Notes from St. Johns Landfill revegetation meeting, 2/2/01
Dennis O'Neil, Maurice Neyman, Janell Davis, Mark Wilson, George Kral, Elaine Stewart

<u>Constraints faced in previous work</u>
- Seed bank contamination
- Nutrient load (use of sewer sludge)
- Small plot sizes (e.g., 0.5 ac)
- Inadequate resources for maintenance
- Soil conditions – variable depth, compaction, etc.

<u>Things to do differently</u>
- Mix soil and sand layer when laying soil out
- Use different plants: forbs, long-lived grasses, oak/ash savanna, shrubs
- Set aside some areas as no-mow or delayed mow, consider grazing
- Avoid use of enriched soil, avoid fertilizer

<u>Possibilities</u>
- Oak or ash savanna
- Shrubs
- Herbaceous prairie/upland plants
- Remove all or part of perimeter road and revegetate

<u>Action items</u>
- Woody vegetation plot on temporary soil pile (from bank stabilization work). This pile will remain for 4-5 years before being moved. Plant it with woody plants of interest to determine whether they penetrate the liner.
- Keep area 5a as it is, use as nursery area for species that persist there. Consider introducing more species.
- Pursue experimental plots. Elaine to provide information to George Kral and Mark Wilson on desirable habitat types. They will recommend approaches for plots. Landfill crew can help with tilling and mowing, and can do herbicide applications (they would prefer to do it in-house rather than hire it out).

<u>Additional points to keep in mind</u>
- Sustainability is a Metro goal, need to move toward it
- Cannot have ponding on the landfill

A. Previous Testplot Work

Summary of Past Work (1992-1998)

Overview
Since the initiation of SJL final closure work in 1992, four series of vegetative testplots were established in 1992, 1994, 1995 and 1996. Specific information about each test plot is summarized in **Table 1: Native Grass Testplots 1992-1996** (revised from: M.G. Wilson, *SJL Vegetation Maintenance Program: Task Two- Native Grassland Management Plan*, 1997). To date, none of the established testplots have been replicated. Each test plot was established using different combinations of site preparation manipulations and seeding methods. While some testplots were successful in the short term, the results obtained from each plot were incomplete and therefore unable to be fully analyzed.

Testplot Results- 1992-1996
Of the twelve total plots seeded, six were abandoned by the 1997 growing season. In five of the six abandoned plots, the seedings of native grasses failed, primarily due to competition from un-seeded non-native grasses in the seedbank or from a seeded covercrop. The sixth plot was abandoned due to it's depredation by waterfowl grazing. It should be noted that of the six grassland plots abandoned, four were on plots that had no site (or soil) preparation manipulation prior to seeding.

Several other factors contributed to the failure of test plots from 1992 through 1996:

- When the final closure soils and composts were placed, heavy road building equipment was used resulting in <u>soil compaction</u>.
- The use of recycled soil (from the temporary soil cover) and imported soil containing weeds has resulted in <u>contaminated soil seedbanks</u>.
- The yard debris compost was poorly mixed with the cover soil.
- <u>The seeding rate of native grasses was not sufficient</u> for good stand establishment in the 1995-1996 plots.
- All testplots were sown with <u>out of area seed</u>.

Testplot Results- 1998
By the beginning of 1998 there were six remaining testplots: 4 in Subarea 1 and 2 in Subarea 5 & 5A [See Table A]. After the consultant surveyed each of the plots and consulted with Metro SJL staff five of the plots were abandoned due to poor native grass performance, leaving only Testplot Number 3A in Subarea 1. Unfortunately, all the Subarea 1 plots were allowed to be grazed by sheep beginning in the early spring of 1998.

Factors that contributed to the failure of the six remaining test plots included:

- When the final closure soils and composts were placed, heavy road building equipment was used resulting in <u>soil compaction</u>.

- The use of recycled soil (from the temporary soil cover) and imported soil containing weeds has resulted in contaminated soil seedbanks.
- The yard debris compost was poorly mixed with the cover soil.
- The seeding rate of native grasses was not sufficient for good stand establishment in the 1995-1996 plots.
- The "cooked" soil placed in the Subarea 5 testplots was not tested for nutrients before it was fertilized. [Nor was the soil tested after fertilization.] Never the less, the resultant stands of native grasses exibited symptoms of very poor nutrition.
- All testplots were sown with out of area seed.

At this time all native grassland plots established in 1992, 1994, 1995 and 1996 have been abandoned.

What has been learned from previous testplot failure?

1. Native grass testplots cannot be successfully established in one growing season due to great amount of non-native seed (primarily ryegrass) in the soil seedbank. It would appear that it is necessary to spend a minimum of one growing season prior to seeding on site/soil preparation activities designed to reduce the affect of a contaminated seedbank.

2. The cover soils in many of the areas tested in the spring of 1998 exibited evidence of inconsistent soil/compost/sand mixing and poor infiltration. Although most of the soil testing was done on Subarea's 2 & 3 only, inferences can be made about the condition of soils throughout the landfill. [see Appendix 3 for additional information].

3. Hydroseeding is a poor method of establishing native grasses and forbs.

4. Native grass seeding rates of approximately 8 lbs and 16 lbs per acre are not adequate to insure good stand establishment.

5. The native grass, Idaho fescue (*Festuca idahoensis*) and forbs supplied from producers in California and east of the Cascades perform poorly in western Oregon.

6. The use of cooked soil on the Subarea 5 testplots resulted in sterile seedbanks, but the vegetation exhibited symptoms of very poor nutrition. Extensive soil nutrient testing and followup fertilization before seeding are recommended if sterile soils are used in the future.

