



Frog Pond Ridge Subdivision

Wilsonville, Oregon



11.13.2020

Request for
Annexation

Zoning Map Amendment

Planned Development – Stage I Preliminary Plan

Planned Development – Stage II Final Plan

Planned Development Waiver

Site Development Review of Parks & Open Space

Tentative Subdivision Plat

Type C Tree Plan

Abbreviated Significant Resource Impact Review

Prepared for:
West Hills Land Development
3330 NW Yeon Ave, Suite 200
Portland, OR 97210

Prepared By:
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Portland, OR 97204

July 2, 2020

Project No. 19489.000



City of Wilsonville
Exhibit B2 DB20-0007 et al



REQUESTS

Annexation, Zoning Map Amendment, Planned Development, Site Development Review, Abbreviated Significant Resource Impact Review, Type C Tree Plan, Subdivision, and Partition Plat approvals are requested for the 16.25-acre site consisting of two properties. The site is located within the West Neighborhood of the Frog Pond Area Plan boundaries and is subject to Planned Development (PD) review. The proposed development consists of two parts:

- Annexation, and a zone map amendment and residential planned development including 63 detached single-family residential dwellings, 8 attached single-family residential dwellings (duplexes), and infrastructure improvements for the Morgan and Coates properties; and
- Dedication of right-of-way by the School District to allow the extension of Brisband Street along its northern boundary.

The site is in rural residential and agricultural use. The Morgan site at 6720 SW Frog Pond Lane contains one existing single-family home and three existing outbuildings. The Arbor Lodge, LLC site (previously the Coates property) is vacant. See Sheets P1.00 and P1.10.

SITE INFORMATION

SUBJECT SITE:	TLIDs 31W12DD 01500 (Arbor Lodge, LLC); 31W12DD 01700 (Coates); a portion of 31W12DD 00400 (School District); a portion of 31W12DD 01800 (Frog Pond Meadows)
SITE AREA:	16.25 ac
COMPREHENSIVE PLAN DESIGNATION:	<i>Current: Clackamas County RFFF5</i> Proposed: Residential Neighborhood RN
ZONING DESIGNATION:	<i>Current: Clackamas County RFFF5</i> <i>Overlay: Significant Resources Overlay Zone SROZ</i> Proposed: Residential Neighborhood RN

APPLICANT/PROPERTY OWNER

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PROJECT DEVELOPMENT TEAM

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- Appendix C — Traffic Impact Study dated October 2018, by DKS and Associates
- Appendix D — Wetland Delineation Report dated December 16, 2019, by AKS Engineering & Forestry
- Appendix E — Significant Resource Impact Report dated January 2020, by AKS Engineering & Forestry
- Appendix F — Tree Plan dated June 26, 2020, by Portland Tree Consulting
- Appendix G — Geotechnical Reports by Hardman Geotechnical Services, Inc.
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Reduced Size Plan Set

- Sheet P0.00 – Cover Sheet
- Sheet P1.00 – Existing Conditions – Aerial Photo
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- Sheet P2.00 – Preliminary Site Plan
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I. Requests

Annexation, Zoning Map Amendment, Planned Development, Site Development Review, Abbreviated Significant Resource Impact Review, Type C Tree Plan, Subdivision, and Partition Plat approvals are requested for the 16.25-acre site consisting of two entire properties and portions of two others. The site is located within the West Neighborhood of the Frog Pond Area Plan boundaries and is subject to Planned Development (PD) review. The proposed development consists of two parts: annexation, and a zone map amendment, and a residential planned development including 63 detached single-family residential dwellings, 8 attached single-family residential dwellings (duplexes), and infrastructure improvements for the Morgan and Coates properties; and the dedication of right-of-way by the School District to allow the extension of Brisband Street along its northern boundary;

The site is in rural residential and agricultural use. The Morgan site at 6720 SW Frog Pond Lane contains one existing single-family home and three existing outbuildings. The West Hills Land Development site (previously the Coates property) is vacant. See Sheets P1.00 and P1.10.

Annexation approval is required to annex the site into City limits and connect to City utilities.

Zoning Map Amendment approval is required to apply the RN zoning to the site.

Planned Development – Stage I and II approvals are required because all development of 2 acres or greater in the RN Zone requires approval as a Planned Development.

Planned Development Waiver approval for reduced setbacks is required to allow Willow Creek Dr to shift to the west to avoid impact to the existing oak tree at the center of the alignment.

Site Design Review approval is required for review of tracts and their landscaping, landscaping in the public right-of-way, and walls.

Tentative Subdivision Plat approval is required to divide the property into 71 lots and five tracts (lots 70 and 71 are a replat of Tract J of Frog Pond Meadows). Land divisions of four lots or more are defined as subdivisions.

Type C Tree Plan approval is required to remove trees on site for development.

Abbreviated Significant Resource Impact Review approval is required due to the presence of mapped SROZ on the site and the impacts of public improvements on those resources.

II. Project Description

The proposed development will include 71 single-family residential lots: 63 detached lots and 8 attached (duplex) lots. The 16.25-acre site consists of two entire properties and portions of two other properties located in unincorporated Clackamas County, within the City of Wilsonville Urban Growth Boundary (UGB) and the Frog Pond West subarea of the city. The site is currently zoned Clackamas County Rural Residential Farm Forest 5-Acre (RRFF5). This application will annex the site to the City of Wilsonville and apply the Residential Neighborhood RN zone to the site.

The site is currently in residential and agricultural use and is adjacent to the City of Wilsonville RN zone to the south and the Clackamas County RRFF5 zone to the west, north, and east. The site to the southwest (TLID 2200) is owned by the school district. The school district intends to dedicate a portion of its site for right-of-way to allow the continuation of Brisband Street across its northern boundary. The site to the south (TLID 1800) is part of the Frog Pond Meadows planned development and the current application includes replatting Tracts J and L.

The Willow Creek SROZ area extends slightly north of Brisband Street and a wetland area is located at the northwest corner of Willow Creek Drive and Brisband Street.

Per Figure 6 of the Frog Pond West Master Plan, the project site is located within the Frog Pond West Subdistricts 4-R7, 5-R7 and 6-R5.

III. Comprehensive Plan Policies

A. Urban Growth Management

Response: Annexation of the site is subject to the provisions of the Urban Growth Management chapter of the Comprehensive Plan, specifically Goal 2.1 and Policy 2.2.1.

Policy 2.2.1

The City of Wilsonville shall plan for the eventual urbanization of land within the local planning area, beginning with land within the Urban Growth Boundary.

Implementation Measure 2.2.1.a

Allow annexation when it is consistent with future planned public services and when a need is clearly demonstrated for immediate urban growth.

Response: The Comprehensive Plan states:

“Based on Metro’s (1981) regional growth allocation statistics, Wilsonville’s population was projected to grow to 15,600 by the year 2000. In the same time period, the City’s economic growth is expected to generate a total of 14,400 jobs. Those projections proved to be surprisingly accurate. In fact, Wilsonville’s population in 2000 approached the 15,600 figure, and the number of jobs exceeded the 14,400 figure.”

The subject site is located within the West Neighborhood of the Frog Pond planning area. The Frog Pond Area Plan was adopted in 2015 and the Frog Pond West Master Plan was adopted in 2017 and provides for single-family residential uses to meet the needs of Wilsonville’s growing population. The Frog Pond Area Plan includes a transportation framework, parks and open space framework, and infrastructure framework to support development within the Frog Pond area and assure adequate public services.

This criterion is met.

Implementation Measure 2.2.1.e

Changes in the City boundary will require adherence to the annexation procedures prescribed by State law and Metro standards. Amendments to the City limits shall be based on consideration of:

- 1. Orderly, economic provision of public facilities and services, i.e., primary urban services are available and adequate to serve additional development or improvements are scheduled through the City’s approved Capital Improvements Plan.*

Response: The Frog Pond Area Plan includes implementation measures to ensure the orderly and economic provision of public facilities and services for the Frog Pond Area, including Frog Pond West. Site development is proposed with concurrent applications for Stage I and Stage II Planned Unit Development and Preliminary Subdivision, which proposes the extension of public facilities and services to the Frog Pond Ridge site. These proposed services are generally consistent with the Frog Pond Area Plan and Frog Pond West Master Plan, and the City’s Finance Plan and Capital Improvements Plan.

This criterion is met.

- 2. Availability of sufficient land for the various uses to insure choices in the marketplace for a 3 to 5 year period.*

Response: The inclusion of the Frog Pond area within the UGB and the adoption of the Frog Pond Area Plan demonstrate the need for residential development in the Frog Pond Area. Annexation of the subject site will allow development of the uses envisioned by the adopted Frog Pond West Master Plan.

3. *Statewide Planning Goals.*

Response: The Statewide Planning Goals provide direction to local jurisdictions regarding the State's policies on land use. These goals are implemented at the local level through Comprehensive Plans, which are required and reviewed by the Department of Land Conservation and Development (DLCD) for conformance with the Statewide Planning Goals. It is assumed that the City's adopted Comprehensive Plan (which includes the adopted Frog Pond Area Plan and Frog Pond West Master Plan) is in compliance with the Statewide Planning Goals (specifically Goal 2: Land Use Planning), and that compliance with the Wilsonville Comprehensive Plan also demonstrates compliance with the Statewide Planning Goals.

Relevant Statewide Planning Goals include:

- Goal 10: Housing
- Goal 12: Transportation
- Goal 14: Urbanization

Responses to each are addressed below.

Goal 10: Housing

This goal identifies a need for "needed housing," which is defined (for cities having populations larger than 2,500) as attached and detached single-family housing, multiple-family housing, and manufactured homes. Annexation of the subject site into the Wilsonville city limits will provide attached and detached single-family housing, which is defined as "needed housing" and will serve an identified need in the city.

Goal 12: Transportation

This goal identifies the importance of a safe, convenient, and economic transportation system, and requires local jurisdictions to adopt a Transportation System Plan (TSP). The proposed annexation area will comply with the Wilsonville Transportation System Plan, which has been updated to include the Frog Pond West area. Annexation of the subject site will allow for development of the site, including new street connections included in the TSP.

Goal 14: Urbanization

This goal identifies the need for orderly and efficient growth, the need to accommodate housing and employment within the urban growth boundary, and the importance of livable communities. The orderly annexation of this site, which is located within the Frog Pond West area, will provide additional housing within the UGB.

4. *Applicable Metro Plans;*

Response: The Metro Code contains applicable requirements. Section 3.07 Urban Growth Management Functional Plan (Functional Plan) provides direction to communities within Metro's jurisdiction regarding the region's land use and transportation policies, and Chapter 3.09 Local Government Boundary Changes identifies requirements for annexations.

Wilsonville is located within the jurisdiction of Metro, and its local plans and land use ordinances are subject to review by Metro. It is assumed that the City's adopted Comprehensive Plan (which includes the adopted Frog Pond West Master Plan) is in compliance with the Functional Plan, and that compliance with the Wilsonville Comprehensive Plan also demonstrates compliance with the Functional Plan.

Metro Code 3.07 Urban Growth Management Functional Plan

Applicable Titles of the Functional Plan are addressed below.

Title 1: Housing Capacity

Annexation of the subject site will increase the housing capacity of the city, as described and confirmed through adoption of the Frog Pond West Master Plan.

Title 11: Planning for New Urban Areas

The City of Wilsonville's adopted Frog Pond Area Plan and Frog Pond West Master Plan include a

comprehensive overview of future development in the Frog Pond planning area. The proposed annexation will expand the boundaries of the city and allow for orderly development of the Frog Pond West Area.

Metro Code 3.09 Local Government Boundary Changes

3.09.040 Requirements for Petitions

- A. *A petition for a boundary change must contain the following information:*
1. *The jurisdiction of the reviewing entity to act on the petition;*
 2. *A map and a legal description of the affected territory in the form prescribed by the reviewing entity;*
 3. *For minor boundary changes, the names and mailing addresses of all persons owning property and all electors within the affected territory as shown in the records of the tax assessor and county clerk; and*
 4. *For boundary changes under ORS 198.855(3), 198.857, 222.125 or 222.170, statements of consent to the annexation signed by the requisite number of owners or electors.*
- B. *A city, county and Metro may charge a fee to recover its reasonable costs to carry out its duties and responsibilities under this chapter.*

Response: The petition included as Appendix A includes the information required by this section.

5. *Encouragement of development within the City limits before conversion of urbanizable (UGB) areas.*

Response: The subject site is located within the Frog Pond West planning area, which has been the subject of a great deal of local planning efforts. Expansion of the city's UGB to include this area was completed due to a determination that there was inadequate development area within the existing city limits. Annexation of this site will allow development that implements the vision of the Frog Pond West Master Plan.

B. Land Use and Development

Response: The requested zone change to RN is subject to compliance with Comprehensive Plan map designation and applicable goals, policies and objectives as well as compliance with the Land Use and Development chapter of the Comprehensive Plan, specifically Policy 4.1.4 and implementation measures 4.1.4.b, d, e, q, and x.

Policy 4.1.4

The City of Wilsonville shall provide opportunities for a wide range of housing types, sizes, and densities at prices and rent levels to accommodate people who are employed in Wilsonville.

Implementation Measure 4.1.4.b

Plan for and permit a variety of housing types consistent with the objectives and policies set forth under this section of the Comprehensive Plan, while maintaining a reasonable balance between the economics of building and the cost of supplying public services. It is the City's desire to provide a variety of housing types needed to meet a wide range of personal preferences and income levels. The City also recognizes the fact that adequate public facilities and services must be available in order to build and maintain a decent, safe, and healthful living environment.

Response: The proposed zone change to Residential Neighborhood RN implements the adopted Frog Pond West Master Plan and allows for development of single-family detached and attached housing. The proposed development permitted by the zone change will provide adequate public facilities and services to serve the new dwellings.

Implementation Measure 4.1.4.d

Encourage the construction and development of diverse housing types, but maintain a general balance according to housing type and geographic distribution, both presently and in the future. Such housing types may include, but shall not be limited to: Apartments, single-family detached, single-family common wall, manufactured homes, mobile homes, modular homes, and condominiums in various structural forms.

Response: The Frog Pond West Master Plan anticipates single-family detached and attached development. The proposed zone change implements the adopted Frog Pond West Master Plan and allows for development of single-family detached and attached housing.

Implementation Measure 4.1.4.e

Targets are to be set in order to meet the City’s Goals for housing and assure compliance with State and regional standards.

Response: The Frog Pond Area Plan and Frog Pond West Master Plan establish minimum and maximum residential densities for this area in compliance with state and regional standards. The proposed zone change will allow development of the subject site in conformance with those densities.

Implementation Measure 4.1.4.q

The City will continue to allow for mobile homes and manufactured dwellings, subject to development review processes that are similar to those used for other forms of housing. Individual units will continue to be allowed on individual lots, subject to design standards. Mobile home parks and subdivisions shall be subject to the same procedures as other forms of planned developments.

Response: No mobile homes or manufactured dwellings are proposed, but the applicant acknowledges that they are allowed.

Implementation Measure 4.1.4.x

Apartments and mobile homes are to be located to produce an optimum living environment for the occupants and surrounding residential areas. Development criteria includes:

1. *Buffering by means of landscaping, fencing, and distance from conflicting uses.*
2. *Compatibility of design, recognizing the architectural differences between apartment buildings and houses.*
3. *On-site recreation space as well as pedestrian and bicycle access to parks, schools, mass transit stops and convenience shopping.*
4. *The siting of buildings to minimize the visual effects of parking areas and to increase the availability of privacy and natural surveillance for security.*

Response: No apartments or mobile homes are proposed or permitted by the requested zoning.

RESIDENTIAL PLANNING DISTRICTS SHOWN ON THE LAND USE MAP OF THE COMPREHENSIVE PLAN

Response: The Frog Pond West Master Plan and the RN zone identify minimum density targets for the Frog Pond West subdistricts. As shown in Table 1 below, the proposed development will consist of 71 lots and meets the minimum zone density.

Table 1: Proposed residential units

Land Use Designation	Sub-district	Gross Site Area (ac)	% of Subdistrict	Minimum du	Maximum du	Proposed du	Comment
R-7	4	5.93	19.67	17	21	21	Meets density requirements
R-7	5	3.22	39.72 ¹	11	13	12	Meets density requirements
R-5	6	7.10	48.31	36	45	38	Meets density requirements
Total		16.25		64	79	71	

1. Including Lots 70 and 71 within Frog Pond Meadows

These densities are not specifically addressed in Comprehensive Plan policies.

C. Areas of Special Interest

AREA L

This area is located north of Boeckman Road, south of Frog Pond Lane, west of Wilsonville (Stafford) Road, and east of Boeckman Creek. It contains a mixture of rural-residential and small agricultural uses. Eventual redevelopment of the area is expected to be primarily residential. The West Linn – Wilsonville School District and a church have acquired property in the area, causing speculation that redevelopment with full urban services could occur prior to 2010. In fact, construction of a new church has already commenced at the corner of Boeckman Road and Wilsonville/Stafford Road.

The existing development patterns, and values of the existing homes in the Frog Pond neighborhood are expected to slow the redevelopment process. Most of the land-owners in the area have expressed little or no interest in urban density redevelopment. The Metro standard for urbanizing residential land is an average residential density of at least 10 units/acre. Those densities may not appeal to many of the current residents of the area who live in large homes on lots with acreage. In view of the School District's plans to construct a school within the neighborhood, the City must prepare plans to serve the new school and the surrounding area.

Response: The site is located within Area L, now known as the Frog Pond Plan Area. The Frog Pond West Master Plan was adopted in 2017 and provides land use and infrastructure plans for urban density redevelopment. The proposed zone change to RN implements the provisions of the Frog Pond West Master Plan.

IV. Zoning Regulations

A. Section 4.035 Site Development Permits

[...]

(.04) Site Development Permit Application.

A. *An application for a Site Development Permit shall consist of the materials specified as follows, plus any other materials required by this Code.*

1. *A completed Permit application form, including identification of the project coordinator, or professional design team.*

Response: Completed application forms have been submitted.

2. *An explanation of intent, stating the nature of the proposed development, reasons for the Permit request, pertinent background information, information required by the development standards and other information specified by the Director as required by other sections of this Code because of the type of development proposal or the area involved or that may have a bearing in determining the action to be taken. As noted in Section 4.014, the applicant bears the burden of proving that the application meets all requirements of this Code.*

Response: This narrative includes a description of the nature of the proposed development, reasons for the request, pertinent background information, and responses to applicable criteria.

3. *Proof that the property affected by the application is in the exclusive ownership of the applicant, or that the applicant has the consent of all individuals or partners in ownership of the affected property.*

Response: The submittal includes application forms signed by the property owners and the applicant, verifying that all owners consent to the application.

4. *Legal description of the property affected by the application.*

Response: A legal description of the property is included in Appendix A.

5. *The application shall include conceptual and quantitatively accurate representations of the entire development sufficient to judge the scope, size and impact of the development on the community, public facilities and adjacent properties; and except as otherwise specified in this Code, shall be accompanied by the following information,*

Response: The exhibits and reports included with this submittal include this information.

6. *Unless specifically waived by the Director, the submittal shall include: ten (10) copies folded to 9" x 12" or (one (1) set of full-sized scaled drawings and nine (9) 8 1/2" x 11" reductions of larger drawings) of the proposed Site Development Plan, including a small scale vicinity map and showing:*
 - a. *Streets, private drives, driveways, sidewalks, pedestrian ways, off-street parking, loading areas, garbage and recycling storage areas, power lines and railroad tracks, and shall indicate the direction of traffic flow into and out of off-street parking and loading areas, the location of each parking space and each loading berth and areas of turning and maneuvering vehicles.*
 - b. *The Site Plan shall indicate how utility service, including sanitary sewer, water and storm drainage, are to be provided. The Site Plan shall also show the following off-site features: distances from the subject property to any structures on adjacent properties and the locations and uses of streets, private drives, or driveways on adjacent properties.*
 - c. *Location and dimensions of structures, utilization of structures, including activities and the number of living units.*
 - d. *Major existing landscaping features including trees to be saved, and existing and proposed contours.*
 - e. *Relevant operational data, drawings and/or elevations clearly establishing the scale, character and relationship of buildings, streets, private drives, and open space.*
 - f. *Topographic information sufficient to determine direction and percentage of slopes, drainage patterns, and in environmentally sensitive areas, e.g., flood plain, forested areas, steep slopes or adjacent to stream banks, the elevations of all points used to determine contours shall be indicated and said points shall be given to true elevation above mean sea level as determined by the City Engineer. The base data shall be clearly indicated and shall be compatible to City datum, if bench marks are not adjacent. The following intervals shall be shown:*
 - i. *One (1) foot contours for slopes of up to five percent (5%);*
 - ii. *Two (2) foot contours for slopes of from six percent (6%) to twelve percent (12%);*
 - iii. *Five (5) foot contours for slopes of from twelve percent (12%) to twenty percent (20%). These slopes shall be clearly identified, and*
 - iv. *Ten (10) foot contours for slopes exceeding twenty percent (20%).*
 - g. *A tabulation of land area, in square feet, devoted to various uses such as building area (gross and net rentable), parking and paving coverage, landscaped area coverage and average residential density per net acre.*
 - h. *An application fee as set by the City Council.*
 - i. *If there are trees in the development area, an arborist's report, as required in Section 4.600. This report shall also show the impacts of grading on the trees.*
 - j. *A list of all owners of property within 250 feet of the subject property, printed on label format. The list is to be based on the latest available information from the County Assessor.*

Response: A site circulation plan is included as Sheet P8.00; utility plans are included as Sheets P4.00 to P4.20; an existing conditions plan, including contours and trees, is included as Sheet P1.10; operational data is included in Sheets P2.00, P3.00, L2.00, and P8.10; topographic information is shown on Sheet P1.0; a tabulation of land area and uses is included in Sheet P7.00; the application fee has been submitted with this application; an arborist report is included as Appendix F; and a list of property owners within 250 ft. of the subject property is included with this application.

B. Section 4.113. Standards Applying to Residential Developments In Any Zone

(.01) Outdoor Recreational Area in Residential Developments

(.02) Open Space Area shall be provided in the following manner

Response: The site is located within the Frog Pond West master plan area, and the provisions of Section 4.127 supersede these standards and are addressed below.

(.03) Building Setbacks

(for Fence Setbacks, see subsection .08). The following provisions apply unless otherwise provided for by the Code or a legislative master plan. [Section .03 Building Setbacks amended by Ord. 806, /17/2017]

A. For lots over 10,000 square feet: [...]

Response: No lots over 10,000 square feet are proposed. These standards are not applicable.

B. For lots not exceeding 10,000 square feet:

1. Minimum front yard setback: Fifteen (15) feet, with open porches allowed to extend to within ten (10) feet of the property line.
2. Minimum side yard setback: One story: five (5) feet; Two or more stories: seven (7) feet. In the case of a corner lot, abutting more than one street or tract with a private drive, the side yard on the street side of such lot shall be not less than ten (10) feet.
3. In the case of a key lot, the front setback shall equal one-half (1/2) the sum of depth of the required yard on the adjacent corner lot along the street or tract with a private drive upon which the key lot faces and the setback required on the adjacent interior lot.
4. No structure shall be erected within the required setback for any future street shown within the City's adopted Transportation Master Plan or Transportation Systems Plan.
5. Minimum setback to garage door or carport entry: Twenty (20) feet. Wall above the garage door may project to within fifteen (15) feet of property line, provided that clearance to garage door is maintained. Where access is taken from an alley, garages or carports may be located no less than four (4) feet from the property line adjoining the alley.
6. Minimum rear yard setback: One story: fifteen (15) feet. Two or more stories: Twenty (20) feet. Accessory buildings on corner lots must observe the same rear setbacks as the required side yard of the abutting lot. [Section 4.113(.03) amended by Ord. 682, 9/9/10]

Response: The site is within the Frog Pond West Master Plan Area and the RN zone is being applied through this application. The site is subject to the setback requirements of Section 4.127, which are addressed in the responses to that section.

(.04) Height Guidelines

The Development Review Board may regulate heights as follows:

- A. Restrict or regulate the height or building design consistent with adequate provision of fire protection and fire-fighting apparatus height limitations.
- B. To provide buffering of low density developments by requiring the placement of buildings more than two (2) stories in height away from the property lines abutting a low density zone.
- C. To regulate building height or design to protect scenic vistas of Mt. Hood or the Willamette River from greater encroachments than would occur if developed conventionally.

Response: No low-density developments are adjacent to the site and no scenic vistas have been identified on the site. No height regulation is needed.

(.05) Residential uses for treatment or training

- A. Residential Homes, as defined in Section 4.001, shall be permitted in any location where a single-family dwelling is permitted.
- B. Residential Facilities, as defined in Section 4.001, shall be permitted in any location where multiple-family dwelling units are permitted.

Response: No residential homes or facilities are proposed. These standards are not applicable.

(.06) Off Street Parking

Off-street parking shall be provided as specified in Section 4.155.

Response: The provisions of Section 4.155 are addressed in Section V.B of this narrative.

(.07) Signs

Signs shall be governed by the provisions of Sections 4.156.01 – 4.156.11.

Response: The provisions of Sections 4.156.01-11 are addressed in Section V.C of this narrative.

(.08) Fences

- A. *The maximum height of a sight-obscuring fence located in the required front yard of a residential development shall not exceed four (4) feet.*
- B. *The maximum height of a sight-obscuring fence located in the side yard of a residential lot shall not exceed four (4) feet forward of the building line and shall not exceed six (6) feet in height in the rear yard, except as approved by the Development Review Board. Except, however, that a fence in the side yard of residential corner lot may be up to six (6) feet in height, unless a greater restriction is imposed by the Development Review Board acting on an application. A fence of up to six (6) feet in height may be constructed with no setback along the side, the rear, and in the front yard of a residential lot adjoining the rear of a corner lot as shown in the attached Figure.*
- C. *Notwithstanding the provisions of Section 4.122(10)(a) and (b), the Development Review Board may require such fencing as shall be deemed necessary to promote and provide traffic safety, noise mitigation, and nuisance abatement, and the compatibility of different uses permitted on adjacent lots of the same zone and on adjacent lots of different zones.*
- D. *Fences in residential zones shall not include barbed wire, razor wire, electrically charged wire, or be constructed of sheathing material such as plywood or flakeboard.*

Response: The site is located within Frog Pond West and is subject to these standards with the exception of the standards of 4.127(0.17) related to the Boeckman Road and Stafford Road frontages. No fences on residential lots are proposed at this time. The provisions of 4.127(0.17) are addressed in Section IV.C of this narrative.

(.09) Corner Vision

Vision clearance shall be provided as specified in Section 4.177, or such additional requirements as specified by the City Engineer.

Response: The provisions of Section 4.177 are addressed in Section V.I of this narrative.

(.10) Prohibited Uses

- A. *Uses of structures and land not specifically permitted in the applicable zoning districts.*
- B. *The use of a trailer, travel trailer or mobile coach as a residence, except as specifically permitted in an approved RV park.*
- C. *Outdoor advertising displays, advertising signs, or advertising structures except as provided in Sections 4.156.05, 4.156.07, 4.156.09, and 4.156.10.*

Response: No prohibited uses are proposed. These provisions are not applicable.

(.11) Accessory Dwelling Units

Accessory Dwelling Units, are permitted subject to standards and requirements of this Subsection. [Amended by Ord. #825, 10/15/18]

Response: No accessory dwelling units are proposed. These standards are not applicable.

(.12) Reduced Setback Agreements

The following procedure has been created to allow the owners of contiguous residential properties to reduce the building setbacks that would typically be required between those properties, or to allow for neighbors to voluntary waive the solar access provisions of Section 4.137. Setbacks can be reduced

to zero through the procedures outlined in this subsection.[...]

Response: No reduced setbacks are requested through these provisions.

(.13) Bed and Breakfasts

Response: No bed and breakfasts are proposed. These standards are not applicable.

C. Section 4.118 Standards Applying in all Planned Development Zones.

(.01) Height Guidelines: In “S” overlay zones, the solar access provisions of Section 4.137 shall be used to determine maximum building heights. In cases that are subject to review by the Development Review Board, the Board may further regulate heights as follows: [...]

Response: The subject site is not located within the “S” overlay zone. These standards are not applicable.

(.02) Underground Utilities shall be governed by Sections 4.300 to 4.320. All utilities above ground shall be located so as to minimize adverse impacts on the site and neighboring properties.

Response: The provisions of Sections 4.300 to 4.320 are addressed in Section VII of this narrative.

(.03) Notwithstanding the provisions of Section 4.140 to the contrary, the Development Review Board, in order to implement the purposes and objectives of Section 4.140, and based on findings of fact supported by the record may:

A. Waive the following typical development standards:

1. minimum lot area;
 2. lot width and frontage;
 3. height and yard requirements;
 4. lot coverage;
 5. lot depth;
 6. street widths;
 7. sidewalk requirements;
 8. height of buildings other than signs;
 9. parking space configuration and drive aisle design;
 10. minimum number of parking or loading spaces;
 11. shade tree islands in parking lots, provided that alternative shading is provided;
 12. fence height;
 13. architectural design standards;
 14. transit facilities; and
 15. On-site pedestrian access and circulation standards; and
 16. Solar access standards, as provided in section 4.137.
- [Amended by Ord. #719, 6/17/13.]

Response: Per Section 4.127, the minimum front yard requirement for lots in the RN zone’s R7 subdistrict is 15 ft. As a result of the Willow Creek Dr realignment to avoid impacts to the existing 34-in. oak, the front yards of Lots 19, 20, and 21 must be reduced to 12 ft. to allow for development with single-family homes. See Table 2 below.

Table 2: Requested Front Yard Setback Waivers

Lot Number	Minimum Front Yard (ft)	Proposed Front Yard	Difference
19	15	12	3 ft /20%
20	15	12	3 ft / 20%
21	15	12	3 ft / 20%

As described in Section IV.G of this narrative, this requested waiver meets the goals and objectives of Section 4.140.

D. Section 4.124. Standards applying to all Planned Development Residential Zones.

(.01) Examples of principal uses that are typically permitted:

- A. Open Space.
- B. Single-Family Dwelling Units.
- C. Duplexes. [Added by Ord. #825, 10/15/18]
- D. Multiple-Family Dwelling Units. [Amended by Ord. #825, 10/15/18]
- E. Public parks, playgrounds, recreational and community buildings and grounds, tennis courts, and similar recreational uses, all of a non-commercial nature, provided that any principal building or public swimming pool shall be located not less than forty-five (45) feet from any other lot.
- F. Manufactured homes, subject to the standards of Section 4.115 (Manufactured Housing).

Response: The proposed development includes open space, single-family dwelling units, and duplexes. As shown on Sheet P2.00, lots 52 to 59 will be attached duplex units. These uses are permitted uses in the PDR zones.

(.02) Permitted accessory uses to single family and detached dwelling units: [Amended by Ord. #825, 10/15/18]

- A. Accessory uses, buildings and structures customarily incidental to any of the principal permitted uses listed above, and located on the same lot.
- B. Living quarters without kitchen facilities for persons employed on the premises or for guests. Such facilities shall not be rented or otherwise used as a separate dwelling unless approved as an accessory dwelling unit or duplex.
- C. Accessory dwelling units, subject to the standards of Section 4.113 (.11). [Amended by Ord. #825, 10/15/18]
- D. Home occupations.
- E. A private garage or parking area.
- F. Temporary real estate signs, small announcement or professional signs, and subdivision signs, as provided in the provisions of Sections 4.156.05, 4.156.07, 4.156.09, and 4.156.10. [Amended by Ord. No. 704, 6/18/12]
- G. Temporary buildings for uses incidental to construction work, which buildings shall be removed upon completion or abandonment of the construction work.
- H. Accessory buildings and uses shall conform to front and side yard setback requirements. If the accessory buildings and uses do not exceed 120 square feet or ten (10) feet in height, and they are detached and located behind the rear-most line of the main buildings, the side and rear yard setbacks may be reduced to three (3) feet.
- 10. Livestock and farm animals, subject to the provisions of Section 4.162.

Response: No accessory uses to the proposed detached single-family dwelling units are permitted at this time. It is possible that future homes may include accessory buildings, which would be reviewed at the time of building permit.

(.03) Permitted accessory uses for duplexes and attached multiple-family dwelling units: [Amended by Ord. #825, 10/15/18]

- A. Accessory uses, buildings, and structures customarily incidental to any of the aforesaid principal permitted uses, located on the same lot therewith.
- B. Home occupations.
- C. A private garage or parking area.
- D. Temporary buildings for uses incidental to construction work, which buildings shall be removed upon completion or abandonment of the construction work.
- E. Accessory buildings and uses shall conform to front and side yard setback requirements. If the accessory buildings and uses do not exceed 120 square feet or ten (10) feet in height, and they are detached and located behind the rear-most line of the main buildings, the side and rear yard setbacks may be reduced to three (3) feet.
- F. Livestock and farm animals, subject to the provisions of Section 4.162.

Response: No accessory uses to the proposed duplex dwelling units are permitted at this time. It is possible that future homes may include accessory buildings, which would be reviewed at the time of building permit.

(.05) Appropriate PDR zone based on Comprehensive Plan Density:

Comprehensive Plan Density	Zoning District
0-1 u/acre	PDR-1
2-3 u/acre	PDR-2
4-5 u/acre	PDR-3
6-7 u/acre	PDR-4
10-12 u/acre	PDR-5
16-20 u/acre	PDR-6
20 + u/acre	PDR-7

Table 1: PDR Zone based on Comprehensive Plan Density

**All dwelling unit types, except accessory dwelling units, are included for calculating density.*

[Section 4.124(.05) amended by Ordinance No. 538, 2/21/02.]

Response: The Comprehensive Plan Designation of Residential Neighborhood is implemented by the Residential Neighborhood RN zone. The RN zoning district is not included in the table above.

(.06) Block and access standards:

1. *Maximum block perimeter in new land divisions: 1,800 feet.*
2. *Maximum spacing between streets or private drives for local access: 530 feet, unless waived by the Development Review Board upon finding that barriers such as railroads, freeways, existing buildings, topographic variations, or designated Significant Resource Overlay Zone areas will prevent street extensions meeting this standard. [Amended by Ord. 682, 9/9/10]*
3. *Maximum block length without pedestrian and bicycle crossing: 330 feet, unless waived by the Development Review Board upon finding that barriers such as railroads, freeways, existing buildings, topographic variations, or designated Significant Resource Overlay Zone areas will prevent pedestrian and bicycle facility extensions meeting this standard.*

Response: The shifting of Street K approximately 45 feet southward results in a block length without a pedestrian access of 335 feet. This exceeds the standard by 5 feet (1.5%). This is mitigated by the realignment of Street K from the Master Plan alignment to correspond with the existing tree grove at its western terminus.

The block bounded by Street I, SW Willow Creek Drive, Frog Pond Lane and the extension of SW Brisband Street exceeds the both the street spacing standard of 530 feet and the pedestrian access standard of 330 feet. East-West Tract A in the center of the block provides a through-block pedestrian accessway aligned with Street K to the east. This results in a pedestrian access standard of 361 feet to the north and 437 feet to the south. This accessway has been shifted from the location shown in the Master Plan to correspond with the shift southward of Street K as described above. This continues the strong visual connection to the existing tree grove at the western terminus of Street K and takes advantage of the opportunity to connect the existing tree grove adjacent to Stafford Road to neighborhoods to the west and ultimately the Boeckman Creek corridor.

This proposed alignment will facilitate the provisions of enhanced open spaces including passive seating areas, natural resources, pedestrian corridors, and water quality features.

(.07) Signs. *Per the requirements of Sections 4.156.01 through 4.156.11. [Amended by Ord. No. 704, 6/18/12]*

Response: No signs are currently proposed with this application.

(.08) Parking. Per the requirements of Section 4.155.

Response: The standards of 4.155 are addressed in Section V.B of this narrative.

(.09) Corner Vision Clearance. Per the requirements of Section 4.177.

Response: The standards of 4.177 are addressed in Section V.I of this narrative.

E. Section 4.127. Residential Neighborhood (RN) Zone.

(.01) Purpose. *The Residential Neighborhood (RN) zone applies to lands within Residential Neighborhood Comprehensive Plan Map designation. The RN zone is a Planned Development zone, subject to applicable Planned Development regulations, except as superseded by this section or in legislative master plans. The purposes of the RN Zone are to:*

- A. *Implement the Residential Neighborhood policies and implementation measures of the Comprehensive Plan.*
- B. *Implement legislative master plans for areas within the Residential Neighborhood Comprehensive Plan Map designation.*
- C. *Create attractive and connected neighborhoods in Wilsonville.*
- D. *Regulate and coordinate development to result in cohesive neighborhoods that include: walkable and active streets; a variety of housing appropriate to each neighborhood; connected paths and open spaces; parks and other non-residential uses that are focal points for the community; and, connections to and integration with the larger Wilsonville community.*
- E. *Encourage and require quality architectural and community design as defined by the Comprehensive Plan and applicable legislative master plans.*
- F. *Provide transportation choices, including active transportation options.*
- G. *Preserve and enhance natural resources so that they are an asset to the neighborhoods, and there is visual and physical access to nature.*

Response: Per Figure 5 of the Frog Pond West Master Plan (below), the Frog Pond Ridge site is located within the RN Comprehensive Plan Map designation and is subject to these provisions and to applicable Planned Development regulations of Section 4.118.

(.02) Permitted uses:

- A. *Open Space.*
- B. *Single-Family Dwelling Unit.*
- C. *Attached Single-Family Dwelling Unit. In the Frog Pond West Neighborhood, a maximum of 2 dwelling units, not including ADU's [sic], may be attached.*
- D. *Duplex.*
- E. *Multiple-Family Dwelling Units, except when not permitted in a legislative master plan, subject to the density standards of the zone. Multi-family dwelling units are not permitted within the Frog Pond West Master Plan area.*
- F. *Cohousing.*
- G. *Cluster Housing.*
- H. *Public or private parks, playgrounds, recreational and community buildings and grounds, tennis courts, and similar recreational uses, all of a non-commercial nature, provided that any principal building or public swimming pool shall be located not less than forty-five (45) feet from any other lot.*
- I. *Manufactured homes.*

Response: As shown on Sheet P2.00, the proposed development includes Open Space and 71 single-family dwelling units: 63 detached single-family dwelling units; and 8 attached single-dwelling units (duplexes) proposed for lots 52 to 59. None of the proposed dwellings exceed 2 dwelling units, and are permitted uses in the RN zone.

(.03) Permitted accessory uses to single family dwellings:

- A. *Accessory uses, buildings and structures customarily incidental to any of the principal permitted uses listed above, and located on the same lot.*
- B. *Living quarters without kitchen facilities for persons employed on the premises or for guests. Such*

facilities shall not be rented or otherwise used as a separate dwelling unless approved as an accessory dwelling unit or duplex.

- C. Accessory Dwelling Units, subject to the standards of Section 4.113 (.11).
- D. Home occupations.
- E. A private garage or parking area.
- F. Keeping of not more than two (2) roomers or boarders by a resident family.
- G. Temporary buildings for uses incidental to construction work, which buildings shall be removed upon completion or abandonment of the construction work.
- H. Accessory buildings and uses shall conform to front and side yard setback requirements. If the accessory buildings and uses do not exceed 120 square feet or ten (10) feet in height, and they are detached and located behind the rear-most line of the main buildings, the side and rear yard setbacks may be reduced to three (3) feet.
- I. Livestock and farm animals, subject to the provisions of Section 4.162.

Response: No accessory uses are proposed at this time.

(.04) Uses permitted subject to Conditional Use Permit requirements:

- A. Public and semi-public buildings and/or structures essential to the physical and economic welfare of an area, such as fire stations, sub-stations and pump stations.
- B. Commercial Recreation, including public or private clubs, lodges or meeting halls, golf courses, driving ranges, tennis clubs, community centers and similar commercial recreational uses. Commercial Recreation will be permitted upon a finding that it is compatible with the surrounding residential uses and promotes the creation of an attractive, healthful, efficient and stable environment for living, shopping or working. All such uses except golf courses and tennis courts shall conform to the requirements of Section 4.124(.04)(D) (Neighborhood Commercial Centers).
- C. Churches; public, private and parochial schools; public libraries and public museums.
- D. Neighborhood Commercial Centers limited to the provisions of goods and services primarily for the convenience of and supported by local residents. Neighborhood Commercial Centers are only permitted where designated on an approved legislative master plan.

Response: No Conditional Uses are proposed.

(.05) Residential Neighborhood Zone Sub-districts:

- A. RN Zone sub-districts may be established to provide area-specific regulations that implement legislative master plans.
 - 1. For the Frog Pond West Neighborhood, the sub-districts are listed in Table 1 of this code and mapped on Figure 6 of the Frog Pond West Master Plan. The Frog Pond West Master Plan Sub-District Map serves as the official sub-district map for the Frog Pond West Neighborhood.

Response: The Frog Pond Ridge site is located within the Frog Pond West neighborhood, and includes properties within Sub-districts 4, 5, and 6, as shown in Figure 6 of the Frog Pond West Master Plan and in Table 1 above.

(.06) Minimum and Maximum Residential Units:

- A. The minimum and maximum number of residential units approved shall be consistent with this code and applicable provisions of an approved legislative master plan.
 - 1. For the Frog Pond West Neighborhood, Table 1 in this code and Frog Pond West Master Plan Table 1 establish the minimum and maximum number of residential units for the sub-districts.
 - 2. For parcels or areas that are a portion of a sub-district, the minimum and maximum number of residential units are established by determining the proportional gross acreage and applying that proportion to the minimums and maximums listed in Table 1. The maximum density on a parcel may be increased, up to a maximum of 10% of what would otherwise be permitted, based on an adjustment to an SROZ boundary that is consistent with 4.139.06.

Response: As shown in Table 1 above the proposed Frog Pond Ridge development includes 71 lots/dwelling units, which meets the minimum density requirements for Sub-districts 4, 5 and 6.

- B. *The City may allow a reduction in the minimum density for a sub-district when it is demonstrated that the reduction is necessary due to topography, protection of trees, wetlands and other natural resources, constraints posed by existing development, infrastructure needs, provision of non-residential uses and similar physical conditions.*

Response: No reduction to minimum density is requested. This provision is not applicable.

(.07) Development Standards Generally

- A. *Unless otherwise specified by this the regulations in this Residential Development Zone chapter, all development must comply with Section 4.113, Standards Applying to Residential Development in Any Zone.*

Response: Compliance with applicable regulations of Section 4.113 is addressed in Section IV.A of this narrative. Some regulations of 4.127 supersede the regulations of 4.113.

(.08) Lot Development Standards:

- A. *Lot development shall be consistent with this code and applicable provisions of an approved legislative master plan.*
- B. *Lot Standards Generally. For the Frog Pond West Neighborhood, Table 2 establishes the lot development standards unless superseded or supplemented by other provisions of the Development Code.*
- C. *Lot Standards for Small Lot Sub-districts. The purpose of these standards is to ensure that development in the Small Lot Sub-districts includes varied design that avoids homogenous street frontages, creates active pedestrian street frontages and has open space that is integrated into the development pattern.*
Standards. Planned developments in the Small Lot Sub-districts shall include one or more of the following elements on each block:
1. *Alleys.*
 2. *Residential main entries grouped around a common green or entry courtyard (e.g. cluster housing).*
 3. *Four or more residential main entries facing a pedestrian connection allowed by an applicable legislative master plan.*
 4. *Garages recessed at least 4 feet from the front façade or 6 feet from the front of a front porch.*

Response: Table 2 of the Frog Pond Master Plan establishes the following lot development standards for the Frog Pond West neighborhood. These standards supersede the setback standards of 4.113(.03). Lot dimensional standards are applied at the time of subdivision approval, while site development standards (setbacks, height, etc.) are applied at the time of building permit review. Sheet P2.00 illustrates the building envelopes for site and Appendix I provides examples of house plans.

As shown in Table 3 below, the proposed lots meet the relevant standards.

Table 3: Compliance with Frog Pond West Neighborhood Lot Standards

Standard	Required	Proposed	Required	Proposed	Comments
	R-7 Medium Lot		R-5 Small Lot		
Min Lot Size (Detached SF)	6,000 sf ^A	6,000-8,795 sf	4,000 sf	4,000 – 5,664 sf	Meets standards.
Min Lot Size (Duplex)	NA	NA	3,000 sf each (6,000 sf total)	4,569 sf (9,142 sf total)	Meets standards
Min Lot Depth	60 ft.	91 –130.8 ft.	60 ft	92– 101.5 ft	Meets standards.
Min Lot Width	35 ft	57-80 ft.	35 ft	40 – 56.1 ft	Meets standards

A. *May be reduced to 80% of minimum lot size where necessary to preserve natural resources (e.g. trees, wetlands) and/or provide active open space. Cluster housing may be reduced to 80% of minimum lot size. Duplexes in the R-5 Sub-District have a 6,000 SF minimum lot size.*

D. *Lot Standards Specific to the Frog Pond West Neighborhood.*

1. *Lots adjacent to Boeckman Road and Stafford Road shall meet the following standards:*
 - a. *Rear or side yards adjacent to Boeckman Road and Stafford Road shall provide a wall and landscaping consistent with the standards in Figure 10 of the Frog Pond West Master Plan.*

Response: There are three lots and one tract (Tract H) proposed adjacent to Stafford Road. As shown on Sheet L2.10, these lots include a wall and landscaping consistent with Figure 10 of the Frog Pond West Master Plan (below).



2. *Lots adjacent to the collector-designated portions of Willow Creek Drive and Frog Pond Lane shall not have driveways accessing lots from these streets, unless no practical alternative exists for access. Lots in Large Lot Sub-districts are exempt from this standard.*

Response: The site includes a portion of collector-designated Willow Creek Drive (between Brisband Street to the south and Frog Pond Lane to the north) and a portion of collector-designated Frog Pond Lane (from Stafford Road to the east and Willow Creek Drive to the west). No driveways are proposed to access this portion of Willow Creek Drive or Frog Pond Lane.

(.09) Open Space:

- A. *Purpose. The purposes of these standards for the Residential Neighborhood Zone are to:*
 1. *Provide light, air, open space, and useable recreation facilities to occupants of each residential development.*
 2. *Retain and incorporate natural resources and trees as part of developments.*
 3. *Provide access and connections to trails and adjacent open space areas.*

For Neighborhood Zones which are subject to adopted legislative master plans, the standards work in combination with, and as a supplement to, the park and open space recommendations of those legislative master plans. These standards supersede the Outdoor Recreational Area requirements in WC Section 4.113 (.01) and (.02).
- B. *Within the Frog Pond West Neighborhood, the following standards apply:*
 1. *Properties within the R-10 Large Lot Single Family sub-districts and R-7 Medium Lot Single Family sub-districts are exempt from the requirements of this section. If the Development Review Board finds, based upon substantial evidence in the record, that there is a need for open space, they may waive this exemption and require open space proportional to the need.*

Response: As shown in Figure 6 of the Frog Pond West Master Plan, the site consists of properties within the R-7 and R-5 sub-districts. The portion of the site within the R-7 sub-district is exempt from the requirements of this section.

The portion of the site within the R-5 sub-district is subject to B.2 below.

2. For properties within the R-5 Small Lot Single Family sub-districts, Open Space Area shall be provided in the following manner:

Response: As shown in Figure 6 of the Frog Pond West Master Plan, the site consists of properties within the R-5 sub-districts and that portion of the subject site is subject to the requirements of this section.

- a. Ten percent (10%) of the net developable area shall be in open space. Net developable area does not include land for non-residential uses, SROZ-regulated lands, streets and private drives, alleys and pedestrian connections. Open space must include at least 50% usable open space as defined by this Code and other like space that the Development Review Board finds will meet the purpose of this section.

Response: As shown in Table 4 below, the required open space and usable open space is provided. The open space is provided in Tract E. The usable open space consists of 8,244 sf of pedestrian pathways and seating areas within Tract E as well as 4,273 sf of lawn and seating area along SW Marigold Terr, also within Tract E. See Sheet P8.10 for details.

Table 4. Required open space

R-5 Net Developable Site Area (sf)	10% Open Space Required (sf)	Open Space Provided (sf) 24.3%	Usable Open Space Provided (sf)	Usable Open Space Provided as % of required
172,898	17,290	42,037	12,517	72%

- b. Natural resource areas such as tree groves and/or wetlands, and unfenced low impact development storm water management facilities, may be counted toward the 10% requirement at the discretion of the Development Review Board. Fenced storm water detention facilities do not count toward the open space requirement. Pedestrian connections may also be counted toward the 10% requirement.

Response: A small wetland is present in the southwestern corner of Tract E, which also contains a tree grove. A portion of the open space is located within a tree grove and pedestrian connections are provided in two locations. These pedestrian connections are located within Tract E, which provides the project's open space.

- c. The minimum land area for an individual open space is 2,000 square feet, unless the Development Review Board finds, based on substantial evidence in the record, that a smaller minimum area adequately fulfills the purpose of this Open Space standard.

Response: There is one qualifying open space tract, Tract E. This tract is 42,037 sq. ft. in area and exceeds the minimum land area.

- d. The Development Review Board may reduce or waive the usable open space requirement in accordance with Section 4.118(.03). The Board shall consider substantial evidence regarding the following factors: the walking distance to usable open space adjacent to the subject property or within 500 feet of it; the amount and type of open space available adjacent or within 500 feet of the subject property, including facilities which support creative play.

Response: No reduction to open space requirements is requested. This standard is not applicable.

- e. The Development Review Board may specify the method of assuring the long-term protection and maintenance of open space and/or recreational areas. Where such protection or maintenance are the responsibility of a private party or homeowners' association, the City Attorney shall review any pertinent bylaws, covenants or agreements prior to recordation.

Response: Open space and recreational areas will be owned and maintained by the homeowners' association. Pertinent bylaws, covenants, and agreements will be provided to the city prior to plat recordation.

(.10) Block, access and connectivity standards:

- A. *Purpose. These standards are intended to regulate and guide development to create: a cohesive and connected pattern of streets, pedestrian connections and bicycle routes; safe, direct and convenient routes to schools and other community destinations; and, neighborhoods that support active transportation and Safe Routes to Schools.*
- B. *Blocks, access and connectivity shall comply with adopted legislative master plans.*
 - 1. *Within the Frog Pond West Neighborhood, streets shall be consistent with Figure 18, Street Demonstration Plan, in the Frog Pond West Master Plan. The Street Demonstration Plan is intended to be guiding, not binding. Variations from the Street Demonstration Plan may be approved by the Development Review Board, upon finding that one or more of the following justify the variation: barriers such as existing buildings and topography; designated Significant Resource Overlay Zone areas; tree groves, wetlands or other natural resources; existing or planned parks and other active open space that will serve as pedestrian connections for the public; alignment with property lines and ownerships that result in efficient use of land while providing substantially equivalent connectivity for the public; and/or site design that provides substantially equivalent connectivity for the public.*

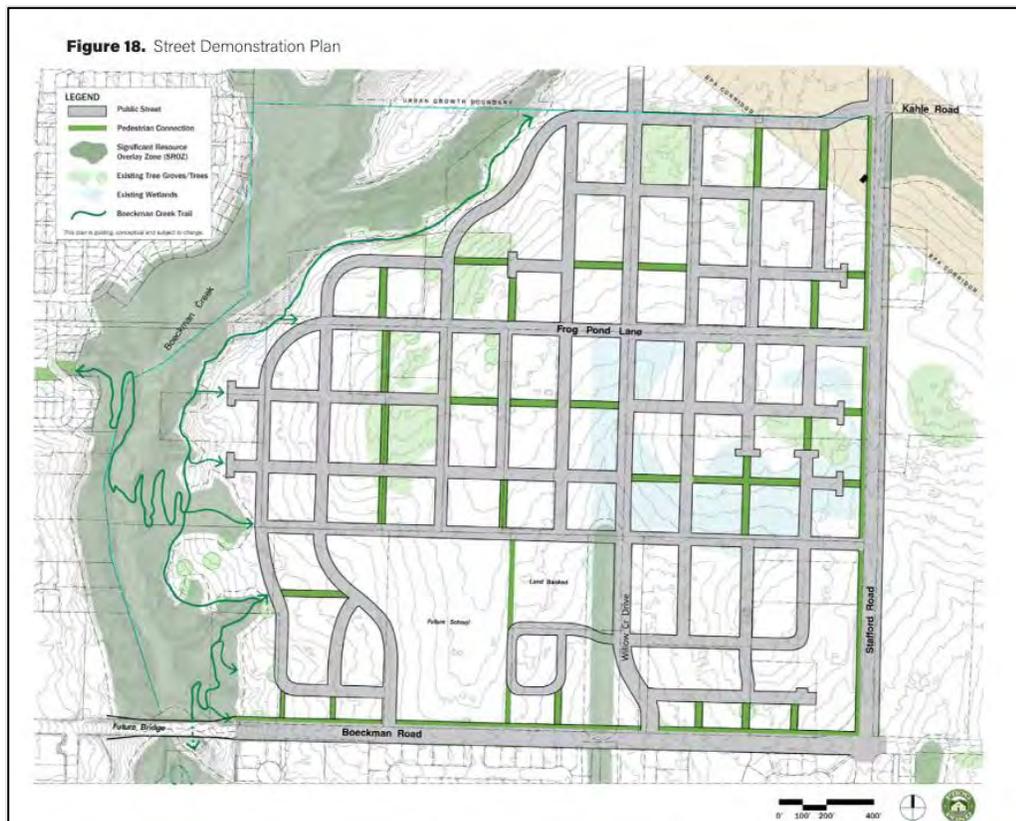
Response: This standard is a guideline pursuant to WDC Section 4.127(.10)(A). However, the City can find that the variation from the Street Demonstration Plan for the northern area of the Frog Pond Ridge planned development provides for the efficient use of land because additional pedestrian connections are unwarranted and because the proposed street and pedestrian connections provide for substantially equivalent connectivity for the public.

As shown in Figure 18, Street Demonstration Plan (below), several public street connections and one pedestrian connection are planned to and through the subject site. Generally, the street network is a modified grid, and access to this area of Frog Pond West is provided by Willow Creek Drive and Frog Pond Lane.

Sheet P8.00 illustrates the proposed blocks, access, and connectivity for Frog Pond Ridge. Willow Creek Drive extends north, intersecting Frog Pond Lane, which connects the north-south Street I, Larkspur Terr, Marigold Terr, and Street H. Proposed pedestrian accessways provide an unbroken pedestrian connection extending east-west for the full width of the site. The proposed pedestrian connection westward from Stafford Road through the existing tree grove to SW Marigold terrace, along with the proposed extension of the pedestrian connection northward through the existing tree grove from SW Alder Lane to the south (within the Stafford Meadows development) to Street H along with the proposed street extensions, provide the network of connectivity envisioned by the Master Plan.

As explained above, the City can find that the modified grid pattern subdivision plan provides an efficient street connection to Stafford Road and Frog Pond Lane and that interior streets then provide efficient pedestrian connections through pedestrian accessways, paths and the attached sidewalks. Because of the efficient grid pattern, the City can find that the proposed subdivision street plan with attached sidewalks provides for a substantially equivalent level of pedestrian connectivity. Further, the proposed street connections do not require out-of-direction pedestrian travel nor do they result in greater distances for pedestrian access to the proposed subdivision from Stafford Road and Frog Pond Lane than would otherwise be the case if the Street Demonstration Plan were adhered to.

The City can find that this standard is satisfied as if it were a mandatory approval standard.



(.011) Signs. Per the requirements of Sections 4.156.01 through 4.156.11 and applicable provisions from adopted legislative master plans.

Response: The requirements of Sections 4.156.01 through 4.156.11 are addressed in Section V.C of this narrative.

(.012) Parking. Per the requirements of Section 4.155 and applicable provisions from adopted legislative master plans.

Response: The requirements of Section 4.155 are addressed in Section V.B of this narrative. The adopted legislative master plan applicable to this site is the Frog Pond West Master Plan, which has been codified in the zoning ordinance.

(.013) Corner Vision Clearance. Per the requirements of Section 4.177.

Response: The requirements of Section 4.177 are addressed in Section V.I of this narrative.

(.014) Main Entrance Standards

A. Purpose. These standards:

1. Support a physical and visual connection between the living area of the residence and the street;
2. Enhance public safety for residents and visitors and provide opportunities for community interaction;
3. Ensure that the pedestrian entrance is visible or clearly identifiable from the street by its orientation or articulation; and
4. Ensure a connection to the public realm for development on lots fronting both private and public streets by making the pedestrian entrance visible or clearly identifiable from the public street.

B. Location. At least one main entrance for each structure must:

1. Be within 12 feet of the longest street-facing front wall of the dwelling unit; and
2. Either:
 - a. Face the street

- b. *Be at an angle of up to 45 degrees from the street; or*
- c. *Open onto a porch. The porch must:*
 - (i) *Be at least 6 feet deep*
 - (ii) *Have at least one entrance facing the street; and*
 - (iii) *Be covered with a roof or trellis*

Response: The individual dwelling designs will be reviewed at the time of building permit submittal. As shown in Appendix I, all example dwellings will include a main entrance that meets the standards of this section.

(.015) Garage Standards

A. Purpose. *These standards:*

1. *Ensure that there is a physical and visual connection between the living area of the residence and the street;*
2. *Ensure that the location and amount of the living area of the residence, as seen from the street, is more prominent than the garage;*
3. *Prevent garages from obscuring the main entrance from the street and ensure that the main entrance for pedestrians, rather than automobiles, is the prominent entrance;*
4. *Provide for a pleasant pedestrian environment by preventing garages and vehicle areas from dominating the views of the neighborhood from the sidewalk; and*
5. *Enhance public safety by preventing garages from blocking views of the street from inside the residence.*

B. Street-Facing Garage Walls

1. *Where these regulations apply. Unless exempted, the regulations of this subsection apply to garages accessory to residential units.*
2. *Exemptions:*
 - a. *Garages on flag lots.*
 - b. *Development on lots which slope up or down from the street with an average slope of 20 percent or more.*
3. *Standards.*
 - a. *The length of the garage wall facing the street may be up to 50 percent of the length of the street-facing building façade. For duplexes, this standard applies to the total length of the street-facing façades. For all other lots and structures, the standards apply to the street-facing façade of each unit. For corner lots, this standard applies to only one street side of the lot. For lots less than 50 feet wide at the front lot line, the standard in (b) below applies.*
 - b. *For lots less than 50 wide at the front lot line, the following standards apply:*
 - (i) *The width of the garage door may be up to 50 percent of the length of the street-facing façade.*
 - (ii) *The garage door must be recessed at least 4 feet from the front façade or 6 feet from the front of a front porch.*
 - (iii) *The maximum driveway width is 18 feet.*
 - a. *Where a dwelling abuts a rear or side alley or a shared driveway, the garage shall orient to the alley or shared drive.*
 - b. *Where three or more contiguous garage parking bays are proposed facing the same street, the garage opening closest to a side property line shall be recessed at least two feet behind the adjacent opening(s) to break up the street facing elevation and diminish the appearance of the garage from the street. Side-loaded garages, i.e., where the garage openings are turned away from the street, are exempt from this requirement.*
 - c. *A garage entry that faces a street may be no closer to the street than the longest street facing wall of the dwelling unit. There must be at least 20 feet between the garage door and the sidewalk. This standard does not apply to garage entries that do not face the street.*

Response: As shown on Sheet P2.00, the site design includes 3 private alleys in easements.

Private Alley Q is located in an easement and will provide access to the rear of single-family detached lots 13 to 20. As required by the Frog Pond West Master Plan, these homes will be oriented to Willow

Creek Dr and will take access from the alley; therefore, the garages will be oriented to the alley. As shown in Sheet P5.00, due to the change in grade in this portion of the site, retaining walls of 1 to 3 feet in height will be required along the rear of Lots 1 to 12, and alley access to these lots is not possible. As such, Lots 1 to 12 are oriented to and will take access from Street I. A 2-ft. non-access landscape easement is shown along the rear of these lots to prevent future dwellings from abutting Private Alley Q.

Private Alley S is located in an easement and will provide access to Lots 52 to 59.

The individual dwelling designs will be reviewed at the time of building permit submittal. As shown on the plan sheets in Appendix I, all example dwellings will include garages that meet the standards of this section.

(0.16) Residential Design Standards

A. *Purpose. These standards:*

1. *Support consistent quality standards so that each home contributes to the quality and cohesion of the larger neighborhood and community.*
2. *Support the creation of architecturally varied homes, blocks and neighborhoods, whether a neighborhood develops all at once or one lot at a time, avoiding homogeneous street frontages that detract from the community's appearance.*

B. *Applicability. These standards apply to all façades facing streets, pedestrian connections, or elsewhere as required by this Code or the Development Review Board. Exemptions from these standards include: (1) Additions or alterations adding less than 50% to the existing floor area of the structure; and, (2) Additions or alterations not facing a street.*

Response: All proposed dwelling façades will face streets or pedestrian connections and are subject to these standards.

C. *Windows. The standards for minimum percentage of façade surface area in windows are below. These standards apply only to facades facing streets and pedestrian connections.*

1. *For two-story homes:*
 - a. *15% - front facades*
 - b. *12.5% – front facades if a minimum of six (6) design elements are provided per Section 4.127 (0.15) E, Design Menu.*
 - c. *10% - front facades facing streets if a minimum of seven (7) design elements are provided per Section 4.127 (0.15) E, Design Menu.*
2. *For one-story homes:*
 - a. *12.5% - front facades*
 - b. *10 % – front facades if a minimum of six (6) design elements are provided per Section 4.127 (0.15) E, Design Menu.*
3. *For all homes: 5% for street-side facades.*
4. *Windows used to meet this standard must provide views from the building to the street. Glass block does not meet this standard. Windows in garage doors and other doors count toward this standard.*

Response: The individual dwelling designs will be reviewed at the time of building permit submittal. As shown in Appendix I, all example dwellings will include windows that meet the standards of this section.

D. *Articulation. Plans for residential buildings shall incorporate design features such as varying rooflines, offsets, balconies, projections (e.g., overhangs, porches, or similar features), recessed or covered entrances, window reveals, or similar elements that break up otherwise long, uninterrupted elevations. Such elements shall occur at a minimum interval of 30 feet on façades facing streets, pedestrian connections, or elsewhere as required by this Code or the Development Review Board. Where a façade governed by this standard is less than 30 feet in length, at least one of the above-cited features shall be provided.*

Response: The individual dwelling designs will be reviewed at the time of building permit submittal. As shown in Appendix I, all example dwellings will include articulation design features that meet the standards of this section.

- E. *Residential Design Menu. Residential structures shall provide a minimum of five (5) of the design elements listed below for front facades, unless otherwise specified by the code. For side facades facing streets or pedestrian connections, a minimum of three (3) of the design elements must be provided. Where a design features includes more than one element, it is counted as only one of the five required elements.*
1. *Dormers at least three (3) feet wide.*
 2. *Covered porch entry – minimum 48 square foot covered front porch, minimum six (6) feet deep and minimum of a six (6) foot deep cover. A covered front stoop with minimum 24 square foot area, 4 foot depth and hand rails meets this standard.*
 3. *Front porch railing around at least two (2) sides of the porch.*
 4. *Front facing second story balcony – projecting from the wall of the building a minimum of four (4) feet and enclosed by a railing or parapet wall.*
 5. *Roof overhang of 16 inches or greater.*
 6. *Columns, pillars or posts at least four (4) inches wide and containing larger base materials.*
 7. *Decorative gables – cross or diagonal bracing, shingles, trim, corbels, exposed rafter ends or brackets (does not include a garage gable if garage projects beyond dwelling unit portion of street façade).*
 8. *Decorative molding above windows and doors.*
 9. *Decorative pilaster or chimneys.*
 10. *Shakes, shingles, brick, stone or other similar decorative materials occupying at least 60 square feet of the street façade.*
 11. *Bay or bow windows – extending a minimum of 12 inches outward from the main wall of a building and forming a bay or alcove in a room within the building.*
 12. *Sidelight and/or transom windows associated with the front door or windows in the front door.*
 13. *Window grids on all façade windows (excluding any windows in the garage door or front door).*
 14. *Maximum nine (9) foot wide garage doors or a garage door designed to resemble two (2) smaller garage doors and/or windows in the garage door (only applicable to street facing garages).*
 15. *Decorative base materials such as natural stone, cultured stone or brick extending at least 36 inches above adjacent finished grade occupying a minimum of 10 % of the overall primary street facing façade.*
 16. *Entry courtyards which are visible from, and connected directly to, the street. Courtyards shall have a minimum depth of 10 feet and minimum width of 80% of the non-garage/driveway building width to be counted as a design element.*

Response: Each of the proposed detached residential structures will include at least five of the listed elements on the front-facing elevations and three of the listed elements on façades facing the pedestrian connections illustrated in Sheet P8.00 and Appendix I.

- F. *House Plan Variety. No two directly adjacent or opposite dwelling units may possess the same front or street-facing elevation. This standard is met when front or street-facing elevations differ from one another due to different materials, articulation, roof type, inclusion of a porch, fenestration, and/or number of stories. Where façades repeat on the same block face, they must have at least three intervening lots between them that meet the above standard. Small Lot developments over 10 acres shall include duplexes and/or attached 2-unit single family homes comprising 10% of the homes – corner locations are preferred.*

Response: Appendix I illustrates examples of home designs. Eight different detached dwelling types are provided, and they will not be repeated on adjacent or opposite lots along the same street frontage. This standard will be verified at the time of building permit submittal.

- G. *Prohibited Building Materials. The following construction materials may not be used as an exterior finish:*
1. *Vinyl siding.*
 2. *Wood fiber hardboard siding.*
 3. *Oriented strand board siding.*
 4. *Corrugated or ribbed metal.*
 5. *Fiberglass panels.*

Response: As shown in Appendix I, no prohibited building materials are proposed. Conformance with these standards will be verified at the time of building permit submittal.

(0.17) Fences

- A. *Within Frog Pond West, fences shall comply with standards in 4.113 (.08) except as follows:*
1. *Columns for the brick wall along Boeckman Road and Stafford Road shall be placed at lot corners where possible.*
 2. *A solid fence taller than 4 feet in height is not permitted within 8 feet of the brick wall along Boeckman Road and Stafford Road, except for fences placed on the side lot line that are perpendicular to the brick wall and end at a column of the brick wall.*
 3. *Height transitions for fences shall occur at fence posts.*

Response: As shown in Sheet P3.00, Tract H is proposed along Stafford Road. A brick wall is proposed along Tract H. See Sheet L2.10. The proposed wall design includes columns at regular intervals along Stafford Road. Columns will be placed at lot corners where they occur along the interval, but the design team believes that the column intervals should take priority over the lot corner placement due to varying zones and lot sizes along the Stafford Road frontage. No fences are proposed within 8 feet of Stafford Road; fences on adjacent lots within 8 feet of the wall will be perpendicular to the wall.

(0.18) Homes Adjacent to Schools, Parks and Public Open Spaces

- A. *Purpose. The purpose of these standards is to ensure that development adjacent to schools and parks is designed to enhance those public spaces with quality design that emphasizes active and safe use by people and is not dominated by driveways, fences, garages, and parking.*
- B. *Applicability. These standards apply to development that is adjacent to or faces schools and parks. As used here, the term adjacent includes development that is across a street or pedestrian connection from a school or park.*

Response: Lots 60-69 are adjacent to the proposed private open space to the south (Tract E). These lots are not subject to these standards. However, the applicant intends to create an attractive appearance for open space users.

- C. *Development must utilize one or more of the following design elements:*
1. *Alley loaded garage access.*
 2. *On corner lots, placement of the garage and driveway on the side street that does not face the school, park, or public open space.*
 3. *Recess of the garage a minimum of four feet from the front façade of the home. A second story above the garage, with windows, is encouraged for this option.*

Response: As noted above, the subject lots are adjacent to private, rather than public, open space. These standards are not applicable but will be considered during home plan selection.

- D. *Development must be oriented so that the fronts or sides of homes face adjacent schools or parks. Rear yards and rear fences may generally not face the schools or parks, unless approved through the waiver process of 4.118 upon a finding that there is no practicable alternative due to the size, shape or other physical constraint of the subject property.*

Response: None of the proposed lots face schools or parks. As noted above, the subject lots are adjacent to private, rather than public, open space. These standards are not applicable but will be considered during home plan selection.

F. Section 4.139. Significant Resource Overlay Zone (SROZ) Ordinance.

Section 4.139.04 Uses and Activities Exempt from These Regulations

A request for exemption shall be consistent with the submittal requirements listed under Section 4.139.06(.01)(B – I), as applicable to the exempt use and activity. [Added by Ord. # 674 11/16/09] [...]

(.08) *The construction of new roads, pedestrian or bike paths into the SROZ in order to provide access to the sensitive area or across the sensitive area, provided the location of the crossing is consistent with the intent of the Wilsonville Comprehensive Plan. Roads and paths shall be constructed so as to minimize and repair disturbance to existing vegetation and slope stability.*

[...]

(.18) *Private or public service connection laterals and service utility extensions.*

[...]

(.20) *The installation of public streets and utilities specifically mapped within a municipal utility master plan, the Transportation Systems Plan or a capital improvement plan.*

Response: The proposed road related impacts are exempt from the regulations of the SROZ Ordinance per (.08) above, which pertains to the construction of new roads or pedestrian/bike paths in the SROZ where the purpose of the crossing is to provide access to or across a sensitive area and where the location of the crossing is consistent with the intent of the City of Wilsonville Comprehensive Plan or (.20) above, which allows the installation of public streets and utilities specifically mapped with a municipal utility master plan, the Transportation System Plan, or a capital improvement plan. The intent of the proposed road work is to provide vehicular, bike, and pedestrian connectivity within the Frog Pond Ridge development, and all these roads are public roads identified in both the City's current Transportation System Plan and the Frog Pond West Master Plan. As such, the proposed crossing meets the criteria required for these exemptions.

[...]

(.22) *Any impacts to resource functions from the above excepted activities, such as gravel construction pads, erosion/sediment control materials or damaged vegetation, shall be mitigated using appropriate repair or restoration/enhancement techniques.*

Response: Impacts will be mitigated per the standards of 4.139.07 and as described in the Significant Resource Impact Report included as Appendix E.

Section 4.139.05 Significant Resource Overlay Zone Map Verification

The map verification requirements described in this Section shall be met at the time an applicant requests a building permit, grading permit, tree removal permit, land division approval, or other land use decision. Map verification shall not be used to dispute whether the mapped Significant Resource Overlay Zone boundary is a significant natural resource. Map refinements are subject to the requirements of Section 4.139.10(.01)(D).

(.01) *In order to confirm the location of the Significant Resource Overlay Zone, map verification shall be required or allowed as follows:*

- A. *Development that is proposed to be either in the Significant Resource Overlay Zone or less than 100 feet outside of the boundary of the Significant Resource Overlay Zone, as shown on the Significant Resource Overlay Zone Map.*
- B. *A lot or parcel that:*
 1. *Either contains the Significant Resource Overlay Zone, or any part of which is less than 100 feet outside the boundary of the Significant Resource Overlay Zone, as shown on the Significant Resource Overlay Zone Map; and*
 2. *Is the subject of a land use application for a partition, subdivision, or any land use application that the approval of which would authorize new development on the subject lot or parcel.*

(.02) *An application for Significant Resource Overlay Zone Map Verification may be submitted even if one is not required pursuant to Section 4.139.05(.01).*

Response: Although the land use application includes a request for a Planned Development, the City's Significant Resource Overlay Map does not include the Frog Pond West area, and map verification is not requested. A map refinement to include an accurate overlay has been requested subject to the requirements of Section 4.139.10(.01)(D). The applicable requirements are addressed in the response to that section.

(.03) *If a lot or parcel or parcel is subject to Section 4.139.05(.01), an application for Significant Resource Overlay Zone Map Verification shall be filed concurrently with the other land use applications referenced in Section 4.139.05(.01)(B)(2) unless a previously approved Significant Resource Overlay Zone Map Verification for the subject property remains valid.*

Response: Although the land use application includes a request for a Planned Development, the City's Significant Resource Overlay Map does not include the Frog Pond West area, and map verification is not

requested. A map refinement to include an accurate overlay has been requested subject to the requirements of Section 4.139.10(.01)(D). The applicable requirements are addressed in the response to that section.

(.04) *An applicant for Significant Resource Overlay Zone Map Verification shall use one or more of the following methods to verify the Significant Resource Overlay Zone boundary:*

- A. *The applicant may concur with the accuracy of the Significant Resource Overlay Zone Map of the subject property;*
- B. *The applicant may demonstrate a mapping error was made in the creation of the Significant Resource Overlay Zone Map;*
- C. *The applicant may demonstrate that the subject property was developed lawfully prior to June 7, 2001.*

Response The applicant's natural resource consultant has prepared a delineation of Willow Creek and calculated its vegetated corridor per City of Wilsonville provisions. This delineation is intended to refine the Significant Resource Overlay Zone Map per (.04)B above.

(.05) *The Planning Director shall determine the location of any Significant Resource Overlay Zone on the subject property by considering information submitted by the applicant, information collected during any site visit that may be made to the subject property, information generated by Significant Resource Overlay Zone Map Verification that has occurred on adjacent properties, and any other relevant information that has been provided.*

(.06) *For applications filed pursuant to Section 4.139.05(.04)(A) and (C), a Significant Resource Overlay Zone Map Verification shall be consistent with the submittal requirements listed under Section 4.139.06(.01)(B-H).*

(.07) *For applications filed pursuant to Section 4.139.05(.04)(B), a Significant Resource Overlay Zone Map Verification shall be consistent with the submittal requirements listed under Section 4.139.06(.02)(D)(1). [Section 4.139.05 added by Ord. # 674 11/16/09]*

Response: The application has been filed pursuant to Section 4.139.05(.04)(B) and is subject to the submittal requirements listed under Section 4.139.06(.02)(D)(1). The requirements are addressed in the response to that section below.

Section 4.139.06 Significant Resource Impact Report (SRIR) and Review Criteria

(.01) *Abbreviated SRIR Requirements. It is the intent of this subsection to provide a user-friendly process for the applicant. Only the materials necessary for the application review are required. At the discretion of the Planning Director, an abbreviated SRIR may be submitted for certain small-scale developments such as single family dwellings, additions to single family dwellings, minor additions and accessory structures. The following requirements shall be prepared and submitted as part of the abbreviated SRIR evaluation:*

- A. *A Site Development Permit Application must be submitted in compliance with the Planning and Land Development Ordinance;*
- B. *Outline of any existing features including, but not limited to, structures, decks, areas previously disturbed and existing utility locations*;*
- C. *Location of any wetlands or water bodies on the site and the location of the stream centerline and top-of-bank;*
- D. *Within the area proposed to be disturbed, the location, size and species of all trees that are more than six (6) inches in diameter at breast height (DBH). Trees outside the area proposed to be disturbed may be individually shown or shown as drip line with an indication of species type or types;*
- E. *The location of the SROZ and Impact Area boundaries*;*
- F. *A minimum of three slope cross-section measurements transecting the site, equally spaced at no more than 100-foot increments. The measurements should be made perpendicular to the stream*;*
- G. *A map that delineates the Metro UGMFP Title 3 Water Quality Resource Area boundary (using Metro Title 3 field observed standards)*;*
- H. *Current photos of site conditions shall be provided to supplement the above information*.*
- I. *A narrative describing the possible and probable impacts to natural resources and a plan to mitigate for such impacts.*

Response: City staff have indicated that an abbreviated SRIR is appropriate for this development. The Significant Resource Impact Report (SRIR) is included as Appendix E and contains all required information.

(.02) Application Requirements for a Standard SRIR. The following requirements must be prepared and submitted as part of the SRIR evaluation for any development not included in paragraph A above: [...]

Response: The applicant is subject to an abbreviated SRIR. These requirements are not applicable.

(.03) SRIR Review Criteria. In addition to the normal Site Development Permit Application requirements as stated in the Planning and Land Development Ordinance, the following standards shall apply to the issuance of permits requiring an SRIR. The SRIR must demonstrate how these standards are met in a manner that meets the purposes of this Section.

A. Except as specifically authorized by this code, development shall be permitted only within the Area of Limited Conflicting Use (see definition) found within the SROZ;

Response: Section 4.139.06.03 only applies to SROZ associated with Willow Creek. Impacts to the SROZ can be considered exempt per Section 4.139.04.08, which allows exemption from submittal requirements because the SROZ impacts are associated with the construction of a new road necessary to cross the SROZ. According to the City's Frog Pond Area Plan Transportation Framework, SW Brisband Street is mapped as a local framework street. Willow Creek flows southerly within the alignment, making avoidance impracticable. Per the Frog Pond West Master Plan, local streets are required to have a minimum 52-foot-wide right-of-way build out consisting of two travel lanes, sidewalks and planter strips. SROZ impacts associated with the SW Brisband Street crossing have been minimized by utilizing curb tight sidewalk, reducing the full right-of-way build out width from 52 feet to 42 feet. The right-of-way remains 52 ft. wide.

B. Except as specifically authorized by this code, no development is permitted within Metro's Urban Growth Management Functional Plan Title 3 Water Quality Resource Areas boundary;

Response: Wetlands and Willow Creek on the project site are not mapped as Title 3 Water Quality Resources.

C. No more than five (5) percent of the Area of Limited Conflicting Use (see definition) located on a property may be impacted by a development proposal. On properties that are large enough to include Areas of Limited Conflicting Use on both sides of a waterway, no more than five (5) percent of the Area of Limited Conflicting Use on each side of the riparian corridor may be impacted by a development proposal. This condition is cumulative to any successive development proposals on the subject property such that the total impact on the property shall not exceed five (5) percent;

Response: The SROZ riparian corridor on the project site meets the City's Type NR-4 Riparian Corridor (stream-riparian ecosystem) which does not have an Area of Limited Conflicting Use. Therefore, this requirement is not applicable.

D. Mitigation of the area to be impacted shall be consistent with Section 4.139.06 of this code and shall occur in accordance with the provisions of this Section;

Response: Locally non-significant wetland impacts will be mitigated through the purchase of wetland mitigation bank credits from the DSL and USACE approved Mud Slough Bank. Unavoidable SROZ impacts associated with the required SW Brisband Street extension will be offset through enhancement of on-site buffer adjacent to remaining locally non-significant wetland in Tract B. The existing condition of the wetland buffer consists of non-native grasses, lacking woody vegetation. Since wetland in Tract B discharges directly into Willow Creek, the installation of native trees and shrubs will provide a net functional benefit to downstream portions of Willow Creek. Proposed SROZ mitigation is consistent with provisions of Section 4.139.

E. *The impact on the Significant Resource is minimized by limiting the degree or magnitude of the action, by using appropriate technology or by taking affirmative steps to avoid, reduce or mitigate impacts;*

Response: Impacts to the SROZ have been minimized by reducing the ROW build out width from the required 52 feet to 42 feet of improved ROW.

F. *The impacts to the Significant Resources will be rectified by restoring, rehabilitating, or creating enhanced resource values within the “replacement area” (see definitions) on the site or, where mitigation is not practical on-site, mitigation may occur in another location approved by the City;*

Response: The unavoidable permanent vegetated corridor impacts associated with the SW Brisband Street crossing will be mitigated on-site by enhancing remaining wetland buffer in Tract B with native trees and shrubs. The native tree and shrub plantings will be consistent with plant quantities, spacing and diversity standards listed under Section 4.139.07.02.E.1.b of City's SROZ ordinance.

G. *Non-structural fill used within the SROZ area shall primarily consist of natural materials similar to the soil types found on the site;*

Response: No fill will be placed in Willow Creek. Most of the fill within SROZ vegetated corridor will consist of structural fill to facilitate development of SW Brisband Street. Non-structural fill material within SROZ will consist of native upland soils from the site.

H. *The amount of fill used shall be the minimum required to practically achieve the project purpose;*

Response: The amount of fill within SROZ is the minimum necessary to construct SW Brisband Street.

I. *Other than measures taken to minimize turbidity during construction, stream turbidity shall not be significantly increased by any proposed development or alteration of the site;*

Response: Erosion control measures consistent with DEQ's 1200C and 401 Water Quality Certification standards will be implemented throughout the duration of construction to avoid the potential for sedimentation and turbidity within Willow Creek.

J. *Appropriate federal and state permits shall be obtained prior to the initiation of any activities regulated by the U.S. Army Corps of Engineers and the Oregon Division of State Lands in any jurisdictional wetlands or water of the United States or State of Oregon, respectively.*

Response: The applicant will obtain DSL and USACE permits as necessary prior to impacts within jurisdictional wetlands and waters on the project site. The Joint Permit Application (JPA) will be submitted to DSL and the USACE January 2020.

Section 4.139.07 Mitigation Standards

The following mitigation standards apply to significant wildlife habitat resource areas for encroachments within the Area of Limited Conflicting Uses, and shall be followed by those proposing such encroachments. Wetland mitigation shall be conducted as per permit conditions from the US Army Corps of Engineers and Oregon Division of State Lands. While impacts are generally not allowed in the riparian corridor resource area, permitted impacts shall be mitigated by: using these mitigation standards if the impacts are to wildlife habitat values; and using state and federal processes if the impacts are to wetland resources in the riparian corridor. Mitigation is not required for trees lost to a natural event such as wind or floods.[...]

Response: Since the SROZ impacts are considered exempt, only the criteria of 4.139.06.01.B-I are required to be addressed. These standards are not applicable.

Section 4.139.11 Special Provisions

(.01) Reduced front, rear and side yard setback. *Applications on properties containing the SROZ may reduce the front, rear and side yard setback for developments or additions to protect the significant*

resource, as approved by the Development Review Board.

(.02) Density Transfer. For residential development proposals on lands which contain the SROZ, a transfer of density shall be permitted within the development proposal site. The following formula shall be used to calculate the density that shall be permitted for allowed residential use on the property:

- A. Step 1. Calculate Expected Maximum Density. The Expected Maximum Density (EMD) is calculated by multiplying the acreage of the property by the maximum density permitted in the Wilsonville Comprehensive Plan.
- B. Step 2. The density that shall be permitted on the property shall be equal to the EMD obtained in Step 1, provided:
 1. The density credit can only be transferred to that portion of the development site that is not located within the designated Significant Resource; and
 2. 50% of the maximum number of dwelling units that are within the SROZ are allowed to be transferred to the buildable portion of the proposed development site provided that the standards for outdoor living area, landscaping, building height and parking shall still be met. Applicants proposing a density transfer must demonstrate compatibility between adjacent properties as well as satisfy the setback requirements of the zone in which the development is proposed or meet Section 4.139.10 A. above; and
 3. The types of residential uses and other applicable standards permitted in the zone shall remain the same; and
 4. Land area within the Significant Resource Overlay Zone may be used to satisfy the requirements for outdoor recreation/open space area consistent with the provisions found in Section 4.113 of the Planning and Land Development Ordinance.

Response: No setback reductions or density transfers are proposed per these special provisions.

(.03) Alteration of constructed drainageways. Alteration of constructed drainageways may be allowed provided that such alterations do not adversely impact stream flows, flood storage capacity and in stream water quality and provide more efficient use of the land as well as provide improved habitat value through mitigation, enhancement and/or restoration. Such alterations must be evaluated through an SRIR and approved by the City Engineer and Development Review Board.

Response: No alteration of constructed drainageways is proposed.

G. Section 4.140. Planned Development Regulations.

(.01) Purpose .

- A. The provisions of Section 4.140 shall be known as the Planned Development Regulations. The purposes of these regulations are to encourage the development of tracts of land sufficiently large to allow for comprehensive master planning, and to provide flexibility in the application of certain regulations in a manner consistent with the intent of the Comprehensive Plan and general provisions of the zoning regulations and to encourage a harmonious variety of uses through mixed use design within specific developments thereby promoting the economy of shared public services and facilities and a variety of complimentary activities consistent with the land use designation on the Comprehensive Plan and the creation of an attractive, healthful, efficient and stable environment for living, shopping or working.
- B. It is the further purpose of the following Section:
 1. To take advantage of advances in technology, architectural design, and functional land use design;
 2. To recognize the problems of population density, distribution and circulation and to allow a deviation from rigid established patterns of land uses, but controlled by defined policies and objectives detailed in the comprehensive plan;
 3. To produce a comprehensive development equal to or better than that resulting from traditional lot land use development.
 4. To permit flexibility of design in the placement and uses of buildings and open spaces, circulation facilities and off-street parking areas, and to more efficiently utilize potentials of sites characterized by special features of geography, topography, size or shape or characterized by problems of flood hazard, severe soil limitations, or other hazards;

5. *To permit flexibility in the height of buildings while maintaining a ratio of site area to dwelling units that is consistent with the densities established by the Comprehensive Plan and the intent of the Plan to provide open space, outdoor living area and buffering of low-density development.*
6. *To allow development only where necessary and adequate services and facilities are available or provisions have been made to provide these services and facilities.*
7. *To permit mixed uses where it can clearly be demonstrated to be of benefit to the users and can be shown to be consistent with the intent of the Comprehensive Plan.*
8. *To allow flexibility and innovation in adapting to changes in the economic and technological climate.*

Response: The applicant requests a waiver to the minimum front yard requirement for Lots 19, 20, and 21. The Frog Pond West Master Plan, a chapter of the Comprehensive Plan, identifies an area that is sufficiently large to allow for master planning of the Frog Pond West area. The Frog Pond West Master Plan identifies the location of infrastructure including arterial and collector roads, utilities, parks, and schools.

As part of the Frog Pond Meadows development, the Willow Creek Dr alignment was revised to retain a 34-in. Oregon white oak determined by the arborist to be in "excellent" condition. In order to allow a 22-ft. protection zone around the tree's roots, it is necessary to reduce the size of the adjacent lots to provide the required space for the street improvements.

The waivers are requested in order to allow Willow Creek Dr to shift to the west in order to avoid the tree protection zone of the white oak. The waivers would meet the purpose of the Planned Development Zones by providing flexibility and allowing a site design that is able to respond to site characteristics.

(.02) Lot Qualification.

- A. *Planned Development may be established on lots which are suitable for and of a size to be planned and developed in a manner consistent with the purposes and objectives of Section 4.140.*
- B. *Any site designated for development in the Comprehensive Plan may be developed as a Planned Development, provided that it is zoned "PD." All sites which are greater than two (2) acres in size, and designated in the Comprehensive Plan for commercial, residential, or industrial use shall be developed as Planned Developments, unless approved for other uses permitted by the Development Code. Smaller sites may also be developed through the City's PD procedures, provided that the location, size, lot configuration, topography, open space and natural vegetation of the site warrant such development.*

Response: The subject site is 16.25 acres in area and is designated in the Comprehensive Plan for residential use. The proposed development will be developed as a residential Planned Development per the provisions of this section.

(.03) Ownership.

- A. *The tract or tracts of land included in a proposed Planned Development must be in one (1) ownership or control or the subject of a joint application by the owners of all the property included. The holder of a written option to purchase, with written authorization by the owner to make applications, shall be deemed the owner of such land for the purposes of Section 4.140.*
- B. *Unless otherwise provided as a condition for approval of a Planned Development permit, the permittee may divide and transfer units or parcels of any development. The transferee shall use and maintain each such unit or parcel in strict conformance with the approval permit and development plan.*

Response: The properties included in the proposed PD are owned by separate ownerships. The ownerships have submitted a joint application for the proposal.

(.04) Professional Design.

