CONSTRUCTION DRAINAGE REPORT
FOR
MACLEOD APARTMENTS

CITY OF ARLINGTON

DATE: 12/23/08

MAC ENGINEERING, LLC
P.O. Box 197
Silvana, WA. 98287
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Date: December 17th, 2008
Project Number: 080003

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DRAINAGE INFORMATION SUMMARY FORM

Project Total Area: 0.11 acres

Project Development Area: 0.11 acres

Number of Lots (if applies): n/a

Summary Table

Drainage Basin Information	**Individual Basin Information**			
	SITE			
On-Site Sub-basin Area (ac)	0.11			
Type of Storage Proposed	INFILTRATION			
Approx. Storage Volume (ft^3)	N/A			
Soil Type(s)	Everett			
Pre-developed Runoff Rates	N/A			
Q (cfs) 2 yr.				
10 yr.				
100 yr.				
Redevelopment Area	N/A			
Post-development Runoff Rates	N/A			
Q (cfs) 2yr.				
10 yr.				
100 yr.				
Offsite Upstream Area (ac)				
Number of acres				
Offsite Downstream Flow				
Q (cfs)				

DRAINAGE ANALYSIS
SECTION I

INTRODUCTION AND EXISTING CONDITIONS

This project will construct an apartment building with parking area on an approximately 0.11 acre site. The site is located at 420 MacLeod Ave in the City of Arlington. The development area slopes east to west at 5 to 18 %. The Soil Survey of Snohomish County identified the onsite soils as Everett gravelly sandy loam. (Hydrologic Soils Group A) The permeability of Everett soils is rapid and is suitable for infiltration, runoff is medium and hazard of water erosion is moderate.

There are no buildings on the site currently. As such, no demolition will be required on site prior to development. The site is vegetated with underbrush and blackberry.

DEVELOPED CONDITIONS

The site will be accessed from onsite parking off of the alley. An infiltration trench system will be installed underneath the proposed driveway and parking areas, to drain the new building and asphalt impervious surface. The infiltration trench system will be sized to infiltrate runoff from the onsite impervious surfaces to the natural ground up to and including the 100yr storm event. A long term design infiltration rate of 3.8 in/hr was used for the design of the infiltration bed. For additional information see the Geotechnical Investigation as provided by RMI Associates LLC attached to the Appendix of this report. The proposed infiltration trench is approximately 35 ft Long x 10 ft Wide x 4 ft deep with an 8" dia PVC perforated pipe and 1 to 1.5" washed drain rock, with filter fabric on the sides and top. No frontage or alley improvements are required for the MacLeod Apartment site.

Runoff rates and volume calculations were performed, using the WWHM3 storm water model as provided by Clear Creek Solutions and the Washington State Department of Ecology .

WATER QUALITY

The 1,800 sf Building will be provided with none pollution generating roof surfaces and the asphalt driveway and parking area is less than 2,000 sf (1,725 sf proposed) and is exempt from quality requirements. To avoid maintenance concerns for the infiltration trench 2' sumps within the CB's with oil water separators (turned down elbow) will be provided.

OPERATION AND MAINTENANCE

The roof downspout, storm drainage piping system and CB's shall be inspected annually to ensure that sediment is not filling up the catchments and shall be cleaned as necessary. Additionally, undesirable vegetation that has the potential to interfere with performance of or damage to the infiltration system shall be removed. The drainage system shall be inspected after large storm events to ensure debris has not caused a blockage and is not hindering the system's performance. Maintain a record of inspections and maintenance activities on site and made available upon request to the city. The Operation and Maintenance has been provided in Section III of this drainage report.

EROSION CONTROL RISK ASSESSMENT AND SWPPP

The project was evaluated to determine the erosion risk category and generate a Storm Water Pollution Prevention Plan (SWPPP). The soil on the proposed project site is classified as Everett gravelly sandy loam, which has a medium erosion risk categorization. The developed site is flat and the project is not located within ¼ mile of a critical area. Surface runoff does not leave the site in the existing condition; overall, the project is classified as low risk for erosion.

Erosion control BMP's will include leaving existing vegetation as much as practical around the site. Temporary cover and/or surface roughening of exposed areas (mulching, plastic, etc.) will be provided. Measures to limit the level of sediment leaving the site will include silt fences and inlet protection of catch basins.

CONVEYANCE SYSTEM

Two 4" diameter PVC roof drains will be provided for roof downspout connections. No concerns regarding the proposed conveyance system's ability to convey the developed flow rates have been observed.

UPSTREAM/DOWNSTREAM CONDITIONS

No off site upstream areas contribute runoff to the MacLeod Apartment site. Because storm runoff will be infiltrated on site in the developed condition, no downstream analysis is required for on-site drainage. No impacts to the downstream drainage system is anticipated with the MacLeod Apartment site.

SECTION II

Western Washington Hydrology Model
PROJECT REPORT

Project Name: MACLEOD APT
Site Address:
City : ARLINGTON
Report Date : 12/17/2008
Gage : Everett
Data Start : 1948/10/01
Data End : 1997/09/30
Precip Scale: 1.20

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Mod	.105

Element Flows To:

Surface	Interflow	Groundwater

Name : Basin 1
Bypass: No
GroundWater: No

Pervious Land Use	Acres

Impervious Land Use	Acres
ROOF TOPS FLAT	0.0413
DRIVEWAYS FLAT	0.0637

Element Flows To:

Surface	Interflow	Groundwater
Gravel Trench Bed 1,	Gravel Trench Bed 1,	

Name : Gravel Trench Bed 1
Bottom Length: 35ft.
Bottom Width : 10ft.
Trench bottom slope 1: 0.001 To 1
Trench Left side slope 0: 0.0001 To 1
Trench right side slope 2: 0.0001 To 1
Material thickness of first layer : 3
Pour Space of material for first layer : 0.35
Material thickness of second layer : 0
Pour Space of material for second layer : 0

Material thickness of third layer : 0
Pour Space of material for third layer : 0
Infiltration On
Infiltration rate : 15.2 (Note:3.8 inches/hour Long term rate)
Infiltration saftey factor : 0.25
Discharge Structure
Riser Height: 2.95 ft.
Riser Diameter: 1000 in.

Element Flows To:
Outlet 1 Outlet 2

Gravel Trench Bed Hydraulic Table

Stage(ft)	Area(acr)	Volume(acr-ft)	Dschrg(cfs)	Infilt(cfs)
0.000	0.008	0.000	0.000	0.000
0.033	0.008	0.000	0.000	0.031
0.067	0.008	0.000	0.000	0.031
0.100	0.008	0.000	0.000	0.031
0.133	0.008	0.000	0.000	0.031
0.167	0.008	0.000	0.000	0.031
0.200	0.008	0.001	0.000	0.031
0.233	0.008	0.001	0.000	0.031
0.267	0.008	0.001	0.000	0.031
0.300	0.008	0.001	0.000	0.031
0.333	0.008	0.001	0.000	0.031
0.367	0.008	0.001	0.000	0.031
0.400	0.008	0.001	0.000	0.031
0.433	0.008	0.001	0.000	0.031
0.467	0.008	0.001	0.000	0.031
0.500	0.008	0.001	0.000	0.031
0.533	0.008	0.001	0.000	0.031
0.567	0.008	0.002	0.000	0.031
0.600	0.008	0.002	0.000	0.031
0.633	0.008	0.002	0.000	0.031
0.667	0.008	0.002	0.000	0.031
0.700	0.008	0.002	0.000	0.031
0.733	0.008	0.002	0.000	0.031
0.767	0.008	0.002	0.000	0.031
0.800	0.008	0.002	0.000	0.031
0.833	0.008	0.002	0.000	0.031
0.867	0.008	0.002	0.000	0.031
0.900	0.008	0.003	0.000	0.031
0.933	0.008	0.003	0.000	0.031
0.967	0.008	0.003	0.000	0.031
1.000	0.008	0.003	0.000	0.031
1.033	0.008	0.003	0.000	0.031
1.067	0.008	0.003	0.000	0.031
1.100	0.008	0.003	0.000	0.031
1.133	0.008	0.003	0.000	0.031
1.167	0.008	0.003	0.000	0.031
1.200	0.008	0.003	0.000	0.031
1.233	0.008	0.003	0.000	0.031
1.267	0.008	0.004	0.000	0.031
1.300	0.008	0.004	0.000	0.031
1.333	0.008	0.004	0.000	0.031
1.367	0.008	0.004	0.000	0.031