TABLE A: SJL NATIVE GRASS TESTPLOTS 1992-1996

Location/Size	Site Prep.	Date/Method	Species	App. Rate	Status
Mesic Plots: SA-1 4 Acres total	None	9/92 - Track & Broadcast Hydroseed	covercrop + 4 grasses 7 forbs	variable (mix)	abandoned: failure
Xeric Plots: SA-1 4.5 Acres total	None	9/92 - Track & Broadcast Hydroseed	covercrop + 4 grasses 3 forbs	variable (mix)	abandoned: failure
Plot 1A: SA-1 .5 Acre	Herbicide-Tillage	9/94 No-till drill	BRca & FEid	8.5 #/Acre equal mix	abandoned: failure
Plot 1B: SA-1 .6 Acre	Herbicide-No Tillage	9/94 No-till drill	BRca & FEid	#/Acre equal mix	abandoned: failure (spring '98)
Plot 2A: SA-1 .10 Acre	Solarization	9/94 No-till drill	BRca & FEid	#/Acre equal mix	abandoned: failure (spring '98)
Plot 2B: SA-1 .25 Acre	Tillage only	9/94 No-till drill	BRca & FEid	8.5 #/Acre equal mix	abandoned: failure (spring '98)
Plot 3A: SA-1 .6 Acre	Tillage only	9/94 No-till drill	BRca & FEid	16.3 #/Acre equal mix	abandoned: grazing damage (summer 98)
Plot 3B: SA-1 .55 Acre	Acid pH	9/94 No-till drill	BRca & FEid	#/Acre equal mix	abandoned: failure
Plot 4: SA-2 1.5 Acres	None	9/94 No-till drill	BRca & Feid	#/Acre equal mix	abandoned: failure
Plot A: SA-4 1 Acre	None	9/95 - Track & Broadcast	Elgl	30 #/Acre	abandoned: waterfowl depredation
Plot B: SA-5 1 Acre	Sterile Soil	9/96 - Track & Broadcast	BRca & ELgl	30 #/Acre equal mix	abandoned: failure (spring '98)
Plot C: SA-5a 6 Acres	Sterile Soil	9/96 - Track & Broadcast	BRca & ELgl	30 #/Acre equal mix	abandoned: failure (spring '98)

Species: BRca=Bromus carinatus/FEid=Festuca idahoensis/ELgl=Elymus glaucus

ESTABLISHMENT OF NATIVE VEGETATION AT ST. JOHNS LANDFILL

Experimental Test Plot Monitoring
[TASK 10: 1999 Annual Report]

Prepared for:

**REGIONAL ENVIRONMENTAL MANAGEMENT DIVISION
METROPOLITAN SERVICES DISTRICT
600 NE GRAND AVENUE
PORTLAND, OR 97232**

Prepared by:

**Mark Griswold Wilson, Restoration Ecologist
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Loverna Wilson, Environmental Consultant**

December 1999

RECOMMENDATIONS FOR LONG TERM VEGETATION MANAGEMENT

A total of twelve native grass testplots were established at SJL between 1992 and 1998. Although the only testplot series scientifically replicated was in 1998, viable stands of native grasses have not been able to be successfully established on any of the testplots for longer than one year. The influence of a *Lolium* dominated soil seedbank and the degradation of physical soil characteristics are thought to be the primary causes of this failure to establish natives. [See the **Discussion** above and **Winter 1998 Soil Testing** in the Appendices to the November 1998 Final Report]. The potential significance of the *Lolium* contamination of the SJL soil seedbanks has been known since native vegetation establishment activities began in 1992. In the 1980's, during temporary closure work, *Lolium perenne* "Manhattan" (perennial ryegrass), and *Agrostis* spp. (bentgrass) were seeded throughout the areas subject to final closure. These soils (and sod and seedbank) were then recycled when final closure work was initiated in 1992. The following spring ryegrass was the primary component in all "closed" areas of SJL. In June of 1994, the Oregon State University Seedlab conducted analyses on 6 soil samples taken from Subareas 1 & 2 to determine soil-seedbank composition. In each 1 pound soil sample, the Seedlab identified between 22 and 67 viable *Lolium* seeds. As of December 1999, all former SJL testplot locations are again primarily composed of ryegrass which, in all likelihood, has germinated from the soil-seedbank.

Based on the results of 7 years of testing, the WBW Project Team makes the following recommendations for the establishment of vegetation at SJL:

- Concentrate on replanting the riparian woodland/wetland around the edges of the landfill. Consider closing or narrowing Road E in order to provide additional planting area. Beaver/nutria protection fencing will be required.
- Determine, through experimental plantings, whether native woody shrub/arborescent tree plant communities can be established in certain SJL locations where the topsoil is deepest. [Soil depths should be =/> 12".] Deer protection fencing will be required.
- Finally, in areas where soil depths are less than 12", manage [e.g. fertilize, lime and mow] the existing ryegrass as waterfowl feeding areas. Alternatively, seed with non-native fescues such as: F. longifolia (hard fescue) or F. commutata (chewings fescue).

PROJECT STATUS REPORT

Site(s):	**St. John's Landfill**
Date:	**December 2000**
Landowner:	**METRO Regional Environmental Management**

Contact: **Dennis O'Neil, St. John's Landfill Supervisor**
METRO REM

Totals To Date:	
Acres Planted:	**14**
Feet of Bank Planted:	**10,200**
Trees Planted:	**30,449**
Shrubs Planted:	**2,709**
Pole Cuttings Planted:	**26,500**
Pounds Seed Sown	**170**

INTRODUCTON

The Watershed Revegetation Program (WRP) in the Bureau of Environmental Services, City of Portland began revegetating the perimeter of Metro St. John's Landfill in 1996 along the Columbia, Blind, and North sloughs. All plantings, interplantings, and treatments since 1996 are recorded in this report. This report also lists future plantings, interplantings, and maintenance prescribed under existing agreements.

Because of its proximity to and inclusion in the Smith and Bybee Lakes Natural Area, the Landfill is an integral ecological component of the Lower Columbia Slough ecosystem. In accordance with the 1996 and 1999 IGAs, WRP has planted and maintained trees, shrubs, and pole cuttings and seeded native grasses along the landfill perimeter as described in the "Plantings" and "Treatments" tables below and the statistics given at the beginning of this report. These plantings include the "Slope Stabilization" project.

HISTORIC SITE CONDITIONS

Historic and remnant habitats in this area of the Lower Columbia Slough generally consist of a mixed deciduous forest of Oregon ash, black cottonwood, and pacific willow. Other dominant species are *Cornus sericea, Sambucus racemosa* and species of willow, with accompanying understory shrubs and herbaceous species of *Symphoricarpos alba, Spiraea douglasii, Carex aperta*, and *Eleocharis palustris*. Prior to the area's development as a landfill, these species occupied the natural silt levee that now serves as a dike keeping solid wastes and contaminated water from contact with surrounding water bodies.

