Included in RFP 97R-9-REM Establishment of Native Vegetation At SJL

NATIVE VEGETATION

FOR

ST. JOHNS LANDFILL

1997

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INTRODUCTION

Metro, which is responsible for managing all aspects of solid waste disposal in the Portland metropolitan area, owns the half-century old St. Johns landfill (Fig. 1). In l996 Metro finished the construction of a multi-layered cover system with associated gas and stormwater collection systems. The cover system prevents rain from entering the solid waste and producing leachate which can contaminate the environment. Vegetation is an important component of this cover system because it presents erosion. This document addresses the use of native vegetation not only to prevent erosion, but to provide other values.

REGULATORY FRAMEWORK

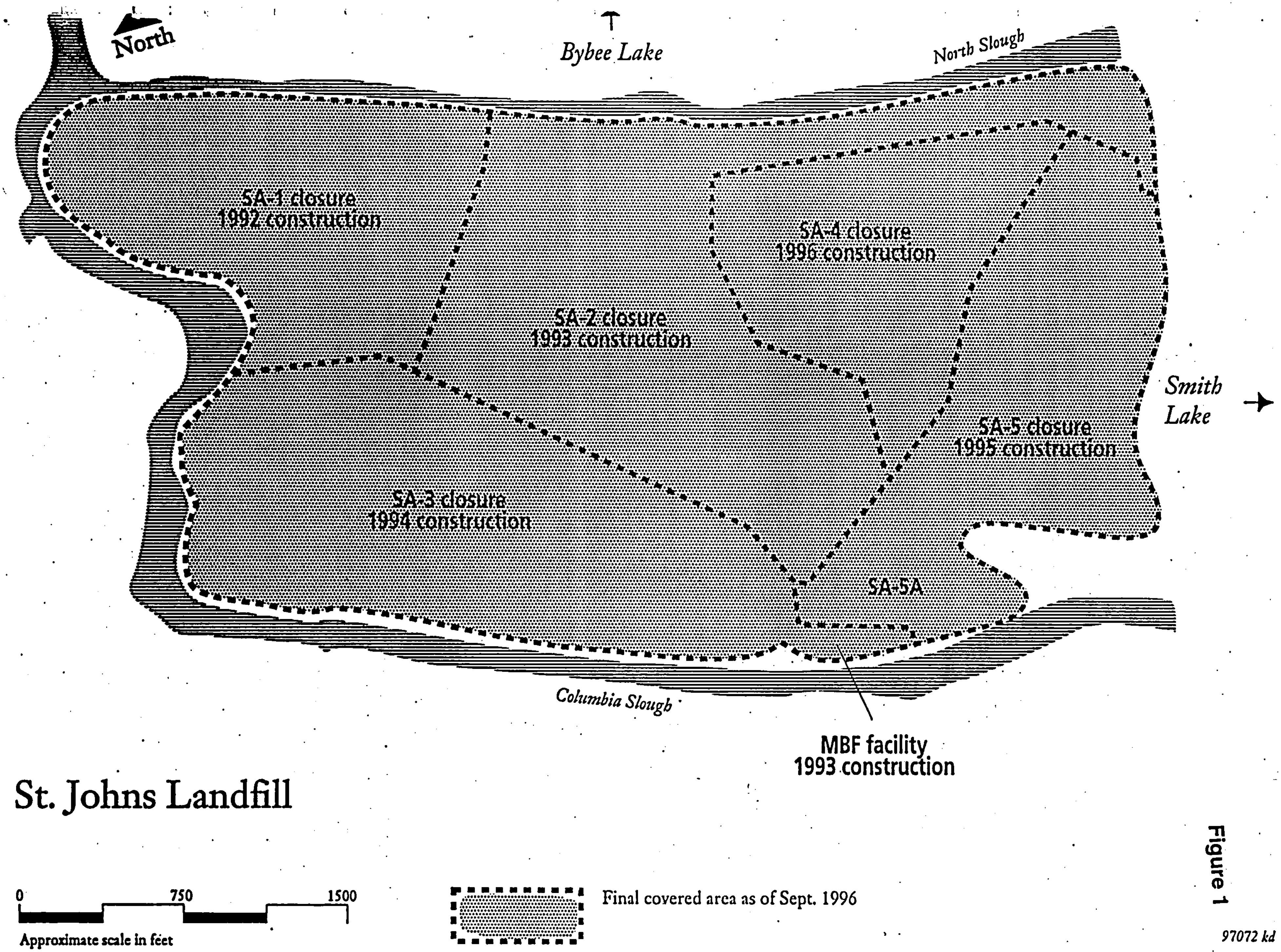
The Oregon Department of Environmental Quality (DEQ) regulates the St. Johns Landfill under several permits including Solid Waste Site Closure Permit No. 119, NPDES Stormwater Permit 1200-G, and an Air Contaminant Discharge Permit which regulates emissions from the gas flares.

Under authority of the Solid Waste Site Closure Permit, DEQ reviewed and approved the improved cover system design and the contract plans and specifications governing construction. Schedule E, condition 2 of the amended Closure Permit states,

> "in accordance with a DEQ approved closure plan, the permittee shall maintain the final surface contours of the disposal site so that rainfall is shed without creating either erosion or ponded water and so that all waste remains covered in accordance with the approved plans. The permittee shall refill with approved soil, grade, and seed all areas that have settled or where water ponds and all areas where the cover soil has been damaged by cracking or erosion. Areas where vegetation has not been fully established shall be fertilized, re-seeded, and maintained."

Schedule E, Condition 3 states, "the permittee shall establish and maintain suitable vegetation over the closed areas of the disposal site consistent with the proposed final use."

Another DEQ permit relevant to the vegetative cover is the NPDES general storm water discharge permit for all landfills including St. Johns Landfill. This permit requires the permittee to develop and follow a stormwater pollution control plan and to monitor stormwater for substances such as nutrients and hazardous materials.



St. Johns Landfill

Figure 1

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Metro's stormwater pollution control plan describes the drainage system for St. Johns Landfill and discusses various stormwater management methods including preventive maintenance such as seeding and planting, mulching and matting. In areas that experience erosion, the area will need to be regraded (if appropriate) and reseeded. Mulching and matting can be used to augment vegetation where erosion is taking place. The plan gives best management practices for temporary seeding and permanent seeding. For permanent seeding the plan specifies a dwarf grass mix (80% Elka Dwarf Perennial Ryegrass, 20% Creeping Red Fescue @ 100 lbs. per year minimum) and a standard height grass mix (40% Annual Ryegrass, 60% Turf-type Fescue @ 100 lbs. per acre minimum.)

The I990 City of Portland Natural Resources Management Plan for Smith and Bybee Lakes adopted by Metro and the Port of Portland, also regulates St. Johns landfill. The goal statement says that Smith and Bybee Lakes, will be maintained and enhanced, to the extent possible, in a manner that is faithful to their original natural condition. Smith Lake and adjacent uplands (presumably including the landfill) will be the principal location for recreational activities.

