Summary Meeting Notes
Smith and Bybee Wetlands Management Committee
~~January 24, 2005~~ Feb. '06

In Attendance:

Larry Devroy (Chair) *	Port of Portland
Troy Clark (Vice Chair)*	Audubon Society of Portland
Pam Arden *	40-Mile Loop Land Trust
Brenda Hanke *	St. John's Neighborhood Assn.
Nancy Hendrickson *	Portland Bureau of Environmental Services
Dan Kromer *	Metro
Patt Opdyke *	North Portland Neighborhoods
Dale Svart *	Friends of Smith and Bybee Lakes
Vickie Eldredge	Metro Parks – Committee Recorder
Elaine Stewart	Metro Parks – Natural Resources Scientist
Paul Vandenberg	Metro Solid Waste and Recycling – Solid Waste Planner
Mitch McDougal	Oregon Bass & Pan Fish Club
Paul Burnet	CH2M Hill

* Denotes voting SBWMC member

The meeting was called to order at 5:34 p.m.

Consideration of Jan. 24, 2006 meeting notes

Larry Devroy would like to **emphasize** in the minutes of Jan. 24, 2006 regaurding the Council's resolution to accept the Smith and Bybee Wetlands Feasibility study, that it directs staff to remove the South Lake Shore segment form further study at this time. I think we need to emphasize that it took the most time at the session. This will allow the door to be a little bit open to potentially consider other alternatives, if everything else falls apart and we never make any progress, we need to emphasize the outcome of the debate.

Meeting notes where then approved – Larry Devroy 1st motion, Patt Opdyke 2nd it.

St. John's Landfill update (Paul Vandenberg)

1. Discussion of the Stages of the site restoration

- Major steps have been taken to stabilize the site. Goals of restoration, to provide a safe environment for practical public access, also open habitat development for the surrounding areas.
- Stages of the restoration: construct cover over waste, implement routine monitoring, collect methane gas, develop vegetation and habitat, conduct remedial investigation, prepare a feasibility study, have DEQ issues a record of decision,

implement remedial actions, and finally provide practical public access via secured trails. Question: Since the 1991 implementation of routine monitoring have there been new contaminants? They look at everything, all the data collected. Samples are taken and sent to a lab and run through standard EPA list of contaminants. There are certain chemicals that will need to be looked at.

- The Site has gone from a polluted dump site to ground able to sustain vegetation and habitat with significant water quality improvement.

There was discussion of the cover being impermeable to the ground water, is the contamination going to remain out of the ground water. There is a double cover and the contaminants shouldn't be able to permeate the ground water.

Power point presentation pictures were shown of the progress in the St. John's fill restoration. Explaining the process of how the natural gases and chemicals are removed through a process of burning as well as being pumped out for use as power. The land is currently being use for grazing by ranchers. There were examples of the restoration of the bank at the North Slough and how it pertains to the St. John's project. Funding was obtained and 1000 ft. section of the slough was stabilized. Paul explained that they received full funding for the design and development plan to stabilize an additional 1000 feet of the slough and are now trying to receive full funding for implementation. Paul invited committee members write letters of support.

2. Vegetation management, habitat development, and the local hydrology. (Elaine Stewart)

- Experimentation with importing soil and planting vegetation.
- There are areas that the topography would allow the deposit of sand and rougher vegetation to encourage the migration of the Horned Lark.
- There may already be some Painted Turtle nesting sites and Northern Harrier foraging site out there.
- The chart on hydrology of the area shows the water levels historically, present day, and how the Smith-Bybee plan has functioned through the seasons.

There were pictures of the dam, (new water control structure), in the slough over time to illustrate how we are intervening in the control of water flow through the area and into the wetlands, positive flow through fish ladders at all times. It also illustrates how the control has changed the slough quality.

3. Trails Project

- Evaluation of the North Slough feasibility study of the perimeter road and ash forest routes, in the long term the spur trail and interpretive opportunities.

These areas were illustrated in the picture provided in the power point presentation copies.

4. Remedial Investigation (Paul Burnet, CH2M Hill)

- The purpose of a remedial investigation is to calculate the risks to human health and to the environment, current and future.
- An overview of the tasks involved in the Work Plan.
- The Conceptual site model for potential human exposures, how are people potentially going to be affected and form that information how can we prevent these exposures.
- The Conceptual site model for potential ecological exposures, how are these exposures going to affect the environment.
- The schedule to include data collection and evaluation to be conducted in the summer of 2006.
- Already completed tasks, soil sampling and shallow groundwater/ surface water discharge, during low water conditions.

The use of historical and current data is being used to determine the risks. The results have been encouraging, several of the levels are already above the risk level other levels show signs of improvement. The maps shown give the areas where the samples were taken. The samples are taken two times per year currently in the spring and the in the fall. It was explained how the process of sampling works and was conducted.

- Current tasks underway are air data, sediment data, groundwater data, the identification of species and habitat types, and the preliminary screening for ecological risks.
- Upcoming tasks for 2006 are to address the shallow groundwater/ surface water at high water conditions, the supplemental sediment sampling, and to describe the nature and extent of groundwater contamination.

Project updates in the future to assess the need for additional data to support risk assessments, conduct human health and ecological risk assessments, and to prepare the range of potential remedial actions in feasibility study. (There is a detailed breakdown of the objectives and tasks available in your copy of the power point presentation.)

Updates

- Requests for support regarding the Bank project. A summary of the project will be provided for the next meeting.

Meeting adjourned – 7:05 p.m.

Stormwater Management Plan

Public Review

The City of Portland, Port of Portland and Multnomah County all operate storm sewer systems within the City's Urban Services Boundary. The three jurisdictions hold a joint stormwater permit issued by the Oregon Department of Environmental Quality in accordance with the federal Clean Water Act.

The permit requires each jurisdiction to develop, implement, and enforce a Stormwater Management Plan (SWMP) for its area of responsibility. The SWMP identifies the best management practices (BMPs) that will be implemented to reduce the discharge of pollutants to the maximum extent practicable, protect water quality, and satisfy requirements of the Clean Water Act.

The three jurisdictions are revising their SWMPs to meet the conditions of their second-term permit and are seeking public comment on their proposed SWMP revisions.

Stormwater Management Plan

Open House

Tuesday, March 14, 2006

5 - 7 PM

Hinson Memorial Baptist Church

1137 SE 20th Avenue

Welcome Room on 2nd floor

To Review the Plans

Beginning Tuesday, February 21, 2006, the draft SWMPs will be available for review online at www.portlandonline.com/bes/index.cfm?c=37842. Call 503-944-7994 to receive hard copies in the mail.

Open House Scheduled

The City of Portland, Multnomah County and the Port of Portland will hold a joint open house regarding Stormwater Management Plans.

To Submit Comments

- Email comments to besstormwater@bes.ci.portland.or.us.
- Submit comments online at www.portlandonline.com/bes/index.cfm?c=37842.
- Fax to 503-823-6995 and mark them "RE: MS4 SWMP public comment."
- Mail comments to:
  Stormwater Management Plan Comments
  City of Portland Environmental Services
  1120 SW 5th Ave., Room 1000, Portland, OR 97204
- Comments must be received by Thursday, March 23, 2006.

After the public review period a summary of material comments and how the comments were addressed will be available online along with the final approved Stormwater Management Plan for each jurisdiction.

PORT OF PORTLAND

MULTNOMAH COUNTY

ENVIRONMENTAL SERVICES
CITY OF PORTLAND
working for clean rivers
Dean Marriott, Director
Sam Adams, Commissioner

PORT OF PORTLAND

MULTNOMAH COUNTY

ENVIRONMENTAL SERVICES
CITY OF PORTLAND
working for clean rivers

Stormwater Management Plan

Public Review Opportunities

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SMITH-BYBEE MANAGEMENT COMMITTEE
600 NE GRAND AVENUE
PORTLAND OR 97221

Public Review
Opportunities

Stormwater Management Plan

ENVIRONMENTAL SERVICES
CITY OF PORTLAND
1120 SW Fifth Avenue, Room 1000
Portland, Oregon 97204-1912

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METRO

February 2, 2006

Elaine Stewart
600 NE Grand Ave.
Portland, OR 97232

Dear Larry:

As discussed at the January 24, 2006 meeting of the Smith and Bybee Wetlands Management Committee (SBMC), Metro is seeking letters of support for a St. Johns Landfill perimeter dike stabilization project. The letters will be included in Metro's request for a FY 2007 federal appropriation for the project. We would like to include a support letter from the SBMC. My understanding is that the SBMC will discuss this project at its February 28 meeting.

Note that the letter can be brief, and generally states support for the project concept (i.e., stabilizing a failing section of perimeter bank at the landfill). As with any project like this, it will eventually go through a City land use review and other permitting procedures, where stakeholders have the opportunity to comment on the project design.

The district office of the U.S. Army Corps of Engineers has determined that the project qualifies for federal funding under the Emergency Stream Bank and Shoreline Protection section of the 1962 Flood Control Act. The project received federal appropriations in fiscal years 2003-2006 that have allowed essentially all project planning and design work to be completed. This work has been carried out by Cornforth Consultants under contract to the USACE. Attached is Cornforth's final Planning and Design Analysis submitted in July 2006. It includes project rationale, site conditions, preliminary design, and cost estimates.

If an amount sufficient to implement the project were appropriated, Metro would provide a local funding match equal to one-third of the project cost. The USACE would manage the project, with Metro as project sponsor.

As you know, the landfill is located in a sensitive environment and is surrounded by surface water. The perimeter dike is the only barrier between the Columbia Slough and the buried solid waste and contaminated liquid (leachate). The dike contains the waste, retards the movement of liquid, and filters out some contaminants. Surface water is eroding this dike, endangering its effectiveness in protecting long-term health, safety and the environment.

In 1997 and 2000, Metro repaired sections of the perimeter representing 12% of the dike fronting Columbia Slough. Future collapse of the dike could cause buried waste and contaminated liquid to fall into the Slough. Metro wants to avoid this emergency by carrying out preventative repairs. The section of dike that is the subject of our request for federal funding is 1,000 lineal feet fronting the North Slough arm of the Columbia Slough. This section has been identified by Metro as the highest priority for repair, due to accelerated erosion. In its field reconnaissance during planning and design, USACE / Cornforth verified that this section of the landfill perimeter has the highest priority.

Thank you for your consideration of this important project.