- A. *The applicant for all proposed Planned Developments shall certify that the professional services of the appropriate professionals have been utilized in the planning process for development.*
- B. *Appropriate professionals shall include, but not be limited to the following to provide the elements of the planning process set out in Section 4.139:*

1. *An architect licensed by the State of Oregon;*
 2. *A landscape architect registered by the State of Oregon;*
 3. *An urban planner holding full membership in the American Institute of Certified Planners, or a professional planner with prior experience representing clients before the Development Review Board, Planning Commission, or City Council; or*
 4. *A registered engineer or a land surveyor licensed by the State of Oregon.*
- C. *One of the professional consultants chosen by the applicant from either 1, 2, or 3, above, shall be designated to be responsible for conferring with the planning staff with respect to the concept and details of the plan.*
- D. *The selection of the professional coordinator of the design team will not limit the owner or the developer in consulting with the planning staff.*

Response: The development team includes Mike Peebles, PE; Keith Buisman, PE; Rose Horton, PE; Steve Dixon, PLA; Gabriel Kruse, PLA; and Li Alligood, AICP. Li Alligood has been designated as the applicant's representative and party responsible for conferring with the planning staff.

(.05) *Planned Development Permit Process.*

- A. *All parcels of land exceeding two (2) acres in size that are to be used for residential, commercial or industrial development, shall, prior to the issuance of any building permit:*
1. *Be zoned for planned development;*
 2. *Obtain a planned development permit; and*
 3. *Obtain Development Review Board, or, on appeal, City Council approval.*

Response: The subject site exceeds 2 acres in size and is proposed for residential development. This application includes a zoning map amendment to apply the RN zone to the site; Planned Development Stage I application; and Planning Development Stage II application.

- B. *Zone change and amendment to the zoning map are governed by the applicable provisions of the Zoning Sections, inclusive of Section 4.197.*

Response: The requested zoning map amendment is subject to the applicable provisions of the Zoning Sections and 4.197. These provisions are addressed in Sections IV and V of this narrative.

- C. *Development Review Board approval is governed by Sections 4.400 to 4.450*
- D. *All planned developments require a planned development permit. The planned development permit review and approval process consists of the following multiple stages, the last two or three of which can be combined at the request of the applicant:*
1. *Pre-application conference with Planning Department;*
 2. *Preliminary (Stage I) review by the Development Review Board. When a zone change is necessary, application for such change shall be made simultaneously with an application for preliminary approval to the Board; and*
 3. *Final (Stage II) review by the Development Review Board*
 4. *In the case of a zone change and zone boundary amendment, City Council approval is required to authorize a Stage I preliminary plan.*

Response: A pre-application conference was held with the Planning Department on November 14, 2019. Concurrent zoning map amendment, Stage I, and Stage II applications (and a number of additional concurrent applications) have been submitted for review by the DRB.

[...]

(.07) *Preliminary Approval (Stage One):*

- A. *Applications for preliminary approval for planned developments shall:*
1. *Be made by the owner of all affected property or the owner's authorized agent; and*
 2. *Be filed on a form prescribed by the City Planning Department and filed with said Department.*
 3. *Set forth the professional coordinator and professional design team as provided in subsection (.04), above.*
 4. *State whether the development will include mixed land uses, and if so, what uses and in what proportions and locations.*

Response: This submittal includes all the above information.

B. The application shall include conceptual and quantitatively accurate representations of the entire development sufficient to judge the scope, size, and impact of the development on the community; and, in addition to the requirements set forth in Section 4.035, shall be accompanied by the following information:

- 1. A boundary survey or a certified boundary description by a registered engineer or licensed surveyor.*
- 2. Topographic information as set forth in Section 4.035*
- 3. A tabulation of the land area to be devoted to various uses, and a calculation of the average residential density per net acre.*
- 4. A stage development schedule demonstrating that the developer intends receive Stage II approval within two (2) years of receiving Stage I approval, and to commence construction within two (2) years after the approval of the final development plan, and will proceed diligently to completion; unless a phased development schedule has been approved; in which case adherence to that schedule shall be considered to constitute diligent pursuit of project completion.*
- 5. A commitment by the applicant to provide in the Final Approval (Stage II) a performance bond or other acceptable security for the capital improvements required by the project.*
- 6. If it is proposed that the final development plan will be executed in stages, a schedule thereof shall be provided.*
- 7. Statement of anticipated waivers from any of the applicable site development standards.*

Response: A boundary survey including topographic information is included as Sheet P1.10. A tabulation of land area and residential density is included in Table 1 within this narrative. Stage I and Stage II approvals are being requested concurrently, and a stage development schedule is not proposed. The applicant is requesting waivers to some setback requirements, which are described elsewhere in this narrative.

(.09) Final Approval (Stage Two):

[Note: Outline Number is incorrect.]

A. Unless an extension has been granted by the Development Review Board, within two (2) years after the approval or modified approval of a preliminary development plan (Stage I), the applicant shall file with the City Planning Department a final plan for the entire development or when submission in stages has been authorized pursuant to Section 4.035 for the first unit of the development, a public hearing shall be held on each such application as provided in Section 4.013.

Response: A Stage II application has been submitted concurrent with the Stage I application.

B. After such hearing, the Development Review Board shall determine whether the proposal conforms to the permit criteria set forth in this Code, and shall approve, conditionally approve, or disapprove the application.

C. The final plan shall conform in all major respects with the approved preliminary development plan, and shall include all information included in the preliminary plan plus the following:

- 1. The location of water, sewerage and drainage facilities;*
- 2. Preliminary building and landscaping plans and elevations, sufficient to indicate the general character of the development;*
- 3. The general type and location of signs;*
- 4. Topographic information as set forth in Section 4.035;*
- 5. A map indicating the types and locations of all proposed uses; and*
- 6. A grading plan.*

Response: A Preliminary Utility Plan is included as Sheet P4.00. Preliminary building elevations are included as Appendix I. Preliminary landscaping plans are included as Sheets L2.10, 2.20, and 2.30. A Preliminary Grading Plan is included as Sheet P5.00. Sign locations and permits will be provided under separate application.

D. *The final plan shall be sufficiently detailed to indicate fully the ultimate operation and appearance of the development or phase of development. However, Site Design Review is a separate and more detailed review of proposed design features, subject to the standards of Section 4.400.*

Response: A concurrent Site Design Review application has been submitted. Section 4.400 Site Design Review criteria are addressed in Section VIII of this narrative.

E. *Copies of legal documents required by the Development Review Board for dedication or reservation of public facilities, or for the creation of a non-profit homeowner's association, shall also be submitted.*

Response: The recorded Declaration of Protective Covenants, Conditions, Restrictions and Easements for Stafford Meadows is included as Appendix H. Frog Pond Ridge will be annexed into the existing Homeowners Association (HOA).

[...]

J. *A planned development permit may be granted by the Development Review Board only if it is found that the development conforms to all the following criteria, as well as to the Planned Development Regulations in Section 4.140:*

1. *The location, design, size and uses, both separately and as a whole, are consistent with the Comprehensive Plan, and with any other applicable plan, development map or Ordinance adopted by the City Council.*

Response: The site is located within the Frog Pond West neighborhood of the Frog Pond planning area. The Frog Pond West Master Plan has been incorporated into the Comprehensive Plan and designates the site for single-family residential development. Consistency with the Comprehensive Plan is addressed in Section III of this narrative. The RN zone is identified as the implementing zone for the Residential Neighborhood RN Comprehensive Plan designation; this zone requires that all development within it be approved as a Planned Development.

2. *That the location, design, size and uses are such that traffic generated by the development at the most probable used intersection(s) can be accommodated safely and without congestion in excess of Level of Service D, as defined in the Highway Capacity Manual published by the National Highway Research Board, on existing or immediately planned arterial or collector streets and will, in the case of commercial or industrial developments, avoid traversing local streets. Immediately planned arterial and collector streets are those listed in the City's adopted Capital Improvement Program, for which funding has been approved or committed, and that are scheduled for completion within two years of occupancy of the development or four year if they are an associated crossing, interchange, or approach street improvement to Interstate 5.*

a. *In determining levels of Service D, the City shall hire a traffic engineer at the applicant's expense who shall prepare a written report containing the following minimum information for consideration by the Development Review Board:*

i. *An estimate of the amount of traffic generated by the proposed development, the likely routes of travel of the estimated generated traffic, and the source(s) of information of the estimate of the traffic generated and the likely routes of travel; [Added by Ord. 561, adopted 12/15/03.]*

ii. *What impact the estimate generated traffic will have on existing level of service including traffic generated by (1) the development itself, (2) all existing developments, (3) Stage II developments approved but not yet built, and (4) all developments that have vested traffic generation rights under section 4.140(.10), through the most probable used intersection(s), including state and county intersections, at the time of peak level of traffic. This analysis shall be conducted for each direction of travel if backup from other intersections will interfere with intersection operations. [Amended by Ord 561, adopted 12/15/03.]*

b. *The following are exempt from meeting the Level of Service D criteria standard:*

i. *A planned development or expansion thereof which generates three (3) new p.m. peak hour traffic trips or less;*

ii. *A planned development or expansion thereof which provides an essential governmental service.*

- c. *Traffic generated by development exempted under this subsection on or after Ordinance No. 463 was enacted shall not be counted in determining levels of service for any future applicant. [Added by Ord 561, adopted 12/15/03.]*
- d. *Exemptions under 'b' of this subsection shall not exempt the development or expansion from payment of system development charges or other applicable regulations. [Added by Ord 561, adopted 12/15/03.]*
- e. *In no case will development be permitted that creates an aggregate level of traffic at LOS "F". ([Added by Ord 561, adopted 12/15/03.]*

Response: DKS Associates has conducted a Traffic Impact Study (TIS) to evaluate traffic impacts from the proposed development. The TIS is included as Appendix C and addresses the provisions above.

- 3. *That the location, design, size and uses are such that the residents or establishments to be accommodated will be adequately served by existing or immediately planned facilities and services.*

Response: The proposal will construct transportation infrastructure with site development and will dedicate 12 ft. of public right-of-way to Stafford Road for future widening and improvement. The site will be adequately served.

[...]

(.10) Early Vesting of Traffic Generation. [...]

Response: No early vesting of traffic generation is requested. This standard is not applicable.

V. General Development Regulations

A. Section 4.154. On-site Pedestrian Access and Circulation.

(.01) On-site Pedestrian Access and Circulation

- A. *The purpose of this section is to implement the pedestrian access and connectivity policies of the Transportation System Plan. It is intended to provide for safe, reasonably direct, and convenient pedestrian access and circulation.*
- B. *Standards. Development shall conform to all of the following standards:*
 - 1. *Continuous Pathway System. A pedestrian pathway system shall extend throughout the development site and connect to adjacent sidewalks, and to all future phases of the development, as applicable.*
 - 2. *Safe, Direct, and Convenient. Pathways within developments shall provide safe, reasonably direct, and convenient connections between primary building entrances and all adjacent parking areas, recreational areas/playgrounds, and public rights-of-way and crosswalks based on all of the following criteria:*
 - a. *Pedestrian pathways are designed primarily for pedestrian safety and convenience, meaning they are free from hazards and provide a reasonably smooth and consistent surface.*
 - b. *The pathway is reasonably direct. A pathway is reasonably direct when it follows a route between destinations that does not involve a significant amount of unnecessary out-of-direction travel.*
 - c. *The pathway connects to all primary building entrances and is consistent with the Americans with Disabilities Act (ADA) requirements.*
 - d. *All parking lots larger than three acres in size shall provide an internal bicycle and pedestrian pathway pursuant to Section 4.155(.03)(B.)(3.)(d.).*

Response: The site is a single-family residential development and includes a network of public sidewalks. In addition to the sidewalk system, pedestrian/bicycle connections are proposed through Tract E and through the block bounded by Willow Creek Drive and Street I (Tract A).

- 3. *Vehicle/Pathway Separation. Except as required for crosswalks, per subsection 4, below, where a pathway abuts a driveway or street it shall be vertically or horizontally separated from the*

vehicular lane. For example, a pathway may be vertically raised six inches above the abutting travel lane, or horizontally separated by a row of bollards.

Response: All proposed pathways will be separated from streets. Tract A will use contrasting paving materials where it crosses Private Alley Q to delineate pedestrian crossing. This standard is met.

4. *Crosswalks. Where a pathway crosses a parking area or driveway, it shall be clearly marked with contrasting paint or paving materials (e.g., pavers, light-color concrete inlay between asphalt, or similar contrast).*

Response: The proposed pathways do not cross a parking area or driveway. Tract A does cross Private Alley Q and the crossing will be clearly marked with contrasting paving materials. This standard is met.

5. *Pathway Width and Surface. Primary pathways shall be constructed of concrete, asphalt, brick/masonry pavers, or other durable surface, and not less than five (5) feet wide. Secondary pathways and pedestrian trails may have an alternative surface except as otherwise required by the ADA.*

Response: The proposed pedestrian pathways will be constructed of concrete, asphalt, brick/masonry pavers, or other durable surface, and will be at least 5 ft. wide. This standard is met.

6. *All pathways shall be clearly marked with appropriate standard signs.*
[Added by Ord. #719, 6/17/13]

Response: The pedestrian pathways will be signed as required.

B. Section 4.155. General Regulations - Parking, Loading and Bicycle Parking.

[...]

(.03) Minimum and Maximum Off-Street Parking Requirements:

- A. *Parking and loading or delivery areas shall be designed with access and maneuvering area adequate to serve the functional needs of the site and shall:*
 1. *Separate loading and delivery areas and circulation from customer and/or employee parking and pedestrian areas. Circulation patterns shall be clearly marked.*
 2. *To the greatest extent possible, separate vehicle and pedestrian traffic.*
- B. *Parking and loading or delivery areas shall be landscaped to minimize the visual dominance of the parking or loading area, as follows: [...]*

Response: There is no off-street loading required or proposed for the proposed single-family development. These provisions are not applicable.

- C. *Off Street Parking shall be designed for safe and convenient access that meets ADA and ODOT standards. All parking areas which contain ten (10) or more parking spaces, shall for every fifty (50) standard spaces., provide one ADA-accessible parking space that is constructed to building code standards, Wilsonville Code 9.000.*
- D. *Where possible, parking areas shall be designed to connect with parking areas on adjacent sites so as to eliminate the necessity for any mode of travel of utilizing the public street for multiple accesses or cross movements. In addition, on-site parking shall be designed for efficient on-site circulation and parking.*
- E. *In all multi-family dwelling developments, there shall be sufficient areas established to provide for parking and storage of motorcycles, mopeds and bicycles. Such areas shall be clearly defined and reserved for the exclusive use of these vehicles.*
- F. *On-street parking spaces, directly adjoining the frontage of and on the same side of the street as the subject property, may be counted towards meeting the minimum off-street parking standards.*

Response: There are no parking areas required or proposed for the proposed single-family development. The required parking is being provided on-site and on-street parking spaces are not requested to count toward the minimum standards.

G. *Tables 5 shall be used to determine the minimum and maximum parking standards for various land uses. The minimum number of required parking spaces shown on Tables 5 shall be determined by rounding to the nearest whole parking space. For example, a use containing 500 square feet, in an area where the standard is one space for each 400 square feet of floor area, is required to provide one off-street parking space. If the same use contained more than 600 square feet, a second parking space would be required. Structured parking and on-street parking are exempted from the parking maximums in Table 5. [Amended by Ordinance No. 538, 2/21/02.]*

Response: Table 5 requires that single units provide one parking space per dwelling unit. There is no maximum number listed. Each single-family dwelling unit will be provided with at least two parking spaces within garages. This standard is met.

H. *Electrical Vehicle Charging Stations:*

1. *Parking spaces designed to accommodate and provide one or more electric vehicle charging stations on site may be counted towards meeting the minimum off-street parking standards.*
2. *Modification of existing parking spaces to accommodate electric vehicle charging stations on site is allowed outright.*

Response: No electrical vehicle charging stations are proposed at this time.

I. *Motorcycle parking:*

1. *Motorcycle parking may substitute for up to 5 spaces or 5 percent of required automobile parking, whichever is less. For every 4 motorcycle parking spaces provided, the automobile parking requirement is reduced by one space.*
2. *Each motorcycle space must be at least 4 feet wide and 8 feet deep. Existing parking may be converted to take advantage of this provision.*

[Amended by Ord. #719, 6/17/13]

Response: No motorcycle parking is proposed.

(.04) Bicycle Parking:

A. *Required Bicycle Parking - General Provisions.*

1. *The required minimum number of bicycle parking spaces for each use category is shown in Table 5, Parking Standards.[...]*

Response: Table 5 states that there is no minimum bicycle parking requirement for detached or attached single-family homes. These provisions are not applicable.

(.05) Minimum Off-Street Loading Requirements: [...]

Response: There is no off-street loading requirement for single-family homes. These provisions are not applicable.

(.06) Carpool and Vanpool Parking Requirements: [...]

Response: There is no carpool or vanpool parking requirement for single-family homes. These provisions are not applicable.

C. Section 4.156. Sign Code Regulations.

Section 4.156.07. Sign Regulations In Residential Zones.

[...]

Response: No signs are proposed at this time. Future signs will be subject to these regulations.

D. Section 4.167. General Regulations - Access, Ingress and Egress.

(.01) Each access onto streets or private drives shall be at defined points as approved by the City and shall be consistent with the public's health, safety and general welfare. Such defined points of access shall be approved at the time of issuance of a building permit if not previously determined in the development permit. [Amended by Ord. 682, 9/9/10]

Response: Proposed driveway access onto streets and private drives is shown in Sheet P2.00.

E. Section 4.169. General Regulations – Double-Frontage Lots.

(.01) Buildings on double frontage lots (i.e., through lots) and corner lots must meet the front yard setback for principal buildings on both streets or tracts with a private drive. [Amended by Ord. 682, 9/9/10]

(.02) Given that double-frontage lots tend to have one end that is regarded as a rear yard by the owner, the Development Review Board may establish special maintenance conditions to apply to such areas. Such conditions may include the requirement that the subject homeowners association, if any, be responsible for the on-going maintenance of the street frontage areas of double-frontage lots.

Response: Four double-frontage lots are proposed. Lots 28-31 have frontage on Frog Pond Lane to the north and Street M to the south. The buildings on these lots will be subject to front yard setbacks on both streets at the time of building permit.

F. Section 4.171. General Regulations - Protection of Natural Features and Other Resources.

(.02) General Terrain Preparation:

- A. All developments shall be planned, designed, constructed and maintained with maximum regard to natural terrain features and topography, especially hillside areas, floodplains, and other significant landforms.
- B. All grading, filling and excavating done in connection with any development shall be in accordance with the Uniform Building Code
- C. In addition to any permits required under the Uniform Building Code, all developments shall be planned, designed, constructed and maintained so as to:
 1. Limit the extent of disturbance of soils and site by grading, excavation and other land alterations.
 2. Avoid substantial probabilities of: (1) accelerated erosion; (2) pollution, contamination, or siltation of lakes, rivers, streams and wetlands; (3) damage to vegetation; (4) injury to wildlife and fish habitats.
 3. Minimize the removal of trees and other native vegetation that stabilize hillsides, retain moisture, reduce erosion, siltation and nutrient runoff, and preserve the natural scenic character.

Response: The site has been planned and designed to avoid the natural features on the site, including a tree grove and a wetland. Grading, filling, and excavating will be conducted in accordance with the Uniform Building code. The site will be protected with erosion control measures and the delineated wetlands on site will be staked prior to commencement of site work to avoid damage to vegetation or injury to habitat. The removal of trees is necessary for site development, but replacement trees will be planted per the provisions of this code.

(.03) Hillsides: All developments proposed on slopes greater than 25% shall be limited to the extent that: [...]

Response: No slopes greater than 25 percent are present on the site.

(.04) Trees and Wooded Areas.

- A. All developments shall be planned, designed, constructed and maintained so that:
1. Existing vegetation is not disturbed, injured, or removed prior to site development and prior to an approved plan for circulation, parking and structure location.
 2. Existing wooded areas, significant clumps/groves of trees and vegetation, and all trees with a diameter at breast height of six inches or greater shall be incorporated into the development plan and protected wherever feasible.
 3. Existing trees are preserved within any right-of-way when such trees are suitably located, healthy, and when approved grading allows.
- B. Trees and woodland areas to be retained shall be protected during site preparation and construction according to City Public Works design specifications, by:
1. Avoiding disturbance of the roots by grading and/or compacting activity.
 2. Providing for drainage and water and air filtration to the roots of trees which will be covered with impermeable surfaces.
 3. Requiring, if necessary, the advisory expertise of a registered arborist/horticulturist both during and after site preparation.
 4. Requiring, if necessary, a special maintenance, management program to insure survival of specific woodland areas of specimen trees or individual heritage status trees.

Response: Existing vegetation will not be disturbed, injured or removed prior to land use and permit approvals. Existing trees have been retained wherever possible; however, many trees will need to be removed to provide area for home construction. The existing grove of trees in the southeast area of the site has been prioritized for protection and have been incorporated into an open space that is a continuation of the open space approved with the Frog Pond Meadows development to the south.

(.05) High Voltage Powerline Easements and Rights of Way and Petroleum Pipeline Easements:

- A. Due to the restrictions placed on these lands, no residential structures shall be allowed within high voltage powerline easements and rights of way and petroleum pipeline easements, and any development, particularly residential, adjacent to high voltage powerline easements and rights of way and petroleum pipeline easements shall be carefully reviewed.
- B. Any proposed non-residential development within high voltage powerline easements and rights of way and petroleum pipeline easements shall be coordinated with and approved by the Bonneville Power Administration, Portland General Electric Company or other appropriate utility, depending on the easement or right of way ownership.

Response: No high voltage powerline easements or petroleum pipeline easements are present on site.

(.06) Hazards to Safety: Purpose:

- A. To protect lives and property from natural or human-induced geologic or hydrologic hazards and disasters.
- B. To protect lives and property from damage due to soil hazards.
- C. To protect lives and property from forest and brush fires.
- D. To avoid financial loss resulting from development in hazard areas.

Response: No hydrologic, soil, fire, or other hazards have been identified on site.

(.07) Standards for Earth Movement Hazard Areas:

- A. No development or grading shall be allowed in areas of land movement, slump or earth flow, and mud or debris flow, except under one of the following conditions:
1. Stabilization of the identified hazardous condition based on established and proven engineering techniques which ensure protection of public and private property. Appropriate conditions of approval may be attached by the City.
 2. An engineering geologic study approved by the City establishing that the site is stable for the proposed use and development. The study shall include the following:
 - a. Index map.
 - b. Project description, to include: location; topography, drainage, vegetation; discussion of previous work; and discussion of field exploration methods.

- c. *Site geology, to include: site geologic map; description of bedrock and superficial materials including artificial fill; location of any faults, folds, etc.; and structural data including bedding, jointing, and shear zones.*
 - d. *Discussion and analysis of any slope stability problems.*
 - e. *Discussion of any off-site geologic conditions that may pose a potential hazard to the site or that may be affected by on-site development.*
 - f. *Suitability of site for proposed development from geologic standpoint.*
 - g. *Specific recommendations for cut slope stability, seepage and drainage control, or other design criteria to mitigate geologic hazards.*
 - h. *Supportive data, to include: cross sections showing subsurface structure; graphic logs of subsurface explorations; results of laboratory tests; and references.*
 - i. *Signature and certification number of engineering geologist registered in the State of Oregon.*
 - j. *Additional information or analyses as necessary to evaluate the site.*
- B. *Vegetative cover shall be maintained or established for stability and erosion control purposes.*
 - C. *Diversion of storm water into these areas shall be prohibited.*
 - D. *The principal source of information for determining earth movement hazards is the State Department of Geology and Mineral Industries (DOGAMI) Bulletin 99 and any subsequent bulletins and accompanying maps. Approved site specific engineering geologic studies shall be used to identify the extent and severity of the hazardous conditions on the site, and to update the earth movement hazards database.*

Response: Geotechnical investigations have been completed for each of the subject properties, and no earth movement hazards have been identified. See Appendix G for geotechnical reports.

(.08) Standards for Soil Hazard Areas:

- A. *Appropriate siting and design safeguards shall insure structural stability and proper drainage of foundation and crawl space areas for development on land with any of the following soil conditions: wet or high water table; high shrink-swell capability; compressible or organic; and shallow depth-to-bedrock.*
- B. *The principal source of information for determining soil hazards is the State DOGAMI Bulletin 99 and any subsequent bulletins and accompanying maps. Approved site-specific soil studies shall be used to identify the extent and severity of the hazardous conditions on the site, and to update the soil hazards database accordingly.*

Response: Geotechnical investigations have been completed for each of the subject properties, and no soil hazard areas have been identified. See Appendix G for geotechnical reports.

(.09) Historic Protection: Purpose:

- A. *To preserve structures, sites, objects, and areas within the City of Wilsonville having historic, cultural, or archaeological significance.*

Response: No historic, cultural, or archaeological items have been identified on the site.

G. Section 4.175. Public Safety and Crime Prevention.

- (.01)** *All developments shall be designed to deter crime and insure public safety.*
- (.02)** *Addressing and directional signing shall be designed to assure identification of all buildings and structures by emergency response personnel, as well as the general public.*
- (.03)** *Areas vulnerable to crime shall be designed to allow surveillance. Parking and loading areas shall be designed for access by police in the course of routine patrol duties.*
- (.04)** *Exterior lighting shall be designed and oriented to discourage crime.*

Response: The Frog Pond Ridge development has been designed to deter crime and insure public safety. Streets and pedestrian connections will be lit for visibility and safety. Homes will be oriented toward these streets to provide “eyes on the street.” All dwellings will be addressed per Building and Fire Department requirements to allow identification for emergency response personnel. No parking and loading areas are proposed. Dwellings will have exterior porch lighting, which will support the street lights to provide safety and visibility. These standards are met.

H. Section 4.176. Landscaping, Screening, and Buffering.

[...]

(.02) Landscaping and Screening Standards.

[...]

C. General Landscaping Standard.

[...]

2. *Required materials. Shrubs and trees, other than street trees, may be grouped. Ground cover plants must fully cover the remainder of the landscaped area (see Figure 21: General Landscaping). The General Landscaping Standard has two different requirements for trees and shrubs:*
 - a. *Where the landscaped area is less than 30 feet deep, one tree is required for every 30 linear feet.*
 - b. *Where the landscaped area is 30 feet deep or greater, one tree is required for every 800 square feet and two high shrubs or three low shrubs are required for every 400 square feet.*

Response: The proposed development consists of single-family dwellings, which are generally subject to the General Landscape Standard except for lots abutting Stafford Road, which are subject to Low Screen Landscaping Standards and the Frog Pond West Master Plan. Sheet L2.10 provides details of proposed landscaping in these areas.

D. Low Screen Landscaping Standard.

1. *Intent. The Low Screen Landscaping Standard is a landscape treatment that uses a combination of distance and low screening to separate uses or developments. It is intended to be applied in situations where low screening is adequate to soften the impact of one use or development on another, or where visibility between areas is more important than a total visual screen. The Low Screen Landscaping Standard is usually applied along street lot lines or in the area separating parking lots from street rights-of-way.*
2. *Required materials. The Low Screen Landscaping Standard requires sufficient low shrubs to form a continuous screen three (3) feet high and 95% opaque, year-round. In addition, one tree is required for every 30 linear feet of landscaped area, or as otherwise required to provide a tree canopy over the landscaped area. Ground cover plants must fully cover the remainder of the landscaped area. A three (3) foot high masonry wall or a berm may be substituted for the shrubs, but the trees and ground cover plants are still required. When applied along street lot lines, the screen or wall is to be placed along the interior side of the landscaped area. (See Figure 22: Low Screen Landscaping).*

Response: The proposed development consists of single-family dwellings, which are generally subject to the General Landscape Standard except for lots abutting Stafford Road, which are subject to Low Screen Landscaping Standards and the Frog Pond West Master Plan. Sheet L2.10 provides details of proposed landscaping in these areas.

E. High Screen Landscaping Standard.

1. *Intent. The High Screen Landscaping Standard is a landscape treatment that relies primarily on screening to separate uses or developments. It is intended to be applied in situations where visual separation is required.*
2. *Required materials. The High Screen Landscaping Standard requires sufficient high shrubs to form a continuous screen at least six (6) feet high and 95% opaque, year-round. In addition, one tree is required for every 30 linear feet of landscaped area, or as otherwise required to provide a tree canopy over the landscaped area. Ground cover plants must fully cover the remainder of the landscaped area. A six (6) foot high masonry wall or a berm may be substituted for the shrubs, but the trees and ground cover plants are still required. When applied along street lot lines, the screen or wall is to be placed along the interior side of the landscaped area. (See Figure 23: High Screen Landscaping).*

Response: The proposed residential development is located adjacent to future residential development. No screening is required or provided between uses.

F. High Wall Standard.

1. *Intent. The High Wall Standard is intended to be applied in situations where extensive screening to reduce both visual and noise impacts is needed to protect abutting uses or developments from one-another. This screening is most important where either, or both, of the abutting uses or developments can be expected to be particularly sensitive to noise or visual impacts, or where there is little space for physical separation.*
2. *Required materials. The High Wall Standard requires a masonry wall at least six (6) feet high along the interior side of the landscaped area (see Figure 24: High Wall Landscaping). In addition, one tree is required for every 30 linear feet of wall, or as otherwise required to provide a tree canopy over the landscaped area. Ground cover plants must fully cover the remainder of the landscaped area.*

Response: There are no visual or noise impacts anticipated from the proposed development, and high walls are not required or proposed.

G. High Berm Standard.

1. *Intent. The High Berm Standard is intended to be applied in situations where extensive screening to reduce both visual and noise impacts is needed to protect abutting uses or developments from one-another, and where it is desirable and practical to provide separation by both distance and sight-obscuring materials. This screening is most important where either, or both, of the abutting uses or developments can be expected to be particularly sensitive to noise or visual impacts.*
2. *Required materials. The High Berm Standard requires a berm at least four (4) feet high along the interior side of the landscaped area (see Figure 25: High Berm Landscaping). If the berm is less than six (6) feet high, low shrubs meeting the Low Screen Landscaping Standard, above, are to be planted along the top of the berm, assuring that the screen is at least six (6) feet in height. In addition, one tree is required for every 30 linear feet of berm, or as otherwise required to provide a tree canopy over the landscaped area. Ground cover plants must fully cover the remainder of the landscaped area.*

Response: There are no visual or noise impacts anticipated from the proposed development, and a high berm is not required or provided.

H. Partially Sight-Obscuring Fence Standard.

1. *Intent. The Partially Sight-Obscuring Fence Standard is intended to provide a tall, but not totally blocked, visual separation. The standard is applied where a low level of screening is adequate to soften the impact of one use or development on another, and where some visibility between abutting areas is preferred over a total visual screen. It can be applied in conjunction with landscape plantings or applied in areas where landscape plantings are not necessary and where nonresidential uses are involved.*
2. *Required materials. Partially Sight-Obscuring Fence Standard are to be at least six (6) feet high and at least 50% sight-obscuring. Fences may be made of wood (other than plywood or particle-board), metal, bricks, masonry or other permanent materials (see Figure 26: Partially Sight-Obscuring Fence).*

I. Fully Sight-Obscuring Fence Standard.

1. *Intent. The Fully Sight-Obscuring Fence Standard is intended to provide a totally blocked visual separation. The standard is applied where full visual screening is needed to reduce the impact of one use or development on another. It can be applied in conjunction with landscape plantings or applied in areas where landscape plantings are not necessary.*
2. *Required materials. Fully sight-obscuring fences are to be at least six (6) feet high and 100% sight-obscuring. Fences may be made of wood (other than plywood or particle-board), metal, bricks, masonry or other permanent materials (see Figure 27: Totally Sight-Obscuring Fence).*

Response: There is no need for partially or totally blocked visual separation. Sight-obscuring fencing is not provided, except for the Stafford Road frontage as required by the Frog Pond West Master Plan.

(.03) Landscape Area. *Not less than fifteen percent (15%) of the total lot area, shall be landscaped with vegetative plant materials. The ten percent (10%) parking area landscaping required by section*

4.155.03(B)(1) is included in the fifteen percent (15%) total lot landscaping requirement. Landscaping shall be located in at least three separate and distinct areas of the lot, one of which must be in the contiguous frontage area. Planting areas shall be encouraged adjacent to structures. Landscaping shall be used to define, soften or screen the appearance of buildings and off-street parking areas. Materials to be installed shall achieve a balance between various plant forms, textures, and heights. The installation of native plant materials shall be used whenever practicable. (For recommendations refer to the Native Plant List maintained by the City of Wilsonville). [Amended by Ord. # 674 11/16/09]

Response: At least 15 percent of the total lot area for each single-family dwelling will be landscaped; conformance with this standard will be reviewed at the time of building permit submittal. There are no parking areas proposed and no parking area landscaping is required. The landscape plan included as Sheets L2.00-L2.40 illustrate the location and type of landscaping within public rights-of-way and tracts.

(.04) Buffering and Screening. Additional to the standards of this subsection, the requirements of the Section 4.137.5 (Screening and Buffering Overlay Zone) shall also be applied, where applicable.

- A. All intensive or higher density developments shall be screened and buffered from less intense or lower density developments.
- B. Activity areas on commercial and industrial sites shall be buffered and screened from adjacent residential areas. Multi-family developments shall be screened and buffered from single-family areas.
- C. All exterior, roof and ground mounted, mechanical and utility equipment shall be screened from ground level off-site view from adjacent streets or properties.
- D. All outdoor storage areas shall be screened from public view, unless visible storage has been approved for the site by the Development Review Board or Planning Director acting on a development permit.
- E. In all cases other than for industrial uses in industrial zones, landscaping shall be designed to screen loading areas and docks, and truck parking.
- F. In any zone any fence over six (6) feet high measured from soil surface at the outside of fenceline shall require Development Review Board approval.

Response: The requirements of 4.137.5 are applicable along the edge of nonresidential zones abutting, or located directly across the street from, residential zones. The proposed development is located within a residential zone and is anticipated to abut residential development in accordance with the Frog Pond Master Plan. These provisions are not applicable.

(.05) Sight-Obscuring Fence or Planting. The use for which a sight-obscuring fence or planting is required shall not begin operation until the fence or planting is erected or in place and approved by the City. A temporary occupancy permit may be issued upon a posting of a bond or other security equal to one hundred ten percent (110%) of the cost of such fence or planting and its installation. (See Sections 4.400 to 4.470 for additional requirements.)

Response: No sight-obscuring fences or planting are required between the proposed residential use and adjacent uses. This standard is not applicable.

(.06) Plant Materials.

- A. **Shrubs and Ground Cover.** All required ground cover plants and shrubs must be of sufficient size and number to meet these standards within three (3) years of planting. Non-horticultural plastic sheeting or other impermeable surface shall not be placed under mulch. Native topsoil shall be preserved and reused to the extent feasible. Surface mulch or bark dust are to be fully raked into soil of appropriate depth, sufficient to control erosion, and are confined to areas around plantings. Areas exhibiting only surface mulch, compost or barkdust are not to be used as substitutes for plant areas. [Amended by Ord. # 674 11/16/09]
 - 1. Shrubs. All shrubs shall be well branched and typical of their type as described in current AAN Standards and shall be equal to or better than 2-gallon containers and 10" to 12" spread.
 - 2. Ground cover. Shall be equal to or better than the following depending on the type of plant materials used: gallon containers spaced at 4 feet on center minimum, 4" pot spaced 2 feet on center minimum, 2-1/4" pots spaced at 18 inch on center minimum. No bare root planting shall be permitted. Ground cover shall be sufficient to cover at least 80% of the bare soil in required

- landscape areas within three (3) years of planting. Where wildflower seeds are designated for use as a ground cover, the City may require annual re-seeding as necessary.
3. Turf or lawn in non-residential developments. Shall not be used to cover more than ten percent (10%) of the landscaped area, unless specifically approved based on a finding that, due to site conditions and availability of water, a larger percentage of turf or lawn area is appropriate. Use of lawn fertilizer shall be discouraged. Irrigation drainage runoff from lawns shall be retained within lawn areas.
 4. Plant materials under trees or large shrubs. Appropriate plant materials shall be installed beneath the canopies of trees and large shrubs to avoid the appearance of bare ground in those locations.
 5. Integrate compost-amended topsoil in all areas to be landscaped, including lawns, to help detain runoff, reduce irrigation and fertilizer needs, and create a sustainable, low-maintenance landscape. [Added by Ord. # 674 11/16/09]

Response: The landscape plan included as Sheets L2.00-L2.40 and L3.20 addresses these requirements.

- B. *Trees. All trees shall be well-branched and typical of their type as described in current American Association of Nurserymen (AAN) Standards and shall be balled and burlapped. The trees shall be grouped as follows:*
1. *Primary trees which define, outline or enclose major spaces, such as Oak, Maple, Linden, and Seedless Ash, shall be a minimum of 2" caliper.*
 2. *Secondary trees which define, outline or enclose interior areas, such as Columnar Red Maple, Flowering Pear, Flame Ash, and Honeylocust, shall be a minimum of 1-3/4" to 2" caliper.*
 3. *Accent trees which, are used to add color, variation and accent to architectural features, such as Flowering Pear and Kousa Dogwood, shall be 1-3/4" minimum caliper.*
 4. *Large conifer trees such as Douglas Fir or Deodar Cedar shall be installed at a minimum height of eight (8) feet.*
 5. *Medium-sized conifers such as Shore Pine, Western Red Cedar or Mountain Hemlock shall be installed at a minimum height of five to six (5 to 6) feet.*

Response: The landscape plan included as Sheets L2.00-L2.40 and L3.40 addresses these requirements.

- C. *Where a proposed development includes buildings larger than twenty-four (24) feet in height or greater than 50,000 square feet in footprint area, the Development Review Board may require larger or more mature plant materials:*
1. *At maturity, proposed trees shall be at least one-half the height of the building to which they are closest, and building walls longer than 50 feet shall require tree groups located no more than fifty (50) feet on center, to break up the length and height of the façade.*
 2. *Either fully branched deciduous or evergreen trees may be specified depending upon the desired results. Where solar access is to be preserved, only solar-friendly deciduous trees are to be used. Where year-round sight obscuring is the highest priority, evergreen trees are to be used.*
 3. *The following standards are to be applied:*
 - a. *Deciduous trees:*
 - i. *Minimum height of ten (10) feet; and*
 - ii. *Minimum trunk diameter (caliper) of 2 inches (measured at four and one-half [4 1/2] feet above grade).*
 - b. *Evergreen trees: Minimum height of twelve (12) feet.*

Response: Some of the proposed residential dwellings will exceed 24 ft. in height but will be far less than 50,000 sq. ft. in footprint area. Requirements for larger or more mature plant materials are not warranted.

- D. *Street Trees. In order to provide a diversity of species, the Development Review Board may require a mix of street trees throughout a development. Unless the Board waives the requirement for reasons supported by a finding in the record, different types of street trees shall be required for adjoining blocks in a development.*

1. All trees shall be standard base grafted, well branched and typical of their type as described in current AAN Standards and shall be balled and burlapped (b&b). Street trees shall be planted at sizes in accordance with the following standards:
 - a. Arterial streets - 3" minimum caliper
 - b. Collector streets - 2" minimum caliper.
 - c. Local streets or residential private access drives - 1-3/4" minimum caliper. [Amended by Ord. 682, 9/9/10]
 - d. Accent or median tree -1-3/4" minimum caliper.

Response: Willow Creek Drive and Frog Pond Lane are classified as a Collector; the other streets within the development are classified as Local Streets or Private Access Drives. As shown in Sheet L2.00, 2-in. caliper balled and burlapped street trees are proposed for all streets within the development.

2. The following trees and varieties thereof are considered satisfactory street trees in most circumstances; however, other varieties and species are encouraged and will be considered:
 - a. Trees over 50 feet mature height: *Quercus garryana* (Native Oregon White Oak), *Quercus rubra borealis* (Red Oak), *Acer Macrophyllum* (Native Big Leaf Maple), *Acer nigrum* (Green Column Black Maple), *Fraxinus americanus* (White Ash), *Fraxinus pennsylvannica* 'Marshall' (Marshall Seedless Green Ash), *Quercus coccinea* (Scarlet Oak), *Quercus pulustris* (Pin Oak), *Tilia americana* (American Linden).
 - b. Trees under 50 feet mature height: *Acer rubrum* (Red Sunset Maple), *Cornus nuttallii* (Native Pacific Dogwood), *Gleditsia triacanthos* (Honey Locust), *Pyrus calleryana* 'Bradford' (Bradford Pear), *Tilia cordata* (Little Leaf Linden), *Fraxinus oxycarpa* (Flame Ash).
 - c. Other street tree species. Other species may be specified for use in certain situations. For instance, evergreen species may be specified where year-round color is desirable and no adverse effect on solar access is anticipated. Water-loving species may be specified in low locations where wet soil conditions are anticipated.
[Section 4.176(.06)(D.) amended by Ordinance No. 538, 2/21/02.]

Response: The proposed street trees include a mix of *Acer rubrum* 'Franksred' TM (Red Sunset Maple), *Alnus rubra* (Red Alder), *Cladrastis kentukea* (American Yellowwood), *Gleditsia triacanthos inermis* 'Halka' (Halka Thornless Honey Locust), *Gleditsia triacanthos inermis* 'Skycole' (Skyline Thornless Honey Locust), *Quercus garryana* (Oregon Oak), *Quercus rubra* (Red Oak), *Tilia americana* (American Linden), *Tilia cordata* 'Glenleven' (Glenleven Littleleaf Linden). All trees listed here have been chosen from the approved street tree list for the Frog Pond West Master Plan, and they have been selected for the qualities that cause them to be frequently specified as street trees: predictable form, disease resistance, tidiness, and visual interest.

E. Types of Plant Species.

1. Existing landscaping or native vegetation may be used to meet these standards, if protected and maintained during the construction phase of the development and if the plant species do not include any that have been listed by the City as prohibited. The existing native and non-native vegetation to be incorporated into the landscaping shall be identified.
2. Selection of plant materials. Landscape materials shall be selected and sited to produce hardy and drought-tolerant landscaping. Selection shall be based on soil characteristics, maintenance requirements, exposure to sun and wind, slope and contours of the site, and compatibility with other vegetation that will remain on the site. Suggested species lists for street trees, shrubs and groundcovers shall be provided by the City of Wilsonville.
3. Prohibited plant materials. The City may establish a list of plants that are prohibited in landscaped areas. Plants may be prohibited because they are potentially damaging to sidewalks, roads, underground utilities, drainage improvements, or foundations, or because they are known to be invasive to native vegetation.
[Section 4.176(.06)(E.) amended by Ordinance No. 538, 2/21/02.]

Response: As shown on Sheets L2.00 – L2.40, the proposed landscape materials include a mix of native trees, shrubs, and groundcovers. No prohibited plant materials are proposed.

F. Tree Credit.

Existing trees that are in good health as certified by an arborist and are not disturbed during construction may count for landscaping tree credit as follows (measured at four and one-half feet above grade and rounded to the nearest inch):

Existing trunk diameter	Number of Tree Credits
18 to 24 inches in diameter	3 tree credits
25 to 31 inches in diameter	4 tree credits
32 inches or greater	5 tree credits

[Amended by Ord. # 674 11/16/09]

1. It shall be the responsibility of the owner to use reasonable care to maintain preserved trees. Trees preserved under this section may only be removed if an application for removal permit under Section 4.610.10(01)(H) has been approved. Required mitigation for removal shall be replacement with the number of trees credited to the preserved and removed tree.
2. Within five years of occupancy and upon notice from the City, the property owner shall replace any preserved tree that cannot be maintained due to disease or damage, or hazard or nuisance as defined in Chapter 6 of this code. The notice shall be based on complete information provided by an arborist. Replacement with the number of trees credited shall occur within one (1) growing season of notice.

Response: As shown on Sheet L1.00 and described in Appendix F, there are 59 trees on the site and 21 trees will be protected on site (an additional 11 trees will be protected off site). Per the calculations above and shown in Table 5 below, 89 tree credits are provided by protected trees.

Table 5: Tree Credits

Count	Tag #	Existing Trunk Diameter	Number of Tree Credits
1	55832	30 in.	4
2	55834	36 in.	5
3	55835	30 in.	4
4	55836	21 in.	3
5	55837	26 in.	4
6	55838	35 in.	5
7	55839	24 in.	3
8	55840	43 in.	5
9	55841	39 in.	5
10	55842	30 in.	4
11	55843	35 in.	5
12	55844	33 in.	5
13	55845	23 in.	3
14	55847	32 in.	5
15	55848	27 in.	4
16	55849	37 in.	5
17	55850	35 in.	5
18	55851	13 in.	0
19	55852	42 in.	5
20	55853	34 in.	5
21	56961	34 in.	5
Total			89

(.07) Installation and Maintenance.

- A. **Installation.** Plant materials shall be installed to current industry standards and shall be properly staked to assure survival. Support devices (guy wires, etc.) shall not be allowed to interfere with normal pedestrian or vehicular movement.
- B. **Maintenance.** Maintenance of landscaped areas is the on-going responsibility of the property owner. Any landscaping installed to meet the requirements of this Code, or any condition of approval established by a City decision-making body acting on an application, shall be continuously maintained

in a healthy, vital and acceptable manner. Plants that die are to be replaced in kind, within one growing season, unless appropriate substitute species are approved by the City. Failure to maintain landscaping as required in this Section shall constitute a violation of this Code for which appropriate legal remedies, including the revocation of any applicable land development permits, may result.

- C. *Irrigation. The intent of this standard is to assure that plants will survive the critical establishment period when they are most vulnerable due to a lack of watering and also to assure that water is not wasted through unnecessary or inefficient irrigation. Approved irrigation system plans shall specify one of the following:*
1. *A permanent, built-in, irrigation system with an automatic controller. Either a spray or drip irrigation system, or a combination of the two, may be specified.*
 2. *A permanent or temporary system designed by a landscape architect licensed to practice in the State of Oregon, sufficient to assure that the plants will become established and drought-tolerant.*
 3. *Other irrigation system specified by a licensed professional in the field of landscape architecture or irrigation system design.*
 4. *A temporary permit issued for a period of one year, after which an inspection shall be conducted to assure that the plants have become established. Any plants that have died, or that appear to the Planning Director to not be thriving, shall be appropriately replaced within one growing season. An inspection fee and a maintenance bond or other security sufficient to cover all costs of replacing the plant materials shall be provided, to the satisfaction of the Community Development Director. Additionally, the applicant shall provide the City with a written license or easement to enter the property and cause any failing plant materials to be replaced.*
- D. *Protection. All required landscape areas, including all trees and shrubs, shall be protected from potential damage by conflicting uses or activities including vehicle parking and the storage of materials.*

Response: As detailed in Note 1 of Sheet L2.00, all landscape areas will be watered by a fully automatic underground irrigation system, except the SROZ. The SROZ will receive establishment irrigation. These standards are met.

(.08) Landscaping on Corner Lots. *All landscaping on corner lots shall meet the vision clearance standards of Section 4.177. If high screening would ordinarily be required by this Code, low screening shall be substituted within vision clearance areas. Taller screening may be required outside of the vision clearance area to mitigate for the reduced height within it.*

Response: High screening is not required on any corner lots and is not proposed. This standard is not applicable.

(.09) Landscape Plans. *Landscape plans shall be submitted showing all existing and proposed landscape areas. Plans must be drawn to scale and show the type, installation size, number and placement of materials. Plans shall include a plant material list. Plants are to be identified by both their scientific and common names. The condition of any existing plants and the proposed method of irrigation are also to be indicated. Landscape plans shall divide all landscape areas into the following categories based on projected water consumption for irrigation:*

- A. *High water usage areas (+/- two (2) inches per week): small convoluted lawns, lawns under existing trees, annual and perennial flower beds, and temperamental shrubs;*
- B. *Moderate water usage areas (+/- one (1) inch per week): large lawn areas, average water-using shrubs, and trees;*
- C. *Low water usage areas (Less than one (1) inch per week, or gallons per hour): seeded fieldgrass, swales, native plantings, drought-tolerant shrubs, and ornamental grasses or drip irrigated areas.*
- D. *Interim or unique water usage areas: areas with temporary seeding, aquatic plants, erosion control areas, areas with temporary irrigation systems, and areas with special water-saving features or water harvesting irrigation capabilities. These categories shall be noted in general on the plan and on the plant material list.*

Response: A landscape plan is included as Sheets L2.00-L2.40. The proposed site development plan includes street tree and mitigation plantings, which consist of native vegetation that that requires low water usage. Individual lot landscaping will be proposed at the time of building permit submittal and will likely include grass and ground coverings. These standards are met.

(.10) Completion of Landscaping. *The installation of plant materials may be deferred for a period of time specified by the Board or Planning Director acting on an application, in order to avoid hot summer or cold winter periods, or in response to water shortages. In these cases, a temporary permit shall be issued, following the same procedures specified in subsection (.07)(C)(3), above, regarding temporary irrigation systems. No final Certificate of Occupancy shall be granted until an adequate bond or other security is posted for the completion of the landscaping, and the City is given written authorization to enter the property and install the required landscaping, in the event that the required landscaping has not been installed. The form of such written authorization shall be submitted to the City Attorney for review.*

Response: Acknowledged. No deferral is requested at this time but may be requested in the future subject to the scenarios above.

(.11) Street Trees Not Typically Part of Site Landscaping. *Street trees are not subject to the requirements of this Section and are not counted toward the required standards of this Section. Except, however, that the Development Review Board may, by granting a waiver or variance, allow for special landscaping within the right-of-way to compensate for a lack of appropriate on-site locations for landscaping. See subsection (.06), above, regarding street trees.*

Response: No waiver or variance for on-site landscaping is requested. This standard is not applicable.

(.12) Mitigation and Restoration Plantings. *A mitigation plan is to be approved by the City's Development Review Board before the destruction, damage, or removal of any existing native plants. Plantings intended to mitigate the loss of native vegetation are subject to the following standards. Where these standards conflict with other requirements of this Code, the standards of this Section shall take precedence. The desired effect of this section is to preserve existing native vegetation.*

- A. *Plant Sources. Plant materials are to be native and are subject to approval by the City. They are to be non-clonal in origin; seed source is to be as local as possible, and plants must be nursery propagated or taken from a pre-approved transplantation area. All of these requirements are to be addressed in any proposed mitigation plan.*
- B. *Plant Materials. The mitigation plan shall specify the types and installation sizes of plant materials to be used for restoration. Practices such as the use of pesticides, fungicides, and fertilizers shall not be employed in mitigation areas unless specifically authorized and approved.*
- C. *Installation. Install native plants in suitable soil conditions. Plant materials are to be supported only when necessary because of extreme winds at the site. Where support is necessary, all stakes, guy wires or other measures are to be removed as soon as the plants can support themselves. Protect from animal and fowl predation and foraging until establishment.*
- D. *Irrigation. Permanent irrigation systems are generally not appropriate in restoration situations, and manual or temporary watering of new plantings is often necessary. The mitigation plan shall specify the method and frequency of manual watering, including any that may be necessary after the first growing season.*
- E. *Monitoring and Reporting. Monitoring of native landscape areas is the on-going responsibility of the property owner. Plants that die are to be replaced in kind and quantity within one year. Written proof of the survival of all plants shall be required to be submitted to the City's Planning Department one year after the planting is completed.*

[Section 4.176 amended by Ordinance No. 536, 1/7/02]

Response: The site is currently in residential and agricultural use, and site plantings consist primarily of grass and clustered trees. The existing grass and many of the trees will be removed for site development, specifically to accommodate the planned street network and desired lotting pattern. Tree removal will be mitigated as detailed in the response to Section 4.610.40. These standards are not applicable.

I. Section 4.177. Street Improvement Standards.

This section contains the City's requirements and standards for pedestrian, bicycle, and transit facility improvements to public streets, or within public easements. The purpose of this section is to ensure that development, including redevelopment, provides transportation facilities that are safe, convenient, and adequate in rough proportion to their impacts.

(.01) *Development and related public facility improvements shall comply with the standards in this section, the Wilsonville Public Works Standards, and the Transportation System Plan, in rough proportion to the potential impacts of the development. Such improvements shall be constructed at the time of development or as provided by Section 4.140, except as modified or waived by the City Engineer for reasons of safety or traffic operations.*

Response: The proposed public facility improvements are designed to comply with the standards in this section, the Wilsonville Public Works Standards, and the Transportation System Plan as modified by the Frog Pond Master Plan. The City Engineer approved a revised cross-section for Willow Creek Drive as part of the Frog Pond Meadows application. The revised Willow Creek Drive cross-section will be mirrored on the western side of the street to complete the tree protection median previously approved.

(.02) Street Design Standards.

A. *All street improvements and intersections shall provide for the continuation of streets through specific developments to adjoining properties or subdivisions.*

- 1. Development shall be required to provide existing or future connections to adjacent sites through the use of access easements where applicable. Such easements shall be required in addition to required public street dedications as required in Section 4.236(.04).*

Response: The street network has been designed per the Frog Pond West Street Demonstration Plan. Future connections to adjacent sites are anticipated to the north, west, and east. This standard is met.

B. *The City Engineer shall make the final determination regarding right-of-way and street element widths using the ranges provided in Chapter 3 of the Transportation System Plan and the additional street design standards in the Public Works Standards.*

Response: The applicant proposes a revision of the Brisband Street right-of-way improvements to minimize impacts to the SROZ. This revision proposes curb-tight sidewalks for the portion of road crossing the SROZ/culvert to reduce grading/wall impacts. The design maintains the roadway width (28 ft.) and right-of-way width (52 ft.) of the standard local street section. The curb tight sidewalk is 6 ft. in width. See Sheets P2.00 and P5.00.

The applicant also proposes narrowing Street K from 52 ft. to 49 ft. between SW Larkspur Terr and SW Willow Creek Drive. This slight narrowing allows the stormwater facility in Tract C to expand slightly and reduce the internal wall height. In addition, it allows the southern sidewalk to better align with the multiuse path within Tract A to the west.

The narrowing is accomplished by reducing the planter strip from 7 ft. to 5.5 ft. See Sheet P2.10 for details. The difference is minor enough to be visually imperceptible while improving the function of the infrastructure. See Sheet P2.00.

C. *Rights-of-way.*

- 1. Prior to issuance of a Certificate of Occupancy Building permits or as a part of the recordation of a final plat, the City shall require dedication of rights-of-way in accordance with the Transportation System Plan. All dedications shall be recorded with the County Assessor's Office.*
- 2. The City shall also require a waiver of remonstrance against formation of a local improvement district, and all non-remonstrances shall be recorded in the County Recorder's Office as well as the City's Lien Docket, prior to issuance of a Certificate of Occupancy Building Permit or as a part of the recordation of a final plat.*
- 3. In order to allow for potential future widening, a special setback requirement shall be maintained adjacent to all arterial streets. The minimum setback shall be 55 feet from the centerline or 25 feet from the right-of-way designated on the Master Plan, whichever is greater.*

Response: The site abuts Stafford Road to the east, which is an arterial street. The project will dedicate 12 ft. of right-of-way to the northwestern Stafford Road frontage, which will increase the right-of-way to 72 ft. Per Figure 21 of the Frog Pond West Master Plan, an additional 12 ft. would need to be dedicated on the east side of Stafford Road to provide the full right-of-way width for the Stafford Road cross-section. As

part of proposed interim improvements to Frog Pond Lane, 21.5 feet of additional right-of-way will be dedicated. No additional setbacks are required.

These standards are met.

D. Dead-end Streets. New dead-end streets or cul-de-sacs shall not exceed 200 feet in length, unless the adjoining land contains barriers such as existing buildings, railroads or freeways, or environmental constraints such as steep slopes, or major streams or rivers, that prevent future street extension and connection. A central landscaped island with rainwater management and infiltration are encouraged in cul-de-sac design. No more than 25 dwelling units shall take access to a new dead-end or cul-de-sac street unless it is determined that the traffic impacts on adjacent streets will not exceed those from a development of 25 or fewer units. All other dimensional standards of dead-end streets shall be governed by the Public Works Standards. Notification that the street is planned for future extension shall be posted on the dead-end street. [Amended by Ord. # 674 11/16/09]

Response: The street network has been designed per the Frog Pond West Master Plan Street Demonstration Plan. A portion of Street L is a private dead-end street. It is approximately 170 ft. Long and serves four lots. This standard is met.

E. Corner or clear vision area.

- 1. A clear vision area which meets the Public Works Standards shall be maintained on each corner of property at the intersection of any two streets, a street and a railroad or a street and a driveway. However, the following items shall be exempt from meeting this requirement:*
 - a. Light and utility poles with a diameter less than 12 inches.*
 - b. Trees less than 6" d.b.h., approved as a part of the Stage II Site Design, or administrative review.*
 - c. Except as allowed by b., above, an existing tree, trimmed to the trunk, 10 feet above the curb.*
 - d. Official warning or street sign.*
 - e. Natural contours where the natural elevations are such that there can be no cross-visibility at the intersection and necessary excavation would result in an unreasonable hardship on the property owner or deteriorate the quality of the site.*

F. Vertical clearance - a minimum clearance of 12 feet above the pavement surface shall be maintained over all streets and access drives.

Response: Clear vision areas will be maintained at the corner of each property.

G. Interim improvement standard. It is anticipated that all existing streets, except those in new subdivisions, will require complete reconstruction to support urban level traffic volumes. However, in most cases, existing and short-term projected traffic volumes do not warrant improvements to full Master Plan standards. Therefore, unless otherwise specified by the Development Review Board, the following interim standards shall apply.

- 1. Arterials - 24 foot paved, with standard sub-base. Asphalt overlays are generally considered unacceptable, but may be considered as an interim improvement based on the recommendations of the City Engineer, regarding adequate structural quality to support an overlay.*
- 2. Half-streets are generally considered unacceptable. However, where the Development Review Board finds it essential to allow for reasonable development, a half-street may be approved. Whenever a half-street improvement is approved, it shall conform to the requirements in the Public Works Standards:*
- 3. When considered appropriate in conjunction with other anticipated or scheduled street improvements, the City Engineer may approve street improvements with a single asphalt lift. However, adequate provision must be made for interim storm drainage, pavement transitions at seams and the scheduling of the second lift through the Capital Improvements Plan.*

[Amended by Ord. 610, 5/1/06]

Response: There are no existing streets within the development site. These standards are not applicable.

(.03) Sidewalks. Sidewalks shall be provided on the public street frontage of all development. Sidewalks shall generally be constructed within the dedicated public right-of-way, but may be located outside of the right-of-way within a public easement with the approval of the City Engineer.

- A. Sidewalk widths shall include a minimum through zone of at least five feet. The through zone may be reduced pursuant to variance procedures in Section 4.196, a waiver pursuant to Section 4.118, or by authority of the City Engineer for reasons of traffic operations, efficiency, or safety.
- B. Within a Planned Development, the Development Review Board may approve a sidewalk on only one side. If the sidewalk is permitted on just one side of the street, the owners will be required to sign an agreement to an assessment in the future to construct the other sidewalk if the City Council decides it is necessary.

Response: As shown on Sheet P2.10 and P2.11, all sidewalks within the development site are at least 5 ft. wide. No adjustments are requested. These standards are met.

(.04) Bicycle Facilities. Bicycle facilities shall be provided to implement the Transportation System Plan, and may include on-street and off-street bike lanes, shared lanes, bike boulevards, and cycle tracks. The design of on-street bicycle facilities will vary according to the functional classification and the average daily traffic of the facility.

Response: The proposed street cross-sections shown on Sheet P2.10 and P2.11 comply with the street classifications and cross-sections identified in the Frog Pond West Master Plan. The Stafford Road and Willow Creek Road cross-sections include buffered bike lanes; bikes will share the vehicular lane with vehicles in the local streets. These standards are met.

(.05) Multiuse Pathways. Pathways may be in addition to, or in lieu of, a public street. Paths that are in addition to a public street shall generally run parallel to that street, and shall be designed in accordance with the Public Works Standards or as specified by the City Engineer. Paths that are in lieu of a public street shall be considered in areas only where no other public street connection options are feasible, and are subject to the following standards.

- A. Paths shall be located to provide a reasonably direct connection between likely pedestrian and bicyclist destinations. Additional standards relating to entry points, maximum length, visibility, and path lighting are provided in the Public Works Standards.
- B. To ensure ongoing access to and maintenance of pedestrian/bicycle paths, the City Engineer will require dedication of the path to the public and acceptance of the path by the City as public right-of-way; or creation of a public access easement over the path.

Response: Pedestrian and bicycle accessways are proposed through Tract E, connecting to proposed Street L to the north and SW Alder Lane to the south (within the Stafford Meadows development). Another pedestrian and bicycle connection (Tract A) is proposed to connect Willow Creek Drive and proposed Street I.

(.06) Transit Improvements

Development on sites that are adjacent to or incorporate major transit streets shall provide improvements as described in this section to any bus stop located along the site's frontage, unless waived by the City Engineer for reasons of safety or traffic operations. Transit facilities include bus stops, shelters, and related facilities. Required transit facility improvements may include the dedication of land or the provision of a public easement.[...]

Response: The site is not adjacent to nor incorporates a major transit street. These standards are not applicable.

(.07) Residential Private Access Drives. Residential Private Access Drives shall meet the following standards:

- A. Residential Private Access Drives shall provide primary vehicular access to no more than four (4) dwelling units, excluding accessory dwelling units.

Response: A portion of Street L will be a private access drive. It will provide primary vehicular access to four lots (lots 60-63). This standard is met.

- B. *The design and construction of a Residential Private Access Drive shall ensure a useful lifespan and structural maintenance schedule comparable, as determined by the City Engineer or City's Authorized Representative, to a local street constructed in conformance to current public works standards.*
1. *The design of residential private access drives shall be stamped by a professional engineer registered in the state of Oregon and shall be approved by the City Engineer or City's Authorized Representative to ensure the above requirement is met.*
 2. *Prior to issuing a certificate of occupancy for any residential dwelling unit whose primary vehicular access is from a Residential Private Access Drive the City Engineer or City's Authorized Representative shall certify construction of the Residential Private Access Drive substantially conforms the design approved by the City Engineer or City's Authorized Representative.*

Response: At the time of construction document submittal, the design shall be stamped by a professional engineer registered in the state of Oregon. These standards will be met.

- C. *Residential Private Access Drives shall be named for addressing purposes. All Residential Private Access Drives shall use the suffix "Lane", i.e. SW Oakview Lane.*
- D. *Residential Private Access Drives shall meet or exceed the standards for access drives and travel lanes established in Subsection (.08) of this Section.*
[Amended by Ord. 682, 9/1/10]

Response: Street L private access drive will meet the appropriate standards as detailed below.

- P. *Unless constrained by topography, natural resources, rail lines, freeways, existing or planned or approved development, or easements or covenants, driveways proposed as part of a residential or mixed-use development shall meet local street spacing standards and shall be constructed to align with existing or planned streets, if the driveway.*
1. *Intersects with a public street that is controlled, or is to be controlled in the planning period, by a traffic signal;*
 2. *Intersects with an existing or planned arterial or collector street; or*
 3. *Would be an extension of an existing or planned local street, or of another major driveway.*

Response: The driveways are designed to meet local spacing standards, as shown in Sheet P2.00.

(.08). Access Drive and Driveway Approach Development Standards.

Response: There is one private access drive, Street L/Tract G, proposed on the site. The access drive provisions of this section area applicable.

- A. *An access drive to any proposed development shall be designed to provide a clear travel lane free from any obstructions.*
- B. *Access drive travel lanes shall be constructed with a hard surface capable of carrying a 23-ton load.*
- C. *Where emergency vehicle access is required, approaches and driveways shall be designed and constructed to accommodate emergency vehicle apparatus and shall conform to applicable fire protection requirements. The City may restrict parking, require signage, or require other public safety improvements pursuant to the recommendations of an emergency service provider.*
- D. *Secondary or emergency access lanes may be improved to a minimum 12 feet with an all-weather surface as approved by the Fire District. All fire lanes shall be dedicated easements.*

Response: The Street L/Tract G access drive is designed to be improved with a 20-ft travel lane and will be constructed with a hard surface. A public access easement will be applied across the access drive. These standards are met.

[...]

(.09) Minimum street intersection spacing standards.

- A. *New streets shall intersect at existing street intersections so that centerlines are not offset. Where existing streets adjacent to a proposed development do not align properly, conditions shall be imposed on the development to provide for proper alignment.*
- B. *Minimum intersection spacing standards are provided in Transportation System Plan Table 3-2.*

Response: The streets within the development are local streets, with the exception of Willow Creek Drive and a portion of Frog Pond Lane, which are Collectors. Per Table 3-2 of the TSP, minimum access spacing standards along a Collector is 100 ft., and the desired access spacing is 300 ft. All proposed local street connections to Willow Creek Drive and Frog Pond Lane exceed the minimum access spacing standard of 100 ft. In most cases, access spacing is approximately 200 ft. to accommodate a side lot orientation to Collector streets while adhering as close as possible to the Frog Pond West Street Demonstration Plan.

No individual lot accesses are proposed to Willow Creek Drive or Frog Pond Lane, and access to each lot is proposed from local streets. These standards are met.

(.10) Exceptions and Adjustments. *The City may approve adjustments to the spacing standards of subsections (.08) and (.09) above through a Class II process, or as a waiver per Section 4.118(.03)(A.), where an existing connection to a City street does not meet the standards of the roadway authority, the proposed development moves in the direction of code compliance, and mitigation measures alleviate all traffic operations and safety concerns. Mitigation measures may include consolidated access (removal of one access), joint use driveways (more than one property uses same access), directional limitations (e.g., one-way), turning restrictions (e.g., right in/out only), or other mitigation. [Section 4.177 amended by Ord. 719, 6/17/13]*

Response: No exceptions or adjustments to the spacing standards are requested.

J. Section 4.180. Exceptions and Modifications - Projections into Required Yards.

(.01) *Certain non-structural architectural features are permitted to project into required yards or courts, without requiring the approval of a Variance or Reduced Setback Agreement, as follows:*

- A. *Into any required yard:*
 - 1. *Architectural features may project into the required yard not more than two (2) inches for each foot of required setback.*
 - 2. *Open, unenclosed fire escapes may project a distance not exceeding forty-eight (48) inches.*
- B. *Into any required yard, adjoining a street or tract with a private drive: [Amended by Ord. 682, 9/9/10]*
 - 1. *Architectural features may project a distance not exceeding forty (40) inches.*
 - 2. *An uncovered porch, terrace, or patio extending no more than two and one-half (2 1/2) feet above the finished elevation may extend within three (3) feet of an interior side lot line, or within ten (10) feet of a front lot line or of an exterior side lot line.*

Response: No buildings are proposed with this application. These provisions are not applicable.

K. Section 4.181. Exceptions & Modifications - Height Limits.

Except as stipulated in Sections 4.800 through 4.804, height limitations specified elsewhere in this Code shall not apply to barns, silos or other farm buildings or structures on farms; to church spires; belfries; cupolas; and domes; monuments; water towers; windmills; chimneys; smokestacks; fire and hose towers; flag poles; above-ground electric transmission, distribution, communication and signal lines, towers and poles; and properly screened mechanical and elevator structures.

Response: No listed structures are proposed at this time. These provisions are not applicable.

L. Section 4.182. Exceptions and Modifications - Setback Modifications.

In any residential zone where the average depth of at least two (2) existing front yards on adjoining lots or within one hundred fifty (150) feet of the lot in question and within the same block front is less or greater than the minimum or maximum front yard depth prescribed elsewhere in this Code, the required depth of

the front yard on such lot shall be modified. In such case, the front yard depth shall not be less than the average depth, nor more than the greater depth, of existing front yards on at least two (2) adjoining lots within one hundred and fifty (150) feet. In the case of a corner lot, the depth of the front yard may be reduced to that of the lot immediately adjoining, provided, however, that the depth of a front yard on any corner lot shall be at least ten (10) feet.

Response: No setback modifications are requested under the provisions of this section. Setback reductions are requested for Lots 19 to 21 through the Planned Development provisions of Section 4.118. These provisions are not applicable.

M. Section 4.197. Zone Changes and Amendments To This Code – Procedures.

(.01) *The following procedure shall be followed in applying for an amendment to the text of this Chapter:[...]*

Response: No zoning text amendments are proposed. This procedure is not applicable.

(.02) *In recommending approval or denial of a proposed zone map amendment, the Planning Commission or Development Review Board shall at a minimum, adopt findings addressing the following criteria:*

A. *That the application before the Commission or Board was submitted in accordance with the procedures set forth in Section 4.008, Section 4.125 (.18)(B)(2) or, in the case of a Planned Development, Section 4.140; and [Amended by Ord 557, adopted 9/5/03]*

Response: The zone map amendment is being requested concurrent with a Planned Development. The application has been submitted in accordance with the procedures set forth in Section 4.140. This criterion is met.

B. *That the proposed amendment is consistent with the Comprehensive Plan map designation and substantially complies with the applicable goals, policies and objectives, set forth in the Comprehensive Plan text; and*

Response: The Comprehensive Plan map designation for the development site is Residential Neighborhood RN, which is implemented by the requested Residential Neighborhood RN zone.

The applicable goals, policies, and objectives of the Comprehensive Plan text are addressed in Section III of this narrative. This criterion is met.

C. *In the event that the subject property, or any portion thereof, is designated as "Residential" on the City's Comprehensive Plan Map; specific findings shall be made addressing substantial compliance with Implementation Measures 4.1.4.b, d, e, q, and x of Wilsonville's Comprehensive Plan text; and [Amended by Ordinance No. 538, 2/21/02.]*

Response: The subject development site is designated "Residential" on the City's Comprehensive Plan Map. Compliance with Implementation Measures 4.1.4.b, d, e, q, and x is addressed in Section III of this narrative. This criterion is met.

D. *That the existing primary public facilities, i.e., roads and sidewalks, water, sewer and storm sewer are available and are of adequate size to serve the proposed development; or, that adequate facilities can be provided in conjunction with project development. The Planning Commission and Development Review Board shall utilize any and all means to insure that all primary facilities are available and are adequately sized; and*

Response: As addressed elsewhere in this narrative, the development will extend roads and sidewalks, water, sewer, and storm sewer to serve the proposed development. This criterion is met.

E. *That the proposed development does not have a significant adverse effect upon Significant Resource Overlay Zone areas, an identified natural hazard, or an identified geologic hazard. When Significant*

Resource Overlay Zone areas or natural hazard, and/or geologic hazard are located on or about the proposed development, the Planning Commission or Development Review Board shall use appropriate measures to mitigate and significantly reduce conflicts between the development and identified hazard or Significant Resource Overlay Zone and

Response: The site contains an SROZ area. The proposed development is a single-family residential development and conforms with the Frog Pond West Master Plan and requested RN zoning. Impacts to the SROZ will result from planned roadway improvements as identified in the Frog Pond West Master Plan and will be mitigated per the regulations of Section 4.139. This criterion is met.

F. That the applicant is committed to a development schedule demonstrating that development of the property is reasonably expected to commence within two (2) years of the initial approval of the zone change; and

Response: The zone change request is being submitted concurrently with a planned development, subdivision, partition, and site plan review application. The applicant is committed to develop the property as soon as these applications and related site development permits are approved, which is expected to occur by the summer 2020. This criterion is met.

G. That the proposed development and use(s) can be developed in compliance with the applicable development standards or appropriate conditions are attached that insure that the project development substantially conforms to the applicable development standards.

Response: The proposed development and use is single-family in accordance with the Frog Pond West Master Plan. Compliance with the applicable development standards of the RN zone is addressed Section IV.D of this narrative.

H. Adequate public facilities, services, and transportation networks are in place, or are planned to be provided concurrently with the development of the property. The applicant shall demonstrate compliance with the Transportation Planning Rule, specifically by addressing whether the proposed amendment has a significant effect on the transportation system pursuant to OAR 660-012-0060. A Traffic Impact Analysis (TIA) shall be prepared pursuant to the requirements in Section 4.133.05.(01).

Response: Adequate public facilities, services, and transportation networks are in place, or are planned to be provided concurrently with the proposed development. The development will extend sewer and water infrastructure into the development from existing lines in Boeckman Road and will provide storm drainage facilities to serve the development. See Sheet P4.00 and Appendix B Preliminary Drainage Report.

SMART routes 6 and 4 serve the site along Boeckman Road. The proposed development includes an internal roadway network per the Frog Pond Area Plan, which includes a Collector connection to Boeckman Road (Willow Creek Drive) and internal local streets. The development will provide frontage improvements along Boeckman Road and Stafford Road in coordination with the City's planned design and reconstruction of the roadway along the project boundary. A Traffic Impact Analysis was prepared by DKS at the direction of the City of Wilsonville and is included as Appendix C.

Compliance with the TPR is included in the Frog Pond Area Plan and assumes full development of the Frog Pond area. The Frog Pond Area Plan determined that the anticipated development within Frog Pond would comply with the TPR with the addition of a traffic signal at the intersection of Stafford Road and Frog Pond Lane.

This criterion is met.

(.03) If affirmative findings cannot be made for all applicable criteria listed above the Planning Commission or Development Review Board shall recommend that the proposed text or map amendment, as the case may be, be denied.

(.04) City Council action approving a change in zoning shall be in the form of a Zoning Order.

(.05) In cases where a property owner or other applicant has requested a change in zoning and the

City Council has approved the change subject to conditions, the owner or applicant shall sign a statement accepting, and agreeing to complete the conditions of approval before the zoning shall be changed.

Response: The proposed development meets the applicable criteria as described above.

VI. Land Divisions

A. Section 4.210. Application Procedure.

(.01) Pre-application conference. Prior to submission of a tentative condominium, partition, or subdivision plat, a person proposing to divide land in the City shall contact the Planning Department to arrange a pre-application conference as set forth in Section 4.010.

- A. **Preparation of Tentative Plat.** The Planning staff shall provide information regarding procedures and general information having a direct influence on the proposed development, such as elements of the Comprehensive Plan, existing and proposed streets, roads and public utilities. The applicant shall cause to be prepared a tentative plat, together with improvement plans and other supplementary material as specified in this Section. The Tentative Plat shall be prepared by an Oregon licensed professional land surveyor or engineer. An affidavit of the services of such surveyor or engineer shall be furnished as part of the submittal.
- B. **Tentative Plat Submission.** The purpose of the Tentative Plat is to present a study of the proposed subdivision to the Planning Department and Development Review Board and to receive approval or recommendations for revisions before preparation of a final Plat. The design and layout of this plan plat shall meet the guidelines and requirements set forth in this Code. The Tentative Plat shall be submitted to the Planning Department with the following information:
1. Site development application form completed and signed by the owner of the land or a letter of authorization signed by the owner. A preliminary title report or other proof of ownership is to be included with the application form.
 2. Application fees as established by resolution of the City Council.
 3. Ten (10) copies and one (1) sepia or suitable reproducible tracing of the Tentative Plat shall be submitted with the application. Paper size shall be eighteen inch (18") by twenty-four inch (24"), or such other size as may be specified by the City Engineer.
 4. Name of the subdivision. No subdivision name shall duplicate or resemble the name of any other subdivision in Clackamas or Washington County. Names may be checked through the county offices.
 5. Names, addresses, and telephone numbers of the owners and applicants, and engineer or surveyor.
 6. Date, north point and scale of drawing.
 7. Location of the subject property by Section, Township, and Range.
 8. Legal road access to subject property shall be indicated as City, County, or other public roads.
 9. Vicinity map showing the relationship to the nearest major highway or street.
 10. Lots: Dimensions of all lots, minimum lot size, average lot size, and proposed lot and block numbers.
 11. Gross acreage in proposed plat.
 12. Proposed uses of the property, including sites, if any, for multi-family dwellings, shopping centers, churches, industries, parks, and playgrounds or other public or semi-public uses.
 13. Improvements: Statement of the improvements to be made or installed including streets, private drives, sidewalks, lighting, tree planting, and times such improvements are to be made or completed. [Amended by Ord. 682, 9/9/10]
 14. Trees. Locations, types, sizes, and general conditions of all existing trees, as required in Section 4.600.
 15. Utilities such as electrical, gas, telephone, on and abutting the tract.
 16. Easements: Approximate width, location, and purpose of all existing and proposed easements on, and known easements abutting the tract.
 17. Deed Restrictions: Outline of proposed deed restrictions, if any.
 18. Written Statement: Information which is not practical to be shown on the maps may be shown in separate statements accompanying the Tentative Plat.

19. If the subdivision is to be a "Planned Development," a copy of the proposed Home Owners Association By-Laws must be submitted at the time of submission of the application. The Tentative Plat shall be considered as the Stage I Preliminary Plan. The proposed By-Laws must address the maintenance of any parks, common areas, or facilities.
 20. Any plat bordering a stream or river shall indicate areas subject to flooding and shall comply with the provisions of Section 4.172.
 21. Proposed use or treatment of any property designated as open space by the City of Wilsonville.
 22. A list of the names and addresses of the owners of all properties within 250 feet of the subject property, printed on self-adhesive mailing labels. The list shall be taken from the latest available property ownership records of the Assessor's office of the affected county.
 23. A completed "liens and assessments" form, provided by the City Finance Department.
 24. Locations of all areas designated as a Significant Resource Overlay Zone by the City, as well as any wetlands shall be shown on the tentative plat.
 25. Locations of all existing and proposed utilities, including but not limited to domestic water, sanitary sewer, storm drainage, and any private utilities crossing or intended to serve the site. Any plans to phase the construction or use of utilities shall be indicated. [Amended by Ord. 682, 9/9/10]
 26. A traffic study, prepared under contract with the City, shall be submitted as part of the tentative plat application process, unless specifically waived by the Community Development Director.
- C. Action on proposed tentative plat:
[...]
- D. Land division phases to be shown. Where the applicant intends to develop the land in phases, the schedule of such phasing shall be presented for review at the time of the tentative plat. In acting on an application for tentative plat approval, the Planning Director or Development Review Board may set time limits for the completion of the phasing schedule which, if not met, shall result in an expiration of the tentative plat approval.
- E. Remainder tracts to be shown as lots or parcels. Tentative plats shall clearly show all affected property as part of the application for land division. All remainder tracts, regardless of size, shall be shown and counted among the parcels or lots of the division.
[...]

Response: A Subdivision is requested to create the lots proposed by the Planned Development. The information described above is included with this submittal. A Preliminary Plat is included as Sheet 3.00; a Preliminary Utility Plan is included as Sheet P4.00; a Tree Removal and Protection Plan is included as Sheet L1.00; Preliminary Street Cross-Sections are included as Sheets P2.10 and P2.11; a TIA is included as Appendix C; and draft Homeowner Association Bylaws and CC&Rs are included as Appendix H. The boundaries of the SROZ on site and proposed development/mitigation are shown Appendix E Significant Resource Impact Report.

B. Section 4.236. General Requirements - Streets.

(.01) *Conformity to the Transportation System Plan. Land divisions shall conform to and be in harmony with the Transportation Systems Plan, the Bicycle and Pedestrian Master Plan, and the Parks and Recreation Master Plan. [Amended by Ord. #719, 6/17/13]*

Response: As confirmed by the TIS, the proposed street plan conforms to the Transportation System Plan and the Frog Pond West Master Plan.

The 2006 Bicycle and Pedestrian Master Plan identifies an improvement, Community Walkway/Bikeway C10, within the site area. The 2017 Frog Pond West Master Plan incorporates a Bicycle and Pedestrian Framework (Figure 17), which identifies bicycle lanes and sidewalks along Willow Creek Drive and Stafford Road adjacent to the project frontage. The development will construct Willow Creek Drive and the bicycle/pedestrian facilities associated with it. The Stafford Road facilities will be constructed as part of the City's Stafford Road project.

The 2018 Parks and Recreation Master Plan identifies a Future School and a Future Outdoor Recreation Location (defined in the Frog Pond West Master Plan as a neighborhood park) south of the subject site and east of the future school site. the Frog Pond West area. The 2017 Frog Pond West Master Plan

defines the types of parks and open space anticipated within the Frog Pond West area. Proposed street improvements will provide access to the future neighborhood park location, identified southwest of the site.

(.02) Relation to Adjoining Street System.

- A. *A land division shall provide for the continuation of the principal streets existing in the adjoining area, or of their proper projection when adjoining property is not developed, and shall be of a width not less than the minimum requirements for streets set forth in these regulations. Where, in the opinion of the Planning Director or Development Review Board, topographic conditions make such continuation or conformity impractical, an exception may be made. In cases where the Board or Planning Commission has adopted a plan or plat of a neighborhood or area of which the proposed land division is a part, the subdivision shall conform to such adopted neighborhood or area plan.*
- B. *Where the plat submitted covers only a part of the applicant's tract, a sketch of the prospective future street system of the unsubmitted part shall be furnished and the street system of the part submitted shall be considered in the light of adjustments and connections with the street system of the part not submitted.*
- C. *At any time when an applicant proposes a land division and the Comprehensive Plan would allow for the proposed lots to be further divided, the city may require an arrangement of lots and streets such as to permit a later resubdivision in conformity to the street plans and other requirements specified in these regulations.*

Response: As shown in Sheet P8.00, the proposed street network is designed for future continuation per the Frog Pond West Master Plan. These standards are met.

(.03) All streets shall conform to the standards set forth in Section 4.177 and the block size requirements of the zone.

Response: The standards of Section 4.177 are addressed in Section V.I of this narrative. These standards are met.

(.04) Creation of Easements: *The Planning Director or Development Review Board may approve an easement to be established without full compliance with these regulations, provided such an easement is the only reasonable method by which a portion of a lot large enough to allow partitioning into two (2) parcels may be provided with vehicular access and adequate utilities. If the proposed lot is large enough to divide into more than two (2) parcels, a street dedication may be required. [Amended by Ord. 682, 9/9/10]*

Response: No street easements are proposed. This standard is not applicable.

(.05) Topography: *The layout of streets shall give suitable recognition to surrounding topographical conditions in accordance with the purpose of these regulations.*

Response: The street layout recognizes topographical conditions, including the location of the SROZ on site. This standard is met.

(.06) Reserve Strips: *The Planning Director or Development Review Board may require the applicant to create a reserve strip controlling the access to a street. Said strip is to be placed under the jurisdiction of the City Council, when the Director or Board determine that a strip is necessary:*

- A. *To prevent access to abutting land at the end of a street in order to assure the proper extension of the street pattern and the orderly development of land lying beyond the street; or*
- B. *To prevent access to the side of a street on the side where additional width is required to meet the right-of-way standards established by the City; or*
- C. *To prevent access to land abutting a street of the land division but not within the tract or parcel of land being divided; or*
- D. *To prevent access to land unsuitable for building development.*

Response: No reserve strip is proposed. The applicant acknowledges that the DRB may require that the applicant create a reserve strip. This standard is met.

(.07) Future Expansion of Street: *When necessary to give access to, or permit a satisfactory future division of, adjoining land, streets shall be extended to the boundary of the land division and the resulting dead-end street may be approved without a turn-around. Reserve strips and street plugs shall be required to preserve the objective of street extension. Notification that the street is planned for future extension shall be posted on the stub street. [Amended by Ord. #719, 6/17/13]*

Response: Willow Creek Drive, Larkspur Terr, Marigold Terr, and Brisband Street have been extended to the boundaries of the site and are intended for future extension. For that reason, no turnarounds are proposed for these streets. The applicant will comply with any requirements related to signage street extension objectives. This standard is met.

(.08) Existing Streets: *Whenever existing streets adjacent to or within a tract are of inadequate width, additional right-of-way shall conform to the designated width in this Code or in the Transportation Systems Plan.*

Response: Stafford Road to the east of the site is of inadequate width. The project will dedicate 12 ft. of additional right-of-way to the street. Frog Pond Lane to the north of the site is of inadequate width. The project will dedicate 21.5 ft of additional right-of-way to the street. This standard is met.

(.09) Street Names: *No street names will be used which will duplicate or be confused with the names of existing streets, except for extensions of existing streets. Street names and numbers shall conform to the established name system in the City, and shall be subject to the approval of the City Engineer.*

Response: The Gateway Collector has been identified by the Frog Pond West Master Plan as Willow Creek Drive, and Larkspur Terrace, Marigold Terrace, and Brisband Lane have been established by previous development applications. Streets H, I, K, L, and M will conform to the City's established name system and will be subject to approval by the City Engineer. This standard is met.

C. Section 4.237. General Requirements – Other.

(.01) Blocks:

- A. *The length, width, and shape of blocks shall be designed with due regard to providing adequate building sites for the use contemplated, consideration of needs for convenient access, circulation, control, and safety of pedestrian, bicycle, and motor vehicle traffic, and recognition of limitations and opportunities of topography.*
- B. *Sizes: Blocks shall not exceed the sizes and lengths specified for the zone in which they are located unless topographical conditions or other physical constraints necessitate larger blocks. Larger blocks shall only be approved where specific findings are made justifying the size, shape, and configuration.*

Response: The length, width, and shape of blocks have been designed to accommodate the development established by the Frog Pond West Master Plan and to comply with the standards of Section 4.177. These standards are addressed in section V.I of this narrative. The site is located within the RN zone and is also subject to the block, access, and connectivity standards of Section 4.127(.10). Those standards are addressed in Section IV.C of this narrative. These standards are met.

(.02) Easements:

- A. *Utility lines. Easements for sanitary or storm sewers, drainage, water mains, electrical lines or other public utilities shall be dedicated wherever necessary. Easements shall be provided consistent with the City's Public Works Standards, as specified by the City Engineer or Planning Director. All of the public utility lines within and adjacent to the site shall be installed within the public right-of-way or easement; with underground services extending to the private parcel constructed in conformance to the City's Public Works Standards. All franchise utilities shall be installed within a public utility easement. All utilities shall have appropriate easements for construction and maintenance purposes. [Amended by Ord. 682, 9/9/10]*
- B. *Water courses. Where a land division is traversed by a water course, drainage way, channel or stream, there shall be provided a storm water easement or drainage right-of-way conforming substantially with the lines of the water course, and such further width as will be adequate for the*

purposes of conveying storm water and allowing for maintenance of the facility or channel. Streets or parkways parallel to water courses may be required.

Response: Public utilities are placed within public rights-of-way or within public utility easements (PUE) adjacent to the public streets. There are proposed stormwater facility easements where these facilities are located on private property and are intended to be shared between more than one lot. The Willow Creek stream and SROZ area has been placed within Tract B and the tree grove has been placed within Tract E.

(.03) Pedestrian and bicycle pathways. *An improved public pathway shall be required to transverse the block near its middle if that block exceeds the length standards of the zone in which it is located.*

- A. *Pathways shall be required to connect to cul-de-sacs or to pass through unusually shaped blocks.*
- B. *Pathways required by this subsection shall have a minimum width of ten (10) feet unless they are found to be unnecessary for bicycle traffic, in which case they are to have a minimum width of six (6) feet.*

Response: Per Section 4.124(.06), the maximum block length for new Planned Development land divisions is 330 ft. Two of the proposed blocks exceeds this length. Pedestrian connections are proposed in two locations, one connecting Street H to SW Alder Lane to the south (within the Frog Pond Meadows development) through Tract E and the second connecting Willow Creek Drive to Street I via Tract A; per the standards above, the proposed pathways are 10 ft. wide.

(.04) Tree planting. *Tree planting plans for a land division must be submitted to the Planning Director and receive the approval of the Director or Development Review Board before the planting is begun. Easements or other documents shall be provided, guaranteeing the City the right to enter the site and plant, remove, or maintain approved street trees that are located on private property.*

Response: Tree planting plans are included as Sheets L2.00 and L2.10. Proposed street trees are located within public right-of-way and additional easements should not be needed. This standard is met.

(.05) Lot Size and shape. *The lot size, width, shape and orientation shall be appropriate for the location of the land division and for the type of development and use contemplated. Lots shall meet the requirements of the zone where they are located.*

- A. *In areas that are not served by public sewer, an on-site sewage disposal permit is required from the City. If the soil structure is adverse to on-site sewage disposal, no development shall be permitted until sewer service can be provided.*
- B. *Where property is zoned or deeded for business or industrial use, other lot widths and areas may be permitted at the discretion of the Development Review Board. Depth and width of properties reserved or laid out for commercial and industrial purposes shall be adequate to provide for the off-street service and parking facilities required by the type of use and development contemplated.*
- C. *In approving an application for a Planned Development, the Development Review Board may waive the requirements of this section and lot size, shape, and density shall conform to the Planned Development conditions of approval.*

Response: The site is served by public sewer, and no on-site sewage disposal is proposed. The property is zoned for residential purposes and is subject to an application for a Planned Development. The site is located within the RN zone and is subject to the standards of that zone. The proposed lots meet the dimensional standards of the RN zone and the R-7 and R-5 sub-districts. These standards are met.