Much of the original vegetation on the dike has been lost over the years due to physical removal and, increasingly, due to displacement by non-native weeds. In 1996, when the City first partnered with Metro to begin restoring native vegetation around the landfill, most of the dike was covered with a wall of Himalaya blackberry. Only a few scattered patches of ash remained, with a negligible number of native shrubs and essentially no native ground cover.

PROJECT HISTORY

In an attempt to be organic in restoring native vegetation, control of existing weeds was originally limited to manual cutting. Rather than releasing native plants, cutting the blackberry released a Pandora's box of other weeds, including morning glory, nightshade, reed canary grass, and poison hemlock, in addition to vigorously resprouting blackberry canes. Despite repeated attempts to cut back rapidly growing weeds, many planted trees and shrubs were out-competed, or were physically damaged in the process of cutting weeds. More recent efforts at weed control through careful hand-application of low-toxicity herbicides have been vastly more effective in reducing competition and allowing planted trees and shrubs to survive and grow.

Severe high water, poor soil conditions, drought, and herbivorous animals have also contributed to substantial losses of stocking around the Landfill.

Although there have been numerous setbacks, discernable patterns of planting success have begun to emerge. Oregon ash has done well in most areas. This species has proven to be very tolerant of weed competition and high water levels, as well as resistant to most types of herbivory. The major downfall of this species is meadow voles, which prefer to gnaw the bark of ash over any other. Red osier dogwood from cuttings and rooted stock have proven very hardy under most conditions. Black hawthorn have grown well and are generally free from damage by most animal species except an occasional beaver clip. Snowberry, elderberry, alder, and a few conifers have persisted only above recent spring high water levels. Black cottonwood, which has shown promise to grow rapidly on many parts of the dike, has been almost completely exterminated by beaver. Several thousand have been planted, only a handful remain. Of the grasses and emergent vegetation re-introduced to stabilize the lowest slopes, *Carex aperta* and *C. obnupta* have excelled.

TREATMENT ACCOMPLISHMENT RECORD

Perimeter (incl. "Blind Slough") ***Total Acres: 14***

Plant Date	*Planting Type*	*Acres*	*Plants/ Acre*	*Total Plants*	*Species Planted*
3/1/96	Initial	7.1	1345.6	5,969	*Abies grandis, Alnus rubra, Fraxinus latifolia, Populus trichocarpa, Salix sp., Thuja plicata, Cornus stolonifera*
12/18/96	Interplant	7	385.7	2,700	*Populus trichocarpa, Salix sp.*
3/7/97	Initial	1	1044	1,044	*Alnus rubra, Fraxinus latifolia, Populus trichocarpa, Salix sp.*
3/11/97	Initial	11	936.1	9,923	*Alnus rubra, Fraxinus latifolia, Populus trichocarpa, Salix* sp.
10/16/97	Interplant	2	210	420	*Crataegus douglasii*
2/11/98	Interplant	7	659.3	4,615	*Crataegus douglasii, Fraxinus latifolia, Populus trichocarpa, Pseudotsuga menziesii, Salix lasiandra, Thuja plicata, Salix fluvialis*
3/2000	Interplant	?	?	1,110	*Crataegus douglasii, Fraxinus latifolia, Populus trichocarpa, Alnus rubra, Rhamnus purshiana, Sambucus cerulea, Sambucus racemosa, Ribes sanguineum*
3/1/96	Interplant	0.1	500	50	*Cornus stolonifera*
4/1/97	Interplant	12	125.8	1,459	*Crataegus douglasii, Oemleria cerasiformis, Sambucus racemosa, Symphoricarpus albus,*
3/1/98	Interplant	1	300	300	*Cornus stoloniferous, Spiraea douglasii*
3/10/99	Interplant	9.5	94.74	2709	*Crataegus douglasii, Rosa pisocarpa, Sambucus racemosa, Sambucus cerulea*
10/14/99	Seeding	2	18.5 lbs/ac	37 lbs	*Agrostis exarata, Bromus carinatus, Elymus glaucus, Festuca occidentalis*
4/14/00	Seeding	6			*Agrostis exarata, Bromus carinatus, Elymus glaucus, Festuca occidentalis*

Treatment Date	*Treatment*	*Acres*
8/20/96	Manual cutting (site prep)	7
6/6/96	Manual cutting	4
8/6/96	Irrigation	7

8/8/96	Manual cutting	10
8/18/96	Irrigation	7
10/20/96	.Manual cutting	10
11/12/96	Manual cutting (site prep)	3
3/7/97	Tubing	1
5/14/97	Mulching/scalping	9
5/21/97	Manual cutting	6
7/16/97	Manual cutting	6
8/20/97	Irrigation	4
9/17/97	Manual cutting	8
11/5/97	Manual cutting (site prep)	1.8
2/11/98	Tubing	7
2/18/98	Tubing	2
3/1/98	Staking	1
5/18/98	Manual cutting	1
5/21/98	Manual cutting	2
5/30/98	Mulching/scalping	2
8/7/98	Manual cutting	2
8/18/98	Irrigation	4
10/31/98	Manual cutting	10
4/12/99	Mulching/scalping	0.3
9/1/99	Herbicide application	4
9/28/99	Manual cutting	0.5
9/28/99	Mowing	2
2/24/00	Herbicide application	6
5/27/00	Mulching/scalping	2

Slope Stabilization — *Total Acres: 1.8*

Plant Date	*Planting Type*	*Acres*	*Plants/ Acre*	*Total Plants*	*Species Planted*
? 2000	interplant	1	1,110	1,110	*Alnus rubra, Crataegus douglasii, Fraxinus latifolia, Populus trichocarpa, Rhamnus purshiana, Ribes sanguineum, Sambucus racemosa, Sambucus cerulea*
? 2000	Interplant Pole cuttings	1	26,500	26,500	*Cornus stolonifera, Salix sp.*

