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# Section **7**

Section 7

# Seismic Resilience

## 7.1 Introduction

This section of the WCSMP summarizes the results of the City's *Wastewater Seismic Resilience Plan* (2019) and the recommendations for collection system improvements relative to seismic resilience. The recommended improvements reduce seismic risk over a 45-year implementation period and are prioritized based on critical community facilities such as hospitals.

The seismic resilience projects are integrated with and prioritized along with other capital improvements in Section 8.

## 7.2 Recommended Seismic Resilience Improvements

The City has recently developed a *Wastewater Seismic Resilience Plan* (2019) which evaluates treatment and collection system seismic risks. Critical backbone is defined as collector and trunk sewers 12 inches and larger as well as smaller piping that is providing service to critical facilities. Critical customers and wastewater facilities serving them are separated into two tiers to help prioritize the collection system pipe projects. The tiers are as follows.

- Tier 1: Hospitals, surgery centers, dialysis centers (in general, emergency facilities requiring no interruption of sewer service);
- Tier 2: Emergency operating centers (fire, police, City Hall), urgent care facilities, emergency shelter locations (in general, emergency facilities that could continue to operate up to 24 hours with no sewer service).

Project phasing is also developed for the 15-year planning period (Short-Term: 2019-2032); a 30-year planning period (Mid-Term: 2033-2047); and a 45-year planning period (Long-Term: 2048-2062). Tier 1 projects are falling into short-term planning period, where tier 2 includes projects falling into short-term (pump stations, force mains, and creek crossings), mid-term (Johnson Creek and Jenne Road trunks), and long-term (improvements throughout Columbia, Wilkes, Rockwood, and East Basin) planning periods. Collection system and outfall risks are defined based on proximity to liquefiable soils and landslide hazard. Technical Memorandum 6, "Implementation Plan" of the *Wastewater Seismic Resilience Plan* (2019) identifies the following seismic improvements for collection system and outfall infrastructure.

### 7.2.1 Pump Stations and Force Mains

Pump station and force main improvements are part of Tier 2 mid-term (2033-2047) improvements and include mechanical piping supports, anchoring of electrical, mechanical, and structural elements, and force main restraints. Recommended improvements for seismic resilience of pump stations and force mains include the following.

- 185th Ave Pump Station
- Cascade Glen #1 Pump Station
- Cascade Glen #2 Pump Station
- College Pump Station
- Linneman Pump Station
- Rockwood Pump Station
- Brookside Pump Station[1]

The estimated total cost for these projects is $4.6 million in 2018 dollars[2].

### 7.2.2 Gravity Piping Improvements

Gravity trunk improvements include structural reinforcement to minimize pipe joints and seams or re-routing of infrastructure away from high risk liquefiable soils. Construction techniques to improve structural integrity include reinforced cured-in-place pipe (CIPP), slip lining with HDPE pipe, pipe bursting with HDPE pipe, or open trench pipe replacement with HDPE.

- Tier 1 Improvements
    - Outfall recommendations include improved pipe connections for the existing 48-inch HDPE outfall piping with an estimated cost of $0.18 million in 2018 dollars[2] (CIP Project No. C-10). [Short-Term]
    - Additional Tier 1 projects throughout Lower Kelly Creek Trunk, Burnside Trunk, and NE 201st Include 30,714 linear feet of pipe upgrades. These projects are estimated to cost $25.0 million in 2018 dollars[2] (CIP Project No. C-15). [Short-Term]

[1] Temporary pump station to be abandoned when gravity system extended to serve Pleasant Valley and can be a $50,000 saving in 2018 dollars.

[2] The costs of the seismic resilience improvements are cited from the Wastewater Seismic Resilience Plan and no additional cost evaluation was performed as part of the WCSMP. The cost evaluation is consistent with Class 5 budget estimates, as established by the American Association of Cost Engineers (AACE). This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -50 percent on the low end, and +30 to +100 percent on the high end. Estimates exclude land acquisition, financing, and inflation. Estimates include labor, materials, engineering, administrative, contractor markups, and construction contingencies in 2018 dollars.

