LAND DEVELOPMENT CONSULTANTS
14525 148th Avenue NE Suite 132
PO Box 33, Woodinville, WA 98072

STORMWATER DRAINAGE REPORT
Orca Beverage Warehouse

Site Address:
118xx Cyrus Way
Mukilteo, WA 98275

Parcel Number:
00441400002700

Applicant:
Cyrus Way Partners LLC
Orca Beverage, Inc.
11903 Cyrus Way #5
Mukilteo, WA 98275
Mike Bourgeois 425.349.9723
mike@orcabeverage.com

Prepared by:

December 7, 2015

DRAFT REPORT / FOR CITY REVIEW ONLY

Tim Schriever, PE, PLS, CESCL
Phone: (206) 669-5218
Fax: (425) 485-4168
tim@civilsiteplan.com

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PO Box 33, Woodinville, WA 98072

Tim Schriever, PE, PLS, CESCL
p. (206)669-5218 f. (425)485-4168

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p. (206)669-5218 f. (425)485-4168

I. PROJECT OVERVIEW

A. *STUDY SCOPE:*

This study includes research, field investigations and engineering analysis for the design of stormwater drainage facilities associated with the Orca Beverage Warehouse Project.

Drainage facilities are designed in accordance with the 2012 DOE Stormwater Management Manual for Western Washington.

B. *PROJECT DESCRIPTION:*

The Orca Warehouse project is a development of a 1.27 acre parcel of land created in the 1993 Harbour Pointe Shopping Center Binding Site Plan. The project will include a warehouse building with a roof area of approximately 33,097 sq. ft. and an associated parking lot and truck loading area.

Project Name: Orca Beverage Warehouse
Site Address: 118__ Cyrus Way, Mukilteo, WA 98275
Tax Parcel No: 00441400002700

The project is located in the jurisdiction of the City of Mukilteo. Public water and sewer services are provided by the Alderwood Water District. Electrical service is from Snohomish PUD.

C. *EXISTING CONDITIONS:*

Existing Site Conditions:
The site is currently vacant land with commercially developed properties adjoining the north, east and west property boundaries. A public street right of way (Cyrus Way) adjoins the south property boundary. The existing ground surface on the site generally slopes to the west on grades of 2-3% and is vegetated with grass and brush.

The westerly property boundary adjoins a public road (Cyrus Way) with a right-of-way width of 60 feet. The existing Cyrus Way road frontage is 300 feet in length with an existing 29' wide asphalt driving surface. The adjoining half street improvement is constructed with an asphalt surface to the face of the vertical curb at 18' from the centerline of the right-of-way, a 5' wide landscape strip behind the curb and 5' wide sidewalk.

The site accesses the adjoining public street from an existing 30' wide curb cut connection to Cyrus Way and an existing 25' wide asphalt driveway along the southerly property line. The existing driveway is in an access easement that jointly serves the east adjoining QFC truck loading area at the back of the QFC store.

Existing Drainage Conditions:
There is an existing stormwater detention pond and biofilter swale on the site that was installed as part of the QFC (Harbor Pointe) shopping center development. A copy of the drainage report and construction plans for the detention pond is attached in the appendix to this report. Stormwater runoff generated on the site generally sheet flows to Cyrus Way and the existing biofilter swale. The stormwater runoff enters the public storm drains in Cyrus Way and is conveyed under the roadway flowing westerly. Excepting the stormwater conveyed from the upstream QFC property, no other concentrated drainage flows enter the site. There are no streams or wetlands on the site.

D. DEVELOPED CONDITIONS:

Developed Site Conditions:
The Orca Warehouse project includes construction of a warehouse building with a roof area of approximately 33,097 sq. ft. and a parking lot constructed between the building and the Cyrus Way right-of-way, and a truck loading area at the back of the building. The existing driveway at the southwest corner of the site will be the main access connection point for trucks and cars. The trucks will enter the site and perform turning movements extending into the existing parking/driveway area of the adjoining Orca Beverage manufacturing building south of the site. Cars will enter the onsite parking lot along a one-way driveway and exit from a new driveway connection to Cyrus Way.

Public water and sewer service connections will be provided by the Alderwood Water & Sewer District. The Alderwood Water District has existing water and sewer mains along the Cyrus Way road frontage and along a 20' easement on the westerly property boundary.

Developed Drainage Conditions:
Surface water runoff flows generated on the site and the upstream offsite drainage basin will be controlled in a stormwater detention vault under the parking lot on the south side of the building. Water quality of the runoff will be treated by filtration through Contech Storm Filters. Due to the flat terrain on the site, the treated storm water will be piped under Cyrus Way and discharge to existing open channel in the Cyrus Way right of way.

E. PROJECT LOCATION:

The Project is located in the NW1/4, NW1/4, Section 27, T28N, R4E, W.M.,

Site Address: 118xx Cyrus Way, Mukilteo, WA 98275

Tax Parcel No: 00441400002700

Figure 1.1 -- VICINITY MAP

F. DRAINAGE BASINS AND SITE CHARACTERISTICS

The project is located in the Picnic Point Creek Drainage Basin flowing to Puget Sound. The site is generally flat with the existing ground surface sloping 2% to the south. The maximum slope on the site is about 5%. Existing vegetation includes grasses, native herbs and scattered trees. Soils are classified as "Till" soils.

Stormwater runoff from land north of the project site (QFC Building and truck loading area) are conveyed in storm drains to a detention pond on the subject property. The existing detention pond facility volume will be replaced in a new stormwater detention vault. No other concentrated flows enter the site. Runoff from the east and west adjoining property generally flow into the existing public storm drains in the Cyrus Way right of way. Additional information about the upstream and downstream drainage basins are provided in Section III of this report.

Figure 1.2 Possession Sound Watershed

G. SOILS

Soils on the site and in the upstream and downstream drainage basins are identified on the U.S.D.A. Soil Conservation Service Soil Survey as Alderwood Gravely Sandy Loam.

Figure 1.3 - USDA Soil Survey Map.

The depth to the seasonal water table is less than three feet below the ground surface. The Alderwood Gravely Sandy Loam soils are classified as "Till Soils".

See the Geotechnical Engineering Study by Tim Peter (Associated Earth Sciences) dated March 13, 2015 attached in the Appendix of this report.

H. SENSITIVE AREAS

During our investigation of the site and review of the ASC Geotech Study, we determined that there are no wetlands, streams, 100 year flood plains, land slide hazard areas, or significant erosion hazards on the Project site. Assessment of seismic hazards is beyond the scope of this report.

