Parametrix, Inc.

7820 N.E. Holman
Suite B-6
Portland, OR 97218
(503) 256-5444 (Tele)

FAX TRANSMISSION INFORMATION SHEET

DATE 6/11/92

FROM Pete Hillmann.
St. Johns Landfill
Field Construction Office
(503) 285-8535 (Fax)
(503) 285-6998 (Tele)

TO Linda Pang Wright

RECEIVING FAX NUMBER (503) 273 - 5586

COMMENTS linda -
Please review Rich's comments and share with Jim Morgan. I'll talk to you when I get back later this morning

OF PAGES (INCLUDING COVER PAGE) _____

Cornforth Consultants Inc
7440 SW Hunziker Rd
Portland, Oregon 97223
Tel. (503) 684-3201
Fax (503) 684-5949

Memo to: George Drake (Parametrix, Inc.) 0647-01

From: Rick Thrall

Date: June 11, 1992

Subject: Sediment Basin W-1, Review Construction Method, SA-1 Closure, St. Johns Landfill Closure, Portland, Oregon

At your request, we reviewed the proposed construction method drawing for the sediment basin W-1. The drawing was submitted to us by your site representative on June 9, 1992. We understand that the sediment basin will be constructed into the refuse to a depth approximately 5 to 7 feet below the present leachate level.

Our review consisted of reviewing the plan, viewing the existing excavation, and conversations with the L&H site foreman. The method proposed in the plan and by L&H appears adequate and should result in a successful construction if the basin is properly dewatered during construction and properly protected after construction is complete.

The potential for uplift of a portion or all of the pond lining materials during or after construction is a concern. The outside leachate levels are high, and if the zone below the lining is not continuously dewatered during the construction, the mat and clay material will potentially be 'lifted' by the hydrostatic pressure. Therefore, we would suggest that duplicate sumps be installed and that round-the-clock pumping be initiated until the construction is completed.

When finished, the pond should be filled with clean water to elevation 17 feet to 'balance' the outside water pressure. Sump pumping can then be discontinued. Water should be kept in the pond until it can be demonstrated that the outside leachate levels have subsided. This may take several years. An alternative to this would be to install a suitable thickness of clay, the weight of which would balance any expected outside hydrostatic pressure.

The following additional comments are offered:

- The bedding materials below the mat should not be rounded, poorly graded drain rock or pea-gravel. Pea-gravel or drain rock cannot be compacted and both are generally unstable and would not provide a good base for construction on the sideslopes or bottom. We would suggest a more angular, well-graded, free-draining material similar to material typically used for road base.
- A greater thickness of clay should be used, say up to 3 to 4 feet thick. The clay should be adequately compacted in thin horizontal lifts in the bottom. The sideslopes can either be built-up horizontally or on an angle. If built on an angle, the sideslopes for compacting the clay should generally conform to the design slope.

July 23, 1992

Dr. Wesley Jarrell
Oregon Graduate Institute
19600 NW Von Neumann Dr.
Beaverton, OR 97006-1999

Dear Dr. Jarrell:

Thank you for the opportunity to read the draft report "St. John's Landfill Cover Vegetation Plan," prepared for the Solid Waste Department of the Portland Metropolitan Service District. The goals of the vegetation plan are to:

1) design a complex of natural plant communities along topographic and hydrologic gradients on and immediately adjacent to the capped landfill,

2) specify the proportions and management of soil constituents needed to develop a substrate with natural soil properties,

3) integrate the site with nearby natural areas and ensure that (no) negative impacts on such areas (do not) occur,

4) develop a monitoring program to document the effectiveness of the vegetation plan.

The report succeeds very well in responding to these goals. The design of the complex of natural plant communities clearly has been given much careful thought. The document is complete in listing the plants suitable for the different areas off the capped landfill. There is no doubt that the vegetation plan can succeed, provided that the second objective is successfully accomplished. Clearly the most difficult aspect of management of the St. John's Landfill is to provide an adequate substrate with natural soil properties. While many of the plant species which have been identified in this proposal will grow well in a shallow layer of soil, many of the plants which could add greatly to the habitat, require a much deeper soil than proposed. The concern here is with the stability of the soil and with the ability of the soil to provide adequate amounts of water to sustain the larger plants with water during the dry part of the year.