(.06) Access. *The division of land shall be such that each lot shall have a minimum frontage on a street or private drive, as specified in the standards of the relative zoning districts. This minimum frontage requirement shall apply with the following exceptions:*

- A. *A lot on the outer radius of a curved street or tract with a private drive, or facing the circular end of a cul-de-sac shall have frontage of not less than twenty-five (25) feet upon a street or tract with a private drive, measured on the arc.*
- B. *The Development Review Board may waive lot frontage requirements where in its judgment the waiver of frontage requirements will not have the effect of nullifying the intent and purpose of this*

regulation or if the Board determines that another standard is appropriate because of the characteristics of the overall development.
[Section 4.237(.06) amended by Ord. 682, 9/9/10]

Response: The minimum lot width in the RN zone/R-7 subdistrict is 35 ft; and the minimum lot width in the RN zone/R-5 subdistrict is 35 ft. As detailed in the response to Section 4.127 and shown on Sheet P3.00, each lot has frontage of at least 35 ft. on a public street. These standards are met.

(.07) Through lots. *Through lots shall be avoided except where essential to provide separation of residential development from major traffic arteries or adjacent non-residential activity or to overcome specific disadvantages of topography and orientation. A planting screen easement of at least ten (10) feet, across which there shall be no access, may be required along the line of lots abutting such a traffic artery or other disadvantageous use. Through lots with planting screens shall have a minimum average depth of one hundred (100) feet. The Development Review Board may require assurance that such screened areas be maintained as specified in Section 4.176.*

Response: Four through lots are proposed. Lots 28-31 have frontage on both Frog Pond Lane and Street M. This block is different from the block to the east because it is bounded by Willow Creek Drive on the west and Frog Pond Lane to the north. Because both Frog Pond Lane and Willow Creek Drive are Collector roads, no driveway access is allowed from street.

Given these constraints, the alternative orientation for these lots would be east-west with alley access from Frog Pond Lane and Street M, which would require a mid-block curb cut on both streets and an exception to the minimum intersection spacing standards of the Public Works Standards.

The proposed configuration orients the lots north-south with access from Street M, a local street. This orientation minimizes curb cuts and intersections on Frog Pond Lane and provides deeper lots to accommodate through lot setback requirements.

(.08) Lot side lines. *The side lines of lots, as far as practicable for the purpose of the proposed development, shall run at right angles to the street or tract with a private drive upon which the lots face.*
[Amended by Ord. 682, 9/9/10]

Response: All side lot lines run at right angles to the street or the tract upon which they face. This standard is met.

(.09) Large lot land divisions. *In dividing tracts which at some future time are likely to be re-divided, the location of lot lines and other details of the layout shall be such that re-division may readily take place without violating the requirements of these regulations and without interfering with the orderly development of streets. Restriction of buildings within future street locations shall be made a matter of record if the Development Review Board considers it necessary.*

Response: No future development tracts are proposed.

(.10) Building line. *The Planning Director or Development Review Board may establish special building setbacks to allow for the future re-division or other development of the property or for other reasons specified in the findings supporting the decision. If special building setback lines are established for the land division, they shall be shown on the final plat.*

Response: No special building setbacks are proposed.

(.11) Build-to line. *The Planning Director or Development Review Board may establish special build to lines for the development, as specified in the findings and conditions of approval for the decision. If special build-to lines are established for the land division, they shall be shown on the final plat.*

Response: There is no maximum setback in the RN zones, and no build-to-lines are proposed.

(.12) Land for public purposes. *The Planning Director or Development Review Board may require property to be reserved for public acquisition, or irrevocably offered for dedication, for a specified period*

of time.

Response: The City has not identified any requirements for property to be reserved for public acquisition. The development will dedicate right-of-way for the public street network.

(.13) Corner lots. *Lots on street intersections shall have a corner radius of not less than ten (10) feet.*

Response: As shown on Sheet P3.00, lots on street intersections have corner radii of at least 20 ft. This standard is met.

D. Section 4.262. Improvements - Requirements.

(.01) Streets. *Streets within or partially within the development shall be graded for the entire right-of-way width, constructed and surfaced in accordance with the Transportation Systems Plan and City Public Works Standards. Existing streets which abut the development shall be graded, constructed, reconstructed, surfaced or repaired as determined by the City Engineer.*

(.02) Curbs. *Curbs shall be constructed in accordance with standards adopted by the City.*

(.03) Sidewalks. *Sidewalks shall be constructed in accordance with standards adopted by the City.*

Response: As shown on Sheets P2.10, P2.11 and P5.00, with the exception of SW Brisband St and the western portion of Street K, streets will be graded, constructed, and surfaced according to the TSP, the cross-sections incorporated into the Frog Pond West Master Plan, and the City's Public Works Standards as modified by the City Engineer. These standards are met.

(.04) Sanitary sewers. *When the development is within two hundred (200) feet of an existing public sewer main, sanitary sewers shall be installed to serve each lot or parcel in accordance with standards adopted by the City. When the development is more than two hundred (200) feet from an existing public sewer main, the City Engineer may approve an alternate sewage disposal system.*

(.05) Drainage. *Storm drainage, including detention or retention systems, shall be provided as determined by the City Engineer.*

Response: The proposed development will be served by public sanitary sewer. Storm drainage systems are being provided as outlined in the City's Site Assessment and Planning standards. See Appendix B and Sheet P4.00. These standards are met.

(.06) Underground utility and service facilities. *All new utilities shall be subject to the standards of Section 4.300 (Underground Utilities). The developer shall make all necessary arrangements with the serving utility to provide the underground services in conformance with the City's Public Works Standards.*

Response: The standards of Section 4.300 are addressed in Section VII of this narrative. These standards are met.

(.07) Streetlight standards. *Streetlight standards shall be installed in accordance with regulations adopted by the City.*

Response: Streetlights will be installed per the Frog Pond West Master Plan and regulations adopted by the City.

(.08) Street signs. *Street name signs shall be installed at all street intersections and dead-end signs at the entrance to all dead-end streets and cul-de-sacs in accordance with standards adopted by the City. Other signs may be required by the City Engineer.*

Response: Street signs will be installed per City standards.

(.09) Monuments. *Monuments shall be placed at all lot and block corners, angle points, points of curves in streets, at intermediate points and shall be of such material, size and length as required by State Law. Any monuments that are disturbed before all improvements are completed by the developer and accepted by the City shall be replaced to conform to the requirements of State Law.*

Response: Monuments will be placed per State, Clackamas County, and City requirements.

(.10) Water. *Water mains and fire hydrants shall be installed to serve each lot in accordance with City standards.*

Response: Water mains and fire hydrants are proposed to serve each lot in accordance with City and Fire Department standards. See Sheet P4.00.

VII. Underground Utilities

A. Section 4.300 General.

(.01) *The City Council deems it reasonable and necessary in order to accomplish the orderly and desirable development of land within the corporate limits of the City, to require the underground installation of utilities in all new developments.*

(.02) *After the effective date of this Code, the approval of any development of land within the City will be upon the express condition that all new utility lines, including but not limited to those required for power, communication, street lighting, gas, cable television services and related facilities, shall be placed underground.*

(.03) *The construction of underground utilities shall be subject to the City's Public Works Standards and shall meet applicable requirements for erosion control and other environmental protection.*

Response: The proposed development is subject to the requirements of this section.

B. Section 4.320. Requirements.

(.01) *The developer or subdivider shall be responsible for and make all necessary arrangements with the serving utility to provide the underground services (including cost of rearranging any existing overhead facilities). All such underground facilities as described shall be constructed in compliance with the rules and regulations of the Public Utility Commission of the State of Oregon relating to the installation and safety of underground lines, plant, system, equipment and apparatus.*

(.02) *The location of the buried facilities shall conform to standards supplied to the subdivider by the City. The City also reserves the right to approve location of all surface-mounted transformers.*

(.03) *Interior easements (back lot lines) will only be used for storm or sanitary sewers, and front easements will be used for other utilities unless different locations are approved by the City Engineer. Easements satisfactory to the serving utilities shall be provided by the developer and shall be set forth on the plat.*

Response: New utilities will be installed underground in accordance with City and other agency requirements. These standards are met.

VIII. Site Design Review

A. Section 4.400. Purpose.

(.01) *Excessive uniformity, inappropriateness or poor design of the exterior appearance of structures and signs and the lack of proper attention to site development and landscaping in the business, commercial, industrial and certain residential areas of the City hinders the harmonious development of the City, impairs the desirability of residence, investment or occupation in the City, limits the opportunity to attain the optimum use in value and improvements, adversely affects the stability and value of property, produces degeneration of property in such areas and with attendant deterioration of conditions affecting the peace, health and welfare, and destroys a proper relationship between the taxable value of property and the cost of municipal services therefor.*

(.02) *The City Council declares that the purposes and objectives of site development requirements and the site design review procedure are to:*

A. *Assure that Site Development Plans are designed in a manner that insures proper functioning of the site and maintains a high quality visual environment.*

- B. *Encourage originality, flexibility and innovation in site planning and development, including the architecture, landscaping and graphic design of said development;*
- C. *Discourage monotonous, drab, unsightly, dreary and inharmonious developments;*
- D. *Conserve the City's natural beauty and visual character and charm by assuring that structures, signs and other improvements are properly related to their sites, and to surrounding sites and structures, with due regard to the aesthetic qualities of the natural terrain and landscaping, and that proper attention is given to exterior appearances of structures, signs and other improvements;*
- E. *Protect and enhance the City's appeal and thus support and stimulate business and industry and promote the desirability of investment and occupancy in business, commercial and industrial purposes;*
- F. *Stabilize and improve property values and prevent blighted areas and, thus, increase tax revenues;*
- G. *Insure that adequate public facilities are available to serve development as it occurs and that proper attention is given to site planning and development so as to not adversely impact the orderly, efficient and economic provision of public facilities and services.*
- H. *Achieve the beneficial influence of pleasant environments for living and working on behavioral patterns and, thus, decrease the cost of governmental services and reduce opportunities for crime through careful consideration of physical design and site layout under defensible space guidelines that clearly define all areas as either public, semi-private, or private, provide clear identity of structures and opportunities for easy surveillance of the site that maximize resident control of behavior -- particularly crime;*
- I. *Foster civic pride and community spirit so as to improve the quality and quantity of citizen participation in local government and in community growth, change and improvements;*
- J. *Sustain the comfort, health, tranquility and contentment of residents and attract new residents by reason of the City's favorable environment and, thus, to promote and protect the peace, health and welfare of the City.*

Response: The City Council adopted the Frog Pond West Master Plan to guide development in this area. The Master Plan addresses visual appeal, infrastructure provisions, and protection of the natural areas within the development site. The proposed development is intended to advance the vision for Frog Pond West by incorporating the natural areas on site, providing attractive streetscapes, and enhancing the existing neighborhood to the south and the future school and park to the west and north. The intent of this purpose statement is incorporated into the proposed site design.

Per City staff, the project elements subject to the standards of this section include: tracts and their landscaping; landscaping in the public right-of-way; the brick wall along Stafford Road; retaining walls; and park furnishings.

B. Section 4.421. *Criteria and Application of Design Standards.*

(.01) *The following standards shall be utilized by the Board in reviewing the plans, drawings, sketches and other documents required for Site Design Review. These standards are intended to provide a frame of reference for the applicant in the development of site and building plans as well as a method of review for the Board. These standards shall not be regarded as inflexible requirements. They are not intended to discourage creativity, invention and innovation. The specifications of one or more particular architectural styles is not included in these standards. (Even in the Boones Ferry Overlay Zone, a range of architectural styles will be encouraged.)*

- A. *Preservation of Landscape. The landscape shall be preserved in its natural state, insofar as practicable, by minimizing tree and soils removal, and any grade changes shall be in keeping with the general appearance of neighboring developed areas.*

Response: Tract B includes the existing Willow Creek drainage and riparian area, and Tract E includes mature oak and ponderosa pine trees. No grade changes are proposed for Tract B and the trees in Tract E will be protected and preserved. This standard is met.

- B. *Relation of Proposed Buildings to Environment. Proposed structures shall be located and designed to assure harmony with the natural environment, including protection of steep slopes, vegetation and other naturally sensitive areas for wildlife habitat and shall provide proper buffering from less intensive uses in accordance with Sections 4.171 and 4.139 and 4.139.5. The achievement of such*

relationship may include the enclosure of space in conjunction with other existing buildings or other proposed buildings and the creation of focal points with respect to avenues of approach, street access or relationships to natural features such as vegetation or topography.

Response: Structures proposed for the site include a brick wall along the Stafford Road frontage and retaining walls.

Sheet L3.10 provides design details for the Stafford Road wall. The brick wall along Stafford Road was designed in accordance with the Frog Pond Master Plan and consists of a 4-ft. brick wall with a 2-ft. wrought iron fence on top. Brick columns with concrete caps are placed at regular intervals along the site frontage and ends at the southern edge of Lot 60 to allow visual and physical access to the open space.

This standard is met.

C. Drives, Parking and Circulation. With respect to vehicular and pedestrian circulation, including walkways, interior drives and parking, special attention shall be given to location and number of access points, general interior circulation, separation of pedestrian and vehicular traffic, and arrangement of parking areas that are safe and convenient and, insofar as practicable, do not detract from the design of proposed buildings and structures and the neighboring properties.

Response: The drives, parking, and circulation within the development is subject to the requirements of the RN Zone, the Planned Development overlay, and Land Division requirements and are not subject to Site Design Review. This standard is not applicable.

D. Surface Water Drainage. Special attention shall be given to proper site surface drainage so that removal of surface waters will not adversely affect neighboring properties of the public storm drainage system.

Response: See Sheet P2.00 for the location of LIDA facilities within the planter strips of the public streets and Sheet P4.00 for the location of stormwater facilities within tracts. See Sheet L2.40 for details of LIDA facility planting; and see Appendix B for the Preliminary Drainage Plan.

This standard is met.

E. Utility Service. Any utility installations above ground shall be located so as to have a harmonious relation to neighboring properties and site. The proposed method of sanitary and storm sewage disposal from all buildings shall be indicated.

Response: As shown on Sheet P4.00, each lot will be served by a sanitary sewer line. Storm sewage disposal is provided by a storm drain system connecting to each on-site stormwater facility. This standard is met.

F. Advertising Features. In addition to the requirements of the City's sign regulations, the following criteria should be included: the size, location, design, color, texture, lighting and materials of all exterior signs and outdoor advertising structures or features shall not detract from the design of proposed buildings and structures and the surrounding properties.

Response: No signs are proposed with this application. This standard is not applicable.

G. Special Features. Exposed storage areas, exposed machinery installations, surface areas, truck loading areas, utility buildings and structures and similar accessory areas and structures shall be subject to such setbacks, screen plantings or other screening methods as shall be required to prevent their being incongruous with the existing or contemplated environment and its surrounding properties. Standards for screening and buffering are contained in Section 4.176.

Response: The proposed development is a single-family residential development, and no storage areas, machinery installations, surface areas, truck loading areas, or utility buildings or structures are proposed. This standard is not applicable.

(.02) *The standards of review outlined in Sections (a) through (g) above shall also apply to all accessory buildings, structures, exterior signs and other site features, however related to the major buildings or structures.*

Response: No accessory buildings, signs, or other site features are proposed. Proposed structures are addressed above.

(.03) *The Board shall also be guided by the purpose of Section 4.400, and such objectives shall serve as additional criteria and standards.*

Response: The purpose of Section 4.400 is addressed earlier in this section. This standard is met.

(.04) *Conditional application. The Planning Director, Planning Commission, Development Review Board or City Council may, as a Condition of Approval for a zone change, subdivision, land partition, variance, conditional use, or other land use action, require conformance to the site development standards set forth in this Section.*

Response: This application includes a zone change and planned development, among other applications, and includes responses to the site development standards of those sections. Per City staff, the project elements subject to Site Design Review and the standards of this chapter are tracts and their landscaping; landscaping in the public right-of-way, and the Stafford Road wall.

(.05) *The Board may attach certain development or use conditions in granting an approval that are determined necessary to insure the proper and efficient functioning of the development, consistent with the intent of the Comprehensive Plan, allowed densities and the requirements of this Code. In making this determination of compliance and attaching conditions, the Board shall, however, consider the effects of this action on the availability and cost of needed housing. The provisions of this section shall not be used in such a manner that additional conditions either singularly or accumulatively have the effect of unnecessarily increasing the cost of housing or effectively excluding a needed housing type.*

Response: The development has been designed in accordance with the Frog Pond West Master Plan, which is part of, and consistent with, the Comprehensive Plan. The proposed development plan is consistent with the densities and other requirements established by the Frog Pond West Master Plan and the implementing RN zone. No additional conditions are needed to ensure that the development remains consistent with the City's adopted policies.

(.06) *The Board or Planning Director may require that certain paints or colors of materials be used in approving applications. Such requirements shall only be applied when site development or other land use applications are being reviewed by the City.*

- A. *Where the conditions of approval for a development permit specify that certain paints or colors of materials be used, the use of those paints or colors shall be binding upon the applicant. No Certificate of Occupancy shall be granted until compliance with such conditions has been verified.*
- B. *Subsequent changes to the color of a structure shall not be subject to City review unless the conditions of approval under which the original colors were set included a condition requiring a subsequent review before the colors could be changed.*

Response: The proposed development is attached and detached single-family residential development. No paints or colors of materials are identified in the design standards of the Frog Pond West Master Plan. It is anticipated that building elevations, including paint and material colors, will be evaluated at the time of building permit review.

C. Section 4.440. Procedure.

(.01) **Submission of Documents.** *A prospective applicant for a building or other permit who is subject to site design review shall submit to the Planning Department, in addition to the requirements of Section 4.035, the following:*

- A. *A site plan, drawn to scale, showing the proposed layout of all structures and other improvements including, where appropriate, driveways, pedestrian walks, landscaped areas, fences, walls, off-street parking and loading areas, and railroad tracks. The site plan shall indicate the location of entrances and exits and direction of traffic flow into and out of off-street parking and loading areas, the location of each parking space and each loading berth and areas of turning and maneuvering vehicles. The site plan shall indicate how utility service and drainage are to be provided.*

Response: Sheet P2.00 shows the proposed layout of improvements, driveways, pedestrian walks, fences, and walls. Sheets L2.00 – L2.40 shows landscaped areas. Sheets L3.00 and L3.10 show the Stafford Road wall and monument sign.

- B. *A Landscape Plan, drawn to scale, showing the location and design of landscaped areas, the variety and sizes of trees and plant materials to be planted on the site, the location and design of landscaped areas, the varieties, by scientific and common name, and sizes of trees and plant materials to be retained or planted on the site, other pertinent landscape features, and irrigation systems required to maintain trees and plant materials. An inventory, drawn at the same scale as the Site Plan, of existing trees of 4" caliper or more is required. However, when large areas of trees are proposed to be retained undisturbed, only a survey identifying the location and size of all perimeter trees in the mass is necessary.*

Response: Sheet L1.10 provides an inventory of existing trees. Sheets L2.00– L2.40 shows landscaped areas and landscape schedules and Sheet L3.20 shows planting details.

- C. *Architectural drawings or sketches, drawn to scale, including floor plans, in sufficient detail to permit computation of yard requirements and showing all elevations of the proposed structures and other improvements as they will appear on completion of construction. Floor plans shall also be provided in sufficient detail to permit computation of yard requirements based on the relationship of indoor versus outdoor living area, and to evaluate the floor plan's effect on the exterior design of the building through the placement and configuration of windows and doors.*

Response: Example building elevations are included as Appendix I.

- D. *A Color Board displaying specifications as to type, color, and texture of exterior surfaces of proposed structures. Also, a phased development schedule if the development is constructed in stages.*
E. *A sign Plan, drawn to scale, showing the location, size, design, material, color and methods of illumination of all exterior signs.*
F. *The required application fee.*

Response: A color board is not included, as exterior dwelling design will be evaluated at the time of building permit review. No signs are proposed at this time. The required application fee has been submitted with this application.

IX. Tree Preservation and Protection

- A. Section 4.600.20. Applicability of Subchapter

(.01) *The provisions of this subchapter apply to the United States and the State of Oregon, and to their agencies and subdivisions, including the City of Wilsonville, and to the employees and agents thereof.*

(.02) *By this subchapter, the City of Wilsonville regulates forest practices on all lands located within its urban growth boundary, as provided by ORS 527.722.*

(.03) *The provisions of this subchapter apply to all land within the City limits, including property designated as a Significant Resource Overlay Zone or other areas or trees designated as protected by the Comprehensive Plan, City zoning map, or any other law or ordinance; except that any tree activities in the Willamette River Greenway that are regulated by the provisions of WC 4.500 - 4.514 and requiring a conditional use permit shall be reviewed by the DRB under the application and review procedures set forth for Tree Removal Permits.*

Response: The site contains the Willow Creek SROZ area and this chapter is applicable.

Section 4.600.30. Tree Removal Permit Required

(.01) Requirement Established. No person shall remove any tree without first obtaining a Tree Removal Permit (TRP) as required by this subchapter.

(.02) Tree Removal Permits will be reviewed according to the standards provided for in this subchapter, in addition to all other applicable requirements of Chapter 4.

(.03) Although tree activities in the Willamette River Greenway are governed by WC 4.500 - 4.514, the application materials required to apply for a conditional use shall be the same as those required for a Type B or C permit under this subchapter, along with any additional materials that may be required by the Planning Department. An application for a Tree Removal Permit under this section shall be reviewed by the Development Review Board.

Response: As shown on Sheet L1.00 and described in Appendix F, the development will remove trees and a Tree Removal Permit is required.

Section 4.600.40. Exceptions

(.01) Exception from requirement. Notwithstanding the requirement of WC 4.600.30(1), the following activities are allowed without a Tree Removal Permit, unless otherwise prohibited:

- A. Agriculture, Commercial Tree Farm or Orchard. Tree removal or transplanting occurring during use of land for commercial purposes for agriculture, orchard(s), or tree farm(s), such as Christmas tree production.*
- B. Emergencies. Actions made necessary by an emergency, such as tornado, windstorm, flood, freeze, utility damage or other like disasters, in order to prevent imminent injury or damage to persons or property or restore order and it is impractical due to circumstances to apply for a permit.
 - 1. When an emergency has occurred, a Tree Removal Permit must be applied for within thirty (30) days following the emergency tree removal under the application procedures established in this subchapter.*
 - 2. In addition to complying with the permit application requirements of this subchapter, an applicant shall provide a photograph of any tree removed and a brief description of the conditions that necessitated emergency removal. Such photograph shall be supplied within seven days of application for a permit. Based on good cause shown arising out of the emergency, the Planning Director may waive any or all requirements of this section.*
 - 3. Where a Type A Permit is granted for emergency tree removal, the permittee is encouraged to apply to the City Tree Fund for replanting assistance.**
- C. City utility or road work in utility or road easements, in utility or road right-of-ways, or in public lands. However, any trees removed in the course of utility work shall be mitigated in accordance with the standards of this subchapter.*
- D. Nuisance abatement. The City is not required to apply for a Tree Removal Permit to undertake nuisance abatement as provided in WC 6.200 et seq. However, the owner of the property subject to nuisance abatement is subject to all the provisions of this subchapter in addition to the requirements of WC 6.200 et seq.*
- E. The removal of filbert trees is exempt from the requirements of this subchapter.*
- F. The Charbonneau District, including its golf course, is exempt from the requirements of WC 4.600.30(1) on the basis that by and through the current CC&R's of the Charbonneau Country Club, the homeowners' association complies with all requirements of WC 4.610.30(1)(C)(1). This exception has been based upon the Tree Maintenance and Protection Plan that has been submitted by the Charbonneau Country Club and approved by the Planning Director. Tree removal activities remain subject to all applicable standards of this subchapter. Unless authorized by the City, this exception does not include tree removal upon any public easements or public property within the district. In the event that the CC&R's are changed relative to the effect of the Tree Maintenance and Protection Plan, then the Planning Director shall review whether such effect is material, whether it can be mitigated, and if not, may disallow the exemption.*

Response: The proposed tree removal is not listed as exempt. The provisions of this chapter are applicable.

Section 4.600.50. Application For Tree Removal Permit

(.01) Application for Permit. A person seeking to remove one or more trees shall apply to the Director for a Tree Removal Permit for a Type A, B, C, or D permit, depending on the applicable standards as provided in this subchapter.

A. An application for a tree removal permit that does not meet the requirements of Type A may be submitted as a Type B application.

(.02) Time of Application. Application for a Tree Removal Permit shall be made before removing or transplanting trees, except in emergency situations as provided in WC 4.600.40 (1)(B) above. Where the site is proposed for development necessitating site plan or plat review, application for a Tree Removal Permit shall be made as part of the site development application as specified in this subchapter.

(.03) Fees. A person applying for a Tree Removal Permit shall pay a non-refundable application fee; as established by resolution of the City Council.

A. By submission of an application, the applicant shall be deemed to have authorized City representatives to have access to applicant's property as may be needed to verify the information provided, to observe site conditions, and if a permit is granted, to verify that terms and conditions of the permit are followed.

Response: The site is proposed for development necessitating site plan and plat review, and this application includes a request for a Type C Tree Removal Permit. The application fee has been submitted with this application.

B. Section 4.610.00. Application Review Procedure

(.01) The permit applicant shall provide complete information as required by this subchapter in order for the City to review the application.

(.02) Departmental Review. All applications for Tree Removal Permits must be deemed complete by the City Planning Department before being accepted for review. When all required information has been supplied, the Planning Department will verify whether the application is complete. Upon request of either the applicant or the City, the City may conduct a field inspection or review meeting. City departments involved in the review shall submit their report and recommendations to the Planning Director who shall forward them to the appropriate reviewing authority.

(.03) Reviewing Authority.

A. Type A or B. Where site plan review or plat approval by the Development Review Board is not required by City ordinance, the grant or denial of the Tree Removal Permit application shall be the responsibility of the Planning Director. The Planning Director has the authority to refer a Type B permit application to the DRB under the Class II administrative review procedures of this Chapter. The decision to grant or deny a permit shall be governed by the applicable review standards enumerated in WC 4.610.10

B. Type C. Where the site is proposed for development necessitating site plan review or plat approval by the Development Review Board, the Development Review Board shall be responsible for granting or denying the application for a Tree Removal Permit, and that decision may be subject to affirmance, reversal or modification by the City Council, if subsequently reviewed by the Council.

C. Type D. Type D permit applications shall be subject to the standards and procedures of Class I administrative review and shall be reviewed for compliance with the Oregon Forest Practice Rules and Statutes. The Planning Director shall make the decision to grant or deny an application for a Type D permit.

D. Review period for complete applications. Type A permit applications shall be reviewed within 10 (ten) working days. Type B permit applications shall be reviewed by the Planning Director within thirty (30) calendar days, except that the DRB shall review any referred application within sixty (60) calendar days. Type C permit applications shall be reviewed within the time frame established by this Chapter. Type D permit applications shall be reviewed within 15 calendar days.

Response: The application is for a Type C Tree Removal Permit and is subject to review and approval by the DRB.

[...]

Section 4.610.10. Standards For Tree Removal, Relocation Or Replacement

(.01) Except where an application is exempt, or where otherwise noted, the following standards shall

govern the review of an application for a Type A, B, C or D Tree Removal Permit:

A. *Standard for the Significant Resource Overlay Zone. The standard for tree removal in the Significant Resource Overlay Zone shall be that removal or transplanting of any tree is not inconsistent with the purposes of this Chapter.*

Response: There are no trees proposed for removal within the SROZ. The standard is not applicable.

B. *Preservation and Conservation. No development application shall be denied solely because trees grow on the site. Nevertheless, tree preservation and conservation as a design principle shall be equal in concern and importance to other design principles.*

Response: As shown on Sheet L1.0, most of the trees to be removed are located within the grading limits of SW Frog Pond Lane, SW Marigold Terrace, and SW Brisband St. The locations of those streets were determined by the Frog Pond West Master Plan and the City's block length and perimeter standards. The remainder of the trees to be removed is located within the building footprint of the individual lots, as determined by minimum setbacks and driveway depth requirements.

Twenty-one (21) trees will be preserved on site: 20 of these trees are part of the oak grove located within Tract E; the other protected tree is located within the Willow Creek Dr median.

C. *Developmental Alternatives. Preservation and conservation of wooded areas and trees shall be given careful consideration when there are feasible and reasonable location alternatives and design options on-site for proposed buildings, structures or other site improvements.*

Response: The Frog Pond West Master Plan provides clear direction for street connections, residential densities, and preservation of the SROZ. The trees within the oak grove will be preserved. This standard is met.

D. *Land Clearing. Where the proposed activity requires land clearing, the clearing shall be limited to designated street rights-of-way and areas necessary for the construction of buildings, structures or other site improvements.*

Response: The proposed land clearing is limited to designated street rights-of-way and areas necessary for the construction of single-family homes. This standard is met.

E. *Residential Development. Where the proposed activity involves residential development, residential units shall, to the extent reasonably feasible, be designed and constructed to blend into the natural setting of the landscape.*

Response: The proposed development is a single-family residential development. The units will be designed and constructed, as much as possible, to blend into the natural areas on the site. This standard is met.

F. *Compliance With Statutes and Ordinances. The proposed activity shall comply with all applicable statutes and ordinances.*

Response: Applicable statutes and ordinances include the City's Development Code. The proposed activity will comply with this code and any other applicable statutes and ordinances. This standard is met.

G. *Relocation or Replacement. The proposed activity shall include necessary provisions for tree relocation or replacement, in accordance with WC 4.620.00, and the protection of those trees that are not to be removed, in accordance with WC 4.620.10.*

Response: As shown in Sheet L1.00 and described in Appendix F, trees to be retained will be protected per the provisions of 4.620.10 and trees will be replaced in accordance with 4.620.00. Those provisions are addressed in the responses to Section 4.620.00 later in this narrative. This standard is met.

- H. *Limitation. Tree removal or transplanting shall be limited to instances where the applicant has provided completed information as required by this Chapter and the reviewing authority determines that removal or transplanting is necessary based on the criteria of this subsection.*
1. *Necessary For Construction. Where the applicant has shown to the satisfaction of the reviewing authority that removal or transplanting is necessary for the construction of a building, structure or other site improvement, and that there is no feasible and reasonable location alternative or design option on-site for a proposed building, structure or other site improvement; or a tree is located too close to existing or proposed buildings or structures, or creates unsafe vision clearance.*

Response: Per the arborist's report included as Appendix F, there are 50 trees on site. Twenty-one (21) of the trees are identified for protection on site; 11 more trees not located on site will require tree protection to ensure off-site tree health (32 total). In total, 29 trees will be removed from the site and 21 trees will be retained.

Removal of the trees on site is necessary for construction of site improvements, including utilities, streets, and detached residential dwellings. The location of streets and connections was determined by the Frog Pond West Master Plan and the block perimeter requirements of the RN zone. In addition, the designation of the site as a single-family area requires the grading of each lot to accommodate single-family dwellings and associated site improvements (driveways and walkways, stormwater management, outdoor yard areas, etc.). Reducing building footprints by increasing height is not a viable alternative as the height limit in the RN zone is 35 ft., or 2.5 stories.

This standard is met.

2. *Disease, Damage, or Nuisance, or Hazard. Where the tree is diseased, damaged, or in danger of falling, or presents a hazard as defined in WC 6.208, or is a nuisance as defined in WC 6.200 et seq., or creates unsafe vision clearance as defined in this Code.*
 - (a) *As a condition of approval of Stage II development, filbert trees must be removed if they are no longer commercially grown or maintained.*

Response: No filbert trees were identified. This standard is not applicable.

3. *Interference. Where the tree interferes with the healthy growth of other trees, existing utility service or drainage, or utility work in a previously dedicated right-of-way, and it is not feasible to preserve the tree on site.*

Response: As shown on Sheet L1.00, many of the trees proposed for removal are located within the SW Frog Pond Lane and SW Marigold Terrace rights-of-way to be dedicated with the plat and the SW Brisband St right-of-way to be dedicated by deed. The construction of SW Frog Pond Land and SW Marigold Terrace and associated sidewalks and utilities requires their removal. These trees cannot be preserved while providing the street network required by the Frog Pond West Master Plan.

4. *Other. Where the applicant shows that tree removal or transplanting is reasonable under the circumstances.*

Response: The proposed development is anticipated by the Frog Pond West Master Plan. While the development requires removal of trees on site, the Willow Creek SROZ is protected and enhanced by the development and 21 mature trees are retained on site. The trees removed will be mitigated, and street trees appropriate for the size and location of the planter strips within the public right-of-way will be planted. These trees will serve to soften the urban environment, contribute to stormwater management, and provide shade and protection for pedestrians.

- I. *Additional Standards for Type C Permits.*
 1. *Tree survey. For all site development applications reviewed under the provisions of Chapter 4 Planning and Zoning, the developer shall provide a Tree Survey before site development as required by WC 4.610.40, and provide a Tree Maintenance and Protection plan, unless specifically exempted by the Planning Director or DRB, prior to initiating site development.*

Response: A tree survey has been completed and incorporated into the Tree Removal and Protection Plan includes as Sheet L1.00. This standard is met.

2. *Platted Subdivisions. The recording of a final subdivision plat whose preliminary plat has been reviewed and approved after the effective date of Ordinance 464 by the City and that conforms with this subchapter shall include a Tree Survey and Maintenance and Protection Plan, as required by this subchapter, along with all other conditions of approval.*

Response: A tree survey has been completed and incorporated into the Tree Removal and Protection Plan included as Sheets L1.00 and L1.10. This standard is met.

3. *Utilities. The City Engineer shall cause utilities to be located and placed wherever reasonably possible to avoid adverse environmental consequences given the circumstances of existing locations, costs of placement and extensions, the public welfare, terrain, and preservation of natural resources. Mitigation and/or replacement of any removed trees shall be in accordance with the standards of this subchapter.*

Response: The utilities will be located and placed within rights-of-way or adjacent PUEs whenever possible. Trees removed from the site will be mitigated and/or replaced per the provisions of 4.620.00. This standard is met.

[...]

Section 4.610.40. Type C Permit

(.01) *Approval to remove any trees on property as part of a site development application may be granted in a Type C permit. A Type C permit application shall be reviewed by the standards of this subchapter and all applicable review criteria of Chapter 4. Application of the standards of this section shall not result in a reduction of square footage or loss of density, but may require an applicant to modify plans to allow for buildings of greater height. If an applicant proposes to remove trees and submits a landscaping plan as part of a site development application, an application for a Tree Removal Permit shall be included. The Tree Removal Permit application will be reviewed in the Stage II development review process, and any plan changes made that affect trees after Stage II review of a development application shall be subject to review by DRB. Where mitigation is required for tree removal, such mitigation may be considered as part of the landscaping requirements as set forth in this Chapter. Tree removal shall not commence until approval of the required Stage II application and the expiration of the appeal period following that decision. If a decision approving a Type C permit is appealed, no trees shall be removed until the appeal has been settled.*

Response: The proposed development requires removal of trees; a landscaping plan has been submitted as part of the site development application, and the application includes a request for a Tree Removal Permit. Mitigation is required and addressed in the responses to Section 4.620.00.

(.02) *The applicant must provide ten copies of a Tree Maintenance and Protection Plan completed by an arborist that contains the following information:*

- A. *A plan, including a topographical survey bearing the stamp and signature of a qualified, registered professional containing all the following information:*
 1. *Property Dimensions. The shape and dimensions of the property, and the location of any existing and proposed structure or improvement.*

Response: See Sheets P1.00 and P1.10 Existing Conditions for the location of existing structures and improvements; See Sheet 2.00 Preliminary Site Plan for the location of proposed improvements.

2. *Tree survey. The survey must include:*
 - a. *An accurate drawing of the site based on accurate survey techniques at a minimum scale of one inch (1") equals one hundred feet (100') and which provides a) the location of all trees having six inches (6") or greater d.b.h. likely to be impacted, b) the spread of canopy of those trees, (c) the common and botanical name of those trees, and d) the approximate location and name of any other trees on the property.*

- b. *A description of the health and condition of all trees likely to be impacted on the site property. In addition, for trees in a present or proposed public street or road right-of-way that are described as unhealthy, the description shall include recommended actions to restore such trees to full health. Trees proposed to remain, to be transplanted or to be removed shall be so designated. All trees to remain on the site are to be designated with metal tags that are to remain in place throughout the development. Those tags shall be numbered, with the numbers keyed to the tree survey map that is provided with the application.*
- c. *Where a stand of twenty (20) or more contiguous trees exist on a site and the applicant does not propose to remove any of those trees, the required tree survey may be simplified to accurately show only the perimeter area of that stand of trees, including its drip line. Only those trees on the perimeter of the stand shall be tagged, as provided in "b," above.*
- d. *All Oregon white oaks, native yews, and any species listed by either the state or federal government as rare or endangered shall be shown in the tree survey.*

Response: See Sheet L1.00 for a tree survey indicating the location of trees greater than 6-in DBH. See Appendix F Tree Plan and Sheet L1.10 for information about the condition of the trees, crown diameter, and proposed action for each tree. Sixteen (16) Oregon white oak trees were identified on the site and are shown on the tree survey. An additional 9 Oregon white oak trees were identified off-site and will be protected

- 3. *Tree Protection. A statement describing how trees intended to remain will be protected during development, and where protective barriers are necessary, that they will be erected before work starts. Barriers shall be sufficiently substantial to withstand nearby construction activities. Plastic tape or similar forms of markers do not constitute "barriers."*

Response: See Appendix F page 1 for a description of activities permitted and prohibited within the root protection zone of trees to be protected. See also the Tree Protection Detail and note on Sheet L1.00.

- 4. *Easements and Setbacks. Location and dimension of existing and proposed easements, as well as all setbacks required by existing zoning requirements.*

Response: See Sheet P2.00 Preliminary Site Plan for setbacks required by zoning requirements. See Sheet P3.00 for the location and dimensions of proposed easements.

- 5. *Grade Changes. Designation of grade changes proposed for the property that may impact trees.*

Response: Sheet L1.00 Tree Removal and Protection Plan includes proposed grading contours.

- 6. *Cost of Replacement. A cost estimate for the proposed tree replacement program with a detailed explanation including the number, size and species.*

Response: No payment into the tree replacement fund is proposed.

- 7. *Tree Identification. A statement that all trees being retained will be identified by numbered metal tags, as specified in subsection "A," above in addition to clear identification on construction documents.*

Response: The Tree Plan Legend on Sheet L1.00 includes a statement identifying the purpose of the tree tags.

C. Section 4.620.00. *Tree Relocation, Mitigation, Or Replacement*

(.01) Requirement Established. *A Type B or C Tree Removal Permit grantee shall replace or relocate each removed tree having six (6) inches or greater d.b.h. within one year of removal.*

(.02) Basis For Determining Replacement. *The permit grantee shall replace removed trees on a basis of one (1) tree replanted for each tree removed. All replacement trees must measure two inches (2") or more in diameter. Alternatively, the Planning Director or Development Review Board may require the permit grantee to replace removed trees on a per caliper inch basis, based on a finding that the large size of the trees being removed justifies an increase in the replacement trees required. Except, however,*

that the Planning Director or Development Review Board may allow the use of replacement Oregon white oaks and other uniquely valuable trees with a smaller diameter.

Response: The proposed tree removal requires replacement of each tree having 6 inches or greater dbh within one year of removal. As noted in Sheet L1.10, 29 trees of 6 inches or greater dbh are proposed for removal. There are 120 street trees proposed on site. The standard is met.

(.03) Replacement Tree Requirements. A mitigation or replacement tree plan shall be reviewed by the City prior to planting and according to the standards of this subsection.

- A. Replacement trees shall have shade potential or other characteristics comparable to the removed trees, shall be appropriately chosen for the site from an approved tree species list supplied by the City, and shall be state Department of Agriculture Nursery Grade No. 1 or better.
- B. Replacement trees must be staked, fertilized and mulched, and shall be guaranteed by the permit grantee or the grantee's successors-in-interest for two (2) years after the planting date.
- C. A "guaranteed" tree that dies or becomes diseased during that time shall be replaced.
- D. Diversity of tree species shall be encouraged where trees will be replaced, and diversity of species shall also be maintained where essential to preserving a wooded area or habitat.

Response: There are 120 replacement trees proposed, including street trees alone. The replacement street trees have been selected from the City's street tree list. Replacement trees will be maintained and replaced if they die within the two-year establishment period.

(.04) All trees to be planted shall consist of nursery stock that meets requirements of the American Association of Nurserymen (AAN) American Standards for Nursery Stock (ANSI Z60.1) for top grade.

(.05) Replacement Tree Location.

- A. *City Review Required.* The City shall review tree relocation or replacement plans in order to provide optimum enhancement, preservation and protection of wooded areas. To the extent feasible and desirable, trees shall be relocated or replaced on-site and within the same general area as trees removed.
- B. *Relocation or Replacement Off-Site.* When it is not feasible or desirable to relocate or replace trees on-site, relocation or replacement may be made at another location approved by the City.

Response: The tree replacement plan/landscaping plan is included as Sheet L2.00. Replacement trees consist of street trees. Trees will likely be planted on the individual dwelling lots at the time of site development but are not proposed to be included in the replacement tree plans. The standard is met.

(.06) City Tree Fund. Where it is not feasible to relocate or replace trees on site or at another approved location in the City, the Tree Removal Permit grantee shall pay into the City Tree Fund, which fund is hereby created, an amount of money approximately the value as defined by this subchapter, of the replacement trees that would otherwise be required by this subchapter. The City shall use the City Tree Fund for the purpose of producing, maintaining and preserving wooded areas and heritage trees, and for planting trees within the City.

- A. The City Tree Fund shall be used to offer trees at low cost on a first-come, first-serve basis to any Type A Permit grantee who requests a tree and registers with the City Tree Fund.
- B. In addition, and as funds allow, the City Tree Fund shall provide educational materials to assist with tree planting, mitigation, and relocation.

Response: There are 120 street trees proposed on site. This exceeds the 29 trees required for replacement. Payment into the City Tree Fund is not requested.

(.07) Exception. Tree replacement may not be required for applicants in circumstances where the Director determines that there is good cause to not so require. Good cause shall be based on a consideration of preservation of natural resources, including preservation of mature trees and diversity of ages of trees. Other criteria shall include consideration of terrain, difficulty of replacement and impact on adjacent property.

Response: The applicant is not requesting an exception to the tree replacement requirement.

Section 4.620.10. Tree Protection During Construction

(.01) Where tree protection is required by a condition of development under Chapter 4 or by a Tree

Maintenance and Protection Plan approved under this subchapter, the following standards apply:

- A. *All trees required to be protected must be clearly labeled as such.*
- B. *Placing Construction Materials Near Tree. No person may conduct any construction activity likely to be injurious to a tree designated to remain, including, but not limited to, placing solvents, building material, construction equipment, or depositing soil, or placing irrigated landscaping, within the drip line, unless a plan for such construction activity has been approved by the Planning Director or Development Review Board based upon the recommendations of an arborist.*
- C. *Attachments to Trees During Construction. Notwithstanding the requirement of WC 4.620.10(1)(A), no person shall attach any device or wire to any protected tree unless needed for tree protection.*
- D. *Protective Barrier. Before development, land clearing, filling or any land alteration for which a Tree Removal Permit is required, the developer shall erect and maintain suitable barriers as identified by an arborist to protect remaining trees. Protective barriers shall remain in place until the City authorizes their removal or issues a final certificate of occupancy, whichever occurs first. Barriers shall be sufficiently substantial to withstand nearby construction activities. Plastic tape or similar forms of markers do not constitute "barriers." The most appropriate and protective barrier shall be utilized. Barriers are required for all trees designated to remain, except in the following cases:*
 1. *Right-of-Ways and Easements. Street right-of-way and utility easements may be cordoned by placing stakes a minimum of fifty (50) feet apart and tying ribbon, plastic tape, rope, etc., from stake to stake along the outside perimeters of areas to be cleared.*
 2. *Any property area separate from the construction or land clearing area onto which no equipment will venture may also be cordoned off as described in paragraph (D) of this subsection, or by other reasonable means as approved by the reviewing authority.*

Response: Sheet L1.00 and the Tree Plan included as Appendix F provide direction regarding the protection of trees on the site.

X. Annexations and Urban Growth Boundary Amendments

- A. *Section 4.700. Procedures Relating To The Processing Of Requests For Annexation And Urban Growth Boundary Amendments.*

(.01) *The City of Wilsonville is located within the Portland Metropolitan Area, and is therefore subject to regional government requirements affecting changes to the city limits and changes to the Urban Growth Boundary (UGB) around Wilsonville. The City has the authority to annex properties as prescribed in State law, but the City's role in determining the UGB is primarily advisory to Metro, as provided in Oregon Revised Statutes. The following procedures will be used to aid the City Council in formulating recommendations to those regional entities. [Amended by Ordinance No. 538, 2/21/02.]*

- A. *Proponents of such changes shall provide the Planning Director with all necessary maps and written information to allow for review by city decision-makers. The Planning Director, after consultation with the City Attorney, will determine whether each given request is quasi-judicial or legislative in nature and will make the necessary arrangements for review based upon that determination.*

Response: The applicant has provided the required information. The Planning Director has determined that the annexation request is subject to quasi-judicial review.

- B. *Written information submitted with each request shall include an analysis of the relationship between the proposal and the City's Comprehensive Plan, applicable statutes, as well as the Statewide Planning Goals and any officially adopted regional plan that may be applicable.*

Response: See Section III of this narrative for a discussion of the relationship between the proposed annexation and the City's Comprehensive Plan.

XI. Conclusion

The request for the Frog Pond Ridge development and related approvals has been shown to be consistent with the applicable standards of the City of Wilsonville. West Hills Land Development LLC respectfully requests approval of the applications.

Appendix A

Annexation Petitions & Certificates



**CERTIFICATION OF PROPERTY OWNERSHIP OF
100% OF LAND AREA**

I hereby certify that the attached petition contains the names of the owners¹ (as shown on the last available complete assessment roll) of 100% of the land area of the territory proposed for annexation as described in the attached petition.

NAME JOSHUA BOLL
TITLE GIS CARTOGRAPHER II
DEPARTMENT CARTOGRAPHY
COUNTY OF CLACKAMAS
DATE 1/16/20



¹ Owner means the legal owner of record or, where there is a recorded land contract which is in force, the purchaser thereunder. If a parcel of land has multiple owners, each consenting owner shall be counted as a percentage of their ownership interest in the land. That same percentage shall be applied to the parcel's land mass and assessed value for purposes of the consent petition. If a corporation owns land in territory proposed to be annexed, the corporation shall be considered the individual owner of that land.

Search Voters

Reports Export

Query executed successfully. No matching results found. Print Screen Help

Select Saved/Published Search Run Search

Precincts	Party / Audits	Extract	Mailing Address	Comment	Custom Fields	Save
Name	Status	Activity	Output	Absentee Address	Residence Address	Districts

Address Type: Standard

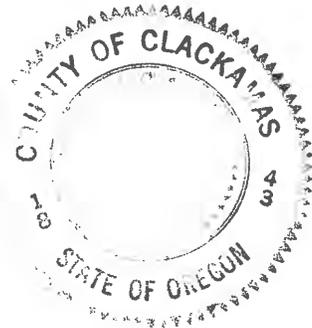
Standard Address

House #	Suffix	Pre Dir	Street Name	Type	Post Dir
6720		SW	FROG POND	LN	
Unit Type	Unit #				
City	Zip				
WILSONVILLE					

Scope: State County CLACKAMAS Show Signatures Search Clear Reset

View Summary Full Image Select < > Close

No active registered voters at 6720 Sw Frog Pond Ln,
Wilsonville, OR.



[Handwritten Signature]
ELECTIONS MANAGER

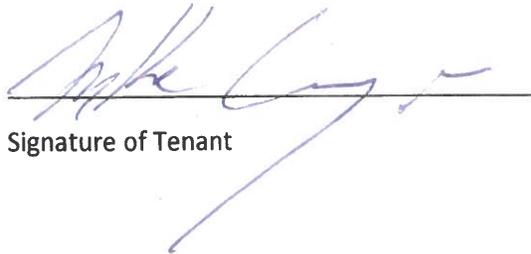
Date: 01/08/2020

Re: 6720 SW Frog Pond Ln

Wilsonville, OR 97070

To Whom It May Concern:

I, Michael D. Geiger, do hereby acknowledge that I currently live at the above referenced address and the previous tenants no longer live at this location.

A handwritten signature in blue ink, appearing to read "Michael D. Geiger", is written over a horizontal line. The signature is stylized and extends below the line.

Signature of Tenant

CERTIFICATION OF LEGAL DESCRIPTION AND MAP

I hereby certify that the description of the property included within the attached petition (located on Assessor's Map 31W12D) has been checked by me and it is a true and exact description of the property under consideration, and the description corresponds to the attached map indicating the property under consideration.

NAME JOSHUA BOLL
TITLE GIS CARTOGRAPHER II
DEPARTMENT CARTOGRAPHY
COUNTY OF CLACKAMAS
DATE: 1/16/20



EXHIBIT A

LEGAL DESCRIPTION

FROG POND RIDGE ANNEXATION

January 5, 2020 (Otak #19489)

Those properties described in Bargain and Sale Deed to the Trustees of the William Ray Morgan and Janice Ellen Morgan Revocable Living Trust U/D/T October 20, 2009, recorded April 24, 2013 as Document No. 2013-027934, and in Statutory Warranty Deed to West Hills Land Development, LLC recorded as Document No. 2018-062022, both of Clackamas County Records, together with the abutting right of way of S.W. Stafford Road, in the southeast quarter of Section 12, Township 3 South, Range 1 West, and the southwest quarter of Section 7, Township 3 South, Range 1 East, Willamette Meridian, Clackamas County, Oregon, more particularly described as follows:

BEGINNING at a 5/8 inch iron rod with no cap found at the southeast corner of said Document No. 2013-027934 property, said POINT OF BEGINNING being on the west right of way line of said S.W. Stafford Road North 01°40'13" East a distance of 1287.07 feet and North 88°35'30" West a distance of 30.00 feet from the southeast corner of said southeast quarter of Section 12;

thence along the north line of that property described in Special Warranty Deed to West Hills Land Development LLC recorded August 20, 2019 as Document No. 2019-049723, Clackamas County Records, North 88°35'30" West a distance of 1015.93 feet;

thence along the west line of said Document No. 2019-049723 property South 01°40'13" West a distance of 429.07 feet to the north line of Partition Plat No. 2019-047, Clackamas County Records;

thence along said north line and the westerly extension thereof, North 88°35'30" West a distance of 507.30 feet to the southeast corner of that property conveyed in Document No. 91-036369, Clackamas County Records;

thence along the east line of said Document No. 91-036369 property North 01°37'43" East a distance of 15.64 feet to the southwest corner of that property described in Quitclaim Deed to Amy Thurmond recorded as Document No. 99-022102, Clackamas County Records;

thence along the south line of said Document No. 99-022102 property the following two courses:

South 88°31'31" East a distance of 209.95 feet;

and North 01°39'15" East a distance of 842.56 feet a point on the south right of way line of S.W Frog Pond Lane (County Road No. 2362) being 33.00 feet wide; thence along said south right of way line, South 88°35'30" East a distance of 1313.53 feet to the northeast corner of said Document No. 2013-027934 property;

thence continuing South 88°35'30" East a distance of 30.00 feet to a point on the section line common to said Sections 7 and 12 also being the centerline of said S.W. Stafford Road;

thence continuing South 88°35'30" East a distance of 30.00 feet to a point on the east right of way line of said S.W. Stafford Road;

thence along said east right of way line, South 01°40'13" West a distance of 428.89 feet;

thence North 88°35'30" West a distance of 30.00 feet to a point on said section line common to said Sections 7 and 12 and the centerline of S.W. Stafford Road;

thence continuing North 88°35'30" West a distance of 30.00 feet to the POINT OF BEGINNING.

Contains 16.53 acres, more or less.



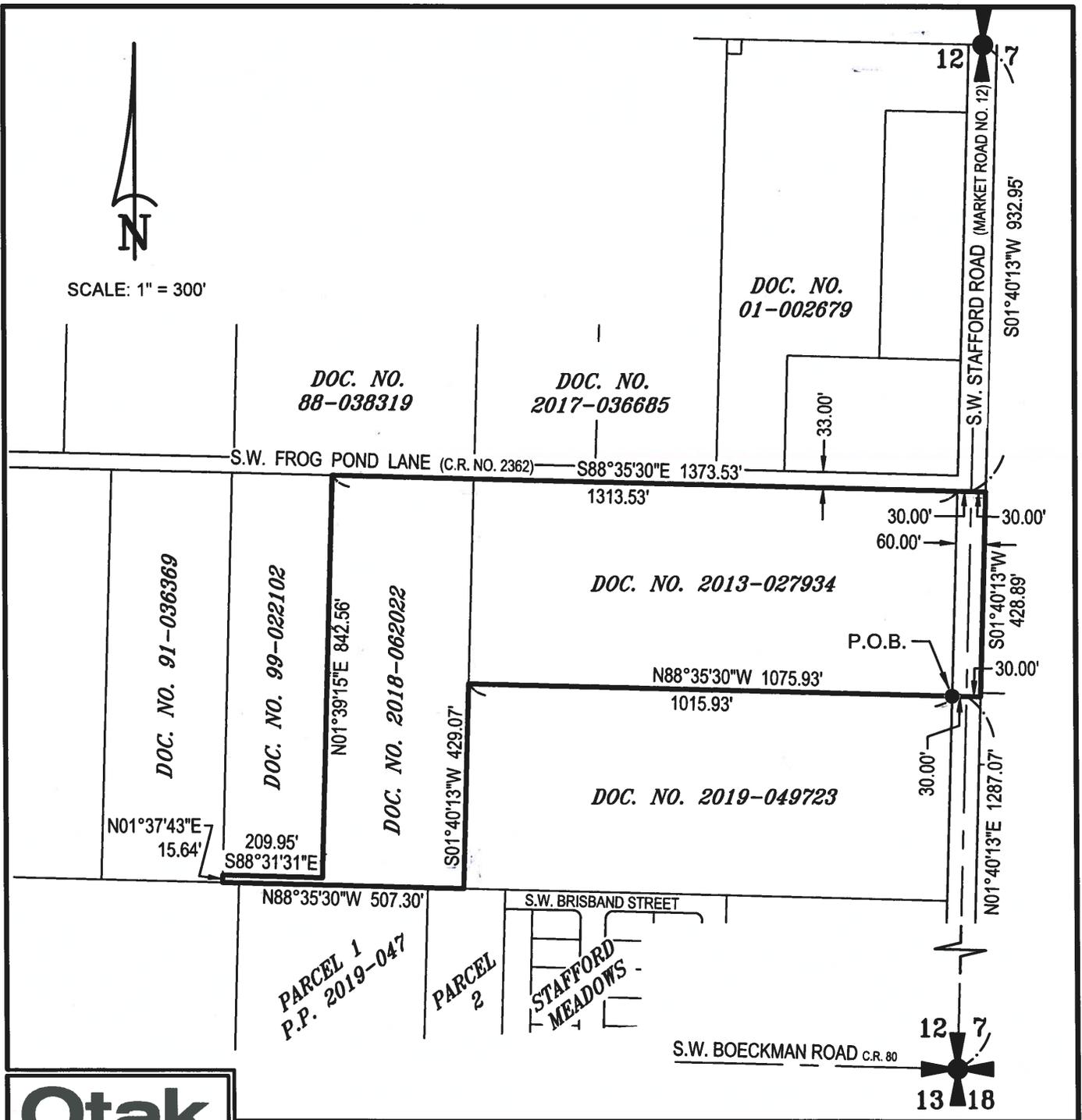
DIGITALLY SIGNED
2020.01.05 21:31:04-08'00'



RENEWS: JUNE 30, 2020



SCALE: 1" = 300'



Otak

808 SW 3rd Ave., Ste. 300
 Portland, Oregon 97204
 Phone: (503) 287-6825
 www.otak.com
 project: 19489

EXHIBIT A

PAGE 3 OF 3

FROG POND RIDGE ANNEXATION AREA
 IN THE SOUTHEAST QUARTER OF SECTION 12, TOWNSHIP 3 SOUTH, RANGE 1 WEST, &
 THE SOUTHWEST QUARTER OF SECTION 7, TOWNSHIP 3 SOUTH, RANGE 1 EAST,
 WILLAMETTE MERIDIAN, CLACKAMAS COUNTY, OREGON

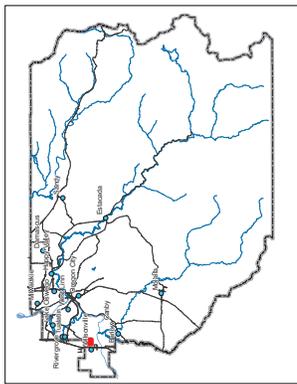
JANUARY 3, 2020

3 1 W 12D
 WILSONVILLE
 S.E. 1/4 SEC. 12 T.3S. R. 1W. W.M.
 CLACKAMAS COUNTY
 1" = 200'

Cancelled Taxlots

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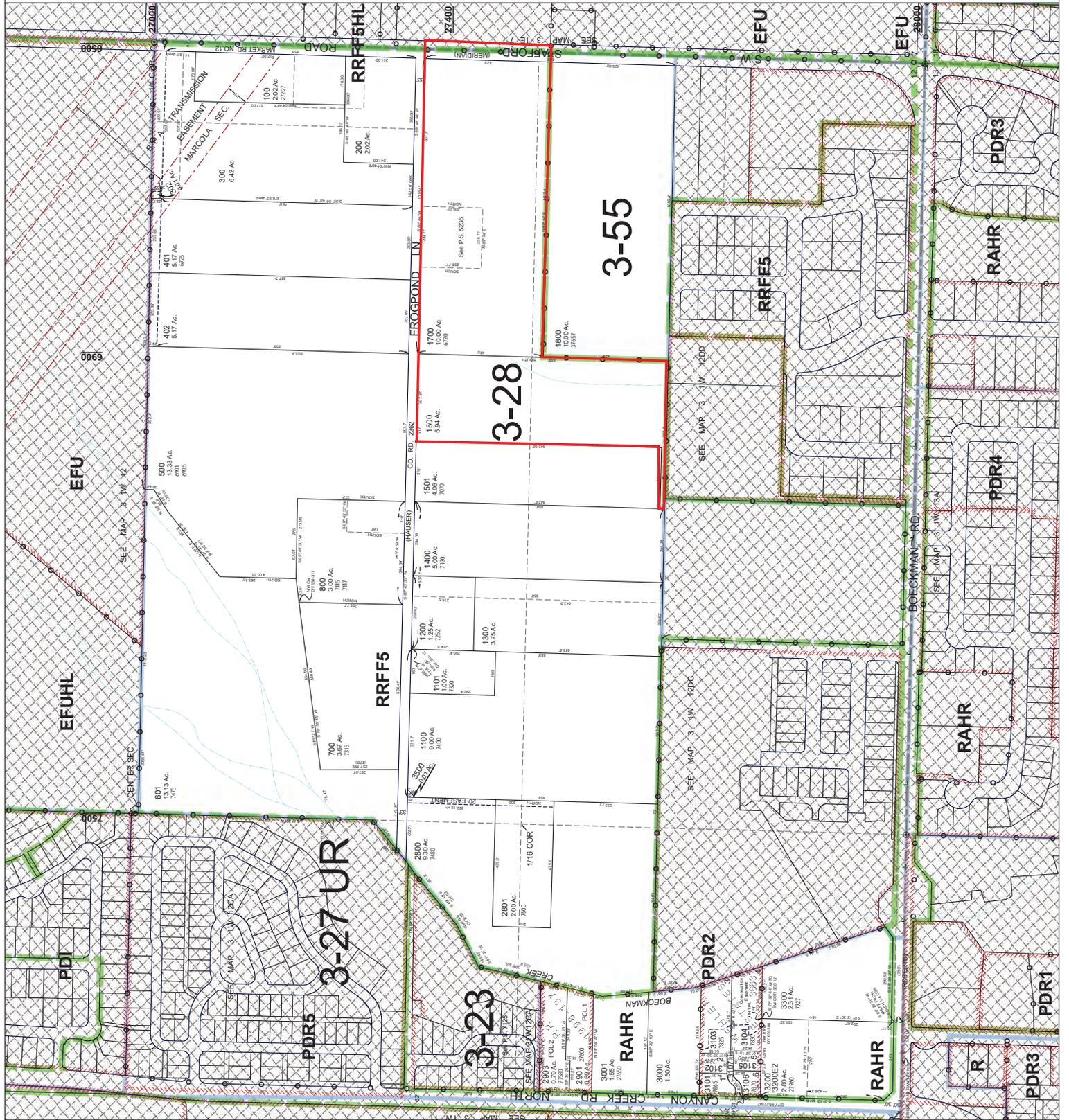
- Parcel Boundary
- Private Road ROW
- Historical Boundary
- Railroad Centreline
- TaxCodeLines
- Map Index
- WaterLines
- Land Use Zoning
- Plats
- Water
- Center
- Section Corner
- 1/16th Line
- Govt Lot Line
- DLC Line
- Meander Line
- PLSS Section Line
- Historic Corridor 40'
- Historic Corridor 20'



THIS MAP IS FOR ASSESSMENT
 PURPOSES ONLY

3 1 W 12D
 WILSONVILLE

6/24/2019



Metro District Annexation

Annexation Petition For Property Owners

We the undersigned owner(s) of property described below and or elector(s) residing at the referenced location hereby petition for and give consent to, annexation of said property to the Metro District. We understand that the Metro Council will review this request in accordance with Chapter 3.09 of the Metro Code and the Oregon Revised Statutes to determine whether to approve or deny this request.

Signature	Printed Name	I am a			Property Description			Date
		PO	RV	OV	Township/Range & Section Map Number	Tax lot	Precinct Number	
	William Morgan	x			31W12DD	1700		
	Janice Morgan	x						

PO: Property Owner, RV: Registered Voter, OV: Property Owner and Registered Voter

Appendix B

Updated Stormwater Report Memorandum





Memorandum

To: City of Wilsonville Community Development Department
From: Mike Peebles, PE
Copies: Dan Grimberg- West Hills Land Development
File
Date: June 29, 2020
Subject: Completeness Review Response for Frog Pond Ridge Subdivision
(DB20-0007 through DB20-0014) - Infiltration Testing Plan for Final Design
Project No.: 19489.000

In response to the completeness comment to "...Coordinate with City's Engineering/Natural Resources Division regarding infiltration testing and design of stormwater facilities on site...", the applicant proposes to complete additional on-site infiltration testing in the five locations noted on the attached plan, plus incorporate infiltration testing results (HA-1 and HA-4) from previous geotechnical studies in proximity of proposed stormwater facilities.

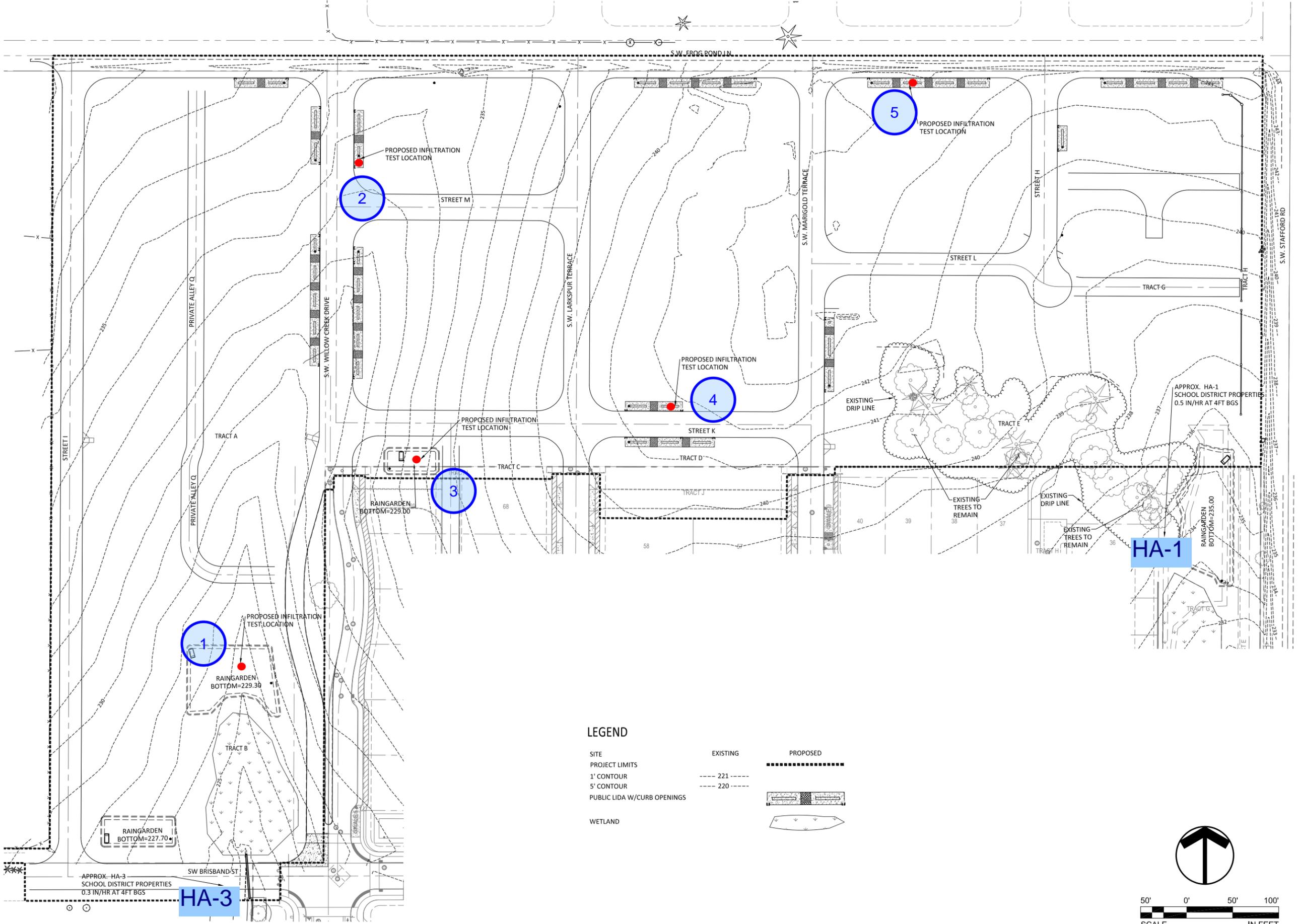
Infiltration testing will be performed using open hole, falling head method in hand auger borings. Soils in the boring will be pre-saturated a minimum of several hours prior to testing. The water level will be measured to the nearest 0.1 inch from a fixed point and the change in water level will be recorded at intervals during the test period.

Infiltration testing will be completed during final design and results will be incorporated into the Final Stormwater Management Report that will be included in the Public Works Permit submittal for the project.

Attachments

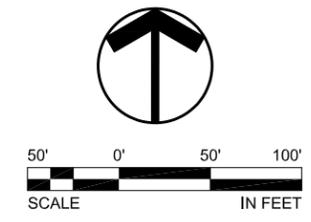
Figure 1: Frog Pond Ridge – Proposed Infiltration Testing Plan dated June 29, 2020

XREF LIST
 Ltscale: 50
 Resolved
 S17868X190
 P18968X240
 P18968X600
 O18968XSL_OTAK
 C19106X230
 C19489X230
 P19489X600
 C19489X001
 C19489X430
 C19489X360
 C19489X240



LEGEND

- SITE
 - PROJECT LIMITS
 - 1' CONTOUR
 - 5' CONTOUR
 - PUBLIC LIDA W/CURB OPENINGS
 - WETLAND
- EXISTING
- PROPOSED



FROG POND RIDGE
 WILSONVILLE, OREGON
PROPOSED INFILTRATION TESTING PLAN

#	DATE	DESCRIPTION

REVISIONS

NAVD 88 DATUM

MDH MAP

DRAWN BY CHECKED BY

LAND USE SUBMITTAL

STATUS

June 29, 2020

DATE

19489 PROJECT NUMBER

Figure 1

© 2020 OTAK, INC.
 If this drawing is not 22" x 34", it has been reduced/enlarged. Scale accordingly.

Plotted: Jun 23, 2020 - 1:46pm resesharon L:\Project\194001\19489\CADD\CADD\DWG\Exhibits\WRF\Figure 3_19489_Proposed Infiltration plan.dwg Layout Name: P5.00

Appendix B-1

Preliminary Stormwater Report Update Memorandum





Technical Memorandum

To: City of Wilsonville, Oregon
From: Otak, Inc.
Copies: Files
Date: May 15, 2020
Subject: Frog Pond Ridge Preliminary Storm Drainage Report Update
Project No.: 19489

Introduction

The proposed Frog Pond Ridge development will consist of 71 single-family residential dwellings as well as associated public infrastructure improvements. This memorandum is a supplemental update to the Preliminary Stormwater Report submitted in January 2020 (Otak, 2020) to present the revisions to the stormwater basins and stormwater management facilities.

Soils

All swales and raingardens are designed with type D soils based on geotechnical investigations on the adjacent Frog Pond Meadows properties on May 17, 2018. These investigations yielded observed infiltration rates between 0.05 in/hr and 0.5 in/hr (Hardman, 2018).

Proposed Development

The proposed site plan was revised to remove an alley driveway from SW Frog Pond Lane and to limit lot impacts to the existing oak forest on the east side of the property. These changes required swales to be removed from Street M and Street L. Revisions were made to the stormwater design to accommodate these site plan changes. Updated output reports from the BMP Sizing tool are attached to this memo, and a revised Facility Summary Table is provided below. The following revisions have been made to the stormwater design:

- On Street M, swales WC 22A, WC 22B, WC 24 and WC 25 have been removed. A new swale WC 22 has been added on SW Larkspur Terrace, and the size of swale WC 26 on SW Frog Pond Lane and swale WC 23 on SW Willow Creek Drive have increased. These revised swales and the Tract C Rain Garden will treat lots 28-31 on this block (see the attached revised Figure 3 for details). An additional storm pipe system was added to SW Willow Creek Drive to convey these basins to the Tract C Rain Garden.
- On Street L, swales SR 22, SR 23, and SR 29 have been removed. These areas will now be managed by the Tract E Rain Garden. Basins 22 and 23 are still shown in Figure 3 for consistency in the tabulation of basin areas (see attached Basin Areas table.)

Facility Summary Table

Basin ID	Facility ID	Function	LID Min. Size, BMP output (sf)	LID Size, Site Plan (sf)	Orifice Diameter (in)
WC 14, 15, 19A	Tract B Rain garden 2	WQ, FC	2058	2501	2.4
WC 13, 16, 17, 28	Tract B Rain garden 1	WQ, FC	5316	6152	3.9
WC 18A	WC 18A Swale	WQ, FC	558	608	1.5
WC 18B	WC 18B Swale	WQ, FC	271	352	1.0
WC 20	WC 20 Swale	WQ, FC	287	320	1.0
WC 21	WC 21 Swale	WQ, FC	411	608	1.2
WC 22	WC 22 Swale	WQ, FC	291	294	1.0
WC 23	Swale WC 23	WQ, FC	181	352	0.8
WC 24	WC 24 Swale	WQ, FC	98	123	0.6
WC 25	WC 25 Swale	WQ, FC	248	255	1.0
WC 26	Swale WC 26	WQ, FC	641	648	1.4
WC 27	WC 27 Swale	WQ, FC	407	656	1.2
P 60	Tract C RG	WQ*	1591	1595	1.6
P 61	P 61 Swale	WQ, FC	280	352	1.0
P 62	P 62 Swale	WQ, FC	380	504	1.2
SR20, SR22, SR23	Tract E RG	WQ, FC	7,073	7,100	4.6
SR 21	SR 21 Swale	WQ, FC	226	368	0.9
SR 24	SR 24 Swale	WQ, FC	282	312	1.0
SR 25	SR 25 Swale	WQ, FC	116	200	0.6
SR 26	SR 26 Swale	WQ, FC	388	656	1.2
SR 27	SR 27 Swale	WQ, FC	256	656	0.9

* Flow control provided by Stafford Meadows detention pond.

Conclusion

These revisions are supplemental to the January 2020 Frog Pond Ridge Preliminary Storm Drainage Report. The stormwater management system was designed to comply with standards set forth by the City of Wilsonville and SLOPES V.

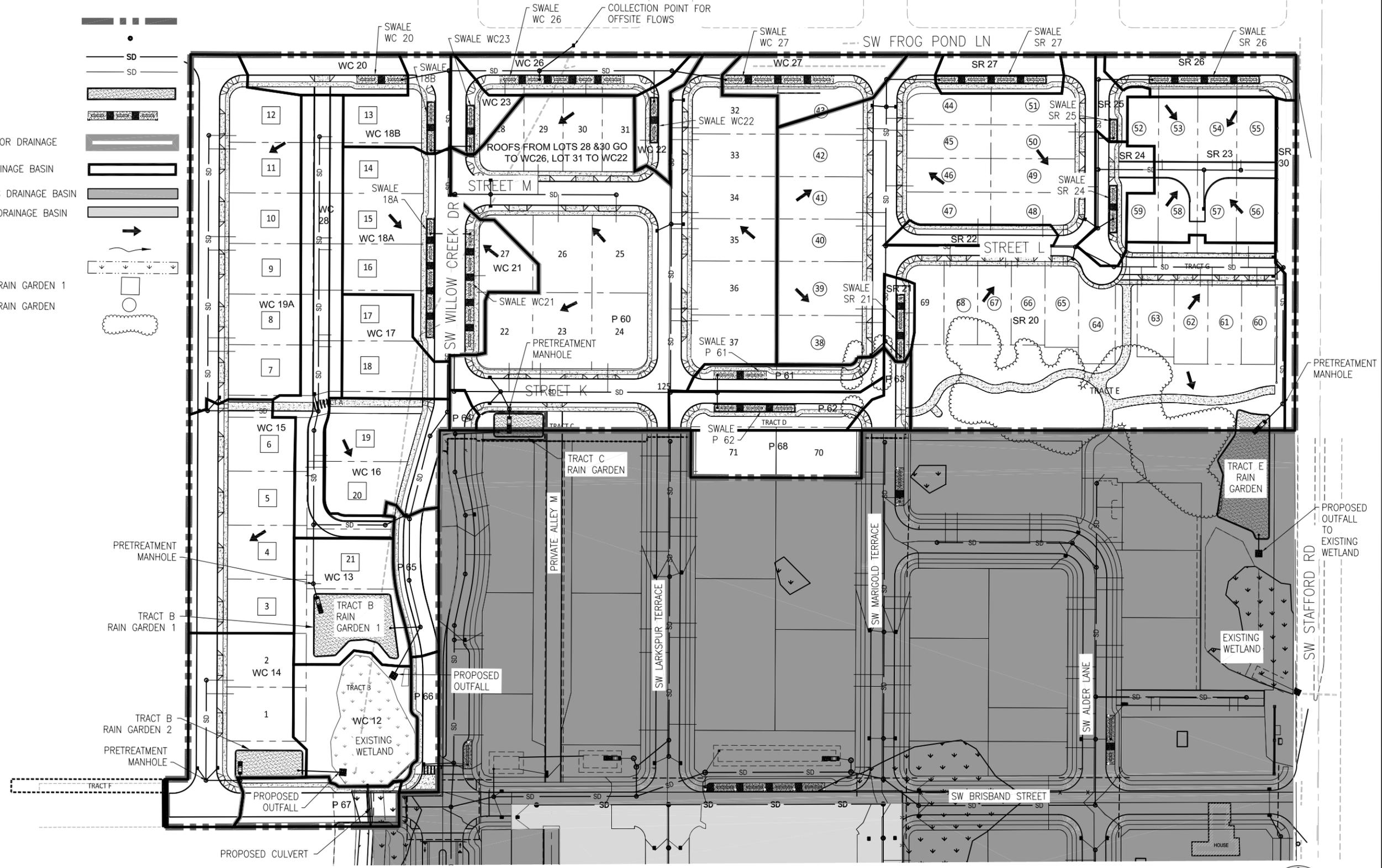
References

Hardman, 2018. *Geotechnical Engineering Report Frog Pond – School District Property #1 Wilsonville, Clackamas County, Oregon*, Hardman Geotechnical Services Inc., May 23, 2018.

Otak, 2020. *Frog Pond Ridge Preliminary Storm Drainage Report*, Otak, Inc, January 9, 2020.

LEGEND

- PROJECT BOUNDARY
- STORM DRAIN MANHOLE
- STORM DRAIN MAIN
- STORM DRAIN LATERAL
- RAIN GARDEN
- STORMWATER SWALE
- FROG POND RIDGE ONSITE MAJOR DRAINAGE BASIN (WC, P, SR)
- FROG POND RIDGE ONSITE DRAINAGE BASIN
- EXISTING FROG POND MEADOWS DRAINAGE BASIN
- EXISTING STAFFORD MEADOWS DRAINAGE BASIN
- DRAINAGE FLOW ARROW
- CREEK FLOW ARROW
- WETLAND AREAS
- ROOFS DRAINING TO TRACT B RAIN GARDEN 1
- ROOFS DRAINING TO TRACT E RAIN GARDEN
- EXISTING TREE DRIPLINE



Plotted: May 15, 2020, 5:44am L:\Project\194\00194889\CADD\CADD\DWG\Exhibits\WRF\Fig3_19488 Proposed Conditions.dwg Layout Name: PROPOSED

FROG POND RIDGE

PRELIMINARY DESIGN
WILSONVILLE, OREGON

PROPOSED DETAILED DRAINAGE CONDITIONS

TITLE	#	DATE	DESCRIPTION

REVISIONS

DRAWN BY	CHECKED BY

STATUS
MAY 14, 2020
DATE
19106
PROJECT NUMBER

FIG 3

© 2018 OTAK, INC.
If this drawing is not 22" x 34", it has been reduced/enlarged. Scale accordingly.

Drainage Basin Areas

19489 Frog Pond Ridge

Existing Conditions:

Basin Name	Impervious Area		Pervious Area		Total Area	
	Total (sf)	Total (ac)	Total (sf)	Total (ac)	(sf)	(ac)
Willow Creek	36,779	0.84	525,455	12.06	562,234	12.91
Stafford Road	6489	0.15	177,780	4.08	184,269	4.23
TOTAL	43,268	0.99	703,234	16.14	746,502	17.14

Duplex Impervious Area per Lot
Impervious Area per Lot

2,000 SF
2,750 SF (2015 Public Works Stds 301.4.01)

Proposed Conditions:

Basin	Drains To	Impervious Area				Pervious Area		Total Area	
		Roadway (sf)	Roof (sf)	Total (sf)	Total (ac)	(sf)	(ac)	(sf)	(ac)
Site Total		264,879	189,250	448,629	10.30	297,873	6.84	746,502	17.14
WC Basins		112,307	68,750	181,057	4.16	135,912	3.12	316,969	7.28
WC 12	Creek	0	0	0	0.00	19,811	0.45	19,811	0.45
WC 13	Tract B RG 1	0	2,750	2,750	0.06	15,676	0.36	18,426	0.42
WC 14	Tract B RG 2	12,948	5,500	18,448	0.42	8,754	0.20	27,202	0.62
WC 15	Tract B RG 2	12,906	11,000	23,906	0.55	9,830	0.23	33,736	0.77
WC 16	Tract B RG 1	4,571	5,500	10,071	0.23	8,602	0.20	18,673	0.43
WC 17	Tract B RG 1	1,526	5,500	7,026	0.16	5,621	0.13	12,647	0.29
WC 18A	SwaleWC18A	6,820	8,250	15,070	0.35	10,190	0.23	25,260	0.58
WC 18B	Swale WC18B	4,169	2,750	6,919	0.16	3,716	0.09	10,635	0.24
WC 19A	Tract B RG 1	20,067	16,500	36,567	0.84	14,654	0.34	51,221	1.18
WC 20	Swale WC20	7,011	0	7,011	0.16	1,835	0.04	8,846	0.20
WC 21	Swale WC21	5,018	2,750	7,768	0.18	3,587	0.08	11,355	0.26
WC 22	Swale WC22	3,382	2,750	6,132	0.14	1,634	0.04	7,766	0.18
WC 23	Swale WC23	2,944	0	2,944	0.07	2,257	0.05	5,201	0.12
WC 24	Swale WC24	1,080	0	1,080	0.02	1,958	0.04	3,038	0.07
WC 25	Swale WC25	2,396	0	2,396	0.06	5,431	0.12	7,827	0.18
WC 26	Swale WC26	8,732	5,500	14,232	0.33	2,542	0.06	16,774	0.39
WC 27	Swale WC27	6,682	0	6,682	0.15	5,061	0.12	11,743	0.27
WC 28	Tract B RG 1	12,055	0	12,055	0.28	14,753	0.34	26,808	0.62
P Basins		78,465	38,500	111,465	2.56	65,617	1.51	177,082	4.07
P 60	Tract C RG	43,774	33,000	76,774	1.76	41,816	0.96	118,590	2.72
P 61	Swale P61	6,150	0	6,150	0.14	1,210	0.03	7,360	0.17
P 62	Swale P62	4,472	0	4,472	0.10	6,369	0.15	10,841	0.25
P 63	Ex. Pond	3,243	0	3,243	0.07	645	0.01	3,888	0.09
P 64	Ex. Pond	1,343	0	1,343	0.03	0	0.00	1,343	0.03
P 65	Ex. Pond	5,592	0	5,592	0.13	2,732	0.06	8,324	0.19
P 66	Ex. Pond	4,817	0	4,817	0.11	313	0.01	5,130	0.12
P 67	Ex. Pond	9,074	0	9,074	0.21	1,146	0.03	10,220	0.23
P 68	Ex. Pond	0	5500	0	0.00	11,386	0.26	11,386	0.26

Drainage Basin Areas

19489 Frog Pond Ridge

Basin	Drains To	Impervious Area				Pervious Area		Total Area	
		Roadway (sf)	Roof (sf)	Total (sf)	Total (ac)	(sf)	(ac)	(sf)	(ac)
Stafford Road		74,107	82,000	156,107	3.58	96,344	2.21	252,451	5.80
SR 20	Tract E RG	43,742	63,250	106,992	2.46	50,504	1.16	157,496	3.62
SR 21	Swale SR21	1,992	2,750	4,742	0.11	1,294	0.03	6,036	0.14
SR 22	Tract E RG	3,776	0	3,776	0.09	880	0.02	4,656	0.11
SR 23	Tract E RG	4,186	16,000	20,186	0.46	8,360	0.19	28,546	0.66
SR 24	Swale SR24	5,396	0	5,396	0.12	2,358	0.05	7,754	0.18
SR 25	Swale SR25	2,143	0	2,143	0.05	1,063	0.02	3,206	0.07
SR 26	Swale SR26	7,411	0	7,411	0.17	3,254	0.07	10,665	0.24
SR 27	Swale SR27	5,461	0	5,461	0.13	1,320	0.03	6,781	0.16
SR 30	Offsite	0	0	0	0.00	7,026	0.16	7,026	0.16
FOREST	Tract E RG	0	0	0	0.00	20,285	0.47	20,285	0.47
TOTAL		264,879	189,250	448,629	10.30	297,873	6.84	746,502	17.14

WES BMP Sizing Report

Project Information

Project Name	Frog Pond Ridge - SR
Project Type	Subdivision
Location	
Stormwater Management Area	9282
Project Applicant	
Jurisdiction	CCSD1NCSA

Drainage Management Area

Name	Area (sq-ft)	Pre-Project Cover	Post-Project Cover	DMA Soil Type	BMP
SR 20 - Imp ROW	43,742	Grass	ConventionalConcrete	D	Tract E Rain Garden
SR 20 - Imp Roof	63,250	Grass	Roofs	D	Tract E Rain Garden
SR 20 - Per	50,504	Grass	LandscapeDsoil	D	Tract E Rain Garden
SR 21 - Imp ROW	1,992	Grass	ConventionalConcrete	D	SR 21 Swale
SR 21 - Per	1,294	Grass	LandscapeDsoil	D	SR 21 Swale
SR 22 - Imp ROW	3,776	Grass	ConventionalConcrete	D	Tract E Rain Garden
SR 22 - Per	880	Grass	LandscapeDsoil	D	Tract E Rain Garden
SR 23 - Imp ROW	4,186	Grass	ConventionalConcrete	D	Tract E Rain Garden
SR 23 - Imp Roof	16,000	Grass	Roofs	D	Tract E Rain Garden
SR 23 - Per	8,360	Grass	LandscapeDsoil	D	Tract E Rain Garden
SR 24 - Imp ROW	5,396	Grass	ConventionalConcrete	D	SR 24 Swale
SR 24 - Per	2,358	Grass	LandscapeDsoil	D	SR 24 Swale
SR 26 - Imp ROW	7,411	Grass	ConventionalConcrete	D	SR 26 Swale
SR 26 - Per	3,254	Grass	LandscapeDsoil	D	SR 26 Swale
SR 27 - Imp ROW	5,461	Grass	ConventionalConcrete	D	SR 27 Swale
SR 27 - Per	1,320	Grass	LandscapeDsoil	D	SR 27 Swale

SR 20 - Forest	20,285	Forested	Forested	D	Tract E Rain Garden
SR 21 - Imp Roof	2,750	Grass	Roofs	D	SR 21 Swale
SR 25 - Imp ROW	2,143	Grass	Conventional Concrete	D	SR 25 Swale
SR 25 - Per	1,063	Grass	Landscape Soil	D	SR 25 Swale

LID Facility Sizing Details

LID ID	Design Criteria	BMP Type	Facility Soil Type	Minimum Area (sq-ft)	Planned Areas (sq-ft)	Orifice Diameter (in)
Tract E Rain Garden	Flow Control and Treatment	Rain Garden - Filtration	D1	7,073.3	7,100.0	4.6
SR 26 Swale	Flow Control and Treatment	Vegetated Swale - Filtration	D1	387.6	656.0	1.2
SR 21 Swale	Flow Control and Treatment	Vegetated Swale - Filtration	D1	225.9	368.0	0.9
SR 24 Swale	Flow Control and Treatment	Vegetated Swale - Filtration	D1	281.9	312.0	1.0
SR 27 Swale	Flow Control and Treatment	Vegetated Swale - Filtration	D1	255.4	656.0	0.9
SR 25 Swale	Flow Control and Treatment	Vegetated Swale - Filtration	D1	115.5	200.0	0.6

Pond Sizing Details

1. FCWQT = Flow control and water quality treatment, WQT = Water quality treatment only
2. Depth is measured from the bottom of the facility and includes the three feet of media (drain rock, separation layer and growing media).
3. Maximum volume of the facility. Includes the volume occupied by the media at the bottom of the facility.
4. Maximum water storage volume of the facility. Includes water storage in the three feet of soil media assuming a 40 percent porosity.