Sincerely,

Paul Vandenberg
Principal Solid Waste Planner

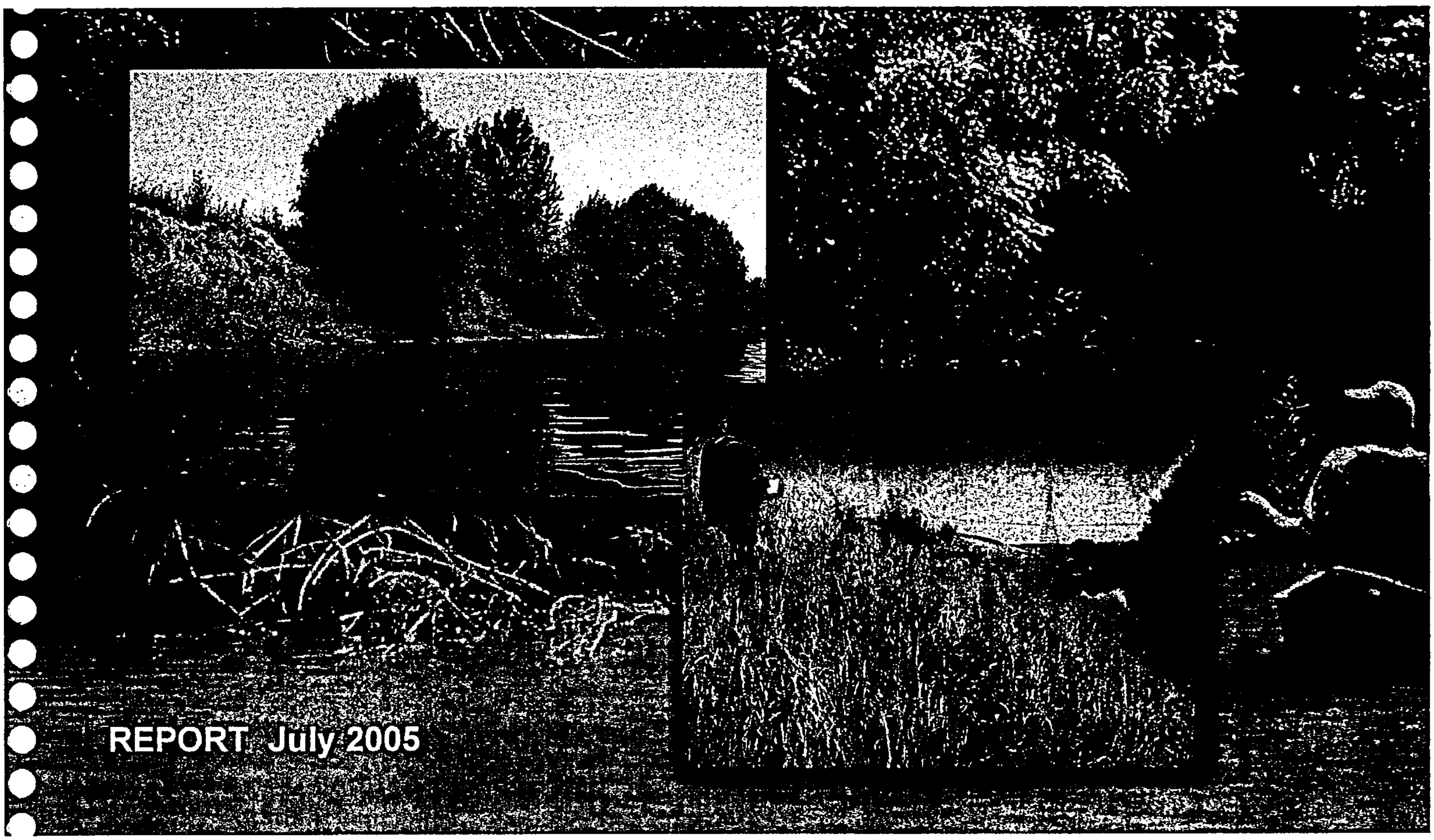
cc: Jim Watkins, Engineering and Environmental Services Division Manager
Elaine Stewart, Metro – Natural Resources Scientist

U.S. ARMY CORPS OF ENGINEERS
PORTLAND DISTRICT

ST. JOHNS LANDFILL DIKE

PHASE 2 STABILIZATION
PLANNING AND DESIGN ANALYSIS

ST. JOHNS LANDFILL - PORTLAND, OREGON



CORNFORTH
CONSULTANTS

Report to:

U.S. Army Corps of Engineers, Portland District
P.O. Box 2946
Portland, OR 97208-2946

ST. JOHNS LANDFILL DIKE
PHASE 2 STABILIZATION

Contract DACW 57-03-D-0006 (Task Order No. 02)

July 2005

Cornforth Consultants, Inc.
10250 SW Greenburg Road, Suite 111
Portland, OR 97223

ST. JOHNS LANDFILL DIKE
PHASE 2 STABILIZATION

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1. INTRODUCTION

1.1 General

The information presented in this report was prepared in response to the "Detailed Statement of Work" for Contract No. DACW57-03-D-0006, Cornforth Consultants, Task Order No. 02, St. Johns Landfill Dike Phase 2 Stabilization. The work includes an evaluation of streambank erosion on the perimeter dike that surrounds the landfill, and preliminary design of dike stabilization methods.

1.2 Project Description

The St. Johns Landfill was constructed within a shallow lake on a floodplain in Portland, Oregon, near the confluence of the Columbia and Willamette Rivers. The landfill location is shown on the Vicinity Map, Figure 1. The site covers 236 acres and was the main landfill for the Portland area for more than 50 years. It is surrounded by surface water, including the Columbia Slough, North Slough and Smith and Bybee Lakes (Fig. 1). Due to its proximity to the Columbia River, the waterways around the landfill have significant tidal fluctuations.

From 1940 to 1991, about 12 to 15 million tons of solid waste was buried in the landfill. The refuse is separated from the surrounding waterways by a perimeter dike, which is comprised of a silty embankment constructed over soft alluvial soils. Erosion along the toe of the perimeter dike has progressively worsened over time, and in some cases caused extensive loss of trees and embankment soil. The problem is particularly severe along portions of the North Slough, where a relatively thin veneer of soil separates the refuse from the waterway. The continued occurrence of slumps at the toe of the dike has lead to concerns that it could fail catastrophically and spill refuse into the sloughs.

Between 1998 and 2001, Cornforth Consultants, Inc. (CCI) assisted the landowner, Metro Regional Services (Metro), with a Phase 1 dike stabilization program. The Phase 1 study included: (i) a shoreline reconnaissance; (ii) modeling of slough channel hydraulics; (iii) design of ecologically and environmentally "green" bank stabilization methods in three critical areas; (iv) preparation of topographic maps of the three critical dike segments; (v) design of a cement-bentonite seepage cutoff wall for a dike segment where erosion had encroached upon buried refuse; (vi) preparation of construction drawings and technical specifications for slope repair work; and (vii) construction control observations.

During the course of the Phase 1 studies, CCI prepared a report titled "Preliminary Dike Stabilization Study, St. Johns Landfill," which was submitted to

Metro in June 1999. The report identified the three critical repair areas shown on the Site Plan, Figure 2, which totaled about 1,150 feet in length. Following the preliminary report submittal, the dike stabilization design was finalized and construction documents were prepared. The "green" dike stabilization design consisted of a biotechnical approach, which incorporated graded rock materials at the toe of the slope, and silty soils reinforced with geotextiles and native plants in the upper portion of the slope. The construction work for the three critical areas was performed in the summer of 2000, and a seepage cutoff wall was constructed in the summer of 2001.

1.3 Phase 2 Priority Repair Area

In 2001, Metro prepared a report titled "Perimeter Bank Stabilization at St. Johns Landfill," which summarized the project background, previous erosion modeling and monitoring, potential repair methods, future repair considerations, and a listing of prioritized repair areas. The study ranked dike repair areas based on proximity to refuse, history of leachate seepage, estimated thickness of the dike (judged from historical air photos), potential for erosion based on location in the slough channel (i.e., constricted vs. non-constricted), and the presence of shoaling/mudflats. Based on Metro's studies, a 1,000-foot long section of dike located along the North Slough on the northwestern portion of the site (see Figure 2) was identified as the highest repair priority. In this area, the existing dike is estimated to be quite low and thin. The location of this repair area is discussed further in Chapter 2.

1.4 Objectives

Unstable conditions caused by continued streambank erosion along un-repaired segments of the perimeter dike require prompt action to minimize the threat to public safety, and to prevent the possible escape of refuse from the landfill. The current study is termed the "Phase 2 Stabilization." The Phase 2 work is being performed under the U.S. Army Corps of Engineers Continuing Authority, Section 14 of the 1946 Flood Control Act, "Emergency Streambank and Shoreline Protection." The goal of the Phase 2 study is to stabilize the prioritized 1,000-foot segment of the perimeter dike along North Slough discussed above. The City of Portland requires the dike stabilization design to provide enhanced fish and wildlife habitat in general accordance with the City's "Smith and Bybee Lakes Wildlife Management Plan," which went into effect in November 1990.

The primary work objectives were divided into Phases 2a and 2b as listed below. Phase 2a includes the mandatory tasks under the current authorization. Phase 2b will be negotiated and completed at a later time.

<u>Phase 2a</u>:

- Prepare a design document (Planning and Design Analysis) with an engineer's construction cost estimate.
- Provide environmental compliance assistance to the Corps of Engineers Portland District (CENWP) for required permits and approvals.

<u>Phase 2b</u>:

- Prepare the construction contract plans and technical specifications and assist in preparation of the Engineering Concerns and Instructions (ECI) document.

1.5 Phase 2a Scope of Work

The Phase 2a scope of work includes the following tasks:

1) <u>Quality Control Plan</u>. A draft Quality Control Plan was submitted to CENWP on July 15, 2004.
2) <u>Planning and Design Analysis (PDA)</u>. The PDA includes the following subtasks:
    a. A limited site reconnaissance to characterize the soils and bank erosion process at the critical locations where erosion is severe.
    b. A review of dike stabilization alternatives, and preliminary design for a recommended method including conceptual quantity and cost estimates.
    c. Identify native plant species that could be incorporated into a biotechnical design.
    d. Topographic map of the proposed repair area, which incorporates up to 1,000 feet of the dike.
    e. Two meetings. A kickoff meeting was held on July 15, 2004, and a checkpoint meeting was held on August 31, 2004.
    f. Prepare the PDA report.
3) <u>Environmental Compliance</u>. The environmental compliance includes the subtasks listed below. The anticipated permit requirements are listed in this report.
    a. Provide assistance to CENWP and Metro as necessary to achieve environmental acceptability of proposed slope treatment alternatives.
    b. Provide specific design data as requested to obtain required permits and approvals.

4) Independent Technical Review. An Independent Technical Review (ITR) was completed on this geotechnical report. The ITR was performed by Randall Hill, P.E., a senior geotechnical engineer with Cornforth Consultants, Inc. (CCI) who was not otherwise involved with the project. Comments and issues identified during the ITR are included in Appendix A, Independent Technical Review.

1.6 Coordination

CCI provided the resources for all work and coordination efforts required for the task order, including the following:

- Mike Meyer and John Sager were Co-Project Managers, and served as the point of contact and liaison between CENWP and CCI.
- Mr. Mark Vlahakis of Fishman Environmental Services, a Division of SWCA, Inc., of Portland, Oregon, provided permitting and native planting studies.
- Crane & Merseth Engineering/Surveying of Milwaukie, Oregon provided topographic survey data.
- Corps of Engineers Portland District contacts were as follows:

  Art Fong, (503) 808-4862 – Technical Lead and P.O.C.

  Doug Putman, (503) 808-4733 – Project Manager

2. SITE CONDITIONS

2.1 General Conditions

The original lake for the landfill site was bounded by a naturally formed dike, which was comprised of alluvium consisting of soft, fine sandy, slightly clayey silt, to loose, sandy silt. During the course of landfill operations, the natural dike was raised around much of the site by placing fill consisting of medium stiff, fine sandy, slightly clayey silt, to loose silty sand. In the early 1980's, the landfill area was expanded to the east by constructing an engineered dike around the eastern perimeter (Fig. 2). The engineered dike was comprised of compacted, slightly sandy, clayey silt.

The landfill surface is generally grass-covered with moderately sloping topography. The perimeter dike is typically covered by grasses, blackberry vines, cottonwoods, willows and ash trees above the average high tide line. Below the average high tide line the slope is relatively bare, with occasional sparse growth of grasses. Many of the trees and bushes along the shoreline have been undercut by erosion, which has exposed the root systems. Several trees have been undercut to the point that they are either leaning or have fallen into the sloughs.

The original elevations for the top of the natural dike are not known. However, subsurface information from borings previously performed by CCI (J-Series borings in 1990) indicates that the natural dike ranged from about elevation 5 feet to elevation 19 feet. The top of the dike currently ranges from about elevation 15 feet to 30 feet, and averages around elevation 20 feet, which suggests that significant filling has occurred over the natural dike.

