APPENDIX D
TEMPORARY WETLAND IMPACTS AND RECLAMATION AND MITIGATION CONCEPTS FOR ST. MARIES RIVER PERMIT AREAS

TEMPORARY WETLAND IMPACTS
AND
RECLAMATION AND MITIGATION CONCEPTS
FOR
ST. MARIES RIVER PERMIT AREAS

BENEWAH AND SHOSHONE COUNTIES, IDAHO

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TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 PROPOSED TEMPORARY IMPACTS
- 2.1 Indirect Impacts to Wetlands 5
  - 2.1.1 Potential Water Quality Degradation 6
  - 2.1.2 Potential Channel Degradation 6
- 2.2 Direct Impacts to Wetlands 6
  - 2.2.1 Incremental Loss of Woody Habitat 6
  - 2.2.2 Temporary Fill 7
  - 2.2.3 Temporary Impacts from Dredging 7

3.0 AVOIDANCE OF INDIRECT IMPACTS
- 3.1 Best Management Practices 8
- 3.2 Mining Design and Implementation Concepts 10
  - 3.2.1 Mining Design Elements 10
  - 3.2.2 Mining Implementation Elements 11

4.0 RECLAMATION CONCEPTS FOR DIRECT WETLAND IMPACTS
- 4.1 Reclamation Design Guidelines 12
- 4.2 Conceptual Grading Plans 13
- 4.3 Reclaimed Wetland Hydrologic Support 14
- 4.4 Vegetation Design Concepts 14
  - 4.4.1 Plant Option 1; Stabilization & Natural Re-establishment of Endemic Species 16
  - 4.4.2 Plant Option 2; Replanting of Pre-mined State 21

5.0 MITIGATION CONCEPTS FOR DIRECT WETLAND IMPACTS
- 5.1 Mitigation Design Guidelines 28
- 5.2 Woody Vegetation Replacement 29
- 5.3 Enhanced Riparian Corridor Habitat 30
- 5.4 Special Habitat Features 31
- 5.5 Wetland Protection 31

6.0 RECLAMATION AND MITIGATION IMPLEMENTATION
- 6.1 Implementation Timeframes 33
- 6.2 Implementation Sequence 34
- 6.3 Annual Implementation Activities 34
- 6.4 Conceptual Reclaimed Landscape 36

7.0 RECLAMATION AND MITIGATION ASSURANCE PLAN
7.1 Reclamation Monitoring Sequence 39
7.2 Performance Standards 39
7.2.1 Wetland Hydrologic Support Standards 39
7.2.2 Wetland Planting Standards 40
7.2.3 Upland Planting Standards 40
7.2.4 Riparian Enhancement Planting Standards 41
7.3 Reclamation Monitoring Methodology 41
7.3.1 *Construction Observation* 41
7.3.2 Compliance Monitoring 42
7.3.3 Long-Term Monitoring 42

8.0 APPENDICES
8.1 BMP Schematics B

LIST OF FIGURES

Figure 1.1: Vicinity Map 2
Figure 1.2: Proposed Mining Areas Showing Wetlands 3
Figure 1.3: Visual Corridor Tree Survey 4
Figure 6.2: Reclamation Sequence 35
Figure 6.4: Pre-mining Wetland Habitats 37

1.0 INTRODUCTION

Emerald Creek Garnet, Ltd. (ECG) is proposing to mine alluvial deposits of industrial garnet found in floodplains and bottomlands in the St. Maries River basin (Figure 1.1). The location and extent of the proposed mining areas have been based on an assessment of 355.8 acres of study area within the active floodplain of the river southwest of Highway 3, and within the historic floodplain and non-floodplain areas northeast of Highway 3. From the 355.8-acres of study area, seven proposed mining areas have been established, comprising 327.5 acres of property adjacent to and near the St. Maries River between Emerald and Carpenter creeks in Benewah and Shoshone counties, Idaho (Figure 1.2).

A wetland delineation, completed in 1999, has identified 133.0 acres of jurisdictional wetland within the proposed mining areas out of 141.9 acres of wetland in the total study area (*SELKIRK ENVIRONMENTAL* 1999, revised 2002). The wetland study identified a mosaic of emergent, scrub-shrub, and forested wetlands. Wetland hydrology in these systems varies from seasonal saturation to permanent inundation. Identified wetlands are highlighted in blue in Figure 1.2.

ECG has completed an inventory of deciduous and coniferous trees within the visual corridor of the proposed permit areas (Figure 1.3). The inventory identified 690 conifers, 1064 deciduous trees, and 50 snags (total of 1804).

ECG proposes to temporarily impact all 133.0 acres of wetland in the proposed mining areas during mining activities over a 10-20-year period. In addition, approximately 693 deciduous and hardwood trees (including snags) will be lost during the same period.

The remaining sections of this report detail proposed impacts, and establish recommended reclamation and mitigation measures that ECG may incorporate into a Plan of Work.

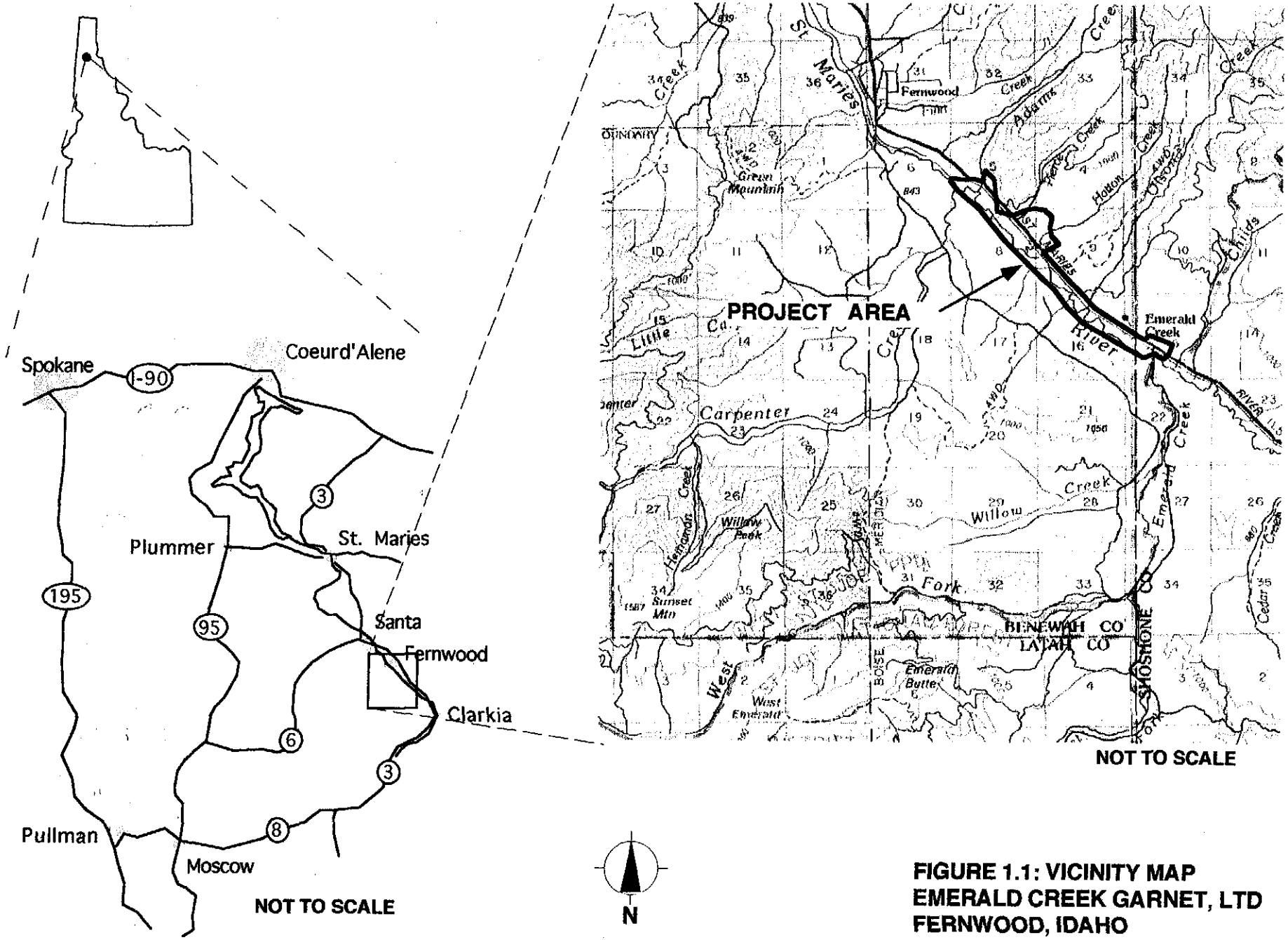


FIGURE 1.1: VICINITY MAP
EMERALD CREEK GARNET, LTD
FERNWOOD, IDAHO

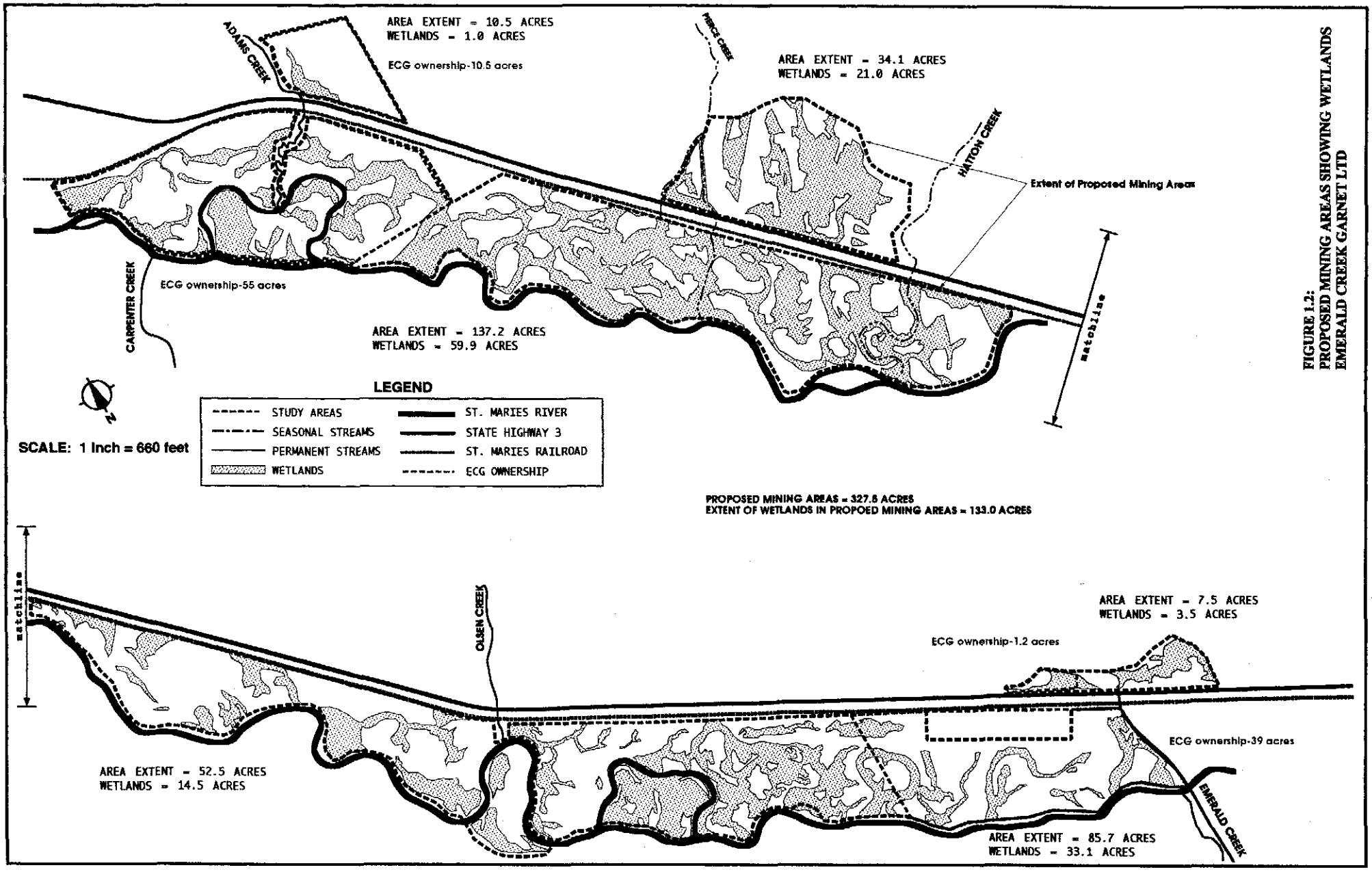


FIGURE 1.2:
PROPOSED MINING AREAS SHOWING WETLANDS
EMERALD CREEK GARNET LTD

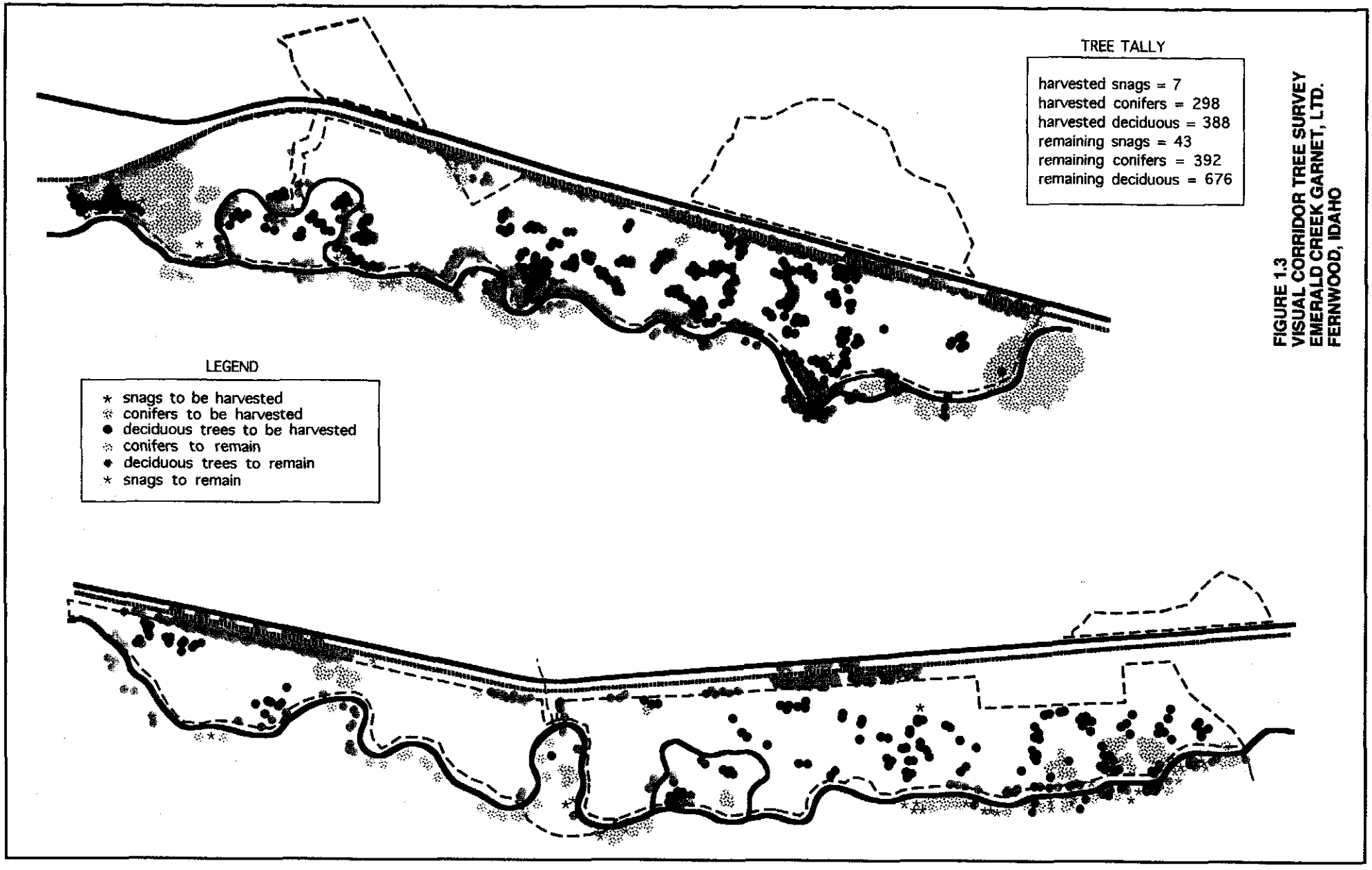


FIGURE 1.3
VISUAL CORRIDOR TREE SURVEY
EMERALD CREEK GARNET, LTD.
FERNWOOD, IDAHO

ECG proposes to dredge mine 327.5 acres in seven proposed permits areas near and adjacent to the St. Maries River. The area is proposed to be mined incrementally, in annual mining units, over a 10 to 20-year period. The proposed annual mining activities should include;

- marking extent of annual mining unit(s) in field,
- harvesting of commercial timber (if any),
- harvesting and storage of non-commercial timber for special habitat features (if any),
- construction of Best Management Practices (BMP's),
- stockpiling of topsoil,
- construction of temporary and haul roads,
- placement of culverts,
- opening a wet panel by stockpiling overburden and locating a washer adjacent to the wet panel,
- withdrawing water from the river to fill the initial wet panel,
- excavate garnet layer from wet panel and run through washer,
- wet panel slowly 'migrates' downstream as garnet is mined,
- open a dry panel by stockpiling overburden,
- excavate garnet layer in dry panel, load into dump truck,
- haul to washer,
- haul washed rock back to dry panel from washer,
- complete regrade of dry panel quickly,
- replace wash rock and overburden in wet panel and close at end of mining year,
- complete rough regrade of mining unit to meet reclamation specifications, and
- initiate revegetation plans.

