Preliminary Drainage Report

Kellogg Creek Planned Development

2322.14258.01

Prepared for

Brownstone Development, Inc.

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Lake Oswego, Oregon 97934

June 12, 2017

Revised from February 8, 2017

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Executive Summary

The proposed Kellogg Creek residential development is located at 13333 Rusk Road in Milwaukie, Oregon (See Figure 1-1 Vicinity Map. The subdivision is approximately 14 acres and will include the construction of 92 new lots intended for single-family attached homes (rowhouses). Two public streets are proposed, these streets are identified as Street A and Street B. Frontage improvements to SE Kellogg Creek Drive will also be completed as part of this project.

Stormwater Management Standards

The proposed storm design will meet the requirements of the City of Milwaukie as listed in the *Public Works Standards* dated February 2015. The City of Milwaukie follows the current City of Portland's *Stormwater Management Manual* for water quality facility design.

The proposed project will fill wetlands located on the site. Therefore, the project must comply with the National Marine Fisheries Service (NMFS) criteria as part of the March 2014 Programmatic Biological Opinion and Essential Fish Habitat Consultation for Revisions to Standard Local Operating Procedures for Endangered Species (SLOPES V) as part of the Wetland Fill Permit with the Army Corp of Engineers.

Additionally, the project is located within the 100-year floodplain of Mt. Scott Creek. All fill placed on the site will be balanced with an equal amount of soil removed per City of Milwaukie Municipal Code 18.04.150 F Balanced Cut and Fill. Excavation will occur within the property boundary.

Water Quality

The project will discharge into Mt. Scott Creek, a tributary of Kellogg Creek and the Willamette River. Mt. Scott and Kellogg Creek are not listed as water quality limited and the Willamette River is listed for E. Coli. Typical pollutants from single -family residential projects include: nutrients, pesticides, metals, oil, grease and other petroleum products, and sediment. Dissolved copper, dissolved zinc, and PAHs are generally the primary constituents of concern for stormwater runoff in Oregon streams for their impact on ESA listed species. These pollutants are specially targeted for treatment in the selected stormwater management systems.

Water quality treatment will occur through stormwater bioretention basins, planters and a pond. These facilities are landscaped reservoirs that collect and treat stormwater runoff through vegetation and soil media. They provide pollution reduction and flow attenuation to reduce hydraulic impacts from urban developments on downstream rivers. Specific elements are incorporated into the design to increase the effectiveness of this stormwater facility type. Design elements include trapped catch basins to remove coarse sediment, soil media to provide stormwater filtration, and vegetation to will provide plant uptake.

The basins are designed using the BMP Sizing Tool developed by Clackamas County. This continuous simulation software is a regional tool for the Portland metro area. City of Milwaukie standards were checked using the City of Portland Presumptive Approach Calculator (PAC). The stormwater facilities were designed to the standards below:

- Water Quality: 50% of the cumulative rainfall from the 2-year storm event. (Using a continuous rainfall/runoff model).

The calculated peak water quality flow from the 5.47 ac of impervious area is 1.08 cfs with an approximate 15,531 cf runoff volume.

Water Quantity

Water quantity control will occur within the proposed bioretention facilities. Control structures will be placed within each facility to limit runoff to the SLOPES V criteria listed below. The City of Milwaukie does not require water quantity control for this project as the site discharge location into Mt. Scott Creek and Kellogg Creek.

- City of Milwaukie = Match existing flow rate to proposed flow from the 2 through 25-year storm event. – Not required for this project.
- SLOPES V = limit pre-developed discharge rates using a continuous simulation for flows between 42% of the 2-year event and the 10-year flow event.

The calculated water quantity volume is approximate 14,168 cf volume.

Conveyance

The proposed conveyance system will be designed using the 100-year storm event in the final Drainage Report.