II. MINIMUM REQUIREMENTS SUMMARY

A. SURFACE WATER MANAGEMENT REQUIREMENTS:

1. DRAINAGE REVIEW

All surface water runoff generated on the proposed project site, including pervious landscape areas and impervious surfaces such as roadways, building roofs, driveways and parking areas must be constructed in accordance with the applicable provisions of the 2012 Stormwater Management Manual for Western Washington and City of Mukiteo codes and standards.

The estimated development areas for the project as follows:

- Total area of Project site: 1.3 acres
- Total area of site disturbance: 1.3 acres
- Total existing impervious area: 0.1 acres
- Total new and replaced impervious area: 1.2 acres
- Total landscape area: 0.1 acres

Because the subject project includes a total new and replaced impervious surface area greater than 5,000 sq. ft. it must meet Minimum Requirements 1 through 9 of 2012 DOE Stormwater Management Manual for Western Washington.

Because the area of site disturbance is greater than 1 acre, a Stormwater Pollution Prevention Plan (SWPPP) per NPDES requirements is required.

2. LOW IMPACT DEVELOPMENT (BMP's)

Low Impact Development BMP's are required for this Project.

B. PERMITS REQUIRED

1. City of Mukilteo Land Use Permit
2. City of Mukilteo Engineering Permit: Clearing & Grading
3. City of Mukilteo Engineering Permit: Right of Way
4. City of Mukilteo Engineering Permit: Stormwater
5. Alderwood Water District: Sanitary Side Sewer
6. Alderwood Water District: Water Service Connection
7. City of Mukilteo: Building Permit

C. *STORMWATER MINIMUM REQUIREMENTS*

1. Min. Requirement No. 1: Preparation of Stormwater Site Plans

This project is required to prepare a Stormwater Site Plan for governmental review. The Stormwater Site Plan must use site-appropriate development principles, as required by applicable development codes, and retain native vegetation and minimize impervious surfaces to the extent feasible. Stormwater Site Plans must be prepared in accordance with 2012 DOE Stormwater Management Manual for Western Washington, and the Low Impact Technical Guidance Manual for Puget Sound.

2. Min. Requirement No. 2: Construction Stormwater Pollution Prevention

All new development and redevelopment projects are responsible for preventing erosion and discharge of sediment and other pollutants into receiving waters. This project will result in greater than 2,000 square feet of new plus replaced hard surface area and disturb more than 7,000 square feet land. A Stormwater Pollution Prevention Plan (SWPPP) must be prepared as part of the Stormwater Site Plan for this project. The SWPPP will include a narrative to explain and justify the pollution prevention facilities for the project, and construction drawings showing minimum erosion and sedimentation control facilities necessary for the proposed site improvements.

3. Min. Requirement No. 3: Source Control of Pollution

The project must implement known, applicable, and reasonable source control BMPs in accordance with the 2012 DOE Stormwater Management Manual for Western Washington. Source control BMPs must be provided to address applicable portions of the Source Control BMP's S406, S411, S412, S417, S421 and S424 identified in Volume IV of the SMMWW.

4. Min. Requirement No. 4: Preservation of Natural Drainage Systems and Outfalls

All surface water runoff from the proposed project, including all pervious and impervious surfaces, such as roads, utilities, buildings, lawns, pastures and forests, must be discharged at the natural location so as not to be diverted onto, or away from, the adjacent downstream property. The manner in which the runoff is discharged from the project site must not create a significant adverse impact to downhill properties or drainage systems.

The existing drainage patterns on and surrounding the property will not be significantly altered by the proposed development. The drainage pattern modifications resulting from new impervious surfaces and storm drainage facilities for the proposed project will not significantly affect basin drainage patterns.

Storm water drainage flows will exit the site in new storm drains under Cyrus Way and discharge onto a rock lined outfall pad to an existing open ditch in the public right of way.

5. **Min. Requirement No. 5: On-site Stormwater Management**

This project must employ On-site Stormwater Management BMPs. Because this project is a redevelopment of a parcel inside the urban growth area (UGA) and is less than 5 acres in size, it is required to meet the Low Impact Development Performance Standard and BMP T5.13 of the DOE Manual.

Low Impact Development Performance Standard:

Stormwater discharges shall match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 8% of the 2-year peak flow to 50% of the 2-year peak flow.

6. **Min. Requirement No. 6: Runoff Treatment**

This project will be developed with greater than 5,000 sq. ft. of pollution generating hard surfaces and is required to provide stormwater quality treatment facilities. The water quality treatment facility will include a wet vault and stormwater filters downstream of the detention vault.

7. **Min. Requirement No. 7: Flow Control**

The project must provide formal flow control facilities to reduce the downstream impacts of stormwater runoff from hard surfaces and land cover conversions because it meets the minimum threshold of creating more than 10,000 sq. ft. of effective impervious surfaces.

The project is required to meet the Stream Protection Standards outlined in the DOE Stormwater Manual for Western Washington which include matching the pre-developed discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow.

The pre-developed condition must be modeled as historic forest land, except the existing upstream drainage basin will be modeled as the existing condition because it was previously accepted by the jurisdiction when built with a flow control system (detention pond). The detention volume provided in the detention pond will be replaced in the new detention vault.

8. **Min. Requirement No. 8: Wetlands Protection**

Runoff from the project discharges to an open ditch that travels downstream and enters Picnic Point Creek and Puget Sound. This proposed project does not discharge into a wetland. Minimum Requirement No. 8 does not apply to this project.

9. **Min. Requirement No. 9: Operations and Maintenance**

To ensure that stormwater control facilities are adequately maintained and operated properly, An Operations and Maintenance Manual must be provided with the Stormwater Site Plan documents.

III. OFFSITE DRAINAGE BASIN ANALYSIS

A. *Purpose of Analysis*

The primary purpose of this off-site drainage analysis is to examine the drainage systems within one-quarter mile downstream of the project site to identify existing or potential/predictable downstream capacity, flooding, erosion, and water quality problems so that appropriate mitigation can be provided to prevent aggravation of these problems. The secondary purpose of this off-site drainage analysis is to evaluate upstream drainage systems to verify and document that significant flooding and erosion impacts will not occur as a result of the proposed project due to any backwater effects created by the project.