2.2 Erosion Assessment

Both the native alluvial soils and dike fills are comprised of silty/sandy soils that are prone to scour and slumping. In general, the older, non-engineered segments of the perimeter dike show signs of erosion and minor slumping commonly observed along the shoreline of other sloughs and rivers in the region. The erosion typically occurs at the outer toe of the dike slope below the average high tide waterline. The eroded portions of the slope are generally over-steepened, ranging from near vertical to about 1.5 horizontal to 1 vertical.

The shear strength of the soft/loose alluvium and fill soils in the dike is relatively low; therefore, erosion at the toe of the slope is likely to cause unstable conditions. This is especially true after flood events when the pore water pressures in the dike are elevated. The face of the dike shows evidence of shallow slumps and occasionally larger failures, which were probably related to oversteepening at the toe of the slope. The presence of minor slumps and slope failures around the landfill perimeter signifies that the overall stability of the dike is marginal at present. Therefore, as the erosion advances, we anticipate that the frequency and magnitude of slope failures would increase. This increases the risk that refuse may enter the slough waterways.

2.3 Previous Repairs and Slope Monitoring

During CCI's Phase 1 investigation, we identified 12 separate slough channel cross-sections around the perimeter dike for evaluation. The locations of the sections are shown on Figure 2. These key areas were selected to include: (i) segments of the dike exhibiting more significant erosion or slope failures, (ii) areas more likely to have higher flow velocity due to channel geometry (i.e., a constricted cross-sectional area or a bend in the channel), and (iii) failed dike sections that were previously repaired. The Phase 2 highest priority repair area identified by Metro, through periodic inspection, monitoring, and review of historical records, lies between Sections 9 and 10 (Fig. 2).

Previous dike repairs by Metro have occurred at Sections 3, 4, 5, 8, and between Sections 10 and 11. The repairs on Sections 3, 5, and 10 to 11 consisted of the Phase 1 biotechnical slope repairs discussed in Chapter 1. Sections 3 and 5 were locations where relatively large slope failures had occurred, and were undermining the access road on top of the perimeter dike. The work between Sections 10 and 11 was necessary to stabilize the dike so that a slurry wall could be installed to cutoff seepage through that section of the dike.

The slope repair work at Section 4 was completed by Metro in 1997. It was an experimental program that consisted of constructing two sand benches on a shallow mudflat at the toe of a raveling slope. The purpose of the benches was to buttress the dike with sand, and to create a level area near the average high tide line where native plants could be established. Metro has experimented with various planting trials on the sand benches since that time, with mixed results. No additional repairs have been made with the sand bench method since 1997 due to permitting issues and concerns about changes in the slough channel hydraulics.

The slope failure at Section 8 occurred in early 1996 during a period of torrential rain and flooding. The failed section was approximately 45 feet in length by 20 feet in height. The failure occurred as a flow slide, which carried soil, trees and other vegetation into the Columbia Slough. Metro repaired the slope in 1997 by removing the loose debris and reconstructing the slope with rockfill materials.

Following the Phase 1 slope repair work in 2000, Metro established a survey monitoring program on eight of the key cross-sections, including Sections 1, 2, 4, 6, 7, 8, 9, and 12. The cross-sections have been surveyed annually, but no clear patterns on scour or sedimentation have been observed.

2.4 Phase 2 Reconnaissance

On July 22, 2004, members of the CCI project team and representatives from CENWP and Metro toured the perimeter of the landfill from canoes. The areas observed included the shoreline along Columbia Slough and North Slough (Fig. 2). The purpose of the boat reconnaissance was to: (i) observe the general condition of the dike during a time when water levels are normally low, and (ii) observe the condition of the Phase 1 dike repair areas that were completed in the summer of 2000. Photographs taken during the reconnaissance are on-file in CCI's office.

In general, the perimeter dike continues to show signs of erosion and shallow slumping. However, the previously repaired segments (Sections 3, 4, 5, 8, and 10 through 11) show no signs of erosion, and appear to be stable. Representative photographs of the Phase 1 repair areas are shown on Figure 3.

Similar to previous reconnaissances of the site, the erosion appears to be most severe below the average high tide waterline. The eroded toe condition is essentially continuous around the non-repaired areas, and there are indications of isolated minor shallow slumps. The most notable scour and slumping appears to be between Sections 9 and 10, and also near Section 12 (Fig. 2). The dike segment between Section 9 and 10 exhibits heavy undercutting of the toe, which has exposed the root masses of numerous trees. Several of the trees have fallen into the slough in this area. The inspection team also observed a few isolated bowl-shaped depressions in the upper portion of the slope through this area, which suggests that some shallow slumping has occurred. As discussed previously, the prioritized Phase 2 repair area lies within this segment of the dike. A photograph of existing shoreline conditions between Sections 9 and 10 is shown on Figure 4.

The dike in the vicinity of Section 12 shows signs of significant erosion and recent slope failures. A photograph of a slope failure near Section 12 is shown on Figure 4. We observed headscarp cracks near the crest of the dike and relatively large bowl-shaped slump features. The ongoing erosion and slumping through this area are occurring in a segment of the naturally formed dike. The engineered dike for the landfill is setback approximately 100 feet through this area, which indicates that it is in no immediate danger of failure. On that basis, the dike segment around Section 12 is not considered a priority repair area.

2.5 Vegetation Survival in Phase 1 Repair Areas

The Phase 1 plantings were installed in the winter of 2000/2001 and included native trees, shrubs, and herbaceous species. Trees and shrubs were installed with a general "species break" at elevation 17 feet. Trees and shrubs able to tolerate wetter conditions were installed on the lower slope below elevation 17 (willow, dogwood, spirea, etc.), while drier species (rose, snowberry, elderberry, etc.) were installed on the upper slope. No plantings were installed below elevation 12 feet.

Tree and shrub plantings between elevation 12 and 15 are showing good survival and moderate vigor. Although the plants appear healthy, their rate of growth has been relatively slow. Tree and shrub plantings above elevation 15 show low survival and low to moderate vigor. In this area, the plants are sparse and the overall growth rate has been slow. Herbaceous cover is generally greater than 90 percent throughout the slope, but only a few of the planted tree and shrub species are conspicuous. The most successful tree and shrub species include Oregon ash, red-osier dogwood, and Douglas spirea along the lower slope, with nootka rose and snowberry doing the best on the upper slope. There is occasional evidence of animal browse.

Based on the Phase 2 reconnaissance, it appears that the growing conditions in the Phase 1 dike repair areas are slightly too dry to support the original planting plan. The slope angle and internal filter/drain layer promote drainage that is necessary to protect the stability of the slope. Except for the lower slope that is subject to highly variable inundation from high water conditions during the winter and spring months, the slope exhibits a drier, more xeric condition. This condition favors plant species that can tolerate a relatively wide range of hydrologic conditions, from moist to wet during the winter and spring, to drought-like conditions in the late part of the growing season. On that basis, the proposed vegetation for the Phase 2 repair work (in Chapter 3) includes native plants that are more tolerant of dryer conditions.

3. PRELIMINARY DIKE REPAIR DESIGN

3.1 General

The primary goals of the dike repairs are to: (i) stabilize the slope and provide erosion protection, (ii) avoid or minimize impacts to water quality, and (iii) provide enhanced ecological values within the Smith and Bybee Lakes/Columbia Slough Management Area. Our preliminary dike repair design attempts to satisfy these goals to the extent possible. Since the primary function of the dike is to prevent refuse from entering the slough, the primary design criterion is to maintain long-term stability of the dike.

3.2 Conceptual Repair Alternatives

During the Phase 1 study, CCI evaluated numerous traditional alternatives to stabilize the dike, and several other methods that incorporate a more "biotechnical" or vegetation-focused approach. An overview of the conceptual repair alternatives is presented below.

3.2.1 Traditional Alternatives. In general, traditional dike repairs have involved techniques such as rock/riprap fills, various types of retaining walls, or commercially available erosion control products. Many of these alternatives involve the use of larger rock pieces and/or man-made materials (e.g., metal or concrete). Specific traditional alternatives considered for the Phase 2 design include: a rockfill buttress with riprap armoring, a sheetpile bulkhead wall, a tied-back wall, a stacked gabion wall, stacked geotubes (i.e., large-diameter, soil-filled geotextile tubes), a micropile wall (dike reinforcement using thin-diameter pipe piles), sand benches, and erosion/scour control products such as A-Jacks, Reno Mats and Petraflex blocks.

Aside from potential problems with wildlife habitat, there are technical concerns that ruled out many of the traditional alternatives. The sheetpile wall, tied-back wall, and micropile wall alternatives would all have to penetrate very deep (35 to 40 feet beneath the dike) to embed into underlying dense sand and gravel layers to provide support for the dike slope, and each method would be susceptible to corrosion. In addition, the micropile option would not address the scour problem occurring at the toe of the dike. The concerns about the stacked gabions and geotubes are that they could overload the soft foundation soils at the toe of the dike, and they would be susceptible to corrosion/degradation. The sand bench option carries potential permitting problems, and would also require significant study to assess the effects on slough channel hydraulics.

The drawback to erosion control products used alone, is that they would not replace the missing support at the toe of the dike that was removed by previous scour and erosion.

Traditional alternatives can be very useful for stabilizing a dike and preventing erosion. However, at St. Johns Landfill they could produce an adverse impact on the existing fish and wildlife resources, and would not be considered visually aesthetic. On that basis, traditional stabilization measures alone would not meet the goals of the Natural Resources Management Plan for Smith and Bybee Lakes.

3.2.2 Biotechnical Alternatives. Biotechnical alternatives typically involve planting willows, grasses, and other vegetation on a slope face that has been reinforced with logs, coconut fiber mats or some other biodegradable product. The vegetation serves several purposes: (i) the root systems help reinforce the slope and reduce erosion, (ii) it improves the appearance of the slope, and (iii) it provides wildlife habitat and shade on the waterways. The vegetation may be particularly useful on the dike around St. Johns Landfill because leachate discharge through the dike could receive some biochemical treatment by the root systems and associated microorganisms (which helps water quality).

Potential problems with biotechnical alternatives include: the length of time before plants become well established and their complex root systems have developed (possibly several growing seasons), inability to successfully establish plants on the lower elevations of the dike due to frequent inundation, predators destroying the plants, and the loss of internal support as the logs or fiber reinforcement mats deteriorate.

Specific biotechnical options considered include: a live crib wall, a gabion wall with vegetation, and a mechanically stabilized earth wall (MSE) that utilize geotextiles and native plants. A live crib wall consists of a vegetated rock and soil slope supported by a log structure. The major disadvantage of a live crib wall is that it is typically limited to about 4 feet in height because it cannot withstand heavy soil and rock loading. The gabion wall with vegetation method would consist of stacked rows of gabion baskets infilled with a mixture of soil and rock that could support plant growth. The primary drawbacks to this method are that the finer/silty soil could erode out of the baskets and destabilize the wall, the baskets could corrode, and the wall could overload the soft foundation soil.

The remaining biotechnical option considered was a vegetated MSE slope. This method involves reconstructing the outer slope of the dike with silty soil reinforced internally with geotextiles. The slope face is heavily planted with vegetation to help provide slope stability and resistance to scour. The benefits of this method are that it provides all the biotechnical advantages listed above. However, for this method to work properly it must have vegetation that grows well. Without a healthy stand of vegetation, the slough current and tidal action could wash out the soil and contribute to slope instability. A key design issue is that at St. Johns Landfill, vegetation does not grow well below the average high tide waterline, which is near elevation 12 feet (City of Portland datum).

