PORT OF PORTLAND

Hillsboro Airport

Stormwater Master Plan

Final

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PORT OF PORTLAND

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Abbreviations and Acronyms

AA	Apron Area
AC	Advisory Circular
AOA	Airport Operations Area
BMP	Best Management Practice
BOD	Biological Oxygen Demand
CB	Catch Basin
CCTV	Closed Circuit Television
CIP	Capital Improvement Program
City	City of Hillsboro
CMP	Corrugated Metal Pipe
CWA	Clean Water Act
COD	Chemical Oxygen Demand
CWS	Clean Water Services
D&C	Design and Construction Standards
DEQ	Oregon Department of Environmental Quality
EA	Environmental Assessment
EPA	United States Environmental Protection Agency
ESA	Environmental Science Associates
ESCP	Erosion and Sediment Control Plan
FAA	Federal Aviation Administration
ft	foot
GIS	Geographic Information System
HDPE	High Density Polyethylene
HEC-RAS	Hydrologic Engineering Center – River Analysis System
HIO	Hillsboro Airport

HSPF	Hydrological Simulation Program-FORTRAN
in	Inch
LF	Linear Feet
LIDA	Low Impact Development Approach
LOC	Letter of Commitment
MH	Manholes
MLFS	Modified Landscape Filter Strips
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
PA	Protected Airspace
Port	Port of Portland
PVC	Polyvinyl Chloride
RKI	Robin Kirschbaum, Inc.
RPZ	Runway Protection Zone
RSA	Runway Safety Area
SDC	System Development Charge
SMA	Stormwater Management Approach
SMP	Stormwater Master Plan
SWMM	Stormwater Management Model
SWPCP	Stormwater Pollution Control Plan
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
WHMP	Wildlife Hazard Management Plan
WLA	Waste Load Allocations

Executive Summary

This Stormwater Master Plan (SMP) for the Hillsboro Airport (HIO) supports the stormwater needs of the 2020 HIO Master Plan and balances environmental commitments with federal standards for aviation safety. The SMP is designed to meet four requirements: support implementation of the HIO Master Plan, identify how the Port of Portland (Port) will meet water quality commitments to Clean Water Services (CWS) and the City of Hillsboro (City), address current and future stormwater conveyance capacity limitations, and identify asset replacement priorities.

HIO is located in the City of Hillsboro, Washington County, Oregon and is owned and managed by the Port, a regional government agency. Stormwater from HIO drains to two watersheds. McKay Creek, including Glencoe Swale, drains the northern portion of the airport, and Dawson Creek drains the southern portion of the airport. Both creeks are part of the Tualatin River watershed.

The Federal Aviation Administration (FAA) recommends that airports update their long-term planning documents every seven to ten years, or as necessary, to evaluate airport capabilities and role, to forecast future aviation demand, and to plan for timely development of improved or new facilities to meet that demand. The HIO Master Plan was last updated and approved by the FAA in 2020 and resulted in a 20-year forecast of facility and infrastructure development needs (see Figure E-1 for the Preferred Development Alternative). Prior to completion of the HIO Master Plan, the Port, CWS, and the City developed a Letter of Commitment (LOC) in which the Port agreed to develop a SMP for HIO that would evaluate stormwater mitigation alternatives and stormwater infrastructure needed to address the Preferred Development Alternative identified in the HIO Master Plan. This HIO SMP plans future stormwater conveyance and stormwater facilities needed to serve development and redevelopment of airport facilities in a way that meets regulatory requirements for water quality and hydromodification mitigation. Each future update of the HIO Master Plan will require re-evaluating and updating the SMP to address future development scenarios and timeframes.

To assess stormwater management needs generated by the Preferred Development Alternative, portions of the facility planned for future development or redevelopment were divided into 16 work areas. The HIO SMP provides a Preferred Stormwater Alternative for the 16 work areas (see Figure E-2). This SMP includes cost estimates and concept designs for 10 of the 16 work areas, allowing the Port to plan and budget for the design and implementation of the stormwater infrastructure to accommodate the Preferred Development Alternative or similar development. In addition to planning stormwater infrastructure to serve future development of the site, the HIO SMP recommends replacement of storm sewer assets based on useful life expended and upsizing of capacity-limited storm sewers. See Table E-1 for a summary of the known cost estimates for recommended stormwater investments.

The HIO Master Plan is a development planning tool for HIO. Actual development at the HIO facility may proceed differently than proposed due to future changes to regulations, development scenarios, private investment priorities, and public agency funding availability. As a result, actual implementation of this SMP may also vary depending on the factors described above. As development projects at HIO are further defined, the associated stormwater facilities will be subsequently refined based on new information and under then-current regulations.

The LOC between the Port, the City, and CWS documents the Port's commitment to develop a SMP which would provide a facility-wide approach to treating stormwater and result in reaching 100% water quality treatment of impervious surfaces faster than a project by project approach. This SMP provides a

path forward in supporting the HIO Master Plan and identifying where proactive stormwater projects would accelerate progress towards the goal of 100% water quality treatment.

Figure E-1 HIO Master Plan Preferred Development Alternative (Figure 5AA from the HIO MP) (Port of Portland, 2020)

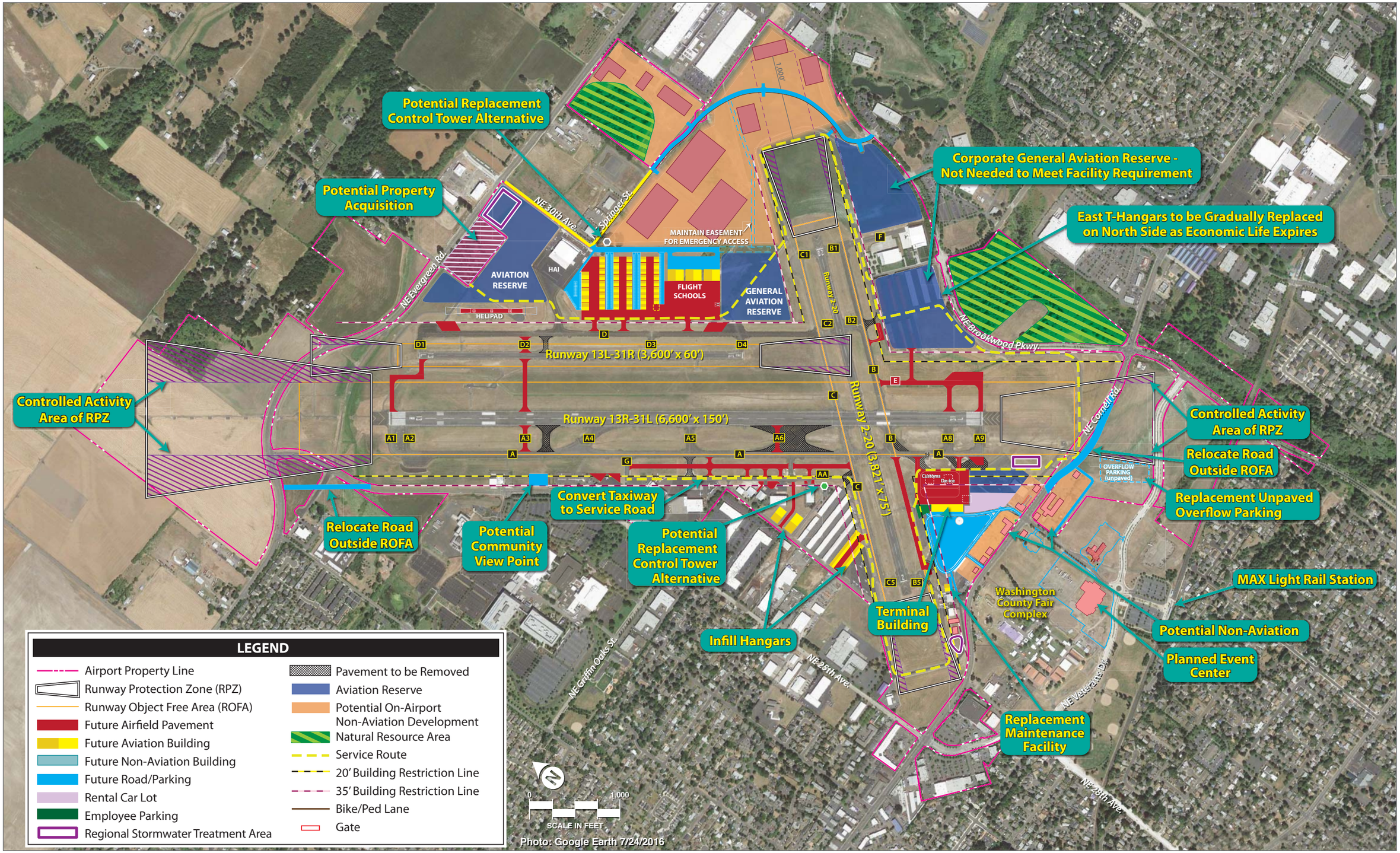

FIGURE E-2

PREFERRED STORM-WATER ALTERNATIVE

HILLSBORO AIRPORT SMP

PORT OF PORTLAND
HILLSBORO, OREGON

MAP EXPLANATION

Work Area 1
Helipad (L13), Twy to Rwy 13 Thresholds (L26, not shown)

Modified Landscape Filter Strip and Underground Detention
Water Quality: Met
Hydromodification: Met
LIDA: Met
No CIP Fact Sheet

Work Area 2
Flight School and Others (L7, L10, L11 (portion), L12, L15)

Extended Dry Basin
Water Quality: Met
Hydromodification: Met
LIDA: Met

Work Area 3
NE 30th Improvement & Springer St. Extension (S2, S3, S4, L1, L2)

Street-Side Planters
Water Quality: Met
Hydromodification: Met
LIDA: Met

Work Area 15
Vehicle Service Route (L11 (portion), L14 (portion))

Permeable Pavement
Water Quality: Met
Hydromodification: Met
LIDA: Met
No CIP Fact Sheet

Work Area 16
Untreated impervious

Modified Landscape Filter Strip
Water Quality: Met
Hydromodification: N/A
LIDA: N/A
No CIP Fact Sheet

Work Area 4
Existing Hangars, Untreated Impervious

Proprietary Underground Treatment
Water Quality: Met
Hydromodification: N/A
LIDA: N/A

Work Area 5
Taxiway E (south) and B2 Improvements, VSR (L4, L5, L14)

Modified Landscape Filter Strip and Underground Detention
Water Quality: Met
Hydromodification: Met
LIDA: Met

Work Area 14
NE 25th Street Realignment (I12)

Street-side Planters
Water Quality: Met
Hydromodification: Met
LIDA: Met
No CIP Fact Sheet

Work Area 6
Cornell Road Realignment (I13)

Underground Detention and Proprietary Underground Treatment
Water Quality: Met
Hydromodification: Met
LIDA: Impractical due to Wildlife Boundary
No CIP Fact Sheet

Work Area 13
Community View Point (L34)

Rain Garden
Water Quality: Met
Hydromodification: Met
LIDA: Met
No CIP Fact Sheet

Work Area 7
Southwest Terminal, Rental Car Parking and others (I2, I3, I5, I6, I7, I8, L6, L18, L19, L20, L23, L30)

Underground Detention and Proprietary Underground Treatment
Water Quality: Met
Hydromodification: Met
LIDA: Impractical due to Wildlife Boundary

Work Area 12
Taxiway AA projects (L25)

Modified Landscape Filter Strip and Underground Detention
Water Quality: Met
Hydromodification: Met
LIDA: Met

Work Area 10
Taxiway B Improvements (L17)

Modified Landscape Filter Strip and Underground Detention
Water Quality: Met
Hydromodification: Met
LIDA: Met

Work Area 11
Infill Hangers, Vehicle Service Road (S7, I16, L35), Replacement Control Tower and Untreated Impervious

Underground Detention and Proprietary Underground Treatment
Water Quality: Met
Hydromodification: Met
LIDA: Impractical due to Wildlife Boundary

Work Area 9
Maintenance Facility and Taxiway B (L28, L33) and Untreated Impervious

Underground Detention and Proprietary Underground Treatment
Water Quality: Met
Hydromodification: Met
LIDA: Impractical due to Wildlife Boundary
Note: private redevelopment is not addressed

Work Area 8
Connect Phase II Loop Road (L31) and Existing Untreated Impervious

Proprietary Underground Treatment
Water Quality: Met
Hydromodification: Fee in Lieu
LIDA: Impractical due to Wildlife Boundary
Note: private redevelopment is not addressed

Existing Conditions
- Contours
- Streams
- Taxlots
- HIO Property Line
- HIO RPZ
- HIO Primary Wildlife Boundary
- HIO Wetlands
- Existing Treated Impervious Surfaces
- Existing Untreated Impervious

Future Conditions
- New Building
- New Impervious

Preferred Stormwater Alternative
- CIP Work Areas (various colors)

Work Area #
HIO Master Plan projects within Work Area (S# (short-term projects), I# (intermediate-term projects), L# (long-term projects)

Stormwater Management Approach
List of Requirements Met

0 500 1,000 2,000 Feet

Date: 5/1/2023
Disclaimer: This data is not to survey accuracy and is meant for planning purposes only.

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Table E-1 Summary of Recommended Stormwater Project Costs

Work Area	Stormwater CIP Project*	Conveyance Capacity Project	Asset Replacement?	Sum of Estimated Costs
1	n/a	n/a	No	Not Estimated
2	2	n/a	No	$7,619,300 to $8,466,300
3	3	n/a	No	$5,836,500 to $6,734,500
4	4	n/a	No	$687,200 to $742,200
5	5	C3	Yes	$2,012,800 to $2,294,800
6	n/a	n/a	Yes	$42,250, stormwater improvements for Cornell Road realignment not estimated
7	7	n/a	Yes	$7,790,500 to $8,649,500
8	8	n/a	Yes	$956,650 to $991,550
9	9	n/a	Yes	$787,750 to $879,050
10	10	n/a	No	$481,800 to $555,900
11	11	n/a	Yes	$1,592,700 to $1,824,700
12	12	n/a	Yes	$2,012,070 to $2,279,070
13	n/a	n/a	No	Not Estimated
14	n/a	n/a	No	Not Estimated
15	n/a	n/a	No	Not Estimated
16	n/a	n/a	No	Not Estimated
Standalone		C2	No	Not Estimated
Standalone		C3	No	Not Estimated
Standalone		n/a	A-A	$64,810
Standalone		n/a	A-B	$355,960
Standalone		n/a	A-C	$231,560
Standalone		n/a	A-D	$21,400
Standalone		n/a	A-E	$186,880
Standalone		n/a	A-F	$604,750
Sum of Cost Estimates				**$31,284,880 to $34,925,180**

**Stormwater projects outside of a work area or that do not have an associated HIO Master Plan project were not given a CIP number.*

Section 1. Introduction

This Stormwater Master Plan (SMP) for HIO identifies how the Port plans to comply with stormwater regulations, including commitments to Clean Water Services (CWS), which is the Washington County stormwater utility, and the City of Hillsboro (City). The objective of this planning process is to develop a phased implementation approach that matches the proposed development needs of the HIO Master Plan. Any Stormwater Management Approaches (SMAs) were evaluated against federal standards for aviation safety. This process identifies potential development mitigation and infrastructure risks, such as conveyance capacity, aging infrastructure, and treatment of new and existing impervious areas.

Overview of Hillsboro Airport

HIO is located in the City of Hillsboro, Washington County, Oregon and is owned and managed by the Port, a regional government agency. HIO is the second busiest airport in Oregon and is home to local corporate flight departments, aircraft charter services, flight schools, aircraft maintenance and repair operations, and corporate air shuttle service. HIO is approximately 963 acres and has three all-weather capable runways. The primary runway (13R/31L) can accommodate most general aviation aircraft; the crosswind runway (2/20) can accommodate smaller single and multi-engine piston powered aircraft; and the third runway (13L/31R) accommodates local training activity. The Federal Aviation Administration (FAA) classifies HIO as a general aviation reliever airport.

Stormwater from HIO drains to two watersheds. McKay Creek, which includes Glencoe Swale, drains the northern portion of the airport, and Dawson Creek drains the southern portion of the airport. Both creeks are part of the Tualatin River watershed. There are seven major drainage basins at HIO that discharge directly to surface water or to City storm sewers.

Hillsboro Airport Master Plan

The FAA recommends that airports update their long-term planning documents every seven to ten years, or as necessary, to evaluate airport capabilities and role, to forecast future aviation demand, and to plan for timely development of improved or new facilities to meet that demand. The HIO Master Plan was updated and approved by the FAA in 2020 and addresses aviation demand while considering potential environmental impacts (Port of Portland, 2020). The HIO Master Plan results in a 20-year forecast of facility and infrastructure development needs.

The HIO Master Plan classifies facilities as either airside, which support the active movement of aircraft, or landside, which support maintenance and passenger services. The HIO Master Plan identifies facility requirements from aviation demand forecasts, a review of design standards, facility maintenance needs, and an evaluation of support facilities. The Preferred Development Alternative includes these priorities:

- Continue focus as a general aviation airport (commercial service is not expected over the next 20 years).
- Replace current terminal building on Cornell; redevelop the terminal area and improve access.
- Maintain current runway lengths and widths, which provide capacity for expected levels of demand.
- Reconfigure some taxiways to improve efficiency and meet current FAA design criteria.
- Prioritize T-hangar and development to the north side of the airport.
- Relocate flight schools to the north quadrant of the airport.
- Preserve space for additional T-hangars and corporate aviation facilities in the north and east quadrants.

Figure 1 shows the Preferred Development Alternative, including future development, pavement that will be removed, natural resource areas, and safety considerations. Figure 2 shows the phasing of future development: short term projects (anticipated within 1-5 years), intermediate term projects (anticipated within 6-10 years), and long-term projects (anticipated within 11-20 years). These projects and their time frames are estimated based on the date of approval of the current HIO Master Plan and will be re-evaluated with subsequent updates. Implementation of the HIO Master Plan is dependent on economic factors, and each stormwater project is similarly dependent on HIO Master Plan implementation and external factors. Each stormwater project will be re-evaluated for current regulatory requirements and design standards at the time of implementation.

Letter of Commitment

During permitting for the HIO Runway 13R-31L Rehabilitation project in 2019, the Port committed to developing a SMP for HIO that would evaluate stormwater mitigation alternatives and stormwater infrastructure needed to address the development that would be identified in the updated HIO Master Plan, which was under development at that time. This commitment was documented in a Letter of Commitment (LOC) that the Port submitted to CWS and the City (Port of Portland, 2019). The LOC summarizes the schedule and approach to develop a SMP that addresses control, water quality treatment, and/or mitigation of stormwater for both existing and new impervious surfaces at HIO. The LOC confirms the Port's commitment to meeting the CWS standard that requires water quality treatment for all new impervious area and three times for any modified impervious area (3:1 mitigation requirement); see §4. 08. 1. d of the CWS Design and Construction Standards (CWS D&C) (CWS, 2019) and the discussion of CWS regulations on page 12 for more information about the 3:1 mitigation requirement. Until the SMP is complete, the Port committed to the following interim steps:

- Development or redevelopment projects would be subject to current stormwater design standards.
- Runway and taxiway projects would be treated at a 1:1 ratio by using vegetated filters strips.
- The Port would regularly report progress towards completing the SMP, stormwater treatment requirements for the airfield, and annual submittal of an impervious area treatment status map (see Figure 3 for the treatment status map).

The LOC also confirms that the SMP will develop a process for keeping track of impervious surfaces that need treatment in conjunction with development that triggers the 3:1 water quality mitigation requirement Implementation of the SMP will result in treatment of 100% of impervious surfaces if the Preferred Development Alternative or a similar level of development occurs over the HIO Master Plan 20-year time frame.

Figure 1 HIO Master Plan Preferred Development Alternative (Figure 5AA from the HIO MP) (Port of Portland, 2020)

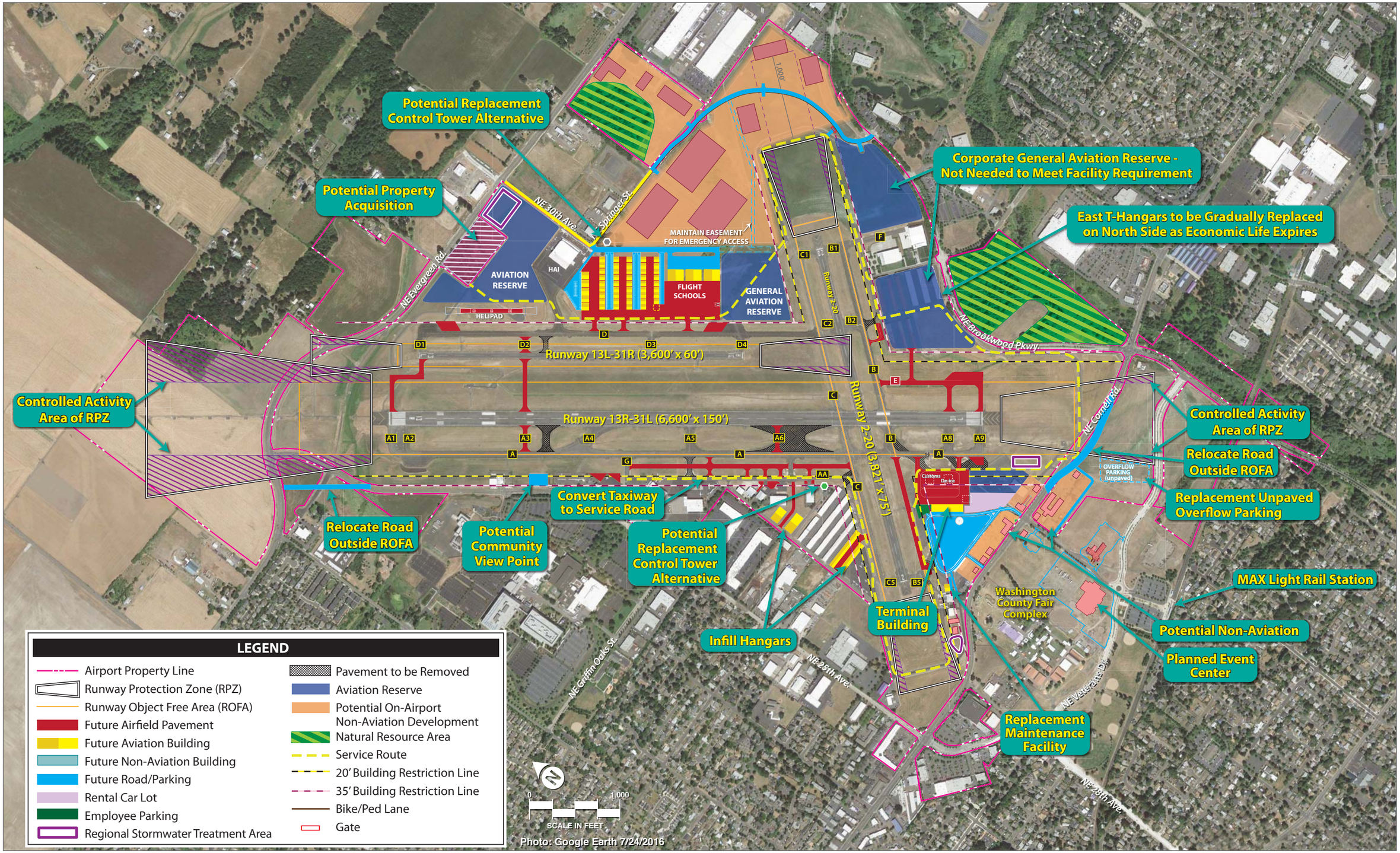


Figure 2 HIO Master Plan Development and Infrastructure Project Phasing (Figure 6B from the HIO MP) (Port of Portland, 2020)

SHORT TERM PROJECTS (1-5 YEARS)

1. Comprehensive Environmental Assessment (EA) -*NP*
2. Widen NE 30th Avenue
3. Widen/Extend NE Springer Street
4. Intersection Improvements at 30th & Evergreen
5. Industrial Development - Enabling Infrastructure (S of Springer St)
6. Industrial Development - Enabling Infrastructure (N of Springer St)
7. Infill Hangar - South
8. Redevelop Hotel
9. Construct Crossfield Twy and Remove Existing Twy A3 and D2

INTERMEDIATE TERM PROJECTS (6-10 YEARS)

1. Comprehensive Environmental Assessment (EA) -*NP*
2. Terminal Building Construction with Phase I Loop Road from 34th Avenue
3. Construct Terminal Apron
4. Construct Regional South Stormwater Treatment Area
5. Construct Rental Car Parking (Phase I)
6. Construct Phase I Parking for New Terminal Building
7. Re-purpose "Mushroom" Building as Possible EV Charging Station and Decommission Tanks
8. Construct Employee Parking
9. Relocate Existing Beacon
10. Remove Existing Terminal Building - *NP*
11. Twy A6 Improvements
12. Relocate NE 25th Including Right-of-Way Swaps and Acquisition
13. Relocate Cornell Road Including Right-of-Way Swaps
14. Construct Single Story Commercial Retail (Middle Parcel)
15. Airport Entrance Monument
16. Infill Hangars - North

LONG TERM PROJECTS (11-20 YEARS)

1. Extend Springer Street to Brookwood Pkwy
2. Intersection Improvements at Springer St & Brookwood Pkwy
3. Industrial Development - Enabling Infrastructure (East Toward Brookwood)
4. Construct South Portion of Twy E
5. Twy B2 Relocation
6. De-icing/Wash Rack/Rental Car Prep
7. Construct North Side Taxilane and Enabling Infrastructure (Phase I)
8. Construct Regional Northeast Water Quality Facility
9. Runup Pad Construction on Twy D
10. NE 30th Extension to Flight School
11. Vehicle Service Route (VSR) Construction
12. Flight School Apron Fuel Island
13. Helipad Construction
14. Construct VSR from Springer to T-hangars and Add Gate
15. Construct North Side Taxilane and Enabling Infrastructure (Phase II)
16. Remove T-Hangars
17. Extend Twy B and Remove Pavement
18. Remove Hillsboro Aero Academy Hangars and Ramp
19. Construct Rental Car Parking (Phase II)
20. Apron Connectors and Pavement Removal
21. Remove 3301 Hangar - *NP*
22. Remove Sheepspen Hangar (3301-A) - *NP*

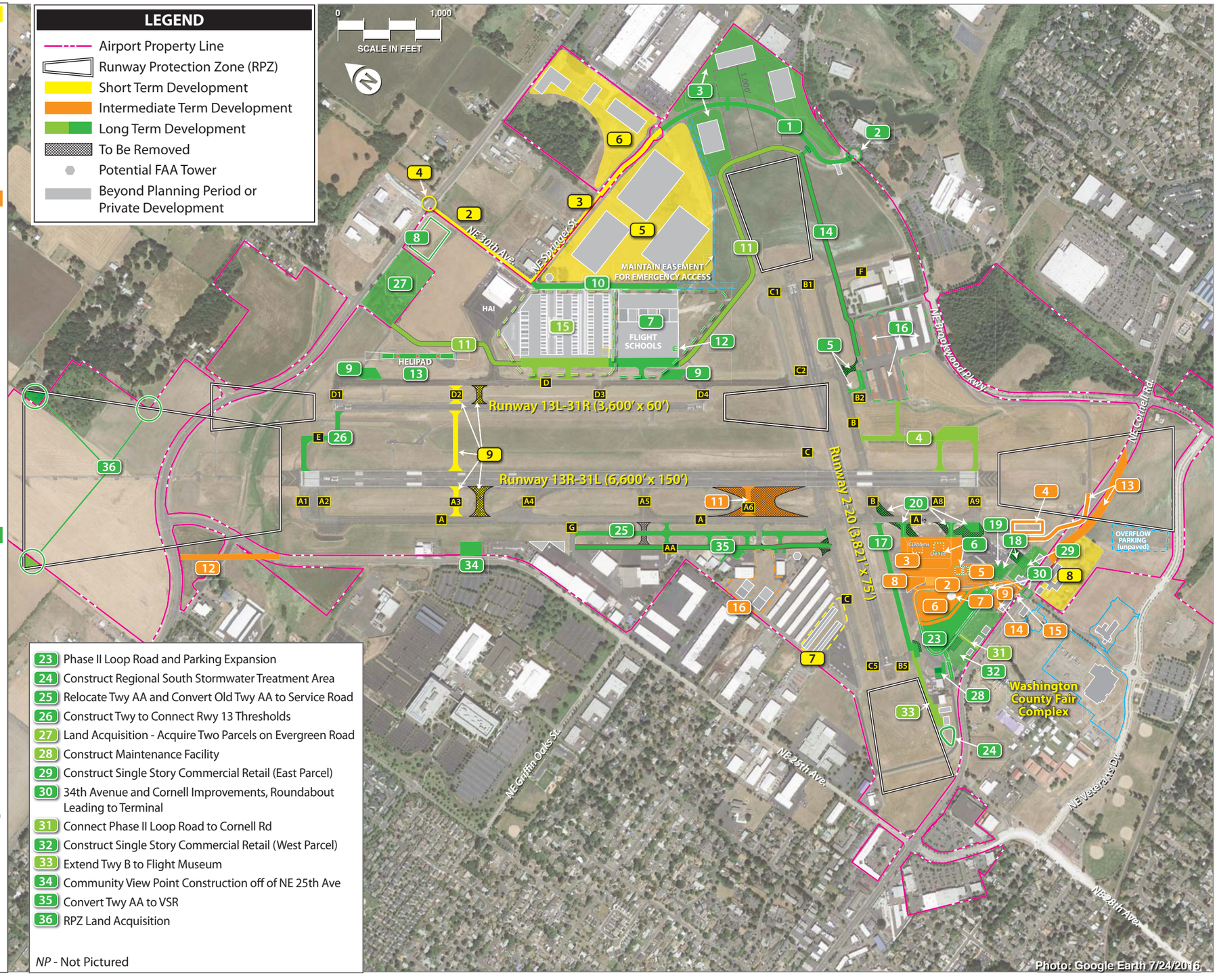
LEGEND

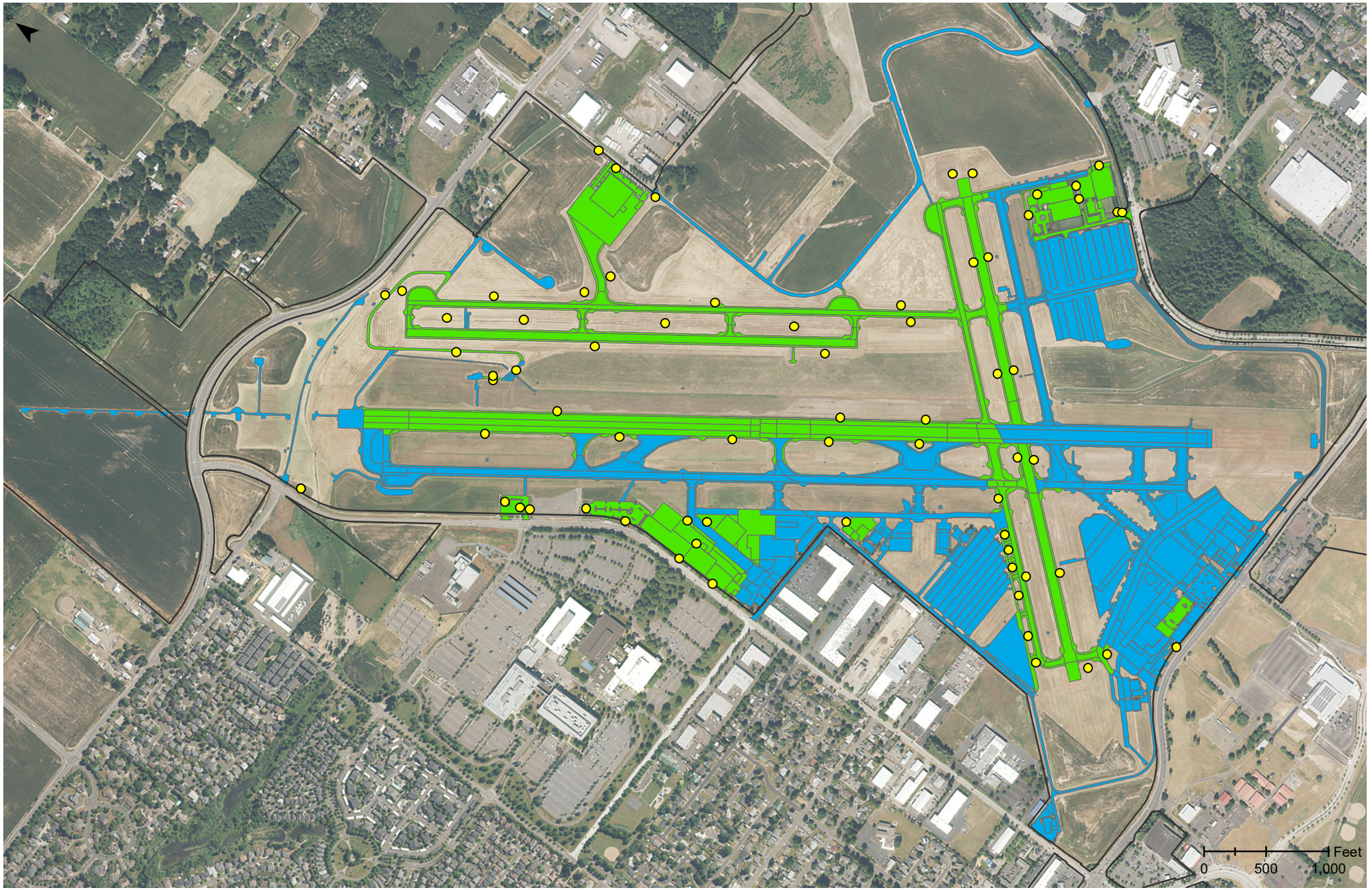
- Airport Property Line
- Runway Protection Zone (RPZ)
- Short Term Development
- Intermediate Term Development
- Long Term Development
- To Be Removed
- Potential FAA Tower
- Beyond Planning Period or Private Development

0 1,000 SCALE IN FEET

23. Phase II Loop Road and Parking Expansion
24. Construct Regional South Stormwater Treatment Area
25. Relocate Twy AA and Convert Old Twy AA to Service Road
26. Construct Twy to Connect Rwy 13 Thresholds
27. Land Acquisition - Acquire Two Parcels on Evergreen Road
28. Construct Maintenance Facility
29. Construct Single Story Commercial Retail (East Parcel)
30. 34th Avenue and Cornell Improvements, Roundabout Leading to Terminal
31. Connect Phase II Loop Road to Cornell Rd
32. Construct Single Story Commercial Retail (West Parcel)
33. Extend Twy B to Flight Museum
34. Community View Point Construction off of NE 25th Ave
35. Convert Twy AA to VSR
36. RPZ Land Acquisition

NP - Not Pictured





Treated Impervious Surface

Untreated Impervious Surface

Stormwater Treatment Facility

HIO Boundary

Impervious Surfaces	Acres
Treated	83
Untreated	118
Total Impervious	201
Percent Treated	41%

Port of Portland
Hillsboro Airport

Impervious Surface Stormwater Treatment Tracking- 2022
Figure 3

Stormwater Master Plan

This HIO SMP presents future stormwater conveyance and infrastructure needs for development and redevelopment of airport facilities in a way that meets regulatory requirements for water quality and hydromodification mitigation. This SMP is also intended to determine the best approach to address future regulatory and infrastructure requirements. Each future HIO Master Plan update will require re-evaluating and updating the SMP to address changes to regulations and future development scenarios and timeframes.

This HIO SMP comprises six sections, including this introduction. Section 2 summarizes current regulatory requirements, including stormwater requirements, FAA design and safety requirements, and design standards. Section 3 summarizes the existing conditions at HIO and includes references to other reports that summarize stormwater data. Section 4 discusses stormwater conveyance and management alternatives to address future development, including selection of the Preferred Stormwater Alternative. Section 5 provides an overview of stormwater assets, including an analysis of asset age and likely replacement cost. Section 6 identifies stormwater projects and their likely phasing, similar to the HIO Master Plan phased approach to development. Appendix A contains fact sheets for a selection of recommended stormwater capital improvements. Appendix B contains a list of draft reports that were produced in the development of this SMP. Appendix C contains an impervious area and water quality tracking spreadsheet and associated map, and Appendix D contains an HIO Project Coordination Checklist.

The approach to creating this HIO SMP includes regulatory review, data discovery, and a planning and engineering assessment and evaluation.

Limitations of the Hillsboro Airport Stormwater Master Plan

The HIO SMP provides the Preferred Stormwater Alternative for serving a proposed future condition presented in the HIO Master Plan. The actual development of the site may differ from the proposed future condition, and implementation of supporting stormwater infrastructure will need to adjust from this plan to accommodate the actual development. This SMP identifies planning-level costs conservatively so that the Port is able to plan and budget for the design and implementation of stormwater infrastructure to accommodate future development even if it differs from the Preferred Development Alternative.

Recommended stormwater improvements serve Port facilities. The plan does not directly plan for water quality, hydromodification, or Low Impact Development Approach (LIDA) stormwater controls for expected private or tenant non-aviation development on the HIO site. The Port expects private parties and tenants to plan for and construct appropriate stormwater management at the time of development. The SMP does directly plan for Port conveyances, which have been sized to accommodate future discharges from expected private development.

The SMP does not provide detailed stormwater management solutions for every proposed development, and conveyance infrastructure smaller than 12-inch diameter has been omitted from analyses. In addition, it also does not address stream flooding or standing water from stream backwater, natural ponds, or wetlands.

The SMP relies on asset data such as diameter, materials, age, and elevations in the Port's geographic information system (GIS). Significant data gaps such as invert elevations and materials exist for many older facilities, which are not addressed in the plan.

Groundwater levels and infiltration rates at HIO are based on assumptions made considering limited available quantitative data. Port staff provided qualitative historical records of areas where ponding is known to occur. Observed ponding at various locations indicates high groundwater and/or low infiltration rates. The consultant team's assumptions have been used in the modeling analysis and capital improvement program (CIP) projects and will require geotechnical studies during project design to confirm actual conditions.

In order to develop planning-level cost estimates for CIPs, the team has evaluated current regulatory requirements and design standards. It is anticipated that regulatory requirements and design standards will change over the course of the 20-year phased implementation timeframe. The Port will re-evaluate regulatory requirements and design standards at the time of project design and implementation.

The Port categorizes the accuracy of scope and the level of engineering as part of project management oversight (Port of Portland, Revised 8/22). The recommended CIP projects in this SMP are categorized as conceptual (Level 2 Scope Accuracy: Level B Engineering Effort). This SMP includes planning-level recommendations that will need to be revisited and updated at the time of design. The Port expects stormwater management solutions and designs to change as individual projects are implemented.

Section 2. Regulatory Requirements

Stormwater management at HIO is subject to a variety of regulations at the federal, state, and local levels. Additionally, there are FAA policies that affect the design of future stormwater facilities. These regulations and policies are likely to be updated over the implementation of the HIO Master Plan and the HIO SMP. All stormwater facilities will need to meet the regulatory requirements, policies, and design standards in place at the time of project implementation. This section provides a snapshot of regulatory requirements in place at the time of HIO SMP development.

Clean Water Act

The federal Clean Water Act (CWA) is the 1972 law that regulates the discharge of pollutants to navigable waters of the United States. It establishes several programs administered by the Environmental Protection Agency (EPA) to oversee such discharges. These programs are delegated to some states to implement through state regulations. In Oregon they are administered by DEQ.

Total Maximum Daily Loads

The CWA regulates pollutants that can enter impaired water bodies through Section 303(d) of the Act. DEQ lists both Lower Rock Creek and Lower McKay Creek on the Section 303(d) list of impaired water bodies. Total Maximum Daily Loads (TMDLs) have been established in both creeks for Dissolved Oxygen and E. coli. Both creeks are within the Tualatin River Subbasin, which has TMDLs for the following parameters:

- Dissolved Oxygen (Ammonia)
- Chlorophyll A (Phosphorus)
- Bacteria (E. coli)
- Temperature
- Mercury (as part of the Willamette Basin Mercury TMDL, which applies to all perennial and intermittent streams in the basin)

Limitations on discharges of these pollutants are incorporated into other permits that impact HIO as described below.

National Pollutant Discharge Elimination System

The National Pollutant Discharge Elimination System (NPDES) section of the CWA authorizes new and existing discharges of stormwater to receiving waters. In Oregon, the Department of Environmental Quality (DEQ) issues these permits. There are several types of NPDES permits that regulate discharge of stormwater from HIO and directly impact placement and design of stormwater facilities.

1200-Z Permit

DEQ issues NPDES 1200-Z general permits to industrial facilities that discharge or may discharge stormwater to surface water or to conveyance systems that discharge to surface water. DEQ delegates administrative responsibilities for 1200-Z permits within the CWS service area to CWS. HIO, which includes air transportation facilities, vehicle maintenance, equipment cleaning operations, and de-icing operations, holds a 1200-Z permit from DEQ (DEQ, 2021). CWS re-issued the five-year HIO 1200-Z permit on July 1, 2021. The 1200-Z permit is issued to the Port and applies to Port and tenant activities at HIO. The 1200-Z permit requires monitoring to ensure compliance with water-quality based effluent limitations.

These monitoring parameters include:

- Total Copper
- Total Lead
- Total Zinc
- pH
- Total Suspended Solids (TSS)

The permit also established sector specific benchmarks and monitoring requirements for Air Transportation (Sector S) for the following constituents:

- Biological Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD)
- Ammonia
- pH

These water quality benchmarks and monitoring requirements were drawn from 303(d) listings and approved TMDL Waste Load Allocations (WLAs). As part of 1200-Z permit compliance, the Port creates and submits a Stormwater Pollution Control Plan (SWPCP) to CWS that identifies all discharge points and monitoring locations and includes operations and maintenance plans for all stormwater management and treatment facilities. The 1200-Z permit also includes inspection and reporting requirements.

Any construction of new stormwater facilities would require updating the SWPCP to reflect current conditions.

1200-CA Permit
The 1200-CA is a general stormwater discharge permit issued to select public agencies. The 1200-CA covers all Port CIPs that disturb one acre or more. The 1200-CA permit requires the development and submittal of an Erosion and Sediment Control Plan (ESCP) prior to the start of construction. Projects that disturb five acres or more must submit ESCPs for public comment. The ESCP demonstrates how the site will implement Best Management Practices (BMPs) to prevent and control erosion and sedimentation. The City also requires BMPs and additional erosion control requirements (see Design Standards, below).

Municipal Separate Storm Sewer System (MS4) Permit
The MS4 permit authorizes discharge of municipal stormwater to surface waters and establishes conditions for compliance. Stormwater discharges from sites such as HIO that connect to a municipal storm system or outfall to a surface water within a regulated jurisdiction are also regulated. Please see more about the CWS MS4 permit on page 12.

Federal Aviation Administration

The FAA is responsible for the safety of aviation activities in the air and on the ground and supports the development and construction of aviation facilities to meet current and future needs. The FAA also provides grant funding for some capital projects at airports. When airport owners accept FAA funds, they must agree to the obligations of the funding, known as “grant assurances.” These grant assurances include a variety of conditions regarding safety and operations and maintenance, and may be attached to restrictive covenants or property deeds. Grant assurances may last for decades beyond the completion of capital improvements. The grant assurances incorporate by reference the current FAA Advisory Circulars (ACs), which include guidance and policy statements on a variety of topics, including design of airport facilities and safety. The list of current FAA ACs is updated regularly and will need to be evaluated at the time of project design. Since the Port receives funding from the FAA, the Port must maintain and operate

HIO and plan for any development so that it stays in compliance with its grant assurances and the current FAA ACs.

Wildlife Management

The FAA AC *Hazardous Wildlife Attractants on or Near Airports* (FAA, 2020) requires that any airport, such as HIO, that serves turbine-powered aircraft to have a 10,000-foot buffer zone between the airport operations area (AOA) and any new land uses that are not compatible with safe air operations, such as municipal solid waste landfills, wastewater treatment facilities, and wetland mitigation projects. However, existing land uses within this zone, such as stormwater detention facilities, may be acceptable if they are not attracting wildlife, or if they are modified to eliminate the attractiveness to wildlife species that can be hazardous to aviation. Where feasible, the FAA states a maximum 48-hour detention period for the design storm, allowing any detention basins to remain dry between wet weather events. The FAA additionally recommends the use of physical barriers for wildlife, especially when the 48-hour detention period is not feasible for existing stormwater management features. The FAA highly recommends use of underground stormwater infiltration systems when feasible since their components typically reduce attraction of hazardous wildlife.

The Port has proactively developed and obtained FAA approval of the HIO Wildlife Hazard Management Plan (WHMP), last updated in 2015 (Port of Portland, 2015). The WHMP defines the following two zones within the context of wildlife management:

- Primary Zone – The area within the airfield perimeter fence, a 300-foot buffer around the perimeter fence, and the runway protection zones (RPZs). The Port's objective within this zone is to eliminate or reduce to the extent practicable all attractants for wildlife species of concern that occur there, and to not allow any new attractants to be located in this zone.
- Secondary Zone – All land, not within the Primary Zone, that falls within a 10,000-foot offset from the AOA. Per the FAA definition of this zone, land uses within the zone must be compatible with safe aircraft operations and should not create new attractants for wildlife species of concern that result in unacceptable risks. Lands in the Secondary Zone include private land not owned by the Port.

The airfield perimeter fence was used as a proxy for these zones related to stormwater management. The WHMP states that stormwater detention basins should be located and designed according to requirements of the *Hazardous Wildlife Attractants on or Near Airports* FAA AC. The WHMP also provides design requirements for other constructed water features, culverts that pass under the perimeter fence, and vegetation selection for turf areas. The WHMP, in responding to the FAA AC, may limit placement and selection of stormwater facility types in order to reduce risk posed by wildlife to airport operations.

Airport Design

The FAA AC *Airport Design* (FAA, 2022) defines several on-airport operational zones that provide for the safety of airfield operations and limit risks to both passenger and public safety. The following zones may impact the selection, layout, and design of stormwater management facilities and must be considered during the stormwater planning and design process:

- Runway Safety Area (RSA) – The defined ground space surface that includes and surrounds the runway and is prepared for the express purpose of reducing damage to aircraft in the event of an undershoot, overshoot, or excursion from the runway surface. Pertinent design standards include:
  - No potentially hazardous ruts, humps, depressions, and other surface variations.
  - Drained by grading or storm sewers to prevent water accumulation.

  - Free of objects, except those needed because of their function (as an example, manholes should be constructed at grade and be capable of supporting loads).
- Apron Area (AA) – The area of an airport used or intended for use to accommodate aircraft during loading and unloading of passengers or cargo, fueling, maintenance, and short/long-term parking. The following drainage considerations are advised:
  - Linear trench drains or slot drains are often employed to accommodate the flat slopes used on aprons.
  - Use oil/water separators to avoid fuel and oil spill entry into the drainage system.
- Runway Protection Zone (RPZ) and Protected Airspace (PA) – The trapezoidal-shaped ground area off the runway end that enhances the safety and protection of the public by controlling the land uses and eliminating incompatible objects and activities. This PA is a family of related three-dimensional airspace surfaces designed to provide obstacle clearance to arriving and departing aircraft. Pertinent allowed land uses in the RPZ include:
  - Irrigation channels that meet requirements of AC 150/5200-33 and the WHMP.
  - Underground facilities that meet other applicable design criteria, such as RSA requirements.

Each of these operational zones has provided guidance as it relates to stormwater management; for simplification of figures and other graphics in the SMP, only the RPZ is shown. There are a number of locations at HIO that are out of compliance with current FAA ACs. The RSA north of the Runway 13R threshold is out of compliance with current FAA design standards as a result of a drainage ditch that traverses the area. Alternatives to bring the RSA up to current design standards are the subject of a separate Environmental Assessment (EA) and the Runway Safety Area project will be constructed in the summer of 2023. HIO has incompatible land uses within its RPZs, but as there are no anticipated changes to the RPZ, there is no need to resolve current incompatibilities at this time. As opportunities arise to clear the RPZ, the Port will pursue and/or support those.

Stormwater Design Standards

FAA, CWS, and the City have requirements for conveyance and drainage systems. Both CWS and the City have stormwater requirements and design standards for development and construction projects that create impervious area or create downstream impacts. The requirements and standards are evaluated during permit review; individual project permits may vary based on project location, scale of development, stormwater conveyance ownership or maintenance, and other local requirements. Individual projects will be re-evaluated using design standards and regulatory requirements in place at the time of design.

Airport Drainage and Construction Design

The FAA AC *Airport Drainage Design* (FAA, 2013) provides guidance for the design and construction of airport surface storm drainage systems and subsurface drainage systems for paved runways, taxiways, and aprons. There are a number of FAA ACs that provide standards and construction guidance, including:

- *Airport Pavement Design and Evaluation* (FAA, 2017), which defines required methods for design and evaluation of airport structural and shoulder pavements used by aircraft.
- *Standards Specifications for Construction of Airports* (FAA, 2018), which details material requirements and methods used for construction of airport operating surfaces and subgrades, including site drainage.
- *Guidelines and Procedures for Maintenance of Airport Pavements* (FAA, 2014), which describes the impact of surface drainage approaches and practices on pavement maintenance.

Clean Water Services

DEQ issues NPDES permits to municipalities and service districts to manage stormwater from urban areas, commonly referred to as the Municipal Separate Storm Sewer System (MS4) permits. CWS holds a watershed-based NPDES permit that authorizes stormwater discharges from urban areas of the Tualatin River watershed to the Tualatin River and its tributaries. The stormwater discharge from Hillsboro's drainage system is included in this watershed-based permit. Hillsboro, along with the County and several other cities, is a co-implementer of the permit. The HIO site is subject to rules and regulations implemented by CWS in response to its NPDES permit. The CWS NPDES permit requires CWS to implement stormwater management requirements for new construction and development. These requirements are addressed through the CWS D&C, most recently updated in 2019 to address hydromodification requirements and mitigation (CWS, 2019). The current five-year permit was issued in late 2022 and will likely lead to additional updates to the CWS D&C in 2024 (DEQ, 2022). All development projects at HIO will need to comply with CWS requirements for water quality treatment, LIDA, quantity control for conveyance capacity, and hydromodification mitigation in place at the time of design.