1.400	0.008	0.004	0.000	0.031
1.433	0.008	0.004	0.000	0.031
1.467	0.008	0.004	0.000	0.031
1.500	0.008	0.004	0.000	0.031
1.533	0.008	0.004	0.000	0.031
1.567	0.008	0.004	0.000	0.031
1.600	0.008	0.004	0.000	0.031
1.633	0.008	0.005	0.000	0.031
1.667	0.008	0.005	0.000	0.031
1.700	0.008	0.005	0.000	0.031
1.733	0.008	0.005	0.000	0.031
1.767	0.008	0.005	0.000	0.031
1.800	0.008	0.005	0.000	0.031
1.833	0.008	0.005	0.000	0.031
1.867	0.008	0.005	0.000	0.031
1.900	0.008	0.005	0.000	0.031
1.933	0.008	0.005	0.000	0.031
1.967	0.008	0.006	0.000	0.031
2.000	0.008	0.006	0.000	0.031
2.033	0.008	0.006	0.000	0.031
2.067	0.008	0.006	0.000	0.031
2.100	0.008	0.006	0.000	0.031
2.133	0.008	0.006	0.000	0.031
2.167	0.008	0.006	0.000	0.031
2.200	0.008	0.006	0.000	0.031
2.233	0.008	0.006	0.000	0.031
2.267	0.008	0.006	0.000	0.031
2.300	0.008	0.006	0.000	0.031
2.333	0.008	0.007	0.000	0.031
2.367	0.008	0.007	0.000	0.031
2.400	0.008	0.007	0.000	0.031
2.433	0.008	0.007	0.000	0.031
2.467	0.008	0.007	0.000	0.031
2.500	0.008	0.007	0.000	0.031
2.533	0.008	0.007	0.000	0.031
2.567	0.008	0.007	0.000	0.031
2.600	0.008	0.007	0.000	0.031
2.633	0.008	0.007	0.000	0.031
2.667	0.008	0.008	0.000	0.031
2.700	0.008	0.008	0.000	0.031
2.733	0.008	0.008	0.000	0.031
2.767	0.008	0.008	0.000	0.031
2.800	0.008	0.008	0.000	0.031
2.833	0.008	0.008	0.000	0.031
2.867	0.008	0.008	0.000	0.031
2.900	0.008	0.008	0.000	0.031
2.933	0.008	0.008	0.000	0.031
2.967	0.008	0.008	1.746	0.031
3.000	0.008	0.008	9.074	0.031

MITIGATED LAND USE

ANALYSIS RESULTS

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.003447
5 year	0.005172
10 year	0.006538
25 year	0.008542
50 year	0.010251
100 year	0.012159

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0
5 year	0
10 year	0
25 year	0
50 year	0
100 year	0

Yearly Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1950	0.002	0.000
1951	0.006	0.000
1952	0.002	0.000
1953	0.003	0.000
1954	0.004	0.000
1955	0.006	0.000
1956	0.006	0.000
1957	0.004	0.000
1958	0.006	0.000
1959	0.006	0.000
1960	0.003	0.000
1961	0.003	0.000
1962	0.004	0.000
1963	0.005	0.000
1964	0.008	0.000
1965	0.003	0.000
1966	0.003	0.000
1967	0.002	0.000
1968	0.004	0.000
1969	0.004	0.000
1970	0.006	0.000
1971	0.002	0.000
1972	0.004	0.000
1973	0.003	0.000
1974	0.002	0.000
1975	0.003	0.000
1976	0.003	0.000
1977	0.002	0.000
1978	0.002	0.000
1979	0.003	0.000
1980	0.009	0.000
1981	0.003	0.000
1982	0.003	0.000
1983	0.003	0.000
1984	0.003	0.000
1985	0.003	0.000
1986	0.004	0.000

1987	0.009	0.000
1988	0.004	0.000
1989	0.002	0.000
1990	0.004	0.000
1991	0.003	0.000
1992	0.003	0.000
1993	0.003	0.000
1994	0.002	0.000
1995	0.002	0.000
1996	0.003	0.000
1997	0.005	0.000
1998	0.012	0.000

Ranked Yearly Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0124	0.0000
2	0.0092	0.0000
3	0.0089	0.0000
4	0.0084	0.0000
5	0.0065	0.0000
6	0.0065	0.0000
7	0.0061	0.0000
8	0.0060	0.0000
9	0.0058	0.0000
10	0.0056	0.0000
11	0.0054	0.0000
12	0.0053	0.0000
13	0.0044	0.0000
14	0.0044	0.0000
15	0.0043	0.0000
16	0.0043	0.0000
17	0.0041	0.0000
18	0.0038	0.0000
19	0.0038	0.0000
20	0.0037	0.0000
21	0.0036	0.0000
22	0.0033	0.0000
23	0.0033	0.0000
24	0.0032	0.0000
25	0.0031	0.0000
26	0.0031	0.0000
27	0.0031	0.0000
28	0.0030	0.0000
29	0.0030	0.0000
30	0.0030	0.0000
31	0.0030	0.0000
32	0.0029	0.0000
33	0.0029	0.0000
34	0.0028	0.0000
35	0.0027	0.0000
36	0.0027	0.0000
37	0.0025	0.0000
38	0.0025	0.0000
39	0.0025	0.0000
40	0.0024	0.0000
41	0.0023	0.0000
42	0.0023	0.0000
43	0.0023	0.0000

44	0.0022	0.0000
45	0.0022	0.0000
46	0.0020	0.0000
47	0.0020	0.0000
48	0.0018	0.0000
49	0.0018	0.0000

POC #1
The Facility PASSED

The Facility PASSED.

Flow(CFS)	Predev	Dev	Percentage	Pass/Fail
0.0017	3381	0	0	Pass
0.0018	2946	0	0	Pass
0.0019	2582	0	0	Pass
0.0020	2252	0	0	Pass
0.0021	1943	0	0	Pass
0.0022	1701	0	0	Pass
0.0022	1474	0	0	Pass
0.0023	1273	0	0	Pass
0.0024	1117	0	0	Pass
0.0025	986	0	0	Pass
0.0026	855	0	0	Pass
0.0027	743	0	0	Pass
0.0028	635	0	0	Pass
0.0028	558	0	0	Pass
0.0029	490	0	0	Pass
0.0030	426	0	0	Pass
0.0031	383	0	0	Pass
0.0032	346	0	0	Pass
0.0033	311	0	0	Pass
0.0034	278	0	0	Pass
0.0034	250	0	0	Pass
0.0035	233	0	0	Pass
0.0036	215	0	0	Pass
0.0037	202	0	0	Pass
0.0038	185	0	0	Pass
0.0039	174	0	0	Pass
0.0040	161	0	0	Pass
0.0040	154	0	0	Pass
0.0041	142	0	0	Pass
0.0042	135	0	0	Pass
0.0043	130	0	0	Pass
0.0044	122	0	0	Pass
0.0045	119	0	0	Pass
0.0046	114	0	0	Pass
0.0047	112	0	0	Pass
0.0047	109	0	0	Pass
0.0048	103	0	0	Pass
0.0049	97	0	0	Pass
0.0050	95	0	0	Pass
0.0051	94	0	0	Pass
0.0052	91	0	0	Pass
0.0053	89	0	0	Pass
0.0053	85	0	0	Pass

0.0054	81	0	0	Pass
0.0055	76	0	0	Pass
0.0056	74	0	0	Pass
0.0057	72	0	0	Pass
0.0058	69	0	0	Pass
0.0059	67	0	0	Pass
0.0059	66	0	0	Pass
0.0060	63	0	0	Pass
0.0061	61	0	0	Pass
0.0062	60	0	0	Pass
0.0063	58	0	0	Pass
0.0064	57	0	0	Pass
0.0065	55	0	0	Pass
0.0065	52	0	0	Pass
0.0066	51	0	0	Pass
0.0067	48	0	0	Pass
0.0068	45	0	0	Pass
0.0069	44	0	0	Pass
0.0070	42	0	0	Pass
0.0071	39	0	0	Pass
0.0072	38	0	0	Pass
0.0072	36	0	0	Pass
0.0073	35	0	0	Pass
0.0074	34	0	0	Pass
0.0075	34	0	0	Pass
0.0076	32	0	0	Pass
0.0077	31	0	0	Pass
0.0078	30	0	0	Pass
0.0078	29	0	0	Pass
0.0079	28	0	0	Pass
0.0080	24	0	0	Pass
0.0081	24	0	0	Pass
0.0082	23	0	0	Pass
0.0083	20	0	0	Pass
0.0084	19	0	0	Pass
0.0084	18	0	0	Pass
0.0085	16	0	0	Pass
0.0086	16	0	0	Pass
0.0087	13	0	0	Pass
0.0088	13	0	0	Pass
0.0089	13	0	0	Pass
0.0090	11	0	0	Pass
0.0090	11	0	0	Pass
0.0091	11	0	0	Pass
0.0092	8	0	0	Pass
0.0093	7	0	0	Pass
0.0094	6	0	0	Pass
0.0095	6	0	0	Pass
0.0096	5	0	0	Pass
0.0096	3	0	0	Pass
0.0097	3	0	0	Pass
0.0098	3	0	0	Pass
0.0099	3	0	0	Pass
0.0100	2	0	0	Pass
0.0101	2	0	0	Pass
0.0102	2	0	0	Pass
0.0103	2	0	0	Pass

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SCREEN CAPTURES

Facility Name Gravel Trench Bed 1

	Outlet 1	Outlet 2	Outlet 3
Downstream Connection	0	0	0

Facility Type Gravel Trench Bed

Precipitation Applied to Facility

Quick Trench

Facility Bottom Elevation (ft) 0

Facility Dimensions

Trench Length	
Trench Bottom Width	
Effective Total Depth	
Bottom slope of Trench	
Left Side Slope	
Right Side Slope	