B. *Major Drainage Basin Description*

The project site is located in one drainage basin known as the Picnic Point Creek Drainage Basin that discharges directly to Puget Sound.

C. *Upstream Drainage Basin*

The upstream drainage basin includes a portion of the easterly adjoining property (QFC Property) that includes 38,200 sq. ft. roof, 41,100 sq. ft. asphalt driveway and 480 sq. ft. sidewalk. The stormwater runoff generated on the upstream basin is collected and conveyed in storm drains to a stormwater detention pond on the southeast corner of the subject site. The detention pond outlet control structure discharges to a biofilter swale with overflow runoff entering the public storm drains in Cyrus Way.

Figure 3.1 Upstream Drainage Map

X. OPERATION AND MAINTENANCE

The City of Mukilteo will be responsible for operation and maintenance of storm drain facilities within Cyrus Way and any Public Drainage Easement right of ways after acceptance by the City.

The property owner(s) are responsible for operation and maintenance of the access driveways from public roads and all drainage facilities within the boundary of their private land or easements.

All roof downspout pipes, roof gutters, catch basins and area drains should be inspected at least two times each year. One inspection should be performed in late fall during a period of moderate to heavy rain to verify that the inlets to the catch basins, area drains and roof gutter/drain are clear of debris and functioning adequately with no overflow of runoff to the ground surface or onto public roadways. A second inspection of the drainage facilities should be performed in late spring for sediment accumulation in catch basins and area drains. If the bottom of the catch basin or area drain is half filled with sediment, it should be cleaned out to prevent or reduce the amount of sediment traveling downstream that could clog pipes and pollute downstream creeks and lakes.

Sediment accumulation in the Detention Vault should be checked annually on July 1. If the depth of sediment accumulation is greater than 6" depth, the sediment should be removed before September 1.

If at any time there is evidence of soil erosion on the property, steps should be taken to redirect the source of surface water causing erosion into the on-site drainage system and take measures to restore or armor the area of erosion.

The storm filters downstream of the detention pond catch basin must be inspected and cleaned annually in accordance with the manufacturer's recommendation.

Tim Schriever, PE, PLS, CESCL
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XI. APPENDIX

A. ***Conveyance Pipe Calculation Worksheets***

B. ***Harbour Pointe Shopping Centre Drainage Report & Construction Plans***

CONVEYANCE PIPE SIZE CALCULATIONS

Conveyance element: 54'-12" LCPE, S=0.90% CB2120 to CB9

RATIONAL METHOD & MANNINGS EQUATION
(Ref: KCSWDM Section 3.2.1 & Isopluvials in SMMWW Appendix III-A)

Average Runoff Coefficient			
	area	C	CxA
Grass	0.04	0.25	0.01
Pavement	1.07	0.90	0.963
			0
			0
total	1.11		0.973

Time of Concentration					
reach	slope	k	length	velocity	time (min)
grass	2.00%	7	5	0.99	0.08
gutter	1.83%	20	320	2.71	1.97
total					2.06

Sub-Basin Area (acre) = 1.1
Average Coefficient, C = 0.88

Time of Concentration = 6.30 minutes
(6.3 min./100 min. max)

Peak Rainfall Intensity			
storm frequency (year)	24 hour precipitation (inch)	unit peak rainfall	peak rainfall intensity
2	1.5	0.54	0.81
10	2.5	0.80	2.01
100	3.5	0.82	2.86

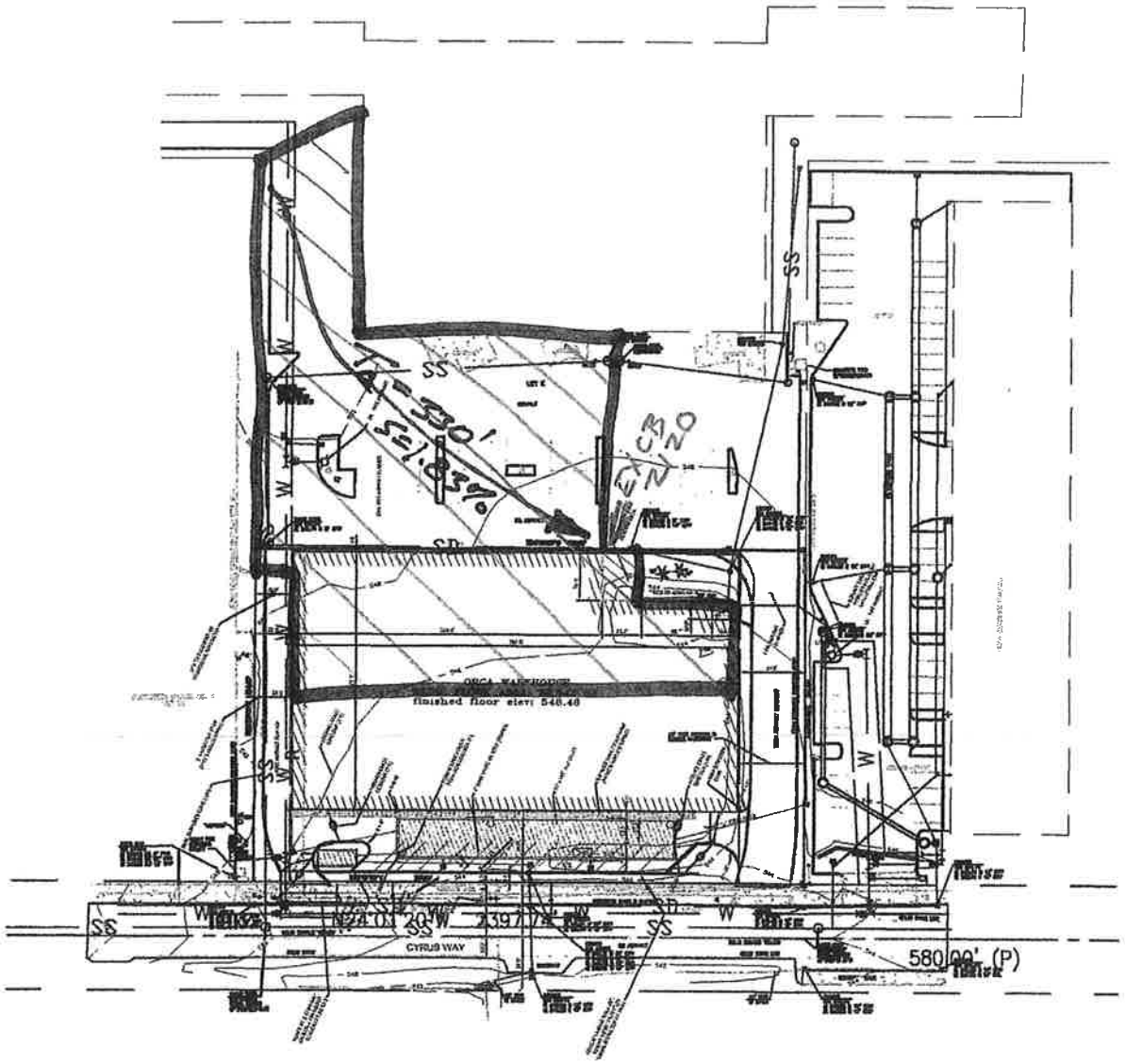
Peak Flow, Q=CIA	
storm frequency (year)	peak flow Q (cfs)
2	0.79
25	1.96
100	2.79