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1 Project Overview

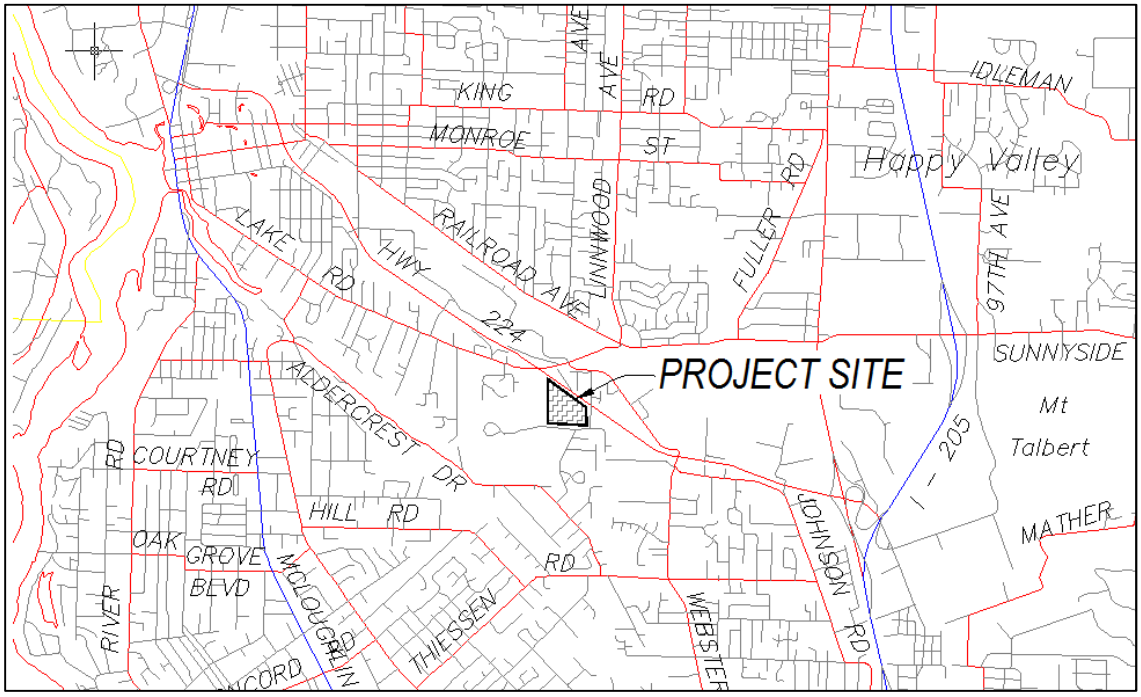
1.1 Project Overview

The Kellogg Creek residential subdivision is approximately 14 acres and will include the construction of 92 new lots intended for single-family attached homes (rowhouses). Two public streets are proposed, these streets are identified as Street A and Street B. Frontage improvements to SE Kellogg Creek Drive will also be completed as part of this project.

1.2 Location

The proposed project is located at 13333 Rusk Road in Milwaukie, Oregon (See Figure 1-1 Vicinity Map). The property includes the following tax lots: TL 22E 06AD 600, TL 22E 06AD 700, TL 22E 06AD 900, and TL 22E 06AD 901.

Figure 1-1 Vicinity Map



1.3 Methodology

The proposed storm design will meet the requirements of the City of Milwaukie as listed in the *Public Works Standards* dated February 2015. The City of Milwaukie follows the current City of Portland's *Stormwater Management Manual* for water quality facility design.

Additionally, the project must conform to Standard Local Operating Procedures for Endangered Species (SLOPES V) as part of the Wetland Fill Permit with the Army Corp of Engineers.

2 Existing Conditions

2.1 Topography

The existing site contains a driveway entrance for the adjacent Turning Point Church, grass, blackberry bushes and a scattering of trees. Fill material was previously placed at the site adjacent to the church parking lot. Mt. Scott Creek runs through the northern portion of the site. The site has gradual slopes between 0.5 and 5% and generally drains towards the northwest - west. Steeper slopes occur at the end of fill placed at the site and along Mt. Scott Creek. The highest elevation within the project area is 78; located along the southeast property corner. The lowest elevation of 66 is located in the western property boundary.

2.2 Climate

The site is in Milwaukie, Oregon and is located approximately 65 miles inland from the Pacific Ocean. There is a gradual change in seasons with defined seasonal characteristics. Average daily temperatures range from 36°F to 83°F. Record temperatures recorded for this region of the state are -3°F and 107°F. Average annual rainfall recorded in this area is 42-inches. Average annual snowfall is approximately 1-inches between December and February.

2.3 Site Geology

The underlying soil types on the site, as classified by the United States Department of Agriculture Soil Survey of Clackamas County, Oregon are identified in Table 2-1 (See Technical Appendix: Hydrologic Soils Map - Clackamas County).