The 2019 CWS D&C requirements include:

- Water quality treatment is required for development that creates or modifies 1,000 square feet or greater of impervious surface or that increases the amount of stormwater runoff leaving the site. Modification occurs when impervious surfaces are removed to expose gravels or soil and then replaced by new impervious surfaces. Repair and maintenance activities are not considered modification. Water quality treatment must be designed to remove 65% of total phosphorus. If water quality treatment is demonstrated not to be feasible, a fee-in-lieu may be paid.
- For projects that trigger the water quality treatment requirement, the stormwater management facility must be sized to manage runoff from all new impervious surfaces as well as three times the amount of modified impervious surface created by the project. The requirement to treat three times the amount of modified impervious surface is a retrofit requirement and is colloquially known as the 3:1 mitigation requirement.
- Quantity control is required when the project creates impacts to the downstream conveyance system. Quantity control can be achieved by construction of on-site detention facilities, improvement of the downstream conveyance system, or payment of a Stormwater Quantity System Development Charge (SDC).
- Hydromodification mitigation is required for development that creates or modifies 1,000 square feet or greater of impervious surface or that increases the amount or rate of stormwater leaving the site. Hydromodification assessments are required for projects that add or modify 12,000 square feet or more of impervious surface. Requirements differ depending on the hydromodification risk level of the receiving surface water body and the type and size of the development. See Figure 4 for the hydromodification risk levels of streams that receive stormwater runoff from HIO. Hydromodification requirements vary by project and site criteria, but in general, can be met by using LIDA, detention facilities sized using peak-flow matching standards, detention facilities sized using flow duration curve matching standards, or payment of a hydromodification fee-in-lieu. The development project may choose to participate in an alternative approach within a CWS-approved stormwater subbasin strategy area. At the time of this HIO SMP, there are no CWS-approved subbasin strategies that include any portion of HIO.

CWS also publishes a LIDA Handbook (CWS, 2021) that has design guidance for stormwater facility types that use infiltration and/or vegetation. The CWS D&C and the LIDA Handbook contain detailed descriptions of the design and documentation requirements for stormwater facilities. The various

standards include required plantings associated with vegetated facilities and operations and maintenance guidelines for a wide range of facility types. The 2022 watershed-based permit prioritizes LIDA as the preferred method of stormwater treatment and control.

City of Hillsboro

The City has adopted the CWS D&C and also publishes its own D&C Standards (Hillsboro, 2018). All closed storm conveyance, treatment, and surface water management facilities must at a minimum meet the CWS D&C, and when the City standard is higher, the requirements of the City's D&C Standards. See Table 1 for a summary of current stormwater design criteria and an evaluation of which design standard is currently more restrictive.

The City adopted a SMP in 2021, which includes a new stormwater detention policy for areas slated for urban growth, such as annexation into the City or planned expansion areas. Any development that triggers CWS medium or large project hydromodification mitigation requirements within expansion areas is required to detain runoff from the 25-year storm (Hillsboro, 2021). Development in some areas of HIO will be subject to this requirement. Planning-level hydromodification facility sizes calculated for this HIO SMP will be sufficient to also manage runoff per the detention policy.

The City requires a grading and erosion permit for any project that disturbs more than 50 square feet or excavates and/or fills more than 20 cubic yards of material. These permit requirements will need to be coordinated with the DEQ 1200-CA permit requirements.

Figure 4

HYDROMODIFICATION RISK

HIO STORMWATER MASTER PLAN | 19442

HILLSBORO, OREGON

LEGEND

Hydromod Risk Levels
- Low
- Moderate
- High

- Expansion Areas
- HIO boundary
- Streams

0 500 1,000 2,000 Feet

Data Sources:
Date: 1/17/2022
Disclaimer: This data is not to survey accuracy and is meant for planning purposes only.

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Otak

Summary of Stormwater Design Criteria

While this HIO SMP identifies specific stormwater facility locations and uses current stormwater design standards to develop planning-level cost estimates, it is assumed that project criteria will be re-evaluated at the time of design to ensure compliance with the federal, state, and local requirements for stormwater while meeting FAA grant assurances and ACs. See Table 1 for a summary of current stormwater design criteria.

Table 1 Stormwater Design Criteria Summary

Stormwater Design Element	Design Storm	Calculation Methodology	Most Restrictive Jurisdiction
Water Quality Facilities	0. 36 inches of precipitation falling in 4 hours with an average storm return period of 96 hours	CWS specific equations for Water Quality Volume and Flow	CWS
Peak-Flow Matching Facilities (proposed conditions matching pre-developed conditions)	50% 2-year – 1. 25 inches in 24 hours 50% 2-year – 2. 5 inches in 24 hours 10-year– 3. 45 inches in 24 hours 25-year– 3. 9 inches in 24 hours	Analysis programs utilizing SBUH or TR-55 methodology or HYD. exe HEC-HMS, SWMM, and HYDRA	CWS
Hydromodification with Infiltration or Partial Infiltration LIDA	10-year– 3. 45 inches in 24 hours With a drawdown of 36 hours or less	Analysis programs utilizing SBUH or TR-55 methodology or HEC-HMS, SWMM, and TRUST	CWS
Conveyance Pipes	10-year through 50-year Varies depending on pipe location and purpose.	Rational Method, SBUH, TR-55, and SWMM	FAA and Port

Section 3. Existing Conditions

This section provides a summary of existing GIS data, hydraulic and hydrologic models, flow monitoring data, and water quality data. This information informs the existing and proposed conditions modeling as well as the Capital Improvement Projects (CIP) developed as part of the SMP. Appendix E of the HIO Master Plan provides additional information about environmental conditions (Port of Portland, 2020).

The consultant team received GIS data from the Port that included various storm sewer system components, discharge points and their respective drainage basins, impervious surfaces, long-term and short-term ponding areas, jurisdictional wetlands, the HIO property boundary, and elevation contours. The consultant team and Port staff made site visits to known locations of potential conveyance capacity limitations, such as localized flooding, to confirm site conditions and GIS records.

Site Conditions

Stormwater from the site discharges to Dawson Creek, Glencoe Swale, and the City's storm sewer system. The southern and eastern portions of the site drain to Dawson Creek, while the northern and western portions drain to Glencoe Swale. A small portion north of the intersection of NE Cornell Road and NE 25th Avenue drains to the City's storm sewer. Glencoe Swale crosses the northern portion of the site from east to west in proximity to airport operational areas, while Dawson Creek flows along the eastern boundary of HIO, east of Brookwood Parkway and adjacent to portions of the site that are disconnected from the main airport property by roadways.

The HIO storm system conveyances may be characterized as generally flat with low cover. Stormwater treatment is provided on the site through structural controls such as portable media filters, vegetated filter strips, vegetated swales, and underground filter vaults. The Port's SWPCP, developed as part of the HIO 1200-Z permit, identifies six drainage basins that encompass the industrial activity at HIO (Port of Portland, 2021). These basins were used as a starting point for modeling the HIO storm sewer system.

Hydrologic and Hydraulic Models

Information from prior modeling efforts were incorporated into the existing conditions model. In 2017, the City and Otak assessed hydraulic conditions in Glencoe Swale from the mouth to its headwaters, including the reaches flowing through HIO, in order to verify or correct a CWS 2006 floodplain modeling effort. Otak also produced a Hydrologic Engineering Center – River Analysis System (HEC-RAS) model of potential impacts to Glencoe Swale from proposed future conditions downstream of HIO in 2018. The study updated the hydrology using a Hydrological Simulation Program-FORTRAN (HSPF) model that was calibrated for the Tualatin River Basin and the McKay Creek sub-basin. Elements of this study were used to inform the modeling effort evaluating current conditions.

For the HIO SMP, the consultant team has developed a planning-level existing conditions hydraulic model using PCSWMM software, which runs the EPA Stormwater Management Model (SWMM), to identify capacity issues in the current storm system. The model has been developed from GIS data, previous models, and field observations. To simplify the analysis, the model inputs include pipes of 12-inch diameter or larger and portions of the storm sewer system that have been deemed non-essential for modeling have been omitted. Additional measures to simplify the model include developing planning-level drainage basins and system input points, consolidating intricate or branching areas of the storm sewer into a single inlet and pipe reach, removing certain inlets and connected laterals along long pipe reaches, and ignoring peripheral portions of the network that do not connect to the main storm sewer system. The

consultant team addressed and reconciled any data gaps needed to complete the model using assumptions. Assumptions are documented in the hydraulic modeling memo included in Appendix B.

Existing Conditions Model Results

For the purposes of assessing the existing conditions modeling results, flooding is defined as the hydraulic grade line exceeding the rim elevation of a given node. Flood time in hours during the 10-year event is used as a metric to define severity of flooding. The existing conditions model results indicate that at the 10-year recurrence interval, flooding is experienced at 14 locations spread throughout the existing stormwater system. The consultant team has evaluated all flooded locations carefully to identify if modeled flooding is a result of conveyance capacity deficiencies in the existing storm system.

Some of the flooding predicted by the existing conditions model may be attributed to a lack of resolution. As a result of the simplified approach, some modeled flooding occurs because drainage basins discharge to the conveyance system at a single point rather than being distributed among individual inlets. These points have been identified and are addressed in the proposed conditions model. Table 2 summarizes flooded locations under existing conditions, severity of flooding, and recommendations.

Figure 5 shows the flooded locations under existing conditions. Although not included in the flooding areas predicted by the model, there is an area of observed flooding near Taxiway A on the northwest side of HIO that is addressed in the proposed conditions model.

Table 2 10-Year Event SWMM Flooding Locations, Existing Conditions

Flooded Node ID	Hours Flooded, Existing	Location	Notes and Recommendations
281	1. 29	NE Sewell Ave. and Evergreen Rd.	This location may require further analysis and design to alleviate flooding. The existing culvert under NE Sewell Rd. is a convergence point of three lines of stormwater conveyance. This site was not selected to be modified in the Preferred Stormwater Alternative.
8	4. 39	North Airfield Drainage System, Glencoe Swale Input	Increase capacity in future conditions model. Conveyance capacity will be increased by adding a proposed 24-inch pipe and upsizing existing pipes to 24 inches.
222	0. 17	North Runway 13R-31L Drainage System, Glencoe Swale Input	Predicted flooding is a result of planning-level modeling resolution. Improve model resolution in future conditions model.
OF1	0. 34	Outfall to NE 25th Ave. Storm System, Glencoe Swale Input	Predicted flooding is a result of planning-level modeling resolution. Improve model resolution in future conditions model.
46	0. 93	North of Runway 2-20	Predicted flooding is a result of planning-level modeling resolution. Improve model resolution in future conditions model.

Flooded Node ID	Hours Flooded, Existing	Location	Notes and Recommendations
185	0. 44	North of Runway 2-20	Predicted flooding is a result of planning-level modeling resolution. Improve model resolution in future conditions model.
45	0. 66	Between Infill Hangars and West Tie-Down Apron	Predicted flooding is a result of planning-level modeling resolution. Improve model resolution in future conditions model.
85	6. 51	Between Infill Hangars and West Tie-Down Apron	Predicted flooding is a result of planning-level modeling resolution. Improve model resolution in future conditions model.
47	1. 72	Near Center Tie-Down Apron	Predicted flooding is a result of planning-level modeling resolution. Improve model resolution in future conditions model.
134	2. 48	Upstream of Dawson Creek Outfall	Predicted flooding is a result of planning-level modeling resolution. Improve model resolution in future conditions model.
178	0. 33	Adjacent to Brookwood Pkwy	Predicted flooding is a result of planning-level modeling resolution. Improve model resolution in future conditions model.
184	21. 53	Near Intersection of Runway 13R-31L and Taxiway C	Predicted flooding is a result of planning-level modeling resolution. Improve model resolution in future conditions model.
304	0. 82	Between Runway 13R-31L and T-Hangars	Future conditions will change the conveyance network in a way that would address capacity issues.
331	16. 83	Apron to T-Hangars from Taxiway B	Increase capacity in future conditions model. A proposed conveyance pipe will drain runoff in this location.
Observed Flooding Location	NA	Between Hillsboro Fire Station #5 and Taxiway A	Increase capacity in future conditions model. Conveyance capacity will be increased by upsizing existing pipes to 15 inches.

EXISTING STORM SYSTEM AND MODELED FLOODING

HILLSBORO AIRPORT SMP

PORT OF PORTLAND
HILLSBORO, OREGON

FIGURE 5

MAP EXPLANATION

GIS Storm System
- Discharge Point
- Outfalls
- Water Quality Manhole
- Storm Filter
- Oil Water Separator
- Subterranian Drainage
- Culvert
- Storm Sewer Ditch Centerline
- Storm Sewer Pipe (>=12-in)

Background Data
- Property Line
- Long-Term Ponding
- Short-Term Ponding
- Wetland
- Port Owned Buildings
- Impervious P.O.P Airport Surface
- Streams

Modeled Flooding Locations
- Modeled Flooding Locations
- Observed Flooding Location

0 1,200 2,400 ft

PORT OF PORTLAND

Otak

Date: 4/26/2023
Disclaimer: This data is not to survey accuracy and is meant for planning purposes only.

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Water Quality Data

The 1200-Z permit for HIO, issued by DEQ and administered by CWS, includes requirements for water quality monitoring. The 1200-Z permit has established statewide benchmarks and monitoring requirements for stormwater discharges (see Section 2 for a discussion of the water quality regulations that apply to HIO).

Historically, galvanized metal surfaces were identified as a significant source of benchmark exceedances for zinc; non-galvanized building materials are recommended for any future construction. De-icing practices have the potential to impact dissolved oxygen but have not shown to be a cause for concern at HIO. Since 2015, no consistent benchmark exceedances have been identified for any constituent within the Port's stormwater samples at HIO. A monitoring waiver was obtained from CWS in 2018 and no sampling occurred through the end of the permit cycle. Sampling resumed in 2021 under the renewed permit, and a monitoring waiver for all parameters was again obtained from CWS in 2022. Sampling will resume in 2025-2026, the final year of the current permit cycle.

This SMP considers current stormwater standards and uses these standards to develop treatment recommendations. Given the past and current water quality results under the 1200-Z permit, this SMP does not include individual point source water quality parameters in treatment recommendations. New stormwater standards and water quality results will be evaluated during future updates.

Section 4. Alternatives

This section summarizes the development of SMP alternatives, analysis, and selection of a Preferred Stormwater Alternative for HIO. It also summarizes how the Preferred Stormwater Alternative meets SMP goals, assesses capacity needs through hydrologic and hydraulic modeling, and estimates a planning-level cost for select capital projects.

Alternative Development

The consultant team has developed three airport-wide alternatives for managing stormwater. Each alternative comprises two independent geographic components. The “A” component covers the portion of the airport that ultimately drains to Glencoe Swale, and the “B” component covers the portion of the airport that ultimately drains to Dawson Creek.

For the alternatives, the consultant team has selected SMAs from the 2019 CWS D&C or equivalent SMAs that have been previously approved by CWS to provide water quality treatment. For example, HIO has successfully utilized a Modified Landscape Filter Strip (MLFS) to treat stormwater flows from runways. The Port will re-evaluate SMA selection and will use current stormwater design standards and requirements in place at the time of project design. Within the Runway Safety Area (RSA), SMAs cannot introduce any potential hazards, including ruts, depressions, or surface variations. Surfaces must be drained by grading or storm sewers to prevent water accumulation. No objects are allowed unless they serve a navigational purpose, and maintenance access should be limited to operations and navigation functions. SMAs within the RSA must be capable, under dry conditions, of supporting snow removal equipment, aircraft rescue and firefighting equipment, and the occasional passage of aircraft without causing structural damage to the aircraft (FAA AC 150/5300).

Each alternative presents an option for managing stormwater from the future condition of HIO based on the Preferred Development Alternative from the HIO Master Plan and consistent with the design goals for conveyance, hydromodification, water quality treatment, and LIDA. Each alternative includes specific SMA project proposals that would cumulatively meet the runoff treatment goals of the LOC. Consistent with the HIO Master Plan, private development on HIO is expected to provide its own local conveyance, treatment, and hydromodification mitigation and LIDA facilities.

Conveyance Goals

The conveyance goals of this SMP are:

- Provide conveyance for entire site, including sufficient capacity in trunk lines to convey expected inputs from future private development on HIO
- Solve flooding issues related to storm system capacity
- Replace older/failing pipes

Hydromodification Goals

Hydromodification mitigation facilities for private developments on HIO are not included unless the stormwater facility is a regional facility that serves a drainage area that includes both private and Port development in the HIO Master Plan. The Port may consider constructing a regional facility and allow tenants to purchase credit(s). The hydromodification goals of the SMP are:

- Provide hydromodification mitigation facilities for new and modified impervious surfaces owned/managed by the Port and for new/modified public roads to be constructed by the Port.

- Size hydromodification mitigation facilities using methods appropriate to meet CWS Category 2 Hydromodification Design (CWS, 2019).

Water Quality Treatment Goals

At full build-out of the Preferred Development Alternative and implementation of SMP projects, all impervious surfaces on HIO will be managed in a water quality treatment facility. Water quality treatment facilities for private developments on HIO are not included unless the stormwater facility is a regional facility with a credit purchase option. Water quality treatments that are required to manage specific pollutants from private developments within the 1200-Z permitted area, such as oil/water separators, are not included. The water quality treatment goals of this SMP are:

- Provide water quality treatment facilities for 100% of existing untreated impervious surfaces (at 1:1)
- Provide water quality treatment facilities for new and modified impervious surfaces owned by Port and for new/modified public roads (at 1:1)
- In lieu of meeting the site-by-site 3:1 water quality treatment mitigation requirement for modified impervious surfaces, achieve 100% treatment of all impervious surfaces on HIO that drain to a stormwater conveyance over the implementation period of this SMP
- Track progress toward achieving 100% treatment

Low Impact Development Approach Goals

This SMP assumes that LIDA is required for all developments under the hydromodification mitigation requirements. The LIDA goals of this SMP are:

- Use LIDA where feasible outside of the Primary Wildlife Exclusion Zone

Alternative Analysis and Selection

Each of the three alternatives developed for the SMP meets the design goals described above. Alternative 1 proposes stormwater facility construction at the time of development and redevelopment and sizes facilities to address the stormwater management needs of those projects. Alternative 2 proposes localized impervious area and drainage basin-specific stormwater facilities, prioritizing the use of proprietary treatment methods. Alternative 3 proposes regional solutions; this approach would require off-site land acquisition and some potential design variances from the CWS D&C Standards.

The alternatives have been qualitatively evaluated for:

- Relative cost
- Operations and maintenance frequency, level of effort, familiarity, and equipment needed
- Compliance with CWS D&C Standards, such as use of standard designs or alternatives previously used or approved in prior projects
- Compliance with City or County stormwater design criteria, such as prior use in the right of way
- Materials disposal considerations, including classification and disposal location
- Ease of phasing
- Total number of facilities
- Compliance with FAA airport design and safety requirements, including stormwater design modifications

After evaluating the three alternatives, a modified version of Alternative 1 has been selected as the Preferred Stormwater Alternative. See Table 3 for a comparison of the alternatives and a summary of the selection criteria considerations.

Table 3: Alternatives Comparison

Alternative Concept	General Description	Relative Cost	Operations and Maintenance	Clean Water Services Approvability	City of Hillsboro / Washington County Approvability	Cost of Material Disposal	Easily Phased?	Total Number of Facilities	Additional Appurtenances Needed for Compatibility with Airport Safety
Preferred Alternative									
1A, 1B (Revised)	Alternative 1 focuses on typical stormwater management alternatives (SMAs) from the Clean Water Services Design & Construction Standards. Proposed facilities are generally sized at a project scale and are intended to be implemented at the time of construction. Where proprietary underground stormwater treatment facilities are proposed, Contech StormFilter is assumed.	Low	Familiarity is high Frequency is average Equipment needed is average Nets add complication to maintenance	All proposed facilities are commonly approved by CWS. Some exceptions to LIDA may be needed.	Proposed ROW facilities are Street-side planters that are approvable in City of Hillsboro and Washington County.	Low	Yes	Neutral	Within the Primary Wildlife Exclusion Zone, facilities include Modified Landscape Filter Strip (MLFS), underground facilities, and Extended Dry Basins (EDB). The EDBs would require nets to reduce wildlife attraction.
Not Under Consideration									
1A, 1B (Original)	Alternative 1 focuses on typical stormwater management alternatives (SMAs) from the Clean Water Services Design & Construction Standards. Proposed facilities are generally sized at a project scale and are intended to be implemented at the time of construction. Where proprietary underground stormwater treatment facilities are proposed, Contech StormFilter is assumed.	Low	Familiarity is high Frequency is average Equipment needed is average	All proposed facilities are commonly approved by CWS.	Proposed ROW facilities are Street-side planters that are approvable in City of Hillsboro and Washington County.	Low	Yes	Neutral	Within the Primary Wildlife Exclusion Zone, facilities include Modified Landscape Filter Strip (MLFS), underground facilities, and one Extended Dry Basin (EDB). The EDB would require nets to reduce wildlife attraction.
2A, 2B	Alternative 2 focuses on smaller specialized and distributed stormwater management facilities that are unique for each basin or impervious surface treated. This alternative focuses on the use of proprietary treatment methods that may be less common in Washington County but that are well-suited to the site configuration and are in general conformance with the CWS Design & Construction Standards.	Neutral	Familiarity is low Frequency is high Equipment needed is specialized	The proprietary treatment BMPs proposed in this alternative all have either a TAPE approval or an "approved equivalent to bioretention" status by Department of Ecology. CWS has previously approved Modular Wetland for non-publicly maintained applications in 2015.	Proposed ROW facilities are Street-side planters that are approvable in City of Hillsboro and Washington County.	Neutral	Yes	High	Within the Primary Wildlife Exclusion Zone, facilities are limited to Modified Landscape Filter Strip (MLFS), a detention pond, and underground facilities. Roof runoff is intended to be managed by above ground planter technologies that utilize plants that are consistent with the goals of minimizing wildlife attractants.
3A, 3B	Alternative 3 focuses on regional solutions and generally uses typical SMAs from the CWS Design & Construction Standards. Therefore, some proposed facilities are larger and are intended to manage runoff from several developments at once. Some proposed facilities are located off-site and would require land acquisition. One proposed enhancement project is not a typical SMA but may be acceptable to CWS.	High because of land costs and significant conveyance costs	Familiarity is high Frequency is average Equipment needed is average	Need to discuss enhancement project with CWS. Not clear that it would be approvable. Proprietary treatment proposed are commonly approved by CWS.	Proposed ROW facilities are Street-side planters that are approvable in City of Hillsboro and Washington County.	Low	No	Low	Within the Primary Wildlife Exclusion Zone, facilities are limited to Modified Landscape Filter Strip (MLFS) and underground facilities.

Cell color corresponds to a qualitative rating. Green = more desirable (least cost, easiest implementation, etc.). Yellow = neutral. Pink = less desirable (more cost, more difficult implementation, etc.).

Preferred Stormwater Alternative

The Preferred Stormwater Alternative groups HIO Master Plan development and redevelopment projects into 16 work areas. Each one is served by proposed SMAs needed to manage stormwater in the work area including conveyance, water quality, hydromodification mitigation, and LIDA consistent with FAA safety and design standards. See Figure 6 for a map of the work areas, including the recommended SMAs and a list of the HIO Master Plan development and redevelopment projects within each one. Figure 6 also includes the HIO RPZ and Primary Wildlife Boundary, which have specific FAA safety requirements that impact placement and choice of SMAs, as well as additional background features for context.

The work areas strategically group HIO Master Plan development and redevelopment projects by regional proximity. Grouping by proximity identifies potential regional options for stormwater management. This approach also encourages the construction of any identified regional SMA at the same time as the first development and redevelopment project to occur within the work area, creating temporary extra capacity. In work areas where regional facilities are not possible, an SMA will be constructed at the same time as the HIO Master Plan project that it is intended to serve.

CWS typically requires that facilities serving more than one parcel to be dedicated to the public stormwater agency. Facilities constructed to serve public roads such as for NE 30th Street, Springer Street, and others will be dedicated to the City of Hillsboro or the County as applicable. On Port property at HIO, most facilities will serve multiple parcels and will not be dedicated to the City for maintenance. The Port intends to maintain its stormwater facilities at HIO. Since HIO is managed as a single facility, HIO will request an exemption to this requirement at the time of permitting.

Stormwater Project Selection

Of the 16 work areas, the SMP includes concept plans and cost estimates for ten. Work areas identified by the HIO Master Plan to be developed or redeveloped by the City or County have been removed from consideration, which eliminates work areas 6 and 14. CIP cost estimates and fact sheets were also not developed for stormwater projects with relatively uncomplicated designs, including projects that only consisted of MLFS, which eliminates work areas 1, 13, 15, and 16. The Port has a successful history of implementing relatively simple SMAs and has current cost estimation and engineering information to design and budget these projects when they are ready for implementation.

The Port categorizes the accuracy of the scope and the level of engineering as part of project management oversight (Port of Portland, Revised 8/22). The recommended CIP projects in this SMP are categorized as conceptual (Level 2 Scope Accuracy and Level B Engineering Effort). This SMP includes planning-level recommendations that would need to be revisited and updated at the time of design. It is anticipated that stormwater management solutions and designs will be modified as needed when individual projects are implemented. The SMP CIPs are based on the HIO Master Plan and all alignment, impervious calculations and stormwater facility locations are planning-level and subject to change as infrastructure project and development proceed. See Appendix A for CIP Fact Sheets that summarize and illustrate the CIP projects and provide conceptual level cost estimates for budgetary planning purposes.

FIGURE 6

PREFERRED STORM-WATER ALTERNATIVE

HILLSBORO AIRPORT SMP

PORT OF PORTLAND
HILLSBORO, OREGON

MAP EXPLANATION

Work Area 1
Helipad (L13), Twy to Rwy 13 Thresholds (L26, not shown)

Modified Landscape Filter Strip and Underground Detention
Water Quality: Met
Hydromodification: Met
LIDA: Met
No CIP Fact Sheet

Work Area 2
Flight School and Others (L7, L10, L11 (portion), L12, L15)

Extended Dry Basin
Water Quality: Met
Hydromodification: Met
LIDA: Met

Work Area 3
NE 30th Improvement & Springer St. Extension (S2, S3, S4, L1, L2)

Street-Side Planters
Water Quality: Met
Hydromodification: Met
LIDA: Met

Work Area 15
Vehicle Service Route (L11 (portion), L14 (portion))

Permeable Pavement
Water Quality: Met
Hydromodification: Met
LIDA: Met
No CIP Fact Sheet

Work Area 16
Untreated impervious

Modified Landscape Filter Strip
Water Quality: Met
Hydromodification: N/A
LIDA: N/A
No CIP Fact Sheet

Work Area 4
Existing Hangars, Untreated Impervious

Proprietary Underground Treatment
Water Quality: Met
Hydromodification: N/A
LIDA: N/A

Work Area 5
Taxiway E (south) and B2 Improvements, VSR (L4, L5, L14)

Modified Landscape Filter Strip and Underground Detention
Water Quality: Met
Hydromodification: Met
LIDA: Met

Work Area 14
NE 25th Street Realignment (I12)

Street-side Planters
Water Quality: Met
Hydromodification: Met
LIDA: Met
No CIP Fact Sheet

Work Area 6
Cornell Road Realignment (I13)

Underground Detention and Proprietary Underground Treatment
Water Quality: Met
Hydromodification: Met
LIDA: Impractical due to Wildlife Boundary
No CIP Fact Sheet

Work Area 13
Community View Point (L34)

Rain Garden
Water Quality: Met
Hydromodification: Met
LIDA: Met
No CIP Fact Sheet

Work Area 7
Southwest Terminal, Rental Car Parking and others (I2, I3, I5, I6, I7, I8, L6, L18, L19, L20, L23, L30)

Underground Detention and Proprietary Underground Treatment
Water Quality: Met
Hydromodification: Met
LIDA: Impractical due to Wildlife Boundary

Work Area 12
Taxiway AA projects (L25)

Modified Landscape Filter Strip and Underground Detention
Water Quality: Met
Hydromodification: Met
LIDA: Met

Work Area 10
Taxiway B Improvements (L17)

Modified Landscape Filter Strip and Underground Detention
Water Quality: Met
Hydromodification: Met
LIDA: Met

Work Area 11
Infill Hangers, Vehicle Service Road (S7, I16, L35), Replacement Control Tower and Untreated Impervious

Underground Detention and Proprietary Underground Treatment
Water Quality: Met
Hydromodification: Met
LIDA: Impractical due to Wildlife Boundary

Work Area 9
Maintenance Facility and Taxiway B (L28, L33) and Untreated Impervious

Underground Detention and Proprietary Underground Treatment
Water Quality: Met
Hydromodification: Met
LIDA: Impractical due to Wildlife Boundary
Note: private redevelopment is not addressed

Work Area 8
Connect Phase II Loop Road (L31) and Existing Untreated Impervious

Proprietary Underground Treatment
Water Quality: Met
Hydromodification: Fee in Lieu
LIDA: Impractical due to Wildlife Boundary
Note: private redevelopment is not addressed

Existing Conditions
- Contours
- Streams
- Taxlots
- HIO Property Line
- HIO RPZ
- HIO Primary Wildlife Boundary
- HIO Wetlands
- Existing Treated Impervious Surfaces
- Existing Untreated Impervious

Future Conditions
- New Building
- New Impervious

Preferred Stormwater Alternative
- CIP Work Areas (various colors)

Work Area #
HIO Master Plan projects within Work Area (S# (short-term projects), I# (intermediate-term projects), L# (long-term projects)

Stormwater Management Approach
List of Requirements Met

0 500 1,000 2,000 Feet

Esri Community Maps Contributors, Hillsboro, Oregon, Oregon Metro, Oregon State Parks, State of Oregon GEO, WA State Parks GIS, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA

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Future Conditions Model Results

The existing conditions hydraulic model has been updated with proposed conditions to confirm the Preferred Stormwater Alternative includes appropriate conveyance infrastructure and the SMAs would meet current CWS standards. The future conditions model assumes full build out of the HIO Master Plan Preferred Development Alternative and also incorporates the capacity increase recommendations described in Section 3. The model is limited to storm sewers 12-inch in diameter and larger, which is consistent with the existing conditions model and asset replacement evaluation in Section 5.

The future conditions model shows the Preferred Stormwater Alternative resolves all but one of the flooded nodes (node 281) identified in the existing conditions model. Flooded nodes are resolved either through a CIP project recommendation, upsizing of specific pipes in the local system, or adding resolution to the model. The future conditions model predicts six new flooded nodes which can be grouped into three locations. The predicted flooding locations in the future conditions model are shown in Table 4. Figures 7-15 show the modeled storm system layout and flooding locations under future conditions. The modeled pipes, nodes, and detention facilities are represented schematically and may not geographically align with facilities proposed in the SMP. See Appendix B for a memorandum documenting the modeling process and results.

Table 4 10-Year Event SWMM Flooding Locations, Future Conditions Model

Location	Flooded Nodes	Hours Flooded, Future	Notes/Recommendations
Glencoe Swale	235	2. 76	Change thought to be due to the planned addition of a culvert on Glencoe Swale in 2023. Plans for the culvert were incorporated into the future conditions model. The SMP does not attempt to manage flooding in the receiving water resulting from watershed-wide hydrology.
	247	2. 36	
Preferred Stormwater Alternative - Work Area 3	248	0. 47	Minor short-term ponding predicted with planning-level design. Survey required to identify drainage patterns of adjacent drainage basins at final design.
	J363*	0. 65	
Preferred Stormwater Alternative - Work Area 11	J341*	0. 32	Storm system GIS data provided in this area shows that all runoff from this work area flows to a detention pipe with an unknown outlet. Survey required at final design.
	140	0. 27	
NE Sewell Ave. and NE Evergreen Rd.	281	1. 2	This site was not selected to be modified in the Preferred Stormwater Alternative. The existing culvert under NE 30th Ave. is a convergence point of three lines of stormwater conveyance. This location may require further analysis and design to alleviate flooding.

**These are new model nodes created for the future conditions model. New model nodes are delineated with 'J.'*

SWMM MODEL SCHEMATIC

HILLSBORO AIRPORT SMP

PORT OF PORTLAND
HILLSBORO, OREGON

FIGURE 7
INDEX FOR MAPS 1-8

MAP EXPLANATION

Modeled Flooding Locations
- Existing Conditions
- Future Conditions
- Exising/Future Conditions
- Observed Flooding Location

Modeled System
- Modeled Nodes - Future
- Modeled Conduits - Future
- Modeled Nodes - Existing
- Modeled Conduits - Existing
- Modeled Basins

GIS Storm System
- Discharge Point
- HIO Drainage Basins

Background Data
- Property Line
- Wetland
- Port Owned Buildings
- Impervious P.O.P Airport Surface
- Streams

ft
0 1,200 2,400

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HILLSBORO AIRPORT SMP

PORT OF PORTLAND

HILLSBORO, OREGON

FIGURE 8 - MAP 1

MAP EXPLANATION

Modeled Flooding Locations

- Future Conditions
- Exising/Future Conditions

Modeled System

- Modeled Nodes - Future
- Modeled Conduits - Future
- Modeled Nodes - Existing
- Modeled Conduits - Existing
- Modeled Basins

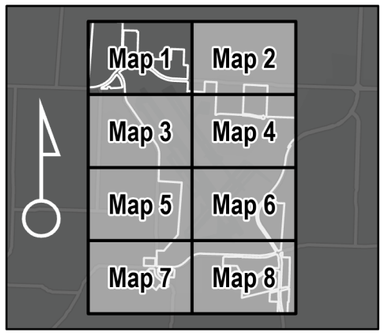
GIS Storm System

- Storm Sewer Pipe
- HIO Drainage Basins

Background Data

- Property Line
- Streams
- Observed Long-Term Ponding
- Observed Short-Term Ponding
- Wetland
- Impervious P.O.P Airport Surface
- Port Owned Buildings

Note: Modeled nodes, conduits, and facilities are represented schematically not geographically.



0 250 500 ft

NW 278th Ave
NW 273rd Ave
NE Sewell Ave
NE Evergreen Rd
NE 25th Ave
247
281
235
PROPOSED CULVERT

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HILLSBORO AIRPORT SMP

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FIGURE 9 - MAP 2

MAP EXPLANATION

Modeled System

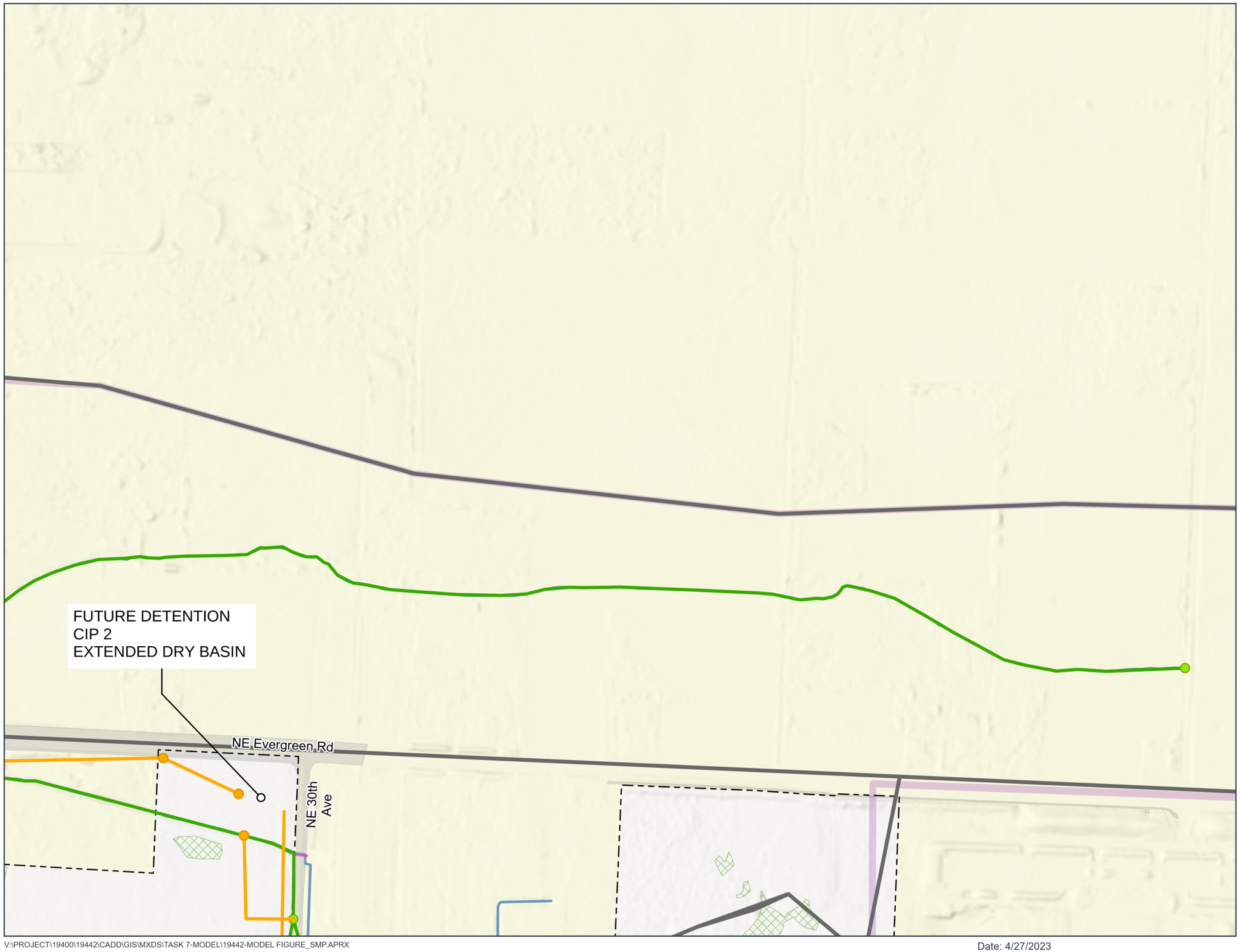
- Modeled Nodes - Future
- Modeled Conduits - Future
- Modeled Nodes - Existing
- Modeled Conduits - Existing
- Modeled Basins

GIS Storm System

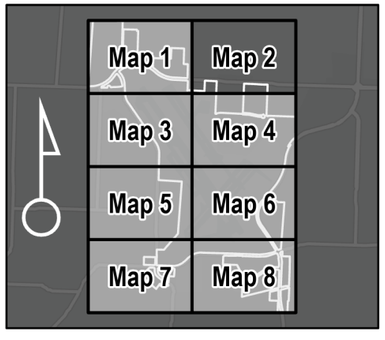
- Storm Sewer Pipe
- HIO Drainage Basins

Background Data

- Property Line
- Streams
- Wetland
- Impervious P.O.P Airport Surface



Note: Modeled nodes, conduits, and facilities are represented schematically not geographically.



0 250 500 ft

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SWMM MODEL SCHEMATIC

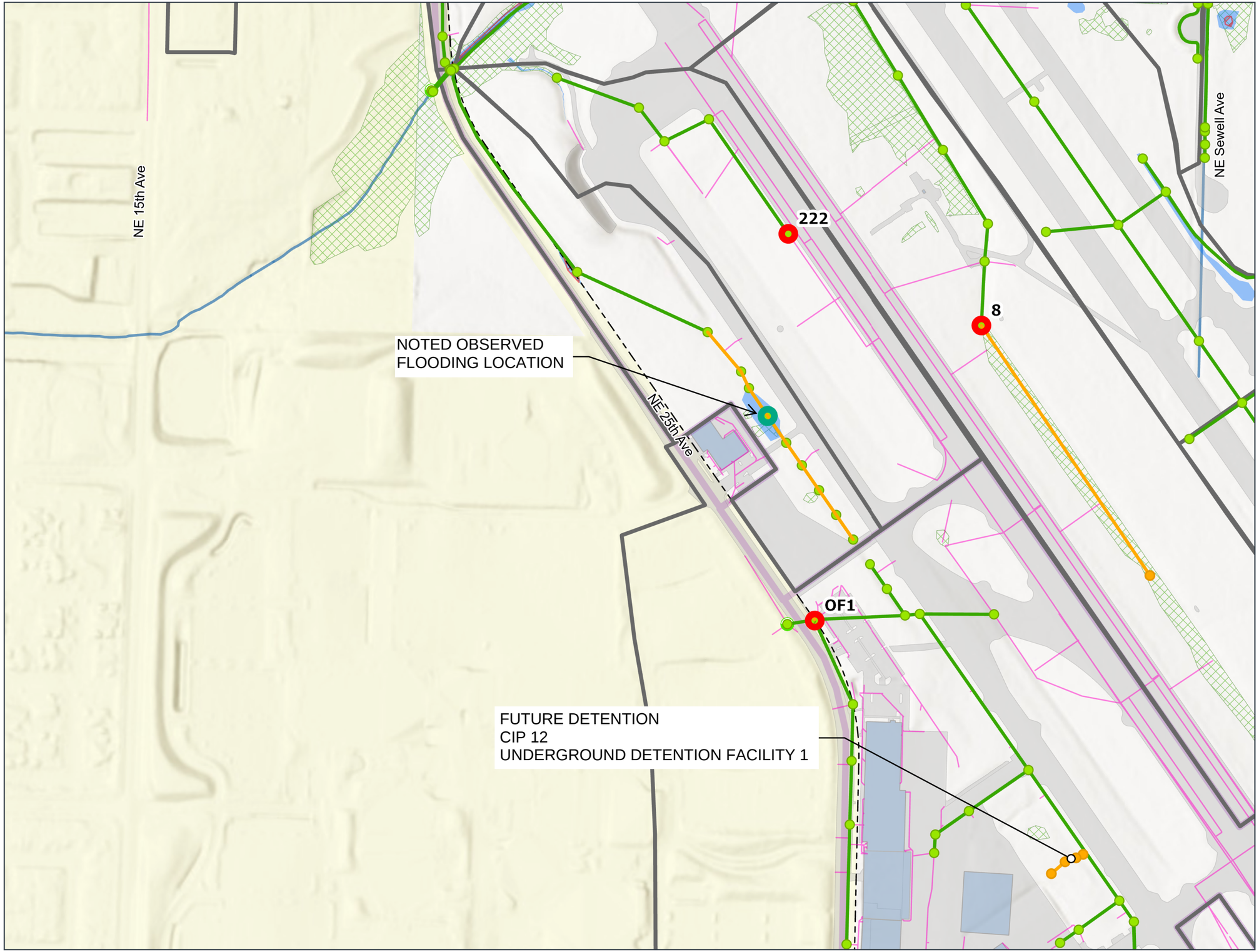
HILLSBORO AIRPORT SMP

PORT OF PORTLAND

HILLSBORO, OREGON

FIGURE 10 - MAP 3

MAP EXPLANATION



Modeled Flooding Locations

- Existing Conditions
- Observed Flooding Location

Modeled System

- Modeled Nodes - Future
- Modeled Conduits - Future
- Modeled Nodes - Existing
- Modeled Conduits - Existing
- Modeled Basins

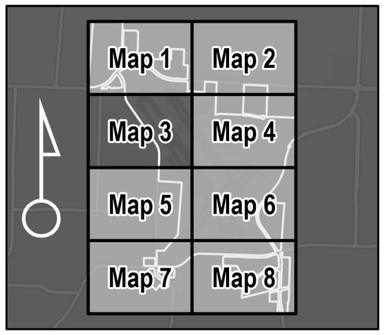
GIS Storm System

- Storm Sewer Pipe
- Discharge Point
- HIO Drainage Basins

Background Data

- Property Line
- Streams
- Observed Long-Term Ponding
- Observed Short-Term Ponding
- Wetland
- Impervious P.O.P Airport Surface
- Port Owned Buildings

Note: Modeled nodes, conduits, and facilities are represented schematically not geographically.



0 250 500 ft

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HILLSBORO AIRPORT SMP

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HILLSBORO, OREGON

FIGURE 11 - MAP 4

MAP EXPLANATION

Modeled Flooding Locations

- Existing Conditions
- Future Conditions

Modeled System

- Modeled Nodes - Future
- Modeled Conduits - Future
- Modeled Nodes - Existing
- Modeled Conduits - Existing
- Modeled Basins

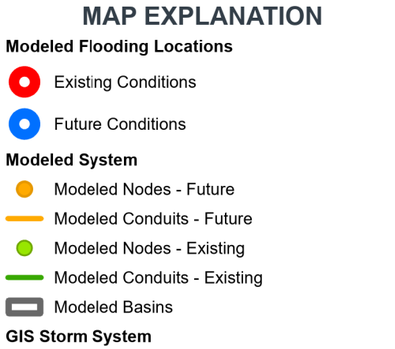
GIS Storm System

- Storm Sewer Pipe
- HIO Drainage Basins

Background Data

- Property Line
- Streams
- Observed Long-Term Ponding
- Observed Short-Term Ponding
- Wetland
- Impervious P.O.P Airport Surface
- Port Owned Buildings

Note: Modeled nodes, conduits, and facilities are represented schematically not geographically.



0 250 500 ft

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HILLSBORO AIRPORT SMP

PORT OF PORTLAND

HILLSBORO, OREGON

FIGURE 12 - MAP 5

MAP EXPLANATION

Modeled Flooding Locations

- Existing Conditions
- Future Conditions

Modeled System

- Modeled Nodes - Future
- Modeled Conduits - Future
- Modeled Nodes - Existing
- Modeled Conduits - Existing
- Modeled Basins

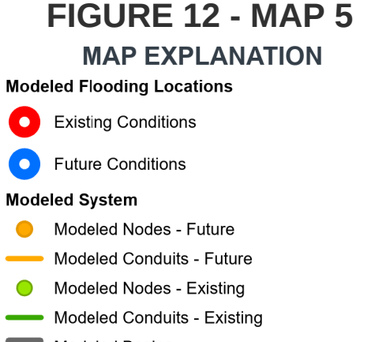
GIS Storm System

- Storm Sewer Pipe
- HIO Drainage Basins

Background Data

- Property Line
- Observed Long-Term Ponding
- Observed Short-Term Ponding
- Wetland
- Impervious P.O.P Airport Surface
- Port Owned Buildings

Note: Modeled nodes, conduits, and facilities are represented schematically not geographically.



0 250 500 ft

NE 15th Ave

NE 25th Ave

FUTURE DETENTION
CIP 11
UNDERGROUND DETENTION FACILITY 1

FUTURE DETENTION
CIP 11
UNDERGROUND DETENTION FACILITY 2

140

J341

85

45

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HILLSBORO AIRPORT SMP

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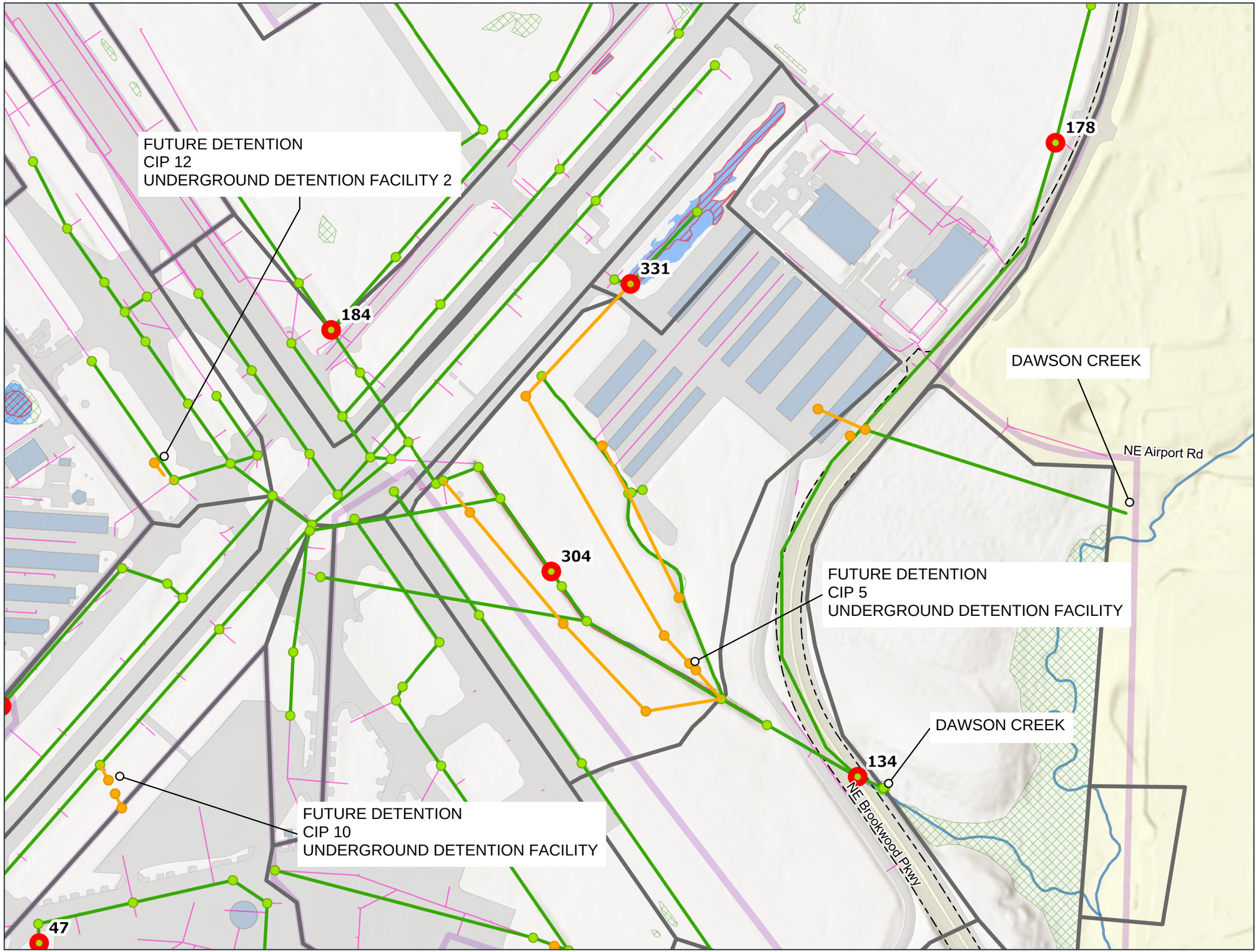
HILLSBORO, OREGON

FIGURE 13 - MAP 6

MAP EXPLANATION



Modeled Flooding Locations

- Existing Conditions

Modeled System

- Modeled Nodes - Future
- Modeled Conduits - Future
- Modeled Nodes - Existing
- Modeled Conduits - Existing
- Modeled Basins

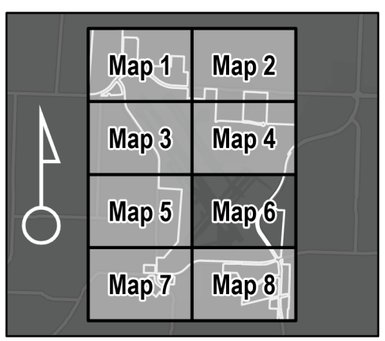
GIS Storm System

- Storm Sewer Pipe
- Discharge Point
- HIO Drainage Basins

Background Data

- Property Line
- Streams
- Observed Long-Term Ponding
- Observed Short-Term Ponding
- Wetland
- Impervious P.O.P Airport Surface
- Port Owned Buildings

Note: Modeled nodes, conduits, and facilities are represented schematically not geographically.