Manning's Eq. Results		
storm event	velocity in pipe (ft/sec)	flow depth (feet)
100 yr	4.52	0.73

n=0.014

The proposed pipe has adequate capacity for a 100 year storm.

BASIN CB2120 – CB9



ONSITE	BLDG ROOF	15,794	
ONSITE	PAVEMENT	707	
ON SITE	GRASS		65
OFFSITE	PAVEMENT		
OFFSITE	GRASS	30,233	1584
		46,734 SF	1649 SF
		1.07 AC	0.04 AC

CONVEYANCE PIPE SIZE CALCULATIONS

Conveyance element: 41'-15" LCPE, S=0.90% CB9 to CB8

RATIONAL METHOD & MANNINGS EQUATION
(Ref: KCSWDM Section 3.2.1 & Isopluvials in SMMWW Appendix III-A)

Average Runoff Coefficient			
	area	C	CxA
Grass	0.07	0.25	0.0175
Pavement	2.18	0.90	1.962
			0
			0
total	2.25		1.9795

Time of Concentration					
reach	slope	k	length	velocity	time (min)
grass	2.00%	7	5	0.99	0.08
gutter	1.83%	20	770	2.71	4.74
SD	0.90%	20.0	54	4.52	0.20
total					5.03

Sub-Basin Area (acre) = 2.3
Average Coefficient, C = 0.88

Time of Concentration = 6.30 minutes
(6.3 min./100 min. max)

Peak Rainfall Intensity			
storm frequency (year)	24 hour precipitation (inch)	unit peak rainfall	peak rainfall intensity
2	1.5	0.54	0.81
10	2.5	0.80	2.01
100	3.5	0.82	2.86

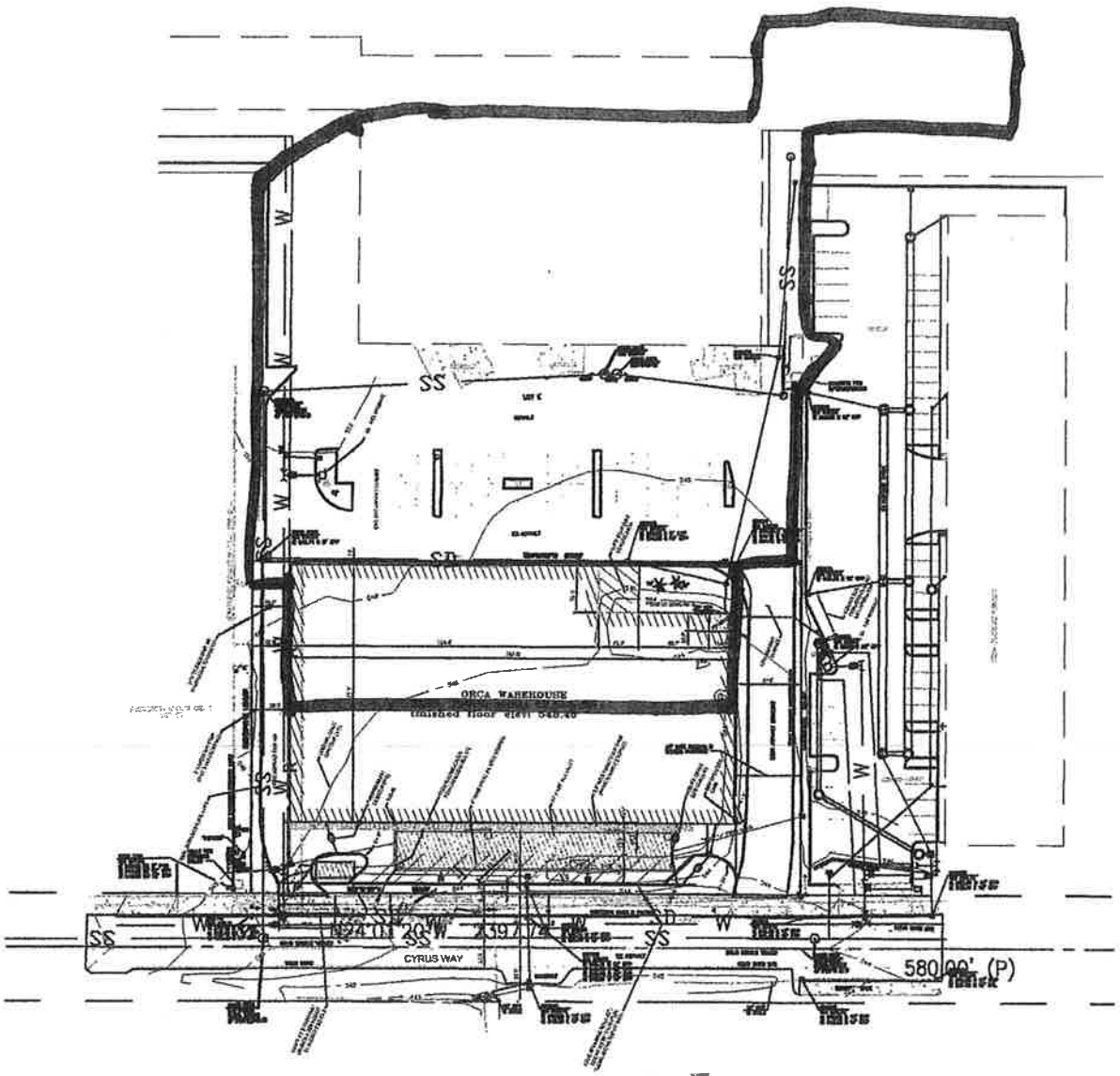
Peak Flow, Q=CIA	
storm frequency (year)	peak flow Q (cfs)
2	1.61
25	3.98
100	5.67

The proposed pipe has adequate capacity for a 100 year storm.