The proposal seems to be based on the premise that the entire landfill area will be covered with a membrane which is impermeable to water and to root penetration. This membrane will follow land contours. In certain areas slopes ranging from 10-20% occur. Important questions to consider are, therefore:

Can the layer of soil on this membrane be expected to remain stable during the projected lifetime of the project? My assumption is that the expected lifetime is indefinite, but certainly measured in decades.

Can the proposed soil thickness adequately sustain the desired vegetation?

The proposal contains as an addendum the paper "Geosynthetic Landfill Cover Design Methodology and Construction Experience in the Pacific Northwest," prepared by R. S. Thiel and M. G. Stewart of EMCON Company. This paper contains a careful analysis of construction criteria for membrane use in connection with landfill closure. Under the heading "top soil" the authors note that the thickness of the layer of topsoil depends on the type of vegetation to be established. The authors indicate that most designs specify a rooting layer of at least 30 cm, covered by 15 cm of organic soil. Then they say that the topsoil layers should be at least as thick as the rooting depth of the proposed vegetation. I am concerned about the adequacy of these criteria. The paper only deals with engineering criteria, construction issues and production. Certainly the engineering aspects of the placement of topsoil and the stability of the topsoil are very important, but the agronomic aspects of how the topsoil is to function with respect to plant growth are no less important. This report does not contain a single reference (citation) regarding successful vegetation establishment. In order to be more confident about the criteria of 30 cm of rooting soil and 15 cm of topsoil, I would consider further investigation of this matter extremely important. (My comments should not be interpreted as a review of this paper. This is a very good manuscript--agronomy is a different issue.)

In making the evaluation of the adequacy of soil thickness over the geomembrane, it must be recognized that the presence of the membrane makes any comparison between the engineered situation and the natural field situation impossible. The membrane breaks all capillary contact with the subsoil. Many plants which seemingly only extract water from a thin layer of soil do, in fact, depend on a water supply from the deeper soil layers. When the upper soil horizons dry out there is a continuous supply of water from lower soil horizons. This rate of supply may be extremely low, but often it is the difference between survival of the plants or not. A very low rate which is sustained over along period of time does move large amounts of substance, in this case, water.

The report states several requirements about the soil to be used in terms of its nutritional status and content on seeds of less desirable plants. Additionally criteria are established regarding the texture of the soil. These are all very important aspects, but in total, I consider these qualities to be less important than soil depth. The important aspect of soil depth is the ability of the soil to supply water, but that involves more than the water holding capacity layer by layer. It also involves capillary continuity.

Is the geomembrane necessary everywhere over the landfill?

My expectation is that the geomembrane has been specified to avoid possible leaching from the landfill caused by infiltration of water from rain. I suggest that it may not be necessary to place the geomembrane over the entire area. I would raise the following question: "What would the hydrology of this area be if the geomembrane were only placed in those areas where water accumulates and where standing water may be expected, that is, along the lower

parts of the slopes and in the drainage ways? In other words, what would the hydrology of the area be if the highest areas of the landfill were left without the geomembrane? In place of the geomembrane, one could use a soil with a low hydraulic conductivity so that the soil infiltration rate would be limited. Experience with modelling of water flow under unsaturated conditions suggest to me that the amount of infiltration would be very small and that the leaching from the landfill would be insignificant when compared with the subsurface hydrology of the natural environment. Remember that even when the entire landfill is covered with the geomembrane, there still is the contact of the lower boundary of the landfill. Consider this question: "What is the removal rate of dissolved material due to rise and fall of the water table?" My expectation is that leaching would contribute very little to this process. Given a little time I could probably prove this to you.

Stability of the soil layer above the membrane on steep slopes

As already mentioned, I am concerned about the stability of the fill on steep slopes. I tried to get some idea of the stability by reading the design papered by Thiel and Stewart. Unfortunately, I could not find an evaluation of the thickness of the soil layer in terms of its stability. This paper is quite hypothetical. There is no reference to actual validation of the models which are being used. In nature, things proceed very differently from how they proceed in textbooks, and this seems to be a textbook approach. Furthermore, the analysis does not allow for soil erosion, which always proceeds in unpredicted ways. The essence of soil erosion is that water rapidly accumulates in the very lowest spot of the profile, and then proceeds to cut channels which very quickly lead to removal of soil. The soil layer on the steep slopes must be sufficiently thick to provide a foothold for the plant community but also it must resist erosion and hold the soil in place.

From an environmental quality perspective there are some important trade-offs to consider here. Can saving be achieved by not covering the entire landfill with a membrane but by making a larger investment in soil thickness and soil stability? What would it look like if one could guarantee zero contribution to leaching due to infiltration of rain water but see all the topsoil wash away due to erosion?

