UNIVERSITY OF CALIFORNIA
Santa Barbara

Wetland Mitigation Alternatives for the Casmalia Resources Disposal Site, Santa Barbara County, California

A Group Project submitted in partial satisfaction of the requirements for the Degree of
Master's in Environmental Science and Management
for the
Donald Bren School of Environmental Science and Management

by

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The Group Project is required of all students in the Master's of Environmental Science and Management (MESM) Program. It is a three-quarter activity in which small groups of students conduct focused, interdisciplinary research on the scientific, management, and policy dimensions of a specific environmental issue. This Final Group Project Report is authored by MESM students and has been reviewed and approved by:

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ABSTRACT

This project seeks to evaluate mitigation alternatives for the wetlands lost during the cleanup of the Casmalia Resources Disposal Site, Casmalia, CA. The Casmalia site wetlands are comprised of five ponds, which support wetland habitat and functions. Given the possibility that up to five of these wetlands would need to be drained and excavated as part of the cleanup of the site, the alternatives were evaluated under three scenarios. They range from the No Action Scenario, where none of the Casmalia site wetlands are drained, excavated or filled during site cleanup activities; the Mitigation of Four Wetlands (**Scenario 2**); and the Mitigation of Five Wetlands (**Scenario 3**).

For each scenario, there are five possible alternatives for the mitigation of the wetlands. First, there is the No Mitigation Alternative which involves the drainage of the Casmalia site wetlands without mitigation. Second, third and forth, there are the B Drainage North Alternative, B Drainage South Alternative, and C Drainage Alternative, all of which involve onsite wetland creation. Fifth, there is the Mitigation Bank Alternative which involves the purchase of credits at an offsite mitigation bank in Santa Barbara County.

Each alternative was evaluated against a set of regulatory, technical and economic criteria. Wetland mitigation goals and conceptual models of each onsite mitigation alternative were developed with the aid of a Geographic Information System (GIS). A final comparative analysis of the five alternatives was performed to determine their relative implementability, feasibility and cost effectiveness. Under Scenario 2, the B Drainage South Alternative is the recommended alternative and under Scenario 3, a combination of onsite and offsite alternatives are recommended.

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LIST OF ACRONYMS

The numerous acronyms used throughout the text are defined below.

ACOE	Army Corps of Engineers
ARARs	Applicable, Relevant and Appropriate Requirements
CBC	CB Consulting
CDFG	California Department of Fish and Game
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CEQA	California Environmental Quality Act
CSC	Casmalia Steering Committee
CWA	Clean Water Act
DTSC	California Department of Toxic Substances Control
EIR	Environmental Impact Report
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FS	Feasibility Study
FWS	Fish and Wildlife Service
GIS	Geographic Information System
GPS	Global Positioning System
HSU	Hydrostratigraphic Unit
MCL	Maximum Contaminant Level

mgy	million gallons per year
NEPA	National Environmental Policy Act
NPDES	National Pollution Discharge Elimination System
NRDA	Natural Resources Damage Assessment
PCBs	Polychlorinated biphenyls
PRG	Preliminary Remediation Goal
PRPs	Potentially Responsible Parties
RI	Remedial Investigation
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SVOCs	Semivolatile Organic Compounds
TDS	Total Dissolved Solids
VOCs	Volatile Organic Compounds

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1.0 EXECUTIVE SUMMARY

Located north of Santa Maria in Santa Barbara County, CA., the Casmalia Resource Disposal facility is a Superfund site currently undergoing cleanup activities under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Between 1973 and 1989, the primary owner/operator of the site accepted more than 5.5 billion pounds of hazardous waste, which was treated, disposed, and stored in storage/evaporation ponds. After operations ceased due to contamination of onsite soil and groundwater, the U.S. Environmental Protection Agency (EPA) initiated cleanup activities, which could potentially involve the draining and removal of sediments from the aforementioned ponds. The cleanup activities would effectively destroy the onsite ponds, identified as functional wetlands providing habitat for Federally-listed species and state-listed species (California red legged frog and western spadefoot toad, respectively), thereby triggering mitigation requirements under the Clean Water Act (CWA). Stakeholders, including the U.S. EPA and the Casmalia Steering Committee (CSC, a group representing the largest hazardous waste contributors to the site), have expressed an interest in determining the legal, technical, and economic feasibility of wetland mitigation alternatives for the Casmalia site. The goal of the Casmalia Wetlands Mitigation Project, therefore, is to provide the U.S. EPA with preliminary wetland mitigation alternatives to compensate for wetlands lost during the cleanup of the site.

Given the possibility that one of the five onsite ponds may not need to be remediated, a range of realistic mitigation scenarios was selected: no draining and mitigation of the wetlands **(Scenario 1)**; draining and mitigation of four of the wetlands **(Scenario 2)**; and draining and mitigation of five wetlands **(Scenario 3)**.

Consultation with project stakeholders resulted in the identification of five alternatives within scenarios 2 and 3, including a **No Action Alternative**, three onsite wetland mitigation alternatives **(B Drainage North Alternative, B Drainage South Alternative, C Drainage Alternative)** and one offsite wetland mitigation alternative **(Mitigation Bank Alternative)**. In order to evaluate these alternatives, a set of evaluation criteria was developed from a literature review of case studies and from consultation with relevant agencies. These criteria consist of overall protection of human health and the environment, regulatory compliance (e.g., 3:1 mitigation size requirement), short-term effectiveness, long-term effectiveness, cost-effectiveness, and implementability. Wetland mitigation goals and conceptual models of each onsite mitigation alternative were developed with the aid of a Geographic

Information System (GIS). Finally, the Analytic Hierarchy Process (AHP), a decision-making tool, was used in a two-step analysis, which assisted in the development of weighted criteria and alternative(s) selection to meet the wetland mitigation goals.

Our analysis highlights the advantages and disadvantages associated with each alternative within each scenario. In the case of Scenario 2, the B Drainage South Alternative most successfully met the criteria, including the mitigation size requirement. In the case of Scenario 3, the inclusion of all onsite and offsite alternatives would be required for the mitigation size requirement to be met. The following sequence of mitigation alternatives is therefore recommended: create wetlands first at B South Alternative, followed by B North Alternative, and finally C Drainage, with the remainder of any outstanding acres to be purchased from the Santa Ynez Mitigation Bank.

2.0 PROJECT BACKGROUND AND GOALS

2.1 SITE HISTORY

The Casmalia Resources Disposal Site (site) is an inactive hazardous waste disposal site located in Santa Barbara County, California, and is currently undergoing closure and remediation activities under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

The Casmalia site was approved as a hazardous waste treatment, storage, and disposal facility by Santa Barbara County in 1972, based on the assumption that the underlying clay soils were impermeable and would preclude percolation of contaminants into the groundwater (Burns, 2001). During the 16-year period between 1973 and 1989, under the regulation of the Central Coast Regional Water Quality Control Board (RWQCB), U.S. Environmental Protection Agency (EPA), and California Department of Toxic Substances Control (DTSC), the primary owner/operator of Casmalia Resources Inc., Kenneth Hunter, Jr., accepted under permit more than 5.5 billion pounds of industrial and commercial wastes from over 10,000 generators.

The site was one of only nine facilities in the United States authorized to accept polychlorinated biphenyls (PCBs) during its time of operation. Other substances accepted at the facility included, but are not limited to: pesticides, metals, acids, solvents, and cyanide. These various hazardous wastes were treated, disposed, and stored in 43 storage/evaporation ponds, 15 evaporation pads, six landfills, seven burial trenches, and three treatment units, as well as other management units. The soil and groundwater onsite became contaminated at levels that potentially threatened human and environmental health (U.S. EPA, 2001a). To date, no human health or ecological risk assessment has been completed for the site (Bertelsen, 2002).

In late 1989, due to the failure of the site to meet regulatory land disposal requirements, the owner/operator ceased accepting shipments of waste and engaged in cleanup actions to properly close the site under orders from the Central Coast RWQCB. In 1991, the owner/operator discontinued all efforts to properly and permanently close and remediate the site, asserting insufficient monies to fund the required cleanup or closure activities (U.S. EPA, 2001a). In August 1992, in response to deteriorating conditions at the Casmalia site, the U.S. EPA initiated interim stabilization activities as part of an emergency response action under CERCLA to prevent further deterioration of site conditions and to control the most immediate threats (U.S. EPA, 2001a). In December 1992, the DTSC transferred the lead enforcement role to the U.S. EPA. From 1992 to 1996, the U.S. EPA took action to collect, treat, and dispose of the subsurface hazardous liquids; control storm water flow from migrating offsite; and determine the best means to stabilize the site.

In addition to initiating cleanup activities, and as authorized by CERCLA, the U.S. EPA took actions to identify the Potentially Responsible Parties (PRPs) who contributed waste to the site and would be strictly liable to finance and continue cleanup activities. In March 1993, having failed to engage the owner/operator in closure and remediation activities, U.S. EPA notified a group of approximately 65 major hazardous waste generators of their potential liability for site remediation. Of these 65 notified generators approximately 54 formed the Casmalia Steering Committee (CSC), which represent primarily aerospace and oil and gas companies responsible for the largest contribution of waste to the site.

The CSC agreed to perform cleanup and closure work at the site under the supervision of U.S. EPA. In September of 1996, U.S. EPA negotiated a settlement with the CSC, which was lodged in U.S. District Court in June of that year. The settlement is embodied in a Consent Decree, which established a four-phase cleanup approach to closing the facility and defined the scope of financial obligations. According to the Decree, the objectives of the cleanup approach include containment of the contaminated landmasses and control of contaminated groundwater. The estimated cost of complete remediation and containment of the site, including costs to date, is $272 million.

The U.S. EPA, in cooperation with the CSC, is seeking further cost recovery from additional PRPs. In November 1997, the CSC filed suit against the State of California, contending that the state was liable for all costs associated with the site cleanup due to alleged negligent regulation during its operation.[1] The U.S. EPA is negotiating with the State of California regarding the state's liability for wastes that the various state departments and agencies shipped to Casmalia. In addition, the U.S. EPA also was a customer of the Casmalia site, and its liability is yet to be determined. In 1999, the U.S. EPA settled with 433 smaller waste contributors (i.e., *de minimis* contributors) who contributed approximately $26.5 million toward cleanup of the site. The U.S. EPA is also in the process of negotiating a settlement with 93 large waste

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[1] *Casmalia Resources Site Steering Committee v. State of California, et al.*

contributors as well as the site's past owners/operators in Federal District court (U.S. EPA, 2001a).[2]

In November 1999, the Central Coast RWQCB issued Waste Discharge Requirements Order Number 99-034 to the CSC. This order contained a National Pollution Discharge Elimination System (NPDES) permit to discharge impounded (and treated) surface runoff from the site into the adjacent Casmalia Creek (Hunt & Associates, 2000).

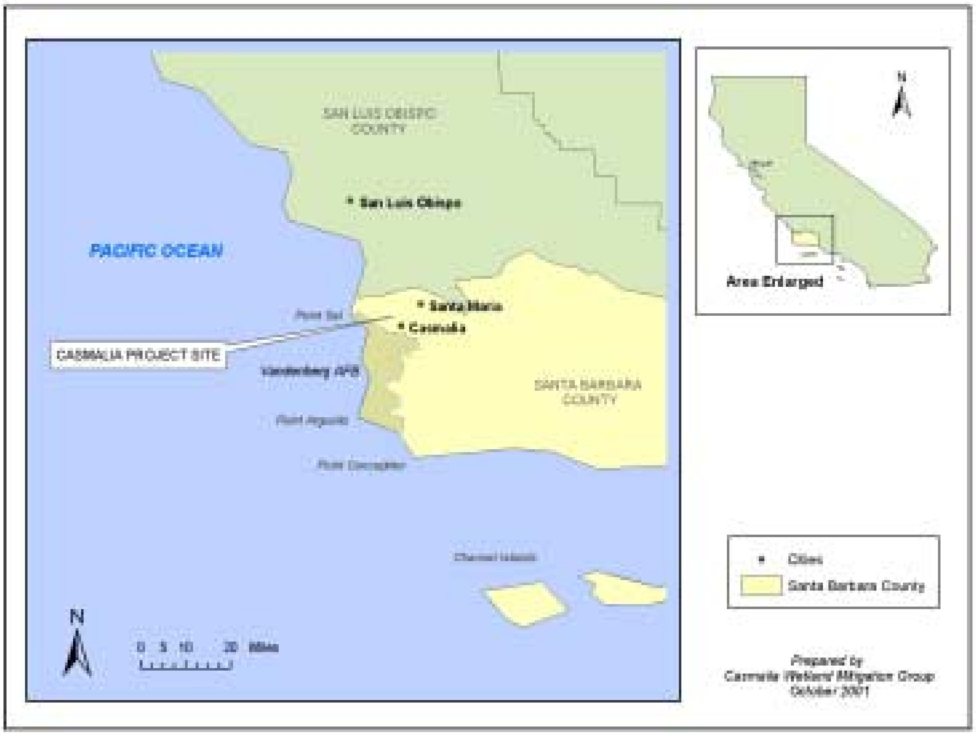
The U.S. EPA listed the Casmalia site on the National Priority List (NPL) of hazardous waste sites on September 13, 2001. The site's listing on the NPL represents its formal status as a Federal Superfund site and ensures the provision of funding, resources and regulatory authority to perform a long-term cleanup under CERCLA. The Casmalia site is the first formally listed Superfund site in Santa Barbara County and the 97th site in California (U.S. EPA, 2001b).

2.2 SITE DESCRIPTION

The 252-acre project site is located in the northwestern corner of Santa Barbara County, California, approximately 1.2 miles north of the unincorporated community of Casmalia, 1.5 miles northeast of Vandenberg Air Force Base, four miles east of the Pacific Ocean and 10 miles southwest of the City of Santa Maria (**Figure 2.1. Project Vicinity**). The site is within the 4,645-acre property currently owned by Kenneth H. Hunter, Jr. The adjacent land uses consist of agriculture, cattle grazing, and oil field development.

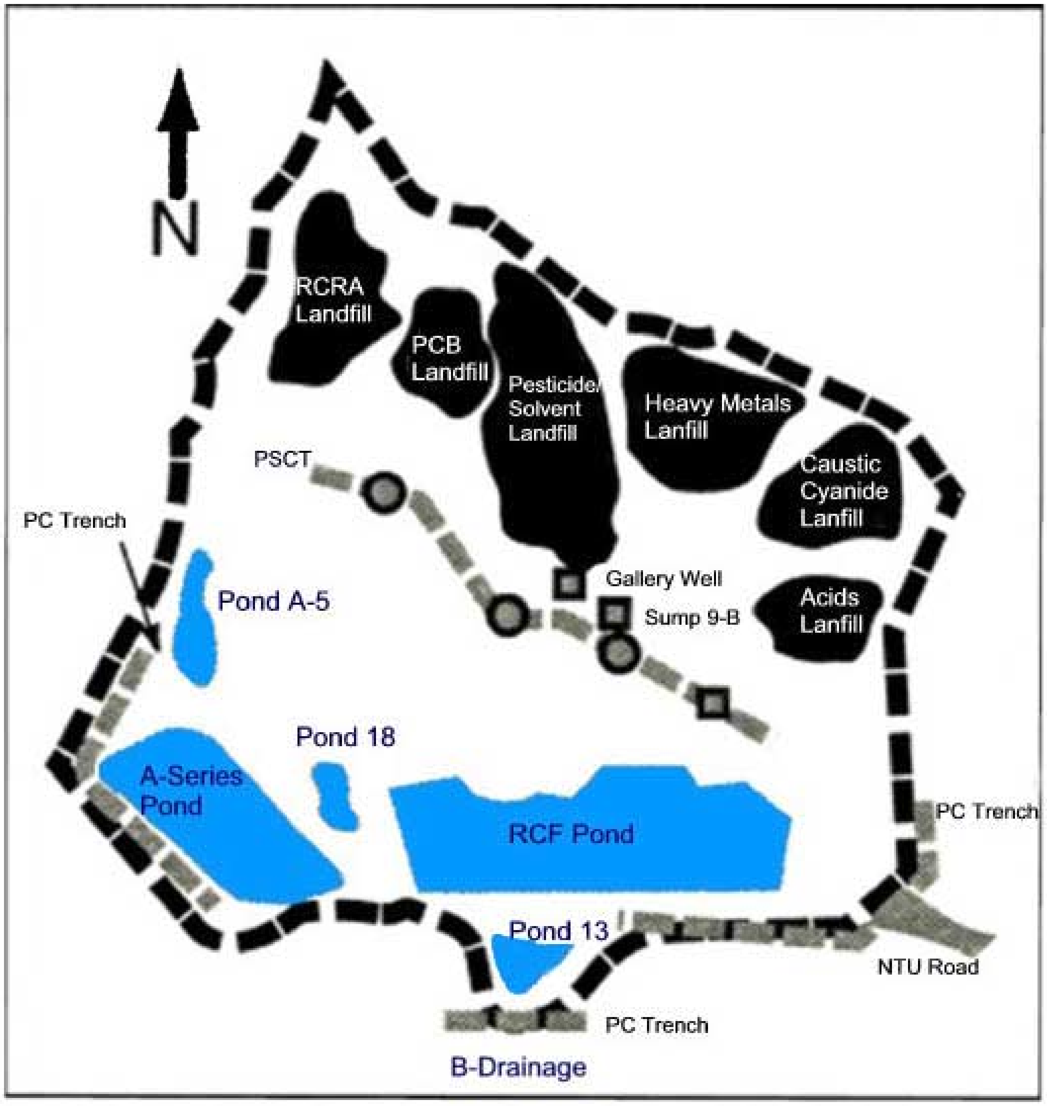
[2] *United States of America v. Kenneth Hunter*, 70 F. Supp. 2d 1100, U.S. Dist., 50 ERC (BNA) 1038 (1999).

Figure 2.1. Project Vicinity



The site is bound by Casmalia Creek to the west, Casmalia Hills to the northwest, an unnamed drainage to the northeast, and an entrance road at the southeast corner of the site (NTU Road). As shown in **Figure 2.2. Site Map,** the site currently contains five inactive waste management areas or landfills, several active subsurface liquid extraction facilities, and five onsite ponds comprising the five Casmalia site wetlands. The site is bisected by a Perimeter Source Control Trench (PSCT), which runs generally east west across the site and acts to intercept and collect contaminated subsurface liquids from the inactive landfills in the northern portion of the site. The five inactive waste management areas or landfills include: PCB landfill, Pesticides/Solvent landfill, Heavy Metals landfill, Caustic Cyanide landfill and Acids landfill. Groundwater extraction facilities that collect and treat contaminated groundwater from the northern portion of the site include the PSCT, the Gallery Well and Sump 9B.

Figure 2.2. Site Map



Source: Modified from U.S. Environmental Protection Agency, 2001

The southern portion of the site contains the five Casmalia site wetlands. Four wetlands (A-Series Pond, RCF Pond, Pond A-5 and Pond 13) are currently used for storm water runoff control and one wetland (Pond 18) is, at this time, used for the disposal of treated hazardous liquids from the subsurface liquid extraction facilities described above. Physical and biological characteristics of these wetlands are discussed in more detail in **Section 4.0, Environmental Setting**. The RCRA Canyon, which currently drains water into the A-Series Pond, is located in the westernmost portion of the site. Groundwater is prevented from migrating from the southern boundary of the site through the installation of three Plume Capture Collection Trenches (PCTs). This southern portion of the site historically contained surface impoundments and disposal pads (40 individual ponds and 15 evaporative pads) that were used for temporary storage, treatment, and evaporative disposal of liquid waste and surface runoff. These ponds and pads were removed during the period 1988 – mid 1990 under the direction of the RWQCB and the DTSC (Dames and Moore, 1997).

2.3 REMEDIAL INVESTIGATION/FEASIBILITY STUDY

As mentioned previously, the Casmalia site is formally listed as a Superfund site and is currently undergoing long-term cleanup activities per CERCLA. Under CERCLA, the U.S. EPA and the CSC are required to initiate the process of preparing a Remedial Investigation/Feasibility Study (RI/FS) for the site. Implementation of the RI/FS process is required for long-term remedial actions in response to a release of hazardous wastes that is serious but that does not pose an immediate threat to life.[3]

In general, the RI/FS process represents the methodology established by the Superfund program for characterizing the nature and extent of risk posed by uncontrolled hazardous waste releases and for the evaluation of potential remedial actions. The RI typically involves a site characterization and assessment of risks to human health and the environment as a result of exposure to hazardous substances. The site characterization and risk assessment ultimately guide the development of the FS, which generally identifies the range of potential remedies and evaluates their feasibility based on nine specific criteria.

The nine evaluation criteria have been developed to address the CERCLA requirements for remedial actions as well as associated statutory considerations.[4] These criteria generally require that the remedial actions be protective of human health and the environment; attain applicable, appropriate and relevant requirements (ARARs); be cost-effective; use long-term or permanent solutions to the maximum extent possible; and satisfy a preference for treatment that reduces toxicity, mobility or volume (U.S. EPA, 1988). The nine evaluation criteria with the associated statutory considerations are:

- Overall protection of human health and the environment;
- Compliance with ARARs;

[3] The RI/FS process is not required for short-term remedial actions that address immediate life-threatening risks from exposure to hazardous waste.
[4] Section 121 (b) (1) (A) of CERCLA

- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume;
- Short-term effectiveness;
- Implementability;
- Cost;
- State acceptance; and
- Community acceptance.

Each remedial action alternative developed during the FS is evaluated according to these nine criteria. The RI/FS process results in the selection of a preferred alternative, which is available for public comment. Finally, the selected remedy for the site is published in a Record of Decision (ROD). To date, the RI/FS for the Casmalia site is underway and is anticipated to be completed by 2004 (Cooper, 2001b, and Valentine, 2002).

2.4 PRIMARY STAKEHOLDERS

The primary stakeholders of the project are the U.S. EPA and CSC, represented by CB Consulting (CBC). Other stakeholders of the project include members of the town of Casmalia, U.S. Army Corps of Engineers (ACOE), U.S. Fish and Wildlife (FWS), California Department of Fish and Game (CDFG), California Department of Toxic Substances and Control (CDTSC), and the Central Coast Regional Water Quality Control Board (RWQCB).

2.5 RESEARCH QUESTION AND OBJECTIVES

Given that two of the five Casmalia site wetlands (Pond A-5 and Pond 18) were former hazardous waste storage ponds, drainage and excavation of contaminated sediments will be required under CERCLA. The remaining three wetlands (A-series Pond, RCF Pond, and Pond 13) may need to be remediated if they are determined to pose an ecological risk during the RI/FS process.[5]

The remediation of the Casmalia site wetlands will effectively destroy the existing wetland function and habitat and trigger mitigation requirements under the Clean Water Act (CWA). In addition, according to the U.S. EPA, the historic hazardous waste treatment, storage and disposal activities on the site have resulted in contamination of wetland habitat for a Federally-listed species under the Endangered Species Act (ESA): the threatened California red legged frog (*Rana aurora draytonii*). The red-legged frog was discovered

[5] The carcinogenic risk to human health as a result of exposure to these onsite ponds is less than the threshold level of one in a million (Bertelson, 2002).

in four of the five site wetlands. In addition, the western spadefoot toad (*Spea hammondii*), a California Species of Special Concern, has been determined by inspection to exist onsite and utilize resources in at least two of the site wetlands. Further, the endangered tiger salamander (U.S. EPA, 2001b and Blevins, 2001) may inhabit the site wetlands, but has yet to be surveyed (Blevins, 2001). All three species are state-listed species regulated under the CDFG code. Further biological investigation is underway as part of the U.S. EPA site characterization for the RI/FS process.

Mitigation alternatives for the wetlands need to be developed to address the unavoidable losses of wetland function and habitat for Federally- and state-listed species. The Casmalia Wetlands Mitigation group project, consisting of a group of Masters students at the Donald Bren School of Environmental Science and Management at UCSB, is charged with assisting in this effort. The goal of the Casmalia Wetlands Mitigation Group Project is to provide the U.S. EPA with preliminary wetland mitigation alternatives to compensate for wetlands lost during the cleanup of the site. The specific objectives of this project are to review relevant case histories, develop an appropriate methodology for prioritizing mitigation alternatives, and identify and evaluate appropriate mitigation alternatives with respect to a modified version of the RI/FS criteria used by the U.S. EPA.

2.6 APPROACH

In order to meet these objectives, our approach involves the following tasks:

- Characterizing onsite wetlands in a historical and physical context and based on similar wetlands in northern Santa Barbara County.
- Conducting a literature survey of relevant case histories.
- Identifying a range of mitigation alternatives based on a comprehensive review of relevant available case histories and the interests of our stakeholders.
- Selecting potential mitigation alternatives, including onsite or offsite (i.e., wetland mitigation bank).
- Developing a methodology and selection criteria for prioritizing wetland mitigation alternatives.
- Applying the methodology to selected alternatives.
- Recommending preferred mitigation alternative(s) based on selected RI/FS criteria.

In the development of wetland mitigation alternatives for the Casmalia site, the following assumptions were made:

- The A-Series Pond, the RCF Pond, Pond 18, Pond A-5, Pond 13, and their surrounding vegetation, are considered wetlands that fall under the jurisdiction of Section 404 of the Clean Water Act and/or Executive Order W-59-93.
- As part of the remedial cleanup actions on the site, up to five of the wetlands would need to be drained, excavated, filled and capped. For the purposes of this report, any wetland that is destroyed will need to be mitigated under the Clean Water Act.
- A 17-acre storm water pond would be constructed as part of the final storm water management system on the site. This pond would provide wetland habitat and function, and therefore would count towards meeting the wetland mitigation size requirements. The size of this storm water pond is based on the specifications outlined in the 1999 Cost Estimate for the Casmalia Site (CH2M Hill, 1999).
- The U.S. EPA has access to the property immediately surrounding the Casmalia site for the purpose of siting onsite mitigation (i.e., constructed wetlands).
- The offsite mitigation bank would be fully operational by the time the final remedy for the site is finalized and documented in the ROD.

2.7 PROJECT SIGNIFICANCE

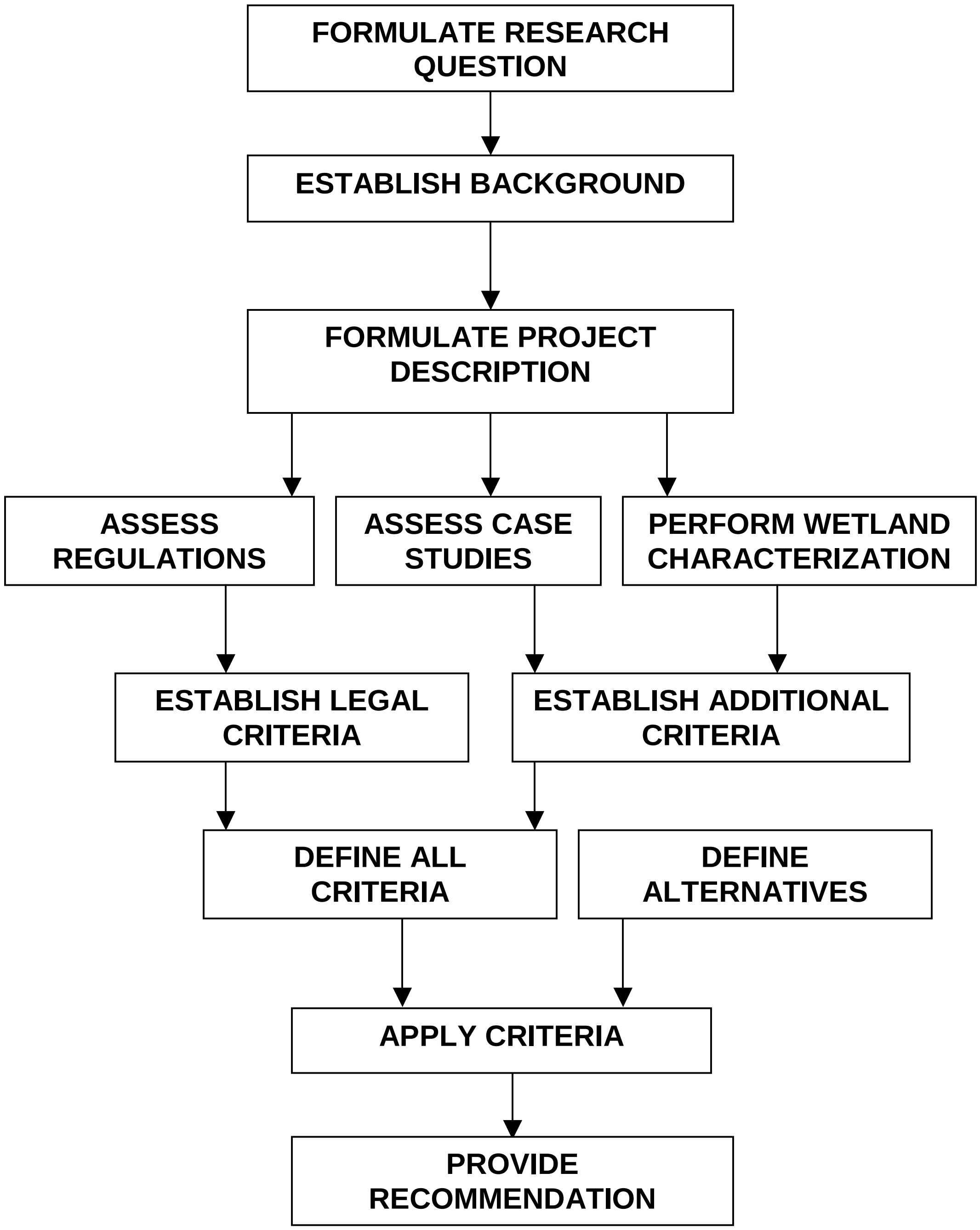
Given that the Casmalia site contains large amounts of various hazardous wastes, the site needs to be cleaned up as required by Federal CERCLA regulations. The remediation of the site, however, will result in the draining of onsite wetlands, which provide habitat for three state-listed species under the CDFG Code, one of which is also Federally-listed as threatened under the ESA.

In addition to CERCLA, the site cleanup potentially requires review under other Federal and state regulations. The CWA requires the compensatory mitigation of wetland losses and the CDFG and the ESA outlaw harm done to any endangered species (i.e., destruction of their habitat). Consequently, we will contribute to the decision-making process by recommending wetland mitigation alternative(s) that will resolve the conflict between the CERCLA requirements, the conditions of the CWA and CDFG Code/ESA, as well as related state laws. Ultimately, our recommendations will help the U.S. EPA complete the “selection of remedy” section of the RI/FS report currently under preparation and expected to be completed by 2004.

2.8 WORK FLOW MODEL

A conceptual model illustrating the methodology for approaching the problem is illustrated in **Figure 2.3. Work Flow Model**.

Figure 2.3. Work Flow Model



3.0 METHODS

The section below contains an overview of the methods applied in the characterization of environmental setting, the review of applicable case studies, the identification of alternatives, the scenario selection, the description of alternatives, the basis for the mitigation ratio chosen, the evaluation criteria, and the alternatives analysis involved in this project.

3.1 CHARACTERIZATION OF ENVIRONMENTAL SETTING

The main objectives of the characterization of the environmental setting were to:

- Describe the general environmental context of the wetlands
- Determine the type and extent (acreage) of the wetlands
- Identify the functions and values of the wetlands

With the exception of the description of biological resources and the delineation of the wetlands, the information in this section is derived from a literature review of various reports, primarily from consultants to the US EPA. The onsite ponds are classified as "wetlands" under Cowardin et al.'s (1979) Wetlands Classification System, as modified by Ferren et al. (1996). Further, the wetlands type and functions were determined through site visits and qualitatively based on the categories put forward in Ferren et al. (2002), Pierce (1993), and NAP (2001). This method was selected rather than the Hydrogeomorphic Method (HGM) due the following two reasons: 1) the HGM requires detailed biological and hydrological surveys, which do not currently exist for the Casmalia site, and 2) the current HGM is specific for riparian environments rather than the open water pond environments such as that of the Casmalia site wetlands. The HGM method is described in PCR Services Corporation (1999).

