GeoResources, LLC

Ph. 253-896-1011
Fx. 253-896-2633

5007 Pacific Hwy. E., Ste. 16
Fife, Washington 98424-2648

March 27, 2010

Mr. Paul Bressi
c/o Vector Engineering
309 Washington St. NE
Olympia, WA 98501

Attn: Mr. Ryan Moore, PE

Geotechnical Report
Stormwater Management
Commercial Storage Facility
10246 Martin Way East
Job No:Bressi.MartinWayE.RH

INTRODUCTION

This report summarizes the results of our geotechnical engineering evaluation regarding the feasibility of storm water infiltration or dispersal at the subject site. The site is situated at 10246 Martin Way East in Thurston County, Washington. The approximately location of the site is shown on the attached Site Vicinity Map, Figure 1.

Our understanding of the project is based on our discussions with you, our review of the documents provided and our site observations and explorations. The site is currently utilized as a gravel parking/storage area. A small office trailer is situated on the east central portion of the site.

SITE CONDITIONS

Surface Conditions

The site is generally rectangular in shape and located at the west margin of a commercial area that is situated just east of I-5 in north Thurston County. The site is currently used for automotive storage and has a small office trailer located in the east central portion of the site. The ground surface at the site is flat to gently sloping to the west, towards an existing drainage ditch/swale located west of the property.

The proposed site development includes constructing a metal building on the southwest portion of the site and paving the southeast portion of the site. Under the current plan the north portion of the site would remain a gravel surface. The dispersal trench/ditch would be located in the northwest portion of the site.

A drainage swale, McAllister Creek, is located west of the site. No areas of significant erosion were observed on the site or adjacent areas at the time of our site visit.

Soils

The United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS), formerly known as the Soil Conservation Service (SCS), maps the site soils as Puget silt loam (88) and Puyallup silt loam (89). Both of these soils are typically derived from alluvium and have little or no erosion hazard.

Geology

The *Geologic Map of the Nisqually 7.5-minute Quadrangel, Thurston and Pierce Counties, Washington, Timothy J. Walsh, Robert L Logan, Michael Polenz and Henry W. Schasse (2003).* The soils in the vicinity of the site are mapped as alluvium (Qa). The alluvium consists of a heterogeneous mixture of silt, sand and gravel that was deposited by moving water, like the Nisqually River. An excerpt from the USGS map is presented as Figure 4 of this report.

Subsurface Explorations

A geologist from our office was on site to evaluate subsurface conditions at the site by observing the open test pits excavated at the site. At that time, we observed three test pits excavated to between 4 and 5 feet below the adjacent ground surface. The approximate locations of our test pits are illustrated on Figure 2. Copies of our test pit logs are included at the end of this report.

The explorations performed as part of this evaluation indicate conditions only at the specific locations and the subsurface conditions in other locations could vary.

Subsurface Conditions

The subsurface conditions encountered in the test pits were consistent and in general conformance with the mapped stratigraphy in the area. The soils encountered in the test pits consisted of 2.5 to 3 feet of sandy gravel fill with cobbles over approximately 2.5 feet of to alluvial sand and gravel (to the depth explored).

Static groundwater was encountered within all of the test pits excavated at the site. Based on our measurements, the water table was approximately 3.6 to 4.0 feet below the adjacent ground surface at the time of excavation. Test pit logs are attached. A photograph of Test Pit TP-1 is also attached.

CONCLUSIONS

Based on the soils encountered in our explorations, it is our opinion that the infiltration of stormwater in the shallow soils at the site is not practical. The high water table precludes the use of any conventional infiltration system, other than a very shallow spreader type. We understand that this type of system is currently planned in the northwest portion of the site. The trench will function as a dispersal trench in the shallow soils. We expect that a portion of the water will infiltrate into the sand and gravel soils during normal precipitation events. Based on our experience with similar conditions, we estimate that infiltration will be between 6 and 8 inches per hour. Once the underlying soils are saturated and/or following extended or heavy precipitation events, water will overflow the trench system into a collector pipe that will discharge to McCallister Creek, located to the west.

CLOSURE

We have prepared this report for Mr. Paul Bressi, Mr. Ryan Moor and other members of the design team for use in design and construction of the various components of this project. The data and report can be utilized for bidding or estimating purposes, but our report, conclusions and recommendations should not be construed as a warranty of the subsurface conditions, as they may vary both vertically and laterally.

If there are changes in the locations or assumptions stated for this project, the conclusions and recommendations presented may not be fully applicable. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in this area at the time this report

was prepared. No warranty, expressed or implied, should be understood.

◆ ◆ ◆

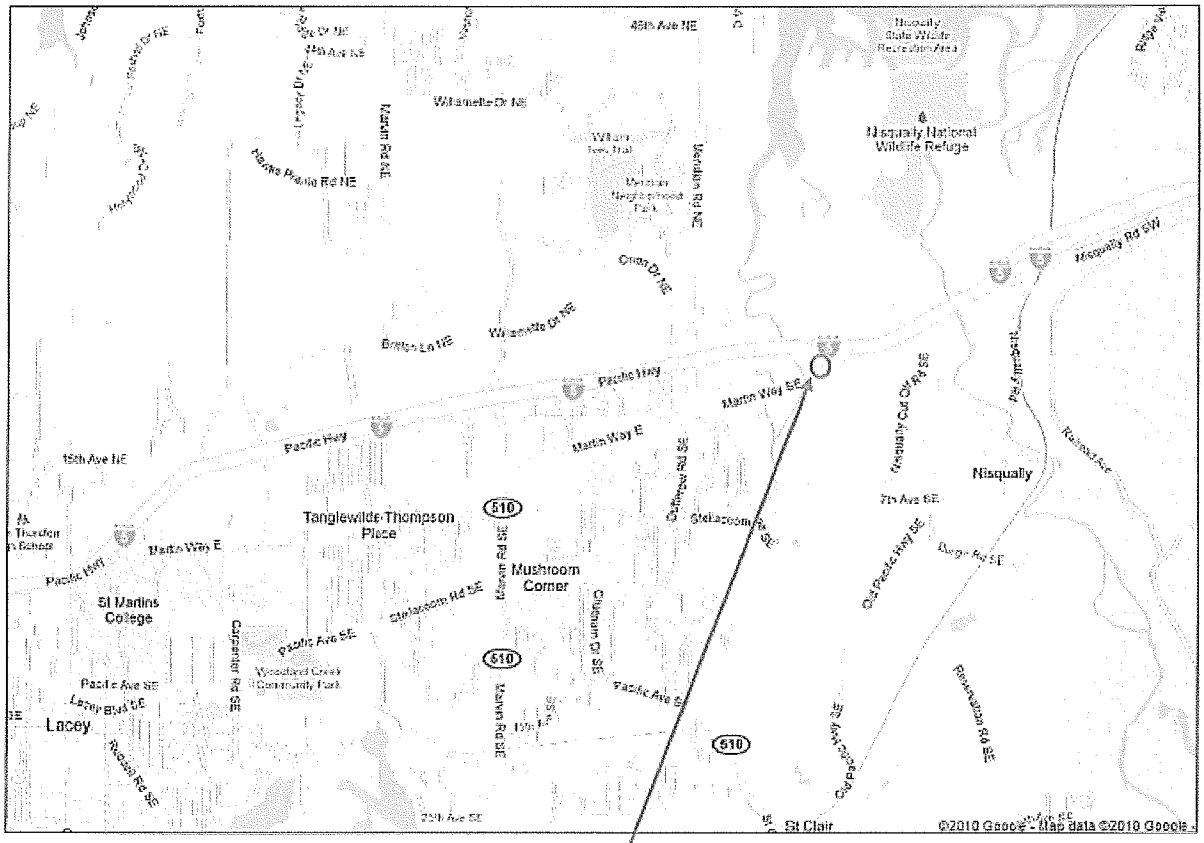
We appreciate the opportunity to be of service to you on this project. Please call if you have any questions regarding this submittal, or if we can provide additional services.

