Util

# GFK Consulting

Land Development Services

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Utilities Div.

Friday, November 02, 2007

Ryan Ellinghaus
Gary Parkinson Architects
2812 Colby Ave
Everett, Wa. 98201

Re: Hertz Equipment Rental, Arlington

Ryan,

Per your request I have reviewed the original drainage report and stormwater site design prepared for the Dwayne Lane North Sound Car and Truck site to see if this design and subsequent site improvements are adequate to serve the proposed new use for the site; Hertz Equipment Rental.

After my reviewing the original drainage report and site design prepared by Bryant Mercil, dated May 20th 2004, it appears that there are no significant changes in the proposed land coverage proposed by the new use; the impermeable and permeable areas used for the original design are identical to your new proposal and the drainage design guidelines within The City of Arlington remain the 1992 DOE Stormwater Management Manual. I see no reason why the original site design and improvements would not meet the needs of your new site plan.

11-12-07

Please call me if you have any questions.

Sincerely

RECEIVED
JAN - 4 2008
BY BLD2008-0002

GREGERS F. KRABBE
STATE OF WASHINGTON
EXPIRES 9/21/08

Greg Krabbe, PE
President

# Drainage Calculations
# Dwayne Lane's North Sound Car and Truck
# 16424 Smokey Point Boulevard N.E.
# Arlington, Washington

Prepared for:
Dwayne Lane Chrysler
16710 Smokey Point Boulevard
Arlington, Washington 98223

Prepared by:
Bryant O. Mercil, P.E.

March 18, 2004
Revised May 20, 2004

## TABLE OF CONTENTS

Introduction: ..... 1

Summary of Results: ..... 2

Basin Summaries: ..... 4

Runoff Curve Number and Time of Concentration: ..... 6

Design Data – Presettling Basin: ..... 11

Design Data – Infiltration Ponds: ..... 13

Drainage Area Map: ..... 23

Maintenance Requirements: ..... 25

Geotechnical Report: ..... 35

## INTRODUCTION

The following report presents the design for an infiltration system for the Dwayne Lane Temporary Car Lot. The proposed development shall consist of a 1,232 square foot temporary (modular) auto sales building, a 1,120 square foot temporary car wash and a 1,680 square foot temporary maintenance shop, with associated temporary parking and display areas. The 4.881-acre project site is located on the west side Smokey Point Boulevard, approximately 3/4 mile southeast of 172nd Street NE in the City of Arlington.

## PRE DEVELOPED DRAINAGE CONDITIONS

The subject site has already been cleared and graded for commercial use, under City Project File Number: GP 00-064 (Turner Property). In accordance with the approved plans, the site was graded and filled to convey stormwater runoff via sheet flow from the middle of the site north and south to perimeter berms located at the north and south boundary lines. The berms were constructed around the entire site to detain all runoff. Temporary infiltration basins, located on the east and west sides of the property and outside of the surrounding berm, were designed to infiltrate any excess runoff. The bottom elevation of the basins were established at 3 feet above the groundwater elevations established from data contained in the Geotechnical Feasibility Study. The project site does not receive any stormwater runoff from adjacent, offsite areas.

## PROPOSED DRAINAGE CONDITIONS

As shown on the grading, and drainage plan included with the temporary use permit application, the toe of the existing perimeter dike along the north and south site boundaries will be regraded and converted to a presettling basin. The underlying soils will be replaced with at least 18-inches of compacted silt loam to prevent infiltration. The basins have been designed per DOE standards to detain and release the total volume of runoff from a 6-month storm in 24-hours. Flows from the presettling basins will discharge to one of four water quality infiltration cells in the temporary infiltration ponds located at the east and west site boundaries. The bottoms of the water quality cells will contain 18-inches of loamy sand with a minimum cation exchange capacity of 5.0 milliequivalents per 100 grams. Peak flows in excess of a 6-month storm will be completely infiltrated in the two infiltration ponds.

The boundary of the proposed drainage area tributary to the infiltration facilities is delineated on the drainage area map at the end of this report. The "Waterworks" program with the Santa Barbara Unit Hydrograph (SBUH) Method and Type 1A rainfall distribution was used to design the proposed facility.

## SUMMARY OF RESULTS

### PROPOSED DETENTION SYSTEM

Total Area of Project Site: ..... 4.881 Acres
Less Undeveloped Areas not Tributary to the Infiltration Ponds: ..... 0.044 Acres
Equals Total Retained Area: ..... 4.837 Acres

### WATER QUALITY INFILTRATION CELLS – 6-MONTH STORM

Peak Inflow to Water Quality Cells: ..... 0.90 cfs
Proposed Release Rate (Infiltration): ..... 0.21 cfs
Design Water Surface Elevation: ..... 119.48
Approximate Volume of Storage Provided: ..... 3,523 cf

### INFILTRATION PONDS 1 AND 2 - 100 YEAR STORM

Peak Inflow to Infiltration Ponds (Cells A, B, and C): ..... 3.28 cfs
Proposed Release Rate (Infiltration): ..... 0.92 cfs
Design Water Surface Elevation: ..... 119.73
Approximate Volume of Storage Provided: ..... 10,418 cf

**RUNOFF CURVE NUMBER**
**TIME OF CONCENTRATION**

## HISTORY OF HYDROGRAPH ACTIVITY

Date of Session: 5/20/04 9:6:28 am

**LPOOL 1 "BASIN 1 6 MO STORM" B1-DEWQ B1-DEWQ STO-1WQ DIS-1WQ 1**

| Description | MatchQ | PeakQ | Sto | Dis | PkStg | OutQ | hyd | Volume |
|---|---|---|---|---|---|---|---|---|
| BASIN 1 6 MO STORM | 0.00 | 0.90 | STO-1WQ | DIS-1WQ | 119.48 | 0.21 | 1 | 3522.74 cf |

**LPOOL 2 "BASIN 1 100 YR STORM" B1-DE100 B1-DE100 STO-1 DIS-1 2**

| Description | MatchQ | PeakQ | Sto | Dis | PkStg | OutQ | hyd | Volume |
|---|---|---|---|---|---|---|---|---|
| BASIN 1 100 YR STORM | 0.00 | 3.28 | STO-1 | DIS-1 | 119.73 | 0.92 | 2 | 10418.33 cf |

# BASIN SUMMARIES

## BASIN SUMMARIES

**BASIN ID: B1-DEWQ** **NAME: BASIN 1 - DEV. 6 MO. STORM**

SBUH METHODOLOGY

| | | | | |
|---|---|---|---|---|
| TOTAL AREA.....: | 4.84 Acres | BASEFLOWS: | 0.00 cfs | |
| RAINFALL TYPE....: | TYPE1A | | PERV | IMP |
| PRECIPITATION....: | 1.15 inches | AREA..: | 0.70 Acres | 4.14 Acres |
| TIME INTERVAL....: | 10.00 min | CN....: | 68.00 | 98.00 |
| | | TC....: | 10.00 min | 6.00 min |

ABSTRACTION COEFF: 0.20

PEAK RATE: 0.90 cfs VOL: 0.32 Ac-ft TIME: 480 min

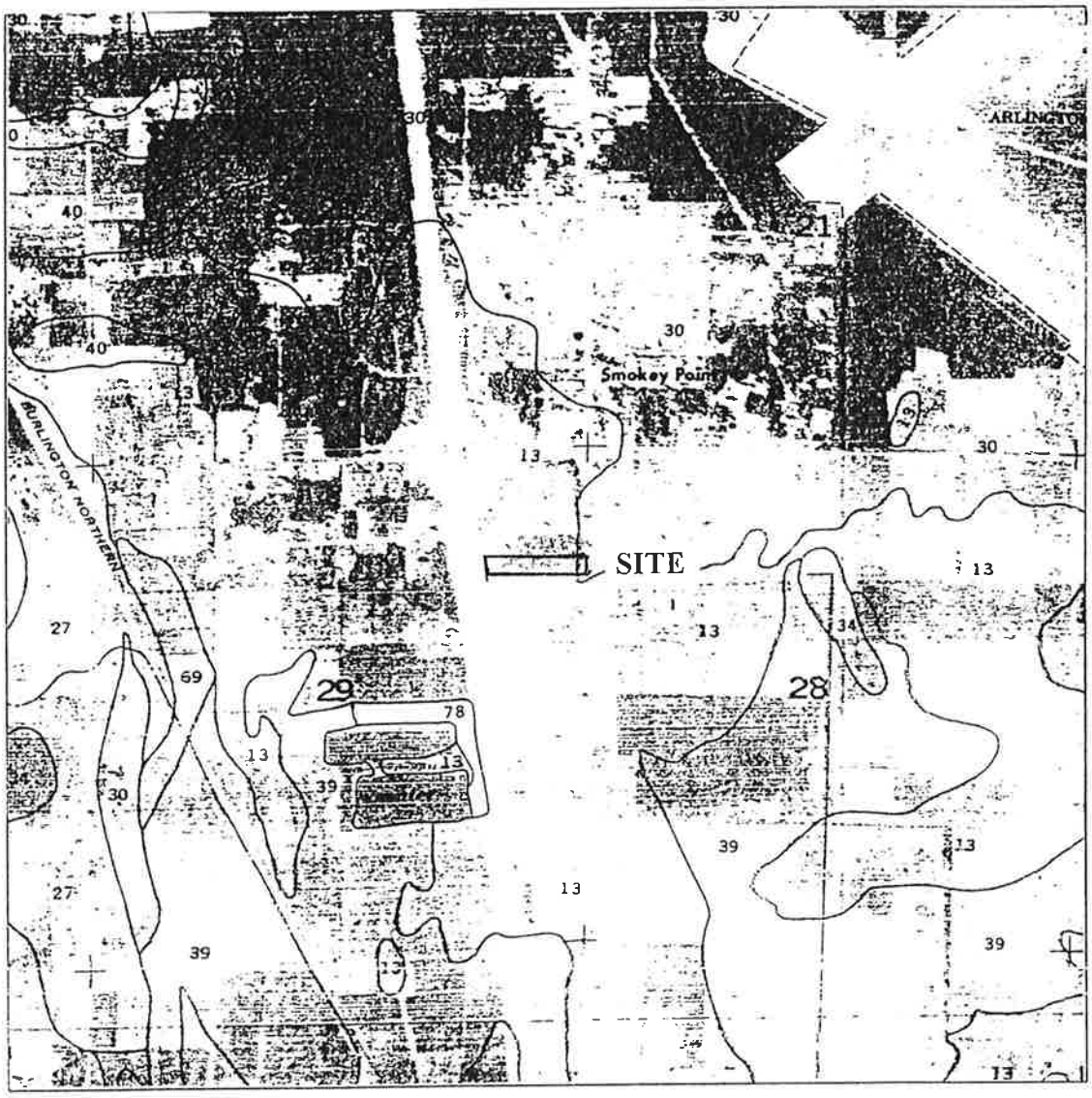
**BASIN ID: B1-DE100** **NAME: BASIN 1 - DEV. 100 YR. STORM**

SBUH METHODOLOGY

| | | | | |
|---|---|---|---|---|
| TOTAL AREA.....: | 4.84 Acres | BASEFLOWS: | 0.00 cfs | |
| RAINFALL TYPE....: | TYPE1A | | PERV | IMP |
| PRECIPITATION....: | 3.70 inches | AREA..: | 0.70 Acres | 4.14 Acres |
| TIME INTERVAL....: | 10.00 min | CN....: | 68.00 | 98.00 |
| | | TC....: | 10.00 min | 6.00 min |

ABSTRACTION COEFF: 0.20

PEAK RATE: 3.28 cfs VOL: 1.25 Ac-ft TIME: 480 min




## SOILS MAP

SCALE: 1" = 2,000'

Reference: Soil Survey of Snohomish County
Sheet Number 19

Soil Type: Symbol 13-Custer Fine Sandy Loam
Hydrologic Soil Group A (Based Upon Geotech Report)