Treatment Date	*Treatment*	*Acres*
6/27/00	Mulching/scalping	13.6

East Side 1998 — *Total Acres: 2*

Plant Date	*Planting type*	*Acres*	*Plants/ Acre*	*Total Plants*	*Species Planted*
2/18/98	Initial	2	902	1,804	*Acer macrophyllum, Crataegus douglasii, Fraxinus latifolia, Populus trichocarpa, Rhamnus purshiana, Salix lasiandra, Thuja plicata, Salix fluviatilis*

Engineered Slopes *Total Acres: 3.2*

Plant Date	*Planting type*	*Acres*	*Total pounds*	*Species Planted*
10/00	Initial	3.2	~25	450g *Helenium autumnale*, 900g *Bidens cernua*, 20 lbs *Tritecum* sp. 2 Agrostis exarata 1 Deschampsia caespitosa .75 Eleocharis palustris .75 Alopecurus geniculatus

CURRENT MONITORING RESULTS

Recent monitoring (November 2000) revealed an average of 483 planted trees and 216 shrubs per acre around the Landfill perimeter. *Cornus sericea* and *Fraxinus latifolia* are the woody species showing greatest survival. Red alder, Douglas-fir, and western redcedar, snowberry and red elderberry are doing well on the highest elevations above spring high water. Only a few widely scattered cottonwood remain. Remnant cottowoods are generally very large and healthy (probably beacons for hungry beaver).

Plant distribution is highly variable, with some clumps of dense stocking interspersed with large non-stocked or poorly stocked areas. Trees average between 3 and 4 feet in height, with some of the largest cottonwood and willow exceeding 15 feet. While most remaining plants are in fair to good condition, past and current animal damage was noted on nearly every monitoring plot.

Cause of mortality:	Percent of total loss:
Predation (beaver, nutria, mice)	20
Flooding	15
Poor soil conditions	5
Competition with weeds	20

RECOMMENDED TREATMENTS

- Implement actions described in existing IGA's
- Increase "Enhancement" section of new IGA to allow additional interplantings with successful species in selected areas around the perimeter.
- Consider permanent wire protection for remaining and additional planted black cottonwood at strategic locations around the perimeter.

Work remaining under the existing IGA's:

IGA	Site	Work remaining	Acres	Through FY
1996 IGA	Landfill perimeter	• Maintenance and monitoring	10	Dec. 2003
2000 IGA	Engineered Slopes	• Planting	1.2	2001
		• Additional perimeter revegetation	5	2001
		• Maintenance, Monitoring, and Reporting		2003

Appendix E1. Summary of habitat relationships and biological objectives for focal species in grassland and savanna habitats of the Westside Lowlands and Valleys Landbird Conservation Planning Region.

Conservation Focus	Focal Species	Key Habitat Relationships			
		Vegetative Composition	Vegetation Structure	Patch size/ Landscape	Special Considerations
large patches of grassland	western meadowlark	herbaceous, shrubs, saplings, oaks,	shrub-tree cover <10%; variable grass heights up to 76 cm	>80 ha; <10% hostile habitat	fencelines or powerlines may provide singing perches in absence of shrub-trees
short grass, bare or sparsely vegetated ground	streaked horned lark, common nighthawk	herbaceous	20-50% bare or sparsely vegetated; herbaceous vegetation <30 cm tall		can use very small patches of suitable habitat, but must be free from disturbance
burrows	burrowing owl		>40% open ground; <40% grass cover		populations of burrow providers and prey populations
scattered shrubs or bunchgrass	Oregon vesper sparrow, lark sparrow (RV)	grasses, shrubs, saplings, oaks	scattered shrub cover 5-15%; variable grass heights <46 cm;	>8 ha	vesper sparrow also uses Christmas tree farms
moderate grass height, little to no bare ground or shrubs	grasshopper sparrow	herbaceous	variable grass heights 15-61 cm; >90% herb cover (70% RV,UV); <5% shrub cover	>20 ha	semi-colonial
wet prairie/ grassland	northern harrier	herbaceous	no activity buffer within 122 m radius around nest; contiguous habitat to change in habitat type	>160 ha; >1/4 from human use	adjacency of wetlands and/or dry prairie to expand suitable habitat
large oaks with cavities	American kestrel (WV,PL), western screech owl (RV,UV)	herbaceous, oaks	oaks >61 cm with cavities; tree canopy cover 10-30%; snrub cover <30%		can use nest boxes for short-term management, but must consider starling presence
large conifer trees	Lewis' woodpecker	herbaceous, shrubs, ponderosa pine	trees >61 cm; 2.5 snags/ha >30 cm; tree canopy cover 10-40%		pine-oak sites may be most suitable

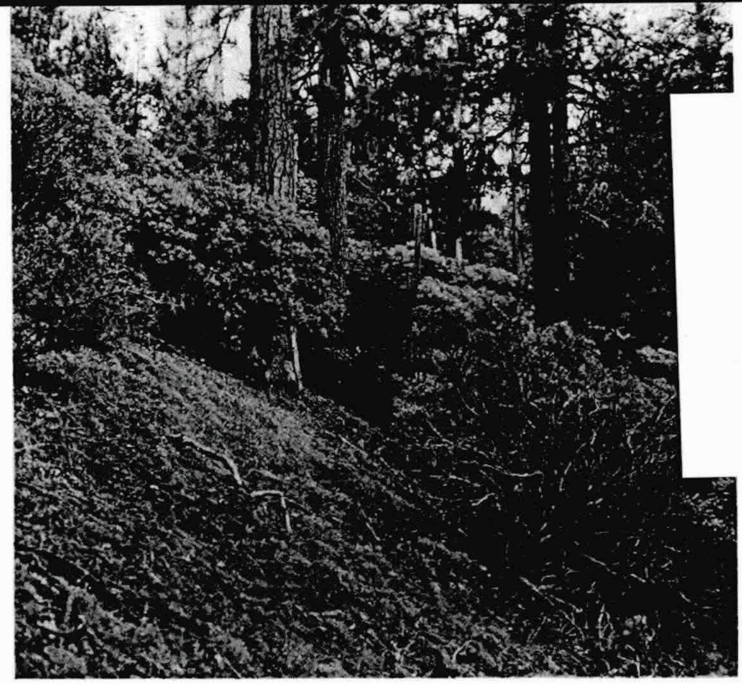

Figure 85.—*Pinus ponderosa-Pseudotsuga menziesii / Arctostaphylos viscida* **community which is found on some of the Rogue River valley foothills (Ashland Research Natural Area, Rogue River National Forest, Oregon).**

Arctostaphylos viscida characterized the understory on driest sites. Gratkowski (personal communication) indicates the major conifers on the valley floor in this area are *Pinus ponderosa* and *Libocedrus decurrens* with *Arctostaphylos viscida* and *Ceanothus cuneatus* as understory dominants (fig. 84).