WES BMP Sizing Report

Project Information

Project Name	Frog Pond Ridge - WC
Project Type	Subdivision
Location	
Stormwater Management Area	22583
Project Applicant	
Jurisdiction	CCSD1NCSA

Drainage Management Area

Name	Area (sq-ft)	Pre-Project Cover	Post-Project Cover	DMA Soil Type	BMP
WC 10 - Imp ROW	6,273	Grass	ConventionalConcrete	D	Tract B RG2
WC 10 - Per	1,143	Grass	LandscapeSoil	D	Tract B RG2
WC 13 - Per	15,676	Grass	LandscapeSoil	D	Tract B RG1
WC 14 - Imp ROW	12,948	Grass	ConventionalConcrete	D	Tract B RG2
WC 14 - Imp Roof	5,500	Grass	Roofs	D	Tract B RG2
WC 14 - Per	8,754	Grass	LandscapeSoil	D	Tract B RG2
WC 17 - Imp ROW	5,500	Grass	ConventionalConcrete	D	Tract B RG1
WC 17 - Imp Roof	5,500	Grass	Roofs	D	Tract B RG1
WC 17 - Per	5,621	Grass	LandscapeSoil	D	Tract B RG1
WC 19A - Imp ROW	20,067	Grass	ConventionalConcrete	D	Tract B RG1
WC 19A - Imp Roof	16,500	Grass	Roofs	D	Tract B RG1
WC 19A - Per	14,654	Grass	LandscapeSoil	D	Tract B RG1
WC 24 - Imp ROW	1,080	Grass	ConventionalConcrete	D	Swale WC 24
WC 15 - Imp ROW	5,465	Grass	ConventionalConcrete	D	Tract B RG1
WC 24 - Per	1,958	Grass	LandscapeSoil	D	Swale WC 24
WC 15 - Per	2,556	Grass	LandscapeSoil	D	Tract B RG1
WC 16 - Imp ROW	4,571	Grass	ConventionalConcrete	D	Tract B RG1

WC 16 - Per	8,602	Grass	LandscapeDsoil	D	Tract B RG1
WC 18A - Imp ROW	6,820	Grass	ConventionalConcrete	D	Swale WC 18A
WC 18A - Per	10,190	Grass	LandscapeDsoil	D	Swale WC 18A
WC 20 - Imp	6,764	Grass	ConventionalConcrete	D	Swale WC 20
WC 20 - Per	580	Grass	LandscapeDsoil	D	Swale WC 20
WC 21 - Imp ROW	5,018	Grass	ConventionalConcrete	D	Swale WC 21
WC 21 - per	3,587	Grass	LandscapeDsoil	D	Swale WC 21
WC 22 - Imp ROW	3,382	Grass	ConventionalConcrete	D	Swale WC 22
WC 22 - per	1,634	Grass	LandscapeDsoil	D	Swale WC 22
WC 23 - Imp ROW	2,944	Grass	ConventionalConcrete	D	Swale WC 23
WC 23 - per	2,257	Grass	LandscapeDsoil	D	Swale WC 23
WC 18A - Imp Roof	8,250	Grass	Roofs	D	Tract B RG1
WC 16 - Imp Roof	5,500	Grass	Roofs	D	Tract B RG1
WC 22 - Imp Roof	2,750	Grass	Roofs	D	Swale WC 22
WC 21 - Imp Roof	2,750	Grass	Roofs	D	Swale WC 21
WC 13 - Imp Roof	2,750	Grass	Roofs	D	Tract B RG1
WC 26 - Imp Roof	5,500	Grass	Roofs	D	Swale WC 26
WC 25 - Imp ROW	2,396	Grass	ConventionalConcrete	D	Swale WC 25
WC 25 - Per	5,431	Grass	LandscapeDsoil	D	Swale WC 25
WC 26 - Imp ROW	8,732	Grass	ConventionalConcrete	D	Swale WC 26
WC 26 - Per	2,542	Grass	LandscapeDsoil	D	Swale WC 26
WC 27 - Imp ROW	6,482	Grass	ConventionalConcrete	D	Swale WC 27
WC 27 - Per	5,261	Grass	LandscapeDsoil	D	Swale WC 27
WC 28 - Imp ROW	12,055	Grass	ConventionalConcrete	D	Tract B RG1
WC 28 - Per	14,753	Grass	Grass	B	NA
WC 15 - Imp ROW	12,906	Grass	ConventionalConcrete	D	Tract B RG2
WC 15 - Imp Roof	11,000	Grass	Roofs	D	Tract B RG1

WC 15 - Per	9,830	Grass	LandscapeDsoil	D	Tract B RG2
WC 18B - Imp ROW	4,169	Grass	ConventionalConcrete	D	Swale WC 18B
WC 18B - Imp Roof	2,750	Grass	Roofs	D	Tract B RG1
WC 18B - Per	3,716	Grass	LandscapeDsoil	D	Swale WC 18B
M upper-imp	3,228	Grass	ConventionalConcrete	D	NA
M upper -perv	2,117	Grass	LandscapeDsoil	D	NA
M lower-imp	3,000	Grass	ConventionalConcrete	D	NA
M lower - perv	1,848	Grass	LandscapeDsoil	D	NA

LID Facility Sizing Details

LID ID	Design Criteria	BMP Type	Facility Soil Type	Minimum Area (sq-ft)	Planned Areas (sq-ft)	Orifice Diameter (in)
Tract B RG2	FlowControlAndTreatment	Rain Garden - Filtration	D1	2,057.4	2,501.0	2.4
Tract B RG1	FlowControlAndTreatment	Rain Garden - Filtration	D1	5,315.4	6,073.0	3.9
Swale WC 18A	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	558.1	588.0	1.5
Swale WC 20	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	286.8	580.0	1.0
Swale WC 21	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	411.2	608.0	1.2
Swale WC 22	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	291.0	294.0	1.0
Swale WC 23	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	181.0	352.0	0.8
Swale WC 25	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	247.9	255.0	1.0
Swale WC 24	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	98.0	123.0	0.6
Swale WC 26	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	640.5	648.0	1.4
Swale WC 27	FlowControlAndTreatment	Vegetated Swale -	D1	406.6	840.0	1.2

		Filtration				
Swale WC 18B	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	270.8	320.0	1.0

Pond Sizing Details

1. FCWQT = Flow control and water quality treatment, WQT = Water quality treatment only
2. Depth is measured from the bottom of the facility and includes the three feet of media (drain rock, separation layer and growing media).
3. Maximum volume of the facility. Includes the volume occupied by the media at the bottom of the facility.
4. Maximum water storage volume of the facility. Includes water storage in the three feet of soil media assuming a 40 percent porosity.

WES BMP Sizing Report

Project Information

Project Name	Frog Pond Ridge
Project Type	Subdivision
Location	27657 SW Stafford Rd
Stormwater Management Area	23310
Project Applicant	
Jurisdiction	CCSD1NCSA

Drainage Management Area

Name	Area (sq-ft)	Pre-Project Cover	Post-Project Cover	DMA Soil Type	BMP
E1 - imp	1,198	Forested	ConventionalConcrete	D	E1
E1 - perv	3,487	Forested	LandscapeSoil	D	E1
E2 - imp	5,305	Forested	ConventionalConcrete	D	E2
E2 - perv	9,006	Forested	LandscapeSoil	D	E2
E3 - imp	2,435	Forested	ConventionalConcrete	D	E3
E3 - perv	6,981	Forested	LandscapeSoil	D	E3
E4 - imp	2,234	Forested	ConventionalConcrete	D	E4
E4 - perv	7,403	Forested	LandscapeSoil	D	E4
E5 - imp	2,464	Forested	ConventionalConcrete	D	E5
E5 - perv	6,962	Forested	LandscapeSoil	D	E5
E9a, E9b - imp	6,276	Forested	ConventionalConcrete	D	Stafford Meadows Pond
E9a, E9b - perv	792	Forested	LandscapeSoil	D	Stafford Meadows Pond
E16b - imp	3,050	Forested	ConventionalConcrete	D	E16b
E16b - perv	6,280	Forested	LandscapeSoil	D	E16b
E16a - imp	7,739	Forested	ConventionalConcrete	D	E16a
E16a - perv	2,421	Forested	LandscapeSoil	D	E16a
E16 - imp	5,644	Forested	LandscapeSoil	D	E16
E16 - perv	2,048	Forested	LandscapeSoil	D	E16

P4, P5 - perv	9,137	Grass	LandscapeDsoil	D	Stafford Meadows Pond
E13 - imp	3,631	Forested	ConventionalConcrete	D	E13
E13 - perv	1,432	Forested	LandscapeDsoil	D	E13
E12 - imp	7,719	Forested	ConventionalConcrete	D	E12
E12 - pervious	3,204	Forested	LandscapeDsoil	D	E12
E12a - imp	6,100	Forested	ConventionalConcrete	D	E12a
E12a - perv	11,160	Forested	LandscapeDsoil	D	E12a
E15 - imp	7,157	Forested	ConventionalConcrete	D	E15
E15 - perv	661	Forested	LandscapeDsoil	D	E15
E10 - imp	4,762	Forested	ConventionalConcrete	D	E10
E10 - perv	7,543	Forested	LandscapeDsoil	D	E10
E8 - imp	3,329	Forested	ConventionalConcrete	D	E8
E8 - perv	7,042	Forested	LandscapeDsoil	D	E8
E5a - imp	1,908	Forested	ConventionalConcrete	D	E5a
E5a - perv	467	Forested	LandscapeDsoil	D	E5a
E2b - imp	2,191	Forested	ConventionalConcrete	D	Stafford Meadows Pond
E2b - perv	385	Forested	LandscapeDsoil	D	Stafford Meadows Pond
E2a - imp	3,408	Forested	ConventionalConcrete	D	Stafford Meadows Pond
E2a - perv	797	Forested	LandscapeDsoil	D	Stafford Meadows Pond
E1a, E1b - imp	4,339	Forested	ConventionalConcrete	D	Stafford Meadows Pond
E1a, E1b - perv	1,247	Forested	LandscapeDsoil	D	Stafford Meadows Pond
E6 - imp	2,742	Forested	ConventionalConcrete	D	E6
E6 - perv	7,134	Forested	LandscapeDsoil	D	E6
E7 - imp	2,347	Forested	ConventionalConcrete	D	E7
E7 - perv	7,447	Forested	LandscapeDsoil	D	E7
E9 - imp	1,907	Forested	ConventionalConcrete	D	E9
E9 - perv	3,827	Forested	LandscapeDsoil	D	E9

E30a, E30b, E31 - imp	8,189	Forested	Roofs	D	Stafford Meadows Pond
E30a, E30b, E31 - perv	2,548	Forested	LandscapeDsoil	D	Stafford Meadows Pond
E31a - imp	3,050	Forested	Roofs	D	E31a
E31a - perv	5,679	Forested	LandscapeDsoil	D	E31a
E32a - imp	3,050	Forested	Roofs	D	E32a
E32a - perv	9,321	Forested	LandscapeDsoil	D	E32a
E33 - imp	3,856	Forested	Roofs	D	E33
E33 -perv	1,396	Forested	LandscapeDsoil	D	E33
E33a - imp	806	Forested	Roofs	D	E33
E33a -perv	1,269	Forested	LandscapeDsoil	D	E33
E34 - imp	5,660	Forested	Roofs	D	E34
E34 - perv	1,633	Forested	LandscapeDsoil	D	E34
E35 - imp	6,951	Forested	ConventionalCo ncrete	D	E35
E35 - perv	1,135	Forested	LandscapeDsoil	D	E35
E35a - imp	3,050	Forested	Roofs	D	E35a
E35a - per	5,397	Forested	LandscapeDsoil	D	E35a
E35b - imp	889	Forested	LandscapeDsoil	D	E35b
E35b - perv	1,829	Forested	LandscapeDsoil	D	E35b
E36a - imp	3,050	Forested	Roofs	D	E36a
E36a - perv	5,758	Forested	LandscapeDsoil	D	E36a
E36b - imp	3,050	Forested	Roofs	D	E36b
E36b - perv	8,041	Forested	LandscapeDsoil	D	E36b
E38 - imp	4,062	Forested	Roofs	D	E38
E38 - perv	1,432	Forested	LandscapeDsoil	D	E38
E38a - imp	3,050	Forested	Roofs	D	E38a
E38a - perv	7,066	Forested	LandscapeDsoil	D	E38a
E39 - imp	3,813	Forested	ConventionalCo ncrete	D	E39
E39 - perv	1,134	Forested	LandscapeDsoil	D	E39
E39a - imp	3,050	Forested	Roofs	D	E39a
E39a - perv	5,178	Forested	LandscapeDsoil	D	E39a
E34a - imp	3,050	Forested	ConventionalCo ncrete	D	E34a
E34a- perv	6,711	Forested	LandscapeDsoil	D	E34a
E37 - imp	2,708	Forested	ConventionalCo ncrete	D	E37
E37 - perv	788	Forested	LandscapeDsoil	D	E37
E16c - imp	3,050	Forested	Roofs	D	E16c

E16c - perv	6,600	Forested	LandscapeDsoil	D	E16c
E30c - imp	1,355	Forested	ConventionalConcrete	D	E30c
E30c - perv	265	Forested	LandscapeDsoil	D	E30c
E32 - imp	2,246	Forested	ConventionalConcrete	D	E32
E32 - perv	532	Forested	LandscapeDsoil	D	E32
E31b - imp	3,050	Forested	Roofs	D	E31b
E31b - perv	5,022	Forested	LandscapeDsoil	D	E31b
E32b - imp	3,050	Forested	Roofs	D	E32b
E32b - perv	5,417	Forested	LandscapeDsoil	D	E32b
E13a - imp	3,050	Forested	Roofs	D	E13a
E13a - perv	8,869	Forested	LandscapeDsoil	D	E13a
E38b - imp	3,050	Forested	Roofs	D	E38b
E38b - perv	5,926	Forested	LandscapeDsoil	D	E38b
E33b - imp	3,050	Forested	Roofs	D	E33b
E33b - perv	5,825	Forested	LandscapeDsoil	D	E33b
p11, p12, p13 - perv	7,457	Grass	LandscapeDsoil	D	Stafford Meadows Pond
p11, p12, p13 - imp	12,320	Grass	Roofs	D	Stafford Meadows Pond
p6, P7 - perv	2,291	Grass	LandscapeDsoil	D	Stafford Meadows Pond
p6, p7 - imp	7,447	Grass	ConventionalConcrete	D	Stafford Meadows Pond
p50, p51- perv	23,602	Grass	LandscapeDsoil	D	Stafford Meadows Pond
p50, p51 - imp	20,684	Grass	Roofs	D	Stafford Meadows Pond
E17 - imp	5,354	Forested	ConventionalConcrete	D	Stafford Meadows Pond
E17 - perv	819	Forested	LandscapeDsoil	D	Stafford Meadows Pond
E9c - imp	1,456	Forested	ConventionalConcrete	D	E9c
E9c - perv	298	Forested	LandscapeDsoil	D	E9c
P23 - imp	7,117	Grass	ConventionalConcrete	D	Stafford Meadows Pond
E1c - imp	3,053	Forested	ConventionalConcrete	D	Stafford Meadows Pond
E1c - perv	481	Forested	LandscapeDsoil	D	Stafford Meadows Pond
E1c - imp	3,036	Forested	ConventionalConcrete	D	Stafford Meadows Pond

E1c - perv	498	Forested	LandscapeDsoil	D	Stafford Meadows Pond
p10 - imp	5,910	Grass	ConventionalConcrete	D	p10
p10 - perv	3,943	Grass	LandscapeDsoil	D	p10
p1, p2 - imp	6,289	Grass	ConventionalConcrete	D	Stafford Meadows Pond
p1, p2 - perv	3,147	Grass	LandscapeDsoil	D	Stafford Meadows Pond
p25 - imp	3,815	Grass	ConventionalConcrete	D	p25
p25 - perv	1,363	Grass	LandscapeDsoil	D	p25
p26 - imp	6,271	Grass	ConventionalConcrete	D	p26
p26 - perv	2,682	Grass	LandscapeDsoil	D	p26
P 62 - Per	4,472	Grass	LandscapeDsoil	D	Swale P 62
P 62 - Imp	6,369	Grass	ConventionalConcrete	D	Swale P 62
P 61 - Per	1,210	Grass	LandscapeDsoil	D	Swale P61
P 61 - Imp	6,150	Grass	ConventionalConcrete	D	Swale P61
P to K- imp	65,084	Grass	ConventionalConcrete	D	Tract K RG
P to K - perv	55,716	Grass	LandscapeDsoil	D	Tract K RG
P to I - imp	137,406	Grass	ConventionalConcrete	D	Tract I RG
P to I - perv	78,293	Grass	LandscapeDsoil	D	Tract I RG
P60 - Per	41,816	Grass	LandscapeDsoil	D	Tract C RG
P60 - Imp	76,774	Grass	ConventionalConcrete	D	Tract C RG
P51- imp	22,773	Grass	Roofs	D	Stafford Meadows Pond
P51 - perv	23,259	Grass	LandscapeDsoil	D	Stafford Meadows Pond
E0- imp	49,500	Forested	Roofs	D	Stafford Meadows Pond
P9, P57 - imp	7,092	Grass	Roofs	D	Stafford Meadows Pond
P9, p57 -perv	6,148	Grass	LandscapeDsoil	D	Stafford Meadows Pond
P5 - imp	5,500	Grass	Roofs	D	Stafford Meadows Pond
P5 - perv	3,298	Grass	LandscapeDsoil	D	Stafford Meadows Pond
p11 - perv	2,500	Grass	LandscapeDsoil	D	Stafford

					Meadows Pond
LargeLot_Drive way	6,400	Forested	ConventionalConcrete	D	Stafford Meadows Pond
P3 - perv	3,302	Grass	LandscapeDsoil	D	Swale 2
P3 - imp	7,361	Grass	ConventionalConcrete	D	Swale 2
P8 - perv	2,401	Grass	LandscapeDsoil	D	Swale 5
P8 - imp	5,524	Grass	ConventionalConcrete	D	Swale 5
P29 - perv	2,317	Grass	LandscapeDsoil	D	Swale 8
P29 - imp	4,345	Grass	ConventionalConcrete	D	Swale 8
P32 - perv	1,043	Grass	LandscapeDsoil	D	Swale 9
P32 - imp	1,565	Grass	ConventionalConcrete	D	Swale 9
P46 - perv	2,867	Grass	LandscapeDsoil	D	Swale 10
P46 - imp	7,502	Grass	ConventionalConcrete	D	Swale 10
P4, P5, - imp	16,500	Grass	Roofs	D	Stafford Meadows Pond
P 63 - Imp	3,243	Grass	ConventionalConcrete	D	Stafford Meadows Pond
P 63 - per	645	Grass	LandscapeDsoil	D	Stafford Meadows Pond
P 64 - Imp	1,343	Grass	ConventionalConcrete	D	Stafford Meadows Pond
P 65 - Imp	5,592	Grass	ConventionalConcrete	D	Stafford Meadows Pond
P 65 - Per	2,732	Grass	LandscapeDsoil	D	Stafford Meadows Pond
P 66 - Imp	4,817	Grass	ConventionalConcrete	D	Stafford Meadows Pond
P 66 - Per	313	Grass	LandscapeDsoil	D	Stafford Meadows Pond
P 67 - Imp	9,074	Grass	ConventionalConcrete	D	Stafford Meadows Pond
P 67 - Perv	1,146	Grass	LandscapeDsoil	D	Stafford Meadows Pond

LID Facility Sizing Details

LID ID	Design Criteria	BMP Type	Facility Soil Type	Minimum Area (sq-ft)	Planned Areas (sq-ft)	Orifice Diameter (in)
E31a	FlowControlAndTreatment	Rain Garden - Filtration	D1	281.0	282.0	0.9

E32a	FlowControlAndTreatment	Rain Garden - Filtration	D1	383.0	383.0	1.1
E33b	FlowControlAndTreatment	Rain Garden - Filtration	D1	285.1	290.0	0.9
E35a	FlowControlAndTreatment	Rain Garden - Filtration	D1	273.1	278.0	0.9
E36b	FlowControlAndTreatment	Rain Garden - Filtration	D1	347.1	350.0	1.1
E36a	FlowControlAndTreatment	Rain Garden - Filtration	D1	283.2	290.0	0.9
E38b	FlowControlAndTreatment	Rain Garden - Filtration	D1	287.9	290.0	1.0
E38a	FlowControlAndTreatment	Rain Garden - Filtration	D1	319.8	331.0	1.0
E34a	FlowControlAndTreatment	Rain Garden - Filtration	D1	309.9	310.0	1.0
E39a	FlowControlAndTreatment	Rain Garden - Filtration	D1	267.0	267.0	0.9
E16b	FlowControlAndTreatment	Rain Garden - Filtration	D1	297.8	312.0	1.0
E16c	FlowControlAndTreatment	Rain Garden - Filtration	D1	306.8	315.0	1.0
E31b	FlowControlAndTreatment	Rain Garden - Filtration	D1	262.6	270.0	0.9
E32b	FlowControlAndTreatment	Rain Garden - Filtration	D1	273.7	274.0	0.9
E13a	FlowControlAndTreatment	Rain Garden - Filtration	D1	370.3	372.0	1.1
E12a	FlowControlAndTreatment	Rain Garden - Filtration	D1	556.5	560.0	1.3
Tract K RG	WaterQuality	Rain Garden - Filtration	D1	1,561.3	1,978.0	1.6
Tract I RG	WaterQuality	Rain Garden - Filtration	D1	2,883.2	3,160.0	2.2
Tract C RG	WaterQuality	Rain Garden - Filtration	D1	1,590.7	1,640.0	1.6
E35b	FlowControlAndTreatment	Stormwater Planter - Filtration	D1	57.1	68.0	0.6
E2	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	580.5	859.0	1.3
E1	WaterQuality	Vegetated Swale - Filtration	D1	54.6	270.0	0.3
E3	WaterQuality	Vegetated Swale -	D1	109.8	221.0	0.5

		Filtration				
E9	WaterQuality	Vegetated Swale - Filtration	D1	68.8	276.0	0.4
E10	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	502.1	805.0	1.2
E13	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	231.7	235.0	0.8
E12	WaterQuality	Vegetated Swale - Filtration	D1	149.4	239.0	0.6
E37	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	163.0	145.0	0.7
E35	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	387.3	219.0	1.0
E34	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	340.2	419.0	0.9
E33	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	326.4	272.0	1.0
E32	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	130.9	312.0	0.6
E16a	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	471.7	478.0	1.1
E16	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	269.2	325.0	1.0
E6	WaterQuality	Vegetated Swale - Filtration	D1	116.0	221.0	0.5
E7	WaterQuality	Vegetated Swale - Filtration	D1	113.4	221.0	0.5
E39	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	230.3	515.0	0.8
E38	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	253.2	319.0	0.8
E4	WaterQuality	Vegetated Swale - Filtration	D1	111.2	221.0	0.5

E15	WaterQuality	Vegetated Swale - Filtration	D1	114.3	229.0	0.5
E30c	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	77.0	85.0	0.4
E5	WaterQuality	Vegetated Swale - Filtration	D1	110.1	225.0	0.5
E5a	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	111.7	173.0	0.5
E8	WaterQuality	Vegetated Swale - Filtration	D1	123.9	331.0	0.5
E9c	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	83.2	152.0	0.5
p10	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	346.8	517.0	1.1
p25	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	190.8	339.0	0.8
p26	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	325.9	585.0	1.1
Swale P 62	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	380.0	504.0	1.2
Swale P61	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	279.9	352.0	1.0
Swale 2	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	386.9	463.0	1.2
Swale 5	WaterQuality	Vegetated Swale - Filtration	D1	108.1	258.0	0.5
Swale 8	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	238.7	582.0	0.9
Swale 9	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	91.8	215.0	0.6
Swale 10	WaterQuality	Vegetated Swale - Filtration	D1	142.6	325.0	0.5

Pond Sizing Details

Pond ID	Design Criteria(1)	Facility Soil Type	Max Depth (ft)(2)	Top Area (sq-ft)	Side Slope (1:H)	Facility Vol. (cu-ft)(3)	Water Storage Vol. (cu-ft)(4)	Adequate Size?
Stafford Meadows Pond	FCWQT	D1	4.00	9,360.0	4	26,421.3	15,732.9	Yes

1. FCWQT = Flow control and water quality treatment, WQT = Water quality treatment only

2. Depth is measured from the bottom of the facility and includes the three feet of media (drain rock, separation layer and growing media).

3. Maximum volume of the facility. Includes the volume occupied by the media at the bottom of the facility.

4. Maximum water storage volume of the facility. Includes water storage in the three feet of soil media assuming a 40 percent porosity.

Simple Pond Geometry Configuration

Pond ID: Stafford Meadows Pond
 Design: FlowControlAndTreatment

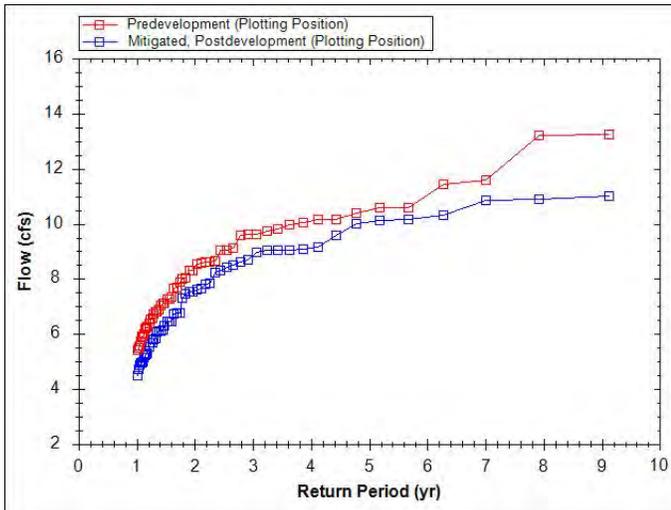
Shape Curve

Depth (ft)	Area (sq ft)
4.0	9,360.0

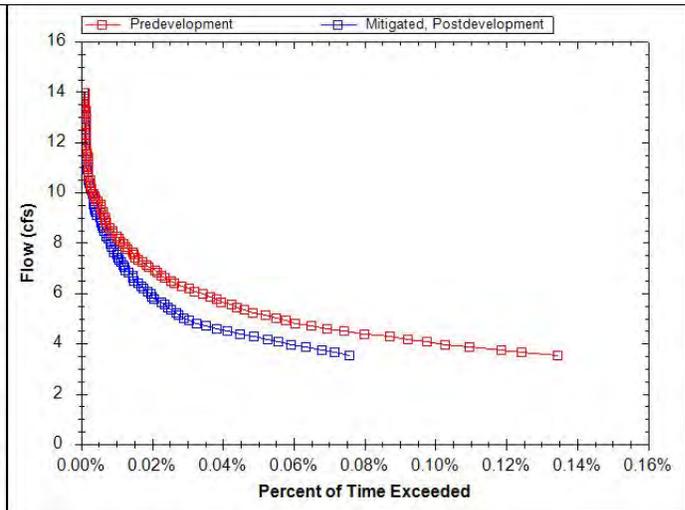
Outlet Structure Details

Lower Orifice Invert (ft)	0.0
Lower Orifice Dia (in)	8.2
Upper Orifice Invert(ft)	2.7
Upper Orifice Dia (in)	18.7
Overflow Weir Invert(ft)	3.0
Overflow Weir Length (ft)	6.3

Flow Frequency Chart



Flow Duration Chart



Appendix B-2
Preliminary Stormwater Report





Frog Pond Ridge
Preliminary Storm Drainage Report
Land Use

Submitted to:
City of Wilsonville
29799 SW Town Center Loop East
Wilsonville, OR 97070

Prepared By:
Otak, Inc.
808 SW 3rd Ave, Suite 300
Portland, OR 97204

Submitted: January 9, 2020

Project No. 19489



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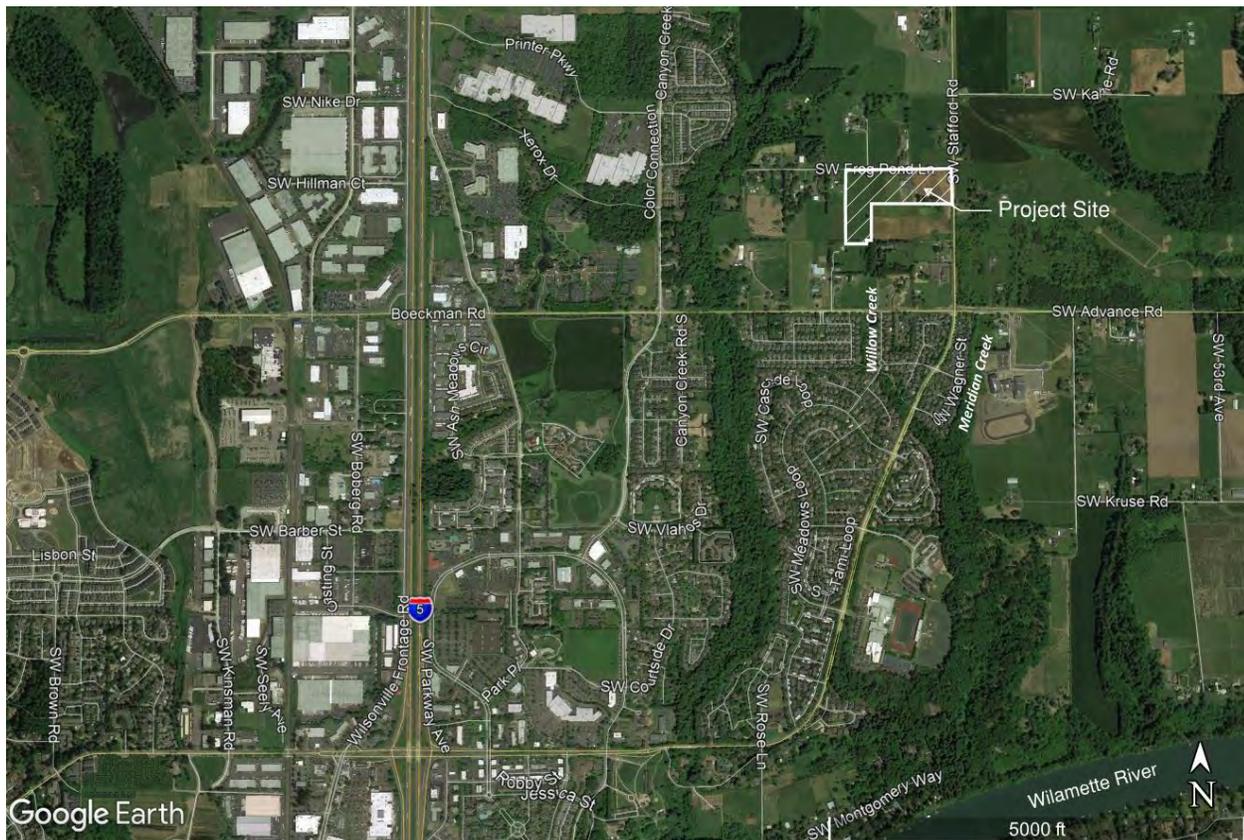
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Section 1—Introduction

The Frog Pond Ridge site is a proposed residential development located within the West Neighborhood of the Frog Pond Area Plan. The 16.89-acre project site is comprised of four separate properties (Tax map 31W12D lots 01500, 01700, 01800, 02200) in unincorporated Clackamas County within the City of Wilsonville Urban Growth Boundary (UGB) (see Vicinity Map). The Frog Pond Ridge development will consist of 71 single-family residential dwellings as well as associated public infrastructure improvements.

The purpose of this document is to outline compliance of the Frog Pond Ridge stormwater management system with the City of Wilsonville *Stormwater and Surface Water Design and Construction Standards (2015)* and the National Marine Fisheries Services (NMFS) *SLOPES V for Stormwater, Transportation or Utilities (USACOE, 2014)*. Descriptions of the existing and proposed hydrologic conditions, as well as documentation showing compliance of the proposed onsite stormwater management system with City of Wilsonville and SLOPES V standards for water quality and quantity are included in this report.



Vicinity Map

Section 2—Project Description

The Frog Pond Ridge proposed residential development consists of 71 new single-family lots, extension of a north-south collector roadway, as well as sidewalks, public roadway improvements, utilities, and stormwater management systems that discharge to Willow Creek and the SW Stafford Road ditch. Stormwater management will be included in these improvements in the form of water quality treatment and flow control. Additionally, this project will include frontage improvements to SW Frog Pond Lane and provide additional right-of-way dedication for future frontage improvements on SW Stafford Road.

Permitting

The following permit applications will be required for this project:

- City of Wilsonville Development Permit
- State removal/fill permit through DSL
- Section 401 water quality certification from DEQ

Existing Conditions

Willow Creek runs north to south in the western portion of the site with a Significant Resource Overlay Zone (SROZ). The site is currently primarily agricultural land with approximately 11.09 acres sloping from 2.5 percent to 4 percent toward Willow Creek. The remaining 5.79 acres drains east towards an existing drainage ditch along SW Stafford Road. The existing 0.99 acres of impervious area on the site consists of a home with associated outbuildings, and driveway (see Figure 1).

This proposed project will maintain existing drainage patterns, discharging to Willow Creek and to a ditch along SW Stafford Road which drains to Meridian Creek, a tributary of Willow Creek. Willow Creek ultimately drains to the Willamette River.

Proposed Conditions

Site improvements will include construction of approximately 10.34 acres of new impervious surfaces in the form of roof, roadway and sidewalk area. Vegetated stormwater facilities are proposed to be constructed in the planter areas between the streets and sidewalks and within tracts to provide low impact development treatment and flow control throughout the proposed residential development.

Another rain garden at the corner of Willow Creek Drive and Street K is proposed to provide water quality treatment for runoff from the central portion of the development. Stormwater will then be conveyed to a detention pond constructed in the Stafford Meadows Development for flow control (see Figure 2). Water quality treatment and flow control facilities will be planted to City standards specific to each type of facility.

Two rain gardens are proposed to provide water quality treatment and flow control for runoff from the northwest portion of the development prior to discharging directly to wetlands along Willow Creek. Vegetated swales along SW Willow Creek Drive, Street M, and SW Frog Pond Lane provide water quality treatment and flow control. This managed runoff will be conveyed Willow Creek wetlands (see Figure 3). Contributing offsite flows will be collected north of SW Frog Pond Lane and will be conveyed through the project site to this same discharge point.

Runoff from 5.80 acres will drain to swales and be conveyed to a rain garden adjacent to the frontage of SW Stafford Road. The swales and rain gardens will provide water quality treatment and flow control prior to discharging to the existing roadside ditch.

An additional twelve feet of width along the property frontage will be dedicated as right of way for the future widening of SW Stafford Road. Most of the dedicated right of way will remain undeveloped with this project.

Section 3—Hydrology

Rainfall Depth

The following rainfall depths listed in Table 1 are provided in the *City of Wilsonville Public Works Standards (2015)*. These depths correspond to design recurrence intervals which are used in hydrologic calculations for various aspects of stormwater management design.

Table 1—24 Hour Precipitation Depths

Recurrence Interval (Years)	Total Precipitation Depth (inches)
2	2.50
10	3.45
25	3.90
100	4.50

Pollutants of Concern

The pollutants of concern are those typically found in roadway runoff. These include sediment, oil and grease, polycyclic aromatic hydrocarbons (PAHs), metals such as Copper, Zinc, and Lead as well as pesticides and other nutrients (DEQ, 2016).

Table 2 lists each waterway affected by this project and DEQ listing status.

Table 2—Pollutants of Concern

Waterway	Parameter	Listing Status
Willow Creek	N/A	None
Meridian Creek	N/A	None
Willamette River (Middle)	Chlorophyll a	303(d), TMDL needed
Willamette River (Middle)	E. Coli	TMDL approved
Willamette River (Middle)	Mercury	303(d), TMDL needed
Willamette River (Middle)	Temperature	TMDL approved

Wetlands

Wetlands exist on the project site and will be impacted; however, development impacts to the wetland that exists along Willow Creek will be limited by using a curb tight sidewalk. A discussion of the impacts to sensitive areas will be included in the report by the environmental consultant, Anchor QEA.

Soils

The Web Soil Survey published by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) was referenced to determine the soil names, symbols, and hydrologic soil groups found on the project site. The USDA soil survey map and the corresponding hydrologic soil group (HSG) for the area of interest are provided in Appendix A.

The site and surrounding areas are comprised of silt loams. Soil types identified within the project corridor were identified as primarily Aloha silt loam (1A and 1B). A portion of the area along Willow Creek and a portion adjacent to SW Stafford Road are identified to have Concord silt loam (21). Huberly silt loam (2225A) is also identified in the northeast of the site near SW Stafford Road. All of these soils are classified as hydrologic soil type C/D, which in an undrained condition generally exhibit very slow infiltration rates when thoroughly wet. See Appendix A for the soils map and soils descriptions for the project and surrounding areas.

A geotechnical investigation was conducted to more accurately determine the site strata and infiltration rates. During the geotechnical investigations in April and August 2018, no static groundwater was encountered in the 5-feet to 8-feet deep excavations. Seepage was observed from the side walls of some excavations at 2.5 to 3 feet below ground surface during the April investigation. The Geotechnical Memorandum by Hardman Geotechnical Services is included in Appendix B.

Flood Hazard

The proposed development for this site is located outside the 100-year floodplain boundary designated by the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) for Clackamas County, Oregon, Incorporated Areas, Panel 243, June 17, 2008 and in non-printed Flood Map Boundary Area. See Appendix A for the FIRMette of the proposed site.

Section 4—Methodology

The stormwater system for the Frog Pond Meadows Development was modeled using the following methods and design standards:

- **Water Quality:** The City of Wilsonville requires capture and treatment of 80 percent of the average annual runoff (approximately 1-inch in 24 hours). SLOPES V guidelines require treatment of a volume equal to 50 percent of the rainfall produced by a 2-year, 24-hour storm. The City of Wilsonville has adopted a BMP Sizing Tool that was developed to aid in the design of detention and water quality low impact development facilities. The City of Wilsonville BMP Sizing Tool was used to size minimum facility footprint areas to meet the water quality treatment standard.
- **Flow Control:** The BMP sizing tool was also used to calculate detention facility sizes. This tool provides the necessary calculations to design a facility to meet City flow duration matching standards whereby the *“duration of peak flow rates from post development conditions shall be less than or equal to the duration of peak flow rates from pre-development conditions for all peak flows between 42 percent of the 2-year storm peak flow rate up to the 10-year peak flow rate.”* SLOPES V requires flow duration and frequency matching for 50 percent of the 2-year through the 10-year event. Therefore, the more conservative City standard will be implemented using the BMP Sizing Tool.
- **Conveyance:** The Santa Barbara Urban Hydrograph (SBUH) method in XP-SWMM software will be used to size the project conveyance system. The City’s design event for pipe conveyance is the 25-year, 24-hour storm, requiring 1-foot of freeboard between the hydraulic grade line and finished grade at structure rims.

BMP Sizing Tool Hydrology

The BMP Sizing Tool was created to aid in designing low impact development facilities for both treating stormwater runoff and matching flow durations between target conditions and developed conditions. Both City standards and SLOPES V requirements consider target conditions to be pre-development, prior to any human settlement. City of Wilsonville standards stipulates that the pre-developed vegetation of Oak Savannah, which applies to the site, should be modeled in the sizing tool as grass. Proposed conditions were set to paved conditions for roof, roadway, and sidewalk, and set to landscaped conditions for landscaped and other disturbed pervious areas within the project boundary.

Vegetated filtration swales, rain gardens, and a detention pond will function to provide both water quality and flow control mitigation. The BMP Sizing Tool provides minimum facility footprint areas for treatment and flow control. The BMP Sizing Tool also provides the corresponding orifice sizes for incorporating the flow control component for these facilities. It is Otak’s understanding that by providing the footprint area and orifice calculated by the BMP Sizing Tool and constructing facilities using the standard LID details adopted by the city, the facilities will meet City and SLOPES V requirements.

Drainage

The developed site drains to Willow Creek approximately 1.2 miles north of its discharge point at the Willamette River. The Willow Creek main branch and SW Stafford Road drainageway join approximately 2,000 feet downstream of SW Boeckman/SW Advance Road. Otak conducted a downstream impact analysis on the downstream storm conveyance system for the proposed Stafford Meadows development draining to Willow Creek per City of Wilsonville standards. A downstream analysis of the SW Stafford Road system was also conducted, and the two downstream impact analyses are included in Appendix C.

Conveyance

The proposed development will include a piped conveyance network that will convey flows to Willow Creek. Pipes draining the project site to these locations will be designed to meet City of Wilsonville conveyance standards.

The Santa Barbara Urban Hydrograph (SBUH) method will be used to calculate runoff rates generated under proposed conditions for contributing areas. The *City of Wilsonville Public Works Standards (2015)* identifies the 25-year, 24-hour storm to be used for conveyance design, maintaining 1-foot of clearance between the hydraulic grade line and conveyance structure rim elevations. The City also requires an assessment of the 100-year storm event impacts to the proposed system. Flow rates during the 100-year may be conveyed overland but are not expected to inundate existing structures. The stormwater conveyance network will be sized during final design.

The conveyance system, pond, and outfall constructed for Stafford Meadows will also be utilized for Frog Pond Ridge. Two new outfalls to Willow Creek will discharge from swales and rain gardens that meet water quality and flow control requirements. A new outfall to the existing wetland along SW Stafford Road will discharge stormwater after it has been managed by the rain garden.

A culvert will be constructed under SW Brisband Street to connect the Willow Creek drainage and wetlands. Culvert sizing will be included in final design. An existing culvert under SW Frog Pond Lane will be removed and the flows from north of SW Frog Pond Lane will be collected and conveyed through the project site using pipe infrastructure designed to convey managed flows, and discharge to the wetlands adjacent to Willow Creek.

Section 5—Water Quality Treatment

Low Impact Development

The City of Wilsonville promotes the use of Low Impact Development (LID) approaches to meet water quality treatment standards. Locations of LID facilities for water quality treatment for the Frog Pond Meadows project site are shown on Figures 2 and 3.

Water Quality Facilities

Water quality treatment will be provided through filtration vegetated swales, rain gardens and a detention pond. The BMP Sizing Tool was used to calculate minimum facility sizes to satisfy water quality requirements. The BMP tool does not calculate a water quality flow rate through the facility; however, it was developed to design facilities that meet the City's water quality design standards. By sizing a facility with the output parameters produced by the sizing tool, it is expected to be designed appropriately to meet water quality treatment criteria by both the City and SLOPES V standards. A HydroCAD model was created to calculate the peak water quality flow rate generated and treated by the development for the SLOPES form. Facility sizing calculation reports from the BMP Sizing Tool are provided in Appendix D.

Section 6—Flow Control

City of Wilsonville Public Works Standards (2015) requires the use of flow attenuation when a proposed development increases impervious surface area by more than 5,000 square feet. Therefore, this project site will require flow control mitigation prior to discharging site runoff to downstream conveyance systems (open or closed channels or conduits). Per City requirements, the “post-development conditions shall be less than or equal to the duration of peak flow rates from pre-development conditions for all peak flows between 42 percent of the 2-year storm peak flow rate up to the 10-year peak flow rate.”

Flow control structures are proposed immediately downstream of vegetated filtration swales, rain gardens, and the existing detention pond, per the City’s standard detail. These facilities provide flow control by installing orifices at the end of corresponding underdrain pipes to backwater flows into the voids present in facility soil and rock layers. Water is released from the facility through the orifice, which is sized to meter flows at a rate that meets flow control standards. Orifices are provided for flow control purposes only; construction details of the flow control structures are provided on the plan sheets. The detention pond was constructed recently as part of the Stafford Meadows Development, using the same design standards.

Section 7—Operations and Maintenance

Vegetated facilities will be maintained by the private development. Operations and Maintenance requirements are included in Appendix E in conjunction with corresponding standard details for each type of facility. The following representative will be responsible for ongoing maintenance of onsite facilities: Dan Grimberg 503-641-7342

Section 8—Conclusion

The proposed Frog Pond Meadows development will include a stormwater management system designed to comply with standards set forth by the City of Wilsonville and SLOPES V. The proposed development will create 9.10 acres of impervious area. Runoff from impervious areas will be treated by LID facilities, including vegetated filtration swales, rain gardens, and a detention pond. Flow control requirements will also be met by the vegetated swales and existing detention pond. The BMP Sizing Tool was used to calculate minimum facility sizes to satisfy water quality and flow control requirements and a summary of facilities is presented in Table 3 below. By sizing a facility with the output parameters calculated by the BMP sizing tool, it is expected to be designed appropriately to meet water quality treatment criteria by both the City and SLOPES V standards. In accordance with City of Wilsonville standards, the conveyance system will be sized to convey the 25-year, 24-hour storm event with a minimum of one foot of freeboard between the hydraulic grade line (HGL) and the finished grade elevation.

Table 3—Facility Summary Table

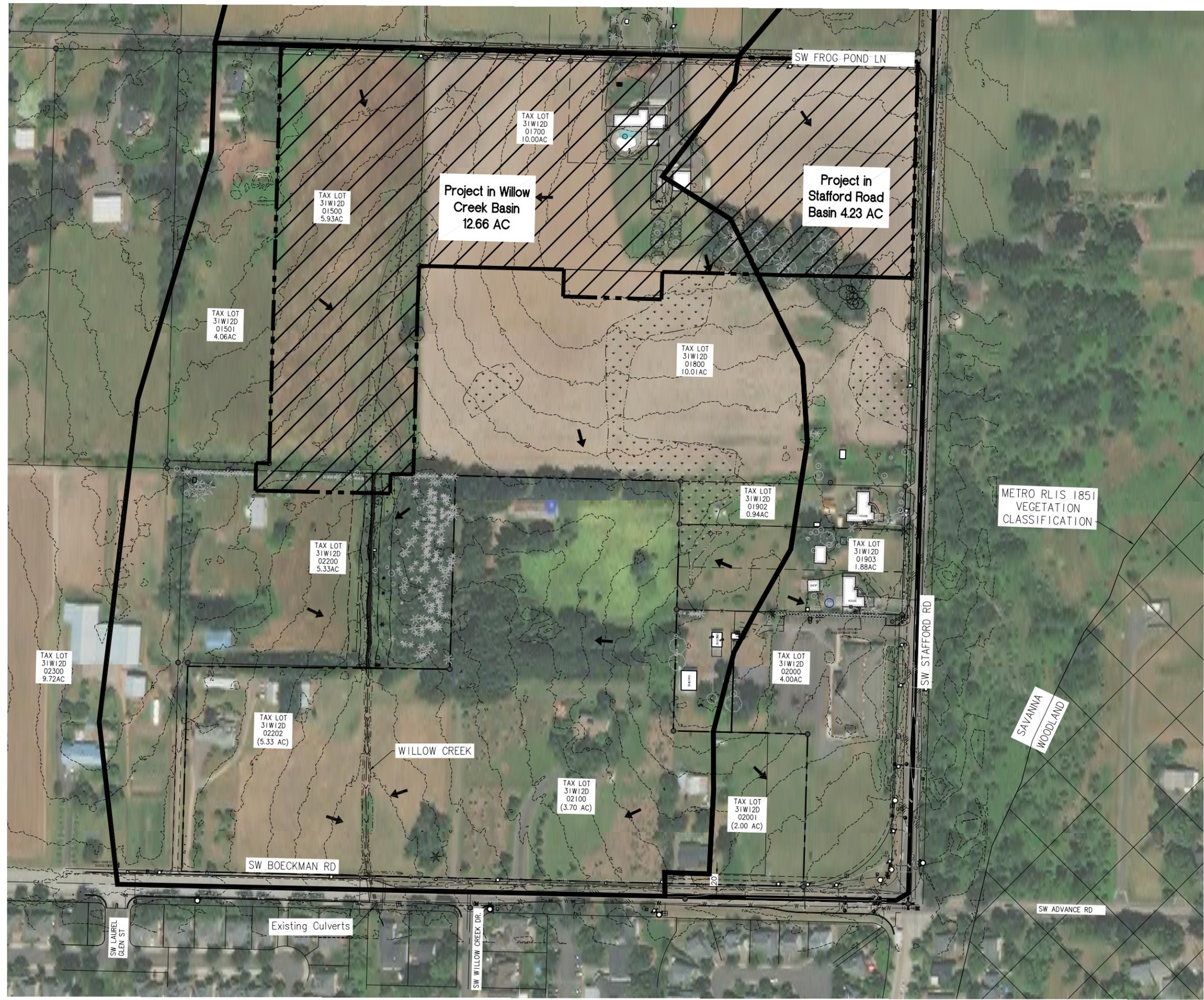
Basin ID	Facility ID	Function	LID Min. Size, BMP Output (sf)	LID Size, Site Plan (sf)	Orifice Diameter (in)
WC 14, 15, 19A	Tract B Rain garden 2	WQ, FC	2058	2501	2.4
WC 13, 16, 17, 28	Tract B Rain garden 1	WQ, FC	5316	6152	3.9
WC 18A	WC 18A Swale	WQ, FC	558	608	1.5
WC 18B	WC 18B Swale	WQ, FC	271	352	1.0
WC 20	WC 20 Swale	WQ, FC	287	320	1.0
WC 21	WC 21 Swale	WQ, FC	491	608	1.3

Basin ID	Facility ID	Function	LID Min. Size, BMP Output (sf)	LID Size, Site Plan (sf)	Orifice Diameter (in)
WC 22A	WC 22A Swale	WQ, FC	381	415	1.1
WC 22B	WC 22B Swale	WQ, FC	227	352	0.9
WC 23	WC 23 Swale	WQ, FC	173	200	0.8
WC 24	WC 24 Swale	WQ, FC	98	123	0.6
WC 25	WC 25 Swale	WQ, FC	248	255	1.0
WC 26A	WC 26A Swale	WQ, FC	347	320	1.1
WC 26B	WC 26B Swale	WQ, FC	328	320	1.0
WC 27	WC 27 Swale	WQ, FC	407	656	1.2
P 60	Tract C Rain garden	WQ	1294	1640	1.5
P 61	P 61 Swale	WQ, FC	280	352	1.0
P 62	P 62 Swale	WQ, FC	380	504	1.2
SR 20	Tract E Rain garden	WQ, FC	6179	6445	4.3
SR 21	SR 21 Swale	WQ, FC	198	368	0.8
SR 22	SR 22 Swale	WQ, FC	449	656	1.2
SR 23	SR 23 Swale	WQ, FC	252	384	0.9
SR 24	SR 24 Swale	WQ, FC	300	352	1.0
SR 25	SR 25 Swale	WQ, FC	115	200	0.6
SR 26	SR 26 Swale	WQ, FC	388	656	1.2
SR 27	SR 27 Swale	WQ, FC	256	656	0.9
SR 29	SR 29 Swale	WQ, FC	364	387	1.1

Section 9—References

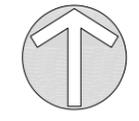
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Figures



LEGEND

- PROPERTY LINE
- PROJECT LIMITS
- EXISTING 10' CONTOUR
- OVERHEAD LINE
- COM. CABLE LINE
- GAS LINE
- WATER LINE
- ELECTRIC LINE
- SANITARY SEWER LINE
- WETLAND AREAS
- CULVERT PIPE
- BASIN BOUNDARY
- FLOW ARROW



FROG POND RIDGE

PRELIMINARY DESIGN
WILSONVILLE, OREGON

EXISTING DRAINAGE CONDITIONS

REVISIONS		
#	DATE	DESCRIPTION

DATUM _____ MAP _____
DRAWN BY _____ CHECKED BY _____
STATUS _____
FEBRUARY 19, 2019
DATE _____
19106
PROJECT NUMBER

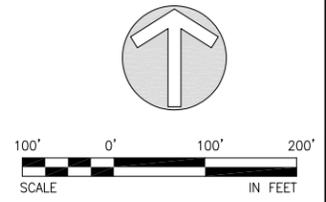
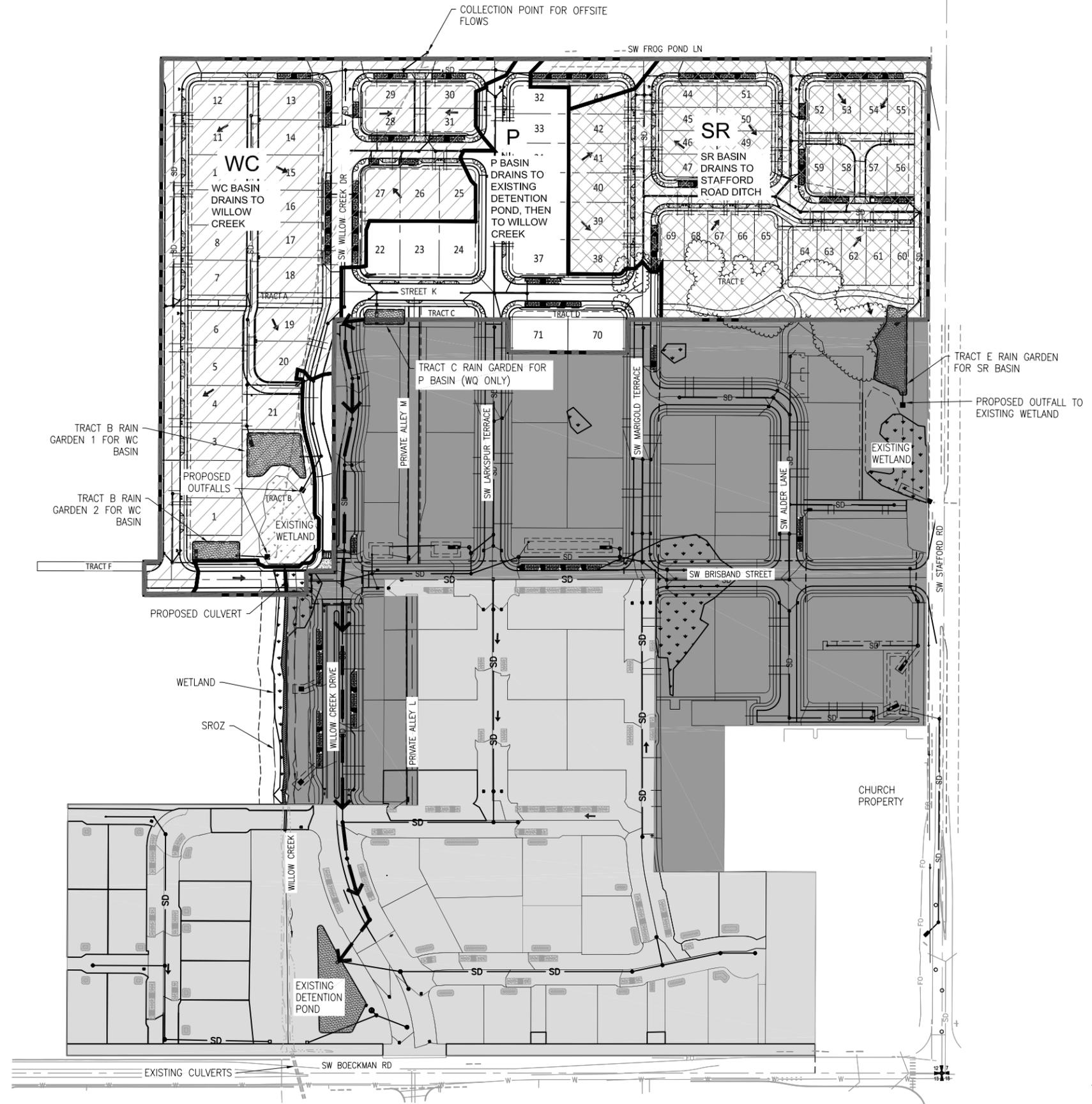
FIG 1

© 2020 OTAK, INC.
If this drawing is not 22" x 34", it has been reduced/enlarged. Scale accordingly.

Plotted: Dec 22, 2019 - 12:57pm user: L:\Project\194001\194001\CADD\DWG\Exhibits\WNR\Figure 1_19408 Existing Conditions.dwg Layout Name: EXISTING

LEGEND

- PROJECT BOUNDARY
- STORM DRAIN MANHOLE
- STORM DRAIN MAIN
- STORM DRAIN LATERAL
- RAIN GARDEN
- STORMWATER SWALE
- FROG POND RIDGE ONSITE DRAINAGE BASIN WC
- FROG POND RIDGE ONSITE DRAINAGE BASIN P
- FROG POND RIDGE ONSITE DRAINAGE BASIN SR
- EXISTING FROG POND MEADOWS DRAINAGE BASIN
- EXISTING STAFFORD MEADOWS DRAINAGE BASIN
- SURFACE RUNOFF FLOW ARROW
- CREEK FLOW ARROW
- PIPED FLOW ARROW
- WETLAND AREAS
- EXISTING TREE DRIPLINE



FROG POND RIDGE

PRELIMINARY DESIGN
WILSONVILLE, OREGON

PROPOSED DRAINAGE CONDITIONS

TITLE		
#	DATE	DESCRIPTION

REVISIONS	

DRAWN BY	CHECKED BY

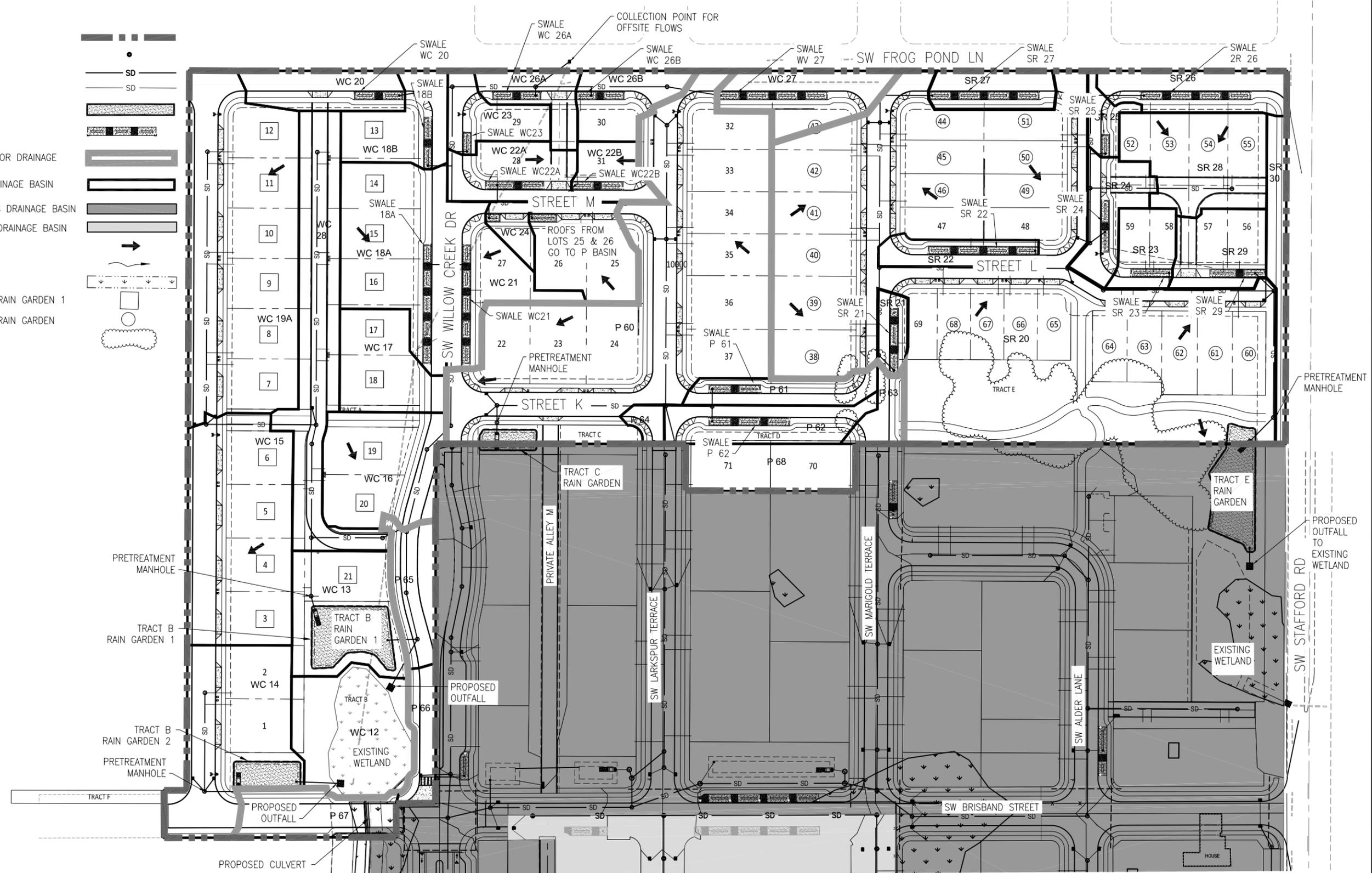
STATUS	
JUNE 21, 2019	DATE
19106	PROJECT NUMBER

FIG 2

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If this drawing is not 22" x 34", it has been reduced/enlarged. Scale accordingly.

LEGEND

- PROJECT BOUNDARY
- STORM DRAIN MANHOLE
- STORM DRAIN MAIN
- STORM DRAIN LATERAL
- RAIN GARDEN
- STORMWATER SWALE
- FROG POND RIDGE ONSITE MAJOR DRAINAGE BASIN (WC, P, SR)
- FROG POND RIDGE ONSITE DRAINAGE BASIN
- EXISTING FROG POND MEADOWS DRAINAGE BASIN
- EXISTING STAFFORD MEADOWS DRAINAGE BASIN
- DRAINAGE FLOW ARROW
- CREEK FLOW ARROW
- WETLAND AREAS
- ROOFS DRAINING TO TRACT B RAIN GARDEN 1
- ROOFS DRAINING TO TRACT E RAIN GARDEN
- EXISTING TREE DRIPLINE



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FROG POND RIDGE

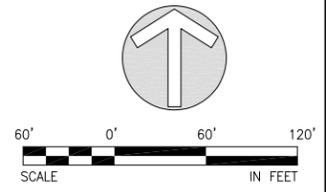
PRELIMINARY DESIGN
WILSONVILLE, OREGON

PROPOSED DETAILED DRAINAGE CONDITIONS

TITLE	#	DATE	DESCRIPTION
REVISIONS			
DRAWN BY _____ CHECKED BY _____			
STATUS			
JUNE 21, 2019			
DATE			
19106			
PROJECT NUMBER			

FIG 3

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If this drawing is not 22" x 34", it has been reduced/enlarged. Scale accordingly.



Appendix A
Hydrology

Hydrologic Soil Group—Clackamas County Area, Oregon



Map Scale: 1:2,380 If printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

12/11/2019
Page 1 of 4

MAP LEGEND

 Area of Interest (AOI)	 C
 Area of Interest (AOI)	 C/D
Soils	 D
Soil Rating Polygons	 Not rated or not available
 A	Water Features
 A/D	 Streams and Canals
 B	Transportation
 B/D	 Rails
 C	 Interstate Highways
 C/D	 US Routes
 D	 Major Roads
 Not rated or not available	 Local Roads
Soil Rating Lines	Background
 A	 Aerial Photography
 A/D	
 B	
 B/D	
 C	
 C/D	
 D	
 Not rated or not available	
Soil Rating Points	
 A	
 A/D	
 B	
 B/D	

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL:
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Clackamas County Area, Oregon
 Survey Area Data: Version 15, Sep 10, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 1, 2019—Sep 12, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1A	Aloha silt loam, 0 to 3 percent slopes	C/D	13.9	66.9%
1B	Aloha silt loam, 3 to 6 percent slopes	C/D	0.5	2.2%
21	Concord silt loam	C/D	3.4	16.5%
91B	Woodburn silt loam, 3 to 8 percent slopes	C	0.0	0.2%
2225A	Huberly silt loam, 0 to 3 percent slopes	C/D	2.9	14.2%
Totals for Area of Interest			20.7	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

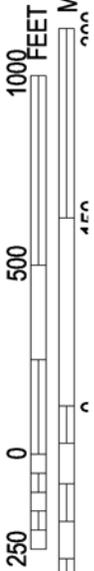
Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options



MAP SCALE 1" = 500'



NFIP

PANEL 0234D

FIRM

FLOOD INSURANCE RATE MAP
CLACKAMAS COUNTY,
OREGON
AND INCORPORATED AREAS

PANEL 234 OF 1175

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CLACKAMAS COUNTY	415588	0234	D
WILSONVILLE, CITY OF	410025	0234	D

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.



MAP NUMBER
41005C0234D
EFFECTIVE DATE
JUNE 17, 2008

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



JOINS PANEL 0253

Site located
in
non-printed
area

Drainage Basin Areas

19489 Frog Pond Ridge

Existing Conditions:

Basin Name	Impervious Area		Pervious Area		Total Area	
	Total (sf)	Total (ac)	Total (sf)	Total (ac)	(sf)	(ac)
Willow Creek	36,779	0.84	514,579	11.81	551,358	12.66
Stafford Road	6489	0.15	177,780	4.08	184,269	4.23
TOTAL	43,268	0.99	692,358	15.89	735,626	16.89

Duplex Impervious Area per Lot
Impervious Area per Lot

2,000 SF
2,750 SF (2015 Public Works Stds 301.4.01)

Proposed Conditions:

Basin	Drains To	Impervious Area				Pervious Area		Total Area	
		Roadway (sf)	Roof (sf)	Total (sf)	Total (ac)	(sf)	(ac)	(sf)	(ac)
Site Total		258,520	197,250	450,270	10.34	285,356	6.55	735,626	16.89
WC Basins		117,896	71,500	189,396	4.35	139,007	3.19	328,403	7.54
WC 12	Creek	0	0	0	0.00	19,811	0.45	19,811	0.45
WC 13	Tract B RG 1	0	2,750	2,750	0.06	15,676	0.36	18,426	0.42
WC 14	Tract B RG 2	12,948	5,500	18,448	0.42	8,754	0.20	27,202	0.62
WC 15	WEST RG	12,906	11,000	23,906	0.55	9,830	0.23	33,736	0.77
WC 16	Tract B RG 1	4,571	5,500	10,071	0.23	8,602	0.20	18,673	0.43
WC 17	Tract B RG 1	1,526	5,500	7,026	0.16	5,621	0.13	12,647	0.29
WC 18A	SwaleWC18A	6,820	8,250	15,070	0.35	10,190	0.23	25,260	0.58
WC 18B	Swale WC18B	4,169	2,750	6,919	0.16	3,716	0.09	10,635	0.24
WC 19A	Tract B RG 1	20,067	16,500	36,567	0.84	14,654	0.34	51,221	1.18
WC 20	Swale WC20	7,011	0	7,011	0.16	1,835	0.04	8,846	0.20
WC 21	Swale WC21	6,109	2,750	8,859	0.20	4,880	0.11	13,739	0.32
WC 22A	Swale WC22A	5,120	2,750	7,870	0.18	2,361	0.05	10,231	0.23
WC 22B	Swale WC22B	2,004	2,750	4,754	0.11	1,298	0.03	6,052	0.14
WC 23	Swale WC23	3,211	2,750	5,961	0.14	1,599	0.04	7,560	0.17
WC 24	Swale WC24	1,080	0	1,080	0.02	1,958	0.04	3,038	0.07
WC 25	Swale WC25	2,396	0	2,396	0.06	5,431	0.12	7,827	0.18
WC 26A	Swale WC26A	4,876	0	4,876	0.11	1,472	0.03	6,348	0.15
WC 26B	Swale WC26B	4,545	2,750	7,295	0.17	1,305	0.03	8,600	0.20
WC 27	Swale WC27	6,482	0	6,482	0.15	5,261	0.12	11,743	0.27
WC 28	Tract B RG 1	12,055	0	12,055	0.28	14,753	0.34	26,808	0.62
P Basins		68,770	35,750	99,020	2.27	55,727	1.28	154,747	3.55
P 60	Tract C RG	33,662	30,250	63,912	1.47	31,926	0.73	95,838	2.20
P 61	Swale P61	6,150	0	6,150	0.14	1,210	0.03	7,360	0.17
P 62	Swale P62	4,472	0	4,472	0.10	6,369	0.15	10,841	0.25
P 63	Ex. Pond	3,243	0	3,243	0.07	645	0.01	3,888	0.09
P 64	Ex. Pond	1,760	0	1,760	0.04	0	0.00	1,760	0.04
P 65	Ex. Pond	5,592	0	5,592	0.13	2,732	0.06	8,324	0.19
P 66	Ex. Pond	4,817	0	4,817	0.11	313	0.01	5,130	0.12
P 67	Ex. Pond	9,074	0	9,074	0.21	1,146	0.03	10,220	0.23
P 68	Ex. Pond	0	5500	0	0.00	11,386	0.26	11,386	0.26

Drainage Basin Areas

19489 Frog Pond Ridge

Basin	Drains To	Impervious Area				Pervious Area		Total Area	
		Roadway (sf)	Roof (sf)	Total (sf)	Total (ac)	(sf)	(ac)	(sf)	(ac)
Stafford Road		71,854	90,000	161,854	3.72	90,622	2.08	252,476	5.80
SR 20	Rain Garden	36,343	65,750	102,093	2.34	46,603	1.07	148,696	3.41
SR 21	Swale SR21	2,436	2,750	5,186	0.12	800	0.02	5,986	0.14
SR 22	Swale SR22	4,792	5,500	10,292	0.24	1,319	0.03	11,611	0.27
SR 23	Swale SR 23	1,352	4,000	5,352	0.12	1,333	0.03	6,685	0.15
SR 24	Swale SR24	5,432	0	5,432	0.12	2,988	0.07	8,420	0.19
SR 25	Swale SR25	2,143	0	2,143	0.05	1,063	0.02	3,206	0.07
SR 26	Swale SR26	7,411	0	7,411	0.17	3,254	0.07	10,665	0.24
SR 27	Swale SR27	5,461	0	5,461	0.13	1,320	0.03	6,781	0.16
SR 28	Tract E RG	3,477	8,000	11,477	0.26	6,803	0.16	18,280	0.42
SR 29	Swale SR29	3,007	4,000	7,007	0.16	3,007	0.07	10,014	0.23
SR 30	Offsite	0	0	0	0.00	7,026	0.16	7,026	0.16
FOREST	Tract E RG	0	0	0	0.00	15,106	0.35	15,106	0.35
TOTAL		258,520	197,250	450,270	10.34	285,356	6.55	735,626	16.89

Appendix B
Geotechnical Report

April 23, 2018
HGSI Project No. 18-2306

Dan Grimberg / Kristi Hosea
West Hills Land Development
3330 NW Yeon Avenue, Suite 200
Portland, Oregon 97210

Via e-mail (pdf format); hard copies can be mailed on request

**Subject: GEOTECHNICAL ENGINEERING REPORT
MORGAN PROPERTY
6720 SW FROG POND LANE
WILSONVILLE, CLACKAMAS COUNTY, OREGON**

This report presents the results of a geotechnical engineering study conducted by Hardman Geotechnical Services Inc. (HGSI) for the property at 6720 SW Frog Pond Lane in Wilsonville, Oregon (Figure 1). The purpose of this study was to evaluate subsurface conditions at the site and to provide geotechnical recommendations for site development. This geotechnical study was performed in accordance with HGSI Proposal No. 18-794, dated March 28, 2018, and your subsequent authorization of our proposal and *General Conditions for Geotechnical Services*.

SITE DESCRIPTION AND PROPOSED DEVELOPMENT

The project totals about 10.01 acres, and is currently occupied by a single-family home constructed in 1965. Other existing site improvements include an in-ground swimming pool, and a detached garage. Site vegetation consists of lawn, landscaping shrubs and trees around the existing home. The majority of the property is grass field or pasture. Site slopes are gentle, generally down toward the south. The site is within an area of rural residential properties.

A grading plan has not been finalized and should be reviewed by HGSI when completed. Underground utilities and onsite stormwater systems are also planned. HGSI should review the grading plan when available to verify consistency with the geotechnical recommendations, and to provide any supplemental or revised input to the design needed based on geotechnical considerations.

REGIONAL GEOLOGY AND SEISMIC SETTING

The subject site lies within the Portland Basin, a broad structural depression situated between the Coast Range on the west and the Cascade Range on the east. The Portland Basin is a northwest-southwest trending structural basin produced by broad regional downwarping of the area. The Portland Basin is approximately 20 miles wide and 45 miles long and is filled with consolidated and unconsolidated sedimentary rocks of late Miocene, Pliocene and Pleistocene age.

The subject site is underlain by Quaternary age (last 1.6 million years) loess, a windblown silt deposit that mantles older deposits and basalt bedrock in the Portland Hills (Madin, 1990). The loess generally consists of massive silt deposited following repeated catastrophic flooding events in the Willamette Valley, the last of

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which occurred about 10,000 years ago. In localized areas, the loess includes buried paleosols that developed between depositional events. Regionally, the total thickness of loess ranges from 5 feet to greater than 100 feet.

The loess is underlain by residual soil formed by in place weathering of the underlying Columbia River Basalt Formation (Madin, 1990). The Miocene aged (about 14.5 to 16.5 million years ago) Columbia River Basalts are a thick sequence of lava flows which form the crystalline basement of the Tualatin Valley. The basalts are composed of dense, finely crystalline rock that is commonly fractured along blocky and columnar vertical joints. Individual basalt flow units typically range from 25 to 125 feet thick and interflow zones are typically vesicular, scoriaceous, brecciated, and sometimes include sedimentary rocks.

At least three major fault zones capable of generating damaging earthquakes are known to exist in the region. These include the Portland Hills Fault Zone, Gales Creek-Newberg-Mt. Angel Structural Zone, and the Cascadia Subduction Zone. These potential earthquake source zones are included in the determination of seismic design values for structures, as presented in the *Seismic Design* section. None of the known faults extend beneath the site.

FIELD EXPLORATION – HAND AUGER BORINGS

The site-specific exploration for this study was conducted on April 19, 2018 and consisted of five hand auger borings (designated HA-1 through HA-5) excavated to maximum depths of approximately 5 feet below ground surface (bgs) at the approximate locations shown on Figure 2. It should be noted that exploration locations were determined in the field by pacing or taping distances from apparent property corners and other site features shown on the plans provided. As such, the locations of the explorations should be considered approximate.

Explorations were conducted under the full-time observation of HGSI personnel. Soil samples obtained from the borings were classified in the field and representative portions were placed in relatively air-tight plastic bags. These soil samples were then returned to the laboratory for further examination. Pertinent information including soil sample depths, stratigraphy, soil engineering characteristics, and groundwater occurrence was recorded. Soils were classified in general accordance with the Unified Soil Classification System.

Summary exploration logs are attached to this report. The stratigraphic contacts shown on the individual borehole logs represent the approximate boundaries between soil types. The actual transitions may be more gradual. The soil and groundwater conditions depicted are only for the specific dates and locations reported, and therefore, are not necessarily representative of other locations and times.

SUBSURFACE CONDITIONS

The following discussion is a summary of subsurface conditions encountered in our explorations. For more detailed information regarding subsurface conditions at specific exploration locations, refer to the attached hand auger logs. Also, please note that subsurface conditions can vary between exploration locations, as discussed in the *Uncertainty and Limitations* section below.

Soil

On-site soils are anticipated to consist of topsoil, clayey silt, and clay, as described below.

Topsoil – From the ground surface, all explorations encountered 1.5 to 2 feet of topsoil, comprised of moist silt. The upper about 1 foot of the topsoil was highly organic.

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Clayey Silt to Silty Clay – Beneath the topsoil in the hand augers, we encountered stiff to very stiff, moist to wet, brown clayey silt to silty clay. The upper several feet of this unit exhibited orange and gray mottling. All of the explorations terminated in the clayey silt to silty clay unit, at maximum depth of about 5 feet bgs.

Groundwater

During the field exploration, no static groundwater table was encountered to the maximum depth of exploration at 5 feet bgs. Slight seepage was encountered in borings HA-1, HA-3 and HA-4 at about 2.5 to 3 feet bgs. Perched groundwater conditions often occur over fine-grained native deposits such as those beneath the site, particularly during the wet season. It is anticipated that groundwater conditions will vary depending on the season, local subsurface conditions, changes in site utilization, and other factors. The groundwater conditions reported above are for the specific date and locations indicated, and therefore may not necessarily be indicative of other times and/or locations.

CONCLUSIONS AND RECOMMENDATIONS

Results of this study indicate that the proposed development is geotechnically feasible, provided that the recommendations of this report are incorporated into the design and construction phases of the project. Recommendations are presented below regarding site preparation and undocumented fill removal, engineered fill, wet weather earthwork, spread footing foundations, below grade structural retaining walls, concrete slabs-on-grade, perimeter footing drains, seismic design, excavating conditions and utility trench backfill, and erosion control considerations.

Site Preparation and Undocumented Fill Removal

The areas of the site to be graded should first be cleared of vegetation, undocumented fill, and any loose debris; and debris from clearing should be removed from the site. Organic-rich topsoil should then be removed to competent native soils. We anticipate that the average depth of topsoil stripping will be about 12 inches over most of the site, however deeper stripping may be needed in localized areas. The final depth of stripping removal may vary depending on local subsurface conditions and the contractor's methods, and should be determined on the basis of site observations after the initial stripping has been performed. Stripped organic soil should be stockpiled only in designated areas or removed from the site and stripping operations should be observed and documented by HGSI. Existing subsurface structures (tile drains, old utility lines, septic leach fields, etc.) beneath areas of proposed structures and pavement should be removed and the excavations backfilled with engineered fill.

There is potential for old fills to be present on site in areas beyond our explorations. Where encountered beneath proposed structures, pavements, or other settlement-sensitive improvements, undocumented fill should be removed down to firm inorganic native soils and the removal area backfilled with engineered fill (see below). HGSI should observe removal excavations (if any) prior to fill placement to verify that overexcavations are adequate and an appropriate bearing stratum is exposed.

In construction areas, once stripping has been verified, the area should be ripped or tilled to a depth of 12 inches, moisture conditioned, and compacted in-place prior to the placement of engineered fill. Exposed subgrade soils should be evaluated by HGSI. For large areas, this evaluation is normally performed by proof-rolling the exposed subgrade with a fully loaded scraper or dump truck. For smaller areas where access is restricted, the subgrade should be evaluated by probing the soil with a steel probe. Soft/loose soils identified during subgrade preparation should be compacted to a firm and unyielding condition or over-excavated and replaced with engineered fill, as described below. The depth of overexcavation, if required, should be evaluated by HGSI at the time of construction.

Engineered Fill

In general, we anticipate that on-site soils will be suitable for use as engineered fill in dry weather conditions, provided they are relatively free of organics and are properly moisture conditioned for compaction. Imported fill material must be approved by the geotechnical engineer prior to being imported to the site. Oversize material greater than 6 inches in size should not be used within 3 feet of foundation footings, and material greater than 12 inches in diameter should not be used in engineered fill.

Engineered fill should be compacted in horizontal lifts not exceeding 8 inches using standard compaction equipment. We recommend that engineered fill be compacted to at least 90 percent of the maximum dry density determined by ASTM D1557 (Modified Proctor) or equivalent. On-site soils may be wet or dry of optimum; therefore, we anticipate that moisture conditioning of native soil will be necessary for compaction operations.

Proper test frequency and earthwork documentation usually requires daily observation and testing during stripping, rough grading, and placement of engineered fill. Field density testing should conform to ASTM D2922 and D3017, or D1556. Engineered fill should be periodically observed and tested by the project geotechnical engineer or his representative. Typically, one density test is performed for at least every 2 vertical feet of fill placed or every 500 yd³, whichever requires more testing.

Wet Weather Earthwork

The on-site soils are moisture sensitive and may be difficult to handle or traverse with construction equipment during periods of wet weather. Earthwork is typically most economical when performed under dry weather conditions. Earthwork performed during the wet-weather season will probably require expensive measures such as cement treatment or imported granular material to compact fill to the recommended engineering specifications. If earthwork is to be performed or fill is to be placed in wet weather or under wet conditions when soil moisture content is difficult to control, the following recommendations should be incorporated into the contract specifications.

- Earthwork should be performed in small areas to minimize exposure to wet weather. Excavation or the removal of unsuitable soils should be followed promptly by the placement and compaction of clean engineered fill. The size and type of construction equipment used may have to be limited to prevent soil disturbance. Under some circumstances, it may be necessary to excavate soils with a backhoe to minimize subgrade disturbance caused by equipment traffic;
- The ground surface within the construction area should be graded to promote run-off of surface water and to prevent the ponding of water;
- Material used as engineered fill should consist of clean, granular soil containing less than about 7 percent fines. The fines should be non-plastic. Alternatively, cement treatment of on-site soils may be performed to facilitate wet weather placement;
- The ground surface within the construction area should be sealed by a smooth drum vibratory roller, or equivalent, and under no circumstances should be left uncompacted and exposed to moisture. Soils which become too wet for compaction should be removed and replaced with clean granular materials;
- Excavation and placement of fill should be observed by the geotechnical engineer to verify that all unsuitable materials are removed and suitable compaction and site drainage is achieved; and
- Bales of straw and/or geotextile silt fences should be strategically located to control erosion.

If cement or lime treatment is used to facilitate wet weather construction, HGSI should be contacted to provide additional recommendations and field monitoring.

Spread Footing Foundations

Shallow, conventional isolated or continuous spread footings may be used to support the proposed structures, provided they are founded on competent native soils, or compacted engineered fill placed directly upon the competent native soils. We recommend a maximum allowable bearing pressure of 2,000 pounds per square foot (psf) for designing spread footings bearing on undisturbed native soils or engineered fill. The recommended maximum allowable bearing pressure may be increased by a factor of 1.33 for short term transient conditions such as wind and seismic loading. Exterior footings should be founded at least 18 inches below the lowest adjacent finished grade. Minimum footing widths should be determined by the project engineer/architect in accordance with applicable design codes.

Assuming construction is accomplished as recommended herein, and for the foundation loads anticipated, we estimate total settlement of spread foundations of less than about 1 inch and differential settlement between two adjacent load-bearing components supported on competent soil of less than about ½ inch. We anticipate that the majority of the estimated settlement will occur during construction, as loads are applied.

Wind, earthquakes, and unbalanced earth loads will subject the proposed structure to lateral forces. Lateral forces on a structure will be resisted by a combination of sliding resistance of its base or footing on the underlying soil and passive earth pressure against the buried portions of the structure. For use in design, a coefficient of friction of 0.5 may be assumed along the interface between the base of the footing and subgrade soils. Passive earth pressure for buried portions of structures may be calculated using an equivalent fluid weight of 390 pounds per cubic foot (pcf), assuming footings are cast against dense, natural soils or engineered fill. The recommended coefficient of friction and passive earth pressure values do not include a safety factor. The upper 12 inches of soil should be neglected in passive pressure computations unless it is protected by pavement or slabs on grade.

Footing excavations should be trimmed neat and the bottom of the excavation should be carefully prepared. Loose, wet or otherwise softened soil should be removed from the footing excavation prior to placing reinforcing steel bars. HGSI should observe foundation excavations prior to placing crushed rock, to verify that adequate bearing soils have been reached. Due to the high moisture sensitivity of on-site soils, construction during wet weather may require overexcavation of footings and backfill with compacted, crushed aggregate.

Below-Grade Structural Retaining Walls

Lateral earth pressures against below-grade retaining walls will depend upon the inclination of any adjacent slopes, type of backfill, degree of wall restraint, method of backfill placement, degree of backfill compaction, drainage provisions, and magnitude and location of any adjacent surcharge loads. At-rest soil pressure is exerted on a retaining wall when it is restrained against rotation. In contrast, active soil pressure will be exerted on a wall if its top is allowed to rotate or yield a distance of roughly 0.001 times its height or greater. If the subject retaining walls will be free to rotate at the top, they should be designed for an active earth pressure equivalent to that generated by a fluid weighing 35 pcf for level backfill against the wall. For restrained walls, an at-rest equivalent fluid pressure of 54 pcf should be used in design, again assuming level backfill against the wall. These values assume that the recommended drainage provisions are incorporated, and hydrostatic pressures are not allowed to develop against the wall.

During a seismic event, lateral earth pressures acting on below-grade structural walls will increase by an incremental amount that corresponds to the earthquake loading. Based on the Mononobe-Okabe equation and peak horizontal accelerations appropriate for the site location, seismic loading should be modeled using the active or at-rest earth pressures recommended above, plus an incremental rectangular-shaped seismic load of magnitude 5H, where H is the total height of the wall.

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We assume relatively level ground surface below the base of the walls. As such, we recommend passive earth pressure of 390 pcf for use in design, assuming wall footings are cast against competent native soils or engineered fill. If the ground surface slopes down and away from the base of any of the walls, a lower passive earth pressure should be used and HGSI should be contacted for additional recommendations.

A coefficient of friction of 0.5 may be assumed along the interface between the base of the wall footing and subgrade soils. The recommended coefficient of friction and passive earth pressure values do not include a safety factor, and an appropriate safety factor should be included in design. The upper 12 inches of soil should be neglected in passive pressure computations unless it is protected by pavement or slabs on grade.

The above recommendations for lateral earth pressures assume that the backfill behind the subsurface walls will consist of properly compacted structural fill, and no adjacent surcharge loading. If the walls will be subjected to the influence of surcharge loading within a horizontal distance equal to or less than the height of the wall, the walls should be designed for the additional horizontal pressure. For uniform surcharge pressures, a uniformly distributed lateral pressure of 0.3 times the surcharge pressure should be added.

The recommended equivalent fluid densities assume a free-draining condition behind the walls so that hydrostatic pressures do not build up. This can be accomplished by placing a 12-inch wide zone of crushed drain rock containing less than 5 percent fines against the walls. A 3-inch minimum diameter perforated, plastic drain pipe should be installed at the base of the walls and connected to a sump to remove water from the crushed drain rock zone. The drain pipe should be wrapped in filter fabric (Mirafi 140N or other as approved by the geotechnical engineer) to minimize clogging. The above drainage measures are intended to remove water from behind the wall to prevent hydrostatic pressures from building up. Additional drainage measures may be specified by the project architect or structural engineer, for damp-proofing or other reasons.

HGSI should be contacted during construction to verify subgrade strength in wall keyway excavations, to verify that backslope soils are in accordance with our assumptions, and to take density tests on the wall backfill materials.

Concrete Slabs-on-Grade

Preparation of areas beneath concrete slab-on-grade floors should be performed as recommended in the *Site Preparation* section. Care should be taken during excavation for foundations and floor slabs, to avoid disturbing subgrade soils. If subgrade soils have been adversely impacted by wet weather or otherwise disturbed, the surficial soils should be scarified to a minimum depth of 8 inches, moisture conditioned to within about 3 percent of optimum moisture content, and compacted to engineered fill specifications. Alternatively, disturbed soils may be removed and the removal zone backfilled with additional crushed rock. For evaluation of the concrete slab-on-grade floors using the beam on elastic foundation method, a modulus of subgrade reaction of 200 kcf (115 pci) should be assumed for the soils anticipated at subgrade depth. This value assumes the concrete slab system is designed and constructed as recommended herein, with a minimum thickness of crushed rock of 8 inches beneath the slab.

Interior slab-on-grade floors should be provided with an adequate moisture break. The capillary break material should consist of ODOT open graded aggregate per ODOT Standard Specifications 02630-2. The minimum recommended thickness of capillary break materials on re-compacted soil subgrade is 8 inches. The total thickness of crushed aggregate will be dependent on the subgrade conditions at the time of construction, and should be verified visually by proof-rolling. Under-slab aggregate should be compacted to at least 90% of its maximum dry density as determined by ASTM D1557 or equivalent.

In areas where moisture will be detrimental to floor coverings or equipment inside the proposed structure, appropriate vapor barrier and damp-proofing measures should be implemented. A commonly applied vapor

barrier system consists of a 10-mil polyethylene vapor barrier placed directly over the capillary break material. With this type of system, an approximately 2-inch thick layer of sand is often placed over the vapor barrier to protect it from damage, to aid in curing of the concrete, and also to help prevent cement from bleeding down into the underlying capillary break materials. Other damp/vapor barrier systems may also be feasible. Appropriate design professionals should be consulted regarding vapor barrier and damp proofing systems, ventilation, building material selection and mold prevention issues, which are outside HGSI's area of expertise.