Objectives directly relevant to vegetation include:

> "Provide for and maintain habitat diversity representative of the lower Columbia River floodplain wetlands."
>
> "Implement a monitoring program to assure early detection of potential environmental problems, and to quantify management programs."
>
> "Develop upland areas in a manner which is compatible with the preservation of the wetlands and use of the lakes for passive recreation."

Upland habitat types within the Smith and Bybee lakes natural area include grassland, riparian woods, and woodlands. The plan points out that degradation of certain habitats has occurred from various activities. It recommends that program plans for restoring or enhancing habitats "consistent with other Management Plan elements (*i.e.* landfill closure, Rivergate filling, water level control structure changes, etc.); initiate restoration and enhancement plans that are appropriate."

Policy 14 of the Plan is the policy most relevant to the type of vegetation on St. Johns Landfill. It states that "the primary use of the landfill site (north of the slough) shall be open meadow habitat, which is complimentary to the wetland habitat in the balance of the Smith-Bybee area."

St. Johns landfill is designated as a special management area in the plan. The goal within the area is to reduce or eliminate unwanted impacts to adjoining higher quality resources (*e.g.*, riparian strips). Objectives include "develop and manage as a complimentary habitat such as a meadow habitat for ground nesting or raptor nesting areas;" "take active steps to reduce or eliminate, escape and establishment of invasive non-native vegetation;" and "employ management practices that have the least negative impact practicable on adjoining resource areas."

The Smith and Bybee Lakes Management Committee advises the Metro Council about carrying out the plan. In October 1991 this committee noted that the safe closure of the landfill is the highest priority. The Committee wished to provide policy guidance where needed and not interfere with operations which have clearly established policies. The committee recommended: 1.) the establishment and maintenance of "a vegetative cover is a critical component to the successful closure of the landfill; 2.) a cost-effective strategy for establishing permanent native plant communities that provide wildlife habitat and scenic values should be developed for the landfill.

Another policy which can affect the establishment of vegetation of St. Johns Landfill is Metro's Alternatives to Pesticides Policy (Executive Order No. 60). The purpose of this policy is to lessen the environmental impact of Metro's landscape practices by reducing reliance on pesticides/herbicides, to serve as a model for others, and to reduce hazardous wastes.

It directs Metro to manage pests that occur at its facilities using integrated pest management principles. For example, complete pest eradication is not possible but it is possible to modify the site to reduce pests. Control measures would be used when the pest population reaches a size which causes a significant risk of damage. Control measures should be based on the use of the site, the threat of the pest, the impact of the control measure on the long term occurrence of the pest, and the environmental, economic, and sociological impacts. It directs that an Integrated Pest Management Coordinator be appointed to prepare and implement a Pest Management Plan which conforms to certain criteria.

VEGETATION ON THE ST. JOHNS LANDFILL COVER - 1980s

An intact vegetative cover promotes infiltration during rain events and holds soil particles in place thus reducing the quantity and sediment load of stormwater runoff and the quantity of windblown dust. A good vegetative cover removes water from the landfill cover soil during the growing season thus reducing the total quantity of water moving downward toward the solid waste. Thus, an intact vegetative cover was an important component of the cover system when Metro began to cover the St. Johns Landfill in l981.

The Contract Documents for the Operation of St. Johns Landfill, May l980 and June 1985, specified that the following seeds used at 50 lb. per acre to establish vegetation on the topsoil layer of St. Johns Landfill: pennfine perennial ryegrass, common (annual) ryegrass, Astoria colonial bentgrass, highland bentgrass, cascade birdsfoot trefoil, New Zealand white clover, climax Timothy, chewing fescue.

The landfill cover material upon which the seed was spread was a 2 foot thickness of a low permeability silt or clay soil. Digested sewage sludge and final cover material were mixed on the surface in a ratio of 10% sludge, 90% cover soil. The mixture was rototilled, raked, and compacted to form the top six inches of the final cover. The above seed mix was applied by hydroseeding with fertilizer (20% N, 10% phosphoric acid, 5% potash @ 400 lb., acre) and fiber mulch. Maintenance consisted of mowing to a height of 6 inches when the height of the plants exceeded 18 inches.

VEGETATION ON THE IMPROVED FINAL COVER SYSTEM OF ST. JOHNS LANDFILL

In 1989 Metro issued a Revised Closure and Financial Assurance Plan for St. Johns Landfill. The centerpiece of this plan was the construction of an improved, multilayered final cover system to virtually eliminate any infiltration of rainwater through the cover into the solid waste. This final cover system consisted (from surface downward) of: A topsoil layer planted with vegetation to reduce erosion (see Fig. 2 for actual topsoil thicknesses), a 12 to 18 inch drainage layer of sand, a composite of a plastic fiber blanket and a grid to assist in drainage, a polyethylene geomembrane about the thickness of an LP record (40 mil) to serve as a barrier to rainwater, and a one foot layer of compacted low permeability soil to serve as a second barrier to water. Associated with this cover system were a network of ditches, flumes, and culverts to collect stormwater.

(see Fig. 3) to minimize erosion, and a gas collection system consisting of numerous wells connected to a network of surface plastic pipes on the ground surface which transported the gas to a facility (near the landfill bridge) where it is burned to minimize air pollution. The pipes were not buried so that they could be adjusted to drain properly as the landfill settled unevenly.