3.2.3 Combined Alternatives. The Phase 1 dike repair design combined traditional and biotechnical techniques to take advantage of the strengths of both methods. The design included traditional rockfill materials below the average high tide line to strengthen and buttress the slope, and to provide scour protection in the vital toe area. The upper portion of the slope was comprised of silty soil reinforced with geotextiles (i.e., geogrids and geocells), coconut fiber mats, and native vegetation, which provided aesthetic and ecological value to the dike.

3.3 Preliminary Phase 2 Dike Design

As discussed in Chapter 2, the dike segments repaired in Phase 1 appear to be performing very well. The repaired slopes have remained stable, and the vegetation has achieved a reasonable degree of success. On that basis, the proposed Phase 2 design is very similar with only a few modifications. The key changes in Phase 2 include a terraced segment along the mid-portion of the slope to help improve the visual aesthetics, and some modifications to the planting design to establish native plants that are more tolerant to dryer slope conditions. A brief description of the proposed design is provided below.

Topographic Map. Crane & Merseth Engineering/Surveying prepared a topographic map and cross-sections of the priority Phase 2 repair area in August 2004. The topographic map is shown on Figures 5 and 6. Crane & Merseth arbitrarily selected the stationing shown on the figures. Station 15+78 on Figure 6 coincides with the west end (i.e., Section 10) of the Phase 1 repair area that occurred in 2000.

Slope Design. Representative cross-sections of the proposed Phase 2 slope design are shown on Figures 5 and 6. The design consists of graded rockfill in the lower portion of the dike slope, and compacted silty soil reinforced with geogrids and stacked geocells in the upper portion. The outer slope would stand at an angle of 1.75 horizontal to 1 vertical.

Some excavation would be required to remove the water-softened debris, trees and roots from the treatment areas, and also to achieve the required geometry for the reconstructed slope. At the toe of the dike, an excavation would be made using a large backhoe or crane to create an 8- to 10-foot bench to support the rock materials.

A crushed rock filter layer would be placed beneath both the lower and upper portions of the slope to prevent/relieve pore water pressure buildup. As with the Phase 1 design, the transition from rockfill to reinforced soil would occur at elevation 12 feet. Graded rockfill material would consist of hard, clean, angular, durable, well graded, 12-inch minus blasted or crushed rock obtained from a hard rock quarry source. Filter material would consist of hard, clean, angular, durable, ¾-inch minus crushed rock obtained from a hard rock quarry source. The filter and graded rockfill materials would be placed in 1-foot lifts and compacted by either tamping with a backhoe bucket or by several passes from the treads of the spreading equipment.

From elevation 12 to 15 feet, the outer face of the MSE portion of the slope would include stacked geocells that are infilled with lightly compacted silt soil. The purpose of the geocells is to provide additional scour protection on the portion of the slope where vegetation can grow, yet is still frequently inundated and subject to scour during winter floods and spring freshets. Above elevation 15 feet, the slope would be comprised of compacted lifts of silty soil reinforced by wraps of geogrid. The soil would consist of sandy silt to slightly clayey silt, that is compacted at a moisture content from 1 percent below to 3 percent over the optimum moisture content, and to at least 95 percent of the maximum dry density as determined by a Standard Proctor compaction test (ASTM D 698). The soil would be placed in 6- to 12-inch lifts, and compacted using a pad-foot roller.

Details on the geogrid and geocell construction are shown on Figures 7 and 8, respectively. As shown on these figures, each lift would be wrapped in a biodegradable coir (coconut fiber) blanket, which would hold moisture for plants and help prevent scour until the plants get established.

Slope Stability. Slope stability analyses were performed in Phase 1 to assess the stability of the reconstructed dike under the design outlined above. The internal stability analyses for the reinforced dike slope were performed by the Tensar company of Atlanta, Georgia, using proprietary software. CCI checked the global stability of the dike using the program UTEXAS3.

The geogrid layout (i.e., vertical spacing and embedment length) was designed to provide a minimum calculated Factor of Safety (FS) of 1.5 for various potential failure modes, including shear through the reinforced soil, geogrid pullout, and compound failures. Tensar indicated that allowances were made in the internal stability analysis for possible damage to the geogrid during installation. The global stability analysis indicated a calculated FS of 1.4 for potential slope failures that pass beneath the geogrid reinforcement and graded rock sections of the dike. The soil density and strength parameters used in the analyses are summarized in Table 3.1 below.

Table 3.1 – Soil Density and Strength Parameters

Element	Unit Weight (pcf)	Effective Cohesion c′ (psf)	Friction Angle ϕ' (degrees)
Silt Fill Reinforced by Geogrids	115	0	32
Rockfill	125	0	42
Existing Levee Fill	115	0	32
Alluvium Foundation	110	0	28

Terrace. The terrace feature discussed above occurs on top of the stacked geocells at elevation 15 feet, between Stations 8+00 and 10+00. The terrace location was selected to visually accentuate a slight inward bend in the dike between Stations 8+00 and 10+00 (see plan view, Fig. 5). The terrace width would be 3 feet (see Section B, Fig. 5).

3.4 Vegetation Design

Re-vegetation of the stabilized dike slopes would be accomplished using the native tree, shrub, grass, and forb species listed in Tables 3.2 through 3.4 below. All plant species are listed in the Metro Native Plant List (1998), and the City of Portland Plant List (updated March 2004).

The goal of the vegetation design would be to establish a native-dominated vegetative community containing tree, shrub, and herbaceous strata within the project area above elevation 12. Plant species have been selected from observations of existing plant communities along the lower Columbia Slough, an assessment of conditions at the Phase 1 dike slope stabilization work, past project experience working with native plant communities in the slough area, and matching species to anticipated Phase 2 site conditions.

For planting purposes, the dike slope is broken up between elevation 12 to 15 and elevation 15 to 18^+ (City of Portland datum). The lower planting slope (elevation 12 to 15) represents the wetter habitat where inundation can occur at varying intervals from heavy winter storms and the Columbia River's spring freshets. This location will also experience the dry conditions typical of late summer and early fall. The upper planting slope (elevation 15 to 18^+) is above typical inundation levels and would experience saturated soils only briefly during heavy rainfall coupled with high river levels. More typical conditions on the upper slope would be moist soils present during much of winter/spring with more xeric conditions during the remainder of the growing season. Plant species selection reflects this anticipated drier riparian habitat, using species that are adaptable to a relatively wide hydrologic range. The terrace between Stations 8+00 and 10+00 would receive a separate planting regime (alder/cedar mix) in an attempt to create a unique visual response and wildlife habitat within the enhanced slope.

Container nursery stock of the 1-gallon size will be generally utilized for the planting of trees and shrubs (except willow). The reasoning for using container stock over seasonal bare-root stock for this project is as follows:

- The slope can be planted in the fall immediately following the anticipated completion of construction in early September.
- Plantings with established root systems should be better able to compete with densely rooted native grasses and forbs for moisture and nutrients.
- There is good access to/from the planting area from the landfill's perimeter road.

Following the completion of tree and shrub installation, the exposed soil would be prepared (loosened) and then seeded in a two-stage operation. First, the specified forbs would be hand broadcast in an evenly manner within the upper slope (elevation 15 to 18^+). Second, the specified native grass mix would be hydroseeded throughout (Elevation 12 to 18^+) using mulch (1,500 lbs/acre minimum) and tacifier.

Table 3.2 - Tree Planting

Tree Species	Elevation	Type	Quantity	Notes
Oregon ash (*F. latifolia*)	12-15	1-gallon container	45	Main species for lower elevation
Pacific willow (*S. lasiandra*)	12-15	Cutting	30	Common slough willow
Sitka willow (*S. sitchensis*)	12-15	Cutting	20	Streamside willow
Black cottonwood (*P. balsamifera*)	15-18$^+$	1-gallon container	80	Throughout higher elevation
Madrone (*A. menziesii*)	15-18$^+$	1-gallon container	10	Few for visual enhancement at top of slope
Scouler's willow (*S. scouleriana*)	15-18$^+$	Cutting	20	Throughout higher elevation (shade intolerant)
Big-leaf maple (*A. macrophyllum*)	15-18$^+$	1-gallon container	125	Main species for higher elevation
Cascara (*R. purshiana*)	15-18$^+$	1-gallon container	40	Few (for diversity on upper slope area)
Black hawthorne (*C. suksdorfii*)	15-18$^+$	1-gallon container	30	Few (for diversity, wildlife habitat)
Red alder (*A. rubra*)	15-18$^+$	1-gallon container	40	Co-plant with cedar on terrace area
Western red cedar (*T. plicata*)	15-18$^+$	1-gallon container	10	Co-plant with alder on terrace area

Notes:
1. Alder/cedar groupings to be planted in "terrace" area (Station 8+00 to 10+00).

? pine & madrone?

Table 3.3 – Shrub Planting

Shrub Species	Elevation	Type	Quantity	Notes
Red-osier dogwood (*C.stolonifera*)	12-15	1-gallon container	240	Main species for low elevation.
High-bush cranberry (*V. edule*)	12-15	1-gallon container	40	Few clustered in groups.
Snowberry (*S. albus*)	15-18^{+}	1-gallon container	520	Main species for higher elevation.
Blue elderberry (*S. caerulea*)	15-18^{+}	1-gallon container	100	Throughout higher elevation.
Nootka rose (*R. nutkana*)	15-18^{+}	1-gallon container	150	Throughout higher elevation in isolated groups.
Flowering current (*R. sanguineum*)	15-18^{+}	1-gallon container	80	Few near top of slope in isolated groups.
Mock orange (*P. lewissi*)	15-18^{+}	1-gallon container	60	Few individuals near top of slope.

Notes:

1. No shrubs to be planted in the "Terrace Area"

Table 3.4 – Grasses and Forbs Planting

Grasses and Forbs	Elevation	Rate	Notes
Blue wildrye (*E. glaucus*)	12-18+	15 lbs./ac	Main species for upper elevation; shade tolerant
Columbia brome (*B. carinatus*)	12-18+	5 lbs./ac	Drought and shade tolerant; quick establishment
Spike bentgrass (*A. exarata*)	12-18+	2 lbs./ac	Quick establishment for lower slope, wide moisture range
Slender hairgrass (*D. elongate*)	12-18+	0.5 lb./ac	Minor bunchgrass species throughout
Roemer's fescue (*F. roemeri*)	12-18+	8 lbs./ac	Main bunchgrass species throughout
Meadow barley (*H. brachyantherum*)	12-18+	10 lbs./ac	Main species for lower elevation; wide moisture range; quick establishment
Canada goldenrod (*S. canadensis*)	15-18+	0.25 lbs./ac	Seed along top of slope
Common yarrow (*A. millefolium*)	15-18+	1 lb./ac	Seed along top of slope
Common gillia (*A. millefolium*)	15-18+	2 lbs./ac	Seed along top of slope
~~River lupine (*L. rivularis*)~~	~~15-18+~~	~~5 lbs./ac~~	~~Aggressive establisher, legume~~

no thanks – L. purshianus or L. bicolor

3.5 Environmental Compliance

The proposed Phase 2 dike stabilization would require environmental compliance from local and federal authorities, as discussed below.

City of Portland. The project would be reviewed by the City of Portland for zoning and comprehensive plan consistency with the Natural Resources Management Plan for Smith and Bybee Lakes. The Plan, adopted by the City of Portland in 1990, guides the management of the Smith and Bybee Lakes area. The overall goals and objectives of the Plan are to preserve Smith and Bybee Lakes as historical remnants of the Columbia River riparian and wetlands systems, and to maintain and enhance their original natural condition. Through the Plan, development activities are evaluated in the overall context of the entire management area, which is in contrast to the City's more site-specific Environmental (E) Zone approach for other areas.