The impacts associated with the proposed mining are considered temporary since permanent placement of fill in waters of the United States, including wetlands, will not occur. Wetlands will be dredged, mined, and regraded to a pre-mining landscape (except where wetland mitigation will require a lower elevation than the pre-mined condition). Temporary fill will be placed for roads, BMP's, equipment staging, and topsoil/overburden storage. This material will also be regraded to the pre-mined state when mining is concluded.

Temporary impacts may be viewed as indirect or direct. Indirect temporary impacts are those that may result subsequent to the proposed mining activity, and may occur on-site or off-site. Direct temporary impacts are those that will result from the proposed mining activity, and will occur only in active mining units.

2.1 Indirect Impacts to Wetlands

Indirect wetland impacts may potentially occur during the mining process, if adequate preventative measures are not employed (see Section 3.0 for avoidance recommendations). These indirect impacts are associated primarily with water quality degradation, and channel degradation.

2.1.1 Potential Water Quality Degradation

The proposed mining activities involve removing vegetation cover and exposing bare ground in 10- to 25-acre increments annually. This type of activity makes exposed soil susceptible to accelerated erosion until the vegetation component is replaced. Under these conditions, erosive forces may transport sediments into on-site and off-site wetlands, creating turbid water, choking vegetation, and reducing flood storage capabilities. Turbid waters also have the potential of leaving the mining area and adding sediment to the adjacent river. These potential impacts can be avoided and minimized through implementation of BMP's, and through design and implementation of a mining plan that is sensitive and responsive to seasonal environmental conditions

2.1.2 Potential Channel Sedimentation

The proposed mining activities involve removing vegetation cover and exposing bare ground in 10- to 25-acre increments annually. This type of activity makes exposed soil susceptible to accelerated erosion until the vegetation component is reclaimed. Under these conditions, erosive forces may transport sediments into off-site wetlands, streams, and rivers. Turbid waters in streams and rivers typically raises water temperatures, possibly to the degree that high temperatures become lethal to salmonids. Increased sediment loads in streams and rivers leads to increased scour and headcutting with eventual deposition in pools and glides. This typically, reduces fishery habitat by filling pools and choking spawning gravels. These potential impacts can be avoided ad minimized through implementation of BMP's, and design and implementation of a mining plan that is sensitive and responsive to seasonal environmental conditions.

2.2 Direct Wetland Impacts

Direct wetland impacts occur during the mining process when the existing vegetation is removed from a mining unit, when BMP's are installed, when fill is temporarily placed for a road into the mining unit, when topsoil/overburden is stockpiled, and when the mining unit is actually dredged (although dredging is not currently a federally regulated activity). Since these impacts can not be avoided, compensatory suggestions are provided in sections 4.0 and 5.0.

2.2.1 Incremental Loss of Woody Habitat

Trees and shrub vegetation will be removed from the subject wetlands and surrounding floodplain areas as mining progresses in annual increments. A total of 693 trees will be lost throughout the overall mining period. Without a designed revegetation plan, a shrub component will become re-established in several years, and will realize the pre-mined condition on approximately 10 to15 years. Likewise, a tree component will naturally re-establish soon after mining is concluded. The tree component will take 20 years or longer to reach the stature and habitat quality provided by the pre-mined condition. These temporary, and temporal, impacts can not be avoided, but can be minimized by a revegetation plan that will accelerate the recovery time.

2.2.2 Temporary Fill

In the process of mining, washed rock or crushed rock will be temporarily placed in wetlands for roads, BMP's, equipment pads, and topsoil/overburden storage. The fill will always be placed in un-mined areas and will be removed as the area is mined. Road fill will last one season for haul roads within the mining unit(s). Road fill for will last for several years for temporary roads constructed outside the mining unit(s). Temporary road fill will be removed and the road mined when it is no longer needed for access. Excavated material from diversion and interceptor channels, and sediment basins will be temporarily side-cast and used as part of the BMP. Topsoil will be temporarily placed as a siltation berm. Fill for equipment pads is seasonal, and is removed as the wet panel migrates within the mining unit. Additional topsoil and overburden will be temporarily stored in each mining unit and respread as soon as mining is completed. All temporary fill areas will be regraded to reclamation design specifications at the conclusion of annual mining activities.

2.2.3 Temporary Impacts from Dredging

A wetland delineation, completed in 1999, has identified 133.0 acres of jurisdictional wetland within the proposed mining areas that total 327.5 acres. The wetland study identified a mosaic of emergent, scrub-shrub, and forested wetlands. Wetland hydrology in these systems varies from seasonal saturation to permanent inundation. The following table shows dredge mining impacts for each wetland habitat identified in the mining areas.

Temporary Dredge Impacts by Wetland Habitat

Wetland	Acreage
open water, permanently flooded - POWH	0.5
emergent, seasonally flooded/saturated - PEMIE	50.2
emergent, semi-permanently flooded - PEM1F	4.4
emergent, permanently flooded - PEM1H	2.2
emergent, farmed - PEMIf	22.0
scrub-shrub, seasonally flooded/saturated - PSSIE	33.2
scrub-shrub, semi-permanently flooded - PSS1F	2.9
forested, seasonally flooded/saturated - PFO1E	17.6
TOTAL WETLANDS	133.0

These impacts will occur incrementally over a 10 to 20 year period. Some wetland habitats will be mined more quickly than others because the habitats occur clustered, rather than uniformly across the landscape.

During the course of mining and reclamation, ECG should incorporate as many of the following concepts as practical into a Plan of Work. The following concepts involve the use of BMP's, and mining design and implementation to avoid potential indirect impacts to off-site waters of the United States, including wetlands, and to on-site reclaimed wetlands.

3.1 Best Management Practices

The following BMP's should be employed during mining and reclamation to control the sedimentation, volume, and release of storm waters in and around active mining units and recently reclaimed areas. These structures and construction techniques have specific uses and when installed correctly will satisfy State of Idaho Best Management Practices (BMP's) for both dredge mining permits and water quality certification as established in Best Management Practices for Mining in Idaho (Idaho Department of Lands 1992). Schematics of BMP's are found in Appendix 10.1. Specific design criteria should be established in a Plan of Work, following IDL requirements, and tailored to site-specific conditions.

Siltation Berm

These structures should be installed around the annual mining unit to capture and contain all surface runoff within the mining unit. They are not be designed or intended to keep river floodflows from entering the annual mining unit(s). The berms should be impermeable, preventing stormwater from entering or leaving the mining unit. All berms should remain in place through the first winter, after all mining activities and rough grading have been completed. The berms may be removed the second spring as topsoil is being replacement, and prior to seeding. A typical installation would include berms installed along the river top-of-bank and the downstream boundaries of the mining unit.

Stabilization Seed Mix

The following seed mix should be used for siltation berm stabilization, interceptor and diversion channel stabilization, and upland revegetation. Application of the seed mix should be completed when a siltation berm has been completed, interceptor or diversion channel excavated and bermed, or an upland regraded and topsoil respread.

Stabilization Seed Mix

SCIENTIFIC NAME	COMMON NAME	PERCENT OF MIX	APPLICATION RATE
Dactylis glomerata	orchard grass	25	3.5 lb/ac
Festuca elatior	meadow fescue	20	6 lb/ac
Trifolium hybridum	Alsike clover	15	2 lb/ac
Trifolium repens	white clover	5	0.5 lb/ac
Phleum pratense	timothy	15	1 lb/ac
Elymus glaucus	blue wildrye	5	3 lb/ac
Lolium sp.	annual ryegrass	15	10 lb/ac
	Total Application Rate		26 lb/ac

Catch Basins

These temporary structures should be used along temporary roads at the outfall of culverts and/or collection points of roadside ditches. These structures should be designed to detain stormwater, and capture the sediment load, preventing degradation of stream and river water quality.

Silt Fencing

These structures should be installed to prevent sediment from entering a specific area or body of water. The structure should be constructed to create a physical barrier that allows sediment to deposit, and water to flow through or over the structure. Use of silt fencing may be on an as-needed basis for the duration of need. They may be implemented for the following typical situations;

- perimeter of stockpiled topsoil,
- along stream banks during culvert placement/removal,
- during temporary road construction/improvement when activities will be within 30 feet of a channel,
- during interceptor/diversion channel and sediment basin construction/reclamation when equipment and/or bare ground will be within 30 feet of a channel,
- in staggered segments paralleling the river in Year 1 reclamation areas,
- during storm/flood events if process waters leak beneath an established silt berm, and
- during storm/flood events if surface water overtops an interceptor/diversion channel, or sediment basin.

Straw Bales

These structures should be installed to prevent sediment from entering a specific area or body of water. The structure should be constructed to create a physical barrier that allows sediment to deposit and the water to flow through or over the structure. Use of straw bales may be on an as-needed basis for the duration of need. They may be implemented for the following typical situations;

- perimeter of stockpiled topsoil,
- along stream banks during culvert placement/removal,
- during temporary road construction/improvement when activities will be within 30 feet of a channel,
- during interceptor/diversion channel and sediment basin construction/reclamation when equipment/bare ground will be within 30 feet of a channel,
- in staggered segments paralleling the river in Year 1 reclamation areas,
- during storm/flood events if process waters leak beneath an established silt berm, and
- during storm/flood events if surface water overtops an interceptor/diversion channel, or sediment basin.

Interceptor Channels

These structures should be constructed upslope of the mining unit to collect overland runoff and convey it around the mining unit. The channel should be constructed using an excavator or dozer with the spoil material placed along the downslope edge of the channel. A typical installation should include the interceptor channel with the downslope berm, a sediment basin at the downstream end of the channel, and a 30-foot buffer strip with undisturbed existing vegetation between the basin and stream or river.

Diversion Channels
These structures should be constructed upslope of the mining unit to collect overland and tributary flow and convey it around the mining unit. The channel should be constructed using an excavator or front-end loader with the spoil material placed along the downslope edge. Channel gradient must be minimized to prevent erosion within the diversion channel. In some locations, an interceptor channel would be merged into a diversion channel to prevent construction of multiple channels along the edge of the mining unit. A typical installation should include the diversion channel with the downslope berm, a sediment basin at the downstream end of the channel, and a 30-foot buffer strip with undisturbed existing vegetation between the basin and stream.

Sediment Basins
Sediment basins should be constructed at the downstream end of all interceptor and diversion channels. The basins should be designed and constructed to detain runoff from 25-year, 24-hour storm events. The basins will allow settling of suspended sediments and allow trapping of organic debris. If the design capacity for a basin is exceeded during a storm event, water would discharge over a long crest with a uniform elevation on the downslope edge. Water would be discharged onto a minimum 30-foot buffer zone of undisturbed, native vegetation on the existing floodplain where further settling of sediments will occur.

Vegetated Buffer Strip
Vegetated buffer strips should be used at the outflow of all sediment basins, adjacent to temporary roads, adjacent to un-mined streams, and along the St. Maries River. The buffer strips would be located to slow storm waters, trap sediments, and bio-filter any surface flow before it enters a stream or river.

Large Woody Debris (LWD)
These structures should be installed to trap sediments, abate flood flows, and minimize scour on recently regraded landscapes. They should be staggered across the floodplain perpendicular to the direction of flood flow.

3.2 Mining Design and Implementation Concepts

Mining design and design implementation can be key elements is minimizing impacts to waters of the United States, including wetlands. The following design and implementation elements should be considered by ECG when developing a Plan of Work.

3.2.1 Mining Design Elements

Small Annual Mining Increments
Annual mining increments (mining units) should be as small as practical to minimize the exposure of bare ground to erosive forces. The best approach is to establish annual mining areas based on the polygons mapped in the reserve report. In this way, a finite amount of ground would be opened for a known amount of garnet.

Sequence Of Mining Units
Mining units should be sequenced so that the following year's mining does not impact the present year's reclamation activities. Mining units should also be configured and sequenced so that at least 50 percent of the active floodplain's horizontal extent (perpendicular to the river) remains available for floodflows and storm water storage.

Dry Mining
Dry mining panels are smaller than wet mining panels, and can be reclaimed faster. Dry panels should be employed in narrow or confined areas and where reclamation needs to be expedited.

Wet Mining
Wet mining panels are essential in all mining units so that a washer is on-site for initial processing of garnet. Wet panels should be located as far as practical from streams and rivers to minimize the possibility of silt-laden process water moving as ground water, and discharging into streams and rivers.

Rapid Revegetation
Mining designs should provide a means of reclaiming the mined landscape as quickly as possible. Regrading and seeding should occur immediately after a mining unit is done. The optimum would be to reclaim the same season as mining, if practical. Otherwise, regrading and seeding should occur the season after mining, and adequate BMP's should be employed during the winter and spring months to minimize potential soil loss.

Irrigation should also be a key ingredient in rapid revegetation. Adequate moisture is a primary element in establishing a solid groundcover quickly. All seeded and planted areas should be irrigated at least one summer season after seeding and/or planting.

3.2.2 Mining Implementation Elements

ECG should assess mining in only the most favorable months, and not mining during periods of inclement weather or during expected floodflow periods. This may mean defining a strict non-mining period, or it may mean establishing shut-down protocol based on weather conditions and serviceability of established BMP's.

Non-mining Period
A strict non-mining period may be developed by assessing the historic flood pattern of the St. Maries River, and determining the annual timeframe when floodflows have occurred. Mining activities would not occur during this flood prone period.

Shut-down Protocol
ECG may also develop shut-down protocol that would cease mining whenever the protocol were realized. The protocol should be developed around the proper functioning of BMP's and weather forecasts. For instance, when BMP's are at capacity and unable to contain more water, mining activities would shut-down. Mining activities would start again when BMP's become able to contain more water. The use of weather forecasts and snow accumulation data would assist in predicting when non-mining periods may happen, and when mining may resume.

This section describes reclamation guidelines and design concepts that are necessary to successfully complete reclamation of ECG's proposed permit areas. Reclamation is used here in the sense of replacing exactly what was temporarily impacted during mining.

4.1 Reclamation Design Guidelines

The following reclamation guidelines should be used in conjunction with the design concepts as a framework for developing the reclamation portion of the Plan of Work.

Guideline 1:
Reclamation of impacted wetlands should be completed at 1:1 on non-ECG properties (see Mitigation Guideline 1, Section 5.1 for ECG property). The pre-mined acreage of open water (POWH), emergent (PEM1E, PEM1F, PEM1H, and PEM1Ef), scrub-shrub (PSS1E and PSS1F), and forested (PFO1E) habitats should be incrementally replaced in-kind as reclamation follows mining.