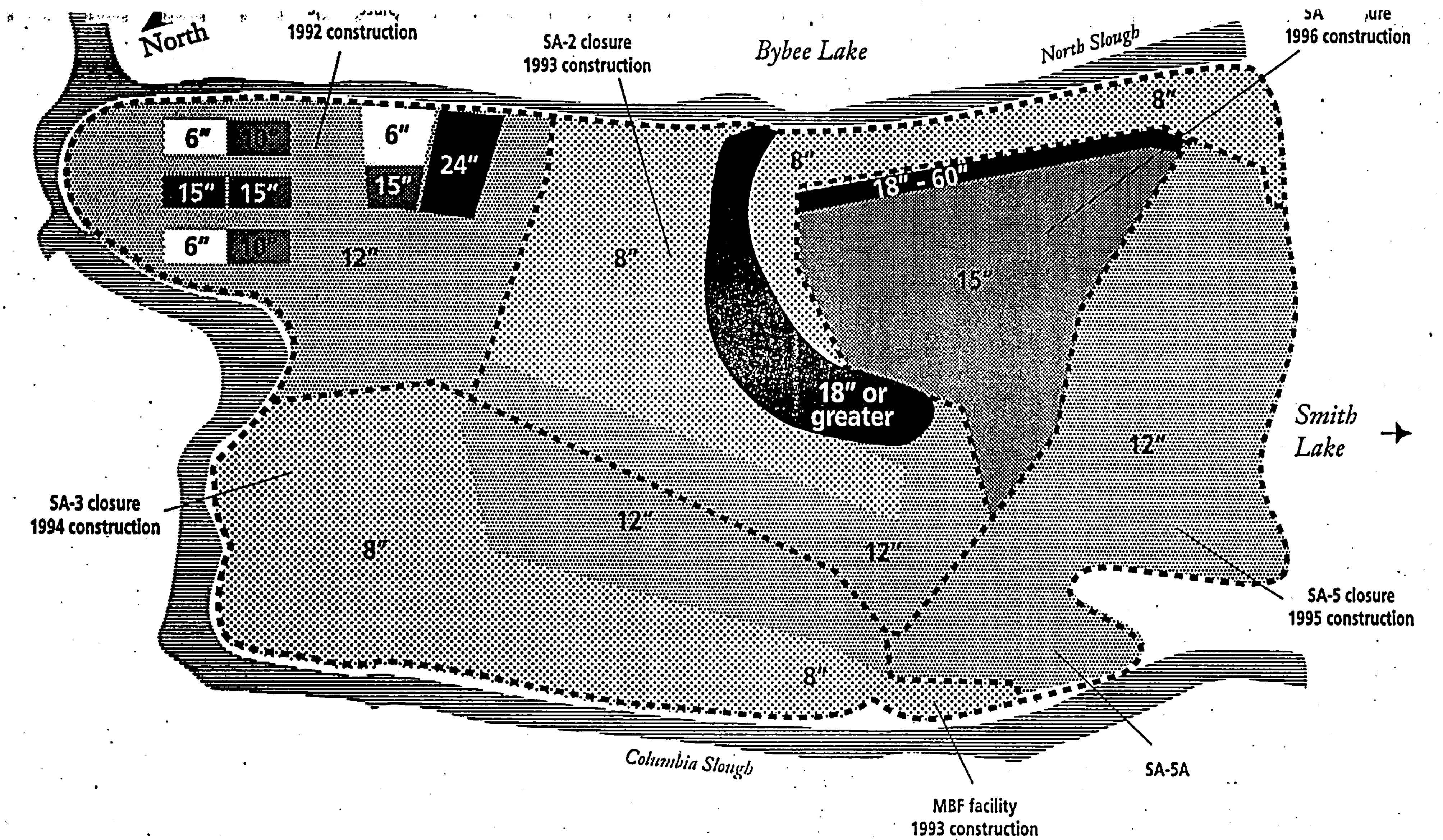
Vegetation on this cover system must exist under conditions unusual for this area. Topsoil averages one foot but is underlain with a permeable sand subsoil which is designed to drain away water as quickly as possible. There is a barrier at 2 feet to
2.5 feet below the surface which stops root penetration and any upward movement of moisture from deeper areas. Heat from solid waste decomposition may radiate upward through the cover layers.

The vegetation may affect the cover system in various ways. Evapotranspiration will remove water from the layers above the geomembrane during part of the year. The soil holding and mulching effect of the vegetation protects against soil erosion. The roots of some types of vegetation might penetrate the geomembrane reducing its effectiveness as a moisture barrier. Burrowing animals attracted by the vegetation may damage the geomembrane. Vegetation roots may clog the drainage layer of sand or the drainage grid causing large sections of the cover layers to slide off the geomembrane on steep slopes due to excessive water retention.

The designers of the cover system attempted to take these factors into account as well as Metro's desire to minimize costs and to use recycled material including topsoil as much as feasible.

Because there was insufficient existing topsoil, topsoil was also imported. Imported topsoil was initially specified as 50% mature, stable compost mixed with 50% of organic surface soil obtained at a depth of 10 inches or less. This specification was later modified as discussed below.

After consulting with a representative of the U.S. Soil Conservation Service, the designers specified "Mecklanberger" sheep fescue and "Manhattan" perennial ryegrass as the vegetation to be used on the cover applied by hydroseeding. They avoided the use of the legume white clover because the SCS representative believed that it might attract burrowing rodents or mammals which might damage the drainage net or membrane. Fertilizer was to be determined after nutrient tests of the topsoil. Seed was to be applied in early fall.



St. Johns Landfill – Topsoil depths

0 750 1500
Approximate scale in feet

Figure 2

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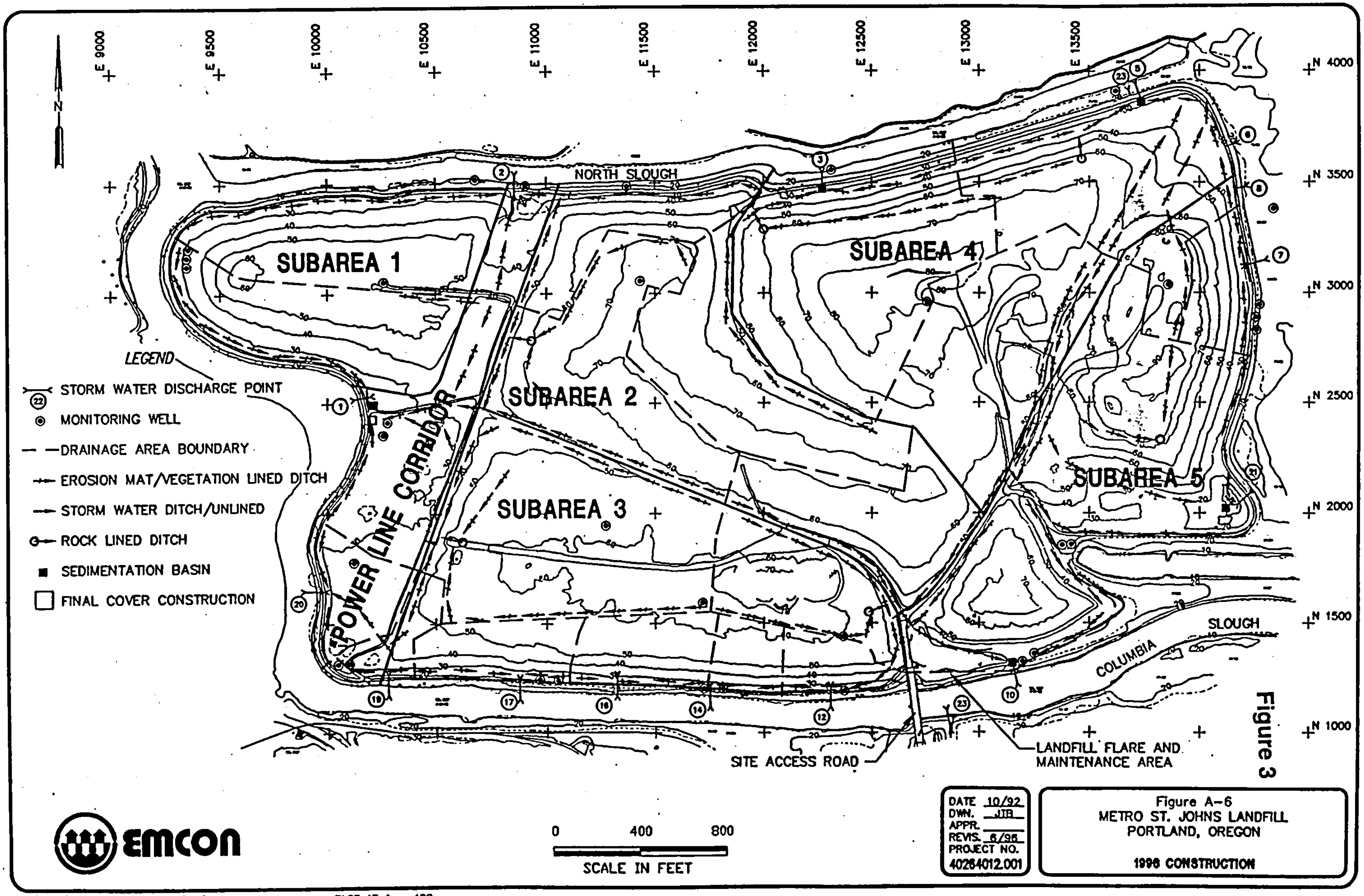