The Plan identifies standards by which development projects are reviewed. The general criteria for approval of developments are listed in Section I of the Plan implementation procedures, which includes the following:

a. The proposed development meets the goals and objectives of the Plan

b. There will be no significant negative impacts on the resources covered in the management area.

Section II of the implementation procedures identifies major and minor exceptions to the types of development activities that may be permitted. The list of minor exceptions includes exception "h," which specifically allows:

> "(h) Placement of material within the slough for bank stabilizations or for reducing of physical contact with landfill leachate or other effluent."

Based on the foregoing, the proposed Phase 2 dike stabilization work meets the broad management goals listed in the Plan, and also qualifies as an exception that was specifically written into the Plan.

Metro Title 3. Metro has been working to complete a new regional natural resource planning component to their Urban Growth Management Functional Plan. The natural resource component is comprised of two parts. The first part is commonly referred to as "Title 3: Water Quality and Flood Management," and the second part is referred to as "Title 3: Fish and Wildlife Habitat." Metro has completed the first part, and the second part is anticipated in 2005. At present, only the "Water Quality and Flood Management" portion can be considered for the Phase 2 dike stabilization.

Regarding the Title 3: Water Quality and Flood Management ordinance, Section 5 (Flood Management) includes a limited number of "uses permitted outright." One of the permitted uses is "Restoration or enhancement of floodplains, riparian, wetland, upland and streams that meet federal and state standards." This section appears to specifically allow the type of work proposed for the Phase 2 dike stabilization.

The dike stabilization design from Phase 1 in 2000 resulted in the placement of a net fill below the average high tide line at elevation 12 feet. Based on interpretations of Title 3 at the time, it was deemed necessary to offset the fill by creating a replacement wetland area at another location in the vicinity of the landfill. Based on that experience, the preliminary Phase 2 design presented in this report was configured to balance the excavation and fill quantities below the average high tide line (see quantity estimates in Chapter 4).

Corps of Engineers. The Portland District, U.S. Army Corps of Engineers (CENWP) would write an Environmental Assessment (EA) for the Phase 2 dike stabilization project to comply with the National Environmental Policy Act (NEPA). The draft EA would go out to Public Notice for 30 days. CENWP would then review and address any comments received. Since the Phase 2 dike restoration design includes biotechnical design and shoreline improvement features, it is anticipated that the project would result in a Finding of No Significant Impacts, followed by a Final EA.

For State of Oregon water quality certification, CENWP would evaluate the water quality impact in accordance with the Clean Water Act Section 404 (b)(1), and then submit the evaluation along with the Draft EA to the Oregon Department of Environmental Quality (DEQ). DEQ would be responsible for issuing the water quality certification for the project.

CENWP would coordinate with both the US Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) for compliance with the Endangered Species Act (ESA). CENWP would prepare a Biological Assessment (BA) for listed species under the jurisdiction of the USFWS. A separate BA and Essential Fish Habitat (EFH) evaluation would be prepared for species under the jurisdiction of NMFS. All ESA consultation would be conducted by CENWP with the regulatory agencies.

CENWP would evaluate any cultural resource issues regarding the project. Coordination and consultation would be conducted by CENWP with the Oregon State Historic Preservation Office and affected Tribes.

Clean Water Act Section 404. The Clean Water Act Section 404 permit is a joint application submitted to CENWP and the Oregon Department of State Lands (ODSL) for the removal or placement of fill in the slough waterway. CENWP does not issue Section 404 permits to itself. However, all requirements for Section 404 compliance would still need to be addressed in the project design and implementation schedule. Based on preliminary discussions with the project sponsor, Metro, it is understood that Metro would likely pursue the remaining half of the Section 404 permit through ODSL.

3.6 Project Implementation

The dike reconstruction work would occur during the in-stream work timeline (typically June 15 to September 15), with grass seeding to occur concurrently as the upper portion of the slope is built. Near-surface soils would need to become moistened with the autumn seasonal rains prior to planting of the shrubs and trees. On that basis, the shrubs and trees would likely be planted during the period of October through early November.

4. CONCEPTUAL QUANTITY AND COST ESTIMATES

4.1 General

The conceptual cost estimates discussed below are based on quantities estimated from the topographic information developed for the proposed Phase 2 repair area, and the actual costs from the Phase 1 construction in 2000. The conceptual costs include the contractor's mobilization, profit, overhead, site preparation and cleanup, erosion and turbidity control, surveying, and health and safety monitoring. The cost estimate does not include engineering design, permitting, administrative or quality control costs. Actual construction bids would depend on many factors such as environmental and permitting restrictions, level of competition between contractors, time of year, etc. The conceptual cost estimates shown are in 2005 dollars.

4.2 Conceptual Quantity Estimates

The estimated construction quantities for the Phase 2 dike repairs are summarized in the table below.

Item	Estimated Quantity
1. Total excavation	5,000 cubic yards
2. Vegetated geogrid slope*	2,450 cubic yards
3. Graded rock fill	1,300 cubic yards
4. Filter	1,300 cubic yards
5. Excavation below el. 12 feet	1,950 cubic yards
6. Total fill below el. 12 feet	1,950 cubic yards
7. Vegetation area from el. 12 to el. 15	6,000 square feet
8. Vegetation area on terrace	600 square feet
9. Vegetation area above el. 15 feet	19,500 square feet

*Includes geocells. Area of geocells exposed on slope face = 6,000 square feet.

4.3 Conceptual Cost Estimate

The total cost for the Phase 1 work in 2000 was $540,000, which did not include the cost of the vegetation planting. This can be used as a starting basis for estimating the Phase 2 costs. The length of dike repaired in Phase 1 was approximately 1,150 feet (i.e., total length for Sections 3, 5, and 10 to 11), which is 15 percent longer than the 1,000-foot length proposed in Phase 2. We recommend allowing for the following: (i) a 15 percent reduction in cost for the shorter dike length, and (ii) a five percent increase per year due to annual increases in construction costs. On that basis, the conceptual cost for the Phase 2 dike construction would be on the order of $575,000 to $625,000 if it were built in 2005. We estimate the cost of the vegetation would add another $50,000 to $75,000, for a projected total of $625,000 to $700,000 in 2005 dollars.

With regard to long-term maintenance costs, the only effort would be noxious weed control. Weed control costs for the Phase 2 dike repair area are estimated to be approximately $1,000 per year (in 2005 dollars).

CORNFORTH CONSULTANTS, INC.

By Michael R. Meyer
Michael R. Meyer, P.E.
Senior Associate Engineer

By John Sager, by EG
John W. Sager, C.E.G.
Senior Associate Geologist

REGISTERED PROFESSIONAL ENGINEER
15644
OREGON
SEPT. 17, 1991
MICHAEL R. MEYER
EXPIRATION DATE: 12/31/06

FISHMAN ENVIRONMENTAL SERVICES / SWCA, INC.

By Mark Vlahakis
Mark Vlahakis
Senior Soil Scientist

Cornforth Consultants, Inc.
Landslide Technology

Limitations in the Use and Interpretation of This Geotechnical Report

Our professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

The geotechnical report was prepared for the use of the Owner in the design of the subject facility and should be made available to potential contractors and/or the Contractor for information on factual data only. This report should not be used for contractual purposes as a warranty of interpreted subsurface conditions such as those indicated by the interpretive boring and test pit logs, cross-sections, or discussion of subsurface conditions contained herein.

The analyses, conclusions and recommendations contained in the report are based on site conditions as they presently exist and assume that the exploratory borings, test pits, and/or probes are representative of the subsurface conditions of the site. If, during construction, subsurface conditions are found which are significantly different from those observed in the exploratory borings and test pits, or assumed to exist in the excavations, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary. If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, this report should be reviewed to determine the applicability of the conclusions and recommendations considering the changed conditions and time lapse.

The Summary Boring Logs are our opinion of the subsurface conditions revealed by periodic sampling of the ground as the borings progressed. The soil descriptions and interfaces between strata are interpretive and actual changes may be gradual.

The boring logs and related information depict subsurface conditions only at these specific locations and at the particular time designated on the logs. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the soil conditions at these boring locations.

Groundwater levels often vary seasonally. Groundwater levels reported on the boring logs or in the body of the report are factual data only for the dates shown.

Unanticipated soil conditions are commonly encountered on construction sites and cannot be fully anticipated by merely taking soil samples, borings or test pits. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. It is recommended that the Owner consider providing a contingency fund to accommodate such potential extra costs.

This firm cannot be responsible for any deviation from the intent of this report including, but not restricted to, any changes to the scheduled time of construction, the nature of the project or the specific construction methods or means indicated in this report; nor can our firm be responsible for any construction activity on sites other than the specific site referred to in this report.

APPENDIX A

Independent Technical Review

CORNFORTH
CONSULTANTS

10250 S.W. Greenburg Road, Suite 111
Portland, Oregon 97223
Phone 503-452-1100 Fax 503-452-1528

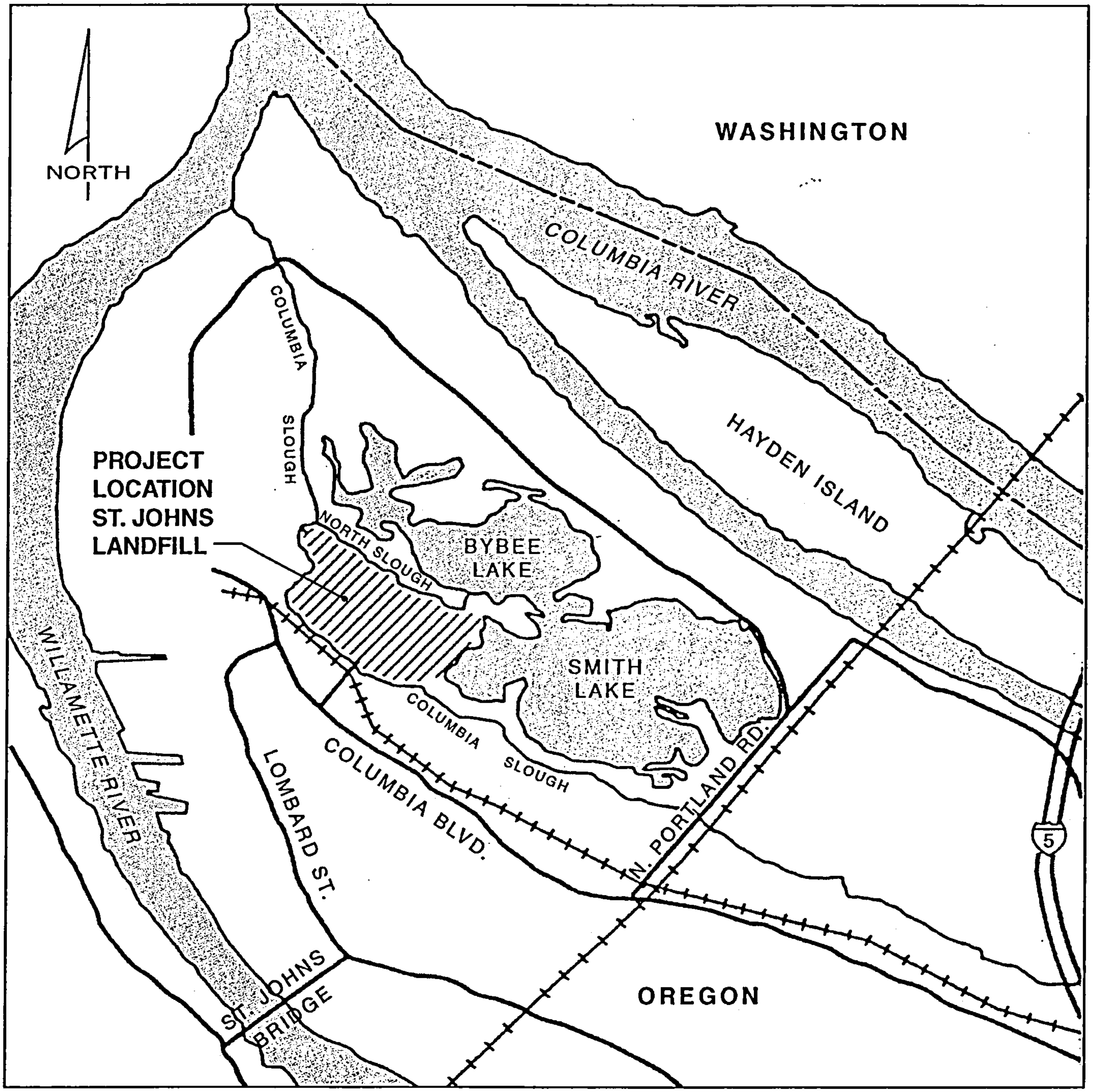
Memo To: File 1509
From: Randall J. Hill, P.E.
Date: October 13, 2004
Subject: Independent Technical Review
St. Johns Landfill Dike - Phase 2 Stabilization
Planning and Design Analysis
Portland, Oregon

An Independent Technical Review (ITR) was performed for the St. Johns Landfill Dike – Phase 2 Stabilization, Planning and Design Analysis study. The ITR included a review of a draft geotechnical report that included preliminary design drawings for slope re-construction measures for the project, as prepared by Cornforth Consultants, Inc. (CCI), dated October 2004. In accordance with the requirements and objectives of an ITR, I had no active role during the project, and was involved only in a review capacity.

