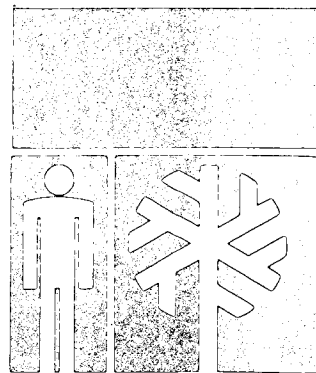


SOLEDUCK VALLEY ROAD

OLYMPIC

NATIONAL PARK • WASHINGTON



Color Scans

10/10/2002

ON MICROFILM

PLEASE RETURN TO:

TECHNICAL INFORMATION CENTER
DENVER SERVICE CENTER
NATIONAL PARK SERVICE

vegetation management and maintenance guide

september 1990

Soleduck Valley Road
OLYMPIC NATIONAL PARK • WASHINGTON

UNITED STATES DEPARTMENT OF THE INTERIOR / NATIONAL PARK SERVICE

TABLE OF CONTENTS

PROJECT OVERVIEW	1
PURPOSE AND NEED	1
RELATIONSHIP WITH PARK NATURAL RESOURCES MANAGEMENT PLAN	1
REVEGETATION PROJECT SUMMARY	1
VEGETATION MANAGEMENT	3
HYDROSEEDING SLOPES	3
Background	3
Maintenance Needs	4
Spot seeding for erosion control	4
Evaluation of seeding treatments	5
HYDROSEEDING DITCHES	6
Background	6
Maintenance Needs	6
Additional ditch seeding	7
Additional armoring	7
Spot reseeding	7
CONTROL OF WOODY SPECIES WITHIN THE TEN-FOOT SAFETY ZONE	8
Background	8
Maintenance Needs	8
Mowing alder and woody shrubs on ditches and road shoulders.	8
Handpulling alder in selected plantings	9
CONTROL OF ALIEN SPECIES	10
Background	10
Maintenance Needs	10
Alien species survey	10
Handpulling aliens	10
Herbicide treatment for knotweeds	10
REFERTILIZING REVEGETATION PLANTINGS	11
Background	11
Maintenance Needs	11
THINNING PLANTED DOUGLAS FIR AND WESTERN HEMLOCK	12
Background	12
Maintenance Needs	12
VISTA CLEARING	12
Background	12
Maintenance Needs	12
PROBLEM SLOPES	13
DRAINAGE	14
HANDCLEANING	14
CULVERT INLET ELBOWS	14
SUBSURFACE DRAINAGE	14
RETAINING WALLS AND GUARD RAILS	15
UTILITIES	16
WASTE DISPOSAL	17
APPENDIX A: SUMMARY OF MAINTENANCE REQUIREMENTS	18

APPENDIX B: SOLEDUCK ROAD PAPER MILEPOST SYSTEM 9/30/88 19

APPENDIX C: VISTA CLEARING INSTRUCTIONS 25

APPENDIX D: COST ESTIMATES 48

APPENDIX E: "AS CONSTRUCTED" DRAWINGS 53

PREPARER AND CONSULTANTS 54

ACKNOWLEDGEMENTS 55

REFERENCES 56

PROJECT OVERVIEW

PURPOSE AND NEED

Between February 1987 and October 1988, about 12 miles of the Soleduck valley road, between U.S. Highway 101 and the Sol Duc Hot Springs Resort, were reconstructed under a Federal Highways Administration (FHWA) contract funded by the Federal Lands Highway Program (FLHP). Because of concern about impacts on the old growth forest stands that border nearly two-thirds of the alignment, the reconstructed road incorporates a number of unique or experimental features. Examples of these unique elements are wooden retaining walls of an unusual design, intended to reduce clearing impacts, and a large-scale, experimental revegetation effort intended to mitigate visual impacts and assist the reestablishment of native forest vegetation. Because some of these unique features have nonstandard maintenance requirements, National Park Service (NPS) management requested preparation of a manual which identified such maintenance requirements and, where appropriate, provided cost estimates. Please note that this manual is not intended to be a comprehensive guide or to address routine maintenance normally scheduled by the park maintenance staff. It addresses *only* the special features associated with the new road design.

RELATIONSHIP WITH PARK NATURAL RESOURCES MANAGEMENT PLAN

Olympic National Park has just updated its Natural Resources Management Plan. Preparation of a Vegetation Management Plan, one of the RMP's elements, is in progress. AS part of regional and park review, this manual has been reviewed for compliance with OLYM 503.03, Management of Roadside Vegetation.

REVEGETATION PROJECT SUMMARY

As part of the Soleduck road reconstruction, the National Park Service requested and received funding from the Federal Lands Highway Program (FLHP) for a revegetation program. The starting point for the program was NPS management's wish to restore the reconstructed road slopes in a manner appropriate for a western park road through an old growth forest. Rather than reproducing the wide grassy road shoulders typically found along interstate highways and eastern parkways, management wanted to restore the visual character of the preconstruction road slopes. Because these slopes were originally covered with a variety of native shrubs, tree seedlings, ferns, herbs, and some grasses, a primary goal of the revegetation program was to assist the recovery of native forest species on the new cuts and fills. Other goals were to control erosion and to protect local gene pools.

The original revegetation program was developed in the summer of 1985 under the assumption that road construction would begin the following fall. The initial approach was relatively simple. Most cuts and fills would be hydroseeded for erosion control with a shortlived nurse crop. High visibility slopes would be planted with sword fern (*Polystichum munitum*), Douglas fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), and other natives salvaged from the construction zone or transplanted directly from nearby native communities.

Delays, which pushed the start of construction back to February 1987, gave the revegetation project additional planning and preparation time. Under the new schedule, it was possible to develop a comprehensive program which included the following elements:

1. Initial hydroseeding for erosion control on the majority of the steep cuts and fills. A short-lived nurse crop consisting of a sterile wheat hybrid (*Agropyron x Triticum*) and annual ryegrass (*Lolium multiflorum*) was used in this first seeding. The intent of this approach, suggested by Park Botanist Edward Schreiner, was to control erosion with fast-establishing species that would not persist in the Soleduck environment. The nurse crop would hold the slopes until they were colonized by natives.
2. Mulching selected areas with locally collected native duff, litter, and rotted wood which contained native seed, roots, and other propagules.
3. Planting the steepest, most highly visible cuts with over 42,000 native ferns, shrub tubelings, and tree seedlings in the fall of 1987 and the spring and fall of 1988. Seventy-five percent of these transplants were either salvaged from the construction zone or were propagated from seed or cuttings collected in the Soleduck drainage. The remainder were grown from certified seed collected in the same seed zone and elevation bands as the project area. Of the 42,000 plants installed, about 80% were propagated. (Private growers produced about 60%; the park nursery produced 20%.) Salvage or direct transplant accounted for the remaining 20%.
4. Reseeding the areas that had not been planted in the fall of 1988. The mix used for this seeding was basically the sterile wheat/annual ryegrass mix. Blue wildrye, a native grass grown from Soleduck seed by the U.S. Soil Conservation Service (SCS) was added to the mix in most areas (11 of 16 hydroseeder loads). Other natives were added to the mix in smaller amounts in selected areas.
5. Seeding approximately 6 miles of ditch area with a mix of mat forming grasses to control erosion and prevent invasion of woody species close to the asphalt roadway.

*Seed zone – a geographic area set up by the USFS, that encompasses populations of forest trees thought to be genetically similar. Seed zones were established because tree plantings were found to be more successful if the seed came from indigenous populations in the same general area as the site being replanted. In Washington state, seed can be purchased that is certified to have been collected in a particular seed zone. The Soleduck road is in seed zone 012.

**Elevation bands – elevation is also important to planting success. Each seed zone is divided into 500 foot elevation bands. Tree stock should be replanted in the elevation band of origin. Seed is also certified as to elevation band. The Soleduck road is in elevation bands 1000 and 1500.

VEGETATION MANAGEMENT

HYDROSEEDING SLOPES

Background

In the fall of 1987, most of the slopes below mile 8.5 (station 450+00) (about the top of North Fork hill) were hydroseeded with a nursecrop of sterile wheat and annual ryegrass. The fall hydroseeding was done at the same time crews were installing transplants on the slopes below mile 2.2 (117+00, the old dump entrance). With two exceptions mile 0.05 left and mile 0.08 left (2+65 left and 4+00 left), none of the planted slopes were hydroseeded because of the concern that competition with grasses might kill the new transplants.

In late October 1988, the road slopes were again seeded with the nursecrop. An interagency agreement with the SCS Plant Materials Center in Corvallis, Oregon, had produced 260 lbs of blue wildrye. This species was added to 11 of the 16 truckloads seeded by the contractor. Other natives were added in selected areas.

In fall 1989, the following cut slopes were reseeded with sterile wheat at 160 lbs per acre and cellulose fiber mulch at 1500 lbs/acre:

mile 2.7 (140+00) to mile 3.0 (160+00)
mile 9.1 (480+00) to mile 11.6 (615+00)

In determining seeding rates, the U.S. Soil Conservation Service guideline of 40 pure live seeds (PLS) per square foot (drilled rate) and 80 PLS per square foot (broadcast rate) were used as a starting point. The recommended rate for reseeding sterile wheat corresponds to 44 PLS per square foot or about one-half the recommended broadcast rate. This reduction was made because of the competitiveness of sterile wheat. The blue wildrye was originally seeded at 24 lbs PLS per acre (which corresponds to 60 seeds per square foot). This was done to stretch the amount of seed available. The recommended rate for spot reseeding is 25 lbs PLS per acre, which will give 80 seeds/square foot. (See page 4 for explanation of PLS.)