Guideline 2:
Wetlands should be reclaimed by replacing the pre-mining plant structure and hydrologic regime. By re-establishing wetlands in this manner, wetland functions should be replaced at their pre-mining values, some nearly immediately, others over time. Hydrologic support and groundwater exchange functions should be replaced as soon as wetland reconstruction has been completed. Storm/flood water storage and abatement should be replaced shortly after wetland construction has been completed. Abatement should be maximized over time with woody plant growth. Water quality improvement functions should be replaced once emergent and groundcover vegetation has been re-established. This takes approximately 3 growing seasons, from ECG's past experience. Natural biologic functions for aquatic organisms should be replaced as soon as wetland reconstruction has been completed and hydrologic stratification is present. The same functions for terrestrial organisms should be replaced over time as woody vegetation matures and stratifies. The woody component should be functional within 5 years of wetland re-establishment, but may take 20 or more years to realize pre-mining conditions.

Guideline 3:
Reclamation must proceed at a rate that minimizes surface water quality degradation. In other words, trying to reclaim too quickly may cause as many water quality problems as failing to reclaim adequately. Farmed wetlands (pasture and hay fields) can be reclaimed the first season following mining. Floodplain wetlands should be reclaimed over a two year period following mining to minimize potential erosion.

Farmed wetlands are separated from the active floodplain by Highway 3 and the adjacent railroad line. These areas should have siltation berms and interceptor/diversion channels from mining remain in place and all topsoil/subsoil stockpiled the first high flow season after mining. These mining BMP's should be removed the first summer season after mining, topsoil/subsoil should be replaced to final grade, and all bare ground seeded with a pasture seed mix. Since flood protection is not imperative in these areas, activities guided by this goal may be

accelerated into the mining year if seeding can occur prior to August 1, allowing time for seedling establishment.

Floodplain wetlands are immediately adjacent to the St. Maries River and receive annual high flows and frequent flood flows. These areas should have siltation berms and interceptor/diversion channels from mining remain in place and all topsoil/subsoil stockpiled the first high flow season after mining. These mining BMP's should assist in trapping sediments during high flows and flood flows, but they are not designed to impede flood flows. Reclamation BMP's, including silt fencing, straw bales, and/or large woody material, should be staggered across the regraded floodplain perpendicular to the river channel. Reclamation BMP's should slow flood velocities, protect regraded overburden and stockpiled topsoil, and trap sediments. Mining BMP's should be removed the first summer season after mining, topsoil/subsoil should be replaced to final grade, and all bare ground seeded with a various wetland and upland seed mixes. In this fashion, the replaced topsoil should have an established groundcover to protect it during typical winter and spring hydrologic patterns. Reclamation BMP's should be re-installed after topsoil replacement for a second season. Woody vegetation should be planted the second summer season after mining. Oxbows should also be constructed during this second season. Reclamation BMP's may be removed after the second high flow season.

4.2 Conceptual Grading Plans

Successful wetland reclamation is keyed to providing adequate wetland hydrology. In the post-mining landscape, this is readily accomplished by proper excavation. In the pasture environment, grading should be focused on creating a generally level landscape with limited seasonal inundation, and saturation. In the active floodplain environments, grading should be focused on re-creating a varied relief landscape that features areas of saturation, seasonal inundation, semi-permanent inundation, and permanent inundation.

Comprehensive grading plans for entire permit areas are not provided in this document. Site-specific grading plans should be developed annually by ECG, for each reclaimed mining unit. Annual grading plans should be based on existing topographic features of the various wetland habitats. The following table shows typical elevational changes for each wetland habitat that should be incorporated into annual designs.

Excavation Depths of Reclaimed Wetlands

Wetland Habitat	Excavation Depth
open water, permanently flooded - POWH	48+ in.
emergent, seasonally flooded/saturated - PEM1E	0 - 18 in.
emergent, semi-permanently flooded - PEM1F	12 - 48 in.
emergent, permanently flooded - PEM1H	24 - 48 in.
emergent, farmed - PEM1Ef	0 - 12 in.
scrub-shrub, seasonally flooded/saturated - PSS1E	0 - 12 in.
scrub-shrub, semi-permanently flooded - PSS1F	6 - 24 in.
forested, seasonally flooded/saturated - PFO1E	0 - 12 in.

All annual reclamation plans should be implemented during the end of the mining year, when overburden is regraded. At this time, grading stakes should be established with cut or fill requirements. The cut and fill requirements can be set in the field using an auto level and rod, or equivalent. An undisturbed wetland edge point in the buffer, or at OHWL should act as a benchmark to identify the cut or fill required at each grading stake. The result of this approach should be the re- creation of the pre-mining condition.

Regrading during the end-of-mining each year should provide the necessary elevations for seasonally flooded/saturated and farmed wetland habitats. Excavation during the first season of reclamation should provide the necessary elevations for semi-permanently flooded, permanently flooded, and open water wetland habitats.

4.3 Reclaimed Wetland Hydrologic Support

Successful wetland reclamation is largely dependent upon restoration of sustainable hydrologic regimes. The grading plans discussed above will re-establish the pre-mining elevation changes between uplands, seasonally saturated areas, semi-permanently inundated areas, and permanently inundated areas. Hydrologic support in these regraded areas should come from one or more of four sources, 1) seasonal flooding of the St. Maries River, 2) seasonally shallow groundwater associated with periods of groundwater recharge, 3) high in-channel flow, and 4) precipitation.

Direct observation of hydrology was made in June 1998. At this time the St. Maries River was at bankful width, and all swales, depressions, and oxbows within the floodplain were at storage capacity. Wetland hydrology was observed over extensive portions of the permit areas at this time.

The St. Maries River historically floods during January and February rain-on-snow events. This cyclic period provides a necessary hydrologic regime to sustain wetlands. Although flood periods usually occur out of the growing season, these floods provide a recharge of deeper aquatic habitats that are permanently, semi-permanently, and seasonally inundated. The truncated depressions and oxbows remain at storage capacity until evaporation and decreasing groundwater levels allow varying degrees of water loss. Swales and oxbows that have a surface connection to the river at normal high flows, drain as the river depths drop to low flow conditions in the early summer.

The St. Maries River typically experiences normal high flow conditions in March, through early June. High flow periods extend well into the growing season and provide hydrology for varying durations, depending upon floodplain accessibility. These flows also recharge deeper aquatic habitats that act as high flow channels during normal run-off periods. Hydrology from this source is maintained until the river depths drop to low flow conditions in the early summer.

Precipitation from storm events also provides wetland hydrology. This hydrologic support is important to shallow depressions that are isolated from flood flows and high flows, and are too shallow to be affected by seasonally high groundwater. This source of hydrology will not be significant in drier spring months, but will be critically important in years where floodflows do not occur and normal high flows are below normal. This source of hydrology is important for shallowly inundated and saturated wetlands, and wetlands that are isolated from normal

high flows. Precipitation is less important for deeper aquatic systems that are influenced by groundwater.

Wetland hydrology also occurs from seasonally shallow groundwater. The Natural Resources Conservation Service (NRCS) has identified the following shallow groundwater conditions for each mapped soil;

- Pokey: 18 to 30 inches February through June; 30 to> 60 inches remainder of year,
- Typic Fluvaquents: 0 to 18 inches February through June; 18 to > 60 inches remainder of year,
- Clarkia: 18 to 24 inches February through June; 24 to > 60 inches remainder of year,
- Reggear: 18 to 36 inches February through April.

Four groundwater monitoring sites were identified to measure typical groundwater fluctuations over a hydrologic cycle. Monitoring sites were established at four locations in upland, wetland, and river top-of-bank areas in the Pokey - Typic Fluvaquents Complex. Four-inch perforated pipe was installed to a depth equaling the depth of the Lake Clarkia clays using a mechanical augur. Perforated pipe was placed in the holes and sealed with bentonite clay. The pipes were back flushed and allowed to stabilize before readings were taken. Depth to shallow groundwater was measured weekly by ECG's Environmental Specialist.

Groundwater levels varied with topographic position just before and during the early portion of the growing season. Between March 19 and May 8, 1999, groundwater levels in topographic lows varied from 0 to 17 inches. At the same time, groundwater levels in topographic highs varied from 20 to 42 inches. This data suggests that shallow groundwater contributes to wetland hydrology early in the growing season in topographic lows, including swales, depressions, and oxbows. Shallow groundwater does not appear to provide wetland hydrology in topographic high positions within the floodplain area. This interpretation is qualified by being a short-term evaluation in a relatively dry spring.

In function, the hydrologic contributions described above cannot be so easily separated. They interact uniquely over a period of years with varied flood flows, varied spring precipitation, and longer-term wet-dry cycles. Cumulatively, however, they provide a relatively predictable pattern of seasonally inundated oxbows, high flow channels, and deeper depressions and swales. The shallower depressions and swales will be inundated in springs with normal precipitation. In drier springs, shallower depressions and swales may lack wetland hydrology, or may only be saturated.

The net result is a diverse complex of hydrologic regimes within the active and historic floodplains. Saturated, seasonally flooded, semi-permanently flooded, and permanently flooded regimes all occur in a matrix within the proposed permit areas.

The following table provides a summary of anticipated hydrologic regimes for each wetland habitat, based on pre-mining conditions, excavation plans to mimic pre-mining conditions, and known groundwater depths.

Hydrologic Regimes of Reclaimed Wetlands

Wetland Habitat	Flooding	High Flows	Storm waters	Groundwater
open water, permanently flooded	recharge	early/midseason	n/a	all season
emergent, seasonally flooded/saturated	n/s	early season	early season	n/a
emergent, semi-permanently flooded	recharge	early/midseason	n/s	early/midseason
emergent, permanently flooded	recharge	early/midseason	n/s	all season
emergent, farmed	n/s	n/a	early season	n/a
scrub-shrub, seasonally flooded/saturated	n/s	early season	early season	n/a
scrub-shrub, semi-permanently flooded	recharge	early/midseason	n/s	early/midseason
forested, seasonally flooded/saturated	n/s	early season	early season	n/a

n/s not significant: n/a not applicable

Varied regrading to re-establish hydrologic support shown in the table above should provide the necessary wetland hydrology for the planting designs, described below.

4.4 Vegetation Design Concepts

Vegetation designs should be focused in one of two areas, 1) soil stabilization, erosion control, and natural introduction of endemic species, or 2) replacing the plant communities by seeding, planting, and transplanting most of the species present in the pre-mining state.

4.4.1 Plant Option 1; Stabilization and Natural Re-establishment of Endemic Species

This reclamation option quickly stabilizes soil, prevents erosion, and allows endemic species to re-establish over time. This option would be successful, if implemented, because the climate of the proposed mining area provides adequate moisture and a 110-120 day growing season in most years. Endemic species would quickly re-establish, as ECG has observed from reclamation activities over the past 10 years in Emerald and Carpenter basins. Planted species and naturally re-introduced species can not be distinguished by the third growing season after reclamation in these basins.

For each wetland habitat, this option provides the use of seed mixes geared to stabilize bare ground and a woody planting density that would provide an initial number of 'mother' plants, rather than providing a higher percent woody cover.

PEM1E Habitat - shallow

The following table identifies the recommended plant materials that should be used to stabilize this seasonally flooded/saturated reclaimed emergent habitat. The following non-pasture wetland seed mix should be established on regraded landscapes that will be

saturated and inundated from 0 to 18 inches during the early part of the growing season and will be dry during the mid and late parts of the growing season.

Emergent, Seasonally Flooded/Saturated-Shallow Seed Palette

SCIENTIFIC NAME	COMMON NAME	PERCENT OF MIX	APPLICATION RATE
Alopecurus pratensis	meadow foxtail	20	12 lb/ac
Agrostis stolonifera	redtop bentgrass	20	1.5 lb/ac
Deschampsia caespitosa	tufted hairgrass	10	1.5 lb/ac
Festuca rubra	red fescue	10	5 lb/ac
Phleum pratense	timothy	10	3 lb/ac
Poa palustris	fowl bluegrass	20	3 lb/ac
Trifolium repens	white clover	10	4 lb/ac
	Total Application Rate		30 lb/ac

This seed mix will stabilize these reclaimed habitats quickly, and will provide the opportunity for endemic species tolerant of and/or adapted to saturated and shallowly inundated conditions to naturally re-establish..

PEM1E Habitat - deep

The following table identifies the recommended plant materials that should be used to stabilize this seasonally flooded/saturated reclaimed emergent habitat. The following non-pasture wetland mix should be established on regraded landscapes that will be saturated and inundated from 6 to 24 inches during the early part of the growing season and will not be inundated during the mid and late parts of the growing season.

Emergent, Seasonally Flooded/Saturated-Deep Seed Palette

SCIENTIFIC NAME	COMMON NAME	PERCENT OF MIX	APPLICATION RATE
Alopecurus pratensis	meadow foxtail	20	8 lb/ac
Agrostis stolonifera	redtop bentgrass	20	1 lb/ac
Deschampsia caespitosa	tufted hairgrass	10	1 lb/ac
Festuca pratensis	red fescue	10	4 lb/ac
Phleum pratense	timothy	10	2 lb/ac
Poa palustris	fowl bluegrass	20	2 lb/ac
Trifolium repens	white clover	10	3 lb/ac
	Total Application Rate		21 lb/ac

This seed mix will stabilize these reclaimed habitats quickly, and will provide the opportunity for endemic species tolerant of and/or adapted to saturated and shallowly inundated conditions to naturally re-establish..

PEM1Ef Habitat

The following table identifies the plant materials that should be used to stabilize and re-establish this seasonally flooded/saturated farmed wetland habitat. These plant materials should be seeded where pasture, emergent vegetation is re-established. The following seed mix should be established on regraded landscapes that will be saturated and inundated

from 0 to 12 inches during the early part of the growing season and will be dry during the mid and late parts of the growing season.

Emergent, Farmed Seed Palette

SCIENTIFIC NAME	COMMON NAME	PERCENT OF MIX	APPLICATION RATE
Alopecurus pratensis	meadow foxtail	40	16 lb/ac
Deschampsia caespitosa	tufted hairgrass	10	1 lb/ac
Phleum pratense	timothy	25	4 lb/ac
Agrostis stolonifera	redtop bentgrass	10	0.5 lb/ac
Agropyron repens	quackgrass	5	7.5 lb/ac
Trifolium repens	white clover	10	3 lb/ac
	Total Application Rate		*32 lb/ac*

This seed mix should re-establish the meadow foxtail-timothy association described in the wetland technical report. Initially, clover will be the dominant plant except in the wettest areas. Over time, clover will decrease with establishment of the other species. The species selected for this habitat should provide the necessary diversity for adequate cover of both saturated and shallowly inundated conditions.

PEM1F Habitat

The following table identifies the plant materials that should be used to stabilize this semi-permanently flooded wetland habitat. The following non-pasture wetland mix should be established on regraded landscapes that will be semi-permanently inundated from 12 to 48 inches during the early and mid portions of the growing season.

Emergent, Semi-permanently Flooded Seed Palette

SCIENTIFIC NAME	COMMON NAME	PERCENT OF MIX	APPLICATION RATE
Alopecurus pratensis	meadow foxtail	20	8 lb/ac
Agrostis stolonifera	redtop bentgrass	20	1 lb/ac
Deschampsia caespitosa	tufted hairgrass	10	1 lb/ac
Festuca pratensis	red fescue	10	4 lb/ac
Phleum pratense	timothy	10	2 lb/ac
Poa palustris	fowl bluegrass	20	2 lb/ac
Trifolium repens	white clover	10	3 lb/ac
	Total Application Rate		21 lb/ac

This seed mix will stabilize these reclaimed habitats quickly, and will provide the opportunity for endemic species adapted to semi-permanently inundated conditions to naturally re-establish.

PEM1H Habitat

The following table identifies the plant materials that should be used to stabilize this permanently flooded wetland habitat. The following non-pasture wetland mix should be established on regraded landscapes that will be permanently inundated from 24 to 48 inches throughout the growing season.

Emergent, Permanently Flooded Seed Palette

SCIENTIFIC NAME	COMMON NAME	PERCENT OF MIX	APPLICATION RATE
Alopecurus pratensis	meadow foxtail	20	8 lb/ac
Agrostis stolonifera	redtop bentgrass	20	1 lb/ac
Deschampsia caespitosa	tufted hairgrass	10	1 lb/ac
Festuca pratensis	red fescue	10	4 lb/ac
Phleum pratense	timothy	10	2 lb/ac
Poa palustris	fowl bluegrass	20	2 lb/ac
Trifolium repens	white clover	10	3 lb/ac
	Total Application Rate		21 lb/ac

This seed mix will stabilize these reclaimed habitats quickly, and will provide the opportunity for endemic species adapted to saturated and permanently inundated conditions to naturally re-establish.