Manning's Eq. Results		
storm event	velocity in pipe (ft/sec)	flow depth (feet)
100 yr	5.29	1.02

n=0.014

BASIN CB9-CB8



ONSITE PVMT — 707
ONSITE ROOF — 15794
ON SITE GRASS 65
OFF SITE ROOF 39200
OFFSITE PVMT 40100 3050
OFFSITE GRASS .....

94801 SF 3115 SF
2.18 AC 0.07 AC

CONVEYANCE PIPE SIZE CALCULATIONS

Conveyance element: 141'-15" LCPE, S=0.90% CB8 to CB7

RATIONAL METHOD & MANNINGS EQUATION
(Ref: KCSWDM Section 3.2.1 & Isopluvials in SMMWW Appendix III-A)

Average Runoff Coefficient			
	area	C	CxA
Grass	0.07	0.25	0.0175
Pavement	2.18	0.90	1.962
			0
			0
total	2.25		1.9795

Time of Concentration					
reach	slope	k	length	velocity	time (min)
grass	2.00%	7	5	0.99	0.08
gutter	1.83%	20	320	2.71	1.97
SD	0.90%	20.0	54	4.52	0.20
total					2.25

Sub-Basin Area (acre) = 2.3
Average Coefficient, C = 0.88

Time of Concentration = 6.30 minutes
(6.3 min./100 min. max)

Peak Rainfall Intensity			
storm frequency (year)	24 hour precipitation (inch)	unit peak rainfall	peak rainfall intensity
2	1.5	0.54	0.81
10	2.5	0.80	2.01
100	3.5	0.82	2.86

Peak Flow, Q=CIA	
storm frequency (year)	peak flow Q (cfs)
2	1.61
25	3.98
100	5.67

Manning's Eq. Results		
storm event	velocity in pipe (ft/sec)	flow depth (feet)
100 yr	5.29	1.02

n=0.014

The proposed pipe has adequate capacity for a 100 year storm.

CONVEYANCE PIPE SIZE CALCULATIONS

Conveyance element: 74'-15" DI, S=0.90% CB7 to Vault

RATIONAL METHOD & MANNINGS EQUATION
(Ref: KCSWDM Section 3.2.1 & Isopluvials in SMMWW Appendix III-A)

Average Runoff Coefficient			
	area	C	CxA
Grass	0.07	0.25	0.0175
Pavement	2.18	0.90	1.962
			0
			0
total	2.25		1.9795

Time of Concentration					
reach	slope	k	length	velocity	time (min)
grass	2.00%	7	5	0.99	0.08
gutter	1.83%	20	320	2.71	1.97
SD	0.90%	20.0	54	4.52	0.20
total					2.25

Sub-Basin Area (acre) = 2.3
Average Coefficient, C = 0.88

Time of Concentration = 6.30 minutes
(6.3 min./100 min. max)

Peak Rainfall Intensity			
storm frequency (year)	24 hour precipitation (inch)	unit peak rainfall	peak rainfall intensity
2	1.5	0.54	0.81
10	2.5	0.80	2.01
100	3.5	0.82	2.86

Peak Flow, Q=CIA	
storm frequency (year)	peak flow Q (cfs)
2	1.61
25	3.98
100	5.67

Manning's Eq. Results		
storm event	velocity in pipe (ft/sec)	flow depth (feet)
100 yr	5.29	1.02

n=0.014

The proposed pipe has adequate capacity for a 100 year storm.

CONVEYANCE PIPE SIZE CALCULATIONS

Conveyance element: 5'-8" LCPE, S=2.00% CB4 to vault

RATIONAL METHOD & MANNINGS EQUATION
(Ref: KCSWDM Section 3.2.1 & Isopluvials in SMMWW Appendix III-A)

Average Runoff Coefficient			
	area	C	CxA
Grass	0	0.25	0
Pavement	0.06	0.90	0.054
			0
			0
total	0.06		0.054

Time of Concentration					
reach	slope	k	length	velocity	time (min)
grass	2.00%	7	0	0.99	0.00
gutter	1.83%	20	40	2.71	0.25
SD	0.90%	20.0	0	4.52	0.00
total					0.25

Sub-Basin Area (acre) = 0.1
Average Coefficient, C = 0.90

Time of Concentration = 6.30 minutes
(6.3 min./100 min. max)

Peak Rainfall Intensity			
storm frequency (year)	24 hour precipitation (inch)	unit peak rainfall	peak rainfall intensity
2	1.5	0.54	0.81
10	2.5	0.80	2.01
100	3.5	0.82	2.86

Peak Flow, Q=CIA	
storm frequency (year)	peak flow Q (cfs)
2	0.04
25	0.11
100	0.15

Manning's Eq. Results		
storm event	velocity in pipe (ft/sec)	flow depth (feet)
100 yr	2.86	0.14

n=0.014

The proposed pipe has adequate capacity for a 100 year storm.

CONVEYANCE PIPE SIZE CALCULATIONS

Conveyance element: 20'-8" LCPE, S=2.00% CB6 to vault

RATIONAL METHOD & MANNINGS EQUATION
(Ref: KCSWDM Section 3.2.1 & Isopluvials in SMMWW Appendix III-A)

Average Runoff Coefficient			
	area	C	CxA
Grass	0	0.25	0
Pavement	0.06	0.90	0.054
Roof	0.2	0.90	0.18
			0
total	0.26		0.234

Time of Concentration					
reach	slope	k	length	velocity	time (min)
grass	2.00%	7	0	0.99	0.00
gutter	0.05%	20	175	0.45	6.52
SD	0.90%	20.0	0	4.52	0.00
total					6.52

Sub-Basin Area (acre) = 0.3
Average Coefficient, C = 0.90

Time of Concentration = 6.30 minutes
(6.3 min./100 min. max)

Peak Rainfall Intensity			
storm frequency (year)	24 hour precipitation (inch)	unit peak rainfall	peak rainfall intensity
2	1.5	0.54	0.81
10	2.5	0.80	2.01
100	3.5	0.82	2.86