Yours very truly,
GeoResources, LLC

Brad Biggerstaff, LHG
Principal

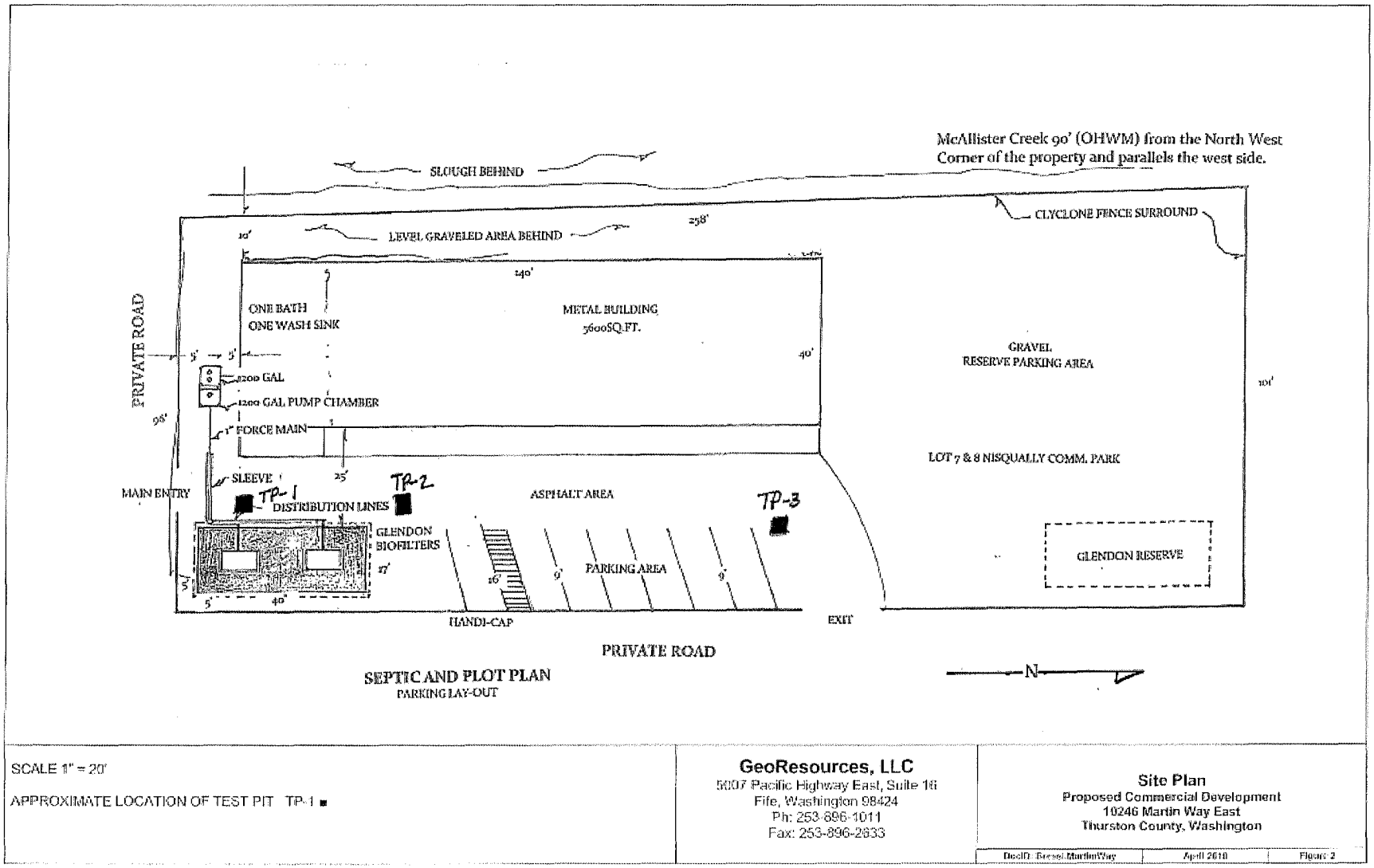
Glen Coad, PE
Principal

BPB:WGC:bob
DocID: Bressi.MartinWay.RH
Attachments:
Figure 1: Site Vicinity Map
Figure 2: Site Plan
Figure 3: NRCS SCS Map
Figure 4: Geologic Map
Figure 5: Unified Soil Classification System (USCS)
Figure 6: Test Pit Logs
Figure 7: Photograph



Approximate Site Location

GeoResources, LLC 5007 Pacific Highway East, Suite 16 Fife, Washington 98424 Phone: 253-896-1011 Fax: 253-896-2633	Site Vicinity Map Proposed Commercial Development 10246 Martin Way East Thurston County, Washington		
	DocID: Bressl.Martin Way E.SVM	March 2010	Figure 1



