Washington State Department of
Enterprise Services
Engineering & Architectural Services

ADDENDUM 3

December 4, 2019

The Washington State Department of Enterprise Services
Eastern Regional Office
Vehicle and Storage Building
Project No. 2019-537
Washington State Department of Ecology

This addendum consists of three (3) items:
1. Correction of Project Goals in Attachment 6
2. Deletion of Project Goals from Attachments 7, 8, 9, and 10
3. Addition of Reference Documents

This addendum does not amend the due date or time for submission of the RFP Submission. The RFP Submission continues to be due no later than 3:00 pm on Monday, December 16, 2019.

1. **Correction of Project Goals in Attachment 6**
    a. REPLACE Project Goals listed in Attachment 6 with the following list of Project Goals.

PROJECT GOALS

The Owner/DES have established the following Project Goals:

A. Develop a highly efficient project that meets the requirements of Executive Order 18-01 and exceeds owner's operational needs.

B. Use effective design and construction methods that minimally impact current occupants on site and neighboring residential areas without compromising health, safety, or security.

C. Design and construct an aesthetically pleasing facility that ties together existing and new facilities.

D. Develop and maintain a collaborative relationship between the Owner/DES and the Design-Builder throughout project duration.

E. Use Design-Builder management processes that keep time with construction, are accurate and complete, and serve as documentation for project auditing at project completion.

F. Reduce impacts to the environment through the use of effective design and construction methods to meet or exceed environmental requirements with no permit violations.

G. Achieve design excellence within the Owner's budget and schedule.

H. Achieve Substantial Completion earlier than December 2020.

I. Establish and maintain throughout the duration of the project quality assurance and quality control processes that ensure project excellence.

2. Deletion of Project Goals from Attachments 7, 8, 9, and 10

a. DELETE the list of Project Goals associated to Attachments 7, 8, 9, and 10. This list of Project Goals is incorrect and for another project. See RFQ Section 1.5 for Project Goals.

3. Addition of Reference Documents

a. ADD Coffman Drainage Report – Phase 1, dated September 2018.
b. ADD USKH Records of Survey, dated July 2009.
c. ADD J. R. Bonnett Drainage Design Calculations, dated June 2009.
d. ADD Budinger ECY Building Stormwater Design, dated June 2009.
e. ADD USKH Topographic Survey, dated April 2009.

# # #

Project Description

The Department of Ecology Eastern Regional Office Phase 1 project includes the construction of parking lots, pedestrian and vehicular circulation, and public alley improvements. Located west of N. Monroe Street, east of N. Madison St., and south of W. Wellesley Ave., the project includes constructing parking lots, a pedestrian plaza, paved access routes, curbs, sidewalks, drainage system components, landscaping and irrigation. Two existing houses located on the southwest corner of the site will be demolished and the lot will be seeded until possible future expansion occurs. The adjacent public alleys will be resurfaced, and existing drainage patterns will be maintained. New curbs and sidewalks will be installed to provide accessible pedestrian routes to and from the building and the parking lots. The site will include paved vehicle circulation to provide efficient and convenient access throughout the project area.

The existing site is developed with asphalt parking lots, concrete curbs, sidewalks, and landscape islands. There are minimal slopes across the project site. The lowest site elevations are located at the southeast corner of the project area. The highest site elevations are located at the existing building. The site is bounded by N. Madison St. to the west, N. Monroe St. to the east, W. Wellesley Ave. to the north, and W. Princeton Ave. to the south. The stormwater runoff is managed by a system of surface flow, curbs, and drainage structures.

The project is located in the City of Spokane, Section 6, Township 25, North, Range 43 East, W.M., City of Spokane, Spokane County, Washington (see Vicinity Map, Attachment "A").

2009 Design Drainage Report and Geotechnical Information

A previous drainage evaluation titled *Drainage Design Calculations of Department of Ecology Eastern Regional Office*, dated June 30, 2009, was performed by J.R. Bonnett Engineering as part of an early design of this project in 2009. Their report was used in designing the storm water management system. The report is included in Attachment "E".

Budinger and Associates performed a geotechnical engineering evaluation to assess the subsurface soil conditions for the project site and to prepare geotechnical recommendations to assist in project planning, design, and construction. Their report, dated June 29, 2009, is included in Attachment "E" as part of the 2009 design drainage report.

Two full-scale drywell tests and one boring was conducted as part of the geotechnical evaluation. Soil samples were taken and returned to the laboratory for examination and testing. The geotechnical site exploration indicated the subsurface soil consists of two soil groups; fill and clean sand. The geotechnical observations indicate the sand extents to a depth of 26 feet below existing ground surface.

Based on site explorations and the results of the laboratory test, Budinger and Associates reported the soils encountered below the ground surface will be suitable for site stormwater infiltration. Budinger and Associates reported that conventional bio-infiltration swales and disposal structures, such as drywells, were feasible. Ground water was not encountered in any explorations.

The final design for stormwater treatment and disposal follows the geotechnical recommendations. The report recommends drywell outflow rates of 0.3 cubic feet per second and 1.0 cubic feet per second for single and double-depth drywells, respectively. Treatment is handled through standard bio-infiltration swales, storage is accomplished in the swales, and drywells assist with disposal.

Pre-Development Basin Information

The existing site is characterized by seven pre-developed drainage basins, labeled numerically. The existing site utilizes the existing slopes and drywells located throughout the site to manage stormwater runoff. See Pre-Developed Basin Boundary Map, page 12 of *Drainage Design Calculations of Department of Ecology Eastern Regional Office*, dated June 30, 2009, by J.R. Bonnett Engineering included in Attachment "E". The pre-developed basins are described as follows:

Basin 1 includes the south half of the west parking lot of the site, including parking spaces and vehicle access for the parking lot. Runoff from this basin follows the slope of the asphalt to a drywell with a grated lid located on the west side of the basin.

Basin 2 includes the north half of the west parking lot of the site, including the west public approach, parking spaces, and vehicle access for the parking lot. Runoff from this basin follows the slope of the asphalt to a drywell with a grated lid located on the west side of the basin.

Basin 3 includes the north portion of the northeast parking lot of the site, including parking spaces and vehicle access for the parking lot. Runoff from this basin follows the slope of the asphalt to a drywell with a grated lid located in the northeast corner of the basin.

Basin 4 includes the middle section of the northeast parking lot of the site, including parking spaces and vehicle access for the parking lot. Runoff from this basin follows the slope of the asphalt to a drywell with a grated lid located on the east side of the basin.

Basin 5 includes the south portion of the northeast parking lot of the site, including parking spaces and vehicle access for the parking lot. Runoff from this basin follows the slope of the asphalt to a drywell with a grated lid located in the southeast corner of the basin.

Basin 6 includes the vehicle access drive north of the building. Runoff from this basin follows the slope of the asphalt to a drywell with a grated lid located on the east side of the basin.

Basin 7 includes the south parking lot of the site, including parking spaces and vehicle access for the parking lot. Runoff from this basin follows the slope of the asphalt to two existing drywells with grated lids located on the south side of the basin.

Roof runoff of the existing Department of Ecology Eastern Regional Office is collected by roof drains and piped directly to existing on-site drywells.

Post-Development Basin Information

The developed site is divided into five post-developed drainage basins, labeled alphabetically. Runoff for each basin was calculated using a 10-year return frequency event. See Post-Developed Basin Map, Attachment "B1", for basin boundaries. A description of each post-developed basin is as follows:

Basin A includes the northeast parking lot of the site, including parking spaces, landscape areas, pedestrian plaza, sidewalks, and vehicle access for the parking lot. Runoff from this basin will be directed to bio-infiltration swale #1 for storage and treatment located on the east side of the basin. A single-depth drywell will be used for disposal. Portions of the pedestrian plaza at the main entrance of the building will be permeable pavers to increase the efficiency of the stormwater system.

Basin B includes the north portion of the west parking lot of the site, including parking spaces, landscape areas, and vehicle access for the parking lot. Runoff from this basin will be directed to bio-infiltration swale #2 for storage and treatment located on the west side of the basin. A single-depth drywell will be used for disposal.

Basin C includes the south portion of the west parking lot of the site, including parking spaces, west public approach, landscape areas, and vehicle access for the parking lot. Runoff from this basin will be directed to bio-infiltration swale #3 for storage and treatment located on the west side of the basin. A single-depth drywell will be used for disposal.

Basin D includes the south parking lot of the site, including parking spaces, landscape areas, sidewalks, and vehicle access for the parking lot. Runoff from this basin will be directed to bio-infiltration swale #4 for storage and treatment located on the south side of the basin. Two existing single-depth drywells will be used for disposal.

Basin E includes the northeast satellite parking lot at the corner of W. Wellesley Ave. and N. Monroe St., including parking spaces, landscape areas, and vehicle access for the parking lot. Runoff from this basin will be directed to bio-infiltration swale #5 for storage and treatment located on the west side of the basin. A single-depth drywell will be used for disposal.

Roof runoff from the existing Department of Ecology Eastern Regional Office will be handled by the pre-development drainage system.

The following table summarizes the results of the post-developed site basin calculations. See Attachment "D" for specific calculations.

POST-DEVELOPED BASIN INFORMATION SUMMARY TABLE

Basin	**Impervious Area (PGIS[1]) (acres)**		**Pervious Area (Non-PGIS[2]) (acres)**	**Total Area**	**Total 10-year Runoff[4]**
	Pavement (C^3 =0.90)	**Sidewalks (C^3 =0.90)**	**Lawns (C^3 =0.22)**	**(acres)**	**(cfs)**
A	0.25	0.06	0.09	**0.40**	**0.77**
B	0.14	-	0.07	**0.21**	**0.38**
C	0.29	-	0.08	**0.37**	**0.72**
D	0.13	0.01	0.05	**0.18**	**0.34**
E	0.14	-	0.06	**0.20**	**0.37**

1 PGIS = Pollutant Generating Impervious Surface
2 Non-PGIS = Impervious surface that does not contribute pollutants to the stormwater
3 Runoff Coefficient from SRSM Table 5-5 (See Supporting Figures, Attachment "C")
4 See Attachment "D" for calculations

Methodology

Stormwater management is provided in conformance with the *Spokane Regional Stormwater Manual (SRSM)*, as published jointly by Spokane County, City of Spokane and City of Spokane Valley, April 2008. Water quality treatment is handled by bio-infiltration swales. The swale design for this project will utilize equation 6-1c ($V = 1133A$) in the *SRSM.* Flow control is handled by bio-infiltration swales and drywells utilizing the Rational Method for peak flow and the Bowstring Method for determining storage volume – each with a 10-year return frequency.

Water Quality Treatment

The water quality treatment facilities are designed to remove pollutants contained in the stormwater runoff from the site. The specific treatment required is as follows:

- **Basic Treatment** will be applied to all Pollutant Generating Impervious Surface (PGIS) areas and hydraulically connected non-pollutant generating impervious surface areas.

Basic treatment is met by providing bio-infiltration swales to filter and percolate stormwater into the ground. The bio-infiltration facilities are also designed to function as a flow control facilities, which accommodate the 10-year design storm event. See calculations in Attachment "D".

Results

Hydrology Calculations

The following table summarizes the results of the sub-basin calculations. See Hydrology Calculations in Attachment "D".

TREATMENT AND FLOW CONTROL REQUIREMENT SUMMARY TABLE

Basin	Runoff Generated 10-yr storm (cfs)	Treatment Volume[1] Required (cf)	Treatment Volume[1] Provided (cf)	Required Storage Volume (cf)	Provided Storage Volume (cf)	Provided Drywell Type
A	0.77	343	408	219	815	(1) Type 1 Drywell
B	0.38	163	209	61	546	(1) Type 1 Drywell
C	0.73	324	331	200	630	(1) Type 1 Drywell

D	0.34	150	165	-43	464	(2) Existing Type 1 Drywells
E	0.37	161	272	57	570	(1) Type 1 Drywell

1 Treatment Volume was calculated using equation 6-1c from the SRSM

Operational Characteristics

The above described system of stormwater treatment and control will function with relatively little oversight. Stormwater from paved parking, driving and walking surfaces will flow overland directly into the bio-infiltration swales located at the low areas of the site. Stormwater in the bio-infiltration swales will begin to infiltrate the underlying soils as quickly as possible until the soil becomes saturated or frozen. Once this occurs, the stormwater will temporarily pond in the swale until it reaches the top of the drywell grate. As ponding reaches the drywell grate depth, stormwater will flow into the grate and directly to the subsurface while the bio-infiltration swale continues to infiltrate stormwater.

Perpetual Maintenance of Facilities

The proposed stormwater facilities will be operated and maintained by the Department of Ecology or their contractors.

Periodic maintenance includes mowing of grass, inspection of the drainage grates, structures and rip rap pads and removal of any debris or vegetation impeding stormwater flow. The grass may also require re-seeding to insure a healthy stand of vegetation is present. Any areas that are found to be without vegetation will need to have immediate erosion control measures installed to protect the drainage structures in the swale until the grass can be re-established. The storm drainage system will require periodic cleaning by physical or mechanical means. This includes the drywells, splash pads, and curb inlets.

VICINITY MAP

ATTACHMENT "A"

Project Site

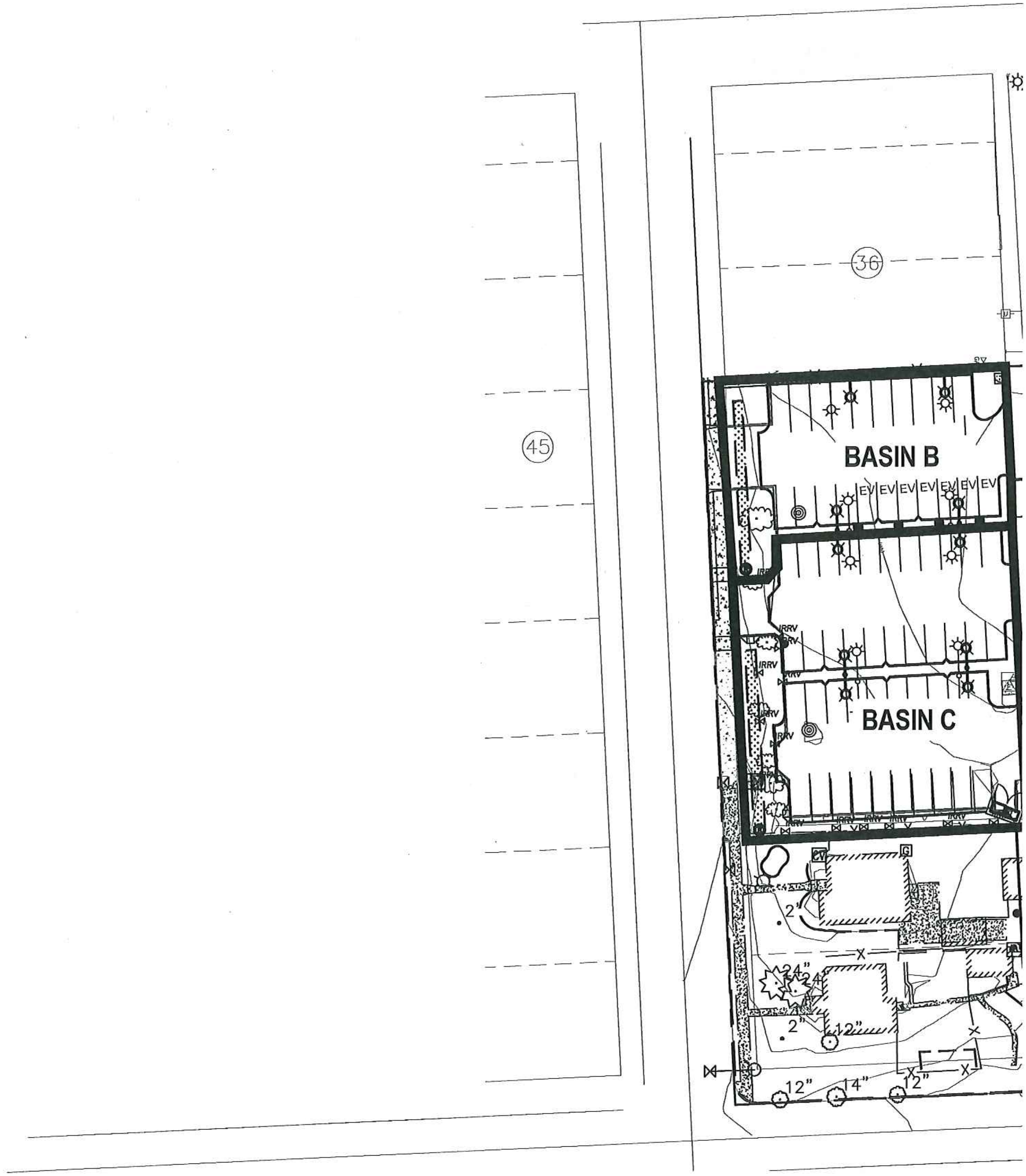
VICINITY MAP

ATTACHMENT "A"

POST-DEVELOPMENT BASIN MAP

ATTACHMENT "B"

S. 6, T.25, R.43, W.M., CITY OF S



LEGEND

BASIN BOUNDARY

BASIN "A" BASIN DESIGNATION

SUPPORTING FIGURES

ATTACHMENT "C"

TABLE 5-5
RUNOFF COEFFICIENTS FOR THE RATIONAL METHOD
(10-YEAR RETURN FREQUENCY)

	Runoff Coefficient (C)		
Type of Cover	**Flat (<2%)**	**Rolling (2% - 10%)**	**Hilly (>10%)**
Pavement and Roofs	0.90	0.90	0.90
Earth Shoulders	0.50	0.50	0.50
Drives and Walks	0.90	0.90	0.90
Gravel Pavement	0.50	0.55	0.60
Lawns, Sandy Soil	0.10	0.15	0.20
Lawns, Heavy Soil	0.17	0.22	0.35
Grass Shoulders	0.25	0.25	0.25
Side Slopes, Earth	0.60	0.60	0.60
Side Slopes, Turf	0.30	0.30	0.30
Median Areas, Turf	0.25	0.30	0.30
Cultivated Land, Clay and Loam	0.50	0.55	0.60
Cultivated Land, Sand and Gravel	0.25	0.30	0.35
Woodland and Forest	0.10	0.15	0.20
Meadow and Pasture Land	0.25	0.30	0.35

Source: WSDOT Hydraulics Manual,
March 2004

TABLE 5-7
INDEX TO RAINFALL COEFFICIENTS

2-year Event		10-year Event		25-year Event		50-year Event		100-year Event	
m	n	m	n	m	n	m	n	m	n
3.47	0.556	6.98	0.609	9.09	0.626	10.68	0.635	12.33	0.643

Source: WSDOT Hydraulics Manual, March 2004

TABLES 5-5 AND 5-7
SPOKANE REGIONAL STORMWATER MANUAL

HYDROLOGY CALCULATIONS

ATTACHMENT "D"

STORM WAT[illegible]ANAGEMENT CALCULATIONS - 10 Year Design Storm

Equation V = 1133 A

COF[illegible]AN ENGINEERS
10 North Post St., Suite 500
Spokane, WA 99201
(509) 328-2994

PROJECT: Department of Ecology Phase 1
DATE: September 28, 2018
BY: Christie Johnson

BASIN: A

RUNOFF STORAGE

1	Single (Type A)	0	Double (Type B)
0.30	Exfiltration (cfs)	1.00	Exfiltration (cfs)

Time of Conc. (min)		5.00		
Area (Acres)		0.40		
Composite "C"		0.74		
Volume Provided	Treatment:	408	Storage:	815
Outflow (cfs)		0.30		
Area * "C" Factor		0.29		
"m" coefficient *		6.98		
"n" coefficient *		0.609		

* "m" and "n" coefficients obtained from Figure 2-5.4 from the WSDOT Hydraulics Manual

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300	2.62	0.77	309	90.00	219
5	300	2.62	0.77	309	90.00	219
10	600	1.72	0.50	353	180.00	173
15	900	1.34	0.39	394	270.00	124
20	1200	1.13	0.33	430	360.00	70
25	1500	0.98	0.29	461	450.00	11
30	1800	0.88	0.26	490	540.00	-50
35	2100	0.80	0.23	517	630.00	-113
40	2400	0.74	0.22	541	720.00	-179
45	2700	0.69	0.20	564	810.00	-246
50	3000	0.64	0.19	586	900.00	-314
55	3300	0.61	0.18	606	990.00	-384
60	3600	0.58	0.17	626	1080.00	-454
65	3900	0.55	0.16	644	1170.00	-526
70	4200	0.53	0.15	662	1260.00	-598
75	4500	0.50	0.15	679	1350.00	-671
80	4800	0.48	0.14	695	1440.00	-745
85	5100	0.47	0.14	711	1530.00	-819
90	5400	0.45	0.13	726	1620.00	-894
95	5700	0.44	0.13	741	1710.00	-969
100	6000	0.42	0.12	756	1800.00	-1044

Rainfall intensities were calculated by using the equation in Section 2-5.4 of the WSDOT Hydraulics Manual

CONTRIBUTING AREAS

Site 0.40 Acres 17222 s.f.

	Areas (Ac.)	"C"	A*C	Non-PGIS Areas (s.f.)	PGIS Areas (s.f.)
Asphalt	0.25	0.90	0.2217	0	10730
Sidewalks	0.06	0.90	0.0511	0	2471
Building / Roof	0.00	0.90	0.0000	0	0
Other	0.00	0.90	0.0000	0	0
Grass / Landscaping	0.09	0.22	0.0203	4021	0
Vegetated Hillside	0.00	0.25	0.0000	0	0
Gravel	0.00	0.55	0.0000	0	0
				4021	13201
	Total A 0.40	Comp "C" 0.74	**Q peak 0.77**		

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to Treatment Elevation (ft)	Treatment Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	Treatment Volume (cf)	Storage Volume (cf)
1	815	0.50	815	1.0	815	407.5	815
x	0	0.50	0	1.0	0	0	0
x	0	0.50	0	1.0	0	0	0
	815					407.5	815

SWALE SIZING

V=	1133	A
PGIS A=	13201	(sf)
	0.30	(acres)

Treatment Volume Required =	343 cf
Treatment Volume Provided =	408 cf
Treatment Volume:	**Adequate**

STORAGE REQUIREMENTS -

10 Year Design Storm

Storage Volume Required =	219 cf
Storage Volume Provided =	815 cf
Storage Volume:	**Adequate**

STORM WATER MANAGEMENT CALCULATIONS - 10 Year Design Storm

Equation V = 1133 A

COFFMAN ENGINEERS
10 North Post St., Suite 500
Spokane, WA 99201
(509) 328-2994

PROJECT: Department of Ecology Phase 1
DATE: September 28, 2018
BY: Christie Johnson

BASIN: B

RUNOFF STORAGE

1	Single (Type A)	0	Double (Type B)
0.30	Exfiltration (cfs)	1.00	Exfiltration (cfs)

Time of Conc. (min)		5.00		
Area (Acres)		0.21		
Composite "C"		0.69		
Volume Provided	Treatment:	209	Storage:	546
Outflow (cfs)		0.30		
Area * "C" Factor		0.14		
"m" coefficient *		6.98		
"n" coefficient *		0.609		

* "m" and "n" coefficients obtained from Figure 2-5.4 from the WSDOT Hydraulics Manual

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300	2.62	0.38	151	90.00	61
5	300	2.62	0.38	151	90.00	61
10	600	1.72	0.25	173	180.00	-7
15	900	1.34	0.19	193	270.00	-77
20	1200	1.13	0.16	211	360.00	-149
25	1500	0.98	0.14	226	450.00	-224
30	1800	0.88	0.13	240	540.00	-300
35	2100	0.80	0.12	253	630.00	-377
40	2400	0.74	0.11	265	720.00	-455
45	2700	0.69	0.10	277	810.00	-533
50	3000	0.64	0.09	287	900.00	-613
55	3300	0.61	0.09	297	990.00	-693
60	3600	0.58	0.08	307	1080.00	-773
65	3900	0.55	0.08	316	1170.00	-854
70	4200	0.53	0.08	324	1260.00	-936
75	4500	0.50	0.07	333	1350.00	-1017
80	4800	0.48	0.07	341	1440.00	-1099
85	5100	0.47	0.07	349	1530.00	-1181
90	5400	0.45	0.06	356	1620.00	-1264
95	5700	0.44	0.06	363	1710.00	-1347
100	6000	0.42	0.06	370	1800.00	-1430

Rainfall intensities were calculated by using the equation in Section 2-5.4 of the WSDOT Hydraulics Manual

CONTRIBUTING AREAS

Site 0.21 Acres 9111 s.f.