Perimeter Footing Drains

Due to the potential for perched surface water above fine grained deposits such as those encountered at the site, we recommend the outside edge of perimeter footings be provided with a drainage system consisting of 3-inch minimum diameter perforated PVC pipe embedded in a minimum of 1 ft³ per lineal foot of clean, free-draining sand and gravel or 1"- ¼" drain rock. The drain pipe and surrounding drain rock should be wrapped in non-woven geotextile (Mirafi 140N, or approved equivalent) to minimize the potential for clogging and/or ground loss due to piping. Water collected from the footing drains should be directed into the local storm drain system or other suitable outlet. A minimum 0.5 percent fall should be maintained throughout the drain and non-perforated pipe outlet. The footing drains should include clean-outs to allow periodic maintenance and inspection.

Down spouts and roof drains should collect roof water in a system separate from the footing drains in order to reduce the potential for clogging. Roof drain water should be directed to an appropriate discharge point well away from structural foundations. Grades should be sloped downward and away from buildings to reduce the potential for ponded water near structures.

Seismic Design

Structures should be designed to resist earthquake loading in accordance with the methodology described in the 2012 International Building Code (IBC) with applicable 2014 Oregon Structural Specialty Code (OSSC) revisions. We recommend Site Class C be used for design per the OSSC, which references ASCE 7-10, Chapter 20, Table 20.3-1. Design values determined for the site using the USGS (United States Geological Survey) *Earthquake Ground Motion Parameters* utility are summarized on Table 1.

Table 1. Recommended Earthquake Ground Motion Parameters (2012 IBC / 2014 OSSC)

Parameter	Value
Location (Lat, Long), degrees	45.3175, -122.7474
Mapped Spectral Acceleration Values (MCE, Site Class B):	
Short Period, S_s	0.928 g
1.0 Sec Period, S_1	0.408 g
Soil Factors for Site Class D:	
F_a	1.129
F_v	1.592
$SD_s = 2/3 \times F_a \times S_s$	0.698 g
$SD_1 = 2/3 \times F_v \times S_1$	0.433 g

Potential seismic impacts also include secondary effects such as soil liquefaction, fault rupture potential, and other hazards as discussed below:

- **Soil Liquefaction Potential** – Soil liquefaction is a phenomenon wherein saturated soil deposits temporarily lose strength and behave as a liquid in response to earthquake shaking. Soil liquefaction is generally limited to loose, granular soils located below the water table. Following development, on-site soils will consist predominantly of engineered fill or stiff clayey native soils above the water table, which are not considered susceptible to liquefaction. Therefore, it is our opinion that special design or construction measures are not required to mitigate the effects of liquefaction.
- **Fault Rupture Potential** – Based on our review of available geologic literature, we are not aware of any mapped active (demonstrating movement in the last 10,000 years) faults on the site. During our field investigation, we did not observe any evidence of surface rupture or recent faulting. Therefore, we conclude that the potential for fault rupture on site is low.
- **Seismic Induced Landslide** – Topography in the vicinity of the subject site is generally flat to gently sloping. The potential for slope instability and seismic induced landslide on site is considered very low.
- **Effects of Local Geology and Topography** – In our opinion, no additional seismic hazard will occur due to local geology or topography. The site is expected to have no greater seismic hazard than surrounding properties and the Wilsonville area in general.

Excavating Conditions and Utility Trench Backfill

We anticipate that on-site soils can be excavated using conventional heavy equipment such as scrapers and trackhoes to a depth of 5 feet and likely greater. Maintenance of safe working conditions, including temporary excavation stability, is the responsibility of the contractor. Actual slope inclinations at the time of construction should be determined based on safety requirements and actual soil and groundwater conditions. All temporary cuts in excess of 4 feet in height should be sloped in accordance with U.S. Occupational Safety and Health Administration (OSHA) regulations (29 CFR Part 1926), or be shored. The existing native soils classify as Type B Soil and temporary excavation side slope inclinations as steep as 1H:1V may be assumed for planning purposes. This cut slope inclination is applicable to excavations above the water table only.

Perched groundwater conditions often occur over fine-grained native deposits such as those beneath the site, particularly during the wet season. If encountered, the contractor should be prepared to implement an appropriate dewatering system for installation of the utilities. At this time, we anticipate that dewatering systems consisting of ditches, sumps and pumps would be adequate for control of groundwater where encountered during construction conducted during the dry season. Regardless of the dewatering system used, it should be installed and operated such that in-place soils are prevented from being removed along with the groundwater.

Vibrations created by traffic and construction equipment may cause some caving and raveling of excavation walls. In such an event, lateral support for the excavation walls should be provided by the contractor to prevent loss of ground support and possible distress to existing or previously constructed structural improvements.

Utility trench backfill should consist of ¾"-0 crushed rock, compacted to at least 90% of the maximum dry density obtained by Modified Proctor (ASTM D1557) or equivalent. Initial backfill lift thicknesses for a ¾"-0 crushed aggregate base may need to be as great as 4 feet to reduce the risk of flattening underlying flexible pipe. Subsequent lift thickness should not exceed 1 foot. If imported granular fill material is used, then the lifts for large vibrating plate-compaction equipment (e.g. hoe compactor attachments) may be up to 2 feet, provided that proper compaction is being achieved and each lift is tested. Use of large vibrating

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compaction equipment should be carefully monitored near existing structures and improvements due to the potential for vibration-induced damage.

Adequate density testing should be performed during construction to verify that the recommended relative compaction is achieved. Typically, one density test is taken for every 4 vertical feet of backfill on each 200-lineal-foot section of trench.

Erosion Control Considerations

During our field exploration program, we did not observe soil types that would be considered highly susceptible to erosion. Erosion at the site during construction can be minimized by implementing the project erosion control plan, which should include judicious use of straw, bio-bags, silt fences, or other appropriate technology. Where used, erosion control devices should be in place and remain in place throughout site preparation and construction. Areas of exposed soil requiring immediate and/or temporary protection against exposure should be covered with either mulch or erosion control netting/blankets.

UNCERTAINTIES AND LIMITATIONS

We have prepared this report for the owner and his/her consultants for use in design of this project only. This report should be provided in its entirety to prospective contractors for bidding and estimating purposes; however, the conclusions and interpretations presented in this report should not be construed as a warranty of the subsurface conditions. Experience has shown that soil and groundwater conditions can vary significantly over small distances. Inconsistent conditions can occur between explorations that may not be detected by a geotechnical study. If, during future site operations, subsurface conditions are encountered which vary appreciably from those described herein, HGSI should be notified for review of the recommendations of this report, and revision of such if necessary.

Sufficient geotechnical monitoring, testing and consultation should be provided during construction to confirm that the conditions encountered are consistent with those indicated by explorations. Recommendations for design changes will be provided should conditions revealed during construction differ from those anticipated, and to verify that the geotechnical aspects of construction comply with the contract plans and specifications.

Within the limitations of scope, schedule and budget, HGSI executed these services in accordance with generally accepted professional principles and practices in the field of geotechnical engineering at the time the report was prepared. No warranty, expressed or implied, is made. The scope of our work did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous or toxic substances in the soil, surface water, or groundwater at this site.



We appreciate this opportunity to be of service.

Sincerely,

HARDMAN GEOTECHNICAL SERVICES INC.



Scott L. Hardman, P.E., G.E.
Geotechnical Engineer

- Attachments: References
 Figure 1 – Vicinity Map
 Figure 2 – Site Plan
 Logs of Hand Auger Borings HA-1 through HA-5



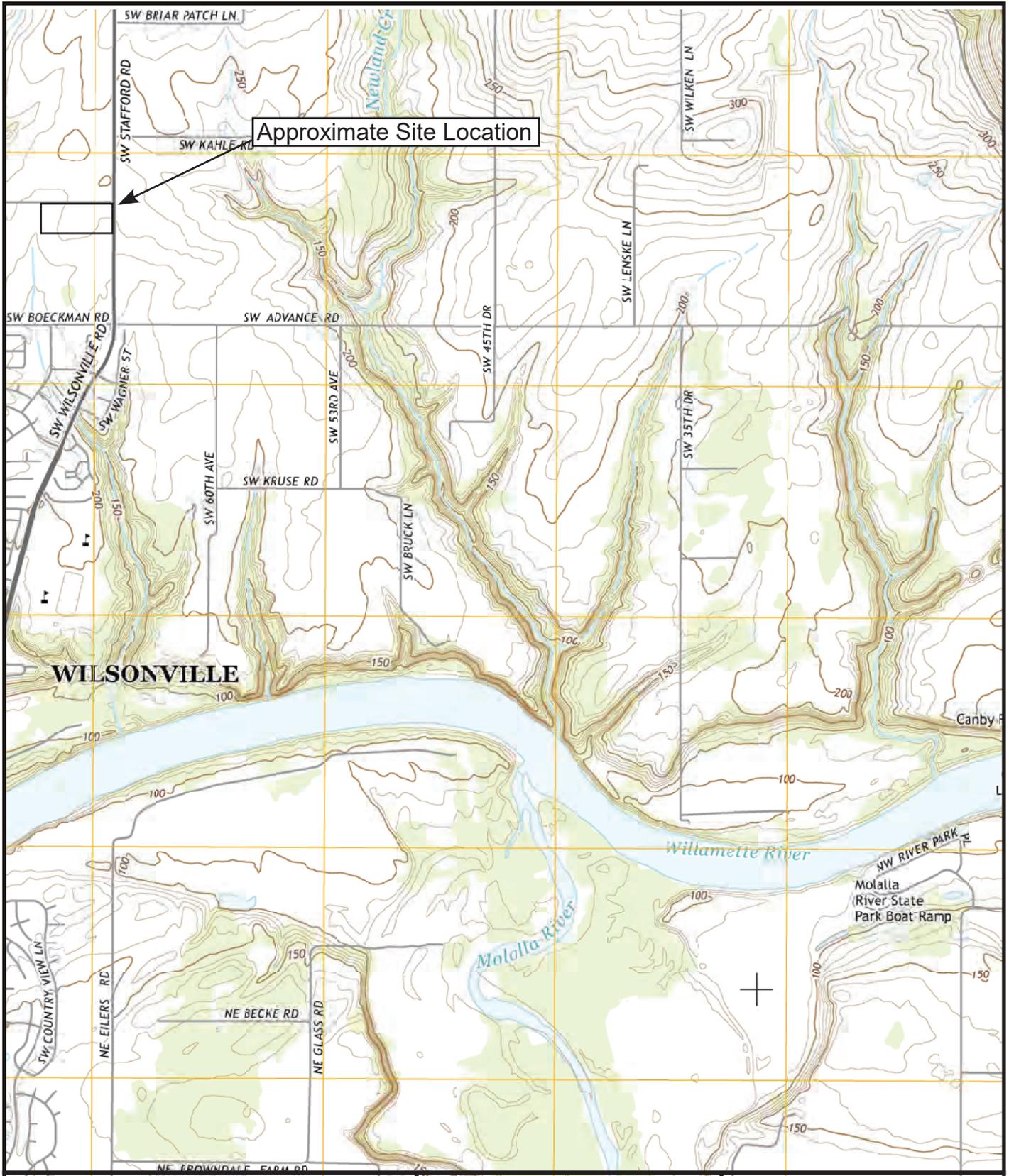
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Project: Morgan Property
Wilsonville, Oregon

Project No. 18-2306

FIGURE 1

**SITE PLAN AND
EXPLORATION LOCATIONS**



Legend	HA-1 Hand Auger Designation and Approximate Location DCP-1 DCP Test Designation and Approximate Location Water Well Septic Tank
Note: For exploration logs and geotechnical recommendations refer to HGS geotechnical report dated April 23, 2018	
Project: Morgan Property Clackamas County, Oregon	Project No. 18-2307
Base map from Google Earth	
FIGURE 2	

HAND AUGER BORING LOG

Project: Morgan Property
Willsonville, Oregon

Project No. 18-2306

Boring No. HA-1

Depth (ft)	Sample Interval	Sample Designation	In-Situ Dry Density (lb/ft ³)	Moisture Content (%)	Groundwater	Material Description
1						Soft to medium stiff, Silt with many fine roots, dark brown, moist (top soil)
2						Stiff, Clayey silt, brown with orange and gray mottling, moist
3						Water at 3 feet, perched on stiff soils below
4						Very stiff to hard, Silty Clay, grey, very moist to wet.
5						Boring terminated at 5 feet
6						
7						

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LEGEND



S-1

Soil Sample Depth
Interval and Designation



Water Level at
Time of Drilling

Date Excavated: 04/19/18

Logged By: EAH

Surface Elevation:

HAND AUGER BORING LOG

Project: Morgan Property
Willsonville, Oregon

Project No. 18-2306

Boring No. HA-2

Depth (ft)	Sample Interval	Sample Designation	In-Situ Dry Density (lb/ft ³)	Moisture Content (%)	Groundwater	Material Description
1						Surface water, soft, Silt with many fine roots, dark brown, saturated (top soil)
2						Stiff, Clayey silt, brown with orange and gray mottling, moist
3						Boring terminated at 2.5 feet
4						
5						
6						
7						

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S-1

Soil Sample Depth Interval and Designation



Water Level at Time of Drilling

Date Excavated: 04/19/18
Logged By: EAH
Surface Elevation:

HAND AUGER BORING LOG

Project: Morgan Property
Willsonville, Oregon

Project No. 18-2306

Boring No. HA-3

Depth (ft)	Sample Interval	Sample Designation	In-Situ Dry Density (lb/ft ³)	Moisture Content (%)	Groundwater	Material Description
1						Soft to medium stiff, Silt with many fine roots, dark brown, moist (top soil)
2						Stiff, Clayey silt, brown with orange and gray mottling, moist Water at 2.5 feet, perched on stiff soils below
3						Very stiff to hard, Silty Clay, grey, very moist to wet.
4						Boring terminated at 4 feet
5						
6						
7						

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S-1



Soil Sample Depth
Interval and Designation

Water Level at
Time of Drilling

Date Excavated: 04/19/18

Logged By: EAH

Surface Elevation:

HAND AUGER BORING LOG

Project: Morgan Property
Willsonville, Oregon

Project No. 18-2306

Boring No. HA- 4

Depth (ft)	Sample Interval	Sample Designation	In-Situ Dry Density (lb/ft ³)	Moisture Content (%)	Groundwater	Material Description
1						Soft to medium stiff, Silt with many fine roots, dark brown, moist (top soil)
2						Stiff, light brown silt, moist, old tilled native.
3						Stiff, Clayey silt, brown with orange and gray mottling, moist Water at 3 feet, perched on stiff soils below
4						Very stiff to hard, Silty Clay, grey, very moist to wet.
5						Boring terminated at 5 feet
6						
7						

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LEGEND



S-1



Soil Sample Depth
Interval and Designation

Water Level at
Time of Drilling

Date Excavated: 04/19/18

Logged By: EAH

Surface Elevation:

HAND AUGER BORING LOG

Project: Morgan Property
Willsonville, Oregon

Project No. 18-2306

Boring No. HA- 5

Depth (ft)	Sample Interval	Sample Designation	In-Situ Dry Density (lb/ft ³)	Moisture Content (%)	Groundwater	Material Description
1						Surface water, soft, Silt with many fine roots, dark brown, saturated (top soil)
2						Stiff, Clayey silt, brown with orange and gray mottling, moist
3						Boring terminated at 2.5 feet
4						
5						
6						
7						

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LEGEND



S-1

Soil Sample Depth
Interval and Designation



Water Level at
Time of Drilling

Date Excavated: 04/19/18

Logged By: EAH

Surface Elevation:

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HGSI Project No. 18-2362

Dan Grimberg / Kristi Hosea
West Hills Land Development
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Portland, Oregon 97210

Via e-mail (pdf format); hard copies can be mailed on request

**Subject: GEOTECHNICAL ENGINEERING REPORT
FROG POND – COATES PROPERTY
TAX LOT 31W12D 01500
WILSONVILLE, CLACKAMAS COUNTY, OREGON**

This report presents the results of a geotechnical engineering study conducted by Hardman Geotechnical Services Inc. (HGSI) for the property located between 7070 SW Frog Pond Lane and 6720 SW Frog Pond Lane at tax lot 31W12D 01500 (Figure 1). The purpose of this study was to evaluate subsurface conditions at the site and to provide geotechnical recommendations for site development.

SITE DESCRIPTION AND PROPOSED DEVELOPMENT

Our understanding of the site and project conditions is based on a review of information provided, and property data obtained online from Clackamas County. The project consists of one tax lot 31W12D 01500, totaling about 6 acres. Please note that the parcel acreage was taken from the Clackamas County GIS website and may not be completely accurate.

There are no structures present on this parcel of land. The lot slopes gradually towards the south and is mostly tall grasses with some blackberry bushes, other brush and a few trees on the boundaries of the property. The site is within an area of rural residential properties.

There is a network of old drain tiles beneath the property, generally trending north to south. Several shallow “sinkholes” are evident on the site, one about mid-point along the east property line, and one in the northwest corner of the property, which are likely related to erosion and “piping” of the soils around the drain tiles, resulting in localized ground loss and subsidence.

The proposed development includes grading the site to support residential lots, with associated underground utilities, roadways and water quality facilities. Details of the planned lot and street layout, and proposed grading, have not yet been developed. HGSI should review the grading plan when available to verify consistency with the geotechnical recommendations, and to provide any supplemental or revised input to the design needed based on geotechnical considerations.

REGIONAL GEOLOGY AND SEISMIC SETTING

The subject site lies within the Portland Basin, a broad structural depression situated between the Coast Range on the west and the Cascade Range on the east. The Portland Basin is a northwest-southwest trending

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structural basin produced by broad regional downwarping of the area. The Portland Basin is approximately 20 miles wide and 45 miles long and is filled with consolidated and unconsolidated sedimentary rocks of late Miocene, Pliocene and Pleistocene age.

The subject site is underlain by Quaternary age (last 1.6 million years) loess, a windblown silt deposit that mantles older deposits and basalt bedrock in the Portland Hills (Madin, 1990). The loess generally consists of massive silt deposited following repeated catastrophic flooding events in the Willamette Valley, the last of which occurred about 10,000 years ago. In localized areas, the loess includes buried paleosols that developed between depositional events. Regionally, the total thickness of loess ranges from 5 feet to greater than 100 feet.

The loess is underlain by residual soil formed by in place weathering of the underlying Columbia River Basalt Formation (Madin, 1990). The Miocene aged (about 14.5 to 16.5 million years ago) Columbia River Basalts are a thick sequence of lava flows which form the crystalline basement of the Tualatin Valley. The basalts are composed of dense, finely crystalline rock that is commonly fractured along blocky and columnar vertical joints. Individual basalt flow units typically range from 25 to 125 feet thick and interflow zones are typically vesicular, scoriaceous, brecciated, and sometimes include sedimentary rocks.

At least three major fault zones capable of generating damaging earthquakes are known to exist in the region. These include the Portland Hills Fault Zone, Gales Creek-Newberg-Mt. Angel Structural Zone, and the Cascadia Subduction Zone. These potential earthquake source zones are included in the determination of seismic design values for structures, as presented in the *Seismic Design* section. None of the known faults extend beneath the site.

FIELD EXPLORATION – TEST PITS AND HAND AUGER BORINGS

The site-specific exploration for this study was conducted on August 30, 2018 and consisted of five test pit excavations (designated TP-1 through TP-5) excavated to maximum depths of approximately 9 feet below ground surface (bgs) at the approximate locations shown on Figure 2. Also included are two hand auger borings done previously as part of our exploration for the School District Properties. The hand auger borings are designated HA-3 and HA-4, at the approximate locations shown on Figure 2. It should be noted that exploration locations were determined in the field by pacing or taping distances from apparent property corners and other site features shown on the plans provided. As such, the locations of the explorations should be considered approximate.

Explorations were conducted under the full-time observation of HGSI personnel. Soil samples obtained from the borings were classified in the field and representative portions were placed in relatively air-tight plastic bags. These soil samples were then returned to the laboratory for further examination. Pertinent information including soil sample depths, stratigraphy, soil engineering characteristics, and groundwater occurrence was recorded. Soils were classified in general accordance with the Unified Soil Classification System.

Summary exploration logs are attached to this report. The stratigraphic contacts shown on the individual borehole logs represent the approximate boundaries between soil types. The actual transitions may be more gradual. The soil and groundwater conditions depicted are only for the specific dates and locations reported, and therefore, are not necessarily representative of other locations and times.

SUBSURFACE CONDITIONS

The following discussion is a summary of subsurface conditions encountered in our explorations. For more detailed information regarding subsurface conditions at specific exploration locations, refer to the attached

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hand auger logs. Also, please note that subsurface conditions can vary between exploration locations, as discussed in the *Uncertainty and Limitations* section below.

Soil

On-site soils are anticipated to consist of topsoil, clayey silt, and clay, as described below.

Topsoil – From the ground surface, all explorations encountered 1.5 to 2 feet of topsoil, comprised of moist silt. The upper about 1 foot of the topsoil was highly organic.

Clayey Silt to Silty Clay – Beneath the topsoil in the hand augers, we encountered stiff to very stiff, moist to wet, brown clayey silt to silty clay. The upper several feet of this unit exhibited orange and gray mottling. All of the explorations terminated in the clayey silt to silty clay unit, at maximum depths of about 5 to 8 feet bgs.

Groundwater

During the field exploration, no static groundwater table was encountered to the maximum depth of exploration at 8 feet bgs. In wet weather conditions, it is probable that perched groundwater conditions would be encountered on site. There is a network of old drain tiles beneath the field, as was commonly done in the past for drainage. Perched groundwater conditions often occur over fine-grained native deposits such as those beneath the site, particularly during the wet season. It is anticipated that groundwater conditions will vary depending on the season, local subsurface conditions, changes in site utilization, and other factors. The groundwater conditions reported above are for the specific date and locations indicated, and therefore may not necessarily be indicative of other times and/or locations.

CONCLUSIONS AND RECOMMENDATIONS

Results of this study indicate that the proposed development is geotechnically feasible, provided that the recommendations of this report are incorporated into the design and construction phases of the project. Recommendations are presented below regarding site preparation and undocumented fill removal, engineered fill, wet weather earthwork, spread footing foundations, below grade structural retaining walls, concrete slabs-on-grade, perimeter footing drains, seismic design, excavating conditions and utility trench backfill, and erosion control considerations.

Site Preparation and Undocumented Fill Removal

The areas of the site to be graded should first be cleared of vegetation, undocumented fill, and any loose debris; and debris from clearing should be removed from the site. Organic-rich topsoil should then be removed to competent native soils. We anticipate that the average depth of topsoil stripping will be about 12 inches over most of the site, however deeper stripping may be needed in localized areas. The final depth of stripping removal may vary depending on local subsurface conditions and the contractor's methods, and should be determined on the basis of site observations after the initial stripping has been performed. Stripped organic soil should be stockpiled only in designated areas or removed from the site and stripping operations should be observed and documented by HGSI. Existing subsurface structures (tile drains, old utility lines, septic leach fields, etc.) beneath areas of proposed structures and pavement should be removed and the excavations backfilled with engineered fill.

There is potential for old fills to be present on site in areas beyond our explorations. Where encountered beneath proposed structures, pavements, or other settlement-sensitive improvements, undocumented fill should be removed down to firm inorganic native soils and the removal area backfilled with engineered fill (see below). HGSI should observe removal excavations (if any) prior to fill placement to verify that overexcavations are adequate and an appropriate bearing stratum is exposed.

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In construction areas, once stripping has been verified, the area should be ripped or tilled to a depth of 12 inches, moisture conditioned, and compacted in-place prior to the placement of engineered fill. Exposed subgrade soils should be evaluated by HGSI. For large areas, this evaluation is normally performed by proof-rolling the exposed subgrade with a fully loaded scraper or dump truck. For smaller areas where access is restricted, the subgrade should be evaluated by probing the soil with a steel probe. Soft/loose soils identified during subgrade preparation should be compacted to a firm and unyielding condition or over-excavated and replaced with engineered fill, as described below. The depth of overexcavation, if required, should be evaluated by HGSI at the time of construction.

Engineered Fill

In general, we anticipate that on-site soils will be suitable for use as engineered fill in dry weather conditions, provided they are relatively free of organics and are properly moisture conditioned for compaction. Imported fill material must be approved by the geotechnical engineer prior to being imported to the site. Oversize material greater than 6 inches in size should not be used within 3 feet of foundation footings, and material greater than 12 inches in diameter should not be used in engineered fill.

Engineered fill should be compacted in horizontal lifts not exceeding 8 inches using standard compaction equipment. We recommend that engineered fill be compacted to at least 90 percent of the maximum dry density determined by ASTM D1557 (Modified Proctor) or equivalent. On-site soils may be wet or dry of optimum; therefore, we anticipate that moisture conditioning of native soil will be necessary for compaction operations.

Proper test frequency and earthwork documentation usually requires daily observation and testing during stripping, rough grading, and placement of engineered fill. Field density testing should conform to ASTM D2922 and D3017, or D1556. Engineered fill should be periodically observed and tested by the project geotechnical engineer or his representative. Typically, one density test is performed for at least every 2 vertical feet of fill placed or every 500 yd³, whichever requires more testing.

Wet Weather Earthwork

The on-site soils are moisture sensitive and may be difficult to handle or traverse with construction equipment during periods of wet weather. Earthwork is typically most economical when performed under dry weather conditions. Earthwork performed during the wet-weather season will probably require expensive measures such as cement treatment or imported granular material to compact fill to the recommended engineering specifications. If earthwork is to be performed or fill is to be placed in wet weather or under wet conditions when soil moisture content is difficult to control, the following recommendations should be incorporated into the contract specifications.

- Earthwork should be performed in small areas to minimize exposure to wet weather. Excavation or the removal of unsuitable soils should be followed promptly by the placement and compaction of clean engineered fill. The size and type of construction equipment used may have to be limited to prevent soil disturbance. Under some circumstances, it may be necessary to excavate soils with a backhoe to minimize subgrade disturbance caused by equipment traffic;
- The ground surface within the construction area should be graded to promote run-off of surface water and to prevent the ponding of water;
- Material used as engineered fill should consist of clean, granular soil containing less than about 7 percent fines. The fines should be non-plastic. Alternatively, cement treatment of on-site soils may be performed to facilitate wet weather placement;

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- The ground surface within the construction area should be sealed by a smooth drum vibratory roller, or equivalent, and under no circumstances should be left uncompacted and exposed to moisture. Soils which become too wet for compaction should be removed and replaced with clean granular materials;
- Excavation and placement of fill should be observed by the geotechnical engineer to verify that all unsuitable materials are removed and suitable compaction and site drainage is achieved; and
- Bales of straw and/or geotextile silt fences should be strategically located to control erosion.

If cement or lime treatment is used to facilitate wet weather construction, HGSI should be contacted to provide additional recommendations and field monitoring.

Spread Footing Foundations

Shallow, conventional isolated or continuous spread footings may be used to support the proposed structures, provided they are founded on competent native soils, or compacted engineered fill placed directly upon the competent native soils. We recommend a maximum allowable bearing pressure of 2,000 pounds per square foot (psf) for designing spread footings bearing on undisturbed native soils or engineered fill. The recommended maximum allowable bearing pressure may be increased by a factor of 1.33 for short term transient conditions such as wind and seismic loading. Exterior footings should be founded at least 18 inches below the lowest adjacent finished grade. Minimum footing widths should be determined by the project engineer/architect in accordance with applicable design codes.

Assuming construction is accomplished as recommended herein, and for the foundation loads anticipated, we estimate total settlement of spread foundations of less than about 1 inch and differential settlement between two adjacent load-bearing components supported on competent soil of less than about ½ inch. We anticipate that the majority of the estimated settlement will occur during construction, as loads are applied.

Wind, earthquakes, and unbalanced earth loads will subject the proposed structure to lateral forces. Lateral forces on a structure will be resisted by a combination of sliding resistance of its base or footing on the underlying soil and passive earth pressure against the buried portions of the structure. For use in design, a coefficient of friction of 0.5 may be assumed along the interface between the base of the footing and subgrade soils. Passive earth pressure for buried portions of structures may be calculated using an equivalent fluid weight of 390 pounds per cubic foot (pcf), assuming footings are cast against dense, natural soils or engineered fill. The recommended coefficient of friction and passive earth pressure values do not include a safety factor. The upper 12 inches of soil should be neglected in passive pressure computations unless it is protected by pavement or slabs on grade.

Footing excavations should be trimmed neat and the bottom of the excavation should be carefully prepared. Loose, wet or otherwise softened soil should be removed from the footing excavation prior to placing reinforcing steel bars. HGSI should observe foundation excavations prior to placing crushed rock, to verify that adequate bearing soils have been reached. Due to the high moisture sensitivity of on-site soils, construction during wet weather may require overexcavation of footings and backfill with compacted, crushed aggregate.

Below-Grade Structural Retaining Walls

Lateral earth pressures against below-grade retaining walls will depend upon the inclination of any adjacent slopes, type of backfill, degree of wall restraint, method of backfill placement, degree of backfill compaction, drainage provisions, and magnitude and location of any adjacent surcharge loads. At-rest soil pressure is exerted on a retaining wall when it is restrained against rotation. In contrast, active soil pressure will be exerted on a wall if its top is allowed to rotate or yield a distance of roughly 0.001 times its height or greater. If the subject retaining walls will be free to rotate at the top, they should be designed for an active earth pressure equivalent to that generated by a fluid weighing 35 pcf for level backfill against the wall. For

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restrained walls, an at-reset equivalent fluid pressure of 54 pcf should be used in design, again assuming level backfill against the wall. These values assume that the recommended drainage provisions are incorporated, and hydrostatic pressures are not allowed to develop against the wall.

During a seismic event, lateral earth pressures acting on below-grade structural walls will increase by an incremental amount that corresponds to the earthquake loading. Based on the Mononobe-Okabe equation and peak horizontal accelerations appropriate for the site location, seismic loading should be modeled using the active or at-rest earth pressures recommended above, plus an incremental rectangular-shaped seismic load of magnitude $5H$, where H is the total height of the wall.

We assume relatively level ground surface below the base of the walls. As such, we recommend passive earth pressure of 390 pcf for use in design, assuming wall footings are cast against competent native soils or engineered fill. If the ground surface slopes down and away from the base of any of the walls, a lower passive earth pressure should be used and HGSI should be contacted for additional recommendations.

A coefficient of friction of 0.5 may be assumed along the interface between the base of the wall footing and subgrade soils. The recommended coefficient of friction and passive earth pressure values do not include a safety factor, and an appropriate safety factor should be included in design. The upper 12 inches of soil should be neglected in passive pressure computations unless it is protected by pavement or slabs on grade.

The above recommendations for lateral earth pressures assume that the backfill behind the subsurface walls will consist of properly compacted structural fill, and no adjacent surcharge loading. If the walls will be subjected to the influence of surcharge loading within a horizontal distance equal to or less than the height of the wall, the walls should be designed for the additional horizontal pressure. For uniform surcharge pressures, a uniformly distributed lateral pressure of 0.3 times the surcharge pressure should be added.

The recommended equivalent fluid densities assume a free-draining condition behind the walls so that hydrostatic pressures do not build up. This can be accomplished by placing a 12-inch wide zone of crushed drain rock containing less than 5 percent fines against the walls. A 3-inch minimum diameter perforated, plastic drain pipe should be installed at the base of the walls and connected to a sump to remove water from the crushed drain rock zone. The drain pipe should be wrapped in filter fabric (Mirafi 140N or other as approved by the geotechnical engineer) to minimize clogging. The above drainage measures are intended to remove water from behind the wall to prevent hydrostatic pressures from building up. Additional drainage measures may be specified by the project architect or structural engineer, for damp-proofing or other reasons.

HGSI should be contacted during construction to verify subgrade strength in wall keyway excavations, to verify that backslope soils are in accordance with our assumptions, and to take density tests on the wall backfill materials.

Concrete Slabs-on-Grade

Preparation of areas beneath concrete slab-on-grade floors should be performed as recommended in the *Site Preparation* section. Care should be taken during excavation for foundations and floor slabs, to avoid disturbing subgrade soils. If subgrade soils have been adversely impacted by wet weather or otherwise disturbed, the surficial soils should be scarified to a minimum depth of 8 inches, moisture conditioned to within about 3 percent of optimum moisture content, and compacted to engineered fill specifications. Alternatively, disturbed soils may be removed and the removal zone backfilled with additional crushed rock. For evaluation of the concrete slab-on-grade floors using the beam on elastic foundation method, a modulus of subgrade reaction of 200 kcf (115 pci) should be assumed for the soils anticipated at subgrade depth. This value assumes the concrete slab system is designed and constructed as recommended herein, with a minimum thickness of crushed rock of 8 inches beneath the slab.

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Interior slab-on-grade floors should be provided with an adequate moisture break. The capillary break material should consist of ODOT open graded aggregate per ODOT Standard Specifications 02630-2. The minimum recommended thickness of capillary break materials on re-compacted soil subgrade is 8 inches. The total thickness of crushed aggregate will be dependent on the subgrade conditions at the time of construction, and should be verified visually by proof-rolling. Under-slab aggregate should be compacted to at least 90% of its maximum dry density as determined by ASTM D1557 or equivalent.

In areas where moisture will be detrimental to floor coverings or equipment inside the proposed structure, appropriate vapor barrier and damp-proofing measures should be implemented. A commonly applied vapor barrier system consists of a 10-mil polyethylene vapor barrier placed directly over the capillary break material. With this type of system, an approximately 2-inch thick layer of sand is often placed over the vapor barrier to protect it from damage, to aid in curing of the concrete, and also to help prevent cement from bleeding down into the underlying capillary break materials. Other damp/vapor barrier systems may also be feasible. Appropriate design professionals should be consulted regarding vapor barrier and damp proofing systems, ventilation, building material selection and mold prevention issues, which are outside HGSI's area of expertise.

Perimeter Footing Drains

Due to the potential for perched surface water above fine grained deposits such as those encountered at the site, we recommend the outside edge of perimeter footings be provided with a drainage system consisting of 3-inch minimum diameter perforated PVC pipe embedded in a minimum of 1 ft³ per lineal foot of clean, free-draining sand and gravel or 1"- ¼" drain rock. The drain pipe and surrounding drain rock should be wrapped in non-woven geotextile (Mirafi 140N, or approved equivalent) to minimize the potential for clogging and/or ground loss due to piping. Water collected from the footing drains should be directed into the local storm drain system or other suitable outlet. A minimum 0.5 percent fall should be maintained throughout the drain and non-perforated pipe outlet. The footing drains should include clean-outs to allow periodic maintenance and inspection.

Down spouts and roof drains should collect roof water in a system separate from the footing drains in order to reduce the potential for clogging. Roof drain water should be directed to an appropriate discharge point well away from structural foundations. Grades should be sloped downward and away from buildings to reduce the potential for ponded water near structures.

Seismic Design

Structures should be designed to resist earthquake loading in accordance with the methodology described in the 2012 International Building Code (IBC) with applicable 2014 Oregon Structural Specialty Code (OSSC) revisions. We recommend Site Class C be used for design per the OSSC, which references ASCE 7-10, Chapter 20, Table 20.3-1. Design values determined for the site using the USGS (United States Geological Survey) *Earthquake Ground Motion Parameters* utility are summarized on Table 1.

Table 1. Recommended Earthquake Ground Motion Parameters (2012 IBC / 2014 OSSC)

Parameter	Value
Location (Lat, Long), degrees	45.3234, -122.7469
Mapped Spectral Acceleration Values (MCE, Site Class B):	
Short Period, S_s	0.930 g
1.0 Sec Period, S_1	0.409 g
Soil Factors for Site Class D:	
F_a	1.128
F_v	1.591
$SD_s = 2/3 \times F_a \times S_s$	0.700 g
$SD_1 = 2/3 \times F_v \times S_1$	0.434 g

Potential seismic impacts also include secondary effects such as soil liquefaction, fault rupture potential, and other hazards as discussed below:

- **Soil Liquefaction Potential** – Soil liquefaction is a phenomenon wherein saturated soil deposits temporarily lose strength and behave as a liquid in response to earthquake shaking. Soil liquefaction is generally limited to loose, granular soils located below the water table. Following development, on-site soils will consist predominantly of engineered fill or stiff clayey native soils above the water table, which are not considered susceptible to liquefaction. Therefore, it is our opinion that special design or construction measures are not required to mitigate the effects of liquefaction.
- **Fault Rupture Potential** – Based on our review of available geologic literature, we are not aware of any mapped active (demonstrating movement in the last 10,000 years) faults on the site. During our field investigation, we did not observe any evidence of surface rupture or recent faulting. Therefore, we conclude that the potential for fault rupture on site is low.
- **Seismic Induced Landslide** – Topography in the vicinity of the subject site is generally flat to gently sloping. The potential for slope instability and seismic induced landslide on site is considered very low.
- **Effects of Local Geology and Topography** – In our opinion, no additional seismic hazard will occur due to local geology or topography. The site is expected to have no greater seismic hazard than surrounding properties and the Wilsonville area in general.

Excavating Conditions and Utility Trench Backfill

We anticipate that on-site soils can be excavated using conventional heavy equipment such as scrapers and trackhoes to a depth of 8 feet and likely greater. Maintenance of safe working conditions, including temporary excavation stability, is the responsibility of the contractor. Temporary cuts in excess of 4 feet in height should be sloped in accordance with U.S. Occupational Safety and Health Administration (OSHA) regulations (29 CFR Part 1926), or be shored. The existing native soils classify as Type B Soil and temporary excavation side slope inclinations as steep as 1H:1V may be assumed for planning purposes. This cut slope inclination is applicable to excavations above the water table only.

Perched groundwater conditions often occur over fine-grained native deposits such as those beneath the site, particularly during the wet season. If encountered, the contractor should be prepared to implement an appropriate dewatering system for installation of the utilities. At this time, we anticipate that dewatering systems consisting of ditches, sumps and pumps would be adequate for control of groundwater where

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encountered during construction conducted during the dry season. Regardless of the dewatering system used, it should be installed and operated such that in-place soils are prevented from being removed along with the groundwater.

Vibrations created by traffic and construction equipment may cause some caving and raveling of excavation walls. In such an event, lateral support for the excavation walls should be provided by the contractor to prevent loss of ground support and possible distress to existing or previously constructed structural improvements.

Utility trench backfill should consist of ¾"-0 crushed rock, compacted to at least 90% of the maximum dry density obtained by Modified Proctor (ASTM D1557) or equivalent. Initial backfill lift thicknesses for a ¾"-0 crushed aggregate base may need to be as great as 4 feet to reduce the risk of flattening underlying flexible pipe. Subsequent lift thickness should not exceed 1 foot. If imported granular fill material is used, then the lifts for large vibrating plate-compaction equipment (e.g. hoe compactor attachments) may be up to 2 feet, provided that proper compaction is being achieved and each lift is tested. Use of large vibrating compaction equipment should be carefully monitored near existing structures and improvements due to the potential for vibration-induced damage.

Adequate density testing should be performed during construction to verify that the recommended relative compaction is achieved. Typically, one density test is taken for every 4 vertical feet of backfill on each 200-lineal-foot section of trench.

Erosion Control Considerations

During our field exploration program, we did not observe soil types that would be considered highly susceptible to erosion. Erosion at the site during construction can be minimized by implementing the project erosion control plan, which should include judicious use of straw, bio-bags, silt fences, or other appropriate technology. Where used, erosion control devices should be in place and remain in place throughout site preparation and construction. Areas of exposed soil requiring immediate and/or temporary protection against exposure should be covered with either mulch or erosion control netting/blankets.

UNCERTAINTIES AND LIMITATIONS

We have prepared this report for the owner and his/her consultants for use in design of this project only. This report should be provided in its entirety to prospective contractors for bidding and estimating purposes; however, the conclusions and interpretations presented in this report should not be construed as a warranty of the subsurface conditions. Experience has shown that soil and groundwater conditions can vary significantly over small distances. Inconsistent conditions can occur between explorations that may not be detected by a geotechnical study. If, during future site operations, subsurface conditions are encountered which vary appreciably from those described herein, HGSI should be notified for review of the recommendations of this report, and revision of such if necessary.

Sufficient geotechnical monitoring, testing and consultation should be provided during construction to confirm that the conditions encountered are consistent with those indicated by explorations. Recommendations for design changes will be provided should conditions revealed during construction differ from those anticipated, and to verify that the geotechnical aspects of construction comply with the contract plans and specifications.

Within the limitations of scope, schedule and budget, HGSI executed these services in accordance with generally accepted professional principles and practices in the field of geotechnical engineering at the time the report was prepared. No warranty, expressed or implied, is made. The scope of our work did not include

September 6, 2018
HGSI Project No. 18-2363

environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous or toxic substances in the soil, surface water, or groundwater at this site.



We appreciate this opportunity to be of service.

Sincerely,

HARDMAN GEOTECHNICAL SERVICES INC.



EXPIRES: 06-30-20 19

Scott L. Hardman, P.E., G.E.
Geotechnical Engineer

- Attachments: References
- Figure 1 – Vicinity Map
- Figure 2 – Site Plan
- Logs of Test Pits TP-1 through TP-5
- Logs of Hand Auger Borings HA-3 and HA-4



REFERENCES

Beeson, M.H., Tolan, T.L., and Madin, I.P., 1991, Geologic map of the Portland Quadrangle, Multnomah, and Washington Counties, Oregon: Oregon Department of Geology and Mineral Industries Geological Map Series GMS-75, scale 1:24,000.

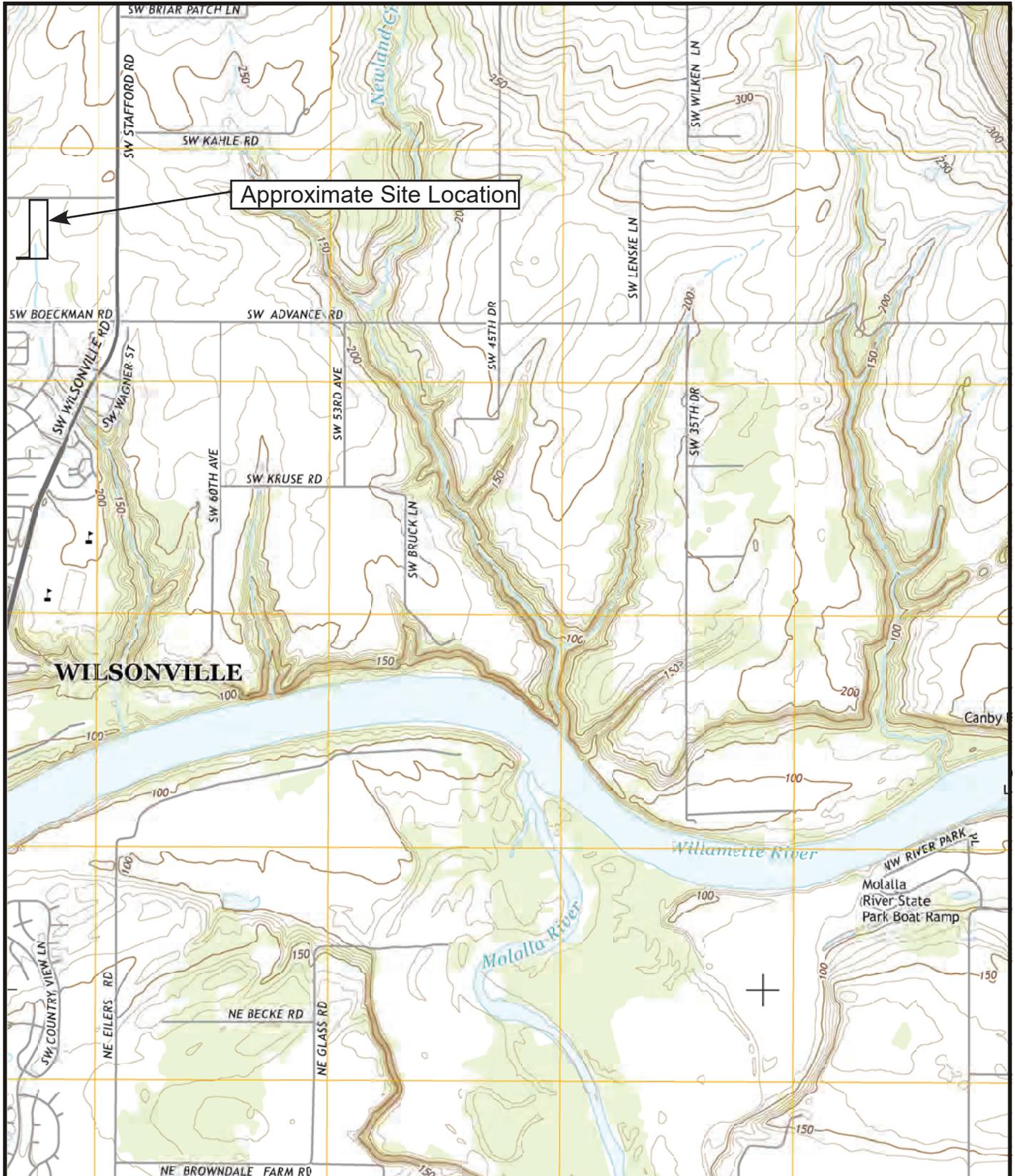
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Snyder, D.T., 2008, Estimated Depth to Ground Water and Configuration of the Water Table in the Portland, Oregon Area: U.S. Geological Survey Scientific Investigations Report 2008-5059, 41 p., 3 plates.

Yeats, R.S., Graven, E.P., Werner, K.S., Goldfinger, C., and Popowski, T., 1996, Tectonics of the Willamette Valley, Oregon: in Assessing earthquake hazards and reducing risk in the Pacific Northwest, Vol. 1: U.S. Geological Survey Professional Paper 1560, P. 183-222, 5 plates, scale 1:100,000.



VICINITY MAP



Project: Coates Property
Wilsonville, Oregon

Project No. 18-2362

FIGURE 1



Legend

TP-4



Test Pit Designation and Approximate Location

HA-4



Hand Auger Boring from Previous Study (School Dist Prop)



Approximate Site Location

Base map obtained from Google Earth

TEST PIT LOG

Project: Frog Pond - Coates Property
Wilsonville, Oregon

Project No. 18-2362

Test Pit No. TP-1

Depth (ft)	Sample Interval	Sample Designation	Pocket Penetrometer (tons/ft ²)	Moisture Content (%)	Groundwater	Material Description
1						Soft, highly organic (grass roots) SILT, dark brown, dessicated (Till zone / disturbed native soil)
2						Very stiff to stiff, clayey SILT (ML), light brown with orange and gray mottling, dessicated (Willamette Formation)
3						
4						
5						Very stiff to stiff, fine grained sandy SILT (ML), light brown with orange and gray mottling, slightly moist (Willamette Formation)
6						
7						Moistening with depth
8						Test pit terminated at 8 feet
9						No groundwater encountered
10						No caving occurred
11						
12						
13						
14						
15						

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LEGEND



Observed seepage
at time of excavation

Date Excavated: 8/30/18

Logged By: CSH

TEST PIT LOG

Project: Frog Pond - Coates Property
Wilsonville, Oregon

Project No. 18-2362

Test Pit No. TP- 2

Depth (ft)	Sample Interval	Sample Designation	Pocket Penetrometer (tons/ft ²)	Moisture Content (%)	Groundwater	Material Description
1						Soft, highly organic (grass roots) SILT, dark brown, dessicated (Till zone / disturbed native soil)
2						Very stiff to stiff, clayey SILT (ML),light brown with orange and gray mottling, dessicated (Willamette Formation)
3						Very stiff to stiff, clayey SILT (ML),light brown with orange and gray mottling, slightly moist (Willamette Formation)
4						Moistening with depth
5						
6						
7						
8						
9						
10						Test pit terminated at 9 feet No groundwater encountered No caving occurred
11						
12						
13						
14						
15						

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LEGEND



Observed seepage
at time of excavation

Date Excavated: 8/30/18

Logged By: CSH

TEST PIT LOG

Project: Frog Pond - Coates Property
Wilsonville, Oregon

Project No. 18-2362

Test Pit No. TP-3

Depth (ft)	Sample Interval	Sample Designation	Pocket Penetrometer (tons/ft ²)	Moisture Content (%)	Groundwater	Material Description
1						Soft, highly organic (grass roots) SILT, dark brown, dessicated (Till zone / disturbed native soil)
2						Very stiff to stiff, clayey SILT (ML),light brown with orange and gray mottling, dessicated (Willamette Formation)
3						
4						
5						
6						Very stiff to stiff, fine grained sandy SILT (ML),light brown with orange and gray mottling, moist (Willamette Formation)
7						
8						Test pit terminated at 8 feet No groundwater encountered No caving occurred
9						
10						
11						
12						
13						
14						
15						

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LEGEND



Observed seepage
at time of excavation

Date Excavated: 8/30/18
Logged By: CSH

TEST PIT LOG

Project: Frog Pond - Coates Property
Wilsonville, Oregon

Project No. 18-2362

Test Pit No. TP- 4

Depth (ft)	Sample Interval	Sample Designation	Pocket Penetrometer (tons/ft ²)	Moisture Content (%)	Groundwater	Material Description
1						Soft, highly organic (grass roots) SILT (OL), dark brown, dessicated (Till zone / disturbed native soil)
2						Medium stiff, moderately organic clayey SILT (ML) Dessicated (Till zone)
3						Medium stiff to stiff, SILT with trace fine grained sand(ML),light brown with orange and gray mottling, slightly moist (Willamette Formation)
4						
5						
6						
7						Medium stiff to stiff, fine grained sandy SILT (ML),light brown with orange and gray mottling, moist (Willamette Formation)
8						
9						Test pit terminated at 8 feet No groundwater encountered No caving occured
10						
11						
12						
13						
14						
15						

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LEGEND



Observed seepage
at time of excavation

Date Excavated: 8/30/18
Logged By: CSH

TEST PIT LOG

Project: Frog Pond - Coates Property
Wilsonville, Oregon

Project No. 18-2362

Test Pit No. TP- 5

Depth (ft)	Sample Interval	Sample Designation	Pocket Penetrometer (tons/ft ²)	Moisture Content (%)	Groundwater	Material Description
1						Soft, highly organic (grass roots) SILT (OL), dark brown, dessicated (Till zone / disturbed native soil)
2						Medium stiff, moderately organic clayey SILT (ML) Dessicated (Till zone)
3						Medium stiff to stiff, SILT with trace fine grained sand(ML),light brown with orange and gray mottling, slightly moist (Willamette Formation)
4						
5						
6						
7						Medium stiff to stiff, fine grained sandy SILT (ML),light brown with orange and gray mottling, moist (Willamette Formation)
8						Test pit terminated at 8 feet No groundwater encountered No caving occurred
9						
10						
11						
12						
13						
14						
15						

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LEGEND



Observed seepage
at time of excavation

Date Excavated: 8/30/18
Logged By: CSH

HAND AUGER BORING LOG

Project: School District Properties
Willsonville, Oregon

Project No. 18-2317

Boring No. HA-3

Depth (ft)	Sample Interval	Sample Designation	In-Situ Dry Density (lb/ft ³)	Moisture Content (%)	Groundwater	Material Description
1						Soft, highly organic (grass roots) SILT, dark brown, moist (Topsoil)
2						very stiff, clay with trace silt, grey brown, moist (dry creek bed)
3						Medium stiff to stiff, clayey SILT (ML), light brown with orange and gray mottling, slightly moist (Willamette Formation)
4						Boring terminated at 4 feet
5						
6						
7						

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LEGEND



S-1

Soil Sample Depth
Interval and Designation



Water Level at
Time of Drilling

Date Excavated: 05/23/18

Logged By: EAH

Surface Elevation:

HAND AUGER BORING LOG

Project: School District Properties
Willsonville, Oregon

Project No. 18-2317

Boring No. HA- 4

Depth (ft)	Sample Interval	Sample Designation	In-Situ Dry Density (lb/ft ³)	Moisture Content (%)	Groundwater	Material Description
1						Soft, highly organic (grass roots) SILT, dark brown, moist (Topsoil)
2						Medium stiff to stiff, clayey SILT (ML), light brown with orange and gray mottling, slightly moist (Willamette Formation)
3						
4						Boring terminated at 4 feet
5						
6						
7						

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LEGEND



S-1

Soil Sample Depth
Interval and Designation



Water Level at
Time of Drilling

Date Excavated: 05/23/18

Logged By: EAH

Surface Elevation:

Appendix C.1
Downstream Analysis
Willow Creek



Technical Memorandum

To: Mike Peebles, PE
From: Rose Horton, PE
Copies: File
Date: October 18, 2018
Subject: Downstream Impact Analysis of Willow Creek Frog Pond Meadows
Project No.: 18968

Introduction

Otak has conducted a downstream impact analysis on the downstream storm conveyance system for the proposed Frog Pond Meadows Development, per City of Wilsonville standards. This proposed development is located north of SW Boeckman Road and west of SW Stafford Road, as shown on Figure 1.

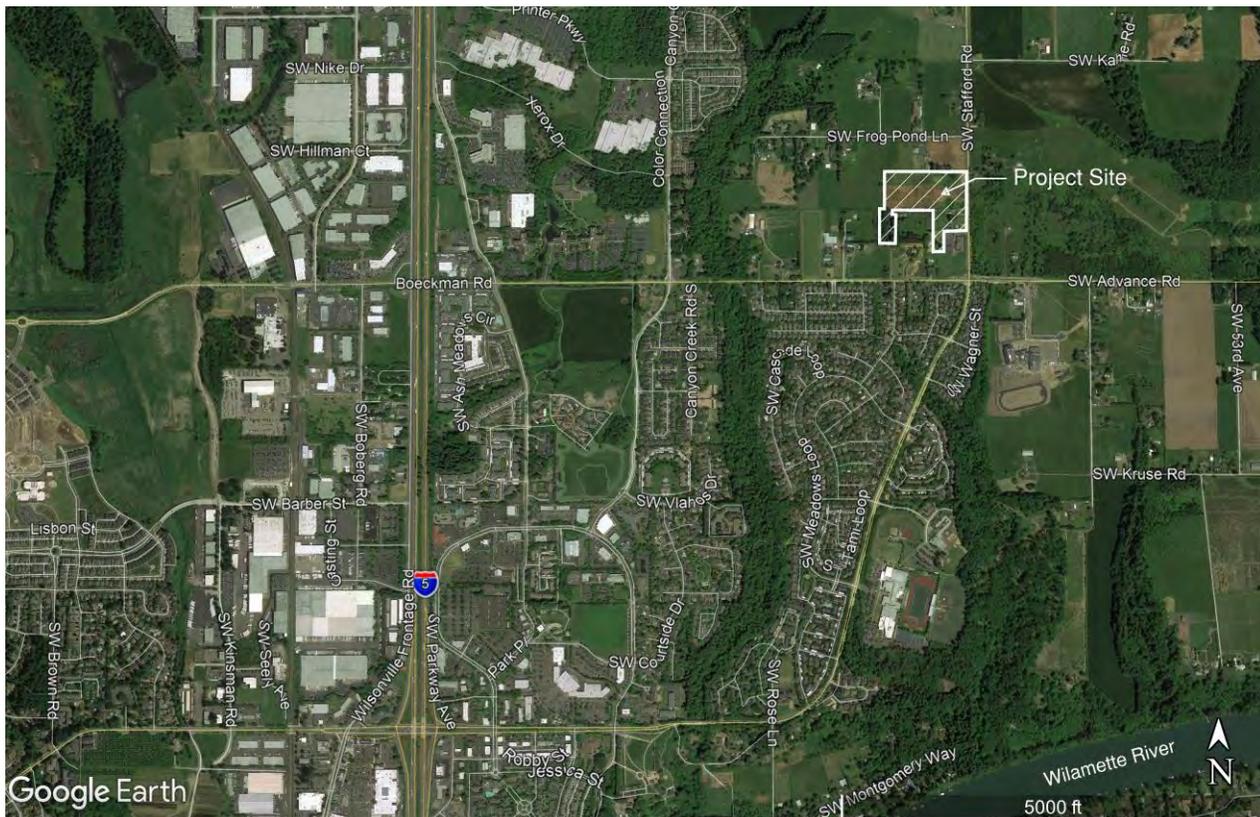


Figure 1 Vicinity Map

The development will meet the City of Wilsonville Public Work Standards Section 301.4.04 which requires flow control from post-development conditions for peak flow rates generated by between 42% of the 2-year storm up to the 10-year storm.

To meet the requirements of City of Wilsonville Public Work Standards Section 301.5.01, a downstream analysis shall include:

- verifying that the downstream system has the capacity to convey the 25-year design storm
- extending the analysis downstream to a point in the drainage system where the proposed development site contributes 10% or less of the total tributary drainage flow or for one-quarter mile downstream of the approved point of discharge. The latter was applied in this case.

Existing Conveyance System

The existing conveyance system used in this analysis is shown on Figure 2, which also includes drainage basin delineation, time of concentration (Tc) flow paths, and runoff node locations represented in the hydraulic model. Details of the downstream conveyance system used to create the hydraulic model were primarily obtained from City GIS as-built information, and field observation. The proposed Frog Pond Meadows development will discharge runoff into the existing Willow Creek channel running south through the site. The creek is conveyed south under SW Boeckman Road through a pair of 18" culverts and then runs in a grassed channel through a neighborhood. The channel is collected in a 36" diameter pipe that crosses under SW Willow Creek Drive where it is joined by runoff from the neighborhood. The combined flows then drain to a deep channel which outfalls to the Willamette River approximately one mile downstream of the end of this analysis.

The proposed development for this site is located above the 100-year floodplain delineated in the Flood Insurance Rate Map (FEMA, 2008) and in non-printed unmapped Flood Map Boundary Area. See Appendix B for the FIRMap corresponding to the proposed site.

Field Visit and Assessment

The project site is located in the headwaters of Willow Creek, which are currently in an agriculture condition. The proposed Stafford Meadows development is one of the first developments added per the *Frog Pond West Master Plan* (Wilsonville, 2017). The basins downstream of SW Boeckman Road are developed single family residential areas and the channel (between Nodes 2 and 3 in Figure 2) is wide and well vegetated. Flow from the grassed channel is conveyed in a 36" storm pipe through the neighborhood and outfalls through a concrete box energy dissipater into a natural channel (between Nodes 5 and 6 in Figure 2). Channel incision persists throughout this reach. Incision is occurring via upstream migration of multiple headcuts, measuring one to two-feet in height, through the fine-grained soil. Riparian habitat was observed in sections above the active channel along the creek with high proportions of non-native, invasive plant species dominating the riparian community. In-stream wood is dispersed throughout the reach due to the scattering of riparian trees available for recruiting.

The stretch of channel downstream of the project site was visited on December 1, 2017 after several days of wet weather. The field assessment started at the onsite drainage channel directly upstream of SW Boeckman Road and extended one quarter mile downstream through the section of channel adjacent to Willow Creek Park. Figure 2 shows the extent of the downstream analysis.

The purpose of the field visit was to observe and document existing channel conditions, road crossings, outfalls, and contributing waterways. Visual documentation of the drainage system along the channel is included in the Photo Log in Appendix A. The estimated downstream distances (in feet), referred to as Stations in this analysis, are referenced to Node 1 at station 0+00. The following section discusses the observations made through each of the reaches.

Table 1 identifies six nodes where drainage basins contribute to the creek. Existing and potential problems are highlighted. Field observations and references to photos are listed in the last column with the goal of emphasizing the more significant channel modifications caused by the existing flow rates.

Table 1: Downstream Impact Analysis - Drainage System Table

Station	Drainage Component	Contributing Drainages (See Figure 2 for referenced basins)	Existing Problems	Potential Problems	Observations (Referenced Photos are in Appendix B)
0+00 to 0+35	Node 1: Existing stream south of development and upstream of outfall.	Basin 1 and Site Agricultural properties with homestead buildings north of Boeckman Road	None	None	Shallow natural channel and wetland located adjacent to Stafford Meadows property. The channel is in good condition without indicators of degradation. (Photo 1)
0+35 to 1+25	Existing pair of 18-inch dia, 80-ft long concrete culverts at SW Boeckman Road	—	None	None	Culvert inlets in Photo 2 . Gravels accumulating at downstream end of culverts in Photo 3 .
1+25 to 6+65	Grassed channel with brushy sides	Basin 2 SW Boeckman Road runoff discharged to channel through culvert and rocked swale	None	None	Grassed channel with brushy banks. Channel typically 6-ft wide, 4H:1V side slopes. Banks vary 2-3' height. Blackberry dominates much of the riparian corridor in this reach. (Photo 4)
6+65 to 7+75	Grassed channel with maintained sides	—	None	None	Channel widens and vegetated side slopes steepen. 10.5-ft bottom width, banks 4-5-ft high. (Photo 5)
7+75 to 7+90	Upstream input from 18-inch, CCP	Basin 3 Neighborhood west of channel managed with two upstream stormwater facilities	None	None	Accumulation of silt and leaves in culvert bottom reduces capacity. (Photo 6)
7+90 to 10+70	36-in dia, 295-ft long concrete culvert at SW Willow creek Drive with angle at manhole halfway	Basin 4 Residential neighborhood located adjacent of channel	None	None	295-ft long, 36-in dia. CPP culvert under SW Willow Creek Dr (Photo 7). Accumulation of debris at upstream grate. Downstream end of culvert drops into grated concrete box (Photo 8) with 24-inch concrete outfall onto riprap (Photo 9). Approximately 3-ft of drop from culvert to channel.

Table 1: Downstream Impact Analysis - Drainage System Table

		Basin 5			
	Natural channel	Park area and channel	Incision	Incision	
10+70 11+15	Natural channel		Incision	Incision	Slightly meandering, 8-ft wide fine grained channel (Photo 10). Incised vertical banks 2-ft high. Top of slope about 10-ft above channel bottom. Slopes heavily vegetated with blackberry, ferns and trees.
11+15 to 11+30	Natural channel	—	Incision	Incision	Channel narrows to 4-ft. A pair of 10-inch drops over 1-ft to 3-ft dia rocks. (Photo 11)
11+30 to 11+45	Natural channel	—	Incision	Incision	Channel narrows to 1-ft wide and 1-ft deep. Vertical right bank 5-ft high. Left bank vertical for 1-ft and then more gradual slope above. (Photo 12)
11+45 to 11+90	Natural channel	—	Incision	Incision	Channel widens to 6-ft width, left bank 18-inches high and right 4-ft high vertically. Large rocks in channel and large wood across. (Photo 13)
11+90 to 12+70	Natural channel	—	None	None	Channel narrows to 3-ft width, 1-ft drop. Left bank 4-ft high (steep) and right bank 3-ft high. Large rocks in channel with ferns established on banks at 3-ft each side. (Photo 14)
12+70 to 13+40	Natural channel	—	None	None	Channel about 2-ft bottom width. 2-ft drops spaced about every 20-ft and wood in channel. Side slopes 1:1. (Photo 15)
13+40 to 13+80	24-inch dia. CPP culvert outfall perched 3-ft above channel.	Basin 6 Residential area west of the channel.			Perched culvert on right side (Photo 16). Channel width 4-ft. 2-ft drop in channel. Right bank near vertical for 10-ft and left 5-ft high with 6-ft wide bench with another 5-ft slope to top. (Photo 17)

Conveyance Hydrology

Peak runoff rates from the drainage basins delineated in Figure 2 and Figure 3, during existing and proposed conditions were calculated using XPSWMM V14. The Santa Barbara Urban Hydrograph (SBUH) method was used to apply the conveyance design event (25-year recurrence interval, 24-hour duration, NRCS Type 1A rainfall distribution), per Section 301.5.01. Time of Concentration values were calculated for each delineated drainage basin using TR-55 equations. Time of Concentration (Tc) flow paths are shown in Figure 2 and corresponding calculations for each drainage basin are included in Appendix B. A time of concentration of 5 minutes, the minimum allowable, was applied to developed impervious areas.

Most of the study area is comprised of silt loam categorized in the hydrologic soil group (HSG) D. HSG D soils generally exhibit very slow infiltration rates when thoroughly wet. A small upland area is categorized as HSG C with low to moderate infiltration, and a section of the channel is HSG B with moderate infiltration. A Curve Number (CN) of 98 was used for all impervious areas. The pervious areas were open space with good grass cover, thus a CN of 61 (HSG B), 74 (HSG C), or 80 (HSG D) was used as applicable.

The basins downstream of the proposed project site are developed residential areas. Impervious percentages were estimated based on existing impervious surfaces captured in 2007 aerial imagery. Figure 2 shows that Basin 1, the Stafford Meadows development and the Frog Pond Meadows development are currently agricultural with few homes, outbuildings, and driveways. Per the *Frog Pond West Master Plan* (Wilsonville, 2017), Basin 1 and the proposed Frog Pond Meadows development is to be developed into primarily a mix of small and medium lot single family homes. The impervious percentage for the proposed Stafford Meadows and Frog Pond Meadows developments were calculated using the proposed site plans and the Frog Pond Meadows impervious percentage applied to Basin 1 in the Fully Developed scenario. The existing two-lane SW Boeckman Road, included in Basin 2, is anticipated to be widened to include bicycle lanes and sidewalks and this improvement is included the Fully Developed scenario.

Table 2 summarizes the 25-year existing and developed peak flowrates in Willow Creek for proposed project conditions calculated in XP-SWMM. The stationing represents the 1,380 feet measured downstream from the starting point of the downstream impact analysis.

Table 2: Peak 25-Year Flowrates					
Node	Station	Contributing Basin Area (ac)	Existing Flow Rate (cfs)	Proposed Flow Rate (cfs)	Fully Developed Flow Rate (cfs)
B	-3+95	30.68*	NA	11.60	26.48
1	0+00	55.6, 27.35**	20.83	26.47	31.15
2	1+25	5.84	24.41	30.61	34.09
3	7+75	5.89	29.36	35.76	38.72
4	7+90	11.87	38.65	45.30	48.04
5	10+70	1.32	39.18	45.86	48.59
6	13+40	9.80	46.76	53.57	56.21

*Proposed/fully developed condition.

**Existing condition and Proposed/Fully developed condition, respectively.

Downstream Conveyance Modeling Analysis

The stormwater conveyance network was analyzed in XP-SWMM. The conveyance system was modeled to determine whether the existing downstream system has sufficient capacity to support the Frog Pond Meadows development runoff undetained during the 25-year, 24-hour storm event. The pipe network reflects inverts from GIS As-built data. A Manning's n value of 0.013 was applied to the storm conveyance pipes in the network and a value of 0.035 was applied to the open channel reach of Willow Creek upstream of SW Willow Creek Drive. A value of 0.04 was applied to the channel and 0.08 was applied to the banks of the open channel reach of Willow Creek downstream of SW Willow Creek Drive. A minimum of one-foot of freeboard between the hydraulic grade line (HGL) and the structure rim elevations was confirmed; therefore, it is assumed that adequate capacity exists.

Appendix C includes output information from the XP-SWMM model, summarizing the pipe network characteristics and results of the hydraulic routing during the design storm. The existing channel at the SW Boeckman Road right of way north of the road (XPSWMM Link 1) site is only about 1.5-ft in depth and in proposed and full build out conditions ponding occurs in the roadside ditch but does not over top the road. Additionally, the runoff generated by the Fully Developed Basin 1 will over top the existing Willow Creek channel through the Stafford Meadows site (XPSWMM Link 12).

Directly downstream of the project site a pair of 18-inch diameter culverts convey Willow Creek beneath SW Boeckman Road. These culverts are approximately 80 feet long and invert elevations were obtained through survey. The hydraulic capacity of these culverts, referred to as Culvert West and Culvert East, was modeled using HY-8 software. The peak flow rate entering the culverts is the 26.5 cfs from the upstream channel (XPSWMM Link 1) under proposed conditions. The results of the hydraulic calculations (see Appendix C) show that the existing culverts do not have adequate capacity to convey the 25-year flow rate without overtopping the existing roadway.

Conclusions

The downstream stormwater conveyance system analyzed as part of this downstream analysis extends from the proposed development approximately one quarter of a mile downstream to the open channel adjacent to Willow Creek Park. The system consists of both open channel and piped conveyance components. A site visit along the downstream reach provided a qualitative assessment of the storm conveyance system and found no evidence of capacity restrictions under existing conditions.

The storm sewer was modeled using XP-SWMM software and shows adequate capacity for the proposed flows, however the onsite channel lacks capacity for Basin 1 Fully Buildout flow rates. Lots adjacent to the channel are raised and stormwater is expected to be confined to the Significant Resource Overlay Zone. The culverts beneath SW Boeckman Road were modeled using HY-8 software, and lack adequate capacity to convey the proposed undetained flows from the Stafford Meadows development.

The proposed development will need to detain high flows on site or increase the capacity at the crossing under SW Boeckman Road to meet City standards.

References

City of Wilsonville. *City of Wilsonville Public Works Standards. Section 3, Stormwater & Surface Water Design and Construction Standards*, City of Wilsonville, Revised December 2015.

FEMA, 2008. *Flood Insurance Rate Map (FIRM) for Clackamas County, Oregon, Incorporated Areas, Panel 243*, Federal Emergency Management Agency, June 17, 2008.

National Resource Conservation Services, United States Department of Agriculture. "Web Soil Survey." <<http://websoilsurvey.nrcs.usda.gov/>> Accessed: December 14, 2017.

Wilsonville, 2017. *Frog Pond West Master Plan*, City of Wilsonville, July 17, 2017.

Figures
DS Analysis Willow Creek

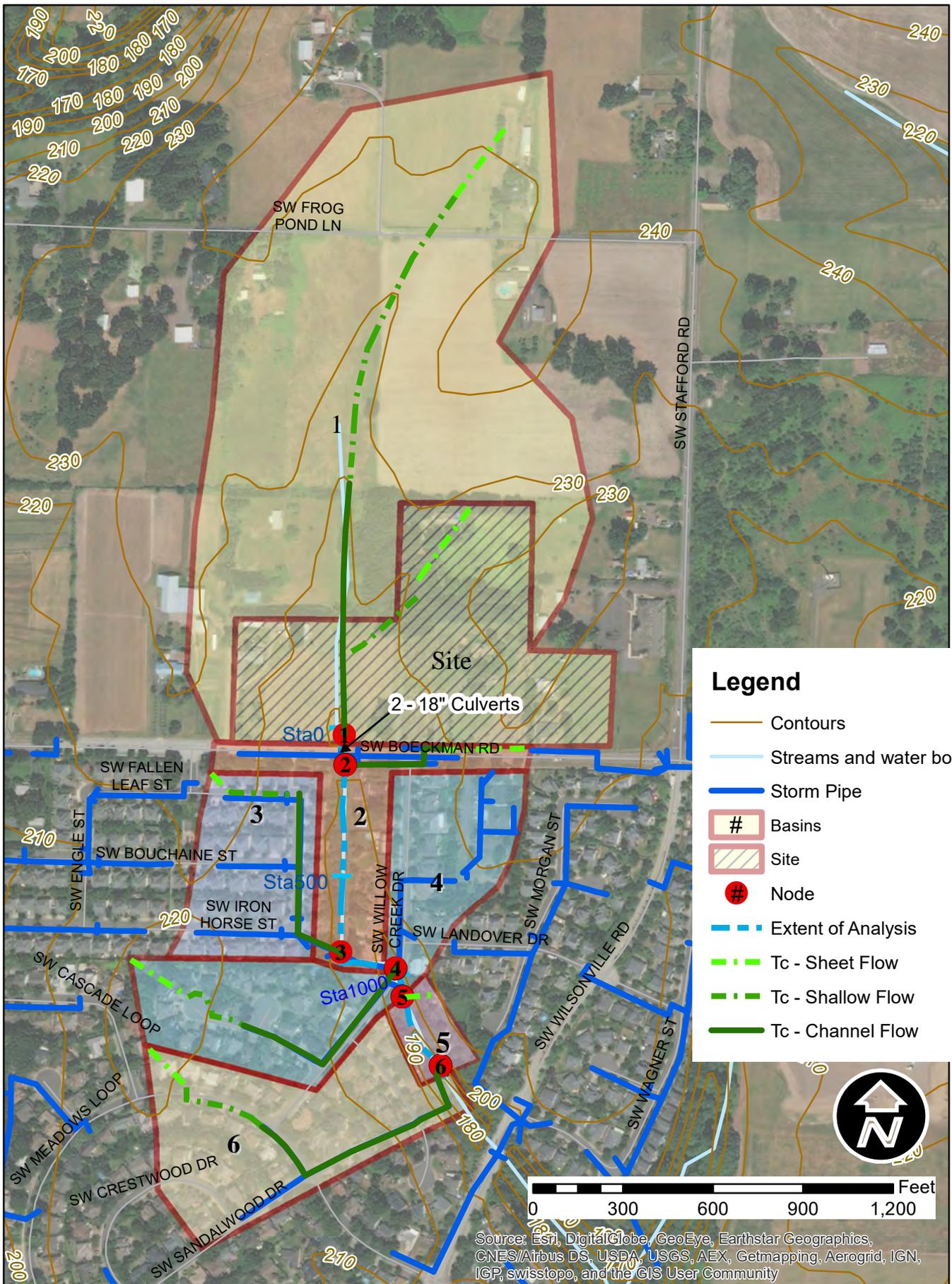


FIGURE 2. Downstream Analysis of Willow Creek - Existing Conditions

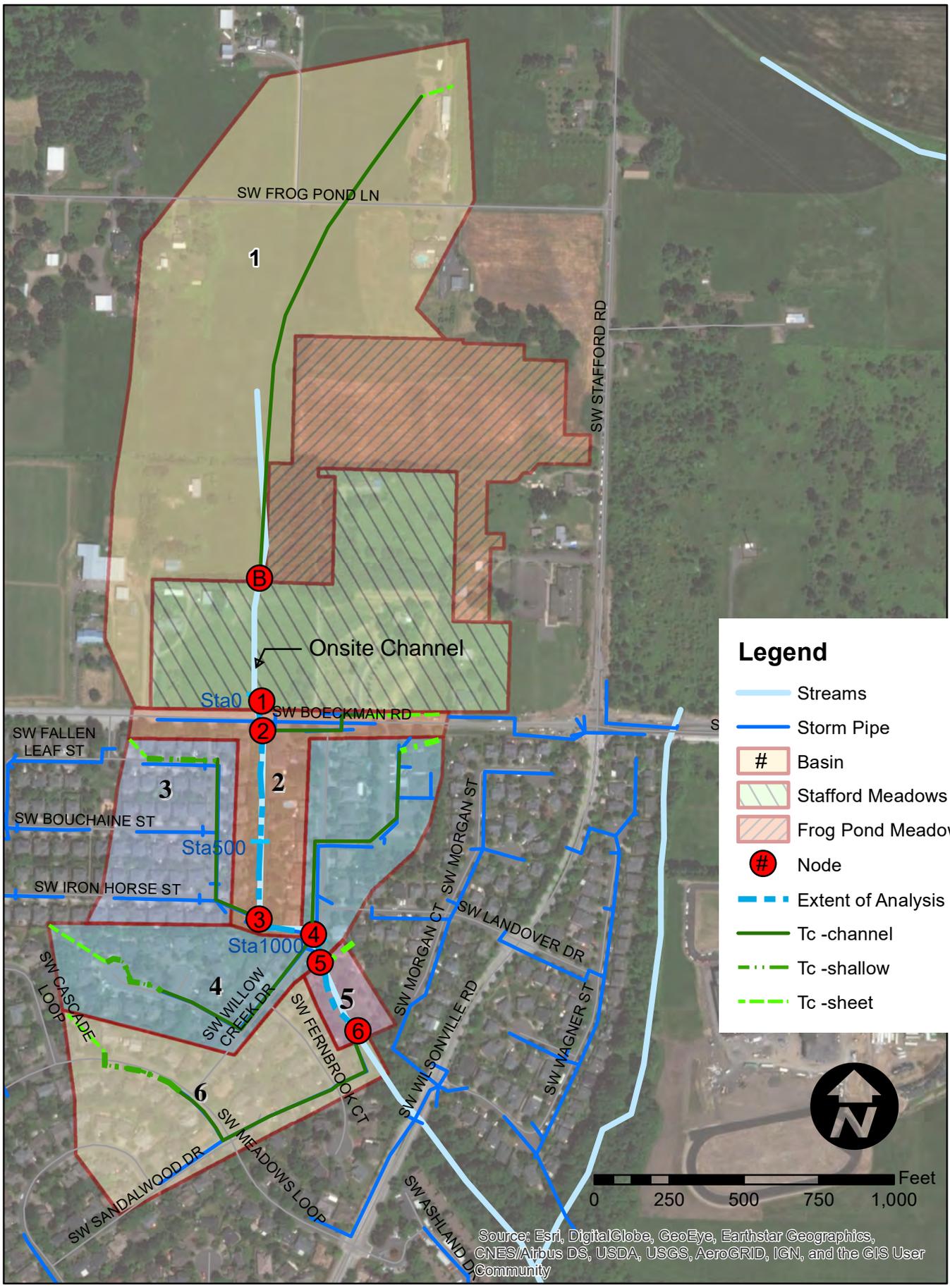


FIGURE 3. Downstream Analysis of Willow Creek- Proposed and Fully Developed Conditions

Appendix A
DS Analysis Willow Creek
Photo Log



Downstream Analysis



Photo 1 Channel in ROW on Frog Property



Photo 2 Upstream Ends of Culverts



Photo 3 Downstream of culvert with gravel accumulation



Photo 4 Vegetated section of channel



Photo 5 Vegetated channel with taller banks and logs channeling flow



Photo 6 Partly submerged 18-inch CCP contributing culvert



Photo 7 36-inch culvert under SW Willow Creek Drive



Photo 8 36-inch Outfall into Concrete Box



Photo 9 24-inch Outfall from energy dissipation Concrete Box at outfall from 36-inch Pipe



Photo 10 Wide Incised Channel



Photo 11 Channel with Drops adjacent to rocks in the channel



Photo 12 Confined channel section



Photo 13 Widened channel with rock and large wood



Photo 14 Channel with steep and eroding banks, and rock in channel



Photo 15 2-ft high drops in Channel



Photo 16 Perched Culvert on Right Bank

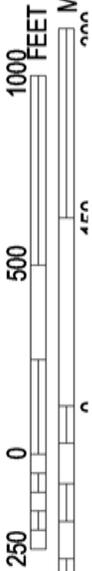


Photo 17 Channel at downstream extent of analysis

Appendix B
DS Analysis Willow Creek
Hydrology



MAP SCALE 1" = 500'



NFIP

PANEL 0234D

FIRM

FLOOD INSURANCE RATE MAP
CLACKAMAS COUNTY,
OREGON
AND INCORPORATED AREAS

PANEL 234 OF 1175

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CLACKAMAS COUNTY	415588	0234	D
WILSONVILLE, CITY OF	410025	0234	D

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.



MAP NUMBER
41005C0234D
EFFECTIVE DATE
JUNE 17, 2008

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

JOINS PANEL 0253

Site located in non-printed area



Existing Conditions											
Basin	HSG	% HSG Type	Basin Area (ac)	Time of Concentration (Tc)	% Impervious	Total Impervious Area (ac)	Area HSG D (ac)	Area HSG C (ac)	Area HSG B (ac)	Total Pervious Area (ac)	Drains To Node
1	C/D	100	40.30	36.1	10	4.03	36.27	0.00	0.00	36.27	1
Site	C/D	100	15.30	33.4	8	1.17	14.13	0.00	0.00	14.13	1
2	C/D	100	5.84	5.0	45	2.63	3.21	0.00	0.00	3.21	2
3	C/D	100	5.89	12.2	60	3.53	2.36	0.00	0.00	2.36	3
4	C/D	100	11.87	30.9	60	7.12	4.75	0.00	0.00	4.75	4
5	C/D, B	41, 59	1.32	8.0	5	0.07	0.51	0.74	0.00	1.25	5
6	C/D, C, B	94, 3, 3	9.80	34.8	60	5.88	3.69	0.12	0.12	3.92	6

Proposed Conditions											
Basin	HSG	% HSG Type	Basin Area (ac)	Time of Concentration (Tc)	% Impervious	Total Impervious Area (ac)	Area HSG D (ac)	Area HSG C (ac)	Area HSG B (ac)	Total Pervious Area (ac)	Drains To Node
1	C/D	100	30.68	36.1	10	3.07	27.61	0.00	0.00	27.61	B
Stafford Meadows	C/D	100	14.90	5.0	45	6.70	8.20	0.00	0.00	8.20	1
Frog Pond Meadows	C/D	100	12.45	5.0	58	7.27	5.18	0.00	0.00	5.18	1
2	C/D	100	5.84	5.0	45	2.63	3.21	0.00	0.00	3.21	2
3	C/D	100	5.89	12.2	60	3.53	2.36	0.00	0.00	2.36	3
4	C/D	100	11.87	30.9	60	7.12	4.75	0.00	0.00	4.75	4
5	C/D, B	41, 59	1.32	8.0	5	0.07	0.51	0.74	0.00	1.25	5
6	C/D, C, B	94, 3, 3	9.80	34.8	60	5.88	3.69	0.12	0.12	3.92	6

Fully Developed											
Basin	HSG	% HSG Type	Basin Area (ac)	Time of Concentration (Tc)	% Impervious	Total Impervious Area (ac)	Area HSG D (ac)	Area HSG C (ac)	Area HSG B (ac)	Total Pervious Area (ac)	Drains To Node
1_developed	C/D	100	30.68	13.8	58	17.79	12.89	0.00	0.00	12.89	B
Stafford Meadows	C/D	100	14.90	5.0	45	6.70	8.20	0.00	0.00	8.20	1
Frog Pond Meadows	C/D	100	12.45	5.0	58	7.27	5.18	0.00	0.00	5.18	1
2_developed*	C/D	100	5.84	5.0	60	3.50	2.34	0.00	0.00	2.34	2
3	C/D	100	5.89	12.2	60	3.53	2.36	0.00	0.00	2.36	3
4	C/D	100	11.87	30.9	60	7.12	4.75	0.00	0.00	4.75	4
5	C/D, B	41, 59	1.32	8.0	5	0.07	0.51	0.74	0.00	1.25	5
6	C/D, C, B	94, 3, 3	9.80	34.8	60	5.88	3.69	0.12	0.12	3.92	6

*Includes widening of Boeckman Road

Time of Concentration Calculations

18968 Frog Pond Meadows Downstream Analysis

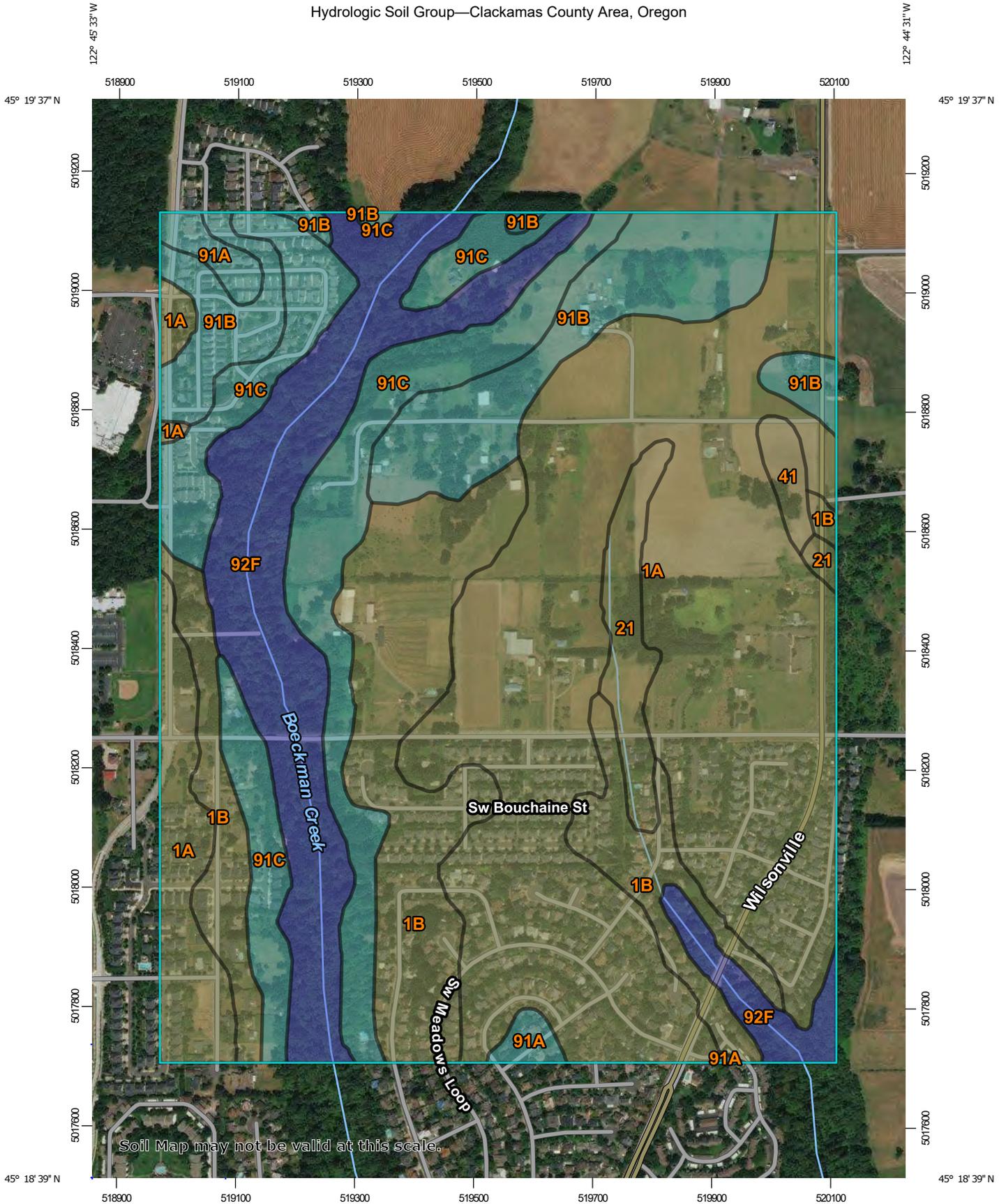
BASINS		1	1 developed	Site	2
SHEET FLOW					
INPUT					
Surface Description (from Table 3-1)		Short grass	Short grass	Short grass	Paved
Manning's Roughness Coefficient		0.15	0.15	0.15	0.011
Flow Length, L (<300 ft)	ft	295	100	300	268
2-Year, 24-Hour Rainfall, P ₂	in	2.5	2.5	2.5	2.5
Land Slope, s	ft/ft	0.020	0.020	0.017	0.025
OUTPUT					
Travel Time	hr	0.44	0.18	0.48	0.05
SHALLOW CONCENTRATED FLOW					
INPUT					
Surface Description (paved or unpaved)		Unpaved		Unpaved	
Flow Length, L	ft	1039		491	
Watercourse Slope, s	ft/ft	0.017		0.018	
OUTPUT					
Average Velocity, V	ft/s	2.12		2.16	
Travel Time	hr	0.14		0.06	
CHANNEL FLOW					
INPUT					
Cross Sectional Flow Area, a	ft ²	3.14	3.14	25	4.71
Wetted Perimeter, p _w	ft	0.79	0.79	16.8	1.77
Channel Slope, s	ft/ft	0.006	0.010	0.011	0.017
Manning's Roughness Coefficient		0.035	0.035	0.035	0.035
Flow Length, L	ft	872	1750	325	373
OUTPUT					
Average Velocity, V	ft/s	8.09	10.83	5.84	10.79
Hydraulic Radius, r = a/p _w	ft	3.97	3.97	1.49	2.66
Travel Time	hr	0.030	0.045	0.015	0.010
Basin Time of Concentration, T_c	hrs	0.60	0.23	0.56	0.06
	min	36.1	13.8	33.4	3.3

Time of Concentration Calculations

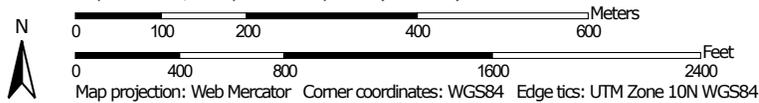
17868 Stafford Meadows Downstream Analysis

BASINS		3	4	5	6
SHEET FLOW					
INPUT					
Surface Description (from Table 3-1)		short grass	Short grass	Short grass	Short grass
Manning's Roughness Coefficient		0.15	0.15	0.15	0.15
Flow Length, L (<300 ft)	ft	82	228	125	175
2-Year, 24-Hour Rainfall, P ₂	in	2.5	2.5	2.5	2.5
Land Slope, s	ft/ft	0.018	0.010	0.070	0.005
OUTPUT					
Travel Time	hr	0.16	0.48	0.13	0.52
SHALLOW CONCENTRATED FLOW					
INPUT					
Surface Description (paved or unpaved)		paved	paved		paved
Flow Length, L	ft	231	243		312
Watercourse Slope, s	ft/ft	0.011	0.029		0.013
OUTPUT					
Average Velocity, V	ft/s	2.16	3.45		2.33
Travel Time	hr	0.03	0.02		0.04
CHANNEL FLOW					
INPUT					
Cross Sectional Flow Area, a	ft ²	3.14	3.14		6.28
Wetted Perimeter, p _w	ft	0.79	0.79		3.14
Channel Slope, s	ft/ft	0.013	0.012		0.031
Manning's Roughness Coefficient		0.035	0.035		0.035
Flow Length, L	ft	471	700		885
OUTPUT					
Average Velocity, V	ft/s	12.26	11.77		11.85
Hydraulic Radius, r = a/p _w	ft	3.97	3.97		2.00
Travel Time	hr	0.011	0.017		0.021
Basin Time of Concentration, T_c	hrs	0.20	0.51	0.13	0.58
	min	12.2	30.9	8.0	34.8

Hydrologic Soil Group—Clackamas County Area, Oregon



Map Scale: 1:8,800 if printed on A portrait (8.5" x 11") sheet.