If sterile wheat is used in a mix with other species it should be no more than 10% of the mix (by number of seeds not by weight). Directions for developing a seed mix can be found in "Seeding Rates", U.S. Department of Agriculture, Soil Conservation Service Technical Notes, Colorado Agronomy Note No. 61.

The following slopes were reseeded with blue wildrye at 24 lbs PLS per acre and mulched at 1000 lbs per acre in the spring of 1990:

left mile 0.16 to 0.31 (8+42 to 16+45)
right mile 0.31 to 0.47 (16+00 to 25+00)
right mile 1.14 to 1.52 (60+00 to 80+00)
right mile 2.08 to 2.22 (110+00 to 117+00)
right mile 2.61 to 3.22 (137+88 to 170+08)
left mile 2.65 to 3.03 (140+00 to 160+00)
right mile 5.34 to 5.47 (282+00 to 288+93)
right mile 5.75 to 5.96 (303+60 to 314+68)
right mile 6.35 to 6.40 (335+49 to 337+72)

right mile 6.76 to 6.79 (357+18 to 358+60)
 right mile 7.35 to 9.73 (388+16 to 513+81)
 right mile 9.77 to 9.83 (515+82 to 518+82)
 right mile 9.88 to 10.04 (521+78 to 530+25)
 right mile 10.10 to 10.17 (533+25 to 536+75)
 right mile 10.50 to 10.52 (554+58 to 555+53)
 right mile 10.83 to 11.05 (572+12 to 583+27)
 right mile 11.25 to 11.53 (593+85 to 608+82)
 right mile 11.63 to 11.78 (613+81 to 621+79)
 right mile 11.86 to 12.12 (626+65 to 640+00)

Maintenance Needs

The following work needs to be done on hydroseeded slopes:

1. Continue spot seeding for erosion control.
2. Evaluate seeding treatments.

Spot seeding for erosion control. The slopes should be examined every spring to identify areas needing reseeding for erosion control. In areas with good potential for natural colonization, use sterile wheat at the rates specified below. Because sterile wheat is very competitive, mixing it with other species is not recommended. If this is necessary, reduce sterile wheat to no more than 10% of the mix (see section on sterile wheat below). For large areas with poor natural colonization potential, use the additional blue wildrye to be provided by SCS in the winter of 1990. Use the rates specified for blue wildrye below. This blue wildrye should *only* be used on the Soleduck road and not in other areas of the park unless this use is approved by the park botanist or resources management specialist. If kept in a cool dry place, this seed will remain viable for several years.

1. Sterile wheat

a. Seeding season: The seeding should be done between April 1 and May 15 or September 1 and October 15 to insure that a good crop of grass is established by the time the winter rains begin. Seeding in September or early October is preferred.

b. Seed mixture: Sterile wheat @ 160 lbs pure live seed per acre. The park's hydroseeder holds about 1,350 gallons. With the mulch rates we are proposing, we will need to apply 160 lbs of seed in about 3 hydroseeder loads per acre. Each load would contain 53 lbs of pure live seed.

The seed purchased will not be 100% pure and not all of it will germinate, so the actual bulk seeding rate will be higher than the 160 lbs per acre or 53 lbs per load. To calculate how much seed you need in a load, find the purity and germination percentages on the tag on the seed bag and plug the figures into the following equation:

$$\text{lbs bulk seed} = \frac{\text{lbs pure live seed}}{(\% \text{ purity}) (\% \text{ germination})}$$

For example, if the seed you buy is 99% pure and the germination percentage is 90%, the calculation would be:

$$\text{bulk seed} = \frac{53 \text{ lbs pure live seed}}{(0.99) \times (0.90)} = 59.5 \text{ lbs}$$

You would put about 60 pounds of seed in a load to get enough pure live seed on the ground.

c. Mulch: Silva fiber or the equivalent @ 1,500 lbs per acre. Since 700 lbs is about the upper limit for the amount of mulch the hydroseeder will hold, we will have to use 3 loads per acre and 500 pounds per load.

d. Fertilizer: None. We have gotten good stands of sterile wheat without fertilizer. Fertilizer can favor aliens over slower-growing natives. The revegetation plants will already have to contend with competition from the sterile wheat we are seeding.

2. Blue wildrye

a. Areas that may need reseeding include:

left mile 0.16 (8+42) to mile 0.31 (16+45), just below fee station
right mile 0.31 (16+45) to mile 0.47 (25+00), just above fee station
left mile 2.65 (140+00) to mile 3.03 (160+00), large open slopes above Aurora Ridge Trailhead

b. Seeding season: September 1 to 30 or April 1 to May 15. The seeding season is different for sterile wheat than for blue wildrye because the late fall (October 22, 1989) seeding of the blue wildrye failed while the sterile wheat was successful. According to SCS, fall seedings should be made no later than the end of September.

c. Seed mixture: Blue wildrye at 25 pounds PLS per acre. (The seeding rate was increased to achieve 80 PLS/square ft. (broadcast rate). This is the standard rate recommended by the U.S. Soil Conservation Service. The rate of 24 lbs PLS per acre corresponds to 60 PLS per square foot. This lower rate was used in 1989 to extend the available seed to cover all areas needing treatment.)

d. Mulch: Silva fiber or the equivalent at 1,500 lbs per acre.

e. Fertilizer: None, or phosphate fertilizer only.

Evaluation of seeding treatments. In fall 1994, 5 years after the last major hydroseeding, the seeding treatments should be evaluated by the park staff (primarily the Maintenance Division and Natural Science Studies). The following questions should be addressed:

1. What is the degree of colonization by native species on the hydroseeded slopes?

2. Did overseeding planted slopes with sterile wheat appear to cause mortality?
3. Was the ditch seeding effective in preventing colonization of the ditches by alder and other woody species?
4. Is there a serious weed problem on any of these slopes?
5. Were the seeding treatments effective in controlling erosion?
6. What maintenance problems are associated with the seeded slopes?
7. Should the use of the same slope and ditch mixes be continued? If not, what should replace them?

HYDROSEEDING DITCHES

Background

Approximately 6 miles of the ditches on both sides of the road were seeded with mat-forming grasses in late October 1988. The purpose of this seeding was to establish a dense grass mat that would inhibit the invasion of alder and other woody shrubs. On about 2/3 of the seeded ditches, enough grass, mainly annual rye, established well enough to stabilize the ditch and planting shoulder material. In other areas, for example, between mile 5.3 (280+00) left and about mile 5.68 (300+00) left (the hill above the bridge) a heavy rain, occurring a few days after hydroseeding, washed away most of the seed. As of May 1989, the grass mat was not yet well enough established to prevent woody material from invading the ditches. Before we decide this technique is ineffective, we need to wait until the red fescue and other species besides annual rye become better established.

Some ditches that were not seeded, for example, the ditch along the wet slope on the left at North Fork Hill, eroded during the winter storms. The worst of these areas have been armored with drain rock and about 5,000 linear ft of additional armoring is planned.

Maintenance Needs

The following work needs to be done on the hydroseeded ditches:

1. Additional seeding of ditches not previously seeded or where seeding washed out – Spring 1990.
2. Additional armoring – Spring 1990.
3. Spot reseeding.
4. Evaluation of ditch seeding (see Evaluation of Seeding, no. 3).

Additional ditch seeding.

1. Seeding areas: The following ditch areas should be reseeded with the seed mixture specified in #3 below:

left and right mile 0.04 to 0.15 (2+00 to 8+00)
left and right mile 0.32 to 0.44 (17+00 to 23+00)
left and right mile 1.10 to 2.20 (58+00 to 116+00)
left and right mile 5.3 to 12.12 (280+00 to 640+00)

Seeding should be confined to the *ditch area*, i.e., the area from the asphalt road edge to the ditch bottom and from the ditch bottom upslope to a point level with the road surface (estimated as about 3 feet). Rather than seed higher on the ditch, let the excess fall on the road. These anticipated problem areas should be rechecked yearly and reseeded until established (see p. 4).

2. Seeding seasons: September 1 to October 15 or April 1 to May 15. For a fall seeding, the work needs to be done early enough for the grass to become established before the fall rains.

3. Seed mixture:
Red fescue, variety Chewings (*Festuca rubra*) @ 8 lbs PLS per acre
Sheep fescue (*Festuca ovina*) @ 8 lbs PLS per acre
Canada bluegrass (*Poa compressa*) @ 8 lbs PLS per acre
Annual ryegrass (*Lolium multiflorum*) @ 10 lbs PLS per acre

For the ditch seeding, do *two hydroseeder loads* per acre. The *per load* pure live seed rates will be:

Red fescue	4 lbs per load
Sheep fescue	4 lbs per load
Canada bluegrass	3 lbs per load
Annual ryegrass	5 lbs per load

4. Mulch: Silva fiber or the equivalent @ 1,000 lbs per acre or 500 lbs per load.

5. Fertilizer: 16:16:0 @ 300 lbs per acre or 150 lbs per load. We are using fertilizer here because we want to try to establish a closed mat quickly.

Additional armoring. Additional armoring should be considered in areas where the additional ditch seeding, proposed above does not work. The extent of the work needed can be determined in early spring 1990. Stabilization with grass is the treatment preferred by park maintenance. Removing earth from a grass ditch is easier than cleaning it from one lined with drain rock, particularly if there are underdrains buried beneath the area that needs cleaning.

For this reason, overlaying the armoring with top soil and seeding the topsoil overlay is recommended.

Spot reseeding. Ditches should be examined every spring and reseeded as needed. Use the ditch mix described above. Use the ditch mix only on ditches and the upper 3 to 4 feet of fills next to the pavement.

CONTROL OF WOODY SPECIES WITHIN THE TEN-FOOT SAFETY ZONE

Background

Shrubs, brush, and trees should not be allowed to develop in critical areas where they will restrict sight distance below 250 feet. This is especially critical on the inside of horizontal curves and on the crest of vertical curves.