We visited the site on November 2, 2001, to inventory the plant vegetation on the site and determine the extent of wetland vegetation around the perimeter of the Casmalia site wetland. Given that the date of our survey was prior to the start of winter rains, the Casmalia site wetlands were likely at their lowest water level, evident by the visible ring of wetland vegetation that would otherwise be submerged during the wet season. We conducted a vegetation survey by taking photographs of individual plant species as well as of the overall plant community structure at each of the Casmalia wetlands. Plant species were identified based on several consultations with Wayne Ferren

(Executive Director at the Museum of Systematics and Ecology at the University of California, Santa Barbara), a biologist familiar with the local vegetation of the Casmalia site.

The extent of wetland vegetation surrounding the Casmalia site wetlands was determined using two methods: a standard 30-meter tape measure and a Garmin GPS III hand-held GPS (Global Positioning System) unit. Readings were taken with both instruments from the edge of the surface water to what we best determined to be the uppermost limit of wetland vegetation; measurements were taken at frequent intervals (approximately every 5 meters or 16 feet) and whenever the extent of vegetation changed significantly. For the purpose of mapping wetland vegetation, we assumed that any green, low-lying vegetation near the water's edge was a wetland plant, and that the taller, dead plants in higher elevations were upland plants. Some of the plant species on the site, such as coyote brush, black mustard, and Russian thistle, were easily recognizable as upland plants and were not included in our delineation.

While in the field, we transferred the tape measure readings to a topographic map to ground-truth the extent of vegetation. The GPS coordinates were later downloaded into GIS databases (ArcView 3.0 and ArcGIS 8.1) and overlaid on a digital orthophoto quad (DOQ) of our project site. This digital aerial photo was dated September 15, 1994, and we have determined that no mechanized alterations have been made to the Casmalia site wetlands since that date. Therefore, it is assumed the size of the wetlands in the field and those on the 1994 DOQ are relatively similar and that the use of the DOQ as a base map was appropriate.

3.2 CASE STUDY REVIEW

We surveyed approximately 10 to 15 case studies within California and nationwide to provide insight into various wetland functional requirements, as well as a baseline by which to compare the alternatives. The literature review involved a preliminary screening for relevant wetland mitigation projects, based on similarities to the Casmalia site. Preferred case studies included wetland mitigation projects that occurred in California, involved CERCLA cleanup activities, impacted endangered species and/or required wetland mitigation under the CWA. Given that case studies with overlapping CERCLA, CWA and ESA policy issues were relatively rare, we reviewed those case studies that were the *most* relevant and applicable to the site.

Based on our preliminary screening and preferred criteria, we selected five wetland mitigation projects for a comprehensive review: Guadalupe Oil Field Dune Restoration Project, Peacekeeper Rail Garrison and Small ICDB

Mitigation Program, Montezuma Wetland Project, Sweetwater Marsh Restoration Project, and the Legacy Terrace Wetland Restoration Plan.
Each case study review includes a brief summary of the site location and project description. Following this introductory section is a presentation of project-specific information, including wetland acreage impacts and presence of endangered species. The relevance of the case study to the Casmalia site is also outlined, including any similar political and/or environmental conditions. Evaluation criteria, followed by the preferred mitigation alternative, are also included. The final section explores the mitigation success of each case study, if available.

3.3 IDENTIFICATION OF ALTERNATIVES

Throughout the initial phase of our project, we considered the potential mitigation alternatives to compensate for the wetlands lost during the cleanup of the site. In addition to a no mitigation alternative, four alternatives for the mitigation of the unavoidable wetland impacts were selected based on the interest of our stakeholders: onsite mitigation at B Drainage North, onsite mitigation at B Drainage South, onsite mitigation at C Drainage, and offsite mitigation at a mitigation bank (**Table 3.1. Wetland Mitigation Alternatives**).

The B Drainage North, B Drainage South and C Drainage Alternatives, which are shown in **Figure 9.1. Onsite Wetland Alternatives**, were considered as suitable locations for wetland creation for the following reasons:

- In the event that the Casmalia site is sold in the future, deed restrictions could be put in place on the area immediately adjacent to the property.[6] Wetlands located closest to the site could be incorporated into these deed restrictions (Bertelsen, 2002). The area adjacent to the hazardous waste disposal property would therefore be considered onsite.
- The alternative sites are drainages with topographic lows, and would effectively maintain standing water.
- The alternative sites are currently undeveloped with land uses primarily comprised of cattle grazing.
- The alternative sites are located within a reasonable distance to the available onsite surface water.

The alternatives are described in more detail in **Section 9.0, Wetland Mitigation Alternatives**.

[6] Under California regulation HSC 25221, restrictions are placed for residential and hospital development within 2,000 acres of a former hazardous waste site.

Table 3.1. Wetland Mitigation Alternatives

ALTERNATIVES	DESCRIPTION of MITIGATION
No Mitigation Alternative	Existing Casmalia site wetlands are drained but not mitigated.
Onsite B Drainage North Alternative	Wetland creation via diked surface water runoff and hand-seeding of emergent wetland and planting of willow/woodland vegetation.
Onsite B Drainage South Alternative	Wetland creation via shallow excavation using surface water runoff and hand-seeding of emergent wetland and planting of willow/woodland vegetation.
Onsite C Drainage Alternative	Wetland creation via shallow excavation near Casmalia Creek using surface water runoff and hand-seeding of emergent wetland and planting of willow/woodland vegetation.
Offsite Mitigation Bank	Purchase of necessary credits at offsite mitigation bank.

3.4 SCENARIO SELECTION

In our initial phase of research, we conservatively assumed that all five of the Casmalia site wetlands would need to be remediated under CERCLA. Based upon consultations with our stakeholders, it became apparent that this conservative assumption would not adequately encompass the uncertainty surrounding the future of the Casmalia site wetlands. Especially unknown is the fate of the A Series Pond, given that this pond may have greater ecological value than the other ponds, such as providing critical habitat for sensitive species. Fewer questions arise concerning the need to drain the other wetlands due to the ecological risk posed from past use as hazardous waste collection ponds (Pond A-5, Pond 18) or violation of California state regulations from the presence of possibly illegal dams (RCF Pond and Pond 13) (Bertelsen, 2002).

Given the possibility that four or all five of the wetlands would need to be mitigated, we chose to select a range of realistic mitigation scenarios (**Table 3.2. Wetland Mitigation Scenarios**). The scenarios range from the no draining and no mitigation of the wetlands (Scenario 1); the draining and mitigation of four wetlands (Scenario 2); and the draining and mitigation of five wetlands (Scenario 3). The distinction between Scenario 2 and Scenario 3 is the exclusion of the A Series Pond in the draining and mitigation in Scenario 2. A brief description of each mitigation scenario is outlined in **Table 3.2**.

Table 3.2. Wetland Mitigation Scenarios

SCENARIOS	DESCRIPTION
1. No Action (Drain and Mitigate No Wetlands)	No wetlands are drained, excavated or filled during site cleanup activities; therefore, no mitigation will be required.
2. Drain and Mitigate Four Wetlands	Four wetlands (Ponds A-5, 18, 13, RCF) will be drained, excavated and filled; therefore, mitigation will be required.
3. Drain and Mitigate Five Wetlands	All five wetlands (Ponds A-5, 18, A Series, 13, and RCF) will be drained, excavated and filled; therefore, mitigation will be required.

3.5 DESCRIPTION OF ALTERNATIVES

An environmental characterization and the conceptual determination of the available area of each alternative site were performed through a number of site visits and a literature review. The objectives of the site visits were to:

- Assess the potential wetland qualities of each alternative in terms of the value they will potentially provide in supporting wetland flora and fauna. This allowed us to assess each alternative with the short-term and long-term criteria.
- Conceptualize a mitigation design for each alternative wetland site.
- Identify the boundary and therefore acreage of each site with the use of a GPS and GIS software (See **Appendix F, Geographic Information Systems**).

3.6 DETERMINATION OF MITIGATION RATIO

The mitigation ratio required by CWA regulations was determined through:

- Consultation with wetland experts
- Consultation with agencies regulating wetland mitigation: CDFG and ACOE
- Review of wetland mitigation ratios from similar case study sites in California

The mitigation ratio is discussed in more detail in **Section 7.2, Mitigation Ratio**.

3.7 EVALUATION CRITERIA

Based on consultation with our stakeholders, the regulatory framework of the site, and our research of the ecological requirements of wetlands, we selected six of the nine RI/FS criteria that are detailed in **Section 2.3, Remedial Investigation/Feasibility Study Process**. Given that the "reduction of toxicity, mobility, or volume" criterion is irrelevant in the context of wetland mitigation, this criterion was excluded from the study. Further, our stakeholders requested that we not address the "state acceptance" and "community acceptance" criteria, as they are considered to be problematic. The RI/FS criteria are appropriate for use in evaluating the alternatives of the Casmalia site because the U.S. EPA, to address the statutory requirements of CERCLA, will ultimately use them in their own RI/FS to be completed in 2004 (Valentine, 2002).

The six criteria are subdivided into two categories: threshold criteria and primary balancing criteria. Alternatives must meet the threshold criteria before further analysis under the primary balancing criteria can occur. The criteria used in our analysis are discussed in more detail in **Section 10.0, Evaluation Criteria**. The six evaluation criteria include the following:

Threshold Criteria

- Overall protection of human health and the environment (OPHH& E); and
- Compliance with applicable or relevant and appropriate regulations (ARARs)

Primary Balancing Criteria

- Short-term effectiveness;
- Long-term effectiveness;
- Implementability; and
- Cost

The primary balancing criteria were further defined through the adaptation of criteria developed for wetland site selection in a case at Vandenberg Air Force Base (US Air Force, 1990).

3.7.1 Overall Protection of Human Health & Environment (OPHH&E)

The degree to which the OPHH&E is achieved in the short-term and long-term for each wetland mitigation alternative was based on:

- The assumed risk posed by the underlying sediment contained in the current onsite wetlands. This risk is to the human health and the environment in the long-term.
- The harm done to the environment by draining the wetlands without mitigation. This harm is interpreted as being in the short-term.

As such, if remediation of the wetlands through sediment removal were not carried out, human health and the environment would be harmed in the long-term. If no mitigation of the wetlands were to occur, the environment would be affected in the short-term through the destruction of critical habitat.

3.7.2 Applicable, Relevant and Appropriate Requirements (ARARS)

Identifying the ARARs and the substantive provisions under these requirements was achieved through a number of different methods outlined below:

- Consultation with Region IX EPA representatives.
- Consultation with representatives at the U.S. Army Corps of Engineers, Ventura Office, California.
- Consultation with representatives at the U.S. Fish and Wildlife Service, Ventura Office, California.
- Consultation with field office representatives from the Department of Fish and Game, Santa Barbara, California.
- Consultation with Tetra Tech Environmental Consultancy, Santa Barbara, California.
- Consultation with Wayne Ferren, UCSB Dept. Ecology, Evolution and Marine Biology.
- Review of wetlands regulatory literature.
- Review of wetlands regulatory guidelines.
- Review of local and national case studies involving wetlands regulations.

Through discussion with the various regulatory agencies and review of the regulatory literature and guidelines, several potential ARARS were identified. The substantive provisions contained within the potential ARARS were also established. **Appendix B, Agency Consultation Meeting Notes**, summarizes our meeting notes from the consultations with the U.S. EPA, ACOE, FWS, CDFG and Tetra Tech Environmental Consultancy.

3.7.3 Short-Term Effectiveness

The short-term effectiveness criterion was adapted from the RI/FS guidelines, which focus exclusively on the short-term environmental impacts during the construction of the wetland during the mitigation process. In addition, the time frame under which the response objectives is achieved was also examined (i.e. the time frame necessary to implement and/or construct the wetland alternative). Other impacts specified under the RI/FS criteria were not addressed because these criteria have limited relevancy to wetland construction. For instance, the short-term effectiveness criterion did not consider impacts to the community or onsite employees.

3.7.4 Long-Term Effectiveness

The long-term effectiveness criterion was taken from the RI/FS criteria and modified to accommodate geological, hydrological, and biological factors. These factors contribute to the long-term success of the created wetland and are identified as key wetland components by ACOE. Within the geological, hydrological, and biological components, a number of specific criteria were defined through adaptation of criteria use in wetland selection on Vandenberg Air Force Base (U.S. Air Force, 1990).

3.7.5 Implementability

The implementability criterion was taken from the RI/FS criteria and was limited to technical feasibility, administrative feasibility, and availability of services and materials (U.S. EPA, 1988).

3.7.6 Costs

Costs were primarily determined through consultation with Santa Barbara County Flood Control District, Corey Bertelsen of CB Consulting, and building construction costs specified in guidance material outlining unit construction costs (RS Means, 1999). Based on the above consultations, we identified four primary cost components that needed to be considered for the mitigation alternatives, including excavation and disposal of excavated materials, wetland construction, maintenance, and monitoring. These costs were compared on a relative scale only and were not meant to reflect absolute costs of wetland creation. For detailed methodology and assumptions included in the cost criterion, see **Appendix E, Costs.**

3.8 ALTERNATIVES ANALYSIS

The method for applying the evaluation criteria to each alternative was based on the methodology outlined in the EPA's guidance for conducting an RI/FS. First, each of the five alternatives was qualitatively analyzed according to the six evaluation criteria and additional sub criteria. Next, a comparative analysis was conducted to compare the five alternatives against each other. The comparative analysis was done through a two-step process. The first step involved a qualitative comparative analysis and a simple ranking to illustrate our relative preference for each alternative. This simple ranking was done on a 0 to 4 scale and served as a basis by which to assess the alternative through the second step, a pair-wise ranking system. This pair wise ranking was achieved through the use of the Criterium DecisionPlus 3.0 software that makes use of the Analytic Hierarchy Process (AHP), an academically recognized method to logically determine the best alternative. See **Appendix G, Analytic Hierarchy Process,** for more information.

Three alternative matrices were developed to summarize the qualitative evaluations, one evaluation matrix for each scenario, as shown in **Table 3.3. Sample Evaluation Criteria Matrix**. The process by which the initial simple ranking was achieved for the threshold and primary criteria are discussed below:

<u>Threshold Criteria</u>

Any alternative assigned a zero score automatically failed to meet the threshold criteria and therefore no further analysis was undertaken. Any alternative scoring greater than zero passed the threshold level. The purpose of initially ranking the threshold criteria, in spite of the fact no threshold criteria were part of the AHP was to illustrate the contribution each alternative provided in meeting the threshold and thereby deepen the discussion of the benefits and drawbacks of each alternative.

<u>Primary Criteria</u>

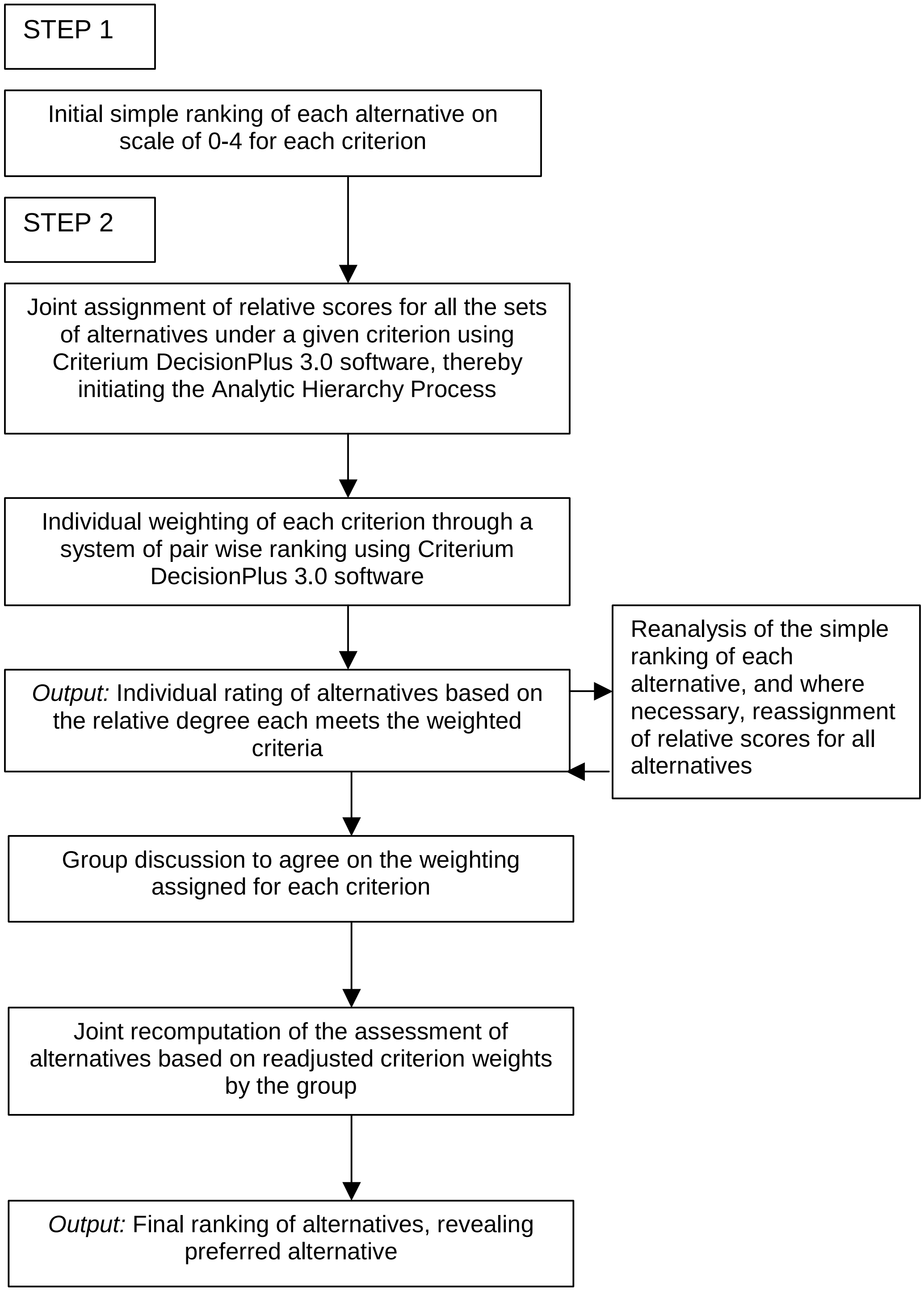
Each alternative is assessed and awarded a score from 0-4 based on the relative degree to which each alternative meets the criteria in a way that replicates the original function of the Casmalia site wetlands.

The AHP process, involved a series of steps, illustrated in the AHP process flow model, **Figure 3.1. AHP Process Flow Model.**

Table 3.3. Sample Evaluation Criteria Matrix

SCENARIO TWO: MITIGATE FOUR WETLANDS					
EVALUATION CRITERIA	**ALTERNATIVES**				
	NO ACTION	**B DRAINAGE NORTH**	**B DRAINAGE SOUTH**	**C DRAINAGE**	**MITIGATION BANK**
OPHH&E					
ARARS COMPLIANCE					
SHORT-TERM EFFECTIVENESS					
LONG-TERM EFFECTIVENESS *Geological Criteria* *Hydrological Criteria* *Biological Criteria*					
IMPLEMENTABILITY *Technical Feasibility* *Administrative Feasibility* *Availability of Services and Materials*					
COSTS					

Figure 3.1. AHP Process Flow Model



4.0 ENVIRONMENTAL SETTING

This section describes the general environmental context of the site, and specifically, the geological, hydrological, and biological characteristics of the site and of the onsite wetlands. This section then leads to the determination of the type, extent, function, and values of the onsite wetlands.

4.1 OVERVIEW

As mentioned previously in **Section 2.2, Site Description**, the Casmalia site is a 252-acre former hazardous waste disposal facility located within the surrounding 4,645-acre Hunter Resources-owned property. The site is located in the south-facing hilly terrain of the Casmalia Hills and is accessed from the NTU Road off of Black Road, approximately one mile north of Casmalia.

4.1.1 Land Use

Land uses on the site are currently limited to cleanup and remediation activities under CERCLA. The surrounding greater proximity of the Hunter Resources property is sparsely settled, with land uses consisting of agriculture, cattle grazing, and oil field development. Agricultural activities include dry land farming of wheat and beans, and to a lesser extent, the production of grapes, tomatoes, strawberries, and other grain crops. The oil fields adjacent to the site are the Casmalia Oil Field, the Orcutt Oil Field, the Guadalupe Oil Field, the Santa Maria Valley Oil Field, and the Jesus Maria Oil Field (URS Corporation and Dames and Moore, 2000).

4.1.2 Climate

The climate of the region is classified as Mediterranean. The monthly average temperatures vary from a low of 42° F measured in January to 79° F measured in September. Most of the precipitation occurs between October and April. Monthly precipitation and evaporation were recorded on the site for the period 1982 through 1992. Based on this data, the average annual precipitation is approximately 13 inches per year and the average annual evaporation rate is 56 inches per year. Therefore, the site has a net annual average evaporation rate of approximately 43 inches per year (Dames and Moore, 1997). Calculated over the surface area of the site, the site receives approximately 150 to 180 million gallons of rainfall per year (Bertelsen, 2002).

4.1.3 Demographics

The population centers closest to the site are unincorporated towns, including Casmalia (approximately 1.2 miles to the south), Betteravia (approximately 4.75 miles to the northeast), and Orcutt (approximately 4.75 miles to the north-northeast). The primary residential area of the Vandenberg Air Force Base is located approximately eight miles south of the site. The cities of Guadalupe (6,050 inhabitants), Santa Maria (80,000 inhabitants), and Lompoc (42,150 inhabitants) are located 8, 10, and 16 miles from the site, respectively (California State Department of Finance, 2001, and Dames & Moore, 1997).

4.2 GEOLOGICAL RESOURCES

4.2.1 Topography

The Casmalia Hills are part of a series of three west-northwest-trending ranges that constitute the southern border of the Santa Maria valley. Rounded hills, slopes of gentle to moderate steepness, and broad valleys characterize the topography (URS Corporation and Dames and Moore, 2000). Site elevations range from 254.5 meters (835 feet) above mean sea level (msl) at the northern site boundary to 114.3 meters (375 feet) above msl at the southern site boundary (Harding ESE, 2001). The site is bounded by topographic ridges along its northern, eastern, and western perimeters. Two small hills are located along the southern edge of the site and rise to the south (Harding Lawson Associates, 2000).

4.2.2 Soils and Earth Materials

Beneath the site lies 396.2 meters (1,300 feet) of the Todos Santos claystone of the Sisquoc Formation, which is considered the primary hydrostratigraphic unit (HSU). The Todos Santos Claystone is comprised of porcellaneous shale, platy shale, claystone, diatomite, siltstone, and silty sandstone (Harding ESE, 2001). This claystone formation constitutes the majority of materials exposed at the site. In restricted areas of the site, alluvium, colluvium, and fill material overly this formation. Alluvial and colluvial sediments, essentially composed of clayey silt and silty clay, are mainly found within the surface drainages. The alluvial layer is the thickest (up to 15.2 meters (50 feet) deep) in the C Drainage. Artificial fill consists of compacted silty clay mixed with sand-sized and larger claystone fragments (Dames and Moore, 1997). Artificial fill previously covered the interstitial areas between the wetlands and pads, but soil excavation and grading that occurred during surface impoundment closure activities in 1988-1990 has reduced the amount of fill present on the site (Dames and Moore, 1997, and Harding Lawson Associates, 2000).

4.3 HYDROLOGICAL RESOURCES

4.3.1 Surface Water

Surface water in the area adjacent to the site occurs as ephemeral streams, which cut into alluvial valley fill sediments creating narrow channels with steep banks. A few springs and seeps are associated with these streams. The ephemeral streams include Casmalia Creek, Shuman Creek, and an unnamed drainage termed North Drainage. Casmalia Creek is located approximately 152.4 meters (500 feet) west of the site and joins Shuman Creek approximately two miles south of the site. Shuman Creek eventually drains into the Pacific Ocean about four miles west of its confluence with Casmalia Creek (URS Corporation and Dames and Moore, 2000).

In addition, three surface water drainages (termed A, B, C) exit the southern site boundary and are located to the southeast, due south, and southwest, respectively (Harding ESE, 2001). The B Drainage merges with the C Drainage about 1,070 meters (3,500 feet) south of the site. The A Drainage is a tributary to Shuman Creek and the B and C Drainages are tributary to Casmalia Creek. These drainages have been significantly altered from their original condition by construction and grading activities at the site, including redirecting of surface runoff into surface water impoundments (Dames and Moore, 1997). The quantity of surface water flow from these streams is very low to non-existent. A percentage of the 150 to 180 million gallons of rainfall per year onsite, referred to as the *runoff coefficient*, represents the portion of the total rainfall that is available as surface runoff, which is currently collected and held onsite in the five wetlands located along the southern boundary of the site.

4.3.2 Groundwater

The groundwater system at the site is part of the Shuman Creek surface water drainage sub-basin, which drains to the Pacific Ocean. This sub-basin is structurally isolated from the two adjacent groundwater basins: the Santa Maria basin to the north and the San Antonio Creek basin to the south (Harding ESE, 2001).

The Todos Santos Claystone constitutes the major HSU beneath the site. This formation is not considered to contain aquifer units due to its very low permeability and very limited water yield (200 gallons per day). The HSU is subdivided into upper and lower units: an upper weathered claystone unit and a lower unweathered claystone unit (Dames and Moore, 1997). The upper HSU is moderately to densely fractured and the lower HSU has a much lower fracture density. Both HSUs have very low transmissivity, with the lower HSU having the lowest. The Hydrogeologic Site Investigation Report states a geometric mean hydraulic conductivity of 70.4 ft/yr in the upper HSU and 1.04 ft/yr in the lower HSU (WCC and CE, 1989). Minor amounts of water are contained in the upper HSU and within joints and fractures in the lower HSU. The groundwater table follows surface topography; with topographic highs corresponding to localized groundwater divides. Overall, the groundwater flows north to south, then west toward the ocean (URS Corporation and Dames and Moore, 2000).

4.3.3 Hydrological Characteristics of the Onsite Wetlands

As discussed in **Section 2.2, Site Description**, the five Casmalia site wetlands are located in the southern portion of the site and were constructed over former ponds and pads. Currently, four wetlands (A-Series Pond, RCF Pond, Pond A-5, and Pond 13) are used for storm water runoff control and one wetland (Pond 18) is used for the disposal of onsite treated hazardous liquids. **Figure 4.1. Existing Casmalia Wetlands** shows the delineated wetland areas.

These wetlands were artificially created in response to the RWQCB Waste Discharge Requirements, which call for zero discharge from the site. They are flooded year-round and the water level in them is maintained at a specified maximum level by onsite personnel in order to contain storm water runoff and treated liquids within the site boundaries. The inflow consists of precipitation, and as described above, storm water runoff and liquids extracted from contaminant collection trenches (Pond 18). Outflow consists of water withdrawals through evaporation, as well as artificial withdrawal for dust control and irrigation of selected onsite areas. With the exception of Pond A-5, the surface water level in the wetlands coincides or is slightly higher than the water table, exhibiting the connection between surface water in the wetlands and groundwater. However, the direction of the flow between the wetlands and the groundwater aquifer varies in time and space, as both gaining and losing gradients are observed (Harding Lawson Associates, 2000).

The hydrological characteristics for each wetland are outlined in **Table 4.1, Hydrological Characteristics of Onsite Wetlands**. The total surface area for all wetlands ranges from 23.1 acres to a maximum 23.8 acres. This maximum figure will be used for mitigation purposes.

Figure 4.1. Existing Casmalia Wetlands

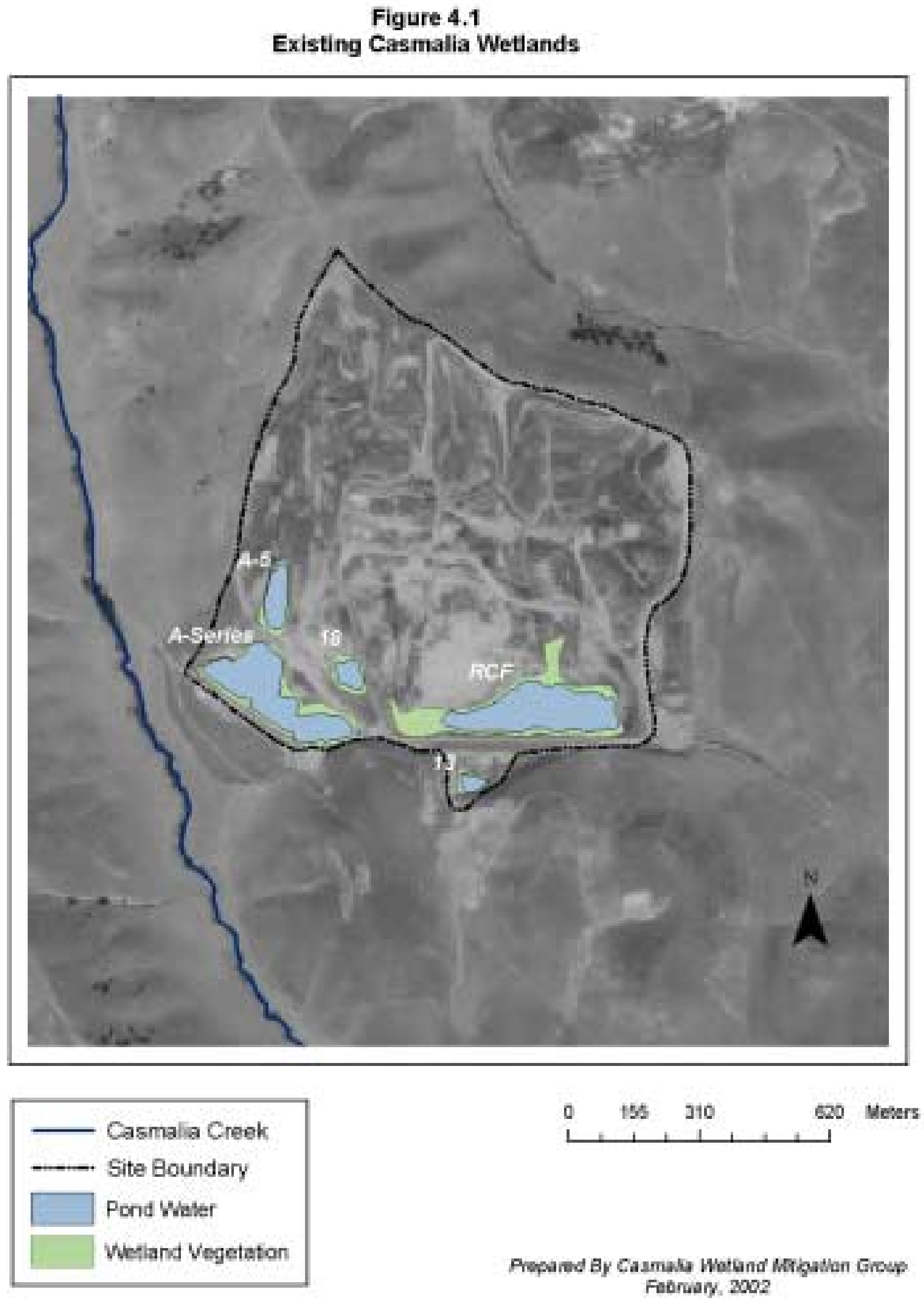


Table 4.1. Hydrological Characteristics of Onsite Wetlands

Wetland Name	Description	Hydrological Characteristics		
		Surface Area (ft^2)	Capacity (million gallons)	Surface Area (acres)
Pond A-5	Collects storm water	50,000-65,000	9-10	1.1-1.5
Pond 18	Contains treated liquids	33,000-50,000	5-7	0.8-1.1
Pond 13	Collects storm water	22,000	3-4	0.5
A-Series Pond	Collects storm water	400,000	80	9.2
RCF Pond	Collects storm water	500,000	150	11.5
TOTAL	--	**1,005,000 - 1,037,000**	**247- 251**	**23.1- 23.8**

Source: Cooper, 2001 and CH2M Hill, 1999.