PSS1E Habitat

The following tables identify plant materials that should be used to stabilize and re-establish this seasonally flooded/saturated wetland habitat. The palettes should be established on regraded landscapes that will be saturated and inundated from 0 to 12 inches during the early part of the growing season and will be dry in the mid and late parts of the growing season.

Scrub-Shrub, Seasonally Flooded/Saturated Seed Palette

SCIENTIFIC NAME	COMMON NAME	PERCENT OF MIX	APPLICATION RATE
Alopecurus pratensis	meadow foxtail	20	8 lb/ac
Agrostis stolonifera	redtop bentgrass	20	1 lb/ac
Deschampsia caespitosa	tufted hairgrass	10	1 lb/ac
Festuca pratensis	red fescue	10	4 lb/ac
Phleum pratense	timothy	10	2 lb/ac
Poa palustris	fowl bluegrass	20	2 lb/ac
Trifolium repens	white clover	10	3 lb/ac
	Total Application Rate		21 lb/ac

This seed mix will stabilize these reclaimed habitats quickly, and will provide the opportunity for endemic species tolerant of and/or adapted to saturated and shallowly inundated conditions to naturally re-establish.

Scrub-Shrub, Seasonally Flooded/Saturated Woody Plant Palette

SCIENTIFIC NAME	COMMON NAME	STOCK TYPE	STOCK SPACING
Populus tremula	quaking aspen	1 gal	up to 5/acre
Populus balsamifera	black cottonwood	poles	up to 5/acre
Crataegus douglasii	Douglas' hawthorne	trans/20 cu in	15/acre
Rosa woodsii	woods rose	20 cu in	35/acre
Cornus serecia	red-osier dogwood	trans/20 cu in	20/acre
Alnus incana	river alder	trans	15/acre

This woody plant palette will provide an initial scrub-shrub component on the reclaimed area. These plants will be 'mother plants', providing an on-site seed source for quick re-establishment of the woody component.

PSS1F Habitat

The following tables identify plant materials that should be used to stabilize and re-establish this semi-permanently flooded wetland habitat. The following palettes should be established on regraded landscapes that will be saturated and inundated from 6 to 24 inches during the early and mid parts of the growing season.

Scrub-Shrub, Semi-permanently Flooded Seed Palette

SCIENTIFIC NAME	COMMON NAME	PERCENT OF MIX	APPLICATION RATE
Alopecurus pratensis	meadow foxtail	20	8 lb/ac
Agrostis stolonifera	redtop bentgrass	20	1 lb/ac
Deschampsia caespitosa	tufted hairgrass	10	1 lb/ac
Festuca pratensis	red fescue	10	4 lb/ac
Phleum pratense	timothy	10	2 lb/ac
Poa palustris	fowl bluegrass	20	2 lb/ac
Trifolium repens	white clover	10	3 lb/ac
	Total Application Rate		21 lb/ac

This seed mix will stabilize these reclaimed habitats quickly, and will provide the opportunity for endemic species tolerant of and/or adapted to saturated and shallowly inundated conditions to naturally re-establish.

Scrub-Shrub, Semi-permanently Flooded Woody Plant Palette

SCIENTIFIC NAME	COMMON NAME	STOCK TYPE	STOCK SPACING
Crataegus douglasii	Douglas' hawthorne	trans/20 cu in	15/acre
Cornus serecia	red-osier dogwood	trans/20 cu in	17/acre
Salix spp.	willow	slips	20/acre
Alnus incana	river alder	trans	17/acre

This woody plant palette will provide an initial scrub-shrub component on the reclaimed area. These plants will be 'mother plants', providing an on-site seed source for quick re-establishment of the woody component.

PFO1E Habitat

The following tables identify the plant materials that should be used to stabilize this seasonally flooded/saturated wetland habitat. The following palettes should be established on regraded landscapes that will be saturated and inundated from 0 to 12 inches during the early part of the growing season and will be dry in the mid and late parts of the growing season.

Forested, Seasonally Flooded/Saturated Seed Palette

SCIENTIFIC NAME	COMMON NAME	PERCENT OF MIX	APPLICATION RATE
Alopecurus pratensis	meadow foxtail	20	8 lb/ac
Agrostis stolonifera	redtop bentgrass	20	1 lb/ac
Deschampsia caespitosa	tufted hairgrass	10	1 lb/ac
Festuca pratensis	red fescue	10	4 lb/ac
Phleum pratense	timothy	10	2 lb/ac
Poa palustris	fowl bluegrass	20	2 lb/ac
Trifolium repens	white clover	10	3 lb/ac
	Total Application Rate		21 lb/ac

This seed mix will stabilize these reclaimed habitats quickly, and will provide the opportunity for endemic species tolerant of and/or adapted to saturated and shallowly inundated conditions to naturally re-establish.

Forested, Seasonally Flooded/Saturated Woody Plant Palette

SCIENTIFIC NAME	COMMON NAME	STOCK TYPE	STOCK SPACING
Populus balsamifera	black cottonwood	poles	18/acre
Populus tremula	quaking aspen	1 gallon	18/acre
Crataegus douglasii	Douglas' hawthorne	trans/20 cu in	up to 35/acre
Rosa woodsii	woods rose	20 cu in	up to 35/acre
Alnus incana	river alder	trans	up to 35/acre

This woody plant palette will provide an initial scrub-shrub component on the reclaimed area. These plants will be 'mother plants', providing an on-site seed source for quick re-establishment of the woody component.

4.4.2 Plant Option 2; Replanting of Pre-Mining State

This planting option allows endemic species to be re-established in the initial reclamation process. For each wetland habitat, this option provides the use of seed mixes geared to provide endemic species, and a woody planting density that would provide an initial high density of woody cover.

PEM1E Habitat - shallow

The following table identifies the recommended plant materials that should be used to stabilize this seasonally flooded/saturated reclaimed emergent habitat. The following non-pasture wetland seed mix should be established on regraded landscapes that will be saturated and inundated from 0 to 18 inches during the early part of the growing season and will be dry during the mid and late parts of the growing season.

Emergent, Seasonally Flooded/Saturated-Shallow Seed Palette

SCIENTIFIC NAME	COMMON NAME	PERCENT OF MIX	APPLICATION RATE
Alopecurus pratensis	meadow foxtail	20	12 lb/ac
Agrostis stolonifera	redtop bentgrass	20	1.5 lb/ac
Deschampsia caespitosa	tufted hairgrass	10	1.5 lb/ac
Festuca rubra	red fescue	10	5 lb/ac
Phleum pratense	timothy	10	3 lb/ac
Poa palustris	fowl bluegrass	20	3 lb/ac
Trifolium repens	white clover	10	4 lb/ac
	Total Application Rate		30 lb/ac

This seed mix will re-establish the meadow foxtail-redtop bentgrass and meadow foxtail-red fescue associations described in the wetland technical report. The species selected for this habitat should provide the necessary diversity for adequate cover of both saturated and shallowly inundated conditions.

PEM1E Habitat - deep

The following table identifies the plant materials that should be used to re-establish this seasonally flooded/saturated emergent wetland habitat. These plant materials should be seeded where natural, emergent vegetation is re-established. The following seed mix should be established on regraded landscapes that will be saturated and inundated from 6 to 24 inches during the early part of the growing season and will not be inundated during the mid and late parts of the growing season.

Emergent, Seasonally Flooded/Saturated-Deep Seed Palette

SCIENTIFIC NAME	COMMON NAME	PERCENT OF MIX	APPLICATION RATE
Alopecurus pratensis	meadow foxtail	30	8 lb/ac
Agrostis stolonifera	redtop bentgrass	25	1 lb/ac
Glyceria striata	fowl mannagrass	10	8 lb/ac
Carex vesicaria	inflated sedge	25	8 lb/ac
Trifolium repens	white clover	10	2 lb/ac
	Total Application Rate		27.0 lb/ac

Note that reed canarygrass should not be seeded, although it is a dominate in portions of the pre-mining landscape. This species is extremely competitive and aggressive, often excluding other vegetation and limiting species diversity. This seed mix will re-establish the meadow foxtail-redtop bentgrass and inflated sedge-redtop bentgrass associations described in the

wetland technical report. Initially, clover will be the dominant plant on the least wet areas. Over time, clover will decrease with establishment of the other species. The species selected for this habitat should provide the necessary diversity for adequate cover of both shallowly and deeply inundated conditions.

PEM1Ef Habitat

The following table identifies the plant materials that should be used to re-establish this seasonally flooded/saturated farmed wetland habitat. These plant materials should be seeded where pasture, emergent vegetation is re-established. The following seed mix should be established on regraded landscapes that will be saturated and inundated from 0 to 12 inches during the early part of the growing season and will be dry during the mid and late parts of the growing season.

Emergent, Farmed Seed Palette

SCIENTIFIC NAME	COMMON NAME	PERCENT OF MIX	APPLICATION RATE
Alopecurus pratensis	meadow foxtail	40	16 lb/ac
Deschampsia caespitosa	tufted hairgrass	10	1 lb/ac
Phleum pratense	timothy	25	4 lb/ac
Agrostis stolonifera	redtop bentgrass	10	0.5 lb/ac
Agropyron repens	quackgrass	5	7.5 lb/ac
Trifolium repens	white clover	10	3 lb/ac
	Total Application Rate		32 lb/ac

This seed mix should re-establish the meadow foxtail-timothy association described in the wetland technical report. Initially, clover will be the dominant plant except in the wettest areas. Over time, clover will decrease with establishment of the other species. The species selected for this habitat should provide the necessary diversity for adequate cover of both saturated and shallowly inundated conditions.

PEM1F Habitat

The following table identifies the plant materials that should be used to re-establish this semi-permanently flooded wetland habitat. These plant materials should be seeded where emergent vegetation is re-established. The following seed mix should be established on regraded landscapes that will be semi-permanently inundated from 12 to 48 inches during the early and mid portions of the growing season.

In addition to the seed mix, substrate material from a portion of an existing semi-permanently flooded wetland should be excavated and respread in the new wetland area. This 'incubation' of substrate will provide plant seeds, rhizomes, tubers, and roots for rapid establishment. The inoculant will also provide detritus and bottom of the food chain organisms, adding a zoological component.

Common cattail should not be seeded, although it is a dominant in portions of the pre-mining landscape. This species is extremely competitive and aggressive, often excluding other deep emergents and limiting species diversity. This plan, which limits the re-establishment of cattail to natural seed sources, should provide the best opportunity to recreate a diverse emergent

community and habitat. This seed mix should re-establish the water sedge-redtop bentgrass association described in the wetland technical report.

Emergent, Semi-Permanently Flooded Seed Palette

SCIENTIFIC NAME	COMMON NAME	PERCENT OF MIX	APPLICATION RATE
Carex aquatilis	water sedge	5	1 lb/ac
Carex amplifolia	big-leaf sedge	5	1 lb/ac
Alopecurus pratensis	meadow foxtail	40	7 lb/ac
Beckmannia syzigachne	sloughgrass	30	5 lb/ac
Glyceria striata	fowl mannagrass	14	7 lb/ac
Sparganium eurycarpum	giant burreed	1	1 lb/ac
Alisma plantago-aquatica	water plantain	5	1 lb/ac
	Total Application Rate		22 lb/ac

PEM1H Habitat

The following table identifies the plant materials that should be used to re-establish this permanently flooded wetland habitat. These plant materials should be seeded where emergent vegetation is re-established. The following seed mix should be established on regraded landscapes that will be permanently inundated from 24 to 48 inches throughout the growing season.

Emergent, Permanently Flooded Seed Palette

SCIENTIFIC NAME	COMMON NAME	PERCENT OF MIX	APPLICATION RATE
Carex aquatilis	water sedge	5	1 lb/ac
Carex amplifolia	big-leaf sedge	5	1 lb/ac
Alopecurus pratensis	meadow foxtail	40	7 lb/ac
Beckmannia syzigachne	sloughgrass	30	5 lb/ac
Glyceria striata	fowl mannagrass	14	7 lb/ac
Sparganium eurycarpum	giant burreed	1	1 lb/ac
Alisma plantago-aquatica	water plantain	5	1 lb/ac
	Total Application Rate		22 lb/ac

In addition to the seed mix, substrate material from a portion of an existing semi-permanently flooded wetland should be excavated and respread in the new wetland area. This 'incubation' of substrate will provide plant seeds, rhizomes, tubers, and roots for rapid establishment. The inoculant will also provide detritus and bottom of the food chain organisms, adding a zoological component.

Common cattail should not be seeded, although it is a dominant in portions of the pre-mining landscape. This species is extremely competitive and aggressive, often excluding other deep emergents and limiting species diversity. This plan, which limits the re-establishment of cattail

to natural seed sources, should provide the best opportunity to recreate a diverse emergent community and habitat. This seed mix will re-establish the water sedge-water plantain association described in the wetland technical report.

PSS1E Habitat

The following tables identify plant materials that should be used to re-establish this seasonally flooded/saturated wetland habitat. These plant materials should be seeded, planted, and transplanted where scrub-shrub and emergent vegetation are re-established. The palettes should be established on regraded landscapes that will be saturated and inundated from 0 to 12 inches during the early part of the growing season and will be dry in the mid and late parts of the growing season.

Scrub-Shrub, Seasonally Flooded/Saturated Seed Palette

SCIENTIFIC NAME	COMMON NAME	PERCENT OF MIX	APPLICATION RATE
Symphoricarpos alba	snowberry	1	2 lb/ac
Agrostis stolonifera	redtop bentgrass	15	1 lb/ac
Festuca rubra	red fescue	30	16 lb/ac
Poa palustris	rigid bluegrass	50	8 lb/ac
Trifolium repens	white clover	5	3 lb/ac
	Total Application Rate		30 lb/ac

Scrub-Shrub, Seasonally Flooded/Saturated Plant Palette

SCIENTIFIC NAME	COMMON NAME	STOCK TYPES	STOCK SPACINGS
Populus tremula	quaking aspen	1 Gal; 4' Ht 5 Gal; 6'-8' Ht. Poles; 16' Ht	up to 15/acre
Populus balsamifera	black cottonwood	1 Gal; 4' Ht 5 Gal; 6'-8' Ht. Poles; 16' Ht	up to 15/acre
Crataegus douglasii	Douglas' hawthorne	transplant 20 cu in 40 cu in 1 Gallon	45/acre
Rosa woodsii	woods rose	20 cu in 40 cu in	100/acre
Cornus serecia	red-osier dogwood	transplant 20 cu in 40 cu in 1 Gallon	50/acre
Alnus incana	river alder	transplant 20 cu in 40 cu in 1 Gallon	45/acre

Different woody plant stock size should be used, depending upon seasonal availability as well as cost and practicality factors discussed in Section 6.0. The established shrub habitat should have a forested component with a 15 to 20 percent aerial cover. Reed canarygrass should not be seeded, although it is a dominant in portions of the pre-mining landscape. This seed and plant palette should re-establish the Douglas' hawthorne/redtop bentgrass association described in the wetland technical report.

PSS1F Habitat

The following tables identify plant materials that should be used to re-establish this semi-permanently flooded wetland habitat. These plant materials should be seeded, planted, and transplanted where scrub-shrub and emergent vegetation are re-established. The following palettes should be established on regraded landscapes that will be saturated and inundated from 6 to 24 inches during the early and mid parts of the growing season. The established shrub habitat should have a forested component with a 15 percent aerial cover. These palettes should re-establish the red-osier dogwood/water sedge association described in the wetland technical report.