Table 2-1 Soil Characteristics

Soil Type	Hydrologic Group
Cove Silty Clay Loam	D
Salem Silt Loam	B
Wapato Silty Clay Loam	C/D
Woodburn Silt Loam	C

A majority of the site is classified as Cove Silty Clay Loam. Therefore, the entire site has conservatively been assigned a soil Group D. Group D soils have very slow infiltration rates when thoroughly saturated.

Groundwater was encountered during the geotechnical evaluation completed by GEO Consultants Northwest. Groundwater depths varied across the site from 3 to12 below the ground surface. This variation of groundwater depths is a result of the varying amount of existing fill at the site. The elevation of groundwater is approximately 65 ft across the site.

2.4 Curve Number

The curve number represents runoff potential from the soil. The major factors for determining the curve number values are hydrologic soil group, cover type, hydrologic condition and antecedent runoff condition. The pervious curve numbers of 79 representing Woods-Grass Combination in Good Condition was used at the site. A pre-development condition of forested was used in conformance with SLOPES V criteria. (See Technical Appendix: Table 2-2c – Technical Release 55-Urban Hydrology for Small Watersheds).

2.5 Time of Concentration

The time of concentration (T_C) as described in NEH-4 Chapter 15 is defined in two ways; the time for runoff to travel from the furthermost point of the watershed to the point in question, and the time from the end of excess rainfall to the point of inflection on the trailing limb of the unit hydrograph. Time of concentration can be estimated from the following formulas. The time of concentration was calculated to be 24 minutes (See Technical Appendix: Time of Concentration Calculation).

Sheet Flow

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} s^{0.4}}$$

T_t = Travel Time (hours) n = Manning's "n" of slope
L = Length of flow (ft) P_2 = 2-Year, 24-hour rainfall (in)
s = Slope (ft / ft)

Shallow Concentrated Flow

$$T_t = \frac{L}{3600V}$$

T_t = Travel Time (hours) L = Flow Length (ft)
V = Average Velocity (ft / s) 3600 = seconds / hour

2.6 Hydrology

Stormwater runoff from the site sheet flows north to Mt. Scott Creek with the exception of the church driveway entrance and a small area of pervious area. Catch basins collect this impervious area and the adjacent church and sends runoff south to a public storm sewer in SE Kellogg Creek Dr. The SE Kellogg Creek Dr. storm sewer heads south and outfalls into a tributary of Kellogg Creek. Water quality treatment is not provided at the site.

2.7 Basin Area

Impervious and pervious surface areas for the existing conditions are shown in Table 2-2. The site is 1.4% impervious. Approximately 1.466 acres of the site drains south to Kellogg Creek (See Technical Appendix: Figure 1 – Existing Basin Delineation).

Table 2-2 Existing Basin Areas

Basin	Impervious Area, ac	Pervious Area, ac	Total Area, ac
Site (Mt Scott Creek)	0.202	13.846	14.048
Kellogg Creek Dr.	0.319	0.044	0.363
Total	0.521	13.890	14.411

3 Proposed Conditions

3.1 Curve Number

The pervious curve numbers of 80 representing Open Space in Good Condition was used at the site. (See Technical Appendix: Table 2-2a – Technical Release 55-Urban Hydrology for Small Watersheds).

3.2 Time of Concentration

A time of concentration of 5 minutes was used for the delineated basins.

3.3 Hydrology

Stormwater runoff outside the limits of work will continue to sheet flow to Mt. Scott Creek. Floodplain grading will occur so that floodwaters will recede back into the creek channel. Two new outfalls are proposed as part of this project. These outfalls are included as part of the wetland fill permit. The church entrance will be modified as part of this project.

Water quality treatment and quantity facilities will be added to the site. A summary of each facility is provided below.

- Bioretention Basin A: Bioretention Pond, Outfall to Mt. Scott Creek
- Bioretention Basin B, C & D: Bioretention Pond, Outfall to Mt. Scott Creek through a flow dispersion trench. Note Basin B, includes street planters identified as Planter C within the calculations.
- Pond E: Extended Dry Pond to the tributary of Kellogg Creek
- Planters A and B: Bioretention Planters, Outfall to Kellogg Creek. Planters A will treat proposed onsite street A. Planter B is located along Kellogg Creek Drive.
- Untreated: Street grading constraints and protected trees prohibit this portion of the street from flowing to a treatment facility.