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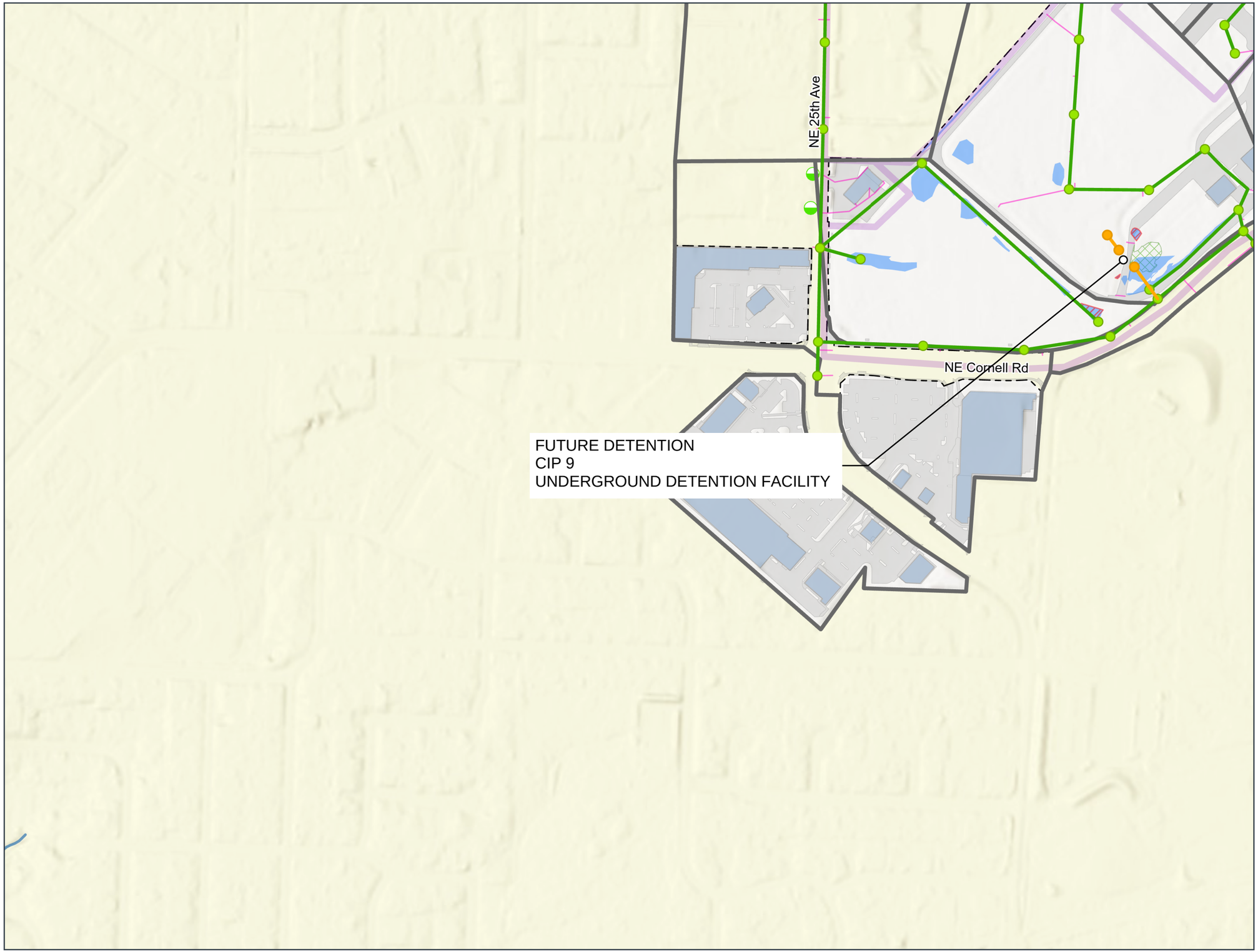
HILLSBORO AIRPORT SMP

PORT OF PORTLAND

HILLSBORO, OREGON

FIGURE 14 - MAP 7

MAP EXPLANATION



Modeled System

- Modeled Nodes - Future
- Modeled Conduits - Future
- Modeled Nodes - Existing
- Modeled Conduits - Existing
- Modeled Basins

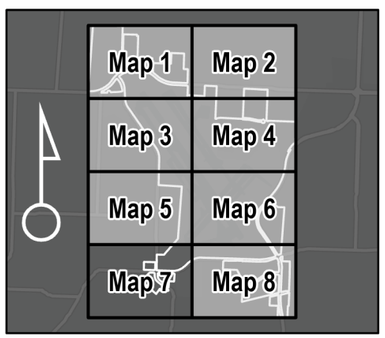
GIS Storm System

- Storm Sewer Pipe
- Discharge Point
- HIO Drainage Basins

Background Data

- Property Line
- Streams
- Observed Long-Term Ponding
- Observed Short-Term Ponding
- Wetland
- Impervious P.O.P Airport Surface
- Port Owned Buildings

Note: Modeled nodes, conduits, and facilities are represented schematically not geographically.



ft

0 250 500

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SWMM MODEL SCHEMATIC

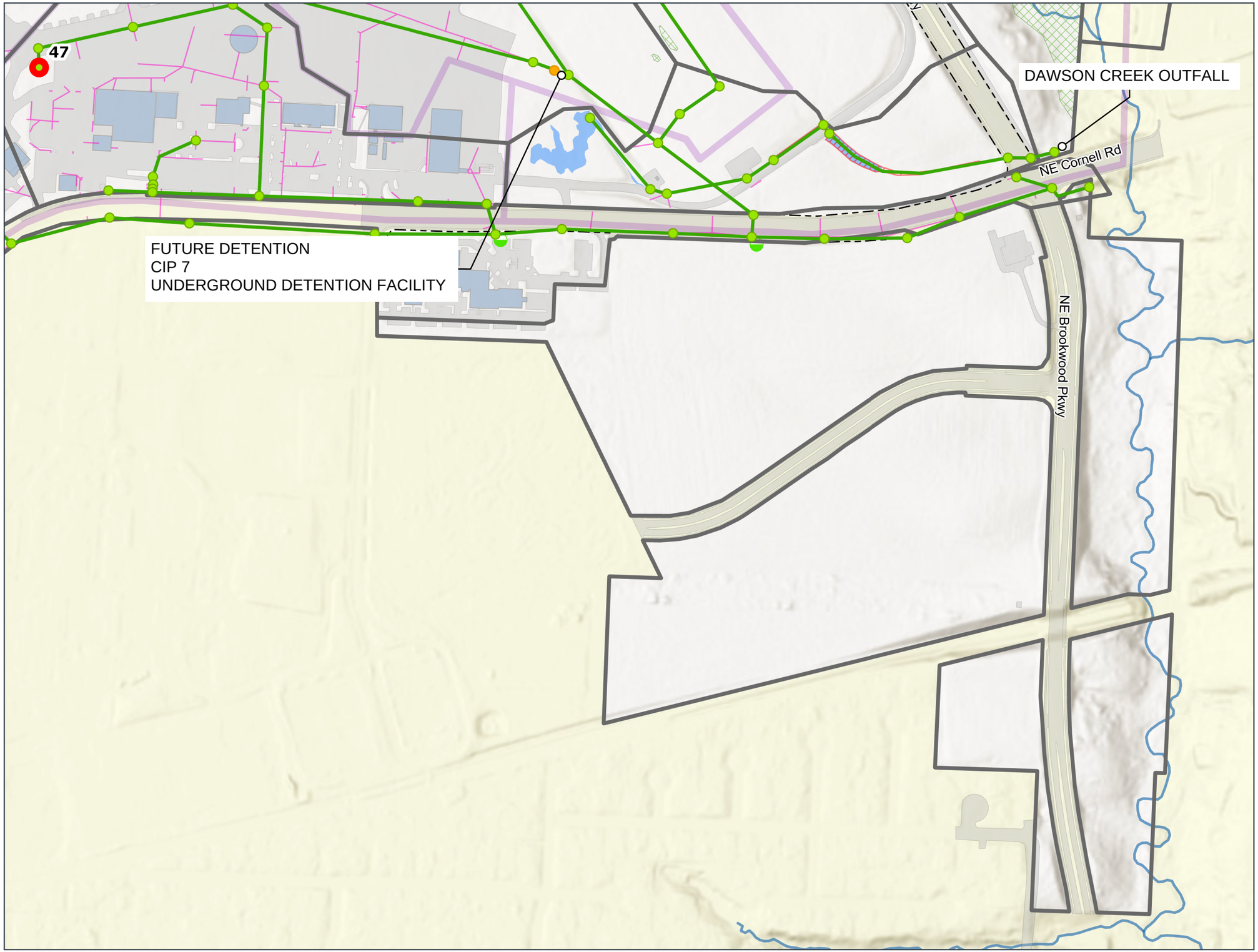
HILLSBORO AIRPORT SMP

PORT OF PORTLAND

HILLSBORO, OREGON

FIGURE 15 - MAP 8

MAP EXPLANATION



Modeled Flooding Locations

- Existing Conditions

Modeled System

- Modeled Nodes - Future
- Modeled Nodes - Existing
- Modeled Conduits - Existing
- Modeled Basins

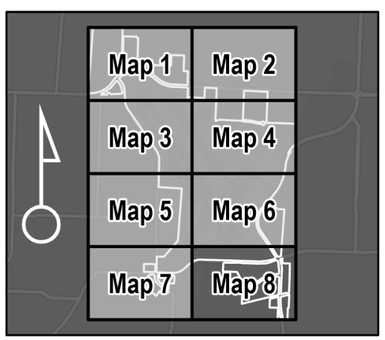
GIS Storm System

- Storm Sewer Pipe
- Discharge Point
- HIO Drainage Basins

Background Data

- Property Line
- Streams
- Observed Long-Term Ponding
- Observed Short-Term Ponding
- Wetland
- Impervious P.O.P Airport Surface
- Port Owned Buildings

Note: Modeled nodes, conduits, and facilities are represented schematically not geographically.



ft

0 250 500

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New conveyance capacity resulting from development and redevelopment under the Preferred Development Alternative is addressed in the respective CIP work areas and has been incorporated into the model. Table 5 and Figure 16 show recommended conveyance capacity increases which address existing flooding and have been incorporated into the proposed conditions model.

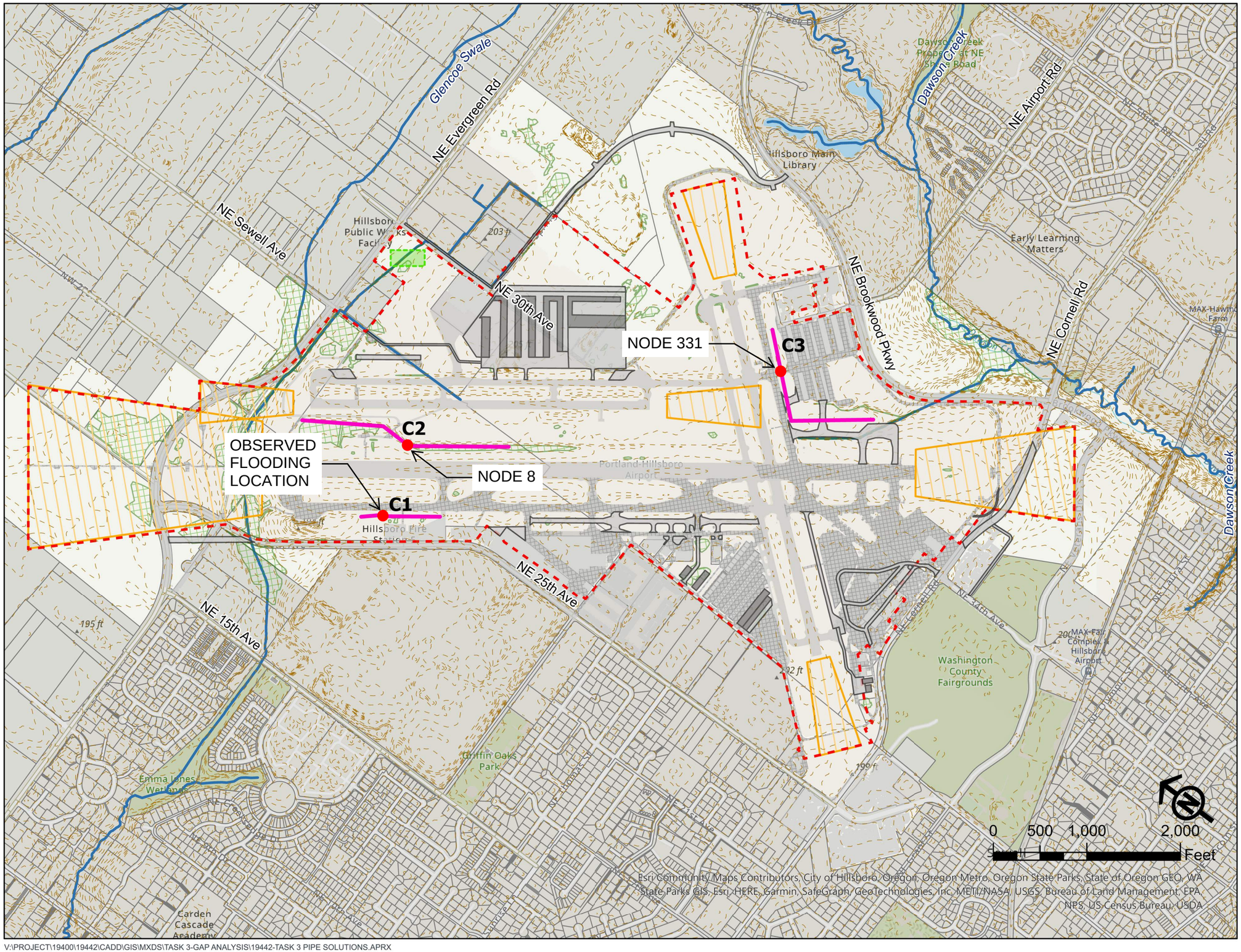
Table 5 Conveyance Capacity Needs

Location	Asset ID	Existing Pipe		Proposed Pipe	
		Length (ft)	Diameter (in)	Length (ft)	Diameter (in)
C1	STSLN0003092	88	12	88	15
	STSLN0003093	61	12	61	15
	STSLN0003094	108	12	108	15
	STSLN0003095	91	12	91	15
	STSLN0003096	100	12	100	15
	STSLN0003097	100	12	100	15
	STSLN0003098	100	12	100	15
	STSLN0003530	84	12	84	15
	STSLN0003531	112	12	112	15
C2	STSLN0007854	213	15	213	24
	STSLN0012980	22	15	22	24
	STSLN0012982	290	15	290	24
	STSLN0012983	290	15	290	24
	STSLN0012984	287	15	287	24
	STSLN0012985	126	15	126	24
	Proposed Pipe 1	N/A	N/A	400	24
C3	Proposed Pipe 2 (Work Area 5)	N/A	N/A	2100	12

FIGURE 16
CONVEYANCE CAPACITY INCREASES

HILLSBORO AIRPORT SMP

PORT OF PORTLAND
HILLSBORO, OREGON



MAP EXPLANATION

- Increased Conveyance Capacity Locations

Existing Conditions

- Contours
- Streams
- Taxlots
- HIO Property Line
- HIO RPZ
- HIO Primary Wildlife Boundary
- HIO Wetlands
- Existing Untreated Impervious
- Existing Treated Impervious

Future Conditions

- New Building
- New Impervious

Date: 5/8/2023

Disclaimer: This data is not to survey accuracy and is meant for planning purposes only.

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V:\PROJECT\19400\19442\CADD\GIS\MXDS\TASK 3-GAP ANALYSIS\19442-TASK 3 PIPE SOLUTIONS.APRX

Capital Project Cost Estimation

A planning-level cost estimate is included for each of the ten stormwater CIPs using Level 2 Scope Accuracy and Level B Engineering Effort as consistent with the Port of Portland One Port Estimating Scale (Port of Portland, Revised 8/22). All concepts use current design standards, and costs should be considered preliminary. Project design will be re-evaluated at the time of implementation to account for design standards and requirements in place at that time.

Each stormwater project includes an engineer's cost assumption for preliminary unit quantities. Unit prices from recently completed local and regional construction projects have been used to estimate project costs. Given current market instability around supply chain availability, labor markets, and interest rates, more conservative estimates have been used, including higher contingency factors. The construction contingency is presented as a range between 30 and 50 percent (see Table 6 for the estimated stormwater project cost for each CIP project). Soft costs are estimated using percentages of total construction costs that are typical for planning CIPs. Construction budgets should be re-evaluated during project design. For cost estimation purposes, the Contech Stormwater Management StormFilter with ZPG media has been chosen to represent proprietary underground stormwater treatment vaults specified in the CIP project. Different proprietary systems may be selected in design.

The majority of the stormwater projects included in this HIO SMP will comprise the required storm system infrastructure needed to support the Preferred Development Alternative. Therefore, many stormwater project costs will be incurred simultaneously with the HIO Master Plan development projects. For these supporting projects, some line-item and soft costs that would typically be included as part of the Master Plan project have been omitted. Omitted costs include mobilization, erosion and sediment control, and all soft costs, including survey, design, permitting, environmental mitigation, and project administration. In contrast, stormwater projects are classified as standalone when they either provide regional stormwater management for several proposed Master Plan projects or their sole purpose is to provide water quality treatment for existing untreated impervious area as required under the LOC. Standalone stormwater projects include those line item and soft costs because there is no associated Master Plan project that would otherwise account for them.

See individual project fact sheets in Appendix A for site specific design assumptions and cost estimates. See Appendix B for the Cost Estimating Memo that describes the cost estimation process for CIP projects.

Table 6 Estimated Project Costs for the SMP CIP

Work Area (CIP #)	Description/Project Name	Dependent HIO Master Plan Project(s)	Estimated Stormwater Project Cost
2	Flight School and Aviation Reserve Extended Dry Basin	L-7, L-10, L-11, L-12, L-15	$7,619,300 to $8,466,300
3	Springer Street/NE 30th Street Planters	S-2, S-3, S-4, L-1, L-2	$5,836,500 to $6,734,500
4	T-Hangars Underground Stormwater Treatment Vaults	L-16*	$687,200 to $742,200
5	Taxiway E MLFS and Underground Detention	L-4, L-5, L-14	$1,832,400 to $2,114,400
7	Southwest Terminal and Rental Car Parking Underground Treatment And Detention	M-2, M-3, M-5, M-6, M-7, M-8, L-6, L-18, L-19, L-20, L-23, L-30	$7,575,550 to $8,434,550
8	Phase II Loop Road Underground Treatment	L-31	$508,200 to $543,100
9	New Maintenance Facility Underground Treatment and Detention	L-28, L-33	$593,500 to $684,800
10	Taxiway B (southwest) MLFS and Underground Detention	L-17	$481,800 to $555,900
11	Infill Hangars and Control Tower Replacement Vicinity Underground Treatment and Detention	S-7, M-16, L-35	$1,508,500 to $1,740,500
12	Taxiway AA MLFS and Underground Detention	L-25	$1,736,700 to $2,003,700
	Sum of Project Cost Estimates		**$28,379,650 to $32,019,950**

Ten work areas were selected for development of concept plans and cost estimates as described in the Stormwater Project Selection section on page 24. See Figure 6 for all work areas and associated SMAs.

**CIP Project 4 is not dependent on L-16 but is adjacent to the project and could be implemented concurrently.*

Section 5. Asset Condition

Existing stormwater conveyance assets provide drainage away from key operational facilities and are critical for meeting airport design and safety criteria. Failure of storm sewers could cause localized ponding or flooding resulting in significant safety and operational consequences. Other consequences of failed storm sewer pipe could include structural impacts to facilities installed above or adjacent to the buried pipe, such as buildings, roadways, runways, or sanitary sewers. This section summarizes the asset conditions of storm sewers 12 inches and larger and presents planning-level cost estimates for replacement of those assets.

Asset Inventory

The Port maintains a GIS inventory of storm sewers, including attribution for age and material. This information is based on construction documents, as-builts, surveys, and visual inspections. See Figure 17 for the mapped inventory of storm sewer assets by age and Figure 18 for the mapped inventory of storm sewer assets by material.

Asset Condition

The combination of age and material can be used to estimate the amount of useful life remaining. This provides a useful prediction of when the asset may be expected to fail under average operational and maintenance conditions given standard lifespans. Age and material can provide a starting point for estimating remaining useful life, and additional inspection and condition assessment can provide additional data to prioritize replacement or repair projects. The actual lifespan of any individual asset can be impacted by site specific factors, such as environmental conditions or quality of construction. The goal would be to replace or repair the asset prior to failure because emergency repair of failed sewer pipes is generally more costly than planned replacement projects. Additionally, targeted repair may extend the lifespan of a sewer until a coordinated replacement project can be implemented.

The Port has estimated the useful life expended for storm sewers 12-inches and larger in diameter (see Figure 19). The estimation is given as a percentage based on pipe age divided by the estimated lifespan for pipe. This is a simplified indicator for likelihood of failure and can help prioritize projects or additional investigations. Any asset categorized as having a greater than 100% useful life expended is past its estimated lifespan.

The SMP recommends a repair and replacement strategy that balances the cost and disruption of replacing aging pipes with the potential consequences of asset failure. The Port should proactively plan for repair or replacement of pipes when development and infrastructure projects coincide with assets that have reached 75% or greater of expected useful life, and they should initiate projects to independently repair or replace pipes that exhibit signs of failure in areas that are not slated for other capital construction. Secondly, the Port should inspect catch basins and manholes during typical cleaning cycles and document the results. Finally, the Port should use closed circuit television (CCTV) camera inspection when staff observe new ponding, misalignment of catch basins or manhole covers, misalignment of pipes, cracked structures or grout, subsidence, or other similar signs of pending failure. See Figure 20 for the recommended asset replacements where the useful life expectancy is greater than 75%; each location is identified as either a standalone project or grouped by SMP CIP project/work area.

Figure 17
Pipe Age
HIO Storm Gravity Pipes - 12in Diameter+
Hillsboro Airport SMP
Port of Portland
Map prepared by Port of Portland

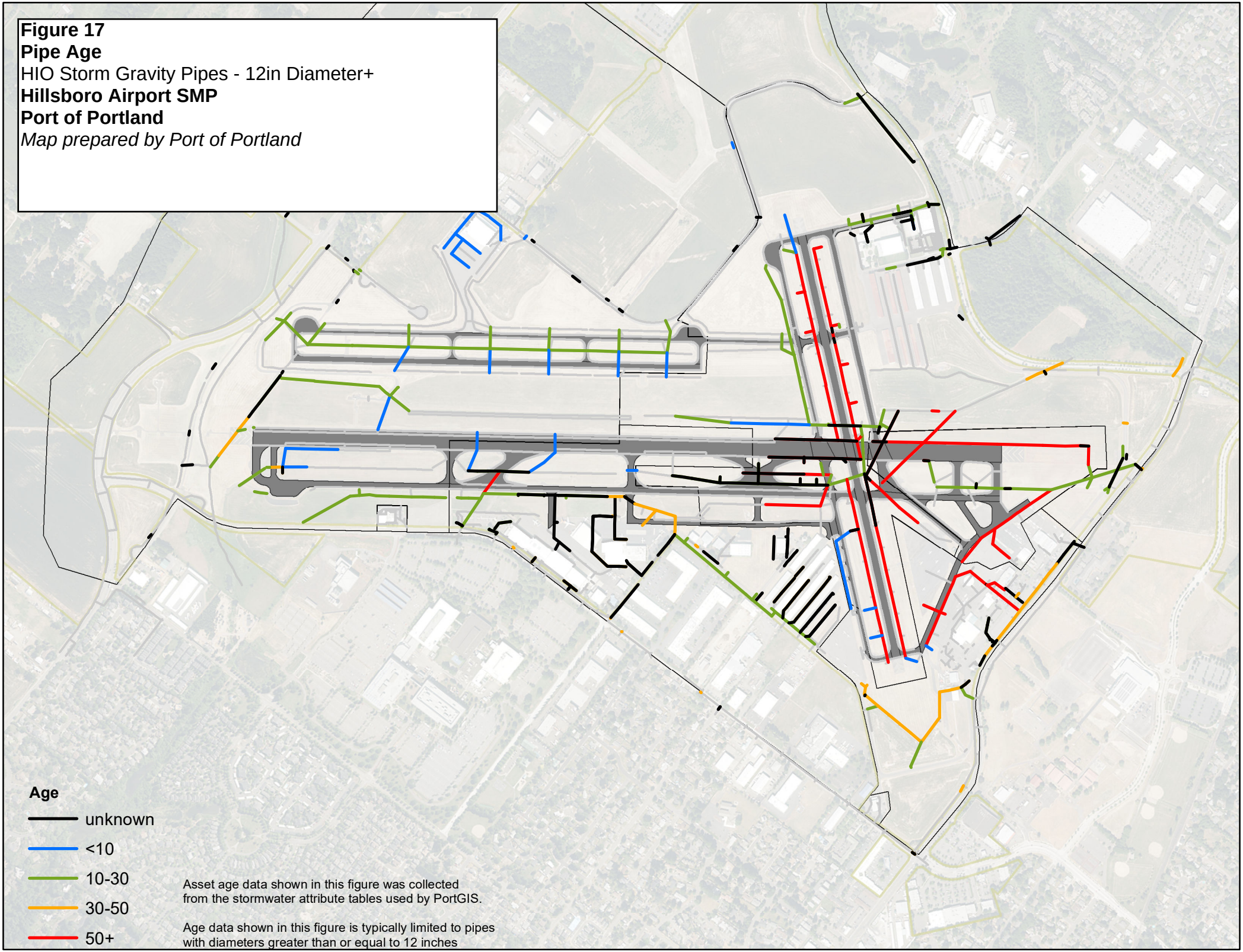
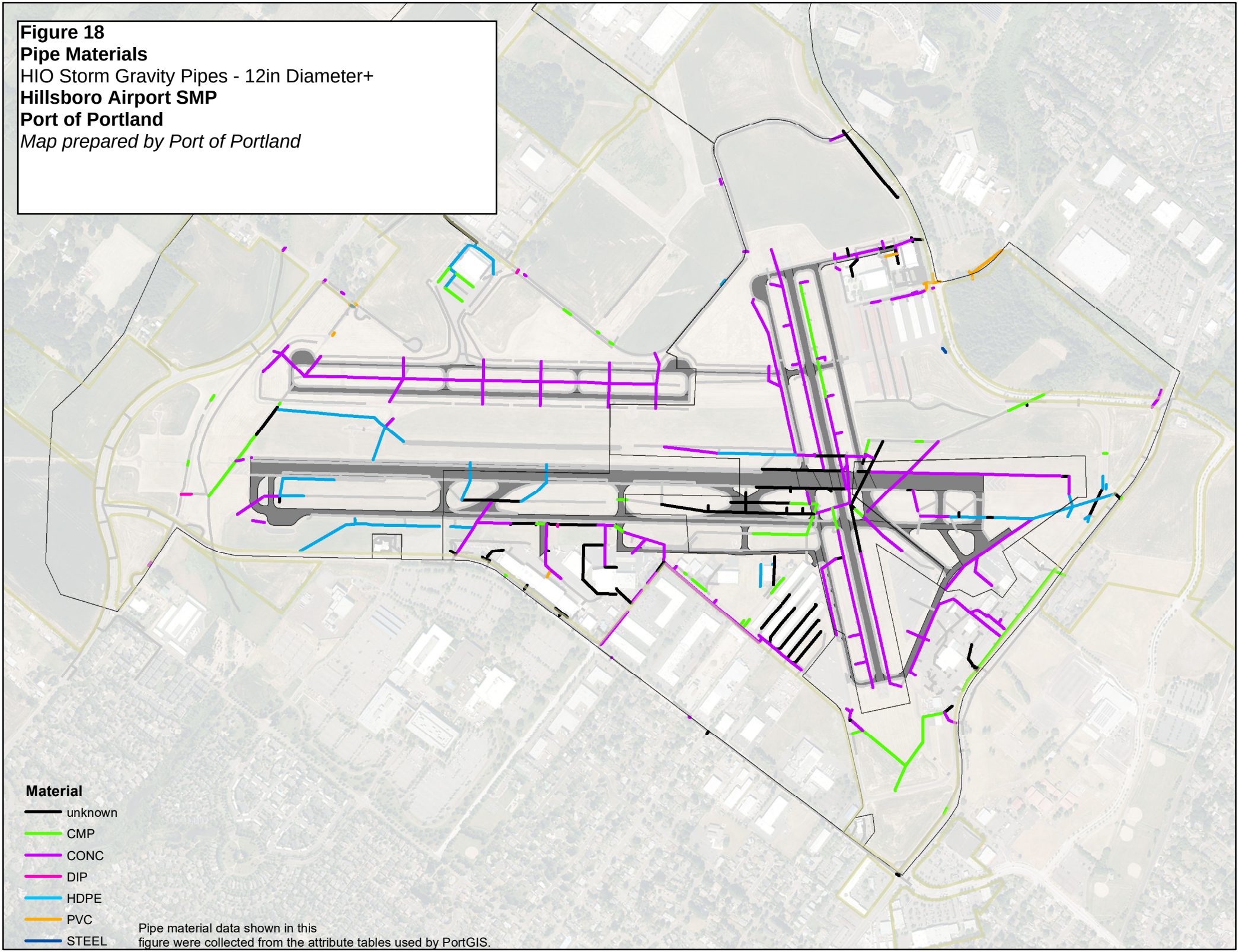
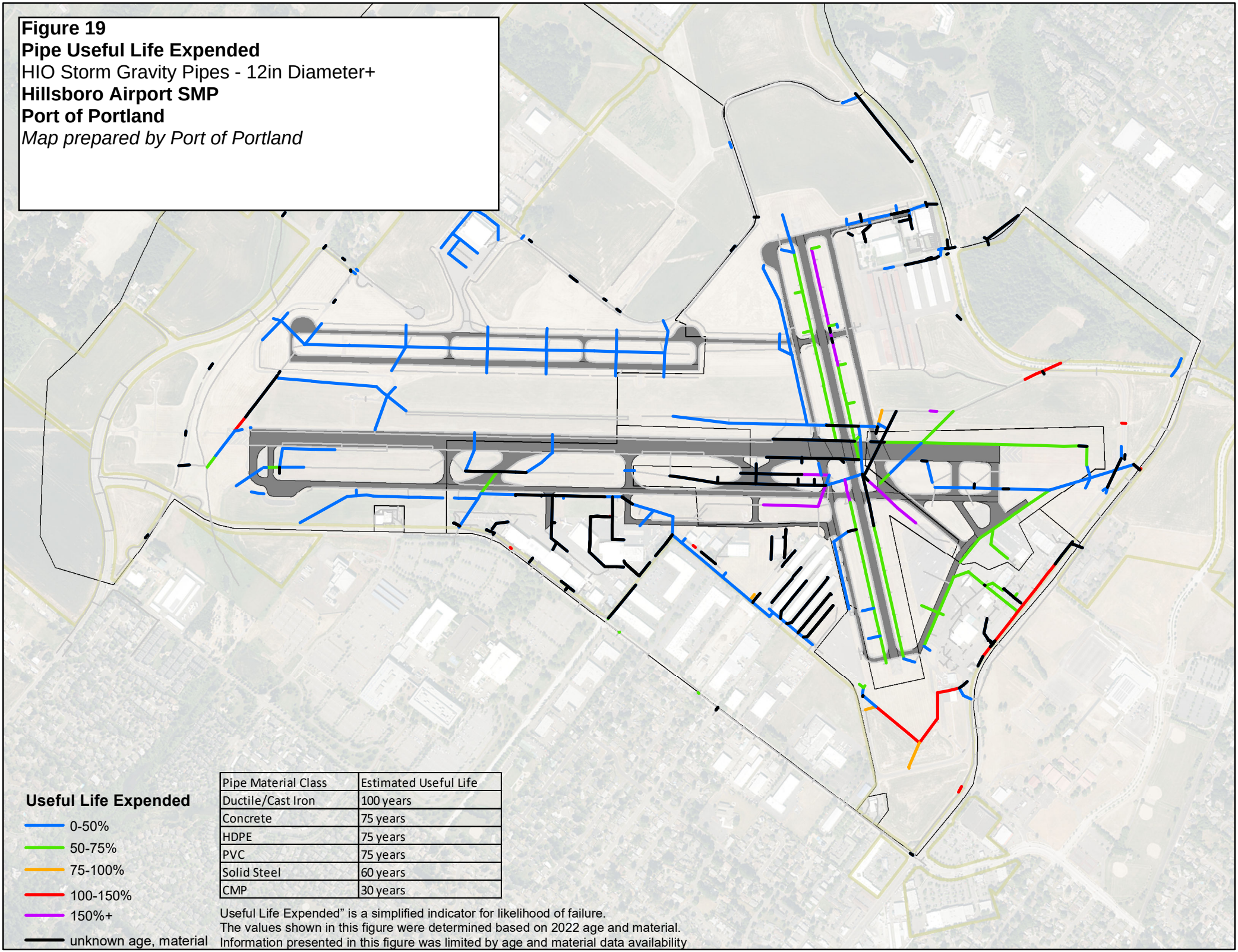


Figure 18
Pipe Materials
HIO Storm Gravity Pipes - 12in Diameter+
Hillsboro Airport SMP
Port of Portland
Map prepared by Port of Portland



Pipe material data shown in this figure were collected from the attribute tables used by PortGIS.

Figure 19
Pipe Useful Life Expended
HIO Storm Gravity Pipes - 12in Diameter+
Hillsboro Airport SMP
Port of Portland
Map prepared by Port of Portland



Useful Life Expended

- 0-50%
- 50-75%
- 75-100%
- 100-150%
- 150%+
- unknown age, material

Pipe Material Class	Estimated Useful Life
Ductile/Cast Iron	100 years
Concrete	75 years
HDPE	75 years
PVC	75 years
Solid Steel	60 years
CMP	30 years

Useful Life Expended" is a simplified indicator for likelihood of failure.
The values shown in this figure were determined based on 2022 age and material.
Information presented in this figure was limited by age and material data availability

Figure 20
RECOMMENDED ASSET REPLACEMENTS

HILLSBORO AIRPORT SMP

PORT OF PORTLAND
HILLSBORO, OREGON

MAP EXPLANATION

Asset Replacement
- Standalone Replacements
- CIP 5
- CIP 7
- CIP 8
- CIP 9
- CIP 11
- CIP 12
- Work Area 6

HIO Conveyances
- Subterranian Drainage
- Culvert
- Storm Sewer Ditch Centerline
- Storm Sewer Pipe

Background Data
- HIO Primary Wildlife Boundary
- HIO Property Line
- HIO RPZ
- HIO Wetlands
- Streams
- HIO Property Mask
- Treated Impervious Surfaces

Date: 3/13/2023
Disclaimer: This data is not to survey accuracy and is meant for planning purposes only.

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0 500 1,000 2,000 Feet

Esri Community Maps Contributors, City of Hillsboro, Oregon, Oregon Metro, Oregon State Parks, State of Oregon GEO, WA State Parks GIS, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA

V:\PROJECT\19400\19442\CADD\GIS\MXDS\TASK 5-ASSET INVENTORY\ASSET REPLACEMENT FIGURE.APRX

Asset Replacement Cost Estimation

For storm sewer segments that are nearing or beyond their estimated lifespan (>75% useful life expended), planning-level cost estimates to replace with Class V reinforced concrete pipe at the same diameter have been developed. This does not include costs for upsizing or adding water quality treatment. Cost estimates include assumptions that would meet current design standards, such as installing two catch basins and one manhole per 400 linear feet of pipe. The unit cost estimates have been derived from 2022 project data from the Oregon Department of Transportation. These planning-level recommendations do not include soft costs and will need to be re-evaluated and updated at the time of design. See Appendix B for the Asset Replacement Memo that describes the cost estimation process for asset replacement and individual asset replacement cost estimates. Cost savings may be possible if asset replacement is included in planned development and redevelopment projects or as part of the phased implementation of the SMP projects. Table 7 summarizes the asset replacement cost estimates by CIP project or work area and Table 8 summarizes the cost estimates for standalone asset replacements.

Table 7 Asset Replacement Costs by SMP CIP Project or Work Area

CIP or Work Area	Asset Replacement Cost Estimate
5	$180,400
6	$42,250
7	$214,950
8	$448,450
9	$194,250
11	$84,200
12	$275,370
Total	**$1,439,870**

Table 8 Standalone Asset Replacement Costs

Standalone Location	Asset Replacement Cost Estimate
A-A	$64,810
A-B	$355,960
A-C	$231,560
A-D	$21,400
A-E	$186,880
A-F	$604,750
Total	**$1,465,360**

Section 6. Implementation

This section discusses project recommendations, potential phasing, and grouping of stormwater projects with HIO Master Plan development projects. Implementation of stormwater projects is dependent on a number of factors, including HIO Master Plan development project implementation, Port funding availability, federal funding or grant appropriations, private investment and/or tenant improvements, land acquisition, other infrastructure investments, and City and County funding and implementation of public road projects. The project recommendations below use project implementation and phasing assumptions consistent with the HIO Master Plan. Recommendations also include the implementation of standalone stormwater projects to help meet LOC goals. The timelines, while aligned with the HIO Master Plan, are not confirmed and should be used for planning purposes only. At the time of actual implementation, the Port will re-evaluate site conditions, design standards, regulatory requirements, and conceptual design assumptions. The Port will also re-evaluate SMA selection and design.

The Preferred Stormwater Alternative identifies 16 work areas. The ten recommended stormwater CIP projects include the conveyance capacity needs for their related work areas. For example, CIP Project 5 includes conveyance capacity recommendation C3. Individual CIP Project Fact Sheets provide additional information on the proposed phasing, design assumptions, and HIO Master Plan project dependencies (see Appendix A for CIP Project Fact Sheets).

Recommended Stormwater Project Implementation

The SMP recommends grouping projects by work area. For work areas with a CIP project, the SMP recommends also including the asset replacement and the conveyance capacity needs in the same design and construction budget. See Table 9 for cumulative cost estimates by work area or standalone project area. The conveyance and asset replacement projects not associated with a work area could be grouped with an HIO Master Plan development project. For example, conveyance capacity projects C1 and C2 could be bundled with HIO Master Plan Project L-26 or implemented as standalone projects at any point. Similarly, standalone asset replacement projects could be bundled with HIO Master Plan projects or implemented as standalone projects. Assets identified as conveyance-limited or useful life-limited could also be grouped by watershed or bundled into similar cost construction projects for ease of design and construction bidding.

Table 9 Summary of Recommended Stormwater Project Costs

Work Area	Stormwater CIP Project	Conveyance Capacity Project	Asset Replacement?	Sum of Estimated Costs
1	n/a	n/a	No	Not Estimated
2	2	n/a	No	$7,619,300 to $8,466,300
3	3	n/a	No	$5,836,500 to $6,734,500
4	4	n/a	No	$687,200 to $742,200
5	5	C3*	Yes	$2,012,800 to $2,294,800
6	n/a	n/a	Yes	$42,250, stormwater improvements for Cornell Road realignment not estimated
7	7	n/a	Yes	$7,790,500 to $8,649,500
8	8	n/a	Yes	$956,650 to $991,550
9	9	n/a	Yes	$787,750 to $879,050
10	10	n/a	No	$481,800 to $555,900
11	11	n/a	Yes	$1,592,700 to $1,824,700
12	12	n/a	Yes	$2,012,070 to $2,279,070
13	n/a	n/a	No	Not Estimated
14	n/a	n/a	No	Not Estimated
15	n/a	n/a	No	Not Estimated
16	n/a	n/a	No	Not Estimated
Standalone		C2	No	Not Estimated
Standalone		C3	No	Not Estimated
Standalone		n/a	A-A	$64,810
Standalone		n/a	A-B	$355,960
Standalone		n/a	A-C	$231,560
Standalone		n/a	A-D	$21,400
Standalone		n/a	A-E	$186,880
Standalone		n/a	A-F	$604,750
Sum of Cost Estimates				**$31,284,880 to $34,925,180**

Stormwater projects outside of a work area or do not have an associated HIO Master Plan project were not given a CIP number.
**Costs are included in CIP Project 5.*

Recommended Stormwater Project Sequencing and Phasing

The HIO Master Plan Preferred Development Alternative recommends project implementation in three phases, short-term (0-5 years), intermediate term (6-10 years), and long-term (11-20 years). The recommended stormwater improvements can be similarly phased. Standalone projects and asset replacements could be grouped with adjacent HIO Master Plan projects or bundled into similarly sized

construction projects. Actual timing of projects is dependent on many factors and likely will vary from the planned phasing.

Short-Term Stormwater Projects (1-5 years)

Three stormwater projects are recommended in the short term:

- SMP CIP Project 3 (Phase 1): Springer Street/NE 30th Street Improvement Planters.
- SMP CIP Project 11: Infill Hangars and Control Tower Replacement Vicinity Underground Treatment and Detention.
- Work Area 16: MLFS for untreated impervious on Taxiway B (northeast) and Runway 13R-31L. This may be implemented with the Taxiway B Reconstruction Project which is currently planned for construction in 2025. There is no fact sheet or cost estimate for this project.

Intermediate-Term Stormwater Projects (6-10 years)

Five stormwater projects are recommended in the intermediate term:

- SMP CIP Project 4: T-Hangar Underground Stormwater Treatment Vaults.
- Work Area 6: Cornell Road Realignment. There is no fact sheet or cost estimate for this project as the project will not be implemented by the Port.
- SMP CIP Project 7: Southwest Terminal and Rental Car Parking Underground Treatment and Detention.
- SMP CIP Project 8: Phase II Loop Road Underground Treatment.
- Work Area 14: NE 25th Realignment Planters. There is no fact sheet or cost estimate for this project as the project will not be implemented by the Port.

Long-Term Stormwater Projects (11-20 years)

Ten stormwater projects are recommended in the long term:

- Work Area 1: Helipad MLFS and Underground Detention. There is no fact sheet or cost estimate for this project.
- SMP CIP Project 2: Flight School and Aviation Reserve Extended Dry Basin
- SMP CIP Project 3 (Phase 2): NE Springer Street extension to Brookwood Pkwy
- SMP CIP Project 5: Taxiway E MLFS and Underground Detention. This includes improvements to conveyance capacity (location C3 on Figure 16).
- SMP CIP Project 9: New Maintenance Facility Underground Treatment and Detention.
- SMP CIP Project 10: Taxiway B (southwest) MLFS and Underground Detention.
- SMP CIP Project 12: Taxiway AA MLFS and Underground Detention.
- Work Area 13: Community View Point Rain Garden. There is no fact sheet or cost estimate for this project.
- Work Area 15: Vehicle Service Route Permeable Pavement. There is no fact sheet or cost estimate for this project.
- Conveyance Capacity Project C1. There is no fact sheet or cost estimate for this project.
- Conveyance Capacity Project C2. There is no fact sheet or cost estimate for this project.

See Table 10 for a summary of the proposed SMP implementation sequence for CIP projects and conveyance improvement projects.

Table 10 SMP Recommended Project by Implementation Phase

HIO Master Plan Implementation Phase	CIP or Conveyance Project	Related HIO Master Plan development and redevelopment project(s)
Short-Term	3	HIO Master Plan S-2, S-3, S-4, L-1, L-2
Short-Term	11	HIO Master Plan S-7, I-16, L-35
Short-Term	16	Could be implemented with Taxiway Bravo project, which is currently being undertaken and does not have a Master Plan identifying number (Taxiway B Reconstruction)
Intermediate-Term	6	HIO Master Plan I-13
Intermediate-Term	7	HIO Master Plan I-2, I-3, I-5, I-6, I-7, I-8, L-6, L-18, L-19, L-20, L-23, L-30
Intermediate-Term	8	HIO Master Plan L-31
Intermediate-Term	14	HIO Master Plan I-12
Intermediate-Term	4	HIO Master Plan L-16
Long-Term	1	HIO Master Plan L-13, L-26
Long-Term	2	HIO Master Plan L-7, L-10, L-11, L-12, L-15
Long-Term	5 (plus C3)	HIO Master Plan L-4, L-5, L-14
Long-Term	9	HIO Master Plan L-28, L-33
Long-Term	10	HIO Master Plan L-17
Long-Term	12	HIO Master Plan L-25
Long-Term	13	HIO Master Plan L-34
Long-Term	15	HIO Master Plan L-11, L-14
Long Term	C1	HIO Master Plan L-26
Long Term	C1	HIO Master Plan L-26

Table 11: HIO Master Plan Project Phasing with Recommended Stormwater Solutions

2018 HIO Master Plan Projects (See Figure 2 from this plan or Exhibit 6B from HIO Master Plan)			HIO SMP Recommendations
Project	**Master Plan Phasing**	**Description**	**SMP Solution(s)**
S-1	Short Term 1-5 Years	Comprehensive Environmental Assessment (EA)	n/a
S-2	Short Term 1-5 Years	Widen NE 30th Ave	CIP 3
S-3	Short Term 1-5 Years	Widen/Extend NE Springer St	CIP 3
S-4	Short Term 1-5 Years	Intersection Improvements at 30th & Evergreen	CIP 3
S-5	Short Term 1-5 Years	Industrial Development - S of Springer Street	tenant responsibility
S-6	Short Term 1-5 Years	Industrial Development - N of Springer Street	tenant responsibility
S-7	Short Term 1-5 Years	Infill Hangar - South	CIP 11
S-8	Short Term 1-5 Years	Redevelop Hotel	tenant responsibility
S-9	Short Term 1-5 Years	Construct Crossfield Twy and Remove Exiting Twy A3 and D2	in progress, not included in SMP
I-1	Intermediate Term 6-10 Years	Comprehensive Environmental Assessment (EA)	n/a
I-2	Intermediate Term 6-10 Years	Terminal Building Constructions with Phase I Loop Road from 34th Ave	CIP 7
I-3	Intermediate Term 6-10 Years	Terminal Apron	CIP 7
I-4	Intermediate Term 6-10 Years	Regional South Stormwater Treatment Area	CIP 7
I-5	Intermediate Term 6-10 Years	Rental Car Parking Phase I	CIP 7
I-6	Intermediate Term 6-10 Years	Phase I Parking for New Terminal Building	CIP 7
I-7	Intermediate Term 6-10 Years	Repurpose Mushroom Building as EV Charging Station and Decommission Tanks	CIP 7
I-8	Intermediate Term 6-10 Years	Employee Parking	CIP 7
I-9	Intermediate Term 6-10 Years	Relocate Existing Beacon	No SWM Requirements
I-10	Intermediate Term 6-10 Years	Remove Existing Terminal Building	No SWM Requirements
I-11	Intermediate Term 6-10 Years	Twy A6 Improvements	in progress, not included in SMP
I-12	Intermediate Term 6-10 Years	Relocate NE 25th	Work Area 14
I-13	Intermediate Term 6-10 Years	Relocate Cornell Road	Work Area 6
I-14	Intermediate Term 6-10 Years	Construct Single Story Commercial Retail (Middle Parcel)	tenant responsibility
I-15	Intermediate Term 6-10 Years	Airport Entrance Monument	No SWM Requirements
I-16	Intermediate Term 6-10 Years	Infill Hangars - North	CIP 11
L-1	Long Term 11-20 Years	Extend Springer St. to Brookwood Pkwy	CIP 3
L-2	Long Term 11-20 Years	Intersection Improvements at Springer St & Brookwood Pkwy	CIP 3
L-3	Long Term 11-20 Years	Industrial Development East Toward Brookwood	tenant responsibility
L-4	Long Term 11-20 Years	South Portion of Twy E	CIP 5 (includes C3)
L-5	Long Term 11-20 Years	Twy B2 Relocation	CIP 5 (includes C3)
L-6	Long Term 11-20 Years	De-icing/Wash Rack/Rental Car Prep	CIP 7
L-7	Long Term 11-20 Years	North Side Taxilane (Phase I)	CIP 2

2018 HIO Master Plan Projects (See Figure 2 from this plan or Exhibit 6B from HIO Master Plan)			HIO SMP Recommendations
Project	**Master Plan Phasing**	**Description**	**SMP Solution(s)**
L-8	Long Term 11-20 Years	Regional Northeast Water Quality Facility	n/a
L-9	Long Term 11-20 Years	Runup Pad Construction on Twy D	Work Area 1
L-10	Long Term 11-20 Years	NE 30th Expansion to Flight School	CIP 2
L-11	Long Term 11-20 Years	Vehicle Service Route (VSR)	CIP 2, Work Area 15
L-12	Long Term 11-20 Years	Flight School Apron Fuel Island	CIP 2
L-13	Long Term 11-20 Years	Helipad Constuction	Work Area 1
L-14	Long Term 11-20 Years	VSR from Springer to T-hangars	CIP 5 (includes C3) and Work Area 15
L-15	Long Term 11-20 Years	North Side Taxilane (Phase II)	CIP 2
L-16	Long Term 11-20 Years	Remove T-Hangars	CIP 4
L-17	Long Term 11-20 Years	Extend Twy B and Remove Pavement	CIP 10
L-18	Long Term 11-20 Years	Remove Hillsboro Aero Academy Hangars and Ramp	CIP 7
L-19	Long Term 11-20 Years	Rental Car Parking Phase II	CIP 7
L-20	Long Term 11-20 Years	Apron Connectors and Pavement Removal	CIP 7
L-21	Long Term 11-20 Years	Remove Hangar 3301	No SWM Requirements
L-22	Long Term 11-20 Years	Remove Sheepspen Hangar (3301-A)	No SWM Requirements
L-23	Long Term 11-20 Years	Phase II Loop Road and Parking Expansion	CIP 7
L-24	Long Term 11-20 Years	Regional South Stormwater Treatment Area	n/a
L-25	Long Term 11-20 Years	Relocate Twy AA and Convert Old Twy AA to Service Road	CIP 12
L-26	Long Term 11-20 Years	Construct Twy To Connect Rwy 13 Thresholds	Work Area 1, C2, and C3
L-27	Long Term 11-20 Years	Land Acquisition on Evergreen Road	No SWM Requirements
L-28	Long Term 11-20 Years	Maintenance Facility	CIP 9
L-29	Long Term 11-20 Years	Single Story Commercial Retail (East Parcel)	tenant responsibility
L-30	Long Term 11-20 Years	34th Ave and Cornell Improvements, Roundabout Leading to Terminal	CIP 7
L-31	Long Term 11-20 Years	Connect Phase II Loop Road to Cornell Rd	CIP 8
L-32	Long Term 11-20 Years	Single Story Commercial Retail (West Parcel)	tenant responsibility
L-33	Long Term 11-20 Years	Extend Twy B to Flight Museum	CIP 9
L-34	Long Term 11-20 Years	Community View Point off of NE 25th Ave	Work Area 13
L-35	Long Term 11-20 Years	Convert Twy AA to VSR	CIP 11
L-36	Long Term 11-20 Years	RPZ Land Acquisition	No SWM Requirements

Tracking Water Quality Treatment Progress

As a condition of the LOC, the Port has committed to developing a process to track impervious surfaces that need treatment. As presented in this SMP, the Port has developed an HIO Impervious Area and Water Quality Tracking Spreadsheet that will help track planned and actual progress towards meeting the goal of water quality treatment for all impervious surfaces. The spreadsheet also tracks the 3:1 water quality mitigation requirement for each individual project as part of progress towards the treatment goal for the entire facility. The spreadsheet consists of three tabs: instructions, project information, and a chart of progress towards the goal of 100% water quality treatment. The Port will update the spreadsheet during the early planning phases of individual projects using preliminary information and will finalize values in the tracker after construction. See Appendix C for the HIO Impervious Area and Water Quality Tracking Spreadsheet with in-progress and future short-term stormwater project information current as of spring 2023. Appendix C also includes an Impervious Surface Stormwater Treatment Tracking map. Both Port and tenant project managers will be required to provide project information. Appendix D includes a draft project checklist for tracking relevant project information at HIO.