Scrub-Shrub, Semi-Permanently Flooded Seed Palette

SCIENTIFIC NAME	COMMON NAME	PERCENT MIX	APPLICATION RATE
Carex aquatilis	water sedge	5	1.5 lb/ac
Carex amplifolia	big-leaf sedge	5	1.5 lb/ac
Alopecurus pratensis	meadow foxtail	40	10 lb/ac
Beckmannia syzigachne	sloughgrass	30	7 lb/ac
	Total Application Rate		20 lb/ac

Scrub-Shrub, Semi-Permanently Flooded Plant Palette

SCIENTIFIC NAME	COMMON NAME	STOCK TYPES	STOCK SPACINGS
Populus balsamifera	black cottonwood	1 Gal; 4' Ht 5 Gal; 6'-8' Ht. Poles; 16' Ht	up to 15/acre
Crataegus douglasii	Douglas' hawthorne	transplant 20 cu in 40 cu in 1 Gallon	45/acre
Salix spp.	willow	transplant 20 cu in 40 cu in 1 Gallon	60/acre
Cornus serecia	red-osier dogwood	transplant 20 cu in 40 cu in 1 Gallon	50/acre
Alnus incana	river alder	transplant 20 cu in 40 cu in 1 Gallon	50/acre

PFO1E Habitat

The following tables identify the plant materials that should be used to re-establish this seasonally flooded/saturated wetland habitat. These plant materials should be seeded, planted, and transplanted where forested, scrub-shrub, and emergent vegetation are re-established. The following palettes should be established on regraded landscapes that will be saturated and inundated from 0 to 12 inches during the early part of the growing season and will be dry in the mid and late parts of the growing season.

Forested, Seasonally Flooded/Saturated Seed Palette

SCIENTIFIC NAME	COMMON NAME	PERCENT OF MIX	APPLICATION RATE
Symphoricarpos alba	snowberry	1	2 lb/ac
Agrostis stolonifera	redtop bentgrass	15	1 lb/ac
Festuca rubra	red fescue	30	16 lb/ac
Poa palustris	rigid bluegrass	50	8 lb/ac
Trifolium repens	white clover	5	3 lb/ac
	Total Application Rate		30 lb/ac

Forested, Seasonally Flooded/Saturated Plant Palette

SCIENTIFIC NAME	COMMON NAME	STOCK TYPES	STOCK SPACINGS
Populus tremula	quaking aspen	1 Gal; 4' Ht 5 Gal; 6'-8' Ht. Poles; 16' Ht	up to 35/acre
Populus balsamifera	black cottonwood	1 Gal; 4' Ht 5 Gal; 6'-8' Ht. Poles; 16' Ht	up to 35/acre
Crataegus douglasii	Douglas' hawthorne	transplant 20 cu in 40 cu in 1 Gallon	100/acre
Rosa woodsii	woods rose	20 cu in 40 cu in	100/acre
Alnus incana	river alder	transplant 20 cu in 40 cu in 1 Gallon	100/acre

The established forest habitat should have a forested component with a 20+ percent aerial cover. These palettes should re-establish the black cottonwood/Douglas' hawthorne association described in the wetland technical report.

Mitigation concepts are developed in this section to complement the reclamation concepts in Section 4. While reclamation is geared to replace the exact type and quantity of wetlands that existed prior to mining, mitigation is geared to address temporal losses of wetlands by providing additional wetland acreage, and by providing long-term protection to the *reclaimed landscape.*

5.1 Mitigation Design Guidelines

Guideline 1:
Reclamation of impacted wetlands can be accomplished at 1.7:1 or greater ratio on ECG's property. The pre-mined acreage of open water (POWH), emergent (PEM1E, PEM1F, PEM1H, and PEM1Ef), scrub-shrub (PSS1E and PSS1F), and forested (PFO1E) habitats can be incrementally replaced in-kind and increased in extent as reclamation follows mining. The excavation, hydrology and plant palette recommendations in Section 4.0 should be incorporated in annual designs to include the creation of additional wetland acreage.

Guideline 2:
Six oxbow complexes were identified in the Wetland Delineation Report (*SELKIRK ENVIRONMENTAL* 1999) as having scrub-shrub and forested components, and having semi-permanent or greater inundation. Five of these are found in the proposed permit areas. These wetland complexes should be reconstructed in nearby, completed mining units before they are mined. These systems should be excavated after topsoil has been placed and groundcover established for one year. The oxbows should be excavated to pre-mining depths and configurations determined by cross sections and pre-mining aerial photography. These complexes should be hydroseeded with specific seed mixes, inoculated with substrate from existing oxbows, and planted with woody species endemic to the St. Maries basin.

Guideline 3:
Mature trees may be replaced as mining proceeds so that a gain in tree density is realized over the lifetime of the mining activities. For example, tree re-establishment at a 200 percent rate could be realized by;

- providing a net increase in forested wetlands (at least 20 percent tree canopy after monitoring,
- providing a5 percent after monitoring tree canopy in all re-established scrub-shrub wetlands, and
- providing approximately 17 acres of upland forest.

Guideline 4:
Riparian enhancement plantings should be incorporated into the reclamation designs. The mining plans propose a 30-foot wide buffer along the St. Maries River. Twenty feet of the buffer adjacent to the river will not altered. A silt berm will occupy 7.5 feet of the buffer for a two-year period. This 30-foot wide area should be planted with native shrubs, and deciduous and coniferous trees where existing woody vegetation is lacking. This should occur after mining has been completed, when woody material is being planted in active reclamation areas.

These riparian plantings should provide additional cover for small mammals, passerines, and ungulates, detritus for the river system, and bank stabilization with deep root structures. At maturity, the trees will decay and topple, providing down logs at top-of-bank and large woody debris (LWD) for the river system.

Guideline 5:
Mitigation designs could provide additional special habitat features to augment the natural biologic functions of the reclaimed and mitigated wetlands. These special features may include down logs, snags, and forested upland pockets and corridors. Down logs provide habitat for insects, small mammals, amphibians, and gallinaceous birds. Snags provide habitat for insects, passerines, woodpeckers, and predatory birds, including raptors. Forested upland pockets and corridors provide cover opportunities, primarily for ungulates. These features may be incorporated into annual site-specific reclamation designs for forested, scrub-shrub, and deeply inundated emergent areas.

Guideline 6:
Protection of the reclaimed and mitigated wetlands from grazing should be provided to some degree. The degree of protection should be based on what is practical for ECG. The following concepts of wetland protection should be explored for practicality, and where land ownership allows such protective measures;

- Short-term fencing until performance standards are realized,
- Long-term fencing until planted trees are no longer susceptible to grazing impacts,
- Permanent fencing around reclaimed and mitigated wetlands, and
- Conservation easements to protect wetlands.

5.2 Woody Vegetation Replacement

ECG identified 1064 deciduous trees, 690 conifers, and 50 snags within the visual corridor of the project area during a 1999 tree inventory. During a proposed 20-year mining cycle, 693 of these trees will be removed, or an average of 35 trees per year. The most conservative reclamation and mitigation plans indicate planting up to 4,140 trees over a 20-year reclamation cycle. These trees will be used to replace lost forested wetlands, provide an overstory component of at least 5 percent in reclaimed scrub-shrub wetlands, and to provide pockets and corridors of upland forest. Performance standards in Section 7.2 suggest that 75 percent of the planted trees must survive. This means that ECG would be insuring at least 3,105 trees survive as a replacement for the 693 trees lost during mining. These trees will be planted in 66.2 acres of reclaimed land, providing an average density of at least 47 trees per acre.

In addition, the reclamation designs indicate that 6627 shrubs will be planted over a 20-year reclamation cycle. These shrubs will be planted over the same 66.2 acres. This will provide an average shrub density of at least 100 shrubs per acre.

5.3 Enhanced Riparian Corridor Habitat

The following table identifies the plant materials that should be used to enhance areas of the 30-foot mining setback that lack woody vegetation.

The enhanced riparian areas will have a forested component by planting at a tree:shrub ratio of 1:5. The product of this effort should be more stable stream banks in the short-term, and more streamside shading in the long-term. Tree species should also eventually be a source of large woody recruitment to the active stream channel.

Riparian Corridor Plant Palette

SCIENTIFIC NAME	COMMON NAME	STOCK TYPES	STOCK SPACINGS
TREES			
Populus tremula	quaking aspen	1 Gal; 4' Ht 5 Gal; 6'-8' Ht Poles; 16' Ht	18/acre
Populus balsamifera	black cottonwood	1 Gal; 4' Ht 5 Gal; 6'-8' Ht. Poles; 16' Ht	18/acre
Pinus contorta	lodgepole pine	2 year old 1 Gal; 4' min. Ht	up to 55/acre
Abies grandis	grand fir	2 year old 1 Gal; 4' min. Ht	up to 55/acre
Abies lasiocarpa	subalpine fir	2 year old 1 Gal; 4' min. Ht	up to 55/acre
Picea engelmannii	Engelmann spruce	2 year old 1 Gal; 4' min. Ht	up to 55/acre
SHRUBS			
Crataegus douglasii	Douglas' hawthorne	transplant 20/40 cu in 1 Gallon	35/acre
Rosa woodsii	woods rose	20/40 cu in	35/acre
Cornus serecia	red-osier dogwood	transplant 20/40 cu in 1 Gallon	20/acre
Alnus incana	river alder	transplant 20/40 cu in 1 Gallon	20/acre
Symphoricarpos alba	snowberry	20/40 cu in 1 Gallon	35/acre
Amelanchier alnifolia	serviceberry	20/40 cu in 1 Gallon	15/acre

5.4 Special Habitat Features

Special habitat features should be added to the landscape as part of the reclamation and mitigation plans. These special features should include down logs, snags, and forested upland pockets and corridors. Down logs should be acquired when existing black cottonwood and conifers are removed during logging of the mining unit (see pre-mining activities). This material should be placed on the ground in PSS1E and PFO1E habitats.. The material should also be anchored into sideslopes in PEM1F, PEM1H, PSS1F, and POWH habitats. Down logs should be placed at 2 to 5 per acre in those habitats. Down logs provide habitat for insects, small mammals, amphibians, and gallinaceous birds.

Snags should be located on the perimeter of emergent habitats and scattered throughout scrub-shrub and forested habitats. Snags should be placed at 3 to 5 per acre. They provide habitat for insects, passerines, woodpeckers, and predatory birds, including raptors.

Forested upland pockets and corridors should be located in numerous areas throughout the permit areas (see Figure 5.6). They should be planted at an initial density of 400 stems per acre, using lodgepole pine, grand fir, Engelmann spruce, subalpine fir, and aspen. The erosion control seed mix should be used for soil stabilization in these areas.

5.5 Wetland Protection

Protection of the reclaimed and mitigated wetlands from grazing may be provided by one or more of the following protection mechanisms.

Short-term Fencing

The first is placement of short-term fencing around each mining unit during the first year of reclamation. This fencing should remain in place and be maintained during the 5-year monitoring period. Fencing may be removed once the monitoring period has ended and all performance standards established in Section 7.2 have been realized.

The second is placement of short-term fencing around all clusters of wetland trees in annually reclaimed units. This fencing should remain in place for different lengths of time, depending upon stock size and growth rate. The purpose of this fencing is to protect young trees from cattle until trees reach a height/age where they are no longer vulnerable to grazing. Cluster fencing duration should based on the following stock size;

- 1 gallon cottonwood or aspen; 4' - 6' Ht. — 10-15 years
- 2 gallon cottonwood or aspen; 6' - 8' Ht. — 8-10 years
- cottonwood poles; 3" caliper, 7' above ground. — 5 years

Long-term Fencing

Long-term fencing could be constructed around all reclaimed wetlands on the permit areas. This would be accomplished by extending temporary fencing as recently mined annual units are seeded and planted. This fencing should be maintained on an annual basis as long as long as property ownership remains the same, or until a change in land use activity occurs.

Permanent Fencing

Permanent, or perpetual, fencing is an option for long-term wetland protection. This option would effectively remove cattle from all wetlands and floodplains in the proposed permit areas, regardless of ownership. Since multiple ownership is involved in the permit areas, the fencing should be managed by a third party, or an ownership association. This option would allow the fencing to be removed if cattle grazing were stopped in the area. This option would also allow future changes in land use.

Conservation Easements

This wetland protection mechanism would be organized with the land owners and a third party, be it a regulatory agency or an environmental organization. Conservation easements place legal covenants on the land title, restricting what activities may take place on the encumbered property. The covenants would be mostly permanent, restricting all future landowners and most future activities. The purpose of these easements is not only to protect wetlands, but also to make the primary use wildlife habitat.

6.0 RECLAMATION AND MITIGATION IMPLEMENTATION

This sections provides recommendations for implementing the reclamation and mitigation concepts discussed in the last two sections. As the varied concepts are pulled together in a cohesive Plan of Operation, the following elements should be adhered to;

- mining BMP's should remain in place through the first high flow season after mining has been completed. Siltation berms, interceptor or diversion channels, and sediment basins are functional at this time, no panels are open, and no mining process water is present in the mining unit,
- reclamation BMP's, including LWD, silt fence, and hay bales, should be in place on the regraded mining unit through the first two high flow seasons to abate flood flows, minimize local scour, and trap sediments;
- topsoil should be spread to final grade and the mining unit seeded the first summer season after mining is completed,
- irrigation should occur as necessary to assure seed and plant palette establishment,
- wetland areas regraded and seeded the first summer season should be planted with woody species the second summer season; and
- oxbow construction should occur before oxbows are mined, and should be constructed the during the second reclamation season, after topsoil is spread, after the area is seeded, but before woody vegetation is planted.

The remainder of this section provides suggested ways of implementing the design recommendations, including implementation timeframes, implementation sequencing ,and annual implementation activities. Also included is a discussion of the conceptually reclaimed landscape, and an estimate of reclamation and mitigation material costs.

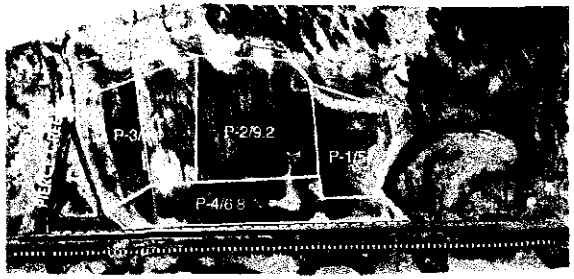
6.1 Implementation Timeframe

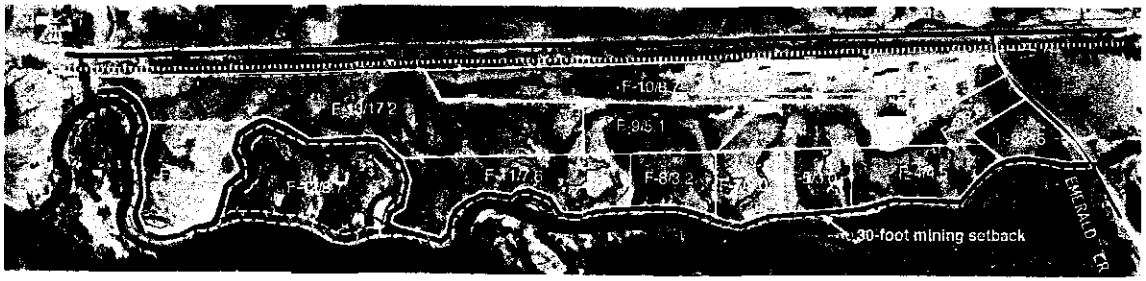
Reclamation activities should be undertaken during the drier summer and fall months, when surface water is not present and groundwater levels are at their deepest. This should the optimum timeframe for reclamation as it follows closely behind the completion of mining and requires dry conditions for spreading topsoil and excavating deeper aquatic systems, including oxbows.

Reclamation activities may be undertaken in one season in areas being reclaimed to pasture lands, and in two seasons in active floodplain areas. Pasture reclamation may be completed the first summer season after mining by removing BMP's, respreading topsoil, seeding a pasture seed mix, and irrigating as needed. Floodplain reclamation should require two seasons for completion. During the first summer season BMP's should be removed, topsoil respread, the unit seeded with upland and wetland seed mixes, and irrigated as needed. The second summer season, woody vegetation should be planted per annual design specifications. Oxbow wetland construction should also occur in the second season in specified mining units.

