



northwest hydraulic consultants

NHC Ref. No. 30000457

2015 March 9

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Attention: Dr. Sukhi Muker
Via email: sukhi@drsukhi.com

Subject: 4701 Piccadilly Place South - Creek Realignment
Hydrology and Hydraulic Design – Updated for Revision 2 Drawing

1 INTRODUCTION

Northwest Hydraulic Consultants Ltd. (NHC) is pleased to present this technical report which outlines the design for the realignment of an ephemeral¹ watercourse at 4701 Piccadilly Place South in the District of West Vancouver (DWV).

The property is bounded by Marine Drive to the north and Piccadilly Drive to the south. The DWV right of way, containing Clovelley Walk and a subsurface storm utility, bound the property on its west side and the residential property of 4699 Piccadilly bound the property to the east. An unnamed watercourse bisects the property from north to south (**Figure 1**).

It is our understanding that the existing house on the property is to be replaced with a new structure and the present alignment of the watercourse is undesirable for the new building footprint.

Re-development of the property and subsequent realignment of the watercourse triggers a number of concerns with respect to the DWV;

1. DWV watercourse protection Bylaw 4364 Section 6 states that: “open watercourses and ditches shall remain above ground and may only be enclosed where no alternatives exist, as determined by the District”.
2. DWV requires an Environmental Development Permit for any work within 15 m of a water course.

¹ watercourse that only holds water during and immediately following rain events.

3. Realignment is expected to result in a no-net loss of riparian habitat (defined by DWV as area within 5 m of the top of bank for non-permanent watercourse).

Prior to the issuing of building permits for the property, DWV requires engineering drawings and a report of the channel realignment for authorization. This report and the enclosed drawings are to be submitted for acquisition of a building permit.

1.1 Site Visit

Prior to NHC being retained a site visit was conducted with Jas Muker (property developer), November 11th, 2014. At this time, initial information of the channel properties, drainage patterns, and realignment constraints were gathered.

A secondary visit was conducted on December 12th, 2014 by Joanna Glawdel and Justin Finn of NHC to collect additional topographic survey and details for channel alignment design.

1.2 Watercourse Description

The watercourse crossing the property may have once been a natural small creek (Ven Huizen Consultants Ltd., 2014). However alterations to the creek upstream, downstream and on the property have limited the water supply and structured the watercourse to its current unnatural form which includes concrete and angular rock lining.

The watercourse originates at the northeast end of the property at the outlet of a corrugated metal pipe under Marine Drive (**Figure 1** and **Photo 1**). During the site visit in December the culvert was dry, despite intense precipitation the previous 4 days; as stated in **Table 1** for the Environment Canada West Vancouver gauge (1108824). Upstream property and road drainage appears to be directed to other systems such as the DWV storm system under Clovelley Walk.

Table 1. West Vancouver Precipitation December 2014, (Environment Canada – Climate ID 1108824)

Day	Daily Precipitation (mm)
8	18.1
9	46.3
10	46.4
11	13.2
12	0.8

In addition, a small drainage channel, which was likely constructed by previous owners, runs west to east along the north boundary of the property (**Figure 1** and **Photo 2**). Regular flow to the drainage channels appears to have previously been provided by a piped and valve controlled connection from the DWV storm utility (now sealed) (**Photo 3**). The drainage channel currently only intercepts seepage and overflow from Marine Drive and directs it to the unnamed watercourse 4 m downstream of the northern

property boundary (**Photo 4**). Similar to the unnamed watercourse, the drainage channel is expected to only convey flow during the most extreme events.

