RHODODENDRON GLEN STREAM RE-ESTABLISHMENT AND ENHANCEMENT PROJECT

by

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A project submitted in partial fulfillment of the
requirements for the degree of

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Acknowledgements
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1. General view of Arboretum. Negative no. UW23849z
2. Rhododendron Glen. Negative no. UW23850z
3. Pond at the foot of Rhododendron Glen. Negative no. UW23851z
4. Rhododendron glen stream courses in upper reaches. Negative no. UW23852z
5. Azalea way looking south. Negative no. UW23857z

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CHAPTER 1

BACKGROUND AND IMPORTANCE OF RHODODENDRON GLEN TO WASHINGTON PARK ARBORETUM

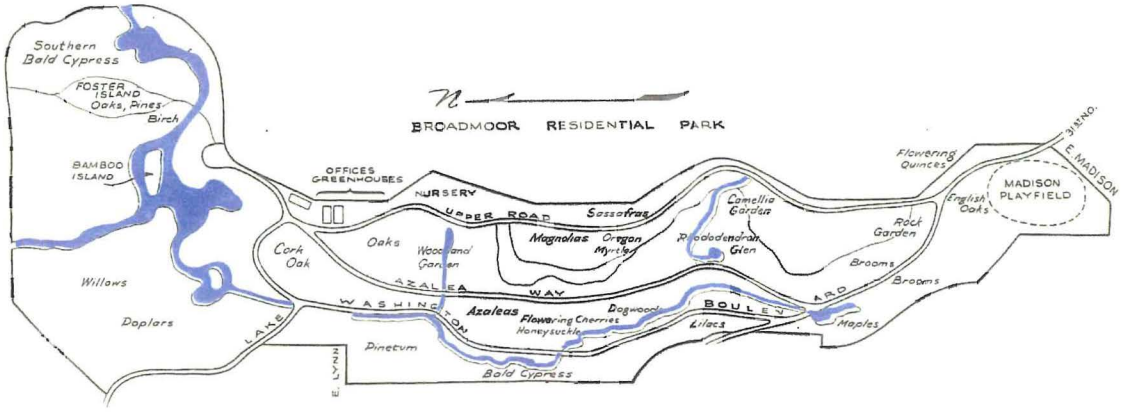
1.1 ***Introduction.*** In 1994, the Arboretum and Botanic Garden Committee began development of a Master Plan to update and improve Washington Park Arboretum concerning such items as plant collections, increased park use, walking, jogging, bird watching, educational tours, visitor traffic and safety, education, conservation and park recreation. The plan was developed over seven years, by the University of Washington, Seattle Parks and Recreation, and the Arboretum Foundation; and was intended to be utilized as a road map for improvements to the 230 acre arboretum for generations to come. Washington Park Arboretum Master Plan was approved by the Seattle City Council and the Board of Regents in May, 2001. Rhododendron Glen Stream Restoration is an important part of the Master Plan. Since the early 1990's, Rhododendron Glen has been under consideration for re-establishment and enhancement because of the inadequacy of the glen's stream to ameliorate current silting problems of the sites ponds. The stream must be re-engineered in a way to flush the ponds more effectively to prevent permanent silting problems to occur. Recommendations must also be made to remove some selected plants growing in Rhododendron Glen. Plants may have grown from volunteers, or have grown well past maturity, or have become diseased, or have crowded out more desirable plants. Recommendations must also be made for the selection of rhododendrons and plants to be grown under conditions found in the glen, such as areas of full sun,

intense shade, and boggy lowlands. Visitors to the glen will be able to see an interpretive garden of rhododendrons and plants growing under two adjacent but different growing conditions: plants grown in warm, dry soils under a south-facing slope, and plants grown in cool, moist soils, under a north-facing slope.

1.1.1 This study will involve the area of visitor education and interpretive gardens, and will make recommendations for long term sustainability of rhododendron and plants grown under two different and adjacent growing conditions: a south-facing slope and a north-facing slope.

1.1.2 Recommendations will be made to remove selected on-site plants to facilitate establishment of rhododendron and plants.

1.1.3 Recommendations will be made for the reengineering of existing streambed from the small pond to the reflecting pond.



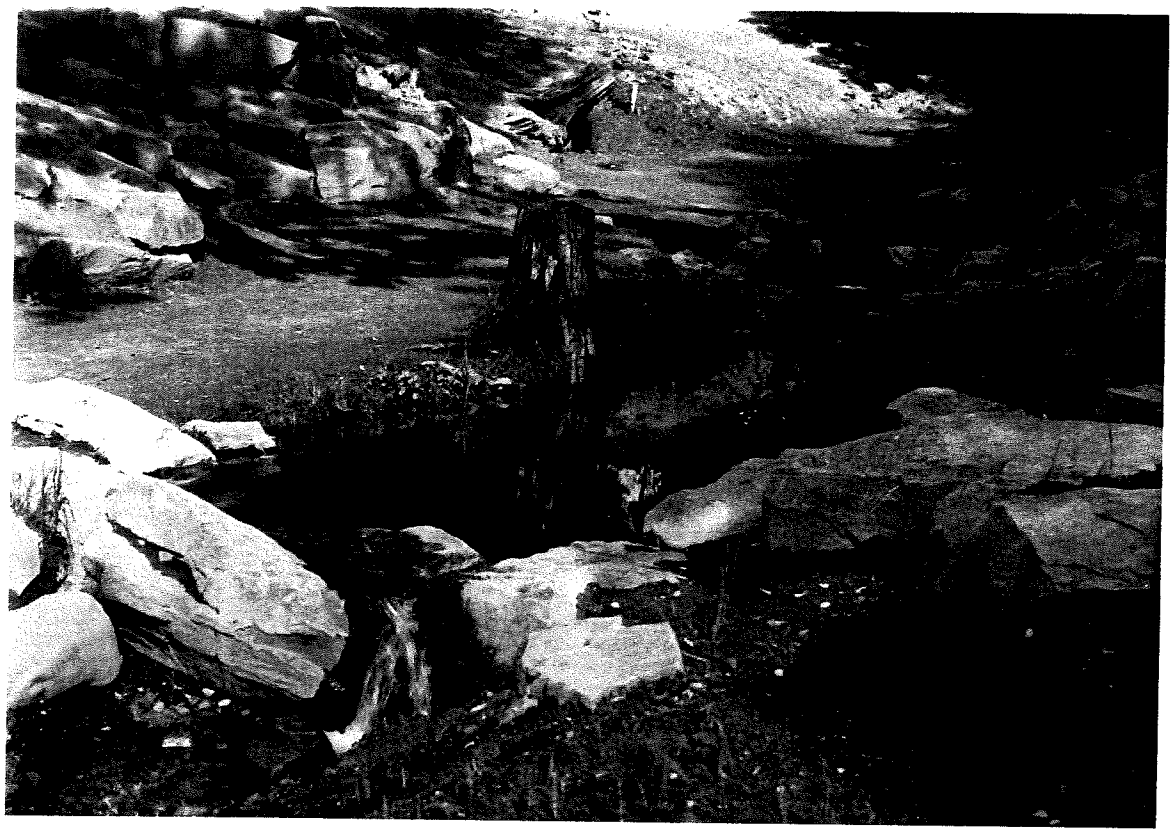
Legend 1. General view of Arboretum. Negative no. UW23849z

1.2 Location. Rhododendron Glen is located at the southern portion of Washington Park Arboretum, just above the reflecting pond adjacent to Azalea Way. Rhododendron Glen may be accessed from Arboretum Drive E; visitors may park their cars in one of the parking lots on the drive and walk a short distance down two flights of wooden stairs to the upper portion of the glen and follow the service road to the small pond and lower portion of the glen, eventually arriving at the Reflection Pond. The glen is easily accessed from the southern portion of Azalea Way as well. Visitors can park their cars at the arboretum's gravel park lot at the south end of the arboretum, and walk one hundred yards east to the reflecting pond.

1.3 *Historical Background.* Washington Park Arboretum was established in 1934 by the Mayor and City Council of Seattle, and the Board of Regents representing the University of Washington. Funds were obtained later in 1936, to design a planting plan for the new arboretum. Rhododendron Glen was originally conceived by the Olmsted Brothers L.A. firm as part of the Master Plan,

and featured over 200 species of flowering shrubs. Rhododendron Glen was first planted in 1938 with a collection of horticultural species donated from Dr. Cecil Tenny, of Seattle, Washington. Plant species and hybrids of *Rhododendron fortunii* were later donated to the arboretum by Mr. C.O. Dexter, of Massachusetts. Plant material came from Professor C.S. Sargent at the Arnold Arboretum, Boston, Massachusetts (BOLA Architecture + Planing and Kiest, 2003), and was planted on the north bank of the glen, facing west. Additional *Rhododendron* species donated and planted in the glen were the R. *argyrophyllum, R. auriculatum, R. arbororetum,* and *R. oreodoxa.* Additionally, various trees of magnolia, cherry, *Cornus kousa*, and *Tsuga mertensiana* have been donated and planted in the glen. Heathers, donated from the American Heather society around 1986, were planted next to *Erica arborорea* var. *alpine.*

1.4 Importance to Arboretum. Rhododendron Glen was once a spectacular showcase of rhododendrons, azaleas, mountain laurel, and other members of the *Ericaceae* (BOLA Architecture + Planning; Kiest, 2003). The glen is situated in a wooded valley in the arboretum, and houses memorial plantings to many well-known Washington nurserymen and horticulturists. People such as Mr. Clarence Prentise, Mr. Nick Tomasiello, Endre Ostbo, and Mrs. Edward Garrett have their memorial plantings in the glen.



Legend 2. Rhododendron Glen. Negative no. UW23850z

1.5 Stream View Potential. Rhododendron Glen is an important viewing area of the arboretum; and may be utilized for the education of visitors who live and garden in the Pacific Northwest who would be interested in rhododendron and plants that would grow under residential landscapes conditions. Rhododendron Glen will allow park visitors a unique opportunity to view an interpretive showcase garden highlighting rhododendron and plants growing under adjacent north and south-facing slopes and growing along a stream (Figure 1). The stream has interpretive aspects for the glen; as well as the plants. Plants, (primarily from *Ericaceae*) will be established along with the rhododendrons to provide partial shade, wind protection, color and texture to the site.

Rhododendron Glen Stream Restoration

Parcel Line
10' Interval Contour *
2' Interval Contour *
Waterbody Shoreline
Stream
Pavement Edge
Spot Elevation *

0 50 100
FEET

PORTION OF:
C.G.D.B. Tile # 318
1/4 Section-Tnshp-Rng: SE21 –25 –4
Kroll Page # 31.E

ORTHOPHOTOGRAPHY DATE: JULY 1999
* DATUM: NAVD88

NOTE: Conversion from City of Seattle Datum to NAVD88 Datum
To convert between City of Seattle and NAVD88 Datums, use:
("City of Seattle Datum" + 9.7ft = NAVD88).
There are inconsistencies in the City of Seattle Datum, the conversion may vary up to +/–1ft in specific areas throughout the City. In areas and applications where a more accurate conversion factor is critical, elevations should be field checked and vertical relationships between the two datums be determined for that particular area.

Produced by the Seattle Public Utilities –Geographic Systems Section on August 19, 2004

Legend 3. A well-enhanced stream with riprap, roughage, large wood, and vegetation.

1.6 Objectives:

1.6.1 Recommend plantings for rhododendron and plants suitable for sustainable growth under two adjacent and distinct growing conditions: a north-facing slope and a south-facing slope.

1.6.2 Recommend selected existing plants to be removed on site to facilitate establishment of rhododendron and plants.

1.6.3 Recommend an environmentally responsible restoration to the site's existing streambed.

1.7 Goals:

1.7.1 Appropriate species and hybrid rhododendrons will be selected and planted under suitable north and south-facing slopes

1.7.2 Appropriate plants from *Ericaceae*, and other complimentary woodland plants will be selected and planted under suitable north and south-facing slopes.

1.7.3 Recommendations will be made to re-establish and enhance existing stream.

1.8 Site Description. Rhododendron Glen has a relatively diverse topography. The south-facing slope is characterized by dense and overcrowded stands of self-sown native *Acer macrophyllum, Thuja plicata,* and *Tsuga canadensis* trees. Since many of the arboretum's tree collection are nearly 50 years of age, some trees may have to be removed due to their poor health or advanced maturity. The north-facing slope is moderately steep and relatively free from shrubs and trees; and therefore this slope will most likely necessitate tree plantings to protect rhododendrons from burning and desiccation. The stream connecting the small pond to the reflecting pond is approximately 130 yards in length. Elevation of the small pond is 25 feet above the reflecting pond, and creates a moderately sloped grade of approximately 8 degrees.

1.8.1 South-Facing Slope Topography. Site is mildly sloped, but provides good accessibility to stream. Topography is moderately steep as

one travels from the stream area, uphill, and east, toward the small pond; 25 feet above the elevation of the reflecting pond. Ground can be spongy immediately after rain, but water permeability in the area is acceptable for good plant growing conditions (Figure 2). The stream is visible from this area; and the upper half of stream is attractive, with a natural look to the banks and streambed. However, the lower half of the stream has been culverted underground for 14 feet in a 12" diameter concrete pipe. The culvert has necked-down the stream to present a ditch-like appearance (stream depth is greater than stream width). The area is dominated by a magnificent stand of red cedars and big leaf maples growing parallel to the stream, and creating an area of dense shade. There is little understory vegetation in this area, save for some salmonberries and a half dozen *Enkianthus* shrubs.