HIO SMP projects that support HIO Master Plan projects will be constructed concurrently, while standalone projects will need to be evaluated by the Port's CIP Planners and entered in the CIP Portfolio. Standalone stormwater treatment projects will be prioritized to help meet treatment goals.

Conclusion

This SMP supports the HIO Master Plan in identifying SMAs, conveyance capacity needs, and recommended stormwater asset replacement to successfully manage stormwater from all HIO Master Plan development and redevelopment projects and from existing development. This SMP identifies general work areas that can accommodate changes to implementation of the HIO Master Plan. The HIO Master Plan is a planning tool and actual development of the HIO facility may proceed differently due to future changes to regulations, development scenarios, private investment priorities, availability of Port funding, and public agency funding. The HIO Master Plan will be updated per FAA guidelines, which will also require the HIO SMP to be updated. While this HIO SMP accounts for development and redevelopment projects as planned in the HIO Master Plan, actual future development or redevelopment projects may not entirely align with either the HIO Master Plan or the HIO SMP.

The LOC between the Port, the City, and CWS set an agreed upon goal of water quality treatment for all impervious surface at HIO. Under current practices, project-by-project water quality mitigation would not result in 100% treatment of impervious surfaces at HIO. This SMP provides a path forward in identifying proactive standalone stormwater projects to accelerate progress towards the goal of 100% water quality treatment. If the SMP is fully implemented, 100% of impervious surfaces on HIO will be served by a water quality treatment facility within the 20-year time frame.

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Appendix A

Capital Improvement Program (CIP) Project Fact Sheets

HIO Stormwater Master Plan
CIP Fact Sheet
Work Area 2

PORT OF PORTLAND

Summary

Work Area	Solution Description	Total Project Cost	Expected Construction
2	Provide regional water quality treatment and hydromodification mitigation using an Extended Dry Basin for planned flight school and aviation reserve	$7,619,300 to $8,466,300	2030-2039

Stormwater Management Need

Required Post-Construction Stormwater Controls – Water Quality	X
Required Post-Construction Stormwater Controls – Hydromodification	X
Required Post-Construction Stormwater Controls – LIDA	X
Water Quality Treatment for Existing Impervious Surfaces	

Development projects in Work Area 2 will include post-construction stormwater management controls as required by City of Hillsboro (City) and Clean Water Services (CWS) standards. The proposed planning-level improvements address the listed requirements. The CIP will manage stormwater runoff from the following HIO Master Plan projects (Figures 1 and 2, respectively, of the HIO SMP) as well as from tenant improvements at the proposed flight school location.

Project No.	Project Name	Project Phasing
L-7	Construct North Side Taxilane and Enabling Infrastructure (Phase I - Flight School)	11-20 Years
L-10	NE 30th Extension to Flight School	11-20 Years
L-11	Vehicle Service Route (VSR) Construction*	11-20 Years
L-12	Flight School Apron Fuel Island	11-20 Years
L-15	Construct North Side Taxilane and Enabling Infrastructure (Phase II)	11-20 Years

* A portion of Project L-11, VSR Construction, is in a different drainage basin and is described in SMP Work Area 15.

Proposed Improvements

The following planning-level improvements are proposed:

- Extended Dry Basin for water quality treatment and hydromodification mitigation.
- Pipe and structures to convey runoff from the proposed improvements to the Extended Dry Basin.
- Bypass pipe to convey flows from the storm system along NE 30th Avenue around the Extended Dry Basin to the existing ditch to the west.

The Extended Dry Basin addresses CWS's preference for vegetated facilities. The location of the basin is within the HIO Primary Wildlife Boundary, so a bird net will be included to limit its attractiveness to wildlife.

The existing site generally slopes to the north. Runoff from the proposed projects and tenant improvements will be conveyed north to the Extended Dry Basin. All current flows upstream of the project site flow west through an existing ditch that runs through the location of the proposed extended dry basin. These flows along with expected flows from future developments upstream of Work Area 2 will be piped around the extended dry basin and discharged to the ditch near the western property line to maintain the existing wetland.

The facility is sited in the low portion of a site which contains an existing conveyance ditch and a wetland. Wetland mitigation will be required.

The design approach assumes groundwater to be approximately 5-feet below ground surface.

Timing and Phasing

The recommended timing is to construct the Extended Dry Basin with the first development which it is intended to serve, and runoff from later phases of development in the facility's drainage should be routed to it as they are constructed. The flow control structure elevation and size should be evaluated to confirm that hydromodification targets are met with each subsequent development phase. Temporary irrigation will be required for plant establishment and is anticipated to be needed for interim plant survival until development phases have been completed.

Solution Sizing Basis

Work Area 2 includes the construction of an Extended Dry Basin to manage the impervious area within a 33.46-acre basin. The required detention volume was estimated using a hydraulic model to match post-development peak runoff rates to pre-development peak runoff rate targets per CWS's peak-flow matching design criteria for hydromodification mitigation. Based on the existing ground surface and downstream conveyance elevation, 4-foot depth of ponding is estimated with a 2-foot-high berm.

Extended Dry Basin

- Manages 28.44 acres of impervious area
- Facility Volume = 293,620 cf
- With a 4-foot depth and 3:1 side slopes, the 293,620 cf volume = approximately 77,000 sf facility footprint

Conveyance Pipe to Extended Dry Basin

- Conveys runoff from 33.46 acres of future development which is similar in runoff characteristics to commercial or industrial development
- Assumes contributing basin is 85% impervious
- 25-year peak flow = 49 cfs calculated using the rational method
- Pipe size and slope = 24-inch diameter at 0.5% slope calculated using Manning's Equation

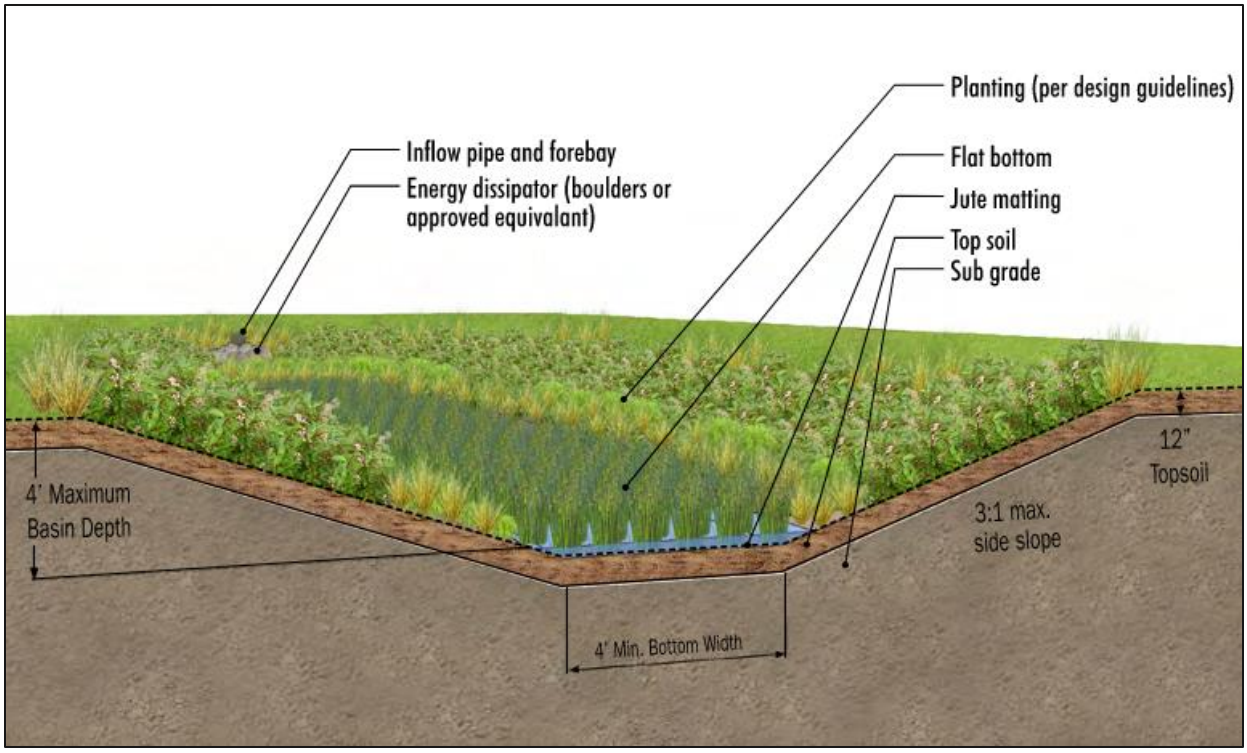
Bypass Pipe to Ditch

- Conveys existing modeled flows of 18 cfs to the ditch
- Conveys flows from future impervious surfaces from NE 30th Avenue and NE Springer Street upstream (see HIO SMP Work Area 3 fact sheet) estimated to be 18 cfs
- Pipe size and slope = 2 parallel 21-inch diameter pipes at 0.3% slope calculated using Manning's Equation

Design and Implementation Considerations and Constraints

Consideration	Description
Data Collection	▪ Geotechnical – Depth to groundwater at location of proposed Extended Dry Basin.
Permitting	▪ Stormwater solutions must be approved by City of Hillsboro with a Service Provider Letter from Clean Water Services. ▪ Wetland impacts must be approved by USACE and DSL. ▪ We assume existing flows to the ditch which flows west onto private property from the site must be maintained. During final design, a downstream analysis is advisable and consideration of other options for maintaining flows or abandoning the ditch and mitigating the impacts could be considered with the permitting agencies.
Siting	▪ The Extended Dry Basin is located at the low area of the site and in a position to connect to the downstream system. ▪ Bypass conveyance pipe is located adjacent to the right-of-way for maintenance access. ▪ Ability to achieve a 48-hour pond drawdown time at the proposed location is unknown and will depend on groundwater elevations, downstream conveyance capacity, and facility layout.
Wildlife Attractants	▪ Attracting wildlife has been mitigated with the use of a bird net.
Coordination	▪ The extended dry basin will manage flows from tenant improvements. The Port may negotiate reimbursement for a proportional share of the project cost with tenants.

Figures



Extended Dry Basin Typical Section Illustration from CWS 2021 LIDA Handbook

Work Area 2 - CIP Cost Opinion

The planning-level cost opinion (2022 dollars) is based on preliminary estimates of quantities. CIP 2 is a standalone project which is not dependent on an underlying Port infrastructure project. Therefore, CIP 2 includes mobilization, erosion and sediment control, survey, design, and project administration. No cost escalation is included. A narrative description of operations and maintenance is included.

Construction	Qty	Unit	Unit Price	Amount
12 Inch Storm Sewer Pipe	3,750	LF	$160	$600,000
18 Inch Storm Sewer Pipe	60	LF	$200	$12,000
21 Inch Storm Sewer Pipe	1,140	LF	$210	$239,400
24 Inch Storm Sewer Pipe	2,200	LF	$220	$484,000
Manhole	15	EA	$8,000	$120,000
Area Drain	75	EA	$5,000	$375,000
Flow Control Structure	1	EA	$14,000	$14,000
Large Mahnhole	2	EA	$16,000	$32,000
Concrete Manholes 60" Dia. Water Quality (with Snout)	1	EA	$10,000	$10,000
Wildlife Deterrent Netting	77,000	SF	$5	$385,000
Extended Dry Basin	77,000	SF	$18	$1,386,000
Temporary Irrigation	77,000	SF	$1	$77,000
Mobilization	5%	of Total Construction		$296,000
Erosion and Sediment Control	3%	of Total Construction		$178,000
Temporary Water Management	1	LS		$25,000
Construction Subtotal				***$4,233,400***
Construction Contingency	30% - 50%			$1,270,000 to $2,117,000
Total Construction Cost				$5,503,400 to $6,350,400

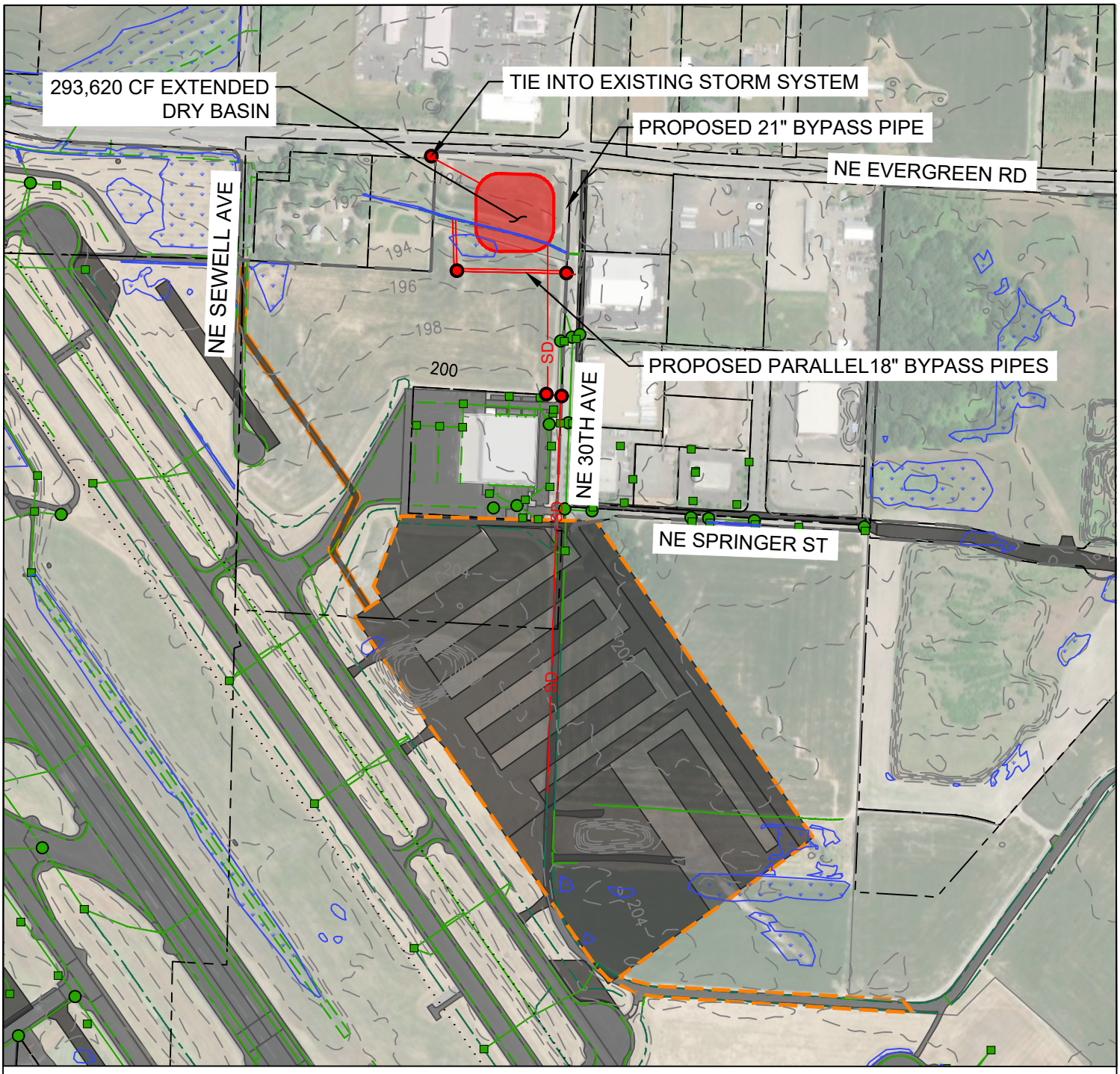
Soft Costs*	Assumptions			
Survey	2%	of Construction		$119,000
Design**	10%	of Construction		$500,000
Basic Permitting	1	LS		$15,000
Water Quality Sensitive Area Permitting	1	LS		$50,000
Environmental Mitigation	9150	SF	$6	$54,900
Project Administration	15%	of Construction		$889,000
Soft Costs Subtotal				***$1,627,900***
Soft Costs Contingency	30%	of Subtotal		$488,000
Total Project Cost				**$7,619,300 to $8,466,300**

* Soft costs are calculated on a total construction cost that includes a 40% construction contingency.

** Design costs are calculated by percentage but are no less than $150,000 and no more than $500,000.

Operation and Maintenance

The Extended Dry Basin should be inspected quarterly for erosion, sediment and trash accumulation, vegetation coverage, and invasive vegetation. Remove sediment from the bottom during the dry season. In the early spring cut tall grass to 4 to 6 inches and prune overgrown shrubs.



LEGEND

- STORM PIPE
- PROPOSED STORM PIPE (SD)
- 2 FT CONTOURS
- HIO BOUNDARY
- PERFORATED STORM PIPE
- DITCH STORM CENTERLINE
- TAXLOTS
- STORM MANHOLE
- STORM CATCH BASIN
- EXISTING IMPERVIOUS
- PROPOSED IMPERVIOUS
- PROPOSED MANHOLE
- PROPOSED CATCH BASIN
- MANAGED IMPERVIOUS AREA BOUNDARY
- PROPOSED EXTENDED DRY BASIN
- JURISDICTIONAL WETLANDS

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PORT OF PORTLAND

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CIP LOCATION 2

HIO Stormwater Master Plan

HIO Stormwater Master Plan
CIP Fact Sheet
Work Area 3

PORT OF PORTLAND

Summary

Work Area	Solution Description	Total Project Cost	Expected Construction
3	Provide water quality treatment and hydromodification mitigation using planters along planned Springer Street improvements and extension and NE 30th Street Extension	$5,836,500 to $6,734,500	2020-2039

Stormwater Management Need

Required Post-Construction Stormwater Controls – Water Quality	X
Required Post-Construction Stormwater Controls – Hydromodification	X
Required Post-Construction Stormwater Controls – LIDA	X
Water Quality Treatment for Existing Impervious Surfaces	

Development projects in Work Area 3 will include post-construction stormwater management controls as required by City of Hillsboro (City) and Clean Water Services (CWS) standards. The proposed planning-level improvements address the listed requirements. The CIP will manage stormwater runoff from the following HIO Master Plan projects (Figures 1 and 2, respectively, of the HIO SMP).

Project No.	Project Name	Project Phasing
S-2	Widen NE 30th Avenue	1-5 Years
S-3	Widen/Extend NE Springer Street	1-5 Years
S-4	Intersection Improvements at 30th & Evergreen	1-5 Years
L-1	Extend Springer Street to Brookwood Pkwy	11-20 Years
L-2	Intersection Improvements at Springer St & Brookwood Pkwy	11-20 Years

Proposed Improvements

The following planning-level improvements are proposed:

- Street-side Planters in the landscape strip.
- Conveyance piping to connect the planters and upstream private development to the downstream conveyance systems.

The Street-side Planter is an ideal water quality and hydromodification solution along the roadway because the facilities fit well within a typical roadway section and the facility meets CWS's preference for vegetated facilities. Most of the work area is outside of the HIO Primary Wildlife Boundary, except for the existing segment of NE Springer Street, which extends east from NE 30th Avenue approximately 1,000 feet to its current end point. Street-side planters minimize wildlife attraction because they have minimal ponding.

Street-side Planters will be constructed in the landscape strips to provide water quality treatment and hydromodification mitigation. A slight high point exists near the half-way point of the proposed Springer Street extension. The area to the south drains south towards NE Brookwood Parkway and the area to the north drains along NE 30th Avenue to NE Evergreen Road. Treated runoff from the planters will be conveyed in pipes to the downstream systems in each basin.

The design assumes both NE 30th Avenue and NE Springer Street will be constructed to the City of Hillsboro Collector Road standard with a 66' right-of-way. The design assumes that intersection improvements at NE 30th Avenue and NE Evergreen Road and at NE Springer Street and NE Brookwood Parkway entail striping and signalization without additional impervious area.

Timing and Phasing

The recommended timing is to construct the required stormwater management facilities with each road project.

Solution Sizing Basis

NE 30th Avenue Widening Street-side Planters

- Manages 0.48 acres of impervious area in the right-of-way
- CWS Hydromodification sizing factor = 12%
- Planter area required for treatment and hydromodification = 2,500 sf

NE Springer Street Widening Street-side Planters

- Manages 0.62 acres of impervious area in the right-of-way
- CWS Hydromodification sizing factor = 12%
- Planter area required for treatment and hydromodification = 3,240 sf

NE Springer Street Extension Street-side Planters

- Manages 3.86 acres of impervious area in the right-of-way
- CWS Hydromodification sizing factor = 12%
- Planter area required for treatment and hydromodification = 20,100 sf

Conveyance Pipe South

- Conveys runoff from 2.64 acres of proposed right-of-way improvements
- Assumes future private development north of the project area will continue to discharge to the same point as in existing conditions and not contribute to the system
- 25-year peak flow = 1.41 cfs estimated using the rational method
- Pipe size and slope = 12-inch diameter at 0.22% slope calculated using Manning's Equation

Conveyance Pipe North

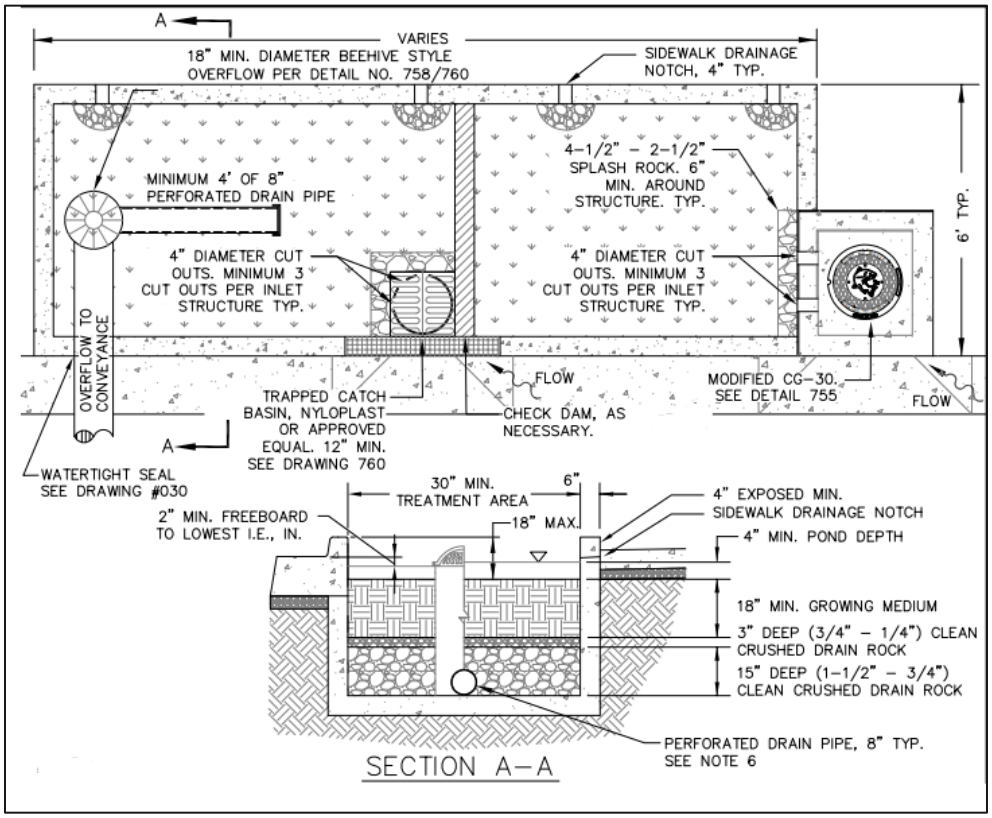
- Conveys runoff from 67 acres of right-of-way and planned private development on HIO
- Assumes contributing private development upstream provides mitigation for hydromodification to pre-developed conditions prior to connecting to the system
- 25-year peak flow = 36 cfs estimated using the rational method
- Pipe size and slope = 21-inch diameter at 0.2% slope calculated using Manning's Equation

Design and Implementation Considerations and Constraints

Consideration	Description
Data Collection	▪ Survey – confirm existing utilities along NE 30th Avenue and NE Springer Street. This project provides the stormwater management that will be required for projects described in the HIO Master Plan. Survey data is assumed to be collected as part of the underlying road project(s). ▪ Hydraulic modeling suggests that the capacity of Glencoe Swale limits the discharge of stormwater through the proposed northern conveyance network. A downstream analysis is recommended during design of the underlying road project(s).
Permitting	▪ Stormwater solutions must be approved by City of Hillsboro with a Service Provider Letter from Clean Water Services. ▪ Assumes any wetland impacts will be permitted with the underlying road project(s).
Siting	▪ Street-side Planter locations have not been selected and will depend on street alignment in relationship to the RPZ and runway, street design grade, and inlet placement.
Wildlife Attractants	▪ Attracting wildlife can be minimized with planter design that limits standing water. ▪ Plants may be selected from the Port of Portland Airport Landscaping Standards. Alternative plant selection may require approval by Clean Water Services.
Coordination	▪ Stormwater management facilities on public streets will be dedicated to the public agency. NE 30th Street is a City of Hillsboro street, and the Springer Street extension is expected to be a City of Hillsboro Street. Street-side Planter design should conform to City of Hillsboro Design and Construction Standards. ▪ The sizing of the northern conveyance network assumes future upstream private developments on HIO will connect to it. ▪ The stormwater management design assumes that upstream developments will provide water quality treatment and mitigation for hydromodification prior to connecting to the conveyance system.

Figures

Example Street-side Planter



LIDA Planter Typical Detail and Section (CWS drawing)

Work Area 3 - CIP Cost Opinion

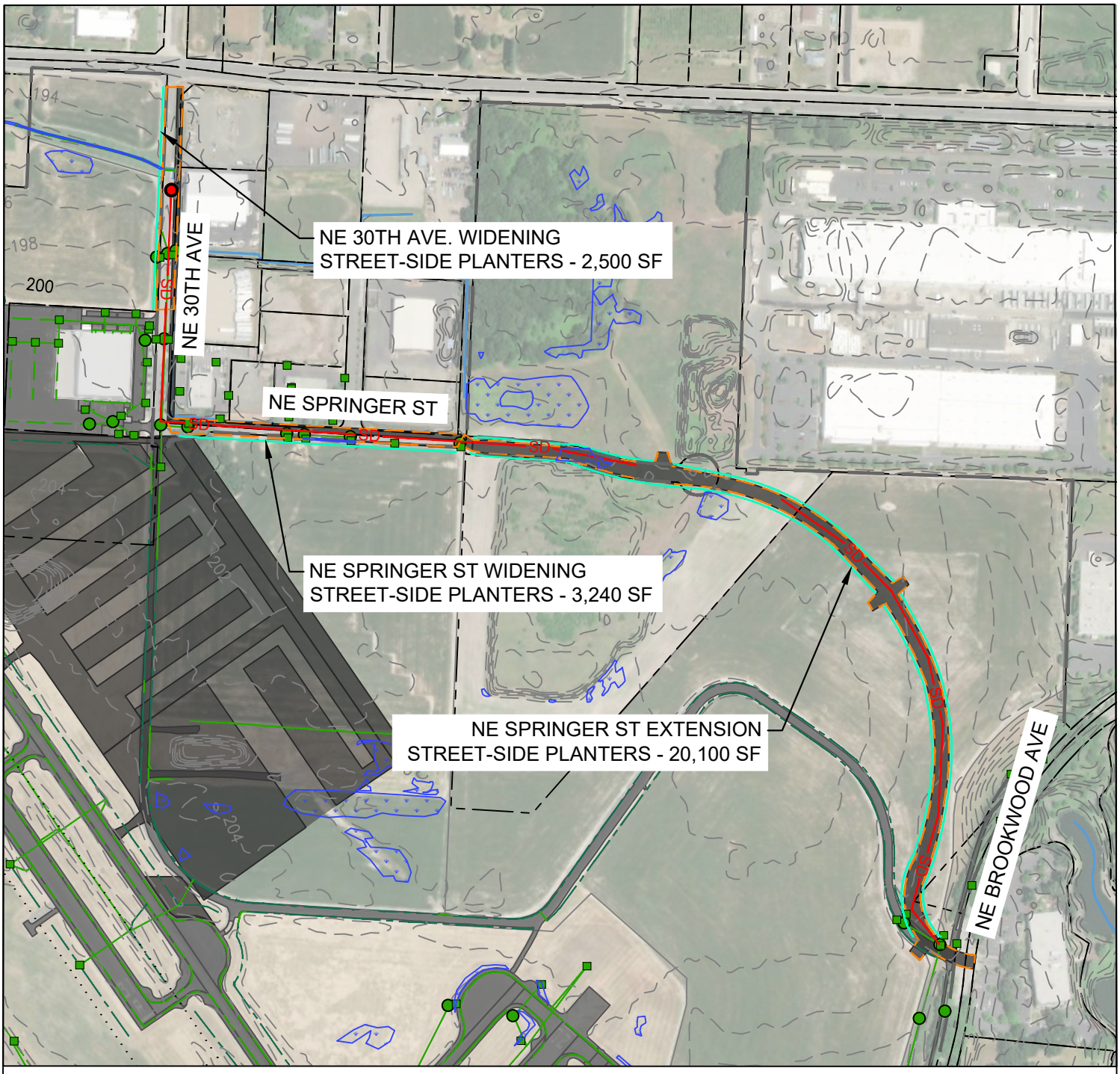
The planning-level cost opinion (2022 dollars) is based on preliminary estimates of quantities. CIP 3 provides stormwater management for Port infrastructure projects and is assumed to be an integral part of those projects. Therefore, CIP 3 includes neither soft costs nor the following construction costs to be covered by the underlying project: mobilization and erosion and sediment control. No escalation is included. A narrative description of operations and maintenance is included.

Construction*	Qty	Unit	Unit Price	Amount
12 Inch Storm Sewer Pipe	2,690	FT	$160	$430,400
21 Inch Storm Sewer Pipe	2,790	FT	$210	$585,900
Manhole	13	EA	$8,000	$104,000
Street-side Planter	25,840	SF	$130	$3,359,200
Temporary Water Management	1	LS		$10,000
Construction Subtotal				***$4,489,500***
Construction Contingency	30% - 50%		$1,347,000 to $2,245,000	
Total Construction Cost			$5,836,500 to $6,734,500	
Total Project Cost			**$5,836,500 to $6,734,500**	

* CIP 3 includes neither soft costs nor the following construction costs to be covered by the underlying project: mobilization and erosion and sediment control.

Operation and Maintenance

As the streets are or will be public roads, the stormwater facilities will be publicly maintained by the City of Hillsboro. The Street-side Planters should be inspected quarterly for erosion, sediment and trash accumulation, vegetation coverage, and invasive vegetation. In the spring, prune vegetation overhanging the edge of the facility and grasses that have become overgrown and remove clippings. Remove sediment and debris from the inlet and remove sediments from the treatment area when sediment depth exceeds three inches.



LEGEND

- STORM PIPE
- 2 FT CONTOURS
- HIO BOUNDARY
- PERFORATED STORM PIPE
- DITCH STORM CENTERLINE
- TAXLOTS
- PROPOSED STREETSIDE PLANTER
- SD — PROPOSED STORM PIPE
- STORM MANHOLE
- STORM CATCH BASIN
- PROPOSED MANHOLE
- EXISTING IMPERVIOUS
- PROPOSED IMPERVIOUS
- MANAGED IMPERVIOUS AREA BOUNDARY
- JURISDICTIONAL WETLANDS

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PORT OF PORTLAND

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CIP LOCATION 3

HIO Stormwater Master Plan

HIO Stormwater Master Plan
CIP Fact Sheet
Work Area 4

PORT OF PORTLAND

Summary

Work Area	Solution Description	Capital Cost	Expected Construction
4	Provide water quality treatment using proprietary underground stormwater treatment vaults for existing hangars	$687,200 to $742,200	As soon as feasible

Stormwater Management Need

Required Post-Construction Stormwater Controls – Water Quality	
Required Post-Construction Stormwater Controls – Hydromodification	
Required Post-Construction Stormwater Controls – LIDA	
Water Quality Treatment for Existing Impervious Surfaces	X

No new development or redevelopment is expected in Work Area 4. Existing impervious surfaces in this location require water quality treatment under an agreement with Clean Water Services (CWS) and City of Hillsboro (City). The proposed planning-level improvements address the listed requirements. The CIP will manage stormwater runoff from the following HIO Master Plan projects (Figures 1 and 2, respectively, of the HIO SMP).

Project No.	Project Name	Project Phasing
n/a	Existing untreated impervious surface at T-Hangars	n/a
L-16	Remove T-Hangars	11-20 Years

Proposed Improvements

The following planning-level improvements are proposed:

- Proprietary underground stormwater treatment vault to manage contributing runoff from the north portion of the T-hangar area.
- Proprietary underground stormwater treatment vault to manage contributing runoff from the south portion of the T-hangar area.
- Piping and inlets to convey the existing stormwater infrastructure in the south basin to the proposed south vault.
- Piping to discharge the treated stormwater to the downstream ditch system.

This treatment option was selected because vaults can fit into the existing conveyance system with minimal construction impact. The work area is also within the HIO Primary Wildlife Boundary, and underground facilities are suitable because they do not attract wildlife. The vaults could be open-top to facilitate maintenance access.

The design assumes that any treated areas were 100% impervious to provide a conservative design. The Port is also considering removing the T-hangars gradually in 11-20 years. At that time, the underground stormwater treatment vaults will continue to serve the remaining pavement and would be available to serve future redevelopment of the site.

Wetlands are delineated in the ditch to the south of the T-hangars. Constructing a new outfall to the ditch will be a wetland impact.

Timing and Phasing

The recommended timing is to construct the project as soon as funding is available to progress toward the goal of installing water quality treatment for 100% of impervious surfaces on HIO.

Solution Sizing Basis

Work Area 4 includes existing T-hangar buildings and pavement. The north area drains to a conveyance system adjacent to NE Penny Way. The south area drains to a ditch that flows south under NE Brookwood Parkway.

6' x 8' Proprietary Underground Stormwater Treatment Vault #1

- Manages contributing runoff from existing impervious on the north side of Work Area 4
- Treats 4.5 acres of impervious area
- Water Quality Flow Rate = 0.60 cfs

6' x 12' Proprietary Underground Stormwater Treatment Vault #2

- Manages contributing runoff from existing impervious on the south side of Work Area 4
- Treats 6.5 acres of impervious area
- Water Quality Flow Rate = 0.40 cfs

Design and Implementation Considerations and Constraints

Consideration	Description
Data Collection	▪ Survey – Confirm elevation of existing downstream ditch at outfall locations.
Permitting	▪ Stormwater solutions must be approved by City of Hillsboro with a Service Provider Letter from Clean Water Services. ▪ Wetland impacts must be approved by USACE and DSL.
Siting	▪ The location of the north vault is constrained by the existing pipe system and likely needs to be located where shown on the plan view figure below. ▪ The location of the south vault is somewhat flexible depending on maintenance access preferences and existing ditch elevations. ▪ Additional conveyance structures and pipes need to be added to the south system to direct runoff to the south treatment vault.
Wildlife Attractants	▪ Attracting wildlife has been avoided through the use of underground vaults.
Coordination	▪ None identified.

Work Area 4 - CIP Cost Opinion

The planning-level cost opinion (2022 dollars) is based on preliminary estimates of quantities. CIP 4 is a standalone project which is not dependent on an underlying Port infrastructure project. Therefore, CIP 4 includes mobilization, erosion and sediment control, survey, design, and project administration. No cost escalation is included. No escalation is included. A narrative description of operations and maintenance is included.

Construction	Qty	Unit	Price	Amount
12 inch Storm Sewer Pipe	460	FT	$160	$73,600
Manhole	2	EA	$8,000	$16,000
Area Drain	1	EA	$5,000	$5,000
Proprietary Underground Stormwater Treatment Vault 1*	1	EA	$52,000	$52,000
Proprietary Underground Stormwater Treatment Vault 2**	1	EA	$71,000	$71,000
Mobilization	10%	of Total Construction		$39,000
Erosion and Sediment Control	3%	of Total Construction		$12,000
Temporary Water Management	1	LS	$10,000	$10,000
Construction Subtotal				***$278,600***
Construction Contingency	30% - 50%			$84,000 to $139,000
Total Construction Cost				$362,600 to $417,600
Soft Costs* **		**Assumptions**		
Survey	4%	of Total Construction		$16,000
Design****	1	LS		$150,000
Basic Permitting	1	LS	$10,000	$10,000
Water Quality Sensitive Area Permitting	1	LS	$15,000	$15,000
Environmental Mitigation	100	SF	$6	$600
Project Administration	15%	of Total Construction		$58,000
Soft Costs Subtotal				***$249,600***
Soft Costs Contingency	30%	of Subtotal		$75,000
Total Soft Costs				$324,600
Total Project Cost				**$687,200 to $742,200**

* For estimating, a Contech 6' x 8' Standard StormFilter® Vault with 8 27-inch ZPG cartridges is assumed.

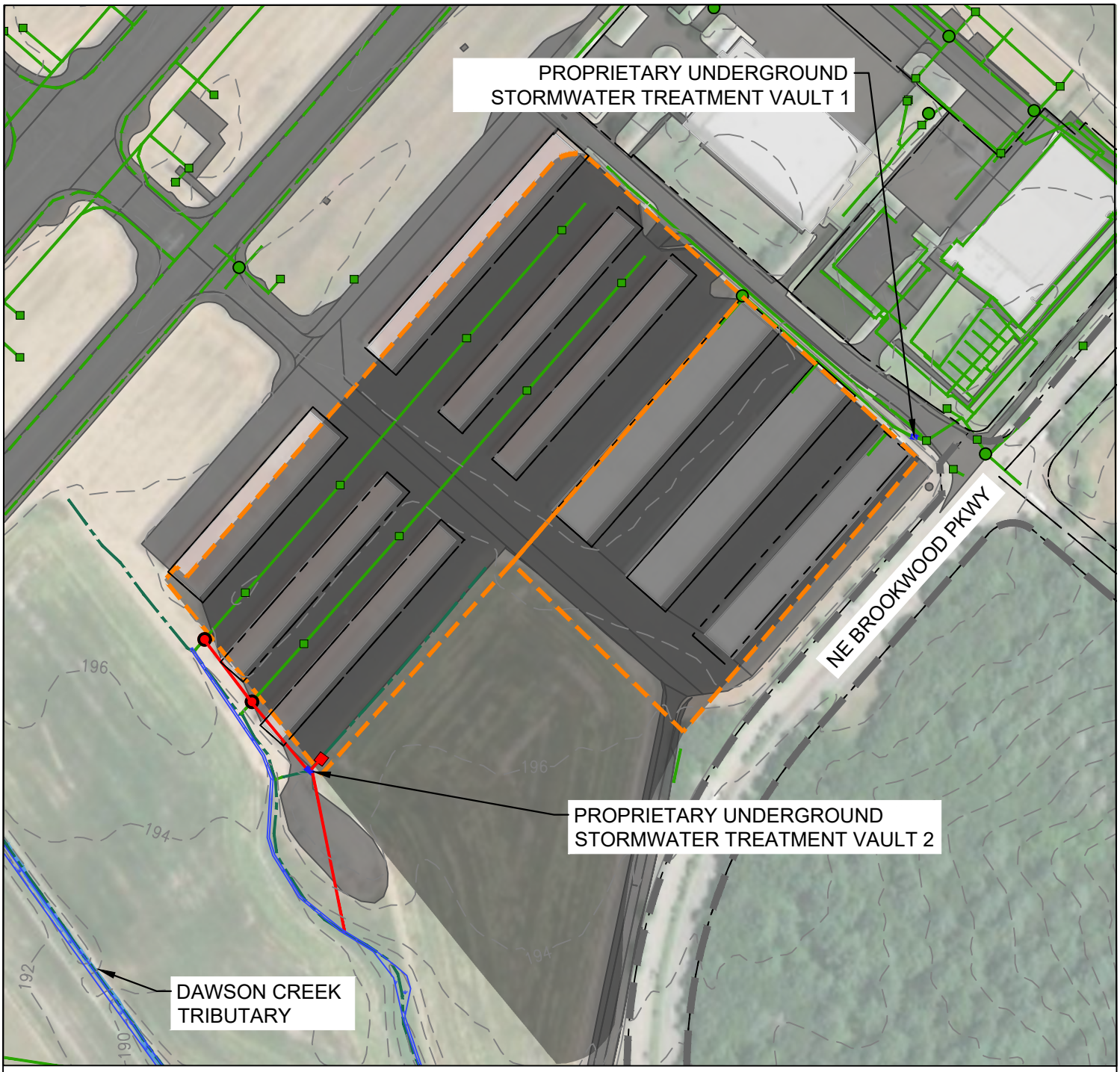
** For estimating, a Contech 6' x 12' Standard StormFilter® Vault with 12 27-inch ZPG cartridges is assumed.

*** Soft costs are calculated on a total construction cost that includes a 40% construction contingency.

**** Design costs are calculated by percentage but are no less than $150,000 and no more than $500,000.

Operation and Maintenance

Inspection of the water quality vaults should be performed annually in the late summer or early fall. The water quality vaults should also be checked after major storms for potential damage from high flows. If warranted, maintenance including filter cartridge replacement and removal of accumulated sediments should be performed during periods of dry weather.



LEGEND

- STORM PIPE
- SD — PROPOSED STORM PIPE
- 2 FT CONTOURS
- HIO BOUNDARY
- PERFORATED STORM PIPE
- DITCH STORM CENTERLINE
- TAXLOTS
- STORM MANHOLE
- STORM CATCH BASIN
- EXISTING IMPERVIOUS
- PROPOSED IMPERVIOUS
- PROPOSED MANHOLE
- PROPOSED CATCH BASIN
- PROPOSED TREATMENT VAULT
- MANAGED IMPERVIOUS AREA BOUNDARY
- JURISDICTIONAL WETLANDS

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PORT OF PORTLAND

Otak

CIP LOCATION 4

HIO Stormwater Master Plan

HIO Stormwater Master Plan
CIP Fact Sheet
Work Area 5

PORT OF PORTLAND

Summary

Work Area	Solution Description	Capital Cost	Expected Construction
5	Provide water quality treatment and hydromodification mitigation using modified landscape filter strips and underground detention for planned Taxiways E, B2, and vehicle service route (VSR) improvements	$1,832,400 to $2,114,400	2030-2039

Stormwater Management Need

Required Post-Construction Stormwater Controls – Water Quality	X
Required Post-Construction Stormwater Controls – Hydromodification	X
Required Post-Construction Stormwater Controls – LIDA	X
Water Quality Treatment for Existing Impervious Surfaces	
Addresses Ponding	X

Development projects in Work Area 5 will include post-construction stormwater management controls as required by City of Hillsboro (City) and Clean Water Services (CWS) standards. The proposed planning-level improvements address the listed requirements. The CIP will manage stormwater runoff from the following HIO Master Plan projects (Figures 1 and 2, respectively, of the HIO SMP).

Project No.	Project Name	Project Phasing
L-4	Construct South Portion of Taxiway E	11-20 Years
L-5	Taxiway B2 Relocation	11-20 Years
L-14*	Construct VSR from Springer to T-hangars	11-20 Years

* A portion of Project L-14, VSR Construction, is in a different drainage basin and is described in SMP Work Area 15.

Proposed Improvements

The following planning-level improvements are proposed:

- Modified Landscape Filter Strip along east and south edges of proposed taxiway to meet water quality treatment requirements.
- Modified Landscape Filter Strip along north edge of proposed vehicle service route (VSR) to meet water quality treatment requirements.
- Area drains and storm pipe to collect treated runoff.
- Underground detention system to meet hydromodification requirements.
- Bypass pipe to replace existing ditch and provide conveyance of upstream system around improvements and to the downstream ditch.

The work area is within the HIO Primary Wildlife Boundary, so preference was given to stormwater management facility types that do not produce standing water. A Modified Landscape Filter Strip was chosen for water quality treatment because it is a low-cost approach that has been utilized for other taxiways and runways at the airport. The Modified Landscape Filter Strip uses grassy vegetation that minimizes wildlife attractants and does not cause standing water, while also accommodating CWS's preference for vegetated facilities. The underground detention facility was selected to meet CWS's hydromodification requirements without attracting wildlife and because of its low maintenance requirements.

The existing site gently slopes to the south and east, and the conceptual solution assumes that the future taxiway will continue to shed runoff in that direction. Area drains will collect treated runoff from the modified landscape filter strips and connect to an underground detention system for flow control.

The south portion of Taxiway E is planned to be constructed over the location of an existing conveyance drainage ditch that currently conveys discharge from an extensive upstream system. A proposed bypass pipe will intercept all conveyance upstream of the outfall of the existing ditch. The bypass pipe will discharge in the remaining portion of the ditch south of the work area.

Existing conditions modeling identifies flooding in two locations within the work area. The flooded locations, as identified in the modeling memorandum, are nodes 331 and 304. They are located north of the proposed VSR and within the existing drainage ditch, respectively. The future conditions model indicates both flooding locations are addressed by the conveyance capacity increases from CIP 5.

The design assumes that areas to be treated are 100% impervious to provide a conservative design. Groundwater is conservatively assumed to be approximately 5-feet below ground surface based on geotechnical reports associated with construction on Taxiway D. Therefore, the detention facility is assumed to require buoyancy anchorage concrete to prevent floatation.

Timing and Phasing

The recommended timing is to construct the detention facility and bypass with the first development project in this Work Area. Water quality treatment facilities and conveyances can be constructed with the respective taxiways and VSR segments they serve.

Solution Sizing Basis

The required detention volume was estimated using a hydraulic model to match post-development peak runoff rates to pre-development peak runoff rate targets per CWS's peak-flow matching design criteria for hydromodification mitigation.