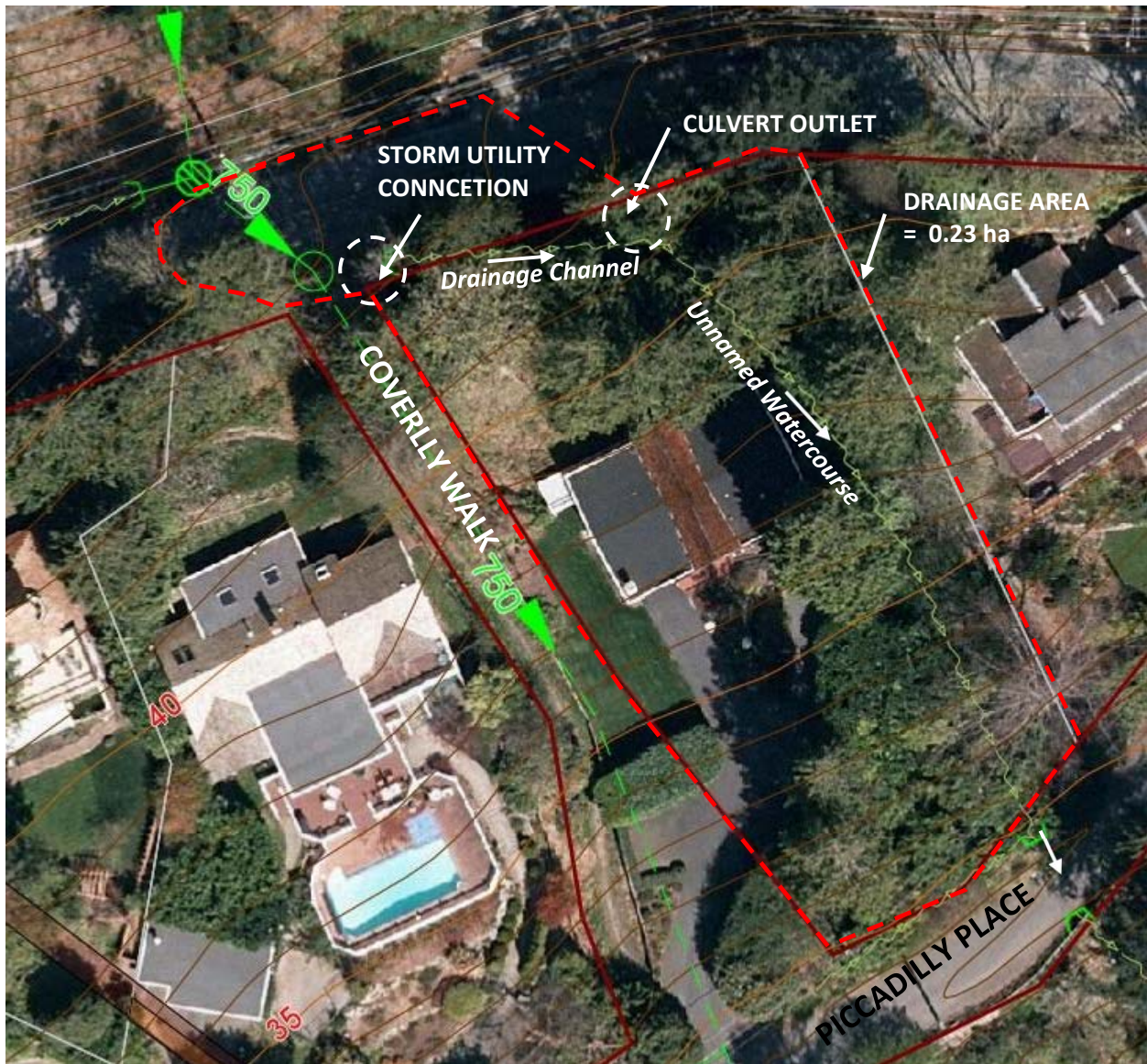


Figure 1. Project Overview and Drainage Area (drainage network and orthophoto from DWV GIS).

The following 14.5 m downstream of the confluence with the drainage channel, the watercourse runs through a vegetated area with well-defined banks (**Photo 5**). After which there is an 8.5 m long concrete lined channel under the deck of the existing house (**Photo 6**). The watercourse then outlets to an approximately 9 m long by 3 m wide and 0.5-1.0 m deep man-made pond where water level is controlled by a concrete weir at the ponds outlet (**Photo 7**). The pond outlets through a small 22 m long grass lined ditch to a rock outcrop (approximately 2.3 m from the properties south boundary), where flow spills over without a defined channel or path (**Photo 8**). At the base of the rock, surface flow is collected by

the road drainage ditch and directed through a culvert under Piccadilly Place South. Flow then continues south in an approximately 0.6m wide by 0.3 m deep rock lined channel along 4704 Dogwood Lane (**Photo 9**) prior to discharging to Dogwood Creek and subsequently Burrard Inlet.