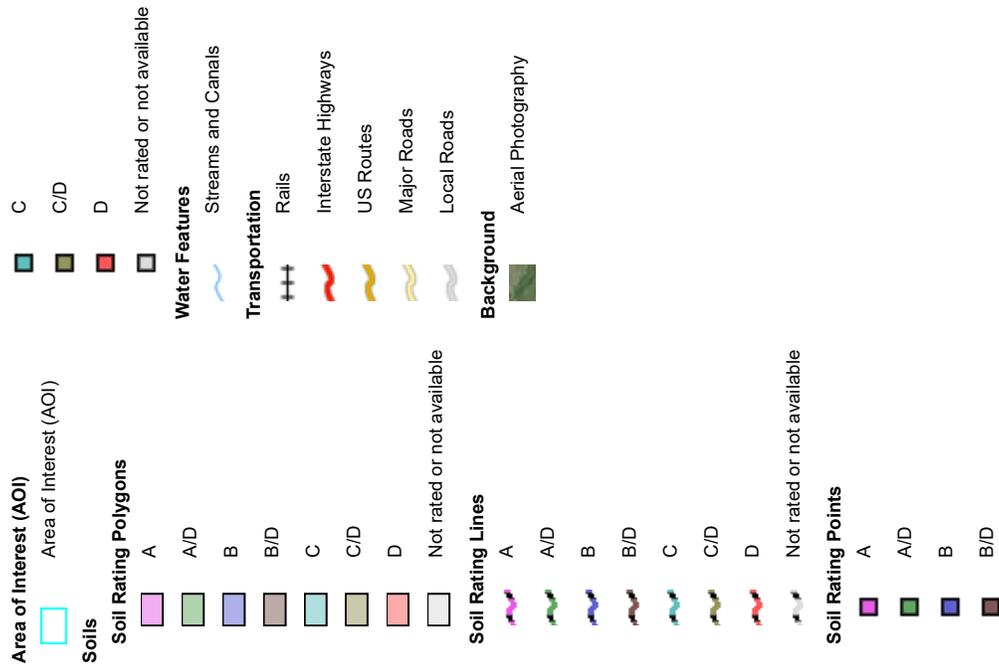


Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

12/14/2017
Page 1 of 4

MAP LEGEND



MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL:
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Clackamas County Area, Oregon
 Survey Area Data: Version 12, Sep 19, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 19, 2015—Sep 13, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1A	Aloha silt loam, 0 to 3 percent slopes	C/D	169.0	42.0%
1B	Aloha silt loam, 3 to 6 percent slopes	C/D	64.8	16.1%
21	Concord silt loam	C/D	10.5	2.6%
41	Huberly silt loam	C/D	3.0	0.7%
91A	Woodburn silt loam, 0 to 3 percent slopes	C	5.0	1.3%
91B	Woodburn silt loam, 3 to 8 percent slopes	C	38.6	9.6%
91C	Woodburn silt loam, 8 to 15 percent slopes	C	55.0	13.7%
92F	Xerochrepts and Haploxerolls, very steep	B	55.9	13.9%
Totals for Area of Interest			401.8	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Table 2-2a Runoff curve numbers for urban areas ^{1/}

Cover description	Average percent impervious area ^{2/}	Curve numbers for hydrologic soil group			
		A	B	C	D
<i>Fully developed urban areas (vegetation established)</i>					
Open space (lawns, parks, golf courses, cemeteries, etc.) ^{3/} :					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61 ←	74 ←	80 ←
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98 ←	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) ^{4/}		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
<i>Developing urban areas</i>					
Newly graded areas (pervious areas only, no vegetation) ^{5/}					
		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

¹ Average runoff condition, and $I_a = 0.2S$.

² The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

³ CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

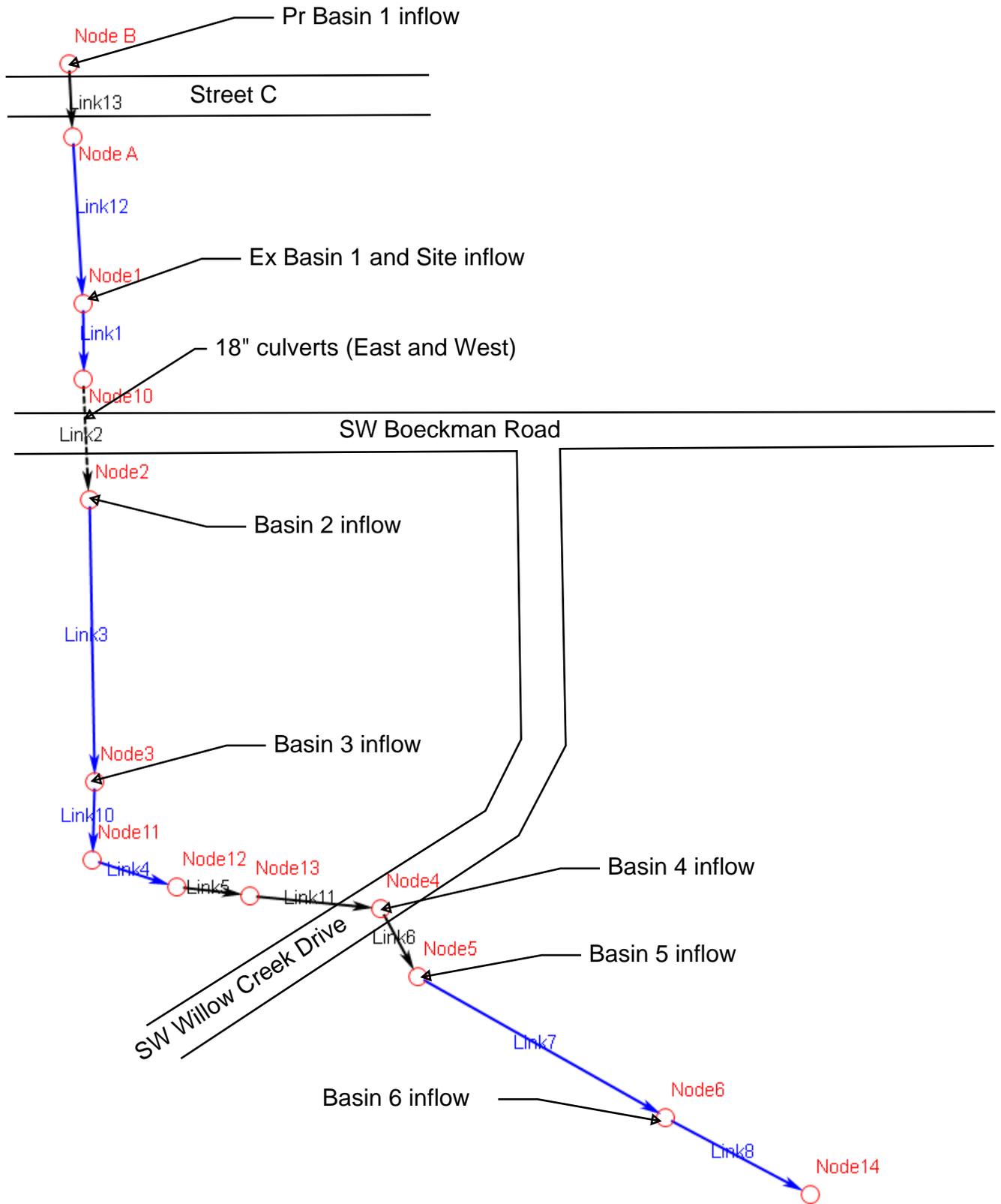
⁴ Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

⁵ Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Appendix C
DS Analysis Willow Creek
Hydraulics

XP-SWMM Layout

Frog Pond Meadows Willow Creek Downstream Analysis



XP-SWMM RUNOFF DATA
Frog Pond Meadows Development

SCS Type 1A 25-Year Storm Event

Existing Conditions

XP-SWMM Input Data					XP-SWMM Output Data		
Node Name	Total Area (ac)	Impervious %	Curve Number	Tc (min)	Unit Hydrograph Method	Infiltration Depth (in)	Surface Runoff Flow (cfs)
Node1	4.030	100	98	5.0	Santa Barbara	2.02	4.727
Node1	36.270	0	80	36.1	Santa Barbara	0.00	10.501
Node1	1.170	100	98	5.0	Santa Barbara	0.00	1.372
Node1	14.130	0	80	33.4	Santa Barbara	0.00	4.234
Node2	2.630	100	98	5.0	Santa Barbara	2.02	3.085
Node2	3.210	0	80	5.0	Santa Barbara	0.00	1.855
Node3	3.530	100	98	5.0	Santa Barbara	2.02	4.141
Node3	2.360	0	80	12.2	Santa Barbara	0.00	1.074
Node4	7.120	100	98	30.9	Santa Barbara	2.02	8.352
Node4	4.750	0	80	5.0	Santa Barbara	0.00	1.471
Node5	0.070	100	98	5.0	Santa Barbara	2.44	0.082
Node5	0.510	0	80	8.0	Santa Barbara	0.00	0.265
Node5	0.740	0	74	8.0	Santa Barbara	0.00	0.259
Node6	5.880	100	98	5.0	Santa Barbara	3.18	6.898
Node6	3.690	0	79	34.8	Santa Barbara	0.00	1.086
Node6	0.120	0	79	34.8	Santa Barbara	0.00	0.023
Node6	0.120	0	79	43.8	Santa Barbara	0.00	0.006

XP-SWMM RUNOFF DATA
Frog Pond Meadows Development

SCS Type 1A 25-Year Storm Event							
Proposed Conditions							
XP-SWMM Input Data					XP-SWMM Output Data		
Node Name	Total Area (ac)	Impervious %	Curve Number	Tc (min)	Unit Hydrograph Method	Infiltration Depth (in)	Surface Runoff Flow (cfs)
Node B	3.070	100	98	5.0	Santa Barbara	2.0	3.601
Node B	27.610	0	79	36.1	Santa Barbara	0.0	7.994
Node1	7.270	100	98	5.0	Santa Barbara	2.0	11.039
Node1	5.180	0	79	5.0	Santa Barbara	0.0	3.601
Node1	6.700	100	98	5.0	Santa Barbara	0.0	7.860
Node1	8.200	0	79	5.0	Santa Barbara	0.0	4.739
Node2	2.630	100	98	5.0	Santa Barbara	2.0	3.085
Node2	3.210	0	79	5.0	Santa Barbara	0.0	1.855
Node3	3.530	100	98	5.0	Santa Barbara	2.0	4.141
Node3	2.360	0	79	12.2	Santa Barbara	0.0	1.074
Node4	7.120	100	98	30.9	Santa Barbara	2.0	8.352
Node4	4.750	0	79	5.0	Santa Barbara	0.0	1.471
Node5	0.070	100	98	5.0	Santa Barbara	2.4	0.082
Node5	0.510	0	79	8.0	Santa Barbara	0.0	0.265
Node5	0.740	0	79	8.0	Santa Barbara	0.0	0.259
Node6	5.880	100	98	5.0	Santa Barbara	3.2	6.898
Node6	3.690	0	79	34.8	Santa Barbara	0.0	1.086
Node6	0.120	0	79	34.8	Santa Barbara	0.0	0.023
Node6	0.120	0	79	43.8	Santa Barbara	0.0	0.006

XP-SWMM RUNOFF DATA
Frog Pond Meadows Development

SCS Type 1A 25-Year Storm Event							
Fully Developed Conditions							
XP-SWMM Input Data					XP-SWMM Output Data		
Node Name	Total Area (ac)	Impervious %	Curve Number	Tc (min)	Unit Hydrograph Method	Infiltration Depth (in)	Surface Runoff Flow (cfs)
Node B	17.790	100	98	5.0	Santa Barbara	2.02	20.869
Node B	12.890	0	79	13.8	Santa Barbara	0.00	5.609
Node1	7.270	100	98	5.0	Santa Barbara	2.02	8.528
Node1	5.180	0	79	5.0	Santa Barbara	0.00	2.994
Node1	6.700	100	98	5.0	Santa Barbara	0.00	7.860
Node1	8.200	0	79	5.0	Santa Barbara	0.00	4.739
Node2	2.630	100	98	5.0	Santa Barbara	2.02	3.085
Node2	3.210	0	79	5.0	Santa Barbara	0.00	1.855
Node3	3.530	100	98	5.0	Santa Barbara	2.02	4.141
Node3	2.360	0	79	12.2	Santa Barbara	0.00	1.074
Node4	7.120	100	98	30.9	Santa Barbara	2.02	8.352
Node4	4.750	0	79	5.0	Santa Barbara	0.00	1.471
Node5	0.070	100	98	5.0	Santa Barbara	2.44	0.082
Node5	0.510	0	79	8.0	Santa Barbara	0.00	0.265
Node5	0.740	0	79	8.0	Santa Barbara	0.00	0.259
Node6	5.880	100	98	5.0	Santa Barbara	3.18	6.898
Node6	3.690	0	79	34.8	Santa Barbara	0.00	1.086
Node6	0.120	0	79	34.8	Santa Barbara	0.00	0.023
Node6	0.120	0	79	43.8	Santa Barbara	0.00	0.006

XP-SWMM HYDRAULICS DATA
Frog Pond Meadows Development - Willow Creek Downstream Analysis

SCS Type 1A 25-Year Storm Event																				
Existing Conditions																				
Location			Conduit Properties					Conduit Profile							Conduit Results					
Link Name	Node Limits		Diameter		Length	Slope	Conduit Type	Ground Elevation (ft)		Invert Elevation (ft)		Freeboard (ft)		Max. HGL Elevation (ft)		Design Flow	Max. Flow	Max. Velocity	Max. Depth	y/d0
	From	To	in	ft	ft	%		US	DS	US	DS	US	DS	US	DS	(cfs)	(cfs)	(ft/s)	(ft)	
Link1	Node1	Node10	18	1.5	35	0.2	open channel	214.70	216.00	212.70	212.63	0.6	2.2	214.1	213.8	17.40	19.99	2.24	1.36	0.90
Link2	Node10	Node2	18	1.5	80	2.0	18" culvert west	216.00	214.50	212.63	211.00	2.2	2.6	213.8	211.9	14.99	10.06	6.81	1.21	0.81
Link2	Node10	Node2	18	1.5	80	2.0	18" culvert east	216.00	214.50	212.64	211.06	2.2	2.6	213.8	211.9	14.76	9.91	6.73	1.20	0.80
Link3	Node2	Node3	24	2.0	540	1.2	open channel	214.50	209.00	211.00	204.40	2.6	3.9	211.9	205.1	152.09	24.41	3.07	0.87	0.43
Link4	Node11	Node12	48	4.0	15	3.3	open channel	208.00	207.60	203.10	202.60	4.3	4.0	203.7	203.6	1736.29	29.35	3.66	1.01	0.25
Link5	Node12	Node13	36	3.0	32	3.9	pipe	207.60	206.00	202.52	201.27	4.0	3.9	203.6	202.1	131.82	29.36	12.93	1.09	0.36
Link6	Node4	Node5	36	3.0	104	6.4	pipe	206.00	200.00	195.11	188.58	9.5	13.5	196.5	186.5	167.13	38.65	12.85	1.36	0.45
Link7	Node5	Node6	120	10.0	270	4.3	open channel	200.00	184.00	185.50	174.00	13.5	7.9	186.5	176.1	5327.19	39.18	5.25	2.12	0.21
Link8	Node6	Node14	120	10.0	40	1.0	open channel	184.00	184.00	174.00	173.60	7.9	9.4	176.1	174.6	674.27	46.76	5.60	2.12	0.21
Link10	Node3	Node11	48	4.0	110	1.2	open channel	209.00	208.00	204.40	203.10	3.9	4.3	205.1	203.7	1033.85	29.36	3.43	0.66	0.17
Link11	Node13	Node4	36	3.0	144	3.9	pipe	206.00	206.00	200.97	195.31	3.9	9.5	202.1	196.5	132.23	29.35	12.30	1.16	0.39
Proposed Conditions																				
Location			Conduit Properties					Conduit Profile							Conduit Results					
Link Name	Node Limits		Diameter		Length	Slope	Conduit Type	Ground Elevation (ft)		Invert Elevation (ft)		Freeboard (ft)		Max. HGL Elevation (ft)		Design Flow	Max. Flow	Max. Velocity	Max. Depth	y/d0
	From	To	in	ft	ft	%		US	DS	US	DS	US	DS	US	DS	(cfs)	(cfs)	(ft/s)	(ft)	
Link1	Node1	Node10	18	1.5	35	0.2	open channel	216.20	216.00	212.70	212.63	1.5	1.4	214.7	214.7	17.40	26.47	2.23	2.02	1.00
Link2	Node10	Node2	18	1.5	80	2.0	18" culvert west	216.00	214.50	212.63	211.00	1.4	2.5	214.7	212.0	14.99	13.15	7.67	2.02	1.35
Link2	Node10	Node2	18	1.5	80	2.0	18" culvert east	216.00	214.50	212.64	211.06	1.4	2.5	214.7	212.0	14.76	13.28	7.65	2.01	1.34
Link3	Node2	Node3	24	2.0	540	1.2	open channel	214.50	209.00	211.00	204.40	2.5	3.9	212.0	205.1	152.09	30.61	3.26	0.98	0.49
Link4	Node11	Node12	48	4.0	15	3.3	open channel	208.00	207.60	203.10	202.60	4.2	3.9	203.8	203.7	1736.29	35.76	3.76	1.14	0.28
Link5	Node12	Node13	36	3.0	32	3.9	pipe	207.60	206.00	202.52	201.27	3.9	3.8	203.7	202.2	131.82	35.76	13.50	1.22	0.41
Link6	Node4	Node5	36	3.0	104	6.4	pipe	206.00	200.00	195.11	188.58	9.4	13.4	196.6	186.6	167.13	45.30	13.10	1.52	0.51
Link7	Node5	Node6	120	10.0	270	4.3	open channel	200.00	184.00	185.50	174.00	13.4	7.7	186.6	176.3	5327.19	45.86	5.48	2.31	0.23
Link8	Node6	Node14	120	10.0	40	1.0	open channel	184.00	184.00	174.00	173.60	7.7	9.2	176.3	174.8	674.27	53.57	5.88	2.31	0.23
Link10	Node3	Node11	48	4.0	110	1.2	open channel	209.00	208.00	204.40	203.10	3.9	4.2	205.1	203.8	1033.85	35.76	3.68	0.73	0.18
Link11	Node13	Node4	36	3.0	144	3.9	pipe	206.00	206.00	200.97	195.31	3.8	9.4	202.2	196.6	132.23	35.76	12.74	1.32	0.44
Link12	Node A	Node1	26	2.2	360	1.0	open channel	224.50	216.20	216.15	212.70	7.6	1.5	216.9	214.7	344.23	10.38	1.71	1.98	0.90
Link13	Node B	Node A	36	3.0	35	1.1	36" box culvert	225.00	224.50	216.53	216.15	7.8	7.6	217.2	216.9	88.45	11.11	5.76	0.78	0.26

XP-SWMM HYDRAULICS DATA
Frog Pond Meadows Development - Willow Creek Downstream Analysis

SCS Type 1A 25-Year Storm Event																					
Fully Developed																					
Location			Conduit Properties				Conduit Type	Conduit Profile								Conduit Results					
Link Name	Node Limits		Diameter		Length	Slope		Ground Elevation (ft)		Invert Elevation (ft)		Freeboard (ft)		Max. HGL Elevation (ft)		Design Flow	Max. Flow	Max. Velocity	Max. Depth	y/d0	
	From	To	in	ft	ft	%		US	DS	US	DS	US	DS	US	DS	(cfs)	(cfs)	(ft/s)	(ft)		
Link1	Node1	Node10	18	1.5	35.0	0.2	open channel	216.20	216.00	212.70	212.63	0.6	0.4	215.6	215.6	17.40	31.15	2.24	2.94	1.00	
Link2	Node10	Node2	18	1.5	80.0	2.0	18" culvert west	216.00	214.50	212.63	211.00	0.4	2.5	215.6	212.0	14.99	15.54	8.98	2.94	1.96	
Link2	Node10	Node2	18	1.5	80.0	2.0	18" culvert east	216.00	214.50	212.64	211.06	0.4	2.5	215.6	212.0	14.76	15.55	8.81	2.93	1.96	
Link3	Node2	Node3	24	2.0	540.0	1.2	open channel	214.50	209.00	211.00	204.40	2.5	3.8	212.0	205.2	152.09	34.09	3.34	1.04	0.52	
Link4	Node11	Node12	48	4.0	15.0	3.3	open channel	208.00	207.60	203.10	202.60	4.2	3.8	203.8	203.8	1736.29	38.72	3.79	1.20	0.30	
Link5	Node12	Node13	36	3.0	32.0	3.9	pipe	207.60	206.00	202.52	201.27	3.8	3.7	203.8	202.3	131.82	38.72	13.74	1.28	0.43	
Link6	Node4	Node5	36	3.0	104.0	6.4	pipe	206.00	200.00	195.11	188.58	9.3	13.3	196.7	186.7	167.13	48.04	13.18	1.59	0.53	
Link7	Node5	Node6	120	10.0	270.0	4.3	open channel	200.00	184.00	185.50	174.00	13.3	7.6	186.7	176.4	5327.19	48.59	5.57	2.39	0.24	
Link8	Node6	Node14	120	10.0	40.0	1.0	open channel	184.00	184.00	174.00	173.60	7.6	9.2	176.4	174.8	674.27	56.21	5.98	2.39	0.24	
Link10	Node3	Node11	48	4.0	110.0	1.2	open channel	209.00	208.00	204.40	203.10	3.8	4.2	205.2	203.8	1033.85	38.72	3.79	0.76	0.19	
Link11	Node13	Node4	36	3.0	144.0	3.9	pipe	206.00	206.00	200.97	195.31	3.7	9.3	202.3	196.7	132.23	38.71	12.89	1.39	0.46	
Link12	Node A	Node1	26	2.2	360.0	1.0	open channel	224.50	216.20	216.15	212.70	7.3	0.6	217.2	215.6	344.23	25.34	1.75	2.88	1.31	
Link13	Node B	Node A	36	3.0	35.0	1.1	36" box culvert	225.00	224.50	216.53	216.15	7.4	7.3	217.6	217.2	88.45	26.42	8.33	1.09	0.36	

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 20 cfs

Design Flow: 26.5 cfs

Maximum Flow: 31.2 cfs

Tailwater Channel Data - SW Boeckman Road

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 6.00 ft

Side Slope (H:V): 4.00 (_:1)

Channel Slope: 0.0120

Channel Manning's n: 0.0350

Channel Invert Elevation: 211.00 ft

Roadway Data for Crossing: SW Boeckman Road

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Roadway Surface: Paved

Roadway Top Width: 68.00 ft

Table 1 - Summary of Culvert Flows at Crossing: SW Boeckman Road

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert West Discharge (cfs)	Culvert East Discharge (cfs)	Roadway Discharge (cfs)	Iterations
215.19	20.00	10.02	9.99	0.00	6
215.38	21.12	10.55	10.52	0.00	24
215.57	22.24	11.10	11.08	0.00	29
215.74	23.36	11.57	11.54	0.16	25
215.80	24.48	11.72	11.70	0.99	11
215.83	25.60	11.81	11.79	1.91	7
215.85	26.50	11.87	11.84	2.71	6
215.88	27.84	11.94	11.91	3.93	6
215.90	28.96	11.99	11.96	4.94	5
215.91	30.08	12.03	12.01	5.93	4
215.93	31.20	12.07	12.05	6.99	4
215.69	22.84	11.43	11.41	0.00	Overtopping

Table 2 - Culvert Summary Table: Culvert West

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
20.00	10.02	215.19	2.563	1.292	5-S2n	0.892	1.218	0.907	0.728	8.973	3.085
21.12	10.55	215.38	2.744	1.478	5-S2n	0.923	1.247	0.939	0.749	9.070	3.135
22.24	11.10	215.57	2.939	1.677	5-S2n	0.955	1.274	0.972	0.770	9.160	3.182
23.36	11.57	215.74	3.109	1.852	5-S2n	0.984	1.296	1.000	0.790	9.229	3.228
24.48	11.72	215.80	3.167	1.911	5-S2n	0.994	1.302	1.009	0.810	9.282	3.272
25.60	11.81	215.83	3.200	1.945	5-S2n	0.999	1.306	1.015	0.829	9.296	3.315
26.50	11.87	215.85	3.222	1.968	5-S2n	1.003	1.308	1.018	0.844	9.307	3.348
27.84	11.94	215.88	3.249	1.996	5-S2n	1.007	1.311	1.022	0.866	9.320	3.395
28.96	11.99	215.90	3.268	2.015	5-S2n	1.010	1.313	1.025	0.884	9.330	3.434
30.08	12.03	215.91	3.284	2.032	5-S2n	1.013	1.315	1.027	0.902	9.339	3.471
31.20	12.07	215.93	3.300	2.048	5-S2n	1.015	1.317	1.030	0.919	9.348	3.508

Table 3 - Culvert Summary Table: Culvert East

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
20.00	9.99	215.19	2.553	1.331	5-S2n	0.899	1.217	0.913	0.728	8.872	3.085
21.12	10.52	215.38	2.734	1.517	5-S2n	0.931	1.246	0.946	0.749	8.967	3.135
22.24	11.08	215.57	2.929	1.716	5-S2n	0.964	1.273	0.979	0.770	9.057	3.182
23.36	11.54	215.74	3.099	1.891	5-S2n	0.993	1.294	1.007	0.790	9.162	3.228
24.48	11.70	215.80	3.157	1.949	5-S2n	1.003	1.301	1.016	0.810	9.193	3.272
25.60	11.79	215.83	3.190	1.984	5-S2n	1.008	1.305	1.022	0.829	9.201	3.315
26.50	11.84	215.85	3.212	2.007	5-S2n	1.012	1.307	1.026	0.844	9.207	3.348
27.84	11.91	215.88	3.239	2.034	5-S2n	1.017	1.310	1.031	0.866	9.215	3.395
28.96	11.96	215.90	3.258	2.054	5-S2n	1.020	1.312	1.034	0.884	9.221	3.434
30.08	12.01	215.91	3.274	2.070	5-S2n	1.022	1.314	1.037	0.902	9.227	3.471
31.20	12.05	215.93	3.290	2.086	5-S2n	1.025	1.316	1.039	0.919	9.232	3.508

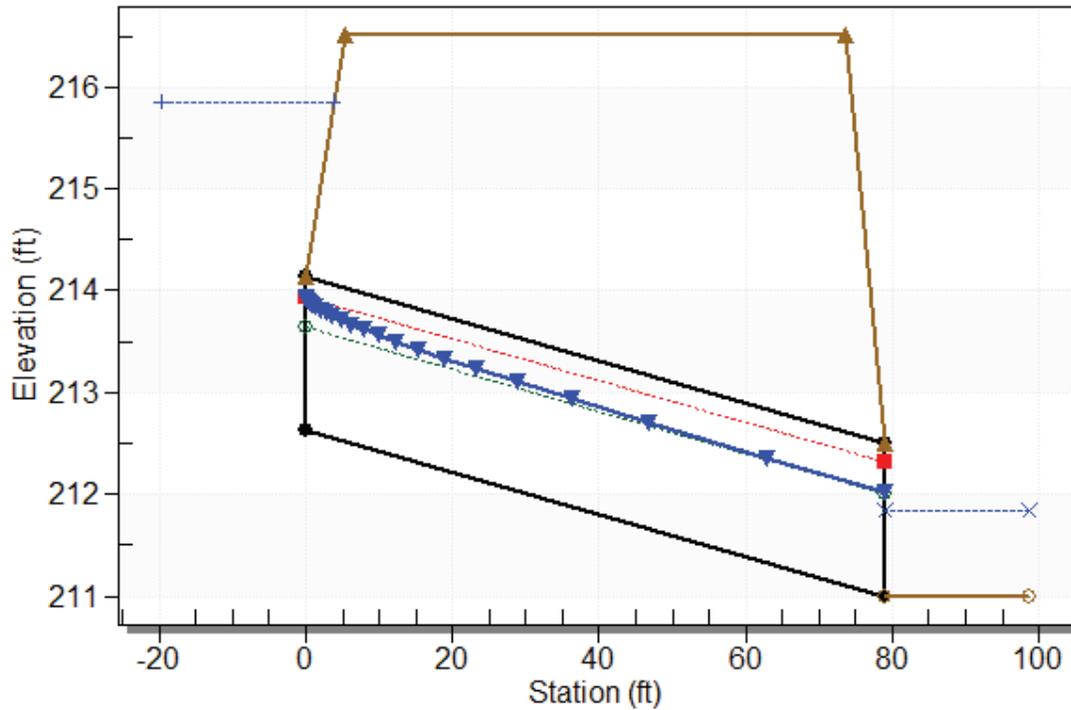
Table 4 - Downstream Channel Rating Curve (Crossing: SW Boeckman Road)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
20.00	211.73	0.73	3.09	0.54	0.73
21.12	211.75	0.75	3.13	0.56	0.74
22.24	211.77	0.77	3.18	0.58	0.74
23.36	211.79	0.79	3.23	0.59	0.74
24.48	211.81	0.81	3.27	0.61	0.74
25.60	211.83	0.83	3.32	0.62	0.75
26.50	211.84	0.84	3.35	0.63	0.75
27.84	211.87	0.87	3.40	0.65	0.75
28.96	211.88	0.88	3.43	0.66	0.75
30.08	211.90	0.90	3.47	0.68	0.76
31.20	211.92	0.92	3.51	0.69	0.76

Water Surface Profile Plot for Culvert: Culvert West

Crossing - SW Boeckman Road, Design Discharge - 26.5 cfs

Culvert - Culvert West, Culvert Discharge - 11.9 cfs



Site Data - Culvert West

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 212.63 ft

Outlet Station: 79.01 ft

Outlet Elevation: 211.00 ft

Number of Barrels: 1

Culvert Data Summary - Culvert West

Barrel Shape: Circular

Barrel Diameter: 1.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

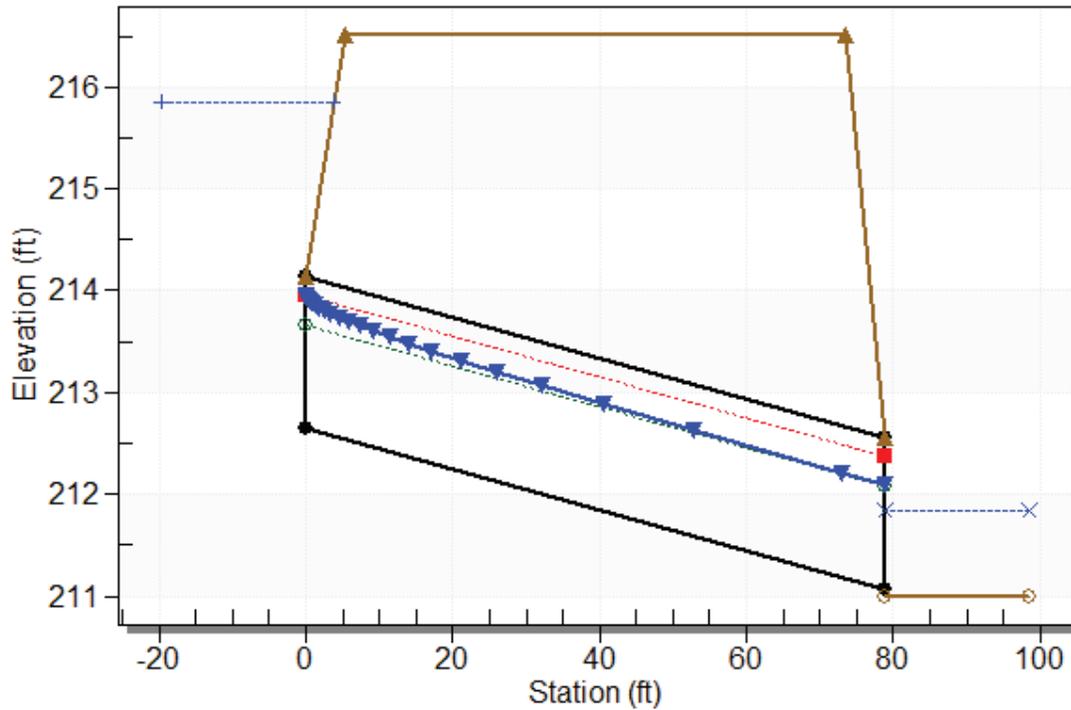
Inlet Depression: NONE

Straight Culvert
Inlet Elevation (invert): 212.63 ft, Outlet Elevation (invert): 211.00 ft
Culvert Length: 79.03 ft, Culvert Slope: 0.0206

Water Surface Profile Plot for Culvert: Culvert East

Crossing - SW Boeckman Road, Design Discharge - 26.5 cfs

Culvert - Culvert East, Culvert Discharge - 11.8 cfs



Site Data - Culvert East

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 212.64 ft

Outlet Station: 78.87 ft

Outlet Elevation: 211.06 ft

Number of Barrels: 1

Culvert Data Summary - Culvert East

Barrel Shape: Circular

Barrel Diameter: 1.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: NONE

Straight Culvert

Inlet Elevation (invert): 212.64 ft, Outlet Elevation (invert): 211.06 ft

Culvert Length: 78.89 ft, Culvert Slope: 0.0200

Appendix C.2
Downstream Analysis
Stafford Road



Technical Memorandum

To: Mike Peebles, PE
Otak, Inc.

From: Teresa Huntsinger, EI
Rose Horton, PE

Copies: File

Date: 1/3/2020

Subject: Downstream Impact Analysis of SW Stafford Road Storm System
Frog Pond Ridge Development

Project No.: 19489

Introduction

The 16.5-acre Frog Pond Ridge Development will include stormwater outfalls to the Willow Creek drainageway and to the existing ditch along SW Stafford Road. This proposed development is located south of SW Frog Pond Lane and west of SW Stafford Road, as shown on Figure 1. Otak has conducted a downstream impact analysis of the storm conveyance system for the proposed Frog Pond Ridge Development, per City of Wilsonville standards. This memo documents the analysis of the drainage way along SW Stafford Road to the headwaters of Meridian Creek south of SW Advance Road.

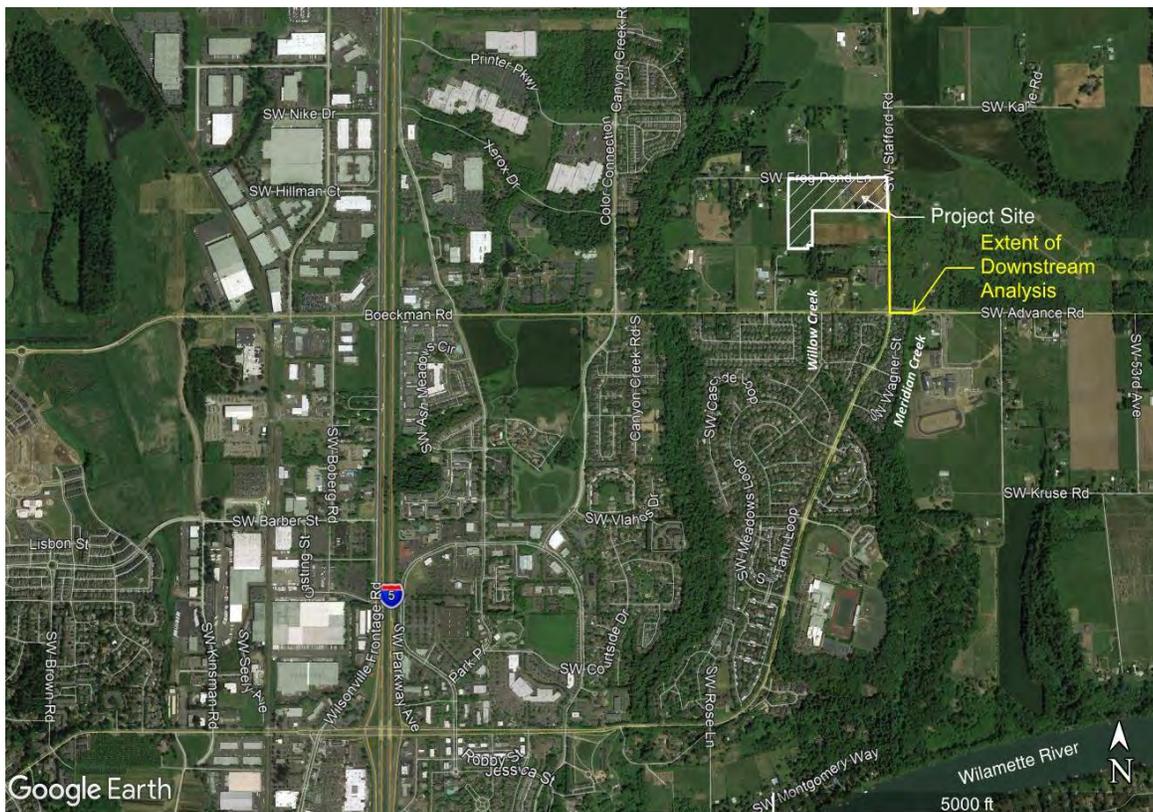


Figure 1 Vicinity map

The development will meet the City of Wilsonville Public Work Standards Section 301.4.04 which requires flow control from post-development conditions for peak flow rates generated by between 42 percent of the 2-year storm up to the 10-year storm.

To meet the requirements of City of Wilsonville Public Work Standards Section 301.5.01, a downstream analysis shall include:

- verifying that the downstream system has the capacity to convey the 25-year design storm.
- extending the analysis downstream to a point in the drainage system where the proposed development site contributes 10 percent or less of the total tributary drainage flow or for one-quarter mile downstream of the approved point of discharge.

The downstream analysis was conducted from the project site's proposed outfall into the existing wetland adjacent to the ditch on Stafford Road down to Meridian Creek south of SW Advance Road, a distance of 0.25 miles.

Existing Conveyance System

The existing conveyance system is shown in Figure 2A, which also includes drainage basin delineation, time of concentration (T_c) flow paths, and runoff node locations represented in the hydraulic model. Details of the downstream conveyance system used to create the hydraulic model were primarily obtained from City as-built information, field survey, and field observation. Two existing ditches drain from north to south on either side of SW Stafford Road. The developed site will discharge to the existing ditch on the west side of SW Stafford Road directly upstream of the 15-inch culvert that crosses SW Stafford Road. Both vegetated ditches drain to inlets approximately 90 feet north of the intersection with SW Boeckman Road/SW Advance Road. Stormwater is then piped east in SW Advance Road until it discharges to Meridian Creek south of Advance Road through an arch culvert. Meridian Creek joins Willow Creek approximately 1,800 feet downstream of the culvert as shown in Figure 1.

In this analysis, existing conditions are considered to be the conditions that existed prior to construction of the Frog Pond Meadows development to the south of Frog Pond Ridge. This construction, which was in progress when this report was being written, is anticipated to remove an existing driveway culvert and fill in a section of the ditch on the west side of SW Stafford Road at SW Brisband Street so that under proposed conditions drainage upstream of the Frog Pond Meadows development will cross SW Stafford Road in the 15-inch culvert and flow to the south in the east ditch.

The proposed development for Frog Pond Ridge is located above the 100-year floodplain delineated in the Flood Insurance Rate Map (FEMA, 2008) and in non-printed unmapped Flood Map Boundary Area. See Appendix B for the FIRMette corresponding to the proposed site.

Field Visit and Assessment

The existing land uses at the project site are currently a mix of agriculture and rural residential land uses. The proposed Frog Pond Ridge development is in the Frog Pond West Master Plan (Wilsonville, 2017).

The ditches and stream channel downstream of the project site were visited on August 30, 2018. The purpose of the field visit was to observe and document existing channel conditions, road crossings, outfalls, and contributing waterways. Visual documentation of the drainage system is included in the Photo Log in Appendix A.

The field assessment started at the existing west ditch directly upstream of the 15-inch cross culvert and continued downstream to Meridian Creek south of SW Advance Road. The field visit and analysis could not be extended beyond the outfall south of SW Advance Road as the creek is located on private property and behind a locked gate. The ditches on both sides of SW Stafford Road were assessed.

West Ditch

The ditch on the west side of SW Stafford Road (West Ditch) continues south of the 15-inch culvert. It is typically 2 to 3 feet deep with a 1.5-foot channel width, and grassy with some blackberry vines. The ditch crosses six driveways in a variety of culvert pipes. The pipe under the church driveway (Node 27), transitions from 10-inch diameter corrugated metal to 8-inch PVC pipe observed at the south (downstream) end.

At Node 31 the right bank side slopes transition from 1:1 to 2:1, and at Node 32 a 10" culvert from the church bioswale outfalls to the ditch. Shortly thereafter, water from the ditch enters a ditch inlet and is piped to a manhole in the road.

East Ditch

Some runoff in the west ditch south of the project site flows through a 15-inch culvert under the road to the ditch on the east side of SW Stafford Rd. This ditch is grassy with blackberry vines, and is typically 3 feet below the roadway, with a 1.5-foot bottom width and 2:1 side slope. Conditions on the left bank (the side away from the roadway) vary from a height of 2.5 feet to as shallow as 1 foot at node 5, where it appears that water may flow overland to the east during high flows. At node 7 just north of the church, there is debris and sedimentation in the ditch, and at node 9 the channel bottom elevation rises 0.8 feet. At the southern end of the ditch, water enters a ditch inlet, where it is then piped to a manhole in SW Stafford Road.

Piped Flow and Open Channel

After entering the ditch inlets, the piped stormwater flow from SW Stafford Road is conveyed east within SW Advance Road until it connects to a 24-inch culvert that conveys flow to an open channel, the headwaters of Meridian Creek. This culvert also collects surface runoff from the site northeast of SW Advance Road (Basin "Offsite 4"). The open channel south of SW Advance Road is on private property behind a fence with a locked gate and was unable to be accessed; however, photographs were taken over the fence. Meridian Creek, downstream of the fence, was observed to be a flat, wide, shallow channel with riprap at the culvert outlet, and a wide floodplain on either side of the channel. There is a tree growing in the middle of the channel.

Hydrology

Peak runoff rates from the drainage basins delineated in Figures 2A, 2B, and 2C during existing, proposed and full buildout conditions, respectively, were calculated using XPSWMM V2018.1. The Santa Barbara Urban Hydrograph (SBUH) method was used to calculate the conveyance design event (25-year recurrence interval, 24-hour duration, NRCS Type 1A rainfall distribution), per Section 301.5.01. Time of Concentration values were calculated for each delineated drainage basin using TR-55 equations. Time of Concentration (Tc) flow paths are shown in Figures 2A, 2B and 2C, and corresponding calculations for each drainage basin are included in Appendix B. A time of concentration of 5 minutes, the minimum allowable, was applied to all developed impervious areas.

The drainage basins described below contribute to the downstream stormwater conveyance system, with the peak runoff rate from each basin being applied to the applicable node in the hydraulics modeling. These drainage basins are shown in Figures 2A, 2B and 2C. Existing conditions are considered to be conditions prior to construction of the Frog Pond Meadows development just south of Frog Pond Ridge. Proposed conditions include development of both Frog Pond Meadows and Frog Pond Ridge. Full Buildout conditions show potential development of the Frog Pond West Master Plan. A summary of drainage basin areas is included in Appendix B.

- The **Church** property includes a bioswale that drains to the west ditch on SW Stafford Road via a 10-inch diameter pipe.
- **Site 1 EX/Site FPM 1** is the portion of the Frog Pond Meadows development that drains to Stafford Road. The basin's shape and size differ between existing to proposed conditions because some of the development that currently drains west to Willow Creek will drain to Stafford Road under proposed conditions. The basin is currently rural residential. Runoff from the site drains to the ditch on the west side of SW Stafford Road, downstream of the culvert that crosses the road to the east ditch.
- **Site 2 EX/Site FPM 2** is a portion of the Frog Pond Meadows site that will remain mostly unaltered. Located north of Site 1, it is currently agricultural land, and it includes a grove of oak trees and a wetland that will be protected. Runoff from the site drains to the ditch on the west side of SW Stafford Road, upstream of the culvert that crosses the road to the east ditch. In proposed conditions it will include a pedestrian path and a rain garden.
- **Site FPR** is the portion of Site 2 EX that is adjacent to Frog Pond Lane. Under existing conditions, it is undeveloped. It is the site of the proposed Frog Pond Ridge development. In proposed and full build-out conditions, its shape and size will be altered as shown in Figure 2C.

- **Offsite 1** is the basin north of Site 1, which drains into the West Ditch. This basin includes the west side of SW Stafford Road.
- **Offsite 2** includes the east side of SW Stafford Road across from Site 1, and land that drains to it. It primarily consists of mowed pasture with some trees and one residence.
- **Offsite 3** is the property just south of the church, which consists of mowed lawn. This basin also includes portions of SW Stafford Road and SW Boeckman Road.
- **Offsite 4** is the large, mostly undeveloped area east of SW Stafford Road at the intersection with SW Advance Road. It is primarily a mixture of trees and grassland.
- **Site West** includes properties to the southwest of the church. In existing conditions, it drains to the ditches and stormwater swales on SW Boeckman Road just west of the intersection with SW Stafford Road. Once developed it will drain west towards Willow Creek.
- **Road 1** is the west side of SW Stafford Road, south of Site 1. It includes the ditch and gravel roadside.
- **Road 2** is the east side of SW Stafford Road, south of Site 1. It includes the ditch and gravel roadside.
- **Road 3** is the east side of SW Stafford Road, south of the ditch inlet, and SW Advance Road west of the culvert.
- **Road 4** is SW Advance Road east of the culvert. This area has been improved with sidewalks and stormwater planters, and there is no ditch or gravel shoulder.

Under existing conditions, approximately 4.09 acres of the Frog Pond Ridge project area drain towards SW Stafford Road and, under proposed conditions, 5.62 acres of the site will drain towards SW Stafford Road. Most of the study area is comprised of silt loam, categorized in the hydrologic soil group (HSG) C/D. HSG C/D soils generally exhibit very slow infiltration rates when thoroughly wet. A small upland area is categorized as HSG C with low to moderate infiltration. There are a variety of existing land uses in the area, with different corresponding runoff Curve Numbers (CN) shown in Table 1.

Table 1: Runoff Curve Numbers			
Basin Name	Soil Group	Pervious CN	CN Description
Existing Church	C/D	80	Open Space, Good
Existing Site 1	C/D	84	Residential 1 acre
Existing Site 2	C/D	80	Pasture, Good
Existing Offsite 1	C	71	Meadow
Existing Offsite 2	C	71	Meadow
Existing Offsite 3	C/D	80	Open Space, Good
Existing Offsite 4	C/D	82	Woods - Grass Combo, Fair
Existing Road 1	C/D	91	Gravel
Existing Road 2	C/D	91	Gravel
Existing Road 3	C/D	91	Gravel
Existing Road 4	C/D	NA	All impervious road/sidewalk
Existing Site West	C/D	84	Residential 1 acre
Proposed Site FPM 1 & 2	C/D	80	Open Space, Good
Proposed Site FPR	C/D	80	Open Space, Good

Existing impervious areas were delineated using aerial imagery. Under proposed development conditions, the site's pervious areas will be grassy open space, with a Curve Number of 80. A Curve Number of 98 was used for all impervious areas. Under proposed conditions, Basin "Site West" is removed from the model since it will drain to Willow Creek rather than into this system. Future imperviousness of the developed basins under proposed conditions and full build-out conditions was estimated based on land use types in the Frog Pond West Master Plan (Table 2). Frog Pond Meadows is zoned small lot and is approximately 65 percent impervious. This

impervious percentage was applied to the other small lot areas and the commercial areas. The area of Frog Pond Ridge is zoned medium and small lot. The proposed development plan makes the site 64 percent impervious. The Church basin is currently 61 percent impervious, and this percentage was applied to Offsite 3, which has the same institutional zoning.

Table 2: Imperviousness of Developed Basins				
Basin Name	Buildout Phase	Future Land Use	Developed Percent Impervious	Existing Percent Impervious (Approx.)
Site FPM 1	Proposed Conditions	R-5 Small Lot	65%	1.5%
Site FPM 2	Proposed Conditions	Open space with path	10%	0%
Site FPR	Proposed Conditions	R-5 Small Lot, with protected tree grove	64%	2.7%
Offsite 1	Full Buildout	R-5 Small Lot	65%	25.2%
Offsite 2	Full Buildout	Institutional/Civic & Commercial	65%	16.1%
Offsite 3	Full Buildout	Institutional/Civic	61%	15.5%
Offsite 4	Full Buildout	R-2.5 and Commercial	65%	4.6%

Downstream Conveyance Modeling Analysis

The stormwater conveyance network was analyzed in XP-SWMM. The conveyance system was modeled to determine whether the existing downstream system has enough capacity to support the undetained Frog Pond Ridge development runoff during the 25-year, 24-hour storm event. Three models were developed: existing conditions, proposed conditions, and full buildout conditions.

Pipe and channel elevations were obtained from GIS LiDAR data, survey information, and as-built plans. Manning’s n values were applied to the pipes and ditches based on their material and thickness of vegetation as shown in Table 3.

Table 3: Conveyance Roughness Coefficients	
Channel Type	Manning’s n Roughness Coefficient
Smooth pipe	0.013
Corrugated pipe	0.024
Vegetated Ditch	Varied - 0.024 to 0.4

Results from the XP-SWMM model, including flows and water depths assuming no detention during existing, proposed, and full buildout conditions are shown in Table 4 and Table 5. Hydraulic modeling found that there may be an existing pipe capacity problem in the pipe under the church driveway in the west ditch that changes from a 10-inch diameter corrugated metal pipe to an 8-inch PVC pipe. The water level is calculated to be only 6 inches below the driveway during the 25-year event. In proposed conditions the backwater caused by the church driveway is alleviated by discharging FPM 1 downstream of the constriction and by directing all the runoff from the basins upstream of SW Brisband Street across Stafford Road in the 15-inch culvert to the east ditch.

There is also a deficiency at the manhole downstream of the two ditch inlets (Node 11), where the existing 12-inch pipe surcharges in proposed conditions. We recommend that the existing 12-inch pipe (Link 259) be upsized to an 18-inch pipe to provide capacity for the proposed flows. In the east ditch, the model predicted that during the 25-year event the flow does not overtop the one-foot deep ditch section under existing and proposed conditions but would likely overtop in full buildout conditions if the ditch is not replaced with a piped system or modified to provide additional capacity.

Under proposed conditions, the 25-year flow at the downstream end of the Downstream Analysis is within 0.7 cfs of existing conditions, because under proposed conditions some portions of the site are redirected toward Willow Creek. Prior analysis of the Willow Creek system found that it has the capacity for those flows. Appendix C includes output information from the XP-SWMM model, summarizing the channel and pipe characteristics and results of the hydraulic routing during the 25-year design storm.

Table 4: Hydraulic Modeling Flow Results for 25-Year Storm			
Location	Existing	Proposed	Full Buildout
Link 263: Upstream of FPM 1 site	1.53 cfs	NA	NA
Link 251: Culvert under Stafford Road	1.82 cfs	6.76 cfs	8.00 cfs
Link 271: Upstream of the Church driveway	2.24 cfs	NA	NA
Link 276: Downstream of FPM 1 proposed discharge	2.24 cfs	1.71 cfs	1.86 cfs
Link 277: Downstream end of West Ditch	3.68 cfs	3.13 cfs	3.51 cfs
Link 257: Downstream end of East Ditch	2.58 cfs	7.45 cfs	10.93 cfs
Link 262: Channel South of Advance Road	20.26 cfs	20.90 cfs	42.34 cfs

Table 5: Hydraulic Modeling Water Depth Results for 25-Year Storm				
Location	Existing	Proposed	Full Buildout	Overflow Depth
Node 28: Upstream of church driveway in West Ditch	2.08 ft	0 ft	2.16 ft	2.6 ft
Node 11: Manhole downstream of ditch inlets	5.87 ft	7.49* ft	7.69 ft*	7.38 ft
Node 5: Downstream end of 1' deep portion of East Ditch	0.54 ft	0.87 ft	1.03 ft*	1 ft

*Overflows

Conclusions

The downstream stormwater conveyance system analyzed as part of this downstream analysis extends from the proposed Frog Pond Ridge development approximately one quarter mile downstream to Meridian Creek, south of SW Advance Road. The system consists of both open channel and piped conveyance components. A site visit along the downstream reach provided a qualitative assessment of the storm conveyance system. The system was modeled under existing, proposed, and full buildout conditions using XP-SWMM software. Modeling found that the existing system is nearing its capacity at two locations: in a pipe under the church driveway on the west side of SW Stafford Road, and in the manhole just south of the two ditch inlets on SW Stafford Road. Cutting off flows from the north at SW Brisband Street will address the capacity issue in the west ditch at the church driveway. Development of Frog Pond Ridge will require improvements to conveyance capacity along SW Stafford Road. Overall, 25-year flows in Meridian Creek at the downstream end of the analysis are calculated to increase by 0.64 cfs under proposed conditions and double under full build-out conditions.

References

City of Wilsonville. *City of Wilsonville Public Works Standards. Section 3, Stormwater & Surface Water Design and Construction Standards*, City of Wilsonville, Revised December 2015.

FEMA, 2008. *Flood Insurance Rate Map (FIRM) for Clackamas County, Oregon, Incorporated Areas, Panel 243*, Federal Emergency Management Agency, June 17, 2008.

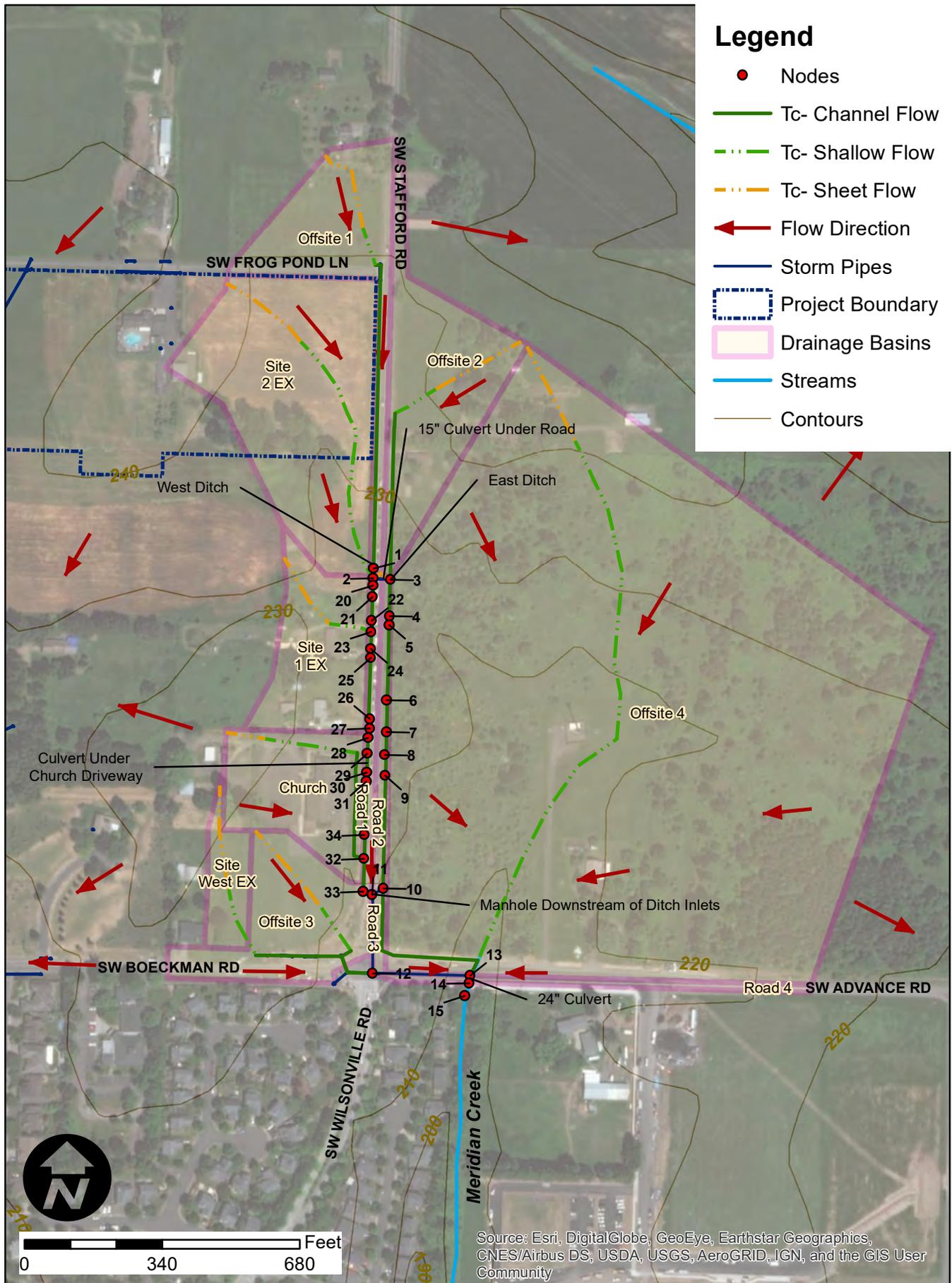
National Resource Conservation Services, United States Department of Agriculture. "Web Soil Survey." <<http://websoilsurvey.nrcs.usda.gov/>> Accessed: December 14, 2017.

Otak, 2018. *Downstream Impact Analysis Stafford Meadows Development*. Otak, January 16, 2018.

WES, 2005. *Results of evaluation and analysis of impervious surface and current and future land use types in CCSD#1 and the Damascus UGB expansion area*. Clackamas County Water Environment Services, July 2005

Wilsonville, 2017. *Frog Pond West Master Plan*, City of Wilsonville, July 17, 2017.

Figures
DS Analysis Stafford Road



- ### Legend
- Nodes
 - Tc- Channel Flow
 - - - Tc- Shallow Flow
 - · · Tc- Sheet Flow
 - ← Flow Direction
 - Storm Pipes
 - ▭ Project Boundary
 - ▭ Drainage Basins
 - Streams
 - Contours

0 340 680 Feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 2A. Frog Pond Ridge Downstream Analysis, Existing Conditions

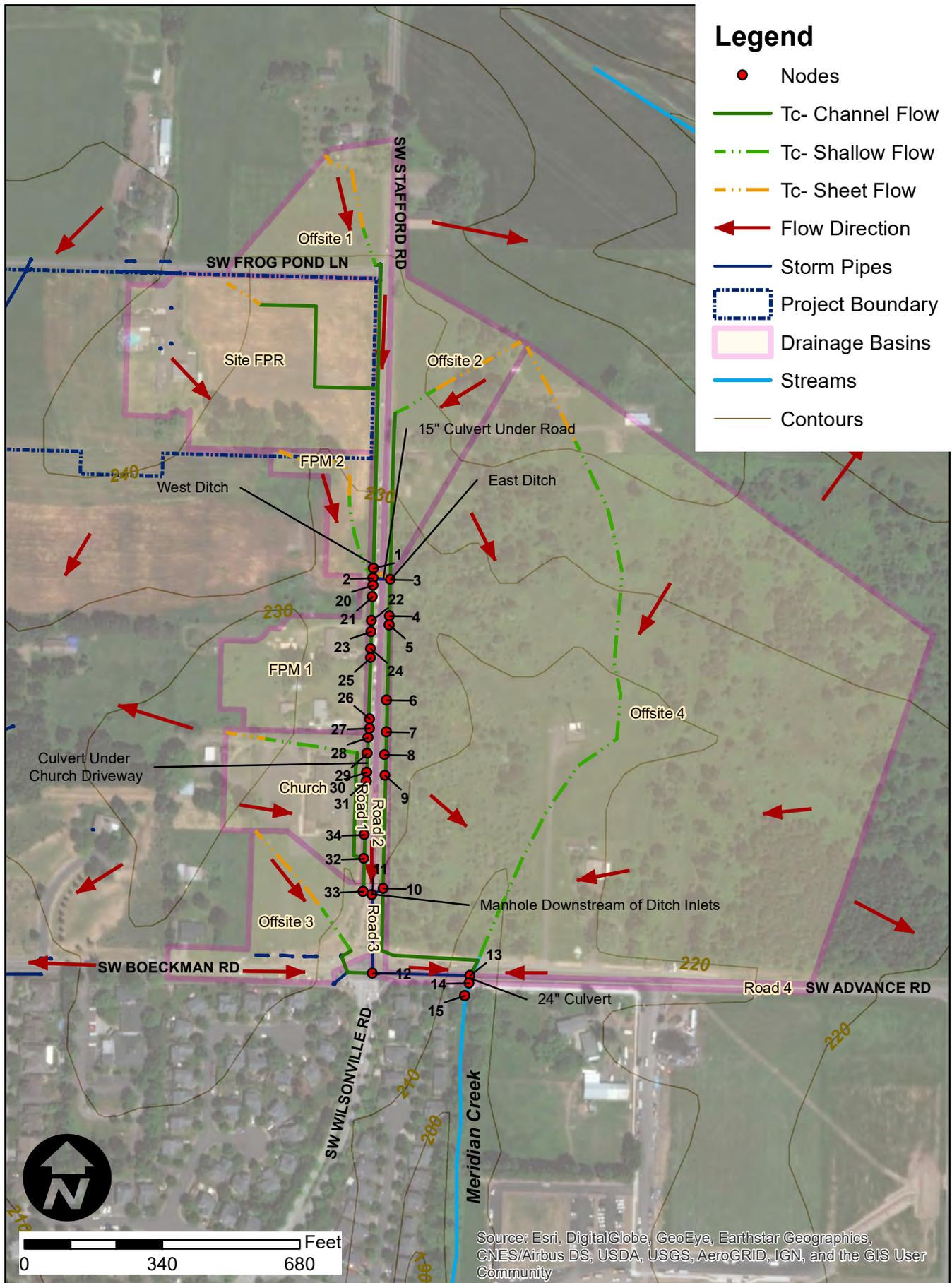


Figure 2B. Frog Pond Ridge Downstream Analysis, Proposed Conditions

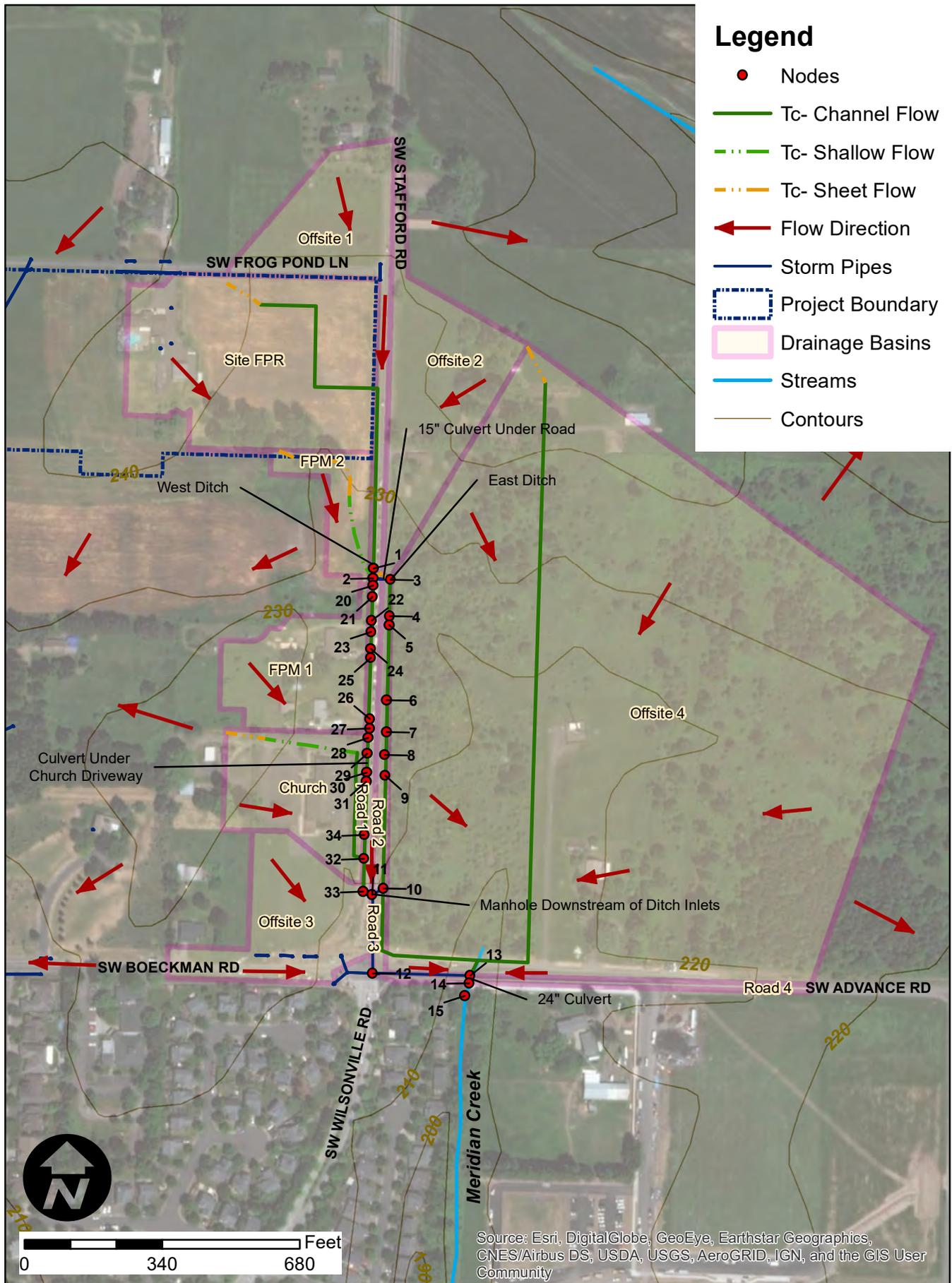


Figure 2C. Frog Pond Ridge Downstream Analysis, Full Buildout Conditions

Appendix A
DS Analysis Stafford Road
Photo Log



Figure 1. Upstream end of 15" culvert in west ditch (Node 2)



Figure 2. East ditch at outlet of 15" culvert (node 3). Gravelly bottom and heavily vegetated 2:1 side slopes. Roadside right bank 3ft height and left bank 2.5ft height.



Figure 3. East ditch with left bank 1 ft in height and appearance of overflow path through vegetation. (node 5)



Figure 4. East ditch vegetated with grasses and left bank at 2.5 foot height. (node 6)



Figure 5. East ditch with sloughing from right bank 2.5 ft height and bottom 2.75 ft width. (node 7)



Figure 6. Debris and sedimentation raises channel bottom 0.8 ft. (Node 9)



Figure 7. East ditch with 3 ft bottom width downstream of elevation change (downstream of Node 9)



Figure 8. East ditch inlet with pipe out to the west (node 10)



Figure 9. West ditch downstream of 15 inch cross culvert, 2 ft depth, 1.5 ft bottom width and densely vegetated 2:1 side slopes, crosses 4 driveways in 12 inch culverts (Node 21).



Figure 10. West ditch at church property with gravel and less vegetation, 2 ft depth, 2 ft bottom width and 2:1 side slopes, upstream of driveway crossing (Node 27).



Figure 11. Pipe under church driveway is 10 inch corrugated metal at upstream end and 8 inch plastic at downstream end (Node 27).



Figure 12. West ditch left bank 2.5 ft high and right bank grassed 3 ft high with transition from 1:1 side slope to 2:1 side slope (Node 31).



Figure 13. West ditch collected in inlet directly downstream of outfall from church swale. Pipe out to east and connects with discharge from east ditch in manhole and continues south.



Figure 14. Upstream end of culvert under SW Advance Road



Figure 15. Outlet of 24" Culvert south of SW Advance Rd (Node 14)

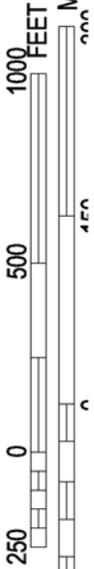


Figure 16. Channel (node 15)

Appendix B
DS Analysis Stafford Road
Hydrology



MAP SCALE 1" = 500'



NFIP

PANEL 0234D

FIRM
FLOOD INSURANCE RATE MAP
CLACKAMAS COUNTY,
OREGON
AND INCORPORATED AREAS

PANEL 234 OF 1175

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY NUMBER PANEL SUFFIX
CLACKAMAS COUNTY 415588 0234 D
WILSONVILLE, CITY OF 410025 0234 D

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.



MAP NUMBER
41005C0234D
EFFECTIVE DATE
JUNE 17, 2008

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

JOINS PANEL 0253

Site located in non-printed area



Time of Concentration Calculations

18968 Frog Pond Meadows

Existing Conditions

BASINS:		Church	Site 2 EX	Site 1 EX
---------	--	--------	-----------	-----------

SHEET FLOW

INPUT

Surface Description (from Table 3-1)		Short Grass	Short Grass	Dense Grass
Manning's Roughness Coefficient		0.15	0.15	0.24
Flow Length, L (<300 ft)	ft	98	236	199
2-Year, 24-Hour Rainfall, P ₂	in	2.5	2.5	2.5
Land Slope, s	ft/ft	0.031	0.017	0.01

OUTPUT

Travel Time	hr	0.15	0.39	0.81
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SHALLOW CONCENTRATED FLOW

INPUT

Surface Description (paved or unpaved)		Paved	Unpaved	Unpaved
Flow Length, L	ft	231	641	106
Watercourse Slope, s	ft/ft	0.026	0.017	0.038

OUTPUT

Average Velocity, V	ft/s	3.28	2.11	3.13
Travel Time	hr	0.02	0.08	0.01

CHANNEL FLOW

INPUT

Surface Description (from Table 3-1)		Swale		
Cross Sectional Flow Area, a	ft ²	28		
Wetted Perimeter, p _w	ft	20.65		
Channel Slope, s	ft/ft	0.020		
Manning's Roughness Coefficient		0.08		
Flow Length, L	ft	281	0	0

OUTPUT

Average Velocity, V	ft/s	3.19		
Hydraulic Radius, r = a/p _w	ft	1.36		
Travel Time	hr	0.024		

Basin Time of Concentration, T_c	hrs	0.20	0.48	0.82
	min	11.8	28.6	49.2

Time of Concentration Calculations

18968 Frog Pond Meadows

Existing Conditions

BASINS:		Offsite 1	Offsite 2	Offsite 3
---------	--	-----------	-----------	-----------

SHEET FLOW

INPUT

Surface Description (from Table 3-1)		Dense Grass	Woods	Short Grass
Manning's Roughness Coefficient		0.24	0.4	0.15
Flow Length, L (<300 ft)	ft	235	242	252
2-Year, 24-Hour Rainfall, P ₂	in	2.5	2.5	2.5
Land Slope, s	ft/ft	0.015	0.012	0.030

OUTPUT

Travel Time	hr	0.60	0.92	0.33
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SHALLOW CONCENTRATED FLOW

INPUT

Surface Description (paved or unpaved)		Unpaved	Unpaved	Unpaved
Flow Length, L	ft	98	120	130
Watercourse Slope, s	ft/ft	0.020	0.083	0.023

OUTPUT

Average Velocity, V	ft/s	2.30	4.66	2.45
Travel Time	hr	0.01	0.01	0.01

CHANNEL FLOW

INPUT

Surface Description (from Table 3-1)		Ditch	Ditch	Ditch
Cross Sectional Flow Area, a	ft ²	16.25	16.25	16.25
Wetted Perimeter, p _w	ft	12.68	12.68	12.68
Channel Slope, s	ft/ft	0.018	0.019	0.016
Manning's Roughness Coefficient		0.08	0.08	0.08
Flow Length, L	ft	766	414	64

OUTPUT

Average Velocity, V	ft/s	2.97	3.05	2.75
Hydraulic Radius, r = a/p _w	ft	1.28	1.28	1.28
Travel Time	hr	0.072	0.038	0.006

Basin Time of Concentration, T_c	hrs	0.68	0.97	0.35
	min	41.0	58.1	21.1

Time of Concentration Calculations

18968 Frog Pond Meadows

Existing Conditions

BASINS:		Offsite 4	Road 1	Road 2
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SHEET FLOW

INPUT

Surface Description (from Table 3-1)		Short Grass	Paved	Paved
Manning's Roughness Coefficient		0.15	0.011	0.011
Flow Length, L (<300 ft)	ft	262	26	22
2-Year, 24-Hour Rainfall, P ₂	in	2.5	2.5	2.5
Land Slope, s	ft/ft	0.011	0.077	0.091

OUTPUT

Travel Time	hr	0.50	0.00	0.00
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SHALLOW CONCENTRATED FLOW

INPUT

Surface Description (paved or unpaved)		Unpaved		
Flow Length, L	ft	1426	0	0
Watercourse Slope, s	ft/ft	0.020		

OUTPUT

Average Velocity, V	ft/s	2.30	0.00	0.00
Travel Time	hr	0.17		

CHANNEL FLOW

INPUT

Surface Description (from Table 3-1)			Ditch	Shallow Ditch
Cross Sectional Flow Area, a	ft ²		16.25	6.75
Wetted Perimeter, p _w	ft		12.68	8.21
Channel Slope, s	ft/ft		0.010	0.010
Manning's Roughness Coefficient			0.08	0.08
Flow Length, L	ft	0	775	765

OUTPUT

Average Velocity, V	ft/s		2.23	1.67
Hydraulic Radius, r = a/p _w	ft		1.28	0.82
Travel Time	hr		0.096	0.127

Basin Time of Concentration, T_c	hrs	0.67	0.10	0.13
	min	40.3	6.1	7.8

Time of Concentration Calculations

18968 Frog Pond Meadows

Existing Conditions

BASINS:		Road 3	Site West EX
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SHEET FLOW

INPUT

Surface Description (from Table 3-1)			Short Grass
Manning's Roughness Coefficient			0.15
Flow Length, L (<300 ft)	ft	0	258
2-Year, 24-Hour Rainfall, P ₂	in		2.5
Land Slope, s	ft/ft		0.023

OUTPUT

Travel Time	hr		0.37
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SHALLOW CONCENTRATED FLOW

INPUT

Surface Description (paved or unpaved)			Unpaved
Flow Length, L	ft	0	179
Watercourse Slope, s	ft/ft		0.028

OUTPUT

Average Velocity, V	ft/s	0.00	2.70
Travel Time	hr		0.02

CHANNEL FLOW

INPUT

Surface Description (from Table 3-1)		Ditch	Ditch
Cross Sectional Flow Area, a	ft ²	16.25	16.25
Wetted Perimeter, p _w	ft	12.68	12.68
Channel Slope, s	ft/ft	0.021	0.038
Manning's Roughness Coefficient		0.08	0.080
Flow Length, L	ft	390	319

OUTPUT

Average Velocity, V	ft/s	3.15	4.26
Hydraulic Radius, r = a/p _w	ft	1.28	1.28
Travel Time	hr	0.034	0.021

Basin Time of Concentration, T_c	hrs	0.03	0.41
	min	2.1	24.6

(5 min.)

Time of Concentration Calculations

19489 Frog Pond Ridge

Proposed & Buildout Conditions

BASINS:		Site FPR	Site FPM 2	Offsite 4 (developed)
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SHEET FLOW

INPUT

Surface Description (from Table 3-1)		Short Grass	Short Grass	Short Grass
Manning's Roughness Coefficient		0.15	0.15	0.15
Flow Length, L (<300 ft)	ft	100	246	100
2-Year, 24-Hour Rainfall, P ₂	in	2.5	2.5	2.5
Land Slope, s	ft/ft	0.040	0.037	0.030

OUTPUT

Travel Time	hr	0.14	0.30	0.16
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SHALLOW CONCENTRATED FLOW

INPUT

Surface Description (paved or unpaved)			Unpaved	
Flow Length, L	ft	0	215	0
Watercourse Slope, s	ft/ft		0.037	
Average Velocity, V	ft/s		3.09	
Travel Time	hr		0.02	

CHANNEL FLOW

INPUT

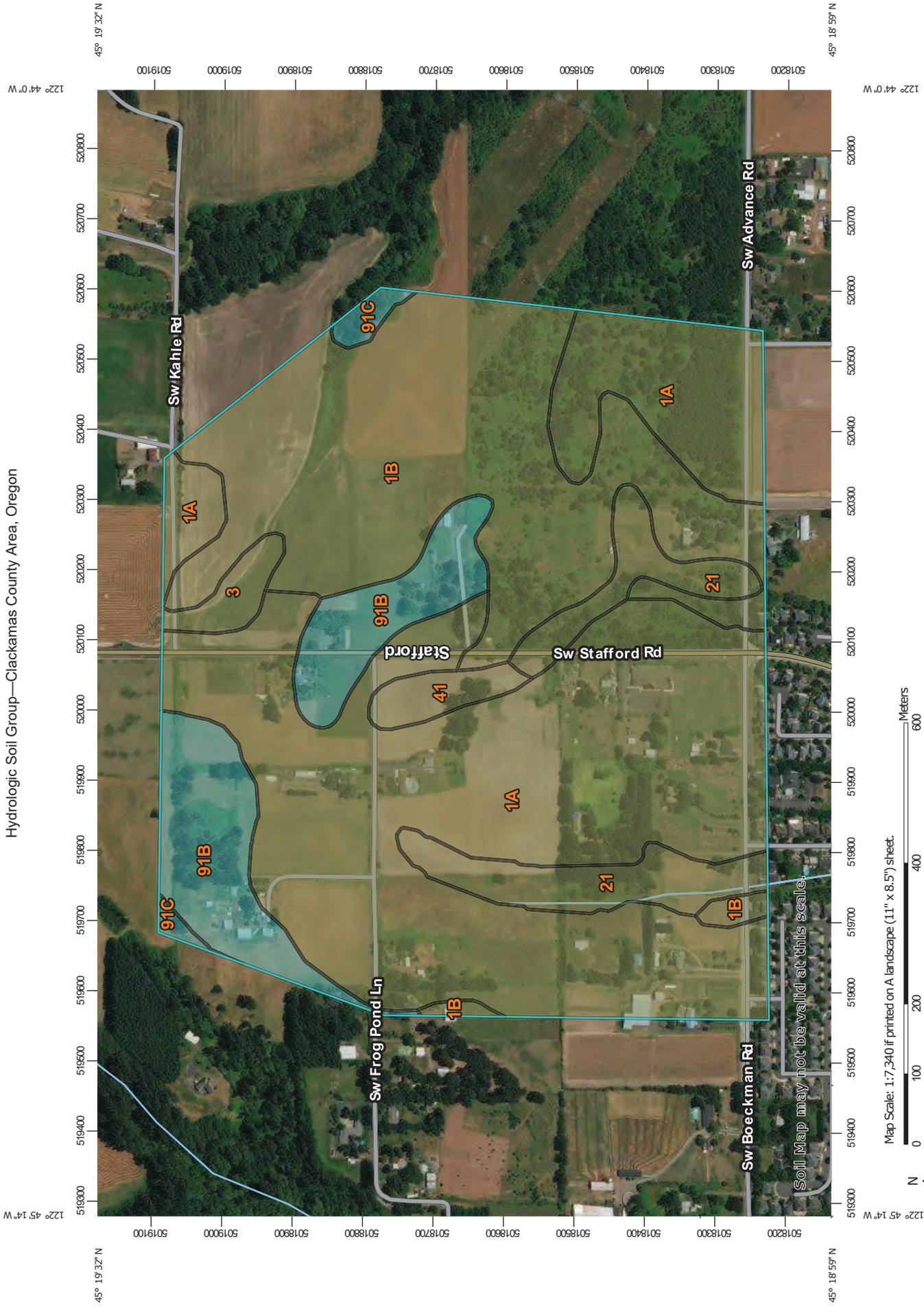
Surface Description (from Table 3-1)		Pipe		Pipe
Cross Sectional Flow Area, a	ft ²	0.8		0.8
Wetted Perimeter, p _w	ft	3.14		3.14
Channel Slope, s	ft/ft	0.01		0.020
Manning's Roughness Coefficient		0.013		0.013
Flow Length, L	ft	940	0	1558

OUTPUT

Average Velocity, V	ft/s	3.36		6.51
Hydraulic Radius, r = a/p _w	ft	0.25		0.25
Travel Time	hr	0.078		0.066

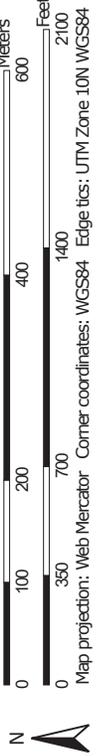
Basin Time of Concentration, T_c	hrs	0.22	0.32	0.22
	min	13.1	19.0	13.4

Hydrologic Soil Group—Clackamas County Area, Oregon

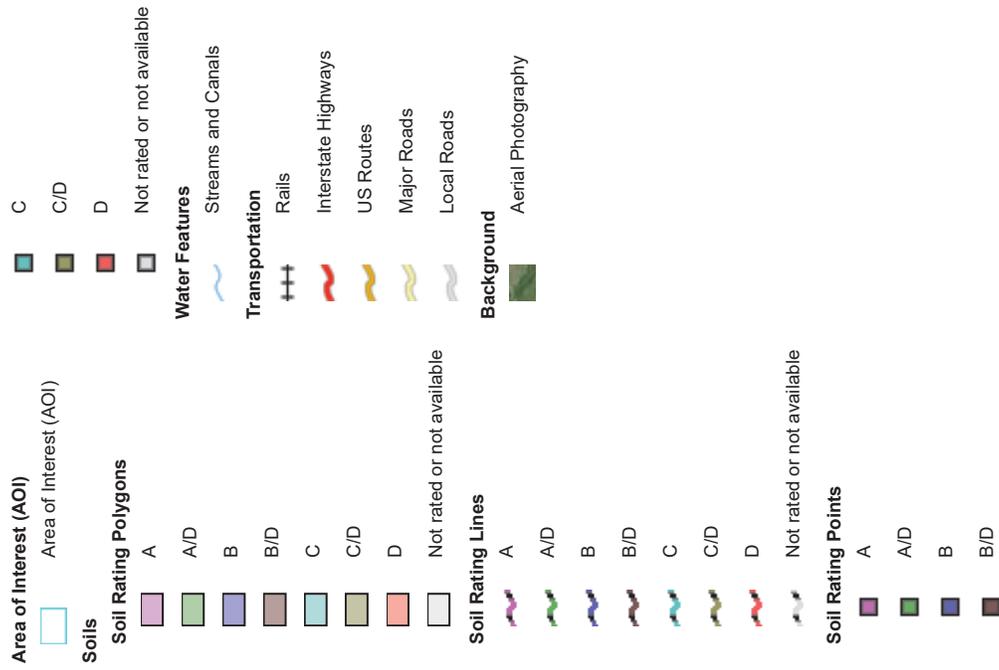


Soil Map may not be valid at this scale.

Map Scale: 1:7,340 if printed on A landscape (11" x 8.5") sheet.