Outlet Structure

Riser Height (ft)	2.95
Riser Diameter(in)	1000
Riser Type	Flat
Notch Type	

Material Layers for

Layer 1 Thickness (ft)	
Layer 1 porosity	
Layer 2 Thickness (ft)	
Layer 2 porosity	
Layer 3 Thickness (ft)	
Layer 3 porosity	

Orifice Number	Diameter (In)	Height (Ft)	QMax (cfs)
1	0	0	0
2	0	0	0
3	0	0	0

Infiltration YES

Measured Infiltration Rate (in/hr)	15.2
Infiltration Reduction Factor (infilt*factor)	0.25
Use Wetted Surface Area (sidewalls)	NO
Total Volume Infiltrated(acre-ft)	16.126
Total Volume Through Riser(acre-ft)	0

Trench Volume at Riser Head (acre-ft) .008

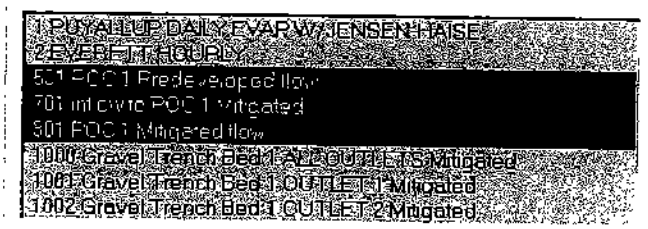
Pond Increment 0.10

Show Pond Table Open Table

Total Volume Through Facility(acre-ft) 16.126

Percent Infiltrated 100

Flow Frequency			
Flow(CFS)	0501	0701	0801
2 Year =	0.0034	0.0378	0.0000
5 Year =	0.0052	0.0503	0.0000
10 Year =	0.0065	0.0591	0.0000
25 Year =	0.0085	0.0710	0.0000
50 Year =	0.0103	0.0803	0.0000
100 Year =	0.0122	0.0901	0.0000
Yearly Peaks			
1949	0.0023	0.0314	0.0000
1950	0.0065	0.0537	0.0000
1951	0.0023	0.0422	0.0000
1952	0.0027	0.0319	0.0000
1953	0.0037	0.0428	0.0000
1954	0.0060	0.0540	0.0000
1955	0.0056	0.0451	0.0000
1956	0.0038	0.0219	0.0000
1957	0.0061	0.0364	0.0000
1958	0.0058	0.0663	0.0000
1959	0.0033	0.0371	0.0000
1960	0.0030	0.0284	0.0000
1961	0.0041	0.0857	0.0031
1962	0.0053	0.0375	0.0000
1963	0.0084	0.0582	0.0000
1964	0.0030	0.0283	0.0000
1965	0.0029	0.0281	0.0000



SECTION III

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CATCH BASINS/MANHOLES

Maintenance Component	Defect	Conditions When Maintenance is Needed	Desired Conditions
General	Trash & debris (Includes Sediment)	Trash or debris of more than ½ ft^3 which is located immediately in front of the catch basin opening or is blocking capacity of the basin by more than 10%.	No trash or debris located immediately in front of catch basin opening.
		Trash or debris (in the basin) that exceeds 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (i.e. methane).	No dead animals or vegetation present within the catch basin.
		Deposits of garbage exceeding 1 ft^3 in volume.	No condition present which would attract or support the breeding of insects or rodents.
	Structure Damage to Frame and/or top slab	Corner of frame extends more than ¾" past curb face into the street (if applicable).	Frame is even with curb.
		Top slab has holes larger that 2 in^2 or cracks wider than ¼" (intent is to make sure all material is running into basin.	Top slab is free of holes & cracks.
		Frame not sitting flush on top slab; i.e. separation of more than ¾" of the frame from the top slab.	Frame is sitting flush on top slab.
	Cracks in Basin Walls/ Bottom	Cracks wider than ½" and longer than 3 ft, any evidence of soil particles entering catch basin through cracks, or maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
		Cracks wider than ½" and longer than 1 ft at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	No cracks more than ¼" wide at the joint of inlet/outlet pipe.
	Sediment/Mis-alignment	Basin has settled more than 1" or has rotated more than 2" out of alignment.	Basin replaced or repaired to design standards.
	Fire Hazard	Presence of chemicals such as natural gas, oil, and/or gasoline.	No flammable chemicals present.
	Vegetation	Vegetation growing across & blocking more than 10% of the basin opening.	No Vegetation blocking opening to basin.
		Vegetation growing in inlet/outlet pipe joints that is more than 6" tall and less than 6" apart.	No vegetation or root growth present.
	Pollution	Non-flammable chemicals of more than ½ ft^3 per 3 ft of basin length.	No pollution present other than surface film.

CATCH BASINS/MANHOLES

Maintenance Component	Defect	Conditions When Maintenance is Needed	Desired Conditions
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by 1 maint. person with proper tools. Bolts into frame have less than ½" of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	1 Maint. person cannot remove lid after applying 80 lbs of lift; intent is to keep cover from sealing off access to maintenance personnel.	Cover can be removed by 1 maint. person.
Ladder	Ladder rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards & allows maint. personnel safe access.
Metal Grates (if applicable)		Grate with opening wider than 7/8"	Grate meets design standards.
	Trash & Debris	Trash & debris that is blocking more than 20% of grate surface.	Grate is free of trash & debris.
	Damaged or Missing	Grate missing or broken member(s) of the grate.	Grate is in place & meets design standards.

CONVEYANCE SYSTEMS (PIPES)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Desired Conditions
Pipes	Sediment & Debris	Accumulated sediment that exceeds 20% of the pipe.	Pipe cleaned of all sediment & debris.
	Vegetation	Vegetation that reduces free movement of water through pipes.	All vegetation removed so water flows freely through pipe.
	Damaged	Protective coating is damaged; rust is causing more than 50% deterioration to any part of the pipe.	Pipe repaired or replaced.
		Any dent that decreases the cross sectional area of the pipe by more than 20%.	Pipe repaired or replaced.
Catch Basins		See "Catch Basins" standard.	See "Catch Basins" standard.
Debris Barriers (e.g. Trash Rack)	Sediment & Debris	Accumulated sediment/debris that exceeds 20% the inlet opening.	Debris barrier is free of sediment & debris.
	Vegetation	Vegetation obstructs more than 20% of the inlet opening.	Debris barrier is free of obstructing vegetation.

INFILTRATION SYSTEMS

Maintenance Component	Defect	Conditions When Maintenance is Needed	Desired Conditions
General	Trash & debris build-up in D box.	Accumulation that exceeds 1 ft^3.	Trash & debris removed from pond.
	Poisonous Vegetation Vegetation	Vegetation such as grass and weeds need to be mowed when it starts to impede aesthetics of pond. Mowing is generally required when height exceeds 18". Mowed vegetation should be removed from areas where it could enter the trench, either when the water level risers, or by rainfall runoff.	Vegetation should be mowed to 4-5" in height. Threes and bushes should be removed where they are interfering with pond maintenance activities.
	Fire Hazard	Presence of chemicals such as natural gas, oil, and/or gasoline.	No flammable chemicals present.
	Vegetation	Vegetation growing across & blocking more than 10% of the basin opening.	No Vegetation blocking opening to basin.
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and the dam or berm repaired.
	Insects	When insects such as wasps and hornets interfere with maint. activities.	Insects destroyed or removed from site.
	Tree Growth	Tree growth does not allow maintenance access or interferes with maintenance activity (i.e. slope mowing, silt removal, vactoring, or equipment movements). If trees are not interfering with access, leave trees alone.	No trees are to be allowed in infiltration areas.
Storage Area	Sediment build-up in system	A soil texture test indicates facility is not working at its designed capabilities or was incorrectly designed.	Sediment is removed and/or facility is cleaned so that infiltration system works according to design. A sediment trapping area is installed to reduce sediment transport into infiltration area.
	Storage area drains slowly (more than 48 hours) or overflows	A soil texture test indicates facility is not working at its designed capabilities or was incorrectly designed.	Additional volume is added through excavation to provide needed storage. Soil is aerated and rototilled to improve drainage.
	Sediment trapping area	Any sediment and debris filling area to 10% of depth from sump bottom to bottom of outlet pipe or obstructing flow into the connector pipe.	Clean out sump to design depth.
Rock Filters	Sediment & debris	By visual inspection little or no water flows through filter during heavy rain storms.	Replace gravel in rock filter.