2 CHANNEL ALIGNMENT

The preferred alignment of the channel by the property owner is on the east side of the existing building which follows the natural drainage slope of the property. The proposed channel realignment is intended to not restrict the future development envelop of the east neighbouring property (4699 Piccadilly Place) such that the entire 5 m riparian area is located within the property of 4701 Piccadilly Place. Hence, the top of bank of the realigned channel is to be no closer than 5.0 m from the property boundary, to avoid placing Environmental Development Permit (EDP) requirements on future development of the neighbouring property².

Additional topographic survey data was collected by NHC in December 2014 to identify additional channel alignment constraints such as exposed bedrock and mature trees and their expected root systems.

The attached Drawing (Drawing 3000457) shows a channel alignment which meets the site constraints. During construction, local changes to the alignment may be required where bedrock or other restrictions (i.e., large boulders) are encountered. At two locations in the alignment, rock excavation will be required and requirements for this work should be reviewed by others. For any changes during construction, the channel centreline alignment is to be set at a minimum of 5.3 m west from the eastern property line to not interfere with future development at the neighbouring property.

3 HYDROLOGY

The drainage area for the channel is conservatively estimated as 0.23 ha which was determined from field investigation and site survey and is shown on **Figure 1**.

Flow data is not available at the site. The Rational Formula has been used to estimate design peak flows, with runoff coefficients and time of concentration estimated from the *District of North Vancouver (DNV) Design Criteria Manual* (2006). The general form of the Rational Formula is as follows:

$$Q = RAIN \quad (1)$$

Where R = runoff coefficient (C) x soil adjustment factor (SAF)

² For a non-permanent watercourse, the DWV requires an EDP for work within 5 m of the top of bank. It is understood by NHC that in Dr. Sukhi Muker's discussions with the neighbouring property owners and DWV staff that the riparian area is to be located within the property of 4701 Piccadilly Place.

A = drainage area in hectares (ha)

I = rainfall intensity in mm/h

N = 0.00278

For return period flows greater than 10-years, a runoff coefficient, C, of 0.6, was estimated for the drainage area which has an impervious area of approximately 46%; a C value of 0.55 was applied for flows less than 10-years. A soil adjustment factor of 1.0 was applied given the permeability of the soil and slope of the drainage area. The time of concentration, T_c , was estimated to be 10 minutes as recommended by BC MoT (2007) for a residential area and is consistent with recommended time of concentrations in DNV (2006).

The Metro Vancouver (MV) rain gauge at the West Vancouver Firehall (VW 49) (**Figure 2**) was used to estimate precipitation at the site due to its proximity to the site. The station contained data for the period of 1995 to 2012, thus providing 18 years of record. The IDF curve was used un-altered for the site and was provided by Metro Vancouver for use in this study.

Peak instantaneous discharge estimates are provided in **Table 2** below with respect to the return period (the rainfall intensity or “I” in Equation 1, are also provided for reference).

Table 2. 4701 Piccadilly Place Peak Instantaneous Discharge Estimates

Return Period (Years)	10 min Rainfall Intensity (mm/hr)	Peak Instantaneous Discharge (L/s)
2	26.3	9.3
25	57.0	22
50	64.7	25
100	72.3	28

