Harlow Construction Company, Inc.
3815 - 100th Street SW #2A
Lakewood, WA 98499

Statement

DATE
12/13/2007

TO:

Barend Van Zanten
P.O. Box 7279
Olympia, WA 98507

TERMS	DUE DATE	AMOUNT DUE	AMOUNT ENC.
	12/13/2007	$4,937.13	

DATE	TRANSACTION	AMOUNT	BALANCE
07/31/2007	Balance forward		0.00
09/03/2007	INV #8221. Due 09/03/2007.	69,188.13	69,188.13
09/07/2007	PMT #Oly Federal Savings.	-47,005.96	22,182.17
10/04/2007	PMT #3735.	-18,722.93	3,459.24
12/13/2007	INV #8948. Due 12/13/2007.	1,477.89	4,937.13

1.5% Finance charge added to all past due accounts.

CURRENT	1-30 DAYS PAST DUE	31-60 DAYS PAST DUE	61-90 DAYS PAST DUE	OVER 90 DAYS PAST DUE	AMOUNT DUE
1,477.89	0.00	0.00	0.00	3,459.24	$4,937.13

Phone #	Fax #	Web Site
(253) 588-4705	(253) 588-4710	www.harlowconstruction.com

3822
1/2/08

Preliminary Drainage and Hydraulics Report

for

1919 Berry Street
Olympia Washington

October 2004

Prepared for:

Berand Van Zanten
Pacific Management Group
P.O. Box 7279
Olympia, WA 98507

Prepared by:

Brian K. Matthews, P.E.
3230 Cain Rd SE
Olympia, WA 98501
(360) 456-2886

Project Description
The proposed project will construct a new multilevel single family residence at 1919 Berry Street in Olympia on an undeveloped parcel of property approximately 0.12 acres in size. The site is shown on the vicinity map at the end of the report. This drainage report is intended to show that by rerouting the existing drainage system to the side of the lot, rather then through the middle. The lot can be developed without impact to the stormwater system.

Existing Condition
The project site, Thurston County parcel # 49300500300 is currently undeveloped and has some brush and small diameter tree growth on the parcel. The lot is located on the west side of Berry Street in an established neighborhood that has houses on the neighboring lot to the south and to the two lots to the north.

Berry Street is cut into the hillside that slopes downward from the east to the west. The roadway runs north and south and has an established right-of-way width of 60 feet. The roadway has a paved width of 22 feet at the project location.

The site is located at a low point in the Berry Street profile. The roadway slopes toward the site starting approximately 200 feet to the north. The roadway then enters a slight sag curve and then begins to gradually rise for approximately 200 feet to the south. The roadway conveys stormwater to two existing concrete catch basins on the east side of Berry Street. The water is then conveyed under the roadway and discharged onto the project site where it cuts through the lot in a defined channel that has been eroded over time and flows unrestricted into a City catch basin and culvert located approximately 100' farther down the slope. The water then flows under East Bay Drive where it discharges into Budd Inlet.

The north culvert is 12" in diameter, 67 feet long and a slope of 20%. The east invert elevation is 121.34 and the west elevation is 107.87. The south culvert is 8" in diameter, 37 feet long and a slope of 10.05%. The east invert elevation is 118.98 and the west elevation is 115.26.

This project will leave the north culvert in place and allow the existing flow to continue down the north side of the project. A protected swale will be required once water flows on to the property to ensure that erosion does not occur.

Off-Site Contribution
The stormwater flow from off site is comprised of the roadway drainage from the north and south of the project, runoff from the driveway of the 6 existing houses on the east side of Berry Street, and the roof area and down spouts from these houses.

The stormwater flows from the north to the south along the roadway where it enters the catch basin on the east side of the roadway and then flows under the road in a 12" diameter concrete culvert. Stormwater from the south flows toward the north where it enters an existing catch basin and is conveyed under the roadway in the existing 8" concrete pipe.

The discharge from these culverts flows toward a defined drainage channel in the middle of the project site, and then flows to the west down the slope above East Bay Drive. The water is collected in a catch basin owned by the City of Olympia, and then flows out to Budd Inlet.

Future Conditions
The stormwater system is analyzed for the peak flow for the existing conditions and the new impervious roof area created by the house.