Red alder (*Alnus rubra*) and other tall woody shrubs should not be allowed to grow close to the road edge. (This does not include low-growing woody shrubs like salal, ferns, or herbaceous plants, which are desirable on roadsides.) Dense stands of alder and other shrubs can block ditches and reduce sight distances. A general guideline is that tall shrubs should not be allowed to grow within 10 feet of the ditch bottom. In some cases, it may be necessary to remove saplings beyond the 10-foot limit to improve sight distances or remove an overhanging shrub. In other cases, shrubs and trees closer than 10 feet may be retained to enhance visual quality or, like old growth trees, because they have special resource value. The width of cleared stretches should be varied irregularly to avoid an unnatural-looking straight edge.

Alder growing too close to park roads is often controlled by flailing or mowing the saplings about every two years. Some locals and park staff report that if alders are cut in July, they "bleed" and do not resprout as they do when cut at other times. These observations are not documented. It would be worthwhile to compare resprouting of alder cut at this time with resprouting of alder cut earlier or later in the season. The remaining options for alder control in the ditch area are pulling seedlings when they are less than about 18 inches high (during their first year) or by establishing a dense grass mat. The second approach has been used by the Bonneville Power Administration to prevent establishment of woody shrubs under their power lines.

Maintenance Needs

The following work is needed:

1. Mow alder and woody shrubs in ditches and road shoulders.
2. Handpull alder on selected planted slopes.

Mowing alder and woody shrubs on ditches and road shoulders. The ditches and road shoulders should be mowed every 3-5 years. As a general guideline, the width of the mowed area should not extend more than about 10 feet from the roadway. In areas with a high alder seed source, a grass mat should be maintained on the ditches and shoulders (see directions in section on Hydroseeding Ditches).

The following areas need attention in 1990, or 1991 at the latest:

1. left and right mile 0.47 (25+00) to about mile 0.70 (37+00) – dense carpet of small alder on the shoulder. This area runs past the continually sloughing problem slope, about 1/2 mile from the entrance.
2. left mile 0.95 (50+00) to left mile 1.33 (70+00) – scattered dense patches developing in ditches. This area starts near the duffed and littered slope on the left,

about a mile up the road, and extends past the big planted slope with waterbars, just before starting up the hill to the dump.

3. left and right mile 3.22 (170+00) to mile 4.26 (225+00) – dense carpet of small alder developing along much of this stretch. This area begins in the forest below the pond and ends just above the *old* crossover.

4. left and right mile 6.11 (322+54) to mile 6.16 (325+44) – scattered patches in the planting shoulder in front of the vista. This area is the first river view vista.

5. left and right mile 6.5 (344+29) to mile 8.0 (357+00) – dense carpet developing in seeded area behind vista parking. Recommend scraping before reseeding. This area is the second river view vista.

6. left and right mile 6.98 (368+40) to mile 9.19 (485+00) – dense carpet developing on many sections of this stretch, particularly above and below Salmon Cascades, along the big wet slope (about mile 8.33, 440+00, to mile 8.43, 445+00) where the drain rock was placed in the ditches, around the turnout on the right just above the wet slope, and in the area connecting the "mini-rainforest" turnouts. This stretch starts below Salmon Cascades where the river view opens up. Alder stops appearing in the ditches above the "mini-rainforest" turnouts where the forest canopy becomes denser.

7. left and right mile 10.80 (570+00) to mile 11.61 (613+00) – dense alder carpet developing on the shoulders and ditches. This area is the open stretch below the ranger station. It starts where the dense forest opens up again, close to milepost 11, and the road runs past several seeps and springs on the left. It ends when the forest reappears, below the ranger station, and just above the gate to the meadow (the contractor's old soil storage area).

Handpulling alder in selected plantings. The handpulled seedlings should not be left in the ditches where they can reestablish. They should be collected and disposed of in some areas where they either will not resprout or where it will not matter if they do. On duffed and littered areas, the bare mineral soil turned up by pulling alder should be covered with a fresh layer of duff or bark. All of the areas where handpulling is specified are relatively flat, so slope destabilization will not be a problem.

Planted areas where alder should be handpulled:

1. left and right mile 3.22 (170+00) to mile 3.41 (180+00) – the planted area below the pond.

2. left and right mile 3.60 (190+00) to mile 4 (223+00) – the planted area above the *new* crossover, but not the steep planted slope at mile 3.50 (185+00) left.

3. planting bed at the ranger station parking area.

Estimated costs for handpulling are in appendix D. Costs for mowing will be inserted by the park during park and region review.

CONTROL OF ALIEN SPECIES

Background

At the park's request, plant taxonomist Nelsa Buckingham prepared a list of alien plant species that should be controlled, eradicated if possible, or prevented from establishing. They are:

Scotch broom	<i>Cytisus scoparius</i>
French broom	<i>Cytisus monspessulanus</i>
Foxglove	<i>Digitalis purpurea</i>
Japanese knotweed	<i>Polygonum cuspidatum</i>
Giant knotweed	<i>Polygonum sachalinense</i>
Holly	<i>Ilex aquifolium</i>
English ivy	<i>Hedera helix</i>
Laurel cherry	<i>Prunus laurocerasus</i>

The species of concern along Soleduck are the brooms, foxglove, and possibly the knotweeds. (A clump of giant knotweed was found and destroyed in the airfield above the resort in 1987.) Holly, ivy, and laurel cherry have not been problems along the Soleduck.

Maintenance Needs

The following work is needed:

1. Survey road corridor for alien species – yearly.
2. Handpulling aliens – yearly.
3. Herbicide treatment of knotweeds – only when a problem is identified.

Alien species survey. The road should be surveyed each spring, by someone from Resources Management or Natural Science Studies (NSS). A list of areas to be treated should be prepared for the maintenance division.

Handpulling aliens. The brooms and foxglove can be removed by hand-pulling. Weeding can be done by YCCs, Choice High School students, scout groups, volunteers, or the park staff. The weeds should be collected in bags and disposed of so they cannot reestablish. Handpulling should be done before seed heads ripen.

To make sure that youth groups and volunteers remove the right plants, a brief training session should be held to make them familiar with the appearance of the target plants, particularly young Scotch broom.

Herbicide treatment for knotweeds. If either of the knotweeds is found, the park botanist or the resources management staff should be notified. These species probably need to be treated with localized applications of herbicides and the proper procedures for obtaining clearance should be followed. The park IPM coordinator should be contacted for information on the proper treatment.

Areas where aliens have already been found are:

left and right	miles 0 to 0.44 (00+00 to 23+00)
left	miles 2.64 to 2.85 (140+00 to 150+00)
left	miles 3.22 to 3.70 (170+00 to 195+00)
left	miles 11.17 to 11.65 (590+00 to 615+00)

Cost estimates are in appendix D.

REFERTILIZING REVEGETATION PLANTINGS

Background

The trees, shrubs, and ferns in the Soleduck revegetation plantings were individually fertilized with Agriform tablets containing a nonburning, slow-release fertilizer that lasts for two years. Agriform comes in a variety of sizes and analyses. Initially a 20-10-5 planting tablet in 5 and 10 gram sizes was used. The 5-gram tablets were used mainly for the salal and other smaller plants.

Applying the tablets is, initially, more labor intensive than broadcasting fertilizer on the slopes, but it does not have to be done as frequently. Another advantage is that the fertilizer is applied to the root zone of the target plant; it is not as readily available to competing seedlings of fast-growing grasses and aliens. Analysis of data from Soleduck test plots suggested that broadcast fertilizer can favor fast-growing aliens over slower-growing natives (National Park Service 1987).

Normally woody plants do not need high levels of fertility. In fact, too much fertilization can be harmful, leading to decreased cold hardiness and increased susceptibility to some diseases (Washington State University Cooperative Extension 1983). Plantings on slopes with sufficient fines should not need additional fertilizer, but those on very poor, rocky slopes may need help after the first Agriform tablet is used up.

Maintenance Needs

A drive-by inspection of all revegetation plantings should be made in the spring of 1990. In addition, on-the-ground inspections should be made of the slopes listed below. These are all slopes identified in field notes as having a high proportion of rock and few fines:

left	miles 1.30 to 1.33 (68+00 to 70+00)
left	miles 1.40 to 1.46 (74+00 to 77+00)
left	miles 1.99 to 2.08 (105+00 to 110+00)
left	miles 3.80 to 3.83 (200+37 to 202+00)
left	miles 5.96 to 6.11 (314+80 to 322+53)
left	miles 6.86 to 6.90 (362+35 to 364+51)
left	miles 7.81 to 7.84 (412+35 to 413+73)
left	miles 8.26 to 8.39 (436+34 to 443+10)
left	miles 10.45 to 10.49 (551+61 to 553+78)
left	miles 10.93 to 11.43 (576+90 to 603+54)
right	miles 4.60 to 4.64 (243+12 to 245+03)
right	miles 5.66 to 5.74 (299+10 to 303+10)
right	miles 9.73 to 9.76 (513+81 to 515+32)

Cost estimates appear in appendix D.

If, and only if, symptoms of nutrient deficiencies are apparent, the plants should be refertilized with the Agriform tablets.

THINNING PLANTED DOUGLAS FIR AND WESTERN HEMLOCK

Background

Very stony soils and areas with bedrock close to the surface made planting very difficult on some slopes. In these areas, the revegetation crews had to plant Douglas fir and western hemlock at lower than normal densities or not at all. Rather than dispose of the excess trees, they were planted at higher than normal densities on slopes where it was possible to get them in the ground. It was expected that mortality would thin some of the plantings naturally.

