010	0	1614375	n/a	Fail
0.0010	0	1612713	n/a	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

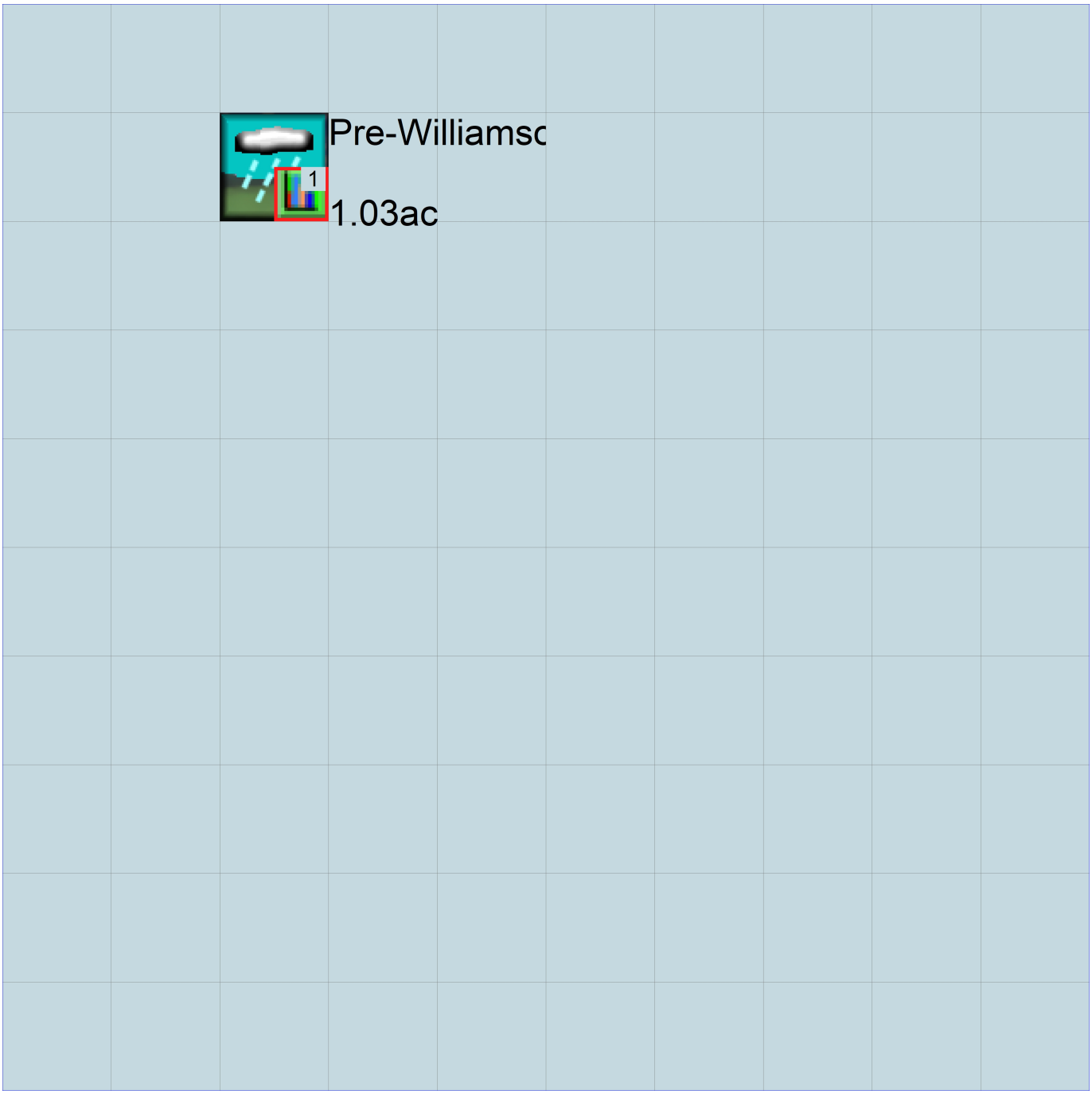
PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

Mitigated UCI File

Predeveloped HSPF Message File

Mitigated HSPF Message File

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Local (360)943-0304

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WWHM2012

PROJECT REPORT

General Model Information

Project Name:	International Pl
Site Name:	
Site Address:	
City:	
Report Date:	10/3/2023
Gage:	38 IN CENTRAL
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2019/09/03
Version:	4.2.16

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data

Predeveloped Land Use

Pre-International

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Flat	4.54
Pervious Total	4.54
Impervious Land Use	acre
Impervious Total	0
Basin Total	4.54

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	4.54
Impervious Total	4.54
Basin Total	4.54

Element Flows To:

Surface	Interflow	Groundwater
Surface retention 1	Surface retention 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Bioretention 1

Bottom Length:	46.88 ft.
Bottom Width:	46.88 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW 12 in/hr
Material thickness of second layer:	1.5
Material type for second layer:	Sand
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	0.5
Orifice Diameter (in.):	6
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	1682.52
Total Outflow (ac-ft.):	1847.135
Percent Through Underdrain:	91.09
Discharge Structure	
Riser Height:	1 ft.
Riser Diameter:	24 in.
Element Flows To:	
Outlet 1	Outlet 2

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0966	0.0000	0.0000	0.0000
0.0549	0.0961	0.0006	0.0000	0.0000
0.1099	0.0951	0.0013	0.0000	0.0000
0.1648	0.0941	0.0019	0.0000	0.0000
0.2198	0.0931	0.0026	0.0000	0.0000
0.2747	0.0922	0.0033	0.0000	0.0000
0.3297	0.0912	0.0040	0.0008	0.0000
0.3846	0.0903	0.0047	0.0010	0.0000
0.4396	0.0893	0.0054	0.0013	0.0000
0.4945	0.0884	0.0061	0.0018	0.0000
0.5495	0.0874	0.0068	0.0022	0.0000
0.6044	0.0865	0.0075	0.0029	0.0000
0.6593	0.0856	0.0083	0.0032	0.0000
0.7143	0.0847	0.0090	0.0042	0.0000
0.7692	0.0837	0.0098	0.0046	0.0000
0.8242	0.0828	0.0105	0.0060	0.0000
0.8791	0.0819	0.0113	0.0062	0.0000
0.9341	0.0810	0.0121	0.0081	0.0000
0.9890	0.0801	0.0129	0.0082	0.0000
1.0440	0.0792	0.0137	0.0105	0.0000
1.0989	0.0784	0.0145	0.0106	0.0000
1.1538	0.0775	0.0154	0.0131	0.0000
1.2088	0.0766	0.0162	0.0136	0.0000
1.2637	0.0757	0.0171	0.0161	0.0000
1.3187	0.0749	0.0179	0.0170	0.0000
1.3736	0.0740	0.0188	0.0195	0.0000
1.4286	0.0731	0.0197	0.0209	0.0000
1.4835	0.0723	0.0206	0.0234	0.0000
1.5385	0.0714	0.0214	0.0253	0.0000