MAP LEGEND



MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL:
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Clackamas County Area, Oregon
 Survey Area Data: Version 12, Sep 19, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 19, 2015—Sep 13, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1A	Aloha silt loam, 0 to 3 percent slopes	C/D	104.2	51.3%
1B	Aloha silt loam, 3 to 6 percent slopes	C/D	57.6	28.3%
3	Amity silt loam	C/D	2.7	1.3%
21	Concord silt loam	C/D	13.6	6.7%
41	Huberly silt loam	C/D	3.0	1.5%
91B	Woodburn silt loam, 3 to 8 percent slopes	C	20.4	10.0%
91C	Woodburn silt loam, 8 to 15 percent slopes	C	1.7	0.8%
Totals for Area of Interest			203.1	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Drainage Basin Areas
19489 Frog Pond Ridge

Existing Conditions

Basin Name	Drains to	Impervious Area (sf)	Impervious Area (ac)	Pervious Area (sf)	Pervious Area (ac)	Total Area (sf)	Total Area (ac)	Total Area	Percent Impervious	Time of Concentration (min)	Soil Group	Slope	Pervious CN	CN Description
Church	Node 32	61,007	1.40	38,615	0.89	99,622	2.29		61.2%	11.8	C/D	0.026	80	Open Space, Good
Site 2 EX	Node 2	4,878	0.11	313,526	7.20	318,404	7.31		1.5%	28.6	C/D	0.017	80	Pasture, Good
Site 1 EX	Node 23	10,511	0.24	85,965	1.97	96,476	2.21		10.9%	49.2	C/D	0.02	84	Residential 1 acre
Offsite 1	Node 1	29,023	0.67	86,012	1.97	115,035	2.64		25.2%	41.0	C	0.018	71	Meadow
Offsite 2	Node 3	23,713	0.54	123,386	2.83	147,099	3.38		16.1%	58.1	C	0.019	71	Meadow
Offsite 3	Node 12	16,305	0.37	88,659	2.04	104,964	2.41		15.5%	21.1	C/D	0.03	80	Open Space, Good
Offsite 4	Node 13	70,356	1.62	1,454,898	33.40	1,525,254	35.02		4.6%	40.3	C/D	0.02	82	Woods - Grass Combo, Fair
Road 1	Node 33	12,822	0.29	9,175	0.21	21,997	0.50		58.3%	6.1	C/D	0.01	91	Gravel
Road 2	Node 10	7,573	0.17	14,311	0.33	21,884	0.50		34.6%	7.8	C/D	0.01	91	Gravel
Road 3	Node 14	7,914	0.18	3,621	0.08	11,535	0.26		68.6%	5.0	C/D	0.021	91	Gravel
Road 4	Node 14	16,188	0.37	0	0.00	16,188	0.37		100.0%	5.0	C/D	0.02	98	All impervious road/sidewalk
Site West EX	Node 12	0	0.00	34,303	0.79	34,303	0.79		0.0%	24.6	C/D	0.038	84	Residential 1 acre
TOTAL	-	260,290	5.98	2,252,471	51.71	2,512,761	57.69		10.4%	-	-	-	-	-

Proposed Conditions

Basin Name	Drains to	Impervious Area (sf)	Impervious Area (ac)	Pervious Area (sf)	Pervious Area (ac)	Total Area (sf)	Total Area (ac)	Total Area	Percent Impervious	Time of Concentration (min)	Soil Group	Slope	Pervious CN	CN Description
Church	Node 32	61,007	1.40	38,615	0.89	99,622	2.29		61.2%	11.8	C/D	0.026	80	Open Space, Good
FPM 2	Node 2	4,578	0.11	41,198	0.95	45,776	1.05		10.0%	19.0	C/D	0.01	80	Open Space, Good
Site FPR	Node 1	161,516	3.71	90,852	2.09	252,368	5.79		64.0%	13.1	C/D	0.02	80	Open Space, Good
FPM 1	Node 34	73,043	1.68	39,331	0.90	112,374	2.58		65.0%	5.0	C/D	0.02	80	Open Space, Good
Offsite 1	Node 1	29,023	0.67	86,012	1.97	115,035	2.64		25.2%	41.0	C	0.018	71	Meadow
Offsite 2	Node 3	23,713	0.54	123,386	2.83	147,099	3.38		16.1%	58.1	C	0.019	71	Meadow
Offsite 3	Node 12	16,305	0.37	88,659	2.04	104,964	2.41		15.5%	21.1	C/D	0.03	80	Open Space, Good
Offsite 4	Node 13	70,356	1.62	1,454,898	33.40	1,525,254	35.02		4.6%	40.3	C/D	0.02	82	Woods - Grass Combo, Fair
Road 1	Node 33	12,822	0.29	9,175	0.21	21,997	0.50		58.3%	6.1	C/D	0.01	91	Gravel
Road 2	Node 10	7,573	0.17	14,311	0.33	21,884	0.50		34.6%	7.8	C/D	0.01	91	Gravel
Road 3	Node 14	7,914	0.18	3,621	0.08	11,535	0.26		68.6%	5.0	C/D	0.021	91	Gravel
Road 4	Node 14	16,188	0.37	0	0.00	16,188	0.37		100.0%	5.0	C/D	0.02	98	All impervious road/sidewalk
Site West EX	Not in System													
TOTAL	-	484,038	11.11	1,990,058	45.69	2,474,096	56.80		19.6%	-	-	-	-	-

Drainage Basin Areas
19489 Frog Pond Ridge

Buildout Conditions

Basin Name	Drains to	Impervious Area (sf)	Impervious Area (ac)	Pervious Area (sf)	Pervious Area (ac)	Total Area (sf)	Total Area (ac)	Percent Impervious	Time of Concentration (min)	Soil Group	Slope	Pervious CN	CN Description
Church	Node 32	61,007	1.40	38,615	0.89	99,622	2.29	61.2%	11.8	C/D	0.026	80	Open Space, Good
FPM 2	Node 2	4,578	0.11	41,198	0.95	45,776	1.05	10.0%	19.0	C/D	0.01	80	Open Space, Good
Site FPR	Node 1	161,516	3.71	90,852	2.09	252,368	5.79	64.0%	13.1	C/D	0.02	80	Open Space, Good
FPM 1	Node 34	73,043	1.68	39,331	0.90	112,374	2.58	65.0%	5.0	C/D	0.02	80	Open Space, Good
Offsite 1	Node 1	74,773	1.72	40,262	0.92	115,035	2.64	65.0%	5.0	C	0.018	80	Open Space, Good
Offsite 2	Node 3	95,614	2.20	51,485	1.18	147,099	3.38	65.0%	5.0	C	0.019	80	Open Space, Good
Offsite 3	Node 12	64,028	1.47	40,936	0.94	104,964	2.41	61.0%	5.0	C/D	0.03	80	Open Space, Good
Offsite 4	Node 13	991,415	22.76	533,839	12.26	1,525,254	35.02	65.0%	13.4	C/D	0.02	80	Open Space, Good
Road 1	Node 33	12,822	0.29	9,175	0.21	21,997	0.50	58.3%	5.0	C/D	0.01	91	Gravel
Road 2	Node 10	7,573	0.17	14,311	0.33	21,884	0.50	34.6%	5.0	C/D	0.01	91	Gravel
Road 3	Node 14	7,914	0.18	3,621	0.08	11,535	0.26	68.6%	5.0	C/D	0.021	91	Gravel
Road 4	Node 14	16,188	0.37	0	0.00	16,188	0.37	100.0%	5.0	C/D	0.02	98	All impervious road/sidewalk
Site West EX	Not in System												
TOTAL	-	1,570,471	36.05	903,625	20.74	2,474,096	56.80	63.5%	-	-	-	-	-

Appendix C
DS Analysis Stafford Road
Hydraulics

XP-SWMM RUNOFF DATA
Frog Pond Ridge
Existing Conditions - SW Stafford Road

SCS Type IA 25-Year Storm Event								
XP-SWMM Input Data					XP-SWMM Output Data			
Node Name	Total Area (ac)	Impervious %	Curve Number	Tc (min)	Max. Rainfall Intensity (in/hr)	Unit Hydrograph Method	Infiltration Depth (in)	Surface Runoff Flow (cfs)
Node1	1.97	0	71	41	1.26	Santa Barbara	0.00	0.27
Node1	0.67	100	98	5	1.26	Santa Barbara	0.00	0.79
Node2	7.20	0	80	28.6	1.26	Santa Barbara	0.00	2.30
Node2	0.11	100	98	5	1.26	Santa Barbara	0.00	0.13
Node3	2.83	0	71	58.1	1.26	Santa Barbara	0.00	0.33
Node3	0.54	100	98	5	1.26	Santa Barbara	0.00	0.63
Node10	0.33	0	91	7.8	1.26	Santa Barbara	0.00	0.29
Node10	0.17	100	98	5	1.26	Santa Barbara	0.00	0.20
Node12	2.04	0	80	21.1	1.26	Santa Barbara	1.70	0.74
Node12	0.37	100	98	5	1.26	Santa Barbara	0.00	0.43
Node12	0.79	0	84	24.6	1.26	Santa Barbara	0.00	0.34
Node13	33.40	0	82	40.3	1.26	Santa Barbara	0.00	10.36
Node13	1.62	100	98	5	1.26	Santa Barbara	0.00	1.90
Node14	0.18	0	91	5	1.26	Santa Barbara	0.00	0.17
Node14	0.08	100	98	5	1.26	Santa Barbara	0.00	0.09
Node14	0.37	100	98	5	1.26	Santa Barbara	0.00	0.43
Node23	1.97	0	84	49.2	1.26	Santa Barbara	0.00	0.62
Node23	0.24	100	98	5	1.26	Santa Barbara	0.00	0.28
Node32	0.89	0	80	11.8	1.26	Santa Barbara	0.00	0.41
Node32	1.40	100	98	5	1.26	Santa Barbara	0.00	1.64
Node33	0.21	0	91	6.1	1.26	Santa Barbara	0.00	0.20
Node33	0.29	100	98	5	1.26	Santa Barbara	0.00	0.34

XP-SWMM RUNOFF DATA
Frog Pond Ridge
Proposed Conditions - SW Stafford Road

SCS Type IA 25-Year Storm Event							
XP-SWMM Input Data					XP-SWMM Output Data		
Node Name	Total Area (ac)	Impervious %	Curve Number	Tc (min)	Max. Rainfall Intensity (in/hr)	Unit Hydrograph Method	Surface Runoff Flow (cfs)
Node1	1.97	0	71	41	1.26	Santa Barbara	0.27
Node1	0.67	100	98	5	1.26	Santa Barbara	0.79
Node1	2.09	0	80	13.1	1.26	Santa Barbara	0.93
Node1	3.71	100	98	5	1.26	Santa Barbara	4.35
Node2	0.95	0	80	5	1.26	Santa Barbara	0.55
Node2	0.11	100	98	5	1.26	Santa Barbara	0.13
Node3	2.83	0	71	58.1	1.26	Santa Barbara	0.33
Node3	0.54	100	98	5	1.26	Santa Barbara	0.63
Node10	0.33	0	91	7.8	1.26	Santa Barbara	0.29
Node10	0.17	100	98	5	1.26	Santa Barbara	0.20
Node12	2.04	0	80	21.1	1.26	Santa Barbara	0.74
Node12	0.37	100	98	5	1.26	Santa Barbara	0.43
Node13	33.40	0	82	40.3	1.26	Santa Barbara	10.36
Node13	1.62	100	98	5	1.26	Santa Barbara	1.90
Node14	0.18	0	91	5	1.26	Santa Barbara	0.17
Node14	0.08	100	98	5	1.26	Santa Barbara	0.09
Node14	0.37	100	98	5	1.26	Santa Barbara	0.43
Node34	0.90	0	80	5	1.26	Santa Barbara	0.52
Node34	1.68	100	98	5	1.26	Santa Barbara	1.97
Node32	0.89	0	80	11.8	1.26	Santa Barbara	0.41
Node32	1.40	100	98	5	1.26	Santa Barbara	1.64
Node33	0.21	0	91	6.1	1.26	Santa Barbara	0.20
Node33	0.29	100	98	5	1.26	Santa Barbara	0.34

XP-SWMM RUNOFF DATA

Frog Pond Ridge

Full Buildout Conditions - SW Stafford Road

SCS Type IA 25-Year Storm Event							
XP-SWMM Input Data					XP-SWMM Output Data		
Node Name	Total Area (ac)	Impervious %	Curve Number	Tc (min)	Max. Rainfall Intensity (in/hr)	Unit Hydrograph Method	Surface Runoff Flow (cfs)
Node1	0.92	0	80	5	1.26	Santa Barbara	0.53
Node1	1.72	100	98	5	1.26	Santa Barbara	2.02
Node1	2.09	0	80	13.1	1.26	Santa Barbara	0.93
Node1	3.71	100	98	5	1.26	Santa Barbara	4.35
Node2	0.95	0	80	19	1.26	Santa Barbara	0.36
Node2	0.11	100	98	5	1.26	Santa Barbara	0.13
Node3	1.18	0	80	5	1.26	Santa Barbara	0.68
Node3	2.20	100	98	5	1.26	Santa Barbara	2.58
Node10	0.33	0	91	5	1.26	Santa Barbara	0.32
Node10	0.17	100	98	5	1.26	Santa Barbara	0.20
Node12	0.94	0	80	5	1.26	Santa Barbara	0.54
Node12	1.47	100	98	5	1.26	Santa Barbara	1.72
Node13	12.26	0	80	13.4	1.26	Santa Barbara	5.39
Node13	22.76	100	98	5	1.26	Santa Barbara	26.70
Node14	0.18	0	91	5	1.26	Santa Barbara	0.17
Node14	0.08	100	98	5	1.26	Santa Barbara	0.09
Node14	0.37	100	98	5	1.26	Santa Barbara	0.43
Node34	0.90	0	80	5	1.26	Santa Barbara	0.52
Node34	1.68	100	98	5	1.26	Santa Barbara	1.97
Node32	0.89	0	80	11.8	1.26	Santa Barbara	0.41
Node32	1.40	100	98	5	1.26	Santa Barbara	1.64
Node33	0.21	0	91	5	1.26	Santa Barbara	0.20
Node33	0.29	100	98	5	1.26	Santa Barbara	0.34

Ridge

XP-SWMM HYDRAULICS DATA

Frog Pond Ridge

Existing Conditions - SW Stafford Road

SCS Type IA 25-Year Storm Event

Link Name	Location		Conduit Properties				Conduit Profile						Conduit Results							
	Node Limits		Type	Diameter	Length	Slope	Ground Elevation (ft)		Invert Elevation (ft)		Max. HGL Elevation (ft)		Freeboard (ft)		Design Flow (cfs)	Max. Flow (cfs)	Max. Velocity (ft/s)	Max. Depth (ft)	y/d0	
	From	To					US	DS	US	DS	US	DS	US	DS						US
Link250	Node1	Node2	Channel	18	1.50	45.00	2.3	231.60	231.00	228.90	227.85	229.08	228.90	2.52	2.10	51.36	1.02	3.56	6.40	0.70
Link251	Node2	Node3	Pipe	15	1.25	39.70	1.4	231.00	231.00	228.18	227.63	228.90	228.21	2.10	2.79	7.60	1.83	3.36	6.20	0.58
Link263	Node2	Node20	Channel	24	2.00	17.00	2.3	231.00	230.90	227.85	227.46	228.90	228.90	2.10	2.00	96.53	1.54	0.42	7.43	0.72
Link252	Node3	Node4	Channel	30	2.50	40.00	0.8	231.00	230.28	227.63	227.31	228.21	227.61	2.79	2.67	63.70	2.67	1.80	3.92	0.23
Link253	Node4	Node5	Channel	12	1.00	52.00	0.8	230.28	230.20	227.31	226.91	227.61	227.45	2.67	2.75	29.93	2.66	1.17	3.15	0.54
Link254	Node5	Node6	Channel	30	2.50	208.00	0.7	230.20	229.00	226.91	225.45	227.45	225.75	3.26	3.26	100.76	2.59	1.62	4.48	0.22
Link281	Node6	Node7	Channel	18	1.50	78.00	0.8	229.00	227.80	225.42	224.80	225.75	225.18	3.26	2.62	65.25	2.59	2.05	4.99	0.25
Link256	Node8	Node9	Channel	24	2.00	50.00	2.0	226.90	225.90	224.90	223.90	225.14	224.32	1.76	1.58	173.03	2.59	2.66	9.61	0.21
Link257	Node9	Node10	Channel	18	1.50	277.00	1.3	225.90	222.75	223.90	220.22	224.32	221.01	1.58	1.74	43.20	2.58	2.85	6.06	0.53
Link258	Node10	Node11	Pipe	12	1.00	24.00	8.8	222.75	222.38	217.97	215.87	221.01	220.87	1.74	1.51	10.54	2.88	7.89	13.42	5.00
Link259	Node11	Node12	Pipe	12	1.00	192.00	1.2	222.38	219.64	215.67	213.34	220.87	213.65	1.51	5.99	3.92	6.69	8.32	5.00	5.20
Link260	Node12	Node13	Pipe	18	1.50	250.00	2.4	219.64	210.50	207.00	206.85	213.65	208.64	1.86	2.15	17.52	19.67	7.17	5.58	0.82
Link261	Node13	Node14	Pipe	24	2.00	25.00	0.5	210.50	210.40	207.00	206.85	208.64	208.25	1.86	2.15	17.52	19.67	7.17	5.58	0.82
Link262	Node14	Node15	Channel	18	1.50	50.00	0.5	210.40	208.50	206.80	206.55	208.25	207.46	2.15	1.04	23.99	20.26	2.28	1.20	0.97
Link264	Node20	Node21	Pipe	12	1.00	28.30	-1.4	230.90	230.70	227.46	227.86	228.78	228.78	2.00	1.92	4.24	1.51	1.93	5.39	1.32
Link265	Node21	Node22	Channel	18	1.50	59.00	0.1	230.70	230.30	227.86	227.82	228.78	228.77	1.92	1.53	7.77	1.47	0.50	1.06	0.63
Link266	Node22	Node23	Pipe	12	1.00	28.00	0.8	230.30	230.20	227.82	227.61	228.77	228.73	1.53	1.47	3.09	1.45	1.88	3.93	1.12
Link267	Node23	Node24	Channel	18	1.50	42.00	-0.7	230.20	229.90	227.90	227.90	228.73	228.72	1.47	1.18	25.84	2.27	0.50	3.45	0.75
Link268	Node24	Node25	Pipe	12	1.00	21.50	-0.4	229.90	229.90	227.63	227.72	228.72	228.43	1.18	1.47	2.31	2.26	2.85	2.93	1.00
Link269	Node25	Node26	Channel	18	1.50	150.50	0.9	229.90	228.30	227.96	226.59	228.43	227.38	1.47	0.92	25.45	2.26	1.80	3.77	0.52
Link270	Node26	Node27	Pipe	12	1.00	24.00	2.5	228.30	227.80	226.40	225.81	227.38	227.08	0.92	0.72	5.59	2.25	3.50	7.11	1.27
Link271	Node27	Node28	Channel	24	2.00	25.00	3.1	227.80	227.60	225.80	225.03	227.08	227.08	1.47	0.52	98.99	2.24	2.03	9.00	1.00
Link272	Node28	Node29	Pipe	8	0.67	50.00	1.1	227.60	226.90	225.03	224.48	227.08	224.77	0.52	2.13	1.28	1.97	5.54	3.64	3.06
Link273	Node29	Node30	Channel	24	2.00	35.00	2.5	226.90	226.00	224.48	223.60	224.77	224.21	2.13	1.80	100.22	2.24	2.55	8.35	0.30
Link274	Node30	Node31	Pipe	12	1.00	42.50	2.1	226.00	226.58	223.60	222.72	224.21	223.25	1.80	3.33	5.13	2.24	4.58	6.53	0.61
Link275	Node31	Node34	Channel	30	2.50	167.80	1.0	226.58	224.86	222.72	221.00	223.25	221.57	3.33	3.29	66.23	2.24	2.34	5.58	0.23
Link277	Node32	Node33	Channel	30	2.50	13.00	0.8	223.30	223.11	220.22	220.11	221.26	221.25	2.04	1.86	78.52	3.68	2.70	5.23	0.46
Link278	Node33	Node11	Pipe	12	1.00	34.00	1.3	223.11	222.38	216.31	215.87	221.25	220.87	1.86	1.51	4.05	4.10	5.43	5.16	5.00
Link255	Node7	Node8	Channel	30	2.50	57.00	1.2	227.80	226.90	224.80	224.10	225.18	225.14	2.92	1.76	165.65	2.59	1.52	8.55	0.42
Link276	Node34	Node32	Channel	30	2.50	72.20	1.0	224.86	223.30	221.00	220.26	221.57	221.26	3.29	2.04	66.22	2.25	2.33	5.58	0.40

XP-SWMM HYDRAULICS DATA
Frog Pond Meadows
Proposed Conditions - SW Stafford Road

SCS Type IA 25-Year Storm Event

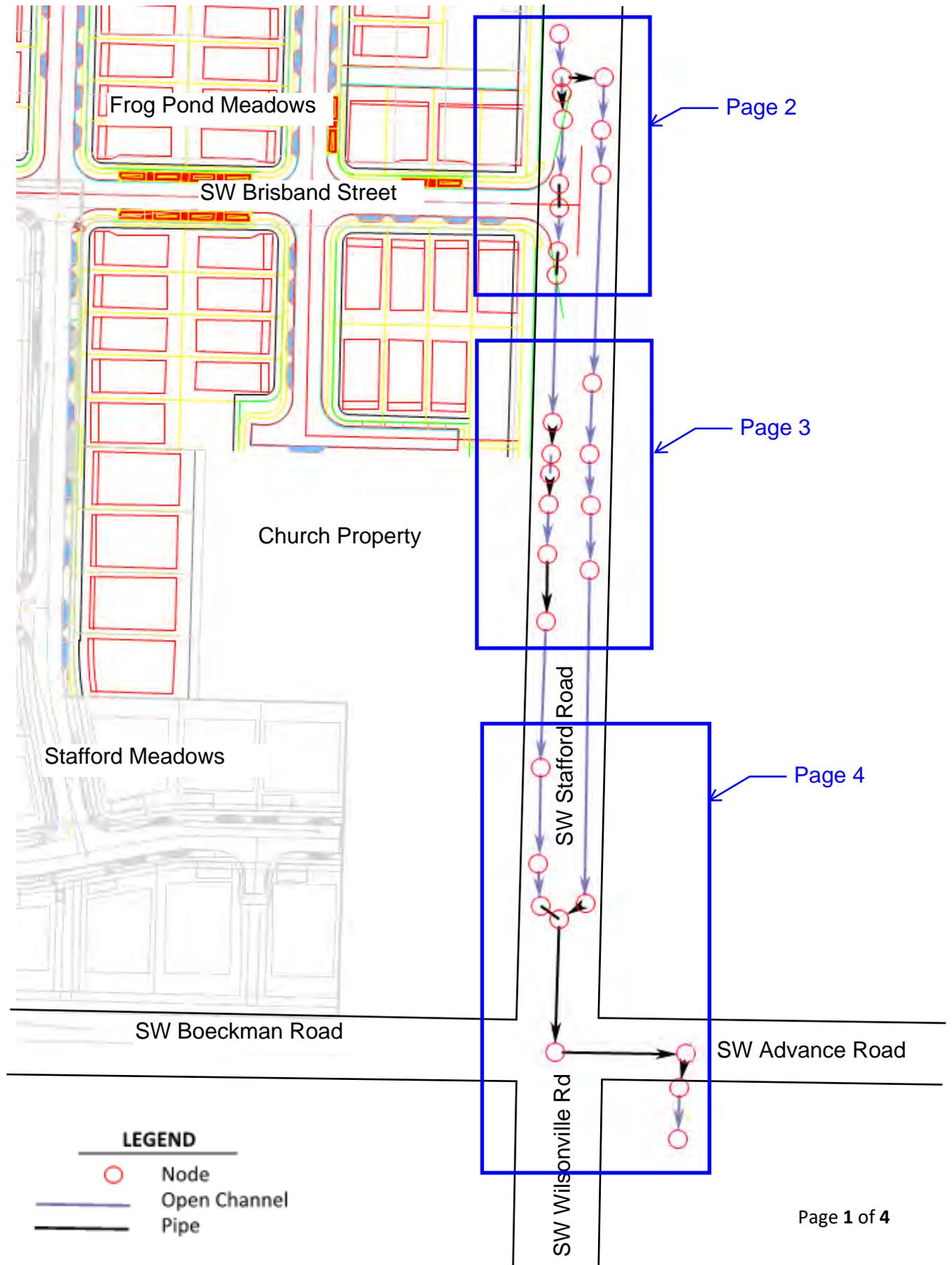
Link Name	Location		Conduit Properties					Conduit Profile						Conduit Results						
	Node Limits		Type	Diameter	Length	Slope	Ground Elevation (ft)		Invert Elevation (ft)		Max. HGL Elevation (ft)		Freeboard (ft)		Design Flow (cfs)	Max. Flow (cfs)	Max. Velocity (ft/s)	Max. Depth (ft)	y/d0	
	From	To					US	DS	US	DS	US	DS	US	DS						
Link250	Node1	Node2	Pipe	18	1.50	45.00	2.3	231.60	231.00	228.90	227.85	230.99	230.00	1.61	1.00	51.36	6.16	3.38	2.15	1.43
Link251	Node2	Node3	Pipe	15	1.25	39.70	1.4	231.00	231.00	228.18	227.63	229.00	228.57	1.00	2.43	7.60	6.76	5.60	1.82	1.45
Link252	Node3	Node4	Pipe	30	2.50	40.00	0.8	231.00	230.28	227.63	227.31	228.57	227.90	2.43	2.38	63.70	7.64	2.49	0.94	0.38
Link253	Node4	Node5	Pipe	12	1.00	52.00	0.8	230.28	230.20	227.31	226.91	227.90	227.78	2.38	2.42	29.93	7.62	1.51	0.87	0.87
Link254	Node5	Node6	Pipe	30	2.50	208.00	0.7	230.20	229.00	226.91	225.45	227.78	225.98	2.42	3.02	100.76	7.50	2.19	0.87	0.35
Link281	Node6	Node7	Pipe	18	1.50	78.00	0.8	229.00	227.80	225.42	224.80	225.98	225.43	3.02	2.37	65.25	7.50	2.76	0.63	0.42
Link256	Node8	Node9	Pipe	24	2.00	50.00	2.0	226.90	225.90	224.90	223.90	225.33	224.60	1.57	1.30	173.03	7.49	3.71	0.70	0.35
Link257	Node9	Node10	Pipe	18	1.50	277.00	1.3	225.90	222.75	223.90	220.22	224.60	222.95	1.30	-0.20	43.20	7.45	3.23	2.73	1.00
Link258	Node10	Node11	Pipe	12	1.00	24.00	8.8	222.75	222.38	217.97	215.87	222.95	222.49	-0.20	-0.11	10.54	5.44	10.03	6.62	6.62
Link259	Node11	Node12	Pipe	12	1.00	192.00	1.2	222.38	219.64	215.67	213.34	222.49	213.68	-0.11	5.96	3.92	7.53	9.28	6.82	6.82
Link260	Node12	Node13	Pipe	18	1.50	250.00	2.4	219.64	210.50	212.90	207.00	213.68	208.67	5.96	1.84	16.14	8.60	8.44	1.67	1.11
Link261	Node13	Node14	Pipe	24	2.00	25.00	0.5	210.50	210.40	207.00	206.85	208.67	208.26	1.84	2.14	17.52	20.29	7.28	1.67	0.83
Link262	Node14	Node15	Pipe	18	1.50	50.00	0.5	210.40	208.50	206.80	206.55	208.26	207.47	2.14	1.03	23.99	20.90	2.28	1.46	0.97
Link270	Node26	Node27	Pipe	12	1.00	24.00	2.5	228.30	227.80	226.40	225.81	226.00	221.80	2.30	6.00	5.59	0.00	0.00	0.00	0.00
Link276	Node34	Node32	Pipe	30	2.50	72.20	1.0	224.86	223.30	221.00	220.26	222.72	222.72	2.14	0.58	66.22	1.71	2.05	2.46	0.99
Link272	Node28	Node29	Pipe	8	0.67	50.00	1.1	227.60	226.90	225.03	224.48	225.00	224.40	2.60	2.50	1.28	0.00	0.00	0.00	0.00
Link272	Node28	Node29	Pipe	0	0.00	0.00	0.0	227.60	226.90	0.00	0.00	225.00	224.40	2.60	2.50	0.00	0.00	0.00	0.00	0.00
Link273	Node29	Node30	Pipe	24	2.00	35.00	2.5	226.90	226.00	224.48	223.60	224.40	223.60	2.50	2.40	100.22	0.00	0.00	0.00	0.00
Link274	Node30	Node31	Pipe	12	1.00	42.50	2.1	226.00	226.58	223.60	222.72	223.60	222.63	2.40	3.95	5.13	0.00	0.00	0.00	0.00
Link275	Node31	Node34	Pipe	30	2.50	167.80	1.0	226.58	224.86	222.72	221.00	222.63	222.72	3.95	2.14	66.23	-0.01	-0.01	1.72	0.69
Link277	Node32	Node33	Pipe	30	2.50	13.00	0.8	223.30	223.11	220.22	220.11	222.72	222.72	0.58	0.39	78.52	3.13	2.45	2.61	1.00
Link278	Node33	Node11	Pipe	12	1.00	34.00	1.3	223.11	222.38	216.31	215.87	222.72	222.49	0.39	-0.11	4.05	3.51	4.32	6.62	6.62
Link271	Node27	Node28	Pipe	24	2.00	25.00	3.1	227.80	227.60	225.80	225.03	221.80	225.00	6.00	2.60	98.99	0.00	0.00	0.00	0.00

XP-SWMM HYDRAULICS DATA
Frog Pond Ridge
Full Buildout Conditions - SW Stafford Road

Location			Conduit Properties					Conduit Profile						Conduit Results							
			Node Limits		Type	Diameter		Length	Slope	Ground Elevation (ft)		Invert Elevation (ft)		Max. HGL Elevation (ft)		Freeboard (ft)		Design Flow	Max. Flow	Max. Velocity	Max. Depth
Link Name	From	To	in	ft	ft	%	US	DS	US	DS	US	DS	US	DS	US	DS	(cfs)	(cfs)	(ft/s)	(ft)	
Link250	Node1	Node2	18	1.50	45.00	2.3	231.60	231.00	228.90	227.85	230.37	230.38	1.23	0.82	51.36	7.61	3.22	2.53	1.69		
Link251	Node2	Node3	15	1.25	39.70	1.4	231.00	231.00	228.18	227.63	230.38	228.75	0.82	2.25	7.60	7.99	6.52	2.20	1.76		
Link252	Node3	Node4	30	2.50	40.00	0.8	231.00	230.28	227.63	227.31	228.75	228.05	2.25	2.23	63.70	11.16	2.78	1.12	0.45		
Link253	Node4	Node5	12	1.00	52.00	0.8	230.28	230.20	227.31	226.91	228.05	227.94	2.23	2.26	29.93	11.13	1.67	1.03	1.00		
Link254	Node5	Node6	30	2.50	208.00	0.7	230.20	229.00	226.91	225.45	227.94	226.09	2.26	2.91	100.76	10.99	2.44	1.03	0.41		
Link281	Node6	Node7	18	1.50	78.00	0.8	229.00	227.80	225.42	224.80	226.09	225.55	2.91	2.25	65.25	10.99	3.04	0.75	0.50		
Link256	Node8	Node9	24	2.00	50.00	2.0	226.90	225.90	224.90	223.90	225.44	224.73	1.47	1.17	173.03	10.98	4.11	0.83	0.42		
Link257	Node9	Node10	18	1.50	277.00	1.3	225.90	222.75	223.90	220.22	224.73	223.29	1.17	-0.54	43.20	10.93	3.33	3.07	1.00		
Link258	Node10	Node11	12	1.00	24.00	8.8	222.75	222.38	217.97	215.87	223.29	222.69	-0.54	5.82	10.54	5.97	10.20	6.82	6.82		
Link259	Node11	Node12	12	1.00	192.00	1.2	222.38	219.64	215.67	213.34	222.69	213.82	-0.31	5.82	3.92	7.63	9.39	7.02	7.02		
Link260	Node12	Node13	18	1.50	250.00	2.4	219.64	210.50	212.90	207.00	213.82	209.70	5.82	0.80	16.14	9.76	8.42	2.70	1.80		
Link261	Node13	Node14	24	2.00	25.00	0.5	210.50	210.40	207.00	206.85	209.70	208.42	0.80	1.98	17.52	41.79	13.27	2.70	1.35		
Link262	Node14	Node15	18	1.50	50.00	0.5	210.40	208.50	206.80	206.55	208.42	207.62	1.98	0.88	23.99	42.34	2.28	1.62	1.08		
Link269	Node25	Node26	18	1.50	150.50	0.9	229.90	228.30	227.96	226.59	227.60	226.00	2.30	2.30	25.45	0.00	0.00	0.00	0.00		
Link270	Node26	Node27	12	1.00	24.00	2.5	228.30	227.80	226.40	225.81	226.00	221.80	2.30	6.00	5.59	0.00	0.00	0.00	0.00		
Link276	Node34	Node32	30	2.50	72.20	1.0	224.86	223.30	221.00	220.26	222.86	222.86	2.00	0.44	66.22	1.86	1.95	2.60	1.00		
Link272	Node28	Node29	8	0.67	50.00	1.1	227.60	226.90	225.03	224.48	225.00	224.40	2.60	2.50	1.28	0.00	0.00	0.00	0.00		
Link272	Node28	Node29	0	0.00	0.00	0.0	227.60	226.90	0.00	0.00	225.00	224.40	2.60	2.50	0.00	0.00	0.00	0.00	0.00		
Link273	Node29	Node30	24	2.00	35.00	2.5	226.90	226.00	224.48	223.60	224.40	223.60	2.50	2.40	100.22	0.00	0.00	0.00	0.00		
Link274	Node30	Node31	12	1.00	42.50	2.1	226.00	226.58	223.60	222.72	223.60	222.86	2.40	3.72	5.13	0.00	0.00	0.14	0.00		
Link275	Node31	Node34	30	2.50	167.80	1.0	226.58	224.86	222.72	221.00	222.86	222.86	3.72	2.00	66.23	-0.17	-0.09	1.86	0.74		
Link277	Node32	Node33	30	2.50	13.00	0.8	223.30	223.11	220.22	220.11	222.86	222.86	0.44	0.25	78.52	3.51	2.32	2.75	1.00		
Link278	Node33	Node11	12	1.00	34.00	1.3	223.11	222.38	216.31	215.87	222.86	222.69	0.25	-0.31	4.05	3.93	4.83	6.82	6.82		
Link271	Node27	Node28	24	2.00	25.00	3.1	227.80	227.60	225.80	225.03	221.80	225.00	6.00	2.60	98.99	0.00	0.00	0.00	0.00		

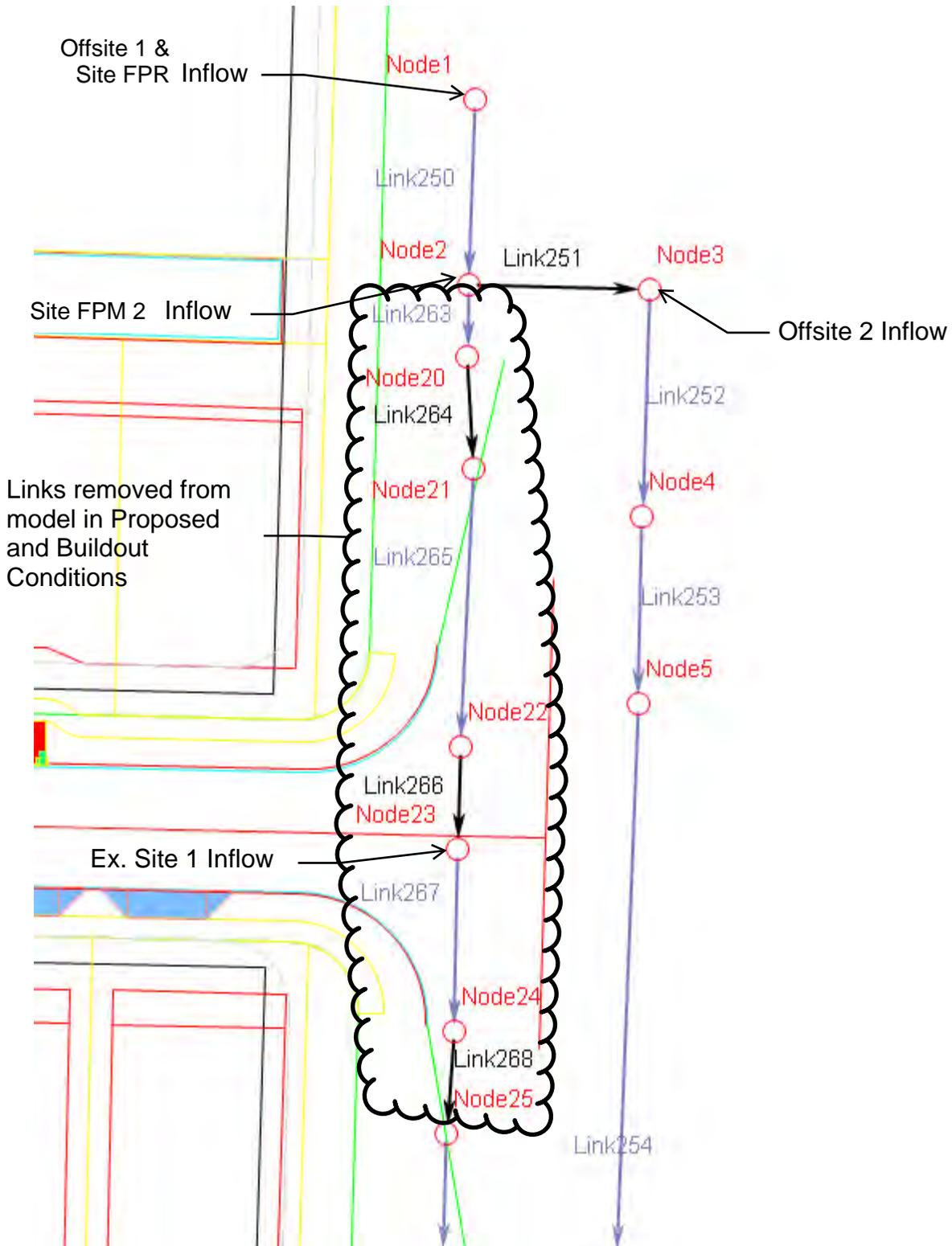
XP-SWMM Layout

Frog Pond Ridge – SW Stafford Road Downstream Analysis



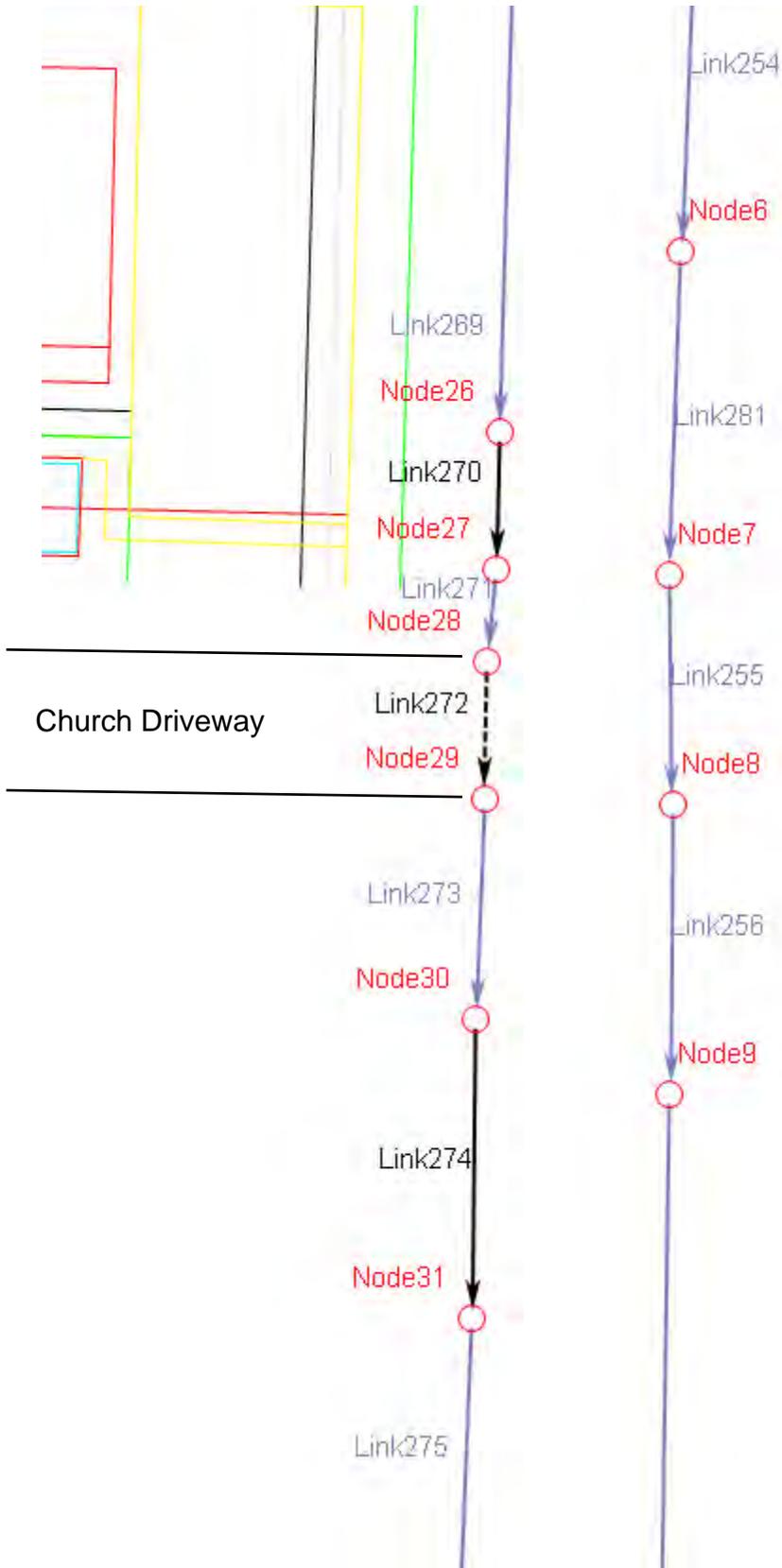
XP-SWMM Layout

Frog Pond Ridge – SW Stafford Road Downstream Analysis



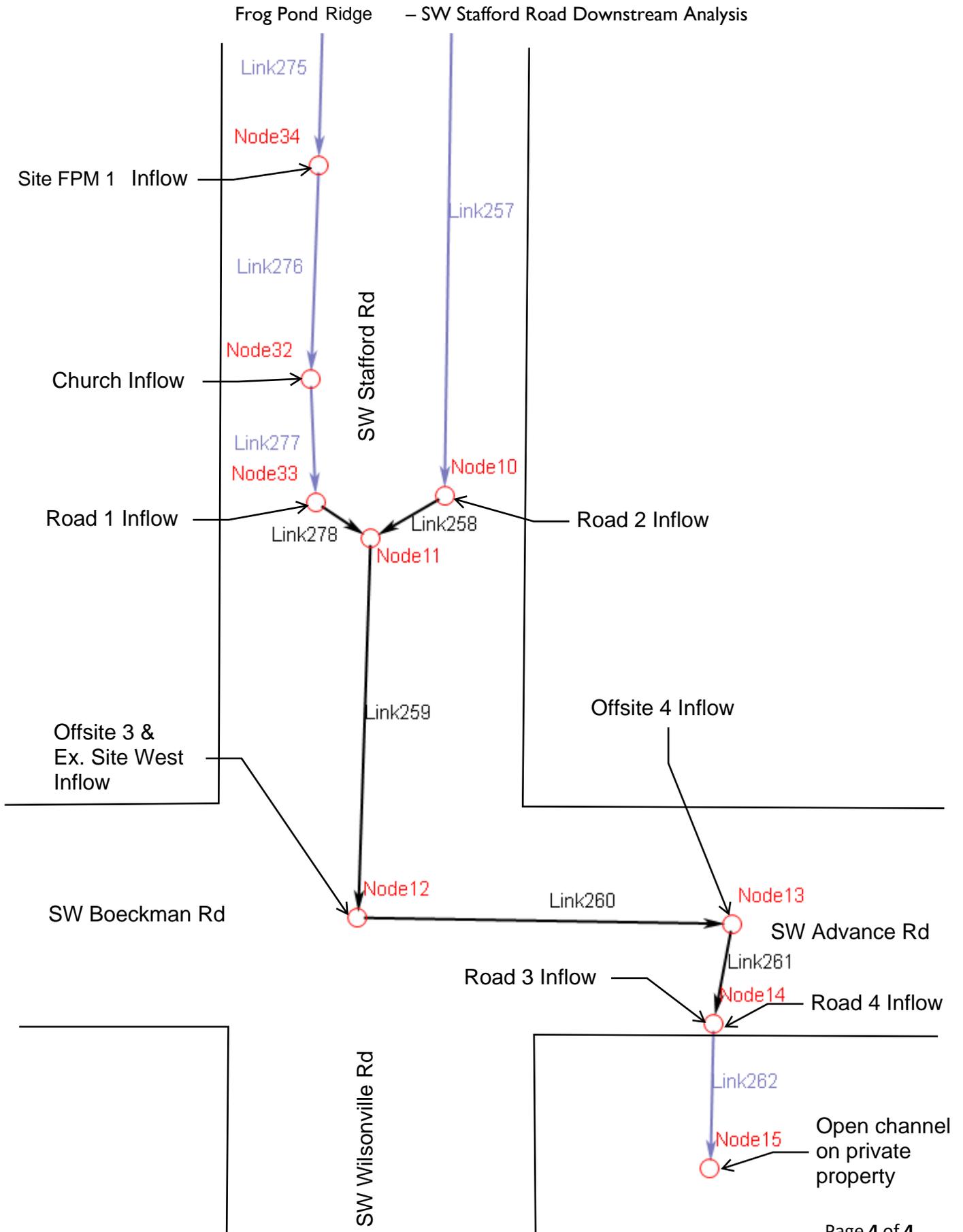
XP-SWMM Layout

Frog Pond Ridge – SW Stafford Road Downstream Analysis



XP-SWMM Layout

- SW Stafford Road Downstream Analysis



Appendix D
BMP Sizing Tool Analysis

Summary for Subcatchment 32S: Total Impervious Treated

Runoff = 2.77 cfs @ 7.91 hrs, Volume= 0.891 af, Depth= 1.03"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
 Type IA 24-hr WQ Rainfall=1.25"

Area (sf)	CN	Description
450,270	98	Paved parking, HSG D
450,270	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

WES BMP Sizing Report

Project Information

Project Name	Frog Pond Ridge
Project Type	Subdivision
Location	27657 SW Stafford Rd
Stormwater Management Area	23310
Project Applicant	
Jurisdiction	CCSD1NCSA

Drainage Management Area

Name	Area (sq-ft)	Pre-Project Cover	Post-Project Cover	DMA Soil Type	BMP
E1 - imp	1,198	Forested	ConventionalConcrete	D	E1
E1 - perv	3,487	Forested	LandscapeSoil	D	E1
E2 - imp	5,305	Forested	ConventionalConcrete	D	E2
E2 - perv	9,006	Forested	LandscapeSoil	D	E2
E3 - imp	2,435	Forested	ConventionalConcrete	D	E3
E3 - perv	6,981	Forested	LandscapeSoil	D	E3
E4 - imp	2,234	Forested	ConventionalConcrete	D	E4
E4 - perv	7,403	Forested	LandscapeSoil	D	E4
E5 - imp	2,464	Forested	ConventionalConcrete	D	E5
E5 - perv	6,962	Forested	LandscapeSoil	D	E5
E9a, E9b - imp	6,276	Forested	ConventionalConcrete	D	Stafford Meadows Pond
E9a, E9b - perv	792	Forested	LandscapeSoil	D	Stafford Meadows Pond
E16b - imp	3,050	Forested	ConventionalConcrete	D	E16b
E16b - perv	6,280	Forested	LandscapeSoil	D	E16b
E16a - imp	7,739	Forested	ConventionalConcrete	D	E16a
E16a - perv	2,421	Forested	LandscapeSoil	D	E16a
E16 - imp	5,644	Forested	LandscapeSoil	D	E16
E16 - perv	2,048	Forested	LandscapeSoil	D	E16

P4, P5 - perv	9,137	Grass	LandscapeDsoil	D	Stafford Meadows Pond
E13 - imp	3,631	Forested	ConventionalConcrete	D	E13
E13 - perv	1,432	Forested	LandscapeDsoil	D	E13
E12 - imp	7,719	Forested	ConventionalConcrete	D	E12
E12 - pervious	3,204	Forested	LandscapeDsoil	D	E12
E12a - imp	6,100	Forested	ConventionalConcrete	D	E12a
E12a - perv	11,160	Forested	LandscapeDsoil	D	E12a
E15 - imp	7,157	Forested	ConventionalConcrete	D	E15
E15 - perv	661	Forested	LandscapeDsoil	D	E15
E10 - imp	4,762	Forested	ConventionalConcrete	D	E10
E10 - perv	7,543	Forested	LandscapeDsoil	D	E10
E8 - imp	3,329	Forested	ConventionalConcrete	D	E8
E8 - perv	7,042	Forested	LandscapeDsoil	D	E8
E5a - imp	1,908	Forested	ConventionalConcrete	D	E5a
E5a - perv	467	Forested	LandscapeDsoil	D	E5a
E2b - imp	2,191	Forested	ConventionalConcrete	D	Stafford Meadows Pond
E2b - perv	385	Forested	LandscapeDsoil	D	Stafford Meadows Pond
E2a - imp	3,408	Forested	ConventionalConcrete	D	Stafford Meadows Pond
E2a - perv	797	Forested	LandscapeDsoil	D	Stafford Meadows Pond
E1a, E1b - imp	4,339	Forested	ConventionalConcrete	D	Stafford Meadows Pond
E1a, E1b - perv	1,247	Forested	LandscapeDsoil	D	Stafford Meadows Pond
E6 - imp	2,742	Forested	ConventionalConcrete	D	E6
E6 - perv	7,134	Forested	LandscapeDsoil	D	E6
E7 - imp	2,347	Forested	ConventionalConcrete	D	E7
E7 - perv	7,447	Forested	LandscapeDsoil	D	E7
E9 - imp	1,907	Forested	ConventionalConcrete	D	E9
E9 - perv	3,827	Forested	LandscapeDsoil	D	E9

E30a, E30b, E31 - imp	8,189	Forested	Roofs	D	Stafford Meadows Pond
E30a, E30b, E31 - perv	2,548	Forested	LandscapeDsoil	D	Stafford Meadows Pond
E31a - imp	3,050	Forested	Roofs	D	E31a
E31a - perv	5,679	Forested	LandscapeDsoil	D	E31a
E32a - imp	3,050	Forested	Roofs	D	E32a
E32a - perv	9,321	Forested	LandscapeDsoil	D	E32a
E33 - imp	3,856	Forested	Roofs	D	E33
E33 -perv	1,396	Forested	LandscapeDsoil	D	E33
E33a - imp	806	Forested	Roofs	D	E33
E33a -perv	1,269	Forested	LandscapeDsoil	D	E33
E34 - imp	5,660	Forested	Roofs	D	E34
E34 - perv	1,633	Forested	LandscapeDsoil	D	E34
E35 - imp	6,951	Forested	ConventionalCo ncrete	D	E35
E35 - perv	1,135	Forested	LandscapeDsoil	D	E35
E35a - imp	3,050	Forested	Roofs	D	E35a
E35a - per	5,397	Forested	LandscapeDsoil	D	E35a
E35b - imp	889	Forested	LandscapeDsoil	D	E35b
E35b - perv	1,829	Forested	LandscapeDsoil	D	E35b
E36a - imp	3,050	Forested	Roofs	D	E36a
E36a - perv	5,758	Forested	LandscapeDsoil	D	E36a
E36b - imp	3,050	Forested	Roofs	D	E36b
E36b - perv	8,041	Forested	LandscapeDsoil	D	E36b
E38 - imp	4,062	Forested	Roofs	D	E38
E38 - perv	1,432	Forested	LandscapeDsoil	D	E38
E38a - imp	3,050	Forested	Roofs	D	E38a
E38a - perv	7,066	Forested	LandscapeDsoil	D	E38a
E39 - imp	3,813	Forested	ConventionalCo ncrete	D	E39
E39 - perv	1,134	Forested	LandscapeDsoil	D	E39
E39a - imp	3,050	Forested	Roofs	D	E39a
E39a - perv	5,178	Forested	LandscapeDsoil	D	E39a
E34a - imp	3,050	Forested	ConventionalCo ncrete	D	E34a
E34a- perv	6,711	Forested	LandscapeDsoil	D	E34a
E37 - imp	2,708	Forested	ConventionalCo ncrete	D	E37
E37 - perv	788	Forested	LandscapeDsoil	D	E37
E16c - imp	3,050	Forested	Roofs	D	E16c

E16c - perv	6,600	Forested	LandscapeDsoil	D	E16c
E30c - imp	1,355	Forested	ConventionalConcrete	D	E30c
E30c - perv	265	Forested	LandscapeDsoil	D	E30c
E32 - imp	2,246	Forested	ConventionalConcrete	D	E32
E32 - perv	532	Forested	LandscapeDsoil	D	E32
E31b - imp	3,050	Forested	Roofs	D	E31b
E31b - perv	5,022	Forested	LandscapeDsoil	D	E31b
E32b - imp	3,050	Forested	Roofs	D	E32b
E32b - perv	5,417	Forested	LandscapeDsoil	D	E32b
E13a - imp	3,050	Forested	Roofs	D	E13a
E13a - perv	8,869	Forested	LandscapeDsoil	D	E13a
E38b - imp	3,050	Forested	Roofs	D	E38b
E38b - perv	5,926	Forested	LandscapeDsoil	D	E38b
E33b - imp	3,050	Forested	Roofs	D	E33b
E33b - perv	5,825	Forested	LandscapeDsoil	D	E33b
p11, p12, p13 - perv	7,457	Grass	LandscapeDsoil	D	Stafford Meadows Pond
p11, p12, p13 - imp	12,320	Grass	Roofs	D	Stafford Meadows Pond
p6, P7 - perv	2,291	Grass	LandscapeDsoil	D	Stafford Meadows Pond
p6, p7 - imp	7,447	Grass	ConventionalConcrete	D	Stafford Meadows Pond
p50, p51- perv	23,602	Grass	LandscapeDsoil	D	Stafford Meadows Pond
p50, p51 - imp	20,684	Grass	Roofs	D	Stafford Meadows Pond
E17 - imp	5,354	Forested	ConventionalConcrete	D	Stafford Meadows Pond
E17 - perv	819	Forested	LandscapeDsoil	D	Stafford Meadows Pond
E9c - imp	1,456	Forested	ConventionalConcrete	D	E9c
E9c - perv	298	Forested	LandscapeDsoil	D	E9c
P23 - imp	7,117	Grass	ConventionalConcrete	D	Stafford Meadows Pond
E1c - imp	3,053	Forested	ConventionalConcrete	D	Stafford Meadows Pond
E1c - perv	481	Forested	LandscapeDsoil	D	Stafford Meadows Pond
E1c - imp	3,036	Forested	ConventionalConcrete	D	Stafford Meadows Pond

E1c - perv	498	Forested	LandscapeDsoil	D	Stafford Meadows Pond
p10 - imp	5,910	Grass	ConventionalConcrete	D	p10
p10 - perv	3,943	Grass	LandscapeDsoil	D	p10
p1, p2 - imp	6,289	Grass	ConventionalConcrete	D	Stafford Meadows Pond
p1, p2 - perv	3,147	Grass	LandscapeDsoil	D	Stafford Meadows Pond
p25 - imp	3,815	Grass	ConventionalConcrete	D	p25
p25 - perv	1,363	Grass	LandscapeDsoil	D	p25
p26 - imp	6,271	Grass	ConventionalConcrete	D	p26
p26 - perv	2,682	Grass	LandscapeDsoil	D	p26
P 62 - Per	4,472	Grass	LandscapeDsoil	D	Swale P 62
P 62 - Imp	6,369	Grass	ConventionalConcrete	D	Swale P 62
P 61 - Per	1,210	Grass	LandscapeDsoil	D	Swale P61
P 61 - Imp	6,150	Grass	ConventionalConcrete	D	Swale P61
P to K- imp	65,084	Grass	ConventionalConcrete	D	Tract K RG
P to K - perv	55,716	Grass	LandscapeDsoil	D	Tract K RG
P to I - imp	137,406	Grass	ConventionalConcrete	D	Tract I RG
P to I - perv	78,293	Grass	LandscapeDsoil	D	Tract I RG
P60 - Per	31,926	Grass	LandscapeDsoil	D	Tract C RG
P 60 - Imp	63,912	Grass	ConventionalConcrete	D	Tract C RG
P51- imp	22,773	Grass	Roofs	D	Stafford Meadows Pond
P51 - perv	23,259	Grass	LandscapeDsoil	D	Stafford Meadows Pond
E0- imp	49,500	Forested	Roofs	D	Stafford Meadows Pond
P9, P57 - imp	7,092	Grass	Roofs	D	Stafford Meadows Pond
P9, p57 -perv	6,148	Grass	LandscapeDsoil	D	Stafford Meadows Pond
P5 - imp	5,500	Grass	Roofs	D	Stafford Meadows Pond
P5 - perv	3,298	Grass	LandscapeDsoil	D	Stafford Meadows Pond
p11 - perv	2,500	Grass	LandscapeDsoil	D	Stafford

					Meadows Pond
LargeLot_Drive way	6,400	Forested	ConventionalConcrete	D	Stafford Meadows Pond
P3 - perv	3,302	Grass	LandscapeDsoil	D	Swale 2
P3 - imp	7,361	Grass	ConventionalConcrete	D	Swale 2
P8 - perv	2,401	Grass	LandscapeDsoil	D	Swale 5
P8 - imp	5,524	Grass	ConventionalConcrete	D	Swale 5
P29 - perv	2,317	Grass	LandscapeDsoil	D	Swale 8
P29 - imp	4,345	Grass	ConventionalConcrete	D	Swale 8
P32 - perv	1,043	Grass	LandscapeDsoil	D	Swale 9
P32 - imp	1,565	Grass	ConventionalConcrete	D	Swale 9
P46 - perv	2,867	Grass	LandscapeDsoil	D	Swale 10
P46 - imp	7,502	Grass	ConventionalConcrete	D	Swale 10
P4, P5, - imp	16,500	Grass	Roofs	D	Stafford Meadows Pond
P 63 - Imp	3,243	Grass	ConventionalConcrete	D	Stafford Meadows Pond
P 63 - per	645	Grass	LandscapeDsoil	D	Stafford Meadows Pond
P 64 - Imp	1,760	Grass	ConventionalConcrete	D	Stafford Meadows Pond
P 65 - Imp	5,592	Grass	ConventionalConcrete	D	Stafford Meadows Pond
P 65 - Per	2,732	Grass	LandscapeDsoil	D	Stafford Meadows Pond
P 66 - Imp	4,817	Grass	ConventionalConcrete	D	Stafford Meadows Pond
P 66 - Per	313	Grass	LandscapeDsoil	D	Stafford Meadows Pond
P 67 - Imp	9,074	Grass	ConventionalConcrete	D	Stafford Meadows Pond
P 67 - Perv	1,146	Grass	LandscapeDsoil	D	Stafford Meadows Pond

LID Facility Sizing Details

LID ID	Design Criteria	BMP Type	Facility Soil Type	Minimum Area (sq-ft)	Planned Areas (sq-ft)	Orifice Diameter (in)
E31a	FlowControlAndTreatment	Rain Garden - Filtration	D1	281.0	282.0	0.9

E32a	FlowControlAndTreatment	Rain Garden - Filtration	D1	383.0	383.0	1.1
E33b	FlowControlAndTreatment	Rain Garden - Filtration	D1	285.1	290.0	0.9
E35a	FlowControlAndTreatment	Rain Garden - Filtration	D1	273.1	278.0	0.9
E36b	FlowControlAndTreatment	Rain Garden - Filtration	D1	347.1	350.0	1.1
E36a	FlowControlAndTreatment	Rain Garden - Filtration	D1	283.2	290.0	0.9
E38b	FlowControlAndTreatment	Rain Garden - Filtration	D1	287.9	290.0	1.0
E38a	FlowControlAndTreatment	Rain Garden - Filtration	D1	319.8	331.0	1.0
E34a	FlowControlAndTreatment	Rain Garden - Filtration	D1	309.9	310.0	1.0
E39a	FlowControlAndTreatment	Rain Garden - Filtration	D1	267.0	267.0	0.9
E16b	FlowControlAndTreatment	Rain Garden - Filtration	D1	297.8	312.0	1.0
E16c	FlowControlAndTreatment	Rain Garden - Filtration	D1	306.8	315.0	1.0
E31b	FlowControlAndTreatment	Rain Garden - Filtration	D1	262.6	270.0	0.9
E32b	FlowControlAndTreatment	Rain Garden - Filtration	D1	273.7	274.0	0.9
E13a	FlowControlAndTreatment	Rain Garden - Filtration	D1	370.3	372.0	1.1
E12a	FlowControlAndTreatment	Rain Garden - Filtration	D1	556.5	560.0	1.3
Tract K RG	WaterQuality	Rain Garden - Filtration	D1	1,561.3	1,978.0	1.6
Tract I RG	WaterQuality	Rain Garden - Filtration	D1	2,883.2	3,160.0	2.2
Tract C RG	WaterQuality	Rain Garden - Filtration	D1	1,293.9	1,640.0	1.5
E35b	FlowControlAndTreatment	Stormwater Planter - Filtration	D1	57.1	68.0	0.6
E2	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	580.5	859.0	1.3
E1	WaterQuality	Vegetated Swale - Filtration	D1	54.6	270.0	0.3
E3	WaterQuality	Vegetated Swale -	D1	109.8	221.0	0.5

		Filtration				
E9	WaterQuality	Vegetated Swale - Filtration	D1	68.8	276.0	0.4
E10	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	502.1	805.0	1.2
E13	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	231.7	235.0	0.8
E12	WaterQuality	Vegetated Swale - Filtration	D1	149.4	239.0	0.6
E37	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	163.0	145.0	0.7
E35	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	387.3	219.0	1.0
E34	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	340.2	419.0	0.9
E33	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	326.4	272.0	1.0
E32	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	130.9	312.0	0.6
E16a	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	471.7	478.0	1.1
E16	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	269.2	325.0	1.0
E6	WaterQuality	Vegetated Swale - Filtration	D1	116.0	221.0	0.5
E7	WaterQuality	Vegetated Swale - Filtration	D1	113.4	221.0	0.5
E39	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	230.3	515.0	0.8
E38	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	253.2	319.0	0.8
E4	WaterQuality	Vegetated Swale - Filtration	D1	111.2	221.0	0.5

E15	WaterQuality	Vegetated Swale - Filtration	D1	114.3	229.0	0.5
E30c	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	77.0	85.0	0.4
E5	WaterQuality	Vegetated Swale - Filtration	D1	110.1	225.0	0.5
E5a	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	111.7	173.0	0.5
E8	WaterQuality	Vegetated Swale - Filtration	D1	123.9	331.0	0.5
E9c	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	83.2	152.0	0.5
p10	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	346.8	517.0	1.1
p25	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	190.8	339.0	0.8
p26	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	325.9	585.0	1.1
Swale P 62	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	380.0	504.0	1.2
Swale P61	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	279.9	352.0	1.0
Swale 2	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	386.9	463.0	1.2
Swale 5	WaterQuality	Vegetated Swale - Filtration	D1	108.1	258.0	0.5
Swale 8	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	238.7	582.0	0.9
Swale 9	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	91.8	215.0	0.6
Swale 10	WaterQuality	Vegetated Swale - Filtration	D1	142.6	325.0	0.5

Pond Sizing Details

Pond ID	Design Criteria(1)	Facility Soil Type	Max Depth (ft)(2)	Top Area (sq-ft)	Side Slope (1:H)	Facility Vol. (cu-ft)(3)	Water Storage Vol. (cu-ft)(4)	Adequate Size?
Stafford Meadows Pond	FCWQT	D1	4.00	9,360.0	4	26,421.3	15,732.9	Yes

1. FCWQT = Flow control and water quality treatment, WQT = Water quality treatment only

2. Depth is measured from the bottom of the facility and includes the three feet of media (drain rock, separation layer and growing media).

3. Maximum volume of the facility. Includes the volume occupied by the media at the bottom of the facility.

4. Maximum water storage volume of the facility. Includes water storage in the three feet of soil media assuming a 40 percent porosity.

Simple Pond Geometry Configuration

Pond ID: Stafford Meadows Pond
 Design: FlowControlAndTreatment

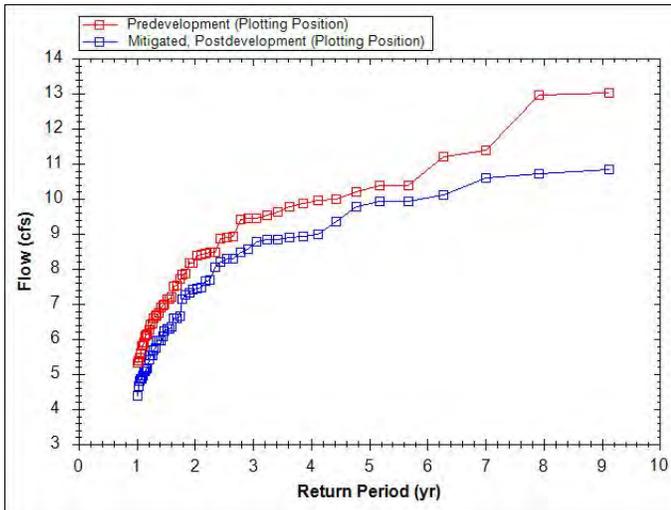
Shape Curve

Depth (ft)	Area (sq ft)
4.0	9,360.0

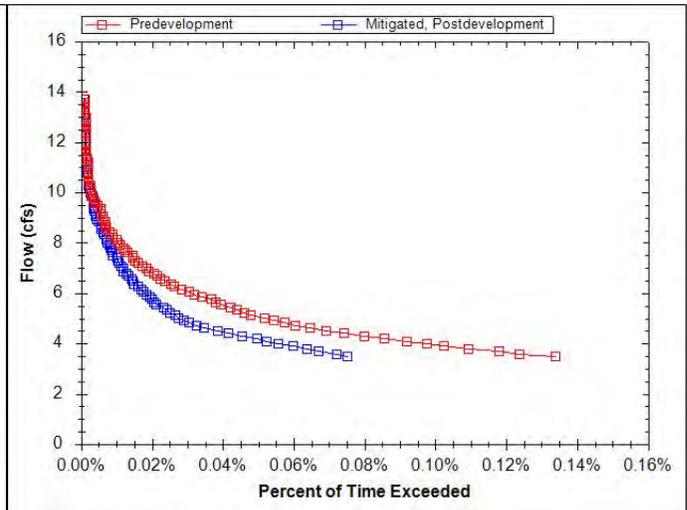
Outlet Structure Details

Lower Orifice Invert (ft)	0.0
Lower Orifice Dia (in)	8.1
Upper Orifice Invert(ft)	2.7
Upper Orifice Dia (in)	18.5
Overflow Weir Invert(ft)	3.0
Overflow Weir Length (ft)	6.3

Flow Frequency Chart



Flow Duration Chart



WES BMP Sizing Report Tool run: 12/20/2019

Project Information

Project Name	Frog Pond Ridge - SR
Project Type	Subdivision
Location	
Stormwater Management Area	0
Project Applicant	
Jurisdiction	CCSD1NCSA

Drainage Management Area

Name	Area (sq-ft)	Pre-Project Cover	Post-Project Cover	DMA Soil Type	BMP
SR20 - Imp ROW	36,343	Grass	ConventionalConcrete	D	Tract E Rain Garden
SR 20 - Imp Roof	65,750	Grass	Roofs	D	Tract E Rain Garden
SR 20 - Per	47,295	Grass	LandscapeDsoil	D	Tract E Rain Garden
SR 21 - Imp ROW	1,638	Grass	ConventionalConcrete	D	SR 21 Swale
SR 21 - Per	800	Grass	LandscapeDsoil	D	SR 21 Swale
SR 22 - Imp ROW	4,792	Grass	ConventionalConcrete	D	SR 22 Swale
SR 22 - Per	1,319	Grass	LandscapeDsoil	D	SR 22 Swale
SR 23 - Imp ROW	1,352	Grass	ConventionalConcrete	D	SR 23 Swale
SR 23 - Imp Roof	4,000	Grass	Roofs	D	SR 23 Swale
SR 23 - Per	1,333	Grass	LandscapeDsoil	D	SR 23 Swale
SR 24 - Imp ROW	5,432	Grass	ConventionalConcrete	D	SR 24 Swale
SR 24 - Per	2,988	Grass	LandscapeDsoil	D	SR 24 Swale
SR 26 - Imp ROW	7,411	Grass	ConventionalConcrete	D	SR 26 Swale
SR 26 - Per	3,254	Grass	LandscapeDsoil	D	SR 26 Swale
SR 27 - Imp ROW	5,461	Grass	ConventionalConcrete	D	SR 27 Swale
SR 27 - Per	1,320	Grass	LandscapeDsoil	D	SR 27 Swale
SR 20 - Forest	15,106	Forested	Forested	D	Tract E Rain

					Garden
SR 28 - Imp ROW	3,477	Grass	ConventionalConcrete	D	Tract E Rain Garden
SR 28 - Imp Roof	8,000	Grass	Roofs	D	Tract E Rain Garden
SR 28 - Per	6,803	Grass	LandscapeDsoil	D	Tract E Rain Garden
SR 21 - Imp Roof	2,750	Grass	Roofs	D	SR 21 Swale
SR 22 - Imp Roof	5,500	Grass	Roofs	D	SR 22 Swale
SR 25 - Imp ROW	2,143	Grass	ConventionalConcrete	D	SR 25 Swale
SR 25 - Per	1,063	Grass	LandscapeDsoil	D	SR 25 Swale
SR 29 - Imp ROW	3,007	Grass	ConventionalConcrete	D	SR 29 Swale
SR 29 - Imp Roof	4,000	Grass	Roofs	D	SR 29 Swale
SR 29 - Per	3,007	Grass	LandscapeDsoil	D	SR 29 Swale

LID Facility Sizing Details

LID ID	Design Criteria	BMP Type	Facility Soil Type	Minimum Area (sq-ft)	Planned Areas (sq-ft)	Orifice Diameter (in)
Tract E Rain Garden	FlowControlAndTreatment	Rain Garden - Filtration	D1	6,178.4	6,445.0	4.3
SR 23 Swale	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	251.4	384.0	0.9
SR 26 Swale	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	387.6	656.0	1.2
SR 21 Swale	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	197.9	368.0	0.8
SR 22 Swale	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	448.6	656.0	1.2
SR 24 Swale	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	300.9	352.0	1.0
SR 27 Swale	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	255.4	656.0	0.9
SR 29 Swale	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	364.5	387.0	1.1

SR 25 Swale	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	115.5	200.0	0.6
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Pond Sizing Details

1. FCWQT = Flow control and water quality treatment, WQT = Water quality treatment only
2. Depth is measured from the bottom of the facility and includes the three feet of media (drain rock, separation layer and growing media).
3. Maximum volume of the facility. Includes the volume occupied by the media at the bottom of the facility.
4. Maximum water storage volume of the facility. Includes water storage in the three feet of soil media assuming a 40 percent porosity.

WES BMP Sizing Report

Project Information

Project Name	Frog Pond Ridge - WC
Project Type	Addition
Location	
Stormwater Management Area	22583
Project Applicant	
Jurisdiction	CCSD1NCSA

Drainage Management Area

Name	Area (sq-ft)	Pre-Project Cover	Post-Project Cover	DMA Soil Type	BMP
WC 10 - Imp ROW	6,273	Grass	ConventionalConcrete	D	Tract B RG2
WC 10 - Per	1,143	Grass	LandscapeSoil	D	Tract B RG2
WC 13 - Per	15,676	Grass	LandscapeSoil	D	Tract B RG1
WC 14 - Imp ROW	12,948	Grass	ConventionalConcrete	D	Tract B RG2
WC 14 - Imp Roof	5,500	Grass	Roofs	D	Tract B RG2
WC 14 - Per	8,754	Grass	LandscapeSoil	D	Tract B RG2
WC 17 - Imp ROW	5,500	Grass	ConventionalConcrete	D	Tract B RG1
WC 17 - Imp Roof	5,500	Grass	Roofs	D	Tract B RG1
WC 17 - Per	5,621	Grass	LandscapeSoil	D	Tract B RG1
WC 19A - Imp ROW	20,067	Grass	ConventionalConcrete	D	Tract B RG1
WC 19A - Imp Roof	16,500	Grass	Roofs	D	Tract B RG1
WC 19A - Per	14,654	Grass	LandscapeSoil	D	Tract B RG1
WC 24 - Imp ROW	1,080	Grass	ConventionalConcrete	D	Swale WC 24
WC 15 - Imp ROW	5,465	Grass	ConventionalConcrete	D	Tract B RG1
WC 24 - Per	1,958	Grass	LandscapeSoil	D	Swale WC 24
WC 15 - Per	2,556	Grass	LandscapeSoil	D	Tract B RG1
WC 16 - Imp ROW	4,571	Grass	ConventionalConcrete	D	Tract B RG1

WC 16 - Per	8,602	Grass	LandscapeDsoil	D	Tract B RG1
WC 18A - Imp ROW	6,820	Grass	ConventionalConcrete	D	Swale WC 18A
WC 18A - Per	10,190	Grass	LandscapeDsoil	D	Swale WC 18A
WC 20 - Imp	6,764	Grass	ConventionalConcrete	D	Swale WC 20
WC 20 - Per	580	Grass	LandscapeDsoil	D	Swale WC 20
WC 21 - Imp ROW	6,109	Grass	ConventionalConcrete	D	Swale WC 21
WC 21 - per	4,880	Grass	LandscapeDsoil	D	Swale WC 21
WC 22A - Imp ROW	5,120	Grass	ConventionalConcrete	D	Swale WC 22A
WC 22A - per	2,361	Grass	LandscapeDsoil	D	Swale WC 22A
WC 23 - Imp ROW	3,211	Grass	ConventionalConcrete	D	Swale WC 23
WC 23 - per	1,591	Grass	LandscapeDsoil	D	Swale WC 23
WC 18A - Imp Roof	8,250	Grass	Roofs	D	Tract B RG1
WC 16 - Imp Roof	5,500	Grass	Roofs	D	Tract B RG1
WC 22A - Imp Roof	2,750	Grass	Roofs	D	Swale WC 22A
WC 21 - Imp Roof	2,750	Grass	Roofs	D	Swale WC 21
WC 13 - Imp Roof	2,750	Grass	Roofs	D	Tract B RG1
WC 22B - Imp ROW	2,004	Grass	ConventionalConcrete	D	Swale WC 22B
WC 22B - Imp Roof	2,750	Grass	Roofs	D	Swale WC 22B
WC 22B - Per	1,298	Grass	LandscapeDsoil	D	Swale WC 22B
WC 23 - Imp Roof	2,750	Grass	Roofs	D	Swale WC 26A
WC 25 - Imp ROW	2,396	Grass	ConventionalConcrete	D	Swale WC 25
WC 25 - Per	5,431	Grass	LandscapeDsoil	D	Swale WC 25
WC 26A - Imp ROW	4,876	Grass	ConventionalConcrete	D	Swale WC 26A
WC 26A - Per	1,472	Grass	LandscapeDsoil	D	Swale WC 26A
WC 26B - Imp ROW	4,545	Grass	ConventionalConcrete	D	Swale WC 26B
WC 26B - Imp Roof	2,750	Grass	Roofs	D	Swale WC 26B
WC 26B - Per	1,305	Grass	LandscapeDsoil	D	Swale WC 26B

WC 27 - Imp ROW	6,482	Grass	ConventionalConcrete	D	Swale WC 27
WC 27 - Per	5,261	Grass	LandscapeSoil	D	Swale WC 27
WC 28 - Imp ROW	12,055	Grass	ConventionalConcrete	D	Tract B RG1
WC 28 - Per	14,753	Grass	Grass	B	NA
WC 15 - Imp ROW	12,906	Grass	ConventionalConcrete	D	Tract B RG2
WC 15 - Imp Roof	11,000	Grass	Roofs	D	Tract B RG1
WC 15 - Per	9,830	Grass	LandscapeSoil	D	Tract B RG2
WC 18B - Imp ROW	4,169	Grass	ConventionalConcrete	D	Swale WC 18B
WC 18B - Imp Roof	2,750	Grass	Roofs	D	Tract B RG1
WC 18B - Per	3,716	Grass	LandscapeSoil	D	Swale WC 18B

LID Facility Sizing Details

LID ID	Design Criteria	BMP Type	Facility Soil Type	Minimum Area (sq-ft)	Planned Areas (sq-ft)	Orifice Diameter (in)
Tract B RG2	FlowControlAndTreatment	Rain Garden - Filtration	D1	2,057.4	2,501.0	2.4
Tract B RG1	FlowControlAndTreatment	Rain Garden - Filtration	D1	5,315.4	6,073.0	3.9
Swale WC 18A	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	558.1	588.0	1.5
Swale WC 20	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	286.8	580.0	1.0
Swale WC 21	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	491.0	588.0	1.3
Swale WC 22A	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	380.9	399.0	1.1
Swale WC 23	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	173.0	270.0	0.8
Swale WC 25	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	247.9	255.0	1.0
Swale WC 24	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	98.0	123.0	0.6

Swale WC 22B	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	226.5	460.0	0.9
Swale WC 26A	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	346.3	420.0	1.1
Swale WC 26B	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	328.3	420.0	1.0
Swale WC 27	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	406.6	840.0	1.2
Swale WC 18B	FlowControlAndTreatment	Vegetated Swale - Filtration	D1	270.8	320.0	1.0

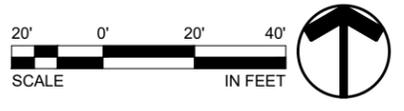
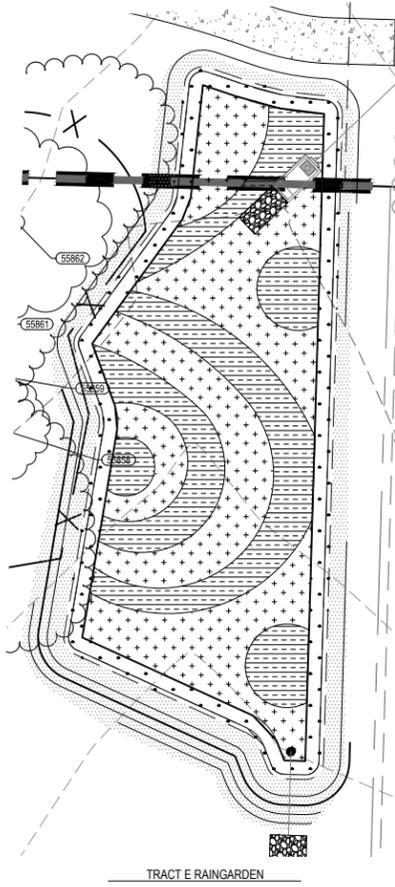
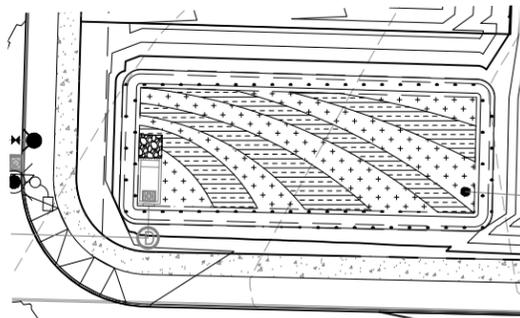
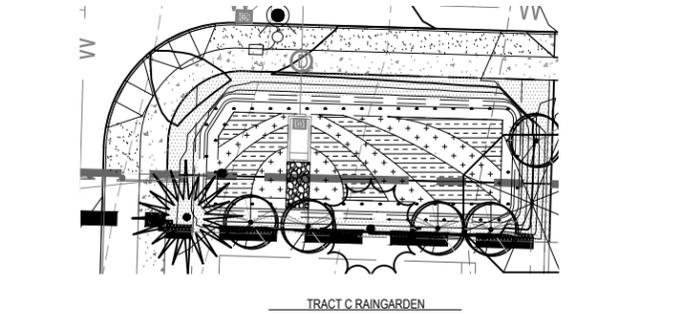
Pond Sizing Details

1. FCWQT = Flow control and water quality treatment, WQT = Water quality treatment only
2. Depth is measured from the bottom of the facility and includes the three feet of media (drain rock, separation layer and growing media).
3. Maximum volume of the facility. Includes the volume occupied by the media at the bottom of the facility.
4. Maximum water storage volume of the facility. Includes water storage in the three feet of soil media assuming a 40 percent porosity.

Appendix E
O&M Plans



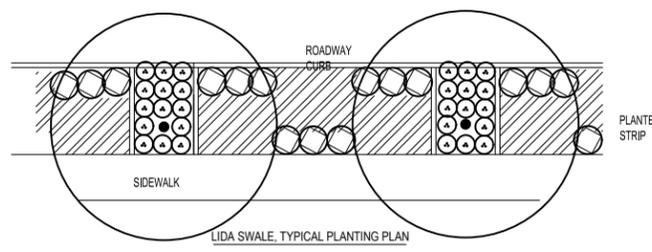
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*NOTE: FINAL PLANT QUANTITIES FOR STORM WATER FACILITIES WILL BE DETERMINED DURING FINAL DESIGN.

LIDA FACILITIES PLANT LEGEND

SYMBOL	QTY	COMMON NAME / Botanical name	Size	Spacing
	TBD	DAGGER LEAF RUSH / <i>Juncus ensifolius</i>	1 GAL.	1' o.c.
	TBD	GOLDNUGGET BARBERRY / <i>Berberis thunbergii</i> 'Gold Nugget'	1 GAL.	2' o.c.
	TBD	KELSEY DOGWOOD / <i>Cornus sericea</i> 'Kelsey'	2 GAL.	3' o.c.



RAIN GARDEN BOTTOM

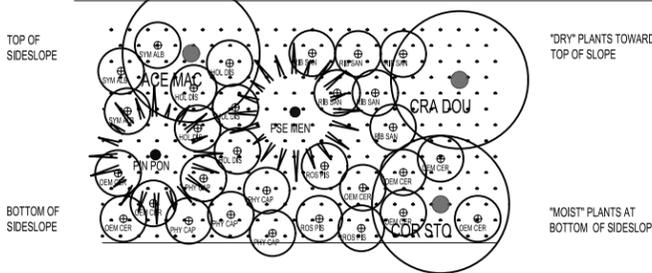
SYMBOL	QUANTITY	COMMON NAME / Botanical Name, SIZE, SPACING
	TBD	SLOUGH SEDGE / <i>Carex obovata</i> , 1 GAL., 2' O.C.
	TBD	SPREADING RUSH / <i>Juncus patens</i> , 1 GAL., 2' O.C.

RAIN GARDEN SIDE SLOPES

SYMBOL	QUANTITY	DESCRIPTION
	TBD SF	DRY AREA SEED MIX PER CITY OF WILSONVILLE PUBLIC WORKS STANDARDS, APPENDIX B, TABLE B.5:
		Botanical Name: COMMON NAME % MIXTURE
		<i>Elymus glaucus</i> BLUE WILDRYE 60%
		<i>Hordeum brachyantherum</i> MEADOW BARLEY 30%
		<i>Bromus carinatus</i> NATIVE CALIFORNIA BROME 10%

SYMBOL	DESCRIPTION
	DECIDUOUS TREE GENUS AND SPECIES CODE DECIDUOUS TREE, 1" CAL. COR STO CORNUS STOLONIFERA (MOIST) CRA DOU CRATAEGUS DOUGLASII (DRY) ACE MAC ACER MACROPHYLLUM (DRY)
	CONIFER TREE GENUS AND SPECIES CODE CONIFER TREE, 6" HT. PSE MEN PSEUDOTSUGA MENZIESII (DRY) PIN PON PINUS PONDEROSA (DRY)
	SHRUBS, 1 GAL. HOL DIS HOLODISCUS DISCOLOR (DRY) OEM CER OEMLERIA CERASIFORMIS (MOIST) PHY CAP PHYSCARPUS CAPITATUS (MOIST) RIB SAN RIBES SANGUINEUM (DRY) ROS FIS ROSA PISOCARPA (MOIST) SYM ALB SYMPHORICARPOS ALBUS (DRY)

POND SIDE SLOPES-TYPICAL PLANTING PLAN



Otak, Inc.
 808 SW Third Avenue, Ste. 800
 Portland, OR 97204
 503.287.6825
 www.otak.com



LAND USE SUBMITTAL - JANUARY 9, 2020

FROG POND RIDGE

WILSONVILLE, OREGON

LIDA AND RAIN GARDEN PLANTING

TITLE	#	DATE	DESCRIPTION

REVISIONS

DATUM
DMH

DRAWN BY	CHECKED BY
	GAJ

LAND USE SUBMITTAL STATUS
JANUARY 9, 2020

DATE
19489

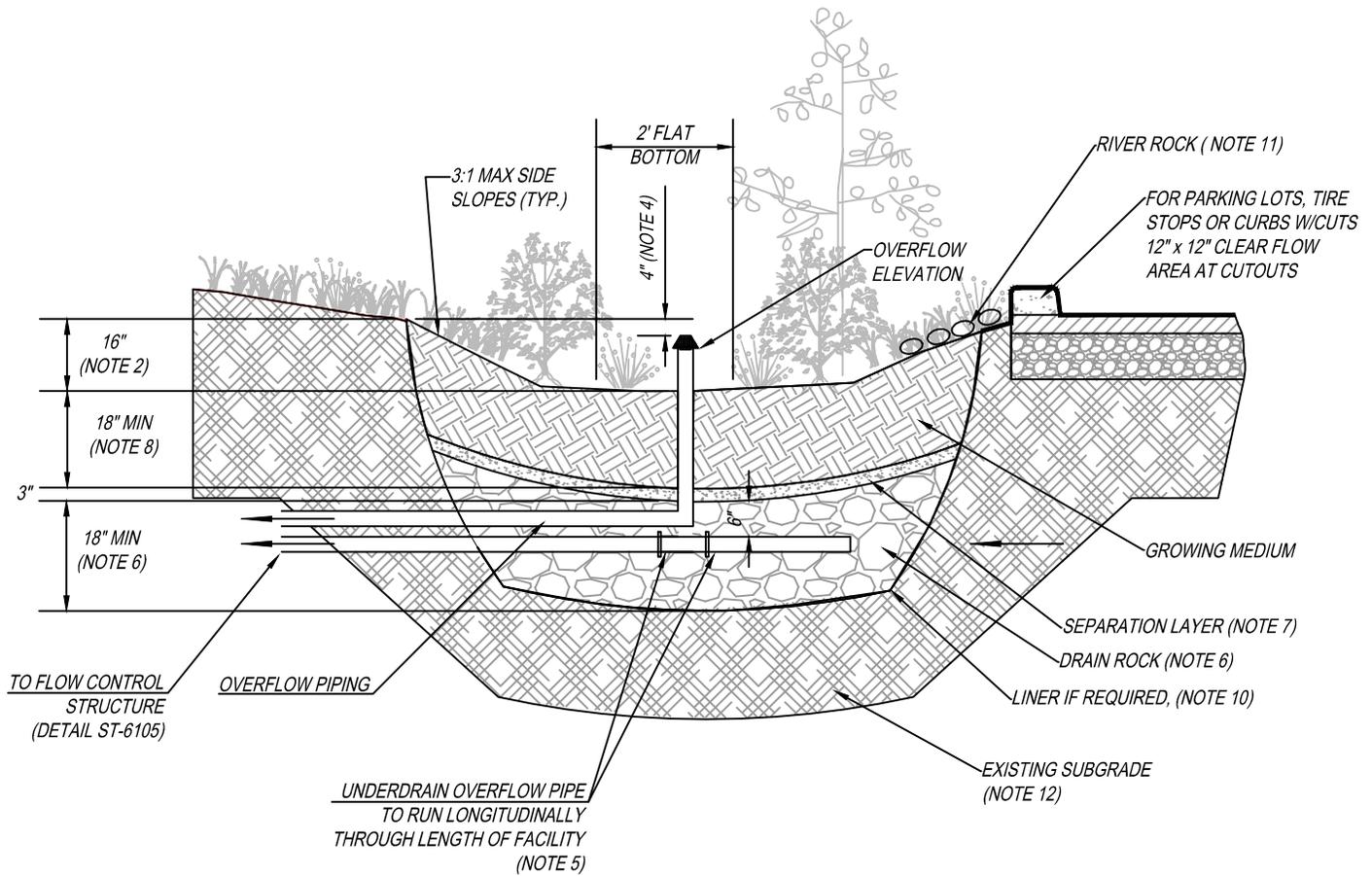
PROJECT NUMBER
L2.30

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If this drawing is not 22" x 34", it has been reduced/enlarged. Scale accordingly.

Plotted: Jan 07, 2020 - 11:38am gabiellek L:\Project\194001\19489\CADD\CADD\Drawings\19489\210.dwg Layout Name: L2.30

This Detail Drawing may not be altered or changed in any manner except by the City Engineer. It is the responsibility of the user to acquire the most current version.