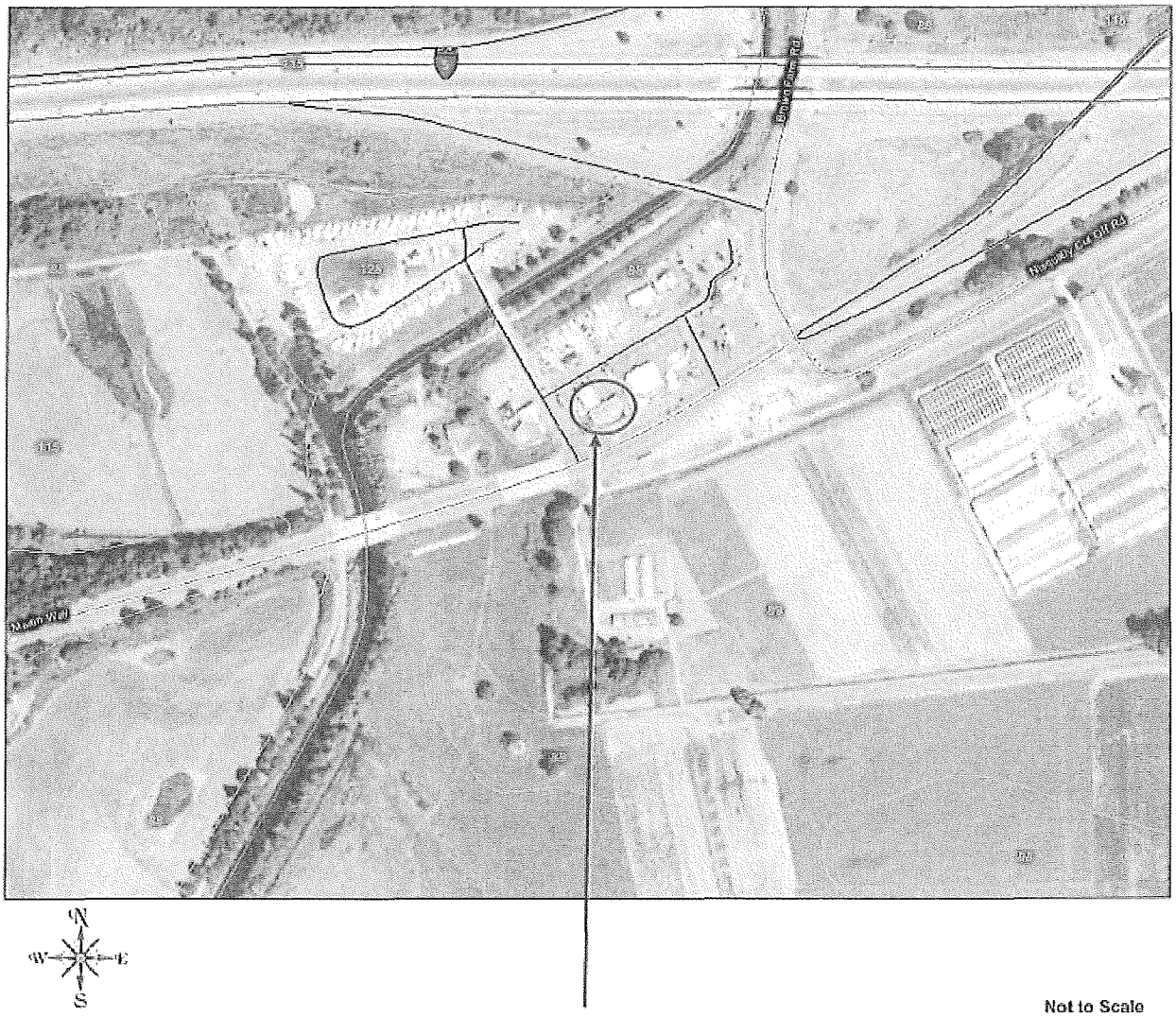
SCALE 1" = 20'

APPROXIMATE LOCATION OF TEST PIT TP-1 ■

GeoResources, LLC
5007 Pacific Highway East, Suite 16
Fife, Washington 98424
Ph: 253-896-1011
Fax: 253-896-2833

Site Plan
Proposed Commercial Development
10246 Martin Way East
Thurston County, Washington

DwgID: Bressel.MartinWay	April 2010	Figure 2



Not to Scale

Approximate Site Location

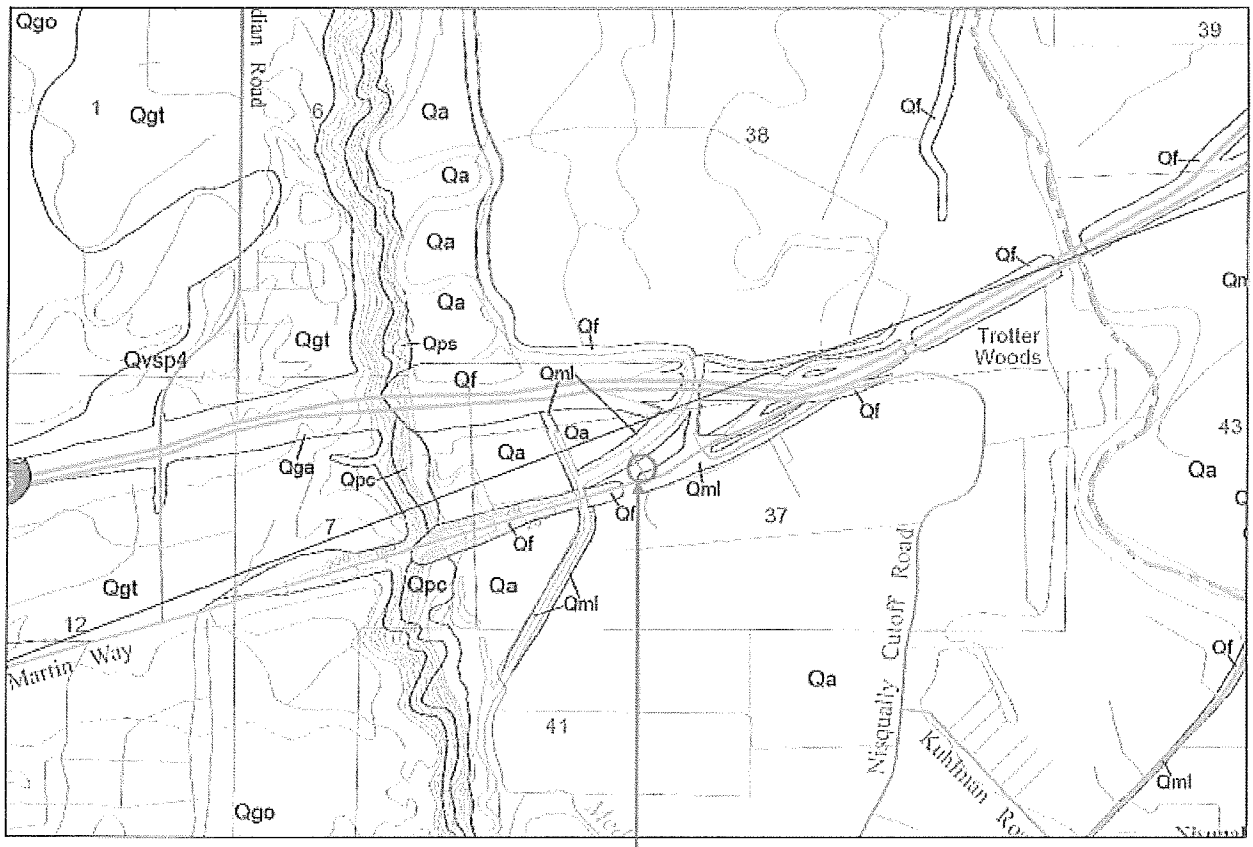
(map created from the USDA Natural Resource Conservation Service Web Soil Survey)