3.4 Basin Area

Impervious and pervious surface areas for proposed conditions are shown in Table 3-1. The site is 36.7 % impervious in proposed conditions. The majority of the project will occur at the site, although some work is being done within church property. Street improvements to SE Kellogg Creek Dr. will also occur as part of this project. The Creek basin will not be developed but includes grading to balance the floodplain. The amount of area draining to the tributary of Kellogg Creek is 1.83 acres, slightly more than in existing conditions (See Technical Appendix: Figure 2 – proposed Basin Delineation).

Table 3-1 Proposed Basin Areas

Basin	Impervious Area, ac	Pervious Area, ac	Total Area, ac
Basin A	1.815	0.871	2.686
Basin B	0.830	0.237	1.067
Basin C	0.692	0.329	1.021
Basin D	0.725	0.290	1.015
Pond E	0.465	0.163	0.628
Planter A	0.133	0.035	0.168
Planter B	0.539	0.187	0.726
Mt. Scott Creek	0.000	6.788	6.788
Kellogg Creek	0.086	0.226	0.312
Total	5.285	9.126	14.411

4 Hydrologic and Hydraulic Analysis

4.1 Design Guidelines

The proposed storm design will meet the requirements of the City of Milwaukie as listed in the *Public Works Standards* dated February 2015. Section 2.0013 describes the allowable flow determination methods including the selected Unity Hydrograph Method.

4.2 Hydrologic Method

The Santa Barbara Urban Hydrograph (SBUH) was used for this analysis. The SBUH method is based on the curve number (CN) approach, and uses the Natural Resources Conservation Service's (NRCS) equations for computing soil absorption and precipitation excess.

The SBUH method converts the incremental runoff depths into instantaneous hydrographs, which are then routed through an imaginary reservoir with a time delay equal to the basin time of concentration.

The runoff function of xpswmm generates surface and subsurface runoff based on design or measured rainfall conditions, land use and topography. xpswmm Version 17.1 was used for our hydrology and hydraulics analysis. xpswmm is based on the public EPA SWMM program. xpswmm is an approved method of analysis by City of Milwaukie.

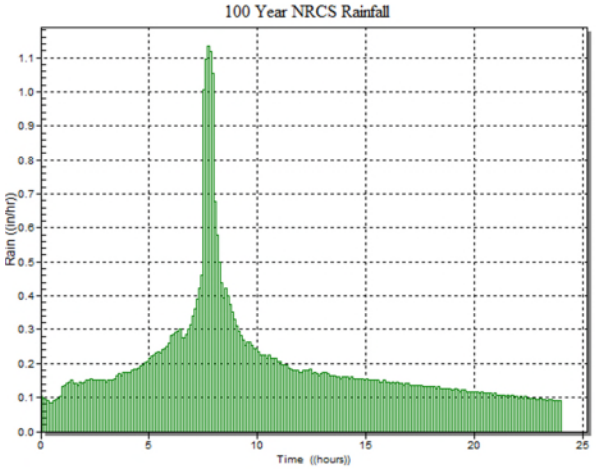
4.3 Design Storm

The rainfall distribution to be used within the City of Milwaukie jurisdiction is the design storm of 24-hour duration based on the standard Type 1A rainfall distribution. Table 4-1 shows total precipitation depths for different storm events. The NRCS Distribution for a type 1A 24-hour rainfall distribution for a 25-year storm event is shown in Figure 4-1.

Table 4-1 Precipitation Depth

Recurrence interval (years)	Total Precipitation Depth (in)
2	2.40
10	3.50
25	4.00
100	4.70

Figure 4-1 100-Year Type 1A Rainfall Ditribution



4.4 Basin Runoff

Table 4-2 lists the runoff rates for existing and proposed conditions for the site during the 2, 10, 25 and 100-year storm events. These values do not include onsite detention. (See Technical Appendix: Existing and Proposed Hydrographs).

Table 4-2 Runoff Rates

Recurrence Interval (years)	Existing Peak Runoff Rate (cfs)	Proposed Peak Runoff Rate (cfs)
2	1.310	4.253
5	2.469	6.045
10	3.569	7.621
25	4.749	9.251
100	6.499	11.602

5 Conveyance Analysis

5.1 Design Guidelines

The analysis and design criteria described in this section will follow the City of Milwaukie's *Public Works Standards.* The manual requires storm drainage system and facilities be designed to convey the 100-year storm event.