	Areas (Ac.)	"C"	A*C	Non-PGIS Areas (s.f.)	PGIS Areas (s.f.)
Asphalt	0.14	0.90	0.1292	0	6252
Sidewalks	0.00	0.90	0.0000	0	0
Building / Roof	0.00	0.90	0.0000	0	0
Other	0.00	0.90	0.0000	0	0
Grass / Landscaping	0.07	0.22	0.0144	2859	0
Vegetated Hillside	0.00	0.25	0.0000	0	0
Gravel	0.00	0.55	0.0000	0	0
				2859	6252
	Total A 0.21	Comp "C" 0.69	**Q peak 0.38**		

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to Treatment Elevation (ft)	Treatment Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	Treatment Volume (cf)	Storage Volume (cf)
1	299	0.50	537	1.0	792	209	545.5
x	0	0.50	0	1.0	0	0	0
x	0	0.50	0	1.0	0	0	0
	299					209	545.5

SWALE SIZING

V=	1133	A
PGIS A=	6252	(sf)
	0.14	(acres)

Treatment Volume Required =	163 cf
Treatment Volume Provided =	209 cf
Treatment Volume:	**Adequate**

STORAGE REQUIREMENTS -

10 Year Design Storm

Storage Volume Required =	61 cf
Storage Volume Provided =	546 cf
Storage Volume:	**Adequate**

STORM WATF ANAGEMENT CALCULATIONS - *10 Year Design Storm*

Equation V = 1133 A

COFI AN ENGINEERS
10 North Post St., Suite 500
Spokane, WA 99201
(509) 328-2994

PROJECT: Department of Ecology Phase 1
DATE: September 28, 2018
BY: Christie Johnson

BASIN: C

RUNOFF STORAGE

1	Single (Type A)	0	Double (Type B)
0.30	Exfiltration (cfs)	1.00	Exfiltration (cfs)

Time of Conc. (min)		5.00		
Area (Acres)		0.37		
Composite "C"		0.75		
Volume Provided	Treatment:	331	Storage:	630
Outflow (cfs)		0.30		
Area * "C" Factor		0.27		
"m" coefficient *		6.98		
"n" coefficient *		0.609		

* "m" and "n" coefficients obtained from Figure 2-5.4 from the WSDOT Hydraulics Manual

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300	2.62	0.72	290	90.00	200
5	300	2.62	0.72	290	90.00	200
10	600	1.72	0.47	331	180.00	151
15	900	1.34	0.37	370	270.00	100
20	1200	1.13	0.31	403	360.00	43
25	1500	0.98	0.27	433	450.00	-17
30	1800	0.88	0.24	460	540.00	-80
35	2100	0.80	0.22	485	630.00	-145
40	2400	0.74	0.20	508	720.00	-212
45	2700	0.69	0.19	529	810.00	-281
50	3000	0.64	0.18	550	900.00	-350
55	3300	0.61	0.17	569	990.00	-421
60	3600	0.58	0.16	587	1080.00	-493
65	3900	0.55	0.15	604	1170.00	-566
70	4200	0.53	0.14	621	1260.00	-639
75	4500	0.50	0.14	637	1350.00	-713
80	4800	0.48	0.13	652	1440.00	-788
85	5100	0.47	0.13	667	1530.00	-863
90	5400	0.45	0.12	682	1620.00	-938
95	5700	0.44	0.12	695	1710.00	-1015
100	6000	0.42	0.12	709	1800.00	-1091

Rainfall intensities were calculated by using the equation in Section 2-5.4 of the WSDOT Hydraulics Manual

CONTRIBUTING AREAS

Site 0.37 Acres 15913 s.f.

	Areas (Ac.)	"C"	A*C	Non-PGIS Areas (s.f.)	PGIS Areas (s.f.)
Asphalt	0.29	0.90	0.2576	0	12466
Sidewalks	0.00	0.90	0.0000	0	0
Building / Roof	0.00	0.90	0.0000	0	0
Other	0.00	0.90	0.0000	0	0
Grass / Landscaping	0.08	0.22	0.0174	3447	0
Vegetated Hillside	0.00	0.25	0.0000	0	0
Gravel	0.00	0.55	0.0000	0	0
				3447	12466
	Total A 0.37	Comp "C" 0.75	**Q peak 0.72**		

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to Treatment Elevation (ft)	Treatment Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	Treatment Volume (cf)	Storage Volume (cf)
1	366	0.67	621	1.0	894	330.645	630
x	0	0.67	0	1.0	0	0	0
x	0	0.67	0	1.0	0	0	0
	366					330.645	630

SWALE SIZING

V=	1133	A
PGIS A=	12466	(sf)
	0.29	(acres)

Treatment Volume Required =	324 cf
Treatment Volume Provided =	331 cf
Treatment Volume:	**Adequate**

STORAGE REQUIREMENTS -

10 Year Design Storm

Storage Volume Required =	200 cf
Storage Volume Provided =	630 cf
Storage Volume:	**Adequate**

STORM WATER MANAGEMENT CALCULATIONS - *10 Year Design Storm*

Equation V = 1133 A

COFFMAN ENGINEERS
10 North Post St., Suite 500
Spokane, WA 99201
(509) 328-2994

PROJECT: Department of Ecology Phase 1
DATE: September 28, 2018
BY: Christie Johnson

BASIN: D

RUNOFF STORAGE

2	Single (Type A)	0	Double (Type B)
0.30	Exfiltration (cfs)	1.00	Exfiltration (cfs)

Time of Conc. (min)		5.00		
Area (Acres)		0.18		
Composite "C"		0.71		
Volume Provided	Treatment:	165	Storage:	464
Outflow (cfs)		0.60		
Area * "C" Factor		0.13		
"m" coefficient *		6.98		
"n" coefficient *		0.609		

* "m" and "n" coefficients obtained from Figure 2-5.4 from the WSDOT Hydraulics Manual

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300	2.62	0.34	137	180.00	-43
5	300	2.62	0.34	137	180.00	-43
10	600	1.72	0.22	157	360.00	-203
15	900	1.34	0.17	175	540.00	-365
20	1200	1.13	0.15	191	720.00	-529
25	1500	0.98	0.13	205	900.00	-695
30	1800	0.88	0.11	218	1080.00	-862
35	2100	0.80	0.10	230	1260.00	-1030
40	2400	0.74	0.10	241	1440.00	-1199
45	2700	0.69	0.09	251	1620.00	-1369
50	3000	0.64	0.08	260	1800.00	-1540
55	3300	0.61	0.08	269	1980.00	-1711
60	3600	0.58	0.08	278	2160.00	-1882
65	3900	0.55	0.07	286	2340.00	-2054
70	4200	0.53	0.07	294	2520.00	-2226
75	4500	0.50	0.07	302	2700.00	-2398
80	4800	0.48	0.06	309	2880.00	-2571
85	5100	0.47	0.06	316	3060.00	-2744
90	5400	0.45	0.06	323	3240.00	-2917
95	5700	0.44	0.06	329	3420.00	-3091
100	6000	0.42	0.06	336	3600.00	-3264

Rainfall intensities were calculated by using the equation in Section 2-5.4 of the WSDOT Hydraulics Manual

CONTRIBUTING AREAS

Site 0.18 Acres 7940 s.f.

	Areas (Ac.)	"C"	A*C	Non-PGIS Areas (s.f.)	PGIS Areas (s.f.)
Asphalt	0.13	0.90	0.1139	0	5515
Sidewalks	0.01	0.90	0.0054	0	260
Building / Roof	0.00	0.90	0.0000	0	0
Other	0.00	0.90	0.0000	0	0
Grass / Landscaping	0.05	0.22	0.0109	2165	0
Vegetated Hillside	0.00	0.25	0.0000	0	0
Gravel	0.00	0.55	0.0000	0	0
				2165	5775
	Total A 0.18	Comp "C" 0.71	**Q peak 0.34**		

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to Treatment Elevation (ft)	Treatment Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	Treatment Volume (cf)	Storage Volume (cf)
1	311	0.50	350	1.0	616	165.25	463.5
x	0	0.50	0	1.0	0	0	0
x	0	0.50	0	1.0	0	0	0
	311					165.25	463.5

SWALE SIZING

V=	1133	A
PGIS A=	5775	(sf)
	0.13	(acres)

Treatment Volume Required =	150 cf
Treatment Volume Provided =	165 cf
Treatment Volume:	**Adequate**

STORAGE REQUIREMENTS -

10 Year Design Storm

Storage Volume Required =	-43 cf
Storage Volume Provided =	464 cf
Storage Volume:	**Adequate**

STORM WAT[illegible]ANAGEMENT CALCULATIONS - *10 Year Design Storm*

Equation V = 1133 A

COF[illegible]AN ENGINEERS
10 North Post St., Suite 500
Spokane, WA 99201
(509) 328-2994

PROJECT: Department of Ecology Phase 1
DATE: September 28, 2018
BY: Christie Johnson

BASIN: E

RUNOFF STORAGE

1	Single (Type A)	0	Double (Type B)
0.30	Exfiltration (cfs)	1.00	Exfiltration (cfs)

Time of Conc. (min)		5.00		
Area (Acres)		0.20		
Composite "C"		0.71		
Volume Provided	Treatment:	272	Storage:	570
Outflow (cfs)		0.30		
Area * "C" Factor		0.14		
"m" coefficient *		6.98		
"n" coefficient *		0.609		

* "m" and "n" coefficients obtained from Figure 2-5.4 from the WSDOT Hydraulics Manual

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300	2.62	0.37	147	90.00	57
5	300	2.62	0.37	147	90.00	57
10	600	1.72	0.24	169	180.00	-11
15	900	1.34	0.19	188	270.00	-82
20	1200	1.13	0.16	205	360.00	-155
25	1500	0.98	0.14	220	450.00	-230
30	1800	0.88	0.12	234	540.00	-306
35	2100	0.80	0.11	247	630.00	-383
40	2400	0.74	0.10	258	720.00	-462
45	2700	0.69	0.10	269	810.00	-541
50	3000	0.64	0.09	280	900.00	-620
55	3300	0.61	0.09	289	990.00	-701
60	3600	0.58	0.08	299	1080.00	-781
65	3900	0.55	0.08	307	1170.00	-863
70	4200	0.53	0.07	316	1260.00	-944
75	4500	0.50	0.07	324	1350.00	-1026
80	4800	0.48	0.07	332	1440.00	-1108
85	5100	0.47	0.07	339	1530.00	-1191
90	5400	0.45	0.06	347	1620.00	-1273
95	5700	0.44	0.06	354	1710.00	-1356
100	6000	0.42	0.06	361	1800.00	-1439

Rainfall intensities were calculated by using the equation in Section 2-5.4 of the WSDOT Hydraulics Manual

CONTRIBUTING AREAS

Site 0.20 Acres 8612 s.f.

	Areas (Ac.)	"C"	A*C	Non-PGIS Areas (s.f.)	PGIS Areas (s.f.)
Asphalt	0.14	0.90	0.1276	0	6174
Sidewalks	0.00	0.90	0.0000	0	0
Building / Roof	0.00	0.90	0.0000	0	0
Other	0.00	0.90	0.0000	0	0
Grass / Landscaping	0.06	0.22	0.0123	2438	0
Vegetated Hillside	0.00	0.25	0.0000	0	0
Gravel	0.00	0.55	0.0000	0	0
				2438	6174
	Total A 0.20	Comp "C" 0.71	**Q peak 0.37**		

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to Treatment Elevation (ft)	Treatment Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	Treatment Volume (cf)	Storage Volume (cf)
1	544	0.50	544	1.0	595	272	569.5
x	0	0.50	0	1.0	0	0	0
x	0	0.50	0	1.0	0	0	0
	544					272	569.5

SWALE SIZING

V=	1133	A
PGIS A=	6174	(sf)
	0.14	(acres)

Treatment Volume Required =	161 cf
Treatment Volume Provided =	272 cf
Treatment Volume:	**Adequate**

STORAGE REQUIREMENTS -

10 Year Design Storm

Storage Volume Required =	57 cf
Storage Volume Provided =	570 cf
Storage Volume:	**Adequate**

2009 DESIGN DRAINAGE REPORT

ATTACHMENT "E"

5804225 15/185

RECORD OF SURVEY

FOR

DEPARTMENT OF ECOLOGY

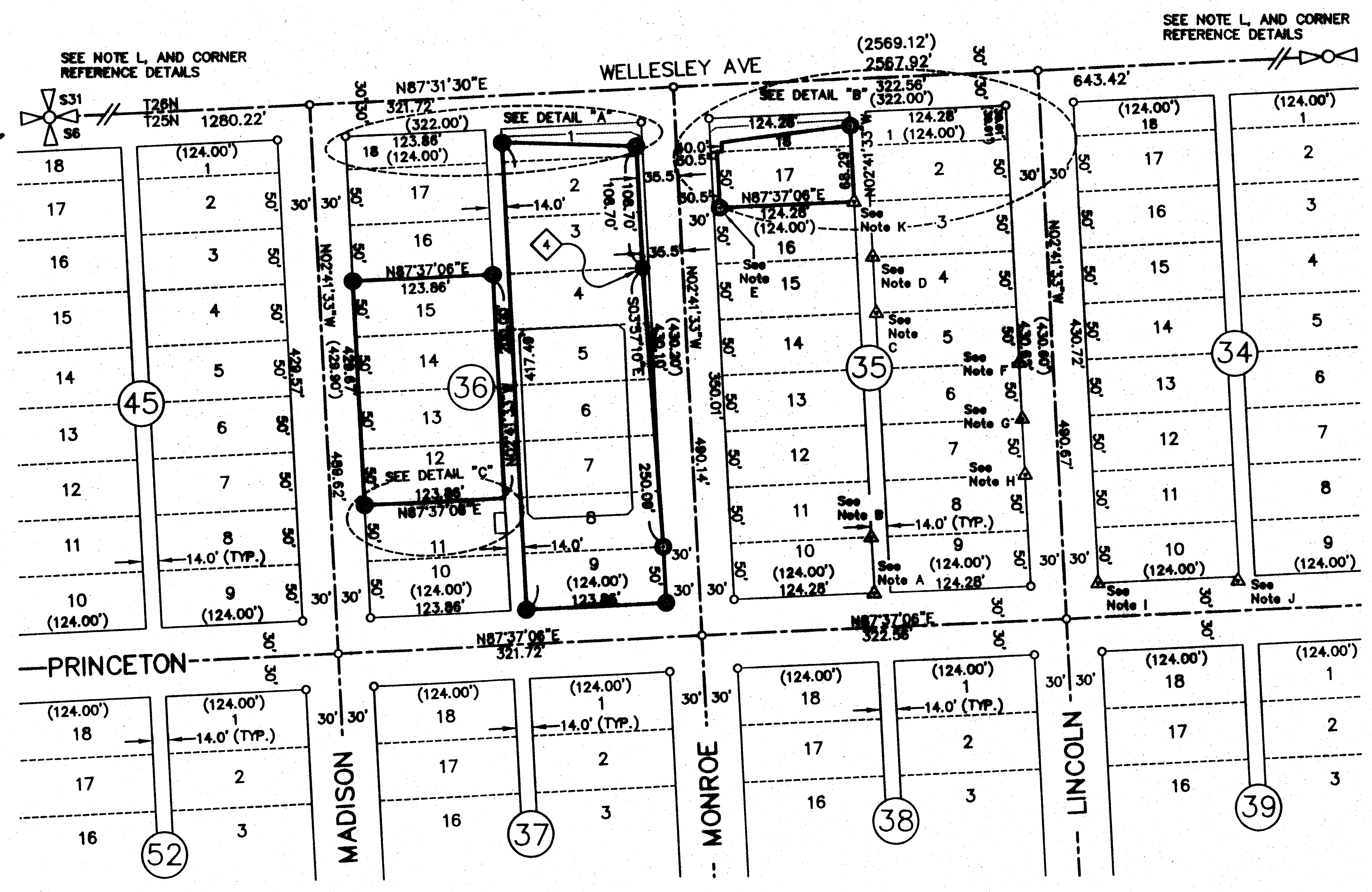
IN THE NW 1/4 OF SECTION 06, TOWNSHIP 25 NORTH, RANGE 43 EAST, W.M., SPOKANE COUNTY, WASHINGTON

AUDITOR'S CERTIFICATE

FILED FOR RECORD THIS 1 DAY OF July 2009 AT 10:15 A.M., IN BOOK 137 OF SURVEYS AT PAGE 85-86, AT THE REQUEST OF USKH, INC.

COUNTY AUDITOR — Rebekah Johnson, DEPUTY AUDITOR

0 100 200
SCALE IN FEET



MONUMENT NOTES

A. FOUND 5/8" REBAR, BENT W/ OLD YPC REMAINS, 0.16 SOUTH AND 0.26 WEST OF CALCULATED POSITION.

B. FOUND 5/8" REBAR WITH NO IDENTIFICATION, 0.16 SOUTH AND 0.27 WEST OF CALCULATED POSITION.

C. FOUND 1 1/4" CAPPED IRON PIPE LEANING SOUTH, 0.16 SOUTH AND 0.36 EAST OF CALCULATED POSITION.

D. FOUND 1"± SQUARE HEAD BOLT, 0.31 NORTH AND 0.18 WEST OF CALCULATED POSITION.

E. FOUND 5/8" REBAR BENT AT CALCULATED POSTION, SET NEW 5/8" REBAR IN SAME SPOT WITH YPC MARKED: LS 30431.

F. FOUND 1/2" SMOOTH STEEL PIN, 0.28 SOUTH AND 0.09 EAST OF CALCULATED POSITION.

G. FOUND 1 1/4" O.D. IRON PIPE, 0.17 SOUTH AND 0.14 EAST OF CALCULATED POSITION.

H. FOUND 7/8" O.D. IRON PIPE, 0.10 SOUTH AND 0.23 EAST OF CALCULATED POSITION.

I. FOUND 2" O.D. IRON PIPE, 0.15 SOUTH AND 0.42 WEST OF CALCULATED POSITION.

J. FOUND 1" O.D. IRON PIPE, 3.77 SOUTH AND 1.09 WEST OF CALCULATED POSITION.

K. FOUND 1/2" REBAR WITH YELLOW PLASTIC CAP MARKED: ABC INC 7317-11315; 0.05 NORTH AND 0.20 EAST OF CALCULATED POSITION.

L. THE POSITION FOR THE NORTH WEST CORNER, AND THE NORTH QUARTER CORNER OF SECTION 6, AS PER CITY OF SPOKANE PLSS CORNER SURVEY FOR GIS DEPARTMENT IN 2000.

LOT AREA

BLOCK 35: LOTS 17,18	=	7446 SQ. FT. 0.17 ACRES
BLOCK 36: LOTS 1-9	=	49,856 SQ. FT. 1.14 ACRES
BLOCK 36: LOTS 12-15:	=	24,772 SQ. FT. 0.57 ACRES

GEODETIC COORDINATES

Point	Grid N	Grid E	Latitude	Longitude
1	274129.601	2479155.057	47°42'02.175"	-117°25'33.678"
2	274132.129	2479230.512	47°42'02.167"	-117°25'32.574"
3	274147.064	2479344.200	47°42'02.264"	-117°25'30.904"
4	274021.033	2479160.162	47°42'01.102"	-117°25'33.674"

SURVEY NOTES

RE-CREATED BLOCKS IN THE FOLLOWING MANNER:

LOCATED FLOW LINES AND BACK OF CURBS ON MADISON BETWEEN BLOCKS 37 & 52, AND 36 & 45. THE SAME WAS DONE ON MONROE BETWEEN BLOCKS 43-44 & 37-38. ALSO ON LINCOLN BETWEEN 38-39 & 34-35. THE SAME INFORMATION WAS GATHERED ON PRINCETON FROM JEFFERSON TO POST. CENTERLINES WERE CREATED AT THE SPLIT OF THESE LINES AND COMPARED. THE CENTERLINE BEARINGS ON MADISON AGREED EXTREMELY WELL WITH EACH OTHER AND MATCHED THE BEARING ON MONROE BETWEEN BLOCKS 37 AND 38. THAT BEARING COMPARED CLOSELY WITH THE CENTERLINE ON LINCOLN. A CENTERLINE WAS CREATED FROM THE MIDPOINT OF A LINE DRAWN BETWEEN FLOW LINES AT THE SOUTH END OF LINCOLN BETWEEN BLOCKS 35 AND 36, AND PROJECTED NORTHERLY AT THE SAME BEARING USED ON MONROE AND MADISON. THIS RESULTED IN A CENTERLINE THAT WAS WITHIN 0.14' OF THE MIDPOINT BETWEEN THE FLOW LINES AT THE NORTH END OF THESE BLOCKS AND WAS ACCEPTED TO CREATE THE EASTERLY BOUNDARY OF BLOCK 36. THE SAME PROCEDURE WAS USED TO CREATE THE CENTERLINE OF PRINCETON FROM MADISON TO LINCOLN. THE CENTERLINE OF WELLESLEY AVENUE WAS CREATED UTILIZING THE FOUND MONUMENTATION OF THE SECTION LINE AT THE INTERSECTIONS OF WELLESLEY WITH POST AND CEDAR STREETS. BLOCKS 35 AND 36 WERE CREATED OFFSETTING THE CENTERLINES AT RECORD WIDTHS. LOTS WERE CREATED AT A FULL 50 FEET COMING FROM THE SOUTH, LEAVING THE REMAINDER ON THE NORTH LOT. (AS DID THE ORIGINAL PLAT). DEEDED EXCEPTIONS TO THE LOTS FOR EXCESS RIGHT OF WAY ALONG WELLESLEY AND MONROE WERE THEN CALCULATED.

THE LOTS THUS CREATED AGREE RELATIVELY WELL WITH A WIDE VARIETY OF MONUMENTATION FOUND OF POSSIBLE UNRECORDED SURVEYS, OR HISTORICAL ATTEMPTS BY LOT OWNERS TO ASCERTAIN BOUNDARY LINES. USKH FOUND EVERYTHING FROM VARIOUS SIZES OF IRON PIPES TO REBARS, BOLTS AND PINS. REFER TO NOTES FOR DETAILS.

BASIS OF BEARING

AN ASSIGNED GPS DERIVED GRID BEARING OF N87°31'30"E BETWEEN FOUND MONUMENTATION OF THE NORTHERLY BOUNDARY LINE OF THE NORTHWEST QUARTER OF SECTION 6.

SURVEY EQUIPMENT & PROCEDURES NOTE:

HORIZONTAL CONTROL FOR THIS SURVEY WAS ESTABLISHED WITH A COMBINATION OF NETWORK STATIC OBSERVATIONS AND REDUNDANT RTK LOCATIONS UTILIZING TRIMBLE R8 MODEL 2 GNSS AND TRIMBLE 5700 DUAL FREQUENCY RECEIVERS. STATIC NETWORK PROCESSED AND ADJUSTED USING TRIMBLE GEOMATICS OFFICE V1.63 SOFTWARE. FIELD TRAVERSE PROCEDURES AND EQUIPMENT USED MEET OR EXCEED STANDARDS ESTABLISHED IN WAC 132.130-090 & -100.

LEGEND

- SECTION CORNERS – SEE NOTE "L"
- ( ) ORIGINAL PLAT COURSE–BLOCKS 17 TO 56 OF MONROE PARK ADD'N.
- ▲ FOUND PROPERTY CORNERS, SEE MONUMENT NOTES
- ○ CALCULATED POINT
- ● SET 5/8" REBAR WITH YELLOW PLASTIC CAP MARKED: "LS 30431"
- ● SET BRASS SCREW AND TAG EPOXYED IN CONCRETE, TAG MARKED "USKH LS 30431"

SURVEYOR'S CERTIFICATE

THIS MAP CORRECTLY REPRESENTS A SURVEY MADE BY ME OR UNDER MY DIRECTION IN CONFORMANCE WITH THE REQUIREMENTS OF THE SURVEY RECORDING ACT, AT THE REQUEST OF DEPARTMENT OF ECOLOGY IN MARCH – APRIL OF 2009.

GARY W ERICKSON, PLS 30431 — DATE 6/30/09

GARY W. ERICKSON, STATE OF WASHINGTON, REGISTERED 30431, PROFESSIONAL LAND SURVEYOR

SECTION INDEX

NW 1/4, SECTION 06
T25N, R43E, W.M.

DWN BY: GWE
CKD BY: DLP
DWN: 04/09/09
REV: 05/08/09
REV: 05/19/09

USKH
Engineering • Land Surveying
Planning • Materials Testing
☒ 621 W. Mallon Ave, Ste 309 Spokane, WA 99201 (509) 328-5139
☐ 313 D Street, Ste 200 Lewiston, ID 83501 (208) 746-2661
☐ 1920 Main Street, Ste 14 Ferndale, WA 98248 (360) 312-1815
☐ 5 North Colville Walla Walla, WA 99362 (509) 522-4843
☐ 115 W. Hermiston Ave, Ste 140 Hermiston, OR 97838 (541) 564-4448

USKH W.O. 1164100

1164100-ROS.dwg

RECORD OF SURVEY
FOR
DEPARTMENT OF ECOLOGY
IN THE NW 1/4 OF SECTION 06, TOWNSHIP 25 NORTH, RANGE 43 EAST, W.M., SPOKANE COUNTY, WASHINGTON

AUDITOR'S CERTIFICATE

FILED FOR RECORD THIS 1 DAY OF July 2009 AT 10:15 A.M., IN BOOK 137 OF SURVEYS AT PAGE 85-86, AT THE REQUEST OF USKH, INC.

COUNTY AUDITOR — DEPUTY AUDITOR

LEGAL DESCRIPTION AS PROVIDED BY D.O.E.

Lots seventeen (17) and eighteen (18), Block thirty-five (35) and Lots one (1), two (2), three (3), four (4), five (5), six (6), seven (7), eight (8), nine (9), twelve (12), thirteen (13), fourteen (14) and fifteen (15), Block thirty-six (36), BLOCKS 17 to 56 OF MONROE PARK ADDITION, according to plat recorded in Volume "E", of Plats, Page 71, EXCEPT that portion of Lot one (1) in said Block thirty-six (36) conveyed to the City of Spokane, described as follows:

Beginning at the Northeast corner of said lot one (1); thence West along the North line of said lot to the Northwest corner thereof; thence South along the West line of said lot, 6.9 feet; thence Easterly to a point 10 feet West of the East line of said lot and 8.5 feet South of the North line thereof; thence Southeasterly to a point on the East line of said lot 13.0 feet South of the Northeast corner thereof; thence North along the East line of said lot to the point beginning.