Additional Comment

I am returning my copy of the report to you. I have written notes in several places, and can discuss those either by phone or at some future meeting.

Thank you for the opportunity to read this report.

Sincerely yours,

Larry Boersma

Larry Boersma
Professor of Soil Science

pw

METRO

Planning Development
2000 S.W. First Avenue
Portland, OR 97201-5398
(503) 221-1646

Memorandum

DATE: July 29, 1992

TO: Dennis O'Neil

FROM: Jim Morgan

SUB: Comments on Draft Landfill Cover Vegetation Plan

There are a few typographic errors and points of clarification requiring attention in the Landfill Cover Vegetation Plan submitted by Fishman associates that I will not list. Below are salient concerns that I wish to discuss.

1. In our scope of work in the RFP, we required that a vegetation cover plan should include cost assessment that considers long-term maintenance as well as establishment cost. The draft plan addresses establishment cost for subarea 1 adequately. However, no figures are given comparing the overall cost-effectiveness of using native and non-native vegetation. Using attributes in Table 1 (page 20), some rough figures may be estimated comparing native and non-native vegetation. Perhaps a goal should be added that reads "Evaluate the cost-effectiveness of using native plant communities compared to non-native plants in terms of establishment and long-term maintenance costs."

2. Shouldn't herbicides be used on all soil going onto subarea 1 prior to planting? On p.28, Regreen is suggested for planting in test plots and for complete cover elsewhere in subarea 1. This conflicts with the Figure Subarea 1 Test Plot Plan showing the southeastern corner of subarea 1 planted in sheep fescue and rye. Soil Type I at bottom of p.21 also indicates the original soil and vegetation design. Didn't we all agreed that no more rye grass would be planted?

3. In the erosion control section, it was suggested that landfill soil surfaces be disced, scarified, or contour perpendicular to slope to minimize erosion. This should be written in the section on landfill soil profile construction, especially in the discussions on mixing subsoil and compost by discing.

4. Information presented in Richard Theil's memo may have significant impact on St. Johns Landfill cover and cover vegetation design. The suggestion that the geonet isn't necessary or actually reduces slope stability on slopes $<10\%$ (most of the landfill) certainly brings into question the small gain in increasing subsurface runoff velocity. The potential cost savings from eliminating this layer (estimated to be \$2.5 -\$3.0 million) warrants further investigation.

METRO

2000 SW First Avenue
Portland, OR 97201-5398
(503) 221-1646
Fax 241-7417

July 30, 1992

Mr. Paul Fishman
Fishman Environmental Services
434 N.W. 6th Ave., Suite 304
Portland, OR 97209

Dear Mr. Fishman:

I am responding to the Draft St. Johns Landfill Cover Vegetation Plan which was submitted to Metro on July 13, 1992. It is an exciting and ambitious plan. Your Engineering Consultant, Mr. Thiel, has suggested a design change which, though it may involve some increased erosion risk, will reduce the cost for the drainage net and increase the viability of certain types of vegetation. I have asked Parametrix, Inc., to comment on Mr. Thiel's suggestions.

Both Jim Morgan and I are concerned that the Draft Plan lacks costs for establishment (including soil construction costs) and long-term maintenance. For example, I am unable to determine how much more or less sand or soil is needed, according to your plan, than that currently needed for Sub-Area 1. Perhaps a goal should be added to your plan that reads: "evaluate the cost effectiveness of using native plant communities compared to non-native plants in terms of establishment and long-term maintenance costs."

I am concerned about the statement that "this plan is not intended to serve as contract specifications." I agree with this statement regarding the overall landfill plan. However, for Sub-Area 1 and the test plots, the specifications should be sufficient for a contractor to prepare a price quote and to be in a contract Change Order to carry out the work.

On page 28, Regreen is suggested for planting in the test plots and for complete cover elsewhere in Sub-Area 1. This conflicts with the figure titled: Sub-Area 1 Test Plot Plan, which shows the southeastern corner of Sub-Area 1 planted to fescue and rye. Soil Type I at the bottom of page 21 also indicates the original soil and vegetation design.

Based on your team's prior recommendation, we have not purchased Mecklenberger Sheep Fescue. Please suggest a cost effective alternate for both fescue and rye grass. Is it more cost effective as an erosion control measure to seed type I soil with Regreen only and then have to re-establish vegetation in a year or so, or is it more cost effective to use the entire Sub-Area as a test plot for Xeric or Mesic Prairie vegetation?