Modified Landscape Filter Strip

- Manages 5.38 acres of impervious area
- CWS LIDA sizing factor = 6%
- Modified Landscape Filter Strip area required for treatment = 14,100 sf

Underground Detention

- Manages 5.38 acres of impervious area
- Maximum achievable storage depth based on the existing ground surface and downstream conveyance elevation = 6 ft
- Facility Volume = 25,700 cf

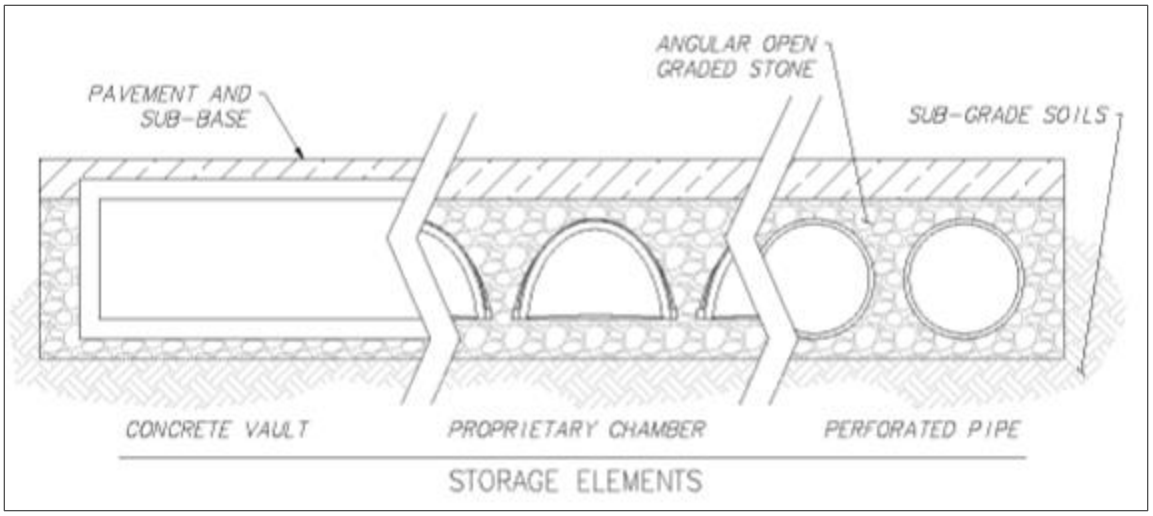
Bypass Pipe

- Modeled flow to the existing conveyance ditch = 38.1 cfs
- Using Manning's Equation, it is estimated that an 18-inch pipe at 0.8% slope would have adequate capacity to convey the existing upstream flows around the work area

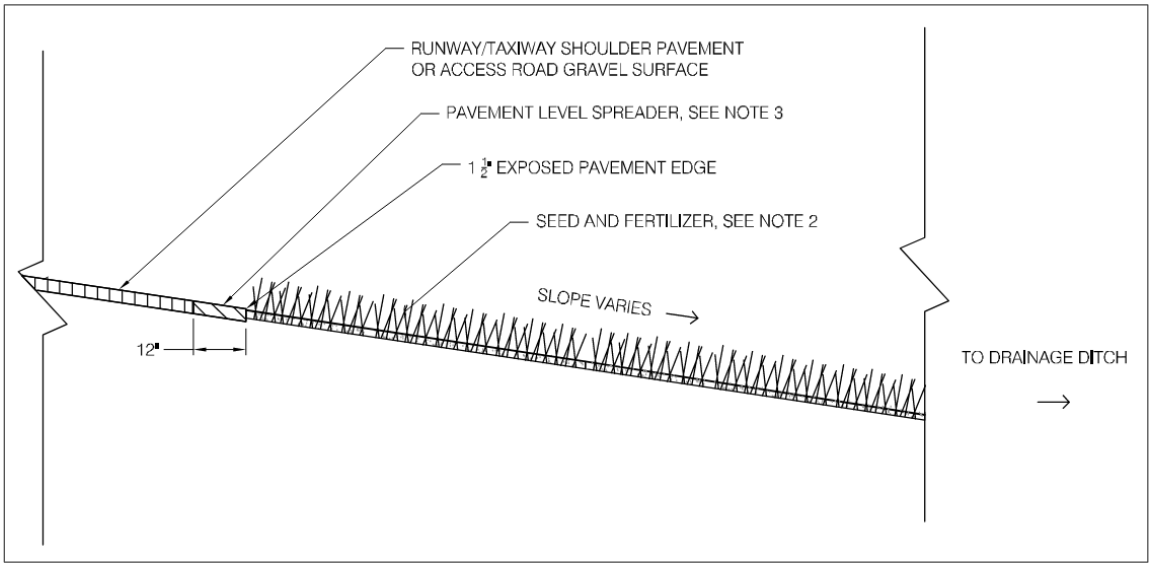
Design and Implementation Considerations and Constraints

Consideration	Description
Data Collection	▪ Geotechnical – Depth to groundwater at location of proposed detention system.
Permitting	▪ Stormwater solutions must be approved by City of Hillsboro with a Service Provider Letter from Clean Water Services. ▪ The underlying Taxiway E project impacts wetlands and water quality sensitive areas. Impacts must be approved by resource agencies, and mitigation may be required. Permitting of natural resources impacts and environmental mitigation costs are assumed to be included with the Taxiway E project.
Siting	▪ Modified Vegetated Filter Strip will be located to receive sheet flow runoff from taxiway and VSR. ▪ Detention pipe siting must be confirmed during final design. ▪ Bypass conveyance pipe location must be confirmed during final design. ▪ Previous geotechnical investigations indicate that groundwater may be as shallow as 5-ft below ground surface. Detention pipes will need to be watertight and buoyancy anchors utilized.
Wildlife Attractants	▪ Attracting wildlife has been avoided through the use of underground vaults and modified filter strips that produce no standing water.
Coordination	▪ None are identified.

Figures



Underground Detention Options – Section View



Modified Landscape Filter Strip Typical Section
(Environmental Science Associates drawing for Port of Portland)

Work Area 5 - CIP Cost Opinion

The planning-level cost opinion (2022 dollars) is based on preliminary estimates of quantities. CIP 5 provides stormwater management for Port infrastructure projects and is assumed to be an integral part of those projects. Therefore, CIP 5 includes neither soft costs nor the following construction costs to be covered by the underlying project: mobilization and erosion and sediment control. No escalation is included. A narrative description of operations and maintenance is included.

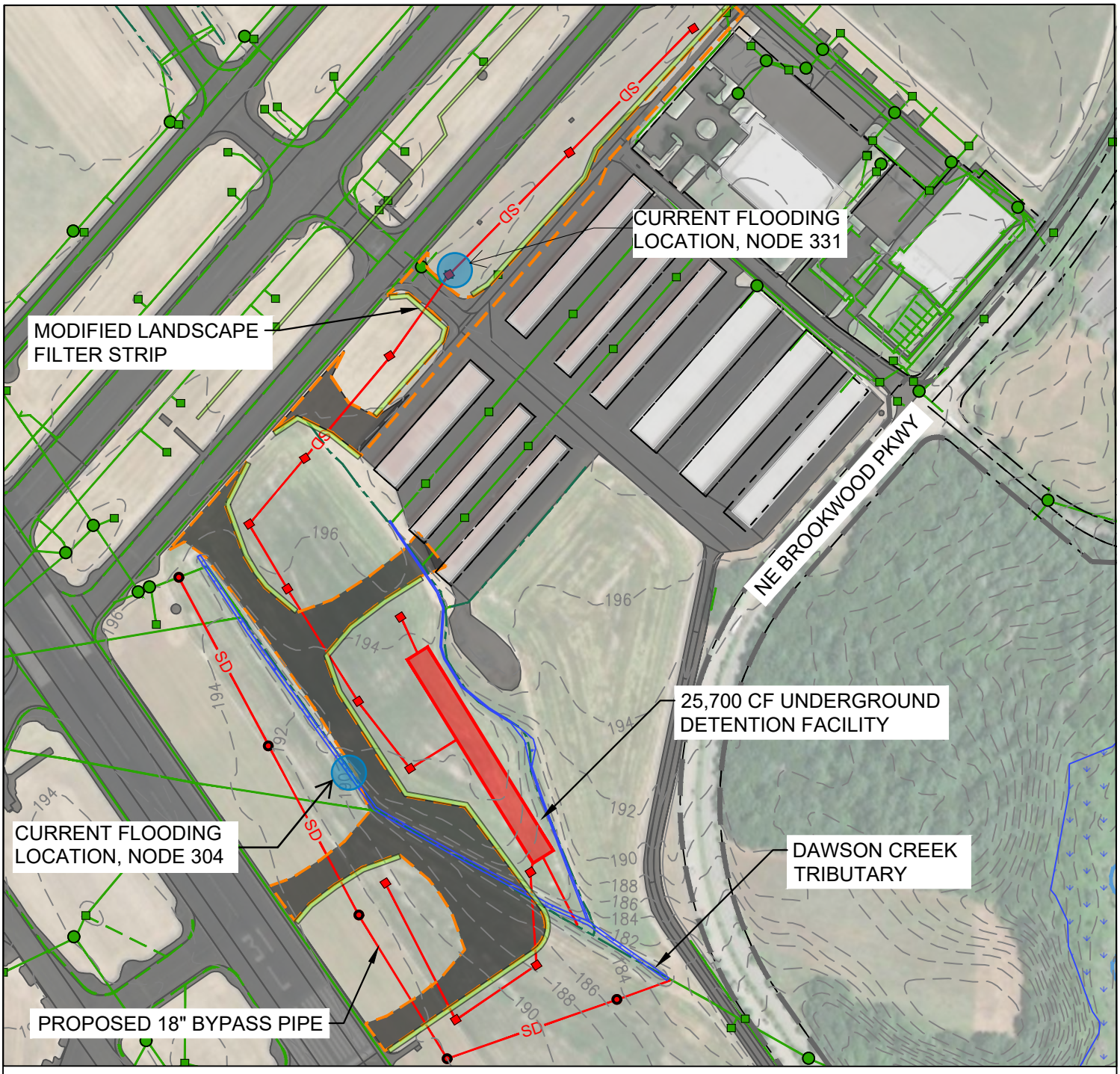
Construction*	Qty	Unit	Unit Price	Amount
12 Inch Storm Sewer Pipe	2,130	FT	$160	$340,800
18 Inch Storm Sewer Pipe	1,670	FT	$200	$334,000
Underground Detention System	25,700	CF	$15	$385,500
Manhole	6	EA	$8,000	$48,000
Inlet	14	EA	$5,000	$70,000
Modified Landscape Filter Strip	14,100	SF	$11	$155,100
Flow Control Structure	1	EA	$14,000	$14,000
Buoyancy Anchorage Concrete for Underground Detention	370	TON	$100	$37,000
Temporary Water Management	1	LS	$25,000	$25,000
Construction Subtotal				***$1,409,400***
Construction Contingency	30% - 50%		$423,000 to $705,000	
Total Construction Cost			$1,832,400 to $2,114,400	
Total Project Cost			**$1,832,400 to $2,114,400**	

* CIP 5 includes neither soft costs nor the following construction costs to be covered by the underlying project: mobilization and erosion and sediment control.

Operation and Maintenance

The Modified Landscape Filter Strip should be inspected quarterly for erosion, sediment and trash accumulation, vegetation coverage, and invasive vegetation. In the spring, cut tall grass to 4 to 6 inches.

The underground detention system should be inspected annually and after any major storm for debris and sedimentation. Removal of accumulated debris and sediments is more easily accomplished during periods of dry weather.



LEGEND

- STORM PIPE
- PROPOSED STORM PIPE (SD)
- 2 FT CONTOURS
- HIO BOUNDARY
- PERFORATED STORM PIPE
- DITCH STORM CENTERLINE
- TAXLOTS
- STORM MANHOLE
- STORM CATCH BASIN
- PROPOSED DETENTION FACILITY
- EXISTING IMPERVIOUS
- PROPOSED IMPERVIOUS
- MODIFIED LANDSCAPE FILTER STRIP
- PROPOSED MANHOLE
- PROPOSED CATCH BASIN/AREA DRAIN
- MANAGED IMPERVIOUS AREA BOUNDARY
- JURISDICTIONAL WETLANDS

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PORT OF PORTLAND

Otak

CIP LOCATION 5

HIO Stormwater Master Plan

HIO Stormwater Master Plan
CIP Fact Sheet
Work Area 7

PORT OF PORTLAND

Summary

Work Area	Solution Description	Total Project Cost	Expected Construction
7	Provide regional water quality treatment and hydromodification mitigation using a proprietary underground stormwater treatment vault and underground detention for planned southwest terminal and rental car parking	$7,575,550 to $8,434,550	2025-2039

Stormwater Management Need

Required Post-Construction Stormwater Controls – Water Quality	X
Required Post-Construction Stormwater Controls – Hydromodification	X
Required Post-Construction Stormwater Controls – LIDA	
Water Quality Treatment for Existing Impervious Surfaces	X

Development projects in Work Area 7 will include post-construction stormwater management controls as required by City of Hillsboro (City) and Clean Water Services (CWS) standards. The proposed planning-level improvements address the listed requirements. The CIP will manage stormwater runoff from the following HIO Master Plan projects (Figures 1 and 2, respectively, of the HIO SMP).

Project No.	Project Name	Project Phasing
I-2	Terminal Building Construction with Phase I Loop Road from 34th	6-10 Years
I-3	Construct Terminal Apron	6-10 Years
I-5	Construct Rental Car Parking (Phase I)	6-10 Years
I-6	Construct Phase 1 Parking for New Terminal Building	6-10 Years
I-7	Re-purpose Mushroom" Building as Possible EV Charging Station and Decommission Tanks	6-10 Years
I-8	Construct Employee Parking	6-10 Years
L-6	De-Icing/Wash Rack/Rental Car Prep	11-20 Years
L-19	Construct Rental Car Parking (Phase II)	11-20 Years
L-23	Phase II Loop Road and Parking Expansion	11-20 Years
n/a	Existing untreated impervious surface at Hillsboro Aero Academy Hangars and Ramp and Apron Connectors	n/a

Proposed Improvements

The following planning-level improvements are proposed:

- One proprietary underground stormwater treatment vault.
- One underground detention system to meet hydromodification requirements.
- Conveyance system upstream to drain the impervious areas to the stormwater management facilities.
- Conveyance system to discharge to the existing conveyance system.

The work area is within the HIO Primary Wildlife Boundary and adjacent to the runway protection zone (RPZ), so BMPs that do not produce standing water are required. Underground facilities were selected to avoid attracting wildlife and for their low maintenance requirements.

The site gently slopes to the southeast and it is assumed that runoff flow direction will be maintained when the site is redeveloped. The stormwater facility depth was estimated based on the anticipated minimum cover and minimum slope required to convey runoff. Depth of the stormwater system was estimated by assuming an upstream conveyance pipe running at minimum cover and slope from the most distant area of the contributing basin.

The design assumes that any treated areas were 100% impervious to provide a conservative design. Groundwater is conservatively assumed to be approximately 5-feet below ground surface based on geotechnical reports associated with construction on Taxiway D. Therefore, the detention facility is assumed to require buoyancy anchorage concrete to prevent floatation.

Timing and Phasing

The recommended timing is to construct the proposed stormwater management system along with the first of the proposed development projects it is intended to serve. Because the existing basin is mostly impervious, the system will provide treatment and hydromodification mitigation for the existing impervious area prior to implementation of the remaining projects.

Solution Sizing Basis

Work Area 7 includes the construction of an underground detention system to manage the impervious area created by several proposed developments (see table on first page). The required detention volume was estimated using a hydraulic model and CWS's peak-flow matching hydraulic design criteria to match post-development peak runoff rates to pre-development peak runoff rate targets.

8' x 24' Proprietary Underground Stormwater Treatment Vault

- Treats 26 acres of impervious area
- Water Quality Flow Rate = 2.4 cfs

Underground Detention System

- Manages 26 acres of impervious area
- Maximum pipe size based on existing ground surface and downstream conveyance elevation = 48 inches in diameter
- A 48-inch diameter pipe yields a detention area footprint of 14% of contributing impervious area

Conveyance Pipe to Underground Detention System

- Conveys runoff from 26.09 acres of future development which is similar in runoff characteristics to commercial or industrial development

- Assumes contributing basin is 85% impervious
- 25-year peak flow = 38 cfs calculated using the rational method
- Pipe size and slope = 24-inch diameter at 0.1% slope calculated using Manning's Equation

Design and Implementation Considerations and Constraints

Consideration	Description
Data Collection	▪ Geotechnical – Depth to groundwater at elevation of proposed detention system. ▪ Survey – Confirm elevations of downstream conveyance.
Permitting	▪ Stormwater solutions must be approved by City of Hillsboro with a Service Provider Letter from Clean Water Services.
Siting	▪ Facility siting is constrained by the existing storm sewer main line that runs along the east side of the project boundary, NE Cornell Road to the south, and the proposed development that the facility is intended to serve on the west. ▪ The detention area is 14% of the contributing area. The designer may need to take loading considerations into account depending on the siting. ▪ Previous geotechnical investigations indicate that groundwater may be as shallow as 5-feet below ground surface. Detention pipes will need to be watertight and buoyancy anchors utilized.
Wildlife Attractants	▪ Attracting wildlife has been avoided through the use of underground vaults.
Coordination	▪ The stormwater management facilities will manage flows from several Port developments (see table on first page) and must be constructed with the first development they will serve. The Port may coordinate internally to share costs proportionally among various projects the facilities will serve.

Work Area 7 - CIP Cost Opinion

The planning-level cost opinion (2022 dollars) is based on preliminary estimates of quantities. CIP 7 provides stormwater management for several Port infrastructure projects and acts as a regional facility which must be constructed with the first such development. Thefore, it is treated as a standalone stormwater project and includes costs for mobilization, erosion and sediment control, survey, design, and project administration that would otherwise be covered with the underlying projects. No cost escalation is included. A brief description of operations and maintenance has been included.

Construction	Qty	Unit	Unit Price	Amount
12 Inch Storm Sewer Pipe	1,860	LF	$160	$297,600
18 Inch Storm Sewer Pipe	1,800	LF	$200	$360,000
24 Inch Storm Sewer Pipe	1,400	LF	$220	$308,000
Underground Detention System	132,490	CF	$15	$1,987,350
Manhole	13	EA	$8,000	$104,000
Area Drain	72	EA	$5,000	$360,000
Flow Control Structure	1	EA	$14,000	$14,000
Buoyancy Anchorage Concrete for Underground Detention	1,876	TON	$100	$187,600
Proprietary Underground Stormwater Treatment Vault*	1	EA	$183,000	$183,000
Mobilization	5%	of Total Construction		$300,000
Erosion and Sediment Control	3%	of Total Construction		$180,000
Temporary Water Management	1	LS		$10,000
Construction Subtotal				***$4,291,550***
Construction Contingency	30% - 50%		$1,287,000 to $2,146,000	
Total Construction Cost			$5,578,550 to $6,437,550	
Soft Costs**	Assumptions			
Survey	2%	of Construction		$120,000
Design***	10%	of Construction		$500,000
Basic Permitting	1	LS		$15,000
Project Administration	15%	of Construction		$901,000
Soft Costs Subtotal				***$1,536,000***
Soft Costs Contingency	30%	of Subtotal		$461,000
Total Project Cost			**$7,575,550 to $8,434,550**	

* For estimating purposes, a Contech 8' x 20' Standard StormFilter® Vault with 47 27-inch ZPG media cartridges is assumed.

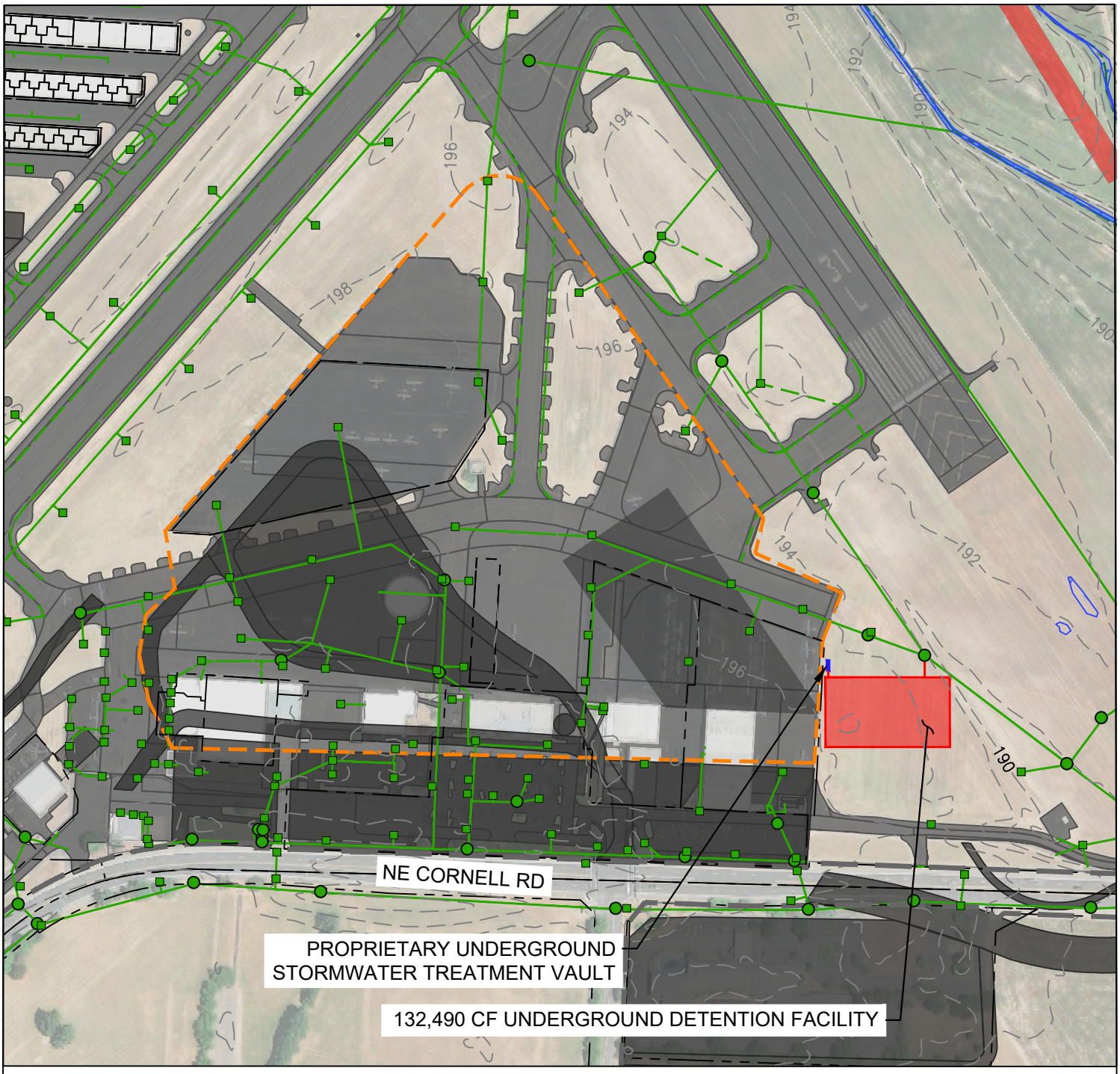
** Soft costs are calculated on a total construction cost that includes a 40% construction contingency.

*** Design costs are calculated by percentage but are no less than $150,000 and no more than $500,000.

Operation and Maintenance

Inspection of the water quality vaults should be performed annually in the late summer or early fall. The water quality vault should also be checked after major storms for potential damage from high flows. If warranted, maintenance including filter cartridge replacement and removal of accumulated sediments should be performed during periods of dry weather.

The underground detention system should be inspected annually and after any major storm for debris and sedimentation. Removal of accumulated debris and sediments is more easily accomplished during periods of dry weather.



LEGEND

- STORM PIPE
- SD — PROPOSED STORM PIPE
- 2 FT CONTOURS
- HIO BOUNDARY
- PERFORATED STORM PIPE
- DITCH STORM CENTERLINE
- TAXLOTS
- STORM MANHOLE
- STORM CATCH BASIN
- PROPOSED DETENTION FACILITY
- EXISTING IMPERVIOUS
- PROPOSED IMPERVIOUS
- PROPOSED MANHOLE
- PROPOSED CATCH BASIN
- PROPOSED TREATMENT VAULT
- MANAGED IMPERVIOUS AREA BOUNDARY
- JURISDICTIONAL WETLANDS

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PORT OF PORTLAND

Otak

CIP LOCATION 7

HIO Stormwater Master Plan

HIO Stormwater Master Plan
CIP Fact Sheet
Work Area 8

PORT OF PORTLAND

Summary

Work Area	Solution Description	Total Project Cost	Expected Construction
8	Provide water quality treatment for existing untreated impervious area and connection of Phase II Loop Road development using a proprietary underground stormwater treatment vault.	$508,200 to $543,100	2030-2039

Stormwater Management Need

Required Post-Construction Stormwater Controls – Water Quality	X
Required Post-Construction Stormwater Controls – Hydromodification	X
Required Post-Construction Stormwater Controls – LIDA	
Water Quality Treatment for Existing Impervious Surfaces	X

This project will provide water quality treatment for existing impervious surfaces within Work Area 8 as required by the Port's agreement with City of Hillsboro (City) and Clean Water Services (CWS) as well as for construction of a portion of the Loop Road. The CIP will manage stormwater runoff from the following HIO Master Plan projects (shown on Figures 1 and 2, respectively, of the HIO SMP).

Project No.	Project Name	Project Phasing
n/a	Existing untreated parking area adjacent to Cornell Road	n/a
L-31	Connect Phase II Loop Road to Cornell Road	11-20 Years

This CIP does not address planned private commercial development on HIO in the vicinity of this site.

Proposed Improvements

The following planning-level improvements and recommendations are proposed:

- Proprietary Underground Stormwater Treatment Vault to provide water quality treatment
- Hydromodification Fee-in-Lieu

This treatment option was selected because vaults can fit into the existing conveyance system with minimal construction impact. The work area is also within the HIO Primary Wildlife Boundary, and underground facilities are suitable because they do not attract wildlife. These vaults could be open-top to facilitate maintenance access.

The proposed proprietary underground stormwater treatment vault to be located along the existing conveyance system at the southeast corner of the work area will be able to treat runoff from all the untreated impervious surface within the work area. Due to grade and cover limitations, a shallow facility configuration is required for this location. The design assumes that 100% of the work area is currently

untreated impervious area that requires treatment. Runoff from the Phase II Loop Road should be piped to the proposed treatment vault to meet water quality treatment requirements.

An existing stormwater treatment vault within this area will not be modified by the proposed improvements, and no additional treatment is proposed for the area served by this facility.

Timing and Phasing

The recommended timing is to construct the stormwater management facility and pay the hydromodification fee-in-lieu with the Phase II Loop Road. Alternative timing is to construct the stormwater management facility as soon as funding is available to progress toward the goal of installing water quality treatment for 100% of impervious surfaces on HIO and to pay the hydromodification fee-in-lieu when the Phase II Loop Road is constructed.

Solution Sizing Basis

The following is a summary of the sizing basis for the proposed facility:

Proprietary Underground Stormwater Treatment Vault

- Treats 6.5 acres of impervious area
- Water Quality Flow Rate = 0.59 cfs

Hydromodification Fee-in-Lieu

- The recommendation to address required hydromodification mitigation for project L-31 to connect the Phase II Loop Road to Cornell Road assumes that less than 12,000 sf of impervious surfaces will be constructed as part of the project and would qualify for fee-in-lieu.

Design and Implementation Considerations and Constraints

Consideration	Description
Data Collection	▪ Survey – Confirm elevations of existing conveyance pipes.
Permitting	▪ Stormwater solutions must be permitted by City of Hillsboro with a Service Provider Letter from Clean Water Services.
Siting	▪ Treatment vault should be located adjacent to the existing conveyance system at the downstream end of the work area. ▪ Existing use in the vicinity of the vault is parking.
Wildlife Attractants	▪ Underground facilities were selected to avoid attracting wildlife.
Coordination	▪ If future planned private commercial development replaces the pavements treated by this CIP, the Port could consider selling capacity in the treatment vault to private developers to recover costs. ▪ Future development should protect the water quality treatment function of this vault for the undisturbed portions of the work area.

Work Area 8 - CIP Cost Opinion

The planning-level cost opinion (2022 dollars) is based on preliminary estimates of quantities. CIP 8 provides stormwater management for one small Port infrastructure project and provides treatment for a significant amount of exiting impervious surface. Therefore, it is treated as a standalone stormwater project and includes costs for mobilization, erosion and sediment control, survey, design, and project administration that would otherwise be covered with the underlying project. No cost escalation is included. A brief description of operations and maintenance has been included.

Construction	Qty	Unit	Unit Price	Amount
12 Inch Storm Sewer Pipe	128	FT	$160	$20,480
Manhole	1	EA	$8,000	$8,000
Flow Diversion Manhole	1	EA	$10,000	$10,000
Proprietary Underground Stormwater Treatment Vault*	1	EA	$79,300	$79,300
Mobilization	10%	of Total Construction		$24,400
Erosion and Sediment Control	3%	of Total Construction		$7,300
Temporary Water Management	1	LS		$25,000
Construction Subtotal				***$174,500***
Construction Contingency	30% - 50%		$52,400	to $87,300
Total Construction Cost			**$226,900**	**to $261,800**
Soft Costs**	Assumptions			
Survey	4%	of Construction		$9,800
Design***	1	LS		$150,000
Hydromodification Fee-in-Lieu	10,000	SF	$1	$10,000
Basic Permitting	1	LS		$10,000
Project Administration	15%	of Construction		$36,600
Soft Costs Subtotal				***$216,400***
Soft Costs Contingency	30%	of Subtotal		$64,900
Total Project Cost			**$508,200**	**to $543,100**

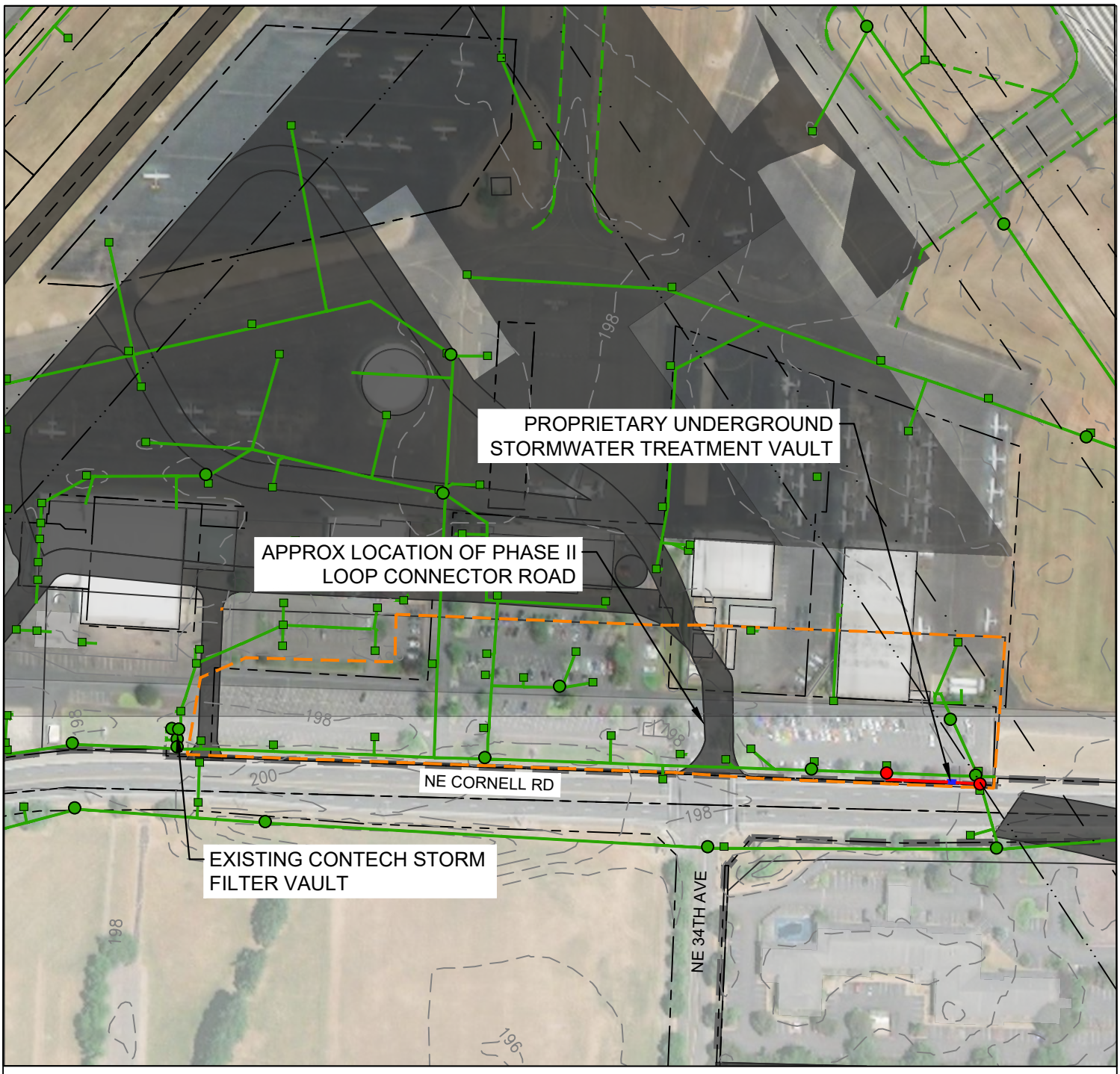
* For estimating purposes, a Contech 8' x 11' Standard StormFilter® Vault with 20 LowDrop ZPG media cartridges is assumed.

** Soft costs are calculated on a total construction cost that includes a 40% construction contingency.

*** Design costs are calculated by percentage but are no less than $150,000 and no more than $500,000.

Operation and Maintenance

Inspection of the water quality vaults should be performed annually in the late summer or early fall. The water quality vaults should also be checked after major storms for potential damage from high flows. If warranted, maintenance including filter cartridge replacement and removal of accumulated sediments should be performed during periods of dry weather.



LEGEND

- STORM PIPE
- SD — PROPOSED STORM PIPE
- 2 FT CONTOURS
- HIO BOUNDARY
- PERFORATED STORM PIPE
- DITCH STORM CENTERLINE
- TAXLOTS
- STORM MANHOLE
- STORM CATCH BASIN
- PROPOSED IMPERVIOUS
- EXISTING IMPERVIOUS
- PROPOSED MANHOLE
- PROPOSED TREATMENT VAULT
- MANAGED IMPERVIOUS AREA BOUNDARY

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PORT OF PORTLAND

Otak

CIP LOCATION 8

HIO Stormwater Master Plan

HIO Stormwater Master Plan
CIP Fact Sheet
Work Area 9

PORT OF PORTLAND

Summary

Work Area	Solution Description	Total Project Cost	Expected Construction
9	Provide water quality treatment and hydromodification mitigation for maintenance facility and Taxiway B extension using proprietary underground stormwater treatment vaults and underground detention facilities.	$593,500 to $684,800	2030-2039

Stormwater Management Need

Required Post-Construction Stormwater Controls – Water Quality	X
Required Post-Construction Stormwater Controls – Hydromodification	X
Required Post-Construction Stormwater Controls – LIDA	
Water Quality Treatment for Existing Impervious Surfaces	X

Development projects in Work Area 9 will include post-construction stormwater management controls as required by City of Hillsboro (City) and Clean Water Services (CWS) standards. In addition, this project will provide water quality treatment for existing impervious surfaces as required by the Port's agreement with City of Hillsboro and Clean Water Services. The proposed planning-level improvements address the listed requirements. The CIP will manage stormwater runoff from the following HIO Master Plan projects (shown on Figures 1 and 2, respectively, of the HIO SMP).

Project No.	Project Name	Project Phasing
L-28	Construct Maintenance Facility	11-20 Years
L-33	Extend Taxiway B to Flight Museum	11-20 Years
n/a	Existing untreated impervious surface adjacent to planned maintenance facility	n/a

Proposed Improvements

The following planning-level improvements are proposed:

- Proprietary Underground Stormwater Treatment Vault #1 to provide water quality treatment for the existing untreated impervious adjacent to the planned maintenance facility.
- Proprietary Underground Stormwater Treatment Vault #2 to provide water quality treatment for the Taxiway B extension and the proposed maintenance facility improvements.
- Underground detention facility to meet the hydromodification requirements for the Taxiway B extension and the proposed maintenance facility improvements.
- New pipes and storm inlets to collect and convey runoff from the new impervious surfaces to the treatment facilities.

Based on the elevations of the existing pipes, this design assumes the maximum achievable storage depth for the detention facility is five feet.

The work area is within the HIO Primary Wildlife Boundary, so preference was given to stormwater management facility types that do not produce standing water. The underground detention facility was selected to meet CWS's hydromodification requirements without attracting wildlife and because of its low maintenance requirements. The treatment option was selected because vaults can fit into the existing conveyance system with minimal construction impact. The vaults could be open-top to facilitate maintenance access.

Timing and Phasing

The recommended timing is to construct all stormwater management facilities with the first development project in Work Area 9. Alternative timing is to construct Vault #1 as soon as funding is available to progress toward the goal of installing water quality treatment for 100% of impervious surfaces on HIO and to construct remaining facilities with the first development project.

Solution Sizing Basis

The following is a summary of the sizing basis for the proposed facilities. The required detention volume was estimated using a hydraulic model to match post-development peak runoff rates to pre-development peak runoff rate targets per CWS's peak-flow matching design criteria for hydromodification mitigation.

Proprietary Underground Stormwater Treatment Vault #1

- Treats 3.9 acres of impervious area
- Water Quality Flow Rate = 0.36 cfs

Proprietary Underground Stormwater Treatment Vault #2

- Treats 1.0 acre of impervious area
- Water Quality Flow Rate = 0.09 cfs

Underground Detention Facility

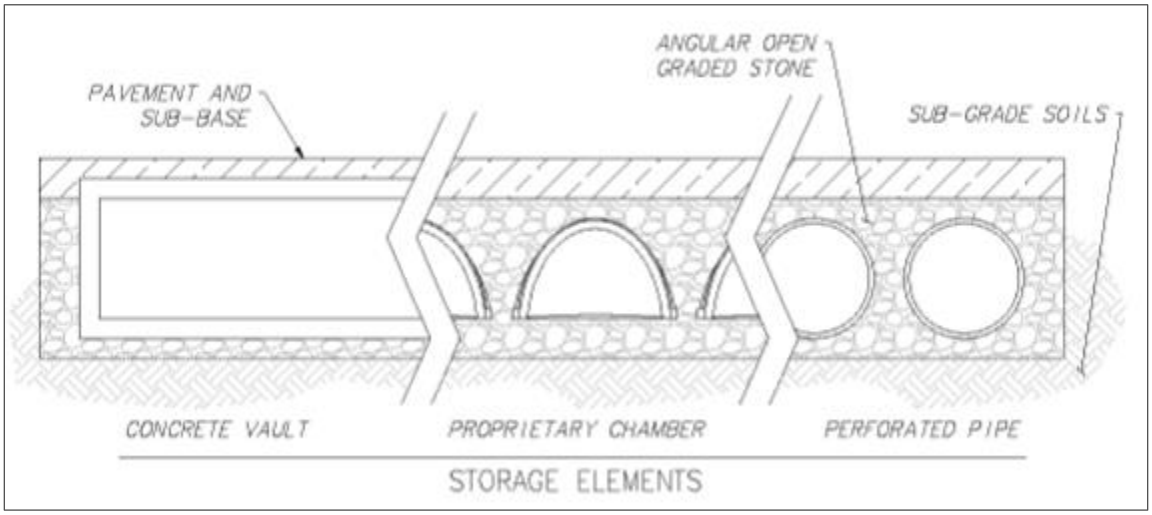
- Manages 1.0 acre of impervious area
- Facility Volume = 5,500 cf

Design and Implementation Considerations and Constraints

Consideration	Description
Data Collection	▪ Survey - Confirm elevation of existing drainage infrastructure and topography.
Permitting	▪ Stormwater solutions must be approved by City of Hillsboro with a Service Provider Letter from Clean Water Services.
Siting	▪ The location of Vault #1 that treats the existing impervious area is constrained by the location of the existing drainage infrastructure and should be constructed at the downstream end of this conveyance system. ▪ The detention facility and Vault #2 that treat the proposed improvements should be located to the south where elevations are lowest, but the precise location can be adjusted to accommodate changes in the proposed development layout.

Consideration	Description
Wildlife Attractants	▪ Underground facilities have been chosen to avoid attracting wildlife.
Coordination	▪ None identified.

Figures



Underground Detention Options – Section View

Work Area 9 - CIP Cost Opinion

The planning-level cost opinion (2022 dollars) is based on preliminary estimates of quantities. CIP 9 provides stormwater management for Port infrastructure projects and is assumed to be an integral part of those projects. Therefore, CIP 9 includes neither soft costs nor the following construction costs to be covered by the underlying project: mobilization and erosion and sediment control. No escalation is included. A narrative description of operations and maintenance is included.

Construction*	Qty	Unit	Unit Price	Amount
Proprietary Underground Stormwater Treatment Vault**	2	EA	$52,000	$104,000
Underground detention	5,500	CF	$15	$82,500
Flow diversion manhole	1	EA	$10,000	$10,000
Bouyancy Anchorage Concrete	100	TON	$100	$10,000
12 Inch Storm Sewer Pipe	1,100	FT	$160	$176,000
Inlet	5	EA	$5,000	$25,000
Manhole	3	EA	$8,000	$24,000
Temporary Water Management	1	LS	$25,000	$25,000
Construction Subtotal				***$456,500***
Construction Contingency	30% - 50%			$137,000 to $228,300
Total Construction Cost				**$593,500 to $684,800**
Total Project Cost				**$593,500 to $684,800**

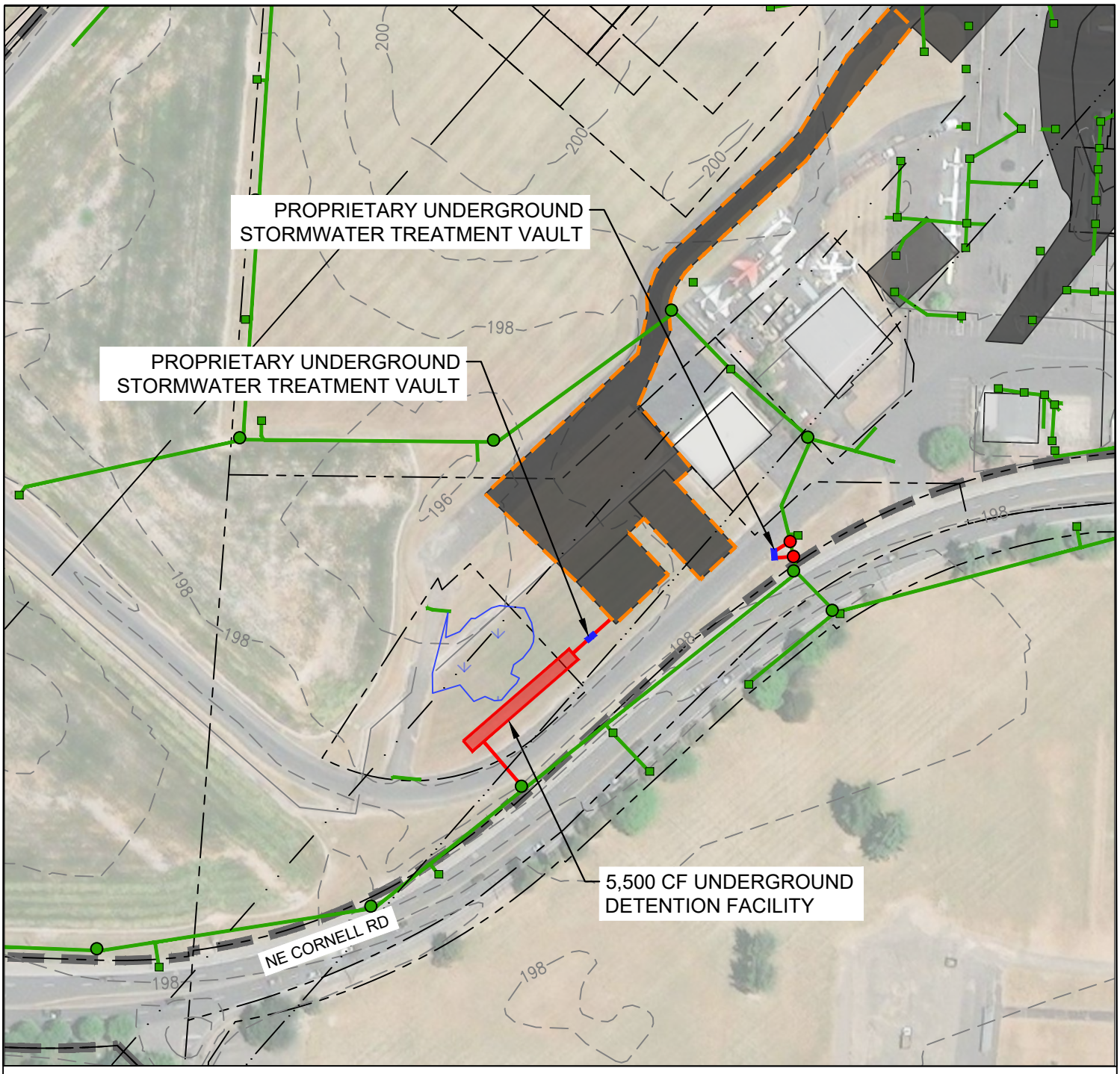
* CIP 9 includes neither soft costs nor the following construction costs to be covered by the underlying project: mobilization and erosion and sediment control.

** For estimating purposes, 2 Contech 6' x 8' Standard StormFilter® Vaults with 2 and 7 27-inch ZPG media cartridges are assumed.

Operation and Maintenance

Inspection of the water quality vaults should be performed annually in the late summer or early fall. The water quality vault should also be checked after major storms for potential damage from high flows. If warranted, maintenance including filter cartridge replacement and removal of accumulated sediments should be performed during periods of dry weather.

The underground detention system should be inspected annually and after any major storm for debris and sedimentation. Removal of accumulated debris and sediments is more easily accomplished during periods of dry weather.



LEGEND

- STORM PIPE
- SD — PROPOSED STORM PIPE
- 2 FT CONTOURS
- HIO BOUNDARY
- PERFORATED STORM PIPE
- DITCH STORM CENTERLINE
- TAXLOTS
- STORM MANHOLE
- STORM CATCH BASIN
- PROPOSED DETENTION FACILITY
- EXISTING IMPERVIOUS
- PROPOSED IMPERVIOUS
- PROPOSED MANHOLE
- PROPOSED TREATMENT VAULT
- MANAGED IMPERVIOUS AREA BOUNDARY
- JURISDICTIONAL WETLANDS

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PORT OF PORTLAND

Otak

CIP LOCATION 9

HIO Stormwater Master Plan

HIO Stormwater Master Plan
CIP Fact Sheet
Work Area 10

PORT OF PORTLAND

Summary

Work Area	Solution Description	Total Project Cost	Expected Construction
10	Provide water quality treatment and hydromodification mitigation for Taxiway B extension using Modified Landscape Filter Strip and Underground Detention.	$481,800 to $555,900	2030-2039

Stormwater Management Need

Required Post-Construction Stormwater Controls – Water Quality	X
Required Post-Construction Stormwater Controls – Hydromodification	X
Required Post-Construction Stormwater Controls – LIDA	X
Water Quality Treatment for Existing Impervious Surfaces	

Development projects in Work Area 10 will include post-construction stormwater management controls as required by City of Hillsboro (City) and Clean Water Services (CWS) standards. The proposed planning-level improvements address the listed requirements. The CIP will manage stormwater runoff from the following HIO Master Plan projects (Figures 1 and 2, respectively, of the HIO SMP).

Project No.	Project Name	Project Phasing
L-17	Extend Taxiway B and Remove Pavement	11-20 Years

Proposed Improvements

The following planning-level improvements are proposed:

- A Modified Landscape Filter Strip along the perimeter of the proposed Taxiway B extension.
- Underground Detention system to meet hydromodification mitigation requirements.

The work area is within the HIO Primary Wildlife Boundary, so preference was given to stormwater management facility types that do not produce standing water. A Modified Landscape Filter Strip was chosen for water quality treatment because it is a low-cost approach that has been utilized for other taxiways and runways at the airport. The Modified Landscape Filter Strip uses grassy vegetation that minimizes wildlife attractants, while also accommodating CWS's preference for vegetated facilities. Underground detention was selected to meet hydromodification requirements while avoiding wildlife attractants. The facility location is within the Object Free Area and is underground to avoid obstructions

Due to the shallow depths of the existing pipe, it is impractical to locate the underground detention facility downstream of all the proposed taxiway improvements. Instead, the facility can be located midway along the existing adjacent conveyance pipe and designed to offset the impacts of the taxiway improvements. The precise location of the facility and its depth should be evaluated during final design. Based on the existing pipe elevations, the maximum achievable storage depth for the detention facility is assumed to be three feet.

Timing and Phasing

The recommended timing is to construct the stormwater management facilities with the project it is intended to serve.

Solution Sizing Basis

The following is a summary of the sizing basis for the proposed facilities. The required detention volume was estimated using a hydraulic model to match post-development peak runoff rates to pre-development peak runoff rate targets per CWS's peak-flow matching design criteria for hydromodification mitigation.

Modified Landscape Filter Strip

- Treats 1.4 acres of impervious area
- Assumed 5-ft width over length of taxiway
- Modified Landscape Filter Strip area required for treatment = 11,800 sf

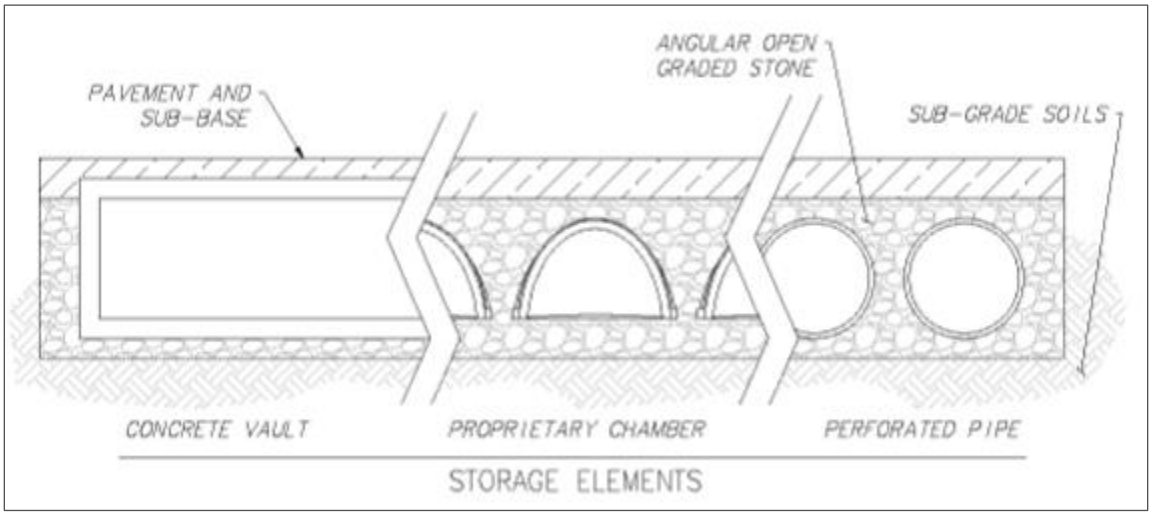
Underground Detention

- Manages 1.4 acres of impervious area
- Facility Volume = 11,800 cf

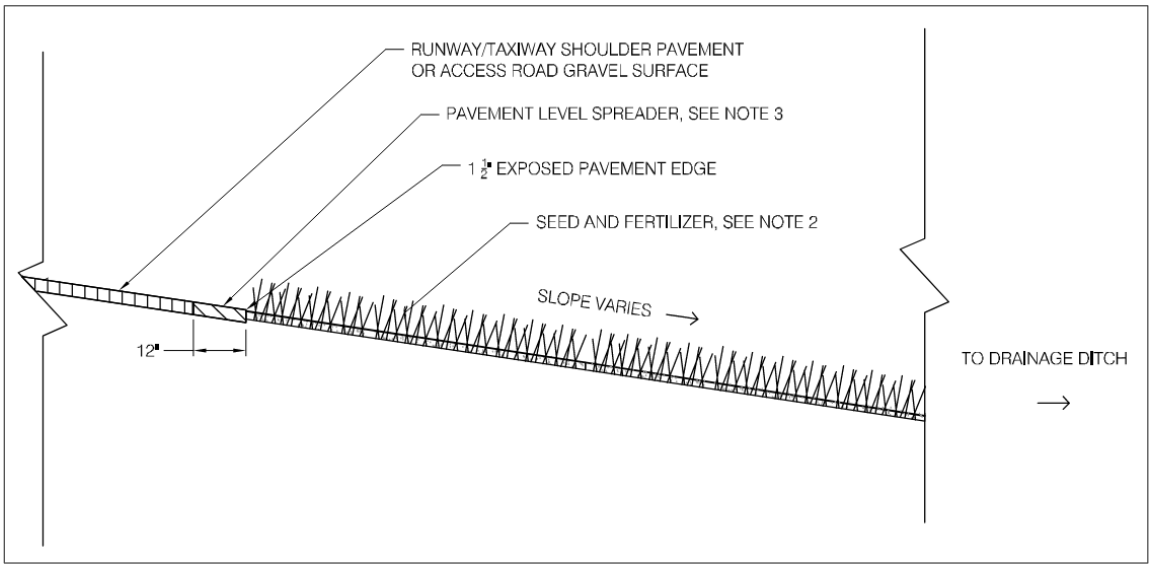
Design and Implementation Considerations and Constraints

Consideration	Description
Data Collection	▪ Survey - Confirm elevation of existing drainage infrastructure and topography.
Permitting	▪ Stormwater solutions must be approved by City of Hillsboro with a Service Provider Letter from Clean Water Services.
Siting	▪ Modified Landscape Filter Strips must be located directly adjacent to the taxiway. ▪ The Underground Detention Facility must be located along the existing conveyance line and in an area where adequate cover can be provided over the system.
Wildlife Attractants	▪ The proposed facilities have been chosen to minimize wildlife attractants.
Coordination	▪ None identified.