AND EXCEPT that portion of Lots one (1), two (2), three (3), four (4), five (5), six (6), seven (7), and eight (8), in said Block thirty-six (36), conveyed to the City of Spokane, described as follows:

Beginning at a point on the East line of said Lot one (1), 17.2 feet North of the Southeast corner thereof; thence Northwesterly along a straight line to a point 10 feet West of the East line of said Lot one (1) and 8.5 feet South of the North line thereof; thence Westerly along a straight line that intersects the West line of said Lot one (1), 6.9 feet South of the Northwest corner thereof, 5.5 feet to a point; thence Southeasterly to a point 8.7 feet North of the South line of said Lot one (1) and 5.5 feet West of the East line thereof; thence South along a line drawn 5.5 feet West of the parallel to the East line of said Lots one (1), two (2), three (3) to the South line of said Lot three (3); thence Southerly to a point on the South line of said Lot four (4), 4.4 feet West of the Southeast corner thereof; thence Southerly to a point on the South line of said Lot five (5), 3.3 feet West of the Southeast corner thereof; thence Southerly to a point on the South line of said Lot six (6), 2.2 feet West of the Southeast corner thereof; thence Southerly to a point on the South line of said Lot seven (7), 1.1 feet West of the Southeast corner thereof; thence Southerly to the Southeast corner of Lot eight (8); thence North along the East line of said Lots eight (8), seven (7), six (6), five (5), four (4), three (3), two (2), and one (1), to the point of beginning;

AND EXCEPT the portion of Lot eighteen (18), in said Block thirty-five (35), conveyed to the City of Spokane, described as follows:

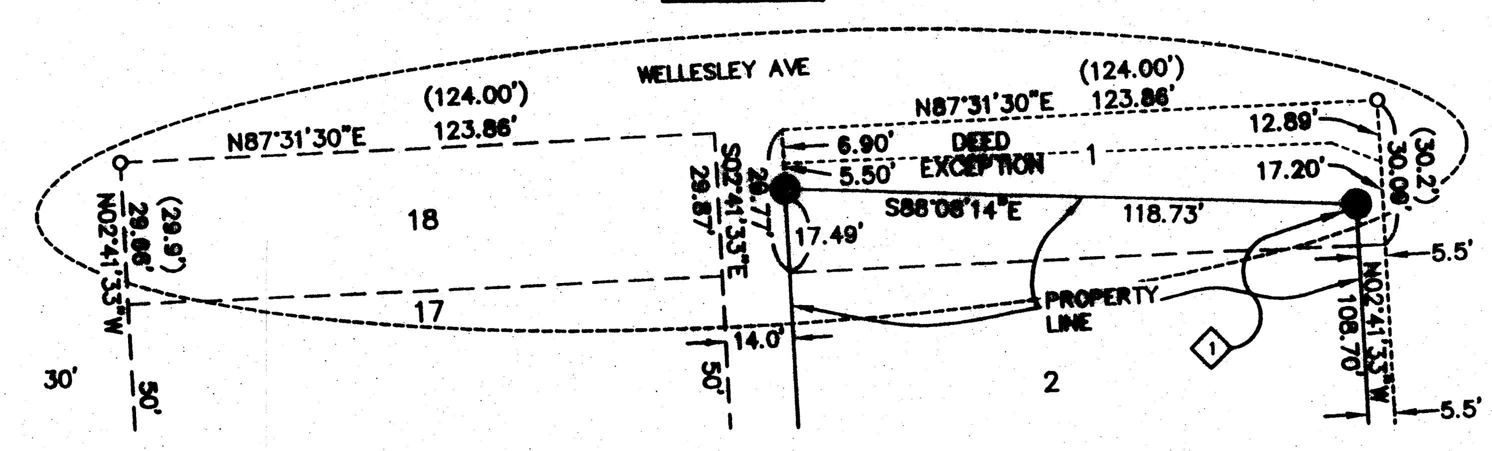
Beginning at the Northeast corner of said Lot eighteen (18); thence West along the North line of said Lot the Northwest corner thereof; thence South along the West line of said lot 13.0 feet; thence Northeasterly to a point 10 feet East of the West line of said lot 8.5 feet South of the North line thereof; thence Easterly to a point on the East line of said lot, 6.4 feet South of the Northeast corner thereof; thence North along the East line of said lot to the point of beginning.

AND ALSO EXCEPTING that portion of Lots seventeen (17) and eighteen (18) in said Block thirty-five (35), conveyed to the City of Spokane, described as follows:

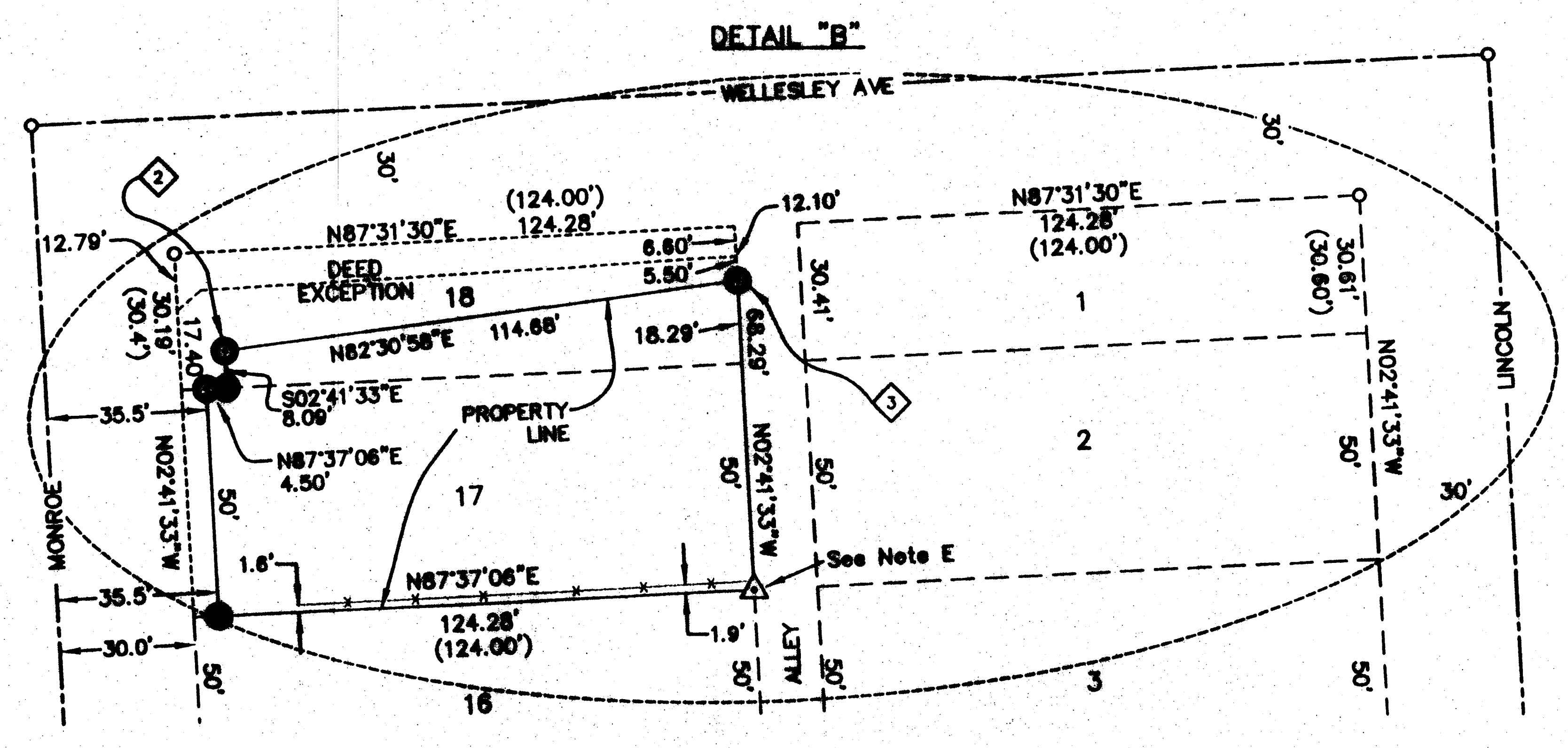
The West 5.5 feet of lot seventeen (17), Block Thirty-five (35), BLOCKS 17 to 56 MONROE PARK ADDITION TO SPOKANE, according to plat recorded in Volume "E" of Plats, Page 71; and that portion of Lot eighteen (18), said Block thirty-five (35) described as follows:

Beginning at the Southwest corner of said Lot 18; thence North along the West line to a point 17.4 feet North of the Southwest corner; thence Northeasterly along a straight line to a point 10 feet east of the West line and 8.5 feet South of the North line; thence Easterly along a straight line that intersects the East line 6.6 feet South of the Northeast corner, 5.5 feet to a point thence Southwesterly along a straight line to a point 5.5 feet East of the West Line and 8.09 feet North of the South line; thence South along a straight line to a point on the South line, 5.52 feet East of the Southwest corner; thence West along the South line to a point of beginning.

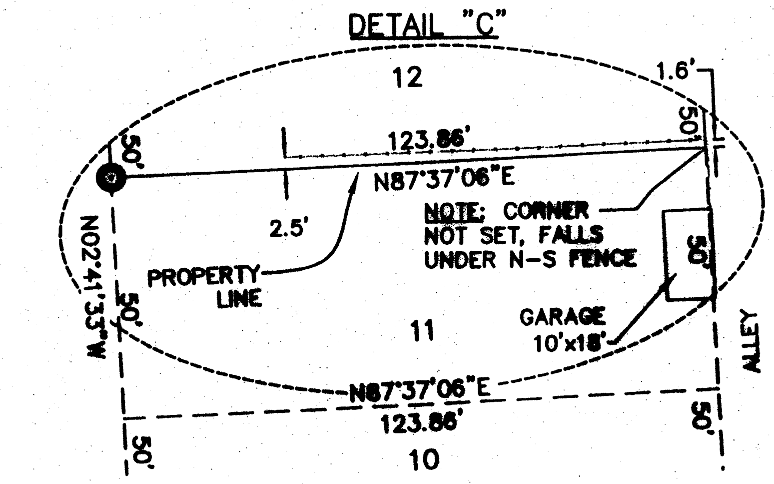
DETAIL "A"

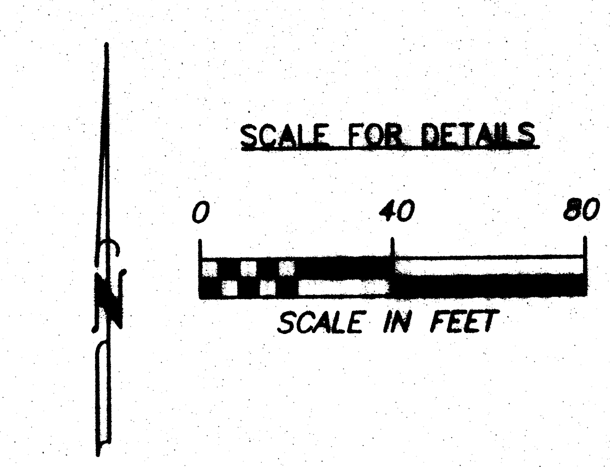


DETAIL "B"

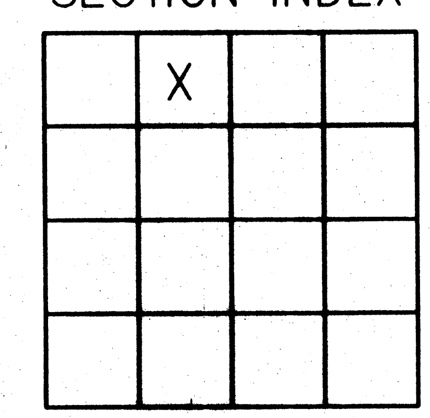


DETAIL "C"



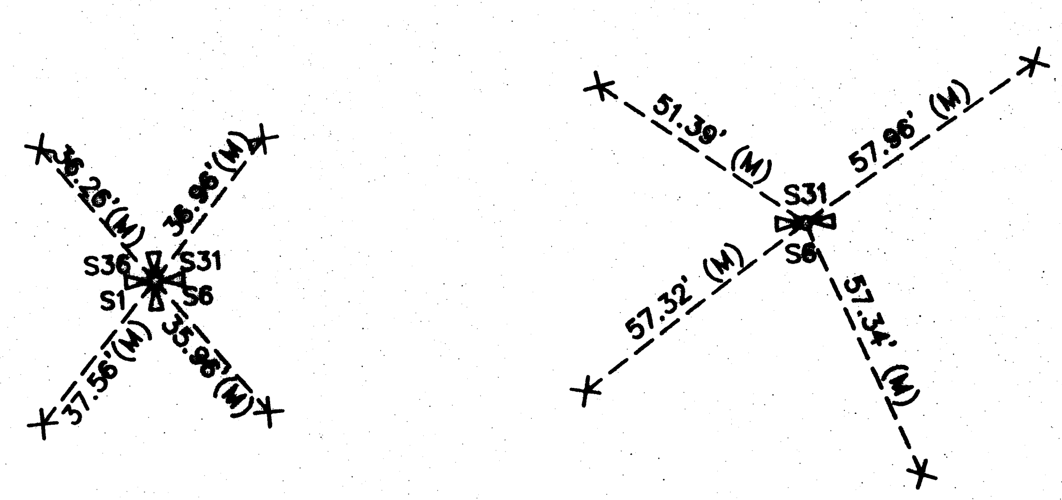


SECTION INDEX



NW 1/4, SECTION 06
T25N, R43E, W.M.

REFERENCE POINTS DETAIL



SURVEYOR'S CERTIFICATE

THIS MAP CORRECTLY REPRESENTS A SURVEY MADE BY ME OR UNDER MY DIRECTION IN CONFORMANCE WITH THE REQUIREMENTS OF THE SURVEY RECORDING ACT, AT THE REQUEST OF DEPARTMENT OF ECOLOGY IN MARCH - APRIL OF 2009.

GARY W ERICKSON, PLS 30431 — DATE 6/30/09

GARY W. ERICKSON — 30431 — REGISTERED PROFESSIONAL LAND SURVEYOR

DWN BY: GWE
CKD BY: DLP
DWN: 04/09/09
REV: 04/20/09
REV: 05/19/09

USKH
Engineering • Land Surveying
Planning • Materials Testing
☒ 621 W. Mallon Ave, Ste 309 Spokane, WA 99201 (509) 328-5139
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USKH W.O. 1164100

J.R. BONNETT ENGINEERING

CIVIL & STRUCTURAL ENGINEERING/CONSULTING
803 E. 3RD Avenue
SPOKANE, WA 99202
PHONE (509) 534-3929
FAX (509) 534-4014

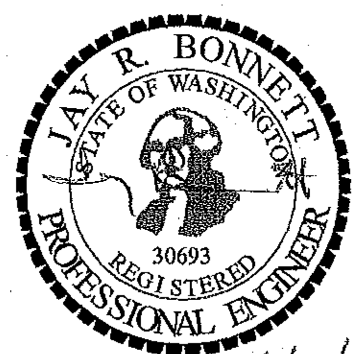
Drainage Design Calculations

of

Department of Ecology Eastern Regional Office

4601 N. Monroe Street
Spokane, WA

for



6/30/09

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Spokane, WA 99201

June, 2009
JRBE Job No. 09-045.10

CSR

DEPARTMENT OF ECOLOGY EASTERN REGIONAL OFFICE PARKING LOT RENOVATION PROJECT

Stormwater Management Narrative

PROJECT DESCRIPTION

This project consists of renovating the existing parking lots for the Department of Ecology Eastern Regional Office building. The project site is located at the northwest corner of Monroe Street and Wellesley Avenue with Madison Street to the west and Princeton Avenue to the south.

PURPOSE

This report has been prepared to summarize the extent of stormwater drainage facilities required to dispose of the proposed project stormwater runoff from a 10-year design frequency storm event in accordance to the Spokane Regional Stormwater Manual.

GEOTECHNICAL INFORMATION

A geotechnical engineering evaluation of the site has been prepared by Budinger and Associates and is attached in the Appendix for review. The onsite soils have been approved for standard drywell use with allowable infiltration rates of 0.3 cfs for single-depth drywells and 1.0 cfs for double-depth drywells, respectfully. As can be seen from the attached soils evaluation and accompanying soils map from the Spokane County Soils Survey as performed by the SCS, the soil types and the soil descriptions are as follows:

McB – Marble Variant Sandy Loam, 0 - 8% slopes: This soil is deep and moderately deep, moderately coarse textured, somewhat excessively drained soil formed from sandy glaciofluvial material; soil is underlain by thick beds of coarse sand.

PRE-DEVELOPMENT BASIN INFORMATION

The project site is currently developed consisting of parking lots on the north, west and south sides of the existing office building. An existing alley bisects the project site between the west parking lot and the office building and connects Princeton Avenue to the south and Wellesley Avenue to the north. The alley will remain undisturbed with its stormwater runoff self contained and is not included in the pre- or post-developed basin boundary maps.

The existing site is divided into seven (7) pre-developed basins; Basins '1' through '7'. Each basin drains to single-depth drywells set flush with the existing pavement and does not provide any pre-treatment prior to disposal. The existing roof will remain undisturbed and has existing roof drains tightlined to drywells located on the east side of the building within existing landscaping.

No offsite stormwater runoff enters onto the site. Please see the attached "Pre-Developed Basin Boundary Map" for additional information.

POST-DEVELOPMENT BASIN INFORMATION

The renovated project site has been divided into four (4) post-developed basins; Basins '1' through '4'. Post-Developed Basin '1', which is located adjacent to Madison Street, combines Pre-Developed Basins '1' and '2' into a single basin and contains a new single-depth drywell and grassy infiltration pond for pre-treatment prior to disposal. Post-Developed Basin '2' combines Pre-Developed Basins '3' and '4' into a single basin and contains an existing single-depth drywell and new grassy infiltration pond for pre-treatment prior to disposal. Post-developed Basin '3' combines Pre-Developed Basins '5' and '6' into a single basin and contains two existing drywells. A new catch basin with a turned-down elbow will be installed upstream of the drywells for pre-treatment prior to disposal. Post-developed Basin '4' is the same as Pre-developed Basin '7' and contains two existing drywells. A new catch basin with a turned-down elbow will be installed upstream of the drywells for pre-treatment prior to disposal.

Post-developed Basin '1' contains two existing drywells with excessive sediment buildup; therefore, Budinger & Associates obtained soil samples within the proposed swale using a test boring that extended to 25' below existing ground surface. Based on the retrieved soil samples and the percent of fines, it is feasible to use typical design outflow rates of 0.3 cfs for single-depth drywells. Please see the attached soils report for additional information.

The following table summarizes the impervious and pervious areas for each drainage basin and the pollutant-generating impervious surfaces.

Table No. 1 – Pollutant-Generating Impervious Surface Summary Table

Basin	Total Basin Area (sf)	Pavement Area (sf)	Roof Area (sf)	Conc. Area (sf)	Landscape Area (sf)	PGIS Area (sf)
'1'	22,613	17,970	0	0	4,643	17,970
'2'	7,678	4,942	0	0	2,736	4,942
'3'	9,073	5,629	0	1,909	1,535	5,629
'4'	6,559	5,494	0	295	770	5,494

CRITICAL AREAS

There are no critical areas affecting the proposed project; therefore, no mitigation measures are required for the proposed drainage facilities.

DOWN-GRADIENT ANALYSIS

All stormwater runoff generated by the proposed project will be directed to onsite swales and/or drywells and discharged into subsurface soils. The onsite soils consist of clean sands that are deep and well drained. The project will not have any down-gradient adverse impacts.

METHODOLOGY

The proposed onsite swales and drywells have been sized using the Rational Method and Bowstring Method to accommodate a 10-year design frequency storm event per the Spokane Regional Stormwater Manual. The times of concentration and rainfall intensity were determined using Table 5-6 and Table 5-7 of the Spokane Regional Stormwater Manual. Drywell infiltration rates are based on the recommended values as listed in the geotechnical engineering evaluation prepared by Budinger & Associates.

WATER QUALITY TREATMENT

This project lies within the Aquifer Sensitive Area (ASA), which requires stormwater runoff from pollutant-generating impervious surfaces (PGIS), such as asphalt pavement, to be pre-treated prior to subsurface discharge. Stormwater runoff from Post-developed Basins '1' and '2' will be directed to grassy bio-infiltration swales for the removal/treatment of Total Suspended Solids, Total Petroleum Hydrocarbons, Metals, and Phosphorous per the requirements of the Spokane Regional Stormwater Manual. Stormwater runoff from Post-Developed Basins '3' and '4' will be directed to newly installed catch basins located upstream of the existing drywells in order to provide the minimum pre-treatment levels required by the Washington State Department of Ecology's Underground Injection Control guidelines.

RESULTS

The proposed bio-infiltration swales have been adequately sized to treat and store the tributary stormwater runoff draining to each swale per the attached table.

Table No. 2 – Treatment and Storage Summary Table

Basin	Treatment Volume Required (cf)	Treatment Volume Provided (cf)	10-yr Storage Volume Required (cf)	10-yr Storage Volume Provided (cf)
'1'	467	473	448	786
'2'	129	130	63	222
'3'	0	0	0	~50 from drywell
'4'	0	0	0	~50 from drywell

OPERATIONAL CHARACTERISTICS

The operational characteristics for this project are simple and straight forward. Stormwater runoff from basins containing grassy swales will flow across the landscape areas onto the asphalt pavement then flow over the paved surface to the swale inlets. The runoff will then fill the grassy swales up to the rim of the drywells and then overflow into the drywells where it will then infiltrate into the subsurface soils.

Stormwater runoff from basins without grassy swales will flow across the landscape areas onto the asphalt pavement then flow over the paved surface to the catch basin grates. The runoff will then drain into the catch basins and then be conveyed to the nearby drywells and then infiltrate into the subsurface soils.

PERPETUAL MAINTENANCE OF FACILITIES

The project owner shall be responsible for the operation and maintenance of the proposed drainage facilities. A homeowner's association is not required for this project; therefore, a sinking fund calculation is not required to demonstrate how the owner will fund the operations and maintenance for the stormwater facilities.

CONCLUSION

As demonstrated by this report, the proposed stormwater facilities will adequately pre-treat and dispose of the generated stormwater runoff from a 10-year design storm event for the proposed onsite improvements.

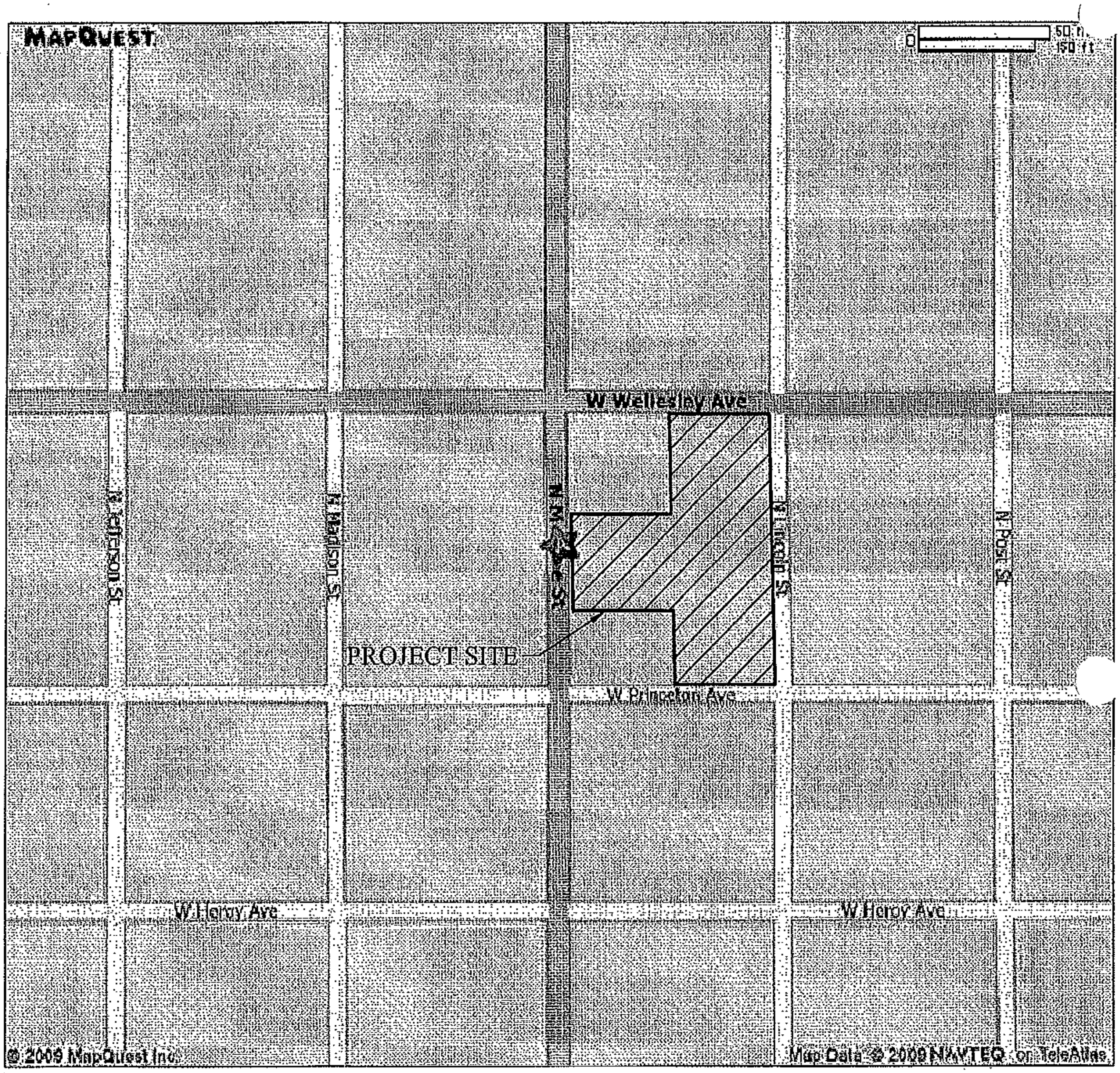
APPENDIX

MAPS
Vicinity Map
Soils Map
Pre-Developed Basin Boundary Map
Post-Developed Basin Boundary Map

DRAINAGE CALCULATIONS
10-Year Rational and Bowstring Basin Analyses
Stormwater Drain Pipe Analysis
Curb Inlet, Sump Condition Analysis
Grate Capacity, Sump Condition Analysis

GEOTECHNICAL EVALUATION

MAPS



VICINITY MAP

N.T.S.