In general, the information and recommendations provided in the draft report appear to satisfy the work tasks negotiated with the US Army Corps of Engineers, Portland District. In my opinion, the work was completed in accordance with the professional standard of care and provides an excellent set of recommendations for slope repair and stabilization.

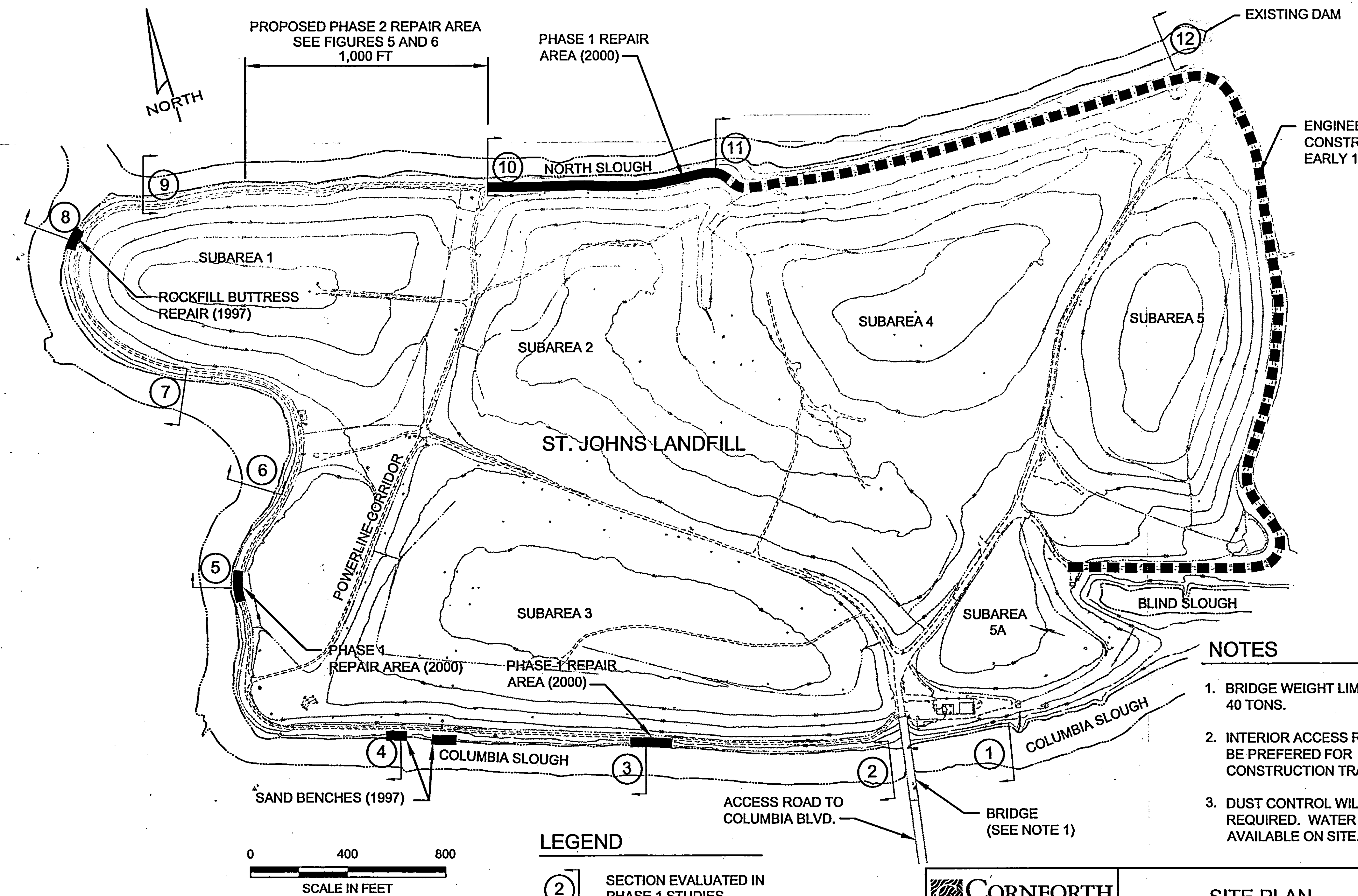
With regard to technical issues, the following comments were provided to CCI staff:

1. Under Section 2.4 Phase 2 Reconnaissance, the report discusses the on-site reconnaissance and indicates that the dike slope between Sections 9 and 10, as identified by a Phase 1 study (which includes approximately 1400 feet), has experienced heavy undercutting of the dike toe and is marginally stable. Only 1000 lineal feet has been identified for repair under the current Phase 2 study. If funding could be arranged, it would be advisable to repair the entire 1400-foot length. It is recognized that this represents a 40 percent increase and may not be possible due to economic constraints.
2. Under Section 4.3 Conceptual Cost Estimate, it was confirmed by discussions with CCI staff that the 1150 feet of slope reconstruction that was completed in 2000, under the Phase 1 work, included not only the long section of dike from Section 10 to a point just beyond Section 11, but also the two shorter segments at Sections 3 and 5. The report was edited to so indicate that the total repair length of 1150 feet was inclusive of these two shorter sections as well.



NOT TO SCALE

CORNFORTH CONSULTANTS 10250 S.W. Greenburg Road, Suite 111 Portland, Oregon 97223 Phone 503-452-1100 Fax 503-452-1528	VICINITY MAP	JUL 2005
		PROJ. 1509
1509\F01 MWT	ST. JOHNS DIKE STABILIZATION - PHASE 2 PORTLAND, OREGON	FIG. 1



LEGEND

(2) SECTION EVALUATED IN PHASE 1 STUDIES (SEE REPORT TEXT)

NOTES

1. BRIDGE WEIGHT LIMITATION IS 40 TONS.
2. INTERIOR ACCESS ROADS WILL BE PREFERED FOR CONSTRUCTION TRAFFIC.
3. DUST CONTROL WILL BE REQUIRED. WATER IS AVAILABLE ON SITE.

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1509\F02 MWT

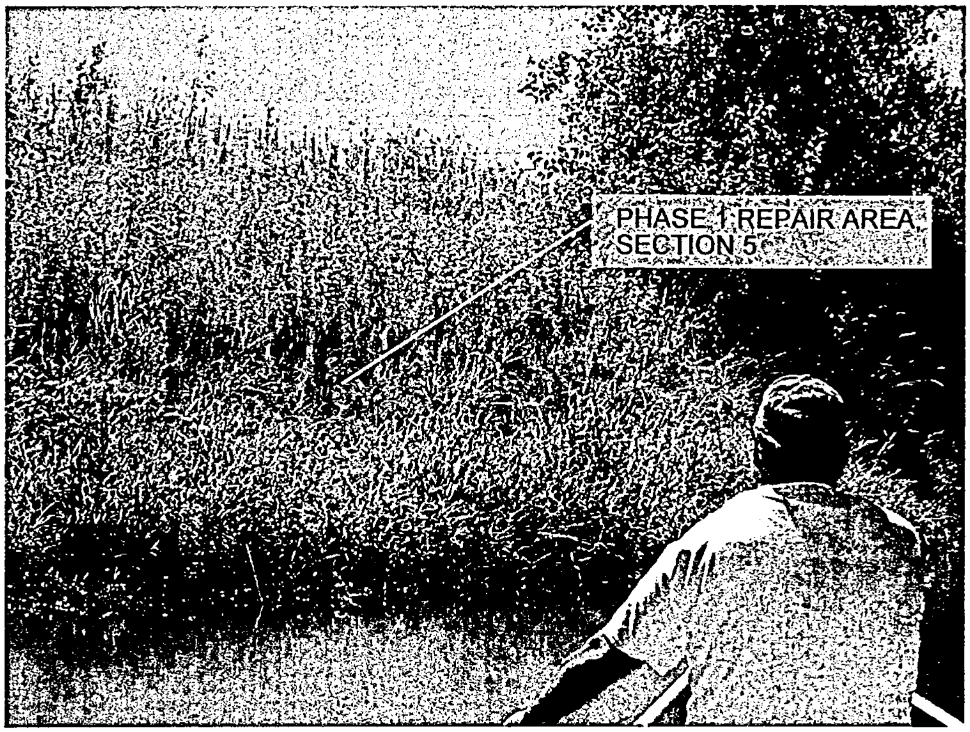
SITE PLAN

ST. JOHNS DIKE STABILIZATION - PHASE 2
PORTLAND, OREGON

JUL 2005

PROJ. 1509

FIG. 2



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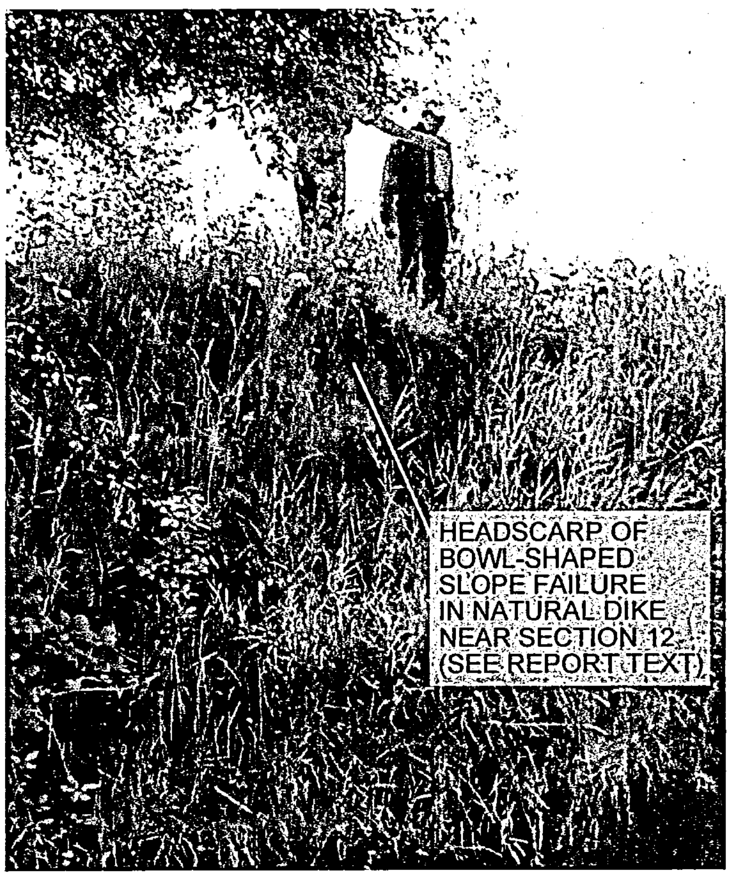
PHOTOS