These reclamation timeframes are recommended to minimize soil loss and potential water quality degradation. This is achieved in two ways. The first is reclaiming only during the drier summer and fall months when surface water is not present within the reclaimed units. The second is the reliance of two seasons to complete reclamation. In this manner, the regraded

SCALE: 1 inch = 660 feet





LEGEND

- MINING AREAS
- STREAMS
- WETLANDS
- STATE HIGHWAY 3
- ST. MARIES RAILROAD
- FIRST SEASON REC
- SECOND SEASON REC

TYPICAL RECLAMATION ACTIVITIES

Mining Units P-1 through P-6
First season; BMP's removed, topsoil/subsoil replaced to final grade. Wetland and Upland pasture seed mixes applied and irrigated.

Mining Units F-1 through F-14
First season; BMP's removed, topsoil/subsoil replaced to final grade. Wetland and Upland seed mixes applied and irrigated.

Second season; Oxbows excavated in Units F-3, F-4, F-5, and F-6. Oxbows 'inoculated' with substrate from existing oxbows. All woody plant species planted per reclamation designs. Irrigation continued through dry portion of growing season.

YEAR TWO

YEAR THREE

YEAR FOUR

YEAR FIVE

YEAR SIX

YEAR SEVEN

YEAR EIGHT

FINAL RECLAMATION YEAR

CONCEPTUAL RECLAMATION SEQUENCE**

Year	Units
2	F-2 F-3
3	F-2 F-3 F-4 P-1
4	F-4 F-5 F-7 P-2
5	F-5 F-7 F-6 F-11 P-3
6	F-6 F-11 F-8 F-9
7	F-8 F-9 F-13 F-14 P-4
8	F-13 F-14
Final	F-1 F-10

**F-12 will be reclaimed if it is mined.

FIGURE 6.2
CONCEPTUAL RECLAMATION SEQUENCE
EMERALD CREEK GARNET, LTD.

overburden and stockpiled topsoil is protected during high flows by mining and reclamation BMP's, regraded topsoil has an established groundcover before becoming vulnerable to the first unprotected highflow period, and oxbow construction occurs in stabilized areas that have been graded and have an established groundcover.

6.2 Reclamation Sequence

Figure 6.2 shows a recommended reclamation sequence for annual mining units F-1 to F-14 in the river floodplain and annual mining units P-1 to P-4 in the pasture. The following table shows the conceptual sequence for reclaiming the mining units in these two permit areas.

Year	Reclamation Activities
2	F-2 and F-3 topsoil respread to final grade and seeded, BMP's removed
3	F-2 and F-3 permanently inundated forested, shrub, and emergent oxbow constructed and planted
	F-4 and P-1 topsoil respread to final grade and seeded, BMP's removed
4	F-4 wetland shrubs and trees planted
	F-5, F-7 and P-2 topsoil respread to final grade and seeded, BMP's removed
5	F-5, F-7 permanently inundated forested, shrub, and emergent oxbow constructed and planted
	F-6, F-11 and P-3 topsoil respread to final grade and seeded, BMP's removed
6	F-6 and F-11 wetland shrubs and trees planted
	F-8 and F-9 topsoil respread to final grade and seeded, BMP's removed
7	F-8 and F-9 wetland shrubs and trees planted
	F-13, F-14 and P-4 topsoil respread to final grade and seeded, BMP's removed
8	F-13 and F-14 wetland shrubs and trees planted
Final	F-1 and F-10 topsoil respread to final grade and seeded; wetland shrubs and trees planted

F-1 and F-10 would be mined when reserves in all other permit areas have been mined. These two mining units will be reclaimed immediately after mining. This sequence is conceptually presented to show how reclamation would proceed.

6.3 Annual Implementation Activities

The reclamation plan should be implemented in annual increments, based on annual plans submitted to the COE and IDL each year. The annual plans would take up to two calendar years to implement, depending upon the type of wetland habitat that is being reclaimed. The design elements would be implemented in the following sequence within each mining unit.

Reclamation year 1
- topsoil respread to final floodplain grade
- appropriate seed mix for PEM1E, PEM1Ef, PSS1E, and PFO1E habitats applied
- revegetated areas irrigated
- reclaimed mining unit fenced until performance standards are realized , except for ECG ownership that will have permanent fencing

Reclamation year 2
- PEM1F, PEM1H, PSS1F, and POWH habitats excavated
- appropriate seed mix for PEM1F, PEM1H, PSS1F, and POWH habitats applied
- downed logs and snags placed
- upland forested corridors and pockets planted
- riparian corridor enhanced
- revegetated areas irrigated

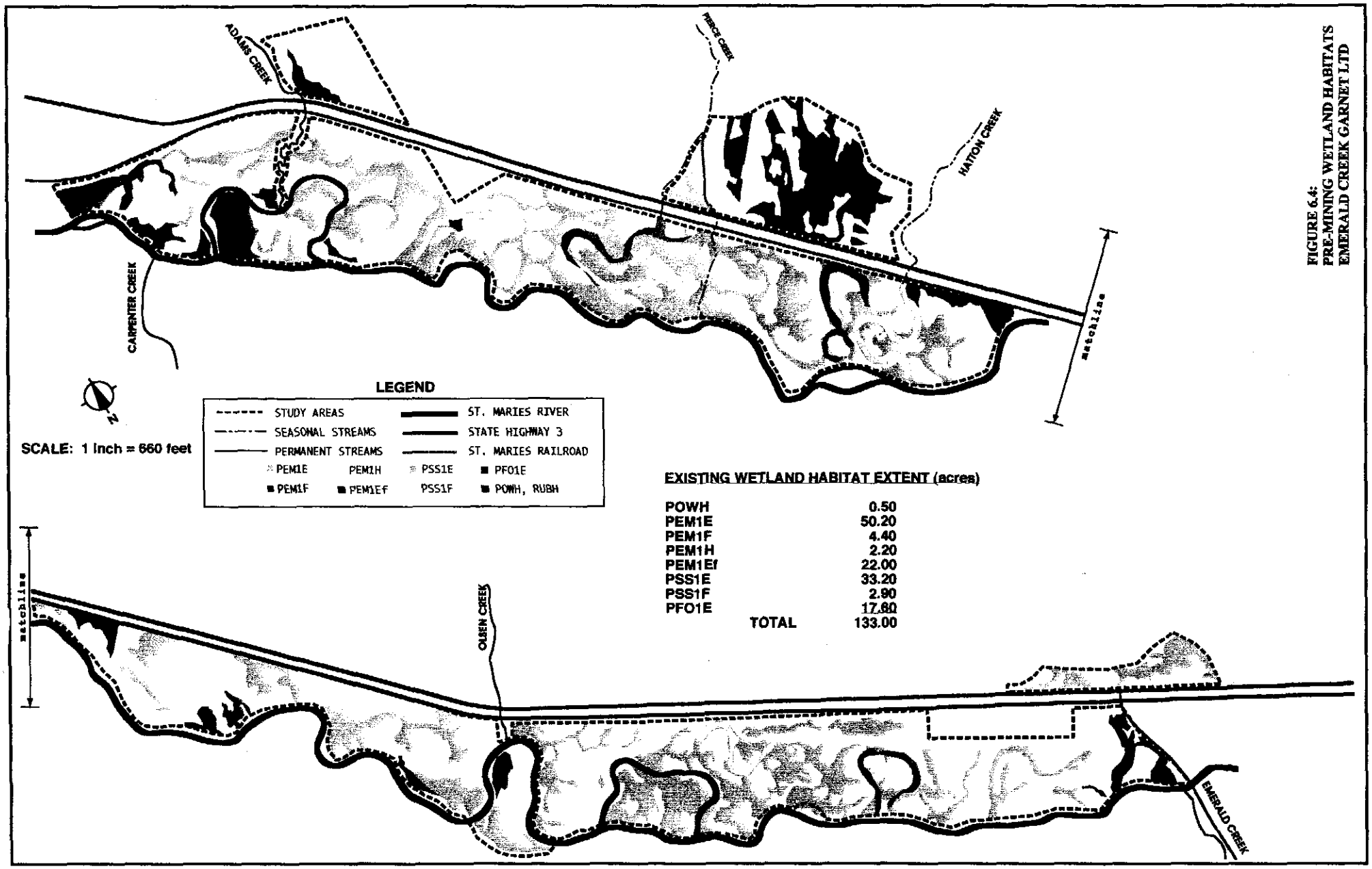
6.4 Conceptual Reclaimed Landscape

By following the design criteria in sections 4.0 and 5.0, wetland hydrology would be restored and functional at the end of reclamation year 1 in farmed wetlands, and reclamation year 2 in other wetlands. Restoration of the vegetative component would take longer to occur. Historically, ECG has had emergent vegetation re-establish with 80 percent groundcover in 3 to 5 years. Woody vegetation would take longer. The planted species will require time to reach a functional size, approximately 5 to 10 years for shrubs and 20+ years for trees. At maturity, the reclaimed landscape would provide the same functions and values as the pre-mined landscape, and would provide the following additional wetland functions:

- hydrologic support by increasing the permanently saturated/inundated component,
- storm and flood water abatement by increasing the percent and density of woody vegetation,
- groundwater exchange to a limited degree by increasing the permanently flooded component,
- water quality improvement by increasing the retention of overland flow, and
- biologic support by diversifying the woody vegetation and by adding special habitat features.

Figure 6.4 provides an overview of the pre-mined landscape by showing general locations of all wetland habitats. The potential reclaimed landscape should be very similar, with wetlands reclaimed in the same approximate locations at 1.7:1 on ECG property and 1:1 elsewhere. This reclaimed landscape would have the following attributes:

- 1:1 in-kind wetland replacement on other ownership, with ECG ownership having 1.7:1 in-kind replacement,
- oxbow complexes reclaimed before they are impacted,
- net increase in semi-permanently and permanently flooded wetlands,
- improved riparian streambank condition,
- net increase of all wetland habitats,
- net increase in riparian trees from 1804 to 4140,
- addition of snags, downed logs, and wildlife corridors.



EXISTING WETLAND HABITAT EXTENT (acres)

POWH	0.50
PEM1E	50.20
PEM1F	4.40
PEM1H	2.20
PEM1Ef	22.00
PSS1E	33.20
PSS1F	2.90
PFO1E	17.60
TOTAL	133.00

FIGURE 6.4:
PRE-MINING WETLAND HABITATS
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The following table summarizes the acreage of reclaimed wetlands for each wetland habitat.

Acreage of Reclaimed Wetland Habitats

	ECG Ownership		Other Ownership	
Habitat	**Pre-mining Acres**	**Reclaimed Acres**	**Pre-mining Acres**	**Reclaimed Acres**
open water, permanently flooded - POWH	0.00	0.00	0.50	0.50
emergent, seasonally flooded/saturated - PEM1E	18.20	30.90	32.0	33.60
emergent, semi-permanently flooded - PEM1F	0.80	1.40	3.6	3.80
emergent, permanently flooded - PEM1H	0.00	0.00	2.2	2.30
emergent, farmed - PEM1Ef	1.00	1.70	21.0	22.00
scrub-shrub, seasonally flooded/saturated - PSS1E	5.20	8.80	28.0	29.40
scrub-shrub, semi-permanently flooded - PSS1F	0.00	0.00	2.90	3.10
forested, seasonally flooded/saturated - PFO1E	9.80	16.70	7.80	8.20
Totals	35.0	59.50	98.00	102.90

This Reclamation Assurance Plan has been developed as a means to monitor the success of implemented reclamation and mitigation plans. This should be an essential element for ECG's internal review and assessment, and is required for agency approval and permitting. This assurance plan includes a monitoring sequence, performance standards, construction observation, compliance monitoring, and long-term monitoring elements.

7.1 Reclamation Monitoring Sequence

Monitoring should follow all reclamation and mitigation activities. Monitoring pasture wetlands should be initiated after one year of reclamation. Monitoring floodplain reclamation should be initiated after woody materials have been planted in the second year of reclamation.

7.2 Performance Standards

The Reclamation Assurance Plan establishes a series of performance standards as a basis of evaluating the success of reclamation activities in both upland and wetland areas. Separate performance standards have been established for hydrologic conditions and vegetation. These performance standards should be evaluated annually as described in Sections 7.3 and 7.4.

7.2.1 Wetland Hydrologic Support Standards

The following performance standards should be employed to evaluate areas designed to have seasonal saturation and inundation(hydrologic class E).

- Direct observation of 0 to 18 inches of inundation and/or saturated soils early in the growing season for the five year monitoring period; and
- Observation of indicators of soil saturation (redoximorphic features) and inundation at any time of the growing season for the five year monitoring period.

The following performance standards should be employed to evaluate areas designed to have semi-permanent inundation (hydrologic class F).

- Direct observation of 6 to 48 inches of inundation with a saturated fringe for at least 50 percent of the growing season for the five year monitoring period; and
- Observation of indicators of soil saturation (redoximorphic features) and inundation at any time of the growing season for the five year monitoring period.

The following performance standards should be employed to evaluate areas designed to have permanent inundation (hydrologic class H).

- Direct observation of 24 to 48+ inches of inundation with a saturated fringe throughout the growing season for the five year monitoring period; and

- Observation of indicators of soil saturation (redoximorphic features) and inundation at any time of the growing season for the five year monitoring period.

7.2.2 Wetland Planting Standards

The following performance standards should be used for monitoring emergent and pasture wetland vegetation.

- Establish at least 80 percent aerial cover at the end of the five year monitoring period;
- Observe a continual increase in cover percentage, plant species diversity, and plant age/size class diversity throughout the five year monitoring period;
- Establish at least 5 ground layer species in the wetland at the end of the five year monitoring period; and
- Allow natural recruitment of desirable wetland species to be included as cover and as species diversity during long-term monitoring.

The following performance standards should be used for monitoring scrub-shrub and forest wetland vegetation.

- Establish at least 80 percent aerial cover of all seeded, planted, and transplanted species at the end of the five year monitoring period;
- Observe a continual increase in cover percentage, plant species diversity, and plant age/size class diversity throughout the five year monitoring period;
- the forested component will have an average 15 to 20 percent aerial cover at the end of the five year monitoring period;
- Establish at least 2 ground layer species, 2 shrub species, and 1 tree species in the wetland at the end of the five year monitoring period;
- Allow natural recruitment of desirable wetland species to be included as cover and as species diversity during long-term monitoring; and
- Up to 25 percent mortality is allowed as long as other performance standards are realized.

7.2.3 Upland Planting Standards

The following performance standards should be used for monitoring meadow and forest upland areas.

- Establish at least 80% aerial cover of all seeded, planted and transplanted species at the end of the five year monitoring period;
- Maintain at least 50% survival of planted trees at the end of the five year monitoring period;
- Establish at least 5 ground layer species in meadow areas at the end of the five year monitoring period;
- Observe a continual increase in cover percentage, plant species diversity, and plant age/size class diversity throughout the five year monitoring period; and
- Natural recruitment of desirable upland species shall be counted as cover and as species diversity during long-term monitoring.

7.2.4 Riparian Enhancement Planting Standards

The following performance standards should be used for monitoring shrub and forest areas in the enhanced buffer.

- Establish at least 80 percent aerial cover of all planted, transplanted, and existing species at the end of the five year monitoring period;
- Observe a continual increase in cover percentage, plant species diversity, and plant age/size class diversity throughout the five year monitoring period;
- The tree:shrub ratio of planted stock will be 1:5 at the beginning of the 5 year monitoring period;
- Establish at least 4 shrub species and 2 tree species in the enhanced riparian corridor at the end of the five year monitoring period; and
- Allow natural recruitment of desirable wetland species to be included as cover and as species diversity during long-term monitoring.

7.3 Reclamation Monitoring Methodology

Reclamation monitoring of various types and durations is necessary to insure that the reclamation activities are recreating conditions similar to or better than the pre-mining conditions. The following monitoring should be completed by ECG's Environmental Consultant.

7.3.1 Construction Observation

Implementation of reclamation and mitigation plans require a significant amount of planning and coordination to ensure all components are considered and incorporated into the plan. Reclamation and mitigation work to be completed within the seven permit areas should be implemented on an annual basis. Prior to beginning work each year, an annual coordination meeting should be held to identify and describe the work to be completed throughout the year.

The Operations Manager and Environmental Consultant should oversee implementation of each annual reclamation plan. Throughout wetland construction, the Consultant should have direct responsibility for informing ECG of construction progress, completions, and any necessary changes required. During actual construction, the Consultant should place grading stakes and inspect grading for accuracy and completeness. The Consultant should also supervise installation of plant materials. The Consultant should be responsible for verifying that the plants used correspond to species and size requirements as specified on the planting palettes. Occasionally, some plants indicated on the planting palettes cannot be obtained. Under these circumstances, the Consultant must suggest suitable and appropriate plant substitutions to the lead agency for approval. These substitutions must follow the general intent of the reclamation goals and objectives, and be compatible with the established hydrologic regimes.