- Tier 2 Improvements
    - Johnson Creek Large Diameter Trunk Mains (25,900 linear-feet of 42-inch, 36-inch, 30-inch, 21-inch, and 15-inch) [Mid-Term]
    - Jenne Road Trunk (1,630 linear-feet of 24-inch, 30-inch, and 36-inch) [Mid-Term]
    - Additional Tier 2 projects throughout Columbia, Wilkes, Rockwood, and East Basin include total 83,900 linear feet of pipe upgrades. These projects are assumed to be completed in the long-term (2048 – 2062), and they are estimated to cost $60.4 million in 2018 dollars[2].[Long-Term]
    - Creek crossing improvements include foundation, abutment, and supports (joints and restraints) for flyovers or bridge crossings, and structural vault improvements for siphon crossings. [Short-Term]
        - Johnson Creek Flyovers
        - Bridge Crossing at NE 185th. Including contingencies and an anticipated start in 2030, the project is estimated to cost $0.19 million in 2018 dollars[2] (CIP Project No. C-13).
        - Jenne Road Sewer Johnson Creek Siphon

**Figure 7-1** illustrates the seismic risk for the plan area, and location of the critical facilities.

### *7.2.2.1 Johnson Creek Sewer Crossings Evaluation and Recommendations*

The *Wastewater Seismic Resilience Plan* (2019) identified facilities along Johnson Creek as high-risk infrastructure with potential for catastrophic failure during a seismic event. These facilities include sanitary sewer pipe aerial crossings over Johnson Creek as shown in **Figure 7-2**. The City is seeking FEMA funding to assist with improvements to the pipe aerial crossings prior to completion of the Master Plan update.

Failure of these two creek crossings or the adjacent trunk sewer may result in environmental contamination of Johnson Creek and loss of sewer service to customers upstream of each crossing. The existing abutments and footings supporting the pipe crossings over the creek include shallow foundation construction and inadequate lateral force design. The north bank of Johnson Creek is subject to liquefaction during a seismic event, while the south bank of the creek is subject to landslides due to steep slopes. The parallel 12-inch trunk sewer adjacent to the crossings is also in an area of liquefiable soils.

Two alternatives were considered for improvement of the pipe aerial crossings. The recommended alternative was selected due to reduced environmental impacts, seismic resilience benefits, and constructability. The proposed improvements, as shown in **Figure 7-2**, include replacement of the existing sanitary sewer pipes and prestressed concrete beams with new 8-inch

pipes and steel casings across Johnson Creek. The existing abutments are to be replaced with new abutments, including installation of piles to competent soils and concrete pile cap construction to support the steel casings and pipelines. Existing walls will be cut down to grade to support the adjacent soil and avoid disruptive excavation within the creek. The existing manholes have minimal lateral support and are in liquefiable soils. Extending the concrete footings around the bases of the existing manholes and installing micropiles to competent soils are recommended. These concrete footings and micropiles will stabilize the manhole structures, thereby reducing risk of structural failure during a seismic event and protecting the 100-year floodplain.

Abandoning the existing 12-inch sewer pipe immediately adjacent to Johnson Creek is recommended to avoid risks associated with pipes constructed in liquefiable soils. A proposed new sewer alignment will be installed to connect the eastern flyover to the existing trunk sewer located in the Springwater Corridor Trail. The new connecting alignment will include 500 feet of new 12-inch diameter pipe.

Each pipe aerial crossing was evaluated for hydraulic capacity. Hydraulic profiles of the pipeline crossings and pipeline re-routing for buildout flow conditions is presented in **Figure 7-3** and **Figure 7-4**. Pipeline re-route connections and crossings require a minimum 8-inch sizing to accommodate peak design flows for buildout during the 5-year design storm event. The planned 8-inch crossings and 12-inch re-route are adequately sized.

