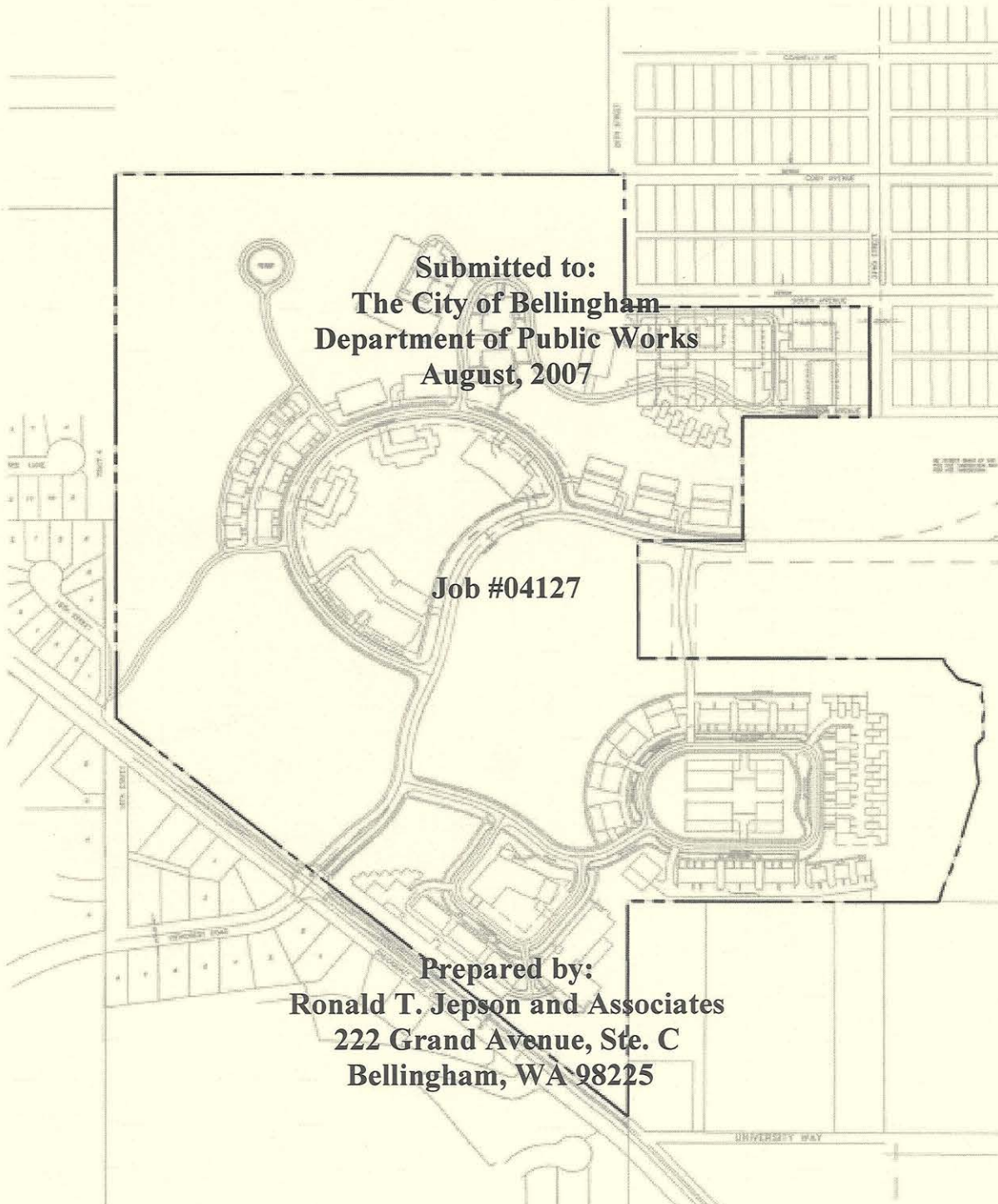




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## STORMWATER SITE PLAN FOR FAIRHAVEN HIGHLANDS





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# 1 Engineer's Declaration

I, Benjamin J. Wasson, a Professional Engineer registered in the State of Washington as a Civil Engineer, do hereby declare that this Stormwater Design Report titled "*Stormwater Site Plan for Fairhaven Highlands*" dated August 2007 was prepared by, or under my personal supervision. The report was prepared in compliance with the City of Bellingham's Development Guidelines and the Washington State Department of Ecology's 2005 Stormwater Management Manual in place at this date and in accordance with generally accepted engineering practices.