**DWAYNE LANE TEMPORARY CAR LOT**
**RUNOFF CURVE NUMBER CALCULATIONS**
**POST DEVELOPED CONDITIONS**

**BASIN NO. 1 - INFILTRATION BASIN NOS. 1 AND 2**
**PERVIOUS AREAS**

Total Retained Area (Acres):..... 4.837

| Soil Name and Hydrologic Soil Group | | Cover Description | Runoff Curve Number RCN | Area (Acres) A | RCN x A |
|---|---|---|---|---|---|
| Name | HSG | | | | |
| Custer | A | Lawn Areas | 68 | 0.700 | 47.600 |
| | | | | | |
| | | | | | |
| | | Totals | | 0.700 | 47.600 |

Runoff Curve Number = (RCN x A) / A: ..... 68.000
Runoff Curve Number Used in Basin Calculations..... 68.000

**IMPERVIOUS AREAS**

| Soil Name and Hydrologic Soil Group | | Cover Description | Runoff Curve Number RCN | Area (Acres) A | RCN x A |
|---|---|---|---|---|---|
| Name | HSG | | | | |
| Custer | A | Impervious Areas | 98 | 4.137 | 405.384 |
| | | | | | |
| | | | | | |
| | | Totals | | 4.137 | 405.384 |

Runoff Curve Number = (RCN x A) / A: ..... 98.000
Runoff Curve Number Used in Basin Calculations..... 98.000

# DWAYNE LANE TEMPORARY CAR LOT
# TIME OF CONCENTRATION
# POST DEVELOPED CONDITIONS
# IMPERVIOUS AREAS
# BASIN NO. 1

***Sheet Flow (Applicable to Tc only)***

| | |
|---|---|
| Surface Description | Pavement |
| Manning's Roughness Coefficient, nsheet | 0.011 |
| Flow Length (L<=300'), Lsheet | 200 feet |
| 2-Year, 24-Hour Rainfall, P2 | 1.80 inches |
| Land Slope, Ssheet | 0.005 ft/ft |
| Tt Sheet | 0.08 hours |
| Tt Sheet | 4.90 min. |

***Shallow Concentrated Flow (See DOE SWM Manual, Page III-1-14)***

| | |
|---|---|
| Surface Description | Pavement |
| Flow Length, Lshallow | 0 ft |
| Watercourse Slope, So | 0.000 ft/ft |
| Time of Concentration Velocity Factor, ks | 27.00 |
| Average Velocity, Vshallow = k x So^0.5 | 0.00 fps |
| Tt Shallow | 0.00 hours |
| Tt Shallow | 0.02 min. |

***Channel Flow (See DOE SWM Manual, Pages III-1-15, III-1-16)***

| | |
|---|---|
| Type of Channel | Pipe |
| Flow Length, Lchannel | 0 ft |
| Watercourse Slope, So | 0.000 ft/ft |
| Time of Concentration Velocity Factor, kc | 42.00 |
| Average Velocity, Vchannel = k x So^0.5 | 0.00 fps |
| Tt Channel | 0.00 hours |
| Tt Channel | 0.00 min. |

***Results: Watershed or Subarea Tc or Tt***

| | |
|---|---|
| Total Tc or Tt | **0.082 hours** |
| Total Tc or Tt | **4.917 min.** |
| Minimum Tc Used in Basin File | **6.000 min.** |

**Note:**

1. Worksheet based on time equations from Stormwater Management Manual for the Puget Sound Basin, Chapter III

# DWAYNE LANE TEMPORARY CAR LOT
# TIME OF CONCENTRATION
# POST DEVELOPED CONDITIONS
# PERVIOUS AREAS
# BASIN NO. 1

***Sheet Flow (Applicable to Tc only)***

| | |
|---|---|
| Surface Description | Lawn |
| Manning's Roughness Coefficient, nsheet | 0.240 |
| Flow Length (L<=300'), Lsheet | 22 feet |
| 2-Year, 24-Hour Rainfall, P2 | 1.80 inches |
| Land Slope, Ssheet | 0.005 ft/ft |
| Tt Sheet | 0.17 hours |
| Tt Sheet | 10.00 min. |

***Shallow Concentrated Flow (See DOE SWM Manual, Page III-1-14)***

| | |
|---|---|
| Surface Description | Pavement |
| Flow Length, Lshallow | 0 ft |
| Watercourse Slope, So | 0.000 ft/ft |
| Time of Concentration Velocity Factor, ks | 27.00 |
| Average Velocity, Vshallow = k x So^0.5 | 0.00 fps |
| Tt Shallow | 0.00 hours |
| Tt Shallow | 0.02 min. |

***Channel Flow (See DOE SWM Manual, Pages III-1-15, III-1-16)***

| | |
|---|---|
| Type of Channel | Pipe |
| Flow Length, Lchannel | 0 ft |
| Watercourse Slope, So | 0.000 ft/ft |
| Time of Concentration Velocity Factor, kc | 42.00 |
| Average Velocity, Vchannel = k x So^0.5 | 0.00 fps |
| Tt Channel | 0.00 hours |
| Tt Channel | 0.00 min. |

***Results: Watershed or Subarea Tc or Tt***

| | |
|---|---|
| Total Tc or Tt | **0.167 hours** |
| Total Tc or Tt | **10.000 min.** |

**Note:**

1. Worksheet based on time equations from Stormwater Management Manual for the Puget Sound Basin, Chapter III

**DESIGN DATA**
**PRESETTLEMENT BASIN**

## DESIGN OF PRE-SETTLING BASIN

| | |
|---|---|
| Required Surface Area of Presettling Basin, As (sf): | 663.19 |
| As = -(Qo / w) * Ln (1-E) | |
| Average Release Rate, Qo = Vr / td (cfs): | 0.1648 |
| Total Runoff Volume for 6-Month Storm, Vr (cf): | 14,241.00 |
| Detention Time, td (hours) | 24.00 |
| Detention Time, td (sec) | 86,400.00 |
| Settling Velocity of Target Particle (Silt), w (fps): | 0.0004 |
| Trap Efficiency (Fraction of Suspended Soilds to Remove), E: | 0.80 |
| Propsed Surface Area of Presettling Basin, As (sf): | 10,660.00 |
| Average Release Rate per Riser, Qr = Qo / Nr (cfs): | 0.0412 |
| Number of Risers, Nr: | 4.00 |

## RELEASE ORIFICE

| | |
|---|---|
| Qor (cfs) = c x Aor x (64.4 x Hor)^0.5: | 0.0432 |
| Head on Orifice, Hor (ft): | 0.5000 |
| Orifice Coefficient, c: | 0.62 |
| Diameter of Low Flow Orifice, Aor (Inches): | 1.500 |
| Orifice Area, Aor (Square Feet): | 0.0123 |
| Average Invert of Low Flow Orifice: | 119.00 |

**DESIGN DATA**
**INFILTRATION BASINS**

## STAGE STORAGE TABLES

**CUSTOM STORAGE** **ID No. STO-1WQ**
Description: WATER QUALITY CELLS - INFILTRATION PONDS 1 AND 2

| STAGE (ft) | STORAGE --cf-- | --Ac-Ft- | STAGE (ft) | STORAGE --cf-- | --Ac-Ft- | STAGE (ft) | STORAGE --cf-- | --Ac-Ft- | STAGE (ft) | STORAGE --cf-- | --Ac-Ft- |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 118.70 | 0.0000 | 0.0000 | 119.05 | 1174 | 0.0270 | 119.40 | 3017 | 0.0693 | 119.75 | 5340 | 0.1226 |
| 118.75 | 167.78 | 0.0039 | 119.10 | 1342 | 0.0308 | 119.45 | 3319 | 0.0762 | 119.80 | 5684 | 0.1305 |
| 118.80 | 335.56 | 0.0077 | 119.15 | 1510 | 0.0347 | 119.50 | 3620 | 0.0831 | 119.85 | 6028 | 0.1384 |
| 118.85 | 503.33 | 0.0116 | 119.20 | 1811 | 0.0416 | 119.55 | 3964 | 0.0910 | 119.90 | 6372 | 0.1463 |
| 118.90 | 671.11 | 0.0154 | 119.25 | 2113 | 0.0485 | 119.60 | 4308 | 0.0989 | 119.95 | 6716 | 0.1542 |
| 118.95 | 838.89 | 0.0193 | 119.30 | 2414 | 0.0554 | 119.65 | 4652 | 0.1068 | 120.00 | 7060 | 0.1621 |
| 119.00 | 1007 | 0.0231 | 119.35 | 2716 | 0.0623 | 119.70 | 4996 | 0.1147 | | | |

**CUSTOM STORAGE** **ID No. STO-1**
Description: INFILTRATION PONDS 1 AND 2

| STAGE (ft) | STORAGE --cf-- | --Ac-Ft- | STAGE (ft) | STORAGE --cf-- | --Ac-Ft- | STAGE (ft) | STORAGE --cf-- | --Ac-Ft- | STAGE (ft) | STORAGE --cf-- | --Ac-Ft- |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 118.70 | 0.0000 | 0.0000 | 119.05 | 2808 | 0.0645 | 119.40 | 6410 | 0.1472 | 119.75 | 10675 | 0.2451 |
| 118.75 | 401.11 | 0.0092 | 119.10 | 3209 | 0.0737 | 119.45 | 6970 | 0.1600 | 119.80 | 11304 | 0.2595 |
| 118.80 | 802.22 | 0.0184 | 119.15 | 3610 | 0.0829 | 119.50 | 7530 | 0.1729 | 119.85 | 11933 | 0.2739 |
| 118.85 | 1203 | 0.0276 | 119.20 | 4170 | 0.0957 | 119.55 | 8159 | 0.1873 | 119.90 | 12562 | 0.2884 |
| 118.90 | 1604 | 0.0369 | 119.25 | 4730 | 0.1086 | 119.60 | 8788 | 0.2017 | 119.95 | 13191 | 0.3028 |
| 118.95 | 2006 | 0.0460 | 119.30 | 5290 | 0.1214 | 119.65 | 9417 | 0.2162 | 120.00 | 13820 | 0.3173 |
| 119.00 | 2407 | 0.0552 | 119.35 | 5850 | 0.1343 | 119.70 | 10046 | 0.2306 | | | |

## STAGE DISCHARGE TABLES

**DISCHARGE LIST** **ID No. DIS-1WQ**
Description: WATER QUALITY CELLS - INFILTRATION PONDS 1 AND 2

| STAGE (ft) | DISCHARGE ---cfs-- ------- | STAGE (ft) | DISCHARGE ---cfs-- ------- | STAGE (ft) | DISCHARGE ---cfs-- ------- | STAGE (ft) | DISCHARGE ---cfs-- ------- |
|---|---|---|---|---|---|---|---|
| 118.70 | 0.0870 | 119.05 | 0.1562 | 119.40 | 0.2017 | 119.75 | 0.2380 |
| 118.75 | 0.0959 | 119.10 | 0.1661 | 119.45 | 0.2069 | 119.80 | 0.2432 |
| 118.80 | 0.1068 | 119.15 | 0.1760 | 119.50 | 0.2120 | 119.85 | 0.2484 |
| 118.85 | 0.1167 | 119.20 | 0.1811 | 119.55 | 0.2172 | 119.90 | 0.2535 |
| 118.90 | 0.1266 | 119.25 | 0.1863 | 119.60 | 0.2224 | 119.95 | 0.2588 |
| 118.95 | 0.1364 | 119.30 | 0.1914 | 119.65 | 0.2276 | 120.00 | 0.2640 |
| 119.00 | 0.1463 | 119.35 | 0.1966 | 119.70 | 0.2328 | | |

**DISCHARGE LIST** **ID No. DIS-1**
Description: INFILTRATION PONDS 1 AND 2

| STAGE (ft) | DISCHARGE ---cfs-- ------- | STAGE (ft) | DISCHARGE ---cfs-- ------- | STAGE (ft) | DISCHARGE ---cfs-- ------- | STAGE (ft) | DISCHARGE ---cfs-- ------- |
|---|---|---|---|---|---|---|---|
| 118.70 | 0.5100 | 119.05 | 0.6679 | 119.40 | 0.8023 | 119.75 | 0.9275 |
| 118.75 | 0.5326 | 119.10 | 0.6904 | 119.45 | 0.8201 | 119.80 | 0.9454 |
| 118.80 | 0.5551 | 119.15 | 0.7130 | 119.50 | 0.8380 | 119.85 | 0.9633 |
| 118.85 | 0.5777 | 119.20 | 0.7309 | 119.55 | 0.8559 | 119.90 | 0.9812 |
| 118.90 | 0.6002 | 119.25 | 0.7487 | 119.60 | 0.8738 | 119.95 | 0.9991 |
| 118.95 | 0.6228 | 119.30 | 0.7666 | 119.65 | 0.8917 | 120.00 | 1.0170 |
| 119.00 | 0.6453 | 119.35 | 0.7844 | 119.70 | 0.9096 | | |