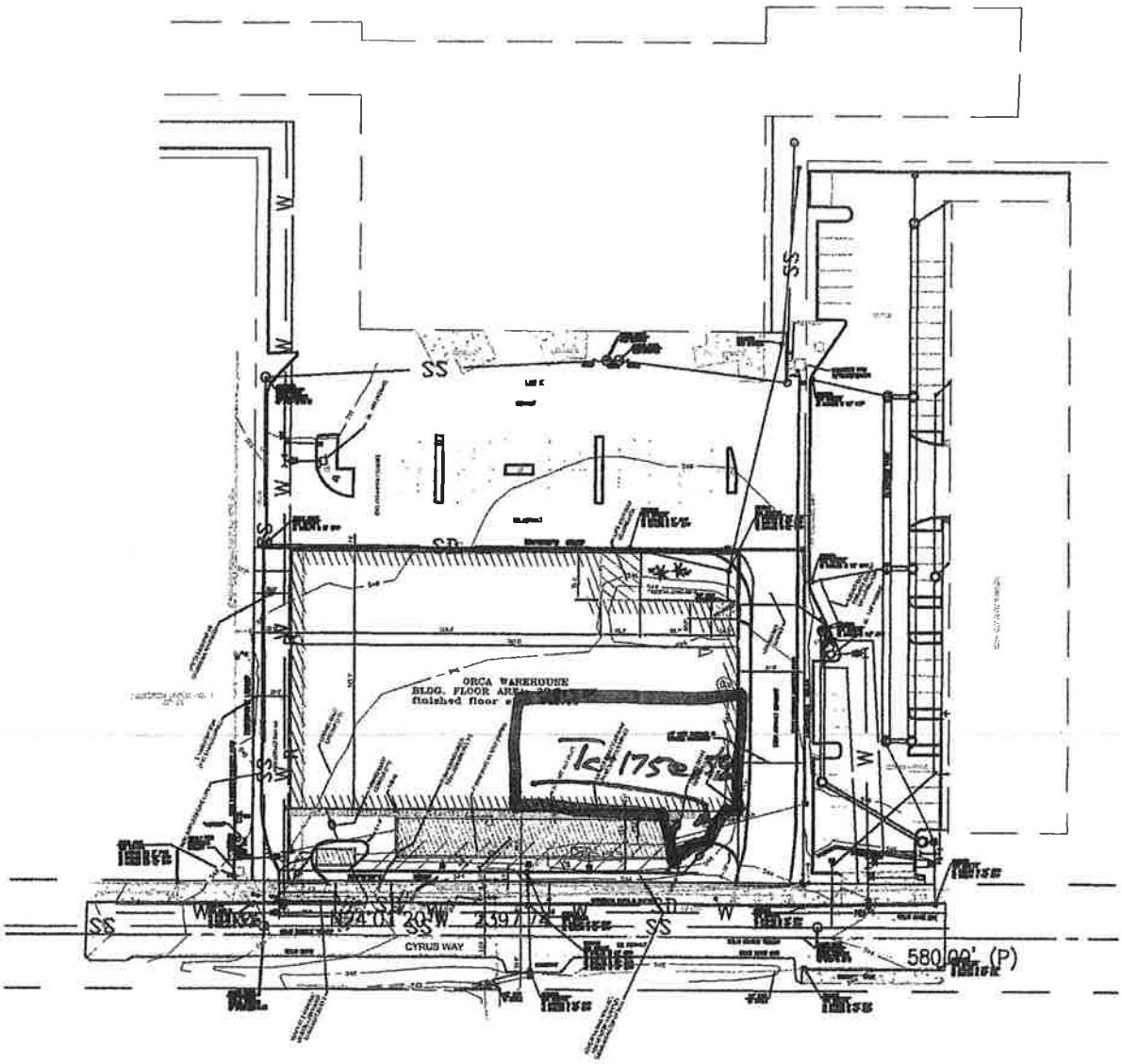
Peak Flow, Q=CIA	
storm frequency (year)	peak flow Q (cfs)
2	0.19
25	0.47
100	0.67

Manning's Eq. Results		
storm event	velocity in pipe (ft/sec)	flow depth (feet)
100 yr	4.36	0.3