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SUBAREA 2
SUBAREA 3
SUBAREA 4
SUBAREA 5
POWER LINE CORRIDOR
COLUMBIA
SLOUGH
SITE ACCESS ROAD
LANDFILL FLARE AND MAINTENANCE AREA
LEGEND
STORM WATER DISCHARGE POINT
MONITORING WELL
DRAINAGE AREA BOUNDARY
EROSION MAT/VEGETATION LINED DITCH
STORM WATER DITCH/UNLINED
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REVIS. 6/96
PROJECT NO. 40264012.001
Figure A-6
METRO ST. JOHNS LANDFILL
PORTLAND, OREGON
1996 CONSTRUCTION

Figure 3

A VEGETATION PLAN FOR ST. JOHNS LANDFILL

After reviewing the construction specifications and receiving the recommendations of the Smith and Bybee Lakes Management Committee, Metro decided to hire environmental consultants to develop a vegetation plan for St. Johns Landfill which would include a landfill cover consistent with the closure plan but also be hospitable to a wider diversity of plants than was specified above. The vegetation plan was to conform to the following criteria in order of decreasing priority:

1. Protects Cover System. Vegetation cover should minimize erosion and not threaten the integrity of the membrane cap. Plant roots in the landfill cover shall not interfere with drainage net functions including minimizing the risk of landslides of cover layers above the geomembrane. The root systems of selected plants shall not allow perforation of the geomembrane nor shall the plants provide habitat for burrowing animals that may endanger the integrity of the cover system.
2. Cost effectiveness. Cost assessments should consider long-term maintenance as well as establishment cost.
3. Minimize Maintenance. A stable diverse native plant community will likely require less maintenance than a grass monoculture and provide flexibility in meeting changing environmental conditions.
4. Habitat Enhancement. Increasing habitat values on the landfill (for non -burrowing animals) can provide food and habitat for indigenous wildlife for the adjacent lakes and wetlands.
5. Aesthetics. Scenic values can be enhanced on the landfill while reducing the need for fencing and screening.

The 1992 St. Johns Landfill Cover Vegetation Plan (Fishman, Wilson, et al) proposed the planting of two primary plant communities for the capped area: An open prairie and drainages planted to shrubby hedgerows (rose, snowberry, etc.). There were two types of proposed prairies specified for seeding according to landscape position [catina]: mesic on ridgetops and drainages and xeric on side slopes. The hedgerow shrubs were proposed for planting in the drainages with deeper soil profiles after suitable drainages were seeded with mesic prairie species. The Sub-Area 1 shrub testplots were planted to identify the minimal soil depth and ground moisture requirements needed to support woody vegetation. The 1992 SJL Cover Vegetation Plan also proposed the planting of bioswales and restoration of existing riparian woodlands adjacent to the Columbia Slough and Smith & Bybee Lakes. See cover drawing (and inside cover explanation) of the plan (1992) and page 2 for specific language.

The plan provided specifics for the installation and management of the major plant communities. This included soil preparation, seeding/planting methods, acquisition of native plants, and propagation methods if a plant nursery is established on site.

Also, the vegetation plan called for a catina approach to landscape development. The thickness of the top soil would vary with the landscape position on a slope as it does in a natural setting (*i. e.,* the topsoil would be thicker at the bottom of the slope and the topsoil would be thinner on the side of a slope)

Native and non-native vegetation was compared relative to installation costs, erosion control value, and ecological parameters. Cost estimates indicated that native plants were more costly to establish but resulted in a lower total long term (30 year) cost because they require less maintenance after stabilization.

A separate section of the report provided for test plots on Sub-Area one (whose cover was currently under construction). An experimental design was described in detail and developed as construction specifications including soil construction, planting methods and proposed plant materials. The use of test plots recognized that there was no previous experience with native vegetation under these exact conditions.

NATIVE VEGETATION ESTABLISHMENT EFFORTS

1992 and 1993 Efforts

To oversee the installation and initial management of the vegetation test plots on Sub-Area one, Metro retained the team of environmental consultants who developed the vegetation plan. The vegetation test plots were planted in September l992 by the contractor constructing the improved cover system on Sub-Area one.

The experimental activities in the test plots were ambitious. The plots were set up to test four soil preparation variations, dual stage hydroseeding versus broadcast track hydroseeding , and mesic prairie versus xeric prairie (both native grasses and forbs) plant communities. The soil variation test plots covered about 30 acres, most of the Sub-Area one construction area. The plots which tested vegetation variation covered about two acres.

The Fishman Plan (1992) specified that soil containing "no weed or crop seeds" be used for the establishment of the initial prairie testplots on Sub-Area 1, but project economics and construction deadlines prevented its acquisition and use. Soil seedbank tests, taken after soil placement, determined that the imported soils, the recycled soils and the compost all contained huge quantities of non-native grasses and pest plant seedbanks.

As recommended by the consultants the genetically sterile hybrid wheat x wheatgrass (trade name Regreen) was planted at 25 pounds per acre over the entire construction area. In areas not seeded with native plants the sterile wheatgrass was expected (aided by inorganic fertilizer) to establish itself quickly to reduce soil erosion during the rainy season and out-compete non native vegetation. Since it was sterile it would not reproduce itself and would die off after its one or two year life span. Areas with this "nurse crop" could then be planted with native plants. For the same erosion control and competitor suppression reasons Regreen was also planted in the test plots containing the native vegetation.

It was initially thought that the seeding of a mix of native and non-native grasses in the vegetation variation testplots would, in a short time result in a largely native stand. It did not due to the aggressiveness of Regreen and non-native grasses and pest plants in the seedbank, shading out of natives, an extremely wet spring and the resultant delays in management.