Maintenance Needs

Because of the high survival rates recorded on tagged plantings, it seems likely that some slopes will need to be thinned. This should be done when the trees have been in the ground 3 years or about 1991. Trees should be thinned to about 8 feet apart.

A National Park Service landscape architect should assist in identifying which trees to leave. The distribution of remaining trees should look natural and should not resemble planted rows.

VISTA CLEARING

Background

As part of planning for the road reconstruction, park management identified a number of vistas that will be maintained to enhance visitors experience of the Soleduck River and the old growth forest stands. Initial vista clearing was done at most of the sites by YCC crews in the summers of 1986 and 1987.

Maintenance Needs

Clear vistas every 3-5 years.

The areas to be cleared and the reasons for maintaining them are listed below:

Photographs and specific directions for work at each site are given in the Vista Clearing appendix.

<u>Area</u>	<u>Rational</u>
left miles 3.39 to 3.43 (179+00 to 181+00)	Maintain view of pond
right miles 6.11 to 6.16 (322+53 to 325+44)	Maintain river view
right miles 6.52 to 6.76 (344+29 to 357+00)	Maintain river view
right miles 6.98 to 7.12 (368+50 to 375+75)	Maintain view of river and Salmon Cascades
right miles 7.37 to 7.44 (389+00 to 393+00)	Maintain river view
right miles 8.50 to 8.54 (449+00 to 451+00)	Maintain view of mountains
right miles 8.75 to 8.77 (462+00 to 463+00)	Maintain view of forest at 1st "Mini-rainforest" turnout
right miles 9.00 to 9.02 (475+00 to 476+00)	Maintain forest view at 2nd "Mini-rainforest" turnout
right miles 9.83 to 10.17 (519+00 to 537+00)	Maintain view of forest interior
left miles 10.04 to 10.13 (530+00 to 535+00)	Maintain view of forest interior

PROBLEM SLOPES

Two slopes, left mile 0.49 (26+00) to mile 0.68 (36+00) and left mile 4.36 (230+00) to mile 4.55 (240+00) will be ongoing maintenance problems.

At upper management's request, the slope stability problem at mile 0.49 (26+00) to mile 0.68 (36+00) left was not corrected as part of the project. The intent was to minimize cost and visual impact. However, to deal with the existing situation, the slope angle needs to be reduced to prevent recurrent slides. The preferred method would be to construct a wall at the toe of the slope, trim back the eyebrow and slope top, allowing the material to fill behind the wall. Bioengineering techniques should also be considered. Until the permanent solution is implemented, bare areas should be reseeded and extreme care should be taken to avoid undercutting the slope when cleaning the ditches in this area. Handcleaning would be advisable.

In addition, vegetation at the eyebrow and top of the slope should be managed to minimize large trees. Movement on the top-heavy large trees during windstorms loosens the soil on these already unstable areas and accelerates raveling. Vegetation bordering the top of the slope should be limited to shrubs or small trees with more extensive root systems and less above-ground mass.

At mile 4.36 (230+00) to mile 4.55 (240+00), there will continue to be slides and rock falls, particularly in wet weather. In this area, there was consensus that the impact of laying back this high, steep slope would be worse than tolerating existing conditions. This slope should be reseeded as needed although this will not prevent major slides. The vegetation at the top of the slope should be managed as described previously.

DRAINAGE

On the Soleduck project, ditch depths and widths were kept to a minimum to lessen the environmental impact of the reconstructed road section. The ditches are only marginally adequate for the anticipated runoff volumes. Special care should be taken to ensure that ditches and cross drains are kept clean of debris and slough material that could alter the flow and result in damage to the roadway.

HANDCLEANING

During the construction of this project, particular emphasis was given to creating a revegetated roadside right up to the pavement edges. Special maintenance practices, including hand removal of debris and slough, will be needed in some areas to avoid stripping away the vegetation from the ditch and shoulder.

CULVERT INLET ELBOWS

A contract modification during construction added elbows to many culvert inlets to reduce the need for inlet basin excavation while providing additional cover over the pipes. These inlets are expected to function well. If they do not, the Denver Service Center would like to be informed of any particular problems encountered.

SUBSURFACE DRAINAGE

Subsurface drainage has been a problem in the Soleduck valley for decades. Much of the distress in the original pavement was caused by the presence of water under and within the pavement structure. Although many of the subsurface water problems were corrected in the 1987-88 reconstruction project, maintenance personnel should watch for pavement distress which may indicate unresolved problems. Additional corrective measures, such as installation of underdrains along the ditchline, may be necessary to control subsurface water.

RETAINING WALLS AND GUARD RAILS

The retaining walls constructed on the Soleduck valley road are an unusual type. They consist of wide-flange steel beams set in drilled shafts filled with lean concrete. Treated timber lagging of 4"x8", 6"x6", or 8"x8" dimensions fills the gaps between these beams. The beams simply act as cantilevers; no tieback anchors are used to support their tops. This was made possible by using lightweight backfill (hog fuel) behind the walls to reduce the outward pressure.

The hog fuel is encapsulated in an impermeable fabric envelope to prevent saturation by groundwater. Drains were installed to carry away groundwater trapped behind the hog fuel envelopes. The location of these drains is shown on the "as-constructed" plans. Their outlets should be checked and cleaned periodically to prevent their being blocked.

Moisture within the hog fuel envelopes is carried by separate drains to drywells to ensure that unfiltered leachates from the hog fuel do not reach live streams. It should be noted that no significant drainage is expected to occur after moisture present during construction is expelled. This part of the drainage system needs no periodic maintenance.

The tops of the hog fuel envelopes lie approximately 4 feet below the roadway surface. This upper 4 feet is backfilled with common excavation materials. Care should be taken during excavation in the wall areas to avoid damage to the envelopes. If damaged, they must be properly repaired to prevent infiltration of water. Saturation will significantly increase both the outward load on the wall and the amount of leachate.

The timber lagging used for the wall face is pressure treated with CCZA to a retention of 0.6 pounds per cubic foot (modified from 0.4 pcf in the contract specifications). This treatment was a water-borne preservative and is not considered as effective as oil-borne pentachlorophenol or creosote in preventing decay and insect attack. These more effective preservatives were excluded for environmental reasons.

While the lagging was stockpiled at the construction site, it became infested with Ambrosia beetles. These insects were attracted by the high moisture content of the freshly cut sapwood. They bored into the wood through the incising slits, producing tiny but clearly visible holes. These holes were not considered damaging to the wood structure. The Ambrosia beetle bores into the wood vertically, in an upward direction, so that the sawdust falls out the entry hole. This was possible when the lagging was separated by stickers in the stacks, but further infestations are not likely with the pieces fitted tightly together in the walls. Furthermore, the beetles are less likely to be attracted to the lagging because the sap has dried up. There is, however, some concern that the existing holes may provide passageways for decay organisms into the untreated interior wood. The lagging should be inspected periodically for signs of decay.

It should be possible to replace individual lagging pieces, if necessary. The lagging is not attached to the steel beams. Simply cut out the old piece, slide a new piece onto one steel beam flange and pull it back halfway inside the other beam's flange. A lagging length of about 9-10 feet should work. The required lagging thickness depends on its vertical position in the wall. Check the "as-constructed" plans for details.

Guardrail posts are toenailed to the inside of the timber lagging. Post replacement will probably require hand excavation so that the toenails can be removed.

UTILITIES

The powerline to the lodge area is buried from the Forest Service road intersection near milepost 4 to the Sol Duc Hot Springs Resort. The powerline is generally positioned about 3 feet below and just inches outside the southbound lane's edge of pavement. Its location does vary in wall areas and near power vaults and possibly in other areas. See the "as-constructed" plans for general information. Do not risk accidents with the high voltage line. HAVE THE POWERLINE LOCATED EXACTLY BY CLALLAM COUNTY PUD #1 BEFORE YOU DIG NEAR THE ROAD.

The telephone line to the lodge areas is buried 6" to 18" below the road grade and above the powerline in the shoulder next to the southbound lane of the roadway. It is vulnerable to any equipment working off the roadway.

Conduits for future utilities were installed at various locations under the roadway. See the "as-constructed" plans.

Modifications of the U.S. 101 intersection required relocation of lights previously installed by Washington State Department of Transportation (WSDOT). Maintenance of the lights remains a WSDOT responsibility.

WASTE DISPOSAL

Minor slides, ravelling cuts, and similar incidents will require disposal of materials. Disposal should not be accomplished by dumping over the side of the roadway fills. In addition to the eyesore this creates, the fills, in many cases, are already steep and marginally stable. Placing additional loads on steep fills increases the risk of failure. It also damages vegetation and wildlife habitat. Material should be disposed of in accordance with park policy.

APPENDIX A: SUMMARY OF MAINTENANCE REQUIREMENTS

- I. CAUTIONS
 - A. Excavating near hog fuel envelopes by walls page 15
 - B. Excavating near utility lines on road edge page 16
 - C. Waste disposal page 17
- II. INSPECTIONS
 - A. Alien species page 10
 - B. Pavement page 14
 - C. Ditches page 14
 - D. Lightweight fill drains page 15
 - E. Wooden lagging on walls page 15
- III. HOW TO REPLACE
 - A. Wooden lagging in walls page 15
 - B. Guardrail posts page 15
- IV. SUMMARY OF MAINTENANCE WORK

	Task	Timeframe	Discussed on Pages
1.	Check ditches and slopes for spot reseeding	Annually, before May 30	4 & 7
2.	Evaluate seeding treatment	Spring 1994	5
3.	Alder and woody species control	Annually	8-9
4.	Alien species control	Annually	10
5.	Refertilization	As needed	11
6.	Thin plantings	As needed	12
7.	Vista clearing	Every 3-5 years	12 & Appendix C
8.	Ditch inspection	As needed	7 & 14
9.	Problem slopes	As needed	13
10.	Watch for pavement distress caused by subsurface water problems	Ongoing	14
11.	Check lightweight fill drains	Twice annually – spring and fall	15
12.	Excavating in wall areas	As needed	15
13.	Inspect wooden lagging on walls	Twice annually – spring and fall	15

APPENDIX B: SOLEDUCK ROAD PAPER MILEPOST SYSTEM 9/30/88

Please note that as the distance from the beginning of the road increases, the mileages from the odometer reading became increasingly different from the mileages from converted station numbers. Use a vehicle odometer to find the general location. Use the landmarks and road plans to find the exact spot.