4.3.4 Water Quality

Groundwater

The U.S. EPA has been performing work at the site since 1992 to address the immediate threat to human health and the environment and to prevent the groundwater migration of contaminants offsite. The contaminants of concern include inorganics, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides and herbicides, and dioxins and furans (CH2MHill, 1999).

As discussed in **Section 2.2, Site Description**, in order to contain the contaminants in the underground plume, three capture collection trenches (labeled as PC Trench in **Figure 2.2. Site Map**) and two clay barriers on the southern boundary were constructed. In addition, a barrier wall known as the Perimeter Source Control Trench (PSCT) bisects the site (**Figure 2.2. Site Map**) and intercepts the contaminated groundwater flowing down-gradient from the former landfills in the northern portion of the site (Harding ESE, 2001).

According to the U.S. EPA's routine groundwater monitoring reports (CH2M Hill, 1999), contaminant concentrations in the groundwater range from very low (less than 0.01 mg/L total organics) to extremely high (1,000-10,000 mg/L total organics). Groundwater monitoring of the site indicates that the majority of groundwater contamination is located north of the PSCT in the vicinity of the landfills. Lower contaminant concentrations are present south of the PSCT in the vicinity of the Casmalia site wetlands. Given the installation of these trenches and barrier walls and the very low level contamination outside the site boundary, the U.S. EPA considers the underground contaminated plume to be contained within the perimeter of the site (Harding ESE, 2001).

Groundwater in the vicinity of the site is naturally high in Total Dissolved Solids (TDS), with concentrations above 3,000 mg/L (Harding Lawson Associates, 2000). The U.S. EPA recommended standard for TDS for drinking water is 500 ppm. Further, the water naturally contains high concentrations of chloride, sodium, and calcium (Dames and Moore, 1997). The poor quality of the groundwater makes it unsuited for municipal or domestic use.

Wetland Water Quality

The water in the wetlands is lightly contaminated with hazardous wastes, including VOCs, SVOCs, dioxins, furans, and inorganic metals (Harding ESE, 2001). This discussion is based on the water quality data presented in the July 2000 Semiannual Monitoring Report prepared by Harding ESE for the CSC. **Table 4.2. Water Quality of Onsite Wetlands,** summarizes the water quality of the onsite wetlands for pH, TDS, and the few contaminants that occur at excessive levels (in bold). A concentration is considered "excessive" when it exceeds the lowest between the California and Federal Maximum Concentration Level (MCL), or the U.S. EPA Region IX Preliminary Remediation Goal (PRG). **Appendix J, Wetlands Water Quality Measurements** contains a table that shows comprehensive detection results for a large number of compounds. **Appendix A, Preliminary Human Health & Ecological Risk Assessment & Remediation Alternatives for Casmalia Site** presents a discussion of the potential human and ecological impacts of a selection of detected contaminants.

Only a few organic compounds were detected in the pond samples, with the widest range found in Pond A-5, where several VOCs (10), a few semi-volatile organic compounds (SVOCs) and a dioxin were detected. The other four ponds did not contain VOCs. Low concentrations of six SVOCs were detected in any of the ponds. Except in Pond 18, diesel-range organics were detected at concentrations ranging from 75 to 250 µg/l. The two organic

Table 4.2. Water Quality of Onsite Wetlands (July 2000)

Water Quality	A-Series Pond	Pond 13	Pond 18	Pond A-5	RCF Pond
TDS (µg/l)	8,950,000	7,550,000	11,800,000	12,400,000	8,000,000
pH	8.6	8.66	8.46	8.69	8.78
Nickel-D (µg/l)[1]	**200**	**310**	**200**	**200**	**200**
Nickel-T (µg/l)[1]	**200**	**300**	**200**	**200**	100
Thallium-D (µg/l) [2]	**3**	ND	**6**	ND	ND
Acetonitrile (µg/l) [3]	ND	ND	ND	**280**	ND
bis(2-Ethylhexyl) phthalate (µg/l) [4]	3.8	1.3	0.68	0.36	**5.4**

TDS = total dissolved solids (i.e., inorganic salts)
ND = Not Detected
1 MCL/PRG levels are 100µg/l for Nickel-D and Nickel-T.
2 MCL/PRG level for Thallium-D is 2 µg/l.
3 MCL/PRG level for Acetonitrile is 79 µg/l.
4 MCL/PRG level for bis(2-Ethylhexyl) phthalate is 4.802 µg/l.

Source: Harding ESE, 2001

chemicals which exceeded MCL/PRG standards were acetonitrile at Pond A-5 and bis(2-Ethylhexyl) phthalate at the RCF Pond. Compared to the levels measured during the previous sampling event in November 1999, detection levels have diminished, namely within Pond A-5. Acetone, which was detected in all five ponds in November 1999, was detected in only Pond A-5 and at a lower concentration (Harding ESE, 2001).

Two inorganic chemicals, nickel and thallium, were detected at levels exceeding MCLs. However, the concentrations of nickel are below the health-based PRG of 730 µg/l. The pH of the ponds was found to be relatively alkaline ranging from 8.46 to 8.78. TDS levels are high, ranging from 7,550 ppm to 12,400 ppm (Harding ESE, 2001).

4.4 BIOLOGICAL RESOURCES

4.4.1. Onsite Vegetation

RCF Pond

The vegetation surrounding the RCF wetland is dominated primarily by Red Goosefoot (*Chenopodium rubrum*), however, its wetland community structure also supports many other plants, including Oxtongue (*Pichris echioides*), Brass Button (*Cotula coronopifolia*), and Heliotrope (*Heliotropium curassavicum*). There are also several stands of Prairie Bulrush (*Scirpus maritimus*), Rabbitfoot Grass (*Polypogon monspeliensis*), Salt Grass (*Distichlis spicata*), and Spearscale (*Atriplex patula triangularis*). There is virtually no emergent vegetation in the wetland itself, except for one stand of California Bulrush (*S. californicus*) a few meters away from shore on the northern edge of the wetland. There is also very obvious terracing on the banks of the wetland, evidence of the differing water levels throughout the year. Upland plant species present include Coyote Brush (*Baccharis pilularis*), Black Mustard (*Brassica nigra*), Bur Clover (*Medicago polymorpha*), and a thistle (*Cirsium vulgare*). Some of the wetland species present are native species, including Bulrush species, Heliotrope, Spearscale, and Salt Grass.

Table 4.3. RCF Pond Vegetation summarizes the plant species present at the RCF Pond. The indicator status of each species is also included, which refers to the frequency with which the species is typically found in a wetland environment. Obligate Wetland plant species (OBL) almost always occur in wetlands under natural conditions (>99%). Facultative Wetland plants (FACW) usually occur in wetlands (67-99%). Facultative plants (FAC) are equally likely to be found in wetlands or upland habitats (34-66%). Facultative Upland plants (FACU) occasionally are found in wetlands (1-33%). Obligate Upland plant species (UPL) very rarely occur in wetlands under natural conditions (<1%). Plus (+) and minus (-) signs are used to indicate where a plant species lies within each category. Plus indicates a species more likely to be found in wetlands, minus indicates that the species is less likely to occur in wetlands (Tiner, 1991).

Pond 13

Pond 13 has steeply sloping banks, and its vegetation is dominated by Prairie Bulrush and Red Goosefoot. There is no emergent vegetation in the wetland, and the southern edge of the wetland is a sheer wall with no plant life at its base. The plant species present at this pond are summarized in **Table 4.4. Pond 13 Vegetation**.

Table 4.3. RCF Pond Vegetation

Scientific Name	Common Name	Indicator Status	Native?
Picris echioides	Oxtongue	FAC	No
Chenopodium rubrum	Red Goosefoot	FACU	No
Cotula coronopifolia	Brass Button	FACW+	No
Heliotropium curassavicum	Heliotrope	OBL	Yes
Polypogon monspeliensis	Rabbitfoot Grass	FACW+	No
Baccharis pilularis	Coyote Brush	FACU	Yes
Cirsium vulgare	Thistle	FAC	No
Brassica nigra	Black Mustard	FACU	No
Distichlis spicata	Salt Grass	FACW	Yes
Medicago polymorpha	Bur Clover	FACU-	No
Scirpus maritimus	Prairie Bulrush	OBL	Yes
Atriplex patula triangularis	Spearscale	FACW	Yes
Hemizonia incresens	Tarweed	FAC	Yes
Conyza canadensis	Horseweed	FAC	No
Salsola tragus	Russian Thistle	FACU+	No
Tamarix ramosissima	Tamarisk	FAC	No
Stephanomeria exigua	Stephanomeria	UPL	Yes
Scirpus californicus	California Bulrush	OBL	Yes

Table 4.4. Pond 13 Vegetation

Scientific Name	Common Name	Indicator Status	Native?
Picris echioides	Oxtongue	FAC	No
Chenopodium rubrum	Red Goosefoot	FACU	No
Cotula coronopifolia	Brass Button	FACW+	No
Scirpus maritimus	Prairie Bulrush	OBL	Yes

A-Series Pond

The A-series wetland vegetation is dominated by Brass Button and Red Goosefoot, and has a few stands of emergent vegetation, both Prairie Bulrush and California Bulrush. There is also a section on the north shore of the easternmost leg where a seemingly upland area is overrun by a very large dead stand of Oxtongue, which most likely grew in the last year or the year before after a particularly wet winter (Ferren, 2001a). The plant species present at this pond are summarized in **Table 4.5. A-Series Pond Vegetation**.

Table 4.5. A-Series Pond Vegetation

Scientific Name	Common Name	Indicator Status	Native?
Picris echioides	Oxtongue	FAC	No
Chenopodium rubrum	Red Goosefoot	FACU	No
Cotula coronopifolia	Brass Button	FACW+	No
Heliotropium curassavicum	Heliotrope	OBL	Yes
Baccharis pilularis	Coyote Brush	FACU	Yes
Cirsium vulgare	Thistle	FAC	No
Brassica nigra	Black Mustard	FACU	No
Scirpus maritimus	Prairie Bulrush	OBL	Yes
Scirpus californicus	California Bulrush	OBL	Yes
Spergularia marina	Saltmarsh Sandspurrey	OBL	Yes
Enteromorpha intestinalis	Green Algae	OBL	Yes

Pond A-5

Wetland A-5 is one of the more contaminated wetlands, indicated by the diminished community structure. The banks of this wetland are steep and sparsely vegetated. Brass Button dominates what little plant community there is at this wetland. The north end of the wetland has a healthier plant community, while the west end is practically barren. The plant species present at this pond are summarized in **Table 4.6. Pond A-5 Vegetation**.

Pond 18

Pond 18 also has a rather sparse plant community, dominated by Red Goosefoot. This wetland has an extremely clear demarcation of the transition from wetland to upland vegetation (i.e., the transition zone is barren). In addition, there is a wide swath of barren soil between the wetland and upland plants. The plant species present at this pond are summarized in **Table 4.7. Pond 18 Vegetation**.

4.4.2. Wildlife

There is a paucity of data regarding the biology of animal species at the site. The Draft Biological Species Habitat Survey Workplan submitted by the CSC contains a list of sensitive species anticipated to be found on the site when wildlife surveys are performed. These species have been divided up into upland species (found on the northern portion of the site) and aquatic species (found near the wetlands). Since this project focuses primarily on the wetlands, only the aquatic species are presented here along with their profiles

Table 4.6. Pond A-5 Vegetation

Scientific Name	Common Name	Indicator Status	Native?
Chenopodium rubrum	Red Goosefoot	FACU	No
Cotula coronopifolia	Brass Button	FACW+	No

Table 4.7. Pond 18 Vegetation

Scientific Name	Common Name	Indicator Status	Native?
Chenopodium rubrum	Red Goosefoot	FACU	No

(Essex Environmental, 2000, Jennings and Hayes, 1994). The sensitive aquatic species that may be found on the site are as follows :

- California red-legged frog (*Rana aurora draytoni*) – Federal Threatened Species, California Species of Special Concern. Found on the edges of freshwater streams and wetlands; its decline is attributed to destruction of habitat and introduction of invasive predators such as the bullfrog. Favored habitats for the red-legged frog are deep, still or slow-moving streams or ponds characterized by shrubby riparian vegetation and submergent plants. Suitable habitat can be provided by Arroyo Willow (*Salix lasiolepis*), Bulrushes (*Scirpus sp.*), and Cattails (*Typha sp.*). These frogs can be found in ephemeral ponds, but the surface water must not completely evaporate in order to ensure year-long populations.

- Western Spadefoot Toad (*Spea hammondii*) – California Species of Special Concern. Found in temporary pools following rainfall in arid habitats. This species has also been affected by habitat loss and invasion by bullfrog and mosquito fish.

- Tiger Salamander (*Ambistoma californiense*)—Federal Endangered Species, California Species of Special Concern. Tiger salamanders require temporary ponds for their winter breeding cycle and ground squirrel burrows for shelter. Favored habitats include grasslands and valley woodlands.

- Southwestern Pond Turtle (*Clemmys marmorata pallida*) – California Species of Special Concern. An aquatic species found in slow moving waters that moves to upland habitat to bask and lay its eggs.

- Least Bell's Vireo (*Vireo bellii pusillus*) – Federal and state-listed Endangered Species. A migratory songbird found in riparian woodland areas; this species tends to nest in willows. Its decline has been attributed to habitat destruction and nest parasitism by an invasive species, the brown-headed cowbird.

- Southwestern Willow Flycatcher (*Empidonax traillii extimus*) – Federal and state-listed Endangered Species. Found in riparian shrub areas; this species tends to nest in willows. In addition, this species is affected by loss of habitat and cowbird parasitism.

- Sharp-Shinned Hawk (*Accipiter striatus*)

- Yellow-Breasted Chat (*Icteria virens auricollis*)

- Yellow Warbler (*Dendroica petechia*) – California Species of Special Concern. A migratory songbird found in riparian shrub areas; nests in small trees or dense shrubs. This species is also affected by loss of habitat and cowbird parasitism.

4.5 WETLANDS TYPE AND EXTENT

As determined previously, the Casmalia wetlands are artificial reservoirs. Because the water input into the wetlands consists of precipitation and surface runoff, these wetlands are considered "surface water depressions" (Pierce, 1993), which are permanently flooded. The seasonal water level variation contributes to the formation of wetland vegetation on the banks of the ponds. All five of the Casmalia site wetlands are classified as lacustrine wetlands under the definition outlined by Cowardin et al (1979) and Ferren et al (1996). To classify as lacustrine, a wetland must:

- Be situated in a topographic depression or dammed river channel.
- Must not have trees, shrubs, or emergent vegetation covering more than 30% of its area.
- Have less than 0.5 ppt ocean-derived salinity.
- Have a total area that exceeds 8 hectares, or 20 acres.

The wetlands meet the first three criteria, but not the fourth. However, the area criteria can be ignored as long as the wetlands are of sufficient depth (i.e., at least 2 meters (6.5 feet) deep at low water) (Ferren et al., 1996), which the Casmalia wetlands are (see **Table 4.1. Hydrological Characteristics of Onsite Wetlands**).

The extent of the wetlands was determined to include both the wetland bank areas containing wetland flora as well as the open water. This was confirmed through consultation with the ACOE (Mace, 2001) and W. Ferren, University of California Santa Barbara (Ferren 2001a). Given that the vegetated banks are covered by pond water when the pond water is at its highest level, the maximum total surface area of the ponds (23.8 acres) calculated in **Table 4.1. Hydrological Characteristics of Onsite Wetlands** is considered to be equivalent to the total acreage of the wetlands area. Therefore, this area of 23.8 acres will be used for mitigation purposes.

4.6 WETLANDS FUNCTIONS AND VALUES

The Casmalia site wetlands perform specific beneficial wetland functions. The functions of the Casmalia site wetlands are storm water management and soil stabilization through water retention and irrigation. These wetlands also serve an important function of providing habitat for a variety of wetland species listed in **Section 4.4, Biological Resources**, including critical habitat for Federally threatened species (California red legged frog) and state-listed species of special concern (California red legged frog and western spadefoot toad).

Other potential ecosystem functions include water quality improvements through sedimentation, potential groundwater recharge (see discussion in **Section 4.3.3, Hydrological Characteristics of the Onsite Wetlands)** and nutrient support and cycling. Because of the restricted access to the site, the socio-economic value of these wetlands is very limited. The wetlands are not used for recreation, research or educational purposes, nor do they produce traded goods.

In mitigating for the loss of the Casmalia site wetlands, the degree to which these functions are replicated is reflected in the comparative discussion and ultimate score of the wetland mitigation alternatives; see **Section 15.0, Recommendations**.

In addition to these beneficial functions, the Casmalia site wetlands are highly disturbed environments. The wetlands consist of generally poor, degraded habitat. Most of the plant species present are non-native and specialized for colonizing disturbed sites, and few existing plant species provide the shelter that red-legged frogs typically need. The wetland water is high in total dissolved solids (TDS) and is lightly contaminated with heavy metals and volatile organic compounds (VOCs). In the more heavily polluted wetlands, water quality may pose an ecological risk to wildlife that exceeds threshold standards for freshwater communities (See **Appendix A, Casmalia Risk Assessment**). These factors will not be replicated in the mitigated wetland, but do influence the mitigation ratio requirements, as discussed in **Section 7.2, Mitigation Ratio**.

5.0 REGULATORY FRAMEWORK

5.1 INTRODUCTION TO APPLICABLE REGULATIONS

The Casmalia site is a U.S. EPA Superfund site being remediated under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Because CERCLA remediation activities on the site could require the draining and excavation of some or all onsite wetlands, a complex legal scenario exists involving several different environmental agencies at Federal and state levels.

Wetlands are protected ecosystems under Federal and California law because of the functional benefits they perform in terms of their ability to provide ecosystem goods and services, such as improving water quality and providing habitat for wildlife. Current regulations have confirmed the critical need for wetland preservation at both the Federal and state level with the implementation of mandates to prevent “no net loss” of wetlands, (MOA, 1993 and Executive Order W-59-93, 1993).

At the Casmalia site, contaminated sediments underlie the wetlands. Therefore, the U.S. EPA must comply with CERCLA by removing the contaminated sediments as part of the remediation process. In order for the sediments to be excavated and removed, the wetlands will need to be drained. The process of draining or dewatering and subsequent sediment removal will trigger laws and requirements aimed at protecting wetlands, as well as the protected species inhabiting the wetlands. Under s. 300.400 (g) of CERCLA, the lead agency (U.S. EPA) and supporting agencies (i.e., ACOE, FWS) shall identify all the regulations that would need to be met during the CERCLA cleanup. The Casmalia Steering Committee, who represents a major portion of the Potentially Responsible Parties and who are liable for a large share of the CERCLA cleanup, will, therefore, need to comply with the substantive provisions of the state and Federal laws during the CERCLA remediation. The state and Federal laws that apply to a CERCLA action are referred to as Applicable or Relevant and Appropriate Requirements (ARARs). The substantive provisions are the requirements that fall under the state and Federal laws, and include measures to mitigate and minimize the loss of wetland to ensure “no net loss.”

5.2 POTENTIAL ARARS

This section identifies the "potential" ARARS to understand the substantive provisions that are required when dewatering the wetlands and subsequently excavating the underlying sediment. In doing so, we will justify the need for wetland mitigation and assess the degree to which the substantive provisions are met by each mitigation alternative proposed. It is crucial that the substantive provisions under the ARARS be reached for the mitigation alternative to meet the threshold criteria. The "potential" ARARS considered are restricted to those involving the protection of wetlands, the protection of species residing in the wetlands, and the creation of new wetlands to mitigate for wetland losses. The potential ARARS that are applicable to wetlands in California are outlined in **Appendix C, Wetland Regulations**. In our discussion, the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) are not considered here because compliance with CERCLA is equivalent to compliance with NEPA and CEQA. Because NEPA or CEQA is not a more stringent state requirement, it is not considered a potential ARAR (URS, 2000).

5.2.1 Federal Regulations

<u>Clean Water Act s.404</u>

The ACOE, with oversight from the U.S. EPA, regulates wetlands as "waters of the United States" as defined by § 404 of the Clean Water Act. For the Casmalia Steering Committee to meet the substantive provisions of § 404 (b) (1) of the CWA, which pertains to discharge and dredging activities, wetland mitigation must be undertaken. The type and level of mitigation required is outlined in the Section 404 Mitigation Memorandum of Agreement (MOA) between the U.S. EPA and ACOE in 1990. Under these guidelines, activities must avoid or, failing that, minimize wetlands impact; and in the event that destruction of the wetlands occurs, compensation is necessary. Wetland compensation takes the form of wetland mitigation where mitigation is appropriate and practicable. Mitigation is considered "appropriate" based on the functions and values of the aquatic resources being impacted and "practicable" when mitigation is determined to be "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes," (section 230.3(q) Guidelines, 1990).

The "appropriate" mitigation reflects the need for in-kind mitigation in order to preserve the same wetland functions in the mitigated wetlands as were present in the lost wetland. **Section 4.6, Wetlands Functions and Values** identifies the function and values of the aquatic resources at Casmalia such that the value and function can be replicated in the alternative mitigation wetland sites. The alternative site with the greatest potential to replicate the original function and value of the onsite wetlands represents the preferred alternative. The MOA also expresses a preference for onsite mitigation, which involves the restoration, enhancement, creation, and preservation of wetlands adjacent to the impact site (i.e., the site of the cleanup activities). The ACOE and U.S. EPA define onsite mitigation as occurring in the "area adjacent or contiguous to the discharge site" (MOA, 1990). Despite the ACOE and U.S. EPA preference for onsite mitigation, this opinion does not preclude the use of offsite alternatives of greater environmental benefits.[7]

The spatial extent of wetland mitigation should be commensurate with the anticipated impacts of the project, (ACOE, Standard Operating Procedures for the Regulatory Program). As previously mentioned, the amount of mitigation is typically determined by a mitigation ratio, which varies depending on the value of the wetland being impacted (higher values require greater mitigation), and/or whether the mitigation occurs prior to impact and is shown to be successful, in which case a lower ratio is required (Mace, 2001). Other factors that determine the replacement ratio include the potential wetland quality of the alternative wetland site. In particular, the ACOE uses a function-based model, the Hydro Geomorphic Model (HGM), to determine the function of the existing wetland. The HGM is also used to determine the appropriate mitigation ratio at each alternative site such that the original wetland function is replicated fully.

With respect to the onsite wetlands of the Casmalia site, the substantive provisions required under s.404 of the CWA are:

- Minimizing impact to greatest extent possible and compensating through wetland mitigation for unavoidable wetland destruction.
- Mitigating for wetlands in-kind and onsite unless offsite, in-lieu or mitigation banking alternatives provide greater environmental benefit.
- Establishing the function of the existing Casmalia Wetlands (using ACOE HGM).
- Establishing a mitigation ratio that replicates the existing wetland value and function in perpetuity for each alternative site (using ACOE HGM).

Because of the limitations of the HGM in our site, (as described in **Section 3.1, Characterization of Environmental Setting**) we have sought alternative means by which to establish the function of the existing Casmalia wetland and the mitigation ratio that would ensure replication of this function in the alternative wetland sites. Although there are wetland values and functions

[7] Federal Register 60 (November 28): 58605-58614.

present at the five wetland locations at the Casmalia site, it is apparent from consultation with the ACOE that not all five wetlands will fall under ACOE jurisdiction. This limited jurisdiction results from recent legislation requiring that wetlands are 'navigable' to be within the bounds of jurisdiction (Welsh, 2001). The navigable criterion is dependent on the extent the wetlands are considered isolated. Only wetlands that are adjacent to or within 200 feet of "waters of the United States" (i.e., Casmalia Creek) fall under ACOE jurisdiction. In the case of the Casmalia site, only two wetlands, Pond A-5 and A-Series, would meet the adjacency criteria and therefore require the substantive provisions mandated by the CWA.

U.S. Endangered Species Act of 1973, as reauthorized 1988

The FWS administers the U.S. ESA. In the case of the Casmalia site, the ESA is relevant because the Act prevents the 'take' of Federally endangered species and/or 'jeopardy' to Federally threatened or endangered species. Given that the Casmalia wetlands provide critical habitat to the California red legged frog, a Federally threatened species (FWS, 2001), this Act is triggered. Draining the wetlands would destroy critical habitat and thus jeopardize the habitat and existence of the red legged frog. Under the ESA, (§.7), any Federal agency undertaking activities that jeopardize an endangered or threatened species is required to enter into formal consultation with the FWS. During this consultation process, a Biological Opinion is issued to the relevant agencies, which outlines the terms and conditions aimed at minimizing adverse effects to the species (Henry, 2001). Currently, a finding of 'no jeopardy' on the Casmalia site is being considered, but the U.S. EPA will still be required to minimize the 'take' of the California red legged frog (Roberts, 2001). The substantive provisions required under the ESA, as well as those determined in the Biological Opinion, are being undertaken by the Casmalia Habitat Restoration Group Project.[8]

5.2.2 California State Regulations

1993 Wetlands Conservation Policy

The objective of the 1993 Wetlands Conservation Policy is to insure no overall net loss of wetlands. This policy can from the 1993 Governor Pete Wilson Executive Order W-59-93. This Policy is administered by an interagency consortium headed by the Resources Agency and Cal-EPA and involves the Department of Fish and Game as well as local and Federal

[8] The objective of the Casmalia Management Plan group project is to provide CB Consulting Inc. and the U.S. EPA with an analysis of restoration and management alternatives for the successful reestablishment and preservation of the California red-legged frog and the western spadefoot toad.

agencies. Specific mitigation ratios are required to ensure the policy of no overall net loss of California wetlands.

California Fish and Game Code, § 1600-1607

Under the CDFG Code, s.1600-1607, any person or government agency cannot divert, obstruct or change the flow of a river stream without a finding from the CDFG that the proposed project will not substantially adversely affect an existing fish or wildlife resource, or until the Department's proposals have been incorporated into the project. In terms of the Casmalia site, the development of an alternative wetland at the C Drainage along Casmalia Creek will require consultation with the CDFG. Given the wetlands of the Casmalia site are not connected to streams or rivers, impact to the wetlands will not be covered under § 600-1607, but minimization of impact and mitigation will be required under the 1993 Wetlands conservation Policy.

Coastal Zone Management Act of 1972 as amended, 1996

Under the Federal Coastal Zone Management Act (CZMA), the California Coastal Commission (CCC) can regulate projects occurring outside the coastal zone as long as they affect resources within the zone. The coastal zone generally extends 1000 yards inland from the mean high tide, except in areas where it extends either to the nearest ridgeline parallel to the sea, or five miles from the mean high tide if no ridgeline exists. The wetlands of the Casmalia site, therefore, do not fall directly under the CZMA as the site falls behind ridgelines running parallel to the ocean. However, impact to the flow of Casmalia Creek during the construction of an alternative wetland site would require coordination with the CCC, to ensure that the flow of Casmalia Creek does not impair resources down stream in the coastal zone.

5.3 PERMITTING REQUIREMENTS

Under § 300.400 (e) of CERCLA, no Federal, state or Local Agency permits are required for *onsite* response actions conducted under CERCLA. The term *onsite* is defined as "the area of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action". Under § 300.400 (e) (2) of CERCLA, if required, permits shall be obtained for all response activities conducted offsite. In terms of the Casmalia site, all wetland mitigation alternative sites that are offsite require the CSC to obtain permits where necessary from the aforementioned regulatory agencies. Where permits are not necessary (i.e., where wetland mitigation occurs onsite), the CSC is exempt from the procedural and administrative aspects of the ARARS. Therefore, the permit application is still required to meet the substantive technical provisions included in the ARARS.

In consideration of alternatives outlined in **Section 9.0, Wetland Mitigation Alternatives**, it is assumed that all mitigation alternatives, with the exception of mitigation banking, will be onsite. Therefore, they are exempt from the permit application process, a stipulation supported by correspondence with the U.S. EPA Casmalia representative, Craig Cooper. Furthermore, as mentioned above and as determined by the ACOE and U.S. EPA under the CWA, onsite mitigation is defined as an "area adjacent or contiguous to the discharge site" (MOA, 1990). Under these definitions, it is presumed that the C Drainage, B Drainage North and B Drainage South alternatives are onsite (see **Figure 9.1. Onsite Wetland Alternatives**).

6.0 CASE STUDIES

6.1 GUADALUPE OIL FIELD DUNE RESTORATION PROJECT

6.1.1 Site Location and Description

The former Guadalupe Oil Field is located within the 15,500-acre Guadalupe-Nipomo Dunes Preserve in southern San Luis Obispo County, approximately 10 miles west of the City of Santa Maria and 15 miles south of the City of San Luis Obispo. The site is part of the 3,000-acre Unocal LeRoy lease and was solely operated by Unocal Corporation from 1953 to 1994. The site boundaries include the Guadalupe-Nipomo Dunes Preserve to the north, Santa Maria River and lagoon to the south, agricultural lands to the east, and the Pacific Ocean to the west. Coastal dunes, freshwater wetlands and marsh ponds are present on and adjacent to the site near the Santa Maria River. The site is also home to several rare, endangered or threatened species, including the California red legged frog, *Rana aurora draytonii* (Arthur D. Little, 1998).

6.1.2 Background

The Guadalupe Oil Field Dune Restoration case study involves the restoration of natural resources that were damaged as a result of petroleum-related contamination. Impacts to sensitive species and habitats that had occurred were addressed through the Natural Resources Damage Assessment (NRDA) process, a court settlement and a proposed restoration plan. Other remedial activities involving the long-term cleanup and abandonment of the site, required per the RWQCB's Cleanup and Abatement Order, were addressed through the CEQA process and the application of several CERCLA guidelines.

The operations of the Former Guadalupe Oil Field involved exploration for and production of crude oil. A petroleum product called diluent was injected into the onsite wells between 1955 and 1990 in order to enhance the extraction of the viscous crude oil. During the period that diluent was used, numerous leaks occurred in parts of the underground storage and distribution system throughout the site. Approximately 12 million gallons of petroleum products were released and over time resulted in petroleum contamination of the groundwater, marine water, and surface water bodies. According to the NRDA conducted for the site, the contamination also resulted in sublethal and lethal injuries to sensitive species inhabiting the contaminated aquatic habitats (Interactive Planning and Management, 2001).

Various state agencies filed a lawsuit against Unocal Corporation for the natural resources that were injured, lost or destroyed as a result of the diluent releases. In 1998, a $43.8 million settlement was reached to cover damages, penalties and past agency costs related to the petroleum contamination. The damages portion of the settlement required Unocal to dedicate $9 million towards the funding of various restoration projects, both onsite and within the surrounding Guadalupe-Nipomo Dunes Preserve. In addition, the settlement required remediation of the site in phases and compliance with the Regional Water Quality Control Board's Cleanup and Abatement Order.

Unocal's permit application with San Luis Obispo County for their proposed remediation and abandonment plan triggered CEQA and the preparation of an EIR. The Final EIR prepared in 1998 evaluated the impacts of this project, which involved the containment, treatment and monitoring of contaminated areas and the abandonment of several surface and underground facilities. Although a response to petroleum contamination is exempt from CERCLA regulations, Unocal selected some, but not all, of the CERCLA guidelines to develop a remediation and abandonment plan.[9]

In August 2001, state agencies prepared the Final Restoration Plan, which outlined the proposed projects (funded by $9 million of the settlement) designed to restore the resources damaged by the diluent contamination. In particular, this plan targets the restoration of the contaminated wetland habitats, dune habitats and associated species.