In the floristically poorer, eastern Siskiyou Mountains, Waring (1969) recognized a Ponderosa Pine Type as the most xeric of his coniferous types (fig. 85). *Pseudotsuga menziesii, Arbutus menziesii,* and, sometimes, *Abies concolor* were associated with the *Pinus ponderosa. Arctostaphylos patula, A. viscida, A. nevadensis, Achillea millefolium* var. *lanulosa, Solidago canadensis, Apocynum pumilum,* and *Lupinus* spp. typified the understory.

Grasslands

Grasslands occupied extensive areas of the interior valleys before they were settled (fig. 86) and continue to do so today. Many of the earlier prairies have been lost to forest and woodland (Johannessen et al. 1971), but new ones have been created by settlers and later farmers by clearing or burning or both (fig. 87). Other grasslands occupy sites that appear incapable of supporting tree growth, e.g., grass balds associated with self-mulching soils (Grumusols) or lithosolic, extremely xeric, southerly exposed slopes. Almost all grassland areas (and *Quercus* savanna) have been heavily grazed by domestic livestock—cattle, sheep, or Angora goats—and are extensively used as unimproved pastureland today (fig. 88).

The nature of the original grassland communities is strictly conjectural, since grazing and introduction of alien species have altered all stands to some degree. Turner (1969) has suggested these grasslands probably looked similar to parts of the "California annual-type grassland" with *Danthonia californica* and *Stipa* spp. typical dominant species. Habeck (1961) provided a list of grasses which may have been characteristic of dry and moist sites in the Willamette valley. Species on well-drained sites included *Agrostis hallii, Agropyron caninum, Bromus carinatus, B. vulgaris, Danthonia californica, Elymus glaucus, Festuca octoflora, F. californica, F. rubra, F. occidentalis, Melica subulata, Poa scabrella, Sitanion jubatum,* and *Stipa lemmonii.* Habeck (1961) suggests a large number of forbs were probably also present on the native prairies.

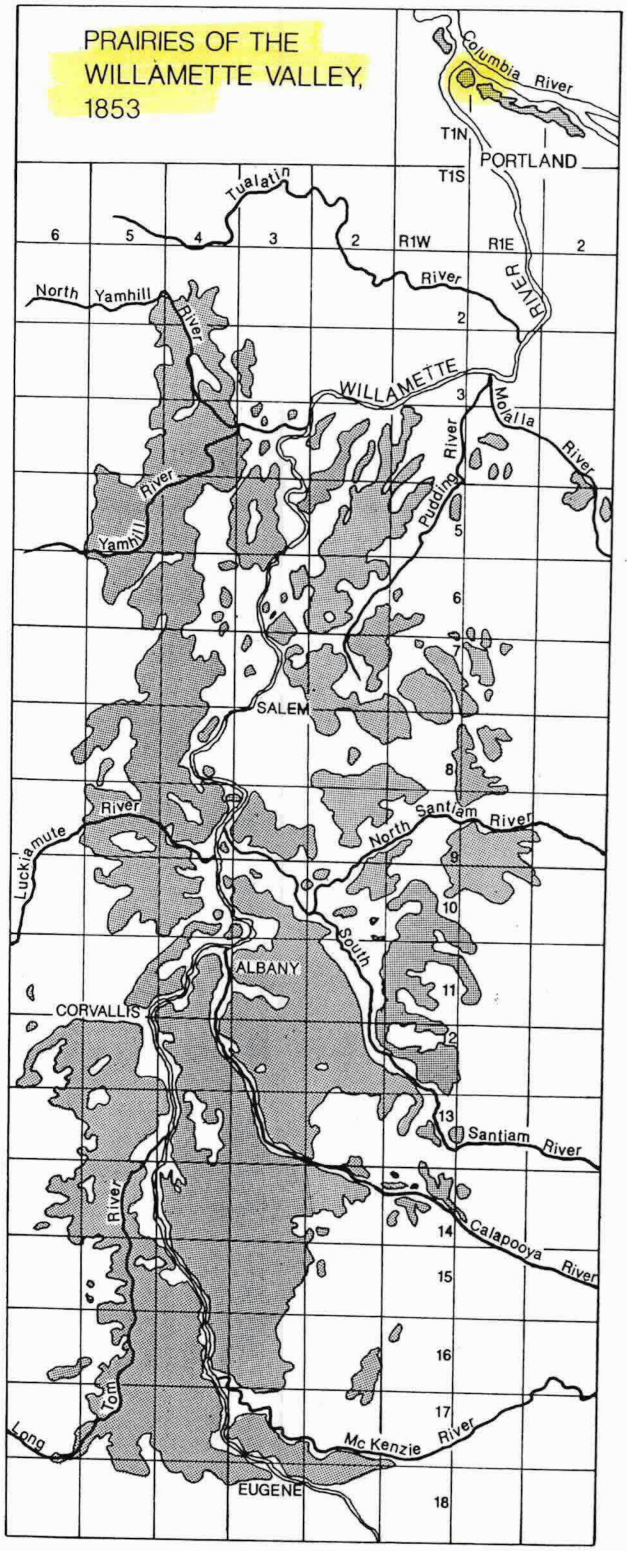

Figure 86.—Extent of prairie or grassland vegetation in the Willamette valley in 1853 (modified from Johannessen et al. (1971)).

Figure 87.—Many of the grasslands in the Interior Valley Zone were created by clearing or burning (or both) of forest lands; burning hill pasture in the Umpqua valley, Oregon.