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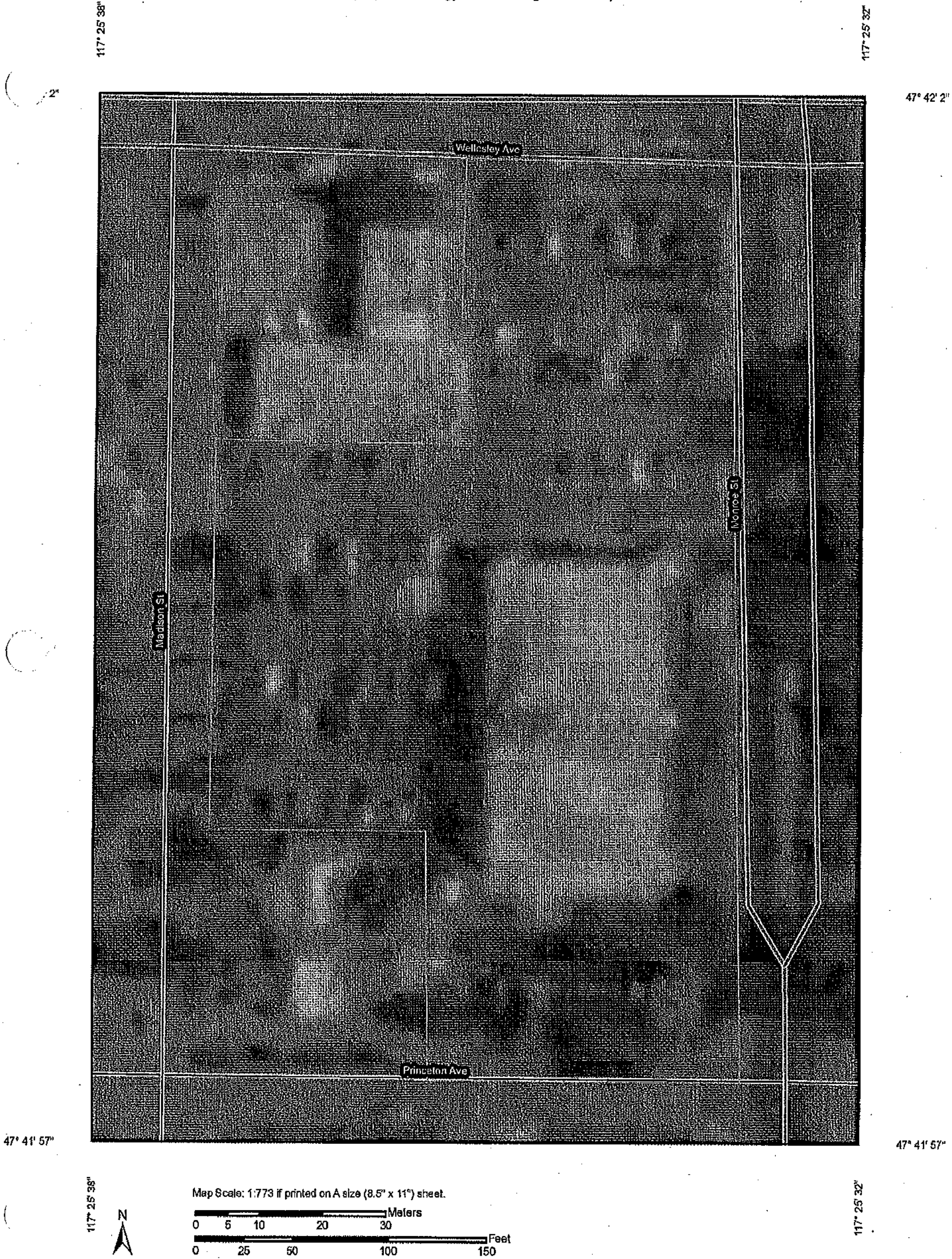

117° 25' 38"
117° 25' 32"
47° 42' 2"
Wellesley Ave
Monroe St
Madison St
Princeton Ave
47° 41' 57"
47° 41' 57"
117° 25' 38"
117° 25' 32"
Map Scale: 1:773 if printed on A size (8.5" x 11") sheet.
N
Meters
0 5 10 20 30
Feet
0 25 50 100 150

9

MAP LEGEND

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

Soils
- Soil Map Units

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

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

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

MAP INFORMATION

Map Scale: 1:773 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 11N NAD83

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

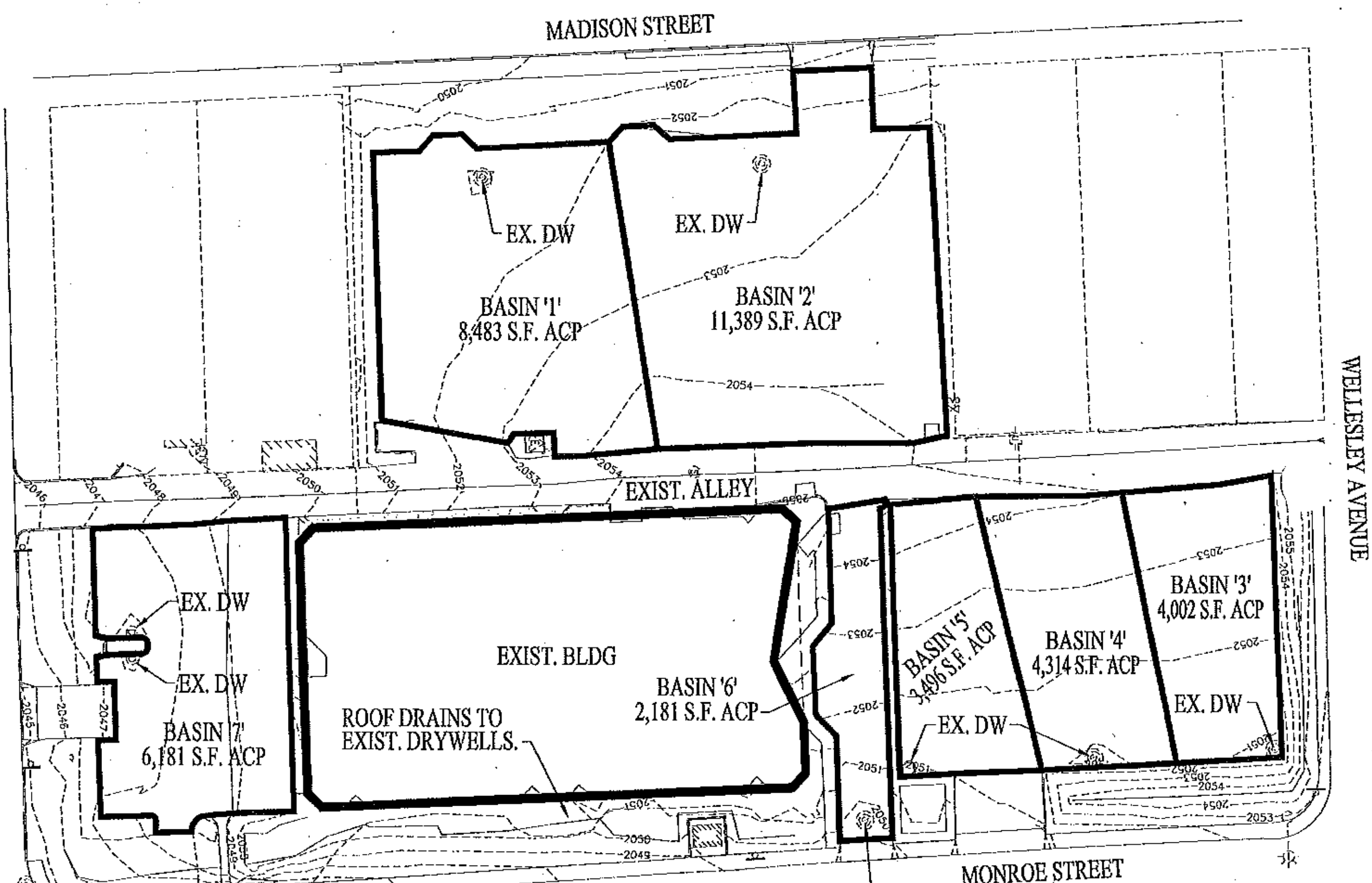
Soil Survey Area: Spokane County, Washington
Survey Area Data: Version 2, Jun 9, 2009

Date(s) aerial images were photographed: 6/27/2006

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

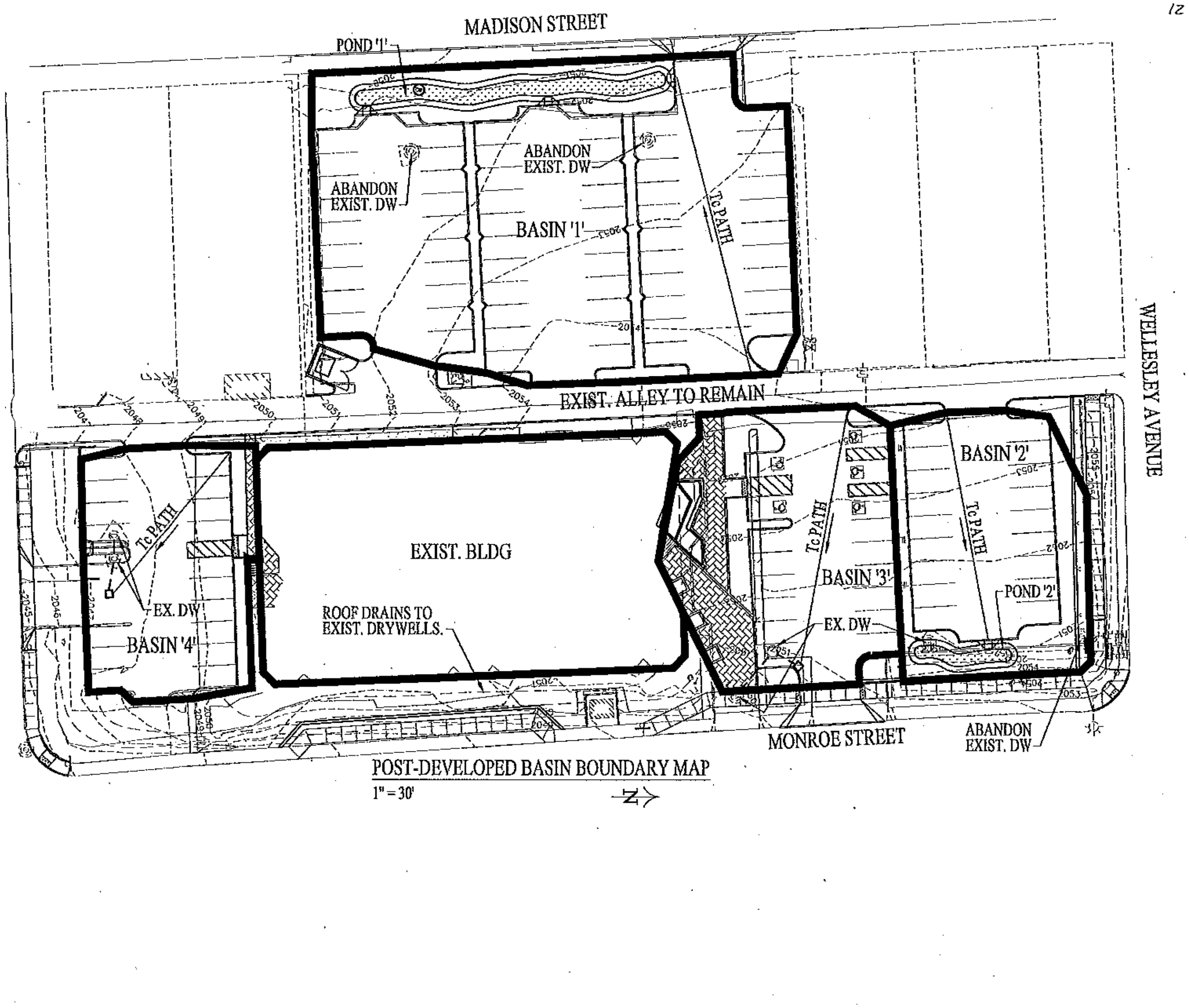
Map Unit Legend

Spokane County, Washington (WA063)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
McB	Marble variant sandy loam, 0 to 8 percent slopes	2.2	100.0%
Totals for Area of Interest		**2.2**	**100.0%**



PRE-DEVELOPED BASIN BOUNDARY MAP

1" = 30'



POST-DEVELOPED BASIN BOUNDARY MAP

1" = 30'

DRAINAGE CALCULATIONS

BOWSTRING M[illegible]OD (10 YEAR STORM DESIGN)				PROJECT:	09-045.10
DETENTION B[illegible]DESIGN				BASIN:	'1'
				REVIEWER:	CSR
NUMBER OF DRYWELLS PROPOSED				DATE:	26-Jun-09
1	Single (type 1)	0	Double (type 2)		
Total Area (calc.)		1.34			
Time of Conc. (calc.)		5.00			
Composite "C" (calc.)		0.38			
Time of Conc. (min)			5.00		
Area (Acres)			1.34		
C' Factor			0.38		
Impervious Asphalt Area to Pond			17970	sf	
Roof Area to Drywell			0	sf	
Other areas			(see above right)		
Outflow (cfs)			0.3		
Area * C" Factor			0.51		

TI[illegible] CONCENTRATION (minutes)			
Tc (s[illegible]et flow)		Tc (gutter)	
K (lawn) =	420	K (gutter) =	2400
L(A) =	0.01	L(gu) =	0.01
S(A) =	0.015	S(gu) =	0.015
Tc (A) =	0.00	Tc (gu) =	0.00
K (ACP) =	1200	Tc (gu) =	0.00
L(B) =	120	Tc (A+B) =	0.62
S(B) =	0.026	Tc (total) =	5.00
Tc (B) =	0.62	Intensity =	2.62

AREA SUMMARY			
	Areas	"C"	A*C
Pvmnt	0.41	0.90	0.371281
Roof	0.00	0.90	0
Sidewalk	0.00	0.90	0
Landscape	0.93	0.15	0.139749
	Total Area	Comp "C"	
	1.34	0.38	
Q (total) = C*I*$A_{(total)}$ =		**1.34**	cfs
Q (acp) = C*I*$A_{(acp)}$ =		**0.97**	cfs

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage Req'd) (cu. ft.) (#5-#6)
5.00	300.00	2.62	1.34	538	90.00	448
5	300	2.62	1.34	538	90	448
10	600	1.72	0.88	616	180	436
15	900	1.34	0.69	687	270	417
20	1200	1.13	0.58	749	360	389
25	1500	0.98	0.50	805	450	355
30	1800	0.88	0.45	855	540	315
35	2100	0.80	0.41	901	630	271
40	2400	0.74	0.38	944	720	224
45	2700	0.69	0.35	984	810	174
50	3000	0.64	0.33	1022	900	122
55	3300	0.61	0.31	1057	990	67
60	3600	0.58	0.29	1091	1080	11
65	3900	0.55	0.28	1123	1170	-47
70	4200	0.53	0.27	1154	1260	-106
75	4500	0.50	0.26	1184	1350	-166
80	4800	0.48	0.25	1213	1440	-227
85	5100	0.47	0.24	1240	1530	-290
90	5400	0.45	0.23	1267	1620	-353
95	5700	0.44	0.22	1293	1710	-417
100	6000	0.42	0.22	1318	1800	-482

DRAINAGE POND CALCULATIONS

Required grassy swale treatment volume:			
1133 x Asphalt/Contaminant Area x (1 ac/ 43,500 sf) =	**467**	**cu. ft.**	
Provided treatment volume (pond bot. to outlet) =	**473**	**cu. ft.**	

DRYWELL REQUIREMENTS - 10 YEAR DESIGN STORM

Maximum storage required by Bowstring =	**448**	**cu. ft.**		
Provided 10-yr total storage volume =	**786**	**cu. ft.**		
Number and type of Drywells Required =	1	Single	0	Double

POND VOL-BASIN 1

Project # 09-045.10
Basin: '1'
Reviewer: CSR
Date: 26-Jun-09

208 POND AREA CALCULATIONS: BASIN '1'

SIDE SLOPE	REQ STORAGE		BOTTOM AREA	TREATMENT AREA	TOP AREA	TOTAL DEPTH	OUTLET ELEV	TREATMENT-VOLUME BELOW OUTLET	10-YR TOTAL STORAGE VOL.
	TREATMENT	10 YR							
3 :1			748.0	1144.0	1347.0	0.75	0.50	473 CF	786 CF
	467 CF	448 CF						473 CF OK	786 CF OK

NOTE: THE TREATMENT AREA LISTED ABOVE IS THE AREA LOCATED ABOVE THE POND FLOOR AT THE "OUTLET ELEV" AND INCLUDES THE POND SIDE SLOPES.

VOL. BELOW OUTLET CALC. = [(BTM AREA + TREATMENT AREA) / 2] X OUTLET ELEV.

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BOWSTRING M[illegible]OD (10 YEAR STORM DESIGN)					PROJECT:	09-045.10
DETENTION B[illegible]DESIGN					BASIN:	'2'
					REVIEWER:	CSR
NUMBER OF DRYWELLS PROPOSED					DATE:	26-Jun-09
1	Single (type 1)	0	Double (type 2)			
Total Area (calc.)			0.40			
Time of Conc. (calc.)			5.00			
Composite "C" (calc.)			0.36			
Time of Conc. (min)				5.00		
Area (Acres)				0.40		
C' Factor				0.36		
Impervious Asphalt Area to Pond				4942	sf	
Roof Area to Drywell				0	sf	
Other areas				(see above right)		
Outflow (cfs)				0.3		
Area * C" Factor				0.15		

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage Req'd) (cu. ft.) (#5-#6)
5.00	300.00	2.62	0.38	153	90.00	63
5	300	2.62	0.38	153	90	63
10	600	1.72	0.25	175	180	-5
15	900	1.34	0.20	196	270	-74
20	1200	1.13	0.16	213	360	-147
25	1500	0.98	0.14	229	450	-221
30	1800	0.88	0.13	244	540	-296
35	2100	0.80	0.12	257	630	-373
40	2400	0.74	0.11	269	720	-451
45	2700	0.69	0.10	280	810	-530
50	3000	0.64	0.09	291	900	-609
55	3300	0.61	0.09	301	990	-689
60	3600	0.58	0.08	311	1080	-769
65	3900	0.55	0.08	320	1170	-850
70	4200	0.53	0.08	329	1260	-931
75	4500	0.50	0.07	337	1350	-1013
80	4800	0.48	0.07	345	1440	-1095
85	5100	0.47	0.07	353	1530	-1177
90	5400	0.45	0.07	361	1620	-1259
95	5700	0.44	0.06	368	1710	-1342
100	6000	0.42	0.06	375	1800	-1425

DRAINAGE POND CALCULATIONS

Required grassy swale treatment volume:		
1133 x Asphalt/Contaminant Area x (1 ac/ 43,500 sf) =	129	cu. ft.
Provided treatment volume (pond bot. to outlet) =	130	cu. ft.

DRYWELL REQUIREMENTS - 10 YEAR DESIGN STORM

Maximum storage required by Bowstring =	63	cu. ft.		
Provided 10-yr total storage volume =	222	cu. ft.		
Number and type of Drywells Required =	1	Single	0	Double

TIM[illegible] CONCENTRATION (minutes)

Tc (s[illegible]et flow)		Tc (gutter)	
K (lawn) =	420	K (gutter) =	2400
L(A) =	0.001	L(gu) =	64
S(A) =	0.015	S(gu) =	0.019
Tc (A) =	0.00	Tc (gu) =	0.19
K (ACP) =	1200	Tc (gu) =	0.19
L(B) =	91	Tc (A+B) =	0.45
S(B) =	0.029	Tc (total) =	5.00
Tc (B) =	0.45	Intensity =	2.62

AREA SUMMARY

	Areas	"C"	A-C
Pvmnt.	0.11	0.90	0.102107
Roof	0.00	0.90	0
Sidewalk	0.00	0.90	0
Landscape	0.29	0.15	0.043457
	Total Area	Comp "C"	
	0.40	0.36	

Q (total) = $C*I*A_{(total)}$ = 0.38 cfs

Q (acp) = $C*I*A_{(acp)}$ = 0.27 cfs

POND VOL-BASIN 2

Project # 09-045.10
Basin: '2'
Reviewer: CSR
Date: 26-Jun-09

208 POND AREA CALCULATIONS: BASIN '2'

SIDE	REQ STORAGE		BOTTOM	TREATMENT	TOP	TOTAL	OUTLET	TREATMENT-VOLUME	10-YR TOTAL
SLOPE	TREATMENT	10 YR	AREA	AREA	AREA	DEPTH	ELEV	BELOW OUTLET	STORAGE VOL.
3 :1			193.0	327.0	399.0	0.75	0.50	130 CF	222 CF
	129 CF	63 CF						130 CF OK	222 CF OK

NOTE: THE TREATMENT AREA LISTED ABOVE IS THE AREA LOCATED ABOVE THE POND FLOOR AT THE "OUTLET ELEV" AND INCLUDES THE POND SIDE SLOPES.

VOL. BELOW OUTLET CALC. = [(BTM AREA + TREATMENT AREA) / 2] X OUTLET ELEV.