6.1.3 Relevance to Casmalia Project

The Guadalupe Oil Field Dune Restoration project was selected as a relevant case study because of its similarities to the issues surrounding the Casmalia project, as well as its potential applicability in helping the Casmalia stakeholders determine appropriate mitigation alternatives. In particular, this case study was selected because of the following factors shared with the Casmalia site:

- geographic location in California and close proximity to the Casmalia site;
- adverse impacts to freshwater wetlands;
- adverse impacts to sensitive wildlife species (particularly the California red legged frog); and

[9] Unocal Corporation did not comply with 42 UCS sections 9601 et seq. of CERCLA or 40 CFR Part 300 of the National Contingency Plan.

- application of CERCLA guidelines.

6.1.4 Evaluation Criteria

According to the 1998 Final Restoration Plan, state agencies screened the alternative approaches to resource restoration based on how closely the alternatives met geographic, threshold and additional selection criteria, including but not limited to the following:

Geographic Criteria

- geographic location (as near as possible to the Guadalupe site)

Threshold Criteria

- technical feasibility
- compliance with relevant and applicable regulations
- avoidance of threats to public health and safety

Additional Criteria

- nexus between restored habitat or acquired land and damaged resources
- avoidance of adverse impacts to environment
- likelihood of success
- total costs

Each restoration alternative had to meet both the geographic and threshold criteria before evaluation under the additional criteria could proceed. Screened restoration alternatives were then classified by location (Guadalupe-Nipomo Dunes Projects versus non Guadalupe-Nipomo Dunes Projects), time period (interim versus long-term) and qualitatively ranked (least-preferred, moderately-preferred, and most-preferred). The differentiation between the least-preferred and most-preferred alternatives indicates the degree to which the alternatives met the selection criteria.

6.1.5 Preferred Mitigation Alternative(s)

Of the numerous habitat restoration alternatives identified in the 1998 Final Restoration Plan, the most-preferred and moderately-preferred projects in the Guadalupe Dunes area included, but are not limited to the following: the Western Snowy Plover Monitoring and Management Program; the Oceano Lagoon Restoration; and the Nipomo Dunes Wetlands Evaluation. Preferred projects outside the Guadalupe Dunes area include the following: City of Guadalupe School Lake and Wetlands Restoration Project (restoration of 24 acres freshwater wetlands); Mahoney Wetlands and Sand Dunes Preserve (preservation of 40 acres of wetlands and 80 acres of sand dunes); the Enhancement of Riparian Habitat within the Santa Maria Levee System (linear plantings of willow); and the Nipomo Native Garden, among others. The proposed restoration projects are currently in the planning phase and final decisions with respect to selection or funding of specific projects has not yet been made. Mitigation ratios are not explicitly defined in the Final Nipomo-Guadalupe Dunes Restoration Plan.

6.1.6 Mitigation Success

Restoration of areas disturbed during remediation and decommissioning activities is ongoing throughout the field. Active restoration is currently underway in foredune habitat (16 acres), dune swale habitat (1 acre), and dune scrub habitat (8 acres). Research has recently been completed on two sensitive wildlife species present at the site, the Western Snowy Plover and the California red legged frog. The results of this research will be used to better ensure the protection of these species during remediation projects, and to facilitate their reintroduction to restored wetlands.

6.2 PEACEKEEPER RAIL GARRISON AND SMALL ICBM MITIGATION PROGRAM

6.2.1 Site Location and Description

Peacekeeper Rail Garrison is located 55 miles north of Santa Barbara, CA. The San Antonio Terrace is a nearly pristine, large, stabilized, sand dune located on the U.S. Air Force Base at Vandenberg, California.

6.2.2 Background

This case study involves the mitigation for the filling of 3.2 acres of wetlands during the construction of test facilities for the then-extent Peacekeeper Rail Garrison and Small ICBM programs. The wetlands occupy the interdunal swales and are surrounded by stabilized sand dunes. To conduct this project, the U.S. Air Force was issued a general permit by the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act, under the condition that wetlands are created and a 5-year monitoring period be put in place. Additional stipulations of the permit state that the construction project fill no more than 10 acres of wetland nor affect threatened or endangered species. The mitigation ratio required for the project was 2:1 (two acres of wetland would be created for every one filled).

The general goal of the Peacekeeper Rail Garrison wetland mitigation project was to create eight acres of dune swale wetlands in two locations to replace wetlands lost during construction. Specifically, the project aimed to create wetlands that would: 1) exhibit physical and biological attributes within the natural variability of monitored dune swale wetlands on the San Antonio Terrace; 2) provide observed functions and values of natural dune swale wetlands (e.g. providing habitat for wetland wildlife); and 3) result in a self-sustaining ecosystem at the end of 5 years. Due to the rapid decline in coastal dune ecosystem types, this project focused on long-term documentation of wetland creation and upland restoration.

6.2.3 Relevance to Casmalia Project

The Peacekeeper Rail Garrison wetland mitigation project was selected because of the involvement of wetland mitigation due to impacts resulting from construction. Additional factors were integral to the selection of this case study, including:

- geographic location in California and close proximity to the Casmalia site;
- adverse impacts to freshwater wetlands;
- adverse impacts to sensitive wildlife species; and
- application of CERCLA guidelines.

6.2.4 Evaluation Criteria

The criteria developed for this project were designed to be simple and flexible to accommodate inconsistencies and fluctuations in physical or natural conditions (e.g., rainfall patterns and subsequent changes in runoff, infiltration, and groundwater levels), and any unique characteristics of the local ecological conditions of the region. A successful wetland creation under this program was one that met the several criteria. First, the created wetlands had to meet unified Federal criteria, including delineation criteria such as hydrology, hydrophytic vegetation, and hydric soil. Secondly, the created wetlands had to exhibit physical and biological attributes within the natural variability of monitored dune swale wetlands, or were judged likely to have functional values of natural dune swale wetlands, or were judged likely to be self-sustaining.

The specific criteria included:

- depth to the ground water table;
- degree of degradation of the site;
- location of the site relative to the affected wetlands;
- wildlife habitat value of the site;

- topography of the site and adjacent area; and
- accessibility of the site.

Based on these criteria and initial characterization, several potential sites were eliminated and new sites were assessed. Subsequently, five feasible wetland sites were identified and underwent further evaluation to identify the most preferable site. The evaluation was based on delineation criteria established by the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (FICWD, 1989). The delineation criteria are: the presence of hydric soil conditions or indicators of reducing conditions; wetland hydrology; and the dominance of hydrophytic vegetation.

6.2.5 Preferred Mitigation Alternative

An ongoing mitigation program included the creation of two wetlands followed by five years of monitoring to compare vegetation development at the created wetland sites with six mature representative wetlands on the Terrace (U.S. Air Force, 1994). The monitoring approach had two primary objectives: 1) to document descriptively the development of the created sites over time, and 2) to assess analytically the similarities between the created wetlands and natural wetlands.

Final created wetland acreages were determined to be 4.66 acres of wetland habitat at Live Oak Springs and 4.65 acres at Wildflower Wetland, total exceeding the required acreage by 1.31 acres (U.S. Air Force, 1994).

6.2.6 Mitigation Success

The wetland mitigation program has met or exceeded its goals; the two created wetlands are flourishing and exceed the target by 16 percent (U.S. Air Force, 1994). Functions and values of the created wetlands are in accordance with program goals and represent a significant beneficial contribution to the ecological resources of the area. Using indigenous seed sources to protect the genetic integrity of the native flora, the areas temporarily disturbed by construction have been stabilized and revegetated with native dune scrub species. Moreover, 26 acres of previously disturbed habitat have been restored to functioning dune scrub ecosystems. Overall, the created sites have proven to be stable ecosystems that are providing a healthy food-chain support, habitat for several sensitive species, breeding habitat for numerous species, and are expected to continue to converge with the surrounding mature wetlands.

6.3 MONTEZUMA WETLAND PROJECT

6.3.1 Site Location and Description

The proposed site is located west of the Primary Zone of the San Francisco Delta, and is adjacent to Suisun Bay and the mixing zone of the San Francisco Bay-Delta Estuary. The site is a 2,394-acre diked bayland and former tidal wetland area. In addition, the area is ecologically sensitive, critical for fish rearing, and the primary habitat of the Federally listed threatened delta smelt (*Hypomesus transpacificus*), Federally-proposed threatened Sacramento Splittail (*Pogonichethys macrolepidotus*), and the Federal candidate longfin smelt (*Spirinchus theleicthys*). Moreover, the Montezuma Slough areas may provide rearing habitat for the Federally-listed endangered winter-run Chinook salmon (*Oncorhynchus tshawytscha*).

6.3.2 Background

The project involves the disposal of up to 400,000 cubic yards of dredged material resulting from dredging in the Port of Oakland and other dredged materials from San Francisco Bay dredging sites. Given that the dredged sediments contain heavy metals, arsenic, lead, pesticides, and PCB's, the material is prohibited from being disposed of in San Francisco Bay or Ocean, and therefore, it is necessary that they be disposed of in an upland area. Originally reclaimed for agriculture, the project area has subsided, and the area has been used for upland hunting and grazing for several years. Levin-Frick, the project manager, proposes to dispose of the dredged material on 1,822 acres of the tidal marsh project site to aid in the restoration of wetlands onsite.

The ongoing project includes the placement of dredged material in constructed cells separated by engineered levees, connecting the project site to tidal flows. The process of placing the non-cover slurry in a cell and allowing it to set uncovered while it dewaters poses a hazard to wildlife. Plant growth may occur and waterfowl may be attracted to the site to forage while there is standing water on the cell and after the water has been drained, but before cover material has been placed. Recycling water through the process numerous times will concentrate soluble contaminants in the decant water, therefore increasing the potential risks and threats to wildlife.

According to the California Regional Water Quality Control Board, the exact acreage of wetland and upland habitat, which would be covered with dredged material, has not yet been specified. The proposed project would result in the loss of approximately five vernal pools, 71 acres of open water (i.e., drainage ditches) and brackish ponds, 572 acres of diked salt marsh, 972 acres of seasonal wetlands and seasonally grazed lands, and 202 acres of uplands, for a total of approximately 1,822 acres. To mitigate these impacts, the project would create approximately 1,822 acres of tidal wetlands.

6.3.3 Relevance to Casmalia Project

The Montezuma Wetland Restoration project involves the mitigation of wetlands due to the disposal of dredged materials. Like the Casmalia site, this project involves the Endangered Species Act due to habitat modification and degradation where wildlife may be killed or injured by the impairment of essential behavioral patterns. In addition, the Clean Water Act will also likely be triggered as a result of spoils transforming into a slurry that will be discharged.

6.3.4 Evaluation Criteria

Criteria developed to evaluate the project are based on compliance with Federal and state regulations for wetland mitigation projects involving the presence of endangered species.

6.3.5 Preferred Mitigation Alternative

To mitigate for the loss of 1,822 acres of tidal wetlands due to the disposal of dredged materials, 1,822 acres of wetlands will be created and/or restored. Despite the involvement of the ESA, the required mitigation ratio is 1:1 for unspecified reasons.

6.3.6 Mitigation Success

To be determined.

6.4 SWEETWATER MARSH RESTORATION PROJECT

6.4.1 Site Location and Description

Sweetwater Marsh is located in Southern San Diego County and involves the impacts on wetlands of San Diego Bay resulting from the widening of Interstate Highway 5. The total impact area was 15.6 acres, including 5.9 acres of mudflats dredged for a flood control channel, 9.6 acres of marsh filled during highway construction, and 7 acres of marsh temporarily filled for the highway.

6.4.2 Background

This project involves the California Department of Transportation's (CALTRANS) plan to expand Interstate 5 and Highway 54 interchange and the ACOE construction of a flood control channel on the Sweetwater River. The project prompted concerns by the US FWS due to the potential adverse impacts to species protected under the Federal Endangered Species Act (ESA) and required compensatory mitigation measures. As a result of the compensatory mitigation required for wetland loss, several beneficial activities (both in-kind and out-of-kind), such as wetland restoration, enhancement, acquisition, and preservation, were undertaken.

The development activities involved two components that were determined to result in the permanent loss of 15.6 acres of wetland habitat. In addition, the FWS determined that adverse impacts to the light-footed clapper rail and the California least tern would result from the temporary fill for the highway and construction activities.

6.4.3 Relevance to Casmalia Project

This wetland mitigation project involves mitigating for harm to endangered species due to road construction, similar to the scenario of mitigating for threatened species on the Casmalia site. Additional factors considered in the selection of this case study include:

- geographic location in California; and
- adverse impacts to freshwater wetlands.

6.4.4 Evaluation Criteria

According to the California Coastal Commissions Procedural Guidance for Evaluating Wetland Mitigation Projects in California's Coastal Zone, this project incorporated adaptive management and was deemed successful based on a number of site-specific performance standards, including:

- channels and emergent wetlands had to provide suitable and functional habitat for the California least tern and light-footed clapper rail;
- emergent wetlands had to be vegetated with specific native species occurring in the Sweetwater River wetlands complex;
- channels had to provide suitable habitat for fish and invertebrate populations that are forage items for the endangered species of interest; and
- the low, middle, and high saltmarsh had to contain specific vegetative species common to marsh habitats.

6.4.5. Preferred Mitigation Alternative(s)

The preferred mitigation alternative involved the adaptive management process to guide the monitoring program and performance evaluation. This process involved the Pacific Estuarine Research Laboratory (PERL), which worked with agency biologists and a technical advisory group in applying the adaptive management process.

The 1:1 mitigation ratio was determined based on several aspects of the project. The flood channel required levee construction and dredging, which resulted in losses to intertidal mudflat habitat. An out-of-kind mitigation resulted which included the gain in tidally influenced openwater habitat in the expanded river channel. In addition, the highway construction resulted in the filling of 9.6 acres of marsh habitat, which was mitigated through the restoration of 9.6 acres of connector marsh (CCC, 1995). The temporary fill of marsh habitat for the highway detour resulted in impacts that were addressed through the subsequent removal of the fill and restoration of the marsh area (i.e., 1:1 mitigation ratio).

Mitigation included the creation of a 17.1 acre functional wetland containing low, middle, and high saltmarsh form existing uplands, and modification of approximately 25 acres of high saltmarsh in the area of the connector marsh to the functional low, middle, and high saltmarsh.

6.4.6. Mitigation Success

The mitigation project had many merits, particularly in terms of providing a well-established mechanism for determining if the required habitat quality was met and in identifying limiting factors, as well as providing a mechanism for taking corrective actions (i.e., adaptive management).

While the mitigation efforts did not achieve all of the targets, the process had two outcomes that were extremely valuable and precedent-setting. For one, the target that was not achieved was determined to be unfeasible for the site, allowing for an alternative mitigation action to be suggested. Secondly, the difficulties encountered through this process educated the broader mitigation process in that decision-makers could no longer assume that mitigation goals were automatically achievable (Zedler, 2000).

6.5 LEGACY TERRACE WETLAND RESTORATION PLAN

6.5.1 Site Location and Description

The 70.5-acre Legacy Terrace project is located in the City of San Jose, CA, north of State Route 237, and east of San Tomas Aquino Creek. The project site consists of a landfill (called the Highway 237 Disposal Site) undergoing closure activities, vacant land and a former truck and construction equipment storage yard.

6.5.2 Background

The proposed project is the development of approximately 45.2 acres of a 70.5 acre Superfund site involving the development of office, research and development, and associated commercial uses totaling 900,000 square feet and a 175-room hotel. The proposed rezoning for office/research and development, hotel and commercial uses requires a final cover of the landfill area of the site to accommodate structures, utilities, landscaping, and private roadways.

Over the span of the project, 50,000 to 80,000 cubic yards of soil from an offsite borrow source will be imported to the site for use as part of the final cover. The relocation of waste, installation of the landfill cap, and construction of the entrance road would permanently affect approximately 5,219 square feet of palustrine emergent wetland habitat within the project site and 1,312 square feet of palustrine emergent wetland habitat just beyond the southern property boundary. Moreover, temporary impacts to palustrine emergent wetlands (an additional 0.65 acre) would result from construction operations.

6.5.3 Relevance to Casmalia Project

This project involved mitigation of wetlands on a former landfill site that was subject to CERCLA, similar to the Casmalia site. Additional parallels considered in the selection of this case study include:

- geographic location in California;
- adverse impacts to freshwater wetlands;
- adverse impacts to sensitive wildlife species; and
- application of CERCLA guidelines.

6.5.4 Evaluation Criteria

None developed.

6.5.5 Preferred Mitigation Alternative(s)

Wetlands mitigation resulting from areas temporarily impacted during construction will involve the reestablishment of wetlands to their original condition. Wetlands reestablished in these areas will be addressed in a detailed wetlands restoration plan.

Although permanent impacts to palustrine emergent wetlands onsite and adjacent to the site were not seen to constitute a significant adverse effect on Federally protected wetlands, impacts to these areas will be off-set by replacement of wetland habitat with wetlands with equal or greater area and function. The ratio of replacement wetlands will be provided at a minimum 1:1. The amount of wetland mitigation habitat will be determined based upon completion of a restoration plan and detailed impact assessment, using detailed site construction plans. The mitigation goal for the restoration plan will be to establish high-quality wetlands habitat within three to five years of site construction.

6.5.6 Mitigation Success

To be determined.

7.0 MITIGATION GOAL

7.1 WETLANDS CREATION

Wetland mitigation should be performed with the goal of creating wetlands of similar type, characteristics, functions and values as those of the Casmalia site wetlands. We thus defined our goal to create wetlands of the same type, emergent freshwater ponds, and which serve the same main function, specifically to support the listed species of concern. However, as discussed in **Section 4.0, Characterization of Environmental Setting**, the existing wetlands habitat consists of poor water quality, is dominated by non-native species and is generally degraded. Given this, the wetland conceptual design emphasizes the establishment of native species over non-native species, improved water quality, and seasonally-flooded vegetation banks over open water.

7.2 MITIGATION RATIO

The determination of a mitigation ratio is site specific and relatively subjective. This discussion attempts to address this subjectivity by:

- recognizing the challenges in determining a mitigation ratio for the Casmalia site wetlands; and
- illustrating that the ratio may be as high as 3:1, and therefore, we have chosen this ratio as a conservative requirement.

Following an evaluation of the functions and value of the existing wetlands and alternative sites, the mitigation ratio was based on the following: consultation of ACOE and CDFG guidelines, discussion with wetland practitioners, and review of case studies.

According to the CWA regulations administered by the ACOE, the mitigation ratio is a function of:

- The original habitat quality;
- The presence of endangered or threatened species; and
- The potential wetland quality of the mitigation site

The ACOE applies the HGM approach to quantify the required mitigation ratio for compensatory mitigation projects. As mentioned in **Section 3.1, Characterization of Environmental Setting**, the HGM approach was not appropriate for the Casmalia site and could not be applied to quantify a mitigation ratio. However, the habitat quality of the existing wetlands and the alternative sites was qualitatively discussed (see **Section 4.0, Environmental Setting,** and **Section 9.0, Wetland Mitigation Alternatives**) and later served as a basis for justifying an appropriate mitigation ratio.

The CDFG's Guidelines (see **Appendix D, CDFG Guidelines**) reflect the quality of the wetland requiring mitigation, taking into consideration the presence of endangered species. In general, isolated, disturbed, and poor quality habitats require a lower mitigation ratio (1:1 or 2:1). Habitat that is of better quality and, according to the CDFG guidelines, habitat for endangered species requires a higher mitigation of 3:1 and 5:1, respectively. From these guidelines, we recognized that a higher mitigation ratio might be required because the Casmalia site wetlands are critical habitat to Federally threatened species, (California red legged frog) and California Species of Special Concern, (California red legged frog and Western Spade-foot Toad). However, we recognized that the Casmalia site wetlands are degraded and have generally low quality habitat, therefore a 5:1 mitigation ratio would be too high.

We further consulted with W. Ferren, Executive Director of the Museum of Systematics and Ecology, UCSB, Maureen Spencer, biologist at Santa Barbara County Flood Control, and Martin Potter, biologist at CDFG.

In addition we considered mitigation ratios from similar Californian wetland mitigation case studies, (see **Section 6.0, Case Studies** and **Table 7.1. Summary of Case Study Mitigation Ratios)**. Based on the regulatory guidelines, consultations and mitigation ratio requirements described in wetland mitigation case studies, we decided on a 3:1 mitigation ratio. We recognize that eventual mitigation may not be as high as 3:1, as is the case in the case studies. Additionally, we recognize that quality wetland habitat should be prioritized over quantity.

Table 7.1. Summary of Case Study Mitigation Ratios

Case Study	Mitigation Ratio
Guadalupe Oil Field Dune Restoration Project	--
Peacekeeper Rail Garrison and Small ICBM Mitigation Program	2.9:1
Montezuma Wetland Project	1:1
Sweetwater Marsh Restoration Project	1:1
Legacy Terrace Wetland Restoration Plan	1:1

8.0 DESCRIPTION OF SCENARIOS

Given the uncertain future of the Casmalia site wetlands (i.e., the exclusion of the A-Series pond from draining due to its ecological value), three mitigation scenarios were considered. These scenarios include the No Action Scenario where no draining and no mitigation of the wetlands occurs (Scenario 1); the Drain and Mitigate Four Wetlands Scenario (Scenario 2); and the Drain and Mitigate Five Wetlands Scenario (Scenario 3). Mitigation acreage requirements are varied for each scenario and are summarized in **Table 8.1. Scenario Mitigation Requirements**.

8.1 SCENARIO 1: NO ACTION (NO DRAINING AND NO MITIGATION OF WETLANDS)

In this scenario, no wetlands will be drained, excavated or filled during site cleanup. Therefore, for this scenario, no mitigation will be required.

8.2 SCENARIO 2: DRAIN AND MITIGATE FOUR WETLANDS

In this scenario, four wetlands (Ponds A-5, 18, 13, and RCF) will be drained, excavated and filled, resulting in a total wetland loss of approximately 12.7 acres. Given the 3:1 mitigation ratio and the construction of the new 17-acre storm water pond that would apply as credit toward meeting the mitigation requirement,[10] Scenario 2 would require mitigation of approximately 21.1 acres.

8.3 SCENARIO 3: DRAIN AND MITIGATE FIVE WETLANDS

In this scenario, all five wetlands (Ponds A-5, 18, A Series, 13, and RCF) will be drained, excavated and filled, resulting in a total loss of approximately 23.8 acres. Given the 3:1 mitigation ratio and the construction of the new 17-acre storm water pond that would apply as credit toward meeting the mitigation requirement, Scenario 3 would require mitigation of approximately 54.4 acres.

[10] As mentioned in our assumptions (**Section 2.0**), a new 17-acre storm water pond would be constructed as part of the final storm water management system on the site and would count towards meeting the wetland mitigation size requirements.

Table 8.1. Scenario Mitigation Requirements

Scenario	Initial Wetlands Lost (acres)	Required 3:1 Mitigation (acres)	Storm Water Pond Credit (acres)	Final Mitigation Required (acres)
Scenario 1	0	--	--	**--**
Scenario 2	12.7	38.1	17	**21.1**
Scenario 3	23.8	71.4	17	**54.4**

9.0 WETLAND MITIGATION ALTERNATIVES

9.1 DESCRIPTION OF ALTERNATIVES

The following paragraphs provide a more detailed description of the alternative sites' current location, delineation, geological resources, hydrological resources, and biological resources. **Figure 9.1. Onsite Wetland Alternatives** illustrates the relative location of B Drainage North, B Drainage South, and the C Drainage.

9.1.1 No Mitigation Alternative

This alternative corresponds to "no action" in response to the draining and dredging of the existing wetlands. For this alternative, no wetlands would be created to mitigate for the loss of the existing onsite wetlands. This alternative serves as a baseline for comparison to other alternatives.

9.1.2 B Drainage North Alternative

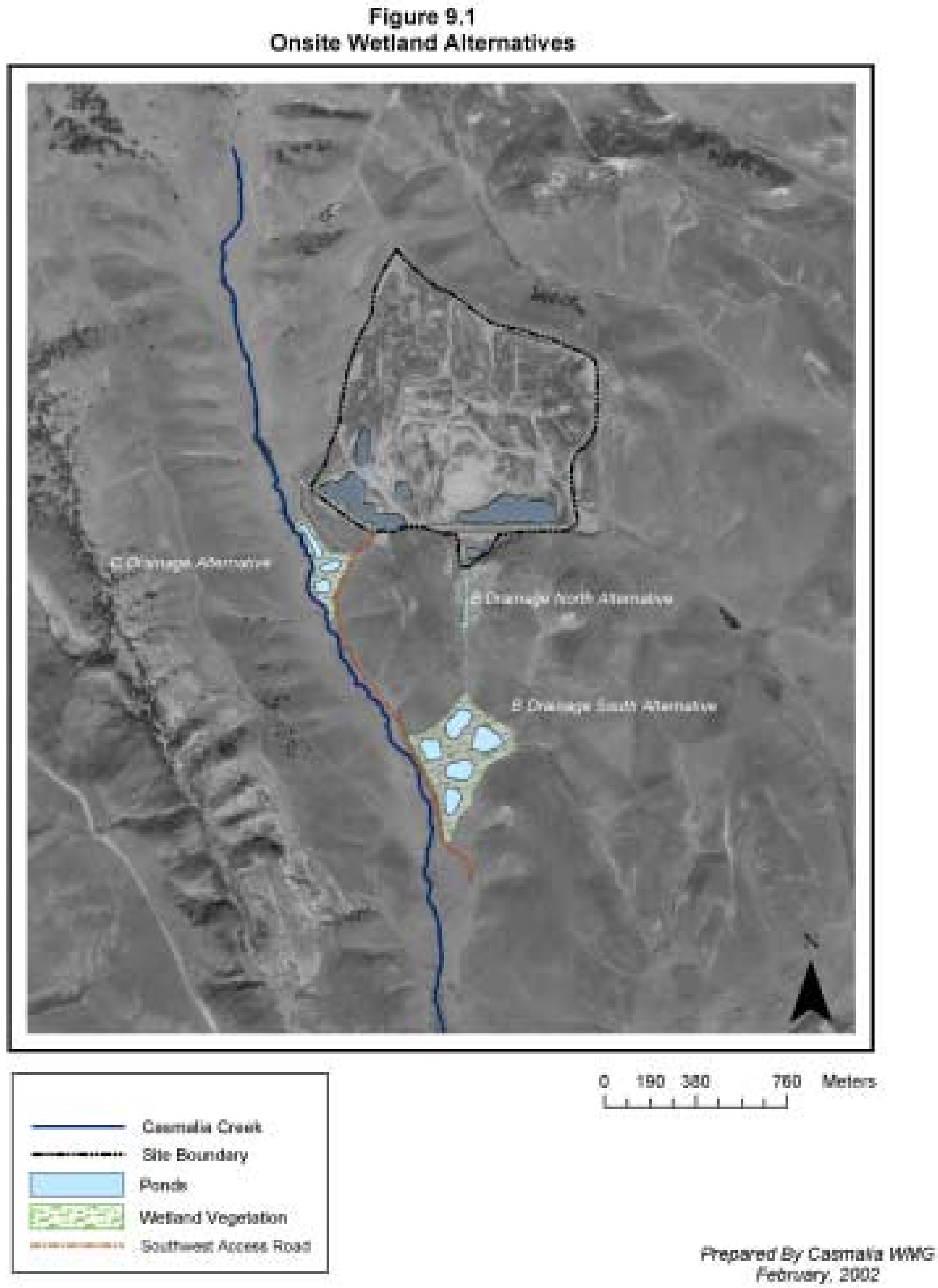
Overview

The B Drainage North Alternative is approximately 2.0 acres and is located immediately south of Pond 13 (see **Figure 9.1. Onsite Wetland Alternatives)**, between two prominent and moderately steep hills. The valley is narrow, up to approximately 17 meters (56 feet) wide and gently slopes towards the south. A dirt road runs along the western edge of the drainage. The northern boundary of the area available for wetlands is immediately south of the gate that provides entrance to the site, and the southern boundary was chosen at the narrowest point of the valley. In several areas, the hillsides are carved by erosion into steep channels. The infrastructure consists of a fence, one pole, and several monitoring wells. The pole, however, does not seem to provide any specific use. Most of the monitoring wells are clustered immediately South of Pond 13 and are located both in the center and on the edge of the delineated area.

Geological Resources

As discussed in **Section 4.2, Geological Resources**, the soils in the B Drainage consist of clayey silt and silty clay alluvial and colluvial overlying weathered claystone bedrock. This area may also contain fill material within

Figure 9.1. Onsite Wetland Alternatives



the dirt road along the drainage, consisting of a mixture of silty clay and sand-sized and larger claystone fragments (Dames and Moore, 1997).

<u>Hydrological Resources</u>

Surface water

The drainage receives water draining down the two adjacent hills. Only a narrow dry creek bed (about 0.9 meter (3 feet) wide and 0.3 meter (1 foot) high) is present within the carved valley, which arises from short-lived intermittent storm events.

Groundwater

Groundwater flows from the site into the B Drainage North, but is restricted by a subsurface clay barrier and collection gallery installed at the head of the B Drainage North and by the perimeter trench (PCT-B) located down-gradient from these two features. As shown in **Table 9.1. Groundwater Elevations**, the water table at B Drainage North, as measured in November 1999, lies about 4 meters (13 feet) below ground level in the northern part and is 0.9 to 3.3 meters (2.9 to 10.8 feet) below ground level depending on topography in the southern part. At the end of the rainy season in April, these elevations are 3 meters (9.8 feet) and 0 to 2.3 meters (7.5 feet), respectively.

<u>Biological Resources</u>

Due to heavy cattle grazing and the steep slope of the land, the soil is unvegetated in many areas. The plant community at B Drainage North is dominated primarily by non-native species, including annual grasses, bur clover, oxtongue, and red goosefoot. The community is not very diverse, nor does it currently provide much in the way of habitat for the native animal species.

9.1.3 B Drainage South Alternative

<u>Overview</u>

The area for B Drainage South lies immediately south of B Drainage North (see **Figure 9.1. Onsite Wetland Alternatives)**, where the drainage widens to a relatively flat and broad area. The delineated area consists of about 30.4 acres and follows the lowest elevation terrain. The B Drainage South Alternative site is bound by a dirt road to the west (which runs along the Casmalia Creek), the edge of a relatively steep slope to the east, a gentle

Table 9.1. Groundwater Elevations

Approximate Location	Well	Ground Elevation (June 2000) (feet above msl)	Water Level Elevation (November 1999)[1] (feet above msl)	Depth to Groundwater (meters)
B Drainage North				
Cluster of wells in northern part	B3M	384.14	371.03	**4.00**
	RP6B	383.9	370.32	**4.14**
	RP6A	383.72	370.65	**3.98**
South-central	RP59B	376.32	365.31	**3.36**
	B4M	367.92	364.1	**1.16**
B Drainage South				
Cluster in north-central area	RP-75A	344.04	335.36	**2.65**
	RP-75B	344.49	329.53	**4.50**
C Drainage				
Along northern boundary	RP-84A-2	419.08	405.23	**4.22**
	RP-84B	417.59	404.62	**3.95**
	RP-76A	411.84	398.63	**4.03**
Along southern boundary	RP-87C-2	385.79	362.11	**7.22**
	RP-72B	382.72	363.31	**5.92**
	RP-72A	377.14	357.44	**6.00**

Source: Harding Lawson Associates, 2000

[1] Water levels were measured between November 2, 1999 and November 5, 1999.

Notes: Groundwater elevations were found to be relatively constant based on measurements taken between 1992 and 2000. The water table is about 0.95 meters (3.12 feet) higher at the end of the rainy season in April (Harding Lawson Associates, 2000)

sloping ridge and hill to the north, and is constrained to the south where it narrows. The infrastructure consists of a fence, electrical poles, and some monitoring wells. Monitoring wells are located within the delineated area of this alternative.

Geological Resources

The geological resources of B Drainage South are similar to those of B Drainage North. However, However, the B Drainage South area probably does not contain any fill materials.

Hydrological Resources

Surface water

As in B Drainage North, this drainage receives water draining southward from adjacent hills and includes a number of dry creek beds. The alternative site is adjacent to the eastern bank of Casmalia Creek.