ODOMETER READING	CONVERTED TO MILEAGE	DISTANCE IN FEET	FALL 1988 STATIONING	CONVERTED TO MILEAGE	LANDMARKS
Road Entrance to Fee Station					
62282.00	0.00		0+00	0	Junction Hwy 10/Soleduck Rd
62282.05	0.05	264.00	5+00	0.09	5+00 station marker, culvert left land 15 mph sign
62282.15	0.15	792.00			Welcome sign/entrance to interpretive-information station
62282.25	0.25	1320.00			Exit from interpretative station/U.S. Fee area sign
Fee Station to Old Dump Entrance					
62282.30	0.30	1584.00			Fee station kiosk
62282.35	0.35	1848.00	20+00	0.38	20+00 station marker
62282.45	0.45	2376.00	25+00	0.47	25+00 station marker, end of large open hydroseeded slope right
62282.55	0.55	2904.00			1987 colonization plots left
62282.60	0.60	3168.00			Culvert/1987 colonization plots on left above eroded road cut
62282.65	0.65	3432.00	35+00	0.66	35+00 station marker
62282.70	0.70	3696.00			1987 colonization plot left
62282.75	0.75	3960.00	40+00	0.76	40+00 station marker
62282.85	0.85	4488.00	45+00	0.85	45+00 station marker/tree spade slope left
62282.95	0.95	5016.00	50+00	0.95	50+00 station marker/moss mat slope
62283.00	1.00	5280.00	52+80	1.00	Mile 1, moss mat slope left
62283.05	1.05	5544.00	55+00	1.04	55+00 station marker
62283.10	1.10	5808.00			tree spaded/tagged salal slope
62283.15	1.15	6072.00			60+00 station marker/tree spaded slope left
62283.25	1.25	6600.00			65+00 station marker/culvert left
62283.30	1.30	6864.00			Turnout left
62283.35	1.35	7128.00			Culvert small stream
62283.45	1.45	7656.00	75+00	1.42	75+00 station marker/culvert
62283.55	1.55	8184.00	80+00	1.52	80+00 station marker/just past water-barred slope left
62283.65	1.65	8712.00	85+00	1.61	85+00 station marker/culvert just uproad
62283.70	1.70	8976.00			beginning first guardrail right
62283.85	1.85	9768.00			rock wall just ahead
62283.90	1.90	10032.00			End of first guardrail right/rock wall left
62284.00	2.00	10560.00			Small guardrail right/stream left
62284.05	2.05	10824.00	105+00	1.99	Beginning third guardrail right
62284.10	2.10	11088.00			105+00 station marker/long waterbarred slope left
					Culvert left

62284.15	2.15	11352.00	105+60 110+00	2.00 2.08	Mile 2 110+00 station marker/tree spaded/salal slope left
62284.25	2.25	11880.00	115+00	2.18	115+00 station marker/old dump entrance left
Old Dump Entrance to Aurora Ridge Trailhead					
62284.45	2.45	12936.00	125+00	2.37	125+00 station marker/new dump entrance/culvert left
62284.55	2.55	13464.00	130+00	2.46	130+00 station marker/Aurora Ridge trailhead left
Aurora Ridge Trailhead to New Crossover					
62284.65	2.65	13992.00	135+00	2.56	135+00 station marker
62284.75	2.75	14520.00	140+00	2.65	140+00 station marker/culvert left just uproad
62284.85	2.85	15048.00			Culvert and seep left
62284.90	2.90	15312.00			Culvert left
62285.00	3.00	15840.00			Turnout right alder/vine maple
62285.10	3.10	16368.00	158+40	3.00	Mile 3
62285.15	3.15	16632.00			Man-made rock wall left
62285.25	3.25	17160.00	165+00	3.13	Culvert left/old <i>Oxalis</i> mat storage site
62285.30	3.30	17424.00	170+00	3.22	165+00 station marker
					170+00 station marker/ colonization plot on rocky slope/culvert just uproad
62285.40	3.40	17952.00	175+00	3.31	175+00 station marker/culvert left
62285.50	3.50	18480.00	180+00	3.41	180+00 station marker/pond left
62285.60	3.60	19008.00	185+00	3.50	185+00 station marker/culvert/ high, dry rocky slope left
62285.65	3.65	19272.00			Culvert
62285.70	3.70	19536.00	190+00	3.60	190+00 station marker/new Forest Service road crossover left
New Crossover to Old Growth S-Curve					
62285.75	3.75	19800.00			Culvert right/big leaf maple stand on left
62285.80	3.80	20064.00	195+00	3.69	195+00 station marker
62285.90	3.90	20592.00	200+00	3.79	200+00 station marker/willow (<i>Salix</i>) and maple (<i>Acer</i>) stands
62285.95	3.95	20856.00			Culvert right
62286.10	4.10	21648.00	210+00	3.98	210+00 station marker
62286.20	4.20	22176.00	211+20 213+94	4.00 4.05	Mile 4 Old Forest Service road crossover right
62286.25	4.25	22440.00			Culvert left/eroded area above it
62286.30	4.30	22704.00	220+00	4.17	220+00 station marker
62286.45	4.45	23496.00			Culvert and stream left
62286.50	4.50	23760.00	230+00	4.36	230+00 station marker/steep eroded road cut left
62286.55	4.55	24024.00			Beginning of short guardrail right/rock wall left
62286.65	4.65	24552.00			Beginning of guardrail right
62286.70	4.70	24816.00	240+00	4.55	240+00 station marker
62286.75	4.75	25080.00			End of guardrail and stream left

Old Growth S-Curve to Bridge

62286.80	4.80	25344.00	245+00	4.64	245+00 station marker/steep slope left/tagged plants
62286.85	4.85	25608.00			Culvert/stream
62286.95	4.95	26136.00	251+00	4.75	Turnout right@251
62287.00	5.00	26400.00	255+00	4.83	255+00 station marker/old road storage site left
62287.05	5.05	26664.00			Ground utilities box right
62287.10	5.10	26928.00	260+00	4.92	260+00 station marker/culvert right
			264+00	5.00	Mile 5
62287.20	5.20	27456.00	265+00	5.02	265+00 station marker/high steep slope
62287.25	5.25	27720.00			Culvert left
62287.29	5.29	27931.20			Culvert left
62287.30	5.30	27984.00	270+00	5.11	270+00 station marker
62287.40	5.40	28512.00	275+00	5.21	275+00 station marker/culvert left/bridge in sight

Bridge to Salmon Cascades

62287.50	5.50	29040.00			Bridge
62287.55	5.55	29304.00			Turnout right
62287.70	5.70	30096.00			Two cable boxes/culvert left
62287.75	5.75	30360.00			Beginning guardrail
					right/unstable slope left
62287.85	5.85	30888.00			End of guardrail
62287.90	5.90	31152.00	300+00	5.68	300+00 station marker/1988 colonization plot left
62287.95	5.95	31416.00	305+00	5.78	305+00 station marker
62288.05	6.05	31944.00			Beginning guardrail right/cable box (#012450)
62288.08	6.08	32102.40	310+00	5.87	310+00 station marker/middle of guardrail
62288.10	6.10	32208.00			End of guardrail
62288.15	6.15	32472.00			Turnout left/cable box (#013350) culvert just uproad
62288.20	6.20	32736.00			Culvert left
			316+80	6.00	Mile 6
62288.30	6.30	33264.00	320+00	6.06	320+00 station marker/turnout just uproad right
62288.40	6.40	33792.00	325+00	6.16	325+00 station marker/large boulder at marker/vista clearing right/culvert just uproad
62288.45	6.45	34056.00			Culvert left
62288.48	6.48	34214.40	330+00	6.25	330+00 station marker
62288.55	6.55	34584.00			Culvert left/utilities ground box just uproad right
62288.58	6.58	34742.40	335+00	6.34	335+00 station marker
62288.65	6.65	35112.00			Culvert left
62288.75	6.75	35640.00	345+00	6.53	345+00 station marker/culvert left
62288.85	6.85	36168.00	350+00	6.63	350+00 station marker/turnout right
62288.90	6.90	36432.00			Culvert left
62288.95	6.95	36696.00			Culvert left
62289.00	7.00	36960.00			Utilities ground box
62289.08	7.08	37382.40	360+00	6.82	360+00 station marker
62289.18	7.18	37910.40	365+00	6.91	365+00 station marker
62289.20	7.20	38016.00			Culvert and stream bed left
			369+60	7.00	Mile 7

62289.25	7.25	38280.00			Culvert
62289.30	7.30	38544.00			Two cable boxes right
62289.35	7.35	38808.00			Vista clearing Salmon
					Cascades
62289.40	7.40	39072.00			Cable box right
62289.45	7.45	39336.00			Salmon Cascades parking lot