1.8.2 North-Facing Slope Topography. *The* site is moderately steep, but with good accessibility to stream. The area is meadow-like and open, and relatively free of plantings; and the area has a beautiful vista of the reflecting pond, Azalea Way, and surrounding areas. There is mature cedar tree growing at stream edge, and several attractive, but smaller cedars and hemlock in the area. The soil can be spongy immediately after rain, and footing may be somewhat treacherous due to the slope. However, water permeability in the area is acceptable for good plant growing conditions (Figure 3.).

1.9 Soil Types

In my study, 16 holes were dug at the glen to confirm soil series type, but holes exhibited a 4 to 8 inch layer of top soil overlying sand to a depth of 30 to 36 inches. The upper horizon soils from the holes dug on-site were all very similar in regard to soil stratification. The top 4 to 6 inches of soil was dark colored topsoil that was friable and moist. Color of the top soil was a dark, rich brown color; indicating a topsoil with organic matter present. Below the topsoil, at lower horizons, soil samples from 16 selected locations of the site were similar: Below the topsoil layer, the profile appeared to be sand to a depth of 30 to 36 inches. Below 36 inches the soil profile appeared to be peat with some blue-colored clay mixed in with the clay, indicating that this soil was most likely brought into the site during the construction phase of the glen in the 1930's. The Hale soil series was the dominant soil at Rhododendron Glen before sand and topsoil from outside the glen was brought into the site. The Hale series consist of deep, rather poorly drained soils. The taxonomic class is a coarse-loamy over sandy or sandy skeletal, isotic over mixed, mesic, Aquic Haplorthods (Stetten, *et al.*, 1994). The Ap – 0 to 10 inch horizon is very dark grayish brown. Bs1 – 10 to 14 inch horizon is a mottle mix of olive grey. Bs2 – 14 to 19 inches is a mottle mix of olive grey (National Cooperative Soil Survey U.S.A., 2004). Soil samples taken in Rhododendron Glen indicated a 4 to 8 inch layer of sandy loam over sand subsoil to a depth of 36 inches. There were bits of blue clay mixed in with the sand – a significant indication of a disturbed soil.

1.10 ***Soil Profile Evaluation.*** A total of 12 soil samples were taken from 6 sites each from the north-facing slope and south-facing slope, respectively. Soil samples were sent to the University of Washington's soil testing laboratory to be tested for bulk density (Pb), pH, texture, organic matter content, and metals. Soil texture and density can be used to evaluate planting potential, and quantify important soil characteristics such as: permeability, drainage, and water-holding capacity (Craul, 1999).

1.10.1 Soil texture was approximated in-field on six individual sites to be a sandy loam (Table 1B). The soil appeared to have much sand but also contained enough silt and clay to make the soil coherent. The soil was moist, friable, and a very dark brown. The soil had a deep and rich, earthy fragrance. The soil, when squeezed together, formed a solid looking cast that shattered easily when disturbed by bouncing the cast from hand to hand. Particle size of > 2mm is not calculated for soil texture. Particle size distribution averaged 79% sand (2-0.05mm); 15% silt (0.05-0.002mm) and 6% clay (<0.002mm) (Table 1B); texture is a sandy loam (Figure 2).

1.10.2 Soil bulk density (Pb) measurements are an indication of the amount of pore space to solids in a soil; a higher proportion of pore space to solids indicates a low soil bulk density. A low bulk density indicates a soil that is not a compacted soil. Thus, the lower the bulk density the

more pore space for moisture and air to flow in the soil and is easily accessible to plant roots. The soil Pb of Rhododendron glen averaged 1.31; this soil is not compacted, and should be acceptable for rhododendron growth and development (Table 1B).

1.10.3 Soil pH measures soil acidity; and is an important soil variable. Soil pH has an influence on the availability of macro and micronutrients to plants (Brady, 2004). The soil pH for Rhododendron glen averaged 5.7; excellent for the establishment rhododendrons (Table 1B).

1.10.4 Soil organic matter content (SOM). Accumulation of organic matter tends to acidify the soil, and such soil contributes to the sustainability for acid-loving plants, such as rhododendrons. Soil organic matter content for Rhododendron Glen averaged 2.93; a bit low but acceptable. This soil may have to be enriched with organic mulch for the establishment of rhododendrons (Table 1B). Rhododendrons benefit from the annual application of mulches. Mulches help conserve soil moisture, enhance soil tilth, provides plant nutrients (Nelson, 2000).

Legend 4. Water poured into holes to determine water permeability.

1.11 Soil Samples for water permeability. Five holes, with a 7.5 inch diameter, and a depth of 24 inches were dug on the north-facing and south-facing slopes, respectively (for a total of ten holes). Holes, on both slopes were spaced at 50 foot intervals from the reflecting pond toward the small pond. Holes were filled with water and allowed to drain. Standing water measurements in the holes were recorded at 5, 10, 15, 20 and 25 hours (Figure3 and Figure 4).

1.12 Microclimate. Rhododendron Glen has a maritime Pacific climate which exhibits a cool winter-rain (Portico Group, 1997b. The Arboretum Plan, p. 178). Prevailing winds are from the southwest and average 9 miles an hour. Some winter storms can produce strong southerly or northerly winds. Usually, adequate

winds prevent air pollutants from accumulating but periods of low wind velocity sometimes allow pollutants to concentrate (Portico Group, 1997b, Master Plan; Affected Environment, Impacts, and Mitigation Measures; p.71). Climate and ecology are influenced by the interactions that occur between seasonally varying weather patterns and the Pacific northwest region's mountain ranges (Climate Impacts Group, 2004). Approximately two-thirds of the region's precipitation occurs from October to March; and from late spring to early fall, the climate remains fairly dry. West of the Cascades, the climate in the valleys is characterized by mild annual temperatures, wet winters and dry summers (Portico Group, 1997b. Master Plan, Affected Environment, Impacts, and Mitigation Measures; p.71; Climate Impacts Group).

1.13 ***Hydrology.*** Hydrology of Rhododendron glen is influenced by drainage from Arboretum Drive East running off into surrounding areas and from ground water movement and irrigation runoff from Broadmoor golf course (Portico Group, 1997b. The Arboretum Plan, p. 159). The golf course is situated on the boundary of the park. Below the golf course, the arboretum is a watershed. There are two ponds and associated stream in the glen. The rhododendron stream originates from a soil drain system from Broadmoor golf course. The stream is fed by a storm drain system within the golf course that is culverted into the upper pond. Flow is augmented by ground water springs around the lower pond (Portico Group, 1997b, The Arboretum Plan, p. 111). The stream alternates between open and culverted sections approximately 130 yards from the reflecting

pond to the smaller upper pond. Above the smaller pond, a channel runs approximately 110 yards that ends at Arboretum Drive (Portico Group, 1997b. The Arboretum Plan, p. 111).

1.14 Surface Water. Washington Park Arboretum is drained by Arboretum Creek that flows along the length of the park from south to north. Presently, much of the surface water from 425 acres of watershed north of East Madison Street contributes flow to the creek (Master Plan, 2001 Affected Environment, Impacts, and Mitigation Measures; p.83). There is a small stream that flows, primarily in the winter months, through Rhododendron Glen into Arboretum Creek. The stream originates from a subsurface drainage system in the Broadmoor golf course. From Arboretum Drive East, the stream flows for approximately 100 yards and drains into a small pond. From the small pond, the stream flows, alternating from open and culverted sections, for approximately 110 yards before draining into to the reflecting pond. From the reflecting pond, the stream flows underground through a culvert for 30 yards underneath Azalea Way, and empties into Arboretum Creek (Portico Group, 2001. Master Plan, Affected Environment, Impacts, and Mitigation Measures; p.83).

Legend 5. Pond at the foot of Rhododendron Glen. Negative no. UW23851z

1.15 Groundwater and Seepage. Groundwater usually flows downhill with the slope of the water table, and flows toward and eventually drains into streams and rivers (Environment Canada, 2004). In 1938, when Rhododendron Glen was constructed, an extensive drainage system was established to collect groundwater and divert it into the reflecting pond. Currently, much of the drainage system is now dysfunctional due to the poor condition of existing drain tiles: many are clogged with soil, and some are broken and no longer functioning. Although the drainage system is no longer functioning well, soil tests from the surrounding area indicate that good water drainage is evident and problems due to high soil-moisture should not be problematic. The soil is friable with a substantial topsoil layer; a sand subsoil underlays topsoil by 30 to 36 inches.

Legend 6. Azalea way looking south. Negative no. UW23857z

1.16 Paths Used by Visitors. Azalea Way is the most heavily used path in the arboretum. By the 1940s, the three-quarter mile long pathway was showcasing 1,700 azaleas, 200 eastern dogwoods and 300 Japanese cherries. Rhododendron Glen is easily accessed by the reflecting pond, just to the East of Azalea Way. Eventually, a new path from Rhododendron Glen to Azalea Way will be constructed from the small upper pond to the reflecting pond. Arboretum Drive East is a well-maintained, two-lane, paved road which passes through Washington Park Arboretum from the Graham Visitors Center in the north to the Gatekeeper's Cottage to the south end of the arboretum. There are no designated bike ways, but bicyclists commonly utilize the drive as they travel

through the arboretum. Additionally, pedestrians walk along the shoulder of the roadway to access points of interest throughout the arboretum.

A visitor path is proposed for implementation in Rhododendron Glen. The pathway is intended to provide access to the glen and the surrounding plantings as well as tie the glen into Azalea Way. The path should remain at least 25 feet away from the steam, but observation points may be constructed that will allow visitors access to view the stream at close range, but at the same time protect the stream from harm by excessive foot traffic and erosion.

1.17 Visitor Safety Concerns. When the path in Rhododendron Glen is designed, it must meet the requirements of the Americans with Disabilities Act (ADA). The ADA prohibits discrimination of disabled people and requires that places of public facilities be designed and constructed in compliance with ADA accessibility standards.

All possible measures will insure that visitors to the glen will be protected from accidents that may occur at the site due to the steepness of the terrain (8 % slope from east to west). The proposed pathway through the glen must address ADA requirements. Potential problem areas must be addressed and eliminated during the design phase, and if needed, during the construction phase of the project. Attempts to improve visitor safety are linked to the elimination or control of factors that may contribute to park accidents (Golding, *et al.*, 2001).

Figure 2. Soil Triangle.

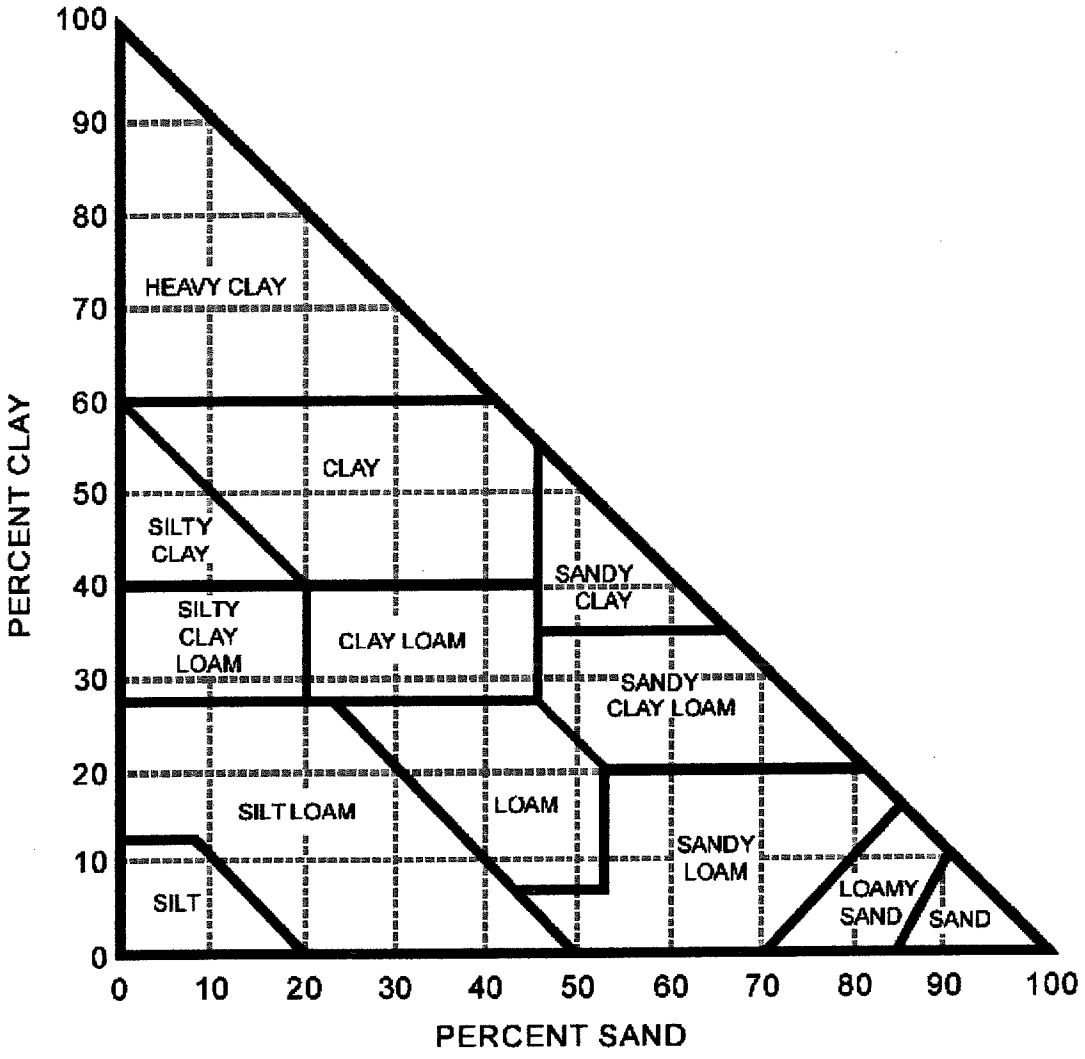


Figure 3. South-Facing Slope: Water Seepage Through 7.5 inch Diameter Hole at Soil Depth of 24 inches