Figures



Underground Detention Options – Section View



Modified Landscape Filter Strip Typical Section
(Environmental Science Associates drawing for Port of Portland)

Work Area 10 - CIP Cost Opinion

The planning-level cost opinion (2022 dollars) is based on preliminary estimates of quantities. CIP 10 provides stormwater management for Port infrastructure projects and is assumed to be an integral part of those projects. Therefore, CIP 10 includes neither soft costs nor the following construction costs to be covered by the underlying project: mobilization and erosion and sediment control. No escalation is included. A narrative description of operations and maintenance is included.

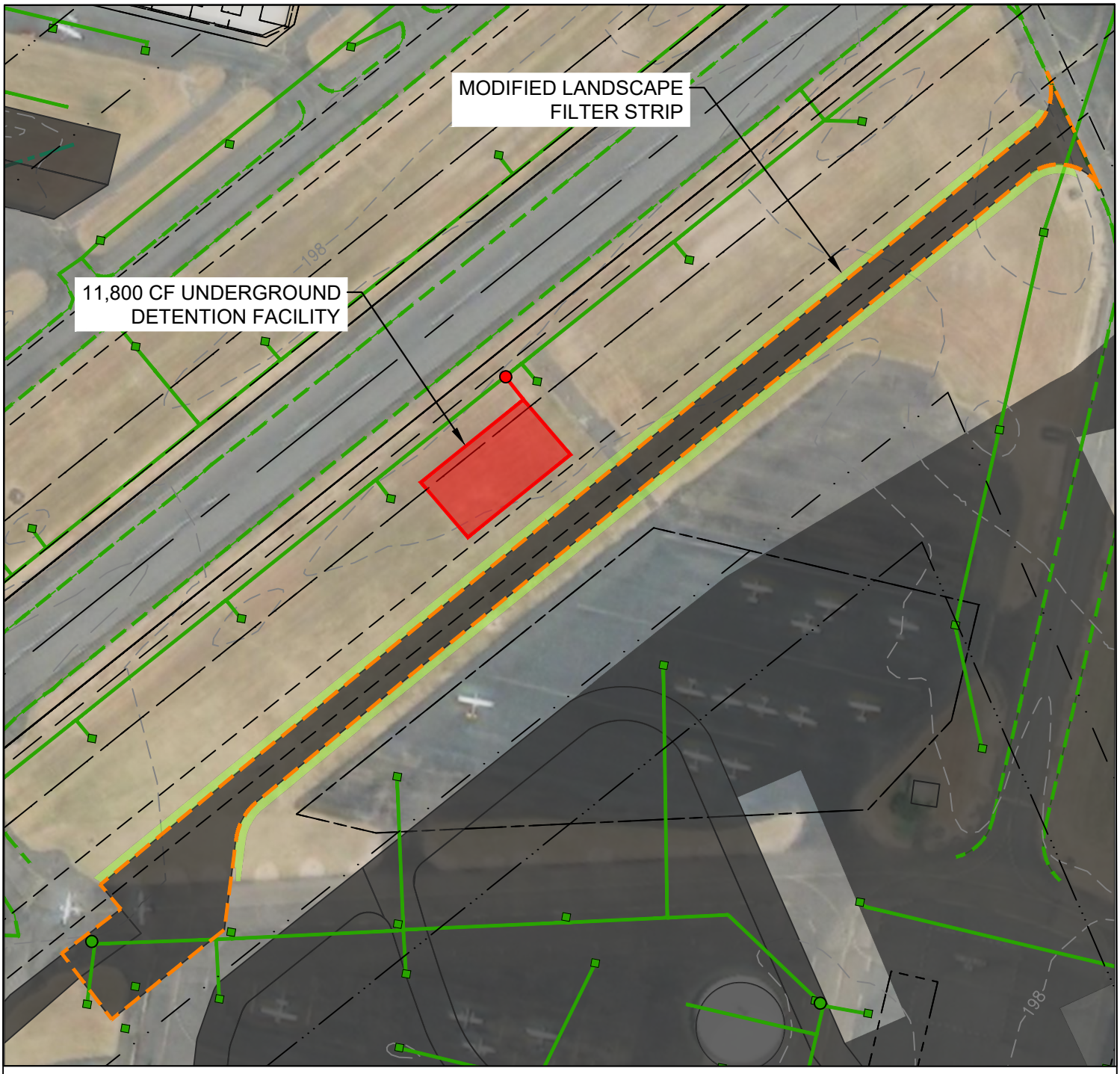
Construction*	Qty	Unit	Unit Price	Amount
Modified Landscape Filter Strip	11,800	SF	$11	$129,800
Underground Detention	11,800	CF	$15	$177,000
12 Inch Storm Sewer Pipe	30	FT	$160	$4,800
Flow control structure	1	EA	$14,000	$14,000
Bouyance Anchorage Concrete	200	TONS	$100	$20,000
Temporary Water Management	1	LS	$25,000	$25,000
Construction Subtotal				***$370,600***
Construction Contingency	30% - 50%		$111,200 to $185,300	
Total Construction Cost			**$481,800 to $555,900**	
Total Project Cost			**$481,800 to $555,900**	

* CIP 10 includes neither soft costs nor the following construction costs to be covered by the underlying project: mobilization and erosion and sediment control.

Operation and Maintenance

The Modified Landscape Filter Strip should be inspected quarterly for erosion, sediment and trash accumulation, vegetation coverage, and invasive vegetation. In the spring cut tall grass to 4” to 6”.

The underground detention system should be inspected annually and after any major storm for debris and sedimentation. Removal of accumulated debris and sediments is more easily accomplished during periods of dry weather.



LEGEND

- STORM PIPE
- SD — PROPOSED STORM PIPE
- 2 FT CONTOURS
- PERFORATED STORM PIPE
- DITCH STORM CENTERLINE
- TAXLOTS
- STORM MANHOLE
- STORM CATCH BASIN
- PROPOSED DETENTION FACILITY
- EXISTING IMPERVIOUS
- PROPOSED IMPERVIOUS
- VEGETATED FILTER STRIP
- PROPOSED MANHOLE
- PROPOSED TREATMENT VAULT
- MANAGED IMPERVIOUS AREA BOUNDARY

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PORT OF PORTLAND

Otak

CIP LOCATION 10

HIO Stormwater Master Plan

HIO Stormwater Master Plan
CIP Fact Sheet
Work Area 11

PORT OF PORTLAND

Summary

Work Area	Solution Description	Total Project Cost	Expected Construction
11	Provide water quality treatment for existing impervious area and water quality treatment and hydromodification mitigation for proposed infill hangar areas using proprietary underground stormwater treatment vaults and underground detention.	$1,508,500 to $1,740,500	2020-2029

Stormwater Management Need

Required Post-Construction Stormwater Controls – Water Quality	X
Required Post-Construction Stormwater Controls – Hydromodification	X
Required Post-Construction Stormwater Controls – LIDA	
Water Quality Treatment for Existing Impervious Surfaces	X

Development projects in Work Area 11 will include post-construction stormwater management controls as required by City of Hillsboro (City) and Clean Water Services (CWS) standards. The proposed planning-level improvements address the listed requirements. The CIP will manage stormwater runoff from the following HIO Master Plan projects (Figures 1 and 2, respectively, of the HIO SMP).

Project No.	Project Name	Project Phasing
S-7	Infill Hangar - South	1-5 Years
I-16*	Infill Hangars - North	6-10 Years
n/a	Existing untreated impervious surface	n/a

* Master Plan project I-16 is not going forward as planned. The Port and FAA are planning to construct a new control tower and parking at the general location of I-16. It is assumed to be going forward immediately.

Proposed Improvements

The following planning-level improvements are proposed:

- Proprietary Underground Stormwater Treatment Vault #1 to provide water quality treatment for the untreated impervious area within the northern portion of Work Area 11.
- Proprietary Underground Stormwater Treatment Vault #2 to provide water quality treatment for the Infill Hangars and untreated impervious area within the southern portion of Work Area 11.
- Proprietary Underground Stormwater Treatment Vault #3 to provide water quality treatment for a portion of untreated impervious area along NE Griffin Oaks St.

- Underground Detention Facility North to provide hydromodification mitigation for the control tower and parking (previously Infill Hangars – North).
- Underground Detention Facility South to provide hydromodification mitigation for Project No 16, Infill Hangars – South.

The design assumes that 100% of the work area is currently untreated impervious area that requires treatment and allows for treatment of runoff from comparatively minor future construction of hangars within the same facilities.

The work area is within the HIO Primary Wildlife Boundary, so preference was given to stormwater management facility types that do not produce standing water. Proprietary underground stormwater treatment vaults were selected because vaults can fit into the existing conveyance system with minimum construction impact. The area is also within the HIO Primary Wildlife Boundary, and underground facilities are not attractive to wildlife. The required maintenance activities for the vault are familiar to Port of Portland Operations staff. These facilities could be open-top to facilitate maintenance access. The underground detention facility was selected to meet CWS's hydromodification requirements without attracting wildlife and because of its low maintenance requirements.

Based on the elevations of the existing pipes, the design assumes that the maximum achievable storage depth for the detention facility North is 1.5 feet, and for the detention facility South is 2 feet. Ground water is conservatively assumed to be approximately 5-feet below ground surface based on geotechnical reports associated with construction on Taxiway D. Therefore, the detention facility is assumed to require buoyancy anchorage concrete to prevent floatation.

At the southern end of the Work Area, the existing conveyance system includes several deep pipes that Port records indicate are part of an existing detention system. The hydraulic modeling predicts minor flooding in this location, however, the available data regarding the design of this system is limited and does not allow for accurate modeling of the detention system. The proposed storm improvements are not intended to address the function of this existing detention system. Final design will need to include an understanding of water surface elevations in the existing detention system and any backwater effects on the proposed improvements.

Timing and Phasing

The recommended timing is to construct all three proprietary underground stormwater treatment vaults with construction of the first Master Plan project to go forward in Work Area 11, which is likely to be the control tower and parking in place of I-16. This timing would progress toward the goal of installing water quality treatment for 100% of impervious surfaces on HIO and provide required treatment for the tower project. The Detention Facilities South and North are required to be constructed at the same time as the respective projects they serve. Alternative timing for the proprietary underground stormwater treatment vaults is to construct Vault #2 with the project it is intended to serve and construct remaining two vaults as soon as funding is available.

Solution Sizing Basis

The following is a summary of the sizing basis for the proposed facilities. The required detention volume was estimated using a hydraulic model to match post-development peak runoff rates to pre-development peak runoff rate targets per CWS's peak-flow matching design criteria for hydromodification mitigation.

6’ x 12’ Proprietary Underground Stormwater Treatment Vault #1
- Treats 5.3 acres of impervious area
- Water Quality Flow Rate = 0.48 cfs

8’ x 14’ Proprietary Underground Stormwater Treatment Vault #2
- Treats 12.8 acres of impervious area
- Water Quality Flow Rate = 1.16 cfs

6’ x 8’ Proprietary Underground Stormwater Treatment Vault #3
- Treats 1.2 acres of impervious area
- Water Quality Flow Rate = 0.11 cfs

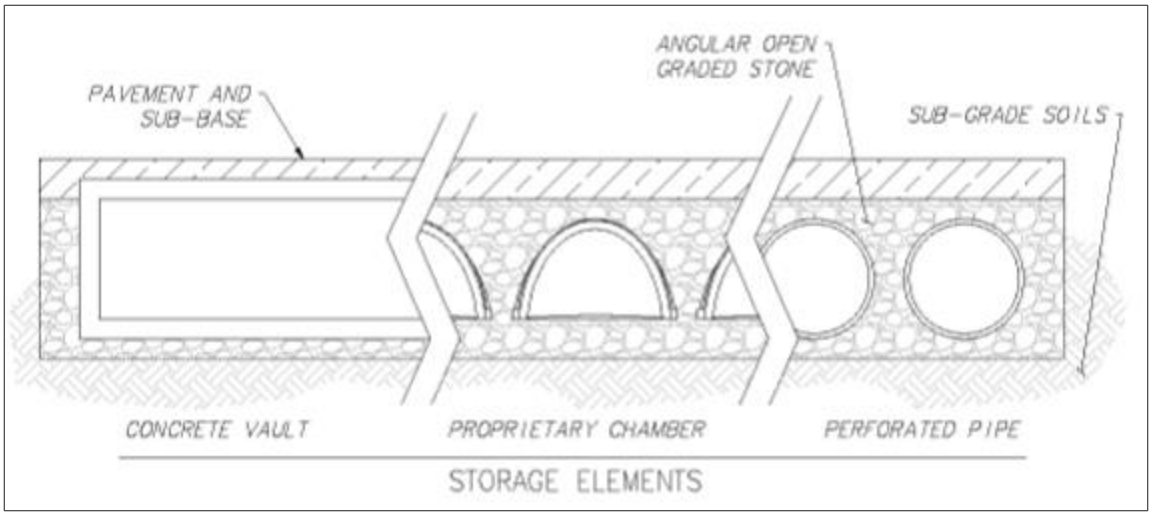
Underground Detention Facility North
- Manages 1.0 acre of impervious area
- Facility Volume = 14,200 cf

Underground Detention Facility South
- Manages 1.0 acre of impervious area
- Facility Volume = 32,700 cf

Design and Implementation Considerations and Constraints

Consideration	Description
Data Collection	▪ Survey - Confirm elevation of existing drainage infrastructure and topography.
Permitting	▪ Stormwater solutions must be approved by City of Hillsboro with a Service Provider Letter from Clean Water Services.
Siting	▪ The water quality vaults must be sited adjacent to the existing conveyance infrastructure and close to the locations where the existing conveyance piping leaves the work area. ▪ There is some flexibility in the precise location of the vaults, however the connection points to the existing system do not have much flexibility. ▪ Underground Detention Facilities should be sited adjacent to the respective infill hangars and at the downstream end of the improvements. Underground detention facilities could be sited under proposed paving. ▪ Previous geotechnical investigations indicate that groundwater may be as shallow as 5-ft below ground surface. Detention pipes will need to be watertight and buoyancy anchors utilized.
Wildlife Attractants	▪ Underground facilities were selected to avoid attracting wildlife.
Coordination	▪ None identified.

Figures



Underground Detention Options – Section View

Work Area 11 - CIP Cost Opinion

The planning-level cost opinion (2022 dollars) is based on preliminary estimates of quantities and includes design, permitting, contingencies, and construction. CIP 11 provides stormwater management for Port infrastructure projects and is assumed to be an integral part of those projects. Therefore, CIP 11 does not include costs to be covered by the underlying project such as mobilization, erosion and sediment control, survey, design, and project administration. It should be noted that CIP 11 also provides treatment for existing impervious surfaces which may be difficult to combine into underlying project costs. No cost escalation is included. A narrative description of operations and maintenance has been included.

Construction*	Qty	Unit	Unit Price	Amount
12 Inch Storm Sewer Pipe	120	FT	$160	$19,200
Manhole	5	EA	$8,000	$40,000
Flow Diversion Manhole	3	EA	$10,000	$30,000
Proprietary Underground Stormwater Treatment Vault 1**	1	EA	$52,000	$52,000
Proprietary Underground Stormwater Treatment Vault 2***	1	EA	$71,000	$71,000
Proprietary Underground Stormwater Treatment Vault 3****	1	EA	$111,800	$111,800
Underground detention	46,900	CF	$15	$703,500
Flow control structure	2	EA	$14,000	$28,000
Buoyancy Anchorage Concrete	800	TON	$100	$80,000
Temporary Water Management	1	LS	$25,000	$25,000
Construction Subtotal				***$1,160,500***
Construction Contingency	30% - 50%		$348,000	to $580,000
Total Construction Cost			**$1,508,500**	**to $1,740,500**
Total Project Cost			**$1,508,500**	**to $1,740,500**

* CIP 11 includes neither soft costs nor the following construction costs to be covered by the underlying project: mobilization and erosion and sediment control.

** For estimating purposes, a Contech 8' x 14' Standard StormFilter® Vaults with 23 27-inch cartridges is assumed.

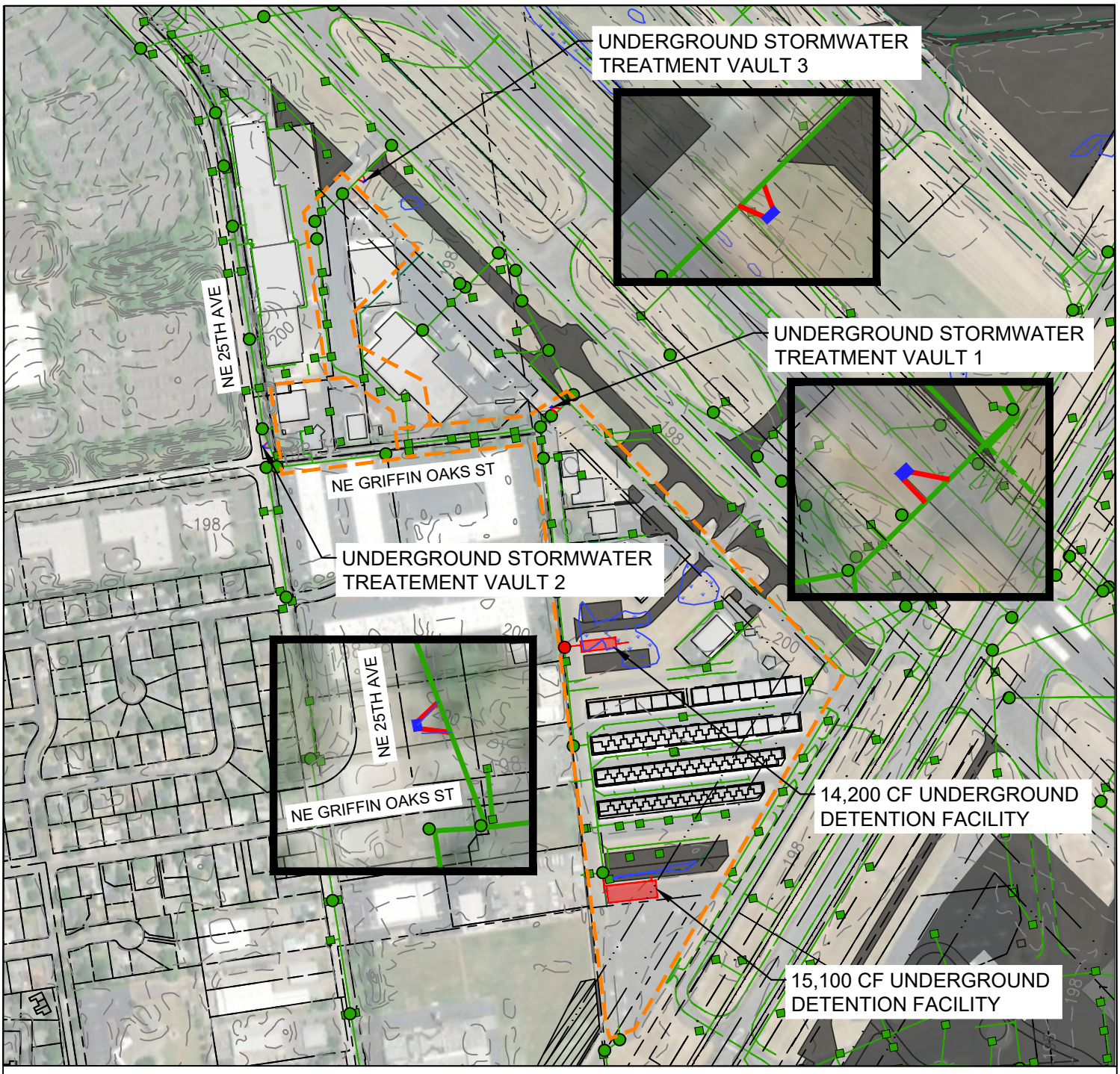
*** For estimating purposes, a Contech 6' x 8' Standard StormFilter® Vaults with 2 27-inch cartridges is assumed.

**** For estimating purposes, a Contech 6' x 12' Standard StormFilter® Vaults with 10 27-inch cartridges is assumed.

Operation and Maintenance

Inspection of the water quality vaults should be performed annually in the late summer or early fall. The water quality vaults should also be checked after major storms for potential damage from high flows. If warranted, maintenance including filter cartridge replacement and removal of accumulated sediments performed during periods of dry weather.

The underground detention system should be inspected annually and after any major storm for debris and sedimentation. Removal of accumulated debris and sediments is more easily accomplished during periods of dry weather.



LEGEND

- STORM PIPE
- SD — PROPOSED STORM PIPE
- 2 FT CONTOURS
- HIO BOUNDARY
- PERFORATED STORM PIPE
- DITCH STORM CENTERLINE
- TAXLOTS
- STORM MANHOLE
- STORM CATCH BASIN
- PROPOSED DETENTION FACILITY
- EXISTING IMPERVIOUS
- PROPOSED IMPERVIOUS
- JURISDICTIONAL WETLANDS
- PROPOSED MANHOLE
- PROPOSED CATCH BASIN
- PROPOSED TREATMENT VAULT
- MANAGED IMPERVIOUS AREA BOUNDARY

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PORT OF PORTLAND

Otak

CIP LOCATION 11

HIO Stormwater Master Plan

HIO Stormwater Master Plan
CIP Fact Sheet
Work Area 12

PORT OF PORTLAND

Summary

Work Area	Solution Description	Total Project Cost	Expected Construction
12	Provide water quality treatment and hydromodification mitigation for proposed Taxiway AA using Modified Landscape Filter Strips and Underground Detention Facilities.	$1,736,700 to $2,003,700	2030-2039

Stormwater Management Need

Required Post-Construction Stormwater Controls – Water Quality	X
Required Post-Construction Stormwater Controls – Hydromodification	X
Required Post-Construction Stormwater Controls – LIDA	X
Water Quality Treatment for Existing Impervious Surfaces	

Development projects in Work Area 12 will include post-construction stormwater management controls as required by City of Hillsboro (City) and Clean Water Services (CWS) standards. The proposed planning-level improvements address the listed requirements. The CIP will manage stormwater runoff from the following HIO Master Plan projects (Figures 1 and 2, respectively, of the HIO SMP).

Project No.	Project Name	Project Phasing
L-25	Relocate Taxiway AA and Convert Old Taxiway AA to Service Road	11-20 Years

Proposed Improvements

The following planning-level improvements are proposed:

- Modified Landscape Filter Strip constructed along the perimeter of the proposed Taxiway AA.
- Two (2) underground detention systems to meet hydromodification requirements for the north and south portions of the Taxiway AA improvements.
- New inlets and piping to collect runoff from the taxiway improvements.

The work area is within the HIO Primary Wildlife Boundary, so preference was given to stormwater management facility types that do not produce standing water. A Modified Landscape Filter Strip was chosen for water quality treatment because it is a low-cost approach that has been utilized for other taxiways and runways at the airport. The Modified Landscape Filter Strip uses grassy vegetation that minimizes wildlife attractants and does not cause standing water, while also accommodating CWS's preference for vegetated facilities. Underground Detention was selected to meet hydromodification requirements while avoiding wildlife attractants.

Timing and Phasing

The recommended timing is to construct the stormwater management facilities with construction of HIO Master Plan Project L-25 to relocate Taxiway AA.

Solution Sizing Basis

In Work Area 12, 3.7 acres of impervious area will be added with the relocation of Taxiway AA. The volume of underground detention required was estimated using a hydraulic model and CWS's peak-flow matching hydraulic design criteria to match post-development peak runoff rates to pre-development peak runoff rate targets. The width of the Modified Landscape Filter Strip was estimated using the width of proposed taxiway.

Modified Landscape Filter Strip

- Assumes 5-foot width along entire length of both sides of new crowned taxiway
- Treats 3.7 acres of impervious area
- Modified Landscape Filter Strip area required for treatment = 26,200 sf

Underground Detention North

- Manages 2.2 acres of impervious area
- Based on existing ground surface and downstream conveyance elevation, maximum achievable storage depth = 2 ft
- Facility Volume = 23,900 cf

Underground Detention South

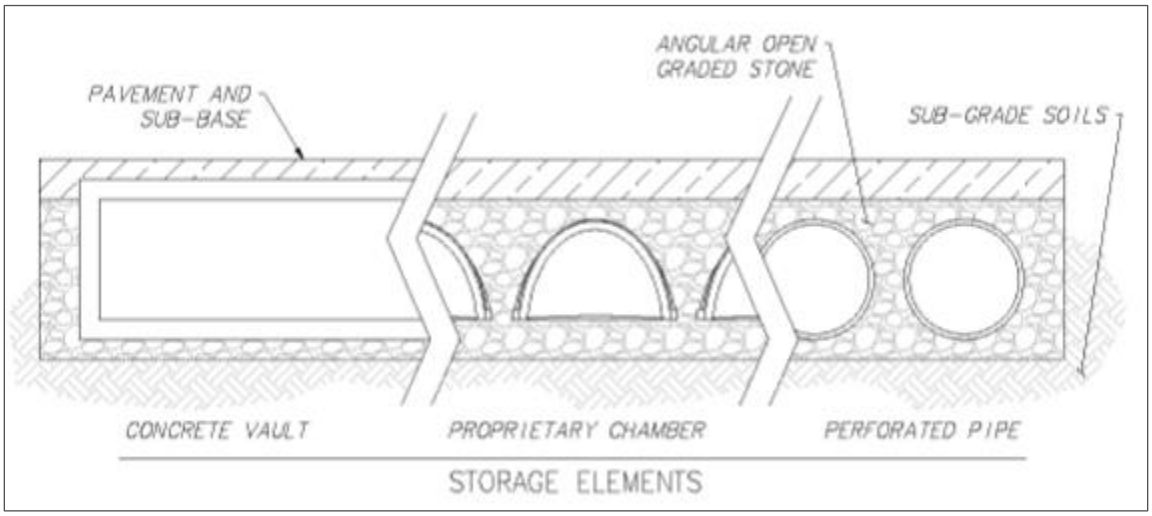
- Manages 1.5 acres of impervious area
- Based on existing ground surface and downstream conveyance elevation, maximum achievable storage depth = 2 ft
- Facility Volume = 20,800 cf

Design and Implementation Considerations and Constraints

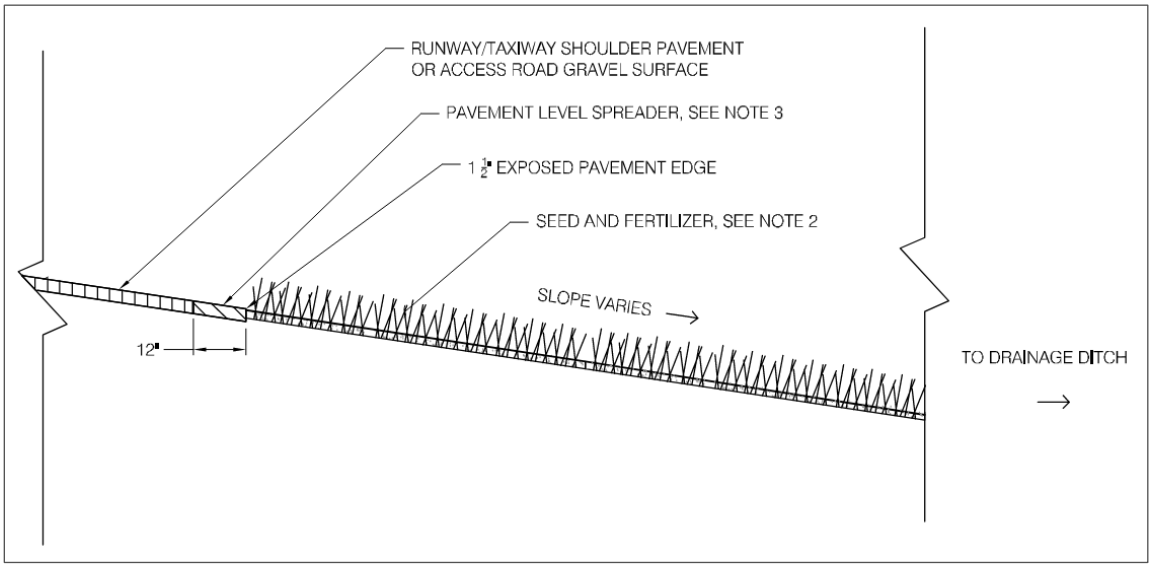
Consideration	Description
Field Data Collection	▪ Survey – Confirm elevation of existing drainage infrastructure and topography.
Permitting	▪ Stormwater solutions must be approved by City of Hillsboro with a Service Provider Letter from Clean Water Services.
Siting	▪ The existing conveyance infrastructure divides the project area into two drainage basins. A detention facility must be connected to each of these conveyance systems. ▪ Modified Landscape Filter Strips must be located directly adjacent to both sides of the taxiway. ▪ The Underground Detention systems may be located in a future Taxiway Safety Area (TSA). Final design should consider configuration options that avoid the TSA or consider the loading requirement of the TSA. ▪ Previous geotechnical investigations indicate that groundwater may be as shallow as 5-ft below ground surface. Pipes will need to be watertight and buoyancy anchors utilized.

Consideration	Description
Wildlife Attractants	▪ The proposed facilities have been chosen to minimize wildlife attractants.
Coordination	▪ None identified.

Figures



Underground Detention Options – Section View



Modified Landscape Filter Strip Typical Section
(Environmental Science Associates drawing)

Work Area 12 - CIP Cost Opinion

The planning-level cost opinion (2022 dollars) is based on preliminary estimates of quantities. CIP 12 provides stormwater management for Port infrastructure projects and is assumed to be an integral part of those projects. Therefore, CIP 12 includes neither soft costs nor the following construction costs to be covered by the underlying project: mobilization and erosion and sediment control. No escalation is included. A narrative description of operations and maintenance is included.

Construction*	Qty	Unit	Unit Price	Amount
12 Inch Storm Sewer Pipe	700	FT	$160	$112,000
Manhole	9	EA	$8,000	$72,000
Inlet	9	EA	$5,000	$45,000
Modified Landscape Filter Strip	26,200	SF	$11	$288,200
Underground detention	44,700	CF	$15	$670,500
Flow control structure	2	EA	$14,000	$28,000
Buoyancy Anchorage Concrete	700	TON	$100	$70,000
Temporary Water Management	1	LS	$50,000	$50,000
Construction Subtotal				***$1,335,700***
Construction Contingency	30% - 50%		$401,000 to $668,000	
Total Construction Cost			**$1,736,700 to $2,003,700**	
Total Project Cost			**$1,736,700 to $2,003,700**	

* CIP 12 includes neither soft costs nor the following construction costs to be covered by the underlying project: mobilization and erosion and sediment control.

Operation and Maintenance

The Modified Landscape Filter Strip should be inspected quarterly for erosion, sediment and trash accumulation, vegetation coverage, and invasive vegetation. In the spring cut tall grass to 4” to 6”.

The underground detention system should be inspected annually and after any major storm for debris and sedimentation. Removal of accumulated debris and sediments is more easily accomplished during periods of dry weather.

LEGEND

- STORM PIPE
- PROPOSED STORM PIPE (SD)
- 2 FT CONTOURS
- HIO BOUNDARY
- PERFORATED STORM PIPE
- DITCH STORM CENTERLINE
- TAXLOTS
- STORM MANHOLE
- STORM CATCH BASIN
- PROPOSED DETENTION FACILITY
- EXISTING IMPERVIOUS
- PROPOSED IMPERVIOUS
- VEGETATED FILTER STRIP
- JURISDICTIONAL WETLANDS
- PROPOSED MANHOLE
- PROPOSED CATCH BASIN
- PROPOSED TREATMENT VAULT
- MANAGED IMPERVIOUS AREA BOUNDARY

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PORT OF PORTLAND

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CIP LOCATION 12

HIO Stormwater Master Plan

Appendix B

Project Reports and Memoranda

Otak

Included in the appendix are the following:

- HIO Stormwater Master Plan Cost Estimating Methodology
- Stormwater Planning Services for Hillsboro Airport (HIO) Asset Replacement
- Stormwater Planning Services for Hillsboro Airport (HIO) Hydraulic Modeling

Otak produced the following reports and memorandum as draft deliverables in creation of this Stormwater Master Plan. Please contact the HIO Stormwater Master Plan Project Manager to access any of the following:

- Requirements and Comprehensive Plan Review Memorandum
- Existing Conditions Assessment Memorandum
- Alternatives Analysis Memorandum

Memorandum

To:	Blake Hamalainen, Port of Portland
From:	Trista Kobluskie, Ryan Makie, PE, Nate Robinson, PE, Rose Horton, PE
Copies:	Maureen Minister, Phil Stenstrom, Port of Portland
Date:	May 1, 2023
Subject:	HIO Stormwater Master Plan Cost Estimation Methodology
Project No.:	19442

Otak has developed a planning level cost estimate for capital improvement projects (CIPs) in the HIO Stormwater Master Plan. Otak has developed 10 projects to a Level 2 Scope Accuracy and Level B Engineering Effort on the Port of Portland One Port Estimating Scale. All concepts and costs should be considered preliminary. This memorandum summarizes the assumptions made in formulating each element of the cost opinion. Given current market instability around supply chain availability, labor markets, and interest rates, Otak has chosen more conservative estimates, including higher contingency factors, to account for current conditions and cost fluctuations.

Cost of Underlying Project

The majority of the projects in the HIO SMP provide the necessary storm system infrastructure for underlying Port of Portland development projects listed in the 2018 HIO Master Plan. We assume that many project costs will be incurred simultaneously and have been estimated or budgeted with the underlying development project. Therefore, we have omitted costs for the following items for supporting projects:

- Mobilization
- Erosion and sediment control
- All soft costs
  - Survey
  - Design
  - Permitting
  - Environmental Mitigation
  - Project Administration

Projects are classified as standalone when they either provide regional stormwater management for several proposed development projects or their sole purpose is the provide water quality treatment for existing impervious area as required under the Port of Portland's agreement with Clean Water Services and City of Hillsboro. We estimated mobilization, erosion and sediment control, and soft costs for the standalone stormwater projects.

Construction Costs

Otak civil engineers researched unit prices from recently completed local and regional construction projects to estimate project costs. Each project includes an engineer's cost assumption for preliminary unit quantities.

Several CIPs call for proprietary underground stormwater treatment vaults. At this planning level of design, we relied on GIS data and could not conclude definitively which proprietary device and configuration will be the most cost effective, constructable, and maintainable. Therefore, for estimating purposes, we assumed Contech StormFilter® Vaults would be installed. Starting with the current retail cost for each unit, we added delivery, installation, and minor pipe connection costs. In future design phases, the Port could consider other proprietary solutions, including distributed individual catch basin filters, open-top vaults, or other proprietary devices.

The following construction costs are estimated as a percentage of the subtotal of the total construction cost including construction contingency.

Item	Percentage of Construction Cost
Mobilization	10% for projects with construction under $3 million
	5% for projects with construction over $3 million
Erosion and Sediment Control	3%

Temporary water management is estimated as a fixed cost based on site conditions.

Site Condition Description	Temporary Water Management Cost
Larger/longer bypass system, longer duration construction	$50,000
Small bypass system, short duration construction	$25,000
Minimal isolation, i.e. turbidity curtain, partial stream isolation, dry weather pipe flows	$10,000

Construction Contingency

Construction contingency is assumed to be a percentage of all total construction costs. A range of 30 to 50 percent is provided and 40 percent is used in calculation of soft costs. Construction budgets should be re-visited in design.

Soft Costs

Separate from construction costs are costs needed to implement and administer the project. These costs were estimated using percentages on total construction costs that are typical for planning capital improvement programs.

Survey

Survey costs are estimated for standalone projects.

Survey	Construction Cost
4%	Under $1 million
2%	Over $1 million

Permitting

Permitting costs are estimated for standalone projects.

Basic Permitting

Estimates depend on both complexity of the permitting requirements and construction costs. All standalone projects are assumed to require basic permitting, which may include permitting or review by the City of Hillsboro and Clean Water Services. A fixed cost has been established for three classes of project based on construction cost.

Basic Permitting Cost	Construction Cost
$15,000	Over $500,000
$10,000	$100,000 to $500,000
$5,000	Under $100,000

Water Quality Sensitive Area Permitting

Water quality sensitive areas, as defined by Clean Water Services, are areas identified through natural resource assessments and can include intermittent and perennial rivers, streams, and springs, existing and created wetlands, and natural lakes, ponds and stream impoundments. The Clean Water Services Design and Construction Standards (Chapter 3) defines sensitive areas and vegetated corridors and requires protection and/or mitigation through construction plan review.

Projects located in a water quality sensitive area are assumed to require additional permitting from state and federal agencies. A fixed cost has been established for three classes of project based on construction cost. If these costs are used in the cost opinion, they are in addition to the Basic Permitting cost.

Water Quality Sensitive Area Permitting Cost	Construction Cost
$50,000	Over $1 million
$30,000	$500,000 to $1 million
$15,000	Under $500,000

Environmental Mitigation

Environmental mitigation in wetland areas is equal to the estimated wetland area to be disturbed and is assumed to require mitigation in a wetland bank.

Primary Type of Anticipated Mitigation	Unit Cost
Requires off-site wetland mitigation (wetland bank)	$6 per square foot

Design

Design costs are estimated for standalone projects as a percent of total construction costs. Design includes Port staff scoping and design, consultant engineering design services (if needed), and consultant geotechnical investigation (if needed). Four tiers have been established using an inverse correlation.

Design Percentage	Construction Cost
10% up to a maximum of $500,000	Over $3 million
15%	Over $1.5 million
20%	$750,001 to $1.5 million
$150,000	$750,000 and less

Project Administration

Project administration is estimated for standalone projects. This cost incorporates staff time for project management, financial management, and construction management into the estimate. Project administration is assumed to be 15% of total construction costs based on discussions with the Port.

Soft Costs Contingency

Soft costs contingency provides a way to account for recent and assumed near-term volatility in supply chain availability, labor markets, and interest rates. Soft costs contingency is assumed to be 30% of all soft costs based on conversations with the Port.

Asset Replacement Costs

Otak prepared planning-level costs to replace pipes on HIO.

Item	Assumption
Pipe Material	Port of Portland requested all pipes 10-inch diameter or greater on the airfield be replaced with concrete pipe. All identified pipe replacements are on the airfield. Class V Reinforced Concrete pipe to meet to meet a HS 25-44 live load is assumed for all replacements.
Pipe Unit Price	Pipe unit prices include materials, trenching, bedding, and backfill for 5-ft depth pipe. Because costs are conservative, minor surface restoration is assumed to be included.
Catch Basins	2 / 400 LF of pipe Type G-2 Catch Basins

Item	Assumption
Manholes	1 / 400 LF of pipe Concrete Storm Sewer Manholes
Soft Costs	Most pipe replacements are considered to be a part of another project. Soft costs were not estimated.

Memorandum

To:	Blake Hamalainen, Port of Portland
From:	Trista Kobluskie, Nate Robinson, PE, Madeline Pommier
Copies:	Maureen Minister, Stephen Nagy, Port of Portland
Date:	March 13, 2023
Subject:	Stormwater Planning Services for Hillsboro Airport (HIO) Asset Replacement
Project No.:	19442

Introduction

Otak, Inc. (Otak) and Robin Kirschbaum, Inc. (RKI) are preparing a Hillsboro Airport Stormwater Master Plan (HIO SMP). As HIO nears 100 years old, some of its oldest stormwater infrastructure is still in place.

This purpose of this memo is to provide the Port with planning cost documentation for construction that will allow for the planned replacement of assets, including those outside of future development plans described in the 2018 HIO Master Plan. This memorandum documents the condition of the stormwater system, identifies assets to be replaced, and develops an estimate of replacement costs. It will become the basis for a chapter in the HIO SMP currently being completed.

Repair and Replacement

HIO Storm System Characterization

The HIO storm system conveyances may be characterized as generally flat with low cover.

The majority of pipes on HIO are concrete followed by corrugated metal pipe (CMP). Other types include ductile iron pipe (DIP), high density polyethylene (HDPE), polyvinyl chloride (PVC), and steel. The materials of a number of pipes primarily in the vicinity of Runway 13R-31L and the Tower Park and Fliteline Hangars, and Aero Air are of unknown materials. Figure 1 presents pipe materials.

Pipes on the southern end of the airfield tend to be older, with a significant number exceeding 50 years. The ages of a number of pipes primarily in the vicinity of Runway 13R-31L, the Tower Park and Fliteline Hangars, and Global Aviation are unknown. Figure 2 presents pipe age.

Asset Failure

Stormwater assets can fail or perform poorly because of structural deterioration over time or because of site conditions that reduce drainage capacity, such as high groundwater and root intrusion. The likelihood of failure increases with time and when condition deteriorates. Likelihood of failure can be evaluated individually with an inspection-based condition assessment program or more generally by using percentage of useful life expended as a proxy. The Port evaluated useful life expended for stormwater

pipes of 12-inches and diameter or more. Useful life expended (Figure 3) is based on pipe material (Figure 1) in combination with age (Figure 2).

In our experience, sudden failure of a stormwater asset such as a storm drainage pipe is rare. Failure of culverts carrying streams is more common and often more consequential. Failure of the typical smaller drainage infrastructure on HIO is most likely to result in ponding or minor flooding. Visible signs often exist prior to failure, such as increased ponding, misaligned catch basins or manhole covers, or subsidence. Failures of water quality facilities could result in decrease runoff treatment performance. The failure of a stormwater asset causing flooding near or on runways and taxiways would be the most consequential. Failure of an asset near or under a habitable building would also be consequential. The consequences of failure were not evaluated for the SMP.

The Port's Asset Management department will continue the process of identifying stormwater assets for inspection and prioritizing needs for repair, rehabilitation, or replacement.

Recommended Repair and Replacement Policy

The SMP recommends a repair and replacement policy that balances the cost and disruption of replacing aging pipes with the potential consequences of asset failure. The Port's Asset Management Department should proactively repair or replace pipes when development and infrastructure projects coincide with assets that have reached 75% or greater of expected useful life, and they should reactively repair or replace pipes that exhibit signs of failure in areas that are not slated for other capital construction. Secondly, the Port should inspect catch basins and manholes during typical cleaning cycles and document the results. Finally, the Port should use closed circuit television (CCTV) camera inspection in locations where assets have both reached 75% or greater of expected useful life and are outside of expected HIO Master Plan projects and in other locations when staff observe new ponding, misalignment of catch basins or manhole covers, misalignment of pipes, cracked structures or grout, subsidence, or other similar signs of pending failure.

Asset Replacement Selection

Given the scope and budget of the project, we focused on stormwater conveyance pipes with a diameter of 12 inches and larger. Pipes smaller than this diameter were excluded from the analysis to help manage the level of detail. Runoff treatment facilities were also excluded. When assets are replaced preventatively or reactively for condition, the Port should assess the connected smaller laterals at the same time.

The assessment relies on generalized assumptions made from GIS of the storm system. HIO does not have an asset condition inspection program. The true likelihood of asset failure can be better ascertained with individual inspection results to identify poor condition of pipe material, joints, and structures as well as to identify impediments to drainage performance such as presence of groundwater and root intrusion.

Assets have been recommended for replacement based on useful life expended and by diameter. Pipe assets which are 12-inch diameter and greater and are currently at 75% or greater of useful life expended are recommended for potential replacement over the 20-year time period covered by the SMP.

In total, six standalone asset replacement projects are recommended. Standalone projects are labelled with alphabetic identifiers. Seven additional asset replacements may be coordinated with HIO SMP capital projects. See Figure 4 and Table 1.

Cost Estimation

Assumptions for cost estimating are documented in the HIO Stormwater Master Plan Cost Estimation Methodology memorandum.

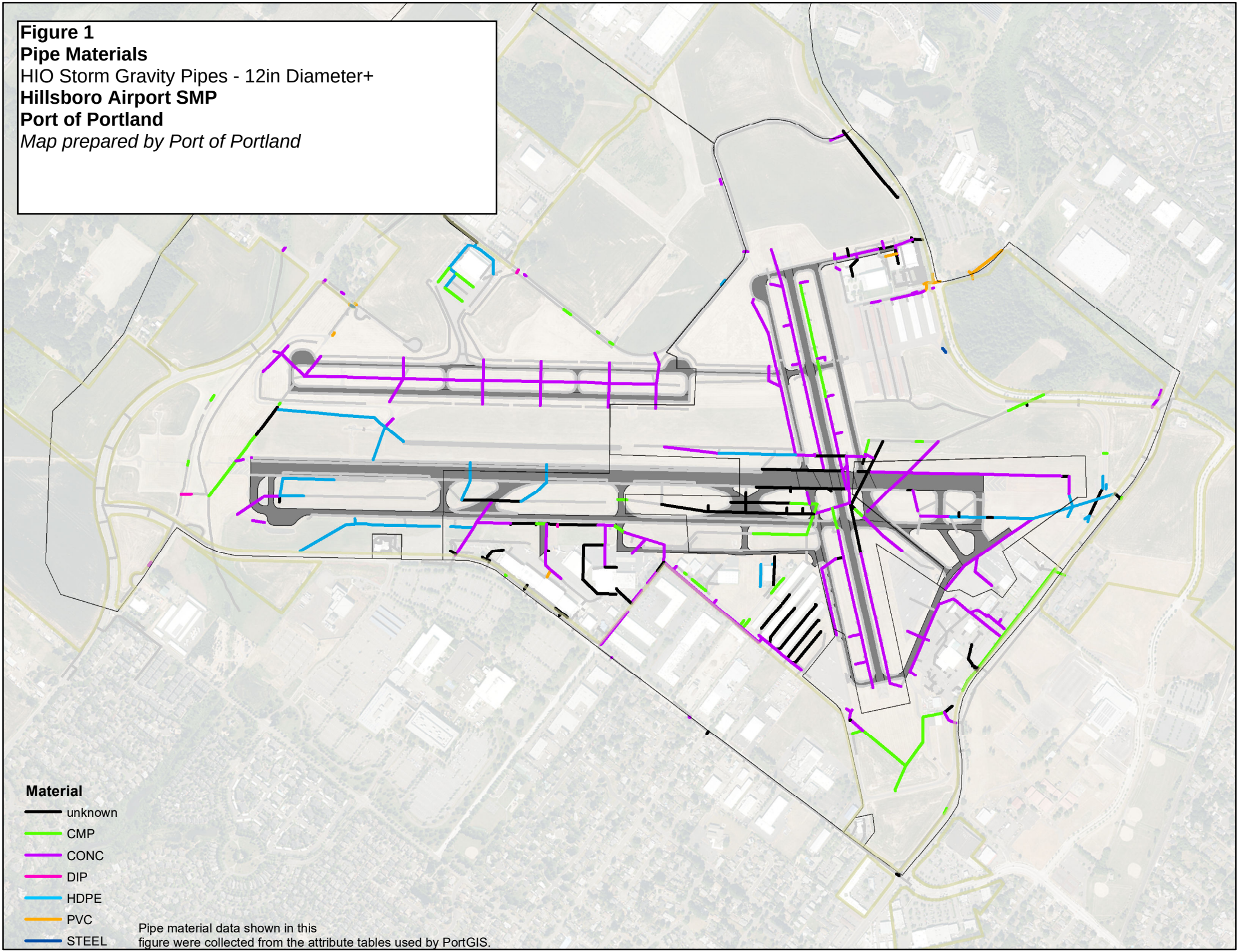
Summary

Port of Portland should proactively replace aging infrastructure when construction projects are planned in the vicinity. Pipe replacements may be coordinated with SMP projects in Work Areas 5, 6, 7, 8, 9, 11, and 12. In many cases, revision of drainage patterns in the coordinated projects may inherently result in replacing the aging pipes, with no further planning or expenditures needed. Six standalone projects are identified at a total cost of $1,465,360.

Figures

Figures 1-4

Figure 1
Pipe Materials
HIO Storm Gravity Pipes - 12in Diameter+
Hillsboro Airport SMP
Port of Portland
Map prepared by Port of Portland



Pipe material data shown in this figure were collected from the attribute tables used by PortGIS.