Groundwater

Groundwater flow comes from the north and, as discussed above, is blocked at the southern boundary of the site by a subsurface clay barrier and collection gallery installed at the head of the B Drainage North and by the perimeter trench (PCT-B) located down-gradient from these two features. The water table at B Drainage South is about 4.5 meters (14.8 feet) deep in the north-central area, as measured in November 1999 (see **Table 9.1. Groundwater Elevations**). It would be as high as 3.5 meters (11.5 feet) deep at the end of the wet season.

Biological Resources

The area is very degraded due to cattle grazing, therefore, vegetation cover tended to be primarily herbaceous plants. The plants that are present are mostly non-native species, including annual grasses, thistle, oxtongue, and bur clover. Tarweed, a native plant, is also present at this site.

9.1.4 C Drainage Alternative

Overview

The C Drainage lies immediately southwest of the site, adjacent to Casmalia Creek, encompassing 9.6 acres (see **Figure 9.1. Onsite Wetland Alternatives**). The incised (approximately 2 meters or 6.5 feet) eastern bank of Casmalia Creek defines the western edge of the delineated area. Electrical poles, which run along a dirt road and monitoring wells, are located along the northern and eastern edges. The southern part narrows as it becomes constrained between gently sloped hills. These hills also contain monitoring wells. None of the monitoring wells were included in the delineated area. A fence is present along the majority of the perimeter of the site. In addition, a pipeline, which does not seem to serve any purpose, is visible toward the southern end of the area, and it likely extends underground through the northern portion of the area.

Geological Resources

As mentioned in **Section 4.2, Geological Resources**, the C Drainage Alternative is characterized by a thin layer of clayey silt and silty clay alluvial sediments overlying weathered claystone.

Hydrological Resources

Surface water

The surface water resources present in the area consist of storm water runoff from adjacent hills and the ephemeral Casmalia Creek, which yields very little water. The water quality in the creek is typical of water bodies in the area, as it has a TDS level of approximately 800 mg/L and a pH of approximately 8.2.

Groundwater

Groundwater flow toward Casmalia Creek is restricted by an underground clay barrier that lies along the southwestern boundary of the site. The water table at C Drainage South is about 4 meters (13 feet) deep along the northern boundary and 6-7 meters (about 20 feet) deep along the southern boundary, as measured in November 1999 (see **Table 9.1, Groundwater Elevations**). The water table is one meter (3.3 feet) higher when it is the fullest at the end of the wet season. The water table elevation is variable along the southern boundary due to the hilly nature of the area.

Biological Resources

The C Drainage Alternative site is generally degraded by existing cattle grazing activities. This alternative site includes the riparian corridor associated with the adjacent Casmalia Creek. In addition to the plants previously mentioned for B Drainage South, plant species in this riparian corridor include live oak (*Quercus agrifolia*), arroyo willow (*Salix lasiolepis*), spiny cocklebur (*Xanthium spinosa*), watercress (*Rorippa nasturtium aquaticum*), elderberry (*Sambucus mexicanus*), sagebrush (*Artemisia tridentata*), coyotebrush (*Baccharis pilularis*), tree tobacco (*Nicotiana glauca*), and poison hemlock (*Conium maculatum*). Of these species, the spiny cocklebur, watercress, tree tobacco, and poison hemlock are non-native. Spiny cocklebur and poison hemlock are both noxious weeds.

9.1.5 Mitigation Bank Alternative

Overview

Mitigation banks are a form of compensatory mitigation for unavoidable impacts to wetlands and/or other aquatic resources. Under Section 404 of the CWA, applicants for individual permits to fill or dredge wetlands must undertake a sequential mitigation process. First, permit applicants must try to avoid impacts altogether, then minimize adverse impacts, and finally compensate for any unavoidable wetland losses (MOA, 1990).

Traditionally, this third step of compensatory mitigation has involved small-scale mitigation on or adjacent to the site of wetland conversion. Mitigation banks offer an alternative form of compensatory mitigation that satisfies the requirements for offsite mitigation of wetland losses. Banking allows permit applicants to purchase credits in a generally larger, centralized bank whose wetlands have been or are contracted to be restored, enhanced or created. Thus, like their traditional counterparts, mitigation banking is designed to satisfy the national policy of "no net loss" of wetlands through the three main types of compensatory mitigation: restoration, enhancement (and to a lesser extent, preservation) of existing wetlands, or creation of new wetlands. Unlike traditional onsite mitigation, banks are designed to mitigate unavoidable wetland losses in advance of permitted impacts and require monitoring in perpetuity.

Criteria for Use of Mitigation Banks

According to the Federal guidance on the establishment, use and operation of mitigation banks (see **Appendix D, Federal Guidelines for the Establishment, Use and Operation of Mitigation Banks**), permit applicants can satisfy the requirements for compensatory mitigation through the use of mitigation banks when onsite mitigation is not practicable, or when the use of the bank is environmentally preferable to onsite mitigation. Banking is considered environmentally preferable when compensating for "minor aquatic resource impacts," including small impacts associated with linear projects (i.e., roadways, utilities corridors). For significant impacts to larger wetlands, use of a mitigation bank may be appropriate, as determined on a case-by-case basis, if the bank is capable of replacing the essential functions of the affected wetlands. In addition, a combination of onsite and offsite (i.e., banked) mitigation may be appropriate. The guidelines also stipulate that in choosing between onsite mitigation and use of an offsite mitigation bank, consideration should be given to the potential likelihood of success, compatibility of the mitigation with adjacent land uses, feasibility of long-term monitoring and maintenance, and cost.

<u>Mitigation Banks in Santa Barbara County</u>

According to the CDFG Habitat Conservation Planning Branch, there are two conservation banks listed in Santa Barbara County, the Gaviota Tarplant Mitigation Bank and the Santa Ynez River Mitigation Bank.

Gaviota Tarplant Mitigation Bank

This 35-acre bank is located approximately 50 miles south of the Casmalia site. The bank's service area includes the Gaviota coastline. The credits for sale are limited to those for the plant species of Gaviota tarplant (*Hemizonia increscens ssp. villosa*) and habitat types of bunchgrass grassland, coastal sage scrub, and live oak woodland. Due to inconsistent vegetation and habitat types between the bank and the Casmalia site wetlands, this bank will provide out-of-kind mitigation.

Santa Ynez River Mitigation Bank

The Santa Ynez River bank site is currently under development. The bank site will be located near the City of Lompoc and is approximately 18 miles south of the Casmalia site. The projected total bank size is approximately 300-500 acres. The type of credits listed for sale would be wetland and riparian, and the habitat types would include riparian and seasonal wetland. Certain portions of coastal Santa Barbara County may not be mitigated at this bank, but these excluded portions are not identified in the available literature.

In some cases, the Federal guidance on wetland mitigation banks supports the sale of credits before the bank is fully functional, particularly when there is adequate financial assurance and there is a high likelihood of success of the mitigation project. According to the guidelines, as long as these conditions are satisfied, it may be appropriate to allow for limited debiting of a percentage of the total credits projected for the bank at maturity. In general, however, the practice of selling credits before maturation at the bank site, or speculating in credit futures is not favorably supported by regulators.

9.2 CONCEPTUAL MITIGATION DESIGN

In order to assess the contribution and wetland value that the B Drainages and C Drainage will provide, it is necessary for us to define how we envision B North, B South and C Drainages as wetlands. Through visiting the sites and understanding the hydrological constraints, we have developed a conceptual design of what each drainage would look like as functioning wetlands and the potential water sources to fill the wetlands. This is used to evaluate both drainages against the criteria.

9.2.1 Water Sources

Groundwater was not considered a technically or economically feasible source of water for wetland construction, given the relatively large depth to groundwater at both the B and C Drainages: up to approximately 2 to 5 meters (6.6 to 16.4 feet) of depth, respectively. The Casmalia Creek is not a viable source of water for the C Drainage or B Drainage South alternatives, primarily due to the low base flow of the creek.

In addition to direct rainfall and rainfall draining down adjacent hills, a feasible water source would be surface water runoff from the site. This water is currently collected in the existing onsite wetlands, but could potentially fill the created wetlands adjacent to the site as all water leaving the site is expected to meet the NPDES water quality standards. The site receives a total of 150 to 180 million gallons of rainfall per year, and a portion of that, represented as the *runoff coefficient*, is available as surface water. Three regions on the site were identified as primary surface water sources for the wetland mitigation sites: the RCRA Canyon; the capped landfills area (including the landfills that have not yet been capped); and a proposed new storm water pond (**Figure 9.1. Onsite Wetlands Alternatives, and Figure 9.2. Surface Water Source Locations**).

The 70-acre RCRA Canyon area is located in the westernmost portion of the site and currently drains into the A-series Pond. The RCRA canyon can provide approximately 12 million gallons of water per year (Bertelsen, 2002). Because all water leaving the site should meet NPDES standards, we assume the water from the RCRA Canyon will be of good quality.

The 60-acre capped landfills area located in the northern portion of the site represents a large source of water. The impermeable nature of the cap and shallow soil horizon discourages precipitation infiltration and encourages increased runoff. The runoff coefficient is thus relatively high (60%) and yields 18 million gallons of water per year (Bertelsen, 2002). Furthermore, the water quality is equivalent to that of rainfall, as it collects above a liner, hence the water is considered to be clean by NPDES standards. See **Table 9.2. Potential Onsite Surface Water Sources**.

Figure 9.2. Surface Water Source Locations

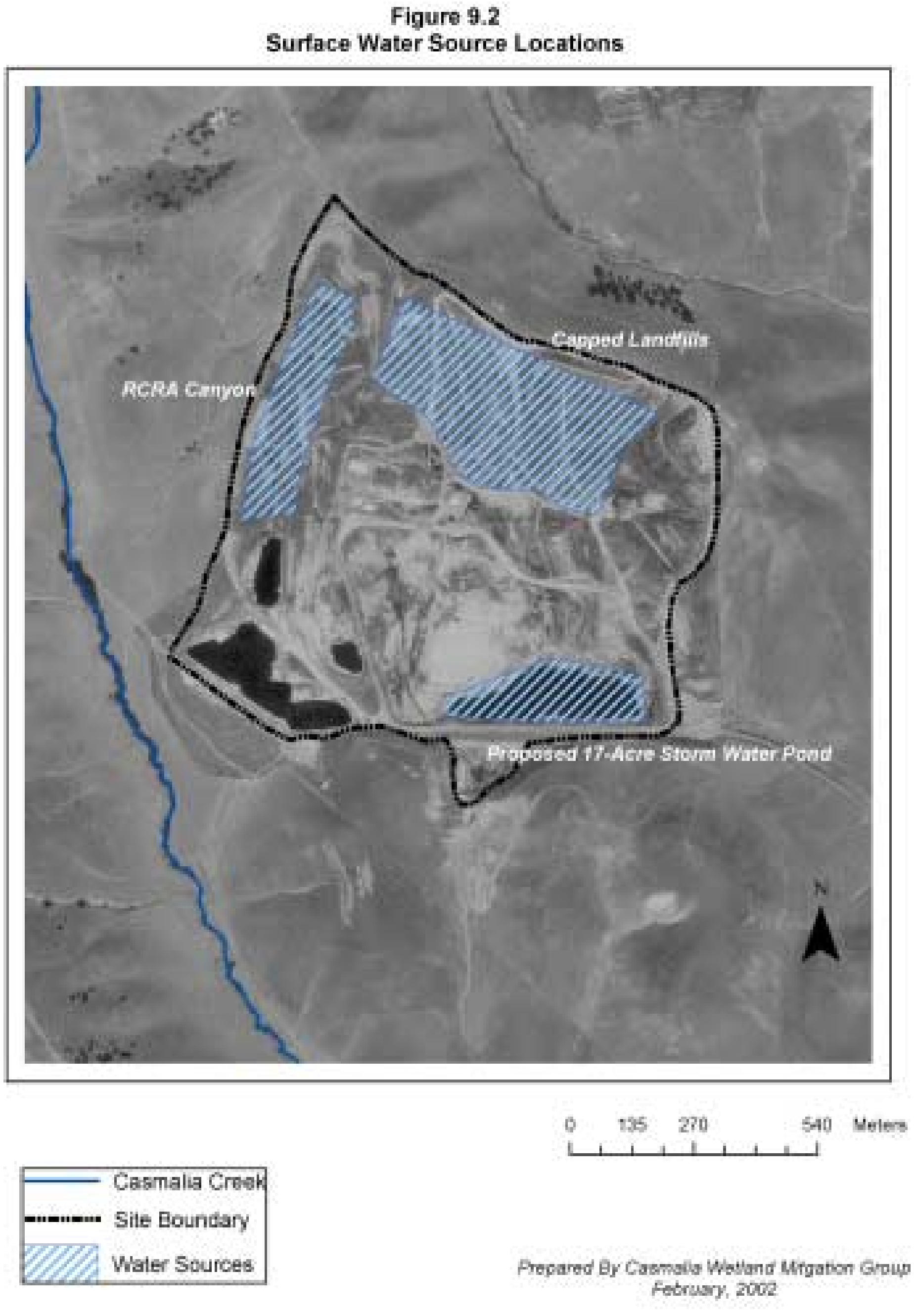


Table 9.2. Potential Onsite Surface Water Sources

Water Source	Area (acres)	Rainfall (mgy)[1]	Runoff Coefficient	Amount Water (mgy)[1]
RCRA Canyon	70	30	0.40	12
New Storm water Pond	17	--	--	50
Capped Landfill Area	60	30	0.60	18

A new 17-acre lined storm water pond is proposed for construction in the footprint of the RCF Pond. This storm water pond is anticipated to hold and treat storm water runoff from the site and ultimately release the water into the adjacent Casmalia Creek. According to the 1999 Cost Estimate for the closure of the Casmalia site wetlands, it is assumed that approximately 50 million gallons of pond water will remain at the time the final cleanup remedy for the site is implemented; this water will be treated for total dissolved solids over a six-month period for ultimate discharge into the creek under the NPDES permit (CH2M Hill, 1999). Rather than discharge this water to the creek, this treated water could also potentially be used as a water source for the wetland mitigation sites (Bertelsen, 2002). We assume the quantity derived from this source is 50 million gallons per year.

9.2.2 Construction Design

We envision each alternative site to contain either one large wetland pond (B Drainage North) or several smaller ones (B Drainage South and C Drainage) with shared banks of wetland habitat. Each body of standing water would be surrounded by saturated conditions supporting wetland plants and would provide habitat for wetland species.

The wetlands would be constructed as surface water depressions as defined by Pierce (1993), because precipitation and surface water are the sole sources of water. This requires that the soil be relatively impermeable. Although the soils at the potential sites are already relatively impermeable, we recommend the use of liners to aid in the retention of water. Furthermore, because the sources of water (rainfall) are relatively unpredictable, it is preferable to plan for very large amounts of water entering the wetlands (from five to ten times the minimum amount of water necessary). It is also critical to provide an outlet passage for excess water to ensure the successful establishment of wetland habitat (Pierce, 1993).

A schematic of the wetlands to be constructed is shown in **Figure 9.3. Conceptual Cross-Section of Constructed Wetlands**. In general, the constructed wetlands would involve excavation of a pond with gradually-sloping banks. First, the soil would be excavated to a maximum soil depth of 2.4 meters (8 feet). The excavated soil area would be covered with a plastic liner. Approximately 0.61 meters (2 feet) of backfill would cover the plastic liner. Then water would be piped to the wetland ponds from Casmalia site water sources; the maximum water depth would be approximately 1.83 meters (6 feet).[11] Emergent wetland vegetation would be hand-seeded and willow-woodland vegetation would be planted in a 15 to 30 meters (50-100 feet) vegetation buffer around the surface water ponds.

9.2.3 B Drainage North Created Wetlands

B Drainage North currently represents a natural pond structure lying between two steep hillsides (see **Figure 9.4. B Drainage North Alternative**). A dike placed between the two hillsides would provide a barrier to water runoff from the site. Water from the site would enter the drainage immediately south of Pond 13. This water would collect behind the dike, filling the lined pond structure into one big pond, shallow to the north and deeper to the south. Only excavation for lining (0.6 meter or 2 feet depth), as well as construction of a dike structure would be required in this area. This pond would have a water capacity of 826,703 gallons of water. Excess water could be directed south towards B Drainage South through a channel or pipe placed at an appropriate elevation.

9.2.4 B Drainage South Created Wetlands

B Drainage South offers a relatively large surface area. Several small ponds could be constructed in topographic lows through shallow excavation to an 8-foot depth (see **Figure 9.5. B Drainage South Alternative)**. This area is connected to the site by a channel that starts at Pond 13 and flows through B Drainage North. Water from the site would be directed through this channel to reach B Drainage South. The constructed ponds together would require 12.4 million gallons. Because of its proximity, excess water could flow into Casmalia Creek.

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[11] Wetlands with a maximum depth of 6 feet is recommended to avoid plant species such as cattail and bulrushes overrunning the pond (Spencer, 2002 and Ferren, 2001b).

Figure 9.3. Conceptual Cross-Section of Constructed Wetlands

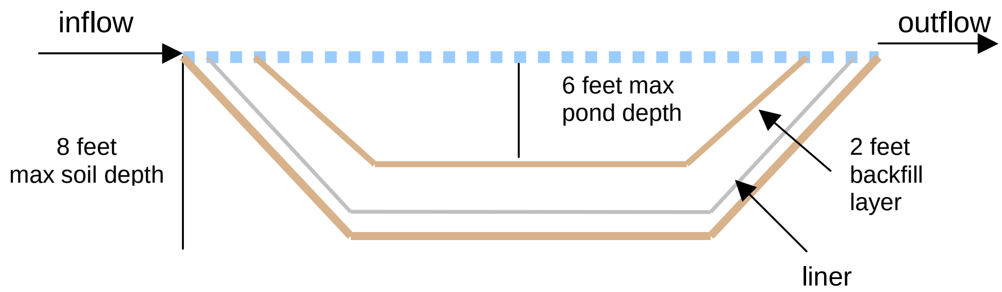


Diagram not to scale.

9.2.5 C Drainage Created Wetlands

The C Drainage is a relatively flat area where several small ponds would be constructed through shallow excavation (see **Figure 9.6, C Drainage Alternative**). These ponds would be filled via gravity flow from the RCRA Canyon through the southwestern corner of the site. This wetland would have a water capacity of 3.3 million gallons of water. Similarly to B Drainage South, excess from overflow of the created wetlands could flow into the Casmalia Creek.

Figure 9.4. B Drainage North Alternative

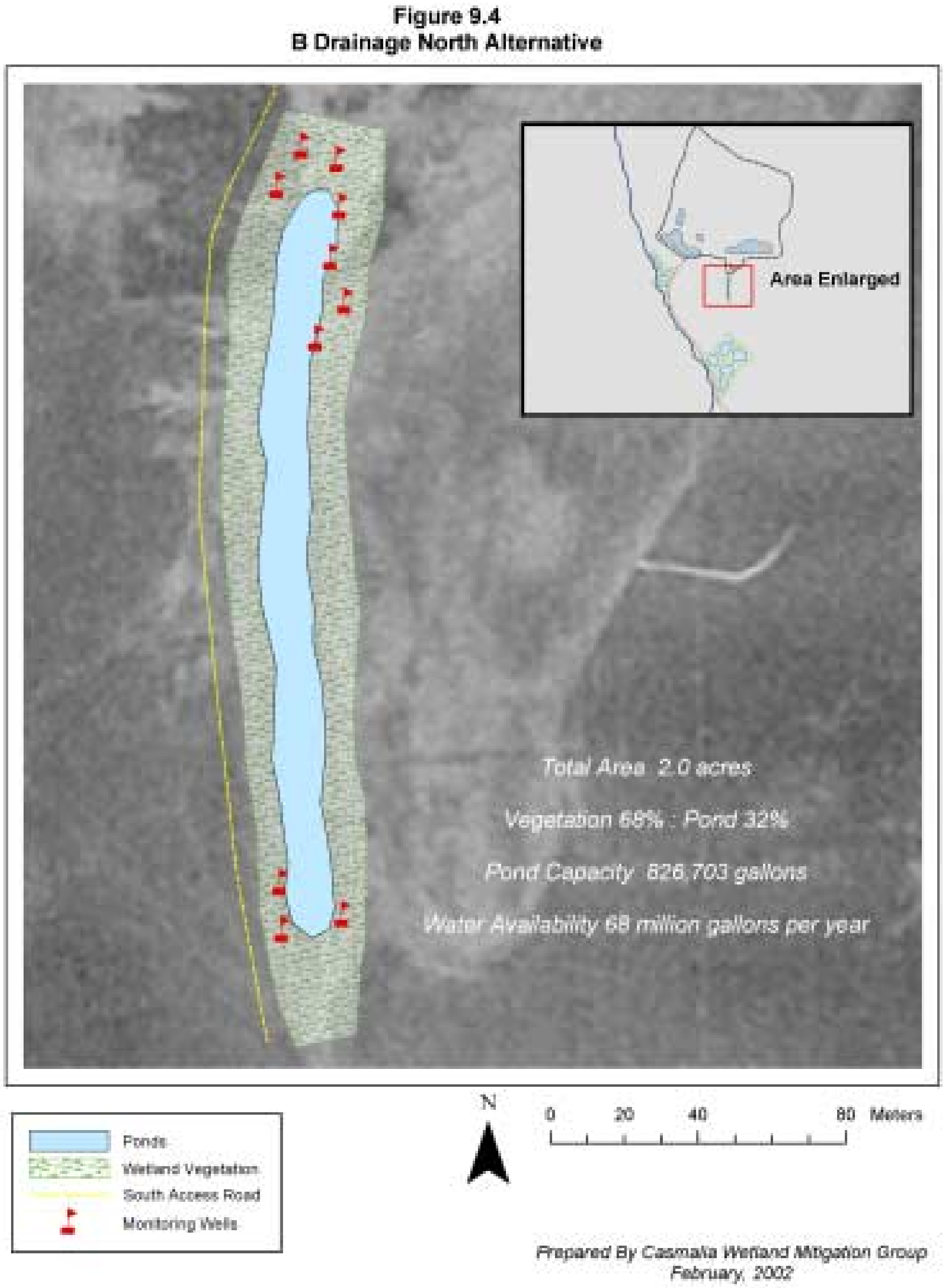


Figure 9.5. B Drainage South Alternative

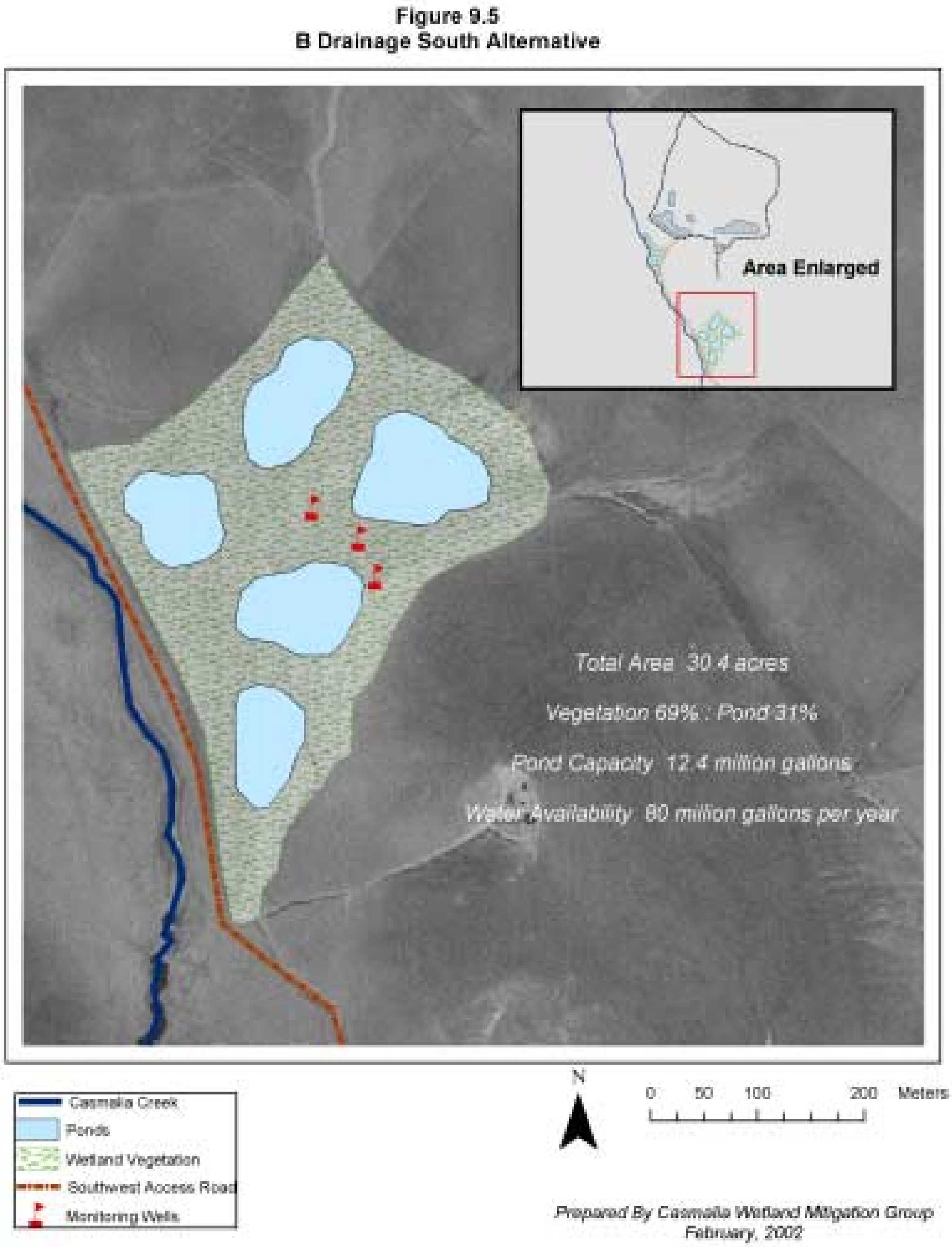
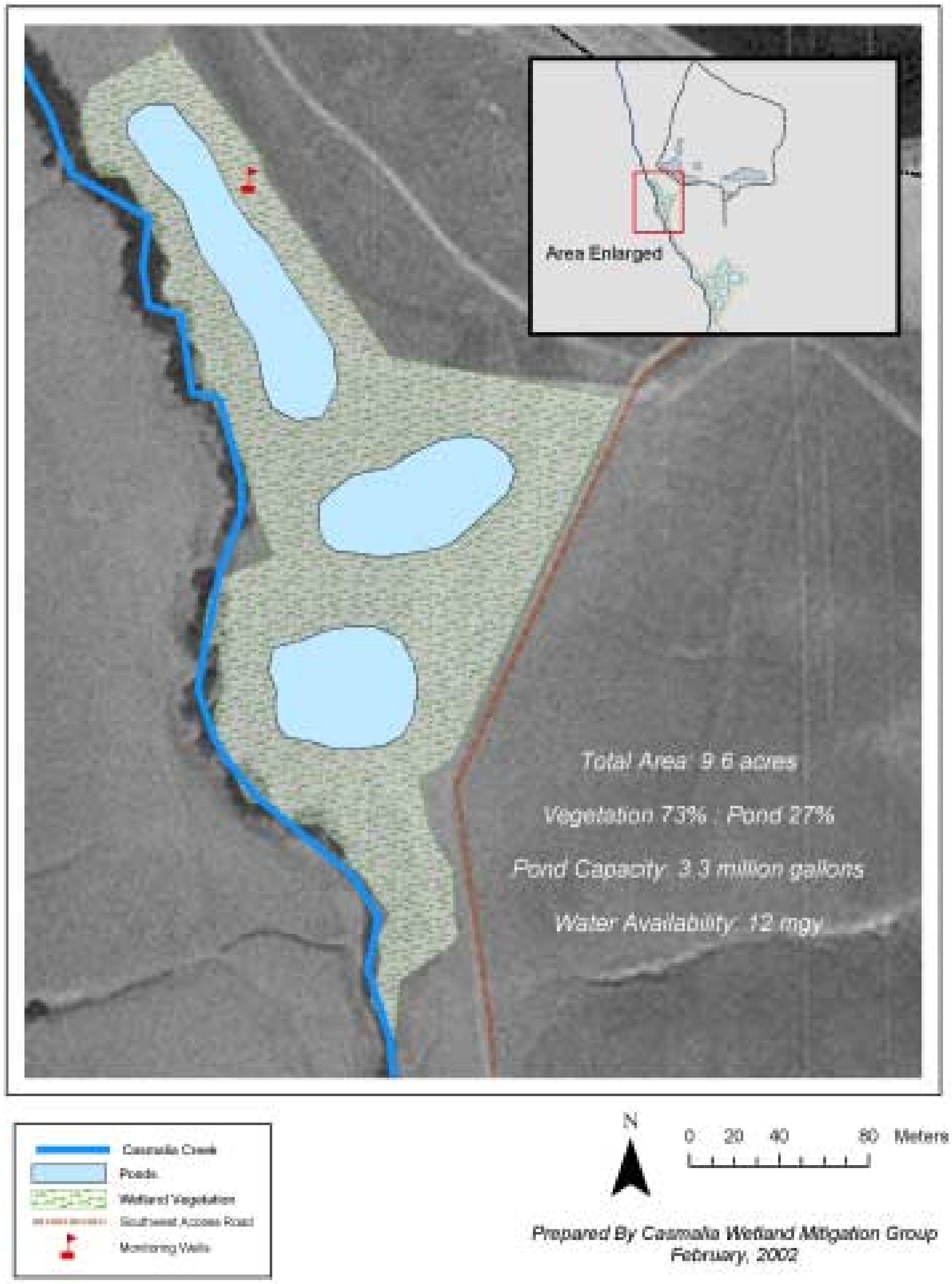


Figure 9.6. C Drainage Alternative

Figure 9.6
C Drainage Alternative



10.0 EVALUATION CRITERIA

This section describes the evaluation criteria for selecting a suitable alternative to mitigate for wetland losses on the Casmalia site. See **Section 3.7, Evaluation Criteria**, for the methods used in selecting these criteria. The threshold and primary balancing criteria are outlined in greater detail below. The criteria have been adapted from the RI/FS criteria under CERCLA and criteria developed from the Peacekeeper Rail Garrison and Small ICBM Mitigation Program case study.

10.1 THRESHOLD CRITERIA

10.1.1 Overall protection of human health and environment (OPHH&E)

Alternatives were assessed to determine whether they would adequately protect human health and the environment, in both the short-term and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of or absence of wetland mitigation. Specifically OPHH&E was assessed by

1. Whether the underlying wetland soil will be remediated and therefore protect human health and the long-term health of the environment.
2. Whether the wetland will be mitigated once drained, dredged and filled, ensuring the short-term protection of the environment.

10.1.2 ARARS Compliance

Alternatives were assessed to determine whether each could meet the substantive provision of the potential ARARs identified in **Section 5.0, Regulatory Framework**. Under the CWA, ACOE regulations require a mitigation ratio to be met during wetland mitigation (MOA, 1993). The CDFG, Cal-EPA and other participating agencies also require wetland mitigation to be carried out in some ratio to insure no overall wetland loss (Executive Order W-59-93). Specifically, assessments of our mitigation alternatives were based on:

1. The degree to which they met a 3:1 mitigation ratio. If a given alternative does not represent part of the necessary mitigation acreage then it failed to meet the threshold criteria and no further analysis was carried out. Due to the uncertainties surrounding the determination of the mitigation ratio and to allow each alternative to progress through this threshold, we considered only the contribution each alternative meets the 3:1 ratio and not whether each alternative completely meets the entire ratio requirement.
2. The determination of whether alternatives wetland sites were ‘onsite’.
3. The determination of whether alternative wetland sites were ‘in-kind’.

The ‘in-kind’ wetland type was determined to be freshwater emergent lacustrine wetlands based on the environmental evaluation of the current wetlands as described in **Section 4.5, Wetlands Type and Extent**.