BOWSTRING M OD (10 YEAR STORM DESIGN)					PROJECT:	09-045.10
DETENTION B ESIGN					BASIN:	'3'
					REVIEWER:	CSR
NUMBER OF EXISTING DRYWELLS					DATE:	26-Jun-09
2	Single (type 1)	0	Double (type 2)			
Total Area (calc.)			0.21			
Time of Conc. (calc.)			5.00			
Composite "C" (calc.)			0.77			
Time of Conc. (min)				5.00		
Area (Acres)				0.21		
C' Factor				0.77		
Impervious Asphalt Area to Pond				5629	sf	
Roof Area to Drywell				0	sf	
Other areas				(see above right)		
Outflow (cfs)				0.6		
Area * C" Factor				0.16		

#1	#2	#3	#4	#5	#6	#7
Time Inc. (min.)	Time Inc. (sec.) (#1*60)	Intensity (in./hr.)	Q dev. (cfs) (A*C*#3)	V in (cu. ft.)	V out (cu. ft.) (Outf.*#2)	Storage Req'd) (cu. ft.) (#5-#6)
5.00	300.00	2.62	0.42	170	180.00	-10
5	300	2.62	0.42	170	180	-10
10	600	1.72	0.28	194	360	-166
15	900	1.34	0.22	216	540	-324
20	1200	1.13	0.18	236	720	-484
25	1500	0.98	0.16	254	900	-646
30	1800	0.88	0.14	269	1080	-811
35	2100	0.80	0.13	284	1260	-976
40	2400	0.74	0.12	297	1440	-1143
45	2700	0.69	0.11	310	1620	-1310
50	3000	0.64	0.10	322	1800	-1478
55	3300	0.61	0.10	333	1980	-1647
60	3600	0.58	0.09	344	2160	-1816
65	3900	0.55	0.09	354	2340	-1986
70	4200	0.53	0.08	364	2520	-2156
75	4500	0.50	0.08	373	2700	-2327
80	4800	0.48	0.08	382	2880	-2498
85	5100	0.47	0.08	391	3060	-2669
90	5400	0.45	0.07	399	3240	-2841
95	5700	0.44	0.07	407	3420	-3013
100	6000	0.42	0.07	415	3600	-3185

TIM CONCENTRATION (minutes)			
Tc (s et flow)		Tc (gutter)	
K (lawn) =	420	K (gutter) =	2400
L(A) =	0.01	L(gu) =	0.0001
S(A) =	0.006	S(gu) =	0.019
Tc (A) =	0.00	Tc (gu) =	0.00
K (ACP) =	1200	Tc (gu) =	0.00
L(B) =	99	Tc (A+B) =	0.41
S(B) =	0.04	Tc (total) =	5.00
Tc (B) =	0.41	Intensity =	2.62

AREA SUMMARY			
	Areas	"C"	A*C
Pvmnt	0.13	0.90	0.116302
Roof	0.00	0.90	0
Sidewalk	0.04	0.90	0.039442
Landscape	0.04	0.15	0.005286
	Total Area	Comp "C"	
	0.21	0.77	
$Q (total) = C*I*A_{(total)}$ =		0.42	cfs
$Q (acp) = C*I*A_{(acp)}$ =		0.30	cfs

DRAINAGE POND CALCULATIONS			
Required grassy swale treatment volume:			
1133 x Asphalt/Contaminant Area x (1 ac/ 43,500 sf) =	146	cu. ft.	
Provided treatment volume (pond bot. to outlet) =	N/A	cu. ft.	NO SWALE REQ'D DUE TO EXISTING DRYWELLS. ADD CATCH BASIN UPSTREAM OF DRYWELL FOR TREATMENT.
DRYWELL REQUIREMENTS - 10 YEAR DESIGN STORM			
Maximum storage required by Bowstring =	0	cu. ft.	DRYWELL OUTFLOW RATE EXCEEDS STORM VOLUME IN; THEREFORE, NO STORAGE REQUIRED.
Provided 10-yr total storage volume =	N/A	cu. ft.	
Number and type of Drywells Required =	2	Single	0 Double

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BOWSTRING METHOD (10 YEAR STORM DESIGN)					PROJECT:	09-045.10
DETENTION BASIN DESIGN					BASIN:	'4'
					REVIEWER:	CSR
NUMBER OF EXISTING DRYWELLS					DATE:	26-Jun-09
2	Single (type 1)	0	Double (type 2)			
Total Area (calc.)			0.15			
Time of Conc. (calc.)			5.00			
Composite "C" (calc.)			0.81			
Time of Conc. (min)				5.00		
Area (Acres)				0.15		
C' Factor				0.81		
Impervious Asphalt Area to Pond				5494	sf	
Roof Area to Drywell				0	sf	
Other areas				(see above right)		
Outflow (cfs)				0.6		
Area * C" Factor				0.12		

TIME OF CONCENTRATION (minutes)			
Tc (sheet flow)		Tc (gutter)	
K (lawn) =	420	K (gutter) =	2400
L(A) =	0.01	L(gu) =	0.0001
S(A) =	0.020	S(gu) =	0.019
Tc (A) =	0.00	Tc (gu) =	0.00
K (ACP) =	1200	Tc (gu) =	0.00
L(B) =	72	Tc (A+B) =	0.30
S(B) =	0.04	Tc (total) =	5.00
Tc (B) =	0.30	Intensity =	2.62

AREA SUMMARY			
	Areas	"C"	A*C
Pvmnt	0.13	0.90	0.113512
Roof	0.00	0.90	0
Sidewalk	0.01	0.90	0.006095
Landscape	0.02	0.15	0.002652
	Total Area	Comp "C"	
	0.15	0.81	
Q (total) = $C*I*A_{(total)}$ =		0.32	cfs
Q (acp) = $C*I*A_{(acp)}$ =		0.30	cfs

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage Req'd (cu. ft.) (#5-#6)
5.00	300.00	2.62	0.32	129	180.00	-51
5	300	2.62	0.32	129	180	-51
10	600	1.72	0.21	147	360	-213
15	900	1.34	0.16	164	540	-376
20	1200	1.13	0.14	179	720	-541
25	1500	0.98	0.12	193	900	-707
30	1800	0.88	0.11	205	1080	-875
35	2100	0.80	0.10	216	1260	-1044
40	2400	0.74	0.09	226	1440	-1214
45	2700	0.68	0.08	235	1620	-1385
50	3000	0.64	0.08	244	1800	-1556
55	3300	0.61	0.07	253	1980	-1727
60	3600	0.58	0.07	261	2160	-1899
65	3900	0.55	0.07	269	2340	-2071
70	4200	0.53	0.06	276	2520	-2244
75	4500	0.50	0.06	283	2700	-2417
80	4800	0.48	0.06	290	2880	-2590
85	5100	0.47	0.06	297	3060	-2763
90	5400	0.45	0.06	303	3240	-2937
95	5700	0.44	0.05	309	3420	-3111
100	6000	0.42	0.05	315	3600	-3285

DRAINAGE POND CALCULATIONS			
Required grassy swale treatment volume:			
1133 x Asphalt/Contaminant Area x (1 ac/ 43,500 sf) =	143	cu. ft.	
Provided treatment volume (pond bot. to outlet) =	N/A	cu. ft.	NO SWALE REQ'D DUE TO EXISTING DRYWELLS.
			ADD CATCH BASIN UPSTREAM OF DRYWELL FOR TREATMENT.
DRYWELL REQUIREMENTS - 10 YEAR DESIGN STORM			
Maximum storage required by Bowstring =	0	cu. ft.	DRYWELL OUTFLOW RATE EXCEEDS STORM VOLUME IN;
			THEREFORE, NO STORAGE REQUIRED.
Provided 10-yr total storage volume =	N/A	cu. ft.	
[illegible] r and type of Drywells Required =	2	Single	0 Do

J. R. BONNETT ENGINEERING
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SPOKANE, WA 99202
TEL: (509) 534-3929
FAX: (509) 534-4014

JOB 09-045.10
SHEET NO. 20 OF
CALCULATED BY CSR DATE 6/2009
CHECKED BY DATE
SCALE

8-INCH STORM DRAIN PIPE.txt

Manning Pipe Calculator

Given Input Data:
- Shape .... Circular
- Solving for .... Flowrate
- Diameter .... 8.0000 in
- Depth .... 7.6250 in
- Slope .... 0.0100 ft/ft
- Manning's n 0.0130

Computed Results:
- Flowrate .... 1.2976 cfs > (0.9) * (2.62 in/hr) * (5,629 sf / 43,560) = 0.30 cfs;
- Area .... 0.3491 ft2 therefore, use 8-inch ductil iron storm drain pipe.
- Wetted Area 0.3431 ft2
- Wetted Perimeter .... 21.6410 in
- Perimeter .... 25.1327 in
- Velocity .... 3.7814 fps
- Hydraulic Radius .... 2.2832 in
- Percent Full .... 95.3125 %
- Full flow Flowrate .... 1.2084 cfs
- Full flow velocity .... 3.4618 fps

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JOB 09-045.10
SHEET NO. 21 OF
CALCULATED BY CSL DATE 6/2009
CHECKED BY DATE
SCALE

Curb Inlet, Sump Condition – north curb inlet to Pond '1'

ACP area = 6,586 sf

$Q_{act} = CIA$

$C = 0.90$

$I = m/T_c^n$ $T_c = 5$ min., $m = 6.98$, $n = 0.609$

$I = 2.62$ in/hr

$Q_{act} = (0.90)(2.62 \text{ in/hr})\left(\frac{6,586 \text{ sf}}{43,560}\right) = 0.36$ cfs

Per SRSM, Eqn 8-26:

$Q_{all} = 3.0 L d^{3/2}$

$L = 2.5'$

$d = 0.25'$

$Q_{all} = (3.0)(2.5')(0.25')^{3/2}$
$= 0.94$ cfs

0.94 cfs ≥ 0.36 cfs ∴
Use 2.5' wide curb inlet

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JOB 09-045.10
SHEET NO. 22 OF
CALCULATED BY CSB DATE 6/2009
CHECKED BY DATE
SCALE

Grate Inlet, Sump Condition – grate inlet for Basin '3'

$Q_{act} = C \cdot I \cdot A$

$C = 0.90$

$I = \frac{m}{T_c^n}$ $T_c = 5$ min, $m = 6.98$, $n = 0.609$

$I = 2.62$ in/hr

$A = 5{,}629$ sf / 43,560 sf/ac = 0.129 ac

$Q_{act} = (0.90)(2.62$ in/hr$)(0.129$ ac$) = 0.30$ cfs

Per SRSM Eqn 8-24:

$Q_{all} = CPd^{3/2}$

$C = 3.0$

$P = 3.13'$ (accounts for 50% clogging)

$d = 0.25'$

$Q_{all} = (3.0)(3.13')(0.25')^{3/2}$
$= 1.17$ cfs

1.17 cfs ≥ 0.30 cfs $\therefore$

Use Type 1 Catch basin w/ slotted grate per Wilbert Precast Product #'s 1827 & 1270

I = rainfall intensity (inches/hour) (refer to Section 5.5.3); and,

A = drainage area (acres).

5.5.1 RUNOFF COEFFICIENTS

Table 5-5 provides runoff coefficients for the 10-year storm frequency. Steeply sloped areas and less frequent, higher intensity storms require the use of higher coefficients because infiltration and other losses have a proportionally smaller effect on runoff. Generally, runoff coefficients should be increased by 10% when designing for a 25-year frequency; by 20% for a 50-year frequency; and by 25% for a 100-year frequency. Runoff coefficients should not be increased above 0.95.

TABLE 5-5
RUNOFF COEFFICIENTS FOR THE RATIONAL METHOD
(10-YEAR RETURN FREQUENCY)

	Runoff Coefficient (C)		
Type of Cover	**Flat (<2%)**	**Rolling (2% - 10%)**	**Hilly (>10%)**
Pavement and Roofs	0.90	0.90	0.90
Earth Shoulders	0.50	0.50	0.50
Drives and Walks	0.90	0.90	0.90
Gravel Pavement	0.50	0.55	0.60
Lawns, Sandy Soil	0.10	0.15	0.20
Lawns, Heavy Soil	0.17	0.22	0.35
Grass Shoulders	0.25	0.25	0.25
Side Slopes, Earth	0.60	0.60	0.60
Side Slopes, Turf	0.30	0.30	0.30
Median Areas, Turf	0.25	0.30	0.30
Cultivated Land, Clay and Loam	0.50	0.55	0.60
Cultivated Land, Sand and Gravel	0.25	0.30	0.35
Woodland and Forest	0.10	0.15	0.20
Meadow and Pasture Land	0.25	0.30	0.35

Source: WSDOT Hydraulics Manual, March 2004

5.5.2 TIME OF CONCENTRATION

The travel time, the time required for flow to move through a flow segment, shall be computed for each flow segment. The time of concentration is equal to the sum of the travel times for all flow segments. The procedure described below was developed by the NRCS. It is sensitive to slope, type of ground cover, and the size of channel. The time of concentration can be calculated as follows:

$$T_t = \frac{L}{K\sqrt{S}} \quad (5\text{-}11)$$

$$T_c = T_{t1} + T_{t2} + \ldots + T_{tn} \quad (5\text{-}12)$$

Where:
- T_t = travel time of flow segment (minutes);
- T_c = time of concentration (minutes);
- L = length of segment (feet);
- K = ground cover coefficient, Table 5-6 (feet/minute);
- S = slope of segment (feet/foot); and,
- n = number of flow segments.

The time of concentration shall not be less than 5 minutes. For a few drainage areas, the time of concentration that produces the largest amount of runoff is less than the time of concentration for the entire basin. This can occur when two or more basins have dramatically different types of cover. The most common case would be a large paved area together with a long narrow strip of natural area. In this case, the engineer shall check the runoff produced by the paved area alone to determine if this scenario would cause a greater peak runoff rate than the peak runoff rate produced when both land segments are contributing flow. The scenario that produces the greatest runoff shall be used, even if the entire basin is not contributing flow to this runoff.

5.5.3 INTENSITY

The equation for calculating rainfall intensity is:

$$I = \frac{m}{T_C^n} \quad (5\text{-}13)$$

Where: m = coefficient of rainfall intensity, Table 5-7;

n = coefficient of rainfall intensity, Table 5-7;

I = rainfall intensity (inches/hour); and,

T_c = time of concentration (minutes).

TABLE 5-6
GROUND COVER COEFFICIENTS

Type of Cover	K (feet/minute)
Forest with heavy ground cover	150
Minimum tillage cultivation	280
Short pasture grass or lawn	420
Nearly bare ground	600
Small roadside ditch w/grass	900
Paved area	1,200
Gutter flow:	
4 inches deep	1,500
6 inches deep	2,400
8 inches deep	3,100
Storm Sewers:	
12 inch diameter	3,000
18 inch diameter	3,900
24 inch diameter	4,700
Open Channel Flow (n = .040):	
12 inches deep	1,100
Narrow Channel (w/d =1):	
2 feet deep	1,800
4 feet deep	2,800
Open Channel Flow (n = .040):	
1 foot deep	2,000
Wide Channel (w/d =9):	
2 feet deep	3,100
4 feet deep	5,000

Source: WSDOT Hydraulics Manual, March 2004

TABLE 5-7
INDEX TO RAINFALL COEFFICIENTS

2-year Event		10-year Event		25-year Event		50-year Event		100-year Event	
m	n	m	n	m	n	m	n	m	n
3.47	0.556	6.98	0.609	9.09	0.626	10.68	0.635	12.33	0.643

Source: WSDOT Hydraulics Manual, March 2004

The rainfall intensity (I) coefficients (m and n) have been determined for Spokane for the 2-, 10-, 25-, 50-, and 100-year storm events. These coefficients were developed from NOAA Atlas 2 and are shown in Table 5-7.

5.6 BOWSTRING METHOD (MODIFIED RATIONAL METHOD)

This method is used to estimate storage requirements for a given design storm using a series of hydrographs for different storm durations (t).

Depending on the relative magnitude of the time of concentration (T_c) and the storm duration, the shape of the hydrograph generated with this method varies from triangular to trapezoidal (see Figure 5-7).

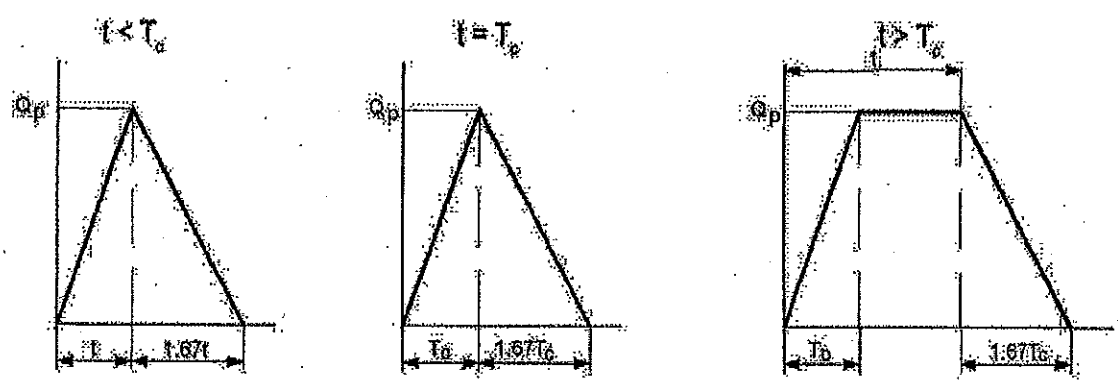

Figure 5-7 – Bowstring Method Hydrographs

The recession period (T_R) of the hydrograph is given by Equation 5-14.

flow control design storm event (refer to Section 2.2.4). If a bio-infiltration facility will also be used as a detention facility, refer to Section 7.3.2 for additional information.

Bio-Infiltration Swale Design

Bio-infiltration swales shall be sized using either Equation 6-1a or 6-1b. These equations estimate the volume required to treat stormwater runoff and were developed using the Alternate Hydrograph Method found in the *Stormwater Management Manual for Eastern Washington.*

$$V = 1133AP^{1.53} \qquad (6\text{-}1a)$$

$$V = 1815AP^{1.53} \qquad (6\text{-}1b)$$

Where: V = volume of bio-infiltration swale (cubic feet);

A = hydraulically connected impervious area to be treated (acres); and,

P = precipitation amount for the 6-month NRCS Type II 24 hour water quality design storm.

P shall be 1 inch for the all of the Spokane region, therefore the above equations can be simplified as follows:

$$V = 1133A \qquad (6\text{-}1c)$$

$$V = 1815A \qquad (6\text{-}1d)$$

Equations 6-1a and 6-1c can only be used when the following requirements are met, otherwise, Equations 6-1b and 6-1d shall be used:

- The subgrade soils have less than 12% fines; and,
- The subgrade soils have an infiltration rate greater than 0.15 in/hr.

Appendix 6A provides an example calculation for bioinfiltration swales.

Bio-Infiltration Swale Minimum Requirements

Bio-infiltration facilities shall meet the minimum requirements for limiting layers, setbacks, slopes, embankments, planting, and general requirements specified in Sections 7.5.2 and 7.8. In addition, the design of bio-infiltration swales shall conform to the requirements described below.

<u>Treatment Design Depth and Soil Criteria:</u> Bio-infiltration swales shall fully contain the design treatment volume with a maximum treatment design depth (from the swale

GEOTECHNICAL EVALUATION

Budinger & Associates
Proudly serving the Inland Northwest for over 30 years

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Gina Bartley, LEED AP
Sherry Pratt Van Voorhis Landscape Architects
621 W. Mallon #306
Spokane, WA 99201

June 29, 2009

Project Number H09170

PROJECT: Department of Ecology Building Stormwater Design
Spokane, WA

SUBJECT: Results of Hydrogeologic
Exploration & Analysis

Dear Ms. Bartley,

Budinger & Associates, Inc. is pleased to provide this report summarizing the results of hydrogeologic exploration and analysis to facilitate design of stormwater improvements at the Eastern Regional Department of Ecology Building on Wellesley Avenue and Monroe Street in Spokane, WA. You retained our services to evaluate subsurface drainage potential to assist the civil engineer in developing a viable stormwater design. Other geotechnical subjects such as pavements, earthwork, and foundations are beyond the scope. The outline of this report is as follows:

- Project Considerations & Scope
- Field & Laboratory Summary
- Surface Conditions
- Subsurface Conditions
- Groundwater
- Soil Permeability
- Conclusions & Recommendations
- Limitations
- Appendix – Field and Laboratory Methods
- Imbedded Tables
    - Table 1 – Estimated Design Discharge
- Attached Tables and Figures
    - Table 2 – Laboratory Summary
    - Figure 1 – Vicinity Map
    - Figure 2 – Site Plan
    - Figure 3 – Guide to Soil & Rock Descriptions
    - Figure 4 – Boring Log
    - Figure 5 – Grain Size Distribution Results
    - Figures 6-1 & 6-2 – Drywell Infiltration Test Results
- Important Information About Your Geotechnical Engineering Report

Project Considerations & Scope
We understand that stormwater improvements are proposed in the Department of Ecology parking areas surrounding the existing building, as illustrated in the attached *Site Plan.* The client would like to determine if existing drywells to the north and south of the building are feasible for reuse in a new stormwater disposal plan and would like information about infiltration potential to the west of the building for proposed drywells.

The services were limited to the following scope in accordance with proposal Number 135H9 dated June 2, 2009 – revised June 12, 2009:

1. Conduct two full scale drywell infiltration tests in accordance with Spokane County Guidelines for Stormwater Management, *Appendix I-4.5 Spokane County Public Works Department Standard for Estimating Outflow Rate from a Drywell under Full-Scale, Constant Head Conditions* (February 6, 1996).
2. Drill a geotechnical boring up to 25 feet deep to evaluate boundary conditions; retain samples at appropriate intervals by split-spoon method.
3. Conduct laboratory testing to further characterize representative index properties of target soils for infiltration.
4. Prepare recommendations and a report for designing stormwater infiltration through drywells

Field & Laboratory Summary
We conducted two full-scale drywell tests and one boring to a depth of 26 feet. A representative sample was tested in the laboratory. The drywell test and boring locations are illustrated in the attached *Site Plan.* The conditions encountered in the boring are described further in the *Boring Log.* A *Guide to Soil & Rock Descriptions* is also included. Figures and Tables are attached as listed on page 1. The field and laboratory methods are described further in the *Appendix.*

Surface Conditions
The site is relatively flat with the highest point near the center of the property (northwest corner of the building) at an elevation of 2055 feet. The lowest portion of the property is near the southeast corner (Monroe Street and Princeton Avenue) at an elevation of 2045 feet.

Existing surface conditions consist of paved parking areas with traffic islands in several areas and landscaped portions on the exterior of the parking areas. Eight drywells are currently present in the parking areas. Each drywell was Type A (single depth). Various amounts of sediment were built-up in the barrel section. At the time of field-work no water was present in the drywells. No treatment occurs prior to injection. The proposed location for a new drywell is in an existing landscaped area with trees and shrubs.

Subsurface Conditions
Based on characteristics relevant to drainage, two layers were encountered: 1) *FILL* and 2) *CLEAN SAND*. The layers are described further below.

FILL
Fill was not encountered in the *Test Boring*, however; known *FILL* including pavements and drain rock which surrounds existing drywells is present. Other *FILL* such as utility trench backfill is likely present.

CLEAN SAND
Sand with small amounts of gravel was encountered from ground surface to the end of exploration at 26 feet. In accordance with the USCS (Unified Soil Classification System), a sample classified as SP. The texture was medium to coarse and the condition was dense. The percentage of fines was 4.2% for the sample tested and the moisture content was 3.4%.

Groundwater
Groundwater was not encountered in the boring during fieldwork.

Soil Permeability
Exfiltration rates for drywells were estimated based on percentage of fines (material passing the # 200 sieve) in accordance with the *Spokane Regional Stormwater Manuel, Appendix 4A Spokane 200 Method* developed for Spokane County and the City of Spokane as summarized in the following table.

TABLE 1

					Estimated Design Discharge
Layer	*Test Boring Number*	*Depth (ft)*	*USCS Classification*	*Fines %*	*IRSCC Determined Rates (cfs/ft)*
CLEAN SAND	*1*	*9½ to 11*	*SP*	*4.2*	*0.07*

* Note: Safety factors were selected based on percent fines and laboratory methods per IRSCC. A safety factor of 1.5 was used for Boring 1 at 9 feet.

We tested two existing drywells in the parking areas as described below.

For drywell #1 (north area of property), a head level of approximately 2.0 feet was maintained for the constant head portion of the test. An average stabilized flow rate of 197 gallons per minute (gpm) was achieved for the steady state period of the test. 197 gpm was the maximum attainable flow through 600 feet of 2.5-inch fire hose. In 8 minutes after water flow to the drywell was stopped, the head level fell from 2.0 feet to 0.2 feet. 0.2 feet of head remained in the drywell 37 minutes after water flow was stopped likely due to approximately 1 foot of sediment build-up in the drywell.

Flow to drywell #2 (south area of property) was maintained at a head level of 1.5 feet for the constant head period of the test. The stabilized flow rate was 258 gpm, which was the maximum attainable flow through 200 feet of 2.5-inch fire hose. The head level fell from 1.5 feet to 0.2 feet in 12 minutes after flow was stopped. We checked the head level again at 28 minutes after flow was stopped and the head level was 0 feet. Infiltration test results are presented in *Figures 6-1 and 6-2*, attached.

Conclusions & Recommendations
We conclude that stormwater infiltration using a drywell is feasible targeting the *CLEAN SAND* layer at typical design outflow rates of 0.3 cubic feet per second (cfs) for a single depth drywell (Type A) or 1.0 cfs for a double depth drywell (Type B). Swales should be sized so that remaining stormwater will fully drain in less than 72 hours.

Limitations

Services were limited to the exploration, testing, and analysis described herein. This report should not be used for other purposes. Geotechnical engineering for other civil, environmental, or permitting aspects of the project are beyond the scope of this involvement.

Thank you for the opportunity to provide these services. Enclosed is a document titled *Important Information About Your Geotechnical Report* to assist with understanding the context within which these services were conducted and provided guidance for using this report appropriately. Please call if you have any questions or would like further assistance.

Respectfully Submitted:
BUDINGER & ASSOCIATES, INC.

Thomas Black, EIT
Staff Engineer

John E. Finnegan, PE, LHG
Geotechnical Engineer

TBB/tb
Addressee - 3
JR Bonnett Engineering (Chad Riggs, PE) – 1

APPENDIX

FIELD AND LABORATORY METHODS

FIELD EXPLORATION

Fieldwork was conducted on June 17 and 23, 2009 by the following Budinger & Associates, Inc. personnel:

- Ethan Hageman (Licensed Driller)
- Thomas Black (Staff Engineer)
- John Finnegan, PE (Principal Engineer)

BORINGS *ASTM D 6151*

A truck mounted Mobile B-57 drill rig was used to drill the boring at the proposed location for stormwater infiltration. Air rotary overburden system was used to advance the borehole and provide a temporary casing. The encountered sand drilled easily.

SOIL SAMPLES

Split-spoon samples were obtained at intervals using 2-inch outside diameter (OD) and 3-inch OD split-spoon samplers. A Safe-T driver and hoist with a 140-pound ram and 30-inch drop height was used to provide a test of penetration resistance. The penetration resistance is recorded as the number of blows per foot to drive the sampler. Cutting samples were returned along the perimeter by the auger flights.

DRYWELL TESTS

We tested two drywells in general accordance with the method presented in the *Spokane Regional Stormwater Manuel, Appendix 4B Full-Scale Drywell Test Method (April 2008)*. Water was supplied from a near by fire hydrant and conveyed with 2.5-inch diameter fire hose. Flow rates were measured with a calibrated in-line meter.

SOIL & ROCK CLASSIFICATION *ASTM D 2488*

The encountered soils were classified visually from split-spoon samples, observation of cuttings, drill rig response, and laboratory testing. A condensed summary of the classification methods is presented in the attached *Guide to Soil & Rock Descriptions*. Further details are below.

UNIFIED SOIL CLASSIFICATION SYSTEM *ASTM D 2487*

The soil descriptions presented on the *Boring Log* is intended to comply with the Unified Soil Classification System (USCS), which is recognized internationally in the fields of engineering and construction.