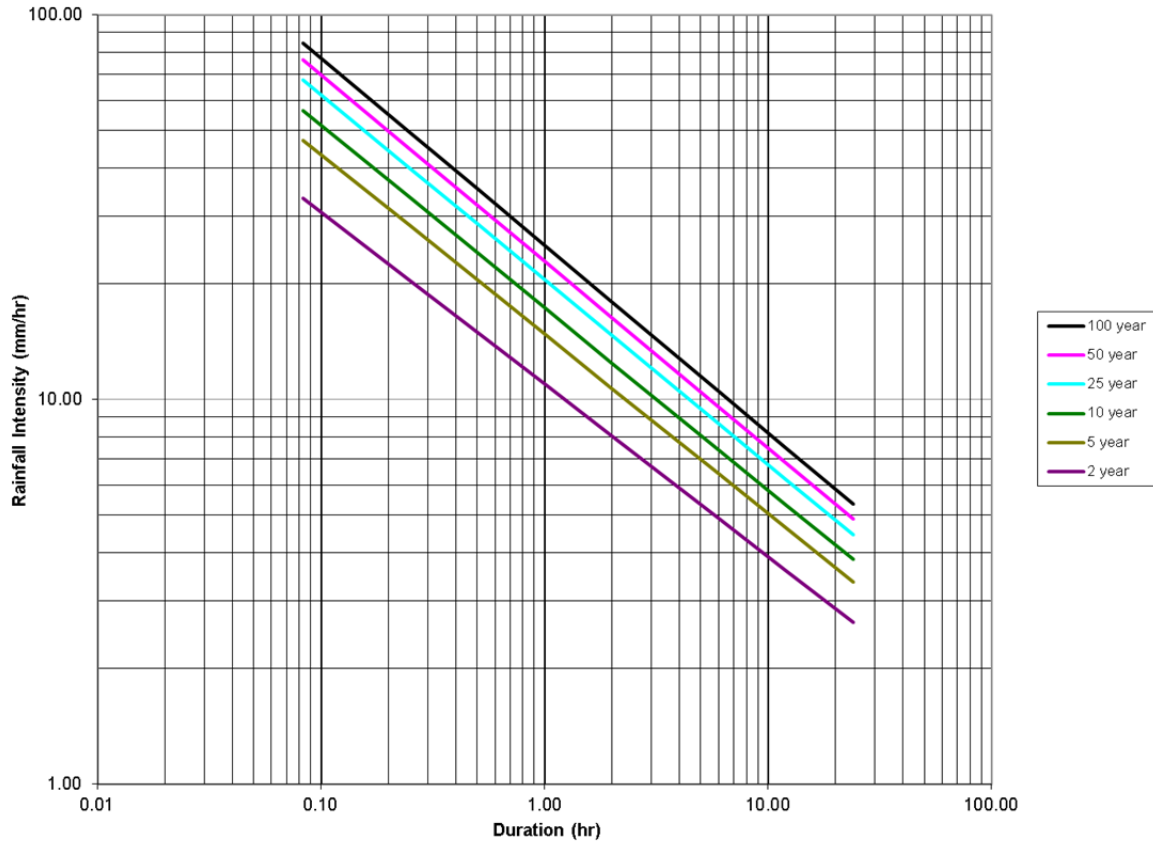


Figure 2. Metro Vancouver West Vancouver Firehall Rainfall Gauge (WV 49) IDF Curve (provided by Metro Vancouver).

4 HYDRAULIC DESIGN

Empirically derived methods (Manning's Equation) were used to size the realigned channel for 100-year design flow. A triangular channel with a 0.6 m top width and 0.3 m depth (at 1H:1V) slopes was found to convey the design flow with 0.2 m freeboard and is similar to the existing channel dimensions downstream of the property. The typical channel section is shown in the attached Drawing. Rock excavation will be required along the alignment. Details of a cross-section in the rock are provided on the drawing. Alternative channel geometries such as a rectangular channel may be provided if requested.

Stable sediment sizes for channel lining were determined using the method from Aguirre-Pe et al. (2003). The minimum required size of material is based on channel slope. The required size has been defined by median diameter of the stone, with a mean size (based on distribution by mass) (D_{50}) ranging from 30 mm gravel to 120 mm cobble (see Drawing).

Assuming the underlying material is sand and gravel ($D_{50} \geq 15$ mm) or bedrock no filter should be required between the channel lining and the underlying material. However, if the underlying material is substantially finer a sand and gravel (100 mm thick) or geotextile filter layer is recommended.

The existing channel on the north side of the house should be filled with excavated material and compacted.

5 RIPARIAN AREA

A recent environmental report pertaining to the watercourse and its potential realignment has already been prepared to support application for realigning (Ven Huizen Consultants Ltd., 2014). The report found that the watercourse is unlikely to be fish bearing due to the many barriers to fish passage and lack of downstream continuity.

According to the DWV Environmental Development Permit requirements, realignment is expected to result in a no-net loss of riparian habitat (riparian habitat defined by DWV as area within 5 m of the top of bank for non-permanent watercourse). The existing riparian area is limited where the channel is covered by the existing building deck (**Photo 6**) and where the asphalt driveway borders the channel top of banks (**Photo 7**). In these areas no riparian area is considered in the estimate. The existing riparian area is estimated as 509 m².