I am concerned that the Plan advocates the use of herbicides to destroy all plant life on Sub-Area 1 soils before the native vegetation or Regreen is planted. What other, less environmentally risky options can be used? What are the costs of these?

In the erosion control section, it was suggested that landfill soil surfaces be disced, scarified, or contoured perpendicular to slope to minimize erosion. This should be written in the section on landfill soil profile construction, especially in the discussions on mixing subsoils and compost by discing.

Is the picture on the Plan cover a picture of St. Johns Landfill? If not, what is the relevance to St. Johns Landfill as it is now, after solid waste is no longer accepted? Do we need a picture? If so, it should be explained in the text how the picture is relevant.

I look forward to meeting with the team on Monday, August 3, at ~~3:00~~ 1:00 o'clock p.m., Room 335 at Metro Headquarters. At that time I will give to you copies of pages of text which show corrections and comments by Jim Morgan and myself.

Sincerely yours,

Dennis O'Neil
Closure Project Manager

DO:clk
s:\oneil\letters\fish0730.ltr

bc: Jim Morgan

United States Department of Agriculture | Soil Conservation Service | 2115 SE Morrison St. Portland, OR 97214 (503) 231-2270

SUBJ: METRO Landfill Veg. Plan and Specifications

DATE: 8/20/92

TO: Scott Lambert (509) 353-2336
PM Specialist
Spokane, WA

CODE: 190

Attached is the information I promised regarding METRO's request for technical assistance in designing the vegetation plan for the St. John's Landfill Closure Plan. These documents represent selected excerpts from the much larger landfill closure document. I asked Jim to provide us a site map, schedule for closure completion, soil medium to be place on-site and any other information he felt may be pertinent. We should review this information before meeting with him, if possible.

I have requested that Jim Morgan, METRO planner coordinating this effort meet us at 9AM at the Portland Field Office. We can visit a similar completed closure site in Vancouver, and then head on to the St. John's site. I expect the field work to be completed by 1PM. We can discuss follow-up plans at the Field Office afterwards.

It may be helpful to also invite Joe Pesek, Oregon Dept. of Fish and Wildlife and a representative of the Native Plant Society, since METRO is interested in maximum wildlife habitat diversity. If you would like them along, let me know.

I appreciate your flexibility in scheduling this appointment. If you need a ride from the airport, let me know. I did request your visit through official channels, and extended an invitation to Jim Hecker to join us.

Peggy A. Olds
District Conservationist
Portland Field Office

cc: Jim Hecker, Area 1 PM Rep.
Jim Morgan, Planner, METRO

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To Dennis O'Neil	From George Drake
Co.	Co.
Dept.	Phone #
Fax #	Fax #

21-1919-02 (31K)

MEMORAI

TO: Dennis O'Neil, Metro

August 28, 1992

FROM: Gene Fox

SUBJECT: *EMCON NW Memo; "Draft" Vegetation Plan*

. . . . . .

After reviewing the above mentioned memo and "Draft" Vegetation Plan, here are my responses to the questions raised by you in your letter to George Drake dated July 24, 1991.

1) Top Slope Stability

Based on interface friction data developed during PMX' design of this project, elimination of the geonet composite Type B over the smooth geomembrane on the top slopes will not provide a satisfactory slope stability safety factor under saturated conditions. In the Emcon NW memo, Mr. Thiel assumed that the interface friction angle between a sand and the smooth geomembrane would be approximately 18°. This would provide a Factor of safety of approximately 1.4. However, actual testing by PMX during design resulted in an interface friction value of 12° between smooth geomembrane and a fine sand. This would provide a Factor of safety of approximately 0.9, which is not acceptable to PMX. The actual sand currently being supplied tends toward the fine side of the specified grain size envelope and is close to the fine sand used for testing. Therefore, the actual interface friction is close to the 12° interface friction angle of the previously tested sand.

If textured geomembrane is used instead of smooth geomembrane and geonet is eliminated on the top slopes, it would provide a satisfactory slope stability Factor of safety under saturated conditions. Based on PMX' testing, the interface friction angle for a textured geomembrane and a fine sand would be approximately 25°. This would result in an acceptable Factor of safety of 2.0.