HORIZONTAL & VERTICAL CONTROL

The boring was located based on plans provided as presented in the attached *Site Plan*. Horizontal locations are accurate to ±5 feet based on the plans provided. The elevations at the surface of the boring is accurate to ±1 feet based on interpolation from topographic information provided.

LABORATORY ANALYSIS

Laboratory testing was performed on representative samples of the native soil encountered to provide data used in our assessment of soil characteristics. The tests were chosen to assess natural moisture contents, and grain-size distribution.

Tests were conducted, where practical, in accordance with nationally recognized standards (ASTM, AASHTO, etc.), which are intended to model in-situ soil conditions and behavior. The results are summarized in the *Laboratory Summary*.

INDEX PROPERTIES

MOISTURE CONTENT *ASTM D 2116*

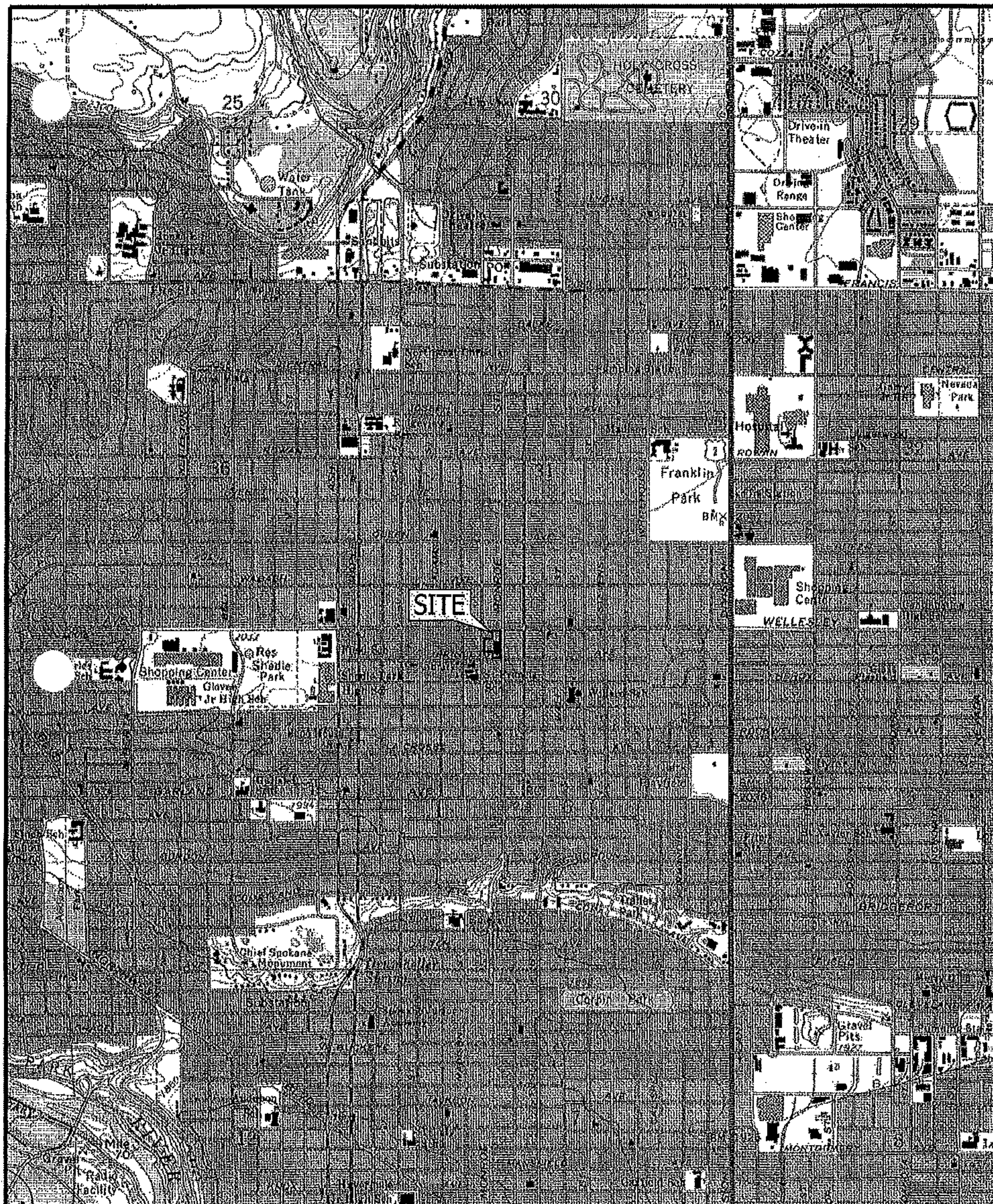
Moisture contents were determined by direct weight proportion (weight of water/weight of dry soil) determined by drying soil samples in an oven until reaching constant weight.

GRADATION *ASTM D 421*

Gradation analysis was performed by the mechanical sieve method. The mechanical sieve method is utilized to determine particle size distribution based upon the dry weight of sample passing through sieves of varying mesh sizes.

Table 2 ***LABORATORY SUMMARY***

		UNITS	Test Methods	
LABORATORY NUMBER				09-2271
TEST PIT NUMBER				1
DEPTH	TOP	ft		9½
	BOTTOM	ft		11
SAMPLE TYPE				3"SS
MOISTURE		%	ASTM D 2216	3.4
USCS CLASSIFICATION				SP
	3"		ASTM D 422	
S	1½"	%		
I	1"			
E	3/4" GRAVEL	P		100
V	1/2"	A		99
E	3/8"	S		99
	#4	S		98
S	#10	I		91
I	#16	N		67
Z	#30 SAND	G		24
E	#40			13
	#100			6
	#200		ASTM D 1140	4.2



N

SCALE: 1"=2000'

0 1000 2000

SECTION 6
T 25 N R 42 E
U.S.G.S. 1986

Budinger & Associates

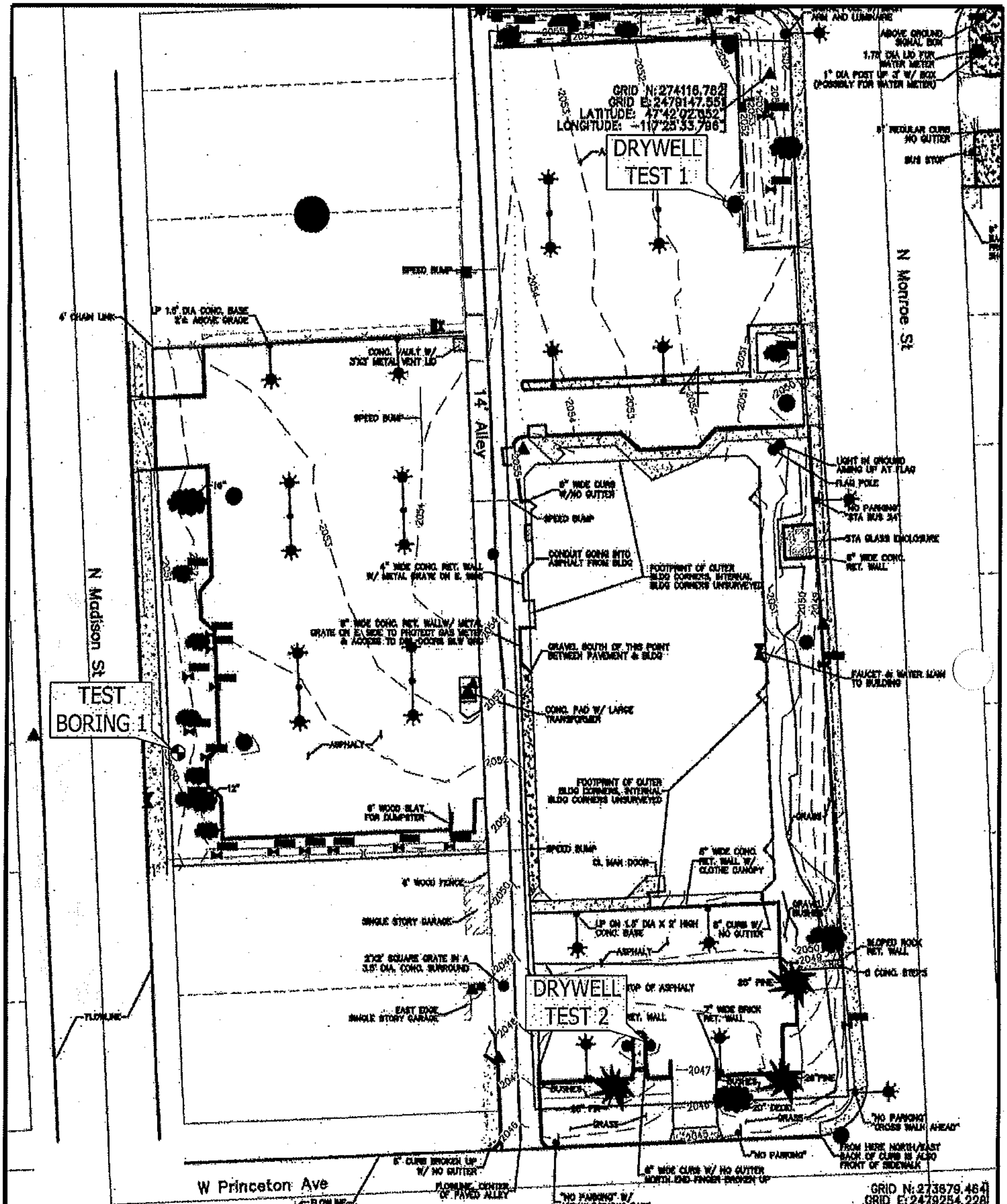
VICINITY MAP

DEPARTMENT OF ECOLOGY
STORMWATER
SPOKANE, WASHINGTON

FIGURE 1

PROJECT NUMBER H09170

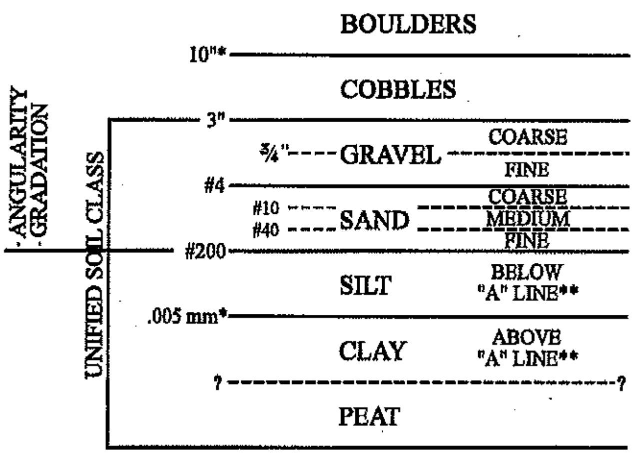
DATE: 6/2009



N SCALE: 1"=50' 0 25 50	PLAN BY: SHERRY PRATT VAN VOORIS LANDSCAPE ARCHITECTS	Budinger & Associates	SITE PLAN	FIGURE 2
			DEPARTMENT OF ECOLOGY STORMWATER SPOKANE, WASHINGTON	PROJECT NUMBER H09170 DATE: 6/2009

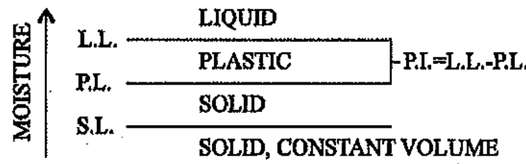
GUIDE TO SOIL & ROCK DESCRIPTIONS

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

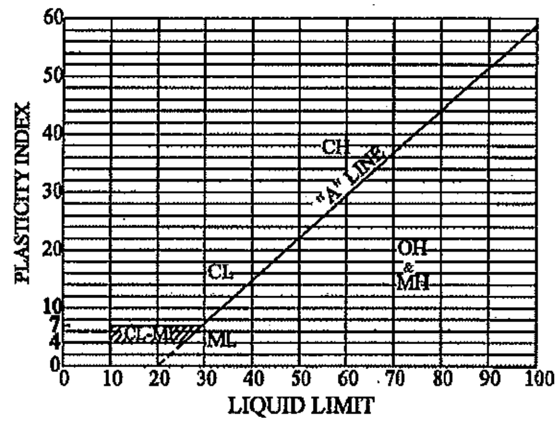


* NOT INCLUDED IN U.S.C.S.
** SEE PLASTICITY CHART

ATTERBERG LIMITS



PLASTICITY CHART



GUIDE TO SOIL DESCRIPTION MODIFIERS, MOISTURE, AND CONDITION PRESENTED ON LOGS.

MODIFIER	ESTIMATED PERCENTAGE OF SAMPLE	MOISTURE
SUFFIX "LY" OR "Y".........	GREATER THAN 40%	DRY
SOME	22% - 45%	SLIGHTLY MOIST
SMALL AMOUNT	8% - 25%	VERY MOIST
TRACE/OCCASIONAL	0% - 12%	SATURATED

CONDITION

COARSE GRAINED:
- VERY LOOSE
- LOOSE
- MEDIUM DENSE
- DENSE
- VERY DENSE

FINE GRAINED:
- VERY SOFT
- SOFT
- MEDIUM
- STIFF
- VERY STIFF
- HARD

ROCK:
- SOFT
- MODERATELY HARD
- HARD
- VERY HARD

▽ GROUNDWATER INDICATION DURING DRILLING

▼ GROUNDWATER INDICATION AFTER DRILLING

SAMPLES

- STANDARD 2" PENETRATION TEST SAMPLER WITH BLOWS PER FOOT
- 3" SPLIT SPOON SAMPLER WITH BLOWS PER FOOT
- DRILL CUTTING SAMPLE
- BULK SAMPLE
- SHELBY TUBE SAMPLE
- DIAMOND CORE RUN WITH % RECOVERY & ROCK QUALITY DESIGNATION
- 4" O.D. SPLIT SPOON SAMPLER WITH BLOWS PER FOOT
- R REFUSAL OF SAMPLE (50+ BLOWS PER 6")

Budinger & Associates, Inc.
Geotechnical & Environmental Engineers
Construction Materials Testing & Inspection

Figure 3

TEST BORING 1

Date of Boring: 6-23-09
Driller: Budinger & Assoc., Inc.
Type of Drill: Mobile B-57 with automatic SPT hammer
Location: S area of landscaping / W side of parking
Surface: landscapping mulch

Elevation: 2050 ft
Logged by: E. Hageman
Size of hole: air rotary overburden system, 4.5 in O.D. casing

DEPTH	SAMPLES	RQD, BLOW COUNTS N (% RECOVERY)	MOISTURE, COLOR, CONDITION	DESCRIPTION	SOIL LOG
0			slightly moist, gray with brown, medium dense	SAND, small amount Gravel, trace Silt, poorly graded (coarse), subrounded-subangular	
			slightly moist, gray, dense	SAND, some Gravel, trace Silt, poorly graded (coarse)	
			dry to slightly moist, gray, dense	SAND, occasional Gravel, trace Silt, poorly graded (medium), subrounded-subangular	
5	■	34 (90%)			
			dense		
10	■	46 (90%)			
			dry to slightly moist, gray, dense	SAND, small amount Gravel, trace Silt, pooly graded (coarse), subrounded-subangular	
15	◪	39 (10%)			
20	■	43 (90%)			
25	■	44 (80%)			
			no free groundwater observed	End of Boring @ 26 ft	
30					

TEST RESULTS

ATTERBERG LIMITS: PL ├──┤ LL
WATER CONTENT ○
STANDARD PEN TEST, N-VALUE (OBSERVED) ◪
3" SPLIT SPOON PENETRATION, BLOWS/FT ■

10 20 30 40 50 60 70 80 90

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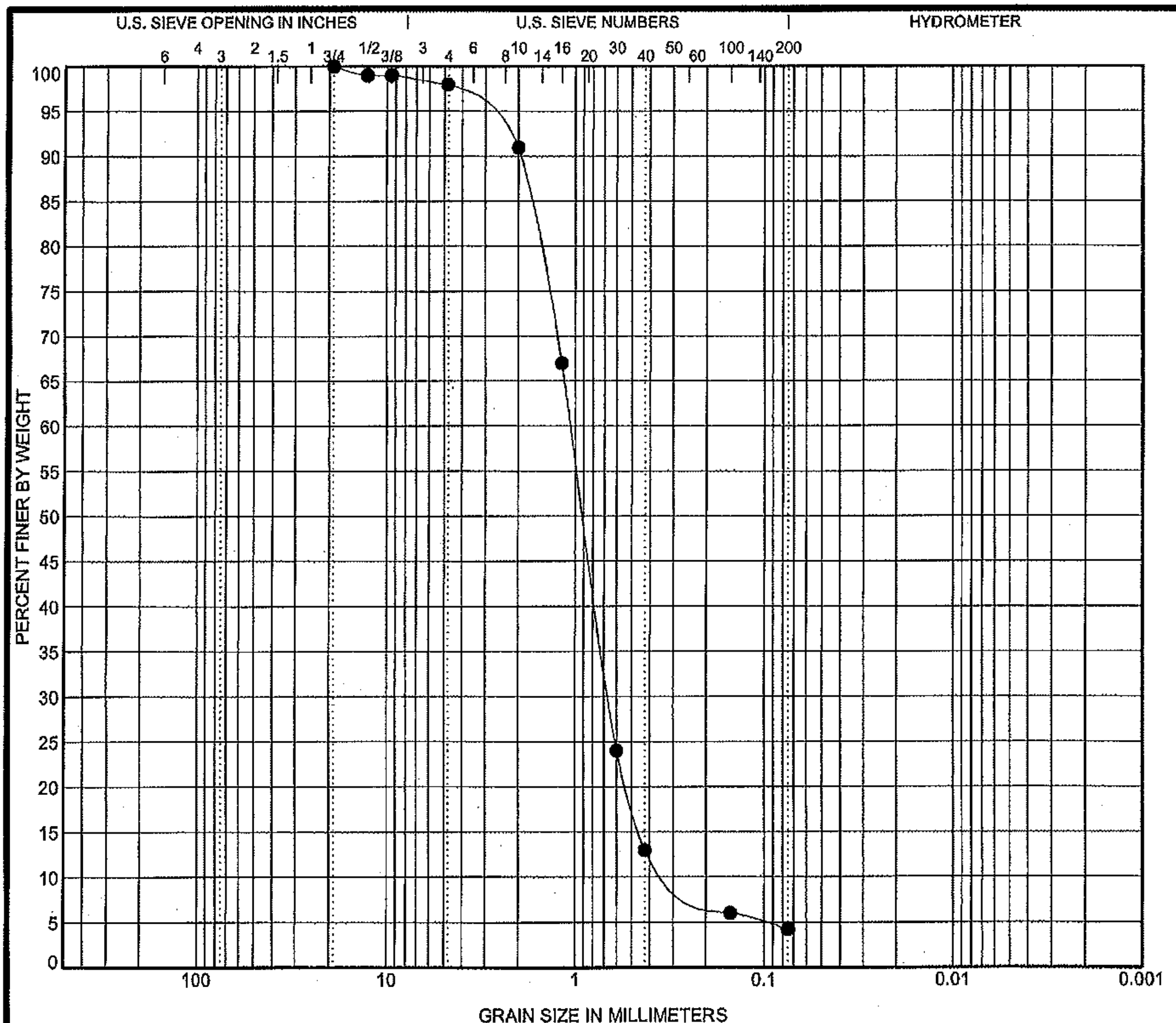
BORING LOGS **FIGURE 4**

Project: Dept. of Ecology Stormwater
Location: Spokane, WA
Number: H09170



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	1	9.5	POORLY GRADED SAND(SP)				1.51	3.89

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	1	9.5	19	1.057	0.659	0.272	2.1	93.7	4.2	

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Spokane Valley, WA 99212

GRAIN SIZE DISTRIBUTION RESULTS

Project: Dept. of Ecology Stormwater

Location: Spokane, WA

Number: H09170

FIGURE 5

US_GRAIN_SIZE H09170 BORING LOG.GPJ BUDINGER.GDT 6/29/09

Figure 6-1: Drywell Infiltration Test Results

WL BGS = water level depth below ground surface (ft)

Drywell #1 **Basin Number:**

Location: Northeast area of parking lot

Condition: single-barrel with 3.1 feet exposed barrel section (~1 foot of silt build-up) no inlet or outlet pipes

Test Method: Spokane Regional Stormwater Manual Appendix 4B

Logged by: TB **Meter type/number:** Sensus Meter/ 64937604

Hydrant Location: 850FT SW of Drywell location

		Total Depth of drywell (ft)			5.5	
		Surface Elevation (ft)				
		Bottom Elevation (ft)		assumed	100.0	
		Depth to Active Barrel (ft)			2.5	
Date/Time	Time (min)	meter 1 (gallons)	Cumulative Volume (gal)	Rate (gpm)	WL BGS	Head
7:24 AM	0.00	850168	0			
7:26 AM	2.00	850485	317	159	4.4	1.1
7:31 AM	7.00	851330	1162	169	3.8	1.8
7:41 AM	17.00	853183	3015	185	3.6	1.9
7:51 AM	27.00	855105	4937	192	3.6	1.9
8:01 AM	37.00	857015	6847	191	3.5	2.0
8:11 AM	47.00	858987	8819	197	3.5	2.0
8:21 AM	57.00	861050	10882	206	3.5	2.0
8:31 AM	67.00	863095	12927	204	3.5	2.0
8:41 AM	77.00	865090	14922	199	3.5	2.0
8:51 AM	87.00	867070	16902	198	3.5	2.0
9:01 AM	97.00	869040	18872	197	3.5	2.0
9:11 AM	107.00	871010	20842	197	3.5	2.0
9:21 AM	117.00	873040	22872	203	3.5	2.0
9:23 AM	119.00				4.1	1.4
9:25 AM	121.00				4.6	0.9
9:28 AM	124.00				5.0	0.5
9:31 AM	127.00				5.1	0.4
9:39 AM	135.00				5.3	0.2
9:50 AM	146.00				5.3	0.2
10:00 AM	156.00				5.3	0.2

average flow rate = 197 gpm
0.44 cfs

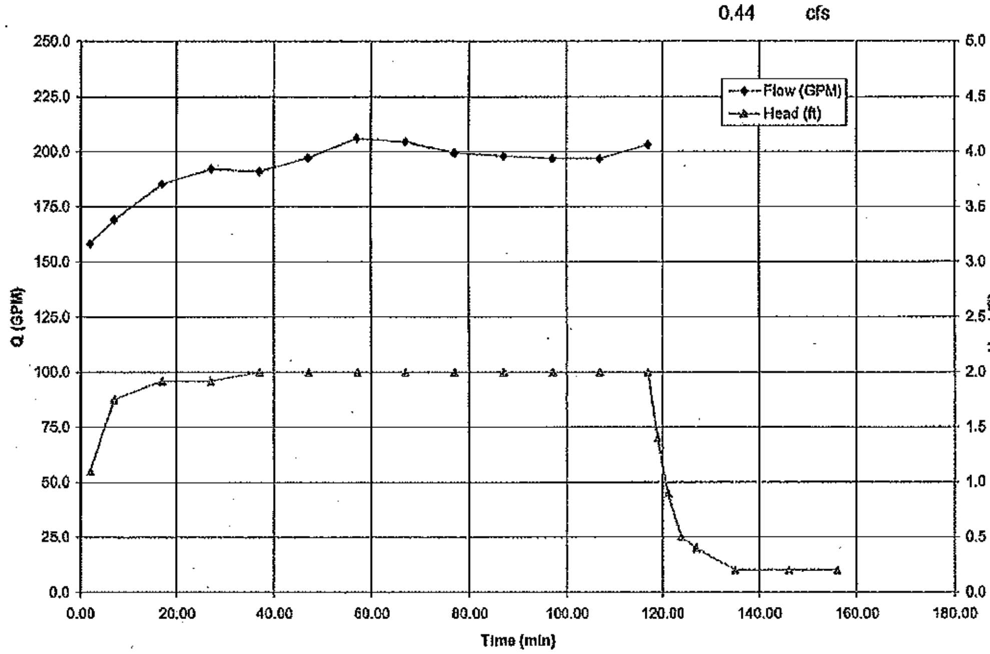


Figure 6-2: Drywell Infiltration Test Results

WL BGS = water level depth below ground surface (ft)

Drywell #2 **Basin Number:**

Location: South of building in parking area

Condition: single-barrel with 4.1 feet exposed barrel section (~2 inches of silt build-up)

no inlet or outlet pipes

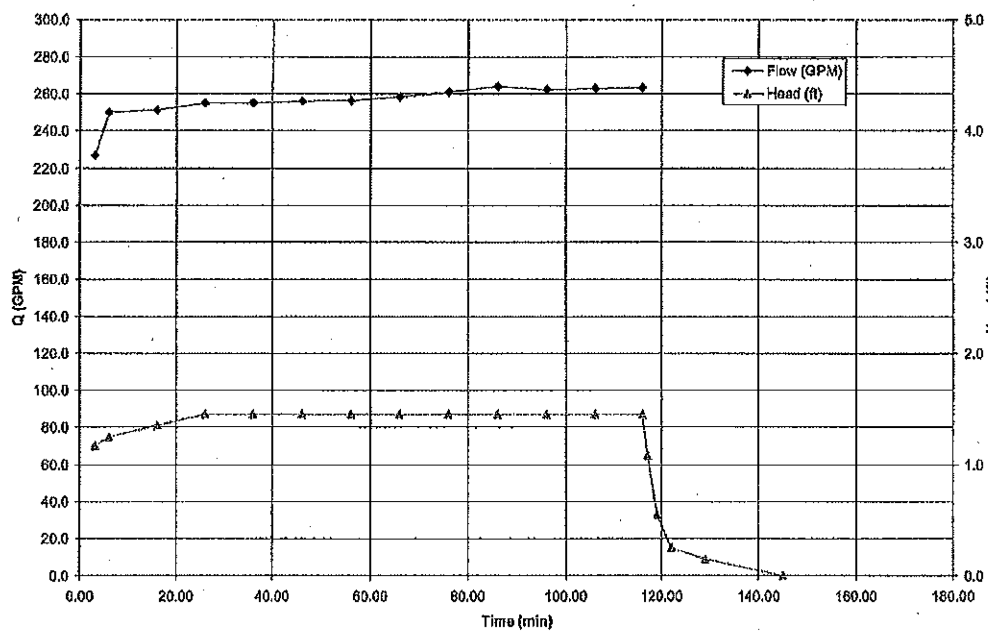
Test Method: Spokane Regional Stormwater Manual Appendix 4B