Stormwater System Improvements and Sizing Recommendations
This project requires that the culvert sizing be checked to ensure that it can carry the stormwater runoff from the existing conditions at the peak storm event flows. The contributing areas are shown on the basin map at the end of this report.

The stormwater analysis was conducted using the Waterworks computer software. The analysis was done using at the largest possible stormwater event that can be modeled. The contributing area for each culvert was analyzed using a Type IA, 100-year storm. The calculated peak flow was then compared to pipe capacity. The following information was used to develop the storm basin model characteristics.

Model Parameters	*North Culvert*	*South Culvert*
Basin Area	0.28 Acres	0.28 Acres
Impervious Area	0.28 Acres	0.28 Acres
Disturbed Pervious Area	0.0 Acres	0.0 Acres
Storm Event	Type I, 100 year, 24-hour	Type I, 100 year, 24-hour
Time of Concentration	5 Minutes	5 Minutes
Precipitation:	12 inches	12 inches

It is assumed that the entire area is impervious. This is a more conservative approach that puts a greater runoff flow rate into the catch basin. Actual flows would be less, however for safety this area is considered all impervious.

The calculated peak runoff for the two basins is shown in the computer model information at the end of this report. The following table shows the projected peak flow for each section of the conveyance system, the calculated capacity and factor of safety included.

	Culvert A	Culvert B	Culvert C	Culvert D
Pipe Size / Type	12" Concrete	8" Concrete	12" PVC	12" PVC
Pipe Location	North of project under Berry Street	South of Project under Berry Street	New pipe along south side of property.	New pipe along west side of property.
Pipe Slope	20%	10.1%	20 %	4.7%
Peak Flow Calculated	1.67 CFS	1.67 CFS	3.70 CFS[1]	3.52 CFS[1]
Maximum Pipe Capacity	18.83 CFS	4.58 CFS	12.63 CFS	9.13 CFS
Factor of Safety	11.3	2.7	3.4	2.6

The analysis shows that the proposed piping system is more than sufficient to meet the greatest peak flow that can be expected with the rainfall record information.