However, non native grasses such as Lolium sp. (Rye) and other non-native plants such as Vicia sp. (vetch) established themselves in quantity, presumably from the seed bank present in the recycled and imported cover soil. These plants took over all of Sub-Area one and completely replaced the sterile wheat grass as it died out. This provided effective erosion control in Sub-Area one. However, only isolated individual native plants established themselves. A November l995 inspection revealed that these were Elymus glaucus, yarrow, and a few small bunches of Festuca idahoensis. It was noted that the high uncut grass in the woody shrub transects was rich in Elymus glaucus.

Also, during the winter dormant period in early l993, two transects on Sub-Area one were planted with the woody shrubs Rosa nutkana, Symphoricarpos albus, Amelanchier alnifolia, Salix scouleriana, Sambucus cerulea as a hedgerow plant community. These transects extended up the east and northeast slopes from a swale to nearly the highest point of Sub-Area one. Their purpose was to test the ability of these plants to establish themselves after being planted as cuttings or as potted plants in various microclimates and soil depths. The plants were watered using drip irrigation during the dry seasons of l993 and l994 to assist in establishment. Attempts were made cut back competing vegetation during the growing season of l993.

In the woody plant transects there appeared to be good survival of Rosa nutkana, Salix scouleriana, and Symphoricarpos albus during an inspection in November l995. In June l996 an inspection report noted that there were a few Rosa nutkana and Symphoricarpos albus plants remaining but they had been heavily eaten by deer or the herd of sheep which was allowed to graze on Sub-Area one and adjoining Sub-Areas from late April l996 to July l996.

In early l993, Metro signed a contract to cover Sub-Area 2 and 3 during the construction seasons of 1993 and 1994 respectively. A specialist in grassland restoration from the Fishman team, was retained to advise the Metro engineer and construction manager concerning contract language and construction management related to topsoil quality and vegetation establishment. He continued to assist Metro concerning test plots and Sub-Area 4 and 5 construction.

This specialist recommended that only Regreen be planted (at 50 pounds per acre) for initial erosion control until the success of vegetating the test plots in Sub-Area one could be assessed. In light of the vigorous growth of the non native seed bank in the topsoil, the specialist recommended low fertility soil, including subsoils, to inhibit the growth of non-native plants. This was initially recommended in the 1992 vegetation plan.

During the fall of 1993 there was unusually dry weather from October through November ending with a freeze in late November. This was followed by torrential rains in December. This resulted in a significant erosion where erosion gullies extended through the topsoil layer and the sand layer of one portion of Sub-Area two. Fortunately, nearly all of this soil ended up (and deepened the soil profile) in the curved swale between Sub-Area 2 and 4 (see Fig. l and 2) or was caught by the sediment pond downstream of this swale.

The primary cause of this erosion is in dispute but it resulted from the cumulative effect of factors such as late seeding in mid October, lack of significant rain after seeding, the continued use of vehicles on the cover by the construction contractor, the use of poor quality, non specification topsoil to favor the slower growing native plants, and the torrential rains during the cold period after plant growth had stopped. This erosion event sensitized Metro staff to the risk of erosion posed by all of these factors.

1994 Test Plots

A series of testplots were set up in 1994 to determine the best means of preparing areas for the planting of native grasses (Testplots 1A, 1B through 4) and to determine the best methods of managing the remaining areas of the landfill grasslands slated to eventually be planted to native vegetation (Testplots 5A and 5B). Additionally, two "no management" plots (Testplots 6 in Sub-Areas 1 and 2) were established to serve as controls. Detailed methods and results are described in Appendix 1.

1995 Test Plot

During the construction of the cover on Sub-Area 5, a the native grass, Elymus glaucus was planted in October l995 in a 150 by 300 foot test plot on the top of Sub-Area 5 between gas wells W-46 and W-45. Elymus glaucus was planted at 30 pounds per acre with about 100 pounds per acre added fertilizer. The purpose was to determine how well this grass, native to the Northwest, would establish itself with no special steps taken to inhibit non-native plants in the imported soil (generally subsoil mixed with sewage sludge compost to 12%).

During an inspection of this test plot in June 1996 some of this native grass was seen along with a similar amount of rye. The grass was subject to significant loss due to grazing by wild geese early in l996. Unfortunately most of Sub-Area 5 including this test plot was mowed before the Elymus glaucus could set seed.

1996 Test Plots

During the construction season of 1996 Metro's contractor had the opportunity to obtain some soil (probably subsoil),originally contaminated with petroleum. This soil had been subjected to a temperature of several hundred degrees F. to remove the petroleum. Metro allowed the contractor to use this soil, mixed with sewage sludge compost at 12%, if its use as surface soil was approved by the Oregon Department of Environmental Quality and if it was stockpiled and spread separately from other imported soil. It was hoped that the high temperature treatment would destroy any seed bank in this soil and thus remove competitors to native grasses. In this soil, in September 1996, Bromus carinatus and Elymus glaucus were planted each at 15 pounds per acre with about 100 pounds per acre of fertilizer in Sub-Area 4 adjacent to the road between Sub-Area 4 and 5 and in certain areas of Sub-Area 5a. The planting method was harrow, broadcast, seed, harrow. As of early 1997 natives were growing in these plots but slower than elsewhere.

All native grasses used on all testplots planted before 1997 were supplied from sources and growers located outside the Willamette Valley. Poor results may occur when out of area seed is used for revegetation. During 1996, several Willamette Valley growers began supplying upland grass seed to the local market.

During the November l995 inspection it was noticed that several patches of volunteer willows and Juncus (rushes) were growing in the swale between Sub-Area 2 and Sub-Area 4 (curved line between Sub-Area 2 and 4 terminating by North Slough in Fig. 2). Because of the erosion problem in December l993 this swale had received a sediment load of mixed sand and silt. This resulted in a soil profile deeper than the original design soil profile.

These volunteer water loving plants suggested that the deeper soil profile and inherently moist swale conditions was especially favorable for various woody plants. Therefore, in early l996 willows were planted in patches. It was hoped that deer would browse plants mostly at the perimeter of each patch, saving those in the center.

COVER CONSTRUCTION 1993-1996

Sub-Area 2 (including the steep portion of Sub-Area 4 overlooking North Slough). About half of the topsoil was reused existing topsoil. Imported topsoil was sandy loam (greater than 10% clay, less than 50% sand). No compost was used in order to inhibit non-native plants. It was planted with Regreen at 20 pounds per acre with 50 pounds per acre of fertilizer in October l993.

Sub-Area 3. Approved imported soil from several locations was mixed with yard debris compost AT 25%. About half the topsoil used was existing topsoil (see Fig. 2) and planted with spring wheat at 100 pounds per acre with approved fertilizer in September l994.

Sub-Area 5 and portions of Sub-Area 5 A. Approved imported soil from several locations was mixed with sewage sludge compost at 12% (in a pug mill) and planted with spring wheat at 100 pounds per acre with approved fertilizer in September and October l995. About one acre was planted with the native grass, Elymus glaucus (see l995 test plot).

Sub-Area 4 and portions of Sub-Area 5A. Approved imported soil from several locations was mixed with sewage sludge compost at 25% compost and planted with spring wheat at 100 pounds per acre with approved fertilizer in September 1996. Several acres were planted with native plants (see 1996 test plot).