Figure 2
Pipe Age
HIO Storm Gravity Pipes - 12in Diameter+
Hillsboro Airport SMP
Port of Portland
Map prepared by Port of Portland

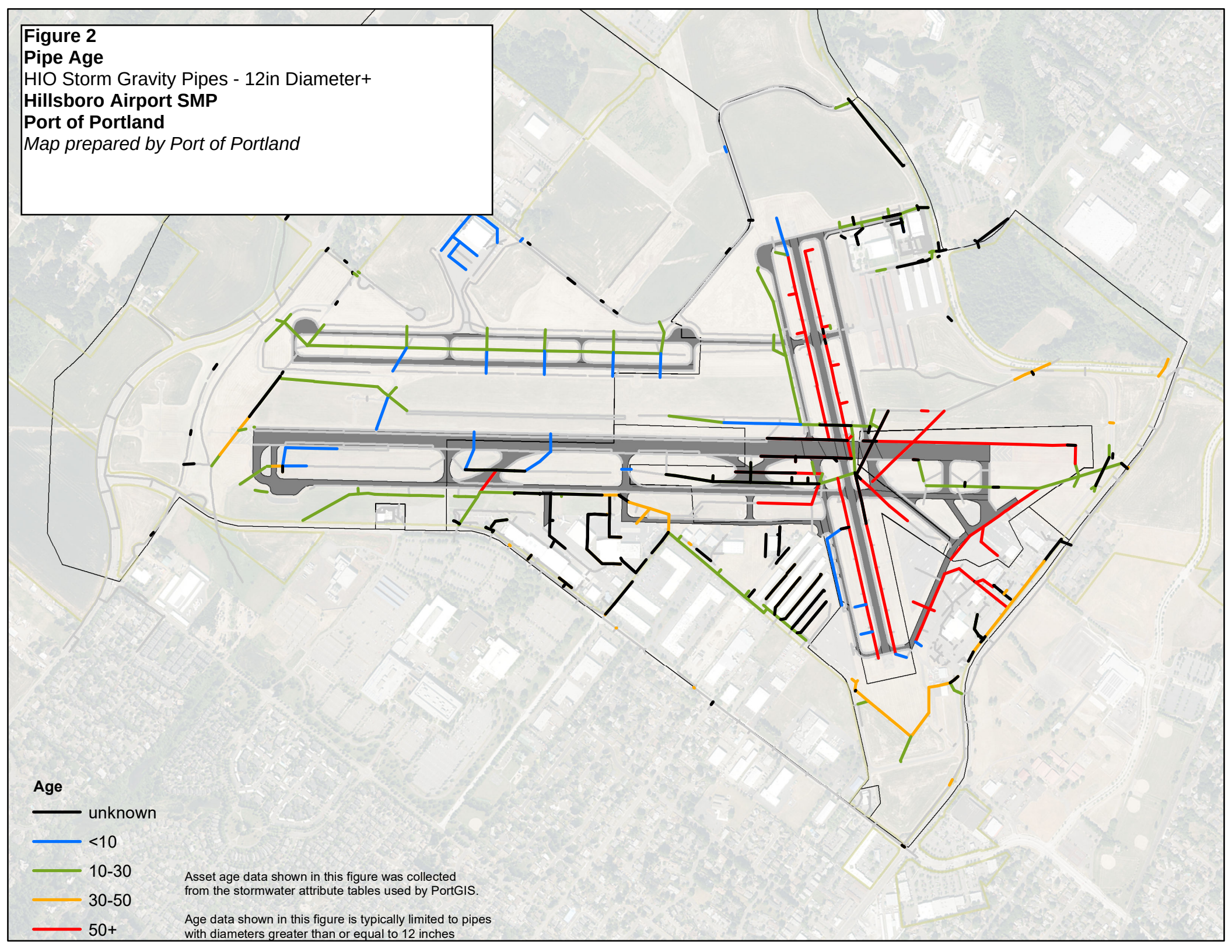
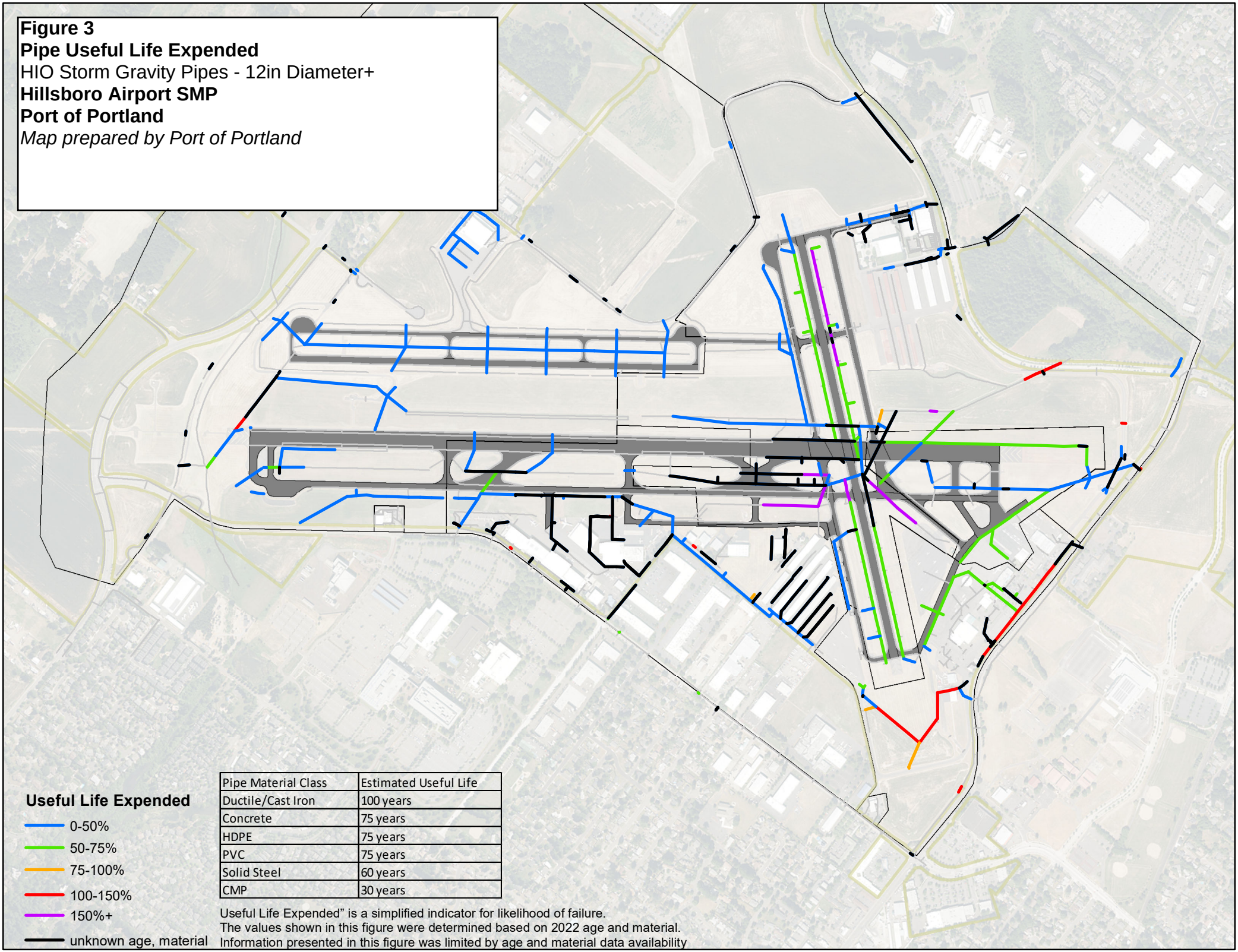


Figure 3
Pipe Useful Life Expended
HIO Storm Gravity Pipes - 12in Diameter+
Hillsboro Airport SMP
Port of Portland
Map prepared by Port of Portland



Useful Life Expended

- 0-50%
- 50-75%
- 75-100%
- 100-150%
- 150%+
- unknown age, material

Pipe Material Class	Estimated Useful Life
Ductile/Cast Iron	100 years
Concrete	75 years
HDPE	75 years
PVC	75 years
Solid Steel	60 years
CMP	30 years

Useful Life Expended" is a simplified indicator for likelihood of failure.
The values shown in this figure were determined based on 2022 age and material.
Information presented in this figure was limited by age and material data availability

FIGURE 4
RECOMMENDED ASSET REPLACEMENTS

HILLSBORO AIRPORT SMP

PORT OF PORTLAND
HILLSBORO, OREGON

MAP EXPLANATION

Asset Replacement
- Standalone Replacements
- CIP 5
- CIP 7
- CIP 8
- CIP 9
- CIP 11
- CIP 12
- Work Area 6

HIO Conveyances
- Subterranian Drainage
- Culvert
- Storm Sewer Ditch Centerline
- Storm Sewer Pipe

Background Data
- HIO Primary Wildlife Boundary
- HIO Property Line
- HIO RPZ
- HIO Wetlands
- Streams
- HIO Property Mask
- Treated Impervious Surfaces

Date: 3/13/2023
Disclaimer: This data is not to survey accuracy and is meant for planning purposes only.

PORT OF PORTLAND

Otak

V:\PROJECT\19400\19442\CADD\GIS\MXDS\TASK 5-ASSET INVENTORY\ASSET REPLACEMENT FIGURE.APRX

Tables

Otak

Hillsboro Airport SMP
Recommended Asset Replacements
Table 1

					Replacement								
	Existing Asset[1]				Pipes[2]		Catch Basins[3]			Manholes[3]			
Project or Coordinated CIP	Asset ID	Diam. (IN)	Useful Life Expended	Pipe Length (LF)	Unit Price	Concrete Pipe Cost	CB Qty (EA)	CB Unit Cost	CB Total	MH Qty (EA)	MH Unit Cost	MH Total	Segment Total
A-A	STSLN1919	24	110	157	330	$51,810	1	$5,000	$5,000	1	$8,000	$8,000	$64,810
A-A Total				**157**									**$64,810**
A-B	STSLN0006303	12	180	17	240	$4,080	1	$5,000	$5,000	1	$8,000	$8,000	$17,080
A-B	STSLN0006304	12	180	101	240	$24,240	1	$5,000	$5,000	1	$8,000	$8,000	$37,240
A-B	STSLN0006305	12	180	250	240	$60,000	2	$10,000	$20,000	1	$8,000	$8,000	$88,000
A-B	STSLN0006306	12	180	350	240	$84,000	2	$10,000	$20,000	1	$8,000	$8,000	$112,000
A-B	STSLN0006317	12	180	55	240	$13,200	1	$5,000	$5,000	1	$8,000	$8,000	$26,200
A-B	STSLN1829	12	180	42	240	$10,080	1	$5,000	$5,000	1	$8,000	$8,000	$23,080
A-B	STSLN1833	12	180	164	240	$39,360	1	$5,000	$5,000	1	$8,000	$8,000	$52,360
A-B Total				**979**									**$355,960**
A-C	STSLN1677	30	113	15	480	$7,200	1	$5,000	$5,000	1	$8,000	$8,000	$20,200
A-C	STSLN2353	30	150	105	480	$50,400	1	$5,000	$5,000	1	$8,000	$8,000	$63,400
A-C	STSLN2364	30	113	147	480	$70,560	1	$5,000	$5,000	1	$8,000	$8,000	$83,560
A-C	STSLN0017551	30	113	14	480	$6,720	1	$5,000	$5,000	1	$8,000	$8,000	$19,720
A-C	STSLN0017552	30	150	66	480	$31,680	1	$5,000	$5,000	1	$8,000	$8,000	$44,680
A-C Total				**347**									**$231,560**
A-D	STSLN2620	12	150	35	240	$8,400	1	$5,000	$5,000	1	$8,000	$8,000	$21,400
A-D Total				**35**									**$21,400**
A-E	STSLN2250a	15	180	62	270	$16,740	1	$5,000	$5,000	1	$8,000	$8,000	$29,740
A-E	STSLN2212	15	180	240	270	$64,800	2	$10,000	$20,000	1	$8,000	$8,000	$92,800
A-E	STSLN1848	15	180	93	270	$25,110	1	$5,000	$5,000	1	$8,000	$8,000	$38,110
A-E	STSLN2250	15	180	49	270	$13,230	1	$5,000	$5,000	1	$8,000	$8,000	$26,230
A-E Total				**444**									**$186,880**

Hillsboro Airport SMP
Recommended Asset Replacements
Table 1

	Existing Asset[1]				Replacement								
					Pipes[2]		Catch Basins[3]			Manholes[3]			
Project or Coordinated CIP	Asset ID	Diam. (IN)	Useful Life Expended	Pipe Length (LF)	Unit Price	Concrete Pipe Cost	CB Qty (EA)	CB Unit Cost	CB Total	MH Qty (EA)	MH Unit Cost	MH Total	Segment Total
A-F	STSLN1760	15	110	127	270	$34,290	1	$5,000	$5,000	1	$8,000	$8,000	$47,290
A-F	STSLN1761	15	110	123	270	$33,210	1	$5,000	$5,000	1	$8,000	$8,000	$46,210
A-F	STSLN2420	18	100	99	300	$29,700	1	$5,000	$5,000	1	$8,000	$8,000	$42,700
A-F	STSLN1759	18	110	124	300	$37,200	1	$5,000	$5,000	1	$8,000	$8,000	$50,200
A-F	STSLN2524	18	110	125	300	$37,500	1	$5,000	$5,000	1	$8,000	$8,000	$50,500
A-F	STSLN2526	18	110	21	300	$6,300	1	$5,000	$5,000	1	$8,000	$8,000	$19,300
A-F	STSLN2549	18	100	233	300	$69,900	2	$10,000	$20,000	1	$8,000	$8,000	$97,900
A-F	STSLN0017544	18	100	11	300	$3,300	1	$5,000	$5,000	1	$8,000	$8,000	$16,300
A-F	STSLN1758	21	110	223	310	$69,130	2	$10,000	$20,000	1	$8,000	$8,000	$97,130
A-F	STSLN2525	21	110	22	310	$6,820	1	$5,000	$5,000	1	$8,000	$8,000	$19,820
A-F	STSLN2608	54	130	58	1800	$104,400	1	$5,000	$5,000	1	$8,000	$8,000	$117,400
A-F Total				**1166**									**$604,750**
CIP 11	STSLN2135	12	120	24	240	$5,760	1	$5,000	$5,000	1	$8,000	$8,000	$18,760
CIP 11	STSLN2231a	12	93	62	240	$14,880	1	$5,000	$5,000	1	$8,000	$8,000	$27,880
CIP 11	STSLN0004158	16	103	7	280	$1,960	1	$5,000	$5,000	1	$8,000	$8,000	$14,960
CIP 11	STSLN1971	36	130	12	800	$9,600	1	$5,000	$5,000	1	$8,000	$8,000	$22,600
CIP 11 Total				**105**									**$84,200**
CIP 12	STSLN2230	15	180	481	270	$129,870	3	$15,000	$45,000	2	$8,000	$16,000	$190,870
CIP 12	STSLN0008955	18	180	63	300	$18,900	1	$5,000	$5,000	1	$8,000	$8,000	$31,900
CIP 12	STSLN1875	18	180	132	300	$39,600	1	$5,000	$5,000	1	$8,000	$8,000	$52,600
CIP 12 Total				**676**									**$275,370**
CIP 5	STSLN2291	24	180	60	330	$19,800	1	$5,000	$5,000	1	$8,000	$8,000	$32,800
CIP 5	STSLN0003198	36	93	126	800	$100,800	1	$5,000	$5,000	1	$8,000	$8,000	$113,800
CIP 5	STSLN0006992	36	93	26	800	$20,800	1	$5,000	$5,000	1	$8,000	$8,000	$33,800
CIP 5 Total				**212**									**$180,400**

Hillsboro Airport SMP
Recommended Asset Replacements
Table 1

					Replacement								
	Existing Asset[1]				Pipes[2]		Catch Basins[3]			Manholes[3]			
Project or Coordinated CIP	Asset ID	Diam. (IN)	Useful Life Expended	Pipe Length (LF)	Unit Price	Concrete Pipe Cost	CB Qty (EA)	CB Unit Cost	CB Total	MH Qty (EA)	MH Unit Cost	MH Total	Segment Total
CIP 7	STSLN2340	12	180	211	240	$50,640	2	$10,000	$20,000	1	$8,000	$8,000	$78,640
CIP 7	STSLN0006685	15	180	272	270	$73,440	2	$10,000	$20,000	1	$8,000	$8,000	$101,440
CIP 7	STSLN0014897	15	183	81	270	$21,870	1	$5,000	$5,000	1	$8,000	$8,000	$34,870
CIP 7 Total				**564**									**$214,950**
CIP 8	STSLN1663	24	150	55	330	$18,150	1	$5,000	$5,000	1	$8,000	$8,000	$31,150
CIP 8	STSLN1664	24	150	100	330	$33,000	1	$5,000	$5,000	1	$8,000	$8,000	$46,000
CIP 8	STSLN2529	24	150	109	330	$35,970	1	$5,000	$5,000	1	$8,000	$8,000	$48,970
CIP 8	STSLN2536	24	150	74	330	$24,420	1	$5,000	$5,000	1	$8,000	$8,000	$37,420
CIP 8	STSLN1656	24	150	101	330	$33,330	1	$5,000	$5,000	1	$8,000	$8,000	$46,330
CIP 8	STSLN1657	24	150	141	330	$46,530	1	$5,000	$5,000	1	$8,000	$8,000	$59,530
CIP 8	STSLN1659	24	150	84	330	$27,720	1	$5,000	$5,000	1	$8,000	$8,000	$40,720
CIP 8	STSLN1660	24	150	171	330	$56,430	1	$5,000	$5,000	1	$8,000	$8,000	$69,430
CIP 8	STSLN1661	24	150	56	330	$18,480	1	$5,000	$5,000	1	$8,000	$8,000	$31,480
CIP 8	STSLN1662	24	150	74	330	$24,420	1	$5,000	$5,000	1	$8,000	$8,000	$37,420
CIP 8 Total				**965**									**$448,450**
CIP 9	STSLN2493	24	137	230	330	$75,900	2	$10,000	$20,000	1	$8,000	$8,000	$103,900
CIP 9	STSLN2504	24	137	84	330	$27,720	1	$5,000	$5,000	1	$8,000	$8,000	$40,720
CIP 9	STSLN2523	24	137	111	330	$36,630	1	$5,000	$5,000	1	$8,000	$8,000	$49,630
CIP 9 Total				**425**									**$194,250**
Work Area 6	STSLN2579	60	130	15	1950	$29,250	1	$5,000	$5,000	1	$8,000	$8,000	$42,250
Work Area 6 Total				**15**									**$42,250**
Grand Total				**6090**									**$2,905,230**

Notes

[1] Class V Reinforced Concrete pipe to meet to meet a HS 25-44 live load is assumed for all replacements.

[2] Pipe unit prices include materials, trenching, bedding, and backfill for 5-ft depth pipe. Because costs are conservative, minor surface restoration is assumed to be included.

[3] Assets aged are pipes. Number of catbh basins and manholes are calculated using assumpions of #/lf of pipe.

Assumptions

2 catch basins per 400 LF of pipe

1 manhole per 400 LF of pipe

Memorandum

To:	Blake Hamalainen, Port of Portland
From:	Joe Brascher, Roger Tiffany, PE, Nate Robinson, PE, Trista Kobluskie
Copies:	Maureen Minister, Phil Stenstrom, Port of Portland
Date:	May 8, 2023
Subject:	Stormwater Planning Services for Hillsboro Airport (HIO) Hydraulic Modeling
Project No.:	19442

Introduction

Otak, Inc. (Otak) and Robin Kirschbaum, Inc. (RKI) are preparing a Hillsboro Airport Stormwater Master Plan (HIO SMP). Otak has been contracted to evaluate both the existing capacity of the storm sewer system managed by the Port of Portland (POP) and future conditions as proposed in the Hillsboro Airport Master Plan and the HIO SMP. These scenarios were evaluated by developing hydraulic models using PCSWMM v.7.4.3240 Professional 2D. The purpose of this memo is to outline the development and results of the modeling effort.

Site Overview

HIO is located in the City of Hillsboro, Oregon, roughly bounded by NE Evergreen Road to the north, NE Brookwood Parkway to the east, NE Cornell Road to the south, and NE 25th Avenue to the west. Portions of the site periphery are in unincorporated Washington County. The airport is owned by the Port of Portland and is classified by the Federal Aviation Administration (FAA) as a National General Aviation Reliever airport. For this plan, HIO is defined as the airport and other Port-owned lands in the vicinity, which together are approximately 963 acres in size.

Stormwater from the site discharges to Dawson Creek, Glencoe Swale, and public storm sewer systems. The southern and eastern portions of the site drain to Dawson Creek, while the northern and western portions drain to Glencoe Swale. Glencoe Swale crosses the site from east to west in proximity to airport operational areas, while Dawson Creek flows at the eastern boundary of HIO, east of Brookwood Parkway and adjacent to portions of the site that are disconnected from the main airport property by roads. The HIO storm system conveyances may be characterized as generally flat with low cover.

Existing Conditions Model

A planning level existing conditions hydraulic model was developed using PCSWMM to identify capacity issues in the current storm system to be addressed in the HIO SMP. The model was developed from various data such as GIS data, previous models, and field observations.

Available Data

Otak received GIS data from the Port that included various storm sewer system components, discharge points and their respective drainage basins, impervious surfaces, long-term and short-term ponding areas, jurisdictional wetlands, the HIO property boundary, and elevation contours. This data provided much of the information necessary to build a functioning model with intermittent gaps throughout.

Otak determined that data regarding the HIO existing stormwater system was adequate to assess current drainage conditions and provide an appropriate level of detail to develop a planning level existing conditions hydraulic model.

Drainage Basins Routing and Runoff

Otak used planning level drainage basins based on previous basins developed by the Port. The drainage basins included in the Port GIS data were evaluated and subdivided to add resolution to the model. The basins were split into equal subbasins to disperse discharge from the basins into the receiving storm system. Each subbasin was connected to a unique node within the model. The number of subbasins was determined by the total size of the basin and amount of storm sewer present. Several basins provided in the GIS data did not drain directly into the port system and would therefore have no effect on model results. These basins were modeled and routed offsite.

A composite runoff curve number (CN) was determined for each drainage basin by calculating impervious percentages within each drainage basin and applying it to predetermined base CNs. The base CNs used were 77 for pervious surfaces and 98 for impervious surfaces. Drainage basin slopes were manually calculated by using contours.

Storm Sewer System Data

The storm system data were provided as shapefiles, and LiDAR topography was provided as a triangular irregular network (TIN) file and were current as of October 2021.

The model of the storm sewer system was simplified by focusing on pipes with 12-inch diameters or larger. Additionally, the data was reduced by removing parts of the storm sewer system that were not necessary for modeling. This included consolidating intricate or branching areas of the storm sewer into a single inlet and pipe reach, removing certain inlets and connected laterals along long pipe reaches, and ignoring peripheral portions of the network that do not connect to the main storm sewer system. Ditches were simplified from the GIS and TIN data provided; most ditches were given a bottom width of 3-ft, depth of 3-ft, and 3:1 side slopes. These dimensions were adjusted in locations like Glencoe Swale where the dimensions were known to be larger or different.

The storm system data contained gaps, which were filled by making certain assumptions. Examples of these data gaps and the assumptions made to reconcile the data can be seen in Table 1.

Table 1 Data Gaps and Assumptions

Data Gap	Assumption
Missing inlet or manhole invert elevations	Incoming or outgoing pipe inlet elevations were used.
Missing inlet or manhole rim elevations	The closest contour elevation was used.
Missing pipe invert elevations	If connected to a structure with an invert elevation, this elevation was used. If there were no reference structures or pipes nearby, a realistic placeholder elevation was used until a real elevation could be determined.
Missing manholes, inlets, or outlets	These structures were added if necessary for modeling purposes. Values for elevation inverts and rim elevations were determined using the same methods mentioned in previous assumptions.
Fragmented pipe data, (e.g., a single reach of pipe broken into three segments)	The pipe segments were merged into one. Invert elevations were determined from upstream and downstream segments.
Missing pipe diameters	Connected upstream or downstream pipe diameters were used. If there were no reference pipes nearby, a realistic place holder diameter was used until a real diameter could be determined.
Missing streams / open channel flow paths	Streams are not a part of the HIO storm system infrastructure, but in some locations, streams or other natural channels need to be included in the model. In these locations, ditches were added by connecting disjointed open channel flow paths. Contours and aerial imagery were used to determine the flow paths.
Ponding occurs in area that are not connected to storm sewer system	Where either a wetland is indicated on the site or ponding occurs in an area with no drainage infrastructure, it was assumed that eventually the wetland/ponded area would drain to the HIO storm system. In these locations, ditches were placed to show a connection to the system.

Flow Monitoring Reports

The Port collected flow monitoring data from five locations in the northern portion of the airport between September 2016 and May 2017, and from three locations in the southern portion of the airport between May 2017 and May 2018. The associated memorandums, authored by Environmental Science

Associates, do not directly provide an assessment of the data but rather accompany the raw data in support of the Port's assessment.

The data collected during the flow monitoring effort could have been used to calibrate the existing conditions hydraulic model created with the on-going HIO SMP. However, the following factors make using this data for model calibration inefficient and less effective:

- The raw data needs to be assessed to make it informative for existing conditions model calibration. This would include identifying accurate rainfall data for the dates and times of interest and tying the recorded depths to elevations in the correct vertical datum.
- Projects (primarily off-airport) have been constructed since the flow monitoring was conducted, which may have an effect on the associated flows.
- High flow data points are most helpful for model calibration. The flow monitoring data was collected over one year, which results in minimal high flow data points.

For these reasons, it is acknowledged that the data is available, but was not used to calibrate the existing condition model.

Glencoe Swale Hydrologic and Hydraulic Analysis

In 2017, City of Hillsboro and Otak assessed hydraulic conditions in Glencoe Swale from the mouth to its headwaters, including the reaches flowing through HIO, in order to verify or correct a 2006 floodplain modeling effort by Clean Water Services (CWS). The existing conditions findings of the study included routine overtopping of NE Lenox St, maintenance of the culvert under NW Connell Ave/P&W Railroad, and potential overtopping of NW Glencoe Rd during large flood events. The study modeled future conditions scenarios including a capacity increase that has since been completed at Lenox St downstream of HIO. The study also updated the hydrology using a Hydrological Simulation Program-FORTRAN (HSPF) model that was calibrated for the Tualatin River Basin and the McKay Creek sub-basin.

Elements of this study were used to inform the modeling effort as described in the next section.

Port Observations

Port staff have observed and photographed ponding at various locations across the site over the course of several years. These data are anecdotal; ponding or flooding is not measured, and observations are not correlated to particular storm frequencies or rainfall amounts. However, these data were considered extremely important in identifying areas of concern in the storm system and in matching modeled existing conditions to observed conditions.

Assessment Methods

Hydrology

The hydrologic calculations in the model of the HIO storm system utilize the Soil Conservation Service (SCS) Type 1A rainfall distribution. Table 2 shows the modeled rainfall events and the corresponding rainfall depths (CWS 2019).

Table 2 SCS Type 1A Rainfall Events

Udlqidoo#Hyhqw	Udlqidoo#Ghswk#lq,
50|u	518
80|u	614
430|u	6178
580|u	61<
830|u	71;
4330|u	71<

Chapter 2 of the Advisory Circular 150/5320-5D states that all areas other than airfields should be based on rainfall of 10-year frequency (USDOT 2013). The 10-year event was selected for the purpose of identifying flooding locations under existing conditions that may warrant further investigation for inclusion in the HIO SMP's capital improvement program.

Hydraulics

The model of the storm system was constructed from the GIS data gathered in the previous section. This data was imported into the PCSWWM model. The infrastructure model included culverts of 12 inches or larger, significant drainage ditches, and known discharge points.

Because Glencoe Swale flows through the site near airport operational areas, and anecdotally is known to impact the airport drainage system during larger events, its hydraulics were characterized for the model. In 2017, Otak produced a HEC-RAS model of the proposed conditions in Glencoe Swale. One purpose of this model was to determine impacts of a proposed improvement downstream of HIO as described above. The downstream improvements were constructed in 2018. The transects from this model were imported into the SWMM model and used to represent Glencoe Swale on HIO. The transects used for each section of Glencoe Swale in the model are shown in Table 3.

The inclusion of the HEC-RAS model allowed for more precise modeling of the impacts of flooding in Glencoe Swale on the airport outfalls to Glencoe Swale. Stage results were taken from the HEC-RAS model to calibrate the flows in the SWMM model for Glencoe Swale. Elevation results for each of the locations shown in Table 3, for each of the six modeled rainfall events, were compared to HEC-RAS elevations. Generally, there was good agreement between the two model results. Only two of the upstream transects produced slightly different results, swale sections 334 and 146. These sections are upstream culverts that flow under different street sections. The culverts modeled in the HEC-RAS model are not the same as the culverts found during field investigations and present in the GIS. The discrepancy is likely due to changes in the system since 2017 that are not included in the HEC-RAS model. Table 3 shows stages for key locations in the SWMM model as compared to stages in the HEC-RAS model for the 10-year event.

Table 3 10-Year Event Elevations for HEC-RAS and SWMM

Glencoe Swale Assigned Transects		HEC-RAS	SWMM
SWMM Number	HEC-RAS Transect Number	Elevation(ft)	Elevation(ft)
334	5618713	193.53	193.03
146	5617987	190.65	190.00
300	5617907	189.83	189.52
299	5617233	187.13	188.32
2	5616700	184.66	183.28
154	5616152	182.48	183.21
292	5615725	181.92	181.95
297	5615613	181.67	181.93
156	5615222	181.54	181.89

A map of the existing flooding areas was used to calibrate or verify the areas of the SWMM model not covered by the existing HEC-RAS model. Existing flooding areas were accounted for by comparing them to modeled flooding areas and adjusting the model as needed. Known flooding issues and simulated flooded areas are shown on Figures 1 through 9.

Results and Recommendations

For the purposes of assessing the existing conditions modeling results, flooding is defined as the hydraulic grade line exceeding the rim elevation of a given node. Flood time in hours during the 10-year event was used as a metric to define severity of flooding. The existing conditions model results indicated that at the 10-year recurrence interval, flooding is experienced at 14 locations spread throughout the site. All flooding locations were carefully evaluated to identify if modeled flooding was a result of conveyance capacity deficiencies in the existing storm system.

Some of the flooding predicted by the existing conditions model may be attributed to a lack of resolution. As a result of the simplified approach, some modeled flooding occurs because drainage basins discharge to the conveyance system at a single point rather than being distributed among individual inlets. These points were identified and addressed in the proposed conditions model. Table 4 summarizes flooded locations under existing conditions, severity of flooding, and recommendations.

Figures 1-9 show the flooded locations under existing conditions. Although not included in the flooding areas predicted by the model, there is an area of observed flooding near Taxiway A on the northwest side of HIO that is addressed in the proposed conditions model.

Table 4 10-Year Event SWMM Flooding Locations, Existing Conditions

Flooded Node ID	Hours Flooded, Existing	Location	Map Page	Notes and Recommendations
281	1.29	NE Sewell Ave. and Evergreen Rd.	Figure 2	This location may require further analysis and design to alleviate flooding. The existing culvert under NE Sewell Ave. is a convergence point of three lines of stormwater conveyance. This site was not selected to be modified in the preferred stormwater alternative.
8	4.39	North Airfield Drainage System, Glencoe Swale Input	Figure 4	Increase capacity in future conditions model. Conveyance capacity will be increased by adding a proposed 24-inch pipe and upsizing existing pipes to 24 inches, see Figure 10, Location C2
222	0.17	North Runway 13R-31L Drainage System, Glencoe Swale Input	Figure 4	Predicted flooding is a result of planning level modeling resolution. Improve model resolution in future conditions model
OF1	0.34	Outfall to NE 25th Ave. Storm System, Glencoe Swale Input	Figure 4	Predicted flooding is a result of planning level modeling resolution. Improve model resolution in future conditions model
46	0.93	North of Runway 2-20, Upstream of CIP 5 Work Area	Figure 5	Predicted flooding is a result of planning level modeling resolution. Improve model resolution in future conditions model
185	0.44	North of Runway 2-20, Upstream of CIP 5 Work Area	Figure 5	Predicted flooding is a result of planning level modeling resolution. Improve model resolution in future conditions model
45	0.66	Between Infill Hangars and West Tie-Down Apron, CIP 11 Work Area	Figure 6	Predicted flooding is a result of planning level modeling resolution. Improve model resolution in future conditions model
85	6.51	Between Infill Hangars and West Tie-Down Apron, CIP 11 Work Area	Figure 6	Predicted flooding is a result of planning level modeling resolution. Improve model resolution in future conditions model

Flooded Node ID	Hours Flooded, Existing	Location	Map Page	Notes and Recommendations
47	1.72	Near Center Tie-Down Apron, CIP 7 Work Area	Figures 7 & 9	Predicted flooding is a result of planning level modeling resolution. Improve model resolution in future conditions model
134	2.48	Upstream of Dawson Creek Outfall	Figure 7	Predicted flooding is a result of planning level modeling resolution. Improve model resolution in future conditions model
178	0.33	Adjacent to Brookwood Pkwy	Figure 7	Predicted flooding is a result of planning level modeling resolution. Improve model resolution in future conditions model
184	21.53	Near Intersection of Runway 13R-31L and Taxiway C, Upstream of CIP 5 Work Area	Figure 7	Predicted flooding is a result of planning level modeling resolution. Improve model resolution in future conditions model
304	0.82	Between Runway 13R-31L and T-Hangars, CIP 5 Work Area	Figure 7	Future conditions in the CIP 5 Work Area will change the conveyance network in a way that would address capacity issues.
331	16.83	Apron to T-Hangars from Taxiway B, Upstream of CIP 5 Work Area	Figure 7	Increase capacity in future conditions model. A proposed conveyance pipe will drain runoff in this location. This capacity increase is incorporated into the proposed conveyance system in CIP 5, see Figure 10, Location C3.
Additional Noted Flooding				
Observed Flooding Location	NA	Between Hillsboro Fire Station #5 & Taxiway A	Figure 4	Increase capacity in future conditions model. Conveyance capacity will be increased by upsizing existing pipes to 15 inches, See Figure 10, Location C1.

Future Conditions

The 2018 HIO Master Plan describes a 20-year preferred alternative for aviation and non-aviation development of the site, and the HIO SMP describes a preferred stormwater alternative to manage runoff from the proposed conditions. The results of the existing conditions model as well as anecdotal reports of ponding were used to inform creation of the recommended stormwater alternative and the subsequent capital improvement project concepts in the HIO SMP. The preferred stormwater alternative includes

changes to the conveyance system as well as hydromodification mitigation facilities and water quality treatment facilities. A hydraulic model of the storm system under the future conditions was created to ensure adequate conveyance capacity in the future condition. The future conditions model also updates Glencoe Swale through HIO to incorporate the ongoing Runway Safety Improvement project which places a portion of the stream in a culvert and is expected to be complete in 2024. The model demonstrates the need for new or upsized pipes, new flow control facilities, and entirely new parts of the stormwater system.

Model Inputs

Storm Sewer System Data

The existing conditions modeled storm sewer was updated for future conditions including replacing parts of the conveyance and adding proposed flow control facilities. Parameters such as pipe diameter, pipe length, and invert elevations were adjusted to reflect proposed changes and proposed recommendations to address capacity.

Drainage Basins Routing and Runoff

The existing drainage basins and subbasins were modified where necessary for use in the future conditions model. The basins were subdivided to ensure that the appropriate areas were being managed by proposed systems and facilities. Additionally, several flooding locations present in the existing conditions model were addressed by further subdividing drainage basins and more evenly dispersing runoff into the stormwater system. If an existing drainage basin was known to drain offsite, it was assumed that the basin would continue to drain offsite in future conditions.

Curve numbers were carried over from the existing conditions model and adjusted appropriately to new impervious areas to be managed under proposed development. Basin imperviousness was derived from the HIO Master Plan Preferred Development Alternative, which is subject to change as projects move forward. Conservative estimates were used to ensure adequate conveyance capacity. It was assumed that all future non-aviation private developments draining to the system would provide hydromodification mitigation in accordance with Clean Water Services' 2019 standards and thus a predeveloped curve number of 80 was used for those drainage basins.

Glencoe Swale Hydrologic and Hydraulic Analysis

All data used from the City of Hillsboro Glencoe Swale hydraulic model were retained for the future conditions model. The proposed culvert under the Runway Safety Area was added to the model in addition to proposed swale grading near the entrance and exits of the culvert (WSP 2020).

Assessment Methods

Assessment methods were unchanged from the existing conditions model.

Results

The future conditions model finds that the SMP Preferred Stormwater Alternative resolves all but one of the flooding nodes (node 281) identified in the existing conditions model. Flooded nodes were resolved either through a capital improvement recommendation, upsizing of specific pipes in the local system, or adding resolution to the model. The future conditions model predicts six new flooding nodes which can be grouped into three locations. The predicted flooding locations in the future conditions model are shown in

Table 5. Figures 1-9 show the modeled storm system layout and flooding locations. The modeled pipes, nodes, and detention facilities are represented schematically and may not geographically align with facilities proposed in the SMP.

Table 5 10-Year Event SWMM Flooding Locations, Future Conditions

Location	Flooded Nodes	Hours Flooded, Future	Map Page	Notes/Recommendations
Glencoe Swale	235	2.76	Figure 2	Change thought to be due to addition of culvert. The SMP does not attempt to manage flooding in the receiving water resulting from watershed-wide hydrology.
	247	2.36	Figure 2	
CIP 3 Work Area, North Conveyance	248	0.47	Figure 5	Minor short-term ponding predicted with planning level design. Survey required to identify drainage patterns of adjacent drainage basins at final design.
	J363*	0.65	Figure 5	
Between Infill Hangars and West Tie-Down Apron, CIP 11 Work Area	J341*	0.32	Figure 6	Storm system GIS data provided in this area shows that all runoff from this work area flows to a detention pipe with an unknown outlet. Survey required at final design.
	140	0.27	Figure 6	
NE Sewell Ave. and Evergreen Rd.	281	1.2	Figure 2	This site was not selected to be modified in the preferred stormwater alternative. The existing culvert under NE Sewell Ave. is a convergence point of three lines of stormwater conveyance. This location may require further analysis and design to alleviate flooding.

**These are new model nodes created for the proposed conditions model. New model nodes are delineated with 'J'*

Summary

The future conditions model demonstrates that existing modeled flooding in 13 of 14 nodes is resolved through model resolution improvements and implementation of the SMP recommendations. The remaining flooding location is at the convergence of three separate stormwater conveyance lines including the public line running along NE Evergreen Parkway. Further analysis of this point is recommended.

The future conditions model identifies six new flooding nodes at three locations. The model indicates increased flooding where the proposed Glencoe Swale culvert will be installed with the ongoing Runway Safety Project. The SMP did not attempt to address flooding locations in Glencoe Swale. Additionally,

there is minor predicted flooding occurring in areas where there is incomplete data to model the storm system. It is recommended that those locations be reevaluated when data gaps have been filled.

New conveyance capacity resulting from development and redevelopment under the HIO Preferred Development Alternative is addressed in the respective CIP Work Areas and has been incorporated into the model. Table 6 and Figure 10 show recommended conveyance capacity increases to address existing flooding.

Table 6 Conveyance Capacity Increases Addressing Existing Conditions

Location	Asset ID	Existing Pipe		Proposed Pipe	
		Length (ft)	Diameter (in)	Length (ft)	Diameter (in)
C1	STSLN0003092	88	12	88	15
	STSLN0003093	61	12	61	15
	STSLN0003094	108	12	108	15
	STSLN0003095	91	12	91	15
	STSLN0003096	100	12	100	15
	STSLN0003097	100	12	100	15
	STSLN0003098	100	12	100	15
	STSLN0003530	84	12	84	15
	STSLN0003531	112	12	112	15
C2	STSLN0007854	213	15	213	24
	STSLN0012980	22	15	22	24
	STSLN0012982	290	15	290	24
	STSLN0012983	290	15	290	24
	STSLN0012984	287	15	287	24
	STSLN0012985	126	15	126	24
	Proposed Pipe 1	N/A	N/A	400	24
C3	Proposed Pipe 2 (CIP 5)	N/A	N/A	2100	12

References and Bibliography

Clean Water Services (CWS 2019). 2019. Design and Construction Standards for Sanitary and Surface Water Management.

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Figures

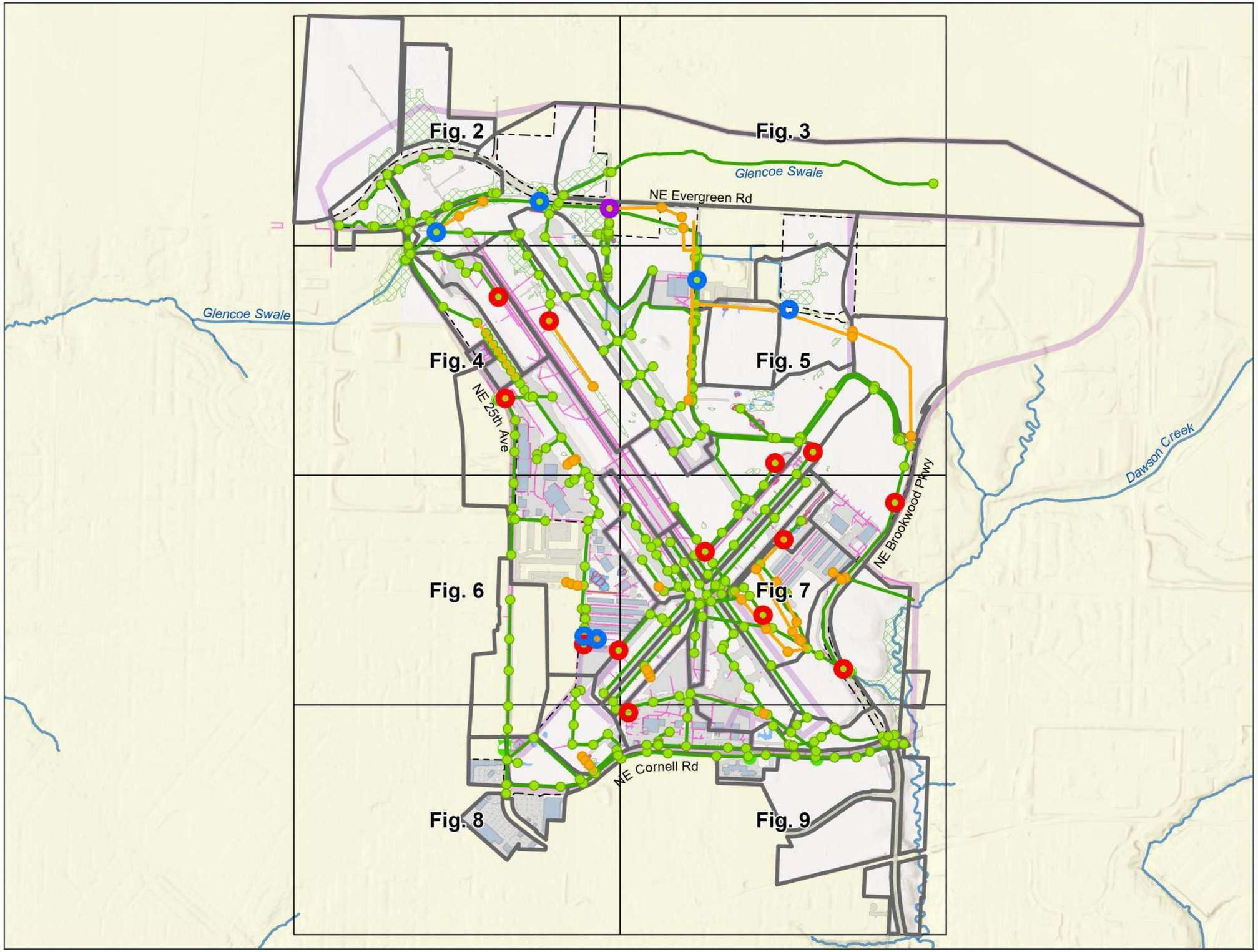
Figures 1-10

SWMM MODEL SCHEMATIC

HILLSBORO AIRPORT SMP

PORT OF PORTLAND
HILLSBORO, OREGON

FIGURE 1 - INDEX



MAP EXPLANATION

Modeled Flooding Locations
- Existing Conditions
- Future Conditions
- Exising/Future Conditions

Modeled System
- Modeled Nodes - Future
- Modeled Conduits - Future
- Modeled Nodes - Existing
- Modeled Conduits - Existing
- Modeled Basins

GIS Storm System
- Discharge Point
- HIO Drainage Basins

Background Data
- Property Line
- Wetland
- Port Owned Buildings
- Impervious P.O.P Airport Surface
- Streams

0 1,200 2,400 ft

PORT OF PORTLAND

Otak

Date: 3/15/2023
Disclaimer: This data is not to survey accuracy and is meant for planning purposes only.

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SWMM MODEL SCHEMATIC

HILLSBORO AIRPORT SMP

PORT OF PORTLAND

HILLSBORO, OREGON

FIGURE 2

MAP EXPLANATION

Modeled Flooding Locations

- Future Conditions
- Exising/Future Conditions

Modeled System

- Modeled Nodes - Future
- Modeled Conduits - Future
- Modeled Nodes - Existing
- Modeled Conduits - Existing
- Modeled Basins

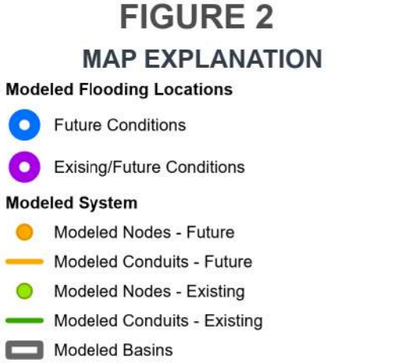
GIS Storm System

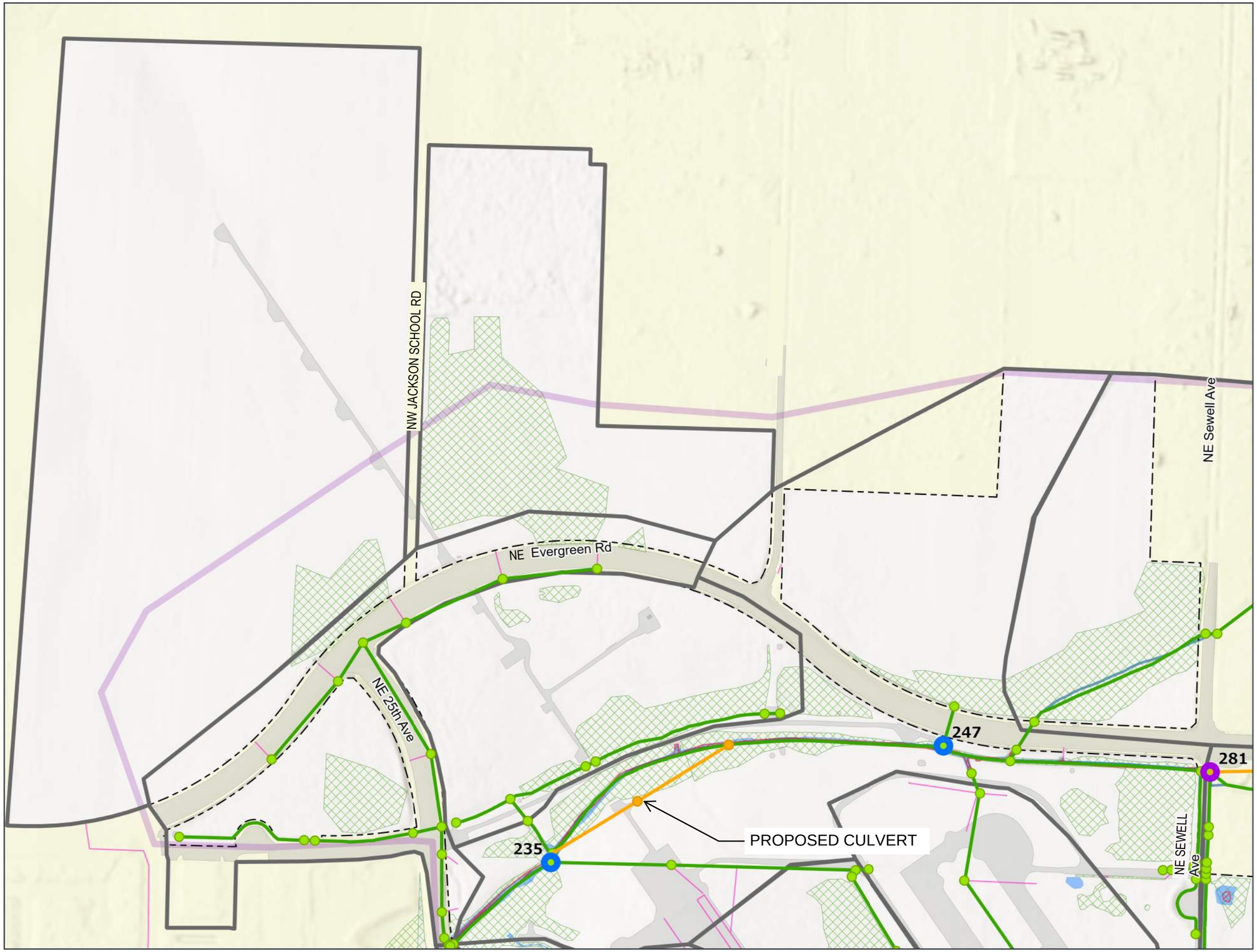
- Storm Sewer Pipe
- HIO Drainage Basins

Background Data

- Property Line
- Streams
- Observed Long-Term Ponding
- Observed Short-Term Ponding
- Wetland
- Impervious P.O.P Airport Surface
- Port Owned Buildings

Note: Modeled nodes, conduits, and facilities are represented schematically not geographically.