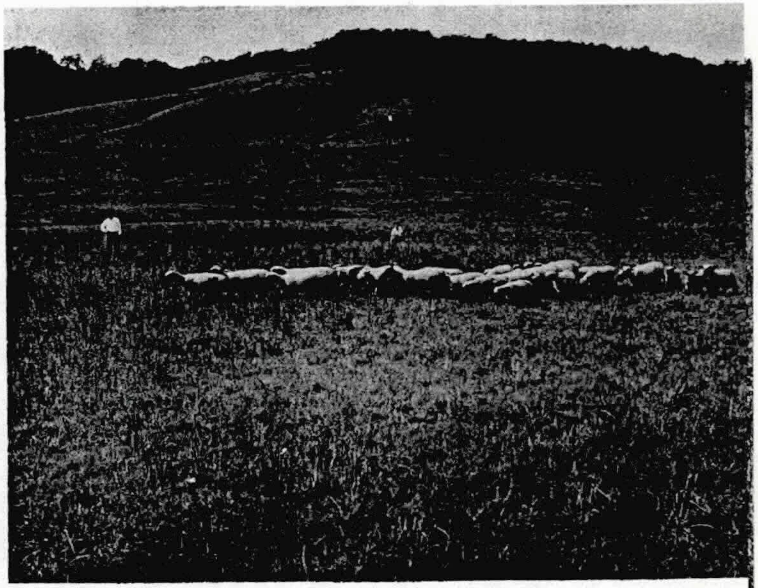

Figure 88.—Grassland areas in the Interior Valley Zone are heavily grazed. Typically low-lying pasturelands are improved (foreground), and hill grasslands and oak woodland (background) are used as unimproved pasture (near Corvallis, Oregon; *photo courtesy Range Management, Oregon State University*).

There are very few descriptive data even for existing valley grasslands, and these are all confined to the vicinity of Corvallis in the Willamette valley (Livingston 1953, Turner 1969, Valassis 1955, Owen 1953), although the general patterns probably have much wider relevance. Typical constituent species are (introduced species are indicated by an asterisk):

Perennial Grasses—*Danthonia californica, Festuca rubra, F. arundinacea**, *Agrostis hallii, A. idahoensis, Poa pratensis**, *P. compressa**, *Elymus glaucus, Danthonia intermedia, Holcus lanatus**, *Stipa occidentalis* var. *minor, Sitanion hystrix, Carex* spp., *Lolium perenne**, *Dactylis glomerata, Koeleria cristata,* and *Arrhenatherum elatius**.

Annual Grasses—*Bromus rigidus**, *B. commutatus**, *B. mollis**, *Elymus caput-medusae**, *Cynosurus echinatus**, *Festuca bromoides**, *F. myuros**, *Avena fatua**, *Aira caryophyllea**, *Briza minor**, and *Gastridium ventricosum**.

Forbs—*Torilis nodosa**, *Daucus carota**, *Ranunculus occidentalis, Lactuca serriola**, *Sherardia arvensis**, *Vicia americana, V. tetrasperma**, *Erodium cicutarium**, *Hypericum perforatum**, *Taraxacum officinale**, *Fragaria chiloensis, Plantago lanceolata**, *Galium divaricatum**, *Veronica peregrina, Lathyrus sphaericus**, *Eriophyllum lanatum, Hypochaeris radicata**, *Achillea millefolium* var. *lanulosa,* and *Sanicula bipinnatifida.*

There is obviously a very high proportion of introduced species in the existing communities; they include all the annual grass dominants. One of these, *Elymus caput-medusae*, is an extremely undesirable species which dominates many stands (Turner et al. 1963, Turner 1969).

Moir and Mika[2] have made the most comprehensive floristic analysis of near-natural prairie communities in the Willamette valley. Their study was confined, however, to a bottomland prairie located in the Willamette Floodplain Research Natural Area (Franklin et al. 1972); the tract had been grazed by domestic livestock but was never plowed. Three major prairie communities were identified: (1) *Deschampsia caespitosa*-dominated grassland, (2) *Rosa eglanteria*-dominated shrub thickets, and (3) a *Poa pratensis-Agrostis* spp. community which was typically ecotonal between the first two types. The *Deschampsia* community was a tall-grass type which occurred on the lower, flatter portions of the landscape (fig. 89). Important codominant species include *Holcus lanatus, Poa ampla, Juncus* spp., *Danthonia californica,* and *Bromus japonicus.* In slight depressions *Hordeum brachyantherum, Beckmannia syzigachne,* and *Alopecurus geniculatus* become more important. *Camassia quamash, Montia linearis,* and *Eleocharis acicularis* dominated the swales. The shrub thicket community occupied central portions of distinctive hummocks within the prairie proper (fig. 89). *Crataegus douglasii, Amelanchier alnifolia, Rhamnus purshiana, Rhus diversiloba,* and *Symphoricarpos albus* were major associates of the *Rosa.* Shrub cover was typically 60 to 90 percent. Certain species of tall forbs such as *Sidalcea campestris* were sometimes conspicuous in shrub thickets. The *Poa-Agrostis* community was of shorter stature than the *Deschampsia* type and, as mentioned, was often located in the ecotones between tall grass and shrub communities (fig. 89) or within openings in the shrub type. *Danthonia californica, Festuca pratensis, Carex* spp., *Geranium dissectum,* and *Aster chilensis* were other significant species in the *Poa-Agrostis* type. *Fraxinus latifolia* and other shrubs or trees appear to have invaded the *Poa-Agrostis* type much more aggressively than the *Deschampsia* type; *Fraxinus latifolia* did occur in each of the communities, however, suggesting a potentially forested climax in the absence of fire.

Turner (1969) was the only investigator who examined community composition on several sites. *Elymus caput-medusae* and *Danthonia californica* were generally the dominants on his study sites. At one location, Turner thought there might be three grassland types: *Festuca rubra*-dominated on the most mesic habitat, *Stipa occidentalis* var. *minor*-dominated on the most xeric, and *Danthonia californica*-dominated on the intermediate habitat. From his descriptions, we would judge that several of the native perennial grasses have considerable ability to resist grazing pressure and persist even though alien annuals are the most widespread dominants.