In the proposed alignment, the channel is day-lighted to a well vegetated area on the eastern boundary of the property. Day-lighting the channel and moving it away from the asphalt driveway improves the riparian area for approximately 20 m in length. Applying a 5 m riparian area to the realigned channel top of banks, the proposed riparian area is 641 m² which is 132 m² greater than under existing conditions.

If the eastern boundary of the future structure encroaches to within 1 m of the proposed creek alignment, there would still be a riparian area gain of roughly 49 m² over the current condition. Discussions with DWV have been initiated with Andrew Vander Helm (Environmental Protection Officer)

regarding a reduction in the riparian area setback in the area of the proposed development. At the time of reporting, comment on a reduction from the DWV has not been received.

6 CLOSURE

This document has been prepared by Northwest Hydraulic Consultants Ltd. in accordance with generally accepted engineering practices and is intended for the exclusive use and benefit of Dr. Sukhi Muker and their authorized representatives for specific application to the realignment of the unnamed watercourse on the property at 4701 Piccadilly Place in West Vancouver, BC. The contents of this document are not to be relied upon or used, in whole or in part, by or for the benefit of others without specific written authorization from Northwest Hydraulic Consultants Ltd. No other warranty, expressed or implied, is made.

Northwest Hydraulic Consultants Ltd. and its officers, directors, employers, and agents assumes no responsibility for the reliance upon this document or any of its contents by any parties other than Dr. Sukhi Muker.

We trust that the information provided herein is sufficient for your present needs. Please contact Joanna Glawdel or Dale Muir by email (JGlawdel@nhcweb.com | dmuir@nhcweb.com) or by telephone (604.980.6011) if you have any questions or concerns regarding the analyses or recommendations presented herein.

Sincerely,

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ENCLOSURE

REFERENCES

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BC MoT (2007). Supplement to TAC Geometric Design Guide. June 2007, 54 pp.

BGC Engineering Inc. 2009. Metro Vancouver Regional IDF Curves, Metro Vancouver Climate Stations: Phase 1. *Prepared for Metro Vancouver*. December, 2009.

District of North Vancouver (DNV). 2006. Schedule D.1 – Design Criteria Manual. *The Development Servicing Bylaw No. 7388*. December, 2006.

Ven Huizen Consultants Ltd. 2014. Riparian Assessment, 4701 Piccadilly South, West Vancouver, BC. *Prepared for Page Guernsey*. June 12, 2014.

PHOTOS



Photo 1. Unnamed watercourse originates at culvert outlet on property at Marine Drive. View looking upstream (North) towards Marine Drive.



Photo 2. Manmade drainage channel running west to east along north boundary of property. View looking upstream (west).



Photo 3. Sealed connection at drainage channel to DWV storm water utility.



Photo 4. Road drainage from Marine Drive directed to drainage channel. View looking west on Marine Drive.



Photo 5. Unnamed watercourse in backyard of existing structure, prior to flowing into concrete lined channel under deck. View looking upstream.



Photo 6. Outlet of concrete lined channel under existing deck. View looking upstream towards existing structure.



Photo 7. Manmade pond with concrete weir at wood bridge. Limited riparian area at rock wall/asphalt drive. View looking downstream towards Piccadilly Drive.



Photo 8. Undefined drainage path at rock outcrop near south east corner of property. View looking upstream towards pond outlet.