In 1997 sheep grazing and mowing will be used to manage the native and non-native grasslands. Native grassland plots will be managed to maintain a high cover of natives and maximize seed production and harvest. An integrated pest management plan will specify control measures for invasive and noxious weeds of concern at the St. Johns Landfill.

ST. JOHNS LANDFILL RIPARIAN AREA

As of l997 the multi-layered cover system generally terminated at the inside edge of the perimeter road around St. Johns landfill. The exception was the perimeter of Sub-Area 5a (no road) and the perimeter of Sub-Areas 4 and 5 where the membrane extended up to five feet into the perimeter road. Along most of its length the perimeter road itself consists of several feet of rock fill on top of the low permeability natural silt (Sub-Area 1, 2, and 3) and engineered dike (Sub-Area 4 and 5).

Outside this perimeter road is a steep bank leading to the tidally and seasonally fluctuating surface water of the Columbia Slough. This is a riparian area which is designated by the City of Portland as an environmentally sensitive zone. Most of the existing trees are Populus trichocarpa (black cottonwood) and Fraximus latifolia (Oregon ash) with a thick growth of pest plants such as Himalayan blackberry and Reed canary grass.

For this riparian area it is important to choose vegetation which grows rapidly to provide shade for the surrounding surface water and tolerates and removes contaminants migrating toward the surface water from the solid waste. Also, the vegetation provides riparian habitat values. Surrounding surface water, especially the Columbia Slough and its North Slough arm, is subject to dissolved oxygen and pH problems due to its nutrient and algae content and high summer temperature. These water quality problems (especially in North Slough) can be reduced if the slough is shaded by vegetation.

The groundwater model for St. Johns Landfill predicts that contaminants such as sodium, potassium, and ammonium salts migrate through the low permeable silt dike toward the surface water. Visible seeps indicate salt migration in some areas. Salt tolerant hydrophytes such as poplars are environmental protection aids because they slow migration by dewatering soil and take up nutrients such as ammonium. Plant roots stimulate microbial activity which may destroy certain contaminants. This new research area is called phytoremediation.

In l995 Metro contracted to have the pest plants mechanically removed along the south bank of the North Slough (see Fig. 1). In November l995 the EnviroCorps planted 1,100 potted plants in the bank from the road to the waterline. These plants were: Populus trichocarpa (black cottonwood), Fraxinus latifolia (Oregon ash), Acer macrophylum (big leaf maple), Alnus rubra (alder), Sambucus racemosa (red elderberry), Amelanchier alnifolia (serviceberry), Symphoricarpos albus (snowberry), Rosa nutkana (Nootka rose). Metro specified that at least 25% of the plants be poplars (in this case the native poplar black cottonwood).

As early as December 1995 there was abnormally high water. The flood of February l996 caused water to briefly cover the highest perimeter road. Water remained abnormally high into the summer. Thus, much of this newly planted vegetation did not survive. Under an agreement with Metro, the City of Portland planted this bank with the plants listed below during the winter of 1996-1997.

In March l996, in cooperation with Metro, the city of Portland mechanically removed pest vegetation and planted vegetation along the bank of the Blind Slough and Columbia Slough to its confluence with the North Slough arm. The vegetation planted was black cottonwood (40%) and grand fir, Douglas fir, Western red cedar, red alder, Oregon ash, pipers willow, other willows (Salix lasiandra, rigida, sitchensis), red elderberry, snowberry, black hawthorn, Indian plum, red ozier dogwood (60%). Under an agreement with Metro the city will replace non-viable vegetation and will continue to cut back pest plants in this area until 2000 AD. Under this agreement the city will also plant willows in two sand "fans" or bars east of the landfill bridge.

Finally, the forester for the city of Portland discovered that the presence of the sand cover layer without topsoil at the east end of Sub-Area 5A favored the growth of ash seedlings originating from the neighboring ash trees. Metro agreed to assist the city in setting up a nursery for these seedlings for use both on the landfill and along other areas of Columbia Slough. Metro agreed not to add topsoil to a one acre area for the time being and to supply irrigation water during the dry season.

INVASIVE NON-NATIVE PLANTS AND NOXIOUS WEEDS

Invasive non-native plants are plants are plants which colonize areas so aggressively that they threaten native plant species and/or the ecological features and processes at these areas. Some invasive exotics are listed as noxious weeds by the City of Portland and the Oregon Department of Agriculture.

The l992 vegetation plan lists plants which should be considered noxious weeds. These include Rubus discolor (Himalayan blackberry) which has long grown along the riparian area surrounding the landfill and Phalaris arundinacea (Reed canary grass) which is common throughout the Smith and Bybee lake wetland surrounding the landfill. The plan suggests a long term pest control program which: identifies pest plants by photo or live specimen, suggests methods of cultural, mechanical, and/or chemical control, and provides for staff training.

Populations of invasive pest plants have been observed on the landfill perimeter and throughout the Sub-Area grasslands. Observed species include: Cytisus scoparius (Scotts broom), Bromus rigidus (ripgut bromo), Bromus secalinus (cheatgrass), Taeniatherum caput-medusa (medusahead rye), Phalaris arundinacca (Reed canary grass), Cirsium arvense, (Canadian thistle), Cirsium vulgare (bull thistle), Cicuta sp. or Conicum sp. (Hemlock) [Carrot family], Rubus discolor (Himalayan blackberry).

It was recommended that hand weeding or hand spraying with herbicide be used to prevent the establishment of broom or Himalayan blackberry in the swale between Sub-Area 2 and 4.

SUMMARY CONCLUSIONS

The policies governing vegetation restoration and enhancement at St. Johns landfill can be summarized as the following goals in order of decreasing priority:

1. Prevent significant risk to the landfill cover integrity and function (i.e. a long term barrier to rain water) and prevent/control erosion so that no significant erosion occurs
2. Develop and use an integrated pest management plan which balances environmental, economic, and sociological impacts and reduces reliance on pesticides.
3. Reduce or eliminate the escape/establishment of invasive, non-native vegetation.
4. Follow a cost effective strategy to establish permanent native plant communities that provide wildlife habitat and scenic values.

In theory there should be no conflict among these goals. Actual practice has shown that, in addition to the unpredictability of weather, conditions at this site are both unique and more complex than theory has allowed for. Conflict has occurred among the goals, especially erosion prevention and establishment of native vegetation. The experience of actual practice has been humbling to all concerned.

Actual practice suggests that:

1. There is much that is still unknown about establishing native vegetation on this disturbed site in a way that best balances the goals.
2. Native vegetation can be established but establishment over the entire landfill should be considered a long term project.
3. Establishment should be carried out by persons who are committed to achieving the best balance of all goals, to frequently and carefully observing each localized area, and to making small scale modifications using scientific methods and evaluation techniques.

The above goals and experience summary suggests the following goals and objectives for present and future efforts.