ST. JOHNS DIKE STABILIZATION - PHASE 2
PORTLAND, OREGON

JUL 2005

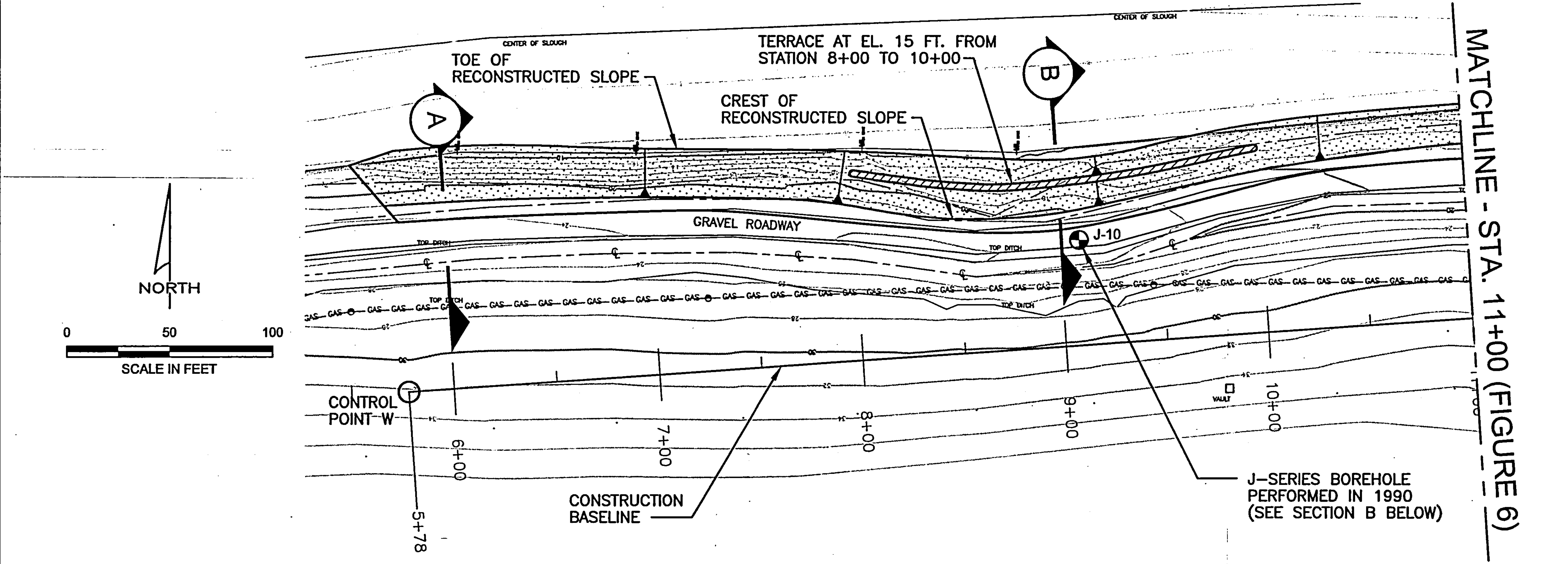
PROJ. 1509

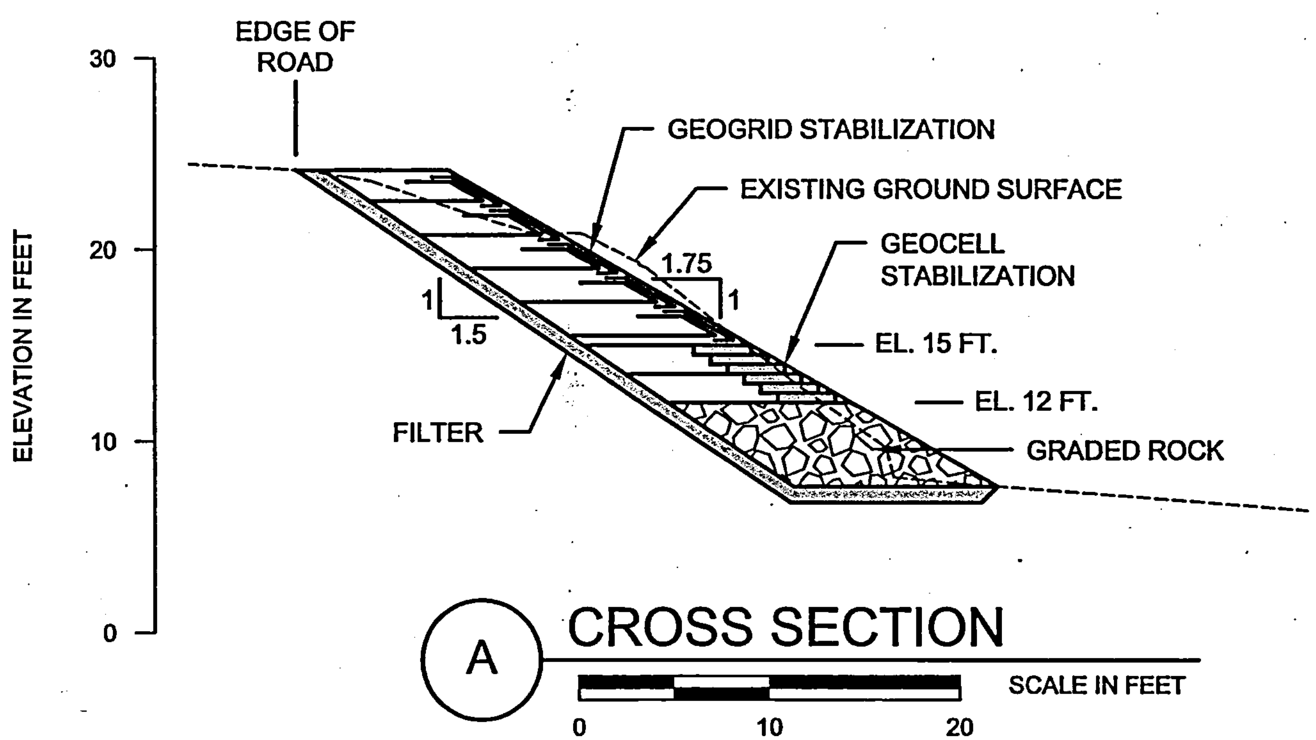
FIG. 3

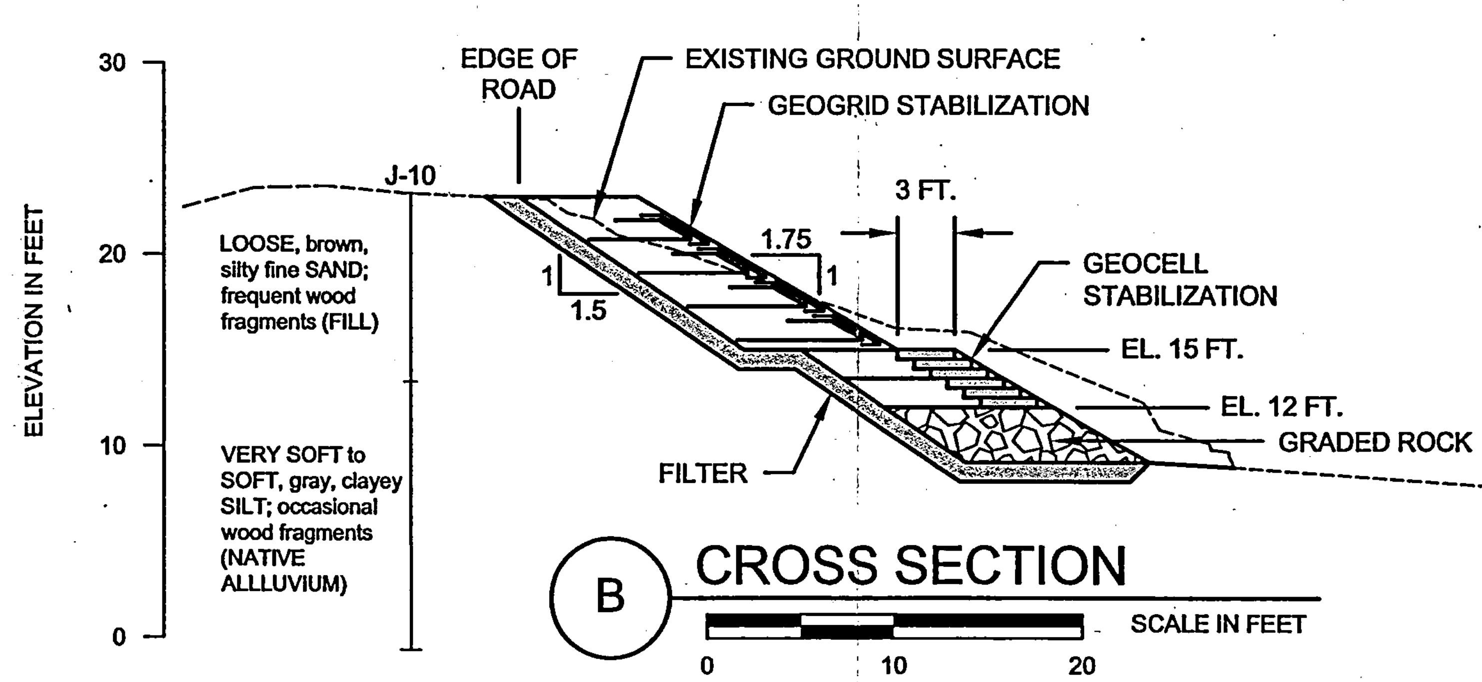


CORNFORTH CONSULTANTS 10250 S.W. Greenburg Road, Suite 111 Portland, Oregon 97223 Phone 503-452-1100 Fax 503-452-1528	PHOTOS ST. JOHNS DIKE STABILIZATION - PHASE 2 PORTLAND, OREGON	JUL 2005 PROJ. 1509 FIG. 4

1509\F04 LJW







NOTE: PLAN AND CROSS SECTIONS ARE BASED ON TOPOGRAPHIC SURVEY INFORMATION OBTAINED BY CRANE & MERSETH ENGINEERING/SURVEYING, DATED AUGUST 2004