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PORT OF PORTLAND

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SWMM MODEL SCHEMATIC

HILLSBORO AIRPORT SMP

PORT OF PORTLAND

HILLSBORO, OREGON

FIGURE 3

MAP EXPLANATION

Modeled System

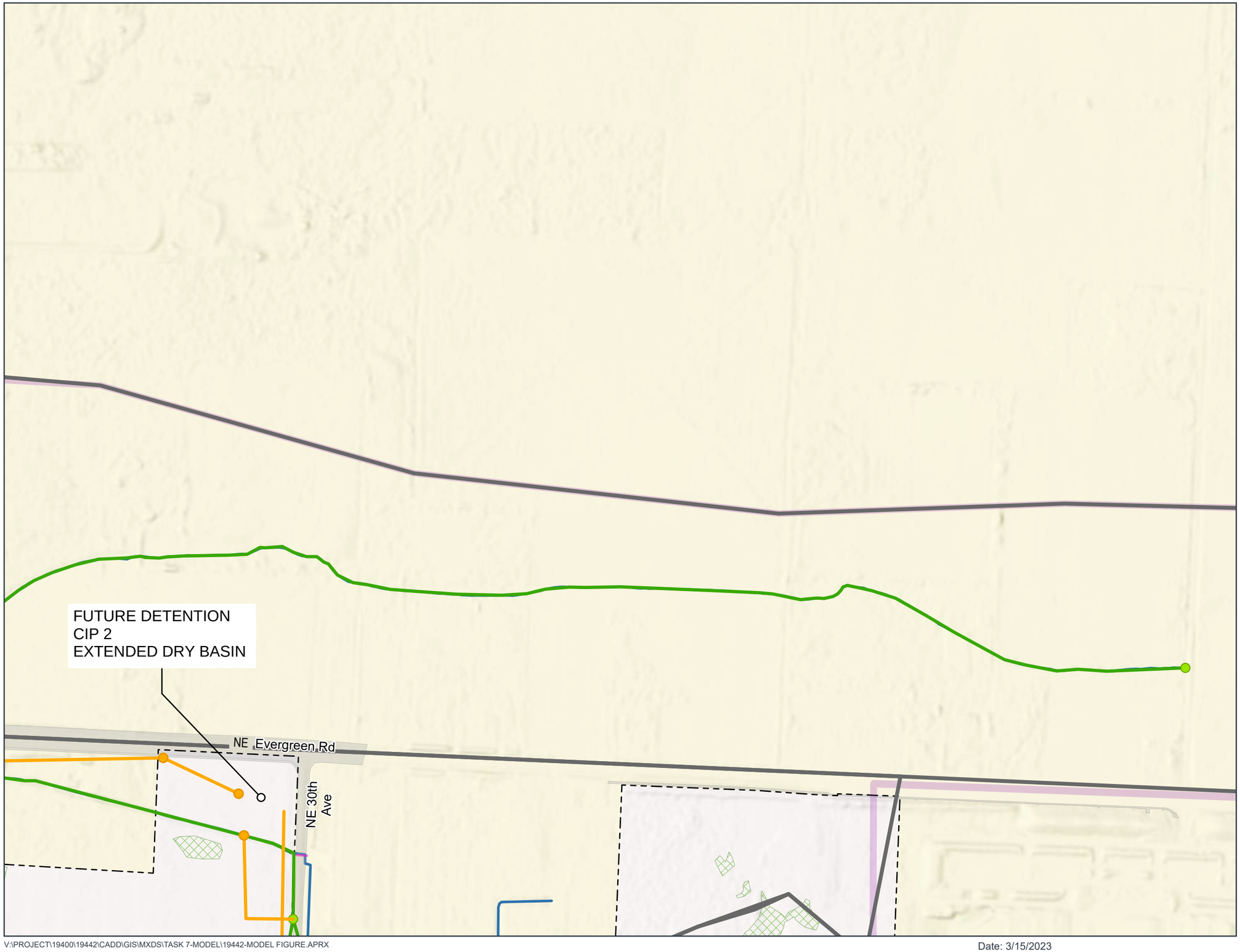
- Modeled Nodes - Future
- Modeled Conduits - Future
- Modeled Nodes - Existing
- Modeled Conduits - Existing
- Modeled Basins

GIS Storm System

- Storm Sewer Pipe
- HIO Drainage Basins

Background Data

- Property Line
- Streams
- Wetland
- Impervious P.O.P Airport Surface



Note: Modeled nodes, conduits, and facilities are represented schematically not geographically.

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PORT OF PORTLAND Otak

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SWMM MODEL SCHEMATIC

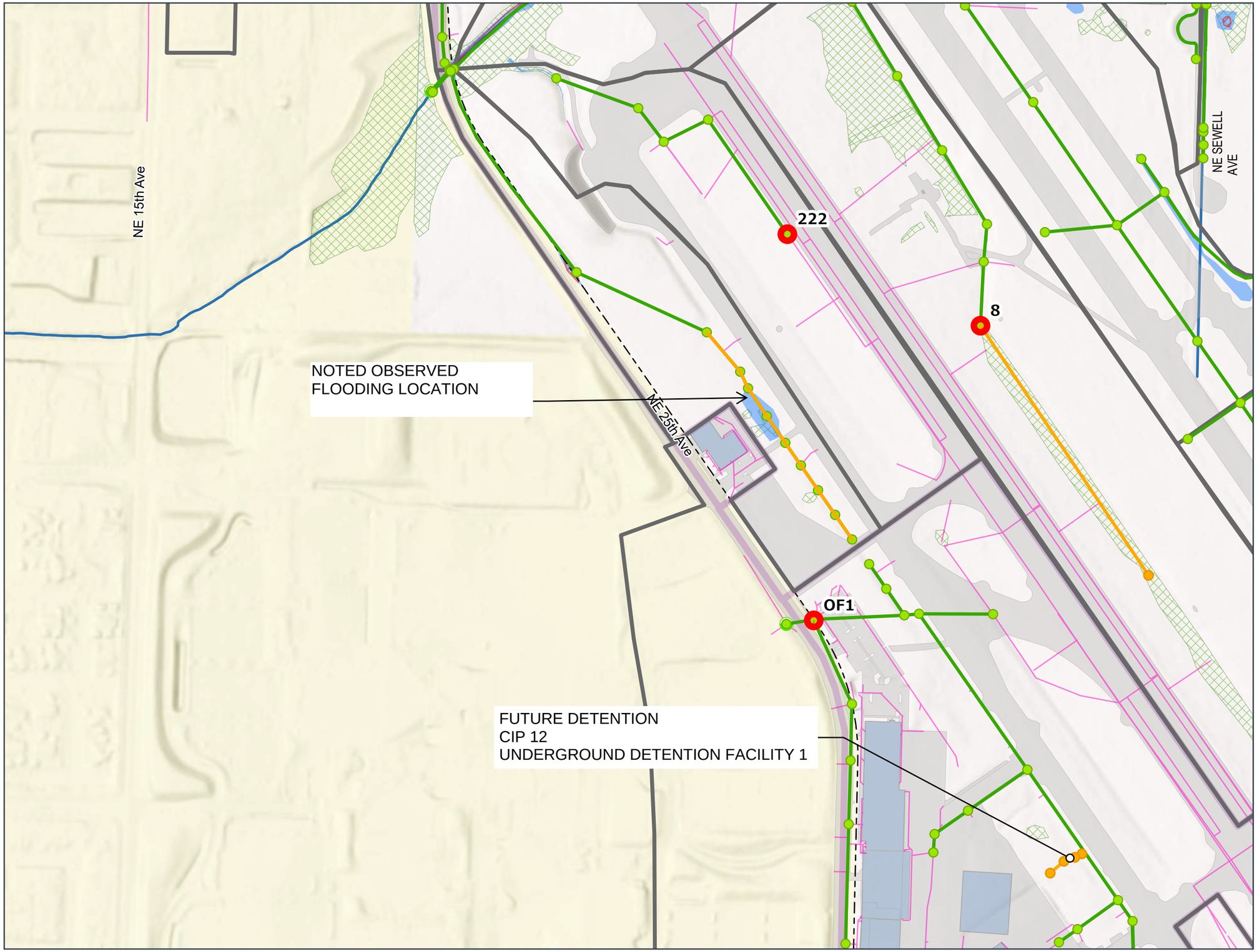
HILLSBORO AIRPORT SMP

PORT OF PORTLAND

HILLSBORO, OREGON

FIGURE 4

MAP EXPLANATION



Modeled Flooding Locations

- Existing Conditions

Modeled System

- Modeled Nodes - Future
- Modeled Conduits - Future
- Modeled Nodes - Existing
- Modeled Conduits - Existing
- Modeled Basins

GIS Storm System

- Storm Sewer Pipe
- Discharge Point
- HIO Drainage Basins

Background Data

- Property Line
- Streams
- Observed Long-Term Ponding
- Observed Short-Term Ponding
- Wetland
- Impervious P.O.P Airport Surface
- Port Owned Buildings

Note: Modeled nodes, conduits, and facilities are represented schematically not geographically.

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PORT OF PORTLAND

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SWMM MODEL SCHEMATIC

HILLSBORO AIRPORT SMP

PORT OF PORTLAND

HILLSBORO, OREGON

FIGURE 5

MAP EXPLANATION

Modeled Flooding Locations

- Existing Conditions
- Future Conditions

Modeled System

- Modeled Nodes - Future
- Modeled Conduits - Future
- Modeled Nodes - Existing
- Modeled Conduits - Existing
- Modeled Basins

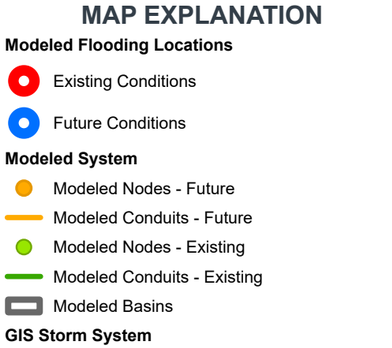
GIS Storm System

- Storm Sewer Pipe
- HIO Drainage Basins

Background Data

- Property Line
- Streams
- Observed Long-Term Ponding
- Observed Short-Term Ponding
- Wetland
- Impervious P.O.P Airport Surface
- Port Owned Buildings

Note: Modeled nodes, conduits, and facilities are represented schematically not geographically.



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Date: 3/15/2023

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SWMM MODEL SCHEMATIC

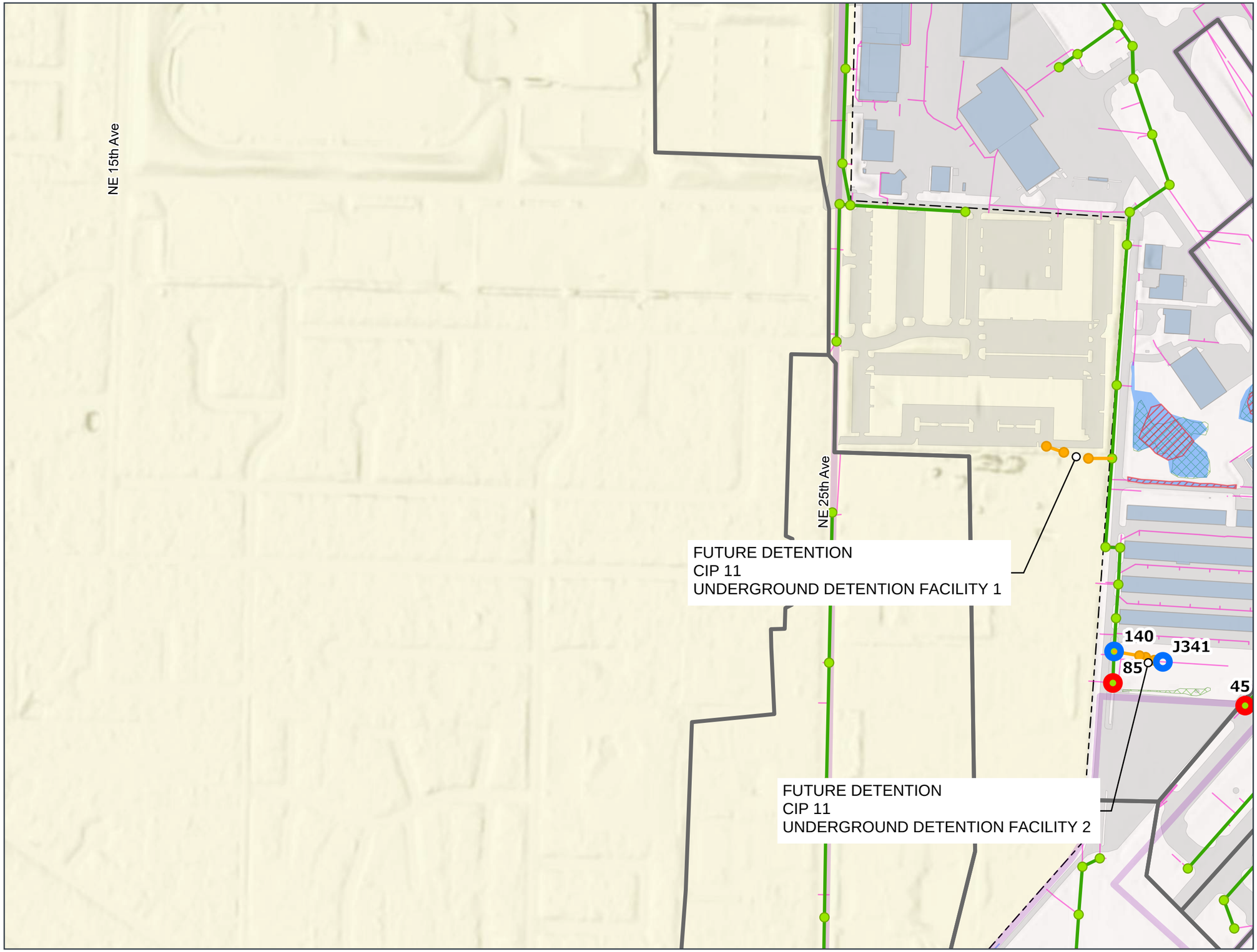
HILLSBORO AIRPORT SMP

PORT OF PORTLAND

HILLSBORO, OREGON

FIGURE 6

MAP EXPLANATION



Modeled Flooding Locations

- Existing Conditions
- Future Conditions

Modeled System

- Modeled Nodes - Future
- Modeled Conduits - Future
- Modeled Nodes - Existing
- Modeled Conduits - Existing
- Modeled Basins

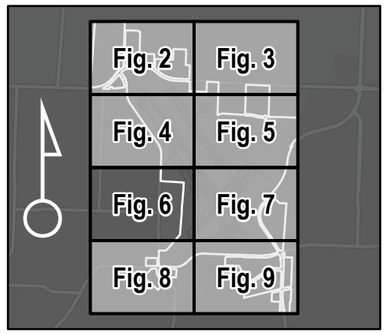
GIS Storm System

- Storm Sewer Pipe
- HIO Drainage Basins

Background Data

- Property Line
- Observed Long-Term Ponding
- Observed Short-Term Ponding
- Wetland
- Impervious P.O.P Airport Surface
- Port Owned Buildings

Note: Modeled nodes, conduits, and facilities are represented schematically not geographically.



ft

0 250 500

V:\PROJECT\19400\19442\CADD\GIS\MXDS\TASK 7-MODEL\19442-MODEL FIGURE.APRX

Date: 3/15/2023

Disclaimer: This data is not to survey accuracy and is meant for planning purposes only.

PORT OF PORTLAND

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SWMM MODEL SCHEMATIC

HILLSBORO AIRPORT SMP

PORT OF PORTLAND

HILLSBORO, OREGON

FIGURE 7

MAP EXPLANATION

Modeled Flooding Locations

- Existing Conditions

Modeled System

- Modeled Nodes - Future
- Modeled Conduits - Future
- Modeled Nodes - Existing
- Modeled Conduits - Existing
- Modeled Basins

GIS Storm System

- Storm Sewer Pipe
- Discharge Point
- HIO Drainage Basins

Background Data

- Property Line
- Streams
- Observed Long-Term Ponding
- Observed Short-Term Ponding
- Wetland
- Impervious P.O.P Airport Surface
- Port Owned Buildings

Note: Modeled nodes, conduits, and facilities are represented schematically not geographically.

0 250 500 ft

FUTURE DETENTION
CIP 12
UNDERGROUND DETENTION FACILITY 2

FUTURE DETENTION
CIP 10
UNDERGROUND DETENTION FACILITY

FUTURE DETENTION
CIP 5
UNDERGROUND DETENTION FACILITY

DAWSON CREEK OUTFALL

DAWSON CREEK OUTFALL

NE Airport Rd

NE Brookwood Pkwy

178

331

184

304

134

47

V:\PROJECT\19400\19442\CADD\GIS\MXDS\TASK 7-MODEL\19442-MODEL FIGURE.APRX

Date: 3/15/2023

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SWMM MODEL SCHEMATIC

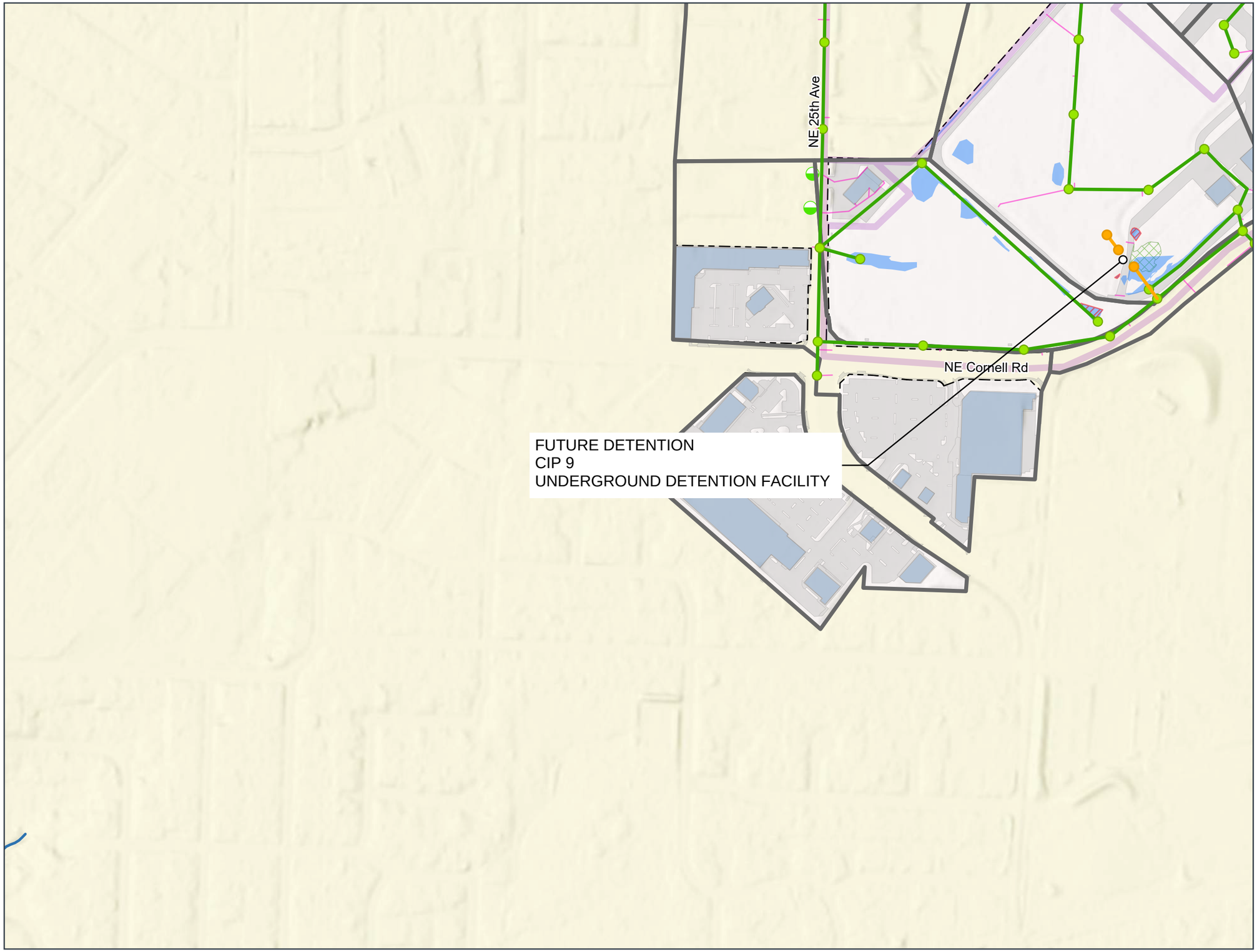
HILLSBORO AIRPORT SMP

PORT OF PORTLAND

HILLSBORO, OREGON

FIGURE 8

MAP EXPLANATION



Modeled System

- Modeled Nodes - Future
- Modeled Conduits - Future
- Modeled Nodes - Existing
- Modeled Conduits - Existing
- Modeled Basins

GIS Storm System

- Storm Sewer Pipe
- Discharge Point
- HIO Drainage Basins

Background Data

- Property Line
- Streams
- Observed Long-Term Ponding
- Observed Short-Term Ponding
- Wetland
- Impervious P.O.P Airport Surface
- Port Owned Buildings

Note: Modeled nodes, conduits, and facilities are represented schematically not geographically.

0 250 500 ft

V:\PROJECT\19400\19442\CADD\GIS\MXDS\TASK 7-MODEL\19442-MODEL FIGURE.APRX

Date: 3/15/2023

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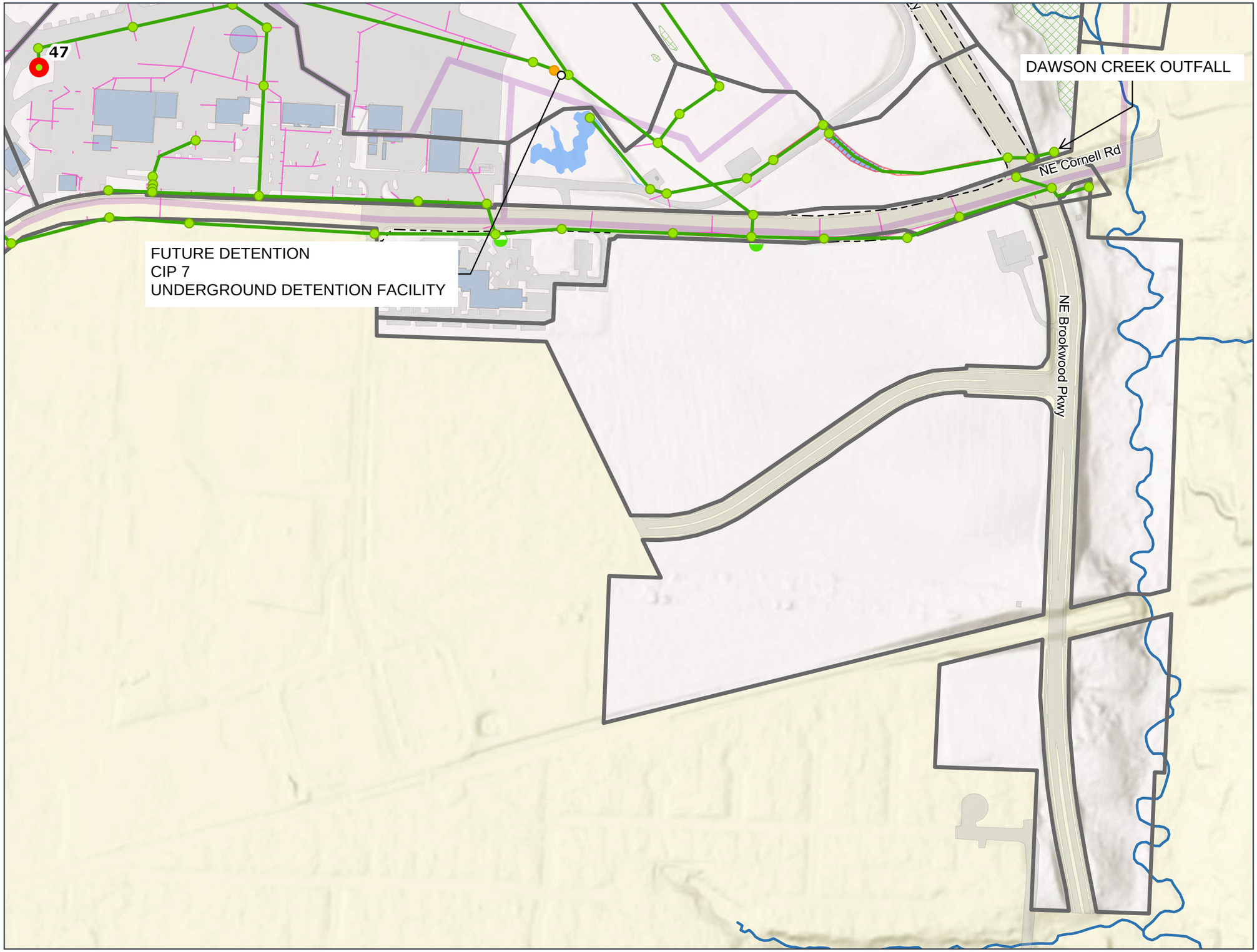


SWMM MODEL SCHEMATIC

HILLSBORO AIRPORT SMP

PORT OF PORTLAND

HILLSBORO, OREGON

FIGURE 9

MAP EXPLANATION

Modeled Flooding Locations

- Existing Conditions

Modeled System

- Modeled Nodes - Future
- Modeled Nodes - Existing
- Modeled Conduits - Existing
- Modeled Basins

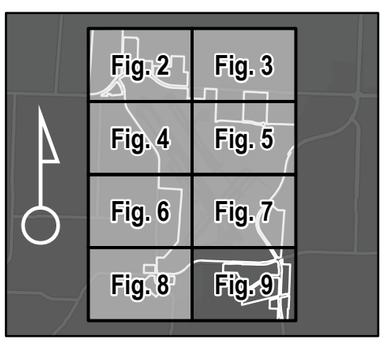
GIS Storm System

- Storm Sewer Pipe
- Discharge Point
- HIO Drainage Basins

Background Data

- Property Line
- Streams
- Observed Long-Term Ponding
- Observed Short-Term Ponding
- Wetland
- Impervious P.O.P Airport Surface
- Port Owned Buildings

Note: Modeled nodes, conduits, and facilities are represented schematically not geographically.



0 250 500 ft

PORT OF PORTLAND Otak

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Date: 3/15/2023

Disclaimer: This data is not to survey accuracy and is meant for planning purposes only.

FIGURE 10
CONVEYANCE CAPACITY INCREASES

HILLSBORO AIRPORT SMP
PORT OF PORTLAND
HILLSBORO, OREGON

MAP EXPLANATION

- Increased Conveyance Capacity Locations

Existing Conditions

- Contours
- Streams
- Taxlots
- HIO Property Line
- HIO RPZ
- HIO Primary Wildlife Boundary
- HIO Wetlands
- Existing Untreated Impervious
- Existing Treated Impervious

Future Conditions

- New Building
- New Impervious

NODE 331
C3
C2
OBSERVED FLOODING LOCATION
NODE 8
C1
Glencoe Swale
NE Evergreen Rd
NE Sewell Ave
NE 30th Ave
NE 25th Ave
NE 15th Ave
NE Brookwood Pkwy
NE Airport Rd
NE Cornell Rd
Dawson Creek
Hillsboro Main Library
Hillsboro Public Works Facility
Hillsboro Fire Station
Portland-Hillsboro Airport
Early Learning Matters
Washington County Fairgrounds
Griffin Oaks Park
Emma Jones Wetlands
Carden Cascade Academy
MAX-Hawthorn Farm
MAX-Fair Complex/Hillsboro Airport
203 ft
202 ft
199 ft
195 ft

0 500 1,000 2,000 Feet

Esri Community Maps Contributors, City of Hillsboro, Oregon, Oregon Metro, Oregon State Parks, State of Oregon GEO, WA State Parks GIS, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA

Date: 5/8/2023
Disclaimer: This data is not to survey accuracy and is meant for planning purposes only.

PORT OF PORTLAND

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V:\PROJECT\19400\19442\CADD\GIS\MXDS\TASK 3-GAP ANALYSIS\19442-TASK 3 PIPE SOLUTIONS.APRX

Appendix C

HIO Impervious Area And Water Quality Tracking Spreadsheet and Map

Otak

Water Quality Tracking
Instructions Updated: 4/19/2023

The "Project WQ Tracking" tab tracks progress towards the water quality treatment of impervious area at HIO. The grey columns include formulas and will update automatically. Information should be entered for each project at HIO that impacts impervious area runoff (addition/creation of new impervious area, modification of existing impervious area, removal of impervious area, and/or treatment of impervious area).

For each development or stormwater retrofit project, enter the information in a single row. This information can be entered prior to project design, but should be confirmed and updated following project completion. Planned future projects and recommended future projects as of spring 2023 have been entered to show planned progress toward 100% treatment of impervious surfaces on HIO.

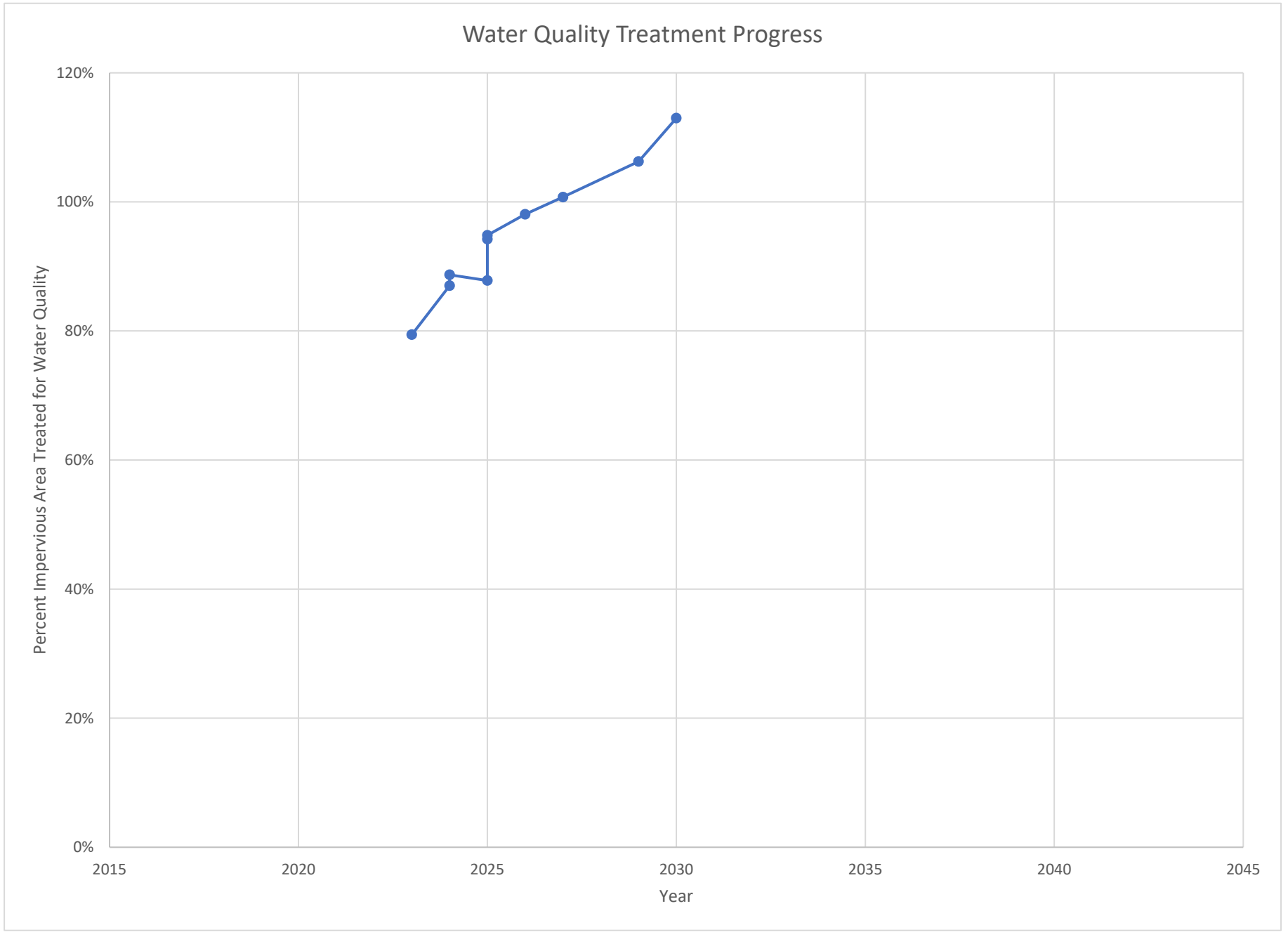
Grey Cells include formulas and are calculated automatically.

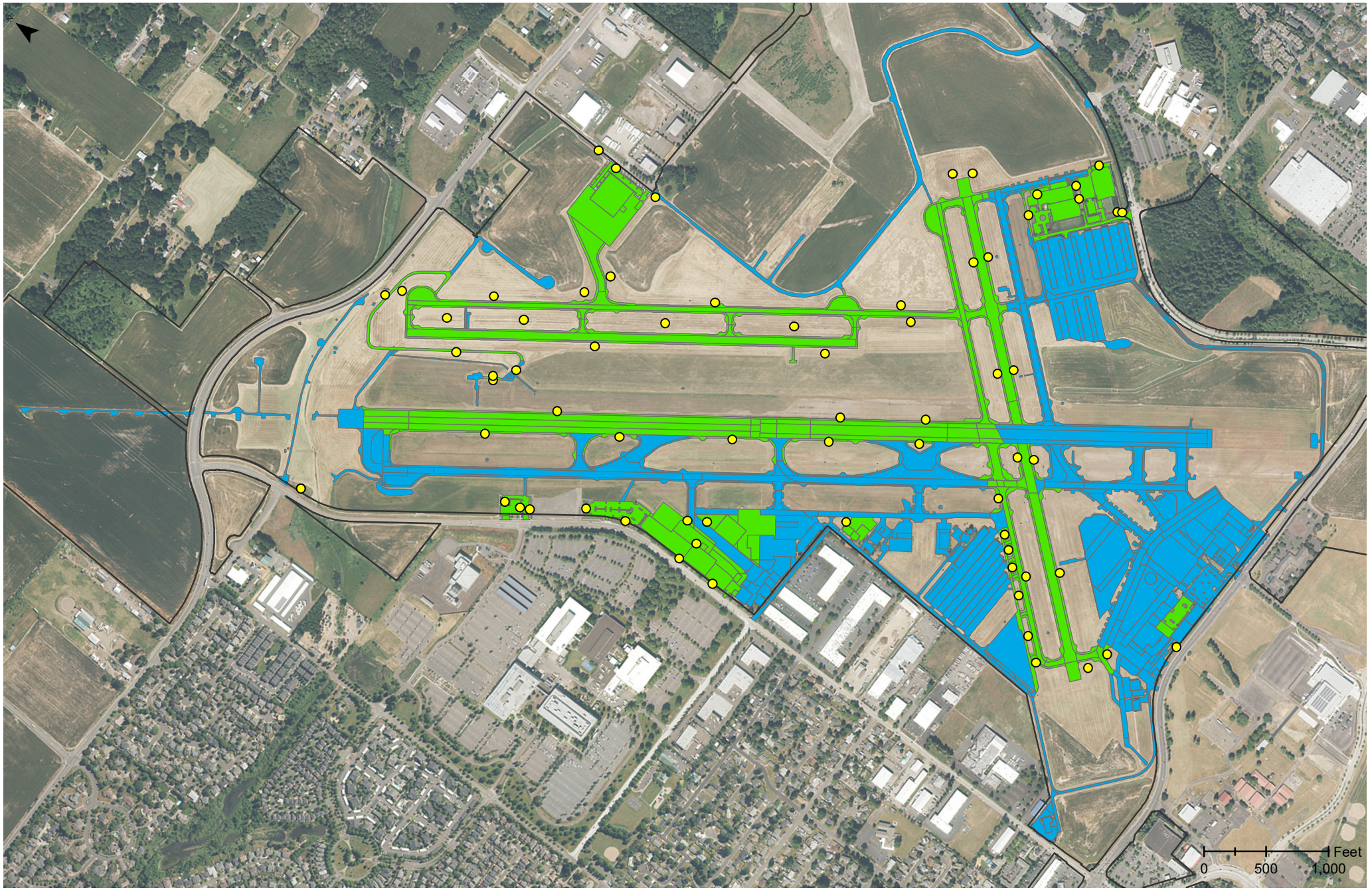
Column	Field Name	Description
A	HIO Master Plan Project #	The HIO Master Plan Project that corresponds to this project. This project may complete a portion of all of the planned HIO MP Project.
B	SMP Project #	The HIO SMP CIP Project that corresponds to this project. This project may complete a portion or all of the planned HIO SMP CIP Project.
C	CIP Project #	Project tracking number used to identify the project.
D	Status	Completed, In Progress, or Future
E	Development/Redevelopment Project Name	Name or Description of Project
F	Actual or Estimated Year Completed	Year completed, or if in project planning, estimated year of completion.
G	Pre-Project Impervious Acreage	Calculated automatically, this field will calculate the total impervious area following the last completed project to provide the total impervious area in acres before the start of a new project (prior row F+H-J). Baseline for this tracking spreadhseet was taken from the 2020 and 2021 Letter of Commitment updates.
H	Pre-Project Acres Treated Water Quality	Calculated automatically, this field will calculate the total impervious area in acres that has been treated for water quality before the start of a new project (prior row G+L). Baseline for this tracking spreadhseet was taken from the 2020 and 2021 Letter of Commitment updates.
I	Project: New Impervious Area (acres)	The acres of impervious area that were created due to this project (new impervious area).
J	Project: Rehab/Repair Impervious Area (acres)	Acres of impervious area that were maintained or repaired due to this project. These areas are exempt from providing water quality treatement.
K	Project: Modified Impervious Area (acres)	The acres of impervious area that were modified due to this project (redevelopment).
L	Project: Removed Impervious Area (acres)	The acres of impervious area that were removed due to this project.
M	Post-Project Impervious Area (acres)	Calculated automatically, the amount of impervious area following project completion (G+I-L)
N	Target Water Quality Treatment (New + 3x(Modified-Removed)) (acres)	Calculated automatically, the target number of acres of water quality treatment for this project, based on the 2019 CWS D&C (H+3x(K-J)). For values less than 0, no water quality is required for this project.
O	Project: New Water Quality Treatment (acres)	The number of acres that will receive new water quality treatment due to this project. Not all projects will be able to meet the targeted acreage due to site limitations or other regulatory drivers.
P	Post-Project Water Quality Treatment (acres)	Calculated automatically, the acreage of impervious area that is being treated for water quality following project completion (H+O)
Q	Water Quality Credit/Debit Status (acres)	Calculated automatically, the cumulative sum of the difference between the target amount of water quality treatment and the actual water quality treatment installed. Credits are shown in black and demonstrate progress towards meeting the goal of 100% water quality treatment for HIO; debits are shown in red and show the acres impervious area that will need to be treated in a future project. Baseline for this tracking spreadhseet was taken from the 2020 and 2021 Letter of Commitment updates.
R	Total Percent Treated (%)	Calculated automatically, the percentage of all impervious area at HIO that will be treated for water quality following completion of this project (M/P)

The "WQ Progress Chart" tab shows the percentage of impervious area treated at HIO. It should update automatically. No action should be needed on this tab.

Port of Portland
HIO Impervious Area and Water Quality Tracking

HIO Master Plan Project Number	SMP Project #	Port CIP Project #	Status	Planned Development / Redevelopment Project Name	Actual or Estimated Year Completed	Pre-Project Impervious Acreage	Pre-Project Acres Treated for Water Quality	Project: New Impervious Area (acres)	Project: Rehab/Repaired Impervious Area (acres)	Project: Modified Impervious Area (acres)	Project: Removed Impervious Area (acres)	Post-Project Impervious Area (acres)	Target Water Quality Treatment (New + 3x(Modified-Removed)) (acres)	Project: New Water Quality Treatment (acres)	Post-Project Water Quality Treatment (acres)	∑ Water Quality Credit/Debit Status (acres)	Total Percent Treated (%)
N/A	N/A	N/A	Completed	Baseline (includes 13-R-31L Rehab)	2020	0.0	0	0.0	0.0	0.0	0.0	201.0	0.0	0.0	83.0	0	41%
N/A	N/A	TBD	In Progress	Taxiway A	2023	201.0	83.0	0.4	0.0	11.8	2.9	198.5	27.2	74.6	157.6	47.4	79%
N/A	N/A	TBD	In Progress	13R-31L RSA (Glencoe Swale Culvert)	2024	198.5	157.6	0.1	3.3	0.0	0.9	197.6	0	14.3	171.9	61.7	87%
N/A	N/A	TBD	In Progress	Taxiway K	2024	197.6	171.9					197.6	0.0	3.3	175.2	65.1	89%
S-7, I-16	11	TBD	Future	Portion of CIP 11: Vault #2, 8' x 14'	2025	197.6	175.2	2.0	0.0	3.5	0.0	199.6	12.5		175.2	77.5	88%
n/a	11	TBD	Future	Portion of CIP 11: Vault #3, 6' x 8'	2025	199.6	175.2	0.0	0.0	0.0	0.0	199.6	0.0	12.8	188.0	90.3	94%
n/a	11	TBD	Future	Portion of CIP 11: Vault #1, 6' x 12'	2025	199.6	188.0	0.0	0.0	0.0	0.0	199.6	0.0	1.2	189.2	91.5	95%
n/a	16	TBD	Future	Modified Landscape Filter Strips for existing runways and taxiways with no treatment (implement with Taxiway Bravo project)	2026	199.6	189.2	0.0	0.0	0.0	0.0	199.6	0.0	6.5	195.7	98.0	98%
n/a	4	TBD	Future	Treat Existing Impervious at T-Hangars	2027	199.6	195.7	0.0	0.0	0.0	0.0	199.6	0.0	5.3	201.0	103.3	101%
L-31	8	TBD	Future	Loop Road (L-31) and Existing Untreated (4)	2029	199.6	201.0	0.0	0.0	0.3	0.0	199.6	0.9	11.0	212.0	115.2	106%
L-16	N/A	TBD	Future	Remove T-Hangers (L-16)	2030	199.6	212.0	0.0	0.0	0.0	3.8	195.8	0	9.2	221.2	124.4	113%


Water Quality Treatment Progress
120%
100%
80%
60%
40%
20%
0%
Percent Impervious Area Treated for Water Quality
2015
2020
2025
2030
2035
2040
2045
Year



Treated Impervious Surface

Untreated Impervious Surface

Stormwater Treatment Facility

HIO Boundary

Impervious Surfaces	Acres
Treated	83
Untreated	118
Total Impervious	201
Percent Treated	41%

Port of Portland
Hillsboro Airport

Figure 12: Impervious Surface Stormwater Treatment Tracking - 2022

Appendix D

HIO SMP Project Coordination Checklist

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HIO Stormwater Master Plan Project Coordination Checklist

The purpose of this HIO Stormwater Master Plan (SMP) Project Coordination Checklist is to provide design engineers and tenants with a method of documenting compliance towards current stormwater standards, design criteria, and other Port of Portland requirements. This checklist is required to be maintained throughout the project and used as a basis for coordination with the Port at design meetings. An updated checklist is required to be submitted with each required design milestone submittal. A final checklist is required to be submitted at the close of construction and must account for variances from the checklist approved with construction documents. The Port will update this project checklist when design standards or project management procedures are updated.

Project Specific Information

Project: _____

Designer Contact (Name): _____

Designer Contact (Company): _____

Designer Contact (E-mail): _____

Date: _____

Total Project Area in Acres: _____

Area Calculations for Stormwater Management

All rows must be filled in.

☐ Total acres of new impervious area: _____
(includes new development and newly created impervious area that did not exist before the project)

☐ Total acres of rehabilitated/repaired impervious area: _____
(includes pavement management activities but does not include removal of impervious areas and replacement with a new surface)

☐ Total acres of modified impervious area: _____
(includes redeveloped impervious area or impervious area that is replaced with other impervious area)

☐ Total acres of removed impervious area: _____
(includes impervious area permanently removed by the project)

☐ Total acres of project impervious area: _____
(project impervious area = new + modified - removed impervious area)

☐ Total acres managed for water quality treatment: _____
(must be a minimum of the amount of new impervious + (three times (3x) the amount of modified impervious area – removed impervious))

☐ Total acres managed for hydromodification: _____
(must be a minimum of 100% of the amount of new and modified impervious area)

Low Impact Development (LID) Approaches

Designers shall complete the following portion of the HIO SMP Project Coordination Checklist to demonstrate the consideration and implementation of LID strategies and the supporting practices into project designs, where applicable. Where LID strategies were considered but found to be not applicable, designers shall provide justification based on project or site constraints, as required in the Clean Water Services (CWS) Design and Construction Standards (D&C)[1]. In the 2019 CWS D&C, stormwater management applicability and design requirements are found in Chapters 1 and 4.

Strategy 1: Minimize Disturbance of Sensitive Areas (Site Selection and Layout)

Design the project to preserve or minimize disturbance of buffers, floodplains, wetlands, natural resources, and natural or undeveloped areas that may be especially susceptible to impacts from stormwater runoff. Practices supporting this strategy include:

- Site the development to avoid natural resource areas.
- Minimize disturbance of natural or undeveloped areas.
- Minimize disturbance of areas that may be highly susceptible to erosion.

Was this strategy incorporated into the project design? ☒ Yes ☐ No

Describe practices used to incorporate strategy into project design (if demonstration is provided within drawings or attached documentation, please indicate below).

Describe project or site constraints or other applicability considerations that limited the incorporation of this strategy into the project design (if justification is provided within drawings or attached documentation, please indicate below).

Strategy 2: Minimize the Impact of Development (Footprint Minimization)

Design project to result in compact development, in a way that reduces the footprint and minimizes the disturbance area (area of clearing and grading or exposed soil). Practices supporting this strategy include:

- Minimize development footprint.
- Minimize compaction of soil in specially designated areas.
- Minimize clearing and grading and changes to natural drainage pattern.
- Reduce extent of effective impervious areas.

[1] See View the Standards - Clean Water Services for the most current version of the CWS D&C.

Was this strategy incorporated into the project design? ☐ Yes ☐ No

Describe practices used to incorporate strategy into project design (if demonstration is provided within drawings or attached documentation, please indicate below).

Describe project or site constraints or other applicability considerations that limited the incorporation of this strategy into the project design (if justification is provided within drawings or attached documentation, please indicate below).

Strategy 3: Manage Runoff from Disturbed Areas (Green Infrastructure and Runoff Management)

Incorporate measures into the project design to manage the quality and quantity of runoff from disturbed areas to minimize the potential for impacts to receiving waters. Place an emphasis on Green Infrastructure (GI) practices that contribute to mimicking pre-development hydrologic functions and promote infiltration, evapotranspiration, or stormwater reuse. Practices supporting this strategy include:

- Disconnect impervious areas to direct runoff from impervious areas into pervious areas that are designed to promote infiltration.
- Implement GI to collect, treat, and infiltrate runoff from developed areas.

Was this strategy incorporated into the project design? ☐ Yes ☐ No

Describe practices used to incorporate strategy into project design (if demonstration is provided within drawings or attached documentation, please indicate below).

Describe project or site constraints or other applicability considerations that limited the incorporation of this strategy into the project design (if justification is provided within drawings or attached documentation, please indicate below).

Infiltration

Designers shall complete the following portion of the HIO SMP Project Coordination Checklist to demonstrate the selection and implementation of appropriate stormwater approaches, as required by the CWS D&C and the City of Hillsboro.

Provide the current understanding of the following parameters for the project design.

- Field infiltration rate: _____

  ☐ Based on historical data (include reference to which data was used)

  ☐ From project field investigations (provide infiltration report)

- Design infiltration rate: _____

  ☐ Based on historical data (include reference to which data was used)

  ☐ From project field investigations (provide infiltration report)

- Depth to groundwater: _____

  ☐ Based on historical data (include reference to which data was used)

  ☐ From project field investigations (provide infiltration report)

- Groundwater separation distance from the bottom of the stormwater facilities: _____

Potential Groundwater Risks (select one)

☐ There is no known contamination of groundwater or soil column.

☐ There is known contamination of groundwater or soil column that has the potential to migrate into groundwater. Describe the findings (if information is provided within attached documentation, please indicate).

Stormwater Facility Sizing

If infiltration data is used to design or size stormwater facilities, describe the approach and assumptions used.

Water Quantity/Hydromodification

Designers shall complete the following portion of the HIO SMP Project Coordination Checklist to demonstrate compliance with the water quantity objectives.

☐ Designers shall also provide brief discussion of the model results.

☐ Identify any pre-existing capacity issues affecting the design.

☐ Discuss any capacity concerns or any area where the objectives cannot be met.

☐ Explain any changes (increases or decreases) in the max water surface elevation (MWSE). Document any Port feedback on results.

If this discussion is included in an attached document, please specify.

Source Controls

Designers shall complete the following portion of the HIO SMP Project Coordination Checklist to demonstrate compliance with the 1200-Z Permit.

List any points of compliance that require Source Control (if provided within an attached document, please indicate).

List any potential existing or new operational source control activities that may be appropriate for implementation (if provided within an attached document, please indicate).

Hazardous Wildlife Attractants

Designers shall complete the following portion of the HIO SMP Project Coordination Checklist to demonstrate compliance with FAA requirements and the HIO Wildlife Hazard Management Plan (WHMP).

Project design includes a BMP or potential hazardous wildlife attractant within the following Hazardous Wildlife Attractant Zone (please check one):

☐ Primary Zone
☐ Intermediate Zone
☐ Secondary Zone
☐ Five Mile Zone
☐ Project design is in compliance with the FAA requirements and the HIO WHMP.

Please describe the identified potential hazard(s) in the design and the measure(s) taken to reduce the attractiveness of the BMP or potential hazardous wildlife attractant (if demonstration is provided within an attached documentation, please indicate).

Erosion and Sediment Control

Designers shall complete the following portion of the HIO SMP Project Coordination Checklist to demonstrate compliance with the City of Hillsboro and Clean Water Services erosion control requirements[2].

☐ Designers have incorporated the Port's technical specification "015713 – Temporary Erosion, Sediment, & Pollution Control" into project design documents.

☐ Designer has determined which City, State, and CWS permit(s) are applicable and have developed construction designs that meet the required standards.

Identify applicable required reviews, approvals, and permits associated with construction.

[2] See INTERDEPARTMENTAL MEMORANDUM (hillsboro-oregon.gov) for grading and erosion control guidelines from the City of Hillsboro.

Stormwater Management Facilities

Designers shall complete the following portion of the HIO SMP Project Coordination Checklist to demonstrate compliance with the City of Hillsboro and Clean Water Services stormwater requirements. The below table should match site plans submitted for review. The table consists of the following fields:

- BMP ID should provide a way to identify the location of the Best Management Practice (BMP), or Stormwater Management Facility (SMF), on the site plan.
- The HIO Drainage Basin should indicate if the stormwater management facility will eventually discharge to McKay Creek or to Dawson Creek.
- The BMP Type should identify the type of stormwater management facility.
- The Impervious Area Managed (sf) should be the square feet of impervious area that the stormwater management facility will manage following construction.
- The Water Quality Treated (sf) should be the square feet of impervious area that the stormwater management facility will treat for water quality following construction.

Designers should add additional lines to the table as needed to provide a single line per stormwater facility. Designers should sum the total amount of impervious area managed and water quality area treated.

BMP ID	HIO Drainage Basin	BMP Type	Impervious Area Managed (sf)	Water Quality Treated Area (sf)
		Total Square Footage Managed		

The Total Impervious Area Managed should equal or exceed the total acres of project impervious area provided at the beginning of the HIO SMP Project Coordination Checklist. The Total Water Quality Treated Area should equal or exceed the total acres managed for water quality treatment provided at the beginning of the HIO SMP Project Coordination Checklist.