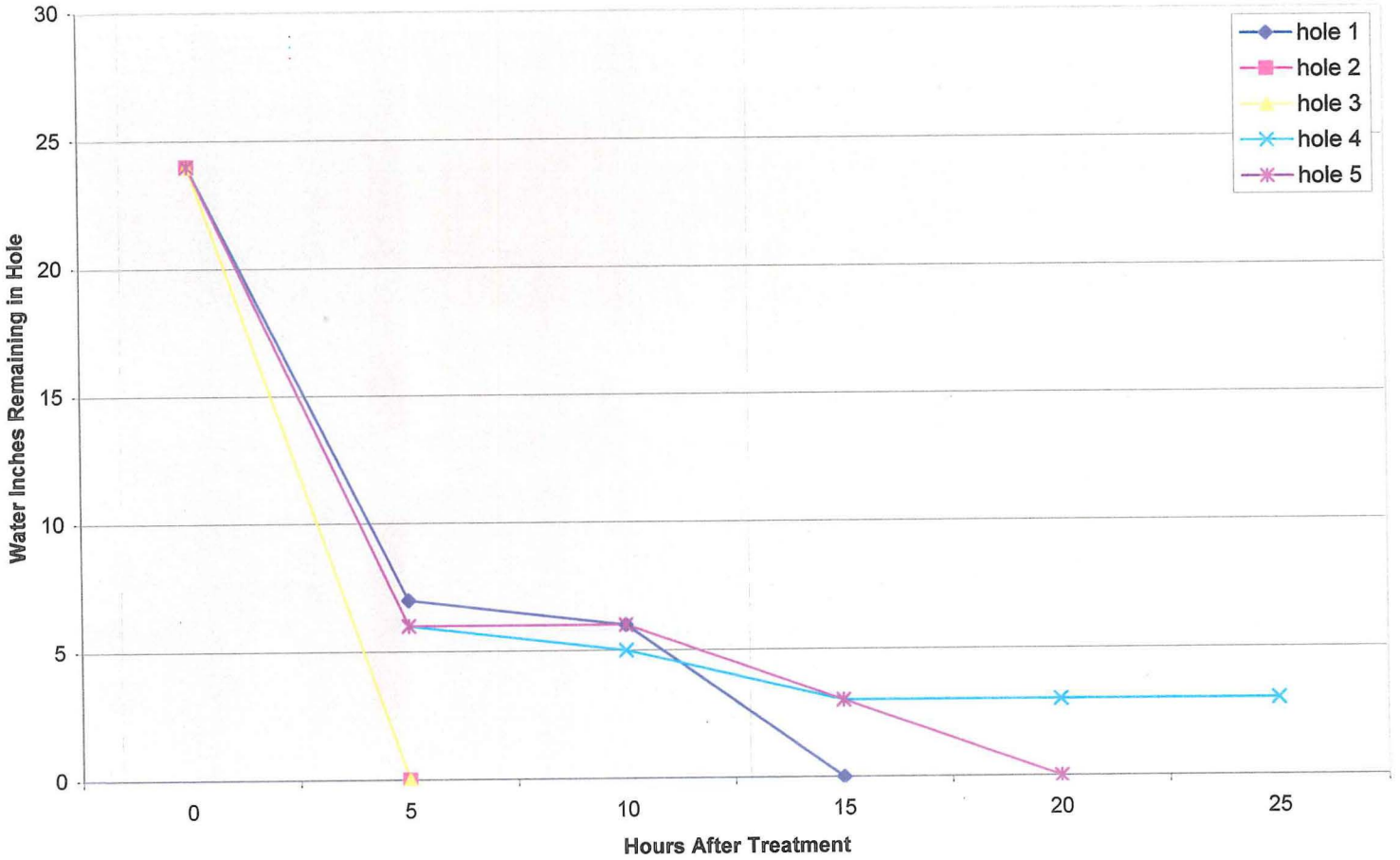


Figure 4. North-Facing Slope: Water Seepage Through 7.5 inch Diameter Hole at Soil Depth of 24 inches

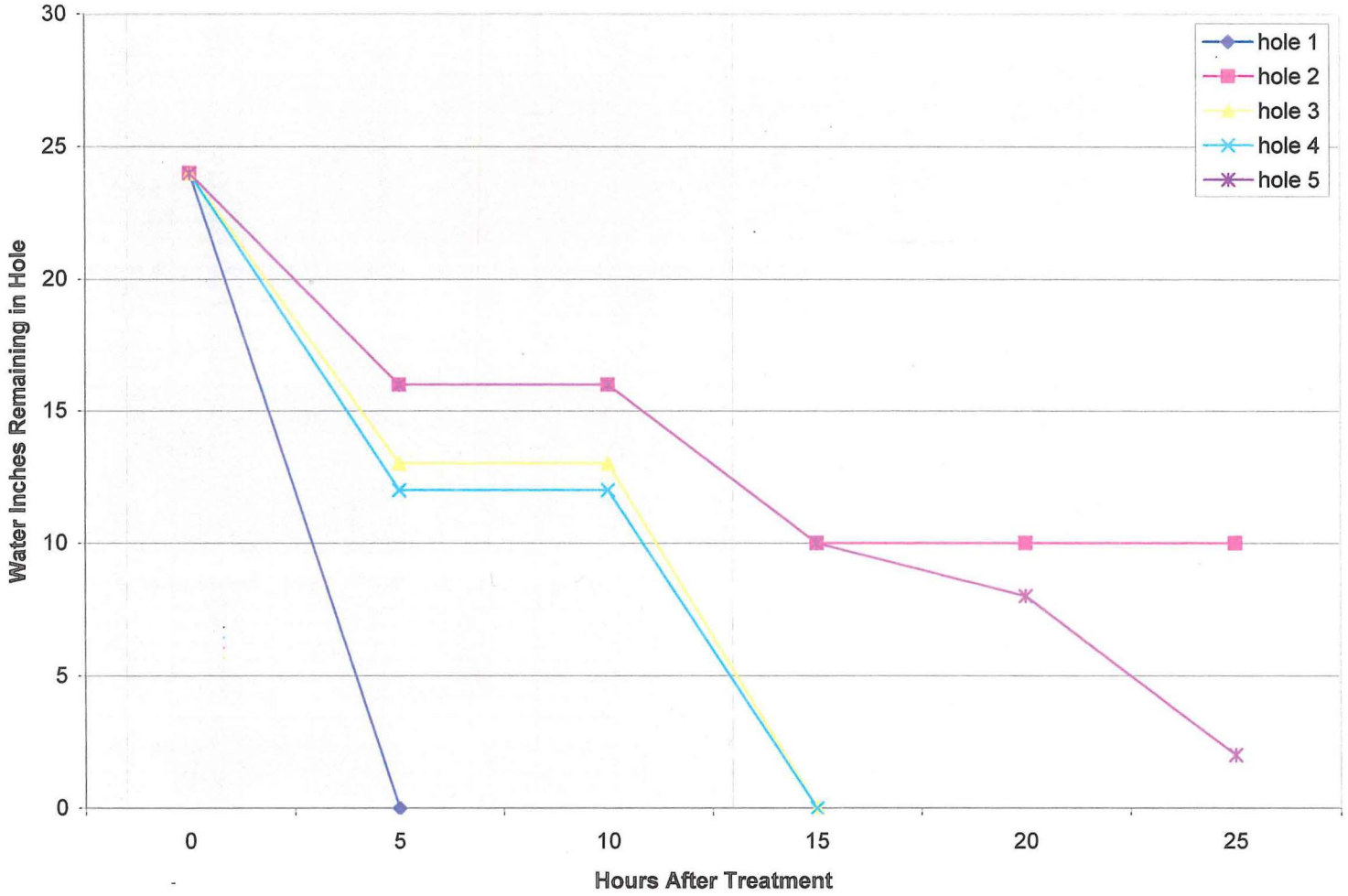


Table 1. Rhododendron Glen Soil Samples: Soil Pb and Gravimetric Water Content (g/g)

No. 1. North-facing Slope at Soil depth (in)	wet mass (g)	dry mass (g)	mass of water (g)	pan + ring wt.	Corrected Wet Mass (g)	Corrected Dry Mass (g)	Volume of Soil Cylinder (cm^3)	Pb (Mg/m^3)	Gravimetric Water Content (g/g)
1	124.3	107.9	16.4	41.40	82.90	66.5	51.5	1.3	0.15
2	121.7	108.2	13.5	41.30	80.40	66.9	51.5	1.3	0.12
3	115.7	107.2	8.5	41.70	74.00	65.5	51.5	1.3	0.08
4	119.5	106.3	13.2	40.40	79.10	65.9	51.5	1.3	0.12
5	118.9	106.7	12.2	40.10	78.80	66.6	51.5	1.3	0.11
6	123.7	110.2	13.5	41.80	81.90	68.4	51.5	1.3	0.12
No. 2. North-facing Slope at Soil depth (in)	**wet mass (g)**	**dry mass (g)**	**mass of water (g)**	**pan + ring wt.**	**Corrected Wet Mass (g)**	**Corrected Dry Mass (g)**	**Volume of Soil Cylinder (cm^3)**	**Pb (Mg/m^3)**	**Gravimetric Water Content (g/g)**
1	133.5	116.4	17.1	49.60	83.90	66.8	51.5	1.3	0.15
2	120.4	110.4	10	47.90	72.50	62.5	51.5	1.2	0.09
3	127.2	110	17.2	48.00	79.20	62	51.5	1.2	0.15
4	123.1	110.3	12.8	48.30	74.80	62	51.5	1.2	0.11
5	132.1	122.7	9.4	49.20	82.90	73.5	51.5	1.4	0.08
6	138	128.9	9.1	48.40	89.60	80.5	51.5	1.6	0.08
No. 3. North-facing Slope at Soil depth (in)	**wet mass (g)**	**dry mass (g)**	**mass of water (g)**	**pan + ring wt.**	**Corrected Wet Mass (g)**	**Corrected Dry Mass (g)**	**Volume of Soil Cylinder (cm^3)**	**Pb (Mg/m^3)**	**Gravimetric Water Content (g/g)**
1	133.6	112.1	21.5	49.10	84.50	63	51.5	1.2	0.19
2	131.6	113.6	18	48.70	82.90	64.9	51.5	1.3	0.16
3	137	118.2	18.8	49.20	87.80	69	51.5	1.3	0.17
4	133.4	115.5	17.9	48.90	84.50	66.6	51.5	1.3	0.16
5	128.2	110.6	17.6	48.70	79.50	61.9	51.5	1.2	0.16
6	130.6	118.2	12.4	49.20	81.40	69	51.5	1.3	0.11
No. 1. South-facing Slope at Soil depth (in)	**wet mass (g)**	**dry mass (g)**	**mass of water (g)**	**pan + ring wt.**	**Corrected Wet Mass (g)**	**Corrected Dry Mass (g)**	**Volume of Soil Cylinder (cm^3)**	**Pb (Mg/m^3)**	**Gravimetric Water Content (g/g)**
1	125.4	104.6	20.8	41.00	84.40	63.6	51.5	1.2	0.20
2	130.1	111.2	18.9	41.70	88.40	69.5	51.5	1.3	0.18
3	128.9	113.5	15.4	41.00	87.90	72.5	51.5	1.4	0.15
4	129.5	115.2	14.3	41.30	88.20	73.9	51.5	1.4	0.14
5	125.6	111.5	14.1	41.50	84.10	70	51.5	1.4	0.13
6	129.9	117.1	12.8	41.20	88.70	75.9	51.5	1.5	0.12
No. 2. South-facing Slope at Soil depth (in)	**wet mass (g)**	**dry mass (g)**	**mass of water (g)**	**pan + ring wt.**	**Corrected Wet Mass (g)**	**Corrected Dry Mass (g)**	**Volume of Soil Cylinder (cm^3)**	**Pb (Mg/m^3)**	**Gravimetric Water Content (g/g)**
1	122.5	108.4	14.1	41.00	81.50	67.4	51.5	1.3	0.13
2	125.4	107.8	17.6	40.90	84.50	66.9	51.5	1.3	0.16
3	126.4	110.4	16	41.20	85.20	69.2	51.5	1.3	0.15
4	127.4	110.8	16.6	40.70	86.70	70.1	51.5	1.4	0.15
5	124.8	108.5	16.3	41.60	83.20	66.9	51.5	1.3	0.15
6	121.7	108.5	13.2	41.50	80.20	67	51.5	1.3	0.12
No. 3. South-facing Slope at Soil depth (in)	**wet mass (g)**	**dry mass (g)**	**mass of water (g)**	**pan + ring wt.**	**Corrected Wet Mass (g)**	**Corrected Dry Mass (g)**	**Volume of Soil Cylinder (cm^3)**	**Pb (Mg/m^3)**	**Gravimetric Water Content (g/g)**
1	118.6	101.1	17.5	41.90	76.70	59.2	51.5	1.1	0.17
2	101.9	88.4	13.5	28.20	73.70	60.2	51.5	1.2	0.13
3	110.2	98.5	11.7	27.60	82.60	70.9	51.5	1.4	0.12
4	123.3	111.5	11.8	41.20	82.10	70.3	51.5	1.4	0.12
5	117.3	101.1	16.2	40.80	76.50	60.3	51.5	1.2	0.16
6	119.6	109.2	10.4	41.60	78.00	67.6	51.5	1.3	0.10