Side Slope Stability

Side slope stability is a concern under saturated conditions. Based on the interface friction results obtained during design and criteria specified in the contract documents, the Factor of safety for side slopes would be 0.7 under saturated conditions. This is inconsistent with the Emcon NW memo. I discussed this with Mr. Thiel on 8/6/92. After further information was provided to him concerning interface friction testing previously performed and the specified interface criteria, he agreed that side slope stability would not be acceptable during saturated conditions. PMX does not recommend any changes to the side slopes design.

Comments

I agree with the implications of cover saturation as described in the Emcon NW memo. Based on interface stability, possible surface sloughing of the cover soil, and access necessary for maintenance, I would not recommend allowing saturated conditions as an acceptable design criteria. Consideration of the cover efficiency is discussed in Item 2 following.

To provide proper drainage within the cover system, a functioning drainage layer must be provided and maintained. Typically, a soil drainage layer should have a permeability of 10^{-2} cm/sec or greater. The approximate permeability of the sand currently being supplied is $1x10^{-3}$ cm/sec. If this material is used as the drainage layer in place of the geonet composite, underdrain collection pipes will have to be installed at very close spacing (5 to 7 feet) which will significantly increase cost and complicate construction. Also, soil materials will be placed directly on the geomembrane. This will significantly increase the potential for construction damage to the liner material, compared to the protection the geonet composite would otherwise provide the geomembrane. Drainage layer design considerations are further discussed in the Engineering Report on page 3-11 and 3-41.

Assuming that a geonet composite is installed as the drainage layer throughout the landfill cover system, assurance must be provided that the roots of the vegetation will not significantly clog the net. Without information on the rooting depths and expanse of the various plant types, planting densities, and/or some type of full-scale testing to determine effects on the drainage layer efficiency, I am not able to evaluate the potential for "significant clogging."

The EPA technical guidance document *Final Covers on Hazardous Waste Landfills and Surface Impoundments* (page 16) suggests limiting vegetation to shallow-rooted species to prevent clogging. Literature on landfill covers that I am familiar with contain similar recommendations. A thorough literature search should be done to determine whether additional information exists to assist in evaluating the effects of the vegetation plan on drainage layer efficiency.

2) Leakage vs. Head Build-up

Based on recent EPA research mentioned in the Emcon NW memo, I agree that the risk of geomembrane penetration by plant roots is low.

To evaluated the potential increase in leachate production due to saturated conditions, we ran the HELP model for two conditions. The first modeled the cover as designed, based on characteristics of the sand and clay being used currently on site. The second modeled the cover with the capacity of the geonet composite reduced from 20 cm/sec to 0.2 cm/sec, representing a root clogged geonet.

The first condition (as designed) resulted in an average annual leakage through the cover system of 8,600 gal/acre. This represents an efficiency of 99% based on total precipitation.

The second condition (saturated cover due to clogged geonet composite) resulted in an average annual leakage through the cover system of 42,000 gal/acre. This represents an efficiency of 95.5% based on total precipitation.

Based on this HELP modeling, leakage through the cover system may be increased by 5 times if the drainage layer becomes ineffective. The actual increase will be dependent on the degree of root growth clogging the geonet composite. The elimination of top slope geonet drainage product and use of the fine sand as a drainage medium would provide leakage through the cover approximately as stated for the second modeling condition. Implementing the recommended underdrain collection pipes in the fine sand layer will provide a functioning drainage layer in line with the original cover system design and is recommended by Parametrix.

3) Additional Information Necessary for Specifications

Based on progress with the SA-1 Contractor on site, specifications for construction are already developed.

cc: G. Drake

METRO

2000 SW First Avenue
Portland, OR 97201-5398
(503) 221-1646
Fax 241-7417

August 31, 1992

Mr. Paul Fishman
Fishman Environmental Services
434 N.W. Sixth Avenue, Suite #304
Portland, Oregon 97204

Dear Mr. Fishman:

Enclosed is an August 28, 1992, memo from Gene Fox of Parametrix, Inc. Mr. Fox responds to my request for comment about the concept of omitting the Geonet composite on the top slopes of St. Johns Landfill. This concept was suggested by your team and was technically evaluated by Mr. Thiel in your draft vegetation plan.

Omission of the Geonet composite could save a significant amount of money and thus would be desirable if it did not result in significant increased risk. Thus it is important that your final vegetation plan state clearly whether or not your team's Engineer (after evaluating Mr. Fox's response) still believes that there is a significant risk of slope failure (or other significant risk) if the Geonet composite is omitted. Your plan should contain a clearly stated and supported recommendation concerning the Geonet issue.