Salmon Cascades to North Fork Trailhead

62289.55	7.55	39864.00			Utilities ground box right/culvert ahead left
62289.68	7.68	40550.40	390+00	7.39	390+00 station marker/Culvert just downroad
62289.70	7.70	40656.00			Culvert left where Soleduck River comes closest to road
62289.75	7.75	40920.00	395+00	7.48	395+00 station marker/parking turnout right
62289.90	7.90	41712.00			Two culverts left/steep bank right
62289.95	7.95	41976.00			Guardrail right/culvert just downroad
62290.00	8.00	42240.00			Culvert
62290.05	8.05	42504.00	410+00	7.77	410+000 station marker/middle of guardrail/1988 colonization plot uproad
62290.18	8.18	43190.40			Culvert left/guardrail right
62290.25	8.25	43560.00			Culvert left/guardrail right
62290.28	8.28	43718.40	420+00	7.95	420+00 station marker/culvert left/guardrail right
62290.30	8.30	43824.00			Culvert left/guardrail right
			422+40	8.00	Mile 8
62290.35	8.35	44088.00	425+00	8.05	425+00 culvert left/guardrail right
62290.40	8.40	44352.00			End of guardrail right/rock wall left
62290.48	8.48	44774.40			1988 colonization plot left
62290.55	8.55	45144.00	435+00	8.34	North Fork trailhead parking

North Fork Trailhead to Meadow Gate

62290.75	8.75	46200.00	445+00	8.43	445+00 seep below marker/"North Fork Hill"
62290.80	8.80	46464.00			Beginning guardrail
62290.85	8.85	46728.00	450+00	8.52	450+00 culvert left/turnout right/guardrail ends
62290.90	8.90	46992.00			Culvert left uproad from 1988 colonization plot
62290.95	8.95	47256.00	455+00	8.62	455+00
62291.00	9.00	47520.00			Culvert left
62291.05	9.05	47784.00	460+00	8.71	460+00
62291.10	9.10	48048.00			"Mini rain forest" turnout right just uproad from culvert left and utilities ground box right
62291.18	9.18	48470.40	465+00	8.81	465+00 turnout on left uproad
62291.25	9.25	48840.00	470+00	8.90	470+00
62291.35	9.35	49368.00	475+00	9.00	475+00 "Night Shadows" turnout on right
62291.45	9.45	49896.00			Culvert left
			475+20	9.00	Mile 9
62291.50	9.50	50160.00			Beginning guardrail right just uproad from culvert left
62291.55	9.55	50424.00	485+00	9.19	485+00/large Douglas-fir
62291.60	9.60	50688.00			Culvert left/guardrail right

62291.65	9.65	50952.00	490+00	9.28	490+00 culvert left/guardrail right
62291.75	9.75	51480.00	495+00	9.38	495+00 end of guardrail right/cable box (#199650) right
62291.78	9.78	51638.40			Culvert left
62291.80	9.80	51744.00			Culvert left
62291.85	9.85	52008.00	500+00	9.47	500+00
62291.95	9.95	52536.00	505+00	9.56	505+00 turnout left
62292.05	10.05	53064.00	510+00	9.66	510+00 fern slope left
62292.15	10.15	53592.00	515+00	9.75	515+00 steep slope left/moss mat slope right
62292.25	10.25	54120.00	520+00	9.85	520+00 turnout right/culvert and ravine left
62292.30	10.30	54384.00			Culvert left
62292.35	10.35	54648.00	525+00	9.94	525+00
62292.40	10.40	54912.00			Culvert left
62292.45	10.45	55176.00	528+00	10.00	Mile 10
62292.50	10.50	55440.00	530+00	10.04	530+00
			535+00	10.13	535+00 Cable box (#199150) right/duff and litter slope uproad left
62292.65	10.65	56232.00	540+00	10.23	540+00 culvert left, just downroad
62292.70	10.70	56496.00	545+00	10.32	545+00 culvert and stream just downroad
62292.85	10.85	57288.00	550+00	10.42	550+00 opposite three large Douglas-firs right/culvert and stream just uproad
62292.90	10.90	57552.00	555+00	10.51	555+00 culvert
62292.95	10.95	57816.00			Culvert and wet eroded slope left
62292.05	10.05	53064.00	560+00	10.61	560+00 culvert just uproad/cable box (#309750)
62293.10	11.10	58608.00	565+00	10.71	565+00 densely planted conifer slope
62293.15	11.15	58872.00			Culvert midway along dense slope
62293.20	11.20	59136.00	570+00	10.80	570+00
62293.28	11.28	59558.40			Culvert left
62293.30	11.30	59664.00			Culvert left
62293.40	11.40	60192.00			Culvert left
62293.45	11.45	60456.00	580+00	10.90	580+00
			580+80	11.00	Mile 11
62293.50	11.50	60720.00	585+00	11.08	585+00 culvert left/turnout and cable box (#309450) right
62293.55	11.55	60984.00			Culvert/cable box (#309350) right
62293.60	11.60	61248.00	590+00	11.17	590+00 culvert and seep left/cable box (#309351) right
62293.65	11.65	61512.00			Culvert left
62293.70	11.70	61776.00	595+00	11.27	595+00 culvert and stream left
62293.80	11.80	62304.00	600+00	11.36	600+00 culvert left
62293.90	11.90	62832.00	605+00	11.46	605+00 culvert left/cable box (#309150) right

Meadow Gate to Resort

62293.95	11.95	63096.00			Gate to Meadow (old barn site)
62294.00	12.00	63360.00	610+00	11.55	610+00
62294.05	12.05	63624.00			Culvert
62294.10	12.10	63888.00	615+00	11.65	615+00
62294.15	12.10	64152.00			Reduce speed sign right
62294.18	12.18	64310.40			Culvert and stream/ maintenance road left

62294.20	12.20	64416.00	620+00	11.74	620+00
62294.25	12.25	64680.00			Speed limit 15 mph sign right
62294.30	12.30	64944.00	625+00	11.84	625+00
62294.35	12.35	65208.00			Culvert left
			633+60	12.00	Mile 12
62294.50	12.50	66000.00	635+00	12.03	635+00 High voltage
					box/culvert left
62294.55	12.55	66264.00			Sol Duc Hot Springs Resort
					entrance

APPENDIX C: VISTA CLEARING INSTRUCTIONS

This appendix provides detailed instructions for the work to be done at each vista. To help crews find the vistas, descriptive information, mileages, and station numbers are given. The mileages in the text were obtained by converting station numbers to miles (e.g., 180+00 = 18000 ft ÷ 5280 ft = 3.41 miles). Even though most of the station markers have been removed from the road, the station numbers can be used to find the vista sites on the maps from the road plans. They can also be used with the temporary paper milepost system in Appendix B. The temporary milepost system includes two sets of mileages. The first was obtained from vehicle odometer readings. It becomes increasingly inaccurate as distance from mile 0 increases. The second set of mileages are from converted stations.

Photographs have been included for nearly every vista. They may illustrate general concepts (e.g., the kinds of scenes that should be maintained as forest vistas) or specific instructions (e.g., do not cut small Sitka spruce at the "mini rainforest" turnout). In most cases, *they do not portray the entire vista that needs to be maintained*. To determine where the ends of the vistas are, follow the written instructions.

AREA 1: Pond below crossover to USFS road (mile 3.41 to mile 3.42 appr.)

LOCATION: Stations left mile 3.41 (180+00) to mile 3.42 (181+00). The pond is about 0.2 miles below the new crossover to the USFS road

VISTA END POINTS:

1. Lower end – Find the culvert outlet into the pond. About 75 feet down the road (toward U.S. 101) is the lower end of the vista (the site of the old 180+00 station marker).
2. Upper end – About 100 feet up the road (toward the resort) is the upper end of the vista.

OBJECTIVES: Maintain view of pond and wetland (see photo C:1). Make pond more visible to approaching drivers by thinning brush at both ends.

INSTRUCTIONS: Selectively remove vine maple and alder 4" in diameter and less at both ends of pond. Taper cleared areas out in long triangles with the bases at the pond and the points at the vista end points. Clear any vegetation from the road fill that runs along the pond.

To determine the size of the lower triangle, stand at the lower end of the vista (i.e., 75 feet down from the culvert toward 101). There is a large hemlock about 40 ft down the road edge from the culvert and set back about 25-26 feet from the road. Sight on a diagonal line from your standpoint through the hemlock to the pond edge. Selectively clear the area between this diagonal line and the road edge.

To find the upper triangle, stand at the upper vista endpoint looking back toward the pond. Find the large stump about 50 feet uproad from the culvert and set back from the road edge 24 to 25 feet. Sight on a diagonal line through the stump to the pond. Clear as directed above between the diagonal line and the road.

PHOTOGRAPH: Photo C:1 depicts the pond vista in the fall of 1988. The general appearance of the vista should be maintained as it is in the photo. Notice that not all vine maple and alder saplings have been removed at the ends of the vistas.



C:1 Pond vista, 180+00
to 181+00, fall 1988.

Directions: Keep pond edge clear;
selectively thin alder clumps.

Cathleen Wilson

AREA 2: First river view

LOCATION: River overlook between stations right mile 6.11 (322+53) and mile 6.16 (325+44). The vista is immediately up the road from the turnout at right mile 6.08 (321+00) to mile 6.10 (322+00).

VISTA ENDPOINTS:

This vista has 2 sections separated by a clump of large conifers.

1. Lower end of 1st section – measure 14 feet up pavement edge from upper end of uppermost turnout log. Sight on large dead stump about 20-21 feet back from the road.
2. End of first section – First clump of three large conifers up road along slope edge.
3. End of second section – First big hemlock uproad after clump of three large conifers.

OBJECTIVES: Maintain view of Soleduck river for turnout users and drive-by visitors.

INSTRUCTIONS: Remove brush 4 inches in diameter and less starting on a line roughly from pavement edge to big stump, to slope edge and down the slope as far as is needed to clear view to river (see Photos C:2 and C:3). Beyond the conifer clump that divides the vista into two sections, continue to remove brush 4 inches and less. Save western red cedar sapling, devil's club, and the serviceberry between them (see Photo C:4). Remove large alder blocking view in this section.