Table1B. Soil Samples: macro and micronutrients												
SAMPLE SET	site	µg/g Al	µg/g As	µg/g B	µg/g Ba	µg/g Ca	µg/g Cd	µg/g Cr	µg/g Cu	µg/g Fe	µg/g K	µg/g Mg
Blank		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sample-1	southFace 50	10446.945	TR	22.978761	54.384071	2203	TR	35.6	26.335398	9219.769	TR	3150
Sample-2	southFace 100	12623.294	TR	27.938721	58.760213	3247	TR	42.4	11.185613	10931.438	309	3580
Sample-3	southFace 150	13147.484	TR	38.530392	70.130392	3010	6.55	50.9	16.401961	16076.383	526	6439
Sample-4	southFace 200	9885.3772	TR	33.1238	45.720729	2917	TR	49.2	13.492322	13764.848	439	4605
Sample-5	southFace 250	13093.416	TR	34.1234	68.071298	2989	6.10	46.2	24.904022	13929.15	262	4400
Sample-6	southFace 300	15067.83	TR	41.721264	69.396552	4882	7.02	38.0	30.143678	16855.551	576	5359
QC		25.000	1.000	1.000	1.000	100.0	1.000	1.000	2.000	25.000	125	25.000
QC run		24.735	0.977	1.116	0.939	93.0	1.001	1.012	2.002	24.303	121	26.879

SAMPLE SET	site	µg/g Mn	µg/g Mo	µg/g Na	µg/g Ni	µg/g P	µg/g Pb	µg/g S	µg/g Se	µg/g Zn	µg/g Si	µg/g Ag
Blank		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sample-1	southFace 50	149	15.7	129	35.5	247	57.3	328	395	42.5	1104	TR
Sample-2	southFace 100	159	18.3	186	39.4	239	44.8	527	467	45.3	1424	TR
Sample-3	southFace 150	291	22.2	138	62.6	370	40.8	200	625	49.6	1309	TR
Sample-4	southFace 200	181	17.6	146	48.7	342	31.9	287	517	53.3	974	TR
Sample-5	southFace 250	280	20.8	157	52.8	286	46.6	332	566	47.9	1235	TR
Sample-6	southFace 300	358	24.2	645	55.1	516	67.7	442	672	68.3	1181	TR
QC		2.500	1.000	5.000	1.000	50.000	1.000	2.500	2.000	1.000	2.000	
QC run		2.449	1.057	5.724	0.830	51.656	0.987	2.826	1.973	1.042	1.932	

Table 1C. Soil Samples: pH, Pb, %C, %N, and Particle Size.						Particle Size			
Sample No.	Sample I.D.	pH	Pb (Mg/m^3)	%	%	gravel	sand	silt	clay
		2:01		C	N	>2mm	2-0.05	0.05-0.002	<0.002mm
						%	%	%	%
Sample-1	southFace 50	5.33	5.33	3.36	0.224	2.41	76.79	15.92	4.88
Sample-2	southFace 100	5.42	5.42	2.66	0.185	4.75	74.95	15.53	4.77
Sample-3	southFace 150	6.07	6.07	1.21	0.06	19.16	64.64	12.15	4.05
Sample-4	southFace 200	5.82	5.82	2.03	0.111	24.77	60.83	12.49	1.91
Sample-5	southFace 250	5.58	5.58	2.39	0.161	2.27	76.93	15.92	4.88
Sample-6	southFace 300	5.72	5.72	5.94	0.293	26.48	59.72	8.27	5.53
QC run		5.01		3.86	1.48				
QC true		5.00		3.95	1.58				

CHAPTER 2

EXISTING VEGETATION OF SOUTH AND NORTH-FACING SLOPES, RECOMMENDATIONS REGARDING PLANT REMOVAL, AND ESTABLISHMENT. PLANTING RECOMMENDATIONS FOR PERSPECTIVE SLOPES.

2.1 Existing Vegetation on South-Facing Slope *(see Appendix A.).* There is currently a grove of western red cedar trees (*Thuja plicata*) that dominate the south-facing slope, just north of the stream. The understory beneath these cedars consists of *Enkianthus* and salmonberries. There are some *Populus cathayana,* and *Populus szechuanica* var. *tibetica* in the area. There are some medium sized rhododendrons in the area as well. There are two, very large, big leaf maples (*Acer macrophyllum*). One of the trees has a distinctive co-dominant leader. Both trees shade a significant area of the south-facing slope.

The large oak tree (*Quercus sp.*), at the foot of the reflecting pond, occupies a tremendous footprint in the front of the south-facing slope; and is easily one of the most distinguishable trees in the glen. The oak, (without a WPA accession number), represents a valuable contribution to the glen and should remain However, it is recommended that the tree's canopy be lifted somewhat, so that visitors may view the glen without the obstruction of the tree's low hanging branches. Additionally, there is a hemlock tree which exhibits a significant trunk crack and has a conk on the exterior of the trunk. However, the tree is mature and attractive, and need not be removed, but it may be monitored for signs of bio-mechanical failure.

There are several *Abies* species, *Berrberis coxii,* and *Berberis lempergiana* growing in the area; as well as some *Kalmia* and *Gaultheria* species. There are several *Magnolia* trees in the area, and some *Pieris* species present. There are several *Podocarpus* species and several *Quercus* trees.

2.2 Rec*ommended Plant Removal on South-Facing Slope.* There are several western (*Thuja plicata*) trees that form a stand, and create a considerable amount of shade for understory vegetation. It is recommended that an examination of this site be made to determine which trees, if any, should be trimmed or removed to facilitate effective establishment and sustainability of rhododendrons and plants. Presently the site appears to be excessive crowded with conifers; judicial thinning may be in order.

There is one large cedar tree that is approximately twenty feet north of the stream and is crowding a *Populus* tree on its left, and a big leaf maple tree on its right. It is recommended that this cedar tree be removed to allow for enhanced growth of both the *Populus* and big leaf maple (*Acer macrophyllum*). Next to the cedar tree is a medium height dogwood tree that should be removed. The tree is crowded next to the cedar and does not contribute to the beauty of the area. There is a large stand of pampas grass growing at stream edge. This grass should be removed. If it is desirable to keep the grass, it may be planted adjacent to the hemlock tree (*Thuja canadensis*) growing near a seep near the reflecting pond. The area there is very wet and will provide the grass with ample room to flourish in partial sun.

2.3 *Rhododendrons for Planting on South-Facing Slope (Table 2.).* These plants will tolerate some drought and will grow in dry soil. These plants will grow under partial shade, or full sun conditions. Many of the species and hybrids selected will tolerate full sun and drought conditions for a limited period. Additionally, species and hybrids were selected that are able to tolerate excessive shade, as there is considerable shade in the area due to a dominant stand of cedar and big leaf maple trees.

2.4 Plants for the South-Facing Slope (Table 4.). Rhododendron Glen has considerable shade on a significant portion of its South-facing slope. Trees and shrubs adapted to partial and full shade must be utilized in this area. Some of the mature trees in the area will have to be trimmed back to allow more light into the area. Some of the trees will have to be removed, if new plantings are to be established. Shady areas may provide opportunities for attractive plantings, of large leaf rhododendrons, provided that suitable plant selection methods are employed, and plants are tended well during their first few years of growth.

2.5 Planting Recommendations for South-Facing Slope. It is known that soil temperatures can differ greatly within a short distance as a result of slope and aspect of the land (Hickman, 2004). South-facing slopes absorb more energy from the sun and will tend to dry out faster than north facing slopes. Therefore, rhododendrons will be identified for planting that have tolerance to

warm soils with relatively low-water content. Rhododendrons planted on a south-facing slope must be protected from inadequate soil-moisture. Many kinds of rhododendrons will grow in full sun, but most prefer partial shade. Rhododendrons have shallow roots and require frequent irrigation to maintain healthy plant growth (Kelley, 1994). For this site, adequate irrigation will be especially important for newly planted rhododendrons.

2.6 *Existing Vegetation on Rhododendron Glen's North-Facing Slope. (Appendix B).* Plants growing on this slope are, for the most part, well-spaced and growing under optimum conditions. There is a large cedar tree growing in this area, as well as a large hemlock. There are 5 cherry trees that may have to be removed if it is ascertained that the maintenance of the trees will be excessive. The trees are well off the service roads and when new plantings are established, may prove to be difficult to maintain. There is a large cedar tree growing close to the stream; the tree is attractive and well-proportioned, and should remain in the glen

There are several *Acer palmatum* trees, and two *Prunus* trees situated toward the southern portion of this slope, near the service road. There are azaleas growing in this area, as well as a large stand of mature rhododendrons, growing in a circle. There is a beautiful *Alnus cordata* growing very near the stream; as well as half dozen *R. occidentale* shrubs near the stream edge. A large *Carpinus turczaninovii* is growing well near the small pond. A *Catalpa fargesii f. duclouxii* is growing here; as well as some E*ricas*, and a nice looking

Styrax japonicum. These trees add color, texture and wind protection for rhododendrons, and should remain.

2.7 Recommended Plant Removal on North-Facing Slope. There are 5 cherry trees on the north-facing slope that may be considered for removal: *Prunus incisa, Prunus serrulata* 'Tanko-shinju', *Prunus x yedoensis, and Prunus x yedoensis* 'Akebono'. Currently, these trees are difficult to maintain and spray, as they off the main service roads where spray equipment can be easily employed. Once the glen is developed and planted, the maintenance of these trees will become more difficult, and subsequently, any tree removal will be far easily accomplished before, rather than after new plantings are installed. There is a vine maple tree, growing very close to a large cedar tree near the stream; and is recommended for removal. As the tree matures, the problems of close planting will be exacerbated, as well as providing excessive shade to understory rhododendrons and plants. There is a medium sized, and seemingly, out of place *Populus maximowiczii* that should be removed with a tree spade and planted elsewhere; perhaps replanted within 50 feet to the north of the stream, where several other *Populus* trees are currently located.

2.8 Rhododendrons for Planting on North-Facing Slope (Table 3.). These plants will grow in moist soil, and grow under partial shade or full sun. Much of the area is open, and subjected to full sun conditions; necessitating the importance of establishing rhododendrons that are tolerant to these conditions

without undue desiccation or sun burning of leaves. Also, there are wet areas in the North-Facing slope; and rhododendrons have been listed that will tolerate wet soil.

2.9 *Plants for Planting on North-Facing Slopes (Table 4).*

Many of the plants listed in Table 4 are appropriate for establishment on the north-facing slope. This slope, in general, has much land area in full sun. Plants for this area, therefore, must be able to tolerate full sun conditions, as well as grow tall enough to provide shading for understory rhododendrons. Plants, such as *Cornus kousa, C. canadensis*, and *Arbutus unendo* were selected to provide sun and wind protection for selected rhododendrons. Plants, such as *Kalmiia macrophylla* and the *Andromeda polifolia* were selected to be established in boggy and flooded areas of the north-facing slope.

2.10 Planting Recommendations on North-Facing Slope. A north-facing slope will tend to warm up less rapidly and may retain more soil-moisture than a south-facing slope (Hickman, 2004). Therefore, rhododendrons will be identified for planting that have tolerance to cool soils with relatively high-water content. Rhododendrons planted on a north-facing slope may be subjected to unfavorable soil-moisture conditions during periods of excessive precipitation or if the soil is poorly-drained or becomes compacted.

It has been recorded that excessive soil-moisture kills a great percentage of rhododendrons purchased (Kelley, 1994). Rhododendrons are fibrous and

shallow-rooted plants that require well drained soils for optimum performance (Kelley, 1994. A rhododendron should be established in a hole to a depth that the plant will be slightly higher than it was in the nursery container. Scarify the sides and bottom of the hole so that the site soil and backfill will be intermingled Fertilizer can be applied to the soil surface after planting if needed

(Harris, *et al.*, 2004, pp 206).

Soil analyses from Rhododendron Glen are favorable for the establishment of rhododendrons. The Soil pH is 5.7; acceptable for rhododendron growth. Soil bulk density is 1.3; excellent for rhododendron growth. Soil % C (3%) and % N (0.2%) are low, but can be modified by the application of organic mulch and nitrogen fertilizer to obtain acceptable nutritional requirement levels for the establishment of rhododendrons.