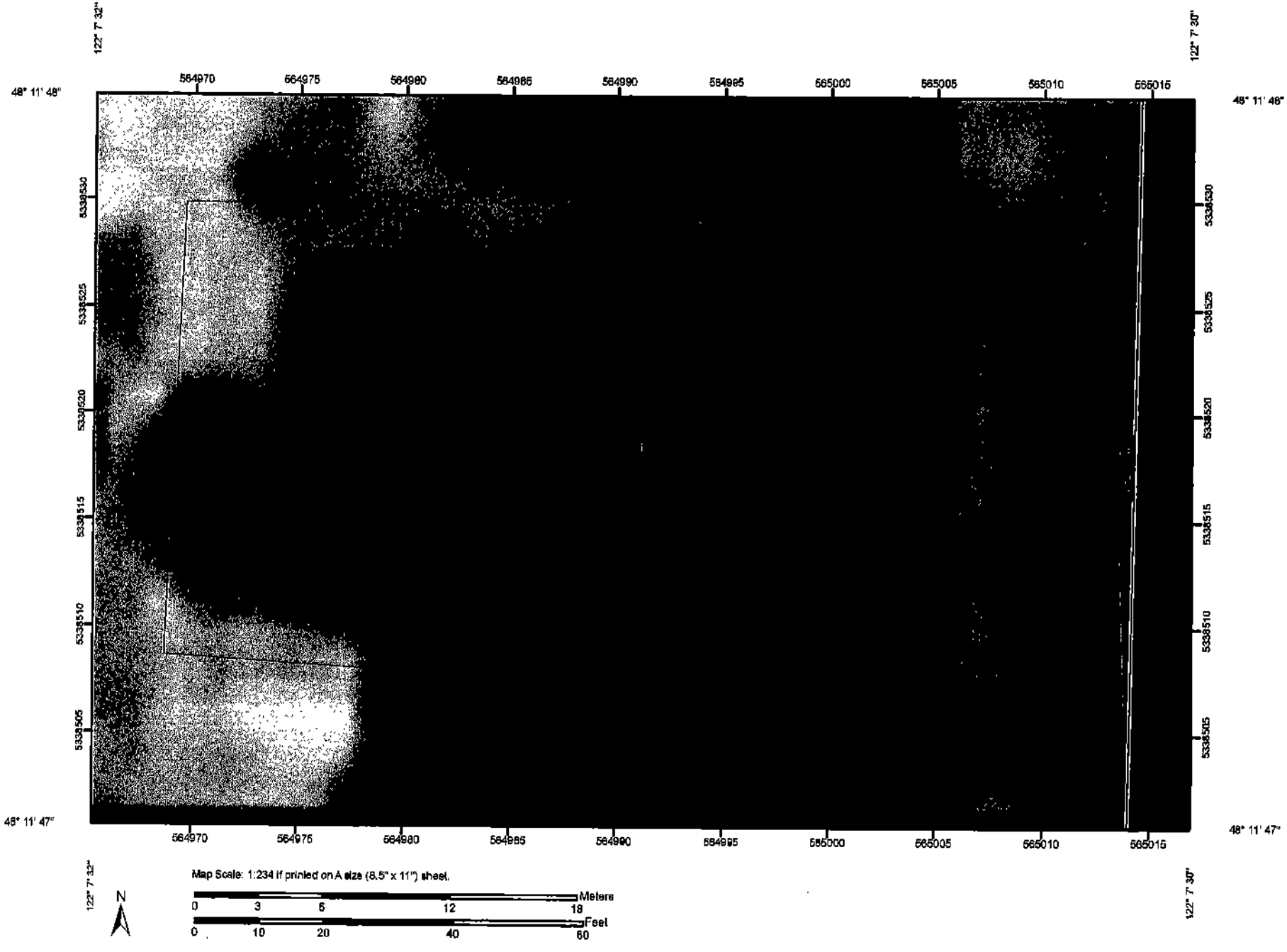
ACCESS ROADS/EASMENTS

Maintenance Component	Defect	Conditions When Maintenance is Needed	Desired Conditions
General	Blocked Roadway	Debris which could damage vehicle tires (glass or metal).	Roadway free of debris which could damage tires.
		Any obstructions which reduce clearance above road surface to less than 14 ft.	Roadway overhead clear to 14 ft high.
		Any obstructions restricting the access to less than 15 ft width.	Obstruction removed to allow at least 15 ft wide access.
Road Surface	Settlement, potholes, mush spots, ruts	When any surface irregularity exceeds 6" in depth and 6 ft^2. In general, any surface defect which hinders or prevents maintenance access	Road surface uniformly smooth with no evidence of settlement, potholes, mush spots, or ruts. Occasionally application of additional gravel or pitrun rock will be needed.
	Vegetation in road surface	Woody growth that could block vehicular access. Excessive weed cover.	Remove woody growth at early stage to prevent vehicular blockage. Cut back weeds if they begin to encroach on road surface.
Shoulders & Ditches	Erosion damage	Erosion within 1ft of the roadway more than 8" wide and 6" deep.	Shoulder free of erosion and matching the surrounding road.

FENCING/SHRUBBERY SCREEN/OTHER LANDSCAPING

Maintenance Component	Defect	Conditions When Maintenance is Needed	Desired Conditions
General	Missing or broken/dead shrubbery	Any defect in the fence or screen that permits easy entry to a facility.	Fence is mended or shrubs replaced to form a solid barrier to entry.
	Erosion	Erosion has resulted in an opening under a fence that allows entry by people or pets.	replace soil under fence so that no opening exceeds 4" in height.
	Unruly vegetation	Shrubbery is growing out of control or is infested with weeds.	Shrubbery is trimmed and weeded to provide appealing aesthetics. Do not use chemicals to control weeds.
Wire Fences	Damaged parts	Posts out of plumb more than 6".	Posts plumb to within 1-1/2" of plumb.
		top rails bent more than 6".	Top rail free of bends greater than 1".
		Any part of fence (including posts, top rails, and fabric) more than 1 ft out of design alignment.	Fence is aligned and meets design standards.
		Missing or loose tension wire.	Tension wire in place and holding fabric.
		Missing or lose barbed wire that is sagging more than 2-1/2" between posts.	Barbed wire in place with less than ¾" sag between posts.
		Extension arm missing, broken, or bent out of shape more than 1-1/2".	Extension arm in place with no bends larger than ¼".
	Deteriorated paint or protective coating	Part or parts that have a rusting or scaling condition that has affected structural adequacy.	Structurally adequate posts or parts with a uniform protective coating.
	Openings in fabric	Openings in fabric are such that an 8" diameter ball could fit through.	No openings in fabric.

APPENDIX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MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:234 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

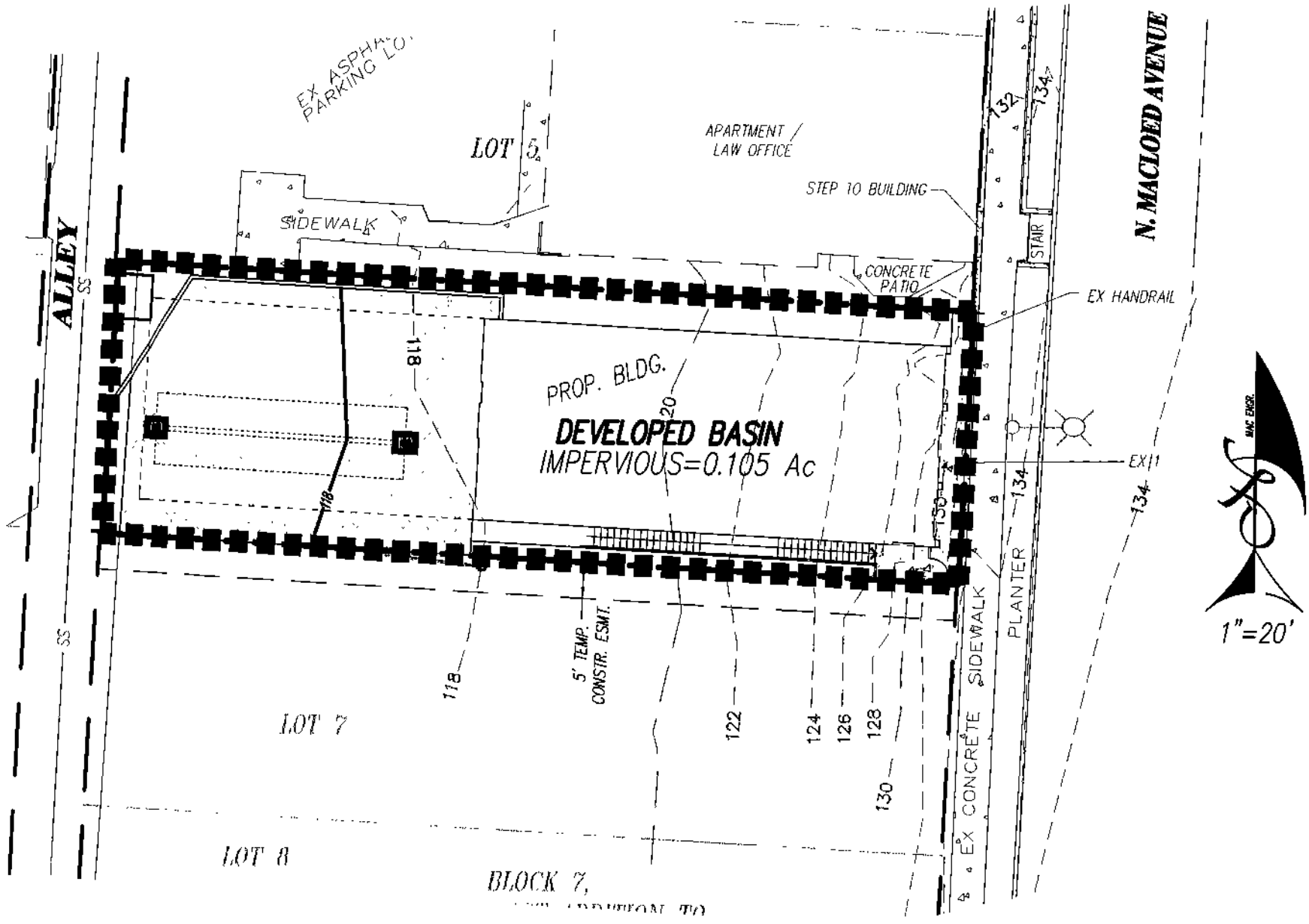
Soil Survey Area: Snohomish County Area, Washington
Survey Area Data: Version 4, Dec 12, 2006

Date(s) aerial images were photographed: 7/24/2006

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.