Sincerely,

Dennis M. O'Neil
Closure Project Manager

DMO:clk
Enclosures
cc: Rick Thiel, EMCON Northwest
Jim Watkins, Engineering and Analysis Manager
Jim Morgan, Senior Planner

METRO

2000 SW First Avenue
Portland, OR 97201-5398
(503) 221-1646
Fax 241-7417

September 10, 1992

Mr. Paul Fishman
Fishman Environmental Services
434 NW 6th Avenue, Suite 304
Portland, OR 97209

RE: Vegetation plan for Sub-Areas 2 and 3 at St. Johns Landfill

Dear Paul:

Reference our telephone conversation of September 9, 1992 regarding the above subject. Our current plan for incorporating at least a portion of your proposed vegetation plan is to plant native grasses and "regreen" as recommended by you for the Sub-Area 1 Test Plot Plan. Our thinking is to use the mixes for "Mesic Prairie" and "Xeric" Prairie" to protect that portion of the landfill with native grasses without waiting for test results from Sub-Area 1. It is our hope that the same processes of natural selection at work on the test plots will produce a viable stand of grass on Sub-Areas 2 and 3. We intend to use the technical specifications that you have already provided.

The soil profiles in Sub-Areas 2 and 3 will be 18" of sand and 12" of topsoil. At least the top 6" of topsoil will be imported to preclude growth of rye grass seed from any existing topsoil which will be used in the construction. Other types of plant communities and further testing can be pursued separately from the Sub-Area 2 and 3 closure contract or be added by change order at a later date.

We request your assistance in dividing Sub-Areas 2 and 3 into areas most appropriate for the two specified grass mixes. A copy of Sheet 8, Road Plan is enclosed for marking out the areas. Please call if there are any questions.

Sincerely,

Pete Hillmann
Construction Coordinator

PH:gbc
Enclosure
cc: Jim Watkins, Metro Engineering & Analysis Manager
Dennis O'Neil, Metro Sr. Solid Waste Planner
Jim Morgan, Metro Sr. Regional Planner
Linda Pang-Wright, Metro Associate Planner
George Drake, Parametrix, Inc.

Mark Griswold Wilson, Horticulturist 980 SW Broadway Drive, Portland, Oregon 97201 (503) 222-0134

MEMORANDUM

November 30, 1992

Dennis O'Neill
METRO-Solid Waste Department

Dear Dennis,

Please find attached two estimates: one for first two year vegetation establishment costs and the other for vegetation maintenance costs at the St. Johns Landfill. Please consider these estimates as addenda to the FES design team final report; they should replace Table 2 on page 20 of the final report document submitted to you last August.

The separation of establishment and long term maintenance costs illustrates that a native plant community of grasses and shrubs/trees will cost more than a grassland of non-natives to establish but will in the long run cost much less to maintain. I made the assumption when compiling costs that maintaining a grassland on the majority of the landfill is the goal; hence the yearly mowing regimen. As you know, grasslands are generally seral (or transitional) plant communities and once yearly mowing should be sufficient maintenance to prevent the expected colonization of woody shrubs.

The native grassland establishment costs will be higher than non-native costs until short term vegetation monitoring identifies the specific herbaceous species that survive and are able to reproduce on the site. Existing mesic and xeric grassland species lists can then be simplified to reflect monitoring results. The higher mowing costs of the native grassland areas for the first two years are necessary if they are to be maintained as seed harvest plots thereby reducing seed acquisition costs for future closure areas.

The great disparity (from the former estimate) for the long term maintenance costs of non-native grasslands is due to my recent receipt of costs from several local farmers and maintenance information regarding other landfill closure projects; formerly the estimate was based on costs submitted to me by several landscape contractors. The project is, as we discussed last week, a long term erosion control farming project so the attached costs are more realistic.

Estimating upland/shrub establishment costs is difficult and is presented as incomplete due to a lack of information about: the willingness of METRO to get into the plant growing business; the success of high cost container plantings versus lower cost in-situ cuttings; and a minimal understanding of which species will do best where. In short, the management plan needs ground testing! This year's shrub transects should answer some of the cost questions. The mychorrizal enrichment cost factor is offered as a possible alternative to fertilization. Fertilization will probably encourage the success of weeds in the grasslands; mychorrizal enrichment of the shrub/tree propagules may enable the young propagules to more efficiently utilize scarce site moisture and nutrients perhaps making them more drought tolerant while not over feeding the understory native grasses. (See mychorrizae information submitted at our November 19th meeting) As the Fresh Kills project is testing mychorrizal enrichment additional information will be available from their monitoring results. Another unknown cost factor is the role volunteers could play in the establishment of shrubs/trees. The establishment labor costs of planting and first two growing season irrigations could be significantly reduced with their help.