10.2 PRIMARY BALANCING CRITERIA

10.2.1 Short-term Effectiveness

The short-term effectiveness criterion considered the potential impacts to sensitive ecosystems present at the alternative location during wetland construction. In addition this criterion considered the time frame required to implement the alternative. Mitigation alternatives that required a lengthy time frame before construction and/or implementation could occur would score poorly.

10.2.2 Long-term Effectiveness

The long-term effectiveness criterion considered how well each alternative would ensure the successful establishment of wetlands in the long-term, along with the degree to which the created wetlands resemble those that we intend to create (i.e. same or better habitat value than existing Casmalia site wetlands). Long-term effectiveness of the alternatives was assessed by considering the following geological, hydrological and biological factors as appropriate criteria.

Geological Criteria

Geological parameters were assessed with respect to the erosion potential and the soil type. The long-term success of wetlands requires that erosion potential on the slopes adjoining the wetland be minimal. Erosion and slope stability are a function of the steepness of the slope, the soil type, and the degree of vegetation cover. The level of erosion was not evaluated in terms of an absolute amount, but rather as a relative assessment of each alternative's potential for soil erosion. Those alternatives with steep slopes were scored lower than those with more gentle slopes. In addition, the soil type of the alternative should be similar to the soil type present at the Casmalia site wetlands (i.e. derived from the same bedrock and same grain size).

<u>Hydrological Criteria</u>

Water Availability and Water Origin

The availability of water is a key limiting factor in the successful establishment of wetland conditions. Alternatives were assessed on the degree to which they were able to capture sufficient surface and subsurface runoff. Based on estimates by Pierce (1993), alternatives receiving more than 5 to 10 times the necessary water have an increased success rate. Based on this estimate, each alternative was assessed with respect to the availability of water the created wetlands could receive. The water quantities that were considered correspond to the water runoff amounts from the Casmalia site described in **Table 9.2. Potential Onsite Surface Water Sources**. In addition, water origin was taken into consideration. Water sourced from the same location as the Casmalia site wetlands reflect the hydrological parameters such as yearly fluctuations and rain water quality that contributed to the function of the site wetlands. Since the goal of the mitigation is replicating wetlands similar to the original wetland, the alternatives that rely on the same hydrological parameters as the Casmalia site wetland scored highest.

Water Quality

Water quality should be absent of pollutants, have no extremes of pH, and have low total dissolved solids. Those alternatives that met the NPDES permit requirements were determined to be equivalent to meeting this criterion successfully.

<u>Biological Criteria</u>

Biological criteria were assessed according to the following aspects:

Degree of Degradation

The alternatives supporting greater numbers of exotic species were optimal for wetland location. Replacing invasive vegetation with native plants is preferable to replacing native upland species with native wetland species.

Presence of Unique Communities

The alternatives should not be the sole location for unique species/communities. Disturbance of such communities will require additional mitigation.

Presence of Threatened or Endangered Species

Such species should be absent from the proposed wetland site to avoid further mitigation.

Presence of Existing Wetlands on Site

The creation of wetlands should not disturb or affect naturally occurring wetlands. Disturbance of existing wetland habitat may require additional mitigation.

Proximity to Existing Wetlands

If possible, alternatives should be located (within few meters to tens of meters) from an existing wetland. This may accelerate the development of hydrological and hydric soil conditions and promote the success of the wetland. Alternative lying closer to an existing wetland were ranked higher.

Potential for Developing a Transition Zone

Gently rising topography (i.e., a slope of 1 foot of vertical gain for every 5 feet horizontally, or approximately 10-12 degree slope) around a mitigation site should encourage the development of a transition zone between upland and wetland communities. In addition, such a transition zone should act as a spatial buffer for erosion control. A gently rising topography also favors the use of the wetlands by wildlife, as steep slopes surrounding the wetlands would obstruct their view of potential predators.

Wildlife Habitat Value

Prior to mitigation, the alternatives should have a low wildlife habitat value. The created wetland should then maximize the increased value of habitat by providing abundant water, food and shelter.

10.2.3 Implementability

The technical and administrative feasibility of implementing each alternative, as well as the accessibility of services and materials necessary during its implementation, was determined.

Technical Feasibility

Specifically, technical feasibility relates to the practicability of constructing a particular alternative and the reliability of technologies associated with implementation. Furthermore, the ease of undertaking additional remedial action, as well as monitoring considerations for each alternative, was considered.

Administrative Feasibility

Administrative feasibility considers the activities necessary to coordinate with various offices and agencies for implementing each alternative. For instance, activities such as obtaining permits for offsite activities or construction were considered.

Availability of Services and Materials

Accessibility and availability of disposal services and storage capacity, as well as necessary equipment and specialists for the implementation of each alternative, was considered.

10.2.4 Costs

The four components of wetland creation listed below incorporate costs of labor and materials. Detailed descriptions of costs and associated assumptions are discussed in **Appendix E, Costs**.

Excavation and Disposal of Excavated Soils

Costs for earth moving and disposal activities necessary in preparing each alternative sites were considered.

Wetland Construction

Costs for wetland construction considered connections to surface water (e.g., pipes, valves, and pumps, and dike construction), liner placement and monitoring well protection, erosion control (e.g., jute netting), purchase of emergent wetland and willow/woodland seed mixes, and hand seeding and planting.

Maintenance

Costs for maintenance considered perimeter fencing, drip irrigation installation, and weeding of the willow/woodland vegetation for the first year. These simplified maintenance costs do not reflect the need for weeding and drip irrigation that may be required after the first year.

Monitoring

Monitoring costs considered site visitation and annual report preparation over a ten-year period.

11.0 EVALUATION OF ALTERNATIVES (SCENARIO 1)

11.1 SCENARIO 1 (NO DRAINING AND NO MITIGATION OF WETLANDS)

Under the No Action Scenario, no wetlands would be drained and no mitigation would be implemented. In the absence of remedial activities that would drain, fill, and mitigate the Casmalia site wetlands, an assessment of the feasibility of the alternative locations (B Drainage North, B Drainage South, C Drainage, or offsite mitigation bank) is not applicable.

12.0 EVALUATION OF ALTERNATIVES (SCENARIO 2)

The following discussion outlines evaluation of alternatives under Scenario 2, which involves the drainage and mitigation of four wetlands.

12.1 NO MITIGATION ALTERNATIVE

12.1.1 Overall protection of human health and environment (OPHH&E)

Overall protection of human health and the long-term health of the environment would be met because contaminated sediment is removed. The short-term overall protection of the environment would not be achieved in the absence of wetland mitigation.

12.1.2 ARARS Compliance

If no wetlands were created as a mitigation measure to the draining and dredging of current wetlands, the mandate of "no net loss" under Federal and state regulations would not be met. The No Mitigation Alternative would not meet the substantive provisions of the Clean Water Act and Executive Order W-59-93--regulations that have been identified as potential ARARs. As a result, this alternative is not in compliance with the potential ARARs.

Given that the No Mitigation Alternative does not sufficiently meet the threshold criteria, no further analysis under the primary balancing criteria is required.

12.2 B DRAINAGE NORTH ALTERNATIVE

12.2.1 Overall protection of human health and environment (OPHH&E)

The overall protection of human health and the long-term health of the environment would be met as a result of the remediation of the contaminated sediments underlying the existing Casmalia site wetlands. The short-term health of the environment would also be met as a result of wetland mitigation, replacing valuable habitat lost during draining and sediment removal.

12.2.2 ARARS Compliance

The extent of B Drainage North Alternative represents 2 acres, which is approximately 9.5% of the necessary 21.1 acre area required by the 3:1

mitigation ratio. Furthermore, this alternative is onsite and in-kind, potentially representing higher environmental benefit compared to offsite, out-of-kind mitigation.

The two threshold criteria are satisfied for the B Drainage North Alternative. Further evaluation of this alternative against the primary balancing criteria is as follows:

12.2.3 Short-term Effectiveness

The Southern access road, which follows the western-most portion of Pond 13 and is intercepted by a gate before continuing to the B Drainage North area, would provide adequate access for construction and earthmoving vehicles. The proximity of the B Drainage north to the site would minimize any threat to sensitive ecosystems. In addition, the B Drainage North has no time constraints in terms of wetland construction.

12.2.4 Long-term Effectiveness

Geological Criteria

Because B Drainage North is located in between two steep hillslopes and the soil is relatively unconsolidated and bare from vegetation, erosion represents a serious potential problem. However, the soil type is similar to that of the original wetlands, as it is derived from the same bedrock.

Hydrological Criteria

Water Availability and Water Origin

Water is available from the proposed new storm water pond to be constructed and the capped landfills, for a total of 68 million gallons per year. This quantity far exceeds the required amount for this alternative, i.e. 826,703 gallons of water. Further, this alternative is favorable to our mitigation goal of imitating similar hydrological conditions, as the water source is onsite.

Water Quality

As discussed previously, the water runoff from the capped landfills is clean. Further, the water in the storage pond will have been treated under the NPDES permit, thus that water is considered free of contaminants.

Biological Criteria

Non-native annual grasses dominate the B Drainage North area. There are no unique communities here, nor are there any existing wetlands. Thus, the existing habitat value of this alternative site is rather low, therefore the net gain in habitat value would be high after wetland creation. The nearest wetland is Pond 13, on the Casmalia Resources site, which is approximately 50 meters (164 feet) away. The constraints imposed on this area by two steep hillsides severely reduce its potential for a substantial transition zone, thereby lowering its potential habitat value as a wetland.

12.2.5 Implementability

Technical Feasibility

Excavation of soil, application of a liner, and construction of a concrete dike would not pose any technical difficulties or unknowns with respect to technical feasibility for the B Drainage North Alternative. In addition, hand-seeding and monitoring/maintenance of emergent and woodland vegetation, although labor-intensive, are relatively reliable and commonly accepted methods of wetland creation (Spencer, 2002).

Administrative Feasibility

The wetland creation activities for the B Drainage North Alternative are considered onsite and fall under the cleanup response action for the Casmalia site, therefore no Federal, state, or local permits are required under CERCLA. However, the stipulations of these permits would still need to be met and could require coordination between the lead agency, U.S. EPA, and appropriate permit-issuing offices and agencies, such as FWS, ACOE, and CDFG.

Availability of Services and Materials

No soil disposal would be required under the B Drainage North Alternative. Construction contractors, landscaping firms, nurseries, and necessary construction equipment are readily available in Santa Barbara County.

12.2.6 Costs

Excavation & Disposal of Excavated Material

Given the natural topographic depression of the B Drainage North Alternative, excavation costs are limited to that necessary for the placement of the liner. All soil removed for the placement of the liner will be back-filled and therefore no soil disposal is required. The total cost for excavation and disposal would be approximately $3,071.

Wetland Construction

Water for B Drainage North Alternative would be received from gravity flow from the proposed 17-acre storm water pond as well as the capped landfills area. In addition, the B Drainage North Alternative would involve the construction of a concrete dike between the two hills flanking this site. The total cost for the surface water connection and dike construction would be approximately $9,917. The liner and monitoring well protection for B Drainage North Alternative would be approximately $26,123. Erosion control was determined to be necessary for B Drainage North Alternative because of the steeply-sloping, exposed hillsides along the western portion of the site, therefore costs for jute netting would be approximately $2,473. The cost of purchasing the emergent wetland seed mix and the willow/woodland seedling mix would be approximately $1,198 and $4040, respectively. The cost of hand seeding the vegetation would be approximately $987. The total cost for wetland construction for the B Drainage North Alternative would be approximately $44,738.

Maintenance

The fencing costs for the B Drainage North Alternative would be approximately $11,683. The cost of drip irrigation for this alternative would be approximately $12,177. The weeding costs for this alternative would be approximately $1,624. Therefore, the total maintenance cost for the B Drainage North Alternative would be approximately $25,484.

Monitoring

Monitoring costs for the B Drainage North Alternative over a ten-year period would be approximately $63, 922 (discounted at a 5% rate).

The summary for total costs of creating wetlands at the B Drainage North Alternative are shown in **Table 12.1. B Drainage North Total Costs**.

Table 12.1. B Drainage North Total Costs

Mitigation Alternative	Excavation and Disposal	Wetland Creation	Maintenance	Monitoring	Total Cost
B Drainage North	$3,071	$44,738	$25,484	$63,922	**$137,215**

12.3 B DRAINAGE SOUTH ALTERNATIVE

12.3.1 Overall protection of human health and environment (OPHH&E)

The overall protection of human health and the long-term health of the environment would be met as a result of the remediation of the contaminated sediments underlying the Casmalia wetland. The short-term health of the environment is also met as a result of wetland mitigation to replace valuable habitat lost during draining and sediment removal.

12.3.2 ARARs Compliance

The extent of B Drainage South Alternative represents 30.4 acres, which is 144% of the necessary 21.1 acre area required by the 3:1 mitigation ratio. In addition this alternative is onsite and in-kind, potentially representing higher environmental benefit compared to offsite, out-of-kind mitigation.

The B Drainage South alternative meets both threshold criteria. Further evaluation of this alternative against the primary balancing criteria is as follows:

12.3.3 Short-term Effectiveness

The southwestern access road which exits the site at the A-Series Pond, runs along the eastern boundary of the C Drainage Alternative, and parallels Casmalia Creek would allow construction vehicles to enter and exit the B Drainage South Alternative with relative ease. The construction of the wetland at this site would potentially disturb cattle that currently graze the site, but would not pose any threat to sensitive ecosystems. In addition there are no time constraints in terms of wetland construction for this alternative.

12.3.4 Long-term Effectiveness

Geological Criteria

The wetlands will be created in shallow depressions in a relatively flat area. Therefore, erosion does not represent a problem. In addition, as in the B North Alternative, the soils are of similar mineral origin as those underlying the Casmalia site wetlands.

Hydrological Criteria

Water Availability and Water Origin

Water is available to the B Drainage South from the capped landfills, the proposed new storm water pond, and the RCRA canyon for a total amount of 80 million gallons of water per year. This represents 6.4 times the 12.4 million gallons necessary to fill this wetland alternative. This alternative provides water originating from onsite. As discussed for B Drainage North, this alternative is favorable to our mitigation goal of imitating similar hydrological conditions.

Water Quality

Similarly to the B Drainage Alternative, the storm water originating from the capped landfills and the proposed new storage pond is clean from pollutants.

Biological Criteria

The B Drainage South Alternative is highly degraded due to cattle grazing. As a result of this activity, there is little native plant life, and the area is dominated by non-native annual grasses. In this area, there are no unique communities, nor are there any existing wetlands. Given that the habitat value of the B Drainage South is rather low, the net gain in habitat value after wetland creation would be high. The nearest wetland is the riparian corridor for Casmalia Creek, which is adjacent to the western portion of this alternative site. The gentle slope of this area should facilitate the development of transition zones, serving to further enhance the potential habitat value of the site.

12.3.5 Implementability

Technical Feasibility

Excavation and disposal of soil and application of a liner would not pose any technical difficulties or unknowns with respect to technical feasibility for the B Drainage South Alternative. In addition, hand-seeding and monitoring/maintenance of emergent and woodland vegetation, although labor-intensive, is a relatively reliable and commonly accepted methods of wetland creation (Spencer, 2002).

Administrative Feasibility

The wetland creation activities for the B Drainage South Alternative are considered onsite and fall under the cleanup response action for the Casmalia site, therefore no Federal, state, or local permits are required under CERCLA. However, the stipulations of these permits would still need to be met and could require coordination between the lead agency, U.S. EPA, and appropriate permit-issuing offices and agencies, such as FWS, ACOE, and CDFG.

Availability of Services and Materials

Although soil disposal would be required under the B Drainage South Alternative, soils would be transported onsite to the former PCB landfill where adequate capacity is available (Bertelsen, 2002). Construction contractors, landscaping firms, nurseries, and necessary construction equipment are readily available in Santa Barbara County.

12.3.6 Costs

Excavation and Disposal of Excavated Material

Wetland creation of the B Drainage South Alternative would involve excavation of soils to an average depth of 1.83 meters (6 feet) and excavated soil would be disposed onsite in the PCB landfill area, with the exception of a 0.61-meter (2-foot) layer of backfill to be placed over the lined and excavated pond. Therefore the excavation and soil disposal cost for the B Drainage South Alternative would be approximately $258,512.

Wetland Construction

The B Drainage South Alternative would receive water from the proposed new storm water pond and the capped landfills via gravity flow, as well as active pumping from the RCRA Canyon area; no dike would be constructed for this alternative. The total cost for the surface water connection would be approximately $43,949. The liner and monitoring well protection for B Drainage South Alternative would be approximately $376,705. No erosion control would be required for the B Drainage South Alternative, therefore no cost for jute netting is considered. The cost of purchasing the emergent wetland seed mix and the willow/woodland seedling mix would be approximately $18,646 and $62,860, respectively. The cost of hand seeding the vegetation would be approximately $15,361. The total cost for wetland construction for the B Drainage North Alternative would total: $517,520.

Maintenance

The fencing costs for the B Drainage South Alternative would be approximately $35,102. The cost of drip irrigation for this alternative would be approximately $189,488. The weeding costs for this alternative would be approximately $25,265. Therefore, the total maintenance cost for the B Drainage South Alternative would be approximately $249,855 (for the first year only).

Monitoring

Monitoring costs for the B Drainage South Alternative over a ten year period would be approximately $63,922.

The summary for total costs of creating wetlands at the B Drainage South Alternative are shown in **Table 12.2. B Drainage South Total Costs**.

12.4 C DRAINAGE ALTERNATIVE

12.4.1 Overall protection of human health and environment (OPHH&E)

The overall protection of human health and the long-term health of the environment would be met as a result of the remediation of the contaminated sediments underlying the Casmalia wetland. The short-term health of the environment would also be met as a result of wetland mitigation to replace valuable habitat lost during draining and sediment removal.

12.4.2 ARARs Compliance

The extent of C Drainage Alternative represents 9.6 acres, which is 45% of the necessary 21.1 acre area required by the 3:1 mitigation ratio. This alternative is onsite and in-kind, potentially representing higher environmental benefit compared to offsite, out-of-kind mitigation.

The C Drainage Alternative meets both threshold criteria. Further evaluation of this alternative against the primary balancing criteria is as follows:

Table 12.2. B Drainage South Total Costs

Mitigation Alternative	Excavation and Disposal	Wetland Creation	Maintena-nce	Monit or-ing	Total Cost
B Drainage South	$258,512	$517,520	$249,855	$63,92 2	**$1,089,809**

12.4.3 Short-term Effectiveness

The southwestern access road which exits the site at the A-Series Pond, runs along the eastern boundary of the C Drainage Alternative, and parallels Casmalia Creek would allow construction vehicles to enter and exit the C Drainage Alternative with relative ease. This alternative is in close proximity to the Casmalia Creek channel, and may necessitate that additional measures be taken to prevent damage to the riparian corridor of the creek and the species that inhabit the ecosystem (Hunt & Associates, 2000). Furthermore, the construction of the wetland at this site would potentially disturb cattle that currently graze the area. No time frame constraints exist for this alternative.

12.4.4 Long-term Effectiveness

<u>Geological Criteria</u>

Similarly to the B Drainage South Alternative, the area is relatively flat. Thus, the threat of erosion is minimal. In addition, because the soils are derived from the bedrock present in the site area, the soil conditions are favorable to meeting our mitigation goal of creating similar environmental conditions as the original wetlands.

<u>Hydrological Criteria</u>

Water Availability and Water Origin

The water source consists of 12 million gallons per year draining from the RCRA canyon. This water availability represents about 4 times what this alternative would require (3.3 million gallons of water). This alternative provides water originating from the Casmalia site. As discussed for B Drainage North and B Drainage South, this alternative is favorable to our mitigation goal of imitating similar hydrological conditions.

Water Quality

Similarly to the storm water from other onsite sources, water flowing from the RCRA canyon is expected to meet water quality standards.

Biological Criteria

The proposed wetland creation area at the C Drainage Alternative site is biologically similar to that of the B Drainage South Alternative site, with nearly identical, non-native dominated vegetation cover in a highly degraded system. The adjacent riparian corridor at Casmalia Creek contains many native species, but will not be affected by this project. There are existing wetlands in the riparian corridor and nearby at the A-Series Pond (approximately 473 meters or 1,552 feet away). The habitat value in this area is significantly higher than that at B Drainage South, due to the increased plant diversity from the close proximity of riparian woodland species. However, the flatter slope of the land means the area will have to be properly graded to allow for the development of wetland transition zones.

12.4.5 Implementability

Technical Feasibility

Excavation and disposal of soil and application of a liner would not pose any technical difficulties or unknowns with respect to technical feasibility for the C Drainage Alternative. In addition, hand-seeding and monitoring/maintenance of emergent and woodland vegetation, although labor-intensive, is a relatively reliable and commonly accepted method of wetland creation (Spencer, 2002).

Administrative Feasibility

The wetland creation activities for the C Drainage Alternative are considered onsite and fall under the cleanup response action for the Casmalia site, therefore no Federal, state, or local permits are required under CERCLA. However, the stipulations of these permits would still need to be met, and could require coordination between the lead agency, U.S. EPA, and appropriate permit-issuing offices and agencies, such as FWS, ACOE, and CDFG.

Availability of Services and Materials

Although soil disposal would be required under the C Drainage Alternative, soils would be transported onsite to the area of the former PCB landfill where adequate capacity is available (Bertelsen, 2002). Construction contractors, landscaping firms, nurseries, and necessary construction equipment are readily available in Santa Barbara County.

12.4.6 Costs

Excavation and Disposal of Excavated Material

Wetland creation of the C Drainage Alternative would involve excavation of soils to an average depth of 1.83 meters (6 feet) and excavated soil would be disposed onsite in the former PCB landfill area, with the exception of a 0.61-meter (2-foot) layer of backfill to be placed over the lined and excavated pond. Therefore the excavation and soil disposal cost for the C Drainage Alternative would be approximately $69,831.

Wetland Construction

The C Drainage Alternative site would receive water via gravity flow from the RCRA Canyon area; no dike would be constructed. The total cost for the surface water connection would be approximately $19,179. The liner and monitoring well protection for the C Drainage Alternative would be approximately $101,758. Erosion control would be necessary for the C Drainage Alternative because of the proximity to the incised creek channel, therefore jute netting costs would be approximately $5,472. The cost of purchasing the emergent wetland seed mix and the willow/woodland seedling mix would be approximately $6,280 and $21,172, respectively. The cost of hand seeding the vegetation would be approximately $5,173. The total cost for wetland construction for the C Drainage Alternative would total: $159,034.

Maintenance

The fencing costs for the C Drainage Alternative would be approximately $25,511. The cost of drip irrigation for this alternative would be approximately $63,821. The weeding costs for this alternative would be approximately $8,509. Therefore, the total maintenance cost for the C Drainage Alternative would be approximately $97,841.

Monitoring

Monitoring costs for the C Drainage Alternative over a ten year period would be approximately $63, 922.

The summary for total costs of creating wetlands at the C Drainage Alternative are shown in **Table 12.3. C Drainage Total Costs**.

12.5 MITIGATION BANK ALTERNATIVE

12.5.1 Overall protection of human health and environment (OPHH&E)

The overall protection of human health and the long-term health of the environment would be met as a result of the remediation of the contaminated sediments underlying the Casmalia wetland. The short-term health of the environment is also indirectly met as a result of wetland mitigation to replace valuable habitat lost during draining and sediment removal. Since this alternative will not directly serve the species living in the Casmalia wetland, its overall short-term protection of the environment is reduced.

12.5.2 ARARs Compliance

The extent of the Mitigation Banking Alternative represents as much of the necessary 21.1 acre area required by the 3:1 mitigation ratio, limited only by the number of credits available to purchase. This alternative is offsite and possibly out-of-kind, potentially representing lower environmental benefit compared to onsite, in-kind mitigation.

The Mitigation Bank Alternative meets both threshold criteria. Further evaluation of this alternative against the primary balancing criteria is as follows:

12.5.3 Short-term Effectiveness

The Mitigation Bank Alternative would not pose and threat to the ecosystems surrounding Casmalia. However, the time frame before any suitable bank in Santa Barbara County is function seriously constrains this alternative.

Table 12.3. C Drainage Total Costs

Mitigation Alternative	Excavation and Disposal	Wetland Creation	Maintenance	Monitoring	Total Cost
C Drainage	$69,831	$159,034	$97,841	$63,922	**$390,628**

12.5.4 Long-term Effectiveness

Geological Criteria

Because we expect mitigation bank sites to provide environmental conditions that favor the establishment of wetlands, soil erosion is not expected to be an issue for the Mitigation Bank Alternative. Yet, the soil type likely differs from that of the Casmalia site wetlands.

Hydrological Criteria

Water Availability and Water Origin

A mitigation bank site is likely to provide ideal hydrological conditions, including sufficient quantities of water. However, the hydrological characteristics may be quite different from those at the Casmalia site.

Water Quality

Likewise, the water at mitigation bank sites is expected to be of good quality.

Biological Criteria

Mitigation banks tend to be more biologically effective when located close to the site of the destroyed wetlands, thereby ensuring connectivity with the existing wetland habitat. Because the Santa Ynez Mitigation Bank is located significantly offsite, it does not effectively meet the criteria for establishing a similar biological community.

12.5.5 Implementability

Technical Feasibility

Mitigation banks are emerging as a solution to compensate for unavoidable wetland losses in California, particularly in Los Angeles and San Diego Counties. While mitigation banks are thought to be cost-effective, the reliability and success rate of banks are still in question (NRC, 2002).

Administrative Feasibility

The use of a mitigation bank is thought to reduce permitting time because operational banks are generally pre-approved prior to the issuance of credits (NRC, 2002). Given this reason, the need for coordination among regulatory agencies would be minimized under the Mitigation Bank Alternative.

Availability of Services and Materials

No mitigation banks to mitigate wetland losses are currently operational in Santa Barbara County. However, it is assumed that the Santa Ynez River Mitigation Bank will be operational by the completion of the ROD (i.e., approximately 10 years).

12.5.6 Costs

The Offsite Mitigation Bank Alternative would not involve the wetland creation costs mentioned above for the onsite alternatives. Rather, costs are limited to the purchase of a credit. The average cost for a credit in California is approximately $1,500 to $3,000 per credit, depending on the amount of credits purchased (Stowers, 2002). Given that approximately 21.1 acres would need to be compensated under this Scenario, the total cost for mitigation banking would be approximately $$31,650-$63,300, as shown in **Table 12.4. Mitigation Bank Total Costs.**

Table 12.4. Mitigation Bank Total Costs

Mitigation Alternative	Excavation and Disposal	Wetland Creation	Maintenance	Total Cost
Mitigation Bank	$0	$31,650-$63,300	$0	**$31,650-$63,300**

13.0 EVALUATION OF ALTERNATIVES (SCENARIO 3)

The following discussion outlines evaluation of alternatives under Scenario 3, which involves the drainage and mitigation of the five wetlands.

13.1 NO MITIGATION ALTERNATIVE

13.1.1 Overall protection of human health and environment (OPHH&E)

See discussion under Scenario 2.

13.1.2 ARARs Compliance

See discussion under Scenario 2.

13.2 B DRAINAGE NORTH ALTERNATIVE

13.2.1 Overall protection of human health and environment (OPHH&E)

See discussion under Scenario 2.

13.2.2 ARARs Compliance

The extent of B Drainage North Alternative represents 2 acres, which is 3.7% of the necessary 54.4 acre area required by the 3:1 mitigation ratio. In addition, this alternative is onsite and in-kind, potentially representing higher environmental benefit compared to offsite, out-of-kind mitigation.

13.2.3 Short-term Effectiveness

See discussion under Scenario 2.

13.2.4 Long-term Effectiveness

See discussion under Scenario 2.

13.2.5 Implementability

Technical Feasibility

See discussion under Scenario 2.

Administrative Feasibility

See discussion under Scenario 2.

Availability of Services and Materials

See discussion under Scenario 2.

13.2.6 Costs

Excavation and Disposal of Excavated Material

See discussion under Scenario 2.

Wetland Construction

See discussion under Scenario 2.

Maintenance

See discussion under Scenario 2.

Monitoring

See discussion under Scenario 2.

13.3 B DRAINAGE SOUTH ALTERNATIVE

13.3.1 Overall protection of human health and environment (OPHH&E)

See discussion under Scenario 2.

13.3.2 ARARS Compliance

The extent of B Drainage South Alternative represents 30.4 acres, which is 55.9% of the necessary 54.4 acre area required by the 3:1 mitigation ratio. This alternative is onsite and in-kind, potentially representing higher environmental benefit compared to offsite, out-of-kind mitigation.

13.3.3 Short-term Effectiveness

See discussion under Scenario 2.

13.3.4 Long-term Effectiveness

See discussion under Scenario 2.

13.3.5 Implementability

Technical Feasibility

See discussion under Scenario 2.

Administrative Feasibility

See discussion under Scenario 2.

Availability of Services and Materials

See discussion under Scenario 2.

13.3.6 Costs

Excavation and Disposal of Excavated Material

See discussion under Scenario 2.

Wetland Construction

See discussion under Scenario 2.

Maintenance

See discussion under Scenario 2.

Monitoring

See discussion under Scenario 2.

13.4 C DRAINAGE ALTERNATIVE

13.4.1 Overall protection of human health and environment (OPHH&E)

See discussion under Scenario 2.

13.4.2 ARARs Compliance

The extent of C Drainage Alternative represents 9.6 acres, which is 13.4% of the necessary 54.4 acre area required by the 3:1 mitigation ratio. In addition, this alternative is onsite and in-kind, potentially representing higher environmental benefit compared to offsite, out-of-kind mitigation.

13.4.3 Short-term Effectiveness

See discussion under Scenario 2

13.4.4 Long-term Effectiveness

See discussion under Scenario 2

13.4.5 Implementability

Technical Feasibility

See discussion under Scenario 2.

Administrative Feasibility

See discussion under Scenario 2.

Availability of Services and Materials

See discussion under Scenario 2.

13.4.6 Costs

Excavation and Disposal of Excavated Material

See discussion under Scenario 2.

Wetland Construction

See discussion under Scenario 2.

Maintenance

See discussion under Scenario 2.

Monitoring
See discussion under Scenario 2.

13.5 MITIGATION BANK ALTERNATIVE

13.5.1 Overall protection of human health and environment (OPHH&E)

See discussion under Scenario 2.

13.5.2 ARARs Compliance

The extent of the Mitigation Banking Alternative represents as much of the necessary 54.4 acre area required by the 3:1 mitigation ratio, limited only by the number of credits available to purchase. This alternative is offsite and possibly out-of-kind, potentially representing lower environmental benefit compared to onsite, in-kind mitigation.

The Mitigation Bank Alternative meets both threshold criteria. Further evaluation of this alternative against the primary balancing criteria is as follows:

13.5.3 Short-term Effectiveness

See discussion under Scenario 2.

13.5.4 Long-term Effectiveness

See discussion under Scenario 2

13.5.5 Implementability

Technical Feasibility

See discussion under Scenario 2.

Administrative Feasibility

See discussion under Scenario 2.

Availability of Services and Materials

See discussion under Scenario 2.

13.5.6 Costs

As under Scenario 2, the Offsite Mitigation Bank Alternative would not involve the wetland creation costs mentioned above for the onsite alternatives. Rather, costs are limited to the purchase of a credit. The average cost for a credit in California is approximately $1,500 to $3,000 per credit, depending on the amount of credits purchased (Stowers, 2002). Given that 54.4 acres would need to be compensated for under this Scenario, the total cost for mitigation banking would be approximately $81,600-$163,200 (See **Table 13.1. Mitigation Bank Total Costs**).

Table 13.1. Mitigation Bank Total Costs

Mitigation Alternative	Excavation and Disposal	Wetland Creation	Maintenance	Total Cost
Mitigation Bank	$0	$81,600-163,000	$0	**$81,600-163,000**

14.0 COMPARATIVE ANALYSIS

The comparative analysis was achieved through a two-step process as described in **Section 3.8, Alternatives Analysis**. The first step involved qualitative comparison and a simple ranking of each alternative on a 0-4 scale. The second step involved the Analytic Hierarchy Process (AHP) using the primary criteria and the alternatives that met the threshold criteria. Since the only difference between Scenario 2 and Scenario 3 is the contribution of each alternative to the mitigation ratio acreage, and because this does not prevent these alternatives from being assessed with the primary criteria we have not distinguished between the two scenarios in the comparative analysis.