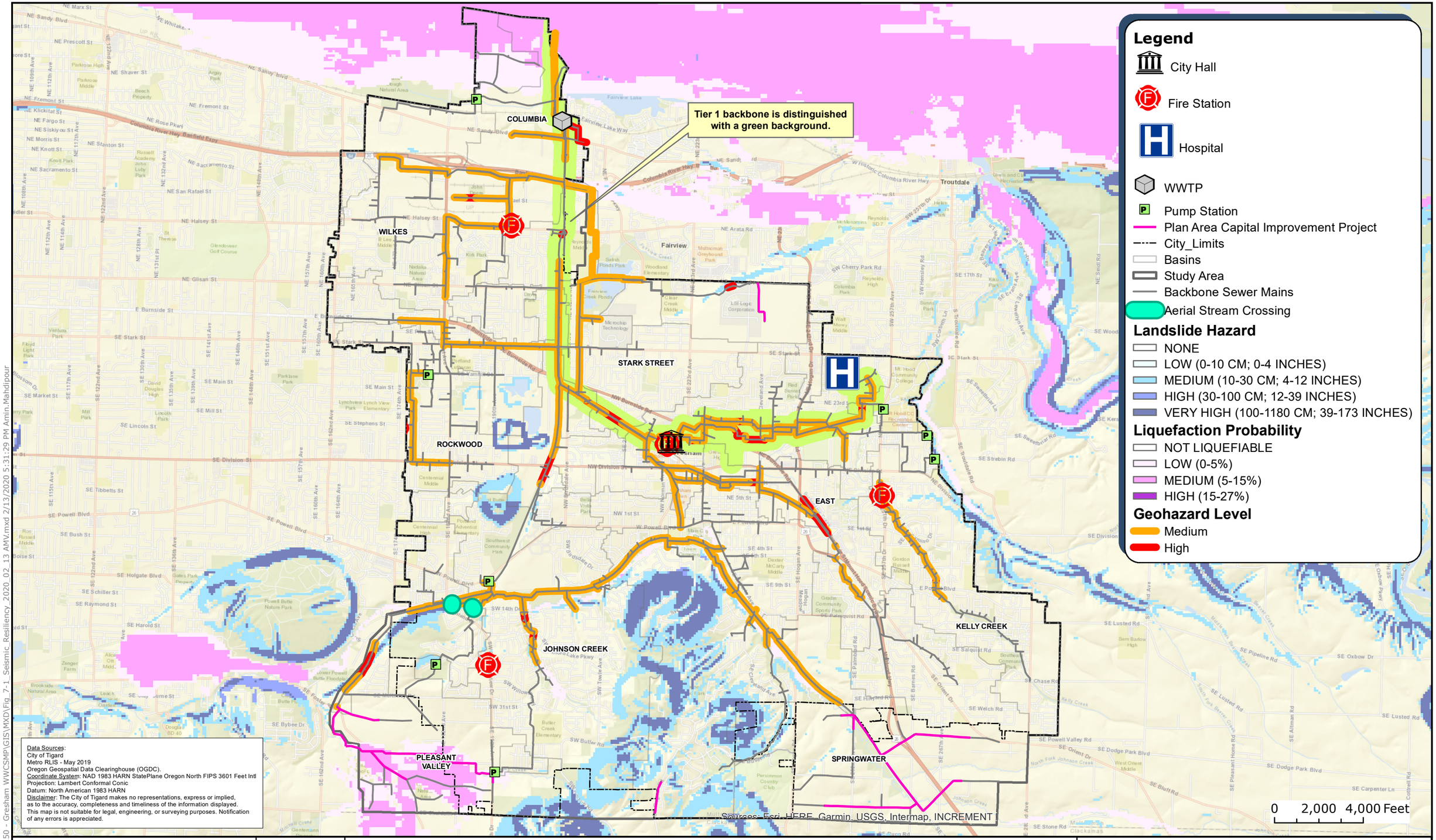
The capital cost[2] was estimated at a total of $1.0 million for the critical pipe aerial crossing improvements and $0.52 million for the 12-inch trunk sewer re-route (CIP Project No. C-09).

## 7.3 Summary

The recommendations for wastewater collection system improvements relative to seismic resilience discussed in the City's *Wastewater Seismic Resilience Plan* (2019) are summarized in this section. In order to prioritize the collection system pipe projects, sewer trunks were separated into two tiers based on critical community facilities such as hospitals, and their risks are defined based on proximity to liquefiable soils and landslide hazard. Tier 1, which includes improvements to infrastructure serving critical community emergency facilities, includes 31,000 linear feet of gravity pipe improvements and reconstruction of the WWTP outfall, at an estimated total cost of $25.18 million in 2018 dollars. The recommended improvements for Tier 2 include 111,000 linear feet of gravity pipe improvements, two stream crossing pipes, the Jenne Road siphon, and improvement of seven pump stations with an estimated total cost of $85.2 million in 2018 dollars.