GOALS:

1. Establish a native-dominant vegetative cover that encourages wildlife use if it does not pose a significant risk to the integrity of the St. Johns Landfill cover system or encourage invasion by noxious weeds.
2. Establish this vegetative cover in phases over the next 30-years using methods which minimize risk to public health, safety, and the environment and which conform to the Metro Alternatives to Pesticides Policy.

OBJECTIVES:

1. By the year 2007, establish native-dominant vegetation on 50 acres of the St. Johns Landfill cover system and on 6,000 lineal feet of its perimeter and develop methods which are reliable, environmentally protective, and cost effective enough to allow later establishment on larger spaces and to control invasive, non-native and noxious vegetation.
2. By the year 2007 develop a time schedule, methodology and cost estimate to establish native vegetation over the remaining cover system and perimeter.

IMPLEMENTATION STRATEGY

The goals and objectives should be met by pursuing an adaptive management plan for establishing native-dominant vegetation over the entire landfill. Establishment methods must not cause significant erosion or risk to the integrity of the cover system. Recognizing that there is much to be learned before this can be accomplished successfully, the establishment scheme would proceed in three to five year phases involving the construction of successive test plots. Each test plot should be carefully designed and monitored to provide information and plants for later plots until native-dominant vegetation is established over the entire landfill. Cost effective vegetation management would be carried out to support the existing native-dominant vegetation by preventing invasive or noxious exotic weeds from seriously threatening it.

Metro will support this effort with it's own qualified staff as necessary plus materials and services necessary to carry out the strategy in a cost effective manner.

Each phase would begin by the development or updating of a plan. This plan would include but not be limited to:

1. A statement of purpose and rationale.
2. Summary and evaluation of past work.
3. Detailed methods for establishment and evaluation of native-dominant vegetation over a three to five-year period in new areas. These methods shall include soil and site preparation, and maintenance(including seed/plant harvesting, integrated pest management plan).
4. Detailed methods to maintain existing native dominant vegetation including integrated pest management methods to control exotic, invasive plants.

5. Detailed methods to manage areas not yet planted with native vegetation.
6. Operation and maintenance needs (equipment, supplies, person hours).
7. Quantitative monitoring including criteria for success.
8. Timeline for implementation.
9. Staffing needed (including expertise) and proposed allocation of tasks between Contractor and Metro staff.
10. Budget (personnel hours/cost, equipment, supplies) by fiscal year (July 1--June 30).

Each phase would end with a report which presents what is learned and makes recommendations for future efforts.

IMPLEMENTATION - PHASE 1

To be attached

REFERENCES

EMCON Northwest, Inc., St. Johns Landfill Storm Water Pollution Control Plan, November 1992.

City of Portland, National Resources Management Plan for Smith & Bybee Lakes, November 1990.

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Mike Burton, Executive Order #60 Establishing an Integrated Pest Management Policy for Metro Facilities and Attachment A, December 1995

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APPENDIX 1

1994 Test Plots

Purpose: To test both herbicide application to kill growing plants and the use of tilling and drilling practices to determine the best method of native plant seedbed preparation.

Method: Spray once with Glyphosate in May. Do not till or till in late May, mid July, mid August and mid September with cultipacking before seeding. Use a drill to plant the no till plot.

Results: In March I995 fairly even stand of Bromus carinatus mixed with moderate population of non natives in test plot 1A. Little or no germination of Bromus in water logged areas. No significant Festuca idahoensis. In late June I996 this plot had some Bromus but also many other non natives. In March I995 there was dense cover of annual non natives in plot 1B.

Test Plot 2, Sub-Area 1 Soil/seedbank solarization (sun cooking)

Purpose: To test to use of a clear plastic membrane tightly covering an area of ground during the summer to destroy growing plants and perhaps near surface seeds by high temperature due to trapped solar energy.

Method: Tilled in May I994 and covered with clear membrane, seeded in September. Monthly mowing in the spring and summer of I995.

Results: In March I995 these was good development of Bromus carinatus, some Festuca idahoensis. Large percentage of bare ground. In November I995 there was about 80% Bromus and a small percentage of Festuca idahoensis. In May I996 this plot was fenced to prevent sheep grazing. In late June 1996 this plot had a dense stand of Bromus carinatus at waist high and about to drop seed. It was allowed to do so without harvesting.

Test Plot 3A, Sub-Area 1 Tillage only

Purpose: To test the use of repeated tilling to inhibit the growth and reproduction of non-native plants so that native plants can out compete them.

Method: Till in late May, mid July, mid August, and mid September with cultipacking before seeding with native plants. Monthly mowing in the spring and summer of I995.

Results: In March I995 good germination and development of Bromus carinatus. Less Festuca idahoensis than in plot 2. The annual non natives were more dense than in plot 2 but less dense than in plot 1B. In November I995 this plot was about one third covered with Bromus carinatus in patches with a few small patches of Festuca. In late June I996 there was Bromus in the tillage only test plot which was not protected by a fence from sheep grazing since late April. It was not as dense as in the solarization test plot but was only lightly grazed by the sheep compared to the non-native rye grass which was heavily grazed.

Test Plot 3B, Sub-Area 1 Acid pH manipulation using sulfur.

Purpose: To use a sulfur based low pH product to kill or inhibit growing plants so that they would not compete successfully with native plants added later.

Method: Till in Late May and mid July, add I,000 pounds per acre of popcorn sulfur, till in August, till and cultipack in September followed by seeding with native plants and fertilizer. Monthly mowing in the spring and summer of 1995.

Results: By November I995 there were some rows of pure Bromus but non native rye constituted most of the rest of the test plot. No Festuca was observed.

Test Plot 4, Sub-Area 2 No inhibition treatment, plant with native grasses.

Purpose: Test success if two native grasses planted on newly placed soil with no prior inhibitory treatment except choice of lower fertility soil.

Method: Took advantage of repair of erosion in August I994. In mid September tillage, cultipacking, and planting with above two grasses and fertilizer.

Results: Native seedlings failed. Cover composed entirely of non-native grasses by spring 1995.

Test Plot 5A, Sub-Area 2 Fallowing.

Purpose: To determine if swathing can reduce the ryegrass seedset.

Method: Plot was seeded with Regreen in fall I993. During I994 growing season plots were cut monthly May through July with sickle bar (sidecutter). Cut hay was left on ground.

Results: Ryegrass dominated by summer of 1994. Less seed produced by ryegrass than in control plots.

Test Plot 5B, Sub-Area 2 Flail mowing

Purpose: To determine if flail mowing can control ryegrass

Method: Plot was seeded with Regreen in fall I993. During I994 growing season plots were cut monthly May through July with a flail mower and chopped residue left on stubble.

Results: Regreen replaced by ryegrass by summer of 1994. More ryegrass seed production than in control plots.

Test Plot 6, Sub-Areas 1 and 2 Control

Purpose: Test effects of no management activity including mowing on two plots of different ages.