Table 14.19. Qualitative Evaluation Matrix for Scenario 2 (Mitigate Four Wetlands) and **Table 14.20. Qualitative Evaluation Matrix for Scenario 3 (Mitigate Five Wetlands)**, show a summary of this comparative analysis.

14.1 STEP 1: SIMPLE RANKING

14.1.1 Overall Protection of Human Health and Environment (OPHH&E)

The OPHH&E would be equally achieved in the long-term and short-term for the B Drainage North Alternative and the B Drainage South Alternative, as well as the C Drainage Alternative. Therefore, these alternatives are each assigned an individual score of 4. The Mitigation Bank Alternative is less able to ensure the OPHH&E because it does not provide adequately for the short-term protection of the environment in terms of providing nearby habitat for the existing wetland fauna; therefore receiving a score of 2. The No Mitigation Alternative does not meet the short-term protection of the environment, receiving a score of 0, and therefore, does not pass this threshold criterion. **Table 14.1. Overall OPHH&E Score**, summarizes the average scores for each alternative.

14.1.2 *ARARS Compliance*

ARARs compliance would be met for all the alternatives except for the No Mitigation Alternative, which is therefore assigned a score of zero. The B Drainage North Alternative and the B Drainage South Alternative, as well as the C Drainage Alternative contribute to the necessary mitigation acreage and in addition are in-kind and onsite. The scoring potential of B Drainage North and South Alternatives and the C Drainage Alternative are based on the

Table 14.1. Overall OPHH&E Score

MITIGATION ALTERNATIVE	SCORE
No Mitigation Alternative	0
B Drainage North	4
B Drainage South	4
C Drainage	4
Mitigation Bank	2

amount of acreage each contributes to the mitigation requirements. In Scenario 2 the mitigation requirement assuming a 3:1 mitigation ratio is 21.2 acres. In Scenario 3 the mitigation requirement assuming a 3:1 mitigation ratio is 54.4 acres.

For Scenario 2, the B Drainage North Alternative represents 9.5% of the required mitigation amount; the B Drainage South Alternative represents 144% of the requires mitigation and the C Drainage Alternative represents 45% of the required mitigation. Under this scenario, these percentages translate to a score of 1 for the B Drainage North Alternative, 4 for the B Drainage South Alternative and 3 for the C Drainage Alternative. **Table 14.2. Mitigation Requirements Under Scenario 2,** summarizes the percentage of mitigation requirement met by each alternative.

For Scenario 3, the B Drainage North Alternative represents 3.7% of the required mitigation amount; the B Drainage South Alternative represents 55.9% of the required mitigation and the C Drainage Alternative represents 13.4% of the required mitigation. Under this scenario, these percentages are inferred to translate to a score of 1 for the B Drainage North Alternative; 3 for the B Drainage South Alternative and 2 for the C Drainage Alternative. **Table 14.3. Mitigation Requirements Under Scenario 3,** summarizes the percentage of mitigation requirement met by each alternative.

The Mitigation Banking Alternative also meets the substantive provision of the potential ARARs, its contribution is only limited by the available credits in the mitigation bank. Since the number of credits in the Santa Ynez River Mitigation Bank will not limit us, the Mitigation Banking Alternative meets 100% of the required mitigation for both scenario 2 and scenario 3. However, since this alternative is offsite and will not be operational for until the final ROD is implemented this alternative is awarded a lower then perfect score,

Table 14.2. Mitigation Requirements Under Scenario 2
(Total Acres to be Mitigated: 21.1 Acres)

Alternatives	Total Area (acres)	Percentage of Mitigation Requirement Met
B Drainage North	2.0	9.5 %
B Drainage South	30.4	144 %
C Drainage	9.6	45 %
Mitigation Bank	21.1	100%

Table 14.3. Mitigation Requirements Under Scenario 3
(Total Acres to be Mitigated: 54.4 Acres)

Alternatives	Total Area (acres)	Percentage of Mitigation Requirement Met
B Drainage North	2.0	3.7 %
B Drainage South	30.4	55.9 %
C Drainage	9.6	13.4 %
Mitigation Bank	54.4	100%

and so is awarded a score of 3. **Table 14.4 and Table 14.5. Overall ARARs Score for Scenario 2 and Scenario 3** respectively summarize the average scores for each alternative.

14.1.3 *Short-Term Effectiveness*

The B Drainage North, B Drainage South and C Drainage Alternatives have no time frame constraints in terms of developing these alternatives into wetlands. The evaluation of these alternatives is therefore only dependent on the impact the construction of a wetland will have on the nearby ecosystem. B Drainage North Alternative is close to the Casmalia site and requires little excavation and so scores highly. B Drainage South is further from the site, increasing the disturbance of the ecosystem during construction and so scores 2. Construction of the C Drainage Alternative could potentially cause serious erosion of the steeply incised Casmalia Creek, despite the fact that this alternative is close to the Casmalia site, C Drainage score 2. Since the Mitigation Banking Alternative is seriously constrained by the 10-year time frame required before the Santa Ynez Mitigation Bank will be operational, this alternative scores a low 1. **Table 14.6. Overall Short-Term Effectiveness Score**, summarizes the average scores for each alternative.

Table 14.4. Overall ARARs Compliance Score Scenario 2

MITIGATION ALTERNATIVE	SCORE
No Mitigation Alternative	0
B Drainage North	1
B Drainage South	4
C Drainage	3
Mitigation Bank	3

Table 14.5. Overall ARARs Compliance Score Scenario 3

MITIGATION ALTERNATIVE	SCORE
No Mitigation Alternative	0
B Drainage North	1
B Drainage South	3
C Drainage	2
Mitigation Bank	3

Table 14.6. Overall Short-Term Effectiveness Score

MITIGATION ALTERNATIVE	SCORE
B Drainage North	3
B Drainage South	2
C Drainage	2
Mitigation Bank	1

14.1.4 *Long-Term Effectiveness*

Geological

The No Mitigation Alternative score is not applicable. The B Drainage North, B Drainage South, and C Drainage alternatives all have soil with a mineral composition similar to that on the Casmalia site. On this aspect, these three alternatives score better than the mitigation bank alternative, which likely has a different soil origin. Because B Drainage North has a high risk of soil erosion compared to the two other drainages, it receives a score of 2. The B Drainage South and C Drainage alternatives would be wetlands lying in shallow depressions within a relatively flat area. Therefore, erosion of the unconsolidated soil is minimized. These two alternatives are thus assigned a score of 4. We assume that soils at the Mitigation Banking site will be stable. However, this alternative receives a score of only 2 because of the difference in soil origin. **Table 14.7. Overall Geological Score**, summarizes the average scores for each alternative.

Hydrological

Water Availability and Water Origin

The No Mitigation Alternative score is not applicable. The B Drainage North, B Drainage South and C Drainage Alternatives will receive water from the same source in the same hydrological context than the Casmalia site wetlands; hence we favor these alternatives over Mitigation Banking. Water available to B Drainage North represents 85 times the requirement, so it receives the score of 4. B Drainage South would potentially receive more than 5 times but less than 10 times the amount of water necessary, thus it receives a moderate score of 3. Because water available to C Drainage is less than 5 times what it requires, it receives a score of 2. The score for Mitigation Banking would be 2, as water may be readily available, but hydrological parameters would be very different from those for the Casmalia site wetlands. **Table 14.8. Overall Water Availability and Source Score**, summarizes the average scores for each alternative.

Water Quality

The No Mitigation Alternative score is not applicable. All storm water runoff leaving the remediated site must meet NPDES requirements. Therefore, the score for water quality is 4 for all three alternatives. The score for Mitigation Banking would also be 4, as we assume the water is of good quality. **Table 14.9. Overall Water Quality Score**, summarizes the average scores for each alternative.

Table 14.7. Overall Geological Score

MITIGATION ALTERNATIVE	SCORE
B Drainage North	2
B Drainage South	4
C Drainage	4
Mitigation Bank	2

Table 14.8. Overall Water Availability and Source Score

MITIGATION ALTERNATIVE	SCORE
B Drainage North	4
B Drainage South	3
C Drainage	2
Mitigation Bank	2

Table 14.9. Overall Water Quality Score

MITIGATION ALTERNATIVE	SCORE
B Drainage North	4
B Drainage South	4
C Drainage	4
Mitigation Bank	4

Biological Community

The No Mitigation Alternative does not meet the threshold criteria; therefore no discussion of its impact on the biological community is necessary. The B Drainage South Alternative is biologically most appropriate for wetland construction. It has a low biodiversity and native species count, and is already graded to make transition zones easier to create. Therefore, it receives a score of 4. The C Drainage Alternative could also easily have transition zones, but it contains or is adjacent to a significantly higher number of native species than B Drainage South, so it is not quite as appropriate. Therefore, it receives a score of 3. The B Drainage North Alternative, like B Drainage South, has very low biodiversity and native species count, but the narrowness and steep sides of the area would make it extremely difficult to form good transition zones. Therefore, the overall habitat quality of the created wetland would be lower than that for C Drainage or B Drainage South, so the B Drainage North Alternative receives a score of 2. Biologically, the Mitigation Bank Alternative is rather inappropriate. Mitigation banks are far more effective when located close to the site of the destroyed wetlands. This alternative would be significantly offsite, so it receives a low score of 1 for the Biological Community.

Table 14.10. Overall Biological Community Score, summarizes the average scores for each alternative.

14.1.5 *Implementability*

Technical Feasibility

The No Mitigation Alternative does not meet the threshold criteria, therefore no discussion of technical feasibility is necessary. All of the onsite alternatives would be technically feasible, therefore, the B Drainage North Alternative, B Drainage South Alternative, and C Drainage Alternative receive a score of 4. The technical feasibility of the Mitigation Bank Alternative is less absolute due to relatively low success rate and therefore receives a lower score of 2. **Table 14.11. Overall Technical Feasibility Score**, summarizes the scores for each alternative.

Administrative Feasibility

The No Mitigation Alternative does not meet the threshold criteria, therefore no discussion of administrative feasibility is necessary. For the onsite alternatives, administrative feasibility would be relatively high due to the fact that these alternatives are located onsite under the jurisdiction of CERCLA, which would not require acquiring permits *per se*, but would require coordination with various agencies potentially delaying implementability of the mitigation process. Therefore, the B Drainage North Alternative, B Drainage South Alternative, and C Drainage Alternative receive a score of 3. The need for coordination with agencies is minimal for the Mitigation Bank Alternative, therefore administrative feasibility under this alternative would

Table 14.10. Overall Biological Community Score

MITIGATION ALTERNATIVE	SCORE
B Drainage North	2
B Drainage South	4
C Drainage	3
Mitigation Bank	1

Table 14.11. Overall Technical Feasibility Score

MITIGATION ALTERNATIVE	SCORE
B Drainage North	4
B Drainage South	4
C Drainage	4
Mitigation Bank	2

receive the highest score of 4. **Table 14.12. Overall Administrative Feasibility Score**, summarizes the scores for each alternative.

<u>Availability of Services and Materials</u>

The No Mitigation Alternative does meet the threshold criteria, therefore no discussion of availability of services and materials is necessary. For the onsite alternatives, the availability of services and materials would be relatively high given that all necessary contractors, landscaping firms, nurseries, and construction equipment are readily available in Santa Barbara County. Therefore, with respect to availability of services and materials, the B Drainage North Alternative, B Drainage South Alternative, and C Drainage Alternative would receive a high score of 4. The Mitigation Bank Alternative would receive a moderate score of 2 given that no banks are currently operational in Santa Barbara County and are not assumed to be operational until the completion of the ROD (i.e., approximately 10 years).

Table 14.13. Overall Availability of Services and Materials Score, summarizes the scores for each alternative.

Table 14.12. Overall Administrative Feasibility Score

MITIGATION ALTERNATIVE	SCORE
B Drainage North	3
B Drainage South	3
C Drainage	3
Mitigation Bank	4

Table 14.13. Overall Availability of Services and Materials Score

MITIGATION ALTERNATIVE	SCORE
B Drainage North	4
B Drainage South	4
C Drainage	4
Mitigation Bank	2

14.1.6 Costs

Excavation and Disposal of Excavated Material

The No Mitigation Alternative does not meet the threshold criteria; therefore no discussion of excavation and disposal of excavated material costs is necessary. The Mitigation Bank Alternative will not require excavation and therefore receives the highest score of 4. Given that the B Drainage North Alternative does not require excavation to the depth of the other onsite alternatives, the unit cost is much lower and therefore receives a high score of 3. The B Drainage South Alternative and C Drainage Alternative have the highest unit cost for excavation and therefore receive a relatively low score of 2. **Table 14.14. Excavation and Soil Disposal Costs Summary Table**, summarizes the costs, unit costs, and individual scores for each alternative.

Table 14.14. Excavation and Soil Disposal Costs Summary Table

MITIGATION ALTERNATIVE	COST ($)	UNIT COST ($/acre)	SCORE
B Drainage North	$3,071	$1,551	3
B Drainage South	$258,512	$8,504	2
C Drainage	$69,831	$7,274	2
Mitigation Bank	$0	$0	4

Wetland Construction

The No Mitigation Alternative does not meet the threshold criteria, therefore no discussion of wetland construction costs necessary. The unit cost for a credit in the Mitigation Bank Alternative is far less than the unit costs of the onsite alternatives (Stowers, 2002), therefore receives a high score of 4. The unit costs of the B Drainage South Alternative and C Drainage Alternative are comparable and more expensive than the Mitigation Bank Alternative unit cost, receiving a slightly lower score of 3. The B Drainage North Alternative has the highest unit cost for wetland construction and therefore receives a low score of 2. **Table 14.15. Wetland Construction Costs Summary Table**, summarizes the costs, unit costs, and individual scores for each alternative.

Maintenance

The No Mitigation Alternative does not meet the threshold criteria, therefore no discussion of maintenance costs is necessary. The Mitigation Bank Alternative would not require maintenance and therefore receives a high score of 4. Although the B Drainage South Alternative has the largest area of the onsite alternatives and has the highest total maintenance cost, this alternative has the lowest unit cost due to economies of scale and therefore receives a score of 3. The B Drainage North Alternative and C Drainage Alternative have lower total maintenance costs relative to the B Drainage South Alternative, but have slightly higher unit costs and therefore both alternatives receive a score of 2. **Table 14.16. Maintenance Costs Summary Table**, summarizes the costs, unit costs, and individual scores for each alternative.

Table 14.15. Wetland Construction Costs Summary Table

MITIGATION ALTERNATIVE	COST ($)	UNIT COST ($/acre)	SCORE
B Drainage North	$44,738	$22,595	2
B Drainage South	$517,520	$17,024	3
C Drainage	$159,034	$16,566	3
Mitigation Bank	$31,650-$63,300 (Scenario 2) $81,600-$163,200 (Scenario 3)	$1,500-$3,000	4

Table 14.16. Maintenance Costs Summary Table

MITIGATION ALTERNATIVE	COST ($)	UNIT COST ($/acre)	SCORE
B Drainage North	$25,484	$12,871	2
B Drainage South	$249,855	$8,219	3
C Drainage	$97,841	$10,192	2
Mitigation Bank	$0	$0	4

14.1.7 Monitoring

The No Mitigation Alternative does not meet the threshold criteria; therefore no discussion of monitoring costs is necessary. The Mitigation Bank Alternative would not require maintenance (the bank sponsor, not the credit purchaser, is responsible for maintenance of the mitigation bank in perpetuity) and therefore receives the highest score of 4. Although the maintenance costs are the same for each alternative, the B Drainage South Alternative has the second lowest unit cost due to economies of scale and therefore receives a score of relatively high score of 3. The C Drainage Alternative and B Drainage North Alternative have the second and third highest costs, respectively, and therefore these alternatives receive lower scores of 2 and 1, respectively. **Table 14.17. Monitoring Costs Summary Table**, summarizes the costs, unit costs, and individual scores for each alternative. The total

Table 14.17. Monitoring Costs Summary Table

MITIGATION ALTERNATIVE	COST ($)	UNIT COST ($/acre)	SCORE
B Drainage North	$63,922	$32,284	1
B Drainage South	$63,922	$2,103	3
C Drainage	$63,922	$6,659	2
Mitigation Bank	$0	$0	4

costs for each alternative are summarized in **Table 14.18. Total Costs Summary Table**.

Table 14.18. Total Costs Summary Table

MITIGATION ALTERNATIVE	Cost ($)	Unit Cost ($/acre)
B Drainage North	$137,215	$69,300
B Drainage South	$1,089,809	$35,849
C Drainage	$390,628	$40,690
Mitigation Bank	$31,650-$63,300 (Scenario 2) $81,600-$163,200 (Scenario 3)	$1,500- $3,000

14.2 STEP 2: ANALYTIC HIERARCHY PROCESS (AHP)

The AHP, through the Criterium DecisionPlus 3.0 software, identified the alternative that best met the criteria critical for successful wetland mitigation. Individual assessments varied, revealing either B Drainage North or B Drainage South as the most successful alternative. All individual assessments identified C Drainage and Mitigation Banking as the third and forth recommended alternatives respectively (**Appendix H)**. The differences in individual results reflect the relative importance given to each criterion by the group member. In particular, results reflected the relative importance of short-term effectiveness, implementability, and water availability. The importance of the criteria was discussed and a consensus on the relative weighting of each criteria was achieved Out of the four major criteria, we weighted long-term effectiveness highest, followed by implementability, short-term effectiveness, and costs. Of the implementability subcriteria, we ranked technical feasibility highest, followed by availability of services and materials and administrative feasibility. Of the long-term effectiveness subcriteria, we decided that biological and hydrological elements were equally important, with the geological elements ranking lower. Out of the hydrological sub-sub-criteria, we placed greater importance on the availability of water than the quality of water.   A final group assessment based on the consensus weighting of criteria revealed the ultimate preferred sequence of alternatives. This result is discussed below.

The B Drainage South Alternative ranked the highest out of the alternatives with a score of 0.359. The B Drainage North Alternative was the second most appropriate alternative with a score of 0.331. The C Drainage Alternative was a much less feasible alternative, scoring only 0.211. Finally, the Mitigation Bank Alternative was our least suitable alternative, with a score of 0.098. **Figure 14.1, AHP Ranking,** illustrates the overall scores assigned to each alternative from our evaluation.

Figure 14.1. AHP Ranking

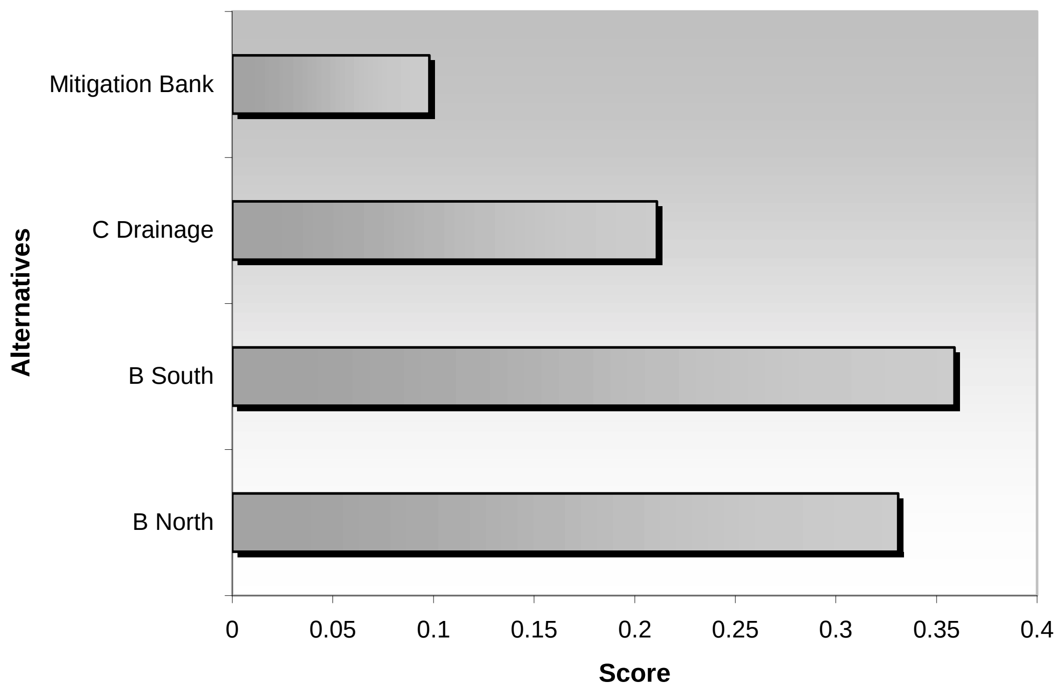


Table 14.19. Qualitative Evaluation Matrix for Scenario 2 (Mitigate Four Wetlands)

EVALUATION CRITERIA	ALTERNATIVES				
	NO MITIGATION	B DRAINAGE NORTH	B DRAINAGE SOUTH	C DRAINAGE	MITIGATION BANK
OPHH&E	Human health and long-term health of environment would be protected; short-term protection of environment would not be achievable.	Overall protection of human health as well as the short-term and long-term health of environment would be met.	Overall protection of human health as well as the short-term and long-term health of environment would be met.	Overall protection of human health as well as the short-term and long-term health of environment would be met.	Short-term protection of the environment would not be achievable.
ARARS COMPLIANCE	"No net loss" mandate, CWA and CDFG Code regulations would not be met.	In kind, onsite mitigation which provides 2 acres, or 9.5% of the required mitigation ratio.	In kind, onsite mitigation which provides 30.4 acres, or 144% of the required mitigation ratio.	In kind, onsite mitigation which could provide 9.6 acres or 45% of the required mitigation ratio.	In kind but offsite mitigation which could provide 21.1 acres or 100% of the required mitigation ratio.
SHORT-TERM EFFECTIVENESS	N/A	Southern access road provides adequate access; potential impacts to existing cattle but none to sensitive ecosystems.	Southwestern access road provides adequate access; potential impacts to existing cattle but none to sensitive ecosystems.	Southwestern access road provides adequate access; potential for construction activities to affect existing cattle and riparian corridor of Casmalia creek.	Constrained by the 10-year time frame required by which the Santa Ynez Mitigation bank will be operational.

EVALUATION CRITERIA	ALTERNATIVES				
	NO MITIGATION	B DRAINAGE NORTH	B DRAINAGE SOUTH	C DRAINAGE	MITIGATION BANK
LONG-TERM EFFECTIVENESS **Geological**	N/A	Erosion potential problem due to steep hillsides, low vegetative cover, and unconsolidated soils. Soil type similar to that of site.	Erosion not a problem given that site is relatively flat with natural shallow depressions for wetlands. Soil type similar to that of site.	Erosion a potential problem in western portion of site only (near steeply incised Casmalia Creek). Rest of site is relatively flat. Soil type similar to that of site.	Assumed to have stable soils, but the soil type will be of different origin.
Hydrological *Water Availability/Origin*	N/A	Onsite water sources would provide 68 million gallons per year, which is over 82 times the amount needed to construct wetlands at this site (826,700 million gallons).	Onsite water sources would provide about 80 million gallons per year, which is six times the amount needed to construct wetlands at this site (12.4 million gallons).	Onsite water source would provide about 12 million gallons per year, which is about 4 times the amount needed to construct wetlands at this site (3.3 million gallons).	Water is likely to be available, but hydrological parameters would be very different from that of existing Casmalia wetlands.
Water Quality	N/A	Water from capped landfills is clean; water from new storage pond would be treated to meet NPDES standards.	Water from capped landfills and RCRA canyon is clean; water from new storage pond would be treated to meet NPDES standards.	Water from the RCRA canyon is clean.	Water is assumed to be of good quality.
Biological	N/A	Low habitat value due to lack of native vegetation or existing wetlands. Steep hillsides limit potential for adequate wetland transition zone.	Low habitat value due to lack of native vegetation or existing wetlands. Potential for creating adequate transition zones.	High habitat value due to plant diversity and proximity to riparian corridor of Casmalia Creek. Flat topography limits potential for adequate wetland transition zone.	Lower habitat value given that the bank is located significantly off-site.

EVALUATION CRITERIA	ALTERNATIVES				
	NO MITIGATION	B DRAINAGE NORTH	B DRAINAGE SOUTH	C DRAINAGE	MITIGATION BANK
IMPLEMENTABILITY **Technical Feasibility**	N/A	No technical difficulties or unknowns anticipated; commonly accepted methods of wetland creation proposed.	No technical difficulties or unknowns anticipated; commonly accepted methods of wetland creation proposed.	No technical difficulties or unknowns anticipated; commonly accepted methods of wetland creation proposed.	Thought to be cost-effective, by reliability and success rate of banks are still in question.
Administrative Feasibility	N/A	Onsite alternative falls under CERCLA, therefore no other permits would be required. However, could still require consultation with appropriate agencies.	Onsite alternative falls under CERCLA, therefore no other permits would be required. However, could still require consultation with appropriate agencies.	Onsite alternative falls under CERCLA, therefore no permits would be required. However, could still require consultation with appropriate agencies.	May reduce permitting time due to pre-approval issuance of credits.
Availability of Services and Materials	N/A	Construction contractors, landscaping firms, nurseries, and construction equipment readily available in Santa Barbara County.	Construction contractors, landscaping firms, nurseries, and construction equipment readily available in Santa Barbara County.	Construction contractors, landscaping firms, nurseries, and construction equipment readily available in Santa Barbara County.	No mitigation banks currently operational in Santa Barbara County, although assumed in operation by completion of ROD.
COSTS	N/A	Excavation/disposal, wetland creation, maintenance/monitoring would cost approximately $137,215 ($69,300/acre).	Excavation and disposal, wetland creation, maintenance and monitoring would cost approximately $1,089,809 ($35,849/acre).	Excavation and disposal, wetland creation, maintenance and monitoring would cost approximately $390,628 ($40,690/acre).	Purchasing credits would cost approximately $31,650-$63,300 ($1,500-$3,000/acre).

Table 14.20. Qualitative Evaluation Matrix for Scenario 3 (Mitigate Five Wetlands)

EVALUATION CRITERIA	ALTERNATIVES				
	NO MITIGATION	B DRAINAGE NORTH	B DRAINAGE SOUTH	C DRAINAGE	MITIGATION BANK
OPHH&E	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix
ARARS COMPLIANCE	"No net loss" mandate, CWA and CDFG Code regulations would not be met.	In kind, onsite mitigation which provides 2 acres, or 3.7% of the required mitigation ratio.	In kind, onsite mitigation which provides 30.4 acres, or 55.9% of the required mitigation ratio.	In kind, onsite mitigation which could provide 9.6 acres or 13.4% of the required mitigation ratio.	In kind but offsite mitigation which could provide 54,4 acres or 100% of the required mitigation ratio.
SHORT-TERM EFFECTIVENESS	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix
LONG-TERM EFFECTIVENESS **Geological**	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix

EVALUATION CRITERIA	ALTERNATIVES				
	NO MITIGATION	B DRAINAGE NORTH	B DRAINAGE SOUTH	C DRAINAGE	MITIGATION BANK
Hydrological *Water Availability/Origin*	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix
Water Quality	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix
Biological	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix
IMPLEMENTABILITY **Technical Feasibility**	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix
Administrative Feasibility	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix
Availability of Services and Materials	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix
COSTS	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix	See Scenario 2 Matrix	Purchasing of credits would cost between $81,600-$163,200 ($1,500-$3,000/acre).

15.0 RECOMMENDATIONS

To facilitate the mitigation of wetland habitat associated with the draining and sediment removal of the Casmalia site wetlands, the following recommendations were made:

For Scenario 2, the B Drainage South Alternative meets the required 21.1 acres needed under a 3:1 mitigation ratio. Therefore, for this scenario, we recommend creating 21.1 acres of wetland habitat at B Drainage South, as outlined in **Section 9.0, Wetland Mitigation Alternatives**.

For Scenario 3, the B Drainage South Alternative although being the recommended alternative would not be sufficient to meet the 54.4 acres of wetland mitigation required by a 3:1 mitigation ratio. Therefore it would be necessary to develop wetlands at other alternative sites to ensure the required mitigation is met. For this scenario we recommend developing wetlands at the B Drainage South Alternative, the B Drainage North Alternative, the C Drainage Alternative and buying 12.4 acres of mitigation banking credits from the Santa Ynez Mitigation Bank.

Due to the subjectivity surrounding the determination of a mitigation ratio, and the conservative choice of a 3:1 ratio, see **Section 7.2, Mitigation Ratio**, we recognize this ratio may be less. We therefore recommend that once a ratio has been determined by the relevant agencies, mitigation should be done in this order until the required acreage is met:

1. Develop B Drainage South as a wetland habitat
2. Develop B Drainage North as a wetland habitat
3. Develop C Drainage as a wetland habitat
4. Buy any outstanding credits from the Santa Ynez Mitigation Bank

This sequence ensures that mitigation alternatives which most successfully meet the evaluation criteria are developed before less successful alternatives.

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Appendix A: Preliminary Human Health & Ecological Risk Assessment & Remediation Alternatives for Casmalia Site

The following report was prepared by Ann Hayden and Vicky Krikelas as part of a course (ESM 223, Management of Soil and Water Quality) in December 2000. This course was offered by the Master's of Environmental Science and Management (MESM) Program at the University of California, Santa Barbara.

EXECUTIVE SUMMARY

The Casmalia Waste Disposal site is a 252-acre site that is an inactive hazardous waste treatment, storage, and disposal facility. The surface water of onsite storage/evaporation ponds is lightly contaminated with metals, such as arsenic, mercury, lead, thallium, nickel, cyanide, copper and volatile organic compounds (VOCs), such as TCE, methyl chloride, acetonitrile, and benzene. The presence of these contaminants could pose a potential risk to onsite receptors including construction workers and endangered species.

This study conducted a human health and ecological risk assessment to determine the level of risk from exposure to these contaminants. Inhalation and dermal exposure to construction workers were the only exposure pathways considered. No significant carcinogenic or non-carcinogenic risks were observed for metals or VOCs. The ecological risk evaluated existing contaminant concentrations based on guidelines outlined by the U.S. EPA for freshwater aquatic communities. From this assessment, four out of seven of the metals of concern (lead, nickel, cyanide, and copper) posed unacceptable ecological risks.

Based on the ecological risk from metals and U.S. EPA's good-faith mandate to protect human health and the environment, remediation technologies were selected that treat metals and VOCs. The preliminary screening of treatment technologies was based on the applicability, effectiveness, and limitations of various containment, in-situ, and ex-situ technologies. From this screening, two alternative scenarios were developed. Alternative 1 involved draining the ponds through gravity-fed pipe collection systems and above ground treatment, followed by soil capping. Alternative 2 involved the conversion of onsite ponds into wetlands using phytoremediation. Although Alternative 2 would take longer (5-10 years) than Alternative 1 (2-3 months), it was more cost-efficient (just over $400,000) and would avoid indirect impacts to existing frog habitat on the site. Therefore, Alternative 2 was determined to be the superior remediation alternative for cleaning up the Casmalia site to within acceptable risk levels.

INTRODUCTION

The Casmalia Waste Disposal site is located in Santa Barbara County, California, approximately 10 miles southwest of Santa Maria, 4 miles from the Pacific Ocean, 1.5 miles southwest of Vandenberg Airforce Base, and 1.2 miles south/southeast from the unincorporated town of Casmalia. The 252-acre site is an inactive hazardous waste treatment, storage, and disposal facility with adjacent land uses consisting of agriculture, cattle grazing, and oil field development.