## 7.4 References

Department of Environmental Services. (2019). *Wastewater Seismic Resilience Plan*. Section 6 Wastewater Collection System. City of Gresham, Oregon.




Data Sources:
City of Tigard
Metro RLIS - May 2019
Oregon Geospatial Data Clearinghouse (OGDC).
Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Projection: Lambert Conformal Conic
Datum: North American 1983 HARN
Disclaimer: The City of Tigard makes no representations, express or implied, as to the accuracy, completeness and timeliness of the information displayed. This map is not suitable for legal, engineering, or surveying purposes. Notification of any errors is appreciated.

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CITY OF GRESHAM 1905

N W E S

# City of Gresham, Oregon
# Wastewater System Facility Plan

## Figure 7-1
## Wastewater System Seismic Resilience

December 2019 17-2150

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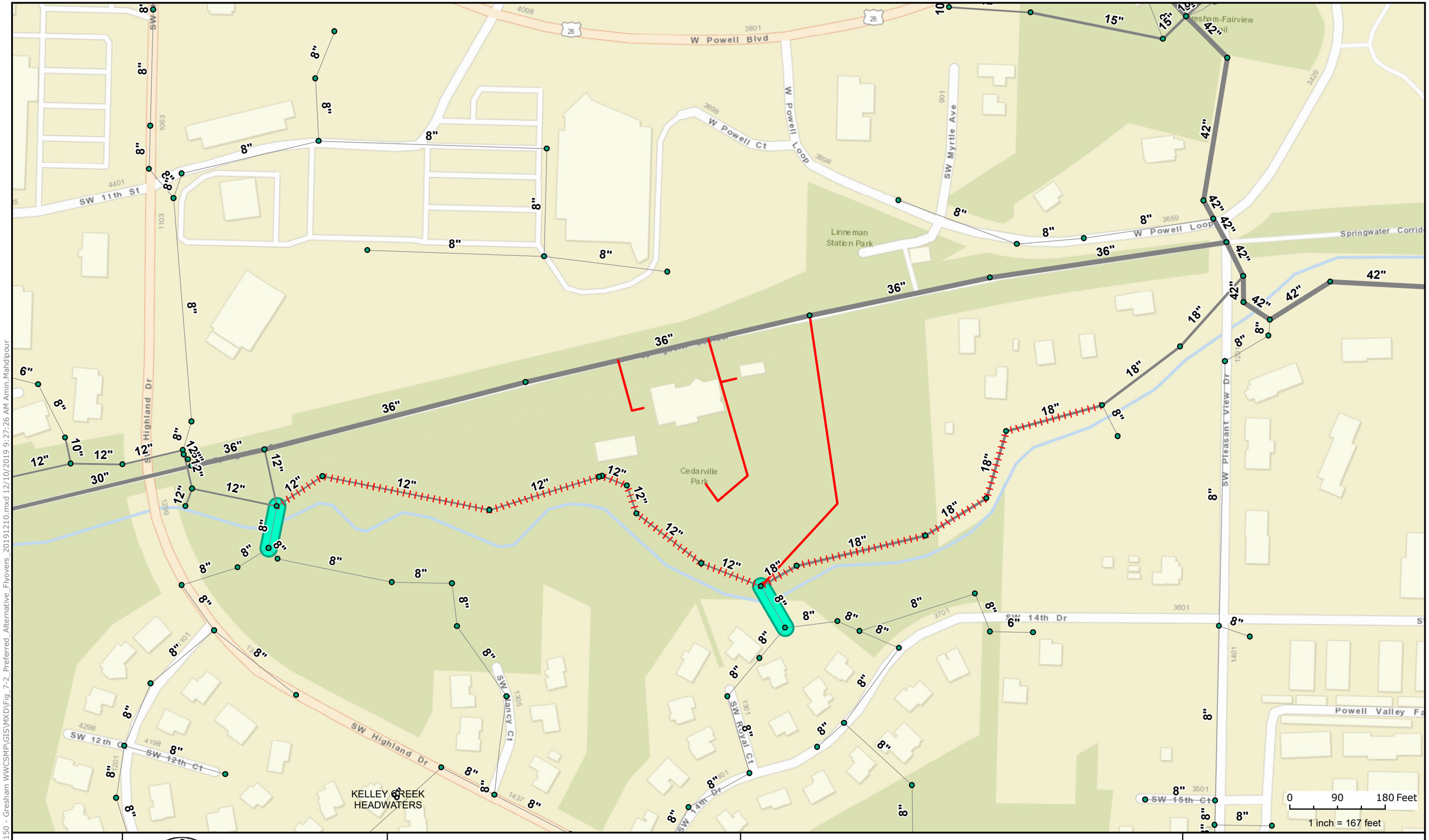