Table 2. Rhododendrons for South-Facing Slopes							
Botanical Name	**Hardy degree F**	**Soil Condition**	**Light Intensity**	**Plant Height**	**Bloom Time**	**Bloom Color**	**Plant Origin**
R. degronianum ssp. yakushimanum	0 to 30	moist	partial shade or partial sun	3 to 10 feet	Spring	pink to pale red	Japan
R. austrinum	-5 to 20	dry, will tolerate drought	partial shade or partial sun	4 to 6 feet	Spring	fragrant orange, yellow	Florida, Georgia
R. alabamense	-10 to 20	dry, will tolerate drought	partial shade or partial sun	3 to 4 feet	Spring	white	Florida, North Carolina
R. arborescens	-10 to 10	dry, will tolerate drought	partial shade or partial sun	4 to 6 feet	Spring	fragrant pink, white	Eastern U.S.
R. atlanticum	-15 to 20	moist	full shade to partial sun	3 to 4 feet	Spring	fragrant pink, white	Eastern U.S.
R. aureum var aureum	-15 to -5	moist	partial shade or partial sun to full sun	1 foot	Spring	white	N. China, E Siberia, N China, N Japan
R. auriculatum	-10 to 5	moist	partial shade or partial sun to full sun	8 to 15 feet	Spring & Summer	white	W. China
R. austrinum	-5 to 20	dry, will tolerate drought	partial shade or partial sun	4 to 6 feet	Spring	fragrant orange, yellow	Florida, Georgia
R. *augustini* 'Bluenose'	-10 to 5	moist	partial shade or partial sun, to full sun	3 to 4 feet	Spring & Summer	purple	China
R. bureavii ssp. taliensia	- 10 to 5	moist	partial shade or partial sun, to full sun	8 to 15 feet	Spring	pink, white	S.W. China
R. calendulaceum 'Flame Azalea'	-20 to 10	dry, will tolerate drought	partial shade or partial sun	4 to 8 feet	Spring & Summer	pink, white	S.W. Pennsylvania to Georgia
R. canescens	-15 to 20	dry, will tolerate drought	partial shade or partial sun	6 to 10 feet	Spring	pink	North Carolina to Florida
R. flammeum	-10 to 5	dry, will tolerate drought	partial shade or partial sun	2 to 3 feet	Spring	orange, red, yellow	Eastern Eurasia
R. fulfum	0 to 5	moist	full shade to full sun	8 to 20 feet	Spring	pink, purple, white	N.E. Burma, W. China
R. Impeditum	-30 to 5	moist	full shade to full sun	6 to 36 inches	Spring	purple	W. China
R. indicum	0 to 30	dry, will tolerate drought	partial shade or partial sun	5 to 6 feet	Spring & Fall	lavander, pink, salmon, white	Japan
R. japonicum	-15 to 10	dry, will tolerate drought	partial shade or partial sun	4 to 6 feet	Spring	red, yellow	Japan
R. kaempferi	0 to 30	dry, will tolerate drought	partial shade or partial sun	4 to 10 feet	Spring & Fall	orange, pink, red, white	Japan
R. luteum	-20 to -5	dry, will tolerate drought	partial shade or partial sun	6 to 12 feet	Spring	yellow	Eastern Euraisa
R. micranthum	-15 to 15	dry, will tolerate drought	partial shade or partial sun	6 to 10 feet	Spring	pink	N. Korea, Manchuria, China
R. mucronulatum	-15 to 25	dry, will tolerate drought	partial shade or partial sun	6 to 10 feet	Spring & Winter	pink, purple	N.E. Asia, Japan
R. x obtusum	-10 to 15	dry, will tolerate drought	partial shade or partial sun	2 to 4 feet	Spring & Fall	lavander, pink, salmon, white	Japan
R. orthocladum var. orthocladum	-10 to 15	dry, will tolerate drought	partial shade or partial sun	2 to 4 feet	Spring	purple	N. Yunan, SW Sichuan
R. x praecox	-10 to 15	dry, will tolerate drought	full shade to partial sun	3 to 5 feet	Spring	pink, purple	Hybrid of R. cilatum and R. dauricum
R. prunifolium	-15 to 5	dry, will tolerate drought	partial shade or partial sun	3 to 4 feet	Summer	orange, red, salmon	Georgia & Alabama
R. rubignosum	0 to 25	dry, will tolerate drought	partial shade or partial sun	8 to 20 feet	Spring	pink, purple	West China
R. satsuki 'Azaka'	0 to 15	dry, will tolerate drought	partial shade or partial sun	18 to 30 inches	Spring & Fall	lavander, pink, salmon, white	Japan
R. stewartiainum	-15 to 5	dry, will tolerate drought	partial shade or partial sun	4 to 8 feet	Spring	pink, red, white, yellow	SE Tibet, Upper Burma
R. poukhanense	-15 to -5	moist	partial shade or partial sun, to full sun	4 feet	Spring	lavender	Korea, Japan (Tsushima)
R. rupicola var. chryseum	-10 to 0	moist	partial shade or partial sun, to full sun	2 feet	Spring & Summer	yellow	N Burma, China (NW Yunnan) SE Tibet
R. rupicola var. rupicola	0 to 15	moist	partial shade or partial sun, to full sun	2 feet	Summer	purple	N Burma, China (NW Yunnan) SE Tibet
R. russatum	-10 to 0	moist	partial shade or partial sun, to full sun	3 feet	Spring & Summer	purple, lavender	China (N Yunnan, SW Sichuan)
R.williamsianum	-5 to 10	moist	partial shade or partial sun, to full sun	2 feet	Spring & Summer	pink	China (Sichuan, Guizhou)
R. concinnum	-5 t0 10	moist	partial shade or partial sun, to full sun	5 feet	Summer	purple	China (Sichuan, Hubei, Shaanxi, Gansu, Henan
R. hyperythrum	-10 to 0	moist	partial shade or partial sun, to full sun	3 feet	Spring	white	N Taiwan
R. 'Chionoides'	-15 to -10	tollerates dry	light shade to full sun	4 to 5 feet	Spring and Summer	white	ponticum hybrid
R. 'Crete'	-10 25	tollerates dry	light shade to full sun	3 to 4 feet	Spring and Summer	light rose	smirnowii x yakushimanum
R. 'Edith Bosley'	-15 to 0	tollerates dry	light shade to full sun	5 feet	Spring & Summer	purple	Dexter Bosley 1035 x Lee's Dark Purple
R. 'Normandy'	-20 to -10	tollerates dry	light shade to full sun	4 feet	Spring and Summer	purple	Newburyport Beauty x Newburyport Belle
R. 'Percy Wiseman'	-5 to 0	tollerates dry	light shade to full sun	3 feet	Summer	white	(degronianum ssp yakushimanum x Fabia Tangerine) selfed
R. 'Scarlet Romance'	-15 to -5	tollerates dry	light shade to full sun	6 feet	Spring and Summer	bright red	Vulcan x (Seffon x H.P. Sargent)
R. 'Yaku Princess'	-15 to -10	tollerates dry	light shade to full sun	3 feet	Summer	pink with green spotting	Lackamas Spice x degronianum ssp yakushimanum
R. 'Mist Maiden'	-20 to -10	tollerates dry	light shade to full sun	3 feet	Spring and Summer	pink	King Tut x degronianum ssp yakushimanum ' Koichiro Wada'
R. 'Cherries and Cream'	-5 to 0	tollerates dry	light shade to full sun	3 feet	Spring	pink	(Fabia x bureavii) x Lem's Cameo
R. 'Yaku Incense'	-5 to 0	tollerates dry	light shade to full sun	3 feet	Summer	White with a slight blush	Lackamos Spice x degronianum ssp yakushimanua
R. 'Dora Amateis'	-15 to 0	tollerates dry	light shade to full sun	3 feet	Summer	white	minus var minus Carolinianum x ciliatum
R. 'Ramapo'	-25 to -15	tollerates dry	light shade to full sun	2 feet	Spring and Summer	purple	fastigatum x minus Carolinianum Group
R. eriocarpum	0 to 15	moist	partial shade or partial sun, to full sun	2 feet.	Summer	white, pink, red	S. Japan

Table 3. Rhododendrons for North-Facing Slopes							
Botanical Name	**Hardy degree F**	**Soil Condition**	**Light Intensity**	**Plant Height**	**Bloom Time**	**Bloom Color**	**Plant Origin**
R. 'Pink Pinwheels'	5 to 10	moist	partial shade or partial sun	5 feet	Spring	pink, white	Flirt x Noyo Chief
R. dichroanthum ssp. apodectum	0 to 15	moist	partial shade or partial sun, to full sun	3 feet	Summer & Fall	orange	NE Burma, China (W. Yunnan)
R. dichroanthum ssp. dichroanthum	0 to 15	moist	partial shade or partial sun, to full sun	3 feet	Summer & Fall	orange	China (W. Yunnan)
R. dichroanthum ssp. scphocalx	0 to 15	moist	partial shade or partial sun, to full sun	3 feet	Summer & Fall	orange	N. Burma, China (W. Yunnan)
R. (x) (subgenus Rhododendron) 'Anna H. Hall'	-20 to 15	moist	partial shade or partial sun	4 to 5 feet	Spring & Summer	pink, white	R. yakushimanum x R. catawbiense
R. calophytum	-10 to 20	moist	full shade to partial sun	6 to 10 feet	Spring	pink	China
R. minus	-20 to 10	moist	partial shade or partial sun	10 to 12 feet	Spring	pink, purple, white	West Virginia, Geogia
R. periclymenoides	-25 to 10	moist	partial shade or partial sun	4 to 9 feet	Spring	pink	Main to South Carolina
R. maximum.	-35 to 5	moist	partial shade or partial sun	15 to 20 feet	Spring	orange, pink, purple, white	W. Virginia, Virginia, Georgia
R. viscosum	-25 to -15	occational wet	partial shade or partial sun	5 to 8 feet	Spring	pink, white	Maine to South Carolina
R. atlanticum	-15 to 20	moist	full shade or partial sun	3 to 4 feet	Spring	fragrant pink, white	Eastern U.S.
R. aureum	-50 to -5	moist	partial shade or partial sun to full sun	2 to 3 feet	Spring	pink	N. China, Korea, Japan
R. auriculatum z.	-10 to 5	moist	partial shade or partial sun to full sun	8 to 15 feet	Spring and Summer	white	W. China
R. bureavii ssp. Taliensia	-10 to 5	moist	partial shade or partial sun	8 to 15 feet	Spring	pink, white	S.W. China
R. bureavi	-10 to 5	moist	partial shade or partial sun	8 to 15 feet	Spring	pink, white	S.W. China
R. calostrotum ssp. riparium	-10 to 5	moist	full shade or to full sun	2 to 5 feet	Spring	pink, purple, white	N.E. Burma, W. China
R. callimorphum	0 to 40	moist	partial shade or partial sun	2-6 feet	Spring	white to rose pink	Yunan, China; Burma
R. campylogynum	0 to 30	moist	partial shade or partial sun	6 to 48 inch	Spring	red, claret, purple	N. India; N. burma; S. China
R. cliatum	0 to 30	moist	partial shade or partial sun	4 to 6 feet	Spring	white to rose	Himalayan
R. ciliicalyx	0 to 30	moist	partial shade or partial sun	5 to 10 feet	Spring	white to pink tinged	W. China
R. cinnabarium	-10 to 30	moist	partial shade or partial sun	5 to 20 feet	Spring	red, pink, yellow	Himalayan
R. dauricum	-20 to 30	moist	partial shade or partial sun	2 to 5 feet	Winter	purple, pink, white	Japan, China, Mongolia
R. davidsonianum	0 to 30	moist	partial shade or partial sun	3 to 20 feet	Spring	white, pink tinged	W. China
R. decorum	0 to 40	moist	partial shade or partial sun	4 to 20 feet	Spring	white to mid-pink	W. China
R. degronianum ssp. yakushimanum	0 to 30	moist	partial shade or partial sun	3 to 10 feet	Spring	pink to pale red	Japan
R. fastigiatum	0 to 30	moist	partial shade or partial sun	18 to 30 inch	Spring	purple, lavender	Yuman, China
R. forrestii	10 to 40	moist	partial shade or partial sun	6 inch	Spring	bright red and waxy	Yuman, China; Tibet; Burma
R. fortunei	-10 to 30	moist	partial shade or partial sun	4 to 30 feet	Spring	pink, white	China
R. griersonianum	10 to 30	moist	partial shade or partial sun	5 to 10 feet	Spring	pinkish orange-red	W. China; Burma
R. griffithianum	10 to 30	moist	partial shade or partial sun	6 to 30 feet	Spring	white to rose-pink	Himalayan
R. hanceanum	10 to 30	moist	partial shade or partial sun	1.5 to 6 feet	Spring	cream to yellow	Sichuan China
R. keikei	-20 to 30	moist	partial shade or partial sun	1 to 10 feet	Spring	pale to bright yellow	Japan
R. kiiusianum	-10 to 40	moist	partial shade or partial sun	2 to 3 feet	Spring	bright red	Japan
R. leucaspis	0 to 30	moist	partial shade or partial sun	2 to 3 feet	Spring	white	W. Chna
R. litiense	-10 to 30	moist	partial shade or partial sun	4 feet	Spring	yellow	W. China
R. molle	0 to 30	moist	partial shade or partial sun	4 to 6 feet	Spring	yellow, orange	E. China
R. mucronulatum	-30 to 30	moist	partial shade or partial sun	5 to 8 feet	Winter	pink , purple	Japan
R. nuttallii	20 to 40	moist	partial shade or partial sun	8 to 30 feet	Spring	fragrant white	Himalayan
R. rusatum	-20 to 30	moist	partial shade or partial sun	2 to 6 feet	Spring	purple, pink, white	W. China
R. saluenense	-10 to 30	moist	partial shade or partial sun	2 to 5 feet	Spring	pink, deep purple	N. Burma
R. schlippenbachii	-30 to 30	moist	partial shade or partial sun	6 to 15 feet	Spring	scented white, pink	Korea, Manchuria
R. thomsonii	-10 to 30	moist	partial shade or partial sun.	2 to 20 feet	Spring	blood red, pink	Himalayan
R. trichostomum	0 to 30	moist	partial shade or partial sun	2 to 5 feet	Spring	white, pink tinged	W. China
R. williamsianum	0 to 30	moist	partial shade or partial sun	2 to 5 feet	Spring	mid-pink, rose	Sichuan China
R. yakushimanum	-20 to 30	moist	partial shade or partial sun	3 to 8 feet	Spring	white, pale pink	Japan
R. yedoense var. poukanense	-20 to 30	moist	partial shade or partial sun	1 to 5 feet	Spring	deep pink, lilac	Korea
R. yunnanense	0 to 30	moist	partial shade or partial sun	5 to 15 feet	Spring	white, pink, lavender	Burma
R. viscosum	-25 to 15	occational wet	partial shade or partial sun	5 to 8 feet	Spring	fragrant pink, white	Maine to South Carolina