In 1972, the county Board of Supervisors approved the site for a hazardous waste site, with the belief that the underlying soil at the site was impermeable. Until 1989, the site received in excess of 4.5 billion pounds of hazardous wastes from approximately 10,000 private and governmental contributors. During that period of time, the site owners/operators, Casmalia Resources, Hunter Resources, and Kenneth H. Hunter Jr., accepted these wastes in various storage/evaporation ponds, landfills, burial trenches, and treatment units. These wastes included pesticides, solvents, acids, metals, caustics, cyanide, and non-liquid polychlorinated biphenyls (PCBs). As a result of these disposal operations, the soil and the groundwater at the site became contaminated at levels that threatened human and environmental health. In 1989, facing several enforcement actions, the facility's owner/operator stopped receiving waste, and engaged in cleanup actions to properly close the site. In 1991, the facility's owner/operator abandoned efforts to properly and permanently remediate the site, claiming financial difficulties.

Given that the site contains hazardous wastes that were improperly disposed, the site will be cleaned up as required by the Federal law, Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). The U.S. EPA has reported that the remediation of the site will likely result in the draining of onsite wetlands, but the specific requirements and recommendations of the clean-up effort will be determined in the findings of this report.

The map of the site (**Figure 2**) shows the six landfills north of the trench (in gray dotted line). The remedial actions that have already been undertaken to date are concentrated on the northern section of the site and include groundwater containment of the contaminated plume and capping of the landfills. Underground trenches were built south of the landfills and south of the site in order to intercept and extract groundwater. The lightly contaminated liquids are treated onsite, while more heavily contaminated liquids are taken to an offsite treatment facility. The U.S. EPA and Casmalia Steering Committee are currently preparing the Remedial Investigation/Feasibility Study (RI/FS) to evaluate alternatives for long-term site-wide remediation of the site. This assessment focuses on the risk posed to human and ecological receptors from metal and volatile organic contamination of the onsite storage ponds.

Site Characterization

Onsite Ponds

The five onsite man-made ponds (Pond A-5, Pond 18, A-Series Pond, RCF Pond, and Pond 13) are located south of the trench on the site map (**Figure 1**), and are lightly contaminated with hazardous wastes. The five ponds were constructed over former ponds and pads, which were never clean-closed. These ponds currently serve the purpose of collecting storm water runoff. Additionally, Pond 18 receives treated groundwater from the onsite groundwater treatment plant. As a means to control overflow of storm water run off, the water level in the ponds is maintained below a certain level through water uptake for onsite irrigation and dust control.

The surface water of the ponds are characterized by light contamination of hazardous wastes. Ponds were found to be contaminated with at several heavy metals (including arsenic, mercury, lead, thallium, nickel, cyanide and copper) and volatile organic compounds (VOCs) including TCE, methyl chloride, acetonitrile and benzene. Maximum concentrations of contaminants were chosen among all five ponds, based on the Casmalia Resources Disposal Site Sampling Report of July, 2000 (Harding ESE, 2001). However, since it was noted that the maximum contaminant concentrations Table 1) were observed *only* in Pond 18, Pond 13 and Pond A-5, this study will assume a total pond area as six acres and volume of 79.5×10^6 liters or 2.1×10^7 gallons.

Recent surveys of the ponds indicate that they may be inhabited by three sensitive species: the California red-legged frog (numerous age classes), the California tiger salamander, and the western spadefoot toad. In addition**,** other reptiles and mammals have been observed onsite, including garter snakes, hawks, great blue herons, snowy egrets, ducks, raccoons, and coyotes.

Pond Soil & Sediments

The pond soil and sediments consist of generally impermeable clay soils, unweathered claystone, siltstone, sandstone, and claystone bedrock. Soil sampling has indicated several contaminants have been found in the northern portion of the site, but to date no information exists for soil contamination in the southern portion of the site, which includes the ponds (URS, 2000). Therefore, this study will not include a risk analysis of exposure to contaminated soils or sediments.

Groundwater

The groundwater flows north to south and the depth to groundwater varies throughout the site, but is approximately 3 meters (10 feet) near the ponds. As mentioned above, the groundwater is currently being treated and prevented from further migration, therefore risks from groundwater flow to the drinking wells of the town of Casmalia are negligible and will not be considered in this study.

Table 1.
Chemicals Concentrations and MCLs/ MCLGs for Casmalia site.

Chemical	Water Concentration (ug/L)	MCL (ug/L)	MCLG (ug/L)
arsenic	4.5	50	0
mercury	0.1	2	2
lead	3	15	0
thallium	6	2	0.5
nickel	310	100	100
cyanide	7.5	200	200
copper	700	130	
vinyl chloride	0.18	2	0
TCE	1.5	5	0
methyl chloride	0.14		
acetonitrile	280	79	
benzene	0.3	5	0

Source: Harding ESE (2001), U.S. EPA (2001) and Water Quality Association (2001).
* Note: To be conservative, the maximum concentration among all five ponds was selected.

Figure 1. Map of Onsite Ponds

CONCEPTUAL MODEL OF SOURCES, PATHWAYS, AND RECEPTORS

As indicated in **Figure 2**, the primary source of contamination is the pond surface water The primary transport mechanism is volatilization since clay soils is assumed to prevent leaching, groundwater is currently both extracted/treated and contained through underground trenches, and surface runoff is controlled through a irrigation system. Given these parameters, the human risk assessment focused on exposure through inhalation and incidental dermal exposure to onsite construction works, while the ecological risk assessment focused on exposure through dermal contact and ingestion of contaminated water by the California red-legged frog (*Rana aurora draytoni)*.

RISK ANALYSIS

Human Health Assessment

For the human health risk analysis, the surface water of the ponds are the source of contamination and the only human receptors considered were onsite construction workers. We assumed that risk posed to town of Casmalia through the ingestion of drinking water to be negligible due to the distant location of community drinking wells, as well as impermeable clay soil underlying the ponds and an underground trench at the south of the site, both of which prevented migration of the pollutants into the groundwater. Therefore, human health risks were limited to construction workers through two pathways: 1) inhalation of contaminated vapors and/or 2) dermal exposure (hands and feet) by accidentally falling into the pond water. The following equations and assumptions (**Table 3**) were used in calculating the human health risks for each pathway:

Figure 2. Conceptual Model of Exposure Scenarios.

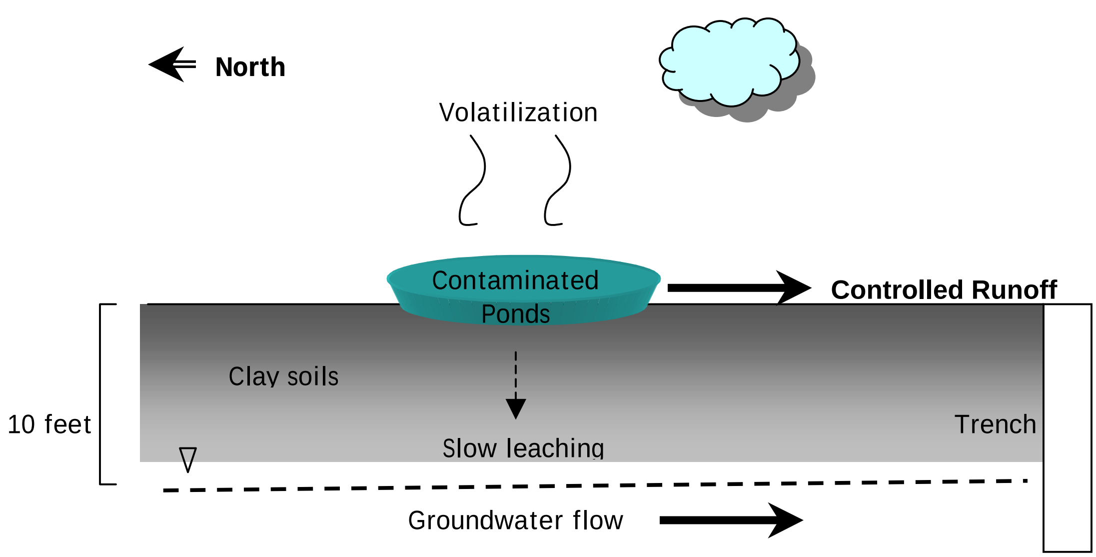

Table 2. Physiochemical Properties of Chemicals of Concern

Chemical	Log K_{ow}	P_{sat} (mm Hg 20 C)	K_H (atm-m^3/mol)	Water Solubility (mg/L)
arsenic-T	-	-	-	-
mercury	-	-	-	-
lead-T	-	-	-	-
thallium	-	-	-	-
nickel-D	-	-	-	-
cyanide	-	-	-	-
copper	-	-	-	-
vinyl chloride	0.6	2580	0.056	1900
TCE	2.29	57.8	0.0103	1000
methyl chloride	0.91	3790	0.01	6550
acetonitrile	-0.34	91.1	3.46E-05	miscible
benzene	2.13	100	0.0053	1770

Source: U.S. EPA EMCI Chemical Reference website and Watts (1999).

Equation 1. Inhalation of vapors from surface water

$$INH_{vapors} = \frac{C_A \ IR \ CF \ ABS \ EF \ ET \ ED}{BW \ AT}$$

Equation 2. Dermal exposure to surface water

$$DER_w = \frac{C_W \ SA \ PC \ CF \ ABS \ EF \ ET \ ED}{BW \ AT}$$

HUMAN HEALTH RESULTS

Tables 4 and **5** summarize the results of the human health risk analysis for both the dermal and inhalation exposure pathways (See **Appendix** for charts showing human risks for each chemical of concern).

Table 3. Assumptions for Human Health Risk Assessment

PARAMETER	VALUE	COMMENTS
General Assumptions		
BW (body weight)	70 kg	Default body weight of an adult
AT (averaging time)		
Carcinogenic	25,550 days	365 days/year * 70 years
Non-carcinogenic	10,950 days	365 days/year * 30 years
CF (conversion factor)	10^{-3} L/cm^3	Unit conversion
ED (exposure duration)	10 years	Conservative estimate of entire site cleanup.
Dermal Exposure to Pond Surface Water		
EF (exposure frequency)	250 days/year	Mean number of work days/year
ET (exposure time)	1 hour/day	Conservative assumption
TSA (total surface area)	20,000 cm^2	Total skin surface area of an adult
FBE (fraction of body exposed)	10%	Conservative value for hands/feet of adult
SA (surface area exposed)	2,000 cm^2	SA= TSA * FBE
PC (permeability constant)	0.035cm/hour	Chemical-specific info N/A; conservative assumption
Inhalation of Volatiles from Pond Surface Water		
EF (exposure frequency)	250 days/year	Mean number of work days/year
ET (exposure time)	6 hours/day	Conservative value for onsite worker
IR (inhalation rate)	1.0 m^3/hour	Conservative value for an adult
ABS (absorption factor)	100%	Conservative assumption

Table 4. Total Cancer and Hazard Risks Associated with Dermal Exposure

Chemical	Cancer Risk	Hazard Quotient
Metals		
arsenic-T	6.60E-7	1.03E-2
mercury	0	2.28E-4
lead-T	0	0
thallium	0	5.14E-2
nickel-D	0	1.06E-2
cyanide	0	2.57E-4
copper	0	9.59E-2
Total Metals	**6.60E-7**	**1.69E-1**
VOCs		
vinyl chloride	0	0
TCE	0	0
methyl chloride	0	0
acetonitrile	1.64E-7	0
benzene	8.51E-10	0
Total VOCs	**1.65E-7**	**0**
TOTAL DERMAL	**8.26E-7**	**1.69E-1**

Table 5. Total Cancer and Hazard Risks Associated with Inhalation Exposure (VOCs only)

Chemical	Cancer Risk	Hazard Quotient
vinyl chloride	0	0
TCE	0	0
methyl chloride	0	0
acetonitrile	0	0
benzene	1.63E-11	0
TOTAL INHALATION	**1.63E-11**	**0**

HUMAN HEALTH DISCUSSION

As indicated by **Table 4**, there are no significant carcinogenic risks ($CR>1x10^{-6}$) or hazard risks (HQ>1) with respect to the dermal exposure pathway. However, arsenic and acetonitrile are within an order of magnitude from the threshold cancer risk level. Only four of the contaminants had hazard risks, but were still well the hazard risk threshold level. Although there are no apparent cancer or hazard risks to construction workers, remedial efforts may still need to address potential risks from arsenic and acetonitrile due to the current concentrations.

Inhalation exposure to construction workers also does not represent a significant cancer risk (**Table 5**). Only benzene posed a cancer risk (1.63×10^{-11}), which was several orders of magnitude below the cancer risk threshold. Non-carcinogenic risk posed an even lower threat than cancer risks: *all* contaminants had a hazard risk of zero. Clearly, there are no significant risks to construction workers inhaling contaminated pond water vapors.

ECOLOGICAL RISK ANALYSIS

Given the presence of red-legged frogs in the ponds, the primary concern of the ecological risk assessment is to the risk posed to tadpoles, either through dermal absorption or ingestion of pond water, and the bioaccumulation through the food chain. In the early stages of development, tadpoles spend the majority of their growth cycle feeding on algae and phytoplankton in the pond sediments. In the absence of data pertaining to sediment contaminant concentrations as well as contaminant concentration in amphibian tissues, we based our ecological assessment solely on the contaminant concentrations in the pond water. While there is existing information as to the food ingestion rate and diet composition of garter snakes and red-tailed hawks, both of which are known predators of the red-legged frog, the lack of information pertaining to contamination concentration in frog tissue precluded quantification of risks through bioaccumulation.

Therefore our analysis is limited to a comparison of pollutant concentration in water to national guidelines for aquatic concentrations of pollutants.

The Criteria Maximum Concentration (CMC) and Criterion Continuous Concentration (CCC) levels for freshwater aquatic communities (U.S. EPA, 1999) were used as screening guidelines to evaluate the risk posed to the aquatic community. The CMC is a value assigned to individual chemicals, which estimates the highest concentration of the particular chemical in surface water to which an aquatic community can be exposed to *briefly* without resulting in an unacceptable effect. Similarly, CCC is the estimated highest concentration of a chemical in surface water to which an aquatic community can be exposed *indefinitely* without resulting in an unacceptable risk. Concentrations that exceed either the CMC or CCC indicate an unacceptable effect to the ecological receptors.

ECOLOGICAL RISK RESULTS & DISCUSSION

As indicated in **Table 6**, the concentrations in the pond water are above the water quality guidelines (CCC) for lead, nickel, cyanide, and copper. Of the chemicals of concern, only copper concentrations exceeded both CMC and CCC water quality guidelines, by as much as 54 to 78 times, respectively. The following chemicals were above the national water quality guidelines: arsenic and mercury (both CMC and CCC), lead (CMC only), nickel (CMC only), and cyanide (CMC only). No national guidelines were available for the VOCs, therefore their effects on the ecological receptors could not be determined.

In terms of the ecological risks on the Casmalia sites, it appears that the presence of metals in the pond water could result in the adverse effects to ecological receptors on the site, including the California red-legged frog and species that depend on the frog for a portion of their diets. Studies have shown that amphibians are highly sensitive aquatic species and tadpoles in particular are susceptible to metal contamination through dermal exposure (Blaustein, 2001 and. Metal contamination has been shown to cause inhibitions to the life cycle and deformities (insert ref). Presumably, species higher on the food chain would result in similarly adverse effects, requiring further remedial action.

Table 6. Freshwater Aquatic Guidelines for Chemicals of Concern

Chemicals of Concern	Water conc. (ug/L)	CMC (ug/L)	CCC (ug/L)	Does Concentration Exceed CMC?	Does Concentration Exceed CCC?	Degree Exceedance of CMC	Degree Exceedance of CCC
Metals							
arsenic	4.5	340	150	below	below	0.01	0.03
mercury	0.1	1.4	0.77	below	below	0.07	0.13
lead	3	65	2.5	below	above	0.05	1.20
thallium	6	n/a	n/a	n/a	n/a	n/a	0
nickel	310	470	52	below	above	0.66	5.96
cyanide	7.5	22	5.2	below	above	0.34	1.44
copper	700	13	9	above	above	53.85	77.78
VOCs							
vinyl chloride	0.18	n/a	n/a	n/a	n/a	n/a	0
TCE	1.5	n/a	n/a	n/a	n/a	n/a	0
methyl chloride	0.14	n/a	n/a	n/a	n/a	n/a	0
acetonitrile	280	n/a	n/a	n/a	n/a	n/a	0
benzene	0.3	n/a	n/a	n/a	n/a	n/a	0

Source: U.S. EPA, 1999.
Text = Unacceptable effect to the ecological receptors
n/a = No information available

REMEDIATION GOALS

Based on the risk assessment results, the remediation of the site will require treatment of metals due to the ecological risk posed. While VOC exposure caused no significant risk to human or ecological receptors, remediation of VOCs is recommended in keeping with the U.S. EPA's good-faith effort to protect human health and the environment, and in doing so will ease the long-standing distrust that the Casmalia community has had with the cleanup process (Cooper, 2001). To determine the targeted level of cleanup for the remediation, standard remediation criteria were reviewed.

The most applicable criteria for cleanup are based on the U.S. EPA's Preliminary Remediation Goals (PRGs) for tap water standards (human receptors) and the Department of Energy's Preliminary Remediation Goals for surface water (ecological endpoints). In particular, the cleanup objectives will help establish goals to reduce risk in a timely manner, verify the effectiveness of remedial actions, and provide guidance with respect to future land uses. As indicated by **Table 7**, all contaminants (with the exception of mercury for which data was unavailable) significantly exceed drinking water PRGs. In contrast, few metals exceeded the ecological endpoint PRGs and include arsenic, nickel, cyanide and copper

The proposed future land uses on the Casmalia site are not expected to be used for residential purposes (i.e., where children are exposed), and therefore, the drinking water standards are considered too stringent. Given the unacceptable risk to ecological receptors, the most appropriate remediation guidelines for our site are those PRGs outlined by the Department of Energy, which apply specifically to surface water media for use by ecological endpoints.

Table 7. Preliminary Remediation Goals for Surface Water

Contaminant	Water (ug/L)	Drinking Water PRG[1] (ug/L)	Concentration as % of PRG	Ecological PRG[2] (ug/L)	Concentration as % of PRG
arsenic	4.5	4.50E-02	10,000%	3.1	145%
mercury	0.1	n/a	n/a	1.3	7.7%
lead	3	4.00E+00	75%	3.2	93 %
thallium	6	3.3E+00	2%	9.0	66.7%
nickel	310	7.30E+02	425%	160	193%
cyanide	7.5	1.8E+00	4.2%	5.2	144%
copper	700	1.4+E3		12	5833%
vinyl chloride	0.18	2.00E-02	900%	782	.02%
TCE	1.5	1.60E+00	94%	470	.32%
methyl chloride	0.14	4.30E+00	3.3%	220	.06%
acetonitrile	280	7.10E+00	39%	N/a	n/a
benzene	0.3	3.90E-01	77%	130	.23%

[1] U.S. EPA Preliminary Remediation Goals for Tap Water

[2] US Department of Energy Preliminary Remediation Goals for Ecological Endpoints
text = concentrations in exceedence of ecological PRG

SCREENING OF REMEDIATION TECHNOLOGIES

The first step in the developing remediation alternatives is the screening of appropriate treatment for technologies for metals and VOCs (**Table 8**). In addition to reviewing the applicability of technologies, the screening process also considered their respective limitations. The following are descriptions of the applicability and limitations of containment, in-situ, and ex-situ treatment technologies considered in the preliminary screening process.

Containment

Drainage

Applicability: Drainage of surface waters using gravity-fed pipes can be used to remove both dissolved VOCs and metals in relatively more cost-effective manner than pump and treat. Extracted water would require aboveground treatment either onsite or transport to an offsite treatment facility.

Limitations: Gravity-based drainage take relatively longer periods of time for large water volumes because pressure or pumping mechanisms are not utilized; therefore this technique is limited to small volumes with low pollutant contamination.

Landfill caps

Applicability: Caps are commonly used in remediation of landfill sites because they are typically the least expensive way to effectively manage human and ecological risks (DOE, 1994). The RCRA C multi-layered landfill cap is a baseline design that is suggested for use in RCRA hazardous waste applications. These caps generally consist of an upper vegetative (topsoil) layer, a drainage layer, and a low permeability layer which consists of a synthetic liner over 2 feet of compacted clay.

Limitations: Landfill caps only prevent migration and don't lessen toxicity or volume of hazardous wastes. A cap alone cannot prevent the horizontal flow of groundwater. Furthermore, the compacted clay liners are effective if they retain a certain moisture content but are susceptible to cracking if the clay material is desiccated. In addition, vegetation harvesting is required to protect cap integrity.

Table 8. Preliminary Screening Matrix Treatment Technologies for Surface Waters

Technology	**Applicability**	
	Metals	VOCs
Containment		
Landfill capping	x	x
Drainage	x	x
In Situ		
Phytoremediation	x	
Ex Situ		
Air Stripping		x
Carbon Adsorption	x	x
Precipitation	x	
Filtration	x	
Ion Exchange	x	
Constructed Wetlands	x	
Bioreactors		x

In-situ Treatment

Phytoremediation

Phytoremediation is a technology that uses plants to remove both inorganics and organics from the soil, groundwater or surface water. Depending on the specific species utilized, trees can act as hydraulic pumps by establishing a dense root system that takes up large quantities of water. Phytodegradation of the pollutants can also occur within the plant tissues using the plant's own enzymes. Finally, photo-volatilization can take up water containing organic pollutants, biodegrade them, and release the byproducts through the pores of the leaves (DOE, 1994).

Applicability: Phytoremediation is used to remove organics from the aqueous phase and has also been shown to be effective at removing metals through plant root uptake. Roots that become saturated with metal contaminants can easily be harvested.

Limitations: This technology is limited to shallow surface waters and requires a large surface area for remediation. Contamination absorbed to the shoots can be released into the atmosphere and must be harvested periodically. Shoots may also be ingested by other species and bioaccumulate through the food chain. Climactic conditions can impact the effectiveness of this technology.

Ex-situ Treatment

Air stripping

Air stripping involves the mass transfer of volatile organics from the water to the air phase by increasing the surface area of the contaminated water exposed to air. Aeration methods involve use of packed towers, diffused aeration, or tray aeration.

Applicability:
Air stripping is effective in removing VOCs from water but ineffective in removing inorganics such as metals. Henry's law constants can be used to determine the applicability of air stripping; generally compounds with constants greater than $1*10^{-5}$ are considered amenable to air stripping. Removal efficiencies for such compounds are as high as 99% for towers with at least 4-6 feet of packing. Compounds that have been successfully removed using air stripping include BTEX, TCE and PCE (DOD, 1994).

Limitations:
The major problem with air stripping is the possibility of biological fouling the air packing material, subsequent reduction of air flow rates and periodic cleaning. Compounds with low volatility may also require preheating, which may increase

costs. Off-gases may require further treatment depending on the effluent concentrations.

Carbon Adsorption

Liquid phase carbon adsorption involves the removal of VOCs from the water phase via physical adsorption to carbon grains. Carbon is activated for the purpose of creating porous particles with large surface areas, between 300 to 2500 square meters per gram of carbon (DOD, 1994). Water is pumped through a series of vessels containing activated carbon to which the dissolved contaminants adsorb. Periodic carbon regeneration is required when the contaminant concentration of the effluent exceeds an acceptable level, either through regeneration in place or removal and regeneration offsite (DOD, 1994).

Applicability: This technology is most effective for treating SVOCs and explosives with limited effectiveness for halogenated VOCs and metals. In addition, this technology is particularly effective for low concentrations of pollutants (<10 mg/L) at nearly any flow rate. These systems can be rapidly implemented and attain high removal efficiency rates.

Limitations: Carbon used for removal of explosives cannot be reused and must be disposed of properly. Metals can foul the system if the carbon is not periodically regenerated. Costs will increase for higher contaminant concentrations or a mixture of contaminants. Not very effective for absorbing water soluble contaminants.

Precipitation

Precipitation is a well-established technology for removal of metals from water, often used as a pre treatment process prior to air stripping or chemical oxidation (where the presence of metals can reduce the effectiveness of these technologies). Precipitation takes pumped groundwater from extraction wells and treats it by adding insoluble salts such as hydroxides, carbonates or sulfides. The process involves a pH adjustment, addition of the precipitating agent, and mixing with flocculation agents. The precipitate can be removed by sedimentation or filtration and finally disposed in a similar manner as contaminated soils, such as in a proper landfill (DOD, 1994).

Applicability: Precipitation is widely used for removal of dissolved metals and is considered the prime method of treatment for heavy metals at industrial sites.

Limitations: Precipitation does not address the source of contamination, the precipitate must treated to regulatory levels before disposal in a landfill, a mixture of metals may reduce the efficiency of the process, and the treated water may require an adjustment in pH.

Filtration

Filtration is a method that concentrates the inorganics through a porous medium for easy removal; the metals are not destroyed. The driving force is either gravity or a pressure differential across a filter. This method is commonly used as either a pre or post treatment process.

Applicability: Filtration is applicable for removing precipitated metals or suspended solids from a fluid stream.

Limitations: Presence of oil or grease may decrease water flow rates.

Ion Exchange

Ion exchange is a process that removes the heavy metal ions from the aqueous phase by exchanging them for relatively innocuous ions held on an ion exchange resin. High inorganic concentrations can affect costs of regeneration of the resin.

Applicability: This process is effective at removing dissolved metals from the contaminated aqueous phase.

Limitations: Oil and grease may clog the ion exchange resin, the pH of the influent water may affect the type of resin selection, oxidants in the water may damage the resin, and wastewater generated by the process will need additional treatment and disposal.

Constructed Wetlands

Constructed Wetlands involve the use of the processes inherent in an artificial wetland in order to accumulate dissolved metals. Microbial activity is responsible for most of the degradation. The technology can involve either a filtration or degradation process. Metals within a constructed wetland system can be removed through ion exchange, adsorption, precipitation, and microbial degradation mechanisms.

Applicability: This technology has been commonly used in the treatment of wastewater and sediments but may also be applied to removing trace metals and other toxic pollutants. Studies have indicated high efficiency of removal for cadmium, chromium, zinc, iron, lead and nickel (DOE, 1994).

Limitations: The construction of wetlands requires large surface areas, careful plant selection, and long-term maintenance and monitoring. In addition, the long term effectiveness is not well known.

Bioreactors

Bioreactors are another ex-situ treatment technology for the degradation of VOCs. Contaminants in extracted groundwater or surface waters are mixed with microorganisms via a bioreactor using either of two methods. In suspended systems, contaminated groundwater is circulated in an aeration basin. In attached systems (such as activated carbon), microorganisms are supported on an inert matrix.

Applicability: Bioreactors are a well-developed technology used primarily for the treatment of SVOCs, hydrocarbons, and other organic materials. When used with co-metabolites, this technology can effectively treat halogenated VOCs as well. Bioreactor equipment and materials are readily available. Bioreactors have generally been found to be more economical compared to carbon adsorption (DOE, 1994).

Limitations: Nutrients may need to be added to enhance microbial degradation, especially when contaminant concentrations are low and relatively long time periods are required (up to several years) depending on site conditions. The effectiveness of bioreactors is also limited by low ambient temperature, presence of nuisance microbes, or very high pollutant concentrations.

REMEDIATION ALTERNATIVES

Based on the low concentrations of surface water contaminants, relatively low exposure risks, and the applicability and limitations of treatment technologies, we arrived at two treatment alternatives. **Alternative 1** includes the initial draining of the pond surface water and above ground treatment, followed by the capping of soils. Above ground treatment will include carbon adsorption (GAC) and metal ion exchange. Ion exchange is commonly used for treatment of metals in water and GAC is effective at treating metals and VOCs and can be easily implemented and requires low maintenance. Treated water will be discharged into the adjacent nearby Casmalia Creek.

It is important to note that Alternative 1 would likely result in the loss of frog habitat, and would therefore mitigation under the Endangered Species Act would need to be considered.

Alternative 2 includes the use of phytoremediation to enhance the conversion of the existing ponds into wetlands, which allows for the uptake of both metals and VOCs. Given that the ponds are already in place, implementing phytoremediation would be relatively straightforward. Phytoremediation will include phytodegradation of the organics in the rhizosphere, while phytoextraction and phytosorption for the metals in the above ground portions of the plants. Fast-growing and deep-rooted trees, such as willows and hybrid poplars, have been shown to be effective in degrading organics in the root zone as well as extracting metals through aboveground shoots and leaves (Suthersan, 1999 and U.S. EPA, 2000). In addition, plants such as poplar trees, hemp, sunflowers and Indian mustard have been shown to accumulate significant amounts of heavy metals (Suthersan, 1999). Finally, phytosorption using attached algae, floating aquatic plants, and BIO-FIX beads have been very effective in absorbing significant quantities of zinc, nickel, copper, lead and cadmium. (Suthersan, 1999).

COST ANALYSIS

ALTERNATIVE 1

Costs (**Table 9**) for drainage of the surface ponds using gravity flow will include the costs of gravity fed pipes to a discharge collection vessel where above ground treatment will occur, after which time, discharge pipes from the treatment system will deliver and discharge the treated water into the adjacent Casmalia

Creek. This process will occur on the order of two months. Subsequent capping of the ponds will occur and monitoring of capped soils will last approximately ten years.

Drainage costs (gravity pipes and discharge vessel) will total approximately $25,375. Given the above ground treatment system will be rented for two months, the costs of GAC will be approximately $27,030 and metal ion exchange will cost approximately $3339. Discharge into the creek and subsequent NPDES monitoring (5 samplings over two months) will cost $34,830 and $10,500, respectively.

Capping the soil with the RCRA C multi-layered landfill cap will cost $225,000/acre based on U.S. EPA guidelines. Given the ponds total 6 acres, the total cost will be $1,417,500, which includes the one time cost for capping and monitoring over ten years.

Therefore, the total cost of remediation under Alternative 1 is approximately **$1,536,818**, however this cost does not include costs for mitigating for the loss of frog habitat or for obtaining Endangered Species Act permits for incidental take of the frogs themselves.

ALTERNATIVE 2

Capital costs for phytoremediation include planting vegetation (buying and planting costs) at $25,000/acre or $150,000 for the site based on U.S. EPA guidelines. The addition of BIO-FIX beads will cost approximately $198,750.

Monitoring and maintenance costs include harvesting and disposal of vegetation, which should occur once every five years at a cost of approximately $15,000. In addition, surface water sampling will occur to ensure compliance with remediation goals at a cost of approximately $50,000.

Therefore, the total cost of remediation under Alternative 2 is approximately **$413,750.**

Detailed cost estimates for both Alternative 1 and Alternative 2 are available in the attached **Appendix**.

REMEDIATION RECOMMENDATIONS

Based on costs alone, Alternative 2 appears to be the superior to Alternative 1. Although the phytoremediation process can typically take years for contaminant concentrations to reach regulatory levels and requires maintenance over the long term, factors specific to Casmalia make this alternative attractive even beyond cost. First, contaminant concentrations were relatively low to begin with and second, metal concentrations for ecological receptors are not far from the regulatory levels (**Table 7**). Phytoremediation is proven to be very effective in the uptake of metals, therefore, the risk to frogs could be reduced to an acceptable level in a timely manner. In addition, phytoremediation is a low-impact technology avoiding major construction activities; therefore, removal and offsite relocation of the endangered species would not be necessary.

Alternative 1 is unfeasible not only because it is cost-prohibitive, it would require the removal of the frogs and habitat mitigation.

Table 9. Estimated Costs for Remediation Alternatives

Alternative 1: Drain, Treat, and Cap		**Alternative 2:** Constructed Wetlands	
Drainage	$25,375	Phytoremediation	$150,000
GAC	$27,030	BIO-FIX Beads	$198,750
Metal Ion Exchange	$3,339	O & M	$65,000
Discharge System	$34,830		
Soil Cap	$1,350,000		
O & M	$96,244		
TOTAL COST	**$1,536,819**	**TOTAL COST**	**$413,750**
ESTIMATED TIME:	2-3 months for Drain/Treat Ongoing Monitoring	ESTIMATED TIME:	5 to 10 years

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