**DWAYNE LANE TEMPORARY AUTO DEALERSHIP**
**STAGE STORAGE TABULATION**
**TEMPORARY WATER QUALITY INFILTRATION BASIN NO. 1 (CELL A)**

| Water Surface Elevation | Depth Of Ponding h, feet | Surface Area As, sf | Incremental Depth feet | Incremental Storage cu ft | Total Storage Volume cu ft |
|---|---|---|---|---|---|
| 118.70 | 0.00 | 850.00 | | | 0.00 |
| | | | 0.45 | 410.00 | |
| 119.15 | 0.45 | 1,010.00 | | | 410.00 |
| | | | 0.35 | 370.00 | |
| 119.50 | 0.80 | 1,150.00 | | | 780.00 |
| | | | 0.50 | 620.00 | |
| 120.00 | 1.30 | 1,350.00 | | | 1,400.00 |
| | | | | | |

NOTES
Depth of Storage, d (feet) = Water Surface Elevation - Bottom Elevation:
Bottom Elevation:..... 118.70

**DWAYNE LANE TEMPORARY AUTO DEALERSHIP**
**STAGE DISCHARGE TABULATION**
**TEMPORARY WATER QUALITY INFILTRATION BASIN NO. 1 (CELL A)**

| Water Surface Elevation | Measured Infiltration Rate f, in\hr | Design Infiltration Rate fd, in\hr | Design Infiltration Rate fd, cfs | Depth to Water Table L, feet | Depth Of Ponding h, feet | Hydraulic Gradient i, feet | Surface Area As, sf | Basin Outflow Qout, cfs | Weir Outflow Qbw, cfs | Total Outflow Qtotal, cfs |
|---|---|---|---|---|---|---|---|---|---|---|
| 118.70 | 2.410 | 1.205 | 0.000028 | 3.00 | 0.00 | 1.00 | 850.00 | 0.024 | 0.000 | 0.024 |
| 119.15 | 2.410 | 1.205 | 0.000028 | 3.45 | 0.45 | 1.13 | 1,010.00 | 0.032 | 0.000 | 0.032 |
| 119.50 | 2.410 | 1.205 | 0.000028 | 3.80 | 0.80 | 1.21 | 1,150.00 | 0.039 | 0.000 | 0.039 |
| 120.00 | 2.410 | 1.205 | 0.000028 | 4.30 | 1.30 | 1.30 | 1,350.00 | 0.049 | 3.764 | 3.813 |
| | | | | | | | | | | |

NOTES
Infiltration Rate (DOE Manual, Table III-3.1), f (in/hr):..... 2.410
Design Infiltration Rate (50% of Tabular Rate) fd (in/hr):..... 1.205
Depth to Water Table, L = Bottom of Infiltration Basin - Water Table Elevation
Water Table Elevation:..... 115.70
Depth of Ponding, h = Water Surface Elevation - Bottom of Basin
Hydraulic Gradient, i = (h+L)/L
Basin Outflow, Qo = fd x i x As

**DWAYNE LANE TEMPORARY CAR LOT**
**STAGE STORAGE TABULATION**
**TEMPORARY WATER QUALITY INFILTRATION BAS N NO. 1 (CELL B)**

| Water Surface Elevation | Depth Of Ponding h, feet | Surface Area As, sf | Incremental Depth feet | Incremental Storage cu ft | Total Storage Volume cu ft |
|---|---|---|---|---|---|
| 118.70 | 0.00 | 1,390.00 | | | 0.00 |
| | | | 0.45 | 670.00 | |
| 119.15 | 0.45 | 1,610.00 | | | 670.00 |
| | | | 0.35 | 590.00 | |
| 119.50 | 0.80 | 1,780.00 | | | 1,260.00 |
| | | | 0.50 | 950.00 | |
| 120.00 | 1.30 | 2,040.00 | | | 2,210.00 |
| | | | | | |

NOTES
Depth of Storage, d (feet) = Water Surface Elevation - Bottom Elevation:
Bottom Elevation:..... 118.70

**DWAYNE LANE TEMPORARY CAR LOT**
**STAGE D SCHARGE TABULATION**
**TEMPORARY WATER QUALITY INFILTRATION BASIN NO. 1 (CELL B)**

| Water Surface Elevation | Measured Infiltration Rate f, in\hr | Design Infiltration Rate fd, in\hr | Design Infiltration Rate fd, cfs | Depth to Water Table L, feet | Depth Of Ponding h, feet | Hydraulic Gradient i, feet | Surface Area As, sf | Basin Outflow Qout, cfs |
|---|---|---|---|---|---|---|---|---|
| 118.70 | 8.270 | 4.135 | 0.000096 | 3.00 | 0.00 | 1.00 | 1,390.00 | 0.133 |
| 119.15 | 8.270 | 4.135 | 0.000096 | 3.45 | 0.45 | 1.13 | 1,610.00 | 0.174 |
| 119.50 | 8.270 | 4.135 | 0.000096 | 3.80 | 0.80 | 1.21 | 1,780.00 | 0.206 |
| 120.00 | 8.270 | 4.135 | 0.000096 | 4.30 | 1.30 | 1.30 | 2,040.00 | 0.254 |
| | | | | | | | | |

NOTES
Infiltration Rate (DOE Manual, Table III-3.1), f (in/hr):..... 8.270
Design Infiltration Rate (50% of Tabular Rate) fd (in/hr):..... 4.135
Depth to Water Table, L = Bottom of Infiltration Trench - Water Table Elevation
Water Table Elevation (From Geotech Report):..... 115.70
Depth of Ponding, h = Water Surface Elevation - Bottom of Trench
Hydraulic Gradient, i = (h+L)/L
Basin Outflow, Qo = fd x i x As

| DWAYNE LANE TEMPORARY AUTO DEALERSHIP<br>STAGE STORAGE TABULATION<br>TEMPORARY WATER QUALITY INFILTRATION BASIN NO. 1 (CELL C) | | | | | |
|---|---|---|---|---|---|
| Water Surface Elevation | Depth Of Ponding h, feet | Surface Area As, sf | Incremental Depth feet | Incremental Storage cu ft | Total Storage Volume cu ft |
| 118.70 | 0.00 | 980.00 | | | 0.00 |
| | | | 0.45 | 470.00 | |
| 119.15 | 0.45 | 1,150.00 | | | 470.00 |
| | | | 0.35 | 420.00 | |
| 119.50 | 0.80 | 1,300.00 | | | 890.00 |
| | | | 0.50 | 700.00 | |
| 120.00 | 1.30 | 1,510.00 | | | 1,590.00 |
| | | | | | |

NOTES

Depth of Storage, d (feet) = Water Surface Elevation - Bottom Elevation:

Bottom Elevation:..... 118.70

| DWAYNE LANE TEMPORARY AUTO DEALERSHIP<br>STAGE DISCHARGE TABULATION<br>TEMPORARY WATER QUALITY INFILTRATION BASIN NO. 1 (CELL C) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Water Surface Elevation | Measured Infiltration Rate f, in\hr | Design Infiltration Rate fd, in\hr | Design Infiltration Rate fd, cfs | Depth to Water Table L, feet | Depth Of Ponding h, feet | Hydraulic Gradient i, feet | Surface Area As, sf | Basin Outflow Qout, cfs | Weir Outflow Qbw, cfs | Total Outflow Qtotal, cfs |
| 118.70 | 2.410 | 1.205 | 0.000028 | 3.00 | 0.00 | 1.00 | 980.00 | 0.027 | 0.000 | 0.027 |
| 119.15 | 2.410 | 1.205 | 0.000028 | 3.45 | 0.45 | 1.13 | 1,150.00 | 0.036 | 0.000 | 0.036 |
| 119.50 | 2.410 | 1.205 | 0.000028 | 3.80 | 0.80 | 1.21 | 1,300.00 | 0.044 | 0.000 | 0.044 |
| 120.00 | 2.410 | 1.205 | 0.000028 | 4.30 | 1.30 | 1.30 | 1,510.00 | 0.055 | 3.764 | 3.819 |
| | | | | | | | | | | |

NOTES

Infiltration Rate (DOE Manual, Table III-3.1), f (in/hr):..... 2.410

Design Infiltration Rate (50% of Tabular Rate) fd (in/hr):..... 1.205

Depth to Water Table, L = Bottom of Infiltration Basin - Water Table Elevation

Water Table Elevation:..... 115.70

Depth of Ponding, h = Water Surface Elevation - Bottom of Basin

Hydraulic Gradient, i = (h+L)/L

Basin Outflow, Qo = fd x i x As

| DWAYNE LANE TEMPORARY AUTO DEALERSHIP<br>STAGE STORAGE TABULATION<br>TEMPORARY WATER QUALITY INFILTRATION BASIN NO. 2 - (CELL A) | | | | | |
|---|---|---|---|---|---|
| Water Surface Elevation | Depth Of Ponding h, feet | Surface Area As, sf | Incremental Depth feet | Incremental Storage cu ft | Total Storage Volume cu ft |
| 118.70 | 0.00 | 1,300.00 | | | 0.00 |
| | | | 0.45 | 630.00 | |
| 119.15 | 0.45 | 1,500.00 | | | 630.00 |
| | | | 0.35 | 550.00 | |
| 119.50 | 0.80 | 1,670.00 | | | 1,180.00 |
| | | | 0.50 | 890.00 | |
| 120.00 | 1.30 | 1,910.00 | | | 2,070.00 |
| | | | | | |

NOTES

Depth of Storage, d (feet) = Water Surface Elevation - Bottom Elevation:

Bottom Elevation:..... 118.70

| DWAYNE LANE TEMPORARY AUTO DEALERSHIP<br>STAGE DISCHARGE TABULATION<br>TEMPORARY WATER QUALITY INFILTRATION BASIN NO. 2 - (CELL A) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Water Surface Elevation | Measured Infiltration Rate f, in\hr | Design Infiltration Rate fd, in\hr | Design Infiltration Rate fd, cfs | Depth to Water Table L, feet | Depth Of Ponding h, feet | Hydraulic Gradient i, feet | Surface Area As, sf | Basin Outflow Qout, cfs | Weir Outflow Qbw, cfs | Total Outflow Qtotal, cfs |
| 118.70 | 2.410 | 1.205 | 0.000028 | 2.55 | 0.00 | 1.00 | 1,300.00 | 0.036 | 0.000 | 0.036 |
| 119.15 | 2.410 | 1.205 | 0.000028 | 3.00 | 0.45 | 1.15 | 1,500.00 | 0.048 | 0.000 | 0.048 |
| 119.50 | 2.410 | 1.205 | 0.000028 | 3.35 | 0.80 | 1.24 | 1,670.00 | 0.058 | 0.000 | 0.058 |
| 120.00 | 2.410 | 1.205 | 0.000028 | 3.85 | 1.30 | 1.34 | 1,910.00 | 0.071 | 3.764 | 3.836 |
| | | | | | | | | | | |