Table 4. Plants for Rhododendron Glen							
Botanical Name	**Hardiness**	**Persistence**	**Light Intensity**	**Soil Moisture**	**Soil pH**	**Bloom Time**	**Bloom Color**
Andromeda polifolia	-50 to -45	perenial	partial shade or partial sun or full sun	tolerates flooding	acid	Spring	white
Arctostaphylos uva ursi	5 to 10	evergreen	full sun	well-drained soil	acid	Spring	pink
Calluna vulgaris	-15 to -20	evergreen	full sun	well-drained soil	acid	Spring	pink, white, lavender, purple
Calluna 'Orange Queen'	-15 to -20	evergreen	full sun	well-drained soil	acid	Autumn	orange
Calluna vulgaris 'Red Haze'	-15 to -20	evergreen	full sun	well-drained soil	acid	Autumn	yellow to red
Cassiope wardii	-15 to -10	evergreen	partial shade to full sun	well-drained soil	acid	Spring	pink
Cassiope lycopodioides	-15 to -10	evergreen	partial shade or partial sun or full sun	well-drained soil	acid	Spring	pink, white, lavender, purple
Cassiope mertensiana	-15 to -10	evergreen	partial shade or partial sun or full sun	well-drained soil	acid	Spring	white, pink, purple
Daboecia cantabrica	-15 to -10	evergreen	partial shade or partial sun or full sun	well-drained soil	acidic to slightly neutral	Summer/Autumn	white, rose-purple
Daboecia 'Rubra'	-15 to -10	evergreen	partial shade or partial sun or full sun	well-drained soil	acidic to slightly neutral	Summer/Autumn	purple
Enkianthus cernus var. rubens	-15 to -10	deciduous	partial shade to full sun	well-drained soil	acidic to slightly neutral	Spring/Summer	red
Enkianthus chinensis	-15 to -10	deciduous	partial shade to full sun	well-drained soil	acidic to slightly neutral	Spring	pinkish yellow
Erica 'Adrienne Duncan'	-15 to -10	evergreen	full sun	well-drained soil	acidic to slightly neutral	Winter/Spring	pinkish red
Erica blenna	-20 to -15	evergreen	full sun	well-drained soil	acidic to slightly neutral	Winter/Spring	orange
Erica x darleyenis	-20 to -15	evergreen	full sun	well-drained soil	acidic to slightly neutral	Winter/Spring	white, pink, purple
Erica pageanna	-20 to -15	evergreen	full sun	well-drained soil	acidic to slightly neutral	Winter/Spring	yellow
Gaultheria cuneata	-10 to -5	evergreen	partial shade to partial sun	moist soil	acidic to slightly neutral	Spring/Summer	white
Gaultheria miqueliana	-10 to -5	evergreen	partial shade to partial sun	tolerates moist soil	neutral to slightly alkaline	Spring/Summer	white
Gaultheria 'Bell's Seedling'	-20 to -15	evergreen	partial shade or partial sun to full sun	tolerates some drought	acidic to slightly neutral	Spring/Summer	white
Gaultheria procumbens	-30 to -25	evergreen	full shade to partial sun	tolerates some drought	acidic to slightly alkaline	Summer	white, pale pink
Gaultheria yunnanensis	-10 to -5	evergreen	partial shade or partial sun or full sun	tolerates some drought	acidic to slightly alkaline	Spring/Summer	white
Kalimia microphylla	-50 to -45	evergreen	partial shade to partial sun	very wet, boggy soil	acid soil	Spring/Summer	pink
Kalimia 'Minuet'	-30 to -25	evergreen	partial shade to partial sun	moist soil	acid soil	Spring/Summer	pink
Kalima occidedentalis	-20 to -10	evergeen	partial shade to partial sun	boggy soil	acid soil	Spring/Summer	white
Kalimia polifolia	-20 to -10	evergreen	partial shade to partial sun	moist soil	acid soil	Spring	pink, lilac
Ledum glandulosum	-15 to -10	evergreen	partial shade to full sun	moist soil	acidic to slightly neutral	Spring	white
Ledum decumbens	-15 to -10	evergreen	partial shade to full sun	moist soil	acidic to slightly neutral	Spring	white
Leucothoe axillaris	-10 to -5	evergreen	partial shade to deep shade	moist soil	acid soil	Spring/Summer	white
Leucothoe davisiae	-10 to -5	evergreen	partial shade to partial sun	boggy soil	acid soil	Summer	white
Leucothoe keiskei	-20 to -15	evergreen	partial shade to deep shade	moist soil	acid soil	Summer	white
Leucothoe 'Rainbow'	-20 to -15	evergreen	partial shade to deep shade	moist soil	acid soil	Spring	white
Oxydendrum arboreum	-20 to -15	deciduous	full sun	moist soil	acid soil	Summer/Autumn	white
Pieris forrestii	0 to 5	evergreen	full sun or light shade	moist soil	acid soil	Spring	white
Pieris japonica	0 to 5	evergreen	full sun or light shade	moist soil	acid soil	Winter/Spring	purple red
Vaccinium brachycerum	0 to 5	deciduous	partial shade to partial sun	moist soil	acid soil	Summer	white
Vaccinium angustifolium	-50 to -45	deciduous	partial shade to partial sun	tolerates some drought	acidic to slightly alkaline	Spring	red
Vaccinium ovatum	-50 to -45	evergreen	partial shade to partial sun	moist soil	acid soil	Spring	pinkish white
Cornus canadensis	0 to 5	deciduous	partial shade to partial sun	moist soil	acidic to slightly alkaline	Spring/Summer	green, red-violet
Cornus mas	-20 to -15	deciduous	partial shade to partial sun	moist soil	acidic to slightly alkaline	Spring	red
Cornus kousa	-30 to -25	deciduous	partial shade to partial sun	tolerates dry soil	acidic to slightly alkaline	Spring/Summer	white
Paxistima canbyi	-40 to -35	evergreen	partial shade to partial sun	tolerates drought	acidic to slightly alkaline	Spring/Summer	white
Arbutus unedo	0 to 5	evergreen	partial shade to partial sun	tolerates dry soil	acid soil	Fall/Winter	pink to red
Tolmiea menziesii	0 to 5	perenial	partial shade to partial sun	moist soil	acid soil	Summer	purple
Tiarella cordifolia	-40 to 25	perenial	full shade to partial sun	tolerates moist soil	neutral	Spring	white, pink, red
Astilbe biternata	-30 to -25	deciduous	partial shade to partial sun	tolerates moist soil	neutral to alkaline	Summer	white to yellow
Astilbe chinensis	-20 to -15	deciduous	full sun	tolerates moist soil	neutral to alkaline	Summer	red to purple
Acorus gramineaus variegates	-35 to -40	perenial	partial shade to partial sun	boggy soil	acid soil	n/a	n/a
Phalaris arundinacea picta	-40 to -35	perenial	partial shade to partial sun	tolerates moist soil	acid soil	Spring	pink

CHAPTER 3

RHODODENDRON GLEN'S STREAM RE-ESTABLISHMENT AND ENHANCEMENT

Legend 7. A well-enhanced stream with roughage, large wood, and overhanging vegetation.

3.1 Stream Renovation. Rhododendron Glen Stream is classified as a Class 5 Stream. The stream is seasonal; with water flowing primarily during the winter months. The stream has little biodiversity associated with it and the stream is not utilized by spawning salmon. The stream originates at the mouth of the small pond, and is approximately 110 yards in length. The small pond is situated 25 feet uphill and due east of the reflecting pond. As the stream leaves the small pond, for a distance of 150 feet, channel width remains fairly constant at 24 to 36

inches, with stream depth about 24 to 30 inches. The stream is under heavy shade, due to growth of salmonberry shrubs, vine maple, and cedar trees. There is little grass growing along stream in this area.

3.2 Objectives

3.2.1 Enhance groundwater recharge in streambed and surrounding area

3.2.2 Enhance biofiltration in streambed

3.2.3 Enhance leaf litter accumulation and enhance insect attraction to streambed by improving aquatic and terrestrial habitats.

3.3 Goals.:

3.3.1 Slow down stream velocity

3.3.2 Judiciously increase stream width

3.3.3 Remove streambank rocks by reflecting pond

3.3.4 Utilize COIR fabric to enhance vegetation establishment along stream

3.3.5 Appropriate species and hybrid rhododendrons and from *Ericaceae*, and other complimentary woodland plants will be selected

and planted along stream to enhance biological values to stream by increased shading and increased habitat complexity.

3.3.6 Augment the amount of groundwater to stream

3.3.7 Utilize turf grass, shrubbery and trees, and selected plantings to enhance biofiltration

3.3.1 Slowing down stream velocity to minimize bank erosion was one of the goals of this study. Flow from a stream may be reduced by increasing its sinuosity. The stream's sinuosity is the ratio of its channel length to valley length and describes the degree of meandering (Saldi-Camile, *et al.*, 2004; Ch. 2. p.7). Increasing stream sinuosity is usually accompanied by increased bed sediment texture, gravel recruitment, large wood recruitment, and the development of streambed edge habitat (Saldi-Camile, *et al.*, 2004; Ch. 2. p.8). Stream flow may be additionally slowed down by incorporating large roughness elements and habitat features that can substantially affect steam hydraulics by reducing velocity, shear, and sediment transport (Saldi-Camile, *et al.*, 2004; Ch. 2. p.29). Large logs can be utilized to create natural channels and enhance stream bank protection (Saldi-Camile, *et al.*, 2004, Large wood and logjams. p.1). Logs may be placed in the stream and allowed to rest naturally in the stream, or may be passively anchored by other logs forming a jam or by gravel or boulders that provide additional weight for stabilization (Saldi-

Camile, *et al.*, 2004, Large wood and logjams. p. 8). Large, immobile boulders may be placed in a steambed to increase or restore structural complexity and hydraulic diversity (Saldi-Camile, *et al.*, 2004, Boulder clusters, p 1). Structural and hydraulic diversity is important to many organisms, including aquatic insects; providing shade, shelter and diversity of habitat. The downstream face of a boulder experiences lower velocities and may provide site attachment for caddis flies, mayflies and stoneflies (Saldi-Camile, *et al.*, 2004, Boulder clusters. p. 2).

3.3.2 In some areas, the stream can be judiciously increased in width to construct a channel that is self-sustaining. A stable channel is not an immobile channel; it is a channel that maintains its form over time (Saldi-Camile, *et al.*, 2004). In order to be self-sustaining, natural structural elements, such as large pieces of wood, or logs, should be incorporated into the channel modification (Saldi-Camile, *et al.*, 2004; Ch. 2. p. 5). Log placements into the channel can provide habitat sites and provide a certain amount of short term stream bed stabilization. Mid-way down the stream from the small pond, the channel is necked-down, and culverted underground for 14 feet by a 12 inch diameter concrete culvert. The culvert is artificially restricting the channel, and should be removed to allow a more natural streambed to form. The stream, as it passes from the culvert is only 8 to 10 inches in width. The stream may be widened somewhat to approximate the channel above the culvert and the stream

bank may be enhanced by cutting the bank back to approximately 30 degrees to provide some stabilization. COIR fabric can be staked to the banks. Native vegetation can be planted through the fabric for further bank stabilization. Restoration of the bank will additionally enhance the stream system by providing shade, large woody material, organic and inorganic debris, terrestrial insects, and habitat (Saldi-Camile, *et al.*, 2004, Riparian restoration and management, p. 1).

3.3.3 Streambank armor has been installed in this stream. The last 25 feet of the stream, before it empties into the reflecting pond, widens to 24 inches, with a depth of 18 inches. The stream banks have been lined with rocks to prevent erosion due to high visitor foot traffic; but as a result, the rocks form an artificial armor which prevents important geomorphic processes, such as bank erosion and channel migration from occurring. Bank erosion recruits wood and sediment and creates in-stream habitats. Removing the artificial armoring and replacing it with deformable alternatives, such as large logs and vegetation should be evaluated. (Saldi-Camile, *et al.*, 2004, Bank protection construction, modification, and removal, p.1). When the rocks have been removed, a small bridge may be constructed above the reflecting pond, spanning the stream to minimize streambank damage by arboretum visitors.

3.3.4 COIR fabric is an erosion technique that has been successfully utilized with plantings along streams. COIR fabric is cylindrical structures composed of coconut fibers that are bound together with coconut twine (USDA, 1996), and is available in 12-inch diameters with 20 foot lengths. The fabric may be staked along stream embankments, and allows rooted cuttings to be planted through the fabric (Legend 8). The fabric is relatively easy to apply, and is secured to the ground by driving wooden 2 x 2 inch stakes on 4 foot centers between the binding twine and coconut fabric. The effective life of the fabric is estimated by the manufactures at between 6 to 10 years. Jute fabric can also be used.

3.3.5 Riparian vegetation provides stability for streambed boundaries, nutrients, detritus, shades, and provides an available source for wood for the stream (Saldi-Camile, *et al.*, 2004; Ch. 2. p. 28). Appropriate species and hybrid rhododendrons and from *Ericaceae*, and other complimentary woodland plants will be selected and planted along stream to enhance biological values to stream by increased shading and subsequent cooling the stream. Some of the areas in Rhododendron Glen are boggy and may benefit from the use of native vegetation planted along the edge of the stream, and in surrounding wet areas of the glen. Bog rosemary (*Andromeda polifolia*) is a low-growing shrub that grows well in boggy areas. Labrador teas (*Ledum groenlandicum*, L. *glandulosum*), a shrub that grows from 3 to 5 feet in height, are also well-suited for planting in

boggy areas close to streams. Bog laurel (Kalima occidentalis), *K. macrophylla*, and Western *Leucothoe* (*Leucothoe davisiae*) will grow well in high soil moisture areas of the glen.