If you have any additional questions regarding the two cost estimates please call me. The FES team has scheduled a final landfill site visit on December 9, 1992. We will make some additional recommendations to you after that visit.

cc: FES team: Fishman, Jarrel & Faha; Jim Morgan

A COMPARATIVE ESTIMATE OF FIRST 2 YEAR PER ACRE VEGETATION ESTABLISHMENT COSTS:
NATIVE PLANT COMMUNITY VERSUS NON-NATIVE GRASSLAND

GRASSLANDS		
	NATIVE	NON-NATIVE
Seed materials only	$ 400.00/acre (mesic) $ 500.00/acre (xeric)	$ 20.00/acre (grass and legume)
Liming materials only	$ 0.00/acre (not necessary)	$ 500.00/acre (year 1 only)
Fertilization materials only	$ 10.00/acre (ammonium sulphate at 50lbs/acre)	$ 180.00/acre (ammonium sulphate at 900lbs/acre)
Lime/Fertilizer application labor	$ 150.00/acre (fertilizer only)	$ 200.00/acre
Mowing equipment and operator	$ 300.00-$500.00/acre (3-5 times per year)	$ 200.00/acre (2 times per year)
SUBTOTAL - GRASSLAND **Average costs/acre**	**$1410.00/acre plus seeding labor**	**$1100.00/acre plus seeding labor**

NATIVE UPLAND/LOWLAND SHRUBS	
Plant Materials mix of containers/collected propagules	$1000.00/acre
Fertilizers **and/or** Mychorrizal Enrichment (Shrubs*) materials only	$ 110.00/acre **and/or** $ 200.00/acre (plant cost plus 20%)
Irrigation gravity/drip system	$?/acre (METRO Staff and Water Truck?)
Labor Supervision volunteer planting and fertilizing/enrichment	$?/acre (METRO Staff or Contractor?)
SUBTOTAL - SHRUBS **Average costs/acre**	**$1310.00/ACRE**[1]

TOTAL ESTIMATED ESTABLISHMENT COSTS/ACRE

Native Plant Community (Grass & Shrubs)	**$2720.00/ACRE (AVERAGE COSTS/ACRE)**[1]
Non-Native (Grass Only)	**$1100.00/ACRE (AVERAGE COSTS/ACRE)**

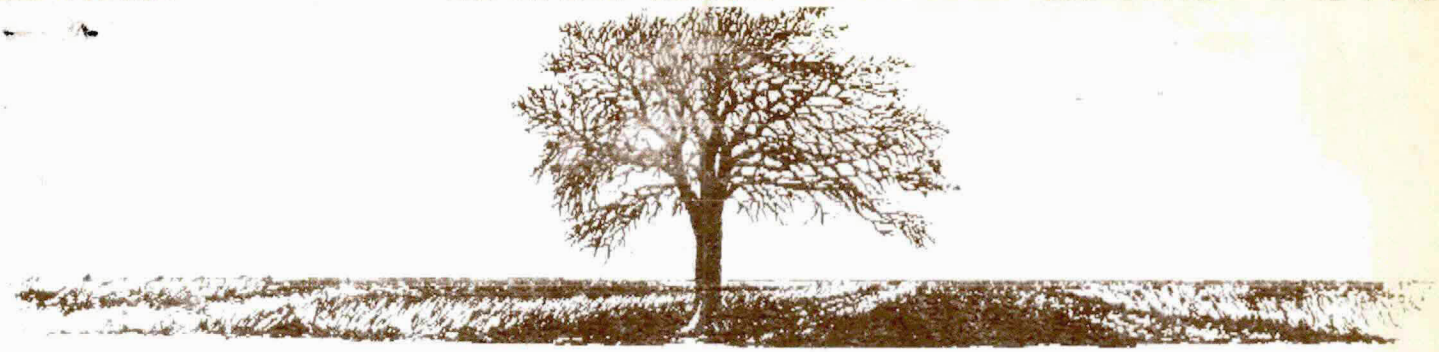
* optional but desirable

[1] Plus irrigation and labor supervision

A COMPARATIVE ESTIMATE OF PER ACRE MAINTENANCE COSTS FOR NATIVE PLANT PRAIRIE COMMUNITIES AND NON-NATIVE GRASS MIXES

(YEAR 3 THROUGH 30)