PHOTOGRAPHS: Photo C:2 is of the view up river from the lower section of the vista. Photo C:3 is the view down river. Photo C:4 is of the upper section of the vista. It shows the large alder to be removed and three small plants to be saved.



Photo C:2--View up river from
just below 372+33 in first section,
fall 1986.

Wilson



Photo C:3--View down river from
about 324+44, fall 1986.

Wilson



Photo C:4--View down river from
about 324+95, fall 1986.

Directions: Remove alder,
save cedar, Devil's club, serviceberry.

Wilson

AREA 3: Second river view

LOCATION: River overlook on right including pullout at mile 6.52 (344+29) to mile 6.76 (357+00).

VISTA ENDPOINTS:

This vista has three sections.

1. Lower end – Very large tree over 4 feet in diameter on the river side of the road about 310 feet below mile 6.53 (345+00). It is also about 760 feet down the road from the lower end of the turnout. Just below the tree is an old informal turnout that looks like the beginning of a road going down to the river. Beyond this "road" are some small trees followed by some large rootwads.
2. End of first section – large tree-covered knoll at upper end of turnout (see Photo C:5).
3. End of second section – First clump of large trees above knoll (see Photo C:6).
4. End of third section – Large alder just below culvert outlet (see Photos C:7 and C:8).

OBJECTIVES: Maintain view of Soleduck river for turnout users and drive-by visitors.

INSTRUCTIONS: Remove brush 4" in diameter and less from road edge to river. Do not clear knoll at upper end of turnout. Prune and limb as needed in that area.

PHOTOGRAPHS: Photo C:5 is a view from the knoll looking down the road toward the end of the vista. Photo C:6 is a view up the river. It shows the second segment of the vista. Photo C:7 is the view up the road toward the third section of the vista. Photo C:8 is a view up river from the third section of the vista.

AREA 4: Third river view – Salmon Cascades

LOCATION: Area below Salmon Cascades parking. Stations right mile 7.00 (368+50) to mile 7.12 (375+75).

VISTA ENDPOINTS:

1. Lower end – culvert outlet on river side of road about 30 feet below mile 7.01 (370+00) or 680-700 feet below utility box #070550.
2. Upper end – Utility box #070550 on right below Salmon Cascades parking.

OBJECTIVES: Maintain view of Salmon Cascades and the Soleduck river below the Cascades (see Photos C:9 to C:11).

INSTRUCTIONS: Remove brush 4" in diameter and less from road edge to river.

PHOTOGRAPHS: Photo C:9 view of Salmon Cascades from upper section of vista just above Salmon Cascades Exhibit sign. Photo C:10 view down river from above Salmon Cascades Exhibit sign. Photo C:11 – view of river looking down the road.



Photo C:5--View from knoll
toward vista end, fall 1988.

Directions: Do not clear knoll.
Prune and limb vegetation
as needed.

Wilson



Photo C:6--View up river through
second vista section, spring 1989.

Knoll, trees marking
upper end of second section.

Dunkle



Photo C:7--View up road
to third vista section, fall 1989

Third section.

Dunkle



Photo C:8--View up river from
third vista section, fall 1986.

Wilson



Photo C:9—View up river
to Salmon Cascades, fall 1988.

Wilson



Photo C:10--View down river
from above Salmon Cascades Exhibit
sign, spring 1989.

Dunkle



Photo C:11--View down road
toward end of vista,
spring 1988.

Wilson

AREA 5: Fourth river view – side channel above Salmon Cascades

LOCATION: View of Soleduck river along low area between right mile 7.37 (389+00) and mile 7.44 (393+00) above upper Salmon Cascades parking area

VISTA ENDPOINTS:

1. Lower end – Very large root wad with large trees growing out of it at about mile 7.36 (388+50).
2. Upper end – Fallen tree trunk (over 4' in diameter) about 40 feet below picnic sign below "Alder, Master of Change" turnout.

OBJECTIVES: Maintain view of river.

INSTRUCTIONS: Remove brush 4" in diameter and less from road edge to river

AREA 6: Mountain view with USFS clearcut

LOCATION: Area behind right pullout at mile 8.50 (449+00) to mile 8.54 (451+00). This is the first pullout on the right after the North Fork trailhead parking.

It is just after the road bends above the long wet slope where ditch armouring was needed.

VISTA ENDPOINTS:

1. Lower end – Upper end of dense maple/alder grove above guard rail (see Photo C:12)
2. Upper end – Large tree between drainpipe outlet and upper end of berm just above pullout.

OBJECTIVES: Maintain view of mountains and National Forest land for turnout users

INSTRUCTIONS: Remove brush 4" in diameter from turnout edge downslope far enough to clear view. Remove larger trees indicated in Photo C:13. Limb other large trees (see Photo C:14).

PHOTOGRAPHS: Photo C:12 – lower end of clearing. Photo C:13 – Trees to be removed at upper end of vistas. Photo C:14 – Cleared center section of vista, fall 1988.

AREA 7: First forest view

LOCATION: First "Ancient Groves" nature trail turnout at right mile 8.75 (462+00) to mile 8.78 (463+50).

VISTA ENDPOINTS: Use turnout ends.

OBJECTIVES: Provide views of typical rainforest scenes for trail, turnout, and drive-by visitors.

INSTRUCTIONS: Selectively thin hemlock saplings and brush 4" in diameter and smaller. Paint hemlock stumps with borax to prevent fungus infection. Do not remove hemlocks from nurse logs (see Photo C:15). Limb as they grow larger.

PHOTOGRAPH: Photo C:15 – Hemlocks on nurselog.



Photo C:12--Alder clump marking
lower end of clearing, spring 1989.

Directions: Stop clearing
at alder clump on right.

Dunkle



Photo C:13--Big leaf maple
to be removed from upper end
of vista, spring 1989.

Directions:
Remove trees.

Dunkle



Photo C:14--Center section
showing cleared vista, fall 1986.





Photo C:15--Hemlocks on nurse log
at about 462+00, spring 1989.

Directions:
Do not clear nurse log.

Dunkle

AREA 8: Second forest view

LOCATION: Second "Ancient Groves" nature trail turnout at right mile 9.00 (475+00) to mile 9.01 (476+00)

VISTA ENDPOINTS: Use turnout ends.

OBJECTIVES: Provide views of typical rain forest scenes for trail, turnout, and drive-by visitors.

INSTRUCTIONS: Selectively thin hemlock saplings and brush 4" in diameter and smaller. Paint hemlock stumps with borax to prevent fungus infection. Do not clear small Sitka spruce near root wad (see Photo C:16). Limb as size increases.

PHOTOGRAPH: Photo C:16 – Forest view with large root wad and Sitka spruce saplings.

AREA 9: Third forest view

LOCATION: Area above and below turnout at right mile 9.86 (520+40). Stations right mile 9.83 (519+00) to mile 10.17 (537+00)

VISTA ENDPOINTS:

1. Lower end – about 100 feet below turnout end
2. Upper end – about 1/4 mile about upper turnout end

OBJECTIVES: Provide view into forest for drive-by visitors.

INSTRUCTIONS: Except for berms and planted slopes, selectively thin hemlock saplings and brush 4" in diameter and smaller. Paint hemlock stumps with borax to prevent fungus infection. The idea is not to clear every hemlock from the road edge, but to do enough clearing to prevent a solid line of doghair from blocking views into the forest (see Photo C:17).

PHOTOGRAPHS: Photo C:17 – Example of forest view. Photo C:18 – View along vista.



Photo C:16--Forest view
at 475+00, fall 1986.

Directions: Save
Sitka spruce seedlings.

Wilson



Photo C:17--Typical forest view.

John Teichert



Photo C:18--Right 519+00 to
537+00. Forest view along
vista, fall 1988.

Wilson

APPENDIX D: COST ESTIMATES

HYDROSEEDING

Fall 1989

1. Materials
 - a. Slope seeding
1,600 pounds sterile wheat (Regreen) @ \$1.30 per pound = \$2,080
230 50-pound bags or 11,500 pounds fiber mulch (Silva fiber or equivalent) @ \$7.00 bag (delivered) = \$1,610
 - b. Ditch seeding
200 pounds annual ryegrass @ \$0.59 per pound = \$118.00
150 pounds Chewings red fescue @ \$1.75 per pound = \$262.50
150 pounds sheep fescue @ \$1.95 per pound = \$292.50
100 pounds Canada bluegrass @ \$3.00 per pound = \$300.00
240 pounds fiber mulch (Silva fiber or equivalent) @ \$7.00 per bad (delivered) = \$1,680
3,600 pounds 16:16:0 fertilizer @ \$13.75 per 80-pound bag = \$618.75
 - c. Materials totals
 - (1) Slopes - \$3,690
 - (2) Ditches - \$3271.75
 - (3) Total materials costs - \$6,961.75 = \$7,000.00
2. Personnel
 - a. Crew hourly rates and hours
1 WG 10 Equipment operator @ \$17.27/hr* x 30 hrs = \$518.00
1 WG 7 Maintenance worker @ \$15.72/hr x 30 hrs = \$471.60
3 WG 3 Laborers @ \$11.50/hr x 30 hrs = \$1,725.00
 - b. Total personnel costs = \$2,725.00
3. GSA Vehicles
 - a. Vehicle rental @ \$150.00/month x 0.25 month = \$37.50
 - b. Estimated mileage @ \$0.225/mile x 100 miles/day x 3 days = \$67.50
 - c. Vehicle totals = \$125.00
4. Totals
 - (a) Materials - \$7,000.00
 - (b) Personnel - \$2,725.00
 - (c) Vehicles - \$125.00
 - (d) Total FY 89 Hydroseeding - \$9,850.00

*All hourly rates include benefits, see Assumptions.