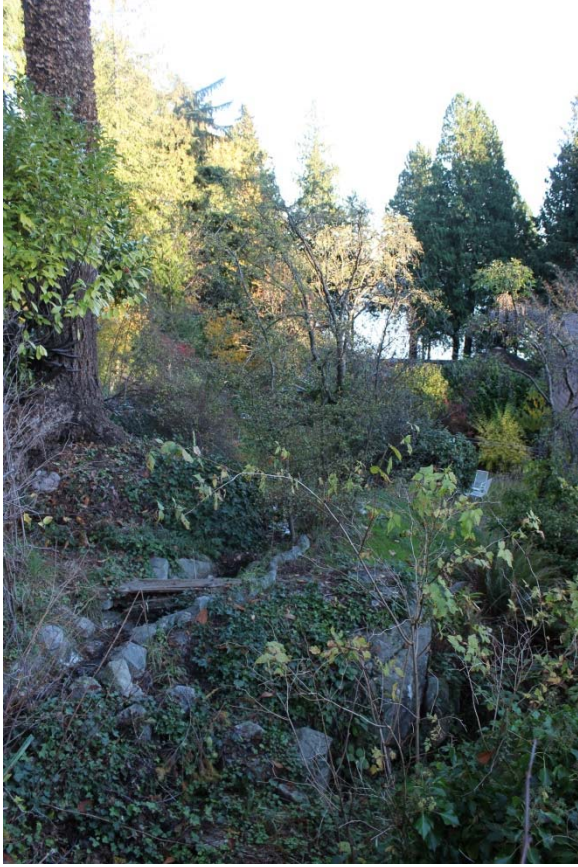
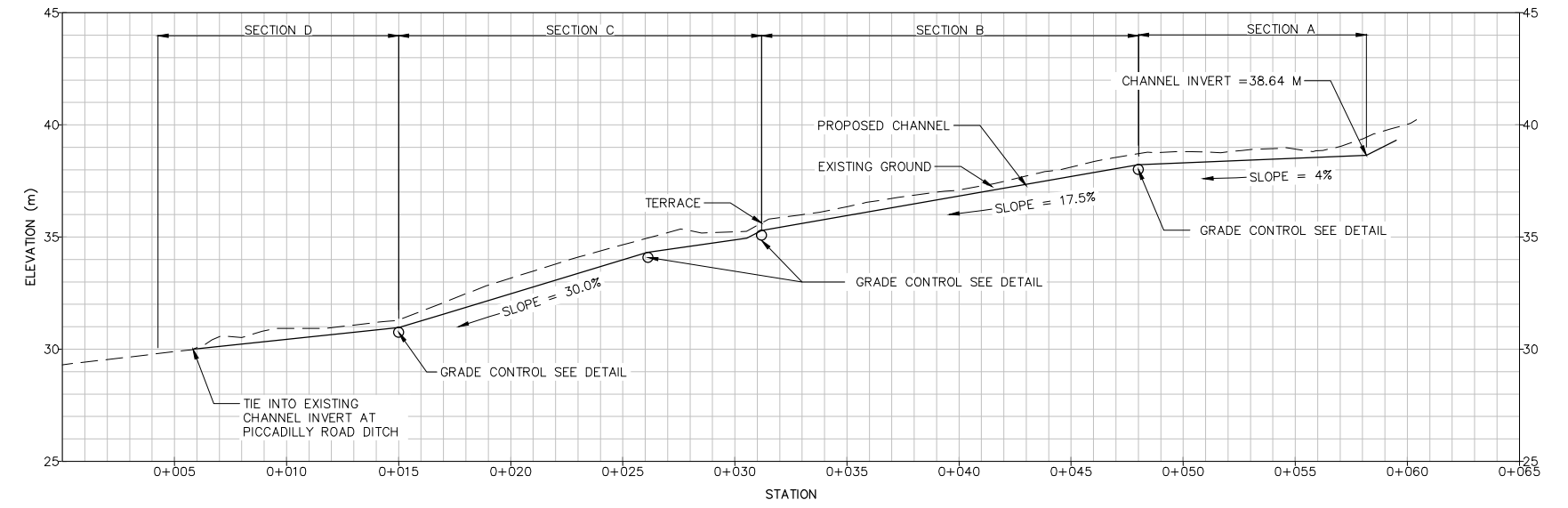
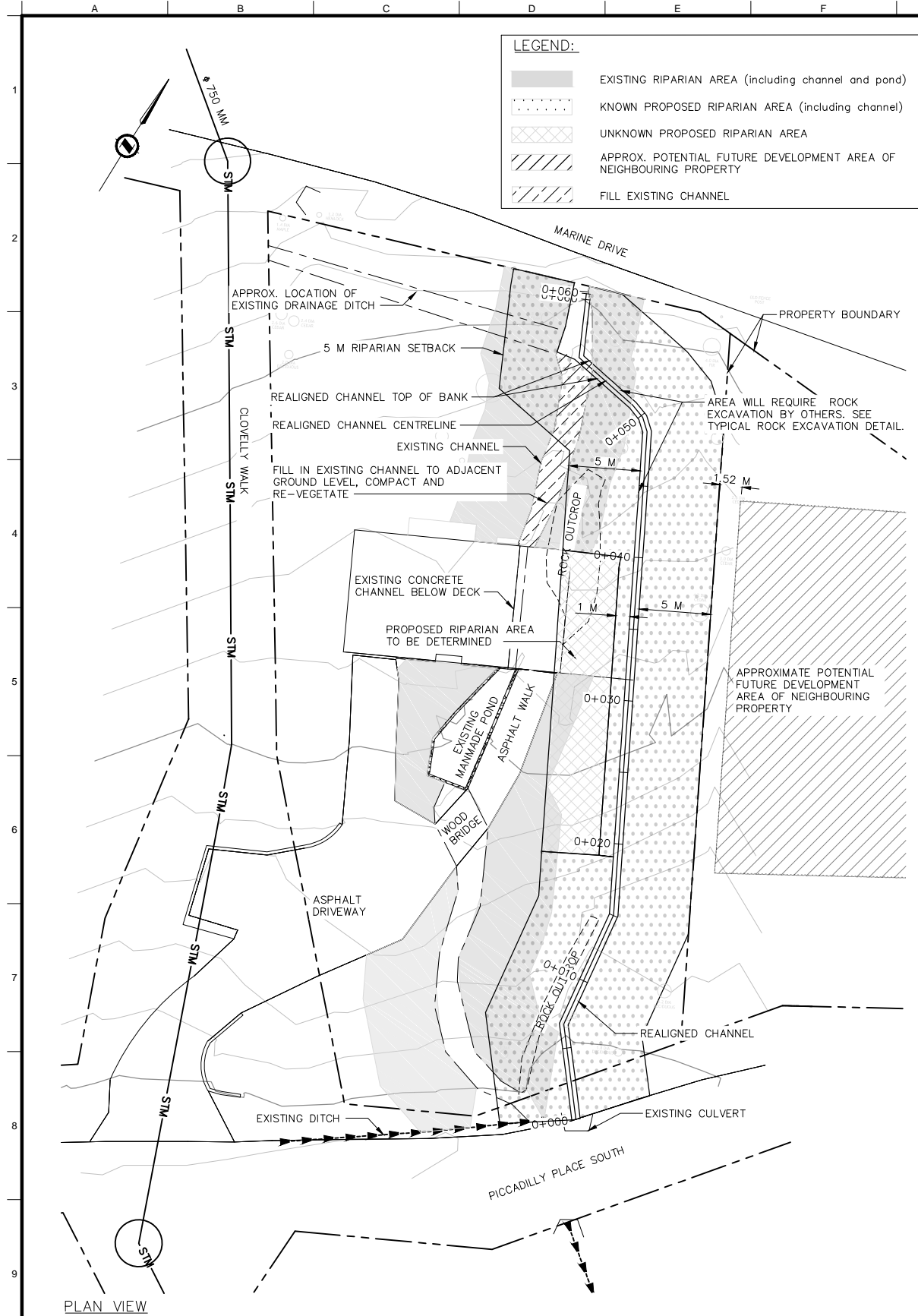