*Benjamin J. Wasson*  
Benjamin J. Wasson, PE

*8/21/2007*  
Date



## 2 Introduction

### 2.1 Project Background

Fairhaven Highlands, a proposed planned residential development, is located within the City of Bellingham, south of Fairhaven, along Chuckanut Drive, immediately adjacent and northeast of Viewcrest Road (Exhibit 1).

The Fairhaven Highlands preliminary plat application was submitted to the City of Bellingham on April 18, 2005. The design standards include the *City of Bellingham Development Standards* and the *February 2005, Washington State Department of Ecology Stormwater Management Manual for Western Washington* (SWMM).

The developer proposes to subdivide the 82.3-acre land parcel into a combination of single-family residential lots, attached duplex units, three-story stacked flats, and multi-family mid-rise structures for a total of 739 dwelling units. The preliminary analysis suggests that there will be a total impervious surface area of approximately 20 acres (includes pervious pavement areas), with the remaining acreage a combination of wetland, forest, and landscape areas.

Additional parcel information for this project is as follows:

<b>Study Name:</b>	<b>Stormwater Site Plan for Fairhaven Highlands</b>
<b>Location:</b>	<b>Portion of the NE ¼ of Section 12, Township 37, Range 2 East, W.M.</b>
<b>Legal Description:</b>	<b>Located in Appendix 1</b>
<b>Parcel Tax No.</b>	<b>370212 359328 370212 264207 370212 478165 370212 447323 370212 477313</b>
<b>Zoning:</b>	<b>Residential Multi-Planned</b>
<b>Owner:</b>	<b>Greenbriar Northwest Associates, LLC 2200 Division Street #E Bellingham, WA 98226-7149</b>
<b>Engineer/Contact</b>	<b>Benjamin J. Wasson, PE Frances Jones, EIT Ronald T. Jepson &amp; Associates 222 Grand Avenue, Suite C Bellingham, WA 98225</b>

## 2.2 *Scope of Study*

The purpose of this report is to evaluate the effects of surface runoff resulting from the proposed development of the property and to detail the methods, data, and conclusions used for the evaluation. This report also provides stormwater mitigation design recommendations that assure that post development stormwater release rates from the site do not exceed the pre-development flow rates for the design frequency storm events as required in Section 2.5.7 of Volume I of the SWMM, that the quality of stormwater runoff is not degraded, and that on and off-site wetlands are not adversely impacted by the quantity and quality of stormwater runoff resulting from the developed condition.

## 2.3 *Method of Approach*

The Western Washington Hydrology Model Version 3 (WVHM3) was used to size the stormwater facilities, bio-retention, and water quality facilities to meet the Department of Ecology's (DOE) 2005 SWMM. The model's Hydrological Simulation Program FORTRAN parameters are based on calibrated watersheds located in Western Washington. For Whatcom County, the program uses precipitation data from a gauge located in Blaine and then scales the precipitation (0.80) to a specific project site using published National Oceanic & Atmospheric Administration rainfall map data.

The model generates 40+ years of hourly runoff data for both predevelopment and post-development land use conditions. Flow duration analysis is conducted for 100 flow levels between the lower erosive zone limit (50% of the pre-development two-year flow frequency) and the upper limit (predevelopment 50-year flow frequency value). There are three criteria by which flow duration values are compared (SWMM, Vol. III, 2-9):

- If the post-development flow duration values exceed any of the predevelopment flow levels between 50% and 100% of the two-year predevelopment peak flow values (100% threshold) then the flow control standard requirement has not been met.
- If the post-development flow duration values exceed any of the predevelopment flow values between 100% of the two-year and 100% of the 50-year predevelopment peak flow values more than 10% of the time (110% threshold) then the flow control standard has not been met.
- If more than 50% of the flow duration levels exceed the 100% threshold then the flow control standard has not been met.

Existing conditions and the pre-development basin characteristics were defined using site-specific topographic data, aerial photography, and aerial topographic information obtained from the City of Bellingham (Exhibit 4). The hydrologic soil types were determined from the US Department of Agriculture's, Natural Resources Conservation Service (NRCS), and

verified/field tested by GeoEngineers: *Fairhaven Highlands Development / Geotechnical Engineering Report* dated July 27, 2007 (GeoEngineers File No. 11911-001-01).