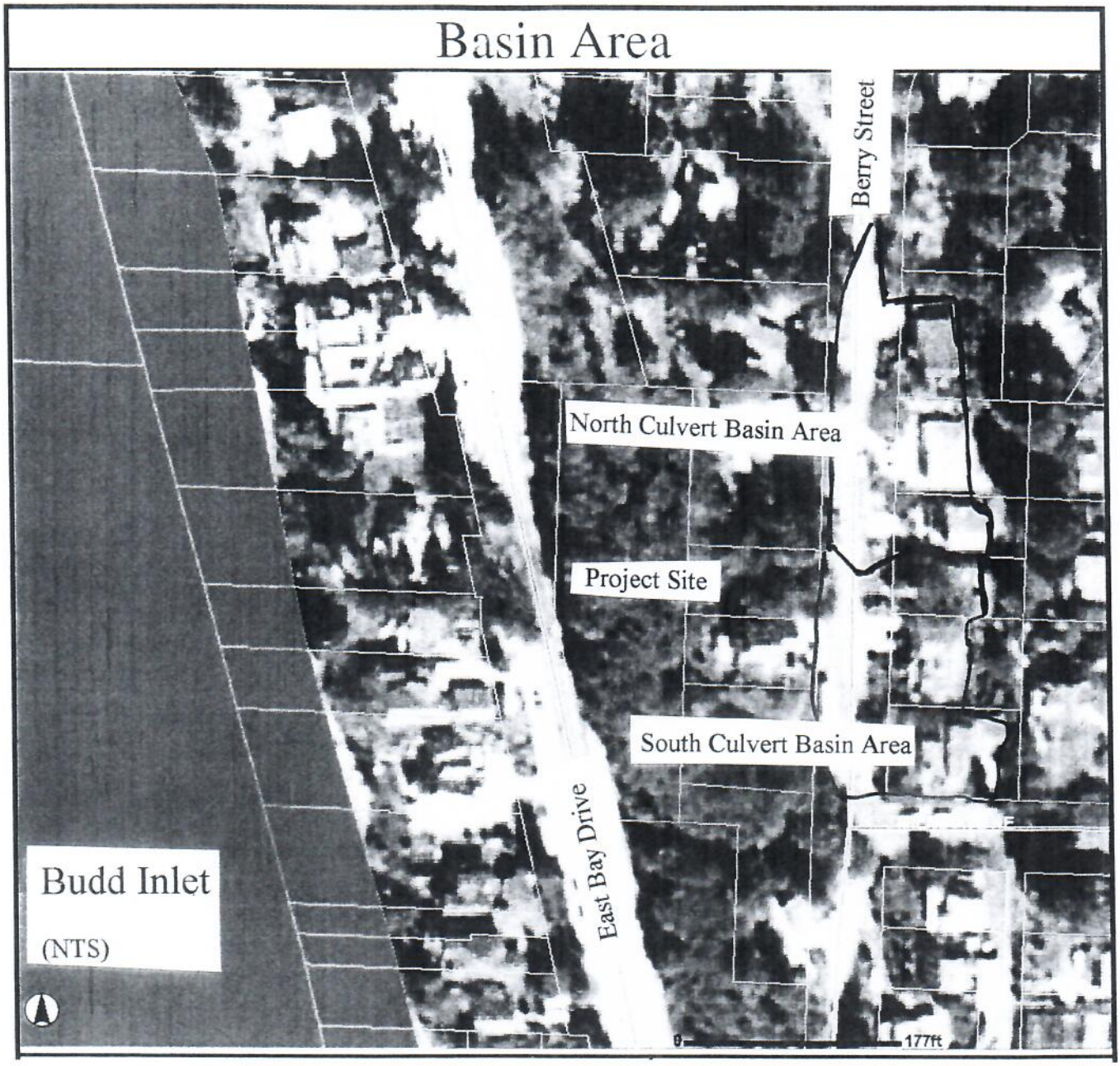
Runoff from the impervious area on the house shall be tight lined and connected to the 12" PVC line on the south property line. French drain lines that are installed around the foundation footing and retaining walls will also be connected into tight line and conveyed off site down the slope and into Budd Inlet.

The final conveyance portion of this flow route is from the new 12" line "Culvert D" overland into the existing catch basin west of the project. The slope averages 20% and needs to convey the 3.52 CFS without causing erosion. The flow velocity from the pipe to the catch basin is calculated to be 11.62 feet per second without any modifications to the channel.

It is recommended that the channel be lined with 4"-6" quarry spalls over a PVC liner to dissipate and retard the flow velocity and reduce the erosion caused by rapid moving water.

[1] This includes the flow from Pipe B and the calculated flow from the house roof drains. The calculated peak rate for the roof is 0.36 CFS based on a 2,500 SF roof area.

Basin Area


Berry Street
North Culvert Basin Area
Project Site
South Culvert Basin Area
East Bay Drive
Budd Inlet
(NTS)
0
177ft

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Van Zanten CULVERT A

Comment: Culvert Capacity

Solve For Full Flow Capacity

Given Input Data:

Diameter.....	1.00 ft
Slope.....	0.2000 ft/ft
Manning's n.....	0.011
Discharge.....	18.83 cfs

Computed Results:

Full Flow Capacity.....	18.83 cfs
Full Flow Depth.....	1.00 ft
Velocity.....	23.98 fps
Flow Area.....	0.79 sf
Critical Depth....	1.00 ft
Critical Slope....	0.1963 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	18.83 cfs
QMAX @.94D.....	20.26 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Van Zanten CULVERT B

Comment: Culvert Capacity

Solve For Full Flow Capacity

Given Input Data:

Diameter.....	0.67 ft
Slope.....	0.1000 ft/ft
Manning's n.....	0.011
Discharge.....	4.58 cfs

Computed Results:

Full Flow Capacity.....	4.58 cfs
Full Flow Depth.....	0.67 ft
Velocity.....	12.98 fps
Flow Area.....	0.35 sf
Critical Depth....	0.67 ft
Critical Slope....	0.0958 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	4.58 cfs
QMAX @.94D.....	4.92 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name:

Comment:

Solve For Full Flow Capacity

Given Input Data:

Diameter.....	1.00 ft
Slope.....	0.0900 ft/ft
Manning's n.....	0.011
Discharge.....	12.63 cfs

Computed Results:

Full Flow Capacity.....	12.63 cfs
Full Flow Depth.....	1.00 ft
Velocity.....	16.08 fps
Flow Area.....	0.79 sf
Critical Depth....	1.00 ft
Critical Slope....	0.0863 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	12.63 cfs
QMAX @.94D.....	13.59 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Culvert 5

Comment:

Solve For Full Flow Capacity

Given Input Data:

Diameter.....	1.00 ft
Slope.....	0.1600 ft/ft
Manning's n.....	0.011
Discharge.....	16.84 cfs

Computed Results:

Full Flow Capacity.....	16.84 cfs
Full Flow Depth.....	1.00 ft
Velocity.....	21.44 fps
Flow Area.....	0.79 sf
Critical Depth.....	1.00 ft
Critical Slope.....	0.1563 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	16.84 cfs
QMAX @.94D.....	18.12 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name:

Comment:

Solve For Full Flow Capacity

Given Input Data:

Diameter.....	1.00 ft
Slope.....	0.0470 ft/ft
Manning's n.....	0.011
Discharge.....	9.13 cfs

Computed Results:

Full Flow Capacity.....	9.13 cfs
Full Flow Depth.....	1.00 ft
Velocity.....	11.62 fps
Flow Area.....	0.79 sf
Critical Depth....	0.99 ft
Critical Slope....	0.0435 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	9.13 cfs
QMAX @.94D.....	9.82 cfs
Froude Number.....	FULL

Open Channel Flow Module, Version 3.11 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

BASIN SUMMARY

BASIN ID: A NAME: Culvert Sizing
SBUH METHODOLOGY

TOTAL AREA.....:	0.28 Acres	BASEFLOWS:	0.00 cfs	
RAINFALL TYPE....:	TYPE1		PERV	IMP
PRECIPITATION....:	12.00 inches	AREA..:	0.00 Acres	0.28 Acres
TIME INTERVAL....:	10.00 min	CN....:	0.00	98.00
		TC....:	0.00 min	5.00 min

ABSTRACTION COEFF: 0.20
PEAK RATE: 1.67 cfs VOL: 0.27 Ac-ft TIME: 590 min

BASIN ID: B NAME: Culvert Sizing
SBUH METHODOLOGY

TOTAL AREA.....:	0.56 Acres	BASEFLOWS:	0.00 cfs	
RAINFALL TYPE....:	TYPE1		PERV	IMP
PRECIPITATION....:	5.10 inches	AREA..:	0.00 Acres	0.56 Acres
TIME INTERVAL....:	10.00 min	CN....:	0.00	98.00
		TC....:	0.00 min	5.00 min

ABSTRACTION COEFF: 0.20
PEAK RATE: 1.41 cfs VOL: 0.23 Ac-ft TIME: 590 min

BASIN SUMMARY

BASIN ID: A NAME: Culvert Sizing
SBUH METHODOLOGY

TOTAL AREA.....:	0.03 Acres	BASEFLOWS:	0.00 cfs	
RAINFALL TYPE....:	TYPE1		PERV	IMP
PRECIPITATION....:	12.00 inches	AREA..:	0.00 Acres	0.03 Acres
TIME INTERVAL....:	10.00 min	CN....:	0.00	98.00
		TC....:	0.00 min	5.00 min

ABSTRACTION COEFF: 0.20
PEAK RATE: 0.18 cfs VOL: 0.03 Ac-ft TIME: 590 min

BASIN ID: B NAME: Culvert Sizing
SBUH METHODOLOGY

TOTAL AREA.....:	0.56 Acres	BASEFLOWS:	0.00 cfs	
RAINFALL TYPE....:	TYPE1		PERV	IMP
PRECIPITATION....:	5.10 inches	AREA..:	0.00 Acres	0.56 Acres
TIME INTERVAL....:	10.00 min	CN....:	0.00	98.00
		TC....:	0.00 min	5.00 min

ABSTRACTION COEFF: 0.20
PEAK RATE: 1.41 cfs VOL: 0.23 Ac-ft TIME: 590 min