5.2 System Capacity

The proposed conveyance system was designed to convey and contain the peak runoff from a 100-year design storm.

5.3 System Performance

A complete conveyance analysis will be completed in the final Drainage Report.

6 Water Quality & Quantity

6.1 Design Guidelines

The proposed water quality and quantity facilities were designed per the City of Milwaukie requirements as listed in the *Public Works Standards* dated February 2015. The City of Milwaukie follows the current City of Portland's *Stormwater Management Manual* for water quality facility design. The City of Milwaukie requires the proposed discharge rate for the 2, 5, 10, and 25-year events to be that of the existing discharge rate. The City of Milwaukie does not require water quantity control for this project as the site discharge location into Mt. Scott Creek and Kellogg Creek.

Detention is also required to meet SLOPES V criteria. SLOPES V limits the proposed discharge rates using a continuous simulation for flows between 42% of the 2-year event and the 10-year flow event of existing flows. Existing conditions are assumed to be forested.

6.2 Water Quality and Quantity Facilities

The project will discharge into Mt. Scott Creek, a tributary of Kellogg Creek and the Willamette River. Mt. Scott and Kellogg Creek are not listed as water quality limited and the Willamette River is listed for E. Coli. Typical pollutants from single-family residential projects include: nutrients, pesticides, metals, oil, grease and other petroleum products, and sediment. Dissolved copper, dissolved zinc, and PAHs are generally the primary constituents of concern for stormwater runoff in Oregon streams for their impact on ESA listed species. These pollutants are specially targeted for treatment in the selected stormwater management systems.

Water quality treatment will occur through stormwater bioretention basins, planters and a pond. These facilities are landscaped reservoirs that collect and treat stormwater runoff through vegetation and soil media. They provide pollution reduction and flow attenuation to reduce hydraulic impacts from urban developments on downstream rivers. Specific elements are incorporated into the design to increase the effectiveness of this stormwater facility type. Design elements include trapped catch basins to remove coarse sediment, soil media to provide stormwater filtration, and vegetation to will provide plant uptake.

The basins are designed using the BMP Sizing Tool developed by Clackamas County. This continuous simulation software is a regional tool for the Portland metro area. City of Milwaukie standards were checked using the City of Portland Presumptive Approach Calculator (PAC).

Bioretention facilities are designed to incorporate the following criteria:

- Water Depth: 10 to 18 inches
- Drain Rock Depth: 6 to 18 inches
- Growing Medium Depth: 18 inches
- Minimum Freeboard: 2 inches
- Perforated Pipe Under Drain
- Minimum Orifice Size: 1 inch

There are seven (7) proposed bioretention facilities located in the proposed project. Each facility was designed to maximize water contact with vegetation for biological treatment. A control structure with one or two orifices will control the allowable release rate. Appropriate vegetation will be planted in the basin as specified by the City of Portland's *Stormwater Management Manual* (See Technical Appendix: WES BMP Sizing Report). Table 6-1 provides a summary of each facility.

Table 6-1 Bioretention Facility Summary

Basin ID	Facility Type	Minimum Top Area (not including Freeboard) (sf)	Minimum Bottom Area (sf)	Water Depth (in)	Soil Depth (in)	Rock Depth (in)	Total Depth (in)
Basin A	Bioretention Basin	3,102	2,445	12	18	6	36
Basin B	Bioretention Basin	849	607	12	18	6	36
Basin C	Bioretention Basin	1,193	887	12	18	6	36
Basin D	Bioretention Basin	1,879	1,397	12	18	6	36
Pond E*	Dry Pond	1,084	507	18	0	0	18
Planter A	Planter	215	-	10	18	7	35
Planter B	Planter	1,497	-	10	18	7	35

* Pond E will include soil media and plantings at the bottom of the pond.

6.3 Flow Dispersion

A flow dispersion trench will be used at the outfall of Bioretention Basin B, C and D. This flow spreader was designed to disperse flow over a large area in an effort to reduce erosive velocities of the stormwater discharge entering the wetland during the 100-year event. The flow spreader will be a gravel filled trench with a perforation pipe in the bottom of the trench.