Logged by: TB **Meter type/number:** Sensus Meter/ 64937604

Hydrant Location: 250FT W of Drywell location

		Total Depth of drywell (ft)			6.8	
		Surface Elevation (ft)				
		Bottom Elevation (ft)		assumed	100.0	
		Depth to Active Barrel (ft)			2.6	
Date/Time	Time (min)	meter 1 (gallons)	Cumulative Volume (gal)	Rate (gpm)	WL BGS	Head
10:38 AM	0.00	873110	0			
10:41 AM	3.00	873790	680	227	5.6	1.2
10:44 AM	6.00	874540	1430	250	5.5	1.3
10:54 AM	16.00	877055	3945	251	5.4	1.4
11:04 AM	26.00	879605	6495	255	5.3	1.5
11:14 AM	36.00	882155	9045	255	5.3	1.5
11:24 AM	46.00	884715	11605	256	5.3	1.5
11:34 AM	56.00	887280	14170	256	5.3	1.5
11:44 AM	66.00	889865	16755	258	5.3	1.5
11:54 AM	76.00	892475	19365	261	5.3	1.5
12:04 PM	86.00	895115	22005	264	5.3	1.5
12:14 PM	96.00	897740	24630	262	5.3	1.5
12:24 PM	106.00	900370	27260	263	5.3	1.5
12:34 PM	116.00	903005	29895	264	5.3	1.5
12:35 PM	117.00				5.7	1.1
12:37 PM	119.00				6.2	0.6
12:40 PM	122.00				6.5	0.3
12:47 PM	129.00				6.6	0.2
1:03 PM	145.00				6.8	0.0

average flow rate = 258 gpm
0.57 cfs



Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* —should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org

Budinger & Associates

Proudly serving the Inland Northwest for over 30 years

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Gina Bartley, LEED AP
Sherry Pratt Van Voorhis Landscape Architects
621 W. Mallon #306
Spokane, WA 99201

June 29, 2009

Project Number H09170

PROJECT: Department of Ecology Building Stormwater Design
Spokane, WA

SUBJECT: Results of Hydrogeologic
Exploration & Analysis

Dear Ms. Bartley,

Budinger & Associates, Inc. is pleased to provide this report summarizing the results of hydrogeologic exploration and analysis to facilitate design of stormwater improvements at the Eastern Regional Department of Ecology Building on Wellesley Avenue and Monroe Street in Spokane, WA. You retained our services to evaluate subsurface drainage potential to assist the civil engineer in developing a viable stormwater design. Other geotechnical subjects such as pavements, earthwork, and foundations are beyond the scope. The outline of this report is as follows:

- Project Considerations & Scope
- Field & Laboratory Summary
- Surface Conditions
- Subsurface Conditions
- Groundwater
- Soil Permeability
- Conclusions & Recommendations
- Limitations
- Appendix – Field and Laboratory Methods
- Imbedded Tables
  - Table 1 – Estimated Design Discharge
- Attached Tables and Figures
  - Table 2 – Laboratory Summary
  - Figure 1 – Vicinity Map
  - Figure 2 – Site Plan
  - Figure 3 – Guide to Soil & Rock Descriptions
  - Figure 4 – Boring Log
  - Figure 5 – Grain Size Distribution Results
  - Figures 6-1 & 6-2 – Drywell Infiltration Test Results
- Important Information About Your Geotechnical Engineering Report

Project Considerations & Scope
We understand that stormwater improvements are proposed in the Department of Ecology parking areas surrounding the existing building, as illustrated in the attached *Site Plan.* The client would like to determine if existing drywells to the north and south of the building are feasible for reuse in a new stormwater disposal plan and would like information about infiltration potential to the west of the building for proposed drywells.

The services were limited to the following scope in accordance with proposal Number 135H9 dated June 2, 2009 – revised June 12, 2009:

1. Conduct two full scale drywell infiltration tests in accordance with Spokane County Guidelines for Stormwater Management, *Appendix I-4.5 Spokane County Public Works Department Standard for Estimating Outflow Rate from a Drywell under Full-Scale, Constant Head Conditions* (February 6, 1996).
2. Drill a geotechnical boring up to 25 feet deep to evaluate boundary conditions; retain samples at appropriate intervals by split-spoon method.
3. Conduct laboratory testing to further characterize representative index properties of target soils for infiltration.
4. Prepare recommendations and a report for designing stormwater infiltration through drywells

Field & Laboratory Summary
We conducted two full-scale drywell tests and one boring to a depth of 26 feet. A representative sample was tested in the laboratory. The drywell test and boring locations are illustrated in the attached *Site Plan.* The conditions encountered in the boring are described further in the *Boring Log.* A *Guide to Soil & Rock Descriptions* is also included. Figures and Tables are attached as listed on page 1. The field and laboratory methods are described further in the *Appendix.*

Surface Conditions
The site is relatively flat with the highest point near the center of the property (northwest corner of the building) at an elevation of 2055 feet. The lowest portion of the property is near the southeast corner (Monroe Street and Princeton Avenue) at an elevation of 2045 feet.

Existing surface conditions consist of paved parking areas with traffic islands in several areas and landscaped portions on the exterior of the parking areas. Eight drywells are currently present in the parking areas. Each drywell was Type A (single depth). Various amounts of sediment were built-up in the barrel section. At the time of field-work no water was present in the drywells. No treatment occurs prior to injection. The proposed location for a new drywell is in an existing landscaped area with trees and shrubs.

Subsurface Conditions
Based on characteristics relevant to drainage, two layers were encountered: 1) *FILL* and 2) *CLEAN SAND.* The layers are described further below.

FILL
Fill was not encountered in the *Test Boring,* however; known *FILL* including pavements and drain rock which surrounds existing drywells is present. Other *FILL* such as utility trench backfill is likely present.

CLEAN SAND
Sand with small amounts of gravel was encountered from ground surface to the end of exploration at 26 feet. In accordance with the USCS (Unified Soil Classification System), a sample classified as SP. The texture was medium to coarse and the condition was dense. The percentage of fines was 4.2% for the sample tested and the moisture content was 3.4%.

Groundwater
Groundwater was not encountered in the boring during fieldwork.

Soil Permeability
Exfiltration rates for drywells were estimated based on percentage of fines (material passing the # 200 sieve) in accordance with the *Spokane Regional Stormwater Manuel, Appendix 4A Spokane 200 Method* developed for Spokane County and the City of Spokane as summarized in the following table.

TABLE 1

					Estimated Design Discharge
Layer	*Test Boring Number*	*Depth (ft)*	*USCS Classification*	*Fines %*	*IRSCC Determined Rates (cfs/ft)*
CLEAN SAND	*1*	*9½ to 11*	*SP*	*4.2*	*0.07*

* Note: Safety factors were selected based on percent fines and laboratory methods per IRSCC. A safety factor of 1.5 was used for Boring 1 at 9 feet.

We tested two existing drywells in the parking areas as described below.

For drywell #1 (north area of property), a head level of approximately 2.0 feet was maintained for the constant head portion of the test. An average stabilized flow rate of 197 gallons per minute (gpm) was achieved for the steady state period of the test. 197 gpm was the maximum attainable flow through 600 feet of 2.5-inch fire hose. In 8 minutes after water flow to the drywell was stopped, the head level fell from 2.0 feet to 0.2 feet. 0.2 feet of head remained in the drywell 37 minutes after water flow was stopped likely due to approximately 1 foot of sediment build-up in the drywell.

Flow to drywell #2 (south area of property) was maintained at a head level of 1.5 feet for the constant head period of the test. The stabilized flow rate was 258 gpm, which was the maximum attainable flow through 200 feet of 2.5-inch fire hose. The head level fell from 1.5 feet to 0.2 feet in 12 minutes after flow was stopped. We checked the head level again at 28 minutes after flow was stopped and the head level was 0 feet. Infiltration test results are presented in *Figures 6-1 and 6-2*, attached.

Conclusions & Recommendations
We conclude that stormwater infiltration using a drywell is feasible targeting the *CLEAN SAND* layer at typical design outflow rates of 0.3 cubic feet per second (cfs) for a single depth drywell (Type A) or 1.0 cfs for a double depth drywell (Type B). Swales should be sized so that remaining stormwater will fully drain in less than 72 hours.

Limitations

Services were limited to the exploration, testing, and analysis described herein. This report should not be used for other purposes. Geotechnical engineering for other civil, environmental, or permitting aspects of the project are beyond the scope of this involvement.

Thank you for the opportunity to provide these services. Enclosed is a document titled *Important Information About Your Geotechnical Report* to assist with understanding the context within which these services were conducted and provided guidance for using this report appropriately. Please call if you have any questions or would like further assistance.

Respectfully Submitted:
BUDINGER & ASSOCIATES, INC.

Thomas Black, EIT
Staff Engineer

John E. Finnegan, PE, LHG
Geotechnical Engineer

TBB/tb
Addressee - 3
JR Bonnett Engineering (Chad Riggs, PE) – 1

APPENDIX

FIELD AND LABORATORY METHODS

FIELD EXPLORATION

Fieldwork was conducted on June 17 and 23, 2009 by the following Budinger & Associates, Inc. personnel:

- Ethan Hageman (Licensed Driller)
- Thomas Black (Staff Engineer)
- John Finnegan, PE (Principal Engineer)

BORINGS *ASTM D 6151*

A truck mounted Mobile B-57 drill rig was used to drill the boring at the proposed location for stormwater infiltration. Air rotary overburden system was used to advance the borehole and provide a temporary casing. The encountered sand drilled easily.

SOIL SAMPLES

Split-spoon samples were obtained at intervals using 2-inch outside diameter (OD) and 3-inch OD split-spoon samplers. A Safe-T driver and hoist with a 140-pound ram and 30-inch drop height was used to provide a test of penetration resistance. The penetration resistance is recorded as the number of blows per foot to drive the sampler. Cutting samples were returned along the perimeter by the auger flights.

DRYWELL TESTS

We tested two drywells in general accordance with the method presented in the *Spokane Regional Stormwater Manuel, Appendix 4B Full-Scale Drywell Test Method (April 2008)*. Water was supplied from a near by fire hydrant and conveyed with 2.5-inch diameter fire hose. Flow rates were measured with a calibrated in-line meter.

SOIL & ROCK CLASSIFICATION *ASTM D 2488*

The encountered soils were classified visually from split-spoon samples, observation of cuttings, drill rig response, and laboratory testing. A condensed summary of the classification methods is presented in the attached *Guide to Soil & Rock Descriptions*. Further details are below.

UNIFIED SOIL CLASSIFICATION SYSTEM *ASTM D 2487*

The soil descriptions presented on the *Boring Log* is intended to comply with the Unified Soil Classification System (USCS), which is recognized internationally in the fields of engineering and construction.

HORIZONTAL & VERTICAL CONTROL

The boring was located based on plans provided as presented in the attached *Site Plan*. Horizontal locations are accurate to ±5 feet based on the plans provided. The elevations at the surface of the boring is accurate to ±1 feet based on interpolation from topographic information provided.

LABORATORY ANALYSIS

Laboratory testing was performed on representative samples of the native soil encountered to provide data used in our assessment of soil characteristics. The tests were chosen to assess natural moisture contents, and grain-size distribution.

Tests were conducted, where practical, in accordance with nationally recognized standards (ASTM, AASHTO, etc.), which are intended to model in-situ soil conditions and behavior. The results are summarized in the *Laboratory Summary*.

INDEX PROPERTIES

MOISTURE CONTENT *ASTM D 2116*

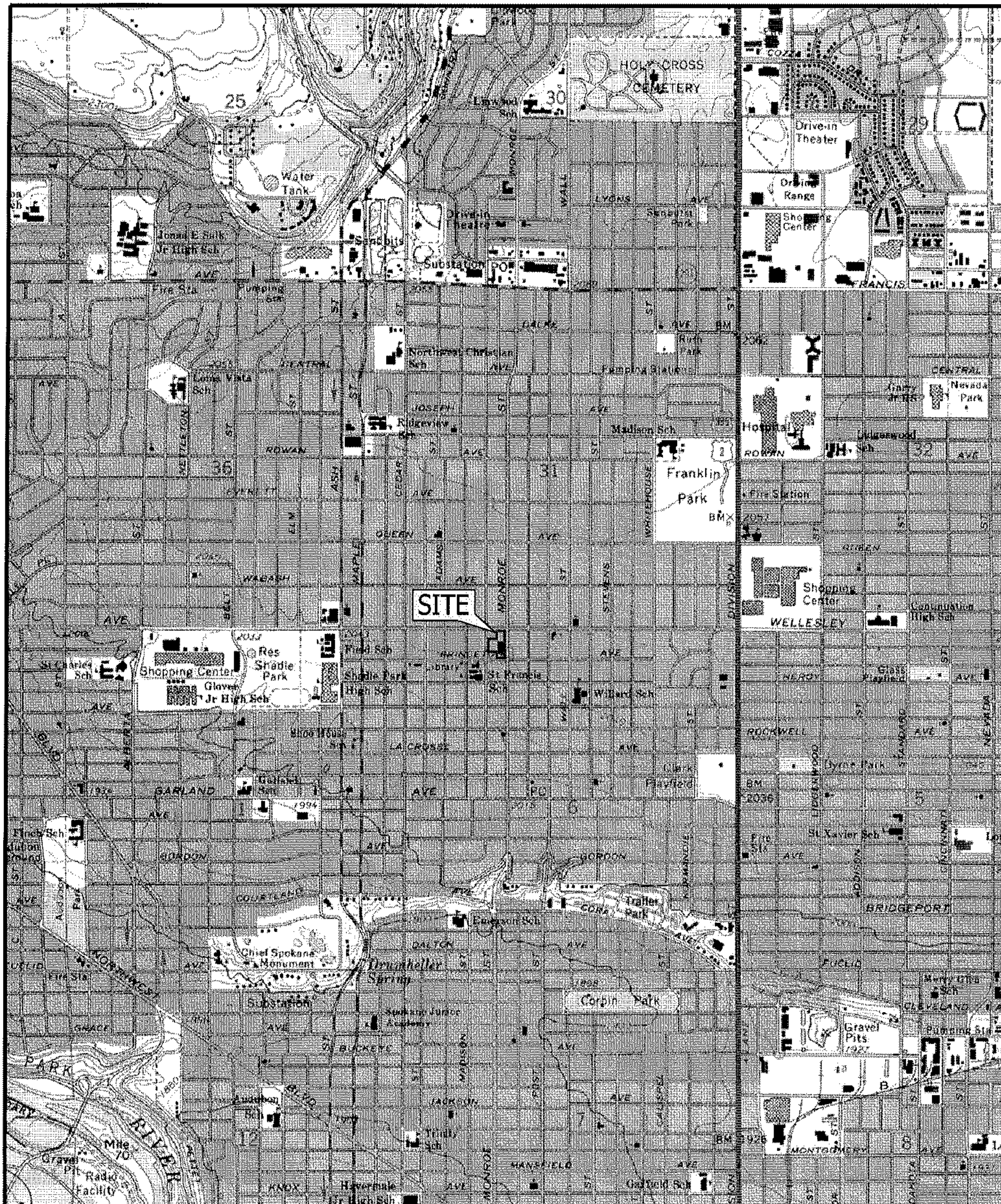
Moisture contents were determined by direct weight proportion (weight of water/weight of dry soil) determined by drying soil samples in an oven until reaching constant weight.

GRADATION *ASTM D 421*

Gradation analysis was performed by the mechanical sieve method. The mechanical sieve method is utilized to determine particle size distribution based upon the dry weight of sample passing through sieves of varying mesh sizes.

Table 2 ***LABORATORY SUMMARY***

			UNITS	Test Methods	
LABORATORY NUMBER					09-2271
TEST PIT NUMBER					1
DEPTH		TOP	ft		9½
		BOTTOM	ft		11
SAMPLE TYPE					3"SS
MOISTURE			%	ASTM D 2216	3.4
USCS CLASSIFICATION					SP
		3"		ASTM D 422	
	S	1½"	%		
	I	1"			
	E	3/4" GRAVEL	P		100
	V	1/2"	A		99
	E	3/8"	S		99
		#4	S		98
	S	#10	I		91
	I	#16	N		67
	Z	#30 SAND	G		24
	E	#40			13
		#100			6
		#200		ASTM D 1140	4.2

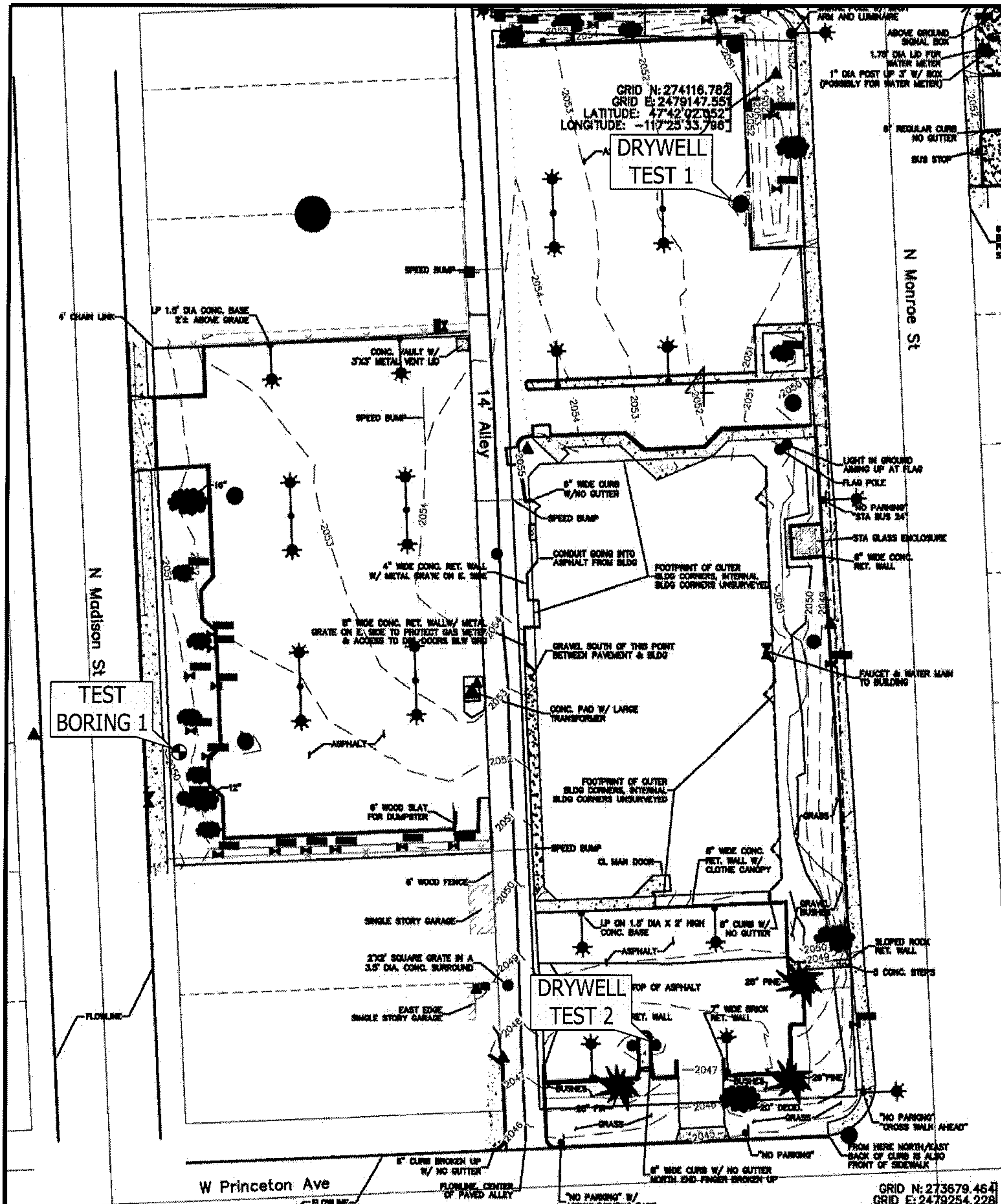


N SCALE: 1"=2000' 0 1000 2000	SECTION 6 T 25 N R 42 E U.S.G.S. 1986	Budinger & Associates	VICINITY MAP DEPARTMENT OF ECOLOGY STORMWATER SPOKANE, WASHINGTON

FIGURE 1

PROJECT NUMBER H09170

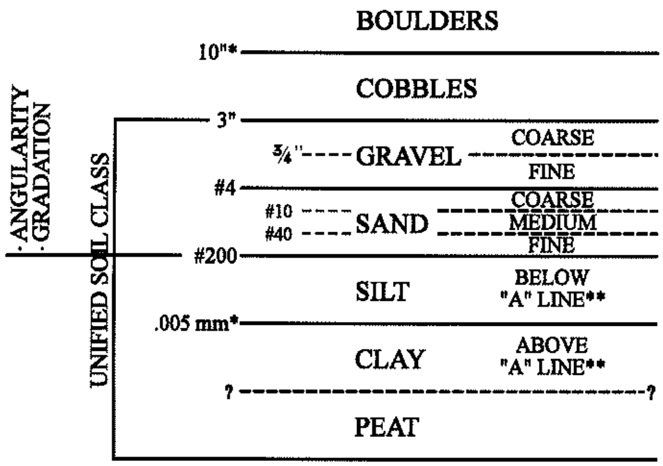
DATE: 6/2009



N SCALE: 1"=50' 0 25 50	PLAN BY: SHERRY PRATT VAN VOORIS LANDSCAPE ARCHITECTS	Budinger & Associates	SITE PLAN DEPARTMENT OF ECOLOGY STORMWATER SPOKANE, WASHINGTON
			FIGURE 2 PROJECT NUMBER H09170 DATE: 6/2009

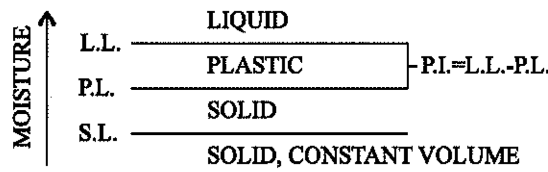
GUIDE TO SOIL & ROCK DESCRIPTIONS

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

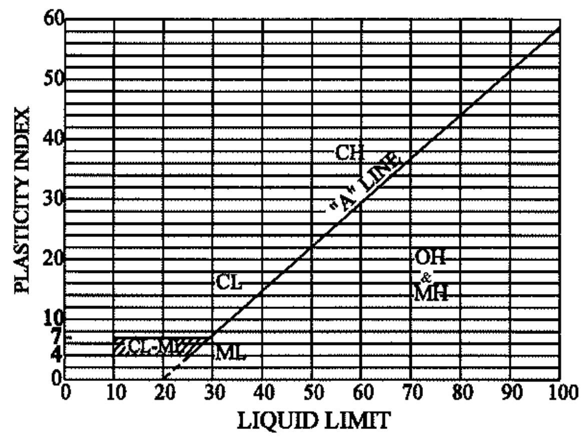


* NOT INCLUDED IN U.S.C.S.
** SEE PLASTICITY CHART

ATTERBERG LIMITS



PLASTICITY CHART



GUIDE TO SOIL DESCRIPTION MODIFIERS, MOISTURE, AND CONDITION PRESENTED ON LOGS.