The post-development basin characteristics were estimated utilizing the subdivision layout plan (Exhibits 7 and 8). The quantities of impervious and pervious cover were overlaid with soil types and tabulated for flow analysis. Additional drainage basins were defined to analyze each wetland, as defined by the *Wetland Delineation for the Fairhaven Highlands*, by Northwest Ecological Services, LLC (NES), dated October 2005 (Appendix 2). Special care was taken to ensure that the wetlands receive adequate post-development flow frequencies, while still matching the point of concentration flow rates as required in the SWMM.

Stormwater from the developed scenario will be treated and dispersed over native vegetation to maintain flows to the wetlands, in a manner that does not impair wetland structure and functionality. In order to conform with the most recent qualitative standards for protection of wetland hydro-periods (duration of inundation), Clear Creek Solutions (CCS) was consulted to provide wetland fluctuation analysis for Wetlands CC and KK based on climatic data from 1948 to 2007. CCS developed the WWHM and provides development and support services to the DOE. CCS is currently working with the DOE to provide a wetland fluctuation analysis component of WWHM. This fluctuation model was calibrated using one year of wetland hydrology monitoring data collected by NES (see Appendix 3). This calibrated model is used to determine the existing flows to the wetlands and provide an engineering baseline to best mimic the post-developed flows to the same wetlands.



## **3 Existing Conditions**

### **3.1 Land Use and Zoning**

The subject property lies within Residential Multi-Planned Zone and has a potential density of 739 residential units. There are no existing structures located on the site property. The property is surrounded by residential development to the north, west, and south. The east side was given to the City as open space by the previous owner. The proposed land use is compatible with surrounding development.

### **3.2 Vegetation**

The *Wetland Delineation for the Fairhaven Highlands* prepared by Northwest Ecological Services, LLC contains the following information (Appendix 2):

*“The majority of the review area is primarily vegetated with native trees and shrubs; with exception of a previously disturbed area in the northern section of the project area which was once an active gravel pit. Five primary plant communities were identified within the review area: Upland forest, upland meadow, palustrine forested wetland, palustrine scrub-shrub wetland, and palustrine emergent wetland.”*

### **3.3 Topography and Drainage**

The 82-acre Fairhaven Highlands project is located within the South Neighborhood of the City of Bellingham and is located within the Chuckanut Creek and Padden Creek watersheds. The site is located south of Fairhaven adjacent to Chuckanut Drive at the intersection of Viewcrest Road.

The site topography consists of three prominent hills dividing the watershed into five drainage sub-basins (See Existing Conditions Map, Exhibit 2 and Pre-Development Basin, Exhibit 6). An east-west sloping valley separate the two northerly hills and one southerly hill. Slopes on the site range from 5% to over 50% (See Slope Analysis, Exhibit 4). The site ranges in elevation from 100ft above sea level at the northwest corner of the property to 299ft at the northeast corner of property.

Runoff from the site drains to Padden Creek and Chuckanut Creek. Stormwater runoff to Padden Creek is discharged from the site and conveyed to Padden Creek via three routes which join approximately 1800ft northwest of the project site (See Downstream Conveyance, Exhibit 10). Padden Creek runoff is conveyed from the property using a combination of techniques. The majority of the water exits the site using an existing conveyance ditch and City stormwater system located in Chuckanut Drive. Additional runoff to Padden Creek exits the site through the forest as sheet flow.

Runoff to Chuckanut Creek is conveyed southerly along Chuckanut Drive in a conveyance ditch and also travels as sheet flow over forested areas.

### **3.4 Soils**

The NRCS maps show approximately 13.2% of the project is a Chuckanut loam, 15 to 30 percent slopes, approximately 74% is an Everett-urban land complex, 5 to 20 percent slopes, 3.4% Pangborn muck, 0 to 2 percent slopes, and 9.2% Squalicum-Urban land complex, 5 to 20 percent slopes (See NRCS Soils Map, Appendix 4).

A geotechnical engineering field investigation was performed by GeoEngineers, dated July 10, 2007 to field verify the site soils as well as review the project site geology, hydrogeology, soil and groundwater conditions. Results of the geotechnical investigation conclude that the majority of the project site consists of moderate to very low permeability soils (SCS Type C).

The design criteria utilized for this stormwater site plan is based on the findings and conclusions detailed in the *Geotechnical Engineering Report Proposed Fairhaven Highlands Development Bellingham Washington, July 27, 2007* prepared by GeoEngineers for Greenbriar Northwest Associates.