GENERAL NOTES:

1. **PROVIDE PROTECTION** FROM ALL VEHICLE TRAFFIC, EQUIPMENT STAGING, AND FOOT TRAFFIC IN PROPOSED INFILTRATION AREAS PRIOR TO, DURING AND AFTER CONSTRUCTION. UNLESS REQUIRED BY SITE CONDITIONS, UNLINED RAIN GARDENS ARE PREFERRED TO MAXIMIZE ONSITE INFILTRATION.
2. **DIMENSIONS:**
 - DEPTH OF BASIN (FROM TOP OF GROWING MEDIUM TO OVERFLOW ELEVATION); 12"
 - FLAT BOTTOM WIDTH: 2' MINIMUM
 - SIDE SLOPES OF RAIN GARDEN: 3:1 MAXIMUM
 - CENTERLINE SLOPE OF RAIN GARDEN: 0.5% OR LESS
3. **SETBACKS:**
 - FILTRATION RAIN GARDEN SHALL BE 10' FROM FOUNDATIONS AND 5' FROM PROPERTY LINES UNLESS APPROVED BY BUILDING OFFICIAL
4. **OVERFLOW:**
 - OVERFLOW REQUIRED. INLET ELEVATION SHALL ALLOW FOR 4" OF FREEBOARD, MINIMUM.
 - PROTECT FROM DEBRIS AND SEDIMENT WITH STRAINER OR GRATE.
5. **PIPING:**
 - PERFORATED UNDER-DRAIN PIPING: SHALL RUN LONGITUDINALLY THROUGH LENGTH OF FACILITY, SHALL BE ABS SCH. 40, CAST IRON, OR PVC SCH.40. MINIMUM DIAMETER IS 6". PIPING SHALL HAVE 1% GRADE AND FOLLOW THE UNIFORM PLUMBING CODE. PVC NOT ALLOWED ABOVE GROUND. WRAP UNDER-DRAIN IN FILTER FABRIC TO REDUCE TRANSPORT OF FINES. OVERFLOW PIPING: SHALL BE ABS SCH. 40, CAST IRON, OR PVC SCH. 40 AND SHALL NOT BE PERFORATED. MINIMUM DIAMETER IS 6". PIPING SHALL HAVE 1% GRADE AND FOLLOW THE UNIFORM PLUMBING CODE. PVC NOT ALLOWED ABOVE GROUND.
6. **DRAIN ROCK:**
 - SIZE: 1 1/2" to 3/4"-0 WASHED
 - DEPTH: 18" MINIMUM
7. **SEPARATION** BETWEEN DRAIN ROCK AND GROWING MEDIUM: SHALL BE A 3" LAYER OF 3/4" - 1/4" OPEN GRADED AGGREGATE.
8. **GROWING MEDIUM:**
 - DEPTH: 18" MINIMUM
 - SEE APPENDIX A FOR SPECIFICATION OR USE SAND/LOAM/COMPOST 3-WAY MIX.
 - FACILITY SURFACE AREA MAY BE REDUCED BY 25% WHEN GROWING MEDIA DEPTH IS INCREASED TO 30" OR MORE.
9. **VEGETATION:** FOLLOW LANDSCAPE PLANS OR REFER TO PLANTING REQUIREMENTS IN APPENDIX A.
10. **WATERPROOF LINER (IF REQUIRED):** SHALL BE 30 MIL PVC OR EQUIVALENT.
11. **INSTALL RIVER ROCK** SPLASH PAD OVER A NON WOVEN GEO TEXTILE FABRIC TO TRANSITION FROM INLETS TO GROWING MEDIUM. SIZE OF ROCK SHALL BE 1" - 3", 4 SQUARE FEET, 6" DEEP.
12. **SEASONAL HIGH GROUNDWATER SEPARATION:**
 - SEPARATION DISTANCE AS REQUIRED BY CITY.

Rain Garden - Filtration

DRAWING NUMBER: ST-6020

DRAWN BY: SR

SCALE: N.T.S.

FILE NAME: ST-6020.DWG

APPROVED BY: NK

DATE: 6/3/16

CITY OF
WILSONVILLE



PUBLIC WORKS STANDARDS

Rain Gardens Operations & Maintenance Plan

What to Look For	What to Do
Structural Components , including inlets and outlets/overflows, shall freely convey stormwater.	
Clogged inlets or outlets	-Remove sediment and debris from catch basins, trench drains and curb inlets and pipes to maintain at least 50% conveyance capacity at all times.
Cracked Drain Pipes	-Repair/seal cracks. Replace when repair is insufficient.
Check Dams	-Maintain 4 to 10 inch deep rock check dams at design intervals.
Vegetation	
Dead or strained vegetation	-Replant per original planting plan, or substitute from Appendix A. -Irrigate as needed. Mulch banks annually. DO NOT apply fertilizers, herbicides, or pesticides.
Tall Grass and Vegetation	-Cut back grass and prune overgrowth 1-2 times per year. Remove cuttings
Weeds	-Manually remove weeds. Remove all plant debris.
Growing/Filter Medium , including soil and gravels, shall sustain healthy plant cover and infiltrate within 72 hours.	
Gullies	-Fill, lightly compact, and plant vegetation to disperse flow.
Erosion	-Replace splash blocks or inlet gravel/rock.
Slope Slippage	-Stabilize 3:1 slopes/banks with plantings from Appendix A
Ponding	-Rake, till, or amend to restore infiltration rate.

Annual Maintenance Schedule:

Summer. Make any structural repairs. Improve filter medium as needed. Clear drain. Irrigate as needed.

Fall. Replant exposed soil and replace dead plants. Remove sediment and plant debris.

Winter. Monitor infiltration/flow-through rates. Clear inlets and outlets/overflows to maintain conveyance.

Spring. Remove sediment and plant debris. Replant exposed soil and replace dead plants. Mulch.

All seasons. Weed as necessary.

Maintenance Records: Record date, description, and contractor (if applicable) for all structural repairs, landscape maintenance, and facility cleanout activities. Keep work orders and invoices on file and make available upon request of the inspector.

Access: Maintain ingress/egress to design standards.

Infiltration/Flow Control: All facilities shall drain within 72 hours. Record time/date, weather, and site conditions when ponding occurs.

Pollution Prevention: All sites shall implement best management practices to prevent hazardous or solid wastes or excessive oil and sediment from contaminating stormwater. Contact _____ for immediate assistance responding to spills. Record time/date, weather, and site conditions if site activities contaminate stormwater.

Vectors (Mosquitoes & Rodents): Stormwater facilities shall not harbor mosquito larvae or rats that pose a threat to public health or that undermine the facility structure. Monitor standing water for small wiggling sticks perpendicular to the water's surface. Note holes/burrows in and around facilities. Call Clackamas County Vector Control for immediate assistance to eradicate vectors. Record time/date, weather, and site conditions when vector activity observed.

Rain Garden O & M Plan

DRAWING NUMBER: ST-6030

DRAWN BY: SR

SCALE: N.T.S.

FILE NAME: ST-6030.DWG

APPROVED BY: NK

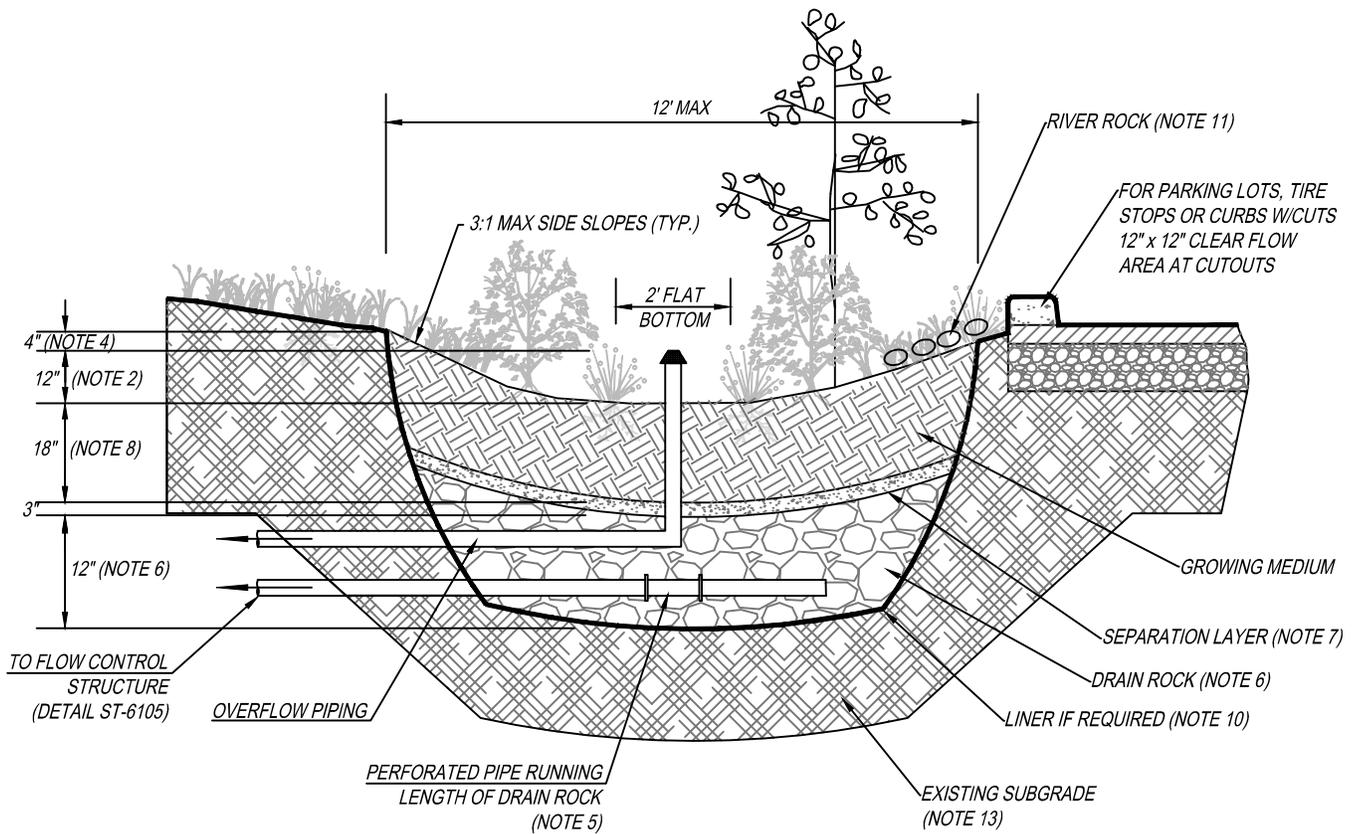
DATE: 10/15/14

CITY OF
WILSONVILLE



PUBLIC WORKS STANDARDS

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GENERAL NOTES:

1. **PROVIDE PROTECTION** FROM ALL VEHICLE TRAFFIC, EQUIPMENT STAGING, AND FOOT TRAFFIC IN PROPOSED INFILTRATION AREAS PRIOR TO, DURING AND AFTER CONSTRUCTION. UNLESS REQUIRED BY SITE CONDITIONS, UNLINED SWALES ARE PREFERRED TO ALLOW MAXIMUM INFILTRATION.
2. **DIMENSIONS:**
 - DEPTH OF SWALE (FROM TOP OF GROWING MEDIUM TO OVERFLOW ELEVATION); 12"
 - LONGITUDINAL SLOPE OF SWALE: 6.0% OR LESS
 - FLAT BOTTOM WIDTH: 2' MINIMUM
 - SIDE SLOPES OF SWALE: 3:1 MAXIMUM
3. **LOCATION/SETBACKS:**
 - FILTRATION SWALES SHALL BE 10' FROM FOUNDATIONS AND 5' FROM PROPERTY LINES UNLESS APPROVED BY BUILDING OFFICIAL
4. **OVERFLOW:**
 - INLET ELEVATION SHALL ALLOW FOR 4" OF FREEBOARD, MINIMUM.
 - PROTECT FROM DEBRIS AND SEDIMENT WITH STRAINER OR GRATE.
5. **PIPING:**
 - PERFORATED UNDER-DRAIN PIPING: SHALL BE ABS SCH. 40, CAST IRON, OR PVC SCH.40. MINIMUM DIAMETER IS 6". PIPING SHALL HAVE 1% GRADE AND FOLLOW THE UNIFORM PLUMBING CODE. PVC NOT ALLOWED ABOVE GROUND. WRAP UNDER-DRAIN IN FILTER FABRIC TO REDUCE TRANSPORT OF FINES.
 - OVERFLOW PIPING: SHALL BE ABS SCH. 40, CAST IRON, OR PVC SCH. 40 AND SHALL NOT BE PERFORATED. MINIMUM DIAMETER IS 6". PIPING SHALL HAVE 1% GRADE AND FOLLOW THE UNIFORM PLUMBING CODE. PVC NOT ALLOWED ABOVE GROUND.
6. **DRAIN ROCK:**
 - SIZE: 1 1/2" - 3/4" WASHED
 - DEPTH: 12"
7. **SEPARATION** BETWEEN DRAIN ROCK AND GROWING MEDIUM: SHALL BE A 3" LAYER OF 3/4" - 1/4" OPEN GRADED AGGREGATE.
8. **GROWING MEDIUM:**
 - 18" MINIMUM
 - SEE APPENDIX C FOR SPECIFICATION OR USE SAND/LOAM/COMPOST 3-WAY MIX.
 - FACILITY SURFACE AREA MAY BE REDUCED BY 25% WHEN GROWING MEDIA DEPTH IS INCREASED TO 30" OR MORE.
9. **VEGETATION:** FOLLOW LANDSCAPE PLANS OR REFER TO PLANTING REQUIREMENTS IN APPENDIX A.
10. **WATERPROOF LINER (IF REQUIRED):** SHALL BE 30 MIL PVC OR EQUIVALENT.
11. **INSTALL RIVER ROCK** SPLASH PAD OVER A NON WOVEN GEO TEXTILE FABRIC TO TRANSITION FROM INLETS TO GROWING MEDIUM. SIZE OF ROCK SHALL BE 1" TO 3", 4 SQUARE FEET, 6" DEEP.
12. **CHECK DAMS:** SHALL BE PLACED ACCORDING TO FACILITY DESIGN. REFER TO DETAIL ST-6100 FOR PROFILE AND SPACING.
13. **SEASONAL HIGH GROUNDWATER SEPARATION:**
 - SEPARATION DISTANCE AS REQUIRED BY CITY.

Vegetated Swale - Filtration

DRAWING NUMBER: ST-6045

DRAWN BY: SR

SCALE: N.T.S.

FILE NAME: ST-6045.DWG

APPROVED BY: NK

DATE: 6/3/16

**CITY OF
WILSONVILLE**



PUBLIC WORKS STANDARDS

Vegetated Swales Operations & Maintenance Plan

What to Look For	What to Do
Structural Components, including inlets and outlets/overflows, shall freely convey stormwater.	
Clogged inlets or outlets	-Remove sediment and debris from catch basins, trench drains, curb inlets and pipes to maintain at least 50% conveyance capacity at all times.
Cracked Drain Pipes	-Replace/seal cracks. Replace when repair is insufficient.
Check Dams	-Maintain 4 - 10 inch deep rock check dams at design intervals.
Vegetation	
Dead or strained vegetation	-Replant per original planting plan, or substitute from Appendix A. -Irrigate as needed. Mulch banks annually. DO NOT apply fertilizers, herbicides, or pesticides.
Tall Grass and Vegetation	-Cut back to 4-6 inches, 1-2 times per year. Remove cuttings
Weeds	-Manually remove weeds. Remove all plant debris.
Growing/Filter Medium, including soil and gravels, shall sustain healthy plant cover and infiltrate within 72 hours.	
Gullies	-Fill, lightly compact, and plant vegetation to disperse flow.
Erosion	-Restore or create outfalls, checkdams, or splash blocks where necessary.
Slope Sippage	-Stabilize Slope.
Ponding	-Rake, till, or amend to restore infiltration rate.

Annual Maintenance Schedule:

Summer. Make any structural repairs. Improve filter medium as needed. Clear drain. Irrigate as needed.

Fall. Replant exposed soil and replace dead plants. Remove sediment and plant debris.

Winter. Monitor infiltration/flow-through rates. Clear inlets and outlets/overflows to maintain conveyance.

Spring. Remove sediment and plant debris. Replant exposed soil and replace dead plants. Mulch.

All seasons. Weed as necessary.

Maintenance Records: Record date, description, and contractor (if applicable) for all structural repairs, landscape maintenance, and facility cleanout activities. Keep work orders and invoices on file and make available upon request of the inspector.

Access: Maintain ingress/egress to design standards.

Infiltration/Flow Control: All facilities shall drain within 72 hours. Record time/date, weather, and site conditions when ponding occurs.

Pollution Prevention: All sites shall implement best management practices to prevent hazardous or solid wastes or excessive oil and sediment from contaminating stormwater. Contact _____ for immediate assistance responding to spills. Record time/date, weather, and site conditions if site activities contaminate stormwater.

Vectors (Mosquitoes & Rodents): Stormwater facilities shall not harbor mosquito larvae or rats that pose a threat to public health or that undermine the facility structure. Monitor standing water for small wiggling sticks perpendicular to the water's surface.

Note holes/burrows in and around facilities. Call Clackamas County Vector Control for immediate assistance to eradicate vectors. Record time/date, weather, and site conditions when vector activity observed.

Vegetated Swale O & M Plan

DRAWING NUMBER: ST-6055

DRAWN BY: SR

SCALE: N.T.S.

FILE NAME: ST-6055.DWG

APPROVED BY: NK

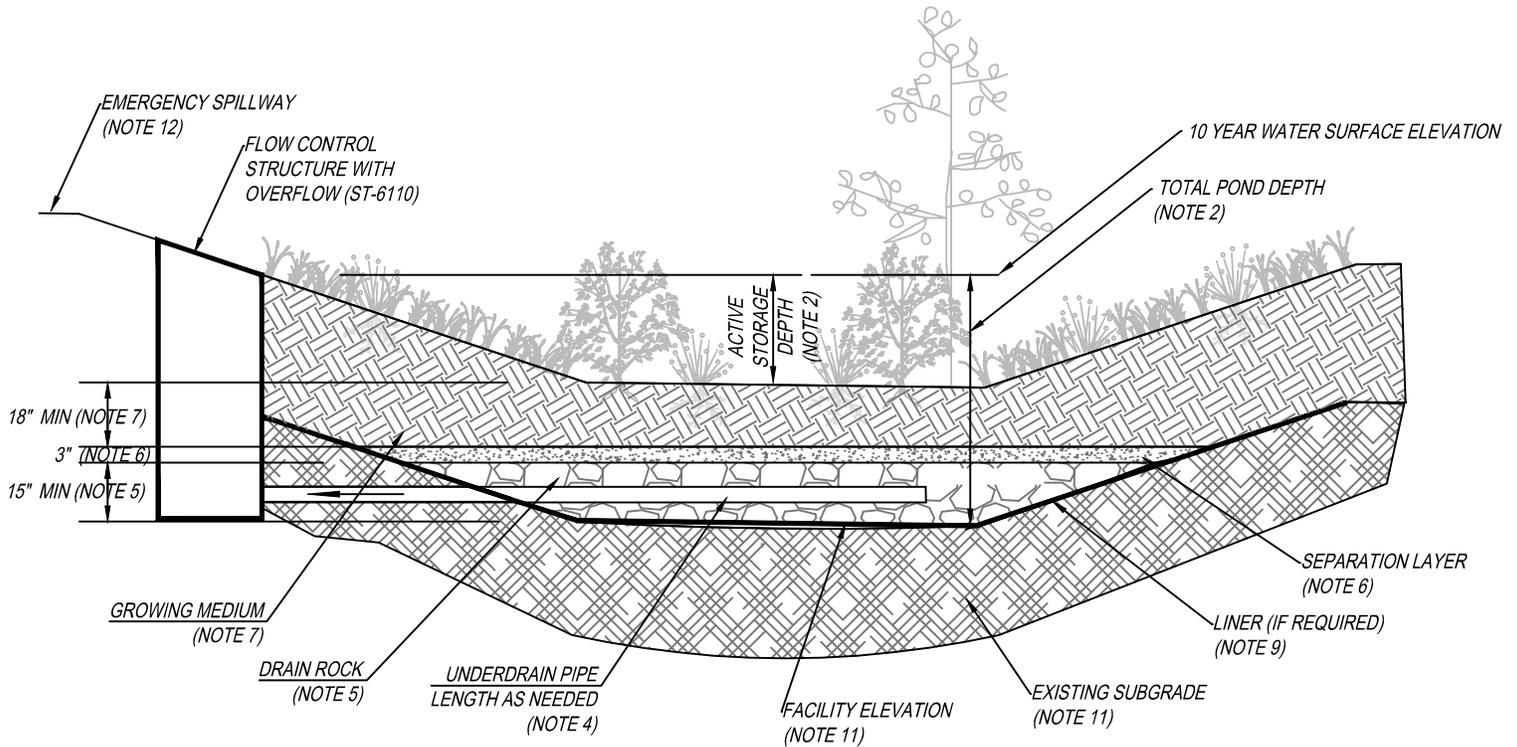
DATE: 10/8/14

CITY OF
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PUBLIC WORKS STANDARDS

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GENERAL NOTES:

1. **PROVIDE PROTECTION** FROM ALL VEHICLE TRAFFIC, EQUIPMENT STAGING, AND FOOT TRAFFIC IN PROPOSED INFILTRATION AREAS PRIOR TO, DURING AND AFTER CONSTRUCTION. UNLESS REQUIRED BY SITE CONDITIONS, UNLINED PONDS ARE PREFERRED TO ALLOW MAXIMUM INFILTRATION.
2. **DIMENSIONS:**
 - ACTIVE STORAGE DEPTH: (FROM TOP OF GROWING MEDIUM TO OVERFLOW ELEVATION); PER FACILITY SIZING MODEL
 - TOTAL POND DEPTH: 4' MINIMUM, PER FACILITY SIZING MODEL
 - BOTTOM SLOPE: 2.0% OR LESS
 - SIDE SLOPES OF DETENTION POND: 3:1 MAXIMUM
3. **LOCATION/SETBACKS:**
 - DETENTION POND SHALL BE 10' FROM FOUNDATIONS AND 5' FROM PROPERTY LINES UNLESS APPROVED BY BUILDING OFFICIAL.
4. **PIPING:**
 - PERFORATED UNDER-DRAIN PIPING: SHALL BE ABS SCH. 40, CAST IRON OR PVC SCH. 40. 6" MINIMUM DIAMETER. PIPING SHALL HAVE 1% GRADE AND FOLLOW THE UNIFORM PLUMBING CODE. PVC NOT ALLOWED ABOVE GROUND. WRAP UNDER-DRAIN PIPE IN FILTER FABRIC TO REDUCE TRANSPORT OF FINES.
 - OVERFLOW PIPING: SHALL BE ABS SCH. 40, CAST IRON OR PVC SCH. 40 AND SHALL NOT BE PERFORATED. MINIMUM DIAMETER IS 6". PIPING SHALL HAVE 1% GRADE AND FOLLOW THE UNIFORM PLUMBING CODE. PVC NOT ALLOWED ABOVE GROUND.
5. **DRAIN ROCK:**
 - SIZE: 1 1/2" - 3/4"-0 WASHED
 - DEPTH: 15" MINIMUM
6. **SEPARATION** BETWEEN DRAIN ROCK AND GROWING MEDIUM: SHALL BE A 3" LAYER OF 3/4" - 1/4" OPEN GRADED AGGREGATE.
7. **GROWING MEDIUM:**
 - 18" MINIMUM
 - SEE APPENDIX C FOR SPECIFICATION OR USE SAND/LOAM/COMPOST 3-WAY MIX.
8. **VEGETATION:** FOLLOW LANDSCAPE PLANS OR REFER TO PLANTING REQUIREMENTS IN APPENDIX A.
9. **WATERPROOF LINER (IF REQUIRED):** SHALL BE 30 MIL PVC OR EQUIVALENT FOR DETENTION POND.
10. **INSTALL RIVER ROCK** SPLASH PAD OVER A NON WOVEN GEO TEXTILE FABRIC TO TRANSITION FROM INLETS TO GROWING MEDIUM. SIZE OF ROCK SHALL BE 1" TO 3", 4 SQUARE FEET 6" DEEP.
11. **SEASONAL HIGH GROUNDWATER SEPARATION:**
 - SEPARATION DISTANCE AS REQUIRED BY CITY.
12. **EMERGENCY SPILLWAY** SIZED TO CONVEY THE 100 YEAR DESIGN STORM (S-2275). SEE PUBLIC WORKS STANDARDS 301.4.09

Detention Pond

DRAWING NUMBER: ST-6060

DRAWN BY: SR

SCALE: N.T.S.

FILE NAME: ST-6060.DWG

APPROVED BY: NK

DATE: 6/3/16

**CITY OF
WILSONVILLE**



PUBLIC WORKS STANDARDS

Detention Pond Operations & Maintenance Plan

Detention Pond removes pollutants through several processes: sedimentation, filtration, and biological processes. The facility owner must keep a log, recording all inspection dates, observations, and maintenance activities. The following items shall be inspected and maintained as stated:

What to Look For	What to Do
Structural Components, including inlets and outlets/overflows, shall freely convey stormwater.	
Clogged inlets or outlets	-Remove sediment and debris from catch basins, trench drains, curb inlets and pipes to maintain at least 50% conveyance capacity at all times.
Cracked Drain Pipes	-Repair/seal cracks. Replace when repair is insufficient.
Check Dams	-Maintain 4 - 10 inch deep rock check dams at design intervals.
Vegetation shall cover 90% of the facility.	
Dead or strained vegetation	-Replant per original planting plan, or substitute from Appendix A. -Irrigate as needed. Mulch banks annually. DO NOT apply fertilizers, herbicides, or pesticides.
Tall Grass and Vegetation	-Cut back grass and prune overgrowth 1-2 times per year. Remove cuttings.
Weeds	-Manually remove weeds. Remove all plant debris.
Growing/Filter Medium, including soil and gravels, shall sustain healthy plant cover and infiltrate within 72 hours.	
Gullies	-Fill, lightly compact, and plant vegetation to disperse flow.
Erosion	-Replace splash blocks or inlet gravel/rock.
Slope Sippage	-Stabilize 3:1 Slopes/banks with plantings from Appendix A
Ponding	-Rake, till, or amend to restore infiltration rate.

Annual Maintenance Schedule:

All facility components, vegetation, and source controls shall be inspected for proper operations and structural stability. These inspections shall occur, at a minimum, quarterly for the first 2 years from the date of installation, and 2 times per year thereafter, and within 48 hours after each major storm event.

Access: Maintain ingress/egress to design standards.

Infiltration/Flow Control: All facilities shall drain within 72 hours. Record time/date, weather, and site conditions when ponding occurs.

Pollution Prevention: All sites shall implement best management practices to prevent hazardous or solid wastes or excessive oil and sediment from contaminating stormwater. Contact _____ for immediate assistance responding to spills. Record time/date, weather, and site conditions if site activities contaminate stormwater.

Vectors (Mosquitoes & Rodents): Stormwater facilities shall not harbor mosquito larvae or rats that pose a threat to public health or that undermine the facility structure. Monitor standing water for small wiggling sticks perpendicular to the water's surface. Note holes/burrows in and around facilities. Call Clackamas County Vector Control for immediate assistance to eradicate vectors. Record time/date, weather, and site conditions when vector activity observed.

Detention Pond O & M Plan

DRAWING NUMBER: ST-6065

DRAWN BY: SR

SCALE: N.T.S.

FILE NAME: ST-6065.DWG

APPROVED BY: NK

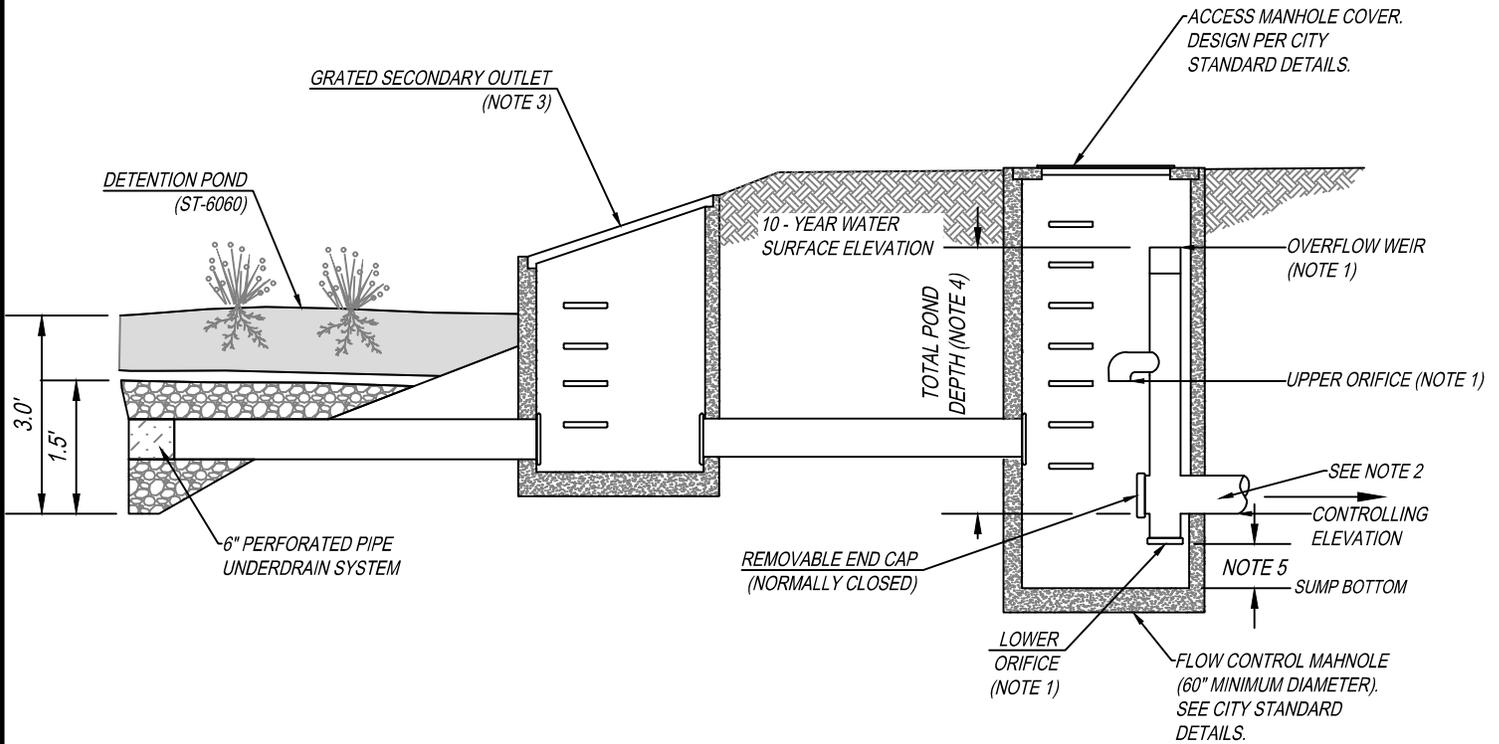
DATE: 10/8/14

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PUBLIC WORKS STANDARDS

DETENTION POND FLOW CONTROL STRUCTURE



NOTES:

1. ORIFICE AND WEIR DIMENSIONS AND ELEVATION DETERMINED THROUGH FACILITY SIZING MODEL.
2. PIPE SIZING DETERMINED BY ENGINEER.
3. SECONDARY OUTLET SIZED FOR PEAK DESIGN STORM.
4. TOTAL POND DEPTH, PER FACILITY SIZING MODEL, INCLUDES GROWING MEDIA, SEPARATION LAYER, AND DRAIN ROCK AS SHOWN ON ST-6060.
5. SEE DETAIL S-2049 FOR SUMP DEPTH

Detention Pond Flow Control Structure

DRAWING NUMBER: ST-6110

DRAWN BY: SR

SCALE: N.T.S.

FILE NAME: ST-6110.dwg

APPROVED BY: NK

DATE: 6/29/16

CITY OF
WILSONVILLE



PUBLIC WORKS STANDARDS

STORMWATER FACILITIES OPERATIONS AND MAINTENANCE CHECKLIST

Problem	Frequency	Trigger	Preferred Condition
<i>Sediment Accumulation in Treatment Area</i>	<i>Monthly from November through April Annually Required</i>	<i>Sediment depth exceeds 3 inches</i>	<i>Sediment removed from vegetated treatment area: level side to side and drains freely toward outlet; no standing water within 24 hours of any major storm (1" in 24 hours)</i>
<i>Erosion Scouring</i>	<i>Monthly from November through April Annually Required</i>	<i>Monthly from November through April Annually Required</i>	<i>Repair ruts or bare areas by filling with topsoil during dry season; regrade and replant large bare areas.</i>
<i>Standing Water</i>	<i>Monthly from November through April and after any major storm (1 inch in 24 hours)</i>	<i>Standing water in the planter between storms that does not drain freely</i>	<i>Remove sediment or trash blockages; improve end to end grade so there is no standing water 24 hours after any major storm (1 inch in 24 hours)</i>
<i>Flow not Distributed Evenly</i>	<i>Monthly from November through April Annually Required</i>	<i>Flows unevenly distributed through planter width due to uneven or clogged flow spreader</i>	<i>Level the spreader and clean so that flows spread evenly over entire planter width</i>
<i>Settlement/ Misalignment</i>	<i>Annually Required</i>	<i>Failure of planters has created safety, function, or design problem</i>	<i>Planter replaced or repaired to design standards</i>
<i>Constant Baseflow</i>	<i>Monthly from November through April Annually Required</i>	<i>Small, continual flow of water through the planter even after weeks without rain; planter bottom has an eroded, muddy channel</i>	<i>Add a low-flow pea gravel drain the length of the planter or bypass the baseflow around the planter</i>
<i>Vegetation</i>	<i>Monthly from November through April Annually Required</i>	<i>Vegetation blocking more than 10% of the inlet pipe opening</i>	<i>No vegetation blocking the inlet pipe opening</i>
<i>Poor Vegetation Coverage</i>	<i>Monthly Annually Required</i>	<i>Grass or other vegetation is sparse, or bare in more than 10% of the planter area</i>	<i>Determine cause of poor growth and correct the condition; replant with plants (per Appendix A) as needed to meet facility standards</i>
<i>Invasive Vegetation</i>	<i>Monthly Annually Required</i>	<i>No invasive vegetation is planted or permitted to remain</i>	<i>no invasive vegetation present; remove excessive weeds. Control if complete eradication is not feasible</i>
<i>Rodents</i>	<i>Monthly Annually Required</i>	<i>Evidence of rodents or rodent damage</i>	<i>No rodents; functioning facility</i>
<i>Insects</i>	<i>Annually Required</i>	<i>Insects such as wasps and hornets that interfere with maintenance activities</i>	<i>Harmful Insects removed</i>
<i>Trash and Debris</i>	<i>Monthly and after any major storm (1 inch in 24 hours) Annually Required</i>	<i>Visual evidence of trash, debris or dumping</i>	<i>Trash and Debris removed from facility</i>
<i>Contamination and Pollution</i>	<i>Monthly from November through April Annually Required</i>	<i>Any evidence of oil, gasoline, contamination or other pollutants</i>	<i>No contaminants or pollutants present; coordinate removal/cleanup with local water quality response agency</i>
<i>Obstructed Inlet/Outlet</i>	<i>Monthly and after any major storm event (1 inch in 24 hours) Annually Required</i>	<i>Inlet/outlet areas clogged with sediment, vegetation or debris</i>	<i>Clear inlet and outlet; obstructions removed</i>
<i>Excessive Shading</i>	<i>Monthly from November through April Annually Required</i>	<i>Vegetation growth is poor because unlight does not reach planter</i>	<i>Trim over-hanging limbs and/or remove brushy vegetation as needed</i>
<i>Vegetation</i>	<i>Monthly from November through April Annually Required</i>	<i>Specified or approved grass grows so tall that it competes with shrubs and/or becomes a fire danger</i>	<i>String trim non-wetland grasses to 4 inch to 6 inch and remove clippings; protect woody vegetation</i>

Stormwater Facilities Operations & Maintenance Checklist

DRAWING NUMBER: ST-6115

DRAWN BY: SR

SCALE: N.T.S.

FILE NAME: ST-6115.DWG

APPROVED BY: NK

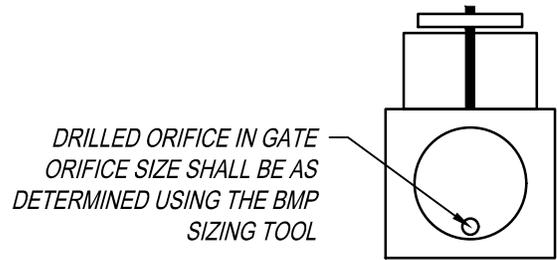
DATE: 10/3/14

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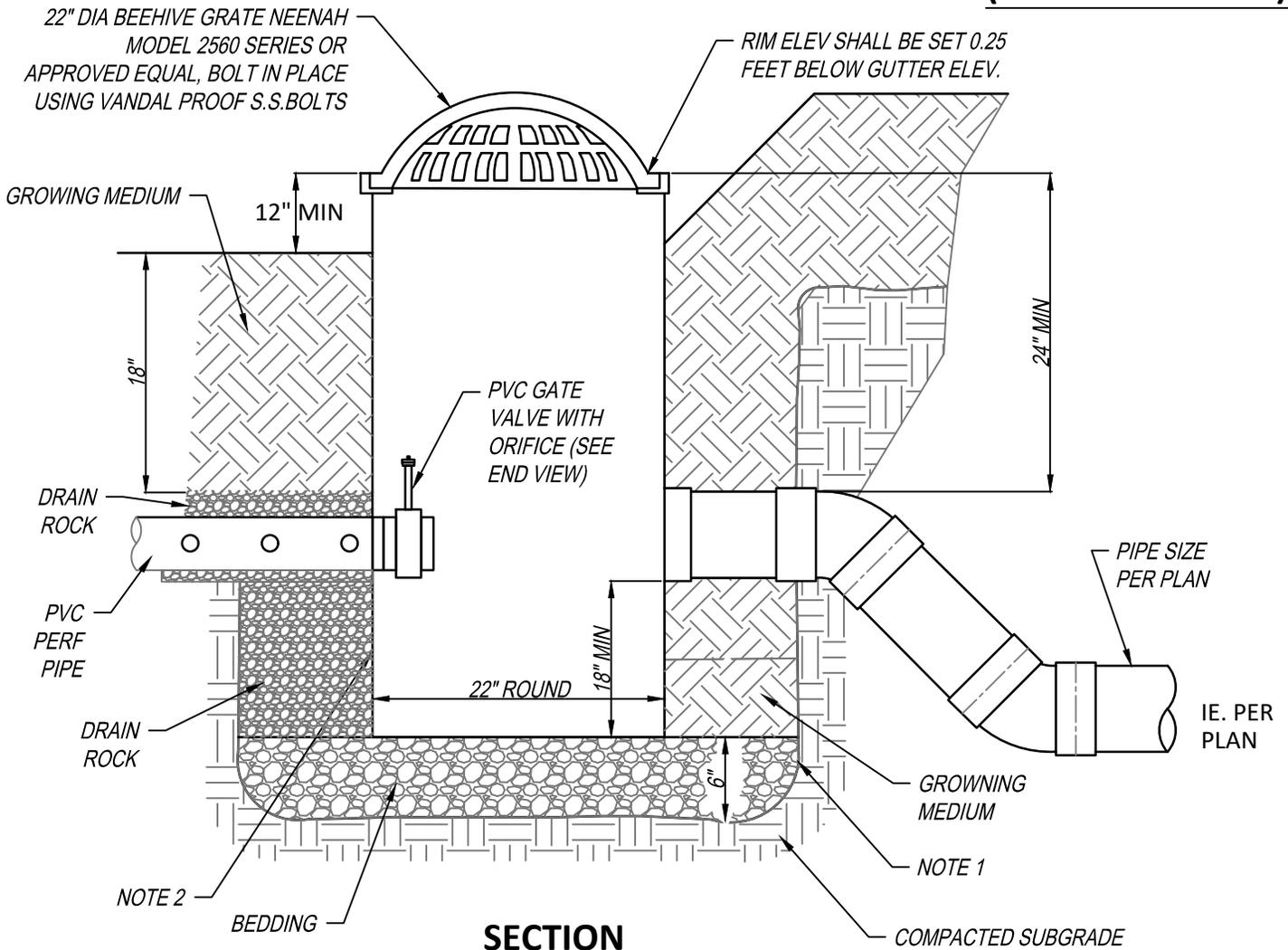


PUBLIC WORKS STANDARDS

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**END VIEW
(PVC GATE VALVE)**



NOTES:

1. CONTRACTOR TO WIDEN EXCAVATION AS REQUIRED TO OBTAIN COMPACTION WITH CONTRACTORS COMPACTION EQUIPMENT.
2. 10 GA. STEEL PLATE, BITUMINOUS COATED BASIN AS MANUFACTURED BY GIBSON STEEL, GRATEMASTER OR APPROVED EQUAL.
3. BEDDING SHALL BE 6" OF COMPACTIONED 3/4"-0 CRUSHED ROCK BASE MATERIAL.

Beehive Overflow Inlet			CITY OF WILSONVILLE  PUBLIC WORKS STANDARDS
DRAWING NUMBER: ST-6120	DRAWN BY: SR	SCALE: N.T.S.	
FILE NAME: ST-6120.dwg	APPROVED BY: NK	DATE: 2/15/18	

Appendix C
Traffic Impact Study



Wilsonville Frog Pond Stafford Meadows *Transportation Impact Study*

Developed for



Developed by



October 2018



117 Commercial St NE
Suite 310
Salem, OR 97301
503.391.8773
dksassociates.com

October 16, 2018

Steve Adams
City of Wilsonville
29799 Town Center Loop East
Wilsonville, OR 97070

Subject: Wilsonville Frog Pond Stafford Meadows Transportation Impact Study P18005-006

Dear Steve,

DKS Associates is pleased to submit this transportation impact study for the proposed Frog Pond Stafford Meadows subdivision located off Boeckman Road between SW Canyon Creek Road and SW Stafford Road in Wilsonville, Oregon.

Please feel free to call if you have any questions or comments regarding this study.

Sincerely,
DKS Associates

Scott Mansur, P.E., PTOE
Transportation Engineer



EXPIRES: 12-31-2018

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CHAPTER 1: INTRODUCTION

This study evaluates the transportation impacts associated with the proposed Frog Pond Stafford Meadows, Phases 2 through 5 residential development of tax parcels 31W12D 01500, 31W12D 01700, 31W12D 01800, 31W12D 01902, 31W12D 01903, and portions of 31W12D 02000 and 31W12D 02200 located on the north side of Boeckman Road and west of SW Stafford Road in Wilsonville, Oregon. The project consists of a maximum of 137 single-family homes. For the purposes of a worst-case transportation evaluation, the maximum development density will be assumed for this analysis. The existing lots include three existing single-family homes that will be removed. An aerial photo of the project location is shown in Figure 1.

This development is part of the Frog Pond West Master Plan that was adopted by the Wilsonville City Council on July 17, 2017 as a supporting document to the Wilsonville Comprehensive Plan. The proposed land use and internal roadway network is consistent with the Frog Pond West Master Plan.

The purpose of this transportation impact analysis is to identify potential mitigation measures needed to offset transportation impacts that the proposed development may have on the nearby transportation network. The impact analysis is focused on the study intersections, which were selected for evaluation in coordination with City staff. The intersections are shown in Figure 2 and listed below:

- Boeckman Road/SW Parkway Avenue
- Boeckman Road/Canyon Creek Road
- Boeckman Road-Advance Road/SW Stafford Road-Wilsonville Road
- Wilsonville Road/Town Center Loop West
- Wilsonville Road/Town Center Loop East-Memorial Drive

This chapter introduces the proposed development. Table 1 lists important characteristics of the study area and proposed project.

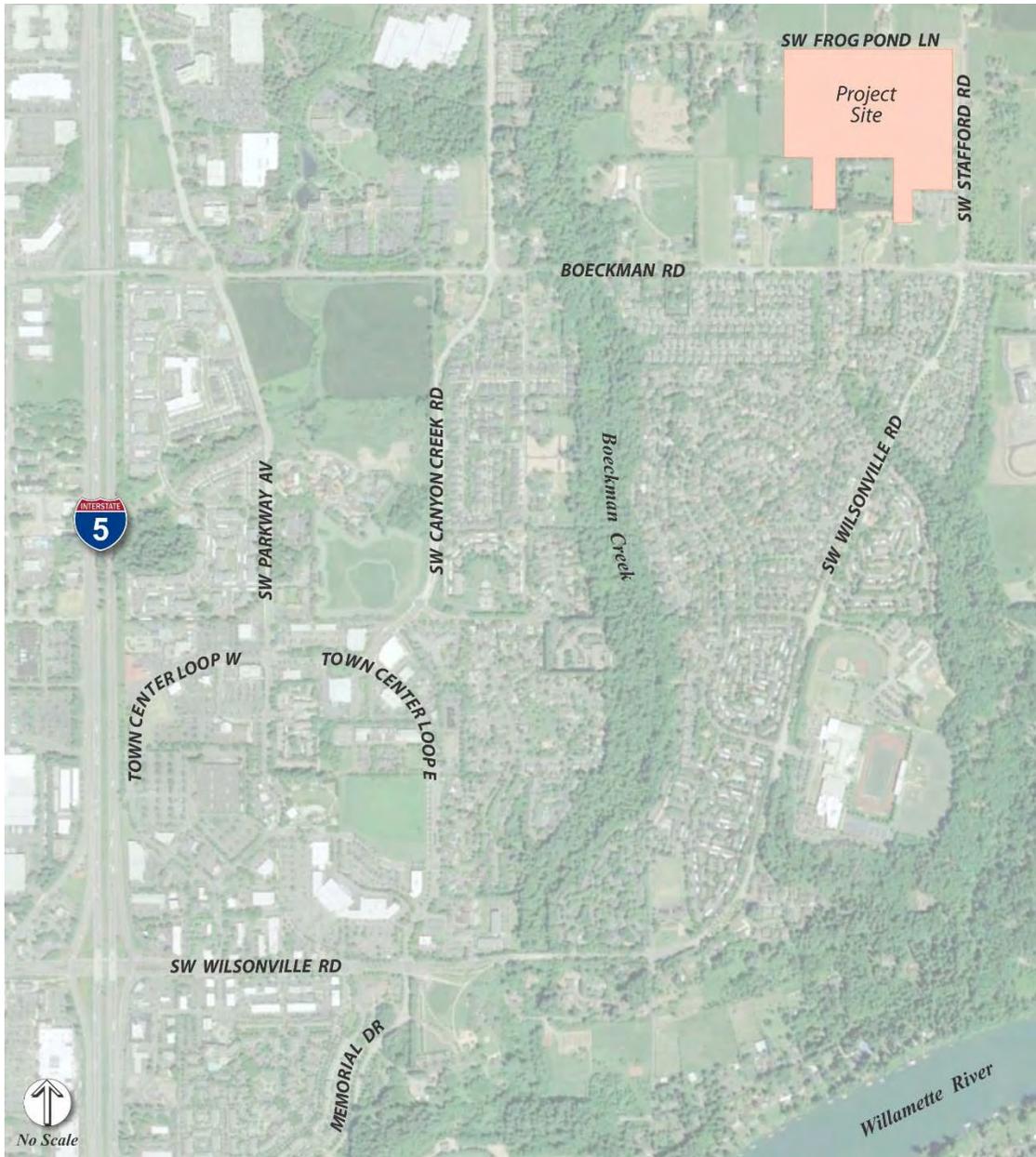


Figure 1: Study Area Aerial Photo



Figure 2: Study Area Map

Table 1: Key Study Area and Proposed Development Characteristics

Characteristics	Information
Study Area	
Number of Study Intersections	5
Analysis Period	Weekday PM Peak Hour (Peak hour between 4-6 PM)
Project Site	
Existing Land Use	3 existing single-family homes
Proposed Development	137 single-family homes
Project Access	One access forming the fourth leg of SW Boeckman Road/SW Willow Creek Drive, one access along the west side of SW Stafford Road north of SW Boeckman Road, and access from the existing SW Frog Pond Lane

CHAPTER 2: EXISTING CONDITIONS

This chapter provides documentation of existing study area conditions, including the study area roadway network, pedestrian and bicycle facilities, and existing traffic volumes and operations. Supporting details for volumes and operations are provided in the appendix.

Project Site

The project sponsor plans to demolish three existing homes and develop a 137-lot subdivision (134 net new homes) in the Frog Pond West Master Plan area of Wilsonville.

Study Area Roadway Network

Key roadways in the study area are summarized in Table 2 along with their existing (or proposed) roadway characteristics. It should be noted that Boeckman Road is currently 2 lanes but is planned to be built to a three-lane roadway with bike lanes and sidewalk, with construction anticipated to occur in the next three years. The functional classifications for City of Wilsonville streets are provided in the *City of Wilsonville Transportation System Plan (TSP)*.¹

Table 2: Study Area Roadway Characteristics (within the Study Area)

Roadway	Classification	No. of Lanes	Posted Speed	Sidewalks	Bike Lanes	On-Street Parking
Boeckman Road	Minor Arterial	2	40 mph	Yes/No ^a	Yes/No	No
SW Parkway Avenue	Minor Arterial	3	40 to 45 mph ^d	Yes/No ^b	Yes/No ^b	No
Canyon Creek Road	Minor Arterial	3	30 to 35 mph ^e	Yes	Yes	No
SW Stafford Road	Major Arterial	2	45 - 35 mph	No	No	No
Wilsonville Road	Major Arterial	4	25 - 35 mph	Yes	Yes	No
Town Center Loop West	Major Arterial	4 ^c	35 mph	Yes	No	No
Town Center Loop East	Collector	3	35 mph	Yes	Yes	No
Memorial Drive	Collector	2	25 mph	Yes	Yes	No

^a No sidewalk along north side between Canyon Creek Road and Stafford Road

^b Sidewalk and bike lane missing along segments of SW Parkway Ave

^c Only one southbound receiving lane at Wilsonville Road

^d Speed is 45 mph north of Boeckman and 40 mph south of Boeckman

^e Speed is 35 mph north of Boeckman and 30 mph south of Boeckman

¹ *Wilsonville Transportation System Plan*, Adopted by Council, June 2013.

Pedestrian and Bicycle Facilities

Near the project site, Boeckman Road is classified by the City as a minor arterial but is unimproved and does not currently have curbs, gutters, or bike lanes. A sidewalk does exist along most of the south side of the roadway. A section of Boeckman Road to the west of the project site is mostly improved, lacking only a sidewalk along the north side.

Public Transit Service

South Metro Area Regional Transit (SMART) operates several fixed routes that serve Wilsonville and the surrounding area.² Route 6 travels on Boeckman Road and Canyon Creek Road and provides service between the SMART Central Station in Wilsonville to the commercial area at SW Elligsen Road, Canyon Creek Road, SW Parkway Center Drive, and SW Burns Way. There are two stops along Route 6 that are located on Boeckman Road, and one stop on Canyon Creek Road at Boeckman Road.

Additionally, Route 4 travels on SW Advance Road and SW Wilsonville Road and provides service between Meridian Creek Middle School, the SMART Central Station, Wilsonville Old Town Square, and the Graham Oaks Nature Park/Boones Ferry Primary School. Stops near the project site include one at SW Wilsonville Road/SW Landover Drive, and one at the Meridian Creek Middle School.

Future Planned Projects

Higher Priority Projects

The following is a list of higher priority projects included in the Wilsonville TSP³. A map of these improvements can be seen in the appendix.

- **BW-04 Boeckman Road Bike Lanes and Sidewalk Infill:** Construct bike lanes (both sides of street) and sidewalks (south side of street) from Parkway Avenue to Canyon Creek Road. Restriping was completed in 2013 to add bike lanes. A sidewalk on the south side will be constructed when the vacant property on the south side of Boeckman Road develops.
- **RE-12A Frog Pond West Neighborhood Collector Roads:** Construct the collector roadways within the west neighborhood as identified in the Frog Pond Area Plan.
- **RT-01A Boeckman Creek Trail (North):** Construct north-south trail through east Wilsonville following Boeckman Creek, with connections to neighborhoods, parks, and

² South Metro Area Regional Transit (SMART) operates several fixed routes that serve Wilsonville and make connections to TriMet in Portland, Cherriots in Salem, and Canby Area Transit. The City's transit center, "SMART Central at Wilsonville Station," provides connections to all SMART routes and to TriMet's Westside Express Service (WES) commuter rail station.

³ *Wilsonville Transportation System Plan*, Adopted by Council, June 2013.

intersection roads (may need a boardwalk for various sections and would require a comprehensive public process).

- **RW-01 Boeckman Road Bridge and Corridor Improvements:** Widen Boeckman Road from Boberg Road to 500 feet east of Parkway Avenue to include additional travel lanes in both directions along with bike lanes and sidewalks; project includes reconstruction of the bridge over I-5 and improvement at Boeckman Road/Boberg Road and Boeckman road/Parkway Avenue intersections.
- **UU-01 Boeckman Road Dip Improvements:** Upgrade at vertical curve east of Canyon Creek Road to meet applicable cross-section standards (i.e., 3 lanes with bike lanes, sidewalks, and transit stop improvements); options should also be considered to make connections to the regional trail system and to remove the culvert and install a 2-lane bridge with pedestrian and bicycle facilities. Project also includes the installation of a traffic signal at Boeckman Road/Canyon Creek Road.
- **UU-02 Boeckman Road Urban Upgrade:** Upgrade along the Frog Pond West frontage to meet Frog Pond West Master Plan cross-section standards (i.e., 3 lanes with bike lanes, sidewalks, and transit stop improvements); project includes a traffic signal or roundabout at the Boeckman Road-Advance Road/Stafford Road-Wilsonville Road intersection. A traffic signal has already been constructed as part of this project at Boeckman Road-Advance Road/Stafford Road-Wilsonville Road.
- **UU-05 Parkway Avenue Urban Upgrade:** Upgrade to meet applicable cross-section standards (i.e., 3 lanes with bike lanes, sidewalks, and transit stop improvements).
- **UU-06 Stafford Road Urban Upgrade:** Upgrade to meet applicable cross-section standards (i.e., 3 lanes with bike lanes, sidewalks, and transit stop improvements).
- **UU-10 Advance Road Urban Upgrade:** Upgrade Advance Road to collector standards starting at Stafford Road to the proposed 63rd Avenue (entrance to proposed Meridian Creek Middle School). The south side has been completed with a bike lane, curbs, gutter, and a sidewalk.

Additional Planned Projects

The following is a planned but unfunded project included in the Wilsonville TSP near the project site. A map of this improvement location can be seen in the appendix.

- **LT-P4 Canyon Creek Trail:** Shared Use Path from Canyon Creek Park to Boeckman Creek Trail providing connectivity to neighborhoods to the south.

Existing Traffic Volumes and Operations

Existing PM peak hour traffic operations were analyzed at the following study intersections based on coordination with city staff⁴:

- Boeckman Road/SW Parkway Avenue
- Boeckman Road/Canyon Creek Road
- Boeckman Road-Advance Road/SW Stafford Road-Wilsonville Road
- Wilsonville Road/Town Center Loop West
- Wilsonville Road/Town Center Loop East-Memorial Drive

Intersection turn movement volumes were collected⁵ at these intersections during two consecutive PM peak periods when schools were in session. The average two-day volume was used in the intersection operations analysis and is shown in Figure 3. The following sections describe intersection performance measures, required operating standards, and existing operating conditions.

⁴ Email from Steve Adams, December 6, 2017.

⁵ Traffic data for all study intersections was collected on September 5th and September 6th, 2018 by All Traffic Data.

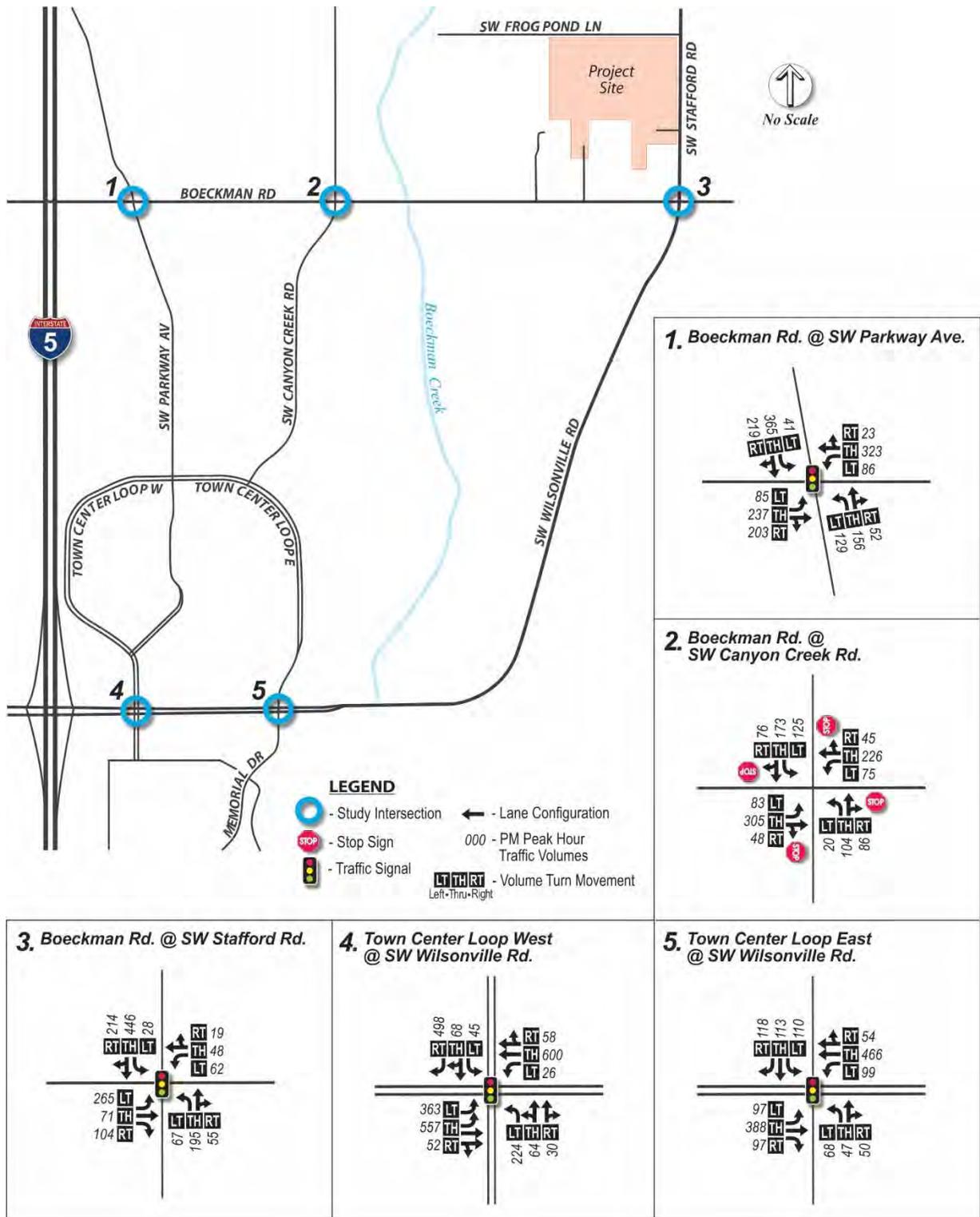


Figure 3: Existing PM Peak Hour Traffic Volumes

Intersection Performance Measures

Level of service (LOS) ratings and volume-to-capacity (v/c) ratios are two commonly used performance measures that provide a good picture of intersection operations.

- **Level of service (LOS):** A “report card” rating (A through F) based on the average delay experienced by vehicles at the intersection.⁶ LOS A, B, and C indicate conditions where traffic moves without significant delays over periods of peak hour travel demand. LOS D and E are progressively worse operating conditions. LOS F represents conditions where average vehicle delay has become excessive and demand has exceeded capacity.
- **Volume-to-capacity (v/c) ratio:** A decimal representation (typically between 0.00 and 1.00) of the proportion of capacity that is being used at a turn movement, approach leg, or intersection. It is determined by dividing the peak hour traffic volume by the hourly capacity of a given intersection or movement. A lower ratio indicates smooth operations and minimal delays. As the ratio approaches 1.00, congestion increases, and performance is reduced. If the ratio is greater than 1.00, the turn movement, approach leg, or intersection is oversaturated and usually results in excessive queues and long delays.

Required Operating Standards

The City of Wilsonville requires study intersections on public streets to meet its minimum acceptable level of service (LOS) standard, which is LOS D per overall intersection for peak periods.⁷

Existing Operating Conditions

Existing traffic operations at the study intersections were determined for the PM peak hour based on the 2000 Highway Capacity Manual (HCM) methodology for signalized intersections, while unsignalized intersections were analyzed with 2010 HCM methodology.⁸ The results were then compared with the City of Wilsonville’s minimum acceptable level of service (LOS) operating standard of LOS D or better. Table 3 lists the estimated delay, LOS, and v/c ratio of each study intersection. The existing study intersections currently meet operating standards.

⁶ A description of Level of Service (LOS) is provided in the appendix and includes a list of the delay values (in seconds) that correspond to each LOS designation.

⁷ *City of Wilsonville Code*, City of Wilsonville Section 4.140(.09)J.2., p.166.

⁸ *2000 & 2010 Highway Capacity Manual*, Transportation Research Board, Washington DC, 2000/2010.

Table 3: Existing PM Peak Study Intersection Operations

Intersection	Operating Standard	Existing PM Peak		
		Delay	LOS	v/c
Signalized				
Boeckman Road/SW Parkway Avenue	LOS D	34.4	C	0.82
Boeckman Road-Advance Road/SW Stafford Road-Wilsonville Road	LOS D	25.6	C	0.83
Wilsonville Road/Town Center Loop West	LOS D	36.7	D	0.65
Wilsonville Road/Town Center Loop East-Memorial Drive	LOS D	30.3	C	0.43
Unsignalized				
Boeckman Road/Canyon Creek Road	LOS D	32.7	C/D	0.78

Signalized Intersections:

Delay = Average Stopped Delay per Vehicle (sec)
 LOS = Level of Service of Intersection
 v/c = Volume-to-Capacity Ratio of Intersection

Unsignalized Intersections:

Delay = Average Stopped Delay per Vehicle (sec) at Worst Movement
 LOS = Level of Service of Major Street/Minor Street
 v/c = Volume-to-Capacity Ratio of Worst Movement

CHAPTER 3: PROJECT IMPACTS

This chapter reviews the impacts that the proposed Frog Pond Stafford Meadows development may have on the study area transportation system. This analysis includes site plan evaluation, trip generation, trip distribution, and future year traffic volumes and operating conditions for the five study intersections.

Proposed Development

The proposed development involves removing three existing homes and constructing a 137-lot subdivision (134 net new homes). This development will have three access points: one access point forming the fourth leg of SW Boeckman Road/SW Willow Creek Drive intersection, one access point along the west side of SW Stafford Road north of SW Boeckman Road, and access from the existing SW Frog Pond Lane. The proposed access locations are consistent with the Frog Pond West Master Plan street plan.

The major roadway connections are consistent with the Frog Pond Area Plan for the internal roadway network, as shown in the appendix.

Trip Generation

Trip generation is the method used to estimate the number of vehicles added to site roadways and the adjacent roadway network by a development during a specified period (i.e., such as the PM peak hour). For this study, typical ITE 10th Edition trip generation data was used which is based on national land use data.

Table 4 provides the trip generation for the proposed residential development, taking into account the removal of the three existing homes, of which two will be removed in Phase 3 and one will be removed in Phase 4.

A prior Frog Pond West Hills development traffic impact analysis with Stage II approval showed Phase 1 developing 50 units.⁹ After Stage II approval, the final number of units developed in Phase 1 was reduced to 44 units.¹⁰ To avoid double-counting the trips generated by the surplus, six units were reduced from Phase 2 of the proposed subdivision.

The development is expected to generate approximately 129 total (81 in, 48 out) PM peak hour trips at the end of Phase 5. The trip generation for the final 131 homes was calculated using the ITE 10th Edition equation rate. To determine the portion of trips from each prior phase, the 131 homes were used to calculate an average rate which turned out to be 1.01 trips per home. This rate was then used to calculate the trips generated by each phase of the development as well

⁹ Frog Pond West Hills TIA. DKS Associates. January 30, 2018.

¹⁰ Email from Steve Adams, City of Wilsonville, September 13, 2018.

as for the existing homes. Note that previous developments have used a rate of 1.02 trips per home, or greater, due to the non-linear ITE trip generation equation.

Table 4: PM Peak Hour Primary Trip Generation

Construction Phase	Proposed Units	Units to Be Removed	Subtotal Units	Cumulative Units	Trip Rate per Unit	PM Trips (based on cumulative units)			
						In	Out	Total	
Phase 2	10	6	4	4		3	1	4	
Phase 3A	42	2	40	44		28	16	44	
Phase 3B	24	0	24	68	1.01 ^b	44	25	69	
Phase 4A	26	1	25	93		59	35	94	
Phase 4B	22	0	22	115		73	43	116	
Phase 5	13	0	13	128		81	48	129	
Total Units	137	9	128	Total PM Trips (through Phase 5)			81	48	129

^aThe six units removed in Phase 2 account for the surplus in units previously Stage II approved in the Phase 1 developed.

^bRate calculated from ITE equation output using 137 total single-family homes

Trip Distribution

Trip distribution provides an estimate of where project-related trips would be coming from and going to. It is given as percentages at key gateways to the study area and is used to route project trips through the study intersections. Figure 4 on the following page shows the expected trip distribution and project trip routing for the additional traffic generated by the Frog Pond Stafford Meadows project. The distribution shows 10% of trips southbound on Wilsonville Road at Boeckman Road, but only half of those trips are expected to continue through the Town Center Loop intersections. The trip distribution was estimated using the City of Wilsonville travel demand model and is consistent with what was assumed for the Frog Pond Area Plan.¹¹

¹¹ Wilsonville Travel Forecast Model, select zone model run for Frog Pond Zone.

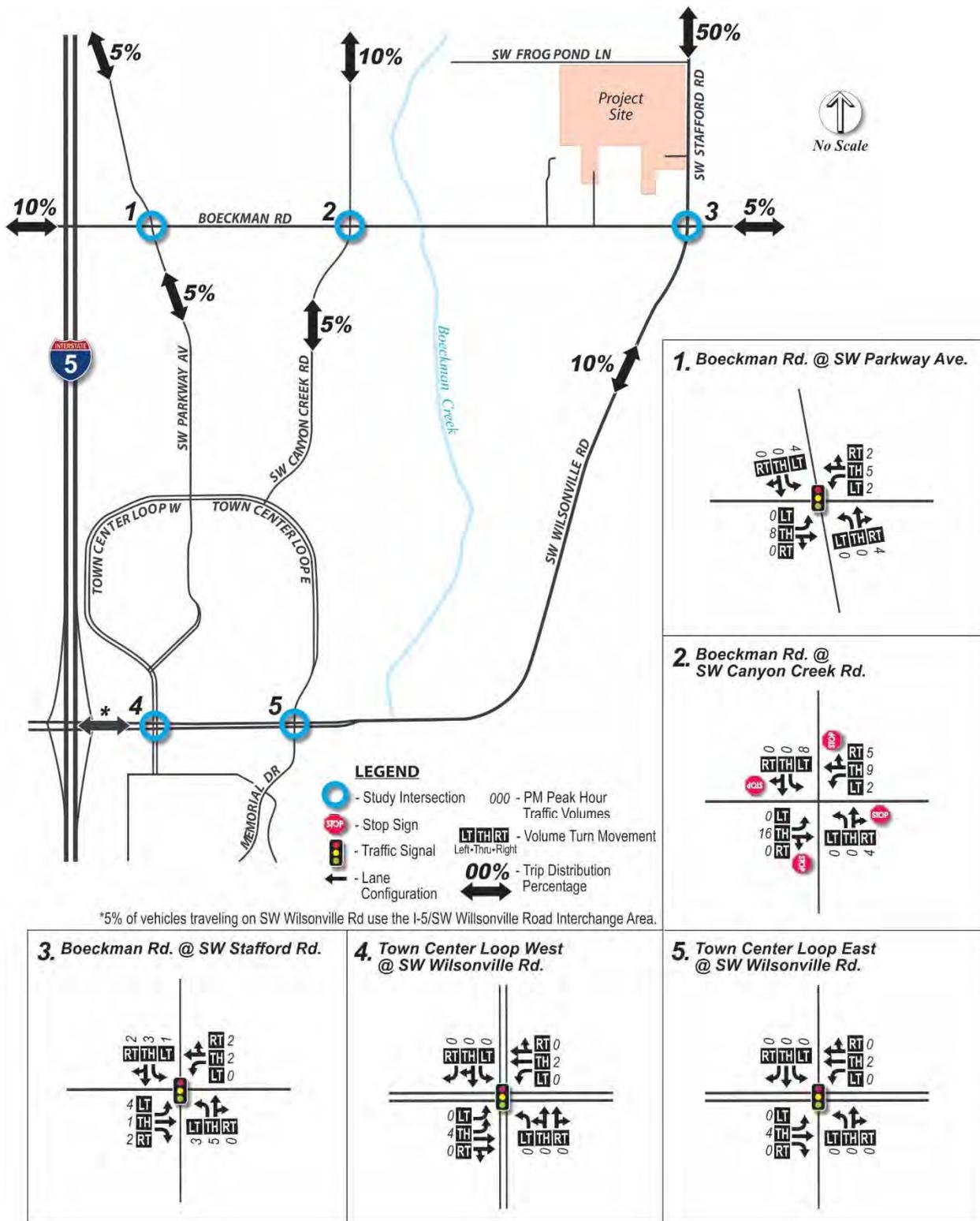


Figure 4: Trip Distribution and Project Trips

Project Trips Through City of Wilsonville Interchange Areas

The project trips through the two City of Wilsonville I-5 interchange areas were estimated based on the trip generation and distribution assumptions from the Frog Pond Area Plan:

“The primary reason why the Area Plan scenario results only in minor changes to the I-5 interchange ramp operating conditions is because the Area Plan is not dependent upon I-5 for interstate access, and as congestion on I-5 increases, alternative routes are expected to be utilized by more drivers. Due to the proximity of the project area to Stafford Road and I-205, less than 10 percent of Area Plan trips are expected to use I-5 during the p.m. peak hour. While approximately 40% of Area Plan trips are expected use Stafford Road to access I-205, only 3% are expected to access I-5 at the Elligsen Road interchange and 5% are expected to use the Wilsonville Road interchange.”¹²

Utilizing the same trip distribution assumptions for the Area Plan, the proposed Frog Pond Stafford Meadows residential development is expected to generate four PM peak hour trips through the I-5/SW Elligsen Road interchange area and six PM peak hour trips through the I-5/Wilsonville Road interchange area.

Future Traffic Volumes and Operating Conditions

Future operating conditions were analyzed at the study intersections for the following future traffic scenarios. The comparison of the following scenarios enables the assessment of project impacts:

- Existing + Stage II (includes traffic from other developments with Stage II approval or are under construction)
- Existing + Project
- Existing + Project + Stage II

Future traffic volumes were estimated at the study intersections for each scenario. The future operating scenarios include various combinations of three types of traffic: existing, project, and Stage II. Stage II development trips are estimated based on the list of currently approved Stage II developments provided by City staff.¹³ The Stage II list and the corresponding PM peak hour trip generation estimates for these developments are included in the appendix. It is important to note that since the proposed Frog Pond Stafford Meadows Phase 1 subdivision is now approved, it was included in the Stage II volumes. Figure 5 and Figure 6 on the following pages show the PM peak hour traffic volumes used to analyze the “Existing plus Stage II” scenario and the “Existing plus Project plus Stage II” scenario respectively.

¹² Frog Pond Area Plan Technical Appendix D: Transportation Analyses, Frog Pond Area Plan Existing and Baseline Transportation Analysis

¹³ Email from Daniel Pauly, City of Wilsonville, September 10, 2018.

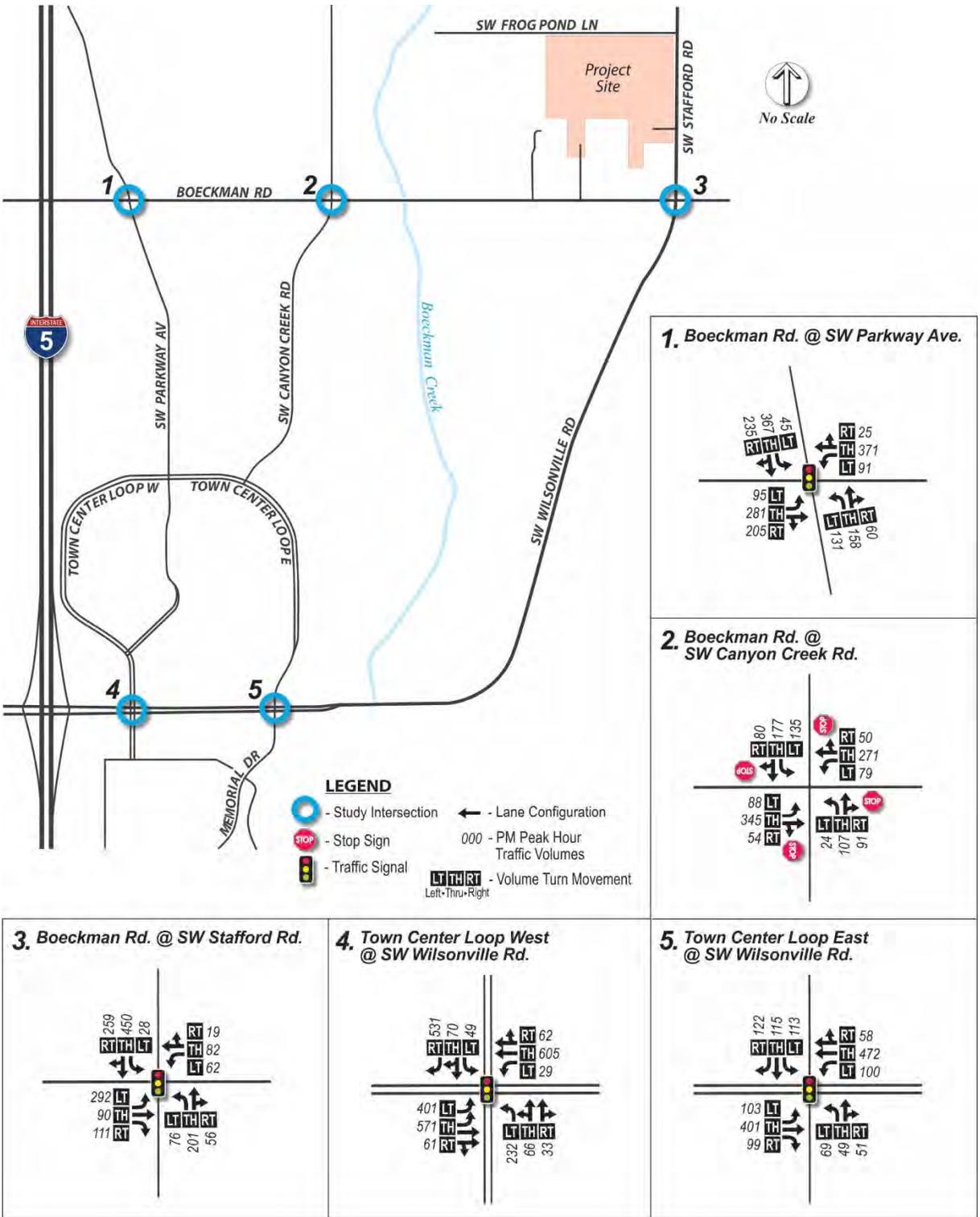


Figure 5: Existing plus Stage II PM Peak Hour Traffic Volumes

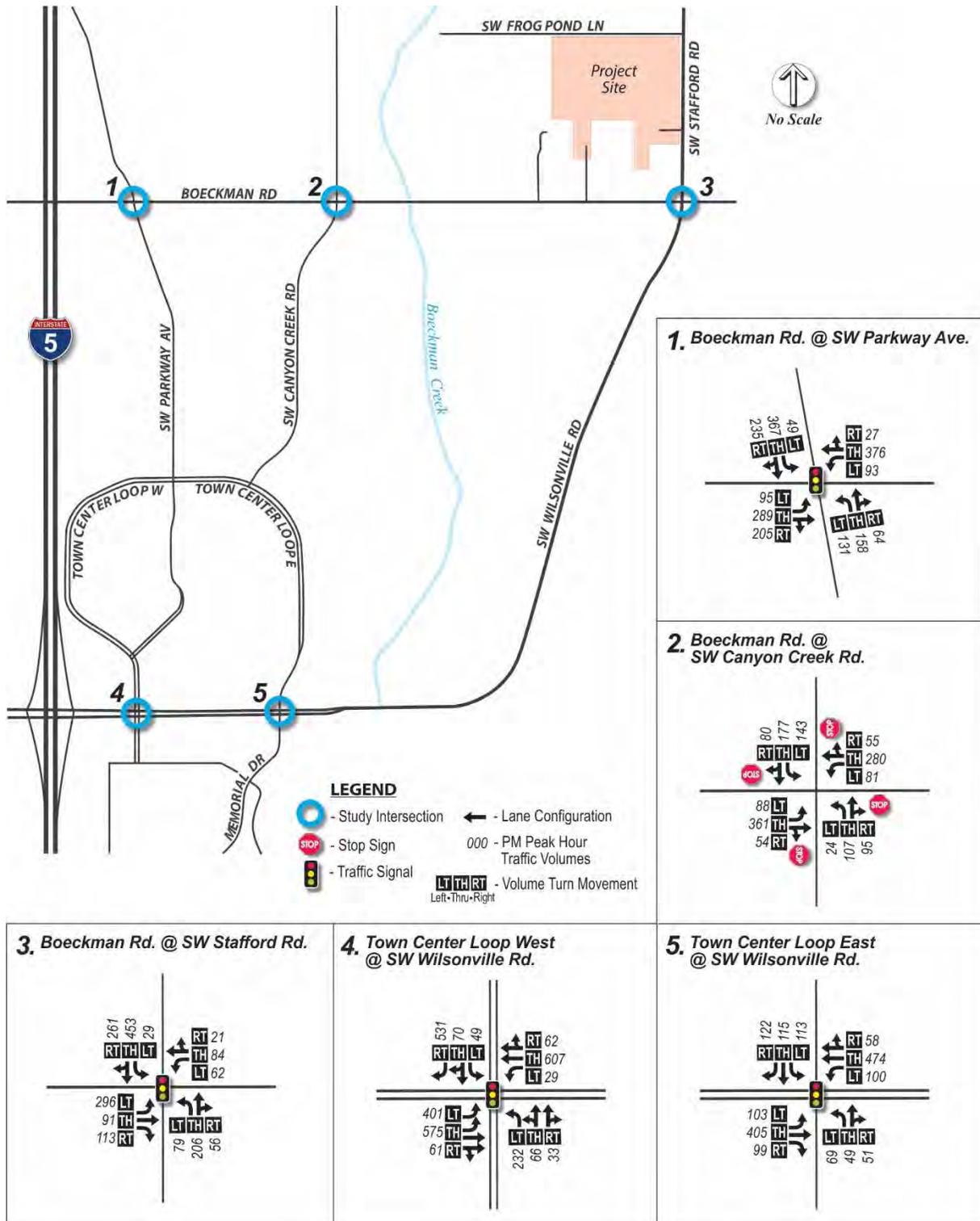


Figure 6: Existing plus Project plus Stage II PM Peak Hour Traffic Volumes

Intersection Operations

The study intersection operating conditions for the project trips after project development and future Stage II developments are listed in Table 5. All study intersections meet operating standards for “Existing plus Project” and “Existing plus Stage II” scenarios. However, the intersection of Boeckman Road/Canyon Creek Road does not meet the LOS D operation standards in the “Existing plus Project plus Stage II” scenario.

Table 5: Future Project and Stage II Intersection Operations Comparison

Intersection	Operating Standard	Existing + Project			Existing + Stage II			Existing + Project + Stage II		
		Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS	v/c
Signalized										
Boeckman Road/SW Parkway Avenue	LOS D	35.0	D	0.82	39.8	D	0.86	40.7	D	0.87
Boeckman Road-Advance Road/SW Stafford Road-Wilsonville Road	LOS D	25.3	C	0.84	33.8	C	0.90	33.6	C	0.92
Wilsonville Road/Town Center Loop West	LOS D	36.7	D	0.65	38.2	D	0.69	38.1	D	0.69
Wilsonville Road/Town Center Loop East-Memorial Drive	LOS D	30.3	C	0.43	30.0	C	0.44	30.0	C	0.44
Unsignalized										
Boeckman Road/Canyon Creek Road	LOS D	25.3	D	0.84	33.7	D	0.94	39.0	E	0.99

Signalized Intersections:

Delay = Average Stopped Delay per Vehicle (sec)
 LOS = Level of Service of Intersection
 v/c = Volume-to-Capacity Ratio of Intersection

Unsignalized Intersections:

Delay = Average Stopped Delay per Vehicle (sec) at Worst Movement
 LOS = Level of Service of Major Street/Minor Street
 v/c = Volume-to-Capacity Ratio of Worst Movement

Bold/Highlighted: Intersection fails to meet operating standard

As shown, the intersection of Boeckman Road/Canyon Creek Road does not meet the LOS D operating standards in the “Existing plus Project plus Stage II” scenario. This intersection will be studied further in the next section.

Additionally, the intersection of Boeckman Road/SW Parkway Avenue is close to falling below the LOS D standard. As Frog Pond develops, operations at this intersection will continue to degrade and may trigger the need for improvements at this intersection as identified as part of the City of Wilsonville TSP project RW-01: Boeckman Road Bridge and Corridor Project.

Mitigation

The intersection of Boeckman Road/Canyon Creek Road operates at an overall LOS E in the scenario with Stage II volumes and project trips (through Phase 5) added to the existing network. Therefore, mitigation measures must be explored to bring the operations back up to LOS D or better, in order to meet the City of Wilsonville standards. Based on evaluation, this intersection fails to meet standards with the buildout of Phase 3A and would continue to fail for all phases afterwards unless mitigations are made.

The Wilsonville Transportation System Plan shows a traffic signal as a high priority project at the intersection of Boeckman Road/Canyon Creek Road as part of project UU-01. To mitigate future impacts of the transportation system, it is recommended that the planned project to signalize the Boeckman Road/Canyon Creek Road intersection described in the Wilsonville TSP be completed. This mitigation was assumed in the following analysis. The same lane geometry and channelization as the existing scenario were assumed.

The construction of a new traffic signal at Boeckman Road/Canyon Creek Road should be coordinated with the other tasks in the project UU-01 Boeckman Road Dip Improvements. This project includes a bridge, sidewalks, and bike lanes across Boeckman Creek. Coordination will be necessary to avoid replacing the new traffic signal when the bridge is constructed.

The “Existing plus Project plus Stage II” scenario is shown with the recommended traffic signal mitigation in Table 6. As shown, the addition of a traffic signal will improve operations to level of service “A”.

Table 6: Future Project and Stage II Intersection Operations with Mitigation

Intersection	Operating Standard	Existing + Project + Stage II (Mitigated)		
		Delay	LOS	v/c
Boeckman Road/Canyon Creek Road	LOS D	7.7	A	0.51

Signalized Intersections:

Delay = Average Stopped Delay per Vehicle (sec)

LOS = Level of Service of Intersection

v/c = Volume-to-Capacity Ratio of Intersection

With the addition of a traffic signal at the Boeckman Road/Canyon Creek Road intersection, all study intersections meet operation standards.

Driveway Analysis

This section analyzes the traffic operations at the two proposed driveways located on Stafford Road. The northern driveway is located on Frog Pond Lane and the southern driveway is located approximately 900 feet north of the Boeckman Road-Advance Road/SW Stafford Road-Wilsonville Road intersection.

Both driveways will have an eastbound shared left/right lane, no turn lanes on Stafford Road, and the minor street approach will be stop-controlled. The results of the driveway analysis is shown in Table 7 below for the Existing + Project + Stage II scenario. As shown, both intersections indicate LOS D for the minor street approach.

Table 7: Driveway Operations

Intersection	Existing + Project + Stage II		
	Delay	LOS	v/c
Stafford Road/Driveway North (Frog Pond Lane)	32.0	A/D	0.11
Stafford Road/Driveway South	26.4	A/D	0.09

Unsignalized Intersections:

Delay = Average Stopped Delay per Vehicle (sec) at Worst Movement

LOS = Level of Service of Major Street/Minor Street

v/c = Volume-to-Capacity Ratio of Worst Movement

Site Plan Evaluation

A site plan showing the proposed development can be found in the appendix. The site plan shows sufficient space for two-way motor vehicle circulation throughout the neighborhood.

The site access to the proposed Frog Pond Stafford Meadows site includes one access forming the fourth leg of SW Boeckman Road/SW Willow Creek Drive, one access along the west side of SW Stafford Road north of SW Boeckman Road, and access via the existing SW Frog Pond Lane. The proposed access locations are consistent with the Frog Pond West Master Plan, as shown in the appendix.

With the adoption of the Frog Pond West Infrastructure Funding Plan, the City has agreed to undertake the design and re-construction of both Boeckman Road and Stafford Road adjacent to the Frog Pond West development. The developer will pay their cost share through the per lot Frog Pond West Infrastructure Supplemental Fee to be paid at the time building permits are issued. The City anticipates the project design Boeckman Road to occur in FY 2018/19; construction is anticipated to occur by 2021, however that is dependent on when sufficient Infrastructure Supplemental Fees have accrued. Design and re-construction of Stafford Road is not anticipated to occur for some five to ten years, dependent on the pace of development within the Frog Pond West neighborhood.

Bicycle and Pedestrian Facilities

The site plan shows sidewalks on all internal streets. Additionally, in conformance with the Frog Pond West Transportation Master Plan, the planned extension of Willow Creek Drive will have buffered bike lanes up to the new Brisbane Street, then have sharrow travel lanes up to Frog

Pond Lane. The re-constructed Frog Pond Lane will have buffered bike lanes up to Willow Creek Drive.

The Frog Pond Stafford Meadows Phase 1 project is currently in progress and includes three pedestrian connections to Boeckman Road. Stafford Meadows Phase 1 will also include buffered bike lanes along the new Willow Creek Drive. A pedestrian connection from the Frog Pond Stafford Meadows Phase 1 site to the Boeckman-Advance / Stafford-Wilsonville Road intersection will provide access for children walking and biking to Boeckman Primary School, Meridian Creek Middle School, and Wilsonville High School.

It is recommended that as the project phases are built, safe and continuous routes for pedestrians be evaluated in the study area. Continuous sidewalks from the housing units to Stafford Road and the intersection of Stafford Road/Boeckman Road should be provided. If infill is needed, it could include a temporary pathway on the west side of Stafford Road or internal sidewalks and pathways in the project area. The pathway on Stafford Road would be temporary until the Stafford Road urban upgrade (TSP Project UU-06) is built.

Access Spacing and Sight Distance

All proposed access points meet the City's required spacing between intersections. The proposed access locations are consistent with the Frog Pond Area Plan.

Prior to occupancy, sight distance at any proposed access points will need to be verified, documented, and stamped by a registered professional Civil or Traffic Engineer licensed in the State of Oregon to assure that buildings, signs or landscaping does not restrict sight distance.

Project Impact Summary

The Frog Pond Stafford Meadows development is anticipated to result in the following impacts:

Trip Generation

- The development consists of 137 single-family homes, to be built in six phases. The development will remove 3 existing homes, for a net increase of 134 homes. The removal of 6 homes from the Frog Pond West Hills development was accounted for in the trip generation for the first construction phase that had Stage II approval.
- The development is expected to generate an additional 129 (81 in, 48 out) PM peak hour trips.
- Of the 129 total project trips, four new PM peak hour trips are estimated to pass through the I-5/SW Elligsen Road interchange area and six PM peak hour trips through the I-5/Wilsonville Road interchange area.

Intersection Operations

- All the study intersections meet operating standards for “Existing plus Project” and “Existing plus Stage II” scenarios.
- The intersection of Boeckman Road/Canyon Creek Road fails under the “Existing plus Project plus Stage II” scenario at the completion of Phase 3A.
- Installing a new traffic signal at the intersection of Boeckman Road/Canyon Creek Road as recommended in project UU-01 in the Wilsonville TSP results in this intersection meeting operation standards. This project should also be coordinated with the future planned bridge that will replace the existing Boeckman Road Dip as identified in project UU-01.

Site Plan Evaluation

- The proposed internal roadway network shown on the proposed site plan is consistent with the approved Frog Pond Area Plan.

Access Spacing and Sight Distance

- The access locations are consistent with the Frog Pond Area Plan.
- Prior to occupancy, sight distance at any proposed access points will need to be verified, documented, and stamped by a registered professional Civil or Traffic Engineer licensed in the State of Oregon to assure that buildings, signs or landscaping does not restrict sight distance.