NOTES

Infiltration Rate (DOE Manual, Table III-3.1), f (in/hr):..... 2.410

Design Infiltration Rate (50% of Tabular Rate) fd (in/hr):..... 1.205

Depth to Water Table, L = Bottom of Infiltration Basin - Water Table Elevation

Water Table Elevation:..... 115.70

Depth of Ponding, h = Water Surface Elevation - Bottom of Basin

Hydraulic Gradient, i = (h+L)/L

Basin Outflow, Qo = fd x i x As

| DWAYNE LANE TEMPORARY CAR LOT<br>STAGE STORAGE TABULATION<br>TEMPORARY WATER QUALITY INFILTRATION BASIN NO. 2 - (CELL B) | | | | | |
|---|---|---|---|---|---|
| Water Surface Elevation | Depth Of Ponding h, feet | Surface Area As, sf | Incremental Depth feet | Incremental Storage cu ft | Total Storage Volume cu ft |
| 118.70 | 0.00 | 3,030.00 | | | 0.00 |
| | | | 0.45 | 1,430.00 | |
| 119.15 | 0.45 | 3,360.00 | | | 1,430.00 |
| | | | 0.35 | 1,220.00 | |
| 119.50 | 0.80 | 3,620.00 | | | 2,650.00 |
| | | | 0.50 | 1,900.00 | |
| 120.00 | 1.30 | 4,000.00 | | | 4,550.00 |
| | | | | | |

NOTES

Depth of Storage, d (feet) = Water Surface Elevation - Bottom Elevation:

Bottom Elevation:..... 118.70

| DWAYNE LANE TEMPORARY CAR LOT<br>STAGE DISCHARGE TABULATION<br>TEMPORARY WATER QUALITY INFILTRATION BASIN NO. 2 - (CELL B) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Water Surface Elevation | Measured Infiltration Rate f, in\hr | Design Infiltration Rate fd, in\hr | Design Infiltration Rate fd, cfs | Depth to Water Table L, feet | Depth Of Ponding h, feet | Hydraulic Gradient i, feet | Surface Area As, sf | Basin Outflow Qout, cfs |
| 118.70 | 8.270 | 4.135 | 0.000096 | 3.00 | 0.00 | 1.00 | 3,030.00 | 0.290 |
| 119.15 | 8.270 | 4.135 | 0.000096 | 3.45 | 0.45 | 1.13 | 3,360.00 | 0.364 |
| 119.50 | 8.270 | 4.135 | 0.000096 | 3.80 | 0.80 | 1.21 | 3,620.00 | 0.419 |
| 120.00 | 8.270 | 4.135 | 0.000096 | 4.30 | 1.30 | 1.30 | 4,000.00 | 0.499 |
| | | | | | | | | |

NOTES

Infiltration Rate (DOE Manual, Table III-3.1), f (in/hr):..... 8.270

Design Infiltration Rate (50% of Tabular Rate) fd (in/hr):..... 4.135

Depth to Water Table, L = Bottom of Infiltration Trench - Water Table Elevation

Water Table Elevation (From Geotech Report):..... 115.70

Depth of Ponding, h = Water Surface Elevation - Bottom of Trench

Hydraulic Gradient, i = (h+L)/L

Basin Outflow, Qo = fd x i x As

| DWAYNE LANE TEMPORARY AUTO DEALERSHIP<br>STAGE STORAGE TABULATION<br>TEMPORARY WATER QUALITY INFILTRATION BASIN NO. 2 - (CELL C) | | | | | | |
|---|---|---|---|---|---|---|
| Water Surface Elevation | Depth Of Ponding h, feet | Surface Area As, sf | Incremental Depth feet | Incremental Storage cu ft | Total Storage Volume cu ft | |
| 119.15 | 0.00 | 2,130.00 | | | 0.00 | |
| | | | 0.35 | 770.00 | | |
| 119.50 | 0.35 | 2,320.00 | | | 770.00 | |
| | | | 0.50 | 1,230.00 | | |
| 120.00 | 0.85 | 2,620.00 | | | 2,000.00 | |
| | | | | | | |

NOTES

Depth of Storage, d (feet) = Water Surface Elevation - Bottom Elevation:

Bottom Elevation:..... 119.15

| DWAYNE LANE TEMPORARY AUTO DEALERSHIP<br>STAGE DISCHARGE TABULATION<br>TEMPORARY WATER QUALITY INFILTRATION BASIN NO. 2 - (CELL C) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Water Surface Elevation | Measured Infiltration Rate f, in\hr | Design Infiltration Rate fd, in\hr | Design Infiltration Rate fd, cfs | Depth to Water Table L, feet | Depth Of Ponding h, feet | Hydraulic Gradient i, feet | Surface Area As, sf | Basin Outflow Qout, cfs | Weir Outflow Qbw, cfs | Total Outflow Qtotal, cfs |
| 119.15 | 2.410 | 1.205 | 0.000028 | 3.00 | 0.00 | 1.00 | 2,130.00 | 0.059 | 0.000 | 0.059 |
| 119.50 | 2.410 | 1.205 | 0.000028 | 3.35 | 0.35 | 1.10 | 2,320.00 | 0.071 | 0.000 | 0.071 |
| 120.00 | 2.410 | 1.205 | 0.000028 | 3.85 | 0.85 | 1.22 | 2,620.00 | 0.089 | 3.764 | 3.854 |
| | | | | | | | | | | |

NOTES

Infiltration Rate (DOE Manual, Table III-3.1), f (in/hr):..... 2.410

Design Infiltration Rate (50% of Tabular Rate) fd (in/hr):..... 1.205

Depth to Water Table, L = Bottom of Infiltration Basin - Water Table Elevation

Water Table Elevation:..... 116.15

Depth of Ponding, h = Water Surface Elevation - Bottom of Basin

Hydraulic Gradient, i = (h+L)/L

Basin Outflow, Qo = fd x i x As

| DWAYNE LANE TEMPORARY CAR LOT<br>STAGE / STORAGE TABULATION<br>TOTAL WATER QUALITY STORAGE IN TEMP INFILTRATION BASINS | | | | | |
|---|---|---|---|---|---|
| Water Surface Elevation | Basin No. 1 Cell A Storage cu. ft. | Basin No. 1 Cell C Storage cu. ft. | Basin No. 2 Cell A Storage cu. ft. | Basin No. 2 Cell C Storage cu. ft. | Total Storage cu. Ft. |
| 118.70 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | | | |
| 119.15 | 410.00 | 470.00 | 630.00 | 0.00 | 1,510.00 |
| | | | | | |
| 119.50 | 780.00 | 890.00 | 1,180.00 | 770.00 | 3,620.00 |
| | | | | | |
| 120.00 | 1,400.00 | 1,590.00 | 2,070.00 | 2,000.00 | 7,060.00 |
| | | | | | |

| DWAYNE LANE TEMPORARY CAR LOT<br>STAGE / STORAGE TABULATION<br>TOTAL WATER QUALITY DISCHARGE IN TEMP INFILTRATION BASINS | | | | | |
|---|---|---|---|---|---|
| Water Surface Elevation | Basin No. 1 Cell A Discharge cfs | Basin No. 1 Cell C Discharge cfs | Basin No. 2 Cell A Discharge cfs | Basin No. 2 Cell C Discharge cfs | Total Discharge cfs |
| 118.70 | 0.024 | 0.027 | 0.036 | 0.000 | 0.087 |
| | | | | | |
| 119.15 | 0.032 | 0.036 | 0.048 | 0.059 | 0.176 |
| | | | | | |
| 119.50 | 0.039 | 0.044 | 0.058 | 0.071 | 0.212 |
| | | | | | |
| 120.00 | 0.049 | 0.055 | 0.071 | 0.089 | 0.264 |
| | | | | | |

**DWAYNE LANE TEMPORARY CAR LOT**
**STAGE / STORAGE TABULATION**
**TOTAL STORAGE IN TEMPORARY INFILTRATION BASINS**

| Water Surface Elevation | Basin No. 1 Cell A Storage cu. ft. | Basin No. 1 Cell B Storage cu. ft. | Basin No. 1 Cell C Storage cu. ft. | Basin No. 2 Cell A Storage cu. ft. | Basin No. 2 Cell B Storage cu. ft. | Basin No. 2 Cell C Storage cu. ft. | Total Storage cu. Ft. |
|---|---|---|---|---|---|---|---|
| 118.70 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 119.15 | 410.00 | 670.00 | 470.00 | 630.00 | 1,430.00 | 0.00 | 3,610.00 |
| 119.50 | 780.00 | 1,260.00 | 890.00 | 1,180.00 | 2,650.00 | 770.00 | 7,530.00 |
| 120.00 | 1,400.00 | 2,210.00 | 1,590.00 | 2,070.00 | 4,550.00 | 2,000.00 | 13,820.00 |

**DWAYNE LANE TEMPORARY CAR LOT**
**STAGE / STORAGE TABULATION**
**TOTAL WATER QUALITY DISCHARGE IN TEMP INFILTRATION BASINS**

| Water Surface Elevation | Basin No. 1 Cell A Discharge cfs | Basin No. 1 Cell B Discharge cfs | Basin No. 2 Cell C Discharge cfs | Basin No. 2 Cell A Discharge cfs | Basin No. 2 Cell B Discharge cfs | Basin No. 2 Cell C Discharge cfs | Total Discharge cfs |
|---|---|---|---|---|---|---|---|
| 118.70 | 0.024 | 0.133 | 0.027 | 0.036 | 0.290 | 0.000 | 0.510 |
| 119.15 | 0.032 | 0.174 | 0.036 | 0.048 | 0.364 | 0.059 | 0.713 |
| 119.50 | 0.039 | 0.206 | 0.044 | 0.058 | 0.419 | 0.071 | 0.838 |
| 120.00 | 0.049 | 0.254 | 0.055 | 0.071 | 0.499 | 0.089 | 1.017 |

DRAINAGE AREA MAP

## 4.6 Maintenance Standards for Drainage Facilities

The facility-specific maintenance standards contained in this section are intended to be conditions for determining if maintenance actions are required as identified through inspection. They are not intended to be measures of the facility's required condition at all times between inspections. In other words, exceedence of these conditions at any time between inspections and/or maintenance does not automatically constitute a violation of these standards. However, based upon inspection observations, the inspection and maintenance schedules shall be adjusted to minimize the length of time that a facility is in a condition that requires a maintenance action.

### No. 1 – Detention Ponds

| Maintenance Component | Defect | Conditions When Maintenance Is Needed | Results Expected When Maintenance Is Performed |
|---|---|---|---|
| General | Trash & Debris | Any trash and debris which exceed 5 cubic feet per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size garbage can). In general, there should be no visual evidence of dumping.<br><br>If less than threshold all trash and debris will be removed as part of next scheduled maintenance. | Trash and debris cleared from site. |
| | Poisonous Vegetation and noxious weeds | Any poisonous or nuisance vegetation which may constitute a hazard to maintenance personnel or the public.<br><br>Any evidence of noxious weeds as defined by State or local regulations.<br><br>(Apply requirements of adopted IPM policies for the use of herbicides). | No danger of poisonous vegetation where maintenance personnel or the public might normally be. (Coordinate with local health department)<br><br>Complete eradication of noxious weeds may not be possible. Compliance with State or local eradication policies required |
| | Contaminants and Pollution | Any evidence of oil, gasoline, contaminants or other pollutants<br><br>(Coordinate removal/cleanup with local water quality response agency). | No contaminants or pollutants present. |
| | Rodent Holes | Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes. | Rodents destroyed and dam or berm repaired. (Coordinate with local health department; coordinate with Ecology Dam Safety Office if pond exceeds 10 acre-feet.) |

## No. 1 – Detention Ponds

| Maintenance Component | Defect | Conditions When Maintenance Is Needed | Results Expected When Maintenance Is Performed |
|---|---|---|---|
| | Beaver Dams | Dam results in change or function of the facility. | Facility is returned to design function.<br>(Coordinate trapping of beavers and removal of dams with appropriate permitting agencies) |
| | Insects | When insects such as wasps and hornets interfere with maintenance activities. | Insects destroyed or removed from site.<br>Apply insecticides in compliance with adopted IPM policies |
| | Tree Growth and Hazard Trees | 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 or maintenance, do not remove<br>If dead, diseased, or dying trees are identified<br>(Use a certified Arborist to determine health of tree or removal requirements) | Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (e.g., alders for firewood).<br>Remove hazard Trees |
| Side Slopes of Pond | Erosion | Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion.<br>Any erosion observed on a compacted berm embankment. | Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.<br>If erosion is occurring on compacted berms a licensed civil engineer should be consulted to resolve source of erosion. |
| Storage Area | Sediment | Accumulated sediment that exceeds 10% of the designed pond depth unless otherwise specified or affects inletting or outletting condition of the facility. | Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion. |
| | Liner (If Applicable) | Liner is visible and has more than three 1/4-inch holes in it. | Liner repaired or replaced. Liner is fully covered. |