7.3.2 Compliance Monitoring

Once all aspects of the reclamation plan have been constructed and planted, a compliance review is warranted. This will assure all parties that the plan was properly and completely implemented. A compliance report will be prepared by ECG to submit to the lead agencies. This report will summarize the implementation process and describe any problems that may have occurred as well as solutions.

7.3.3 Long-Term Monitoring

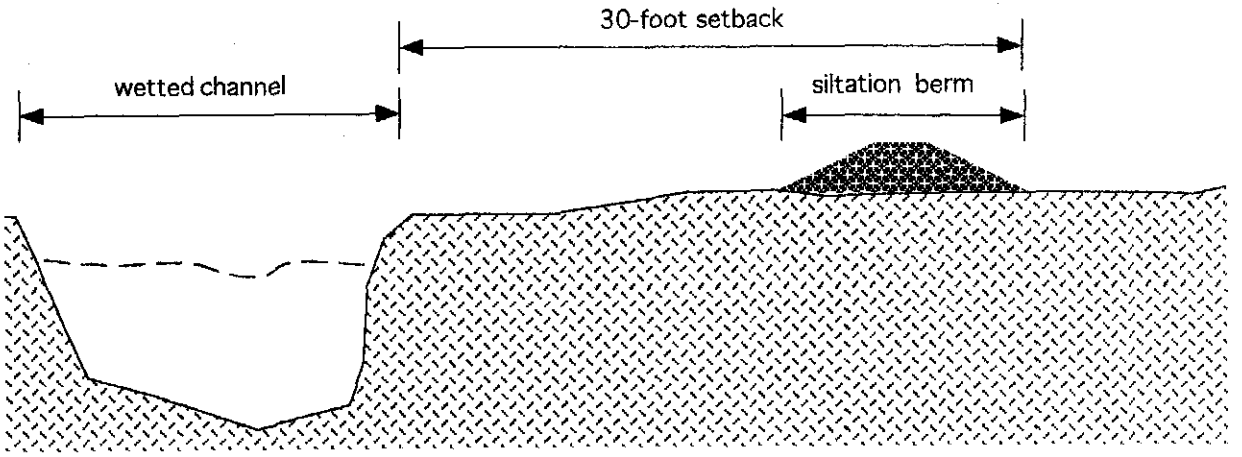
A long-term monitoring program should be used to evaluate the success of the reclamation and mitigation activities against the performance standards established in Section 7.2. Overall monitoring should extend 5 years following completion of each reclamation component in each reclaimed annual mining unit, or until performance standards are met. During this time, observations of wetland and upland plantings, and wetland hydrologic support should be made at permanent one-hundredth acre (11.8-foot radius) plots located in each annual increment. Monitoring should be conducted twice a year, during the growing season in May and August. Results of the site monitoring completed each year should be included in annual reports submitted by ECG to the lead agencies.

At each monitoring plot, percentage of plant cover would be estimated for the tree, shrub, and groundcover layers and summed to assess total aerial cover. Signs of stress such as dead wood, root suckering, and disease would be noted. Vigor and vitality would be evaluated through signs of new growth, vegetative propagation, leader length, and flowering. Introduction and establishment of desirable successional species would be noted and their cover estimates included in the overall cover estimate. Invasion of weedy species would also be noted. Observations would include hydrologic support of reclaimed wetland areas, including observance of surface inundation and depth to soil saturation. Photographs would be taken at established photopoints for each plot during each monitoring session.

In addition to on-site monitoring, off-site monitoring may also be conducted, providing a baseline for evaluation of vegetation re-establishment and hydrologic conditions. These baseline plots may be established in areas similar in elevation, floodplain width, elevation, and vegetation cover (relative to the permit area's pre-mined state). Baseline plots would be used to assess plant leader growth, plant propagation, general plant vigor, hydrologic regimes, and floodplain scour and deposition relative to the growing season's weather patterns. Monitoring these plots is essential to determine the response of reclaimed areas to possible atypical run-off events, periods of drought, and other extreme climatic conditions.

8.1 BMP Schematics

Siltation Berm: This berm is constructed 22.5 feet back from the creek, and along the perimeter of the mining unit. These berms will have a core of gravel and cobble, a topsoil surface, a 1.5-foot minimum height, a 1.5-foot minimum top width, and a 1V:2H sideslope. Single season berms will be covered with plastic as shown below. Longer term berms will be stabilized with erosion control vegetation.



Typical Siltation Berm Cross Section

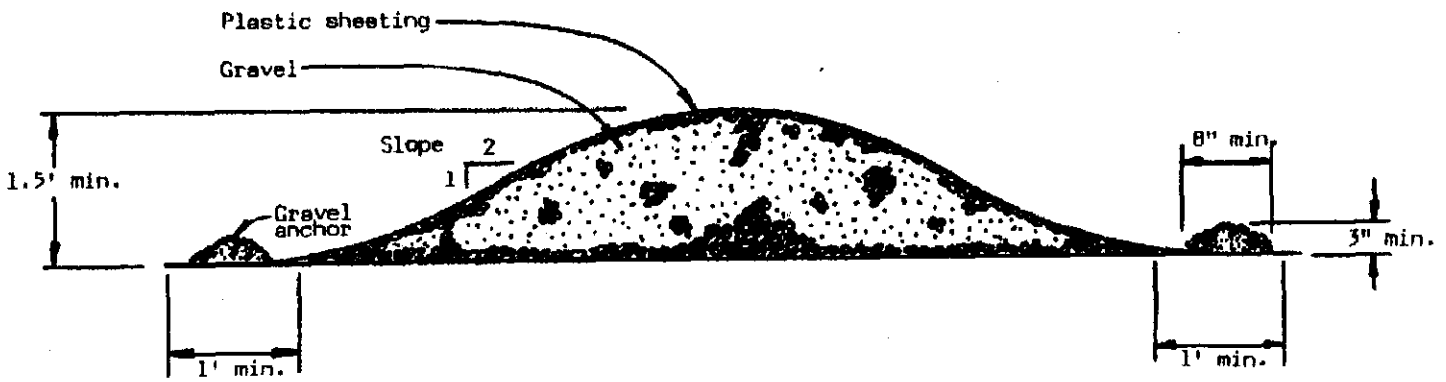
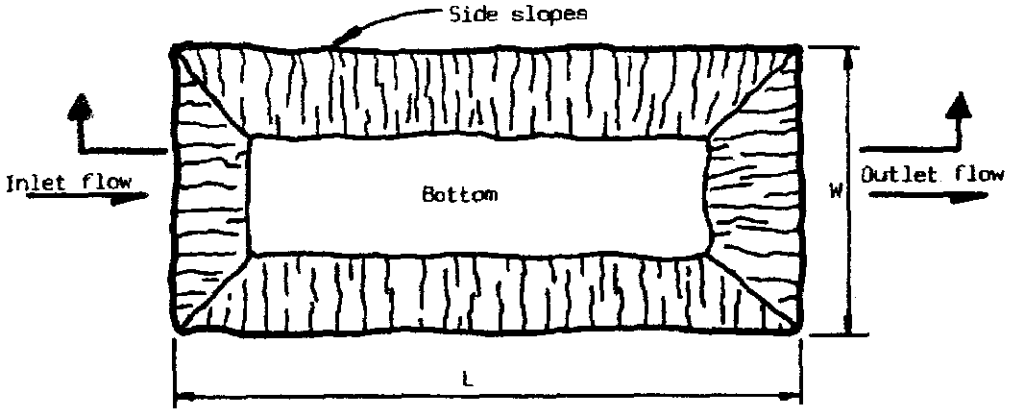


EXHIBIT 8.1.A: BMP III.4: SILTATION BERM



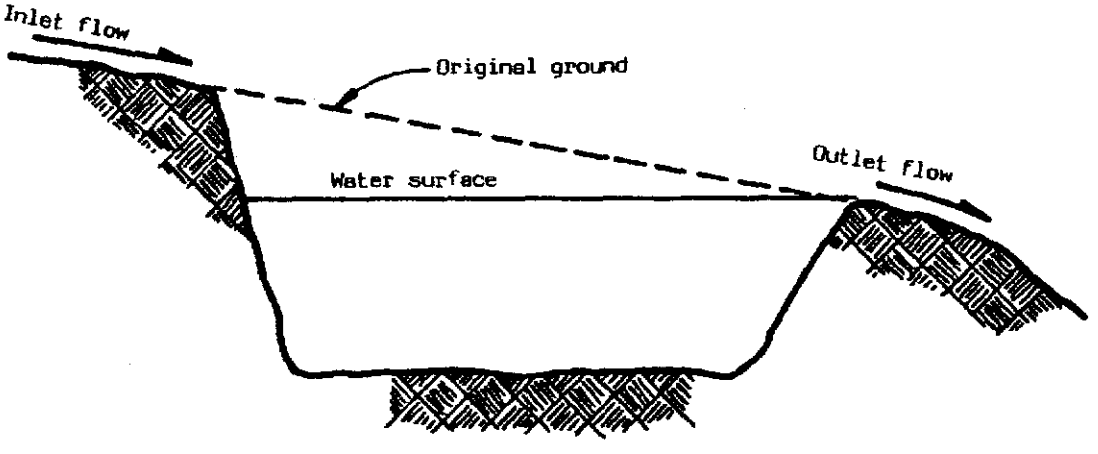
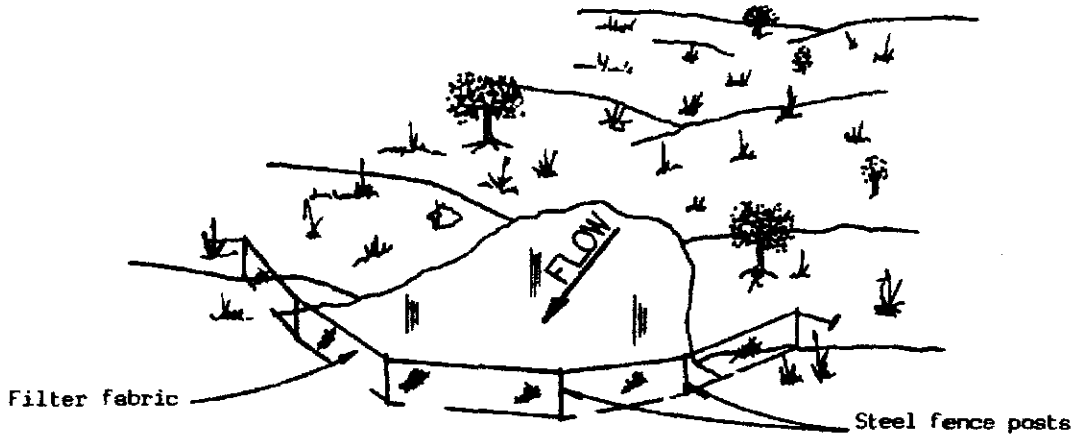
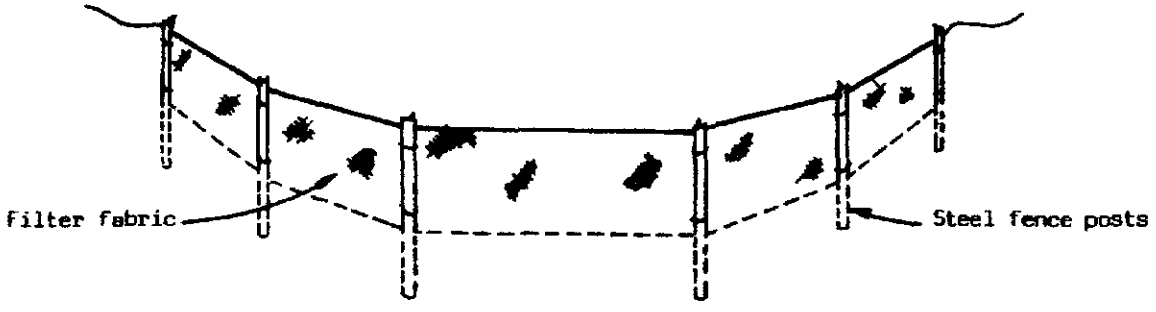


EXHIBIT 8.1.B: BMP V.2: CATCH BASIN





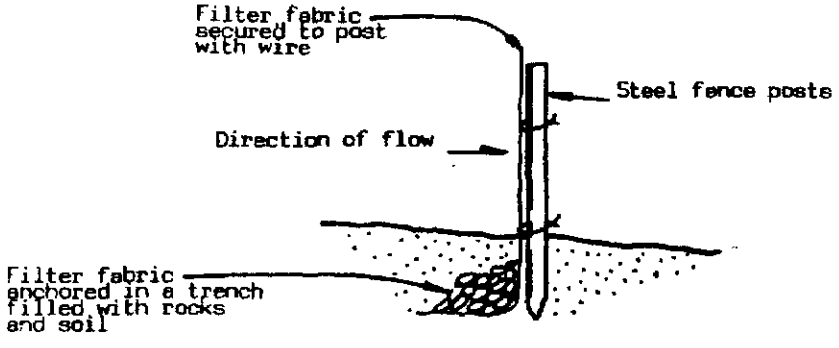
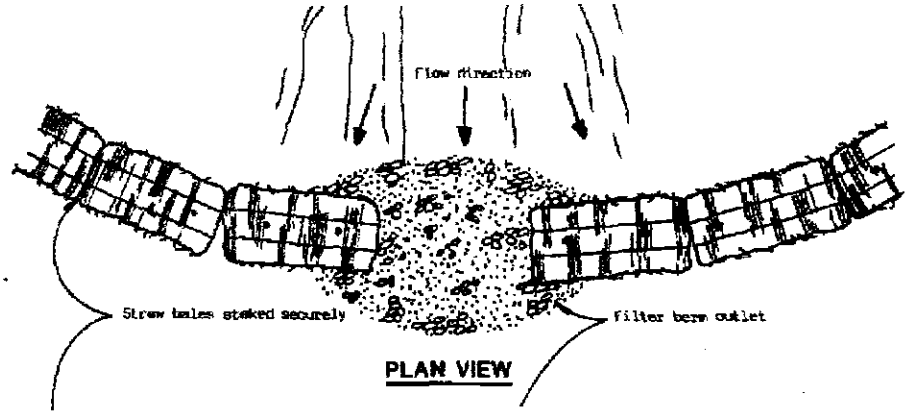
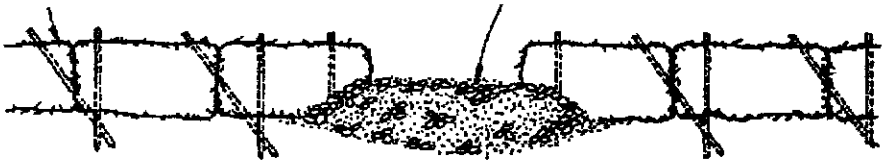