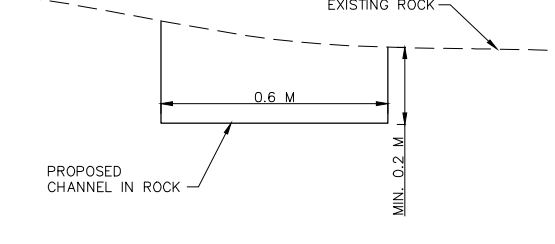
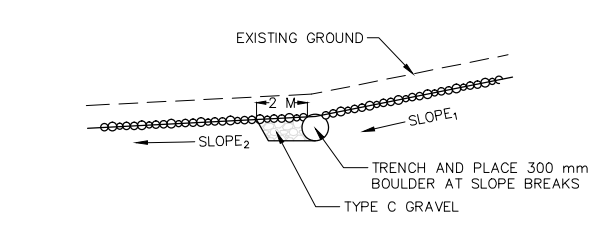
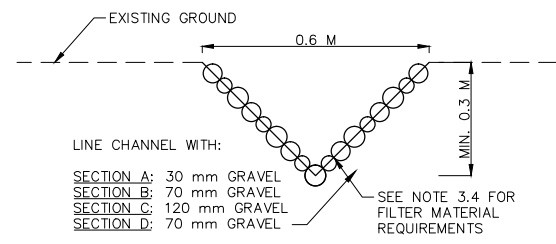