Method: Plot on Sub-Area one planted in Fall I992; plot in Sub-Area 2 planted in fall 1993. mowing was not possible so no management activity after initial planting.

Results: Ryegrass seedset and germination the same as other unmanipulated areas of the landfill.

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EXECUTIVE ORDER: No. 60

EFFECTIVE DATE: December 20, 1995

SUBJECT: **Establishing an Integrated Pest Management Policy for Metro Facilities**

Integrated pest management is a pest management strategy that focuses on long-term prevention or suppression of pest problems by using a variety of control tactics. Examples of tactics include plant selection, appropriate plant maintenance practices, mechanical and biological controls, and least-toxic chemical controls that have minimum impact on human health, the environment, and non-target organisms (Flint, et al., 1990).

Metro manages many public facilities that include buildings, landscaped areas and natural areas, and is obligated to maintain them so they continue to be attractive and safe places for the public to visit. Maintenance practices at Metro facilities include the use of pesticides to control insect, disease, weed, and vertebrate pests.

Goal 13 of the *Regional Solid Waste Management Plan* directs Metro to develop specific methods to minimize the amount of hazardous wastes entering the mixed waste stream and solid waste facilities. Hazardous wastes include, but are not limited to, some cleaners, solvents, pesticides, automotive paint and other products (ORS 459).

While in the short run pesticides are usually effective at accomplishing their stated purpose, in a longer view their costs in economic, environmental, and sociological terms can exceed their benefits. Due to overuse, more than 600 pests are known to be resistant to one or more pesticides (Georghiou, 1986). Furthermore, pesticides can also have undesired effects when they move to locations where they were not intended. Current research supports the theory that pesticide use will continue to foster pest resurgence, secondary pest outbreaks, and pesticide resistance, and will continue to have the potential for harming non-target organisms.

Metro is in a position to address pesticide use in the Portland metropolitan area. Pesticide use in urban areas has been found to be as high as twice that in agriculture (von Rumker et al., 1972). A survey in the mid-1970's found that more than 90 percent of American households use pesticides on their property (U.S. EPA, 1979), and fewer than 50 percent of home owners read the label on the container (Bennet, et al., 1983).

Therefore, in order to:

1. Serve as a model for local governments and home owners in the Portland metropolitan area regarding pesticide use;
2. Lessen the environmental impact of our landscape practices by reducing our reliance on pesticides;
3. Reduce hazardous waste, as directed by the *Regional Solid Waste Management Plan*; Metro will hereby manage the pests that occur at its facilities using integrated pest management principles as outlined in Attachment A.

Ordered by the Executive Officer this 20th day of December 1995.

Mike Burton, Executive Officer

ATTACHMENT A TO EXECUTIVE ORDER NO. 60

METRO

ALTERNATIVES TO PESTICIDES POLICY

December 1995

Integrated Pest Management: Principles

Although many definitions of integrated pest management can be found in literature, the basic tenets of integrated pest management are consistent throughout them:.

1. Although pest eradication is not feasible, it is possible and desirable to modify a site so that pest occurrence is greatly reduced or eliminated from the site.
2. Pests must first be correctly identified before any measures to control them are attempted.
3. Monitoring of the pests is essential to an IPM program.
4. Thresholds mark the pest population size that causes damage.
5. Control measures are not used until thresholds are reached.
6. Control measures other than pesticides often exist for a given pest, and selection criteria for them are based on the use of the site, the threat of the pest, and the impact that the control measure will have on the long-term occurrence of the pest, as well as the environmental, economic, and sociological impacts of the control measure.
7. Records of pest control tactics are maintained and occasionally reviewed to evaluate long-term success or failure of the strategy. Modifications to the plan are made as needed to further reduce pests.

Integrated Pest Management: Implementation and Documentation

In order to implement the principles of integrated pest management outlined above, the operations manager at each Metro facility will designate an Integrated Pest Management Coordinator. The Coordinator will be responsible for the preparation and implementation of Pest Management Plans. The Pest Management Plans will include:

1. **A description of the life cycle and behavior of the pest and the damage that it causes.**
2. **The intended use of the building, landscape, or natural area.** A written statement for the site indicating its use will help identify how much time and effort will be needed to maintain it. For example, a playfield that is used occasionally by park visitors for pickup games can tolerate more weeds than a field used regularly for league soccer.
3. **A quantifiable monitoring program.** It will include a) some measure of the pest, such as actual sightings, damage that the pest causes, or visitor complaints, and b) the frequency with which monitoring will take place, such as weekly, monthly, several times a year coinciding with emergence times, or only after a sighting is made. "Quantifiable" means that the results of monitoring will be written, indicating a measure of the pest - its presence or absence, evidence of damage, number of trapped individuals, or a subjective measure of density - "heavy", "moderate", or "light" infestation, for example.
4. **The options for control, including cultural practices, physical traps and barriers, available biological control agents, and one or more least-toxic chemical controls.** The options for control will indicate the impact each control measure will have on the long term occurrence of the pest, the cost of each control measure, and the hazards that each control poses to the practitioner, to the environment, and to the general public. Chemical

control measures that are included will be listed by the common name of the active ingredient, for example "glyphosate" will be listed instead of "Roundup," "insecticidal soap" will be listed instead of "Safer's soap," etc. It is the responsibility of the user to select the correct product for the intended use. Other pesticides will often be available for control of the pests. The Oregon State University Cooperative Extension Service can provide the names of those that are labeled for use on the pest in question. Although the pest management plans will list the least-toxic chemical controls, site managers will not be bound to use only those materials indicated in the plans. The purpose of the plan is to identify the alternatives available to them and their associated costs. Ideally, there will be at least one alternative that will provide long-term control of the pest problem.

5. **The name(s) or position(s) (for example, "gardener," "site staff," "contractor") of the person(s) that will decide whether action must be taken, what tactic(s) will be used, and who will carry out the tactic(s).** The selected person will judge the need for control of a pest based on the intended use of the site, the results of monitoring, and the severity of the threat that the pest poses. The economic, ecological, and sociological costs of the pest management tactics will be given equal weight when considering which tactics to use. Wherever possible, several options will be used in concert to reduce pests. Wherever possible, long-term strategies or those that prevent reoccurrence will be used.
6. **Evaluation of the selected tactics and documentation.** Often, continued monitoring will be sufficient to evaluate the effectiveness of a control measure. Results of the initial monitoring efforts will serve as the baseline. Licensed applicators are required to maintain records of the pesticides they use, so no further documentation of them is necessary. However, the uses of alternatives to pesticides will be unique to each site and should be documented.

Integrated Pest Management: Annual Review and Reporting

1. The IPM Coordinator at each site will provide a written annual report to the Executive Officer that includes the results of monitoring, the tactics used, and the results of the tactics for each pest at the site. The report will be in the form of a memo, and submitted to the Executive Office by September 30th of each year.
2. The Pest Management Plans will be reviewed annually, and updated as needed to add or delete pests, and to reflect recent research.

References

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