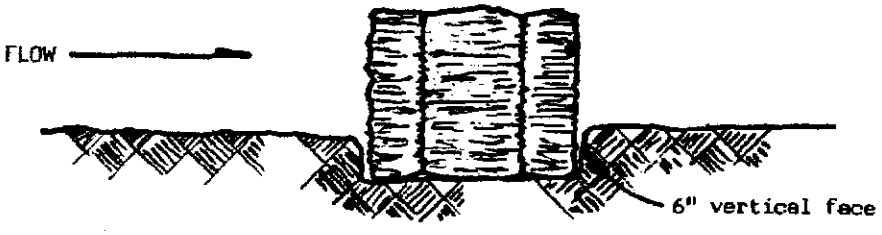
EXHIBIT 8.1.C: BMP V.4: SILT FENCING



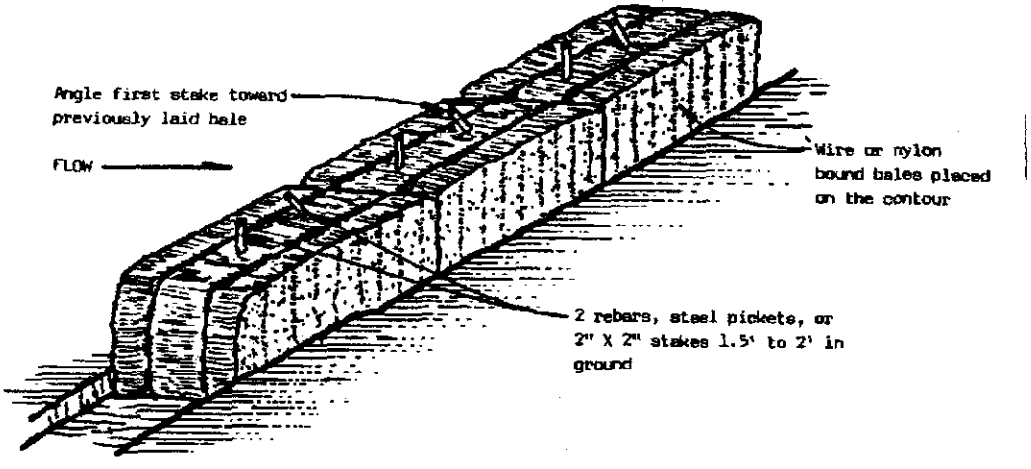
PLAN VIEW



ELEVATION



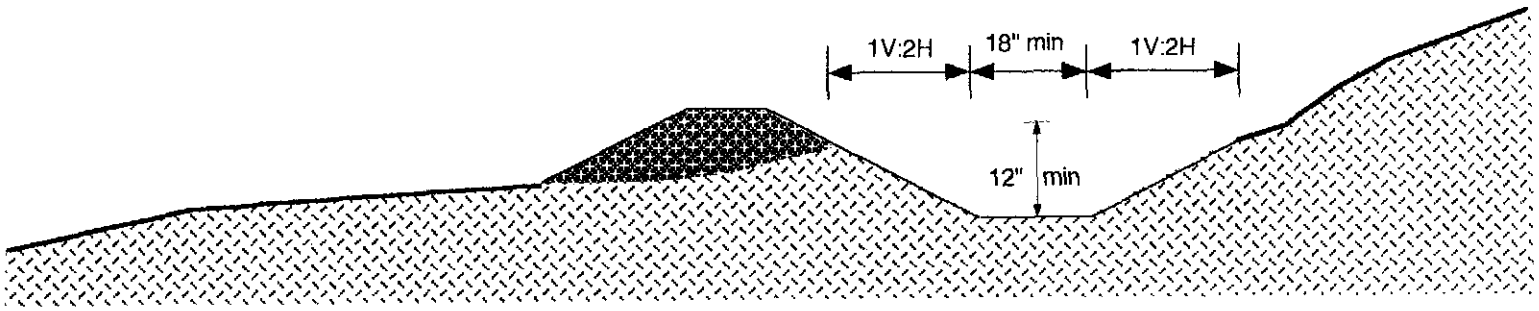
EMBEDDING DETAIL



ANCHORING DETAIL

EXHIBIT 8.1.D: BMP V.1: STRAW BALES

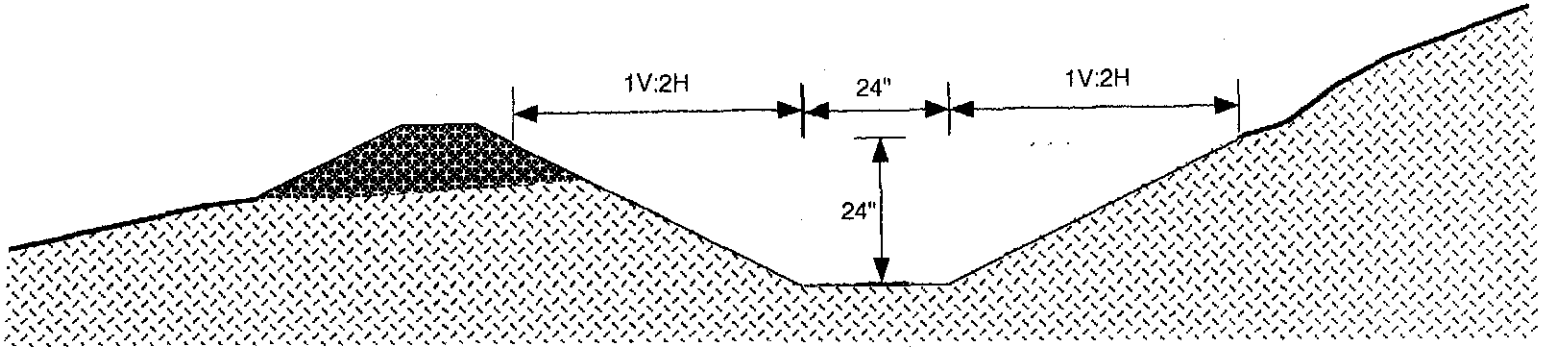
Interceptor Channel: This channel is constructed along the upslope perimeter of the mining unit to collect off-site overland run-off and convey it around the mining unit. These structures have been sized for a drainage area of less than 1.0 square miles. They have a minimum depth of 1.0 feet, a bottom width of 1.5 feet, a gradient of 1.5 percent, and sideslopes of 1V:2H.



Typical Interceptor Channel Cross Section

EXHIBIT 8.1.E: BMP III.2: INTERCEPTOR CHANNEL

Diversion Channel: This channel is constructed along the upslope perimeter of the mining unit to collect off-site overland run-off and waters from ephemeral swales, and convey them around the mining unit. These structures have been sized for a minimum drainage area of 1.0 square miles. They have a minimum depth of 2.0 feet, a bottom width of 2.0 feet, a gradient of 1.5 percent, and sideslopes of 1V:2H.

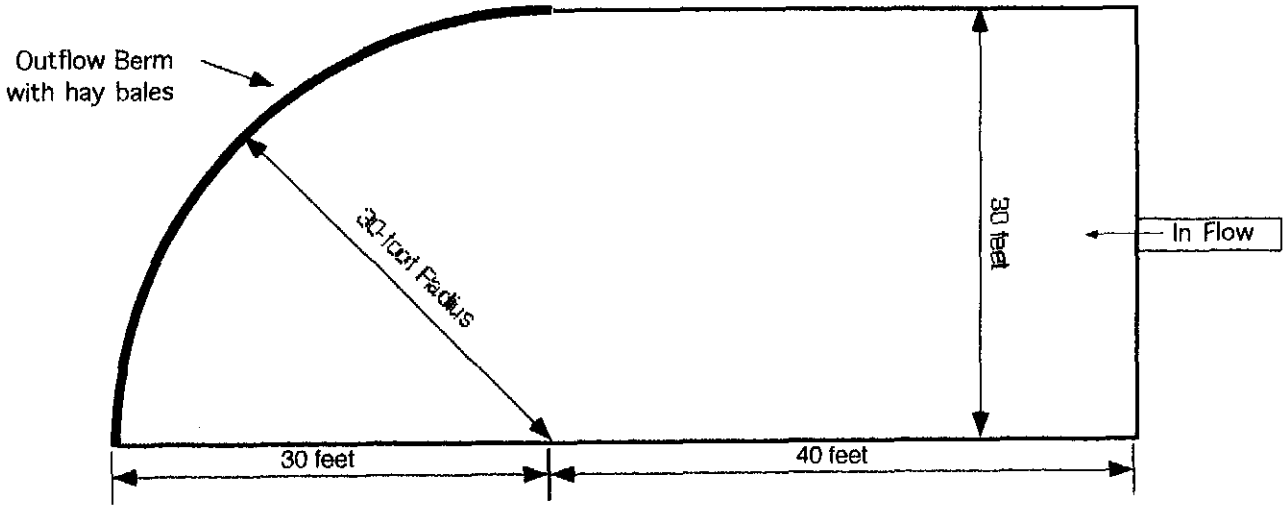


Typical Diversion Channel Cross Section

EXHIBIT 8.1.F: BMP III.1: DIVERSION CHANNEL

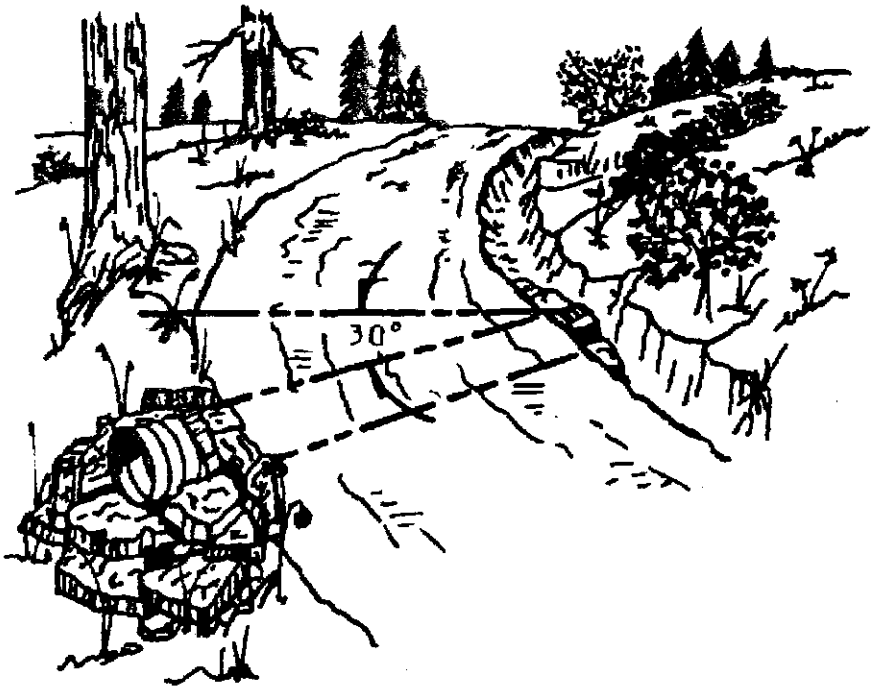
Sedimentation Basin: These basins will be placed at the down-channel end of both interceptor and diversion channels to allow deposition of bedload, suspended sediments, and organic debris. Water flowing out of the basins will trickle over the \long crest along the downslope edge. Once over the crest, water will sheetflow through at least 30 feet of native vegetation on the existing floodplain or reclaimed wetland. The structures shown below have been sized for drainage areas of less than 1.0 square mile. These basins will have a depth grading from 2.0 to 4.0 feet, a berm top-width of 4 feet to 6 feet, and a gradient of 0 to 0.5 percent. Basin dimensions required to detain flow from interceptor and diversion channels are a 30-foot width and a 70-foot length. Hay bales will line the entire arc of the outflow berm.

Typical Sedimentation Basin - Longitudinal Cross Section



Typical Sedimentation Basin - Plan View

EXHIBIT 8.1.G: BMP V.6: SEDIMENTATION BASIN



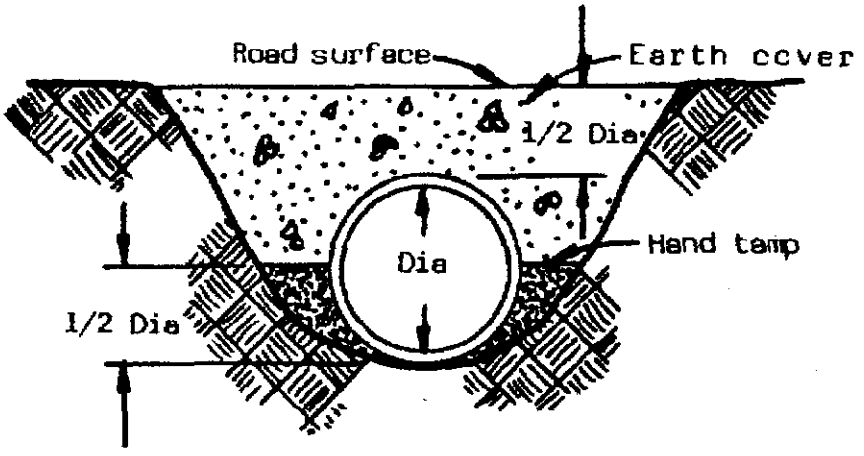


EXHIBIT 8.1.H: CULVERT PLACEMENT

Floodplain protection during reclamation period is provided by staggering straw bales, silt fencing, LWD perpendicular to the direction of flow. BMP length to be approximately 20 to 25 percent of floodplain width with rows spaced 40 to 50 percent of floodplain width. These BMP's to remain in place through first high flow season of reclamation period.

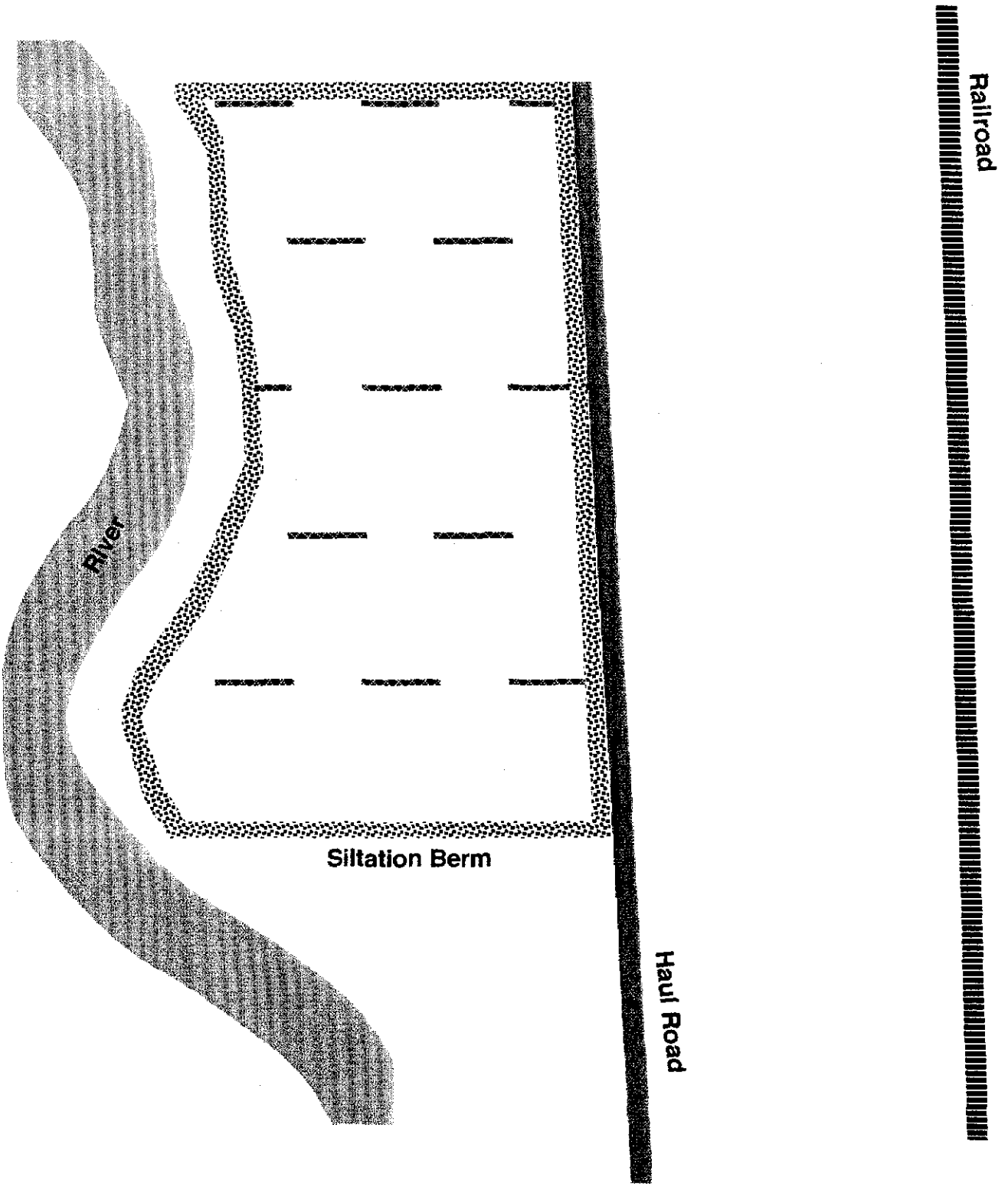


EXHIBIT 8.1.I: FLOODPLAIN PROTECTION