3.3.6 Augmenting the amount of groundwater available from the surrounding areas can be exploited to increase the natural replenishment of surface waters into the groundwater aquifers (Water Pollution Control Commission, 2004). Groundwater recharge in the streambed and surrounding area can be enhanced by using overflow water from the small pond, and directing storm runoff and seepage into the stream. Rain-gardens are sunken gardens that receive storm-water runoff; and have been successful in reducing groundwater loss (Potter, 2003). Low areas in Rhododendron Glen could be utilized for small rain-gardens and the storm-water accumulated.

3.3.7 One can utilize turf grass, shrubbery and trees, and selected plantings to enhance biofiltration along streambed and act as biological filters that mine nutrients, especially nitrates and phosphates from runoff water, before the water enters the stream. One can enhance leaf litter accumulation and enhance insect attraction to the streambed. The reconstructed streambed may incorporate enhancing habitats; and this may be accomplished by increasing habitat complexity; such as incorporating boulders or large pieces of wood into the channel (Saldi-

Camile, *et al.*, 2004; Ch. 2. p.28). Some insects prefer protected areas in the shade, as opposed to sunny areas. Some stream insects utilize leaf litter for food; thus shrubs and trees planted along streams may provide leaf litter, as well as shade for insects.

3.4 Small pond needs reconstruction. Currently, the small pond, at the head of the stream in Rhododendron Glen is in need of repair. Groundwater appears to be pushing upward into the base of the pond, preventing silt and debris from being flushed from the pond. At one time, bentonite clay was applied to the bottom of the pond to seal, but the clay is no longer functional. A building contractor was consulted and building recommendations and construction schematics have been provided (Figures 1, 2, 3, and 4).

Legend 8. COIR fabric staked down on Duck Bay embankment along Lake Washington in Washington Park Arboretum.

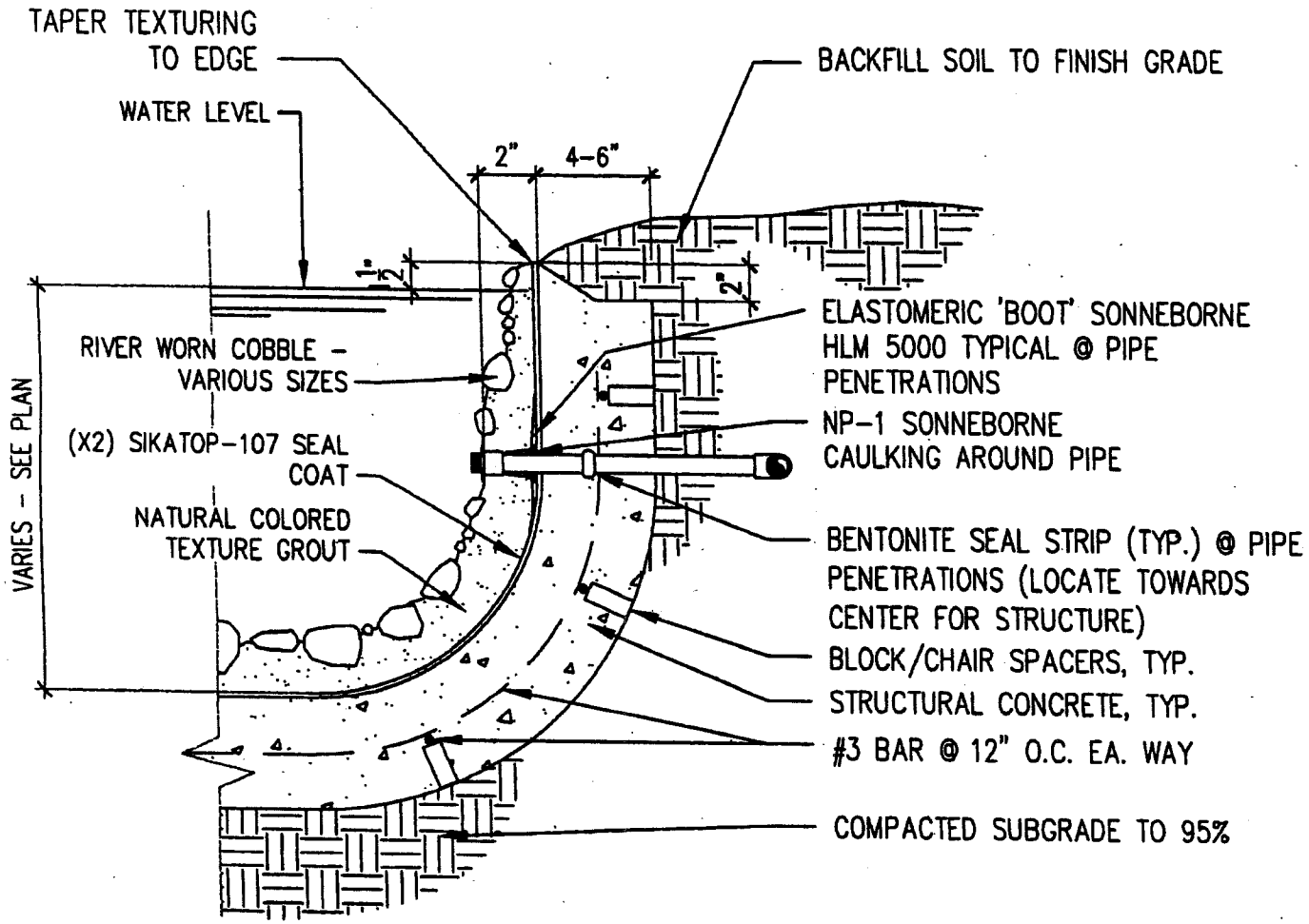


Figure 5. Small Pond: Construction Schematics

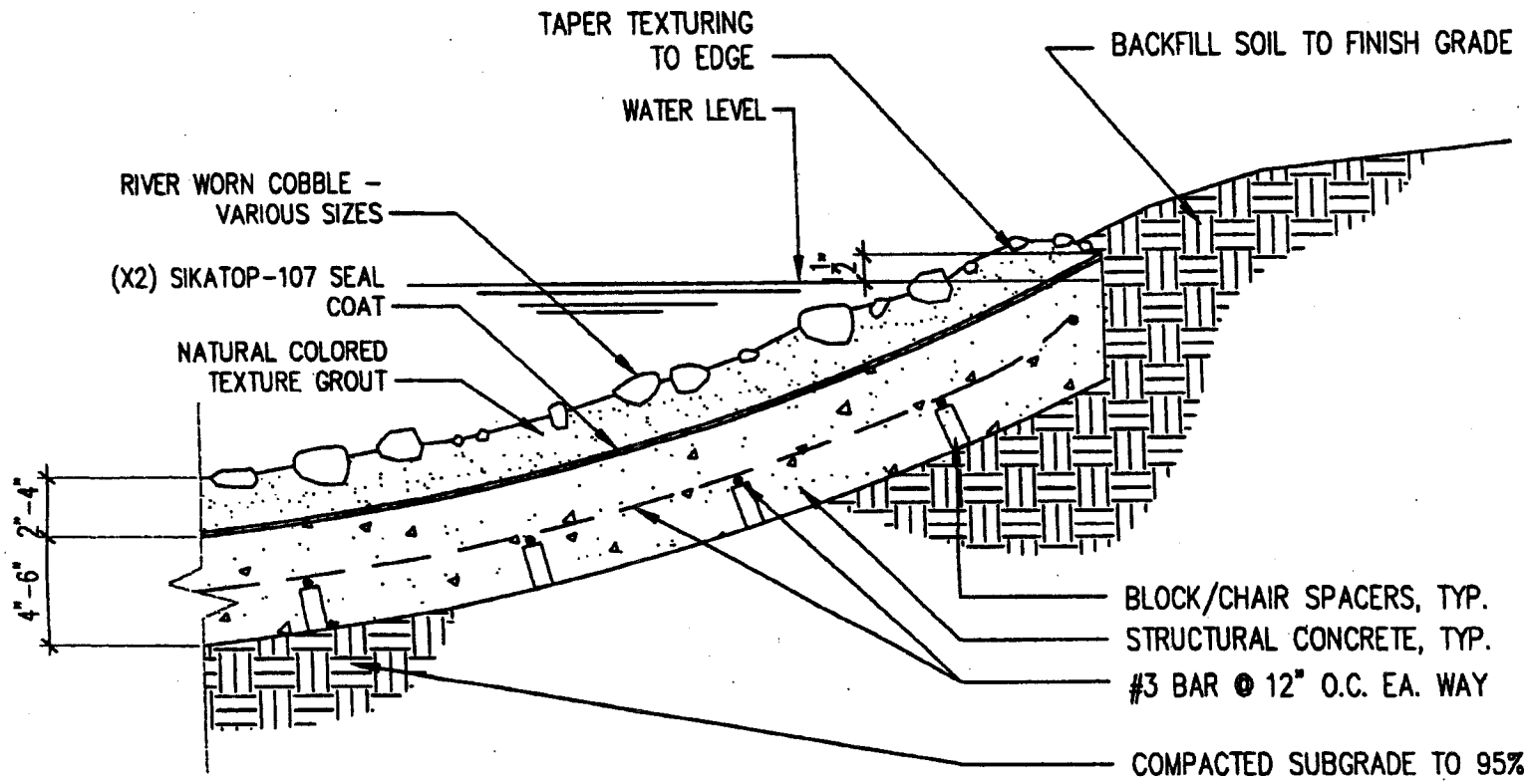


Figure 6. Small Pond: Sloped Pond/Stream Detail

Figure 7. Small Pond: Aquatic Planter Detail

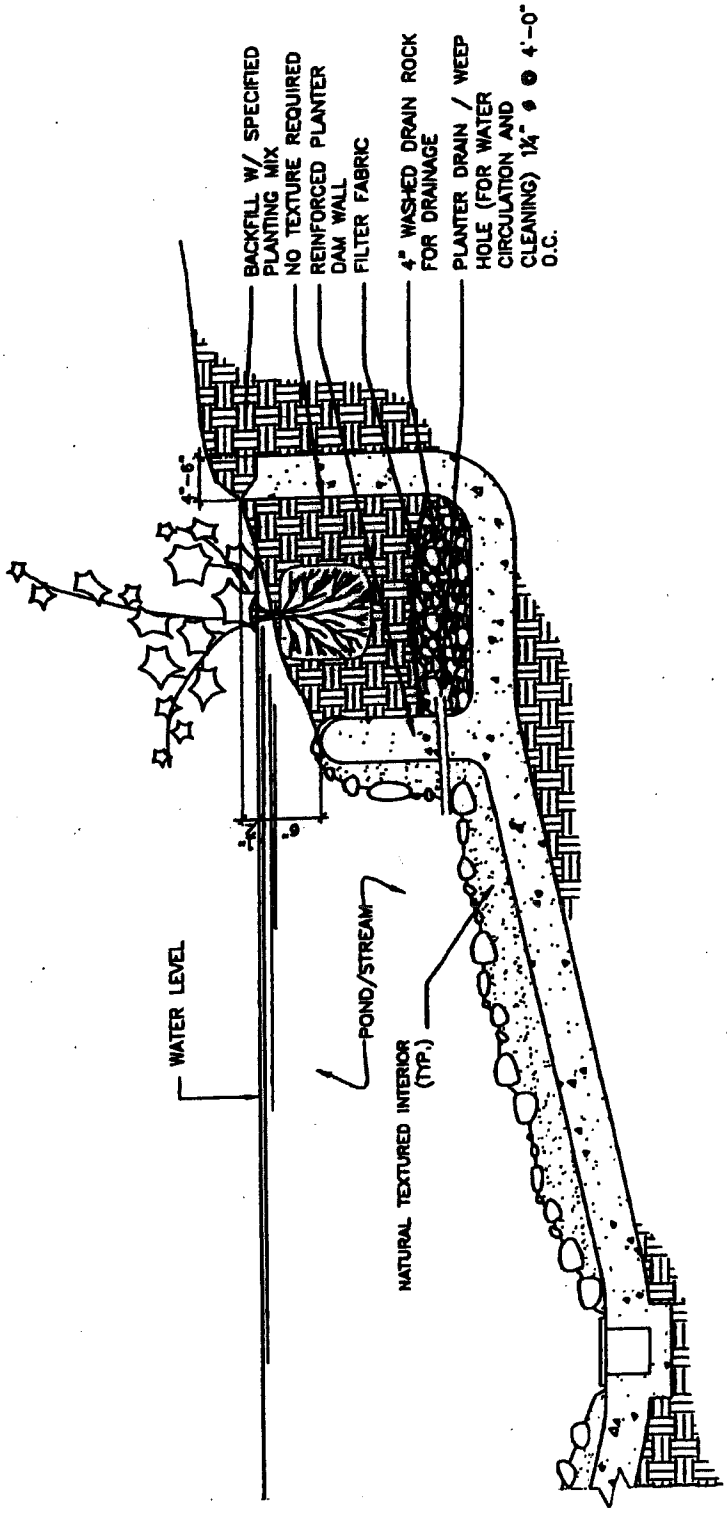
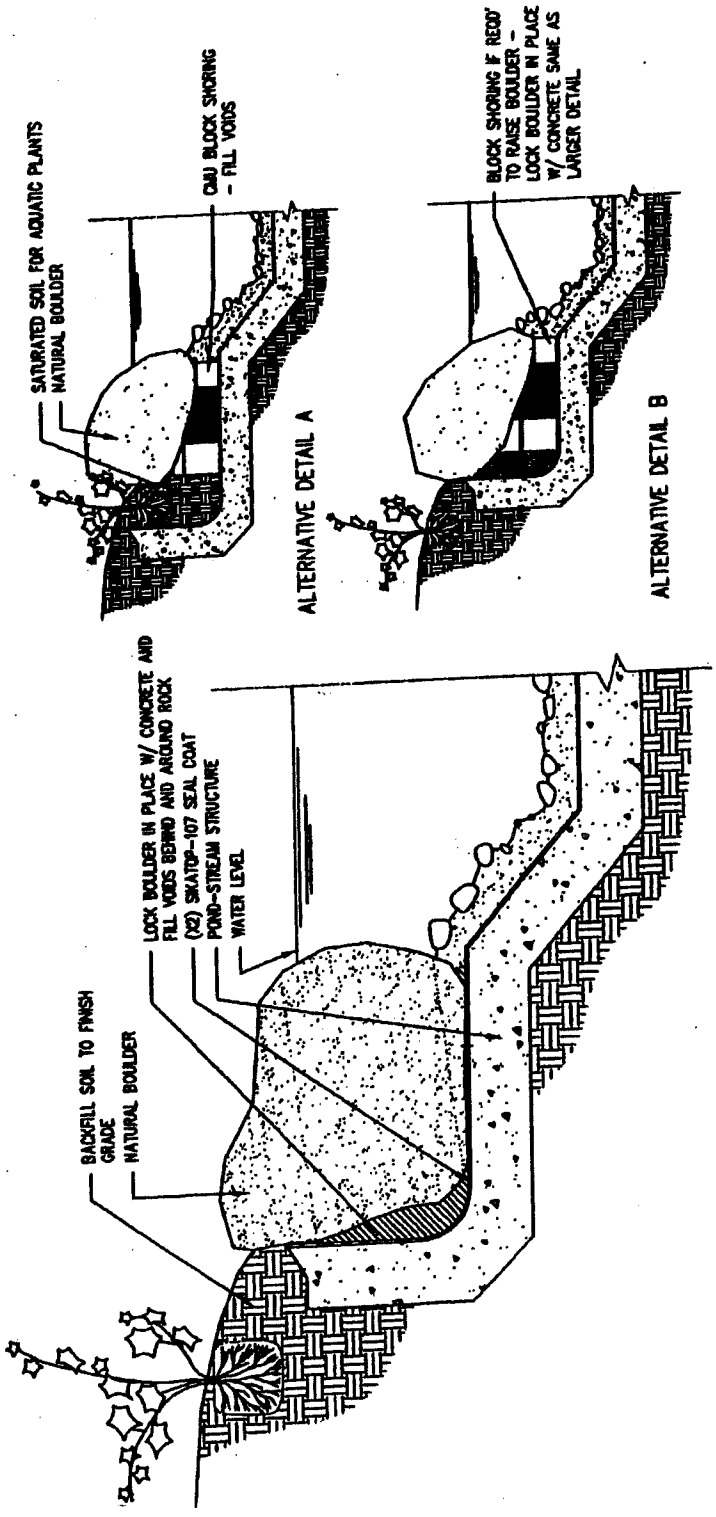