Soils in the proposed discharge location were conservatively assumed to consist of silty clay loam. This soil type has a maximum permissible velocity of 0.5-fps, which was used to determine the facility length (See Technical Appendix: Chow – Fig. 7-3 U.S. and U.S.S.R. data on Permissible Velocities for Non-cohesive Soils). The flow spreader was treated as a broad crested weir with a weir coefficient of 2.4. The broad crested weir equation is shown below.

$$q = 2.4H^{3/2}$$

Where:

q= Volumetric flow rate per unit length, cfs/ft

H= Depth of flow over weir

Table 6-2 Flow Dispersion Trench

Length (ft)	Discharge (cfs)	Depth (ft)	q (cfs/ft)	Velocity (fps)
135	3.01	0.04	0.02	0.50

7 Floodplain Analysis

FEMA Flood Insurance Rate Maps were used to determine the 10, 25 and 100-year flood stage for Mt. Scott Creek. The site is located on map number FM41005C0036D, with an effective date of June 17, 2008. Elevations are provided in the NAVD 1988 datum, the same as used for this project. The upstream most cross section is C located just downstream of Hwy 224. The 100-year elevation at cross section C is 69.9.

The 25-year elevation was interpolated from the FEMA profile. These elevations were used to balance the floodplain and determine the elevation of the stormwater facilities. FEMA determined elevations are listed in Table 7-1 (See Technical Appendix: Flood Insurance Study, Clackamas County - Mt. Scott Creek Profile).

Table 7-1 Mt. Scott Creek Water Surface Elevations

Recurrence Interval (years)	Water Surface Elevation	
	Upstream Property Boundary	Downstream Property Boundary
10	69.4	67.5
25	69.7	67.3
100	69.9	67.3

8 Operation & Maintenance

Maintenance of water quality and quantity facilities is very important to ensure they operate as designed. Inadequate maintenance can be attributed to premature failures of these facilities. Stormwater facilities for the site will be maintained and operated privately by the homeowners. Prior to creation of an HOA, please contact Randy Myers at 503-358-4460 or Randy@Brownstonehomes.net about inspection and maintenance of the proposed stormwater facilities.

The owners must insure the water quality systems efficiently perform their function of removing petroleum hydrocarbons, sediments, metals, bacteria and nutrients from stormwater runoff and that the water quantity system performs their function of regulating the rate and volume of stormwater runoff leaving the property.

The Operation and Maintenance Plan is provided within the Technical Appendix.

9 Summary

The proposed water quality and quantity facility design follows the City of Milwaukie's *Public Works Standards* dated February 2015. The City of Milwaukie follows the current City of Portland's *Stormwater Management Manual* for water quality facility design.

Additionally, the project must comply with the National Marine Fisheries Service (NMFS) criteria as part of the March 2014 Programmatic Biological Opinion and Essential Fish Habitat Consultation for Revisions to Standard Local Operating Procedures for Endangered Species (SLOPES V) as part of the Wetland Fill Permit with the Army Corp of Engineers.

Bioretention facilities are proposed to provide a high level of treatment and detention.

Technical Appendix

Technical Appendix

- Figure 1 – Existing Basin Delineation
- Figure 2 – Proposed Basin Delineation

- Hydrologic Soil Map – Washington County
- Table 2-2c – Runoff Curve Numbers for Other Agricultural Lands
- Table 2-2a – Runoff Curve Numbers for Urban Areas
- Time of Concentration
- WES BMP Sizing Report
- PAC
- Existing & Proposed Hydrographs
- Flood Insurance Study, Clackamas County - Mt. Scott Creek Profile
- Chow – Fig. 7-3 U.S. and U.S.S.R. data on Permissible Velocities for Non-cohesive Soils
- Operation and Maintenance Plan
- Geotechnical Evaluation – Kellogg Creek Development, GEO Consultants Northwest, October 7, 2016.

References

Flood Insurance Study (FIS) – Clackamas County, Oregon and Incorporated Areas, FEMA, June 17, 2008.

Public Works Standards, City of Milwaukie, February 2015.

Stormwater Management Manual, City of Portland, August 2016.

Programmatic Biological Opinion and Essential Fish Habitat Consultation for Revisions to Standard Local Operating Procedures for Endangered Species (SLOPES V), National Marine Fisheries Service (NMFS), March 2014.