Map Unit Legend

Snohomish County Area, Washington (WA661)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
17	Everett gravelly sandy loam, 0 to 8 percent slopes	0.2	100.0%
Totals for Area of Interest		0.2	100.0%



MACLEOD APARTMENTS
DEVELOPED CONDITIONS
BASIN MAP EXHIBIT

MAC ENGR. JOB # 080003

RMI ASSOCIATES LLC

GEOTECHNICAL ENGINEERING REPORT
MacLeod APARTMENTS
ARLINGTON, WASHINGTON
For
MR. DAVID CLARK

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November 18, 2008

Mr. David Clark
731 250th Street NW
Stanwood, Washington 98292

Geotechnical Engineering Report
MacLeod Apartments
MacLeod Ave
Arlington, Washington
RMI File No. 50008

Dear sirs:

This report summarizes the results of our geotechnical engineering investigation and evaluation of your proposed site for apartments at about 420 MacLeod Ave, Arlington, Washington.

INTRODUCTION

The site is located at about 420 MacLeod Ave, Kirkland as shown on the Vicinity Map in Figure 1. You have retained us to explore the subsurface conditions within the project site and provide recommendations for site development. We were provided a site plan for the project by the architect.

You plan to construct an apartment building with associated parking on the site. Runoff is intended to be handled onsite by an infiltration trench.

SCOPE

The purpose of this study is to explore and characterize subsurface conditions, and provide recommendations for site development. Specifically, our scope of services includes the following items:

1. Review geologic maps of the area and information in our files.

2. Explore the site subsurface conditions with geotechnical test pits. Your company supplied the backhoe.
3. Arrange for gradation analyses to be done by a laboratory and use the 10% figure to calculate the long-term design infiltration rates as recommended by the Department of Ecology.
4. Provide recommendations for site preparation and grading, including structural fill material and placement.
5. Provide recommendations for foundation support.
6. Provide recommendations for retaining walls, including lateral pressures.
7. Prepare a written report documenting our observations, conclusions, and recommendations.

SITE CONDITIONS

Surface

The site is rectangular-shaped and slopes gently up from an alley between MacLeod Ave and N. Olympic Ave. Near MacLeod Ave it slopes more steeply up to a concrete retaining wall supporting the sidewalk on MacLeod Ave. The base of the wall is visible from this lot.

The northern portion of the lot is bare and is being used for parking at this time. The rest of the lot is covered with blackberry bushes.

Geology

Most of the Puget Sound region was affected by past continental glaciations. The last period of glaciation, the Vashon Stade, ended approximately 10,000 to 13,000 years ago. Many of the geomorphic features seen today are a result of scouring and overriding by glacial ice. During the Vashon Stade, the Puget Sound region was overridden by over 3,000 feet of ice. Soil layers overridden by the ice sheet were compacted to a much greater extent than those that were not. A typical glacial sequence includes recessional outwash deposits over glacial till overlying advance outwash, underlain by transitional deposits and older non-glacial and glacial sediments.

We reviewed the Geologic Map of The Port Townsend 30- by 60- Minute Quadrangle, Puget Sound Region, Washington by Fred Pessl, JR. et al (USGS 1989). The site area is mapped as Recessional Deposits (Qvrc). These are deposits of sand, gravel and silt deposited predominantly by meltwater from the receding Vashon-age ice sheet.

Our explorations encountered sand and silty sand consistent with recessional deposits.

Explorations

The subsurface conditions within the site were explored on November 14, 2008 by digging two test pits to depths between 6.5 and 9 feet below the existing surface using a backhoe. The approximate locations of the explorations are shown on the Site Plan in Figure 2. A geotechnical engineer from RMI was present during the explorations, examined the soils and geologic conditions encountered, obtained a sample of the soil type, and maintained logs of the explorations.

The soils were visually classified in general accordance with the Unified Soil Classification System, presented in Figure 3. The test pit logs are attached to this report and are presented as Figure 4. We present a brief summary of the subsurface conditions in the following section. For a detailed description of the subsurface conditions, please review the boring logs.

Subsurface Conditions

Our explorations encountered between 3.6 and 5.0 feet of fill in Test Pits (TP) 1 and 2. Below the fill was up to 2.4 feet of weathered sand consisting of a medium dense fine sand. The sand beneath this weathered zone was a dense fine to medium sand.

Hydrologic Conditions and Infiltration Potential

Ground water seepage was not observed in any of the test pits during our site exploration. A Particle Size Distribution Test (Figure 5) was done by a soils laboratory and D_{10} size was used to calculate the long-term design infiltration rate as detailed by the Department of Ecology: this rate was 3.8 inches/hour.

SENSITIVE AREA EVALUATION

Seismic Hazard

The site Class is C as shown in Table 1613.5.2 of the 2006 International Building Code.

Hazards associated with seismic activity include liquefaction potential, slope instability, and amplification of ground motion due to soft soil. The medium dense to very dense glacial soils that are interpreted to underlie this site do not have a significant potential for liquefaction, slope instability or amplification of ground motion.

Erosion Hazard

The criteria used for evaluation of erosion hazards include soil type, slope gradient, vegetation cover, and ground water conditions. The surface soil types (group classification) are related to the underlying geologic soil units. Because of the slight slope to the lot and the denseness of the underlying soils there is only a slight potential for erosion, which good erosion control measures would prevent.

CONCLUSIONS AND RECOMMENDATIONS

General

It is our opinion, from a geotechnical standpoint, that the site is compatible with the planned development. Our explorations within the site indicate that glacial deposits underlie the site. The native soils should provide adequate support for the planned housing. We recommend that the apartments be designed utilizing shallow foundations. Footings should extend through the fill and loose surficial soils and be founded on the medium dense or better native soils. Where the loose soils are unacceptably deep to excavate, a 2-foot depth should be overexcavated below footing level and 2 feet to either side of the footing. The excavated hole should be filled with structural fill or rock spalls. If rock spalls are used, a filter fabric should be placed below and above the spalls. Footings placed in this fashion should be linked by grade beams to limit differential settlement.

The silty soils likely to be exposed during construction are moderately to highly moisture-sensitive and may be disturbed when wet. We recommend that construction take place during the drier months. However, if construction takes place during the wet season, additional expenses and delays should be expected due to the wet conditions. Additional expenses could include the export of on-site soil, the import of clean granular soil for fill, and the need to place a blanket of rock spalls in the access roads, construction traffic areas, and pavement areas prior to placing structural fill. The on-site soils may be used as structural fill provided they can be compacted to plan specifications. We can be retained to determine if the on-site soils can be used during construction. After grading has been finished, the exposed subgrade should be protected from softening due to wet conditions and traffic.

Erosion Control Measures

The erosion hazard for the on-site soils is considered slight. The erosion hazard will be dependent on how the site is graded and water is allowed to accumulate. Best Management Practices (BMPs) should be used to control erosion. Areas disturbed during construction should be protected from erosion. Measures

taken may include diverting surface water away from the stripped areas. Silt fences should be erected to prevent muddy water from leaving the site.

Site Preparation and Grading

The first step of site preparation should be to strip the fill and topsoil, or loose soils to expose medium dense or better native soils in the foundation area where feasible. The fill and topsoil should be removed from site or the topsoil may be stockpiled for use in the landscaping.

The underlying soils expected to be encountered after site stripping are considered highly moisture-sensitive. We expect that if they become wet during construction, a thin surficial layer may be disturbed. Any disturbed soil should be stripped from the subgrade before the foundations are installed. This should not be a problem if earthwork is conducted during the dry weather.

If the ground surface, after the stripping operation, should appear to be loose, it should be proofrolled and compacted to a non-yielding condition and then probed. Areas observed to pump or weave should be reworked to structural fill specifications or overexcavated and replaced with properly compacted structural fill or rock spalls. If significant surface water flow is encountered during construction, this flow should be diverted around areas to be developed. Shallow ground water, where it is encountered, should be intercepted with cut off drains and routed outside of the planned grading area.

If wet or soft subgrade conditions are encountered, alternative site preparation methods may be necessary. These methods may include utilizing wide-track dozers or smooth-bucket trackhoes to complete site stripping and diverting construction traffic around prepared subgrades. The prepared subgrade may be protected from disturbance by placing a blanket of rock spalls or imported sand and gravel in traffic and roadway areas.

Temporary Cut Slopes

Temporary cut slope stability is a function of many factors, such as the type and consistency of soils, depth of the cut, surcharge loads adjacent to the excavation, length of time a cut remains open, and the presence of surface or ground water. It is exceedingly difficult under these variable conditions to pre-establish a "safe and maintenance-free" temporary cut slope angle. Therefore, it should be the responsibility of the contractor to maintain safe slope configurations, since they are continuously at the

job site, able to observe the nature and condition of the cut slopes, and able to monitor the subsurface materials and ground water conditions encountered.

The following information is provided solely for the benefit of the owner and other design consultants and should not be construed to imply that RMI ASSOCIATES LLC assumes responsibility for job site safety. The project contractor is the sole entity responsible for job site safety.

For planning purposes, we recommend that temporary cuts in the soil be no greater than 1 Horizontal to 1 Vertical (1H: 1V). Where ground water seepage is encountered, flatter inclinations will be necessary. We recommend that cut slopes be protected from erosion. Measures taken may include covering cut slopes with plastic sheeting and diverting surface runoff away from the top of cut slopes. We do not recommend vertical slopes for cuts deeper than 4 feet, if worker access is necessary. We recommend that cut slope heights and inclinations conform to WISHA/OSHA standards.

Final slope inclinations for structural fill and the stable, native soils should be no steeper than 2H: 1V. Slopes can be protected with a blanket of rock or planted with vegetation, with some risk of maintenance to be expected. The blanket of rock should be at least 1 foot in thickness and constructed with rock spalls. We are available to consult to you on specific permanent or temporary cuts during the construction process. Lightly compacted fills or common fills should be no steeper than 3H: 1V. Common fills are defined as fill material with or without some organics that are "trackrolled" into place. They would not meet the compaction specification of structural fill.

Structural Fill

General: Fill placed beneath buildings, pavements, or other settlement-sensitive features should be placed as structural fill. Structural fill, by definition, is placed in accordance with prescribed methods and standards, and is monitored by an experienced geotechnical professional or soils technician. Field monitoring procedures would include the performance of a representative number of in-place density tests to document the attainment of the desired degree of relative compaction. Any areas to receive fill should be prepared as outlined in the **Site Preparation and Grading** subsection of this report.

Materials: Imported structural fill should consist of a good quality, free-draining granular soil, free of organics and other deleterious material, and be well graded to a maximum size of about 3 inches.

Imported, all-weather fill should contain no more than about five percent fines (soil finer than a U.S. No. 200 sieve, based on that fraction passing the U.S. 3/4-inch sieve).

The use of on-site soils as structural fill would be dependent on moisture-content control. Some drying of the soils may be necessary in order to achieve compaction. During warm, sunny days this could be accomplished by spreading the material in thin lifts and compacting. Some aeration and/or addition of moisture may also be necessary.

Fill Placement: Following subgrade preparation, placement of the structural fill may proceed. All backfilling should be accomplished in 6- to 8- inch thick uniform lifts. Each lift should be spread evenly and be thoroughly compacted prior to placement of subsequent lifts. All structural fill underlying building areas, and within 2 feet of pavement subgrade, should be compacted to a minimum of 95 percent of its maximum dry density. Maximum dry density, in this report, refers to that density as determined by the ASTM D 1557 Compaction Test procedure. Fills more than 2 feet beneath sidewalks and pavement subgrades should be compacted to 90 percent of their maximum dry density. The moisture content of the soils to be compacted should be within about 2 percent of optimum so that a readily compactable condition exists. It may be necessary to overexcavate and remove wet soils in cases where drying to a compactable condition is not feasible. All compaction should be accomplished by equipment of a type and size sufficient to attain the desired degree of compaction.

Foundations

Conventional shallow spread foundations should be placed on undisturbed medium dense or better native soils or be supported on structural fill or rock spalls extending to those soils. Where less dense soils are encountered at footing bearing elevation, the subgrade should be overexcavated to expose suitable bearing soil. The overexcavation may be filled with structural fill or rock spalls, or the footing may be extended down to the bearing native soils. If footings are supported on structural fill or rock spalls, the fill zone should extend outside the edges of the footing a distance equal to the depth of overexcavation below the footing.

Footings, including interior footings, should extend at least 18 inches below the lowest adjacent finished ground surface for frost protection and/or bearing capacity considerations. Minimum foundation widths of 18 and 24 inches are recommended for continuous and isolated spread footings, respectively. Standing

water should not be allowed to accumulate in footing trenches. All loose or disturbed soil should be removed from the foundation excavation prior to placing concrete.

For foundations constructed as outlined above, we recommend an allowable design bearing pressure of not more than 2,000 pounds per square foot (psf) be used for the design of footings founded on the medium dense to dense glacial deposits. A representative from our firm should evaluate the foundation bearing soil. We should be consulted if higher bearing pressures are needed. Current International Building Code (IBC) guidelines should be used when considering increased allowable bearing pressure for short-term transitory wind or seismic loads. Potential foundation settlement using the recommended allowable bearing pressure is estimated to be less than 1 inch total and 1/2 inch differential between adjacent footings or across a distance of about 25 feet, based on our experience with similar projects.

Lateral loads may be resisted by friction on the base of the footing and passive resistance against the subsurface portions of the foundation. A coefficient of friction of 0.35 may be used to calculate the base friction and should be applied to the vertical dead load only. Passive resistance may be calculated as a triangular equivalent fluid pressure distribution. An equivalent fluid density of 200 pounds per cubic foot (pcf) should be used for passive resistance design for a level ground surface adjacent to the footing. This level surface should extend to a distance equal to at least three times the depth to bearing of the footing. These recommended values incorporate safety factors of 1.5 and 2.0 applied to the estimated ultimate values for frictional and passive resistance, respectively. To achieve this value of passive resistance, the foundations should be poured "neat" against the native medium dense soils or compacted fill should be used as backfill against the front of the footing. We recommend that the upper 1-foot of soil be neglected when calculating the passive resistance.

Subsurface and Retaining Walls

The lateral pressure acting on subsurface walls and retaining walls is dependent on the nature and density of the soil behind the wall, the amount of lateral wall movement which can occur as backfill is placed, wall drainage conditions, and the inclination of the backfill. For walls that are free to yield at the top at least one thousandth of the height of the wall (active condition), soil pressures will be less than if movement is limited by such factors as wall stiffness or bracing (at-rest condition). We recommend that walls supporting horizontal backfill and not subjected to hydrostatic forces be designed using a triangular

earth pressure distribution equivalent to that exerted by a fluid with a density of 35 pcf for yielding (active condition) walls, and 60 pcf for non-yielding (at-rest condition) walls.

These recommended lateral earth pressures for level backfill are based on the assumption of a horizontal ground surface adjacent to and behind the wall for a distance of at least the subsurface height of the wall, and do not account for surcharges. Additional lateral earth pressures should be considered for surcharge loads acting adjacent to subsurface walls and within a distance equal to the subsurface height of the wall. This would include the effects of surcharges such as traffic loads, floor slab loads, slopes or other surface loads. Surcharge effects should be considered, if appropriate.

The lateral pressures on walls may be resisted by friction between the foundation and subgrade soil, and by passive resistance acting on the below-grade portion of the foundation. Recommendations for frictional and passive resistance to lateral loads are presented in the **Foundations** subsection of this report.

All wall backfill should be well compacted as outlined in the **Structural Fill** subsection of this report. Care should be taken to prevent the buildup of excess lateral soil pressures, due to overcompaction of the wall backfill. This can be accomplished by placing wall backfill in 8-inch loose lifts and compacting it with small, hand-operated compactors within a distance behind the wall equal to at least one-half the height of the wall.

Permanent drainage systems should be installed for retaining walls. We recommend that these drainage systems consist of an 18-inch-wide zone of clean (less than 3 percent fines), free-draining granular material placed along the back of the walls. Pea gravel is an acceptable drain material, or drainage composite may be used instead. We recommend that we be retained to evaluate the proposed wall drain backfill material for its suitability.

The granular material should be placed up the back of the wall to within 1 foot of the ground surface. The top 1-foot should be a layer of compacted, low permeability soil to limit surface water and fines infiltration and should be separated from the underlying free-draining material by a layer of visqueen or building paper. A rigid, perforated or slotted PVC drainpipe, having a minimum diameter of 4 inches, should be embedded in pea gravel or some other free-draining, material wrapped in a non-woven filter

fabric at the base of the wall, along its entire length. This drainpipe should discharge into tightlines leading to an appropriate collection and discharge point. Surface water drains and roof drains should not be connected to wall or footing drains.

Slabs-on-Grade

Slabs-on-grade should be supported on subgrade soils prepared as described in the **Site Preparation and Grading** subsection of this report. Where moisture-control is important, we recommend that all floor slabs be underlain by at least 6 inches of free-draining sand or gravel for use as a capillary break. We recommend that the capillary break be hydraulically connected to the footing drain system to allow free drainage from under the slab. A suitable vapor barrier, such as heavy plastic sheeting (10-mil or thicker is recommended), should be placed over the capillary break material. An additional 4-inch-thick crushed rock blanket covered by a layer of visqueen may be used to cover the vapor barrier. This crushed rock blanket is to protect the vapor barrier membrane and to aid in curing the concrete. The visqueen will also prevent cement paste leaking down into the capillary break through the joints or tears in the vapor barrier.

Site Drainage

Surface Drainage: The finished ground surface should be graded such that storm water is directed to an appropriate storm water collection system such as an infiltration trench. Water should not be allowed to stand in any area where footings, slabs, or pavements are to be constructed. Final site grades should allow for drainage away from the buildings. We suggest that the finished ground be sloped at a minimum gradient of 3 percent for a distance of at least 10 feet away from the building. Roof drains should discharge into an infiltration trench.

Subsurface Drainage: We recommend the use of footing drains around the planned structures and retaining walls. Footing drains should be installed at least 1 foot below planned finished floor slab. The drains should consist of minimum 4-inch-diameter, rigid, slotted or perforated, PVC pipe surrounded by free-draining material wrapped in a non-woven filter fabric such as Mirafi 140NSL. We recommend that the free-draining material consist of an 18-inch-wide zone of clean (less than 3 percent fines), granular material placed along the back of the wall. Pea gravel is an acceptable drain material or drainage composite may be used instead. The free-draining material should extend up the wall to 1 foot below the finished surface. The top foot of soil should consist of impermeable soil placed over plastic sheeting or building paper to minimize surface water or fines migration into the footing drain. Footing drains should

discharge into tightlines leading to an appropriate collection and discharge point with convenient cleanouts to prolong the useful life of the drains. Roof drains should not be connected to wall or footing drains.

Construction Considerations

You intend to construct a retaining wall against the existing wall supporting the sidewalk on MacLeod Ave. Since the new wall will have its foundations below those of the existing wall you will need to support the existing wall by bracing it during construction until the new wall is complete.

USE OF THIS REPORT

This report is the property of **RMI ASSOCIATES LLC.** and has been provided to Mr. David Clarke and his agents, for use in the planning and design of this project on this site only. The scope of our work does not include services related to construction safety precautions and our recommendations are not intended to direct the contractors' methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design. There are possible variations in subsurface conditions between the explorations and also with time. Our report, conclusions, and interpretations should not be construed as a warranty of subsurface conditions. A contingency for unanticipated conditions should be included in the budget and schedule.

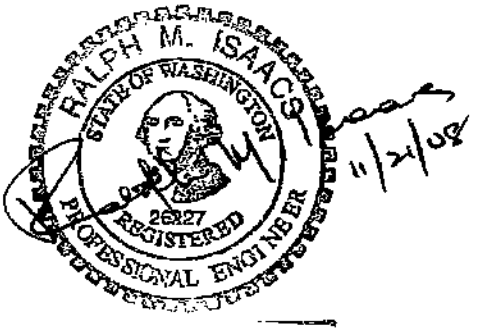
RMI should be retained to provide monitoring and consultation services during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether or not earthwork and foundation installation activities comply with contract plans and specifications. We should be contacted a minimum of two weeks prior to construction activities and could attend pre-construction meetings if requested.

Within the limitations of scope, schedule and budget, our services have been performed in accordance with generally accepted geotechnical engineering practices in effect in this area at the time this report was prepared. No other warranty, expressed or implied, is made. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the owner.

It has been a pleasure to provide service to you on this project. If you have any questions or require further information, please call.

Sincerely,

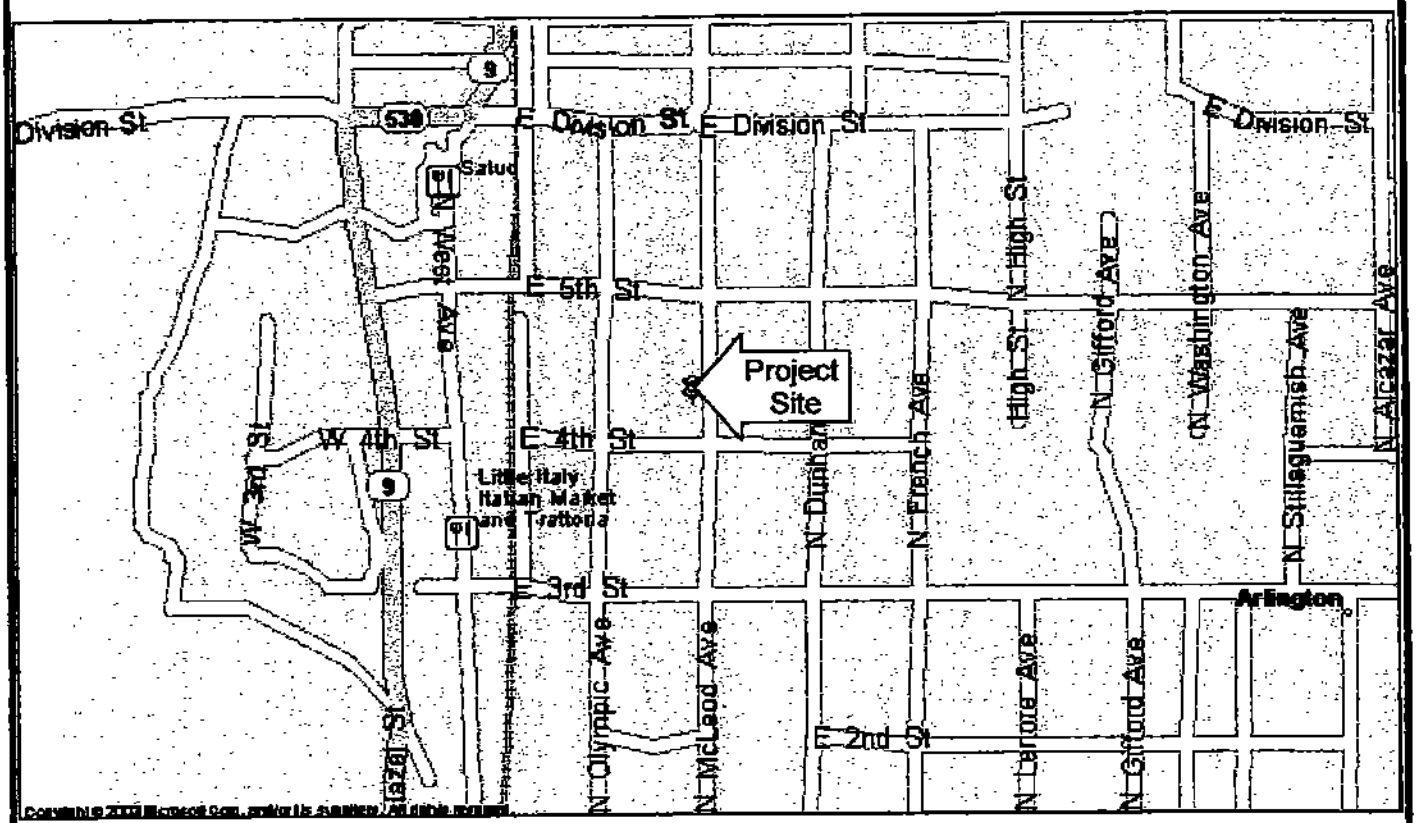
RMI ASSOCIATES LLC



Ralph M. Isaacs, Ph. D., PE
Principal

Two Copies Submitted
Five Figures

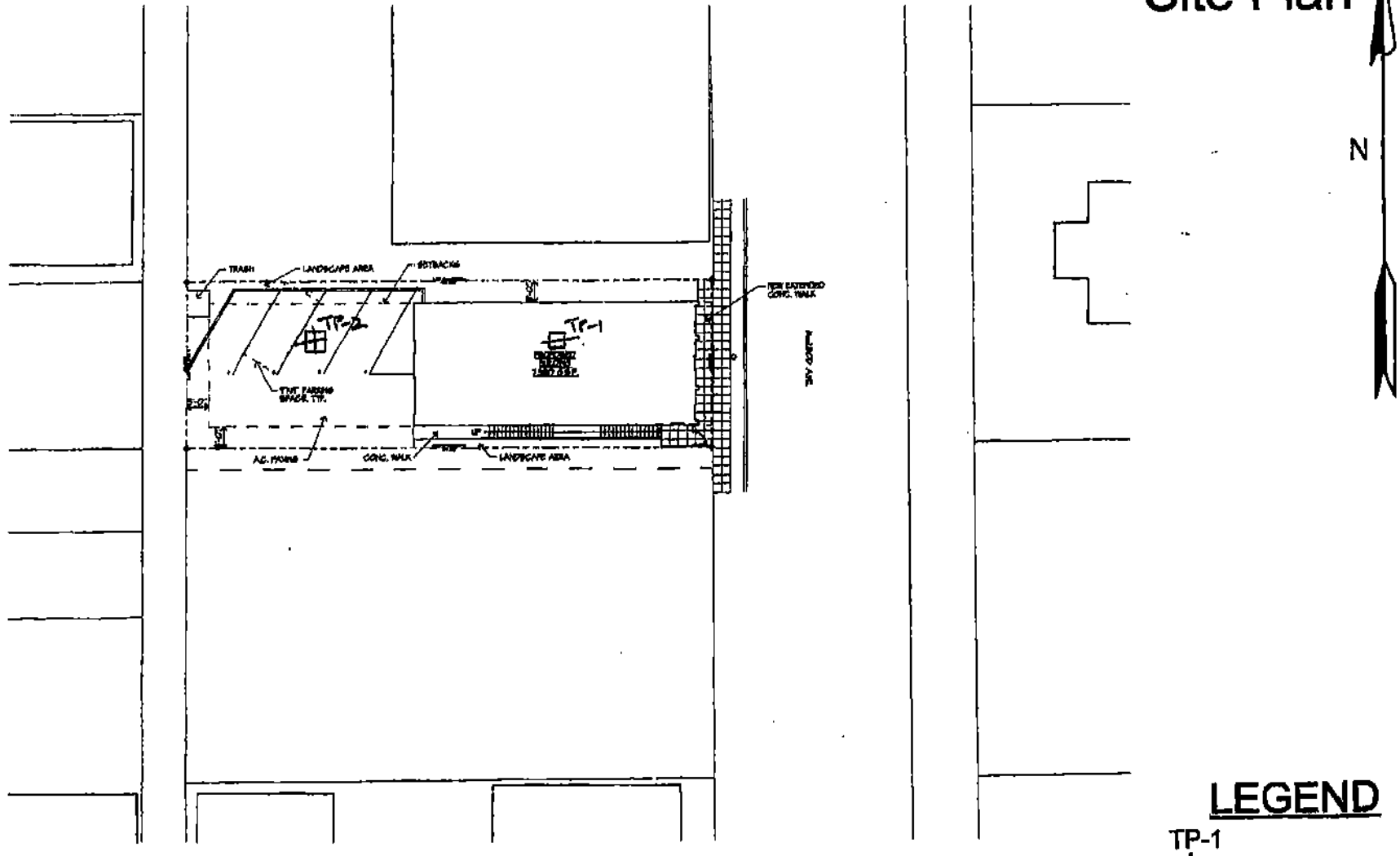
Vicinity Map



Not to scale

RMI ASSOCIATES LLC *Geotechnical Consultants* **824 E. Utsalady Road** **Camano Island, Washington 98282**	MacLEOD APARTMENTS	
	FILE NO. 50008	FIGURE 1

Site Plan



LEGEND

TP-1 — Test Pit

1 SITE PLAN

Reference: Site plan based on plan supplied by the architect.

RMI ASSOCIATES LLC
Geotechnical Consultants
824 E. Utsalady Road
Camano Island, Washington 98282

MacLEOD APARTMENTS

FILE NO.	FIGURE
50008	2

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE-GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVEL MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND MORE THAN 50% OF COARSE FRACTION PASSES NO. 4 SIEVE	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE-GRAINED SOILS MORE THAN 50% PASSES NO. 200 SIEVE	SILT AND CLAY LIQUID LIMIT LESS THAN 50%	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY LIQUID LIMIT 50% OR MORE	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1) Field classification is based on visual examination of soil in general accordance with ASTM D 2488-93.
2) Soil classification using laboratory tests is based on ASTM D 2487-93.
3) Descriptions of soil density or consistency are based on interpretation of blowcount data, visual appearance of soils, and/or test data.

SOIL MOISTURE MODIFIERS

Dry- Absence of moisture, dusty, dry to the touch

Moist- Damp, but no visible water

Wet- Visible free water or saturated, usually soil is obtained from below water table

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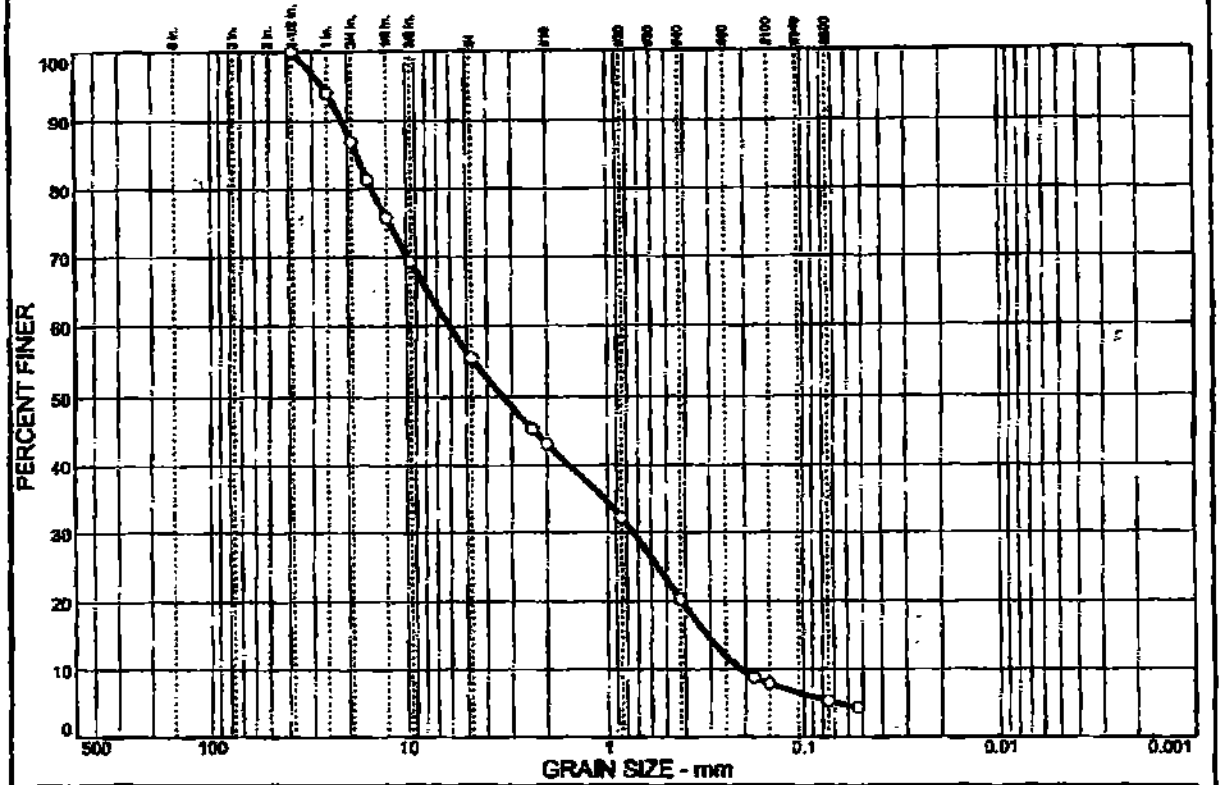
UNIFIED SOIL CLASSIFICATION SYSTEM

FILE NO.	FIGURE
50008	3

LOG OF EXPLORATION

DEPTH	USC	SOIL DESCRIPTION
TEST PIT ONE		
0.0 – 5.0		Dark brown to gray fine sand with buried wood (Loose to Medium Dense, Moist) - (Fill)
5.0 – 6.5	SM	Reddish brown weathered silty fine sand with cobbles. (Medium Dense, Moist) - (Qvrc)
		NO SAMPLE WAS COLLECTED GROUND WATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 6.5 FEET ON 11/14//08
TEST PIT TWO		
0.0 – 3.6		Dark brown fine sand with cobbles (Medium Dense, Moist) - Fill
3.6 – 6.0	SP	Reddish brown weathered fine sand with cobbles (Medium Dense, Moist) – (Qvrc)
6.0 - 9.0	SW	Brown medium sand with cobbles (Medium Dense, Moist) - (Qvrc)
		SAMPLE WAS COLLECTED AT 6.0 FEET GROUND WATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 9.0 FEET ON 11/14/08

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	13.2	31.3	12.4	22.8	14.9	5.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5 in.	100.0		
1 in.	94.0		
.75 in.	86.8		
.625 in.	81.4		
.5 in.	75.7		
.375 in.	69.3		
#4	55.5		
#8	45.3		
#10	43.1		
#20	32.2		
#40	20.3		
#80	11.8		
#100	7.9		
#200	5.4		
#270	4.4		

* (no specification provided)

Material Description

Red Brown Coarse Silty Sand with Gravel
RMI # 50008 Dated 11-14-2008
TP-2 @ 6'

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 17.9 D_{60}= 6.07 D_{50}= 3.33
D_{30}= 0.739 D_{15}= 0.310 D_{10}= 0.209
C_u= 29.04 C_c= 0.43

Classification

USCS= AASHTO=

Remarks

TP-2 @ 6'
F.M.=2.35

Sample No.: 8437 **Source of Sample:** **Date:** 11-18-2008
Location: **Elev./Depth:**

CASCADE TESTING LABORATORY, INC.
TESTING & INSPECTION / ENGINEERING

Client: RMI Associates
Project: 2008 Lab Services
Project No: 0610-35
Signed:

RMI ASSOCIATES LLC
Geotechnical Consultants
824 E. Utsalady Road
Camano Island, Washington 98282

Particle Size Distribution

FILE NO.	FIGURE
50008	5