MODIFIER	ESTIMATED PERCENTAGE OF SAMPLE	MOISTURE
SUFFIX "LY" OR "Y".........	GREATER THAN 40%	DRY
SOME	22% - 45%	SLIGHTLY MOIST
SMALL AMOUNT	8% - 25%	VERY MOIST
TRACE/OCCASIONAL	0% - 12%	SATURATED

CONDITION

COARSE GRAINED:
- VERY LOOSE
- LOOSE
- MEDIUM DENSE
- DENSE
- VERY DENSE

FINE GRAINED:
- VERY SOFT
- SOFT
- MEDIUM
- STIFF
- VERY STIFF
- HARD

ROCK:
- SOFT
- MODERATELY HARD
- HARD
- VERY HARD

▽ GROUNDWATER INDICATION DURING DRILLING
▼ GROUNDWATER INDICATION AFTER DRILLING

SAMPLES

- STANDARD 2" PENETRATION TEST SAMPLER WITH BLOWS PER FOOT
- 3" SPLIT SPOON SAMPLER WITH BLOWS PER FOOT
- DRILL CUTTING SAMPLE
- BULK SAMPLE
- SHELBY TUBE SAMPLE
- DIAMOND CORE RUN WITH % RECOVERY & ROCK QUALITY DESIGNATION
- 4" O.D. SPLIT SPOON SAMPLER WITH BLOWS PER FOOT
- R REFUSAL OF SAMPLE (50+ BLOWS PER 6")

Budinger & Associates, Inc.
Geotechnical & Environmental Engineers
Construction Materials Testing & Inspection

Figure 3

TEST BORING 1

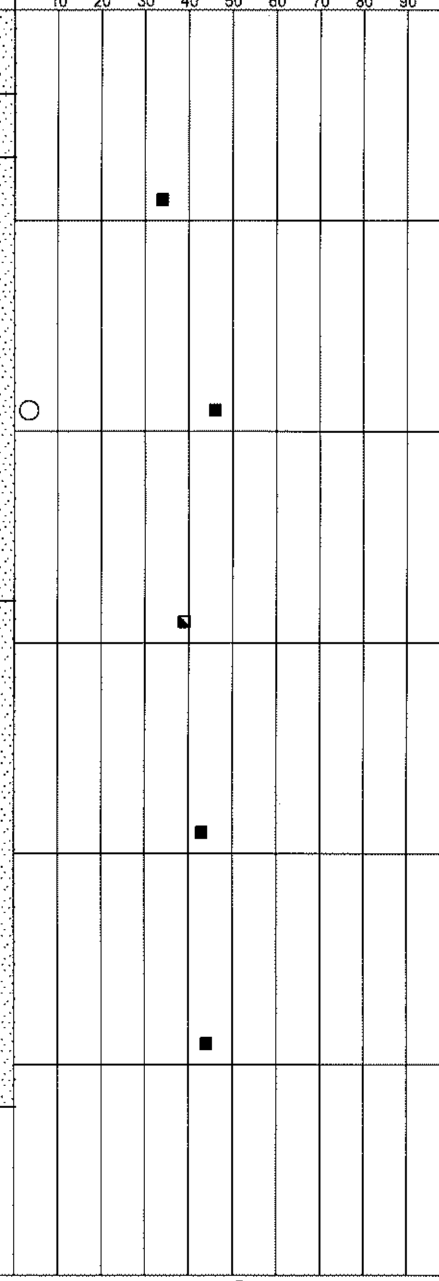
Date of Boring: 6-23-09
Driller: Budinger & Assoc., Inc.
Type of Drill: Mobile B-57 with automatic SPT hammer
Location: S area of landscaping / W side of parking
Surface: landscapping mulch

Elevation: 2050 ft
Logged by: E. Hageman
Size of hole: air rotary overburden system, 4.5 in O.D. casing

DEPTH	SAMPLES	RQD, BLOW COUNTS N (% RECOVERY)	MOISTURE, COLOR, CONDITION	DESCRIPTION	SOIL LOG	TEST RESULTS
0			slightly moist, gray with brown, medium dense	SAND, small amount Gravel, trace Silt, poorly graded (coarse), subrounded-subangular		
			slightly moist, gray, dense	SAND, some Gravel, trace Silt, poorly graded (coarse)		
5		34 (90%)	dry to slightly moist, gray, dense	SAND, occasional Gravel, trace Silt, poorly graded (medium), subrounded-subangular		
10		46 (90%)	dense			
15		39 (10%)	dry to slightly moist, gray, dense	SAND, small amount Gravel, trace Silt, pooly graded (coarse), subrounded-subangular		
20		43 (90%)				
25		44 (80%)				
			no free groundwater observed	End of Boring @ 26 ft		
30						

TEST RESULTS legend:
ATTERBERG LIMITS: PL ├──┤ LL
WATER CONTENT ○
STANDARD PEN TEST, N-VALUE (OBSERVED) ◪
3" SPLIT SPOON PENETRATION, BLOWS/FT ■

Scale: 10 20 30 40 50 60 70 80 90



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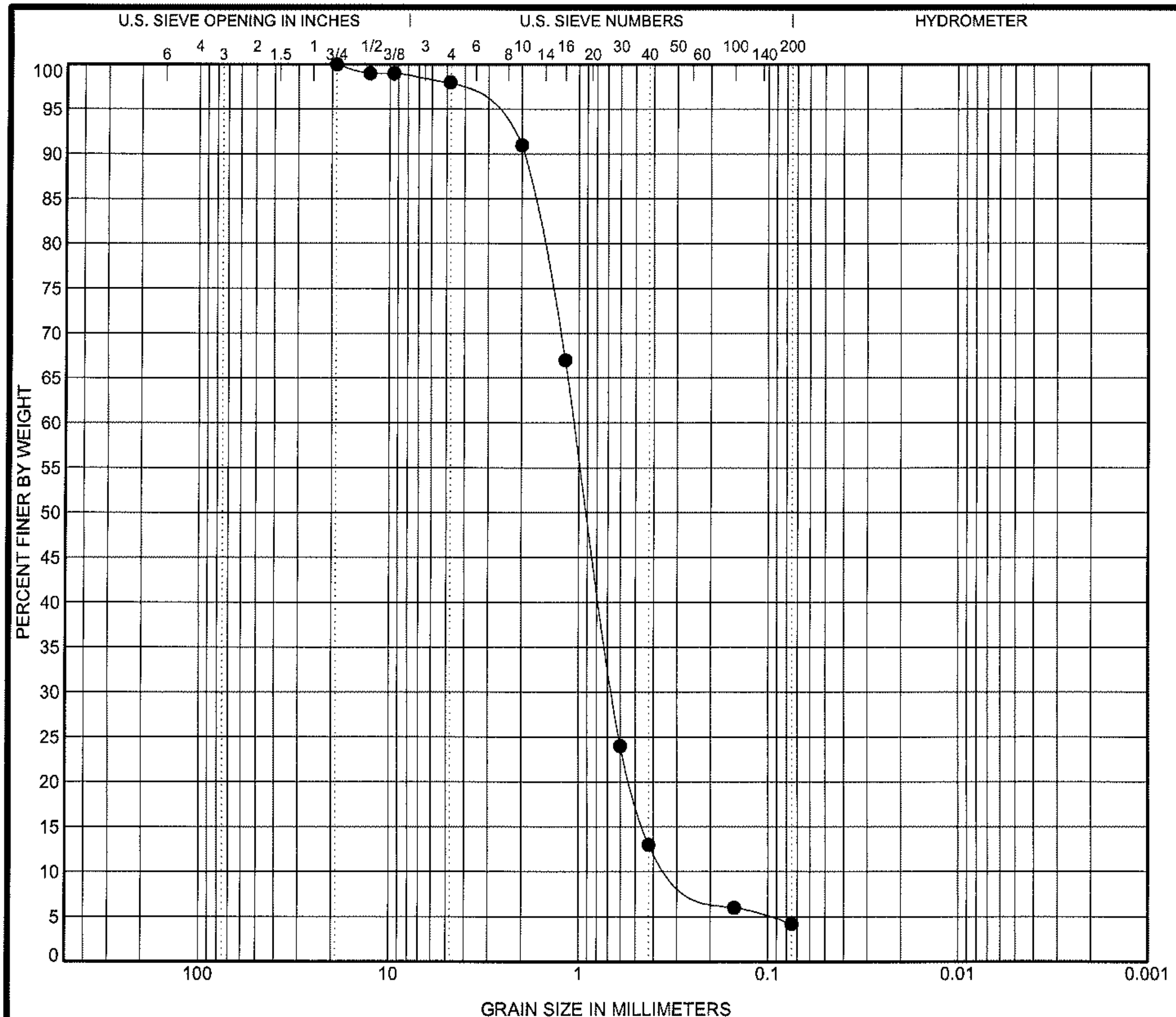
Spokane Valley, WA 99212

BORING LOGS **FIGURE 4**

Project: Dept. of Ecology Stormwater
Location: Spokane, WA
Number: H09170



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	LL	PL	PI	Cc	Cu
● 1	9.5	**POORLY GRADED SAND(SP)**				**1.51**	**3.89**

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 1	9.5	**19**	**1.057**	**0.659**	**0.272**	**2.1**	**93.7**	**4.2**	

Budinger & Associates
1101 North Fancher Road
Spokane Valley, WA 99212

GRAIN SIZE DISTRIBUTION RESULTS

Project: Dept. of Ecology Stormwater

Location: Spokane, WA

Number: H09170

FIGURE 5

US GRAIN SIZE H09170 BORING LOG.GPJ BUDINGER.GDT 6/29/09

Figure 6-1: Drywell Infiltration Test Results

WL BGS = water level depth below ground surface (ft)

Drywell #1 **Basin Number:**

Location: Northeast area of parking lot

Condition: single-barrel with 3.1 feet exposed barrel section (~1 foot of silt build-up) no inlet or outlet pipes

Test Method: Spokane Regional Stormwater Manual Appendix 4B

Logged by: TB **Meter type/number:** Sensus Meter/ 64937604

Hydrant Location: 850FT SW of Drywell location

		Total Depth of drywell (ft)			5.5	
		Surface Elevation (ft)				
		Bottom Elevation (ft)		assumed	100.0	
		Depth to Active Barrel (ft)			2.5	
Date/Time	Time (min)	meter 1 (gallons)	Cumulative Volume (gal)	Rate (gpm)	WL BGS	Head
7:24 AM	0.00	850168	0			
7:26 AM	2.00	850485	317	159	4.4	1.1
7:31 AM	7.00	851330	1162	169	3.8	1.8
7:41 AM	17.00	853183	3015	185	3.6	1.9
7:51 AM	27.00	855105	4937	192	3.6	1.9
8:01 AM	37.00	857015	6847	191	3.5	2.0
8:11 AM	47.00	858987	8819	197	3.5	2.0
8:21 AM	57.00	861050	10882	206	3.5	2.0
8:31 AM	67.00	863095	12927	204	3.5	2.0
8:41 AM	77.00	865090	14922	199	3.5	2.0
8:51 AM	87.00	867070	16902	198	3.5	2.0
9:01 AM	97.00	869040	18872	197	3.5	2.0
9:11 AM	107.00	871010	20842	197	3.5	2.0
9:21 AM	117.00	873040	22872	203	3.5	2.0
9:23 AM	119.00				4.1	1.4
9:25 AM	121.00				4.6	0.9
9:28 AM	124.00				5.0	0.5
9:31 AM	127.00				5.1	0.4
9:39 AM	135.00				5.3	0.2
9:50 AM	146.00				5.3	0.2
10:00 AM	156.00				5.3	0.2

average flow rate = 197 gpm
0.44 cfs

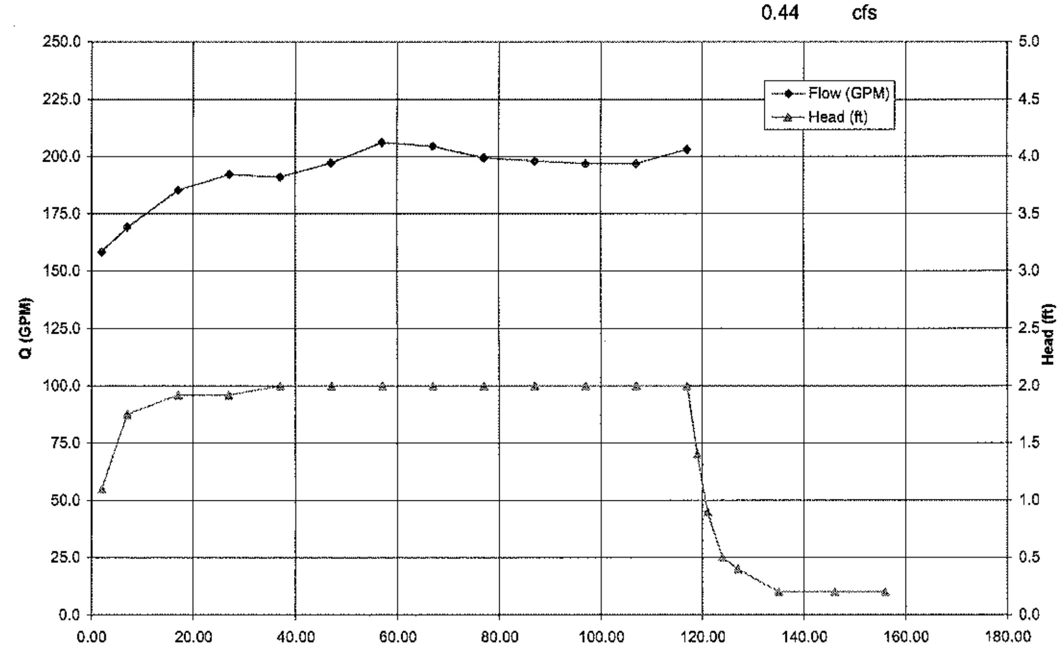


Figure 6-2: Drywell Infiltration Test Results

WL BGS = water level depth below ground surface (ft)

Drywell #2 **Basin Number:**

Location: South of building in parking area

Condition: single-barrel with 4.1 feet exposed barrel section (~2 inches of silt build-up) no inlet or outlet pipes

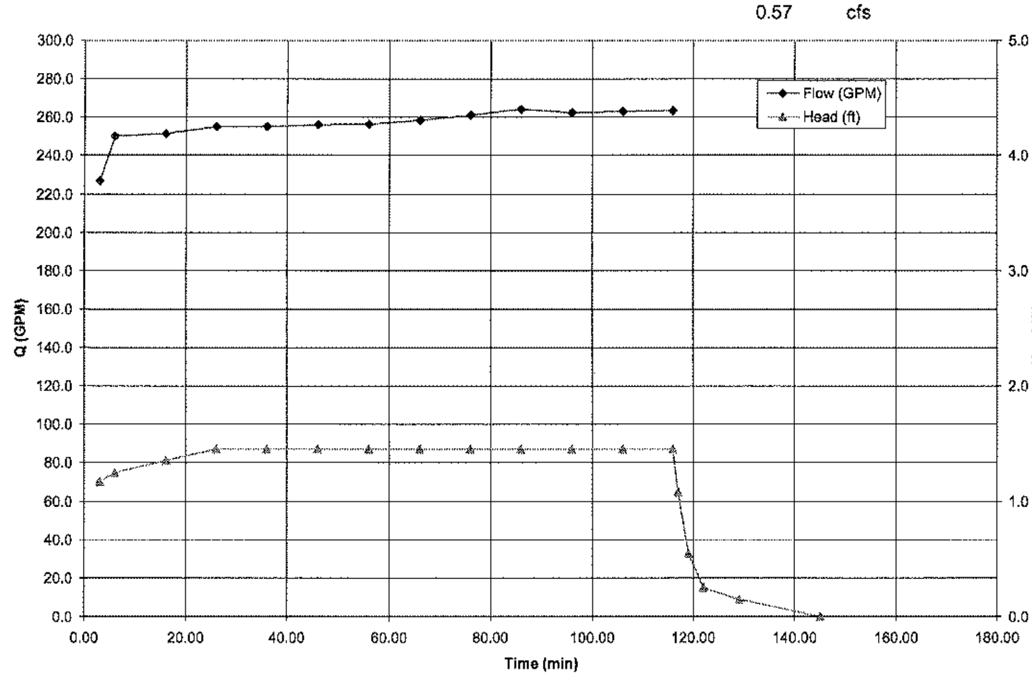
Test Method: Spokane Regional Stormwater Manual Appendix 4B

Logged by: TB **Meter type/number:** Sensus Meter/ 64937604

Hydrant Location: 250FT W of Drywell location

		Total Depth of drywell (ft)			6.8	
		Surface Elevation (ft)				
		Bottom Elevation (ft)		assumed	100.0	
		Depth to Active Barrel (ft)			2.6	
Date/Time	Time (min)	meter 1 (gallons)	Cumulative Volume (gal)	Rate (gpm)	WL BGS	Head
10:38 AM	0.00	873110	0			
10:41 AM	3.00	873790	680	227	5.6	1.2
10:44 AM	6.00	874540	1430	250	5.5	1.3
10:54 AM	16.00	877055	3945	251	5.4	1.4
11:04 AM	26.00	879605	6495	255	5.3	1.5
11:14 AM	36.00	882155	9045	255	5.3	1.5
11:24 AM	46.00	884715	11605	256	5.3	1.5
11:34 AM	56.00	887280	14170	256	5.3	1.5
11:44 AM	66.00	889865	16755	258	5.3	1.5
11:54 AM	76.00	892475	19365	261	5.3	1.5
12:04 PM	86.00	895115	22005	264	5.3	1.5
12:14 PM	96.00	897740	24630	262	5.3	1.5
12:24 PM	106.00	900370	27260	263	5.3	1.5
12:34 PM	116.00	903005	29895	264	5.3	1.5
12:35 PM	117.00				5.7	1.1
12:37 PM	119.00				6.2	0.6
12:40 PM	122.00				6.5	0.3
12:47 PM	129.00				6.6	0.2
1:03 PM	145.00				6.8	0.0

average flow rate = 258 gpm
0.57 cfs



Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org

IIGER06045.0M

LINETYPES LEGEND

- PROPERTY LINE
- BUILDING
- CURB & GUTTER (BACK)
- EDGE OF CONCRETE
- EDGE OF GRAVEL
- EDGE OF PAVEMENT
- EDGE OF VEGETATION
- FENCE
- FLOW LINE/CURB GUTTER
- GRADE BREAK
- LANDSCAPE AREA
- RETAINING WALL
- SIDEWALK (BACK)
- SIDEWALK (FRONT)
- STRIPING (PVMT)
- TOE OF SLOPE/BANK
- TOP OF SLOPE/BANK

HATCH LEGEND

- BUILDING
- CONCRETE
- GRAVEL

GENERAL NOTES

1) THIS DRAWING INDICATES GENERAL CONDITIONS AT THE TIME OF THE SURVEY ONLY.
2) SURVEY PERFORMED BY USKH INC. ON MARCH 31 THROUGH APRIL 1, 2009.
3) CONTROL AND TOPOGRAPHY COLLECTED USING A COMBINATION OF POST-PROCESSED AND REAL TIME KINEMATIC (RTK) GPS TECHNIQUES USING TRIMBLE MODEL R8 AND 5700 DUAL-FREQUENCY RECEIVERS AND CONVENTIONALLY USING A TRIMBLE 5600 ROBOTIC TOTAL STATION.
4) ALL UNITS ARE U.S. SURVEY FEET.
5) ALL GEODETIC COORDINATES RELATED TO NAD83(CORS96) (EPOCH2002.00).

COORDINATE SYSTEM

A GROUND COORDINATE SYSTEM IN U.S. SURVEY FEET DEVELOPED BY USKH FOR THIS PROJECT, AS A MODIFICATION TO WASHINGTON COORDINATE SYSTEM, NORTH ZONE, NAD83(CORS96) (EPOCH 2002.00). THE GROUND COORDINATE SYSTEM PRESERVES A STATE PLANE BEARING BASIS, BUT PROVIDES GROUND DISTANCES AT THE PROJECT LOCATION (SEE CONVERSION PARAMETERS).

CONVERSION PARAMETERS

TO CONVERT FROM THE GROUND COORDINATE SYSTEM TO NAD83 STATE PLANE WASHINGTON NORTH ZONE PERFORM THE FOLLOWING;
1. SCALE ABOUT 54,116.782N, 79,147.551E BY 0.99987349.
2. ADD 220,000N, 2,400,000E TO THE RESULTING COORDINATES.

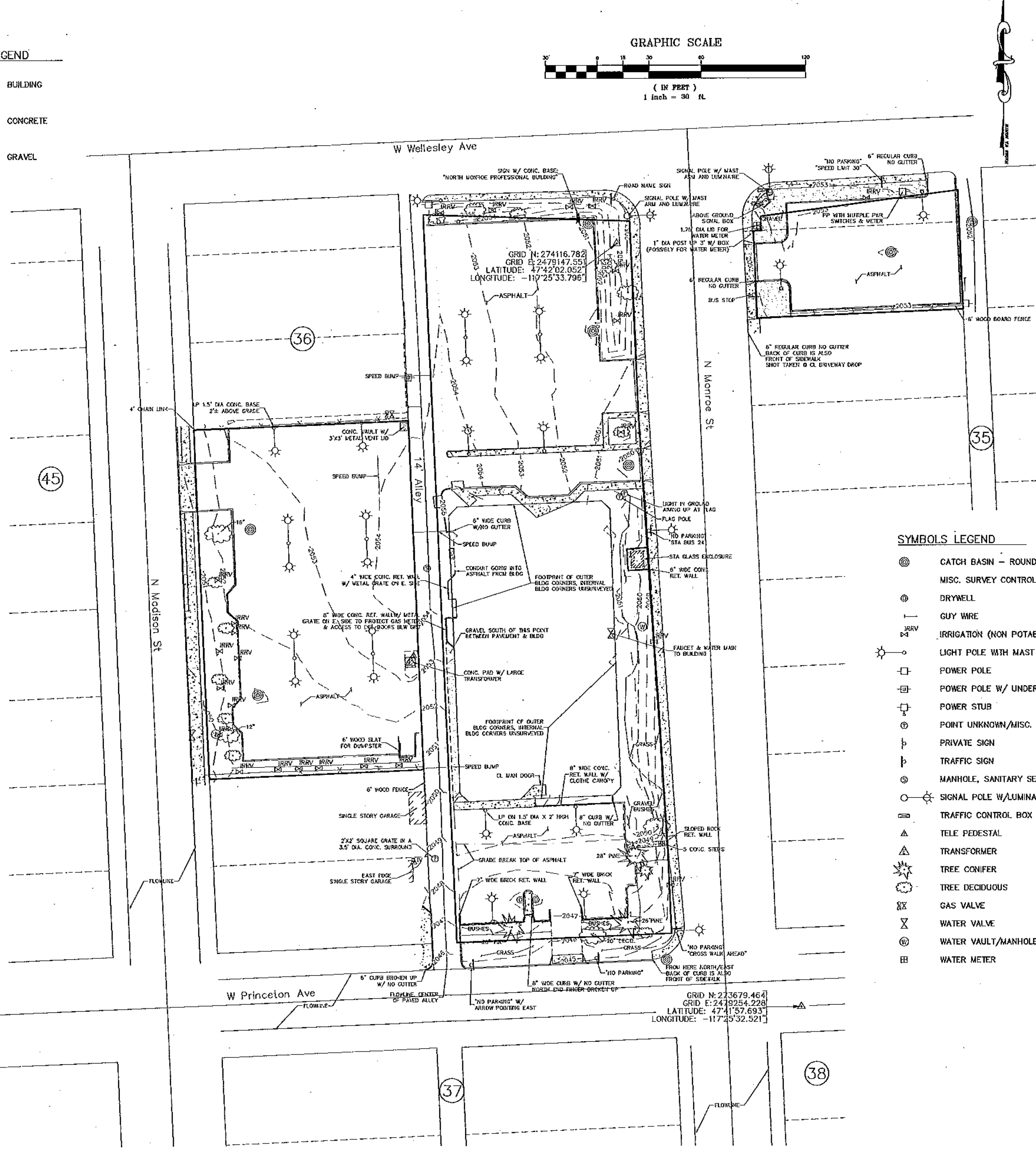
TO CONVERT FROM NAD83 STATE PLANE WASHINGTON NORTH ZONE TO THE GROUND COORDINATE SYSTEM PERFORM THE FOLLOWING;
1. SCALE ABOUT 274,116.782N, 2,479,147.551E BY 1.00012653.
2. SUBTRACT 220,000N, 2,400,000E FROM THE RESULTING COORDINATES.

BASIS OF GEODETIC COORDINATES

THE PUBLISHED NAD83(CORS96) (EPOCH 2002.00) POSITIONS OF THE FOLLOWING NATIONAL GEODETIC SURVEY (NGS) CONTINUOUSLY OPERATING REFERENCE STATIONS (CORS) WERE HELD FIXED: "P451" (PID: DH4096), "P020" (PID: DG7408), AND "SPN6" (PID: DK3593).

BASIS OF VERTICAL

VERTICAL DATUM IS GPS DERIVED NAVD88 USING GEOID03(CONUS) HOLDING THE PUBLISHED ELLIPSOID HEIGHTS OF THE CORS STATIONS LISTED HEREIN.



SYMBOLS LEGEND

- CATCH BASIN – ROUND RIM
- MISC. SURVEY CONTROL
- DRYWELL
- GUY WIRE
- IRRIGATION (NON POTABLE) VALVE
- LIGHT POLE WITH MAST ARM
- POWER POLE
- POWER POLE W/ UNDERGROUND
- POWER STUB
- POINT UNKNOWN/MISC. OBJECT
- PRIVATE SIGN
- TRAFFIC SIGN
- MANHOLE, SANITARY SEWER
- SIGNAL POLE W/LUMINARE
- TRAFFIC CONTROL BOX
- TELE PEDESTAL
- TRANSFORMER
- TREE CONIFER
- TREE DECIDUOUS
- GAS VALVE
- WATER VALVE
- WATER VAULT/MANHOLE
- WATER METER

Date Stamped:

By	Revision	Date

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Project:

Department of Ecology Complex

Wellesley Ave & Monroe St Spokane, Wa.

Kiemle & Hagood Co.
Spokane, WA

Project Mgr.	
Drawn	DJB
Drawn	DLP
Checked	GWE
Date	4/28/2009

Sheet Contents:

TOPOGRAPHIC SURVEY

Sheet No.:

1/1

USKH W.O. 1164100

FILE: I:\1164100\SURVEY\DWGS\1164100-TOPO.DWG PLOTTED: Jun 1, 2009 – 2:22:22 PM (Dan Proszek)