1509\FIGURES MWT

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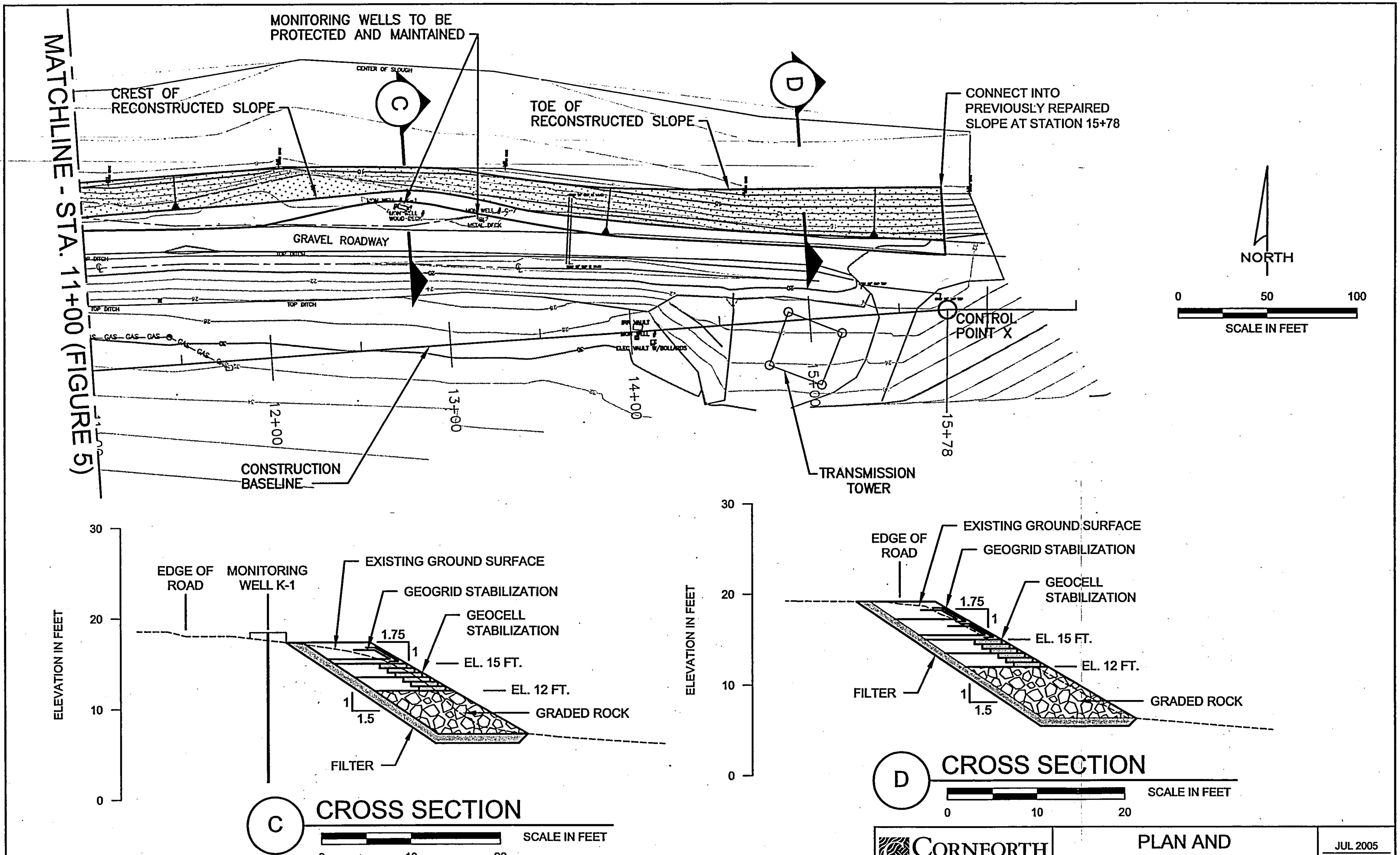
PLAN AND CROSS SECTIONS	JUL 2005
ST. JOHNS DIKE STABILIZATION - PHASE 2 PORTLAND, OREGON	PROJ. 1509
	FIG. 5



NOTE: PLAN AND CROSS SECTIONS ARE BASED ON TOPOGRAPHIC SURVEY INFORMATION OBTAINED BY CRANE & MERSETH ENGINEERING/SURVEYING, DATED AUGUST 2004

1509\FIGURES MWT

CORNFORTH CONSULTANTS
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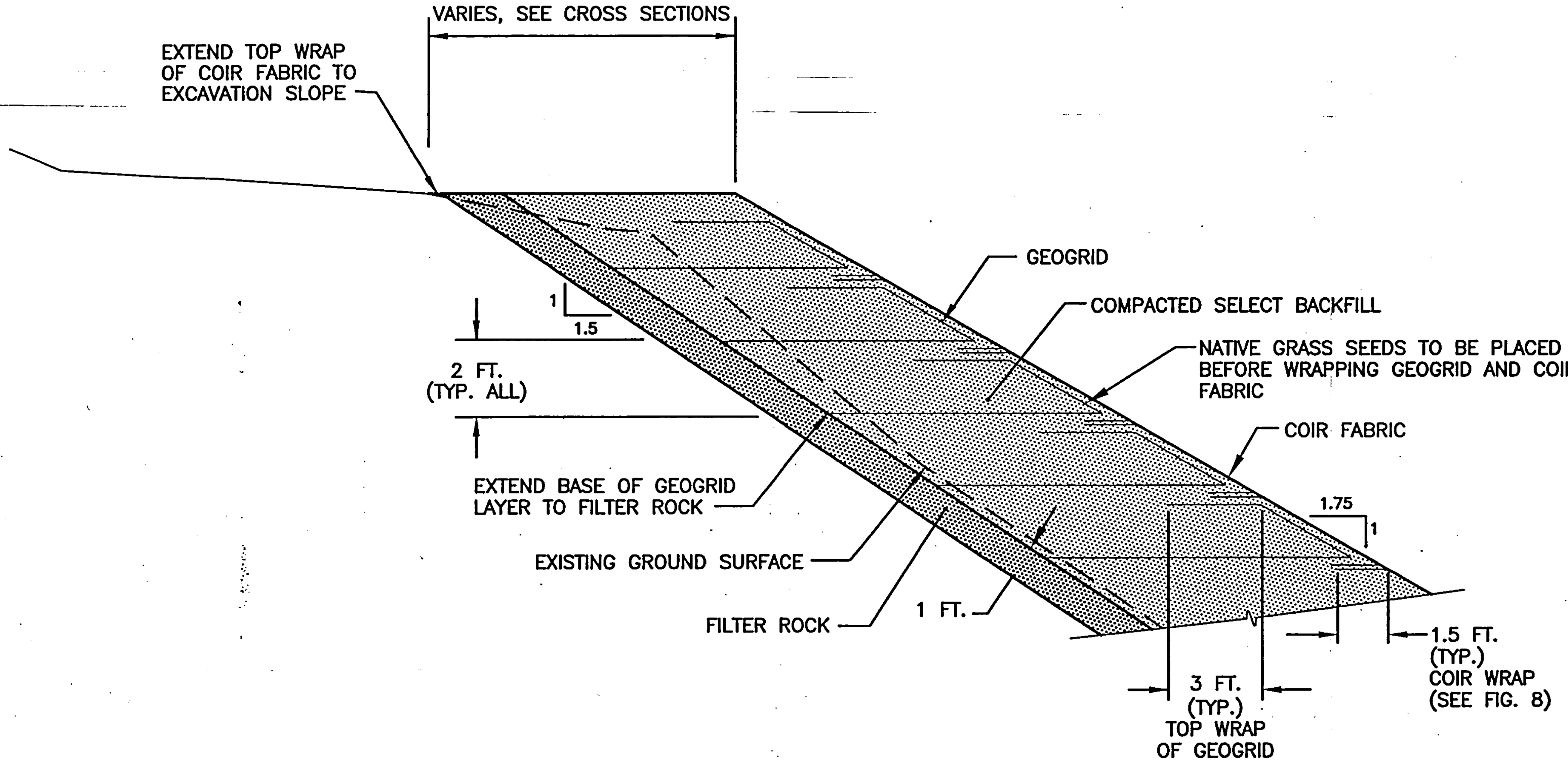
Portland, Oregon 97223
Phone 503-452-1100 Fax 503-452-1528

PLAN AND CROSS SECTIONS

ST. JOHNS DIKE STABILIZATION - PHASE 2
PORTLAND, OREGON

JUL 2005
PROJ. 1509
FIG. 6

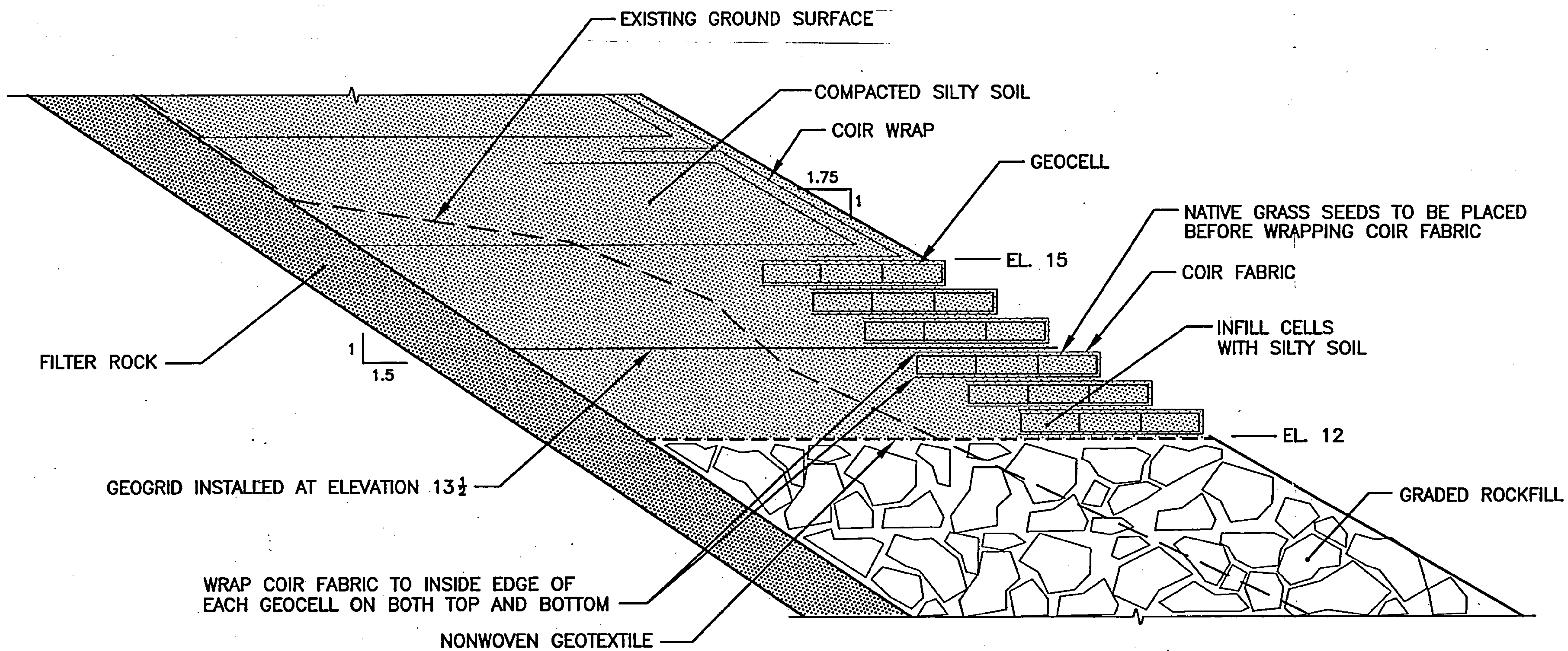


1 GEOGRID STABILIZATION

NOT TO SCALE

CORNFORTH CONSULTANTS 10250 S.W. Greenburg Road, Suite 111 Portland, Oregon 97223 Phone 503-452-1100 Fax 503-452-1528	DETAIL 1 ST. JOHNS DIKE STABILIZATION - PHASE 2 PORTLAND, OREGON	JUL 2005 PROJ. 1509 FIG. 7

1509\FIGURES MWT



2 GEOCELL STABILIZATION

NOT TO SCALE

1509\FIGURES MWT	CORNFORTH CONSULTANTS 10250 S.W. Greenburg Road, Suite 111 Portland, Oregon 97223 Phone 503-452-1100 Fax 503-452-1528	DETAIL 2 ST. JOHNS DIKE STABILIZATION - PHASE 2 PORTLAND, OREGON	JUL 2005 PROJ. 1509 FIG. 8