## No. 1 – Detention Ponds

| Maintenance Component | Defect | Conditions When Maintenance Is Needed | Results Expected When Maintenance Is Performed |
|---|---|---|---|
| Pond Berms (Dikes) | Settlements | Any part of berm which has settled 4 inches lower than the design elevation.<br>If settlement is apparent, measure berm to determine amount of settlement.<br>Settling can be an indication of more severe problems with the berm or outlet works. A licensed civil engineer should be consulted to determine the source of the settlement. | Dike is built back to the design elevation. |
| | Piping | Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue.<br>(Recommend a Goethechnical engineer be called in to inspect and evaluate condition and recommend repair of condition. | Piping eliminated. Erosion potential resolved. |
| Emergency Overflow/ Spillway and Berms over 4 feet in height. | Tree Growth | Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping.<br>Tree growth on berms over 4 feet in height may lead to piping through the berm which could lead to failure of the berm. | Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A licensed civil engineer should be consulted for proper berm/spillway restoration. |
| | Piping | Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue.<br>(Recommend a Goethechnical engineer be called in to inspect and evaluate condition and recommend repair of condition. | Piping eliminated. Erosion potential resolved. |
| Emergency Overflow/ Spillway | Emergency Overflow/ Spillway | Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of out flow path of spillway.<br>(Rip-rap on inside slopes need not be replaced.) | Rocks and pad depth are restored to design standards. |
| | Erosion | See "Side Slopes of Pond" | |

## No. 2 – Infiltration

| Maintenance Component | Defect | Conditions When Maintenance Is Needed | Results Expected When Maintenance Is Performed |
|---|---|---|---|
| General | Trash & Debris | See "Detention Ponds" (No. 1). | See "Detention Ponds" (No. 1). |
| | Poisonous/Noxious Vegetation | See "Detention Ponds" (No. 1). | See "Detention Ponds" (No. 1). |
| | Contaminants and Pollution | See "Detention Ponds" (No. 1). | See "Detention Ponds" (No. 1). |
| | Rodent Holes | See "Detention Ponds" (No. 1). | See "Detention Ponds" (No. 1) |
| Storage Area | Sediment | Water ponding in infiltration pond after rainfall ceases and appropriate time allowed for infiltration.<br>(A percolation test pit or test of facility indicates facility is only working at 90% of its designed capabilities. If two inches or more sediment is present, remove). | Sediment is removed and/or facility is cleaned so that infiltration system works according to design. |
| Filter Bags (if applicable) | Filled with Sediment and Debris | Sediment and debris fill bag more than 1/2 full. | Filter bag is replaced or system is redesigned. |
| Rock Filters | Sediment and Debris | By visual inspection, little or no water flows through filter during heavy rain storms. | Gravel in rock filter is replaced. |
| Side Slopes of Pond | Erosion | See "Detention Ponds" (No. 1) | See "Detention Ponds" (No. 1). |
| Emergency Overflow Spillway and Berms over 4 feet in height. | Tree Growth | See "Detention Ponds" (No. 1). | See "Detention Ponds" (No. 1). |
| | Piping | See "Detention Ponds" (No. 1). | See "Detention Ponds" (No. 1). |
| Emergency Overflow Spillway | Rock Missing | See "Detention Ponds" (No. 1). | See "Detention Ponds" (No. 1). |
| | Erosion | See "Detention Ponds" (No. 1). | See "Detention Ponds" (No. 1). |
| Pre-settling Ponds and Vaults | Facility or sump filled with Sediment and/or debris | 6" or designed sediment trap depth of sediment. | Sediment is removed. |

## No. 3 – Closed Detention Systems (Tanks/Vaults)

| Maintenance Component | Defect | Conditions When Maintenance is Needed | Results Expected When Maintenance is Performed |
|---|---|---|---|
| Storage Area | Plugged Air Vents | One-half of the cross section of a vent is blocked at any point or the vent is damaged. | Vents open and functioning. |
| | Debris and Sediment | Accumulated sediment depth exceeds 10% of the diameter of the storage area for 1/2 length of storage vault or any point depth exceeds 15% of diameter.<br>(Example: 72-inch storage tank would require cleaning when sediment reaches depth of 7 inches for more than 1/2 length of tank.) | All sediment and debris removed from storage area. |
| | Joints Between Tank/Pipe Section | Any openings or voids allowing material to be transported into facility.<br>(Will require engineering analysis to determine structural stability). | All joint between tank/pipe sections are sealed. |
| | Tank Pipe Bent Out of Shape | Any part of tank/pipe is bent out of shape more than 10% of its design shape. (Review required by engineer to determine structural stability). | Tank/pipe repaired or replaced to design. |
| | Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab | Cracks wider than 1/2-inch and any evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound.<br>Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls. | Vault replaced or repaired to design specifications and is structurally sound.<br>No cracks more than 1/4-inch wide at the joint of the inlet/outlet pipe. |
| Manhole | Cover Not in Place | Cover is missing or only partially in place. Any open manhole requires maintenance. | Manhole is closed. |
| | Locking Mechanism Not Working | Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread (may not apply to self-locking lids). | Mechanism opens with proper tools. |
| | Cover Difficult to Remove | One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance. | Cover can be removed and reinstalled by one maintenance person. |
| | Ladder Rungs Unsafe | Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks. | Ladder meets design standards. Allows maintenance person safe access. |
| Catch Basins | See "Catch Basins" (No. 5) | See "Catch Basins" (No. 5). | See "Catch Basins" (No. 5). |

## No. 4 – Control Structure/Flow Restrictor

| Maintenance Component | Defect | Condition When Maintenance is Needed | Results Expected When Maintenance is Performed |
|---|---|---|---|
| General | Trash and Debris (Includes Sediment) | Material exceeds 25% of sump depth or 1 foot below orifice plate. | Control structure orifice is not blocked. All trash and debris removed. |
| | Structural Damage | Structure is not securely attached to manhole wall. | Structure securely attached to wall and outlet pipe. |
| | | Structure is not in upright position (allow up to 10% from plumb). | Structure in correct position. |
| | | Connections to outlet pipe are not watertight and show signs of rust. | Connections to outlet pipe are water tight; structure repaired or replaced and works as designed. |
| | | Any holes--other than designed holes–in the structure. | Structure has no holes other than designed holes. |
| Cleanout Gate | Damaged or Missing | Cleanout gate is not watertight or is missing. | Gate is watertight and works as designed. |
| | | Gate cannot be moved up and down by one maintenance person. | Gate moves up and down easily and is watertight. |
| | | Chain/rod leading to gate is missing or damaged. | Chain is in place and works as designed. |
| | | Gate is rusted over 50% of its surface area. | Gate is repaired or replaced to meet design standards. |
| Orifice Plate | Damaged or Missing | Control device is not working properly due to missing, out of place, or bent orifice plate. | Plate is in place and works as designed. |
| | Obstructions | Any trash, debris, sediment, or vegetation blocking the plate. | Plate is free of all obstructions and works as designed. |
| Overflow Pipe | Obstructions | Any trash or debris blocking (or having the potential of blocking) the overflow pipe. | Pipe is free of all obstructions and works as designed. |
| Manhole | See "Closed Detention Systems" (No. 3). | See "Closed Detention Systems" (No. 3). | See "Closed Detention Systems" (No. 3). |
| Catch Basin | See "Catch Basins" (No. 5). | See "Catch Basins" (No. 5). | See "Catch Basins" (No. 5). |

## No. 5 – Catch Basins

| Maintenance Component | Defect | Conditions When Maintenance is Needed | Results Expected When Maintenance is performed |
|---|---|---|---|
| General | Trash & Debris | Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%. | No Trash or debris located immediately in front of catch basin or on grate opening. |
| | | Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe. | No trash or debris in the catch basin. |
| | | Trash or debris in any inlet or outlet pipe blocking more than 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 (e.g., methane). | No dead animals or vegetation present within the catch basin. |
| | Sediment | Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe. | No sediment in the catch basin |
| | Structure Damage to Frame and/or Top Slab | Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch<br>(Intent is to make sure no material is running into basin). | Top slab is free of holes and cracks. |
| | | Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached | Frame is sitting flush on the riser rings or top slab and firmly attached. |
| | Fractures or Cracks in Basin Walls/ Bottom | Maintenance person judges that structure is unsound. | Basin replaced or repaired to design standards. |
| | | Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks. | Pipe is regrouted and secure at basin wall. |
| | Settlement/ Misalignment | If failure of basin has created a safety, function, or design problem. | Basin replaced or repaired to design standards. |
| | Vegetation | Vegetation growing across and 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 six inches tall and less than six inches apart. | No vegetation or root growth present. |

## No. 5 – Catch Basins

| Maintenance Component | Defect | Conditions When Maintenance is Needed | Results Expected When Maintenance is performed |
|---|---|---|---|
| | Contamination and Pollution | See "Detention Ponds" (No. 1). | No pollution present. |
| 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 one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread. | Mechanism opens with proper tools. |
| | Cover Difficult to Remove | One maintenance person cannot remove lid after applying normal lifting pressure.<br>(Intent is keep cover from sealing off access to maintenance.) | Cover can be removed by one maintenance person. |
| Ladder | Ladder Rungs Unsafe | Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges. | Ladder meets design standards and allows maintenance person safe access. |
| Metal Grates (If Applicable) | Grate opening Unsafe | Grate with opening wider than 7/8 inch. | Grate opening meets design standards. |
| | Trash and Debris | Trash and debris that is blocking more than 20% of grate surface inletting capacity. | Grate free of trash and debris. |
| | Damaged or Missing. | Grate missing or broken member(s) of the grate. | Grate is in place and meets design standards. |

## No. 6 – Debris Barriers (e.g., Trash Racks)

| Maintenance Components | Defect | Condition When Maintenance is Needed | Results Expected When Maintenance is Performed |
|---|---|---|---|
| General | Trash and Debris | Trash or debris that is plugging more than 20% of the openings in the barrier. | Barrier cleared to design flow capacity. |
| Metal | Damaged/ Missing Bars. | Bars are bent out of shape more than 3 inches. | Bars in place with no bends more than 3/4 inch. |
| | | Bars are missing or entire barrier missing. | Bars in place according to design. |
| | | Bars are loose and rust is causing 50% deterioration to any part of barrier. | Barrier replaced or repaired to design standards. |
| | Inlet/Outlet Pipe | Debris barrier missing or not attached to pipe | Barrier firmly attached to pipe |

## No. 11 – Wetponds

| Maintenance Component | Defect | Condition When Maintenance is Needed | Results Expected When Maintenance is Performed |
|---|---|---|---|
| General | Water level | First cell is empty, doesn't hold water. | Line the first cell to maintain at least 4 feet of water. Although the second cell may drain, the first cell must remain full to control turbulence of the incoming flow and reduce sediment resuspension. |
| | Trash and Debris | Accumulation that exceeds 1 CF per 1000-SF of pond area. | Trash and debris removed from pond. |
| | Inlet/Outlet Pipe | Inlet/Outlet pipe clogged with sediment and/or debris material. | No clogging or blockage in the inlet and outlet piping. |
| | Sediment Accumulation in Pond Bottom | Sediment accumulations in pond bottom that exceeds the depth of sediment zone plus 6-inches, usually in the first cell. | Sediment removed from pond bottom. |
| | Oil Sheen on Water | Prevalent and visible oil sheen. | Oil removed from water using oil-absorbent pads or vactor truck. Source of oil located and corrected. If chronic low levels of oil persist, plant wetland plants such as Juncus effusus (soft rush) which can uptake small concentrations of oil. |
| | Erosion | Erosion of the pond's side slopes and/or scouring of the pond bottom, that exceeds 6-inches, or where continued erosion is prevalent. | Slopes stabilized using proper erosion control measures and repair methods. |
| | Settlement of Pond Dike/Berm | Any part of these components that has settled 4-inches or lower than the design elevation, or inspector determines dike/berm is unsound. | Dike/berm is repaired to specifications. |
| | Internal Berm | Berm dividing cells should be level | Berm surface is leveled so that water flows evenly over entire length of berm. |
| | Overflow Spillway | Rock is missing and soil is exposed at top of spillway or outside slope. | Rocks replaced to specifications. |

# GEOTECHNICAL REPORT

**Western Geotechnical Consultants, Inc.**

*4181 Saltsprings Drive • Ferndale, WA 98248*
*Phone (360) 380-2507 • Fax (360) 380-2507*

May 7, 2001

Mr. Wallace Turner
1315 Wall Street
Everett, WA 98201

**Re: Fill & Compaction Requirements**
**Wallace Turner Property**
**Tax Parcel #2931 051 014 0007**
**West Side of Smokey Point Blvd.**
**Sec 29, T31N, RE5E, WM**
**Snohomish County, Washington**

This letter provides guidance and recommendations for fill material to be placed at the above referenced property. We understand that the site grade will be raised on the order of 2 to 3 feet for site development using structural fill. We make the following recommendations for site preparation and fill placement and compaction.