Figure 8. Small Pond: Boulder Installation Detail



CHAPTER 4

PERMITS REQUIRED FOR THE RE-ESTABLISHMENT AND ENHANCEMENT OF RHODODENDRON GLEN'S STREAM

4.1 Approvals and Permits. Permits that may be required for stream enhancement are the following:

4.1.1 Joint Aquatic Resource Permit Application (J.A.R.P.A.). Application would be necessary for any work done in or near a stream. JARPA Forms can be found at http://apps.ecy.wa.gov/opas/

4.1.2 Hydraulic Project Approval (HPA) from WDFW.

Contact: Stewart Reinbold at 425-649-4423

4.1.3 Section 404 from US Army Corps of Engineers.

Contact: Suzanne Skadowski 206-764-6984

4.1.4 Section 401 Certification from Department of Ecology.

Contact Alice Kelly 4255-649-7145

PERMITS REQUIRED FOR THE RE-ESTABLISHMENT AND ENHANCEMENT OF RHODODENDRON GLEN'S STREAM (continued)

4.1.5 State Environmental Policy Act (S.E.P.A.) Permit. SEPA Form web at http://www.ecy.wa.gov/programs/sea/sepa/e-review.html

4.1.5.1 Require diagrams pertaining to the proposed stream work.

4.1.5.2 Reference where proposed trail will go.

4.1.5.3 Associated planting plans to site area surrounding stream.

Glossary

Baseflow: the ground water contribution of streamflow.

Channel: a natural or manmade waterway that continuously or intermittently carries water.

Current: the flow of water through a stream channel.

Deposition: the accumulation of soil particles on the channel bed, banks, and flood plain.

Discharge: the volume of water passing through a channel during a given time, usually measured in cubic feet per second.

Ditch: is a long narrow trench with its bottom width less than its depth. The system can be easily designed to fit the topographic and geologic conditions at a site.

Erosion control fabric: woven or spun material made from natural or synthetic fibers and placed to prevent surface erosion.

Erosion: the wearing away of the land by the natural forces of wind, water, or gravity.

Fines: silt and clay particles.

Flanking: streamflow between a structure and the bank that creates an area of scour.

Flow rate: volume of flow per unit of time: usually expressed as cubic feet per second.

Geotextile: any permeable textile used with foundation soil, rock, or earth as an integral part of a product, filtration, or drainage.

Ground water: water contained in the voids of the saturated zone of geologic strata.

Riprap: a layer, facing, or protective mound of rubble or stones randomly placed to prevent erosion, scour, or sloughing of a structure or embankment; also, the stone used for this purpose.

Scour: removal of underwater material by waves or currents, especially at the base or toe of a streambank or shoreline.

Glossary (continued)

Sediment load: the amount of sediment in transport.

Sediment: soil particles transported from their natural location by wind or water.

Seepage: the movement of water through the ground, or water emerging on the face of a bank.

Streambank: the side slopes within which streamflow is confined.

Streambed: the bottom of a channel.

Streamflow: the movement of water within a channel.

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Appendix A. Existing Vegetation on South-Facing Slope: Grids 4-2E, 14-3E, and 14-4E.

Botanical Name. Grid # 13-1E

- *Prunus incisa* (4)
- *Prunus serrulata* 'Tanko-shinju'
- *Prunus x yedoensis*
- *Prunus x yedoensis* 'Akebono'

Botanical Name . Grid # 14-2E

- *Enkianthus campanulatus* (3)
- *Enkianthus campanulatus* var. palibinii
- *Populus cathayana*
- *Populus szechuanica* var. tibetica
- *Prunus serrulata* 'Ojochin'
- *Prunus* sp.

Botanical Name . Grid # 14-3

- *Acer nipponicum*
- *Enkianthus campanulatus* (7)
- *Prunus* 'Accolade'
- *Prunus* 'Hally Jolivette
- *Prunus* 'Pandora' (2)
- *Prunus sieboldii*
- *Prunus x yedoensis*
- *Rhododendron* 'Lodauric'
- *Syringa vulgaris x oblata* var. *dilatata* 'Minnehaha'

Botanical Name . Grid # 14-4E

- *Abies amabilis* prostrate form
- *Abies lasiocarpa*
- *Acer pseudosieboldianum*
- *Berberis coxii*
- *Berberis lempergiana*
- *Buxus microphylla* var. *sinica*
- *Chamaecyparis obtusa* 'Compacta'
- *Coriaria japonica*
- *Fokenia hodginsii (2)*
- *Gaultheria miqueliana*
- *Kalmia latifolia* (dwarf form)
- *Kalmia latifolia 'Pristine'*
- *Leucothoe davisiae*
- *Magnolia denudate*

- *Magnolia stellata*
- *Magnolia x proctoriana* 'Slavin's Snowy'
- *Pieris japonica* 'Coleman'
- *Pieris japonica* 'Crispa'
- *Pieris japonica* 'Little Heath Green'
- *Podocarpus hallii*
- *Podocarpus nivalis*
- *Polygonum aff.* 'Dimity' (2)
- *Quercus chrysolepis*
- *Quercus hypoleudes (2)*
- *Rhododendron* 'Bric-a-brac' (2)
- *Rhododendron* 'Dormouse'
- *Rhododendron* 'Exbury Seedling'
- *Rhododendron* 'Ginny Gee'

Botanical Name . Grid # 14-4E (continued)

- *Rhododendron* 'Honey'
- *Rhododendron luteum*
- *Rhododendron russatum* (2)
- *Rhododendron* 'Shamrock'
- *Rhododendron* 'Yaku Princess' (3)
- *Ruscus hypoglossum*
- *Vaccinium moupinense (2)*
- *Weigela subsessilis*

Appendix B. Existing Vegetation on North-Facing Slope: Grids 12-1E, 13-2E, and 13-3E, and 13-4E.

Botanical Name. Grid #12-1E

- *Amelanchier alnifolia* var. alnifolia
- *Amelanchier arborea*
- *Amelanchier laevis (2)*
- *Amelanchier spicata (2)*
- *Gunnera manicata*
- *Hibiscus* 'Lohengrin'
- *Prunus subhirtella* 'Rosea'
- *Thalia dealbata*

Botanical Name. Grid #13-2E

- *Cornus florida f. rubra*
- *Ilex amelanchier*
- *Populus maximowiczii*
- *Prunus* 'Accolade'
- *Prunus serrlata* 'Ukon'
- *Prunus serrulata var.* Spontanea

Botanical Name. Grid #13-3E

- *Alnus cordata*
- *Carpinus tuczaninovii*
- *Catalpa fargesii f. duclouxii*
- *Enkianthus campanulatus*
- *Prunus* 'Accolade' (2)
- *Rhododendron luteum* (3)
- *Rhododendron occidentale*

Boanical Name. Grid #13-4E

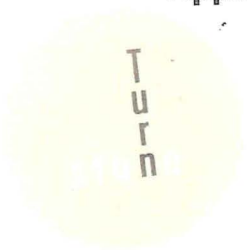
- *Abies lasiocarpa*
- *Acer palmatum* 'Sagara Nishiki'
- *Alnus japonica*
- *Bruckenthalia spiculifolia*
- *Cephalotaxis harringtonia* var. nana (2)
- *Chionochloa* sp.
- *Cornus florida* 'Pluribracteata'
- *Enkianthus campanulatus* 'Albiflorus'
- *Erica arborea* var. alpine
- *Erica ciliaris* 'David McClintock'
- *Erica ciliaris* 'Golden Drop'
- *Erica cinerea*

- *Erica cinerea* 'Colligan Bridge'
- *Erica erigena* 'Alba'
- *Erica terminalis*
- *Erica tetralix* 'Alba'
- *Erica tetralix* 'George Fraser'
- *Erica tetralix* 'Pink Star'
- *Erica vagans* 'Lyonesse'
- *Erica vagans* 'Mrs. D. F. Maxwell'
- *Erica* x *veitchii*
- *Erica* x *watsonii* 'Dawn'
- *Gaultheria miqueliana*
- *Gaultheria myrsinoides*
- *Gaultheria nummularioides*
- *Gaultheria pyroloides*
- *Gaultheria veitchiana*
- *Gunnera tinctoria*

Boanical Name. Grid #13-4E

- *Incarvillea arguta*
- *Kalmia latifolia* 'Pristine'
- *Leptospermum nitidum*
- *Leucothoe davisiae*
- *Microbiota decussata*
- *Pinus strobus* 'Pendula'
- *Podocarpus nivalis*
- *Prunus* x *yedoensis* (3)
- *Rhododendron augustinii (2)*
- *Rhododendron* 'Blue Tit'
- *Rhododendron davidsonianum*
- *Rhododendron hemitrichotum*
- *Rhododendron homophorum 'Album'*
- *Rhododendron* 'Honey'
- *Rhododendron lutescens* 'Apricot'
- *Rhododendron luteum* (2)
- *Rhododendron* sp. aff. *cuneatum* (yu 7860)
- *Rhododendron* 'Trewithen Orange'
- *Rhododendron williamsianum* (dwarf form)
- *Rhododendron* 'Yaku Princess'
- *Rhododendron yakushimanum* (4)
- *Rhododendron* 'Yellow Wolf' x *caloxanthum* (3)
- *Rhododendron yunnanense* (2)
- *Styrax japonicum* 'Emerald Pagoda'
- *Taxus cuspidata* 'Bright Gold'
- *Tsuga canadensis* 'Hussii'

Appendix C. Pond Construction Cost Bid Proposal



Turnstone Construction Inc.

November 17, 2002

Mike McClear
5244 Mithun Pl NE
Seattle, WA 98105

Dear Mike,

The following pricing is to provide and place all materials to build the steel reinforced and waterproofed pond shell, stream section, and re-circulating mechanical system at the Arboretum:

Pond Renovation

Inclusions:

- Removal of 12" of material in the pond area
- #3 steel reinforcing at 12" on center each way
- 6" thick shotcrete basin to 1" above the weir height
- Waterproofing of the basin
- 2' wide texture band around the perimeter of the pond – colored mortar and cobbles

Exclusions:

- Hauling excavated materials off Arboretum grounds
- Permitting
- Sales Tax

Price for the excavation and hauling to a site on the Arboretum grounds	$3690
Price for the waterproof shell	$8692
Price for the texture band	$2924
Total Price	$15,306

Turnstone Construction, Inc. 3950-A 6th Avenue N.W. Seattle, WA 98107 tel: 206.634.1521 fax: 206.634.1570 www.turnstoneconstruction.com