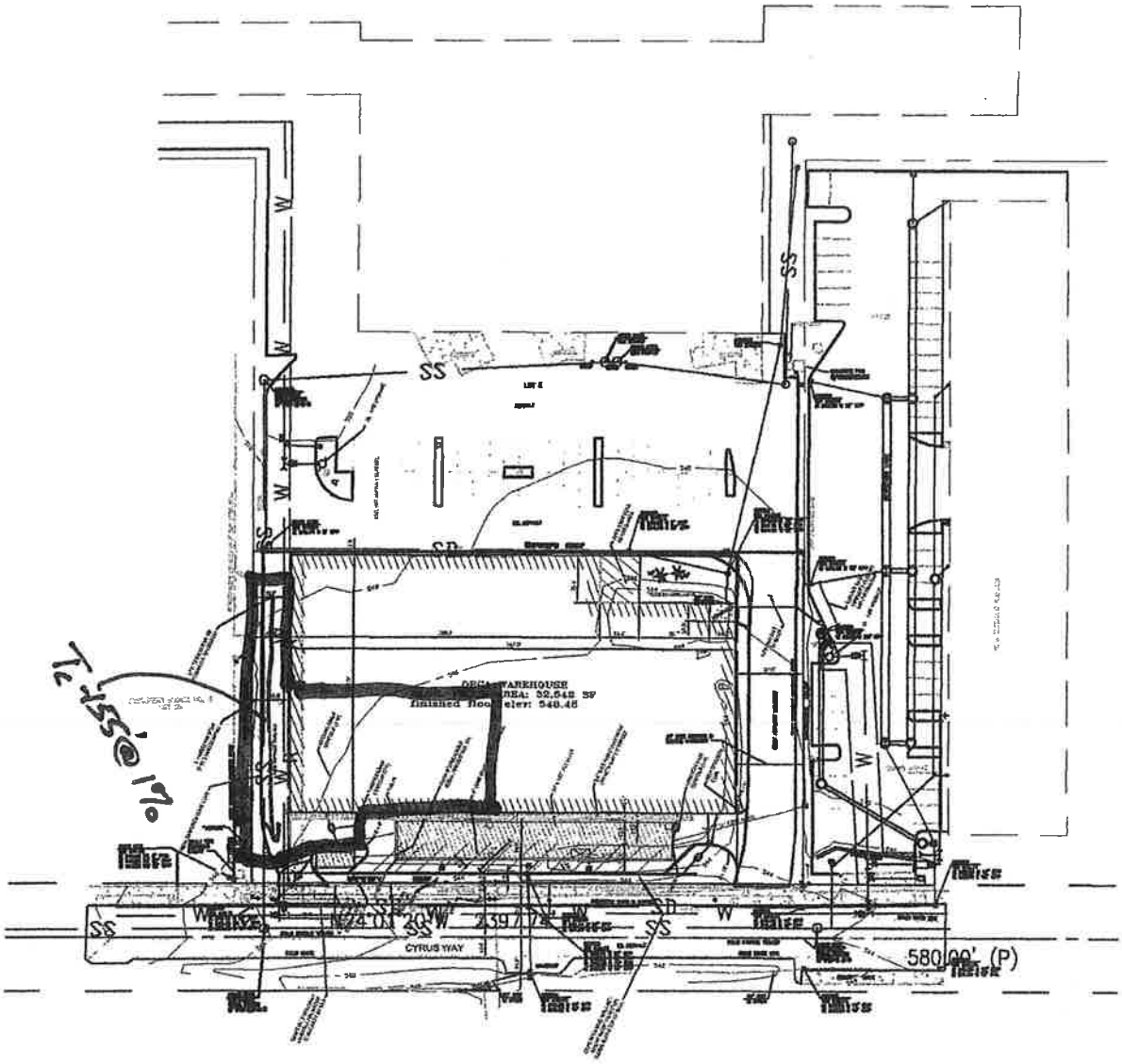
n=0.014

The proposed pipe has adequate capacity for a 100 year storm.

BASIN CB6-VAULT



BASIN CBS- VAULT



JOHNSON COASTLINE, ASSOC

STORM DRAINAGE REPORT AND CALCULATIONS

FOR

HARBOUR POINTE SHOPPING CENTRE
PHASE II DEVELOPMENT
CITY OF MUKILTEO

PREPARED FOR:

HARBOUR POINTE SOPPING CENTRE PARTNERS
C/O GROUP WEST ASSOCIATES, INC.
19105 36TH AVE. WEST, SUITE 101
LYNNWOOD, WASHINGTON 98036

PREPARED BY

JOHNSON COASTLINE, ASSOCIATES INC.
2911 BOND STREET, SUITE 201
EVERETT, WASHINGTON 98201

JANUARY 10, 1994

JCL # 93-153-100

This report has been prepared by Johnson/Coastline for Mr. Bill Brust for the Harbour Pointe Shopping Centre, Phase 2, submittal to the City of Mukilteo. Any revisions to the proposed project may not use or depend upon this report without the written permission of Johnson/Coastline Associates, Inc.

City requirements for grading and drainage for this permit are generally as follows:

1. Provide a grading and drainage plan.
2. Show detention and biofiltration.
3. Provide storm drainage calculations.

Calculations (Appendix A) and design plans are based on good engineering practice, methods, and procedures in Snohomish County Title 24, Drainage Ordinance Procedure Manual, 1979, and field investigation of the existing system in the project area.

General Site Description/Condition

The subject site, which consists of approximately 1.88 acres, is located on a 13.5 acre piece of land, the majority of which was previously developed in Phase 1 of the Harbour Pointe Shopping Centre project. The site is roughly graded and is currently used for the storage of excess topsoil and the existing detention pond. The most westerly portion of the 13.5 acres currently contains the rear detention pond and biofiltration swale.

Existing Drainage

This site has been previously developed and has a drainage system in place. Original drainage calculations and design anticipated the work proposed for Phase 2 development. The northern portion of the site has been cleared and graded and currently has an average slope of approximately 2.5% to the east towards the detention pond (the Front Pond) along the Mukilteo Speedway. The most westerly portion of the site currently provides for surface storage of storm drainage (the Back Pond) prior to exit to a drainage way west of Cyrus Way.

Proposed Drainage

Improvements to the site consist of reconfiguring both ponds to provide the same amount of detention as currently exists and installing several additional catch basins to provide drainage for Phase 2 construction. Additional improvements include the addition of a small amount of underground storage for the front pond. The Back Pond will be completely reconfigured and a control M.H. will be installed to provide overflow control to a biofiltration swale which will flow to the existing 12" diameter pipe under Cyrus Way.

The conveyance system has been sized using the Rational Method for a 25-year return period design storm. The detention facilities were previously sized to store the post development 25-year return period design storm with a 10-year pre-development release rate.

Proposed Development and Impacts

Minor grading is proposed to provide parking for the proposed use and improve the collection of surface water runoff on the site. Runoff will be released via metered outlets from the proposed detention system. The rear pond discharge will run through a substantial length of biofiltration before being discharged to the existing drainage at the west side of the property. The front pond has a two cell configuration. The majority of storm water tributary to the front pond will run through either the existing oil/water separator or a biofiltration swale prior to entering the upstream detention cell.

During the site investigation, no evidence of significant erosion was observed around the existing grading or along the drainage within the subject property. Based on this, and fact that the original drainage study included Phase 2 development in the post development conditions, detention volumes, allowable release rates, and outlet structures are to remain the same.

Specifically:

Front Pond: $Q_{Allow10}$ = 2.26 cfs
Q_{Allow2} = 1.41

Req. Detention = 22,787 cu.ft.

Back Pond: Q_{100} = 3.37 cfs
$Q_{Allow10}$ = .327
Q_{Allow2} = .182

Req. Detention = 2,529 cu.ft.

APPENDIX A

REAR POND BIOFILTRATION SWALE DESIGN CALCULATIONS

The design is based on Snohomish County Title 24 and the DOE Puget Sound Stormwater Management Program requirements.

Grass is a Red Fescue & Kentucky Bluegrass mix.

Winter design height = 4"
Design flow depth = y = 2"
Dense grass => n = .05
Trapezoidal section w/ side slopes of 3H:1V => z = 3
Slope = .5%

Design Flows:

Storm Event	Q_{all}
2yr	.182 cfs
10yr	.327 cfs
100yr	3.37 cfs
6mth = 64% of 2yr =	.116 cfs

Find base width for Q = 6 mth

$b = Qn/1.486 * y^{1.667} * SQRT(s) - Z*y$

$= .116(.05)/1.486*(.167)^{1.667} SQRT(.005) - 3*.167 = .596'$ use 2'

X-Sec. Area = by + Zy^2 = .596(.167) + 3(.167) = .6 sq. ft.