Site Preparation

All topsoil, organic rich soil, or other deleterious material must be striped and removed from those areas to receive structural fill. Based on our test pit excavations, which were documented in our February 4, 2000 report, the stripping depth should be on the order of about 1/2 foot. Note however, that there could be deeper areas of unsuitable soils which if encountered would need to be removed, and replaced with structural fill. Following stripping and site excavation, the exposed sub-grade should be inspected by qualified personnel to insure that the excavation is down to firm bearing soil.

Structural Fill and Compaction

Structural fill is defined as any non-organic fill material used to support structural improvements such as roads, buildings, parking lots, driveways, etc. As the quality of structural fill increases the cost of placement and compaction is decreased. Typically materials that are free draining with little or no fines can be readily compacted at minimal placement cost since moisture control is not a problem. As the percent of silt and clay material increases the material becomes increasingly moisture sensitive, and often it becomes more expensive to place and compact such materials since more compaction is necessary to achieve minimal compaction. Table 1 provides soil types as classified by the Unified Soils Classification System (USCS) from most expensive but least expensive to compact down to least expensive material that is typically most expensive to place and compact.

# Table 1
## Types of Structural Fill[1]

| Soil Type from most expensive to least expensive | Placement and compaction costs from least expensive to most expensive |
|---|---|
| GW SW<br>SP GP | GW SW<br>SP GP[2] |
| GM | GM |
| SM | SM |
| ML | ML |
| CL | CL |

All structural fill should be placed and compacted on a horizontal sub-grade surface. Structural fill should extend beyond the edges of any structural improvements a distance equal to the thickness of the fill beneath the structural improvement. All structural fill should be placed in maximum 8 to 10 inch loose horizontal lifts and be thoroughly compacted. We recommend that structural fill be compacted to a minimum of 95 % of maximum dry density as determined by ASTM D-1557 test procedure. We recommend that all structural fill be tested by a certified testing firm to certify that the site is underlain by structural fill.

We appreciate the opportunity to be of assistance to you on this project. If you have any questions regarding the contents of this report or if we can be of further assistance, please contact our office.

Sincerely,

**Western Geotechnical Consultants, Inc.**

Theodore A. Hammer, P.E.
Geotechnical Engineer

File:01691

[1] Soil classified by the USCS
[2] SP & GP soils can be susceptible to rutting during placement. Particle angularity becomes a significant factor.
Note that crushed or angular coarse-grained soils are more expensive but provide a stronger base.

**Western Geotechnical Consultants, Inc.**

*4181 Saltsprings Drive • Ferndale, WA 98248*
*Phone (360) 380-2507 • Fax (360) 380-2507*

| Post-it® Fax Note 7671 | Date 12/11/00 | # of pages ▶ 3 |
|---|---|---|
| To Bryant | From Ted Hammer | |
| Co./Dept. | Co. | |
| Phone # | Phone # | |
| Fax # | Fax # | |

March 14, 2000

Mr. Wallace Turner
1315 Wall Street
Everett, WA 98201

**Re: Supplemental Letter Report**
**Seasonal High Water Table Determination**
**Wallace Turner Property**
**Tax Parcel #2931 051 014 0007**
**West Side of Smokey Point Blvd.**
**Sec 29, T31N, RE5E, WM**
**Snohomish County, Washington**

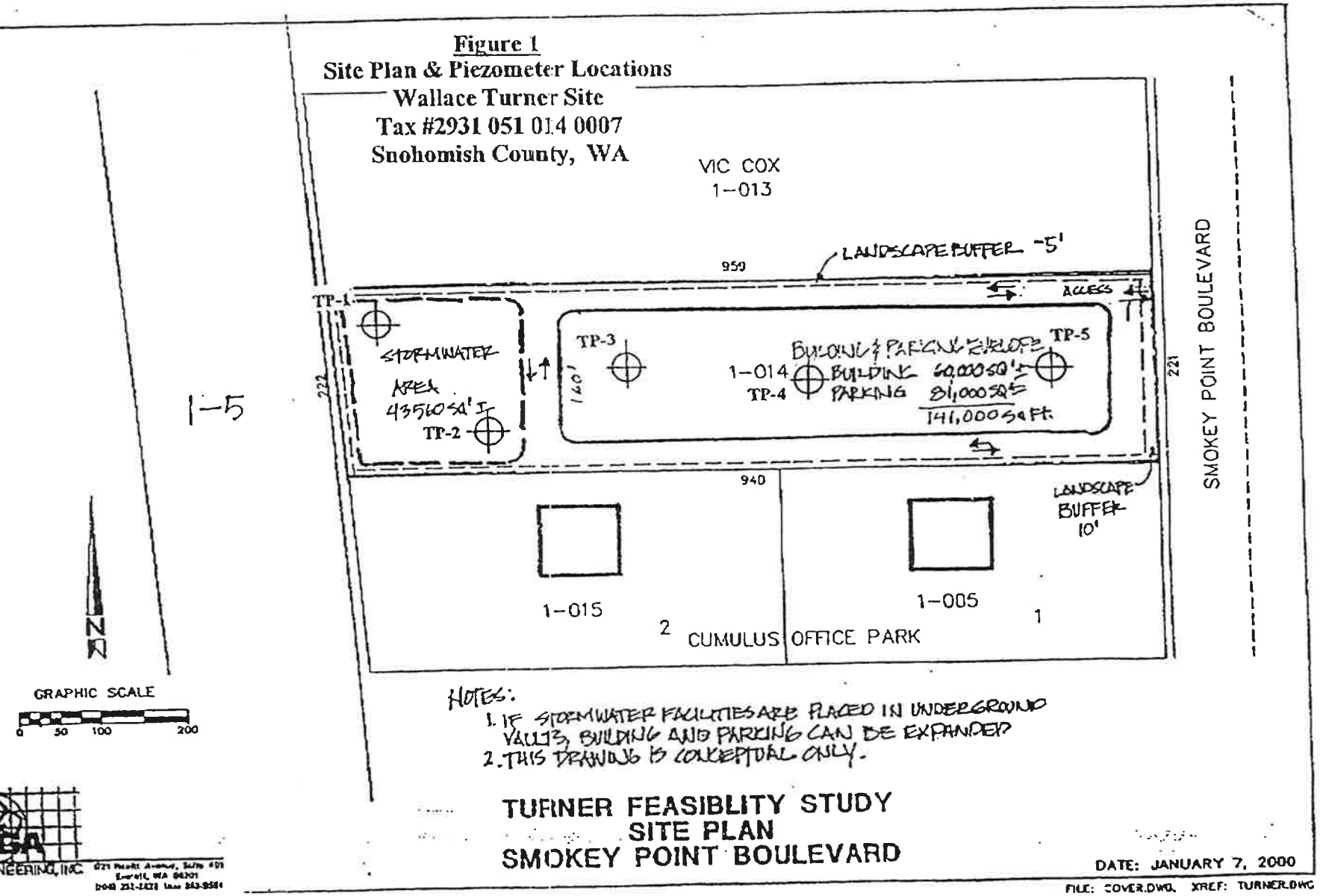
This report provides supporting data for the determination of the seasonal high water table to supplement our geotechnical investigation report dated February 28, 2000.

We performed a Geotechnical feasibility study at the subject site on January 24, 2000. The investigation included excavation of 5 test pits across the site and we installed piezometers in each of the test pits at that time. We have monitored water levels on three occasions since that time (1/24/00, 1/31/00, and 2/12/00). Figure 1 is a site plan sketch showing the approximate piezometer locations. Based on our piezometer readings, it is our opinion that we have determined the seasonal high ground water table for the site.

The seasonal high water levels are tabulated below.

| Piezometer # | Distance to water table below ground surface (feet) |
|---|---|
| TP-1 | 1.8 |
| TP-2 | 3.1 |
| TP-3 | 1.5 |
| TP-4 | 2.1 |
| TP-5 | 2.5 |

**Figure 1**
**Site Plan & Piezometer Locations**
**Wallace Turner Site**
**Tax #2931 051 014 0007**
**Snohomish County, WA**




NOTES:
1. IF STORMWATER FACILITIES ARE PLACED IN UNDERGROUND VAULTS, BUILDING AND PARKING CAN BE EXPANDED
2. THIS DRAWING IS CONCEPTUAL ONLY.

**TURNER FEASIBLITY STUDY**
**SITE PLAN**
**SMOKEY POINT BOULEVARD**

DATE: JANUARY 7, 2000

FILE: COVER.DWG XREF: TURNER.DWG

RIDA ENGINEERING, INC.
2121 Hewitt Avenue, Suite 101
Everett, WA 98201
(425) 252-2323 Fax 343-9561

**Western Geotechnical Consultants, Inc.**

*4181 Saltsprings Drive • Ferndale, WA 98248*
*Phone (360) 380-2507 • Fax (360) 380-2507*

February 4, 2000

Mr. Wallace Turner
1315 Wall Street
Everett, WA 98201

**Re: Geotechnical Feasibility Study**
**Wallace Turner Property**
**Tax Parcel #2931 051 014 0007**
**West Side of Smokey Point Blvd.**
**Sec29, T31N, RE5E, WM**
**Snohomish County, Washington**

Western Geotechnical Consultants, Inc. is pleased to present the results of our subsurface site investigation conducted at the above referenced property. On January 24, 2000 a geotechnical engineer and a geologist from our firm traveled to the site to oversee the excavation of 5 test pits across the property. The project plan involves site development for an approximately 60,000 square foot building and associated parking and an approximately one-acre stormwater detention facility. It is possible that stormwater facilities will be placed in underground vaults in which case building and parking facilities could be expanded. The property encompasses approximately 4.8 acres and is located south of 169$^{th}$ Place NE between Smokey Point Boulevard and Interstate 5. Figure 1 is a site plan showing the general property layout together with the approximate test pit locations.

The purpose of our investigation was to obtain subsurface soil and groundwater information for use in evaluating the feasibility of constructing detention facilities on the site and to obtain information for general site development. Specifically the scope of our services included:

- Excavating 5 test pits across the site to obtain subsurface information for use in general site development. Specifically we excavated 2 test pits at the storm water detention location and 3 additional test pits across the remainder of the site to obtain general geotechnical information. Piezometers were installed in the test pits for future water level reading so as to define the seasonal high water table.
- Developing continuous logs of subsurface soil and groundwater conditions encountered. Soils encountered were classified in accordance with the Unified Soils Classification System (USCS).

- Performing engineering analyses and laboratory testing as deemed necessary in developing our conclusions and recommendations.
- Preparation of this report including a summary of work performed and our conclusions and recommendations regarding detention pond design parameters and general geotechnical issues associated with development of the site.

## GENERAL GEOLOGY

Northwestern Washington has been occupied by continental glaciers at least four times during the Pleistocene Epoch (1.6 million to 10,000 years ago). During these glacial and accompanying interglacial periods, the underlying bedrock was eroded and a relatively thick layer of glacial and interglacial fluvial sediments were deposited over the underlying bedrock in the vicinity of the subject property.