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CITY OF GRESHAM 1905

N W E S

# City of Gresham, Oregon
# Wastewater System Facility Plan

**Proposed Alternative**
- Proposed Realignment
- Proposed Pipe Abandonment
- AERIAL STREAM CROSSING

Manholes

**Gravity Main**
- 8" and Less
- 9" - 12"
- 13" - 21"
- 22" - 30"
- 31" - 54"

## Figure 7-2. Preffered Alternative, Johnson Creek Flyovers

December 2019 17-2150

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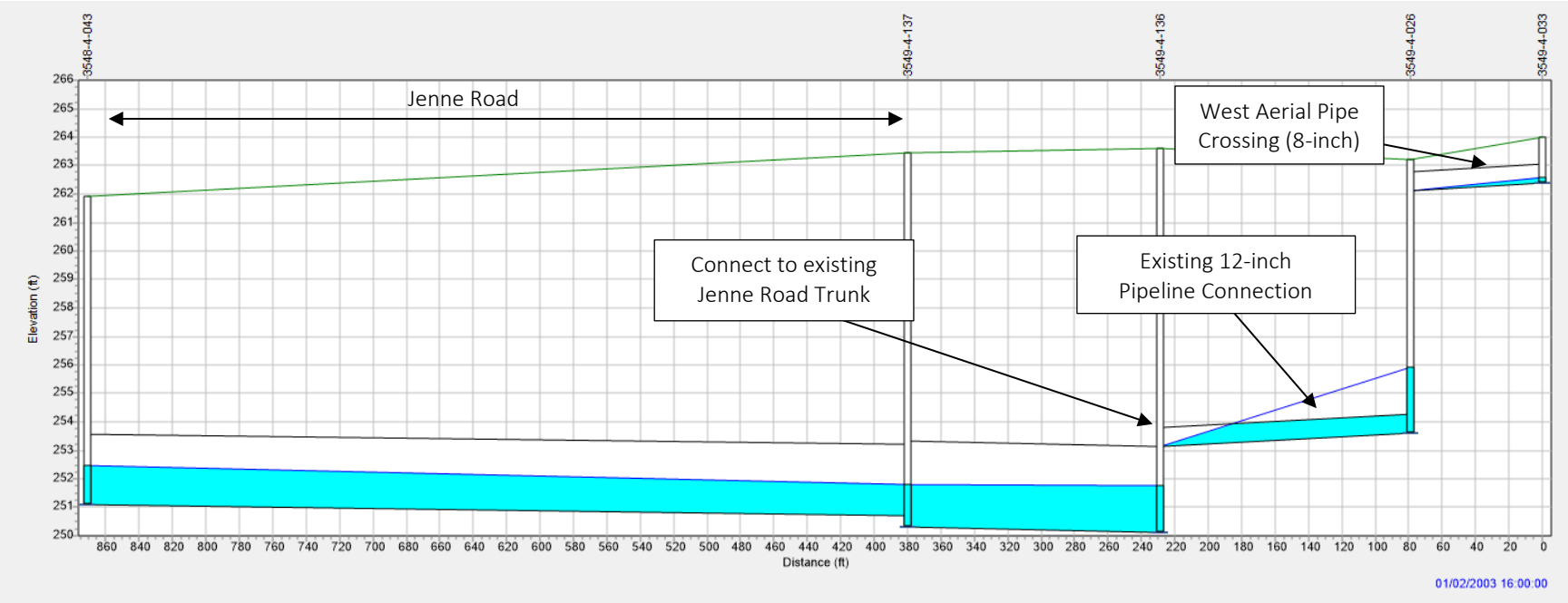
Figure 7-3
West Crossing, Hydraulic Profile during Peak Buildout Design Flow (5-year design storm)



## Figure 7-4
## East Crossing & Re-Route, Hydraulic Profile during Peak Buildout Design Flow (5-year design storm)