Soil Type	Soil Name	Parent Material	Slopes
88	Puget silt loam	Alluvium	0 to 3
89	Puyallup silt loam	Alluvium	0 to 3

GeoResources, LLC
5007 Pacific Highway East, Suite 16
Fife, Washington 98424
Phone: 253-896-1011
Fax: 253-896-2633

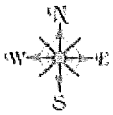
NRCS SCS Soils Map
Proposed Commercial Development
10246 Martin Way East
Thurston County, Washington

DocID: Bressi.Martin Way E.SCS	March 2010	Figure 3



Approximate Site Location

An excerpt from the *Geological Map of the Nisqually 7.5-minute Quadrangle, Thurston and Pierce Counties, Washington* by Timothy J. Walsh, Robert L. Logan, Michael Polenz, and Henry W. Schasse (2003)



Not to Scale

GeoResources, LLC
5007 Pacific Highway East, Suite 16
Fife, Washington 98424
Phone: 253-896-1011
Fax: 253-896-2633

USGS Geologic Map
Proposed Commercial Development
10246 Martin Way East
Thurston County, Washington

DocID: Bressi.Martin Way E.USGS	March 2010	Figure 4

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 D2488-90.
2. Soil classification using laboratory tests is based on ASTM D2487-90.
3. Description of soil density or consistency are based on interpretation of blow count data, visual appearance of soils, and or test data.

SOIL MOISTURE MODIFIERS:

Dry- Absence of moisture, dry to the touch

Moist- Damp, but no visible water

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

GeoResources, LLC
5007 Pacific Highway East, Suite 16
Fife, Washington 98424
Phone: 253-896-1011
Fax: 253-896-2633

Soil Classification System
Proposed Commercial Development
10246 Martin Way East
Thurston County, Washington

DocID: Bressl.MartinWay	April 2010	Figure 5

Test Pit TP-1

Location: SE Corner of site, gravel parking area

Depth (ft)	Soil Type	Soil Description
0 - 2	SP	Brown SAND with gravel, cobbles, min. silt (dense, moist) (Fill)
½ - 3	SP	Brown gravelly sand w/ cobbles, boulders (dense, damp) (Fill?)
3 - 4.5	SP	Gry brown SAND with silt, min. gravel, (dense, wet)

Terminated at 4.5 feet below ground surface.
Minor caving observed.
Static groundwater observed @ 3.6 feet

Test Pit TP-2

Location: SE portion of site, 10 feet north of TP-1

Depth (ft)	Soil Type	Soil Description
0 - 2	SP	Brown SAND with gravel, cobbles, min. silt (dense, moist) (Fill)
½ - 3	SP	Brown gravelly sand w/ cobbles, boulders (dense, damp) (Fill?)
3 - 5.0	SP	Gry brown SAND with silt, min. gravel, (dense, wet)

Terminated at 5.0 feet below ground surface.
Minor caving observed.
Static groundwater observed @ 3.8 feet

Test Pit TP-3

Location: North of trailer, NE corner of lot

Depth (ft)	Soil Type	Soil Description
0 - 2.5	GP	Brown sandy GRAVEL with cobbles, minor silt (dense, moist) (Fill)
2.5 - 3.5	SP	Brown gravelly SAND with cobbles, minor silt (dense, moist) (Fill)
3.5 - 5.0	SP	Org Brn SAND w/ cobbles, min. silt (dense, wet) (Native alluvial)

Terminated at 5.0 feet below ground surface.
Minor caving observed.
Static groundwater observed @ 4.0 feet

Logged by: B.P.B.

GeoResources, LLC
5007 Pacific Highway East, Suite 16
Fife, Washington 98424
Phone: 253-896-1011
Fax: 253-896-2633

Test Pit Logs
Bressi Site
Martin Way
Thurston County, Washington

JOB# Bressi.MartinWay.RG	April 2010	Figure 6

CAUTION CAUTION CAUTION

Appendix C – Analysis and Design Calculations

WESTERN WASHINGTON HYDROLOGY MODEL PROJECT REPORT C2-C12
BF.04 BASIC FILTER STRIP CALCULATIONS C13
2-YEAR, 24-HOUR WESTERN WASHINGTON ISOPLUVIAL C14
MANUAL VOLUME V, FIGURE 5.1A C15

Western Washington Hydrology Model
PROJECT REPORT

Project Name: Nisqually Towing
Site Address: 10240 Martin Way East
City : Olympia
Report Date : 4/22/2010
Gage : Fairgrounds (Kaiser)
Data Start : 1955/10/01
Data End : 2008/09/30
Precip Scale: 0.88
WWHM3 Version:

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
SAT, Forest, Flat	.238

Impervious Land Use	Acres

Element Flows To:

Surface	Interflow	Groundwater

Name : Basin 2
Bypass: No

GroundWater: No

Pervious Land Use	Acres
SAT, Forest, Flat	.129

Impervious Land Use	Acres

Element Flows To:

Surface	Interflow	Groundwater

Name : Basin 3

Bypass: No

GroundWater: No

Pervious Land Use	Acres
SAT, Forest, Flat	.235

Impervious Land Use	Acres

Element Flows To:

Surface	Interflow	Groundwater

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
SAT, Lawn, Flat	.069

Impervious Land Use	Acres
PARKING FLAT	0.169

Element Flows To:

Surface	Interflow	Groundwater

Name : Basin 2
Bypass: No

GroundWater: No

Pervious Land Use	Acres

Impervious Land Use	Acres
ROOF TOPS FLAT	0.129

Element Flows To:

Surface	Interflow	Groundwater

Name : Basin 3
Bypass: No

GroundWater: No

Pervious Land Use	Acres
SAT, Lawn, Flat	.04

Impervious Land Use	Acres
SIDEWALKS FLAT	0.016
PARKING FLAT	0.191

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

ANALYSIS RESULTS

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.021217
5 year	0.039466
10 year	0.048428
25 year	0.056103
50 year	0.059811
100 year	0.062334

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.068046
5 year	0.093593
10 year	0.112904
25 year	0.140192
50 year	0.162727
100 year	0.187248

Yearly Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1957	0.027	0.069
1958	0.041	0.095
1959	0.016	0.055
1960	0.012	0.063
1961	0.039	0.075
1962	0.020	0.045
1963	0.004	0.052
1964	0.036	0.107
1965	0.029	0.066
1966	0.044	0.070
1967	0.010	0.046
1968	0.028	0.054
1969	0.014	0.047

1970	0.011	0.051
1971	0.018	0.045
1972	0.022	0.056
1973	0.041	0.066
1974	0.016	0.059
1975	0.020	0.078
1976	0.014	0.061
1977	0.025	0.062
1978	0.009	0.094
1979	0.026	0.096
1980	0.027	0.081
1981	0.019	0.090
1982	0.029	0.087
1983	0.035	0.098
1984	0.013	0.121
1985	0.026	0.061
1986	0.009	0.054
1987	0.037	0.071
1988	0.041	0.068
1989	0.006	0.044
1990	0.004	0.045
1991	0.011	0.076
1992	0.086	0.121
1993	0.137	0.251
1994	0.020	0.080
1995	0.011	0.136
1996	0.022	0.090
1997	0.039	0.079
1998	0.042	0.148
1999	0.043	0.113
2000	0.019	0.065
2001	0.006	0.057
2002	0.001	0.051
2003	0.025	0.060
2004	0.009	0.042
2005	0.006	0.073
2006	0.000	0.058
2007	0.013	0.066
2008	0.017	0.060
2009	0.006	0.052

Ranked Yearly Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.1367	0.2506
2	0.0860	0.1479
3	0.0440	0.1357
4	0.0432	0.1213
5	0.0423	0.1210
6	0.0409	0.1127
7	0.0409	0.1070
8	0.0405	0.0979
9	0.0393	0.0963
10	0.0386	0.0948
11	0.0369	0.0941
12	0.0362	0.0904
13	0.0353	0.0899

14	0.0291	0.0868
15	0.0289	0.0811
16	0.0284	0.0800
17	0.0270	0.0791
18	0.0268	0.0784
19	0.0262	0.0762
20	0.0260	0.0747
21	0.0249	0.0730
22	0.0247	0.0706
23	0.0225	0.0700
24	0.0220	0.0689
25	0.0204	0.0684
26	0.0202	0.0661
27	0.0196	0.0658
28	0.0190	0.0657
29	0.0189	0.0653
30	0.0178	0.0631
31	0.0174	0.0621
32	0.0165	0.0612
33	0.0160	0.0606
34	0.0135	0.0601
35	0.0135	0.0601
36	0.0128	0.0592
37	0.0127	0.0578
38	0.0119	0.0568
39	0.0113	0.0559
40	0.0111	0.0552
41	0.0109	0.0542
42	0.0096	0.0542
43	0.0094	0.0521
44	0.0092	0.0519
45	0.0087	0.0508
46	0.0061	0.0506
47	0.0058	0.0474
48	0.0057	0.0460
49	0.0056	0.0453
50	0.0038	0.0450
51	0.0036	0.0446
52	0.0006	0.0442
53	0.0002	0.0415

POC #1

Facility FAILED duration standard for 1+ flows.

Flow(CFS)	Predev	Dev	Percentage	Pass/Fail
0.0106	1669	33285	1994	Fail
0.0111	1530	31074	2030	Fail
0.0116	1420	28973	2040	Fail
0.0121	1309	27152	2074	Fail
0.0126	1221	25405	2080	Fail
0.0131	1132	23714	2094	Fail
0.0136	1050	22227	2116	Fail
0.0141	984	20815	2115	Fail
0.0146	916	19514	2130	Fail
0.0151	863	18293	2119	Fail

0.0156	796	17187	2159	Fail
0.0161	752	16089	2139	Fail
0.0166	709	15096	2129	Fail
0.0171	664	14245	2145	Fail
0.0176	620	13385	2158	Fail
0.0181	596	12563	2107	Fail
0.0186	565	11864	2099	Fail
0.0191	536	11143	2078	Fail
0.0196	508	10504	2067	Fail
0.0201	474	9935	2095	Fail
0.0205	438	9387	2143	Fail
0.0210	417	8857	2123	Fail
0.0215	401	8359	2084	Fail
0.0220	378	7885	2085	Fail
0.0225	354	7451	2104	Fail
0.0230	333	7071	2123	Fail
0.0235	319	6696	2099	Fail
0.0240	299	6319	2113	Fail
0.0245	287	5968	2079	Fail
0.0250	274	5613	2048	Fail
0.0255	263	5308	2018	Fail
0.0260	247	5012	2029	Fail
0.0265	236	4732	2005	Fail
0.0270	219	4479	2045	Fail
0.0275	209	4237	2027	Fail
0.0280	199	3986	2003	Fail
0.0285	187	3786	2024	Fail
0.0290	176	3602	2046	Fail
0.0295	170	3384	1990	Fail
0.0300	163	3211	1969	Fail
0.0305	154	3061	1987	Fail
0.0310	144	2890	2006	Fail
0.0315	132	2751	2084	Fail
0.0320	124	2606	2101	Fail
0.0325	119	2483	2086	Fail
0.0330	110	2357	2142	Fail
0.0335	104	2238	2151	Fail
0.0340	101	2134	2112	Fail
0.0345	94	2044	2174	Fail
0.0350	90	1937	2152	Fail
0.0355	85	1853	2180	Fail
0.0360	80	1752	2190	Fail
0.0365	73	1676	2295	Fail
0.0369	70	1597	2281	Fail
0.0374	67	1525	2276	Fail
0.0379	62	1450	2338	Fail
0.0384	61	1385	2270	Fail
0.0389	57	1323	2321	Fail
0.0394	55	1268	2305	Fail
0.0399	54	1201	2224	Fail
0.0404	52	1153	2217	Fail
0.0409	46	1111	2415	Fail
0.0414	46	1069	2323	Fail
0.0419	44	1021	2320	Fail
0.0424	42	976	2323	Fail
0.0429	42	926	2204	Fail
0.0434	40	884	2210	Fail

0.0439	40	845	2112	Fail
0.0444	39	815	2089	Fail
0.0449	38	781	2055	Fail
0.0454	38	737	1939	Fail
0.0459	37	710	1918	Fail
0.0464	37	684	1848	Fail
0.0469	36	657	1825	Fail
0.0474	34	622	1829	Fail
0.0479	33	605	1833	Fail
0.0484	33	584	1769	Fail
0.0489	33	557	1687	Fail
0.0494	32	532	1662	Fail
0.0499	32	512	1600	Fail
0.0504	32	492	1537	Fail
0.0509	32	472	1475	Fail
0.0514	32	452	1412	Fail
0.0519	32	437	1365	Fail
0.0524	31	418	1348	Fail
0.0529	30	399	1330	Fail
0.0534	27	385	1425	Fail
0.0538	26	373	1434	Fail
0.0543	26	349	1342	Fail
0.0548	25	335	1340	Fail
0.0553	24	316	1316	Fail
0.0558	24	302	1258	Fail
0.0563	23	293	1273	Fail
0.0568	23	282	1226	Fail
0.0573	22	269	1222	Fail
0.0578	22	261	1186	Fail
0.0583	21	253	1204	Fail
0.0588	21	242	1152	Fail
0.0593	21	237	1128	Fail
0.0598	21	226	1076	Fail

The development has an increase in flow durations from 1/2 predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.

Water Quality BMP Flow and Volume for POC 1.
On-line facility volume: 0.0268 acre-feet
On-line facility target flow: 0.01 **cfs.**
Adjusted for 15 min: 0.0304 **cfs.**
Off-line facility target flow: 0.0172 **cfs.**
Adjusted for 15 min: 0.0172 **cfs.**

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	Flow(cfs)
2 year	0.032449
5 year	0.06036
10 year	0.074066
25 year	0.085805
50 year	0.091476
100 year	0.095334

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	Flow(cfs)
2 year	0.131386
5 year	0.179036

10 year	0.214795
25 year	0.265024
50 year	0.306286
100 year	0.350996

Yearly Peaks for Predeveloped and Mitigated. POC #2

Year	Predeveloped	Mitigated
1957	0.041	0.123
1958	0.062	0.176
1959	0.025	0.104
1960	0.018	0.125
1961	0.060	0.147
1962	0.030	0.085
1963	0.006	0.103
1964	0.055	0.201
1965	0.044	0.131
1966	0.067	0.127
1967	0.015	0.091
1968	0.043	0.105
1969	0.021	0.091
1970	0.017	0.097
1971	0.027	0.088
1972	0.034	0.111
1973	0.063	0.121
1974	0.025	0.117
1975	0.031	0.156
1976	0.021	0.119
1977	0.038	0.116
1978	0.014	0.186
1979	0.040	0.191
1980	0.041	0.161
1981	0.029	0.173
1982	0.045	0.163
1983	0.054	0.194
1984	0.020	0.241
1985	0.040	0.115
1986	0.014	0.108
1987	0.056	0.126
1988	0.062	0.118
1989	0.009	0.088
1990	0.005	0.090
1991	0.017	0.145
1992	0.132	0.203
1993	0.209	0.446
1994	0.031	0.159
1995	0.017	0.270
1996	0.034	0.180
1997	0.059	0.150
1998	0.065	0.289
1999	0.066	0.214
2000	0.029	0.130
2001	0.009	0.113
2002	0.001	0.101
2003	0.038	0.115
2004	0.013	0.083
2005	0.009	0.145
2006	0.000	0.115
2007	0.019	0.129
2008	0.027	0.119
2009	0.009	0.103

Ranked Yearly Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	0.2090	0.4455
2	0.1315	0.2895
3	0.0673	0.2698
4	0.0660	0.2405
5	0.0647	0.2139
6	0.0626	0.2034

7	0.0625	0.2006
8	0.0620	0.1938
9	0.0601	0.1911
10	0.0590	0.1862
11	0.0564	0.1797
12	0.0554	0.1760
13	0.0539	0.1728
14	0.0446	0.1633
15	0.0441	0.1613
16	0.0434	0.1588
17	0.0414	0.1558
18	0.0410	0.1503
19	0.0400	0.1474
20	0.0398	0.1451
21	0.0380	0.1445
22	0.0377	0.1315
23	0.0344	0.1298
24	0.0337	0.1292
25	0.0313	0.1269
26	0.0309	0.1257
27	0.0299	0.1254
28	0.0291	0.1229
29	0.0289	0.1209
30	0.0272	0.1195
31	0.0266	0.1190
32	0.0252	0.1180
33	0.0245	0.1166
34	0.0207	0.1158
35	0.0207	0.1152
36	0.0195	0.1150
37	0.0195	0.1148
38	0.0182	0.1129
39	0.0173	0.1111
40	0.0169	0.1077
41	0.0167	0.1047
42	0.0147	0.1038
43	0.0143	0.1035
44	0.0140	0.1032
45	0.0133	0.1010
46	0.0094	0.0966
47	0.0088	0.0913
48	0.0087	0.0913
49	0.0085	0.0901
50	0.0057	0.0880
51	0.0055	0.0879
52	0.0009	0.0851
53	0.0004	0.0825

POC #2

Facility FAILED duration standard for 1+ flows.

Flow(CFS)	Predev	Dev	Percentage	Pass/Fail
0.0162	1669	46629	2793	Fail
0.0170	1530	43897	2869	Fail
0.0177	1420	41351	2912	Fail
0.0185	1308	39028	2983	Fail
0.0193	1221	36853	3018	Fail
0.0200	1132	34809	3075	Fail
0.0208	1050	32913	3134	Fail
0.0215	983	31166	3170	Fail
0.0223	916	29512	3221	Fail
0.0231	863	27933	3236	Fail
0.0238	795	26502	3333	Fail
0.0246	752	25164	3346	Fail
0.0253	709	23844	3363	Fail

0.0261	662	22655	3422	Fail
0.0269	620	21484	3465	Fail
0.0276	596	20387	3420	Fail
0.0284	565	19328	3420	Fail
0.0291	534	18324	3431	Fail
0.0299	508	17392	3423	Fail
0.0307	474	16535	3488	Fail
0.0314	438	15726	3590	Fail
0.0322	417	14948	3584	Fail
0.0329	401	14264	3557	Fail
0.0337	378	13582	3593	Fail
0.0345	354	12926	3651	Fail
0.0352	333	12353	3709	Fail
0.0360	319	11734	3678	Fail
0.0367	299	11195	3744	Fail
0.0375	287	10653	3711	Fail
0.0383	274	10153	3705	Fail
0.0390	263	9694	3685	Fail
0.0398	247	9266	3751	Fail
0.0405	236	8852	3750	Fail
0.0413	219	8469	3867	Fail
0.0421	209	8099	3875	Fail
0.0428	199	7716	3877	Fail
0.0436	188	7378	3924	Fail
0.0443	176	7038	3998	Fail
0.0451	170	6743	3966	Fail
0.0459	163	6466	3966	Fail
0.0466	154	6176	4010	Fail
0.0474	144	5893	4092	Fail
0.0481	132	5618	4256	Fail
0.0489	124	5369	4329	Fail
0.0497	119	5109	4293	Fail
0.0504	110	4904	4458	Fail
0.0512	105	4696	4472	Fail
0.0519	101	4483	4438	Fail
0.0527	94	4271	4543	Fail
0.0535	90	4090	4544	Fail
0.0542	84	3897	4639	Fail
0.0550	80	3734	4667	Fail
0.0558	73	3566	4884	Fail
0.0565	70	3412	4874	Fail
0.0573	67	3276	4889	Fail
0.0580	62	3137	5059	Fail
0.0588	61	3000	4918	Fail
0.0596	57	2881	5054	Fail
0.0603	55	2775	5045	Fail
0.0611	54	2639	4887	Fail
0.0618	52	2537	4878	Fail
0.0626	46	2433	5289	Fail
0.0634	46	2344	5095	Fail
0.0641	44	2252	5118	Fail
0.0649	42	2169	5164	Fail
0.0656	42	2081	4954	Fail
0.0664	40	2002	5005	Fail
0.0672	40	1924	4810	Fail
0.0679	39	1852	4748	Fail
0.0687	38	1783	4692	Fail

0.0694	38	1703	4481	Fail
0.0702	37	1634	4416	Fail
0.0710	37	1582	4275	Fail
0.0717	36	1526	4238	Fail
0.0725	34	1463	4302	Fail
0.0732	33	1395	4227	Fail
0.0740	33	1339	4057	Fail
0.0748	33	1293	3918	Fail
0.0755	32	1245	3890	Fail
0.0763	32	1202	3756	Fail
0.0770	32	1154	3606	Fail
0.0778	32	1115	3484	Fail
0.0786	32	1069	3340	Fail
0.0793	32	1027	3209	Fail
0.0801	31	991	3196	Fail
0.0808	30	953	3176	Fail
0.0816	27	911	3374	Fail
0.0824	26	874	3361	Fail
0.0831	26	847	3257	Fail
0.0839	25	811	3243	Fail
0.0846	24	781	3254	Fail
0.0854	24	755	3145	Fail
0.0862	23	736	3200	Fail
0.0869	23	719	3126	Fail
0.0877	22	691	3140	Fail
0.0884	22	671	3050	Fail
0.0892	21	645	3071	Fail
0.0900	21	627	2985	Fail
0.0907	21	605	2880	Fail
0.0915	21	577	2747	Fail

The development has an increase in flow durations from 1/2 predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.

Water Quality BMP Flow and Volume for POC 2.
On-line facility volume: 0.0502 acre-feet
On-line facility target flow: 0.01 **cfs.**
Adjusted for 15 min: 0.0582 **cfs.**
Off-line facility target flow: 0.033 **cfs.**
Adjusted for 15 min: 0.033 **cfs.**

Perlnd and Implnd Changes

No changes have been made.

This program and accompanying documentation is provided 'as-is' without warranty of any kind. The entire risk regarding the performance and results of this program is assumed by the user. Clear Creek Solutions and the Washington State Department of Ecology disclaims all warranties, either expressed or implied, including but not limited to implied warranties of program and accompanying documentation. In no event shall Clear Creek Solutions and/or the Washington State Department of Ecology be liable for any damages whatsoever (including without limitation to damages for loss of business profits, loss of business information, business interruption, and the like) arising out of the use of, or inability to use this program even if Clear Creek Solutions or the Washington State Department of Ecology has been advised of the possibility of such damages.

Thurston County Drainage Design and Erosion Control Manual
Volume V - Stormwater BMPs
BF.04 Basic Filter Strip

EQUATION 1

$y = [KQn/1.49Ts^{0.5}]^{0.6}$

y Design depth of flow, ft. (1-inch maximum)
K The ratio determined by using Figure 5.1a. If SBUH model is used for water quality design flow rate calculations, K = 1.
Q Peak Water Quality Design Flow Rate based on an approved continuous runoff model, ft^3/sec.
n Manning's roughness coefficient. 0.35 (0.45 if compost-amended, and mowed to maintain grass height ≤ 4 inches).
T Width of filter strip perpendicular to the direction of flow, ft.
s Longitudinal slope of filter strip parallel to direction of flow, ft/ft.

K	2.5	y, *ft.* = 0.0521
Q	0.0886	y, *in.* = 0.63
n	0.45	
T	92	
s	0.01	

EQUATION 2

$V = KQ/Ty$

V Design flow velocity, ft/sec. V must not exceed 0.5 ft/sec.

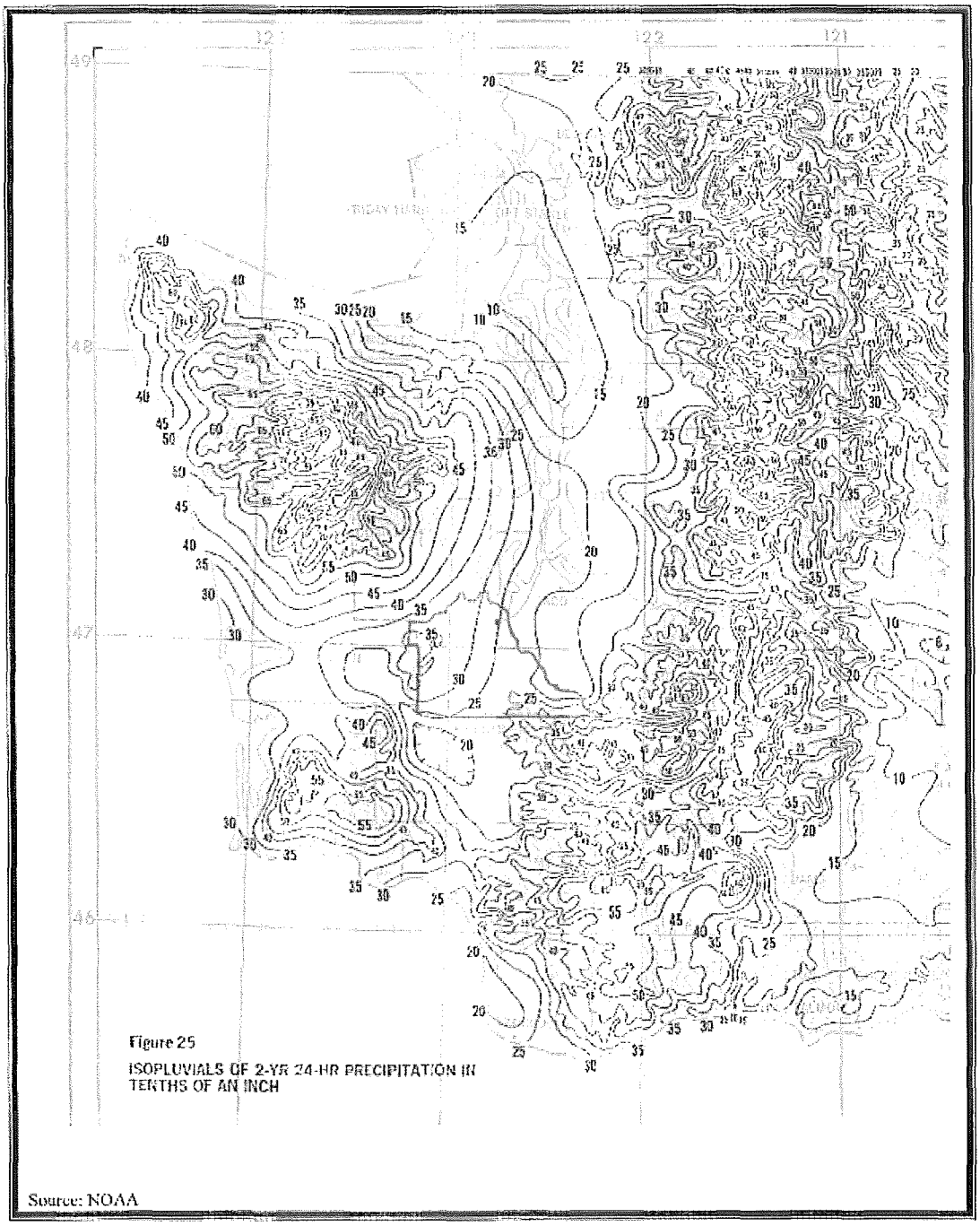
K	2.5	V, *ft/sec* = 0.05
Q	0.0886	
T	92	
y	0.0521	

EQUATION 3

$L = tV = 540V$

L Required length (ft) of the filter strip at the minimum hydraulic residence time, t, of 9 minutes.
t Minimum hydraulic residence time, sec.

t	540	L, *ft* = 24.95
V	0.05	



Western Washington Isopluvial 2-year, 24-hour

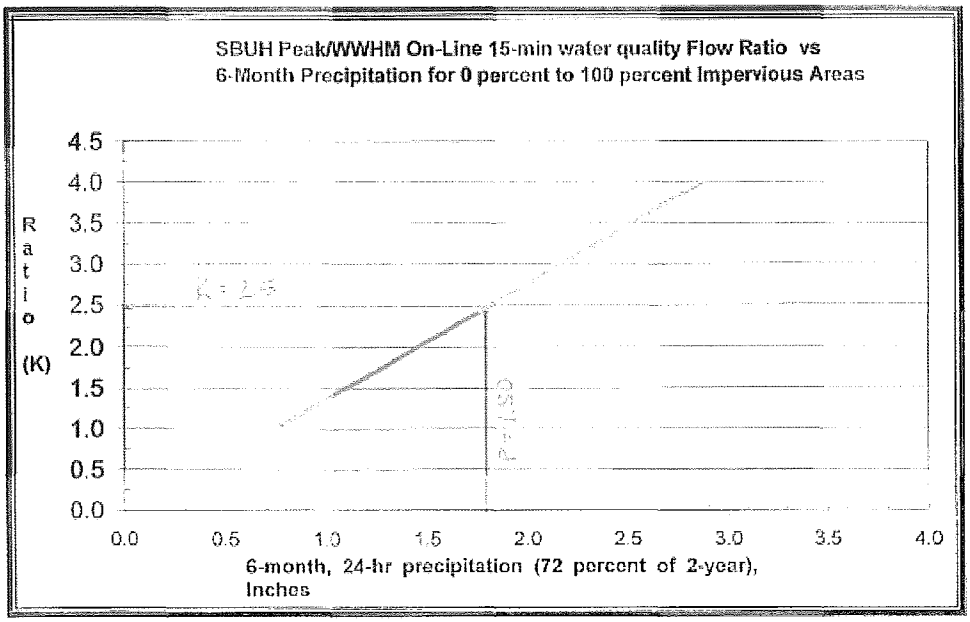


Figure 5.1.a. Ratio of SBUH Peak/Water Quality Flow.

6-MONTH, 24 HR P = 72% (2.5 IN) = 1.80 IN

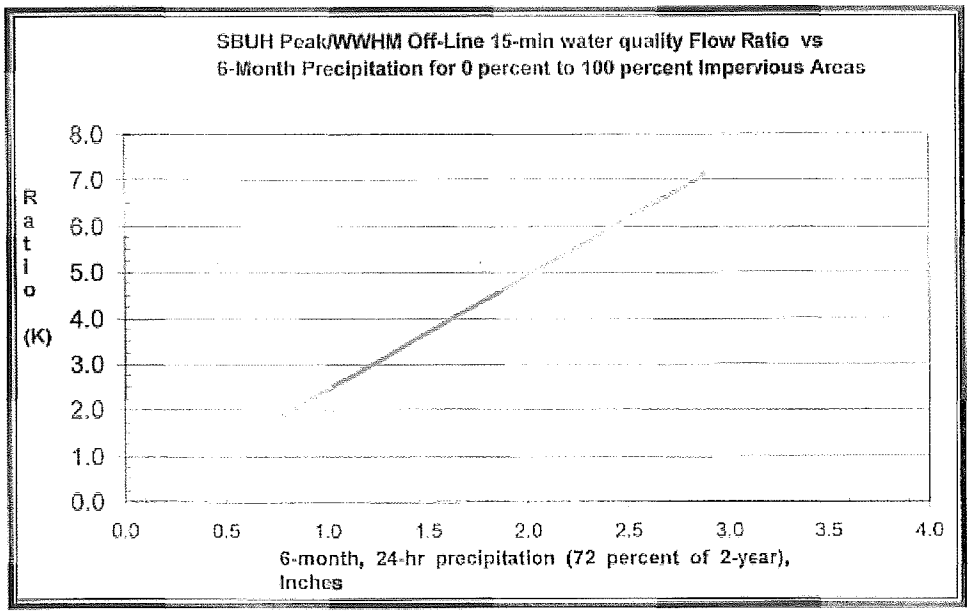


Figure 5.1.b. **Ratio of SBUH Peak/Water Quality Flow.**