Livingston (1953) provided a short list of grasses for *Quercus* savanna used as unimproved pasture: *Melica geyeri, Dactylis glomerata, Poa compressa, Lolium perenne, Bromus mollis, Festuca myuros,* and *Cynosurus echinatus.*

The successional status of valley grasslands is little known. Johannessen et al. (1971) clearly feel that the vast majority, if not all, of the prairies are potentially forested if fire and other disturbances are eliminated. Moir and Mika (see footnote 2) found trees (*Fraxinus latifolia*) and tall shrubs in their prairie communities. Scattered bushes of *Rosa eglanteria* and *Rhus diversiloba* are found in many grasslands (fig. 90) and can become dominant over parts of pastures. Sprague and Hansen (1946) describe invasion of some grasslands by *Quercus* spp. It is our belief that most Willamette valley grasslands are seral communities created and maintained by fire or other human influences. Successional rates vary widely, however, and are probably much slower on some of the poorly drained, heavy floodplain soils than on better drained sites. Furthermore, other habitats appear to be climax grassland sites including some with relatively deep fine-textured, self-mulching soils (Grumusols) as well as xeric lithosolic sites. Both conditions are often noted as grass balds on valley hillsides.

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[2] William Moir and Peter Mika. Prairie vegetation of the Willamette valley, Benton County, Oregon. Unpublished report on file at USDA Forest Service Forestry Sciences Laboratory, Corvallis, Oregon. 1972.

Figure 89.—Prairie communities in the floodplain of the Willamette valley (Willamette Floodplain Research Natural Area, William L. Finley National Wildlife Refuge, Corvallis, Oregon). Left: Shrub thickets dominated by *Rosa eglanteria* and *Poa pratensis-Agrostis* spp. community which is often ecotonal between the thickets on raised topography and *Deschampsia* community. Right: *Deschampsia caespitosa* community, typical of lower lying areas with seasonally wet soils.

Figure 90.—Grasslands are sometimes invaded by *Rosa eglanteria* or *Rhus diversiloba* in the Interior Valley Zone; *Rosa eglanteria* is common in this annual grassland dominated by *Bromus mollis*, *Cynosurus echinatus*, *Lolium perenne*, and *Daucus carota* (*photo courtesy Range Management, Oregon State University*).

ESTABLISHMENT OF NATIVE VEGETATION
AT ST. JOHNS LANDFILL

Experimental Test Plot Monitoring

[TASK 10: 1999 Annual Report]

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BACKGROUND: 1997-1998 EXPERIMENTAL PLOTS
The 1997-98 test plots were prepared during fall 1997 and spring 1998, and seeded in fall 1998. Experimental treatments applied in fall 1998 included:

Two seed mixtures:

1. Grasses only [California brome (*Bromus carinatus*) plus blue wild-rye (*Elymus glaucus*)]
2. Grasses (brome + wild-rye) plus Spanish clover (*Lotus purshianus*).

Two mycorrhizal treatments:

1. added mycorrhizal inoculum
2. no added mycorrhizal inoculum.

The combination of two seed treatments and two mycorrhizal treatments can be described as four separate experimental treatments:

1. Grass only (G)
2. Grass + legume (GL)
3. Grass + mycorrhizal inoculum (GM)
4. Grass + legume + mycorrhizal inoculum (GLM)

These four treatments were applied to three separate test plot locations (SA2, SA3N, and SA3S) in a strip-plot design.

VEGETATION COVER ANALYSIS: 1997-1998 EXPERIMENTAL PLOTS
Methods- Quantitative monitoring of vegetation cover in the 1997-98 test plots was designed to answer the question, "Which of the experimental treatments provides the best growth of native or native-dominant vegetation during the 5-year contract period?" Quantitative monitoring of vegetation in the test plots was conducted on July 16, 1999.

Despite good equipment performance, error-free planting, and successful application of mycorrhizal inoculum in fall 1998, establishment of seeded species (*Bromus carinatus, Elymus glaucus,* and *Lotus purshianus*) was very low in the test plots during 1998-99 (see **Results** below). Given the scarcity of the seeded species, we chose to sample observation areas of approximately 10 square meters rather than the 1 sq m quadrats originally planned. This maximized the chances of detecting any of the seeded species within the observation areas.

Four roughly circular 10 sq m observation areas were located within each subplot, spaced evenly along a line bisecting the subplot lengthwise. These four observation areas produced a total sampling area of approximately 10% of the subplot area, compared to less than 0.5% of each subplot that would have been sampled using 1 sq m quadrats. Within each 10 sq m observation area, we recorded percent cover for all plant species present at higher than 5% cover.

Results- Quantitative monitoring of vegetation cover in July 1999 showed no significant difference (p>10%) in cover of native vegetation among the experimental treatments. In addition, there was no significant difference (p>10%) in cover of native vegetation among the three experimental plot locations (SA2, SA3N, SA3S).

The most common species in the test plots was perennial ryegrass, *Lolium perenne* -- the same species that had been dominant in the test plot areas before initiation of the experiment (see **Discussion** below). Cover of *Lolium perenne* averaged 66%, and did not differ significantly between locations or experimental treatments (p>10%). Several species of clover (*Trifolium dubium*, *Trifolium repens*, and *Trifolium subterraneum*) were common in the plots. Since it was difficult to distinguish between some of the *Trifolium* species due to plant senescence, cover of *Trifolium* species was analyzed for the genus as a whole rather than for individual species. Cover of *Trifolium* species averaged 11% and did not differ significantly between locations or experimental treatments.

Cover of seeded species (*Bromus carinatus*, *Elymus glaucus*, and *Lotus purshianus*) was very low. *Bromus carinatus* was not detected in any of the subplots. *Elymus glaucus* was detected in 45 of the 144 observation areas, but average cover was under 1% for every subplot. Individual *Elymus glaucus* plants were small and spindly, and were difficult to detect due to lack of seedheads (see **Discussion** below). *Lotus purshianus* was observed in only 10 of the 144 observation areas, and had average cover of less than 1% for every subplot.

Discussion- Herbicide applications during 1997-1998 did not effectively control *Lolium perenne*. Observation of test plots in fall 1997 and spring 1998 showed that each application of Roundup© herbicide killed most of the established ryegrass plants. But, a thick stand of new ryegrass plants sprouted because Roundup© does not have the residual soil activity necessary to control soil seedbanks.