Photo 9. Rock lined channel along 4704 Dogwood Lane. View looking downstream towards Burrard Inlet.

DRAWING



PLAN VIEW
1:200



NOTES:

- GENERAL
 - ALL ELEVATIONS AND DIMENSIONS IN METERS UNLESS OTHERWISE NOTED.
 - SURVEY CONDUCTED IN JULY 2014 BY HOBBS, WINTER AND MACDONALD & DECEMBER 2014 BY NORTHWEST HYDRAULIC CONSULTANTS.
 - ELEVATIONS AND COORDINATES EXPRESSED ARE IN METERS ON LOCALLY ESTABLISHED COORDINATE SYSTEM AND DATUM. LOCAL BENCHMARK LOCATED ON HOBBS, WINTER AND MACDONALD (JULY 2014) SURVEY.
 - MATURE TREES ARE NOT TO BE DISTURBED UNLESS DIRECTED BY PROJECT ARBORIST, DANGER TREE ASSESSOR OR ENVIRONMENTAL PROFESSIONAL.
- CHANNEL
 - CHANNEL ALIGNMENT MAY REQUIRE FIELD FITTING WHERE BEDROCK IS ENCOUNTERED. CHANNEL CENTRELINE TO LOCATED MIN. 5.3 M WEST FROM EASTERN PROPERTY BOUNDARY.
 - CHANNEL REQUIRES ROCK EXCAVATION BY OTHERS.
 - CHANNEL BOTTOM IS TO HAVE A TRIANGULAR-SHAPED CROSS-SECTION.
 - CHANNEL BANKS TO BE SLOPED AT 1H:1V TO DESIGN ELEVATIONS UNLESS OTHERWISE SHOWN IN DETAILS.
- CHANNEL MATERIALS
 - GRADATION OF CHANNEL MATERIALS TO BE AS FOLLOWS OR LARGER:

TYPE A - 30 MM GRAVEL	TYPE B - 70 MM COBBLE	TYPE C - 120 MM COBBLE
D15 - 15 mm	D15 - 30 mm	D15 - 50 mm
D50 - 30 mm	D50 - 70 mm	D50 - 120 mm
D85 - 60 mm	D85 - 140 mm	D85 - 250 mm
 - SPECIFIC GRAVITY IS TO BE GREATER OR EQUAL TO 2.65 T/m³.
 - THICKNESS OF CHANNEL MATERIALS SHALL BE A MINIMUM OF THE GREATER OF 100 MM OR 2 X D50.
 - IF UNDERLYING MATERIAL IS SAND AND GRAVEL (D50 >= 15 mm) OR BEDROCK, NO FILTER MATERIAL BETWEEN CHANNEL LINING AND UNDERLYING MATERIAL IS REQUIRED. IF UNDERLYING MATERIAL IS SUBSTANTIALLY FINER, A SAND AND GRAVEL (100 mm THICK) OR GEOTEXTILE FILTER LAYER IS RECOMMENDED.
- CONSTRUCTION
 - ALL TEMPORARY SLOPES AND EXCAVATIONS ARE THE RESPONSIBILITY OF THE CONTRACTOR.

PRELIMINARY NOT FOR CONSTRUCTION	Revisions		Drawing Information	
	No.	Date	Description	Date
	0	DEC 2014	ISSUED FOR INFORMATION	09 March 2015
	1	JAN 2015	ISSUED WITH REPORT	ISSUED WITH REPORT
	2	MAR 2015	UPDATED WITH COMMENTS	Designer: JXG
				Drafter: JXG
				Checked: DPM
				File Name: 4701 Piccadilly Place_R5.dwg
				Plotted Scale: 0 1/2 1

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**4701 PICCADILLY PLACE SOUTH
UNNAMED CREEK REALIGNMENT**

Job Number: 3000457
Sheet Number: **1**

Plan, Profile View and Typical Sections

Sheet 1 of 1