Spring 1990

1. Materials

No cost. Blue wildrye from the U.S. Soil Conservation Service has already been paid by funds from FY 89 Soleduck Revegetation Project account.

2. Personnel

a. Crew hourly rates and hours

1 WG 10 Equipment operator @ \$17.27/hr x 30 hrs = \$518.00

1 WG 7 Maintenance worker @ \$15.72/hr x 30 hrs = \$471.60

3 WG 3 Laborers @ \$11.50/hr x 30 hrs = \$1,725.00

b. Total personnel costs = \$2,714.60 = \$2,725.00

3. GSA Vehicles

a. Vehicle rental @ \$150/month x 0.25 month = \$37.50

b. Estimated mileage @ \$0.225/miles x 100 mile/day x 3 days = \$67.50

c. Vehicle totals @ \$125.00

4. Totals

(a) Materials - \$0

(b) Personnel - \$2,725.00

(c) Vehicles - \$125.00

(d) Total FY 90 Hydroseeding - \$2,850.00

MOWING ALDER - Included in vista clearing.

HANDPULLING ALDER AND ALIEN SPECIES

1. Materials - \$100 (miscellaneous)

2. Personnel

a. Road Crew Alternative - hourly rates and hours

1 WG 7 Motor vehicle operator @ \$15.72/hr x 40 hrs = \$628.80

5 WG 3 Laborers @ \$11.50/hr = \$2,300.00

b. YCC Crew Alternative

1 WG 3 Laborer (YCC supervisor) @ \$11.50/hr x 80 hrs = \$920.00

5 YCCs @ \$4.53/hr x 80 hrs = \$1,812

c. Total personnel costs

(1) Road crew - \$2,928.8 → \$2,950

(2) YCCs - \$2,732 → \$2,750

3. GSA Vehicles

a. Vehicle rental @ \$150/month

(1) Road crew

x

1/4 month = \$37.50

(2) YCC

x

1/2 month = \$75

b. Estimated mileage @ \$0.225/mile x 100 miles/day

(1) Road crew x 4 days = \$90.00

(2) YCCs x 10 days = \$225

c. Vehicle totals

(1) Road crew - \$127.50 - \$150

(2) YCCs - \$300

4. Totals
 - a. Materials – \$100
 - b. Personnel
 - (1) Road crew – \$2,950
 - (2) YCCs – \$2,750
 - c. Vehicles
 - (1) Road crew – \$150.00
 - (2) YCCs – \$300
 - d. Total
 - (1) Road crew – \$3,100
 - (2) YCCs – \$3,050

REFERTILIZING TRANSPLANTS

1. Materials – \$300 (fertilizer tablets)
2. Personnel
 - a. Road Crew Alternative – hourly rates and hours
 - 1 WG 7 Motor vehicle operator @ \$15.72/hr x 30 hrs = \$471.60
 - 5 WG 3 Laborers @ \$11.50/hr x 30 hrs = \$1,725
 - b. YCC Crew Alternative
 - 1 WG 3 Laborer (YCC supervisor) @ \$11.50/hr x 60 hrs = \$690
 - 5 YCCs @ \$4.53/hr x 60 hrs = \$1,354
 - c. Total personnel costs
 - (1) Road crew = \$2,196.60 → \$2,200
 - (2) YCCs = \$2,044 → \$2,050
3. GSA Vehicles
 - a. Vehicle rental @ \$150/month
 - (1) Road crew = \$28.00
 - (2) YCCs = \$56.25
 - b. Estimated mileage
 - (1) Road crew
 - 100 miles/day x 3 days x \$.225/mile = 67.50
 - (2) YCCs
 - 100 miles/day x 7 days x \$.225/mile = \$1180.00
 - c. Vehicle totals
 - (1) Road crew = \$105.50
 - (2) YCCs = \$236.25
4. Totals
 - a. Materials = \$300
 - b. Personnel
 - (1) Road crew = \$2,200
 - (2) YCCs = \$2,050
 - c. Vehicles
 - (1) Road crew = \$105.50
 - (2) YCCs = \$236.25
 - d. Total
 - (1) Road crew = \$2,605 = \$2,625
 - (2) YCCs = \$2,586 = \$2,600

THINNING TRANSPLANTS

1. Materials
2. Personnel
 - a. Crew hourly rates and hours
5 WG 3 Laborers @ 11.50/hr x 40 hrs = \$2,300
 - b. YCC Crew Alternative
1 WG 3 Laborer (YCC supervisor) @ \$11.50/hr x 80 hrs = \$920
5 YCCs @ \$4.53/hr x 80 hrs = \$1812
 - c. Total personnel costs
 - (1) Road crew = \$2,300
 - (2) YCCs = \$2,732.00 → \$2,750.00
3. GSA Vehicles
 - a. Vehicle rental @ \$150/month
 - (1) Road crew x 1/4 month = \$37.50
 - (2) YCCs x 1/2 month = \$75.00
 - b. Estimated mileage @ \$0.225/mile x 100 miles/day
 - (1) Road crew x 4 days = \$90
 - (2) YCCs x 10 days = \$225
 - c. Vehicle totals
 - (1) Road crew - \$127.50 → \$150.00
 - (2) YCCs - \$300
4. Totals
 - a. Materials - \$100
 - b. Personnel
 - (1) Road crew - \$2,300
 - (2) YCCs - \$2,750
 - c. Vehicles
 - (1) Road crew - \$150.00
 - (2) YCCs - \$300
 - d. Total
 - (1) Road crew - \$2,550
 - (2) YCCs - \$3,150

VISTA CLEARING

1. Materials - \$800 (miscellaneous)
2. Personnel
 - a. Crew hourly rates and hours
1 WG 10 Equipment operator @ \$17.27/hr x 80 hrs = \$1,381.60
1 WG 7 Maintenance worker @ \$15.72/hr x 320 hrs = \$5,030.40
5 WG 3 Laborers @ \$11.50/hr x 320 hours = \$18,400
 - b. YCC Crew Alternative
1 WG 3 Laborer (YCC supervisor) @ \$11.50/hr x 288 hrs = \$3,312
1 WG 3 Laborer (chainsaw operator) @ \$11.50 hr x 288 hrs = \$3,312
12 YCCs @ \$4.53/hr x 288 hrs = \$15,655.68
 - c. Total personnel costs
 - (1) Road crew - \$24,812 → 24,825
 - (2) YCCs - \$26,758.88 → \$26,775
3. GSA Vehicles
 - a. Vehicle rental @ \$150/month
 - (1) Road crew x 2 months = \$300
 - (2) YCCs x 2 vehicles x 2 months = \$600

- b. Estimated mileage @ 100 miles/day
 - (1) Road crew x \$0.225 x 32 = \$721
 - (2) YCCs x 2 vehicles x 0.225/mile x 40 days = \$1,800
- c. Vehicle totals
 - (1) Road crew - \$1,025 → 1,025
 - (2) YCCs - \$2,400
- 4. Totals
 - a. Materials - \$800
 - b. Personnel
 - (1) Road crew - \$24,825
 - (2) YCCs - \$26,700
 - c. Vehicles
 - (1) Road crew - \$1,025
 - (2) YCCs - \$2,400
 - d. Total
 - (1) Road crew - \$26,650
 - (2) YCCs - \$29,975

Assumptions

- 1. All WG 3 employees are assumed to be temporaries and benefits are computed at the rate used for temporaries.
- 2. All employees above WG 3 are assumed to be permanents and their benefits are computed at the highest rate used for permanent employees.
- 3. YCCs are assumed to do one-half the work of an equal number of adults.

APPENDIX E: "AS CONSTRUCTED" DRAWINGS

To be added later when completed by FHWA.

Until the "as constructed" drawings are completed, refer to the contract plans for the Soleduck Valley Road, drawing no. 149/41,954, on file at the Denver Service Center Technical Information Center.

PREPARER AND CONSULTANTS

PREPARER

Nancy Dunkle, Natural Resource Specialist, DSC

CONSULTANTS

Olympic National Park (ONP)

Robert Chandler, Superintendent
John Teichert, Assistant Superintendent, Planning and Development
Pete Fielding, Facilities Manager
Edward Schreiner, Park Botanist
Gordon Grall, Roads Foreman

Pacific Northwest Region

Geoff Swan, Landscape Architect

Denver Service Center, Western Team, Park Roads Program

Jerald Lorenz, Project Manager
Camden Hugie, Design and Construction Coordinator and former park landscape architect, ONP

Federal Highways Administration, Western Direct Federal Division

Lonnie Moss, Planning Engineer

ACKNOWLEDGEMENTS

Soleduck revegetation project staff, crews, and volunteers, 1985-1988, especially

Matthew Albright
Ben Alexander
Kim Bierly
Susan Buis
Michael Gracz
Richard Hadley
Elizabeth Hubert
Kirsten Krueger
Radd Leighton
Richard Mitchell
Robin Reid
Sam Reid
Michael Reynolds
Cathleen Wilson

REFERENCES

National Park Service, U.S. Department of the Interior

1987 "Unpublished data on sterile wheat test plots" analyzed by Richard Ellison. On file at the Denver Service Center, Lakewood, Colorado.

Soil Conservation Service, U.S. Department of Agriculture

1981 *Technical Notes, Colorado Agronomy Notes NO. 61: Seeding Rates.*

Washington State University Cooperative Extension

1983 *Fertilizer Guide No. FG-49: Ornamentals.* College of Agriculture, Washington State University, Pullman, WA.



As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural and cultural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

Publication services were provided by the graphics and editorial staffs of the Denver Service Center. NPS D-183.