Vigorous growth of *Lolium perenne* in the testplots may have prevented establishment of the seeded native species by shading the soil surface (light is necessary for germination of many seeds). In addition, individuals of the seeded species that did successfully germinate may have been killed by competition from the dense ryegrass sward. The *Elymus glaucus* plants that were observed were small, poorly tillered, and etiolated. This supports the idea that competition from ryegrass greatly affected the native plantings.

Despite low percent cover, the frequency of *Elymus glaucus* (present in 45 of 144 observation areas) shows that it established more successfully than *Bromus carinatus* in the test plots. It is possible that over several years, *Elymus glaucus* may become more prominent within the experimental plots. *Elymus glaucus* is present (though not dominant) on other portions of the landfill (see **Summer 1998 Vegetation Survey**, in the Appendices to the November 1998 report). Its presence increases the diversity of the perennial grass community, and may improve the resilience of the grass community over the years to come.

Quantitative monitoring of *Elymus glaucus* cover was made more difficult by the small size of the *Elymus glaucus* plants in the test plots, and by their lack of seedheads. Close observation of the plots showed that seed heads were present only on *Elymus glaucus* stems that were prostrate. These head-bearing stems appeared to have been knocked down or crushed -- possibly during the mowing conducted in spring 1999. It seems likely that many more seed heads of *Elymus glaucus* were present during mowing, but were removed by the mower blades. Since grasses receive a large part of their photosynthate from the leaves of the flowering stems, the mowing not only made *E. glaucus* harder to identify, but may also have reduced their vigor. Unfortunately, the best time of mowing to control the height of Lolium is not always the optimal time for native grasses. In the future, timing of mowing should be carefully planned in relation to the timing of seedhead development of native grasses.

Other factors besides heavy growth of *Lolium perenne* may have caused the poor establishment and low cover of seeded native species. Soil physical testing during 1998 showed soil characteristics that are very challenging for establishment of native species [see **Winter 1998 Soil Testing** in the Appendices to the November 1998 Final Report]. Soils on the test plots have surface layers of clay and sand that are poorly mixed, resulting in highly variable infiltration rates ranging from 0.5 cm/hr (poorly-drained) to over 150 cm/hr (excessively drained). Low infiltration rates can result in saturated surface soils, creating anaerobic conditions that prevent germination or kill new seedlings. High infiltration rates can produce droughty conditions that kill young plants during early summer, particularly if those plants have already been stressed by anaerobic conditions during the previous winter.

Table 1. Percent cover of dominant and seeded plant species in 97-98 experimental plots, measured in July 1999. NOTE: Differences in percent cover between treatments and locations were not significant.

		Treatment				
Location	Species	grass only	grass + legume	grass + legume + mycorrhizae	grass + mycorrhizae	mean % cover
SA2	*Lolium perenne*	71.25	73.75	63.33	51.67	65.00
	Trifolium spp.	14.58	16.17	18.33	22.08	17.79
	Elymus glaucus	0.20	0.18	0.00	0.29	0.17
	Lotus purshianus	0.00	0.02	0.00	0.25	0.07
SA3N	*Lolium perenne*	79.58	71.67	72.50	58.75	70.63
	Trifolium spp.	0.42	0.00	0.00	1.25	0.42
	Elymus glaucus	0.08	0.29	0.08	0.61	0.27
	Lotus purshianus	0.03	0.01	0.01	0.01	0.01
SA3S	*Lolium perenne*	54.17	62.08	67.08	68.33	62.92
	Trifolium spp.	22.08	16.25	5.83	12.08	14.06
	Elymus glaucus	0.00	0.00	0.00	0.00	0.00
	Lotus purshianus	0.00	0.00	0.00	0.01	0.00
ALL LOCATIONS	*Lolium perenne*	68.33	69.17	67.64	59.58	66.18
	Trifolium spp.	12.36	10.81	8.06	11.81	10.76
	Elymus glaucus	0.09	0.16	0.03	0.30	0.15
	Lotus purshianus	0.01	0.01	0.00	0.09	0.03

RECOMMENDATIONS FOR LONG TERM VEGETATION MANAGEMENT

A total of twelve native grass testplots were established at SJL between 1992 and 1998. Although the only testplot series scientifically replicated was in 1998, viable stands of native grasses have not been able to be successfully established on any of the testplots for longer than one year. The influence of a *Lolium* dominated soil seedbank and the degradation of physical soil characteristics are thought to be the primary causes of this failure to establish natives. [See the **Discussion** above and **Winter 1998 Soil Testing** in the Appendices to the November 1998 Final Report]. The potential significance of the *Lolium* contamination of the SJL soil seedbanks has been known since native vegetation establishment activities began in 1992. In the 1980's, during temporary closure work, *Lolium perenne* "Manhattan" (perennial ryegrass), and *Agrostis* spp. (bentgrass) were seeded throughout the areas subject to final closure. These soils (and sod and seedbank) were then recycled when final closure work was initiated in 1992. The following spring ryegrass was the primary component in all "closed" areas of SJL. In June of 1994, the Oregon State University Seedlab conducted analyses on 6 soil samples taken from Subareas 1 & 2 to determine soil-seedbank composition. In each 1 pound soil sample, the Seedlab identified between 22 and 67 viable *Lolium* seeds. As of December 1999, all former SJL testplot locations are again primarily composed of ryegrass which, in all likelihood, has germinated from the soil-seedbank.

Based on the results of 7 years of testing, the WBW Project Team makes the following recommendations for the establishment of vegetation at SJL:

- Concentrate on replanting the riparian woodland/wetland around the edges of the landfill. Consider closing or narrowing Road E in order to provide additional planting area. Beaver/nutria protection fencing will be required.
- Determine, through experimental plantings, whether native woody shrub/arborescent tree plant communities can be established in certain SJL locations where the topsoil is deepest. [Soil depths should be =/> 12".] Deer protection fencing will be required.
- Finally, in areas where soil depths are less than 12", manage [e.g. fertilize, lime and mow] the existing ryegrass as waterfowl feeding areas. Alternatively, seed with non-native fescues such as: F. longifolia (hard fescue) or F. commutata (chewings fescue).