COST FACTORS	NATIVE	NON-NATIVE
LIMING		
labor & materials	$ 0 (not necessary)	$ 850.00/Acre (1 application/2 years)
FERTILIZATION		
materials	$ 0 (not necessary)	$ 360.00 -/Acre (1-2 X Year)
application labor	$ 0 (not necessary)	$ 200.00 -/Acre
MOWING		
equipment & operator	$100.00/Acre (1 mow/year)	$100 - $200/Acre (1 - 2 Mows/Year)
TOTAL COSTS	**$100.00/Acre/Year**	**$1510.00 - $1610.00/Acre/Year**



Mark Griswold Wilson, Horticulturist 980 SW Broadway Drive, Portland, Oregon 97201 (503) 222-0134

MEMORANDUM

December 15, 1992

TO: Paul Fishman
FROM: MGW
RE: St. Johns Landfill-90% Review of proposed contract for Subarea 2 & 3 closure

I have reviewed the 90% contract specs and plans for Subarea 2 & 3 closure. See attached Subarea 2 & 3 specs for specific comments. My general comments are as follows:

GENERAL COMMENTS (PMX SECTIONS 1041, 02920 & 02220)

1. The specifications as written do not cross reference the important categories of: Construction phasing and Milestones found only in SECTION 1041. All site prep and vegetation establishment work should reference SECTION 1041. The following additional omissions are also noted: 1. Seed acquisition is not listed as an important milestone. Because specified nativ seed is scarce in the marketplace prompt acquisition is vital; 2. Seeding of grasslands should be specified to be accomplished during an identified period rather than by a certain date; 3. Contractor should be required to submit a written work sequencing plan [see example in attached SECTION 01010 of St. Johns Landfill Construction Documents; Fishman Environmental Services; 1992]

2. Timely site/work inspections by METRO and/or their representative should be tied to contract specified completion dates identified in the Milestones in order to assure that all site preparation and seeding work is high quality and completed in a timely fashion. Stiff penalties should be put in place to insure compliance.

   The site inspections should focus on three main tasks:
   1. Acquisition of specified seed
      - -no substitutions! (Native genus & species only; no cultivars)
      - -source verification invoice & seed tag inspection
      - -acquisition and/or contract collection agreements by 5/1/93 & 5/1/94
   2. Timely placement of final soil cover as specified
      - -work quality inspections timed to the placement of existing soil and/or import soil and compost

mixing. [See example in attached SECTION 01010 of St. Johns Landfill Construction Documents; Fishman Environmental Services; 1992]

-depth testing of final cover soil (as specified for placement of low permeable soil).

3. Timely seeding as specified

-seeding window: 9/15 to 9/30. No exceptions!

-work quality inspections during seeding window

[Note seeding rate corrections in proposed Subarea 2 & 3 attachment]

I RECOMMEND IMPLEMENTATION OF THE FOLLOWING <u>RE: SPECS</u>

A. Delete seed acquisition from the construction cor t. Assign a METRO staff member (or contracted specialist) to acquire seed. Seed acquisition and/or seed harvest contracts should be in place no later than May 1 of each closure year.

B. Contract with an independent landscape construction specialist to assist METRO engineer with the inspection of site soil prep, fertilization and seeding of grasslands.

I RECOMMEND REVISION OF THE FOLLOWING <u>RE: PLANS</u>

A. <u>Sheet 14</u>: Revise drainage outlet culvert design. Landfill closure goals can be attained more efficiently and economically by designing bioengineering solutions for drainages. [see Suggested Bioengineering Techniques for Erosion Control; compiled by Mark G. Wilson; submitted to METRO October 19, 1992]

B. <u>Sheet 21</u>: Delete Erosion Control Mat from all upper drainage ditches. Seeding alone or seeding combined with check dam creation should be adequate erosion protection. Little evidence of water flow in up slope ditches has been noted thus far during winter 1992.

C. <u>Sheet 23</u>: Revise vegetation plan to match those proposed in Fishman Environmental Services Site Management Plan; submitted to METRO August 1992] Specific locations of boundaries for each cover type should be approved by METRO engineer (or their representative) in the field prior to final cover soil placement.