The Surficial Geologic Map of the Port Townsend 30- by 60-Minute Quadrangle, Puget Sound Region, Washington (Pessl, Dethier, Booth and Minard, 1989) indicate the subject property is underlain recessional marine deposits. The recessional marine deposits are described as consisting of medium- to well-sorted, massive to laminated sand, silt, and clay deposited shortly after the glacial ice retreated at a time when relative sea-level was higher than at present. The deposits are mapped as consisting primarily of sand in the vicinity of the subject property and this is interpreted as having been deposited in an estuarine environment. Our test pit observations are consistent with the above described soil profile.

## SITE CONDITIONS

### Surface Conditions

The subject property is approximately 5 acres in size and it is very nearly flat. Except for a few areas of brush and small trees near an old home site, the property is predominantly grass-covered.

### Subsurface Conditions

Subsurface conditions at the site were evaluated by excavating a total of 5 test pits on January 24, 2000 with a CAT 416 rubber tire backhoe using a 3-foot-wide bucket. The approximate locations of the test pits are shown on the attached Site Plan, Figure 1. The test pits were roughly located in the field by pacing and by using a cloth tape to measure from the property boundaries on the site. Piezometers were installed in all of the test pits and the test pits were loosely backfilled upon completion of the explorations.

# Log of Test Pits

| | | | Table A-1<br>Log of Test Pits | | File:<br>Turner | |
|---|---|---|---|---|---|---|
| Test Pit No. | Depth Interval (feet) | USCS Class. | Soil Description | Sample No./ Depth (feet) | Water Content (%) | Pocket Pen. (Kg/sq. cm) |
| 1 | 0.0-0.5 | OL | Dark brown organic-rich sandy SILT (moist, soft) (topsoil) | | | |
| | 0.5-5.5 | SP | Brown to gray fine to medium SAND with trace gravel (relatively non-compact, moist grading wet)<br>(saturated at 3.5 feet)<br>(Caving at ground water depth) | 1-1/3.5 | 29.7% | |

Notes:

- Test Pit terminated on 1/24/00 at 5.5 feet
- Test Pit backfilled upon completion
- Ground water encountered at 3.5 feet
- Piezometer installed to 5 feet

| | | | Table A-1<br>Log of Test Pits | | File:<br>Turner | |
|---|---|---|---|---|---|---|
| Test Pit No. | Depth Interval (feet) | USCS Class. | Soil Description | Sample No./ Depth (feet) | Water Content (%) | Pocket Pen. (Kg/sq. cm) |
| 2 | 0.0-0.5 | OL | Dark brown organic-rich sandy SILT (moist, soft) (topsoil) | | | |
| | 0.5-8.0 | SP | Gray fine to medium SAND with trace gravel (relatively non-compact, moist grading wet)<br>(Saturated at 5.5 feet)<br>(Caving at ground water depth) | 2-1/4.0 | 22.1% | |

Notes:

- Test Pit terminated on 1/24/00 at 8.0 feet
- Test Pit backfilled upon completion
- Ground water encountered at 5.5 feet
- Piezometer installed to 6 feet

| | | | Table A-1<br>Log of Test Pits | | File:<br>Turner | |
|---|---|---|---|---|---|---|
| Test Pit No. | Depth Interval (feet) | USCS Class. | Soil Description | Sample No./ Depth (feet) | Water Content (%) | Pocket Pen. (Kg/sq. cm) |
| 3 | 0.0-0.5 | OL | Dark brown organic-rich sandy SILT (moist, soft) (topsoil) | | | |
| | 0.5-5.0 | SP | Gray fine to medium SAND with silt (relatively non-compact, moist grading wet)<br>(Saturated at 2.5 feet)<br>(Caving at ground water depth) | 3-1/3.0 | 27.5% | |

Notes:

- Test Pit terminated on 1/24/00 at 5.0 feet
- Test Pit backfilled upon completion
- Ground water encountered at 2.5 feet
- Piezometer installed to 5 feet

| | | | Table A-1<br>Log of Test Pits | | File:<br>Turner | |
|---|---|---|---|---|---|---|
| Test Pit No. | Depth Interval (feet) | USCS Class. | Soil Description | Sample No./ Depth (feet) | Water Content (%) | Pocket Pen. (Kg/sq. cm) |
| 4 | 0.0-0.5 | OL | Dark brown organic-rich sandy SILT (moist, soft) (topsoil) | | | |
| | 0.5-5.0 | SP/SM | Gray silty fine to medium SAND with trace gravel (relatively non-compact, moist grading wet)<br>(Saturated at 3.5 feet)<br>(Caving at ground water depth) | 4-1/4.0 | 38.6% | |

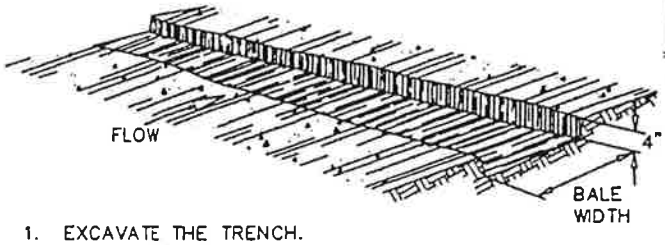
Notes:

- Test Pit terminated on 1/24/00 at 5.0 feet
- Test Pit backfilled upon completion
- Ground water encountered at 3.5 feet
- Piezometer installed to 5 feet

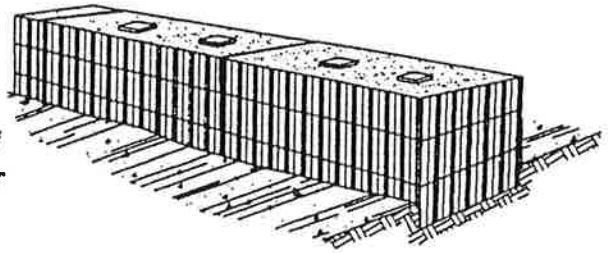
| | | | **Table A-1**<br>**Log of Test Pits** | | File:<br>Turner | |
|---|---|---|---|---|---|---|
| Test Pit No. | Depth Interval (feet) | USCS Class. | Soil Description | Sample No./ Depth (feet) | Water Content (%) | Pocket Pen. (Kg/sq. cm) |
| 5 | 0.0-0.5 | OL | Dark brown organic-rich sandy SILT (moist, soft) (topsoil) | | | |
| | 0.5-7.0 | SP | Gray fine to medium SAND with trace gravel (relatively non-compact, moist grading wet)<br>(Saturated at 4.0 feet)<br>(Caving at ground water depth) | 5-1/4.0 | 25.5% | |

Notes:

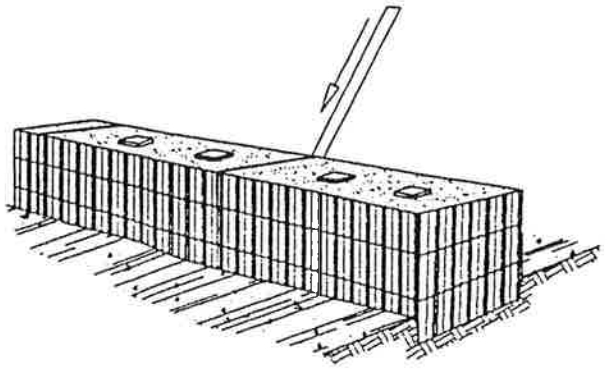
- Test Pit terminated on 1/24/00 at 7.0 feet
- Test Pit backfilled upon completion
- Ground water encountered at 4.0 feet
- Piezometer installed to 7 feet



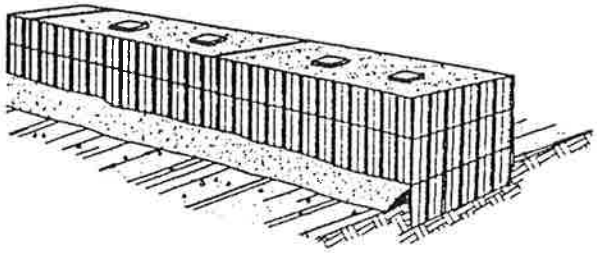

1. EXCAVATE THE TRENCH.



2. PLACE AND STAKE STRAW BALES.



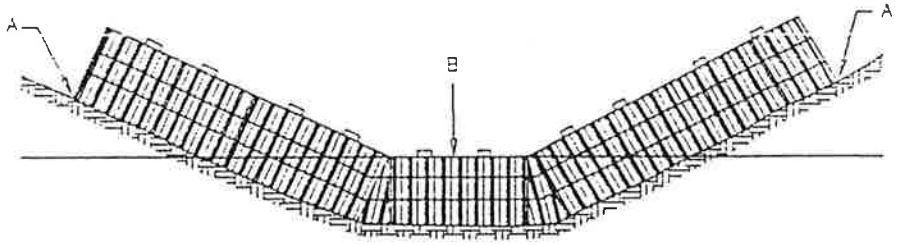
3. WEDGE LOOSE STRAW BETWEEN BALES.



4. BACKFILL AND COMPACT THE EXCAVATED SOIL.

## CONSTRUCTION OF A STRAW BALE BARRIER

NOT DRAWN TO SCALE




POINTS A SHOULD BE HIGHER THAN POINT B

## PROPER PLACEMENT OF STRAW BALE BARRIER IN DRAINAGE WAY

NOT DRAWN TO SCALE

| | | |
|---|---|---|
| JOB NO.: | **Western Geotechnical Consultants, Inc.** | SEDIMENT CONTROL<br>STRAW BALE BARRIER |
| DESIGNED BY: | | |
| DRAWN BY: | *4181 Saltsprings Drive • Ferndale, WA 98248* | |
| CHECKED BY: | *Phone (360) 380-2507 • Fax (360) 380-2507* | DATE: SCALE: H: N/A V: N/A |

The soils encountered in the test pits were classified using the Unified Soils Classification System (USCS) and a log was maintained for each test pit. Edited, tabulated test pit logs are included in this report along with a USCS Chart explaining soil descriptions.

Dark brown to black organic-rich sandy SILT topsoil (OL by USCS classification) in a moist and soft condition was encountered in all the test pits from the surface to a depth of approximately 0.5 feet.

Mottled brown to gray SAND with trace silt and gravel (SP by USCS classification) was encountered in all test pits below the topsoil layer. This soil unit was moist to saturated and it was in a relatively non-compact state.

### Ground Water Conditions

Ground water was encountered in all the test pits at a depth ranging from 2.5 to 5.5 feet. At the proposed storm water detention facility, the water table was measured at 3.5 to 5.5 feet below the surface at the time of the investigation. Piezometers were installed in each of the test pits for future monitoring of ground water levels. Water levels will be measured later this winter to establish the seasonal high ground water level.

## Conclusions and Recommendations

### General

Based on our geotechnical engineering investigation, we conclude that the site will likely be suitable for development of the type proposed, provided our recommendations are followed and provided good construction practices are followed. The area contains a high groundwater table, which is problematic for storm water detention facilities. Stormwater detention is planned for the west side of the property adjacent to Interstate 5 (Figure 1), and the proposed building and parking will utilize the remainder of the site. We understand that if a stormwater vault is utilized at the site due to high seasonal ground water, additional space will be available on the site, which can be utilized to expand buildings and parking. The following sections provide recommended soil and groundwater parameters for stormwater detention and general site development.

Stormwater Detention

The subject property is relatively flat and it covers approximately 4.8 acres. The proposed stormwater detention location occupies the westernmost one acres of the site. We excavated a total of 2 test pits within the proposed storm water detention area along with 3 additional test pits across the remainder of the site. Piezometers were installed in all of the test pits for future monitoring of groundwater. The groundwater table within the proposed stormwater detention area (Figure 1) at the time of our investigation (January 24, 2000) was logged at 3.5 to 5.5 feet below grade. Subsequent piezometer readings (January 31, 2000) revealed that the stabilized water table in the proposed storm water location (west side) varies between 2.2 and 3.5. These water table measurements are very high and it may be necessary to design an underground vault system to control stormwater runoff.

Piezometers were also installed in the remaining test pits and they revealed a relatively high water table ranging between 2.5 feet and 4.0 feet at the time of the investigation. Subsequent readings of the piezometers on January 31, 2000 revealed a stabilized static water table ranging between 1.5 and 2.6 feet. The piezometers will be read again during the rainy season and they are intended to demonstrate the seasonal high water level.