$V = Q/A = .116cfs/.6ft^2 = .19$ <1.5=> ok

CHANNEL STABILITY CALCULATIONS

Assume low retardant condition.
Combination of Red Fescue & Kentucky Bluegrass yields an approximate max. velocity of 3.5 fps.

V_{max} = 3.5 fps

say n = .05

VR = 1.5

$R = VR/V_{max} = 1.5/3.5 = .429$

$VR = 1.486*R^{*1.667}*SQRT(s)/n$

$= 1.486*.429^{*1.667}*SQRT(.005)/.05 = .51$ (ng)

Try n = .036

Then VR = 4.5

$R = VR/V_{max} = 4.5/3.5 = 1.286$

$VR_{Calc.} = 4.44$ (ok)

V = VR/R = 4.44/1.286 = 3.45 fps < 3.5 fps (ok)

A = Q/V = 3.37/3.45 = .98 sq. ft.

say b = 2′

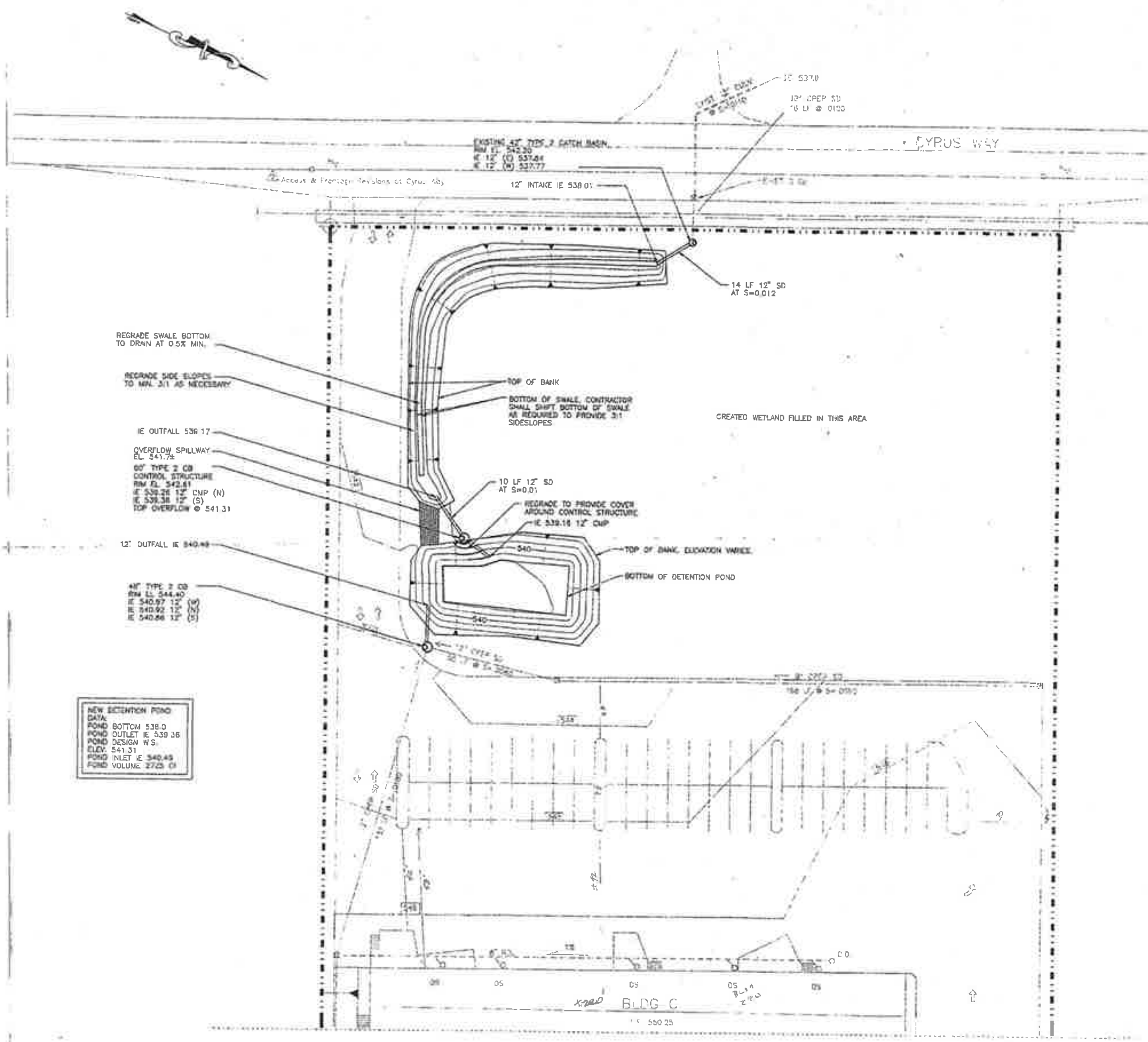
THEN .98 = 2y + 3y^2 => Y = .33′

b = 2′ y = 1.33 Z = 3

R = .765′
Possible Q = 14 cfs > 3.37 cfs (ok)

Therefore:

Length = 200′
Bottom Width = 2′
Top Width = 11′ min.



GENERAL NOTES

CONTRACTOR SHALL REGRADE SWALE BOTTOM TO DRAIN FROM POND OUTLET TO SWALE OUTLET AT A CONSTANT GRADE.

CONTRACTOR SHALL GRADE SWALE SIDE SLOPES TO 3H:1V.

WHEN GRADING REWORK IS COMPLETED, CONTRACTOR SHALL HYDROSEED AS DIRECTED ON SHEET C-2 OF ORIGINAL REAR DETENTION POND PLAN.

THIS PLAN REPRESENTS CHANGES MADE IN FIELD, SURVEY INFORMATION PROVIDED BY OWNER

job no.	93-153-200
design	RKR
drawn	TM
opp'v'd	RKR
date	1-17-96
dwg.	C:\HBPPN\1HPNT
scale	1" = 20'

no.	date	item

revisions

Johnson
COASTLINE ASSOC
2911 Bond St, Suite 201, Everett, Wa 98201
Phone: (206) 259-6071 Fax: (206) 259-1309

HARBOUR POINTE SHOPPING CENTRE
MUKILTEO WASHINGTON
PHASE II
REAR DETENTION POND PLAN

sheet
1 OF 1
93-153-200