1.5934	0.0706	0.0222	0.0276	0.0000
1.6484	0.0698	0.0230	0.0303	0.0000
1.7033	0.0689	0.0238	0.0323	0.0000
1.7582	0.0681	0.0246	0.0358	0.0000
1.8132	0.0673	0.0255	0.0374	0.0000
1.8681	0.0665	0.0263	0.0418	0.0000
1.9231	0.0657	0.0272	0.0430	0.0000
1.9780	0.0648	0.0280	0.0484	0.0000
2.0330	0.0640	0.0289	0.0490	0.0000
2.0879	0.0632	0.0298	0.0556	0.0000
2.1429	0.0625	0.0307	0.0556	0.0000
2.1978	0.0617	0.0316	0.0626	0.0000
2.2527	0.0609	0.0325	0.0634	0.0000
2.3077	0.0601	0.0334	0.0701	0.0000
2.3626	0.0593	0.0344	0.0719	0.0000
2.4176	0.0586	0.0353	0.0782	0.0000
2.4725	0.0578	0.0363	0.0810	0.0000
2.5275	0.0570	0.0372	0.0868	0.0000
2.5824	0.0563	0.0382	0.0907	0.0000
2.6374	0.0555	0.0392	0.0959	0.0000
2.6923	0.0548	0.0402	0.1011	0.0000
2.7473	0.0541	0.0412	0.1055	0.0000
2.8022	0.0533	0.0422	0.1122	0.0000
2.8571	0.0526	0.0432	0.1154	0.0000
2.9121	0.0519	0.0443	0.1180	0.0000
2.9670	0.0512	0.0453	0.1180	0.0000
3.0000	0.0505	0.0460	0.2544	0.0000

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.0966	0.0460	0.0000	0.1526	0.0000
3.0549	0.0976	0.0513	0.0000	0.1526	0.0000
3.1099	0.0986	0.0567	0.0000	0.1638	0.0000
3.1648	0.0996	0.0621	0.0000	0.1694	0.0000
3.2198	0.1006	0.0676	0.0000	0.1750	0.0000
3.2747	0.1016	0.0732	0.0000	0.1806	0.0000
3.3297	0.1026	0.0788	0.0000	0.1862	0.0000
3.3846	0.1036	0.0845	0.0000	0.1918	0.0000
3.4396	0.1047	0.0902	0.0000	0.1974	0.0000
3.4945	0.1057	0.0960	0.0000	0.2030	0.0000
3.5495	0.1067	0.1018	0.0000	0.2086	0.0000
3.6044	0.1077	0.1077	0.0000	0.2141	0.0000
3.6593	0.1088	0.1137	0.0000	0.2197	0.0000
3.7143	0.1098	0.1197	0.0000	0.2253	0.0000
3.7692	0.1109	0.1257	0.0000	0.2309	0.0000
3.8242	0.1119	0.1318	0.0000	0.2365	0.0000
3.8791	0.1130	0.1380	0.0000	0.2421	0.0000
3.9341	0.1141	0.1443	0.0000	0.2477	0.0000
3.9890	0.1151	0.1506	0.0000	0.2533	0.0000
4.0440	0.1162	0.1569	0.1956	0.2589	0.0000
4.0989	0.1173	0.1633	0.6592	0.2645	0.0000
4.1538	0.1184	0.1698	1.2766	0.2701	0.0000
4.2088	0.1195	0.1763	2.0109	0.2756	0.0000
4.2637	0.1206	0.1829	2.8369	0.2812	0.0000
4.3187	0.1217	0.1896	3.7318	0.2868	0.0000
4.3736	0.1228	0.1963	4.6731	0.2924	0.0000
4.4286	0.1239	0.2031	5.6376	0.2980	0.0000
4.4835	0.1250	0.2099	6.6018	0.3036	0.0000

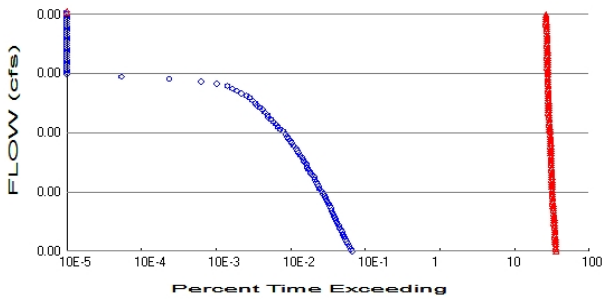
4.5385	0.1261	0.2168	7.5423	0.3092	0.0000
4.5934	0.1272	0.2238	8.4368	0.3148	0.0000
4.6484	0.1284	0.2308	9.2649	0.3204	0.0000
4.7033	0.1295	0.2379	10.010	0.3260	0.0000
4.7582	0.1306	0.2450	10.660	0.3316	0.0000
4.8132	0.1318	0.2522	11.211	0.3372	0.0000
4.8681	0.1329	0.2595	11.664	0.3427	0.0000
4.9231	0.1341	0.2668	12.034	0.3483	0.0000
4.9780	0.1352	0.2742	12.347	0.3539	0.0000
5.0000	0.1357	0.2772	12.805	0.3562	0.0000

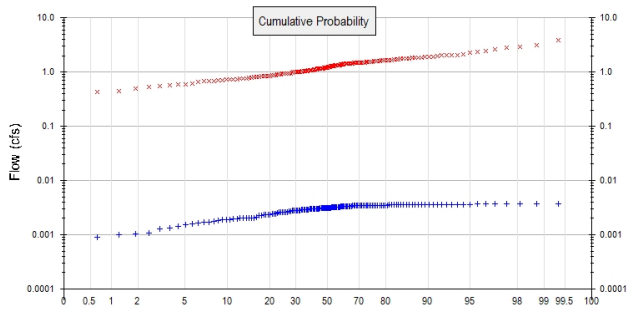
Surface retention 1

Element Flows To:

Outlet 1	Outlet 2
	Bioretention 1

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 4.54
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 4.54

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.002955
5 year	0.003646
10 year	0.003966
25 year	0.004266
50 year	0.004433
100 year	0.004566

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	1.201841
5 year	1.679526
10 year	1.993077
25 year	2.385451
50 year	2.674974
100 year	2.962258

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1902	0.003	1.087
1903	0.001	1.810
1904	0.003	2.044
1905	0.003	0.894
1906	0.002	1.030
1907	0.004	1.506
1908	0.003	1.155
1909	0.003	1.226
1910	0.003	1.487
1911	0.003	0.986

1912	0.004	2.791
1913	0.003	0.833
1914	0.003	2.960
1915	0.003	0.700
1916	0.004	1.845
1917	0.002	0.678
1918	0.003	1.445
1919	0.002	0.721
1920	0.004	0.921
1921	0.004	0.844
1922	0.003	1.162
1923	0.003	0.730
1924	0.002	0.804
1925	0.002	0.847
1926	0.003	1.191
1927	0.002	1.002
1928	0.003	1.141
1929	0.003	2.072
1930	0.003	2.057
1931	0.003	1.024
1932	0.003	1.208
1933	0.003	1.093
1934	0.004	1.869
1935	0.002	0.895
1936	0.003	0.829
1937	0.003	1.625
1938	0.003	1.009
1939	0.002	0.887
1940	0.003	1.793
1941	0.003	1.060
1942	0.002	1.588
1943	0.002	1.671
1944	0.004	2.461
1945	0.003	1.815
1946	0.003	0.814
1947	0.002	1.127
1948	0.003	1.310
1949	0.004	1.755
1950	0.002	0.745
1951	0.003	0.593
1952	0.003	2.354
1953	0.004	2.140
1954	0.003	1.178
1955	0.001	0.541
1956	0.001	0.438
1957	0.003	1.009
1958	0.004	1.550
1959	0.003	1.487
1960	0.003	0.698
1961	0.004	3.124
1962	0.003	1.217
1963	0.002	0.810
1964	0.002	1.582
1965	0.003	1.325
1966	0.003	0.668
1967	0.003	1.014
1968	0.003	0.945
1969	0.003	1.278

1970	0.003	1.427
1971	0.004	1.454
1972	0.004	3.823
1973	0.004	1.872
1974	0.003	1.420
1975	0.003	2.070
1976	0.003	1.541
1977	0.003	0.833
1978	0.004	1.625
1979	0.003	0.742
1980	0.003	1.230
1981	0.003	1.493
1982	0.002	1.175
1983	0.003	1.683
1984	0.003	1.299
1985	0.003	0.858
1986	0.003	0.942
1987	0.003	1.362
1988	0.002	0.922
1989	0.003	0.921
1990	0.002	1.120
1991	0.004	1.642
1992	0.003	1.532
1993	0.004	1.720
1994	0.003	1.366
1995	0.004	0.494
1996	0.004	1.160
1997	0.003	0.759
1998	0.003	1.429
1999	0.003	0.680
2000	0.003	1.485
2001	0.001	0.996
2002	0.004	1.891
2003	0.002	1.088
2004	0.004	1.473
2005	0.003	1.771
2006	0.003	0.603
2007	0.003	1.775
2008	0.004	1.024
2009	0.002	1.085
2010	0.002	1.538
2011	0.002	0.424
2012	0.003	1.469
2013	0.003	0.780
2014	0.003	0.721
2015	0.003	1.340
2016	0.002	0.575
2017	0.004	2.250
2018	0.004	1.361
2019	0.004	1.897
2020	0.003	1.001
2021	0.004	1.411
2022	0.002	1.178
2023	0.002	1.442
2024	0.004	2.649
2025	0.002	0.762
2026	0.003	1.109
2027	0.003	1.346

2028	0.001	0.537
2029	0.003	1.184
2030	0.003	1.431
2031	0.001	0.686
2032	0.002	0.427
2033	0.001	0.597
2034	0.003	1.200
2035	0.003	1.491
2036	0.002	1.024
2037	0.003	0.909
2038	0.003	1.528
2039	0.002	1.326
2040	0.003	1.257
2041	0.004	1.489
2042	0.004	1.663
2043	0.004	1.615
2044	0.003	1.343
2045	0.004	0.772
2046	0.003	1.045
2047	0.003	1.322
2048	0.003	1.293
2049	0.002	1.721
2050	0.003	1.141
2051	0.004	1.968
2052	0.003	0.947
2053	0.003	1.267
2054	0.004	1.624
2055	0.003	0.874
2056	0.001	1.404
2057	0.003	0.989
2058	0.003	1.108
2059	0.004	1.575

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	0.0037	3.8233
2	0.0037	3.1244
3	0.0037	2.9603
4	0.0037	2.7914
5	0.0037	2.6492
6	0.0036	2.4607
7	0.0036	2.3537
8	0.0036	2.2498
9	0.0036	2.1396
10	0.0036	2.0722
11	0.0036	2.0702
12	0.0036	2.0567
13	0.0036	2.0440
14	0.0036	1.9683
15	0.0036	1.8972
16	0.0036	1.8913
17	0.0036	1.8718
18	0.0036	1.8691
19	0.0036	1.8450
20	0.0036	1.8150
21	0.0036	1.8104
22	0.0036	1.7925

23	0.0036	1.7751
24	0.0036	1.7708
25	0.0036	1.7547
26	0.0036	1.7213
27	0.0035	1.7204
28	0.0035	1.6828
29	0.0035	1.6707
30	0.0035	1.6634
31	0.0035	1.6422
32	0.0035	1.6254
33	0.0035	1.6250
34	0.0035	1.6238
35	0.0035	1.6148
36	0.0035	1.5885
37	0.0035	1.5821
38	0.0035	1.5753
39	0.0035	1.5495
40	0.0035	1.5407
41	0.0035	1.5376
42	0.0035	1.5324
43	0.0035	1.5282
44	0.0034	1.5057
45	0.0034	1.4929
46	0.0034	1.4913
47	0.0034	1.4887
48	0.0034	1.4873
49	0.0034	1.4866
50	0.0034	1.4850
51	0.0034	1.4729
52	0.0034	1.4691
53	0.0034	1.4541
54	0.0034	1.4454
55	0.0034	1.4424
56	0.0034	1.4309
57	0.0034	1.4292
58	0.0034	1.4272
59	0.0034	1.4201
60	0.0033	1.4111
61	0.0033	1.4042
62	0.0033	1.3658
63	0.0033	1.3617
64	0.0033	1.3614
65	0.0033	1.3455
66	0.0033	1.3432
67	0.0033	1.3396
68	0.0032	1.3260
69	0.0032	1.3245
70	0.0032	1.3223
71	0.0032	1.3104
72	0.0032	1.2993
73	0.0032	1.2930
74	0.0032	1.2784
75	0.0032	1.2670
76	0.0031	1.2568
77	0.0031	1.2301
78	0.0031	1.2264
79	0.0031	1.2171
80	0.0031	1.2085

81	0.0031	1.1995
82	0.0031	1.1905
83	0.0031	1.1838
84	0.0031	1.1779
85	0.0031	1.1777
86	0.0031	1.1754
87	0.0031	1.1616
88	0.0030	1.1603
89	0.0030	1.1553
90	0.0030	1.1407
91	0.0030	1.1407
92	0.0030	1.1271
93	0.0030	1.1197
94	0.0030	1.1093
95	0.0030	1.1085
96	0.0030	1.0929
97	0.0030	1.0880
98	0.0030	1.0867
99	0.0030	1.0850
100	0.0029	1.0605
101	0.0029	1.0447
102	0.0029	1.0296
103	0.0029	1.0244
104	0.0029	1.0243
105	0.0029	1.0238
106	0.0028	1.0139
107	0.0028	1.0089
108	0.0028	1.0086
109	0.0028	1.0023
110	0.0028	1.0005
111	0.0028	0.9964
112	0.0028	0.9890
113	0.0027	0.9860
114	0.0027	0.9468
115	0.0027	0.9453
116	0.0026	0.9424
117	0.0026	0.9225
118	0.0026	0.9212
119	0.0026	0.9210
120	0.0026	0.9088
121	0.0026	0.8955
122	0.0025	0.8941
123	0.0024	0.8873
124	0.0024	0.8738
125	0.0024	0.8582
126	0.0024	0.8467
127	0.0023	0.8445
128	0.0023	0.8334
129	0.0023	0.8331
130	0.0023	0.8293
131	0.0022	0.8141
132	0.0021	0.8102
133	0.0021	0.8042
134	0.0020	0.7798
135	0.0020	0.7718
136	0.0020	0.7624
137	0.0020	0.7587
138	0.0020	0.7446

139	0.0020	0.7419
140	0.0019	0.7304
141	0.0019	0.7214
142	0.0019	0.7212
143	0.0019	0.6998
144	0.0018	0.6983
145	0.0017	0.6856
146	0.0017	0.6803
147	0.0017	0.6782
148	0.0017	0.6684
149	0.0016	0.6027
150	0.0015	0.5965
151	0.0014	0.5927
152	0.0013	0.5748
153	0.0013	0.5414
154	0.0011	0.5371
155	0.0010	0.4939
156	0.0010	0.4378
157	0.0009	0.4265
158	0.0008	0.4241

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0015	3718	1985005	53389	Fail
0.0015	3552	1976695	55650	Fail
0.0015	3389	1968385	58081	Fail
0.0016	3240	1960075	60496	Fail
0.0016	3131	1951765	62336	Fail
0.0016	3014	1943454	64480	Fail
0.0017	2891	1935698	66956	Fail
0.0017	2787	1927388	69156	Fail
0.0017	2687	1919632	71441	Fail
0.0017	2595	1911876	73675	Fail
0.0018	2487	1904120	76562	Fail
0.0018	2414	1896918	78579	Fail
0.0018	2317	1886392	81415	Fail
0.0019	2230	1876420	84144	Fail
0.0019	2155	1866448	86610	Fail
0.0019	2080	1856475	89253	Fail
0.0020	2020	1846503	91411	Fail
0.0020	1953	1836531	94036	Fail
0.0020	1893	1827113	96519	Fail
0.0020	1829	1817141	99351	Fail
0.0021	1764	1807169	102447	Fail
0.0021	1697	1797751	105937	Fail
0.0021	1636	1787779	109277	Fail
0.0022	1574	1780023	113089	Fail
0.0022	1499	1775037	118414	Fail
0.0022	1443	1770604	122702	Fail
0.0023	1354	1765618	130400	Fail
0.0023	1303	1761186	135163	Fail
0.0023	1249	1756754	140652	Fail
0.0023	1208	1751768	145013	Fail
0.0024	1164	1747336	150114	Fail
0.0024	1127	1742904	154649	Fail
0.0024	1057	1738472	164472	Fail
0.0025	1010	1734040	171687	Fail
0.0025	963	1729608	179606	Fail
0.0025	922	1725176	187112	Fail
0.0026	904	1720744	190347	Fail
0.0026	863	1716312	198877	Fail
0.0026	815	1712434	210114	Fail
0.0026	790	1708002	216202	Fail
0.0027	751	1704124	226913	Fail
0.0027	699	1699692	243160	Fail
0.0027	678	1695260	250038	Fail
0.0028	649	1691382	260613	Fail
0.0028	616	1687503	273945	Fail
0.0028	567	1683625	296935	Fail
0.0029	545	1679193	308108	Fail
0.0029	519	1673099	322369	Fail
0.0029	496	1664789	335642	Fail
0.0029	473	1657033	350324	Fail
0.0030	439	1648723	375563	Fail
0.0030	398	1640967	412303	Fail
0.0030	371	1633211	440218	Fail
0.0031	349	1625455	465746	Fail

0.0031	331	1617145	488563	Fail
0.0031	302	1609389	532910	Fail
0.0031	279	1601633	574062	Fail
0.0032	270	1593876	590324	Fail
0.0032	247	1586120	642153	Fail
0.0032	231	1581688	684713	Fail
0.0033	212	1578918	744772	Fail
0.0033	197	1576148	800075	Fail
0.0033	186	1573378	845902	Fail
0.0034	171	1570608	918484	Fail
0.0034	157	1567838	998622	Fail
0.0034	140	1565622	1118301	Fail
0.0034	121	1562852	1291613	Fail
0.0035	106	1560082	1471775	Fail
0.0035	91	1557312	1711331	Fail
0.0035	78	1555096	1993712	Fail
0.0036	57	1552326	2723378	Fail
0.0036	35	1549556	4427302	Fail
0.0036	13	1547340	11902615	Fail
0.0037	3	1544570	51485666	Fail
0.0037	0	1542354	n/a	Fail
0.0037	0	1539584	n/a	Fail
0.0037	0	1537368	n/a	Fail
0.0038	0	1534598	n/a	Fail
0.0038	0	1532382	n/a	Fail
0.0038	0	1529612	n/a	Fail
0.0039	0	1527396	n/a	Fail
0.0039	0	1524626	n/a	Fail
0.0039	0	1522410	n/a	Fail
0.0040	0	1519640	n/a	Fail
0.0040	0	1517424	n/a	Fail
0.0040	0	1515208	n/a	Fail
0.0040	0	1512437	n/a	Fail
0.0041	0	1510221	n/a	Fail
0.0041	0	1508005	n/a	Fail
0.0041	0	1505789	n/a	Fail
0.0042	0	1503573	n/a	Fail
0.0042	0	1500803	n/a	Fail
0.0042	0	1498587	n/a	Fail
0.0043	0	1495263	n/a	Fail
0.0043	0	1488061	n/a	Fail
0.0043	0	1480305	n/a	Fail
0.0043	0	1472549	n/a	Fail
0.0044	0	1465347	n/a	Fail
0.0044	0	1457591	n/a	Fail
0.0044	0	1450389	n/a	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
retention 1 POC	☐	1680.89			☐	0.00			
Total Volume Infiltrated		1680.89	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

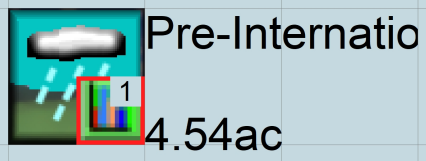
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   International Pl.wdm
MESSU      25   MitInternational Pl.MES
           27   MitInternational Pl.L61
           28   MitInternational Pl.L62
           30   POCInternational Pl1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       1
      GENER        2
      RCHRES       1
      RCHRES       2
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Surface retention  1        MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
    2        24
  END OPCODE
  PARM
    #    #         K ***
    2             0.
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
```

```
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1           400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1             0         0
  END IWAT-PARM3

  IWAT-STATE1
```

```
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
IMPLND   1                        4.54     RCHRES   1      5

******Routing******
IMPLND   1                        4.54     COPY     1     15
RCHRES   1                           1     RCHRES   2      8
RCHRES   2                           1     COPY   501     16
RCHRES   1                           1     COPY   501     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
GENER    2 OUTPUT TIMSER      .0011111     RCHRES   1     EXTNL  OUTDGT 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                         in  out                              ***
    1     Surface retentio-006    2    1    1    1   28    0    1
    2     Bioretention  1         1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1        0  1  0  0    4  5  0  0  0       0  1  0  0  0       2  1  2  2  2
    2        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1              1      0.01       0.0       0.0       0.0       0.0
    2              2      0.01       0.0       0.0       0.0       0.0
```

```
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                          ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
*** User-Defined Variable Quantity Lines
***                          addr
***                         <------>
*** kwd  varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><--------> <><-> <><-> <--> ***
  UVQUAN vol2   RCHRES   2 VOL              4
  UVQUAN v2m2   GLOBAL     WORKSP  1        3
  UVQUAN vpo2   GLOBAL     WORKSP  2        3
  UVQUAN v2d2   GENER    2 K       1        3
*** User-Defined Target Variable Names
***                  addr or                       addr or
***                 <------>                      <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m2    1 WORKSP  1         1.0 QUAN
  UVNAME  vpo2    1 WORKSP  2         1.0 QUAN
  UVNAME  v2d2    1 K       1         1.0 QUAN
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><--------> <> <-><->
  GENER   2                               v2m2            =  2231.2
*** Compute remaining available pore space
  GENER   2                               vpo2            =  v2m2
  GENER   2                               vpo2           -=  vol2
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo2 < 0.0) THEN
  GENER   2                               vpo2            =  0.0
END IF
*** Infiltration volume
  GENER   2                               v2d2            =  vpo2
END SPEC-ACTIONS
FTABLES
  FTABLE      2
   56    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.096644  0.000000  0.000000
  0.054945  0.096055  0.000638  0.000000
  0.109890  0.095079  0.001286  0.000000
  0.164835  0.094107  0.001942  0.000000
  0.219780  0.093141  0.002608  0.000000
  0.274725  0.092179  0.003282  0.000000
  0.329670  0.091222  0.003966  0.000752
  0.384615  0.090271  0.004660  0.001036
  0.439560  0.089324  0.005362  0.001340
  0.494505  0.088382  0.006074  0.001805
  0.549451  0.087446  0.006796  0.002154
  0.604396  0.086514  0.007527  0.002864
  0.659341  0.085587  0.008267  0.003219
  0.714286  0.084666  0.009017  0.004246
  0.769231  0.083749  0.009777  0.004560
  0.824176  0.082837  0.010547  0.005983
  0.879121  0.081930  0.011327  0.006199
  0.934066  0.081029  0.012117  0.008104
  0.989011  0.080132  0.012916  0.008156
  1.043956  0.079240  0.013726  0.010451
  1.098901  0.078353  0.014545  0.010636
  1.153846  0.077471  0.015375  0.013101
  1.208791  0.076595  0.016215  0.013603
```

```
1.263736  0.075723  0.017066  0.016125
1.318681  0.074856  0.017927  0.017030
1.373626  0.073994  0.018798  0.019538
1.428571  0.073137  0.019679  0.020938
1.483516  0.072285  0.020572  0.023356
1.538462  0.071439  0.021361  0.025348
1.593407  0.070597  0.022160  0.027594
1.648352  0.069760  0.022969  0.030282
1.703297  0.068928  0.023787  0.032266
1.758242  0.068101  0.024614  0.035757
1.813187  0.067279  0.025451  0.037386
1.868132  0.066462  0.026297  0.041794
1.923077  0.065650  0.027154  0.042967
1.978022  0.064843  0.028019  0.048408
2.032967  0.064041  0.028895  0.049021
2.087912  0.063244  0.029781  0.055561
2.142857  0.062452  0.030676  0.055619
2.197802  0.061665  0.031581  0.062596
2.252747  0.060883  0.032497  0.063441
2.307692  0.060106  0.033422  0.070138
2.362637  0.059334  0.034357  0.071889
2.417582  0.058567  0.035303  0.078193
2.472527  0.057805  0.036259  0.080979
2.527473  0.057048  0.037225  0.086768
2.582418  0.056296  0.038201  0.090722
2.637363  0.055549  0.039188  0.095860
2.692308  0.054807  0.040185  0.101129
2.747253  0.054070  0.041193  0.105453
2.802198  0.053338  0.042211  0.112207
2.857143  0.052611  0.043240  0.115420
2.912088  0.051889  0.044280  0.117985
2.967033  0.051172  0.045330  0.117985
3.000000  0.050459  0.051221  0.254400
END FTABLE  2
FTABLE      1
 38    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.050459  0.000000  0.000000  0.000000
0.054945  0.097628  0.005337  0.000000  0.152640
0.109890  0.098618  0.010729  0.000000  0.163823
0.164835  0.099613  0.016174  0.000000  0.169414
0.219780  0.100612  0.021675  0.000000  0.175005
0.274725  0.101617  0.027231  0.000000  0.180596
0.329670  0.102626  0.032842  0.000000  0.186187
0.384615  0.103641  0.038509  0.000000  0.191779
0.439560  0.104660  0.044231  0.000000  0.197370
0.494505  0.105685  0.050010  0.000000  0.202961
0.549451  0.106714  0.055845  0.000000  0.208552
0.604396  0.107749  0.061737  0.000000  0.214143
0.659341  0.108788  0.067686  0.000000  0.219735
0.714286  0.109833  0.073692  0.000000  0.225326
0.769231  0.110882  0.079755  0.000000  0.230917
0.824176  0.111937  0.085877  0.000000  0.236508
0.879121  0.112996  0.092056  0.000000  0.242100
0.934066  0.114060  0.098294  0.000000  0.247691
0.989011  0.115130  0.104590  0.000000  0.253282
1.043956  0.116204  0.110946  0.195553  0.258873
1.098901  0.117284  0.117360  0.659242  0.264464
1.153846  0.118368  0.123834  1.276591  0.270056
1.208791  0.119457  0.130368  2.010935  0.275647
1.263736  0.120552  0.136962  2.836899  0.281238
1.318681  0.121651  0.143615  3.731796  0.286829
1.373626  0.122756  0.150330  4.673072  0.292420
1.428571  0.123865  0.157105  5.637608  0.298012
1.483516  0.124979  0.163942  6.601841  0.303603
1.538462  0.126099  0.170839  7.542349  0.309194
1.593407  0.127223  0.177799  8.436754  0.314785
1.648352  0.128352  0.184820  9.264852  0.320376
1.703297  0.129486  0.191903  10.00993  0.325968
```

```
  1.758242  0.130626  0.199049  10.66024  0.331559
  1.813187  0.131770  0.206258  11.21062  0.337150
  1.868132  0.132919  0.213530  11.66425  0.342741
  1.923077  0.134073  0.220865  12.03449  0.348333
  1.978022  0.135233  0.228263  12.34684  0.353924
  2.000000  0.135698  0.231240  12.80450  0.356160
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1              RCHRES   1     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    1              RCHRES   2     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   2 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   2 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1002 STAG     ENGL      REPL
RCHRES   1 HYDR   O      1 1        1      WDM   1003 FLOW     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       16
RCHRES     ROFLOW                          COPY           INPUT  MEAN
  END MASS-LINK   16

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

Legal Notice

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WWHM2012

PROJECT REPORT

General Model Information

Project Name:	Manchester Pl
Site Name:	
Site Address:	
City:	
Report Date:	10/2/2023
Gage:	
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2019/09/03
Version:	4.2.16

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Flat	0.7
Pervious Total	0.7
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.7

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	0.7
Impervious Total	0.7
Basin Total	0.7

Element Flows To:

Surface	Interflow	Groundwater
Surface retention 1	Surface retention 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Bioretention 1

Bottom Length:	14.82 ft.
Bottom Width:	14.82 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW 12 in/hr
Material thickness of second layer:	1.5
Material type for second layer:	Sand
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	0.5
Orifice Diameter (in.):	6
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	263.17
Total Outflow (ac-ft.):	288.755
Percent Through Underdrain:	91.14
Discharge Structure	
Riser Height:	1 ft.
Riser Diameter:	12 in.
Element Flows To:	
Outlet 1	Outlet 2

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0247	0.0000	0.0000	0.0000
0.0549	0.0244	0.0001	0.0000	0.0000
0.1099	0.0239	0.0001	0.0000	0.0000
0.1648	0.0235	0.0002	0.0000	0.0000
0.2198	0.0230	0.0003	0.0000	0.0000
0.2747	0.0225	0.0004	0.0000	0.0000
0.3297	0.0220	0.0004	0.0001	0.0000
0.3846	0.0216	0.0005	0.0001	0.0000
0.4396	0.0211	0.0006	0.0001	0.0000
0.4945	0.0206	0.0007	0.0002	0.0000
0.5495	0.0202	0.0008	0.0002	0.0000
0.6044	0.0197	0.0009	0.0003	0.0000
0.6593	0.0193	0.0010	0.0003	0.0000
0.7143	0.0189	0.0011	0.0004	0.0000
0.7692	0.0184	0.0012	0.0005	0.0000
0.8242	0.0180	0.0013	0.0006	0.0000
0.8791	0.0176	0.0014	0.0006	0.0000
0.9341	0.0172	0.0015	0.0008	0.0000
0.9890	0.0168	0.0017	0.0008	0.0000
1.0440	0.0164	0.0018	0.0010	0.0000
1.0989	0.0160	0.0019	0.0011	0.0000
1.1538	0.0156	0.0020	0.0013	0.0000
1.2088	0.0152	0.0022	0.0014	0.0000
1.2637	0.0148	0.0023	0.0016	0.0000
1.3187	0.0144	0.0025	0.0017	0.0000
1.3736	0.0140	0.0026	0.0020	0.0000
1.4286	0.0137	0.0028	0.0021	0.0000
1.4835	0.0133	0.0029	0.0023	0.0000
1.5385	0.0129	0.0031	0.0025	0.0000

1.5934	0.0126	0.0032	0.0028	0.0000
1.6484	0.0122	0.0034	0.0030	0.0000
1.7033	0.0119	0.0035	0.0032	0.0000
1.7582	0.0115	0.0037	0.0036	0.0000
1.8132	0.0112	0.0039	0.0037	0.0000
1.8681	0.0109	0.0040	0.0042	0.0000
1.9231	0.0105	0.0042	0.0043	0.0000
1.9780	0.0102	0.0044	0.0048	0.0000
2.0330	0.0099	0.0046	0.0049	0.0000
2.0879	0.0096	0.0048	0.0056	0.0000
2.1429	0.0093	0.0049	0.0056	0.0000
2.1978	0.0090	0.0051	0.0063	0.0000
2.2527	0.0087	0.0053	0.0063	0.0000
2.3077	0.0084	0.0055	0.0070	0.0000
2.3626	0.0081	0.0058	0.0072	0.0000
2.4176	0.0078	0.0060	0.0078	0.0000
2.4725	0.0075	0.0062	0.0081	0.0000
2.5275	0.0073	0.0064	0.0087	0.0000
2.5824	0.0070	0.0066	0.0091	0.0000
2.6374	0.0067	0.0069	0.0096	0.0000
2.6923	0.0065	0.0071	0.0101	0.0000
2.7473	0.0062	0.0074	0.0105	0.0000
2.8022	0.0060	0.0076	0.0112	0.0000
2.8571	0.0057	0.0079	0.0115	0.0000
2.9121	0.0055	0.0081	0.0118	0.0000
2.9670	0.0053	0.0084	0.0118	0.0000
3.0000	0.0050	0.0086	0.0254	0.0000

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.0247	0.0086	0.0000	0.0153	0.0000
3.0549	0.0252	0.0099	0.0000	0.0153	0.0000
3.1099	0.0257	0.0113	0.0000	0.0164	0.0000
3.1648	0.0262	0.0128	0.0000	0.0169	0.0000
3.2198	0.0268	0.0142	0.0000	0.0175	0.0000
3.2747	0.0273	0.0157	0.0000	0.0181	0.0000
3.3297	0.0278	0.0172	0.0000	0.0186	0.0000
3.3846	0.0283	0.0188	0.0000	0.0192	0.0000
3.4396	0.0289	0.0203	0.0000	0.0197	0.0000
3.4945	0.0294	0.0219	0.0000	0.0203	0.0000
3.5495	0.0300	0.0236	0.0000	0.0209	0.0000
3.6044	0.0305	0.0252	0.0000	0.0214	0.0000
3.6593	0.0311	0.0269	0.0000	0.0220	0.0000
3.7143	0.0316	0.0286	0.0000	0.0225	0.0000
3.7692	0.0322	0.0304	0.0000	0.0231	0.0000
3.8242	0.0327	0.0322	0.0000	0.0236	0.0000
3.8791	0.0333	0.0340	0.0000	0.0242	0.0000
3.9341	0.0339	0.0358	0.0000	0.0248	0.0000
3.9890	0.0345	0.0377	0.0000	0.0253	0.0000
4.0440	0.0351	0.0396	0.0977	0.0259	0.0000
4.0989	0.0357	0.0416	0.3281	0.0264	0.0000
4.1538	0.0363	0.0435	0.6273	0.0270	0.0000
4.2088	0.0369	0.0456	0.9624	0.0276	0.0000
4.2637	0.0375	0.0476	1.3006	0.0281	0.0000
4.3187	0.0381	0.0497	1.6096	0.0287	0.0000
4.3736	0.0387	0.0518	1.8629	0.0292	0.0000
4.4286	0.0393	0.0539	2.0472	0.0298	0.0000
4.4835	0.0400	0.0561	2.1721	0.0304	0.0000

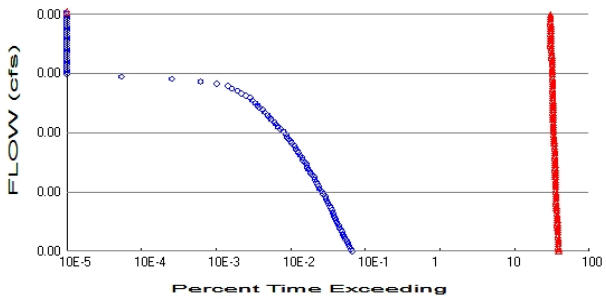
4.5385	0.0406	0.0583	2.3112	0.0309	0.0000
4.5934	0.0412	0.0606	2.4263	0.0315	0.0000
4.6484	0.0419	0.0628	2.5361	0.0320	0.0000
4.7033	0.0425	0.0652	2.6414	0.0326	0.0000
4.7582	0.0432	0.0675	2.7426	0.0331	0.0000
4.8132	0.0438	0.0699	2.8402	0.0337	0.0000
4.8681	0.0445	0.0723	2.9346	0.0343	0.0000
4.9231	0.0452	0.0748	3.0261	0.0348	0.0000
4.9780	0.0459	0.0773	3.1148	0.0354	0.0000
5.0000	0.0461	0.0783	3.2011	0.0356	0.0000

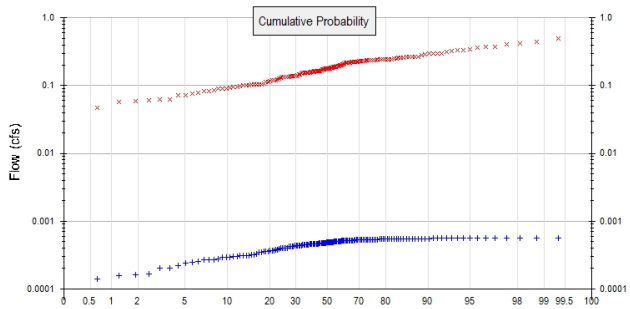
Surface retention 1

Element Flows To:

Outlet 1	Outlet 2
	Bioretention 1

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.7
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 0.7

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.000456
5 year	0.000562
10 year	0.000612
25 year	0.000658
50 year	0.000684
100 year	0.000704

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.179131
5 year	0.25555
10 year	0.298835
25 year	0.345887
50 year	0.376104
100 year	0.40278

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1902	0.000	0.173
1903	0.000	0.190
1904	0.000	0.263
1905	0.000	0.145
1906	0.000	0.102
1907	0.001	0.241
1908	0.001	0.156
1909	0.001	0.180
1910	0.001	0.236
1911	0.000	0.137

1912	0.001	0.438
1913	0.001	0.132
1914	0.001	0.283
1915	0.000	0.139
1916	0.001	0.295
1917	0.000	0.100
1918	0.001	0.219
1919	0.000	0.104
1920	0.001	0.108
1921	0.001	0.160
1922	0.000	0.184
1923	0.001	0.114
1924	0.000	0.083
1925	0.000	0.133
1926	0.000	0.165
1927	0.000	0.160
1928	0.000	0.175
1929	0.000	0.330
1930	0.001	0.207
1931	0.000	0.163
1932	0.000	0.193
1933	0.000	0.176
1934	0.001	0.298
1935	0.000	0.127
1936	0.000	0.154
1937	0.001	0.258
1938	0.001	0.160
1939	0.000	0.078
1940	0.000	0.266
1941	0.000	0.102
1942	0.000	0.261
1943	0.000	0.264
1944	0.001	0.374
1945	0.000	0.237
1946	0.000	0.091
1947	0.000	0.179
1948	0.001	0.208
1949	0.001	0.301
1950	0.000	0.104
1951	0.000	0.094
1952	0.001	0.373
1953	0.001	0.339
1954	0.001	0.166
1955	0.000	0.084
1956	0.000	0.057
1957	0.000	0.136
1958	0.001	0.240
1959	0.001	0.247
1960	0.001	0.143
1961	0.001	0.412
1962	0.001	0.193
1963	0.000	0.095
1964	0.000	0.227
1965	0.001	0.227
1966	0.000	0.096
1967	0.000	0.162
1968	0.000	0.152
1969	0.001	0.176

1970	0.001	0.226
1971	0.001	0.230
1972	0.001	0.498
1973	0.001	0.337
1974	0.000	0.251
1975	0.001	0.327
1976	0.000	0.243
1977	0.000	0.099
1978	0.001	0.258
1979	0.000	0.103
1980	0.001	0.157
1981	0.000	0.154
1982	0.000	0.180
1983	0.000	0.268
1984	0.000	0.184
1985	0.001	0.136
1986	0.000	0.153
1987	0.001	0.217
1988	0.000	0.146
1989	0.000	0.134
1990	0.000	0.180
1991	0.001	0.243
1992	0.001	0.226
1993	0.001	0.155
1994	0.000	0.218
1995	0.001	0.060
1996	0.001	0.189
1997	0.000	0.118
1998	0.000	0.231
1999	0.000	0.075
2000	0.001	0.234
2001	0.000	0.153
2002	0.001	0.234
2003	0.000	0.190
2004	0.001	0.182
2005	0.001	0.201
2006	0.001	0.089
2007	0.000	0.285
2008	0.001	0.137
2009	0.000	0.105
2010	0.000	0.244
2011	0.000	0.058
2012	0.000	0.224
2013	0.000	0.120
2014	0.000	0.047
2015	0.000	0.200
2016	0.000	0.072
2017	0.001	0.357
2018	0.001	0.216
2019	0.001	0.301
2020	0.000	0.139
2021	0.001	0.223
2022	0.000	0.105
2023	0.000	0.231
2024	0.001	0.409
2025	0.000	0.121
2026	0.000	0.175
2027	0.000	0.169

2028	0.000	0.063
2029	0.000	0.163
2030	0.001	0.229
2031	0.000	0.090
2032	0.000	0.024
2033	0.000	0.073
2034	0.000	0.170
2035	0.001	0.239
2036	0.000	0.164
2037	0.000	0.115
2038	0.000	0.246
2039	0.000	0.063
2040	0.000	0.191
2041	0.001	0.194
2042	0.001	0.265
2043	0.001	0.235
2044	0.000	0.217
2045	0.001	0.121
2046	0.000	0.166
2047	0.001	0.135
2048	0.000	0.197
2049	0.000	0.226
2050	0.001	0.179
2051	0.001	0.312
2052	0.001	0.137
2053	0.000	0.203
2054	0.001	0.249
2055	0.000	0.086
2056	0.000	0.234
2057	0.001	0.153
2058	0.000	0.123
2059	0.001	0.247

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	0.0006	0.4983
2	0.0006	0.4384
3	0.0006	0.4119
4	0.0006	0.4088
5	0.0006	0.3743
6	0.0006	0.3725
7	0.0006	0.3574
8	0.0006	0.3389
9	0.0006	0.3367
10	0.0006	0.3299
11	0.0006	0.3274
12	0.0006	0.3121
13	0.0006	0.3011
14	0.0006	0.3010
15	0.0006	0.2981
16	0.0006	0.2947
17	0.0006	0.2854
18	0.0006	0.2831
19	0.0006	0.2681
20	0.0006	0.2659
21	0.0006	0.2651
22	0.0006	0.2643

23	0.0006	0.2633
24	0.0006	0.2608
25	0.0005	0.2582
26	0.0005	0.2576
27	0.0005	0.2508
28	0.0005	0.2489
29	0.0005	0.2469
30	0.0005	0.2468
31	0.0005	0.2455
32	0.0005	0.2440
33	0.0005	0.2433
34	0.0005	0.2431
35	0.0005	0.2410
36	0.0005	0.2404
37	0.0005	0.2390
38	0.0005	0.2371
39	0.0005	0.2359
40	0.0005	0.2354
41	0.0005	0.2336
42	0.0005	0.2336
43	0.0005	0.2336
44	0.0005	0.2314
45	0.0005	0.2314
46	0.0005	0.2295
47	0.0005	0.2292
48	0.0005	0.2269
49	0.0005	0.2267
50	0.0005	0.2262
51	0.0005	0.2259
52	0.0005	0.2259
53	0.0005	0.2244
54	0.0005	0.2233
55	0.0005	0.2185
56	0.0005	0.2178
57	0.0005	0.2174
58	0.0005	0.2167
59	0.0005	0.2161
60	0.0005	0.2084
61	0.0005	0.2068
62	0.0005	0.2034
63	0.0005	0.2008
64	0.0005	0.1996
65	0.0005	0.1970
66	0.0005	0.1940
67	0.0005	0.1932
68	0.0005	0.1927
69	0.0005	0.1913
70	0.0005	0.1905
71	0.0005	0.1900
72	0.0005	0.1888
73	0.0005	0.1844
74	0.0005	0.1844
75	0.0005	0.1817
76	0.0005	0.1801
77	0.0005	0.1801
78	0.0005	0.1798
79	0.0005	0.1794
80	0.0005	0.1794

81	0.0005	0.1762
82	0.0005	0.1761
83	0.0005	0.1752
84	0.0005	0.1752
85	0.0005	0.1726
86	0.0005	0.1703
87	0.0005	0.1691
88	0.0005	0.1658
89	0.0005	0.1656
90	0.0005	0.1648
91	0.0005	0.1637
92	0.0005	0.1635
93	0.0005	0.1633
94	0.0005	0.1620
95	0.0005	0.1601
96	0.0005	0.1600
97	0.0005	0.1596
98	0.0005	0.1569
99	0.0005	0.1563
100	0.0004	0.1546
101	0.0004	0.1541
102	0.0004	0.1540
103	0.0004	0.1535
104	0.0004	0.1526
105	0.0004	0.1526
106	0.0004	0.1516
107	0.0004	0.1456
108	0.0004	0.1450
109	0.0004	0.1432
110	0.0004	0.1389
111	0.0004	0.1385
112	0.0004	0.1375
113	0.0004	0.1371
114	0.0004	0.1366
115	0.0004	0.1360
116	0.0004	0.1357
117	0.0004	0.1352
118	0.0004	0.1335
119	0.0004	0.1326
120	0.0004	0.1321
121	0.0004	0.1268
122	0.0004	0.1228
123	0.0004	0.1208
124	0.0004	0.1207
125	0.0004	0.1205
126	0.0004	0.1176
127	0.0004	0.1147
128	0.0004	0.1137
129	0.0004	0.1081
130	0.0004	0.1053
131	0.0003	0.1050
132	0.0003	0.1037
133	0.0003	0.1035
134	0.0003	0.1032
135	0.0003	0.1023
136	0.0003	0.1018
137	0.0003	0.1004
138	0.0003	0.0987

139	0.0003	0.0963
140	0.0003	0.0946
141	0.0003	0.0939
142	0.0003	0.0909
143	0.0003	0.0904
144	0.0003	0.0891
145	0.0003	0.0861
146	0.0003	0.0839
147	0.0003	0.0825
148	0.0003	0.0783
149	0.0002	0.0753
150	0.0002	0.0725
151	0.0002	0.0716
152	0.0002	0.0632
153	0.0002	0.0630
154	0.0002	0.0601
155	0.0002	0.0583
156	0.0002	0.0566
157	0.0001	0.0475
158	0.0001	0.0241

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0002	3714	2152869	57966	Fail
0.0002	3561	2147329	60301	Fail
0.0002	3387	2140681	63202	Fail
0.0002	3268	2135141	65334	Fail
0.0002	3135	2128493	67894	Fail
0.0003	3006	2121845	70586	Fail
0.0003	2902	2116858	72944	Fail
0.0003	2787	2110764	75736	Fail
0.0003	2693	2105224	78173	Fail
0.0003	2596	2099130	80860	Fail
0.0003	2483	2093036	84294	Fail
0.0003	2418	2088050	86354	Fail
0.0003	2317	2081956	89855	Fail
0.0003	2235	2075862	92879	Fail
0.0003	2157	2064228	95699	Fail
0.0003	2077	2052040	98798	Fail
0.0003	2024	2042622	100920	Fail
0.0003	1955	2030433	103858	Fail
0.0003	1893	2021015	106762	Fail
0.0003	1831	2009381	109742	Fail
0.0003	1759	1997193	113541	Fail
0.0003	1700	1991099	117123	Fail
0.0003	1637	1986667	121360	Fail
0.0003	1589	1983343	124817	Fail
0.0003	1501	1979465	131876	Fail
0.0003	1439	1975033	137250	Fail
0.0003	1360	1971709	144978	Fail
0.0004	1303	1967831	151023	Fail
0.0004	1260	1964507	155913	Fail
0.0004	1210	1960629	162035	Fail
0.0004	1162	1956197	168347	Fail
0.0004	1127	1953427	173329	Fail
0.0004	1057	1948995	184389	Fail
0.0004	1008	1945116	192967	Fail
0.0004	966	1942346	201071	Fail
0.0004	920	1938468	210703	Fail
0.0004	907	1935144	213356	Fail
0.0004	865	1931820	223331	Fail
0.0004	813	1927942	237139	Fail
0.0004	792	1925172	243077	Fail
0.0004	749	1921294	256514	Fail
0.0004	703	1918524	272905	Fail
0.0004	678	1914646	282396	Fail
0.0004	647	1907998	294899	Fail
0.0004	620	1898580	306222	Fail
0.0004	567	1886946	332794	Fail
0.0004	549	1877528	341990	Fail
0.0004	520	1865894	358825	Fail
0.0004	490	1854259	378420	Fail
0.0005	475	1844841	388387	Fail
0.0005	439	1836531	418344	Fail
0.0005	400	1834315	458578	Fail
0.0005	371	1831545	493677	Fail
0.0005	349	1828775	524004	Fail

0.0005	332	1826559	550168	Fail
0.0005	301	1823789	605909	Fail
0.0005	283	1822127	643861	Fail
0.0005	270	1819357	673835	Fail
0.0005	247	1816587	735460	Fail
0.0005	231	1814371	785441	Fail
0.0005	210	1812155	862930	Fail
0.0005	199	1809939	909517	Fail
0.0005	186	1807723	971894	Fail
0.0005	170	1804953	1061737	Fail
0.0005	158	1802737	1140972	Fail
0.0005	139	1800521	1295338	Fail
0.0005	121	1797751	1485744	Fail
0.0005	107	1796089	1678587	Fail
0.0005	90	1793319	1992576	Fail
0.0005	80	1791657	2239571	Fail
0.0006	57	1788887	3138398	Fail
0.0006	34	1786671	5254914	Fail
0.0006	14	1784455	12746107	Fail
0.0006	3	1782239	59407966	Fail
0.0006	0	1780577	n/a	Fail
0.0006	0	1777807	n/a	Fail
0.0006	0	1775591	n/a	Fail
0.0006	0	1773928	n/a	Fail
0.0006	0	1771712	n/a	Fail
0.0006	0	1769496	n/a	Fail
0.0006	0	1767280	n/a	Fail
0.0006	0	1757308	n/a	Fail
0.0006	0	1745674	n/a	Fail
0.0006	0	1730162	n/a	Fail
0.0006	0	1718528	n/a	Fail
0.0006	0	1703016	n/a	Fail
0.0006	0	1698584	n/a	Fail
0.0006	0	1697476	n/a	Fail
0.0006	0	1695260	n/a	Fail
0.0006	0	1694152	n/a	Fail
0.0006	0	1691936	n/a	Fail
0.0006	0	1690274	n/a	Fail
0.0007	0	1689166	n/a	Fail
0.0007	0	1686949	n/a	Fail
0.0007	0	1685841	n/a	Fail
0.0007	0	1683625	n/a	Fail
0.0007	0	1681963	n/a	Fail
0.0007	0	1680855	n/a	Fail
0.0007	0	1679193	n/a	Fail
0.0007	0	1677531	n/a	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
retention 1 POC	☐	262.77			☐	0.00			
Total Volume Infiltrated		262.77	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

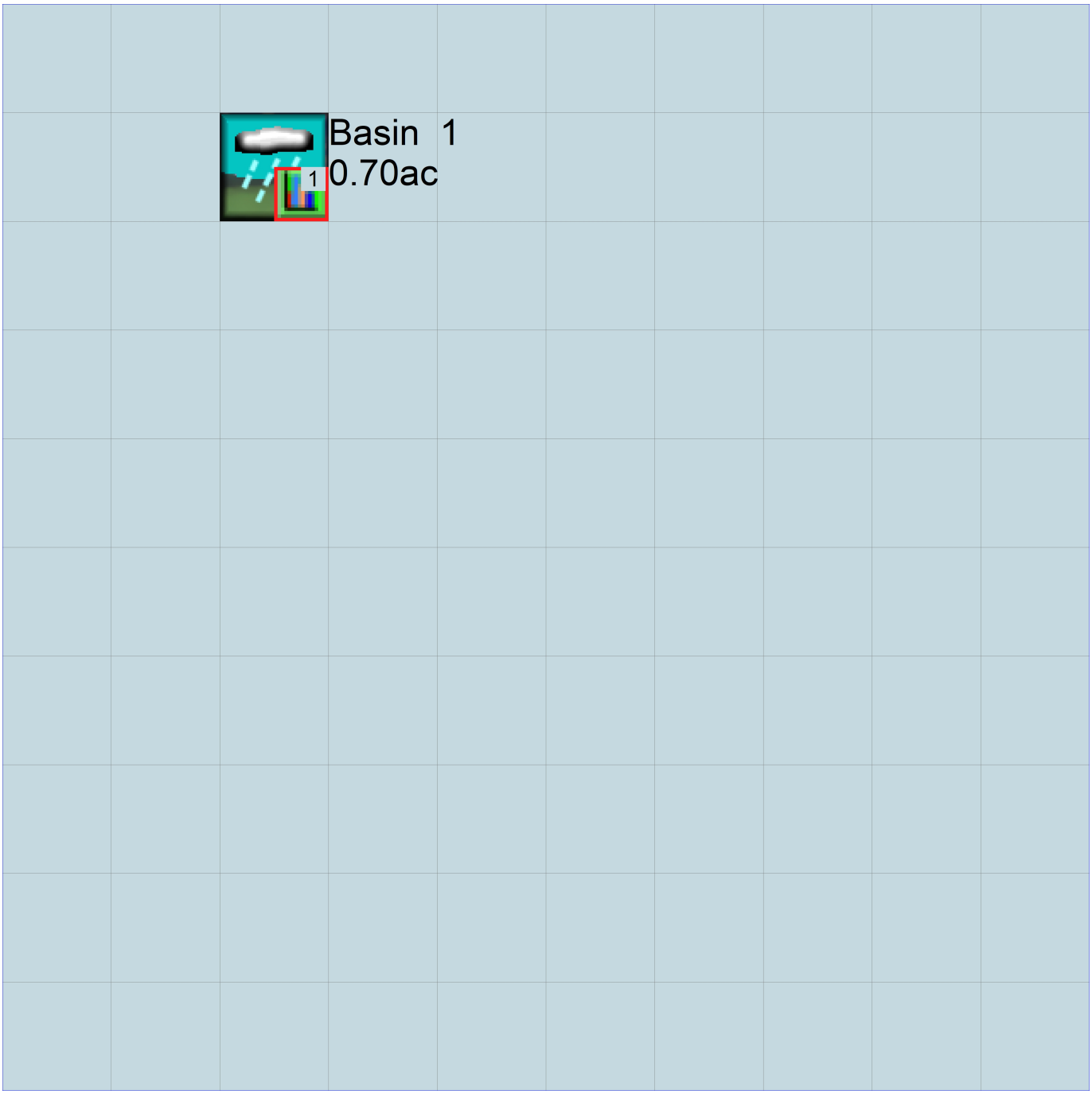
PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

Mitigated UCI File

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

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