It is our opinion that the stabilized readings taken on January 31, 2000 are at or near the seasonal high water level (2.2 feet minimum). Based on these initial water level readings, it may be necessary to design a detention vault system. We will read the piezometer once again this winter (in February) to more accurately define the seasonal high water table, which will be documented under a separate report. Once the seasonal high water level has been established the detention facilities can be final designed by Higa Engineering, Inc.

General Site Development

The site contains a relatively high groundwater table. The seasonal high groundwater level is yet to be determined but is expected to be close to 1-1/2 to 2-1/2 feet below grade in building and parking areas (piezometer readings taken January 31, 2000). We make the following general site development recommendations in addition to our stormwater detention design information.

Site Preparation

All topsoil or other organic or soft material must be striped away from areas to be occupied by building foundations, paved areas, or other structural improvements. Based on our test pit explorations, we estimate that the stripping depth should be about ½ foot. Note that there could be isolated areas with deeper pockets of organic material (root balls, etc.), old building foundations, or soft soils beneath structures that we did not encounter in our limited test pit investigation.

Fill and Compaction

We have assumed that some structural fill may be required beneath structures and/or paved areas. Structural fill may be required to obtain proper elevation for the design of storm water detention facilities or to promote positive surface drainage away from structures. Structural fill used to obtain final grade elevations for footings and other structural improvements (pavements, floor slabs, etc.), must be properly placed and compacted.

Structural fill is defined as any non-organic, predominantly granular soil that is placed in maximum 8- to 10- inch loose, horizontal lifts and compacted to 95% of maximum dry density as determined by the ASTM D-1557 test procedure. The on-site native non-organic sandy soils could be used as structural fill provided the moisture content can be properly controlled and adequate compaction can be achieved.

Foundation

The on site soils will support moderately light structures using conventional shallow spread footings. Typical 1 to 2 story structures without heavy column loads would be considered moderately light structures. Due to the limited depth and coverage of our test pits, an evaluation of foundations for heavily loaded structures was beyond the scope of this study. Test pit coverage was not extensive since the site layout is still in the preliminary planning stages. Once plan specifications are known, it may be necessary to excavate additional test pits at known building locations or drill borings if heavy foundation loads will be part of the design. For conventional structures, conventional shallow spread foundations proportioned in accordance with the Uniform building code (UBC) will perform satisfactorily.

Drainage

We recommend that an exterior footing drain system be constructed around the perimeter of all building foundations. The footing drain system is typically constructed with a perforated or slotted pipe placed in clean, free-draining gravel with less than 3% by weight passing the U.S. No. 200 sieve size, based on a wet sieve analysis of that portion passing the U.S. No. 4 Sieve. The perforated or slotted pipe should be placed at or below the level of the base of the footings and 1/2 foot outside the footings. Based on the sandy native soils present on the site, we recommend surrounding the footing drain system with a separation geotextile (Mirafi 4NP or equivalent). If fine grained soils are encountered at foundation level (silts or clays) we recommend against the use of a separation geotextile.

The footing drains should discharge to the storm drainage system. Roof drainage must not be introduced into the perimeter footing drain, but should be discharged separately to the storm drainage system by tightline. The final ground surface should be graded away from the building to promote surface runoff away from the footing drain system.

Erosion Control

Erosion control during construction of the proposed facilities can be accomplished through placement of proper sedimentation control facilities. We recommend siltation control facilities, consisting of either hay bales or silt fences that are fabricated around the construction areas. Typical details for siltation control facilities using either hay bales or silt fences are attached to this report.

Siltation devices should be placed down gradient of all construction areas and cleared areas to provide siltation control during construction. All siltation control devices should be maintained in operable condition during construction, and left in operable condition until the site has been revegetated and siltation is no longer a threat. At that time the siltation facilities should be remove.

We appreciate the opportunity to be of assistance to you on this project. If you have any questions regarding the contents of this report, or if we can be of further assistance, please contact our office.

Sincerely,

**Western Geotechnical Consultants, Inc.**

Theodore A. Hammer, P.E.
Geotechnical Engineer

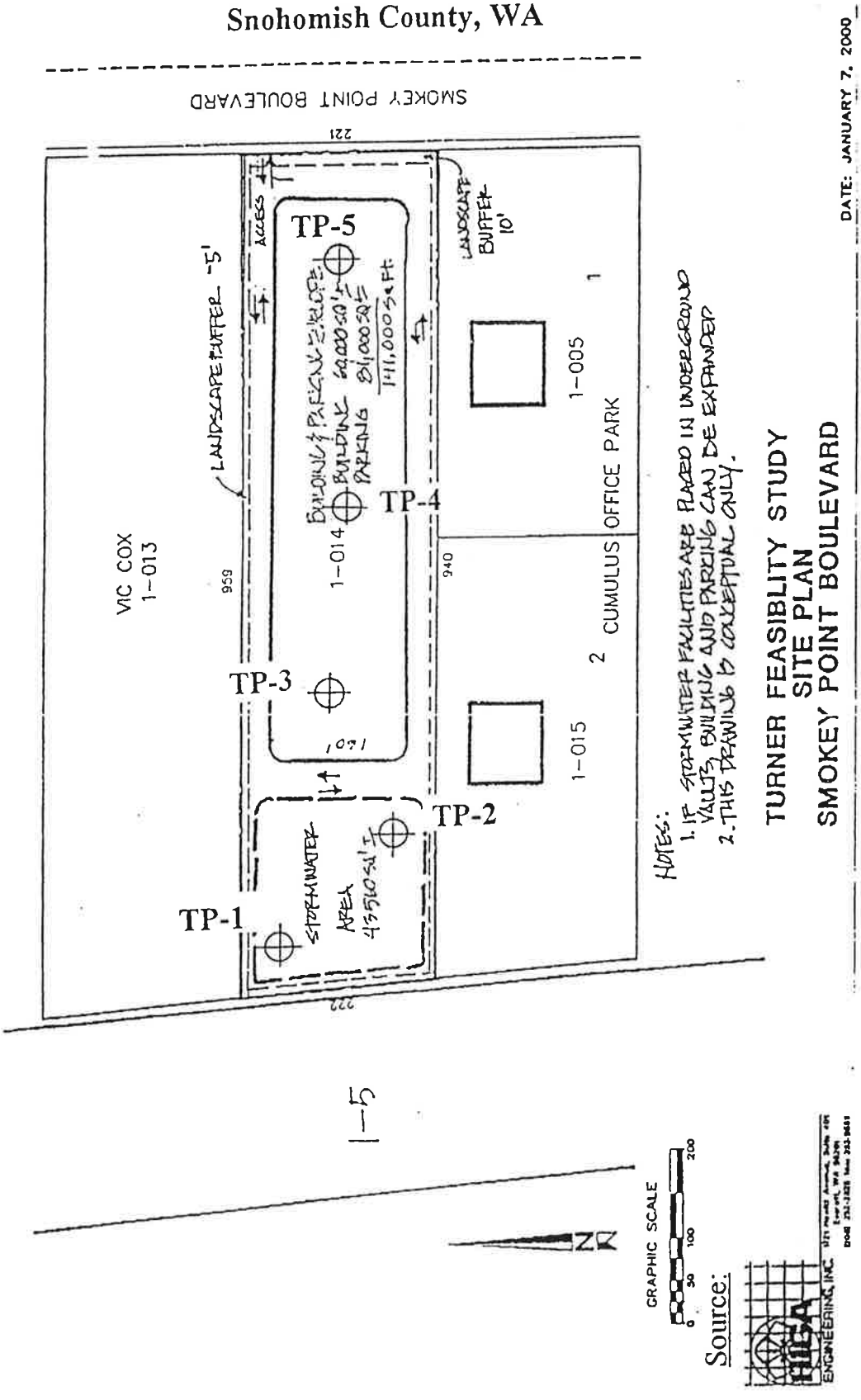
Attachment: Figure 1, Site Plan Sketch
USCS Classification Chart
Tabulated Test Pit Logs
Typical Erosion Control Facilities

cc: Higa Engineering, Inc.

File:20061

(Page 7 of 11)

## Figure 1
## Site Plan & Test Pit Locations
## Wallace Turner Site
## Tax #2931 051 014 0007
## Snohomish County, WA



## UNIFIED SOIL CLASSIFICATION CHART (USCS)

| MAJOR DIVISIONS | | | GRAPH SYMBOL | LETTER SYMBOL | TYPICAL DESCRIPTIONS |
|---|---|---|---|---|---|
| COARSE GRAINED SOILS (MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE) | GRAVEL AND GRAVELLY SOILS (MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE) | CLEAN GRAVELS (LITTLE OR NO FINES) <5% | | GW | WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES |
| | | | | GP | POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES |
| | | GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES) <12% | | GM | SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES |
| | | | | GC | CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES |
| | SAND AND SANDY SOILS (MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE) | CLEAN SANDS (LITTLE OR NO FINES) <5% | | SW | WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES |
| | | | | SP | POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES |
| | | SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES) <12% | | SM | SILTY SANDS, SAND-SILT MIXTURES |
| | | | | SC | CLAYEY SANDS, SAND-CLAY MIXTURES |
| FINE GRAINED SOILS (MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE) | SILTS AND CLAYS (LIQUID LIMIT LESS THAN 50) | | | ML | INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY |
| | | | | CL | INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS |
| | | | | OL | ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY |
| | SILTS AND CLAYS (LIQUID LIMIT GREATER THAN 50) | | | MH | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS |
| | | | | CH | INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS |
| | | | | OH | ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS |
| HIGHLY ORGANIC SOILS | | | | PT | PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS |

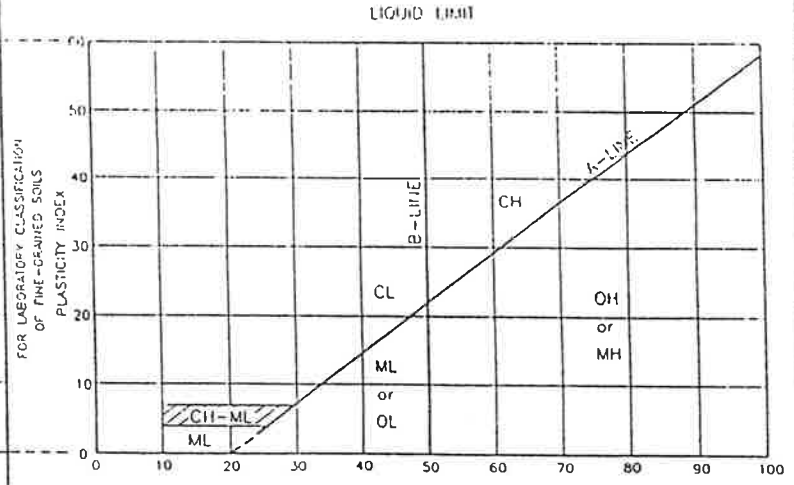
## GRADATION CHART

| MATERIAL SIZE | PARTICLE SIZE | | | |
|---|---|---|---|---|
| | LOWER LIMIT | | UPPER LIMIT | |
| | MILLIMETERS | SIEVE SIZE | MILLIMETERS | SIEVE SIZE |
| SAND | | | | |
| FINE | .074 | #200 * | 0.42 | #40 * |
| MEDIUM | 0.42 | #40 * | 2.00 | #10 * |
| COARSE | 2.00 | #10 * | 4.76 | #4 * |
| GRAVEL | | | | |
| FINE | 4.76 | #4 * | 191 | 3/4" * |
| COARSE | 191 | 3/4" * | 762 | 3" * |
| COBBLES | 76.2 | 3" * | 304.8 | 12" * |
| BOULDERS | 304.8 | 12" * | 914.4 | |

* U.S. STANDARD * CLEAR SQUARE OPENINGS

5–12% FINES (SILT & CLAY) DUAL CLASS

## PLASTICITY CHART

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Key to Test Pit Logs Using the Unified Soil Classification System

DATE: 5/11/95 SCALE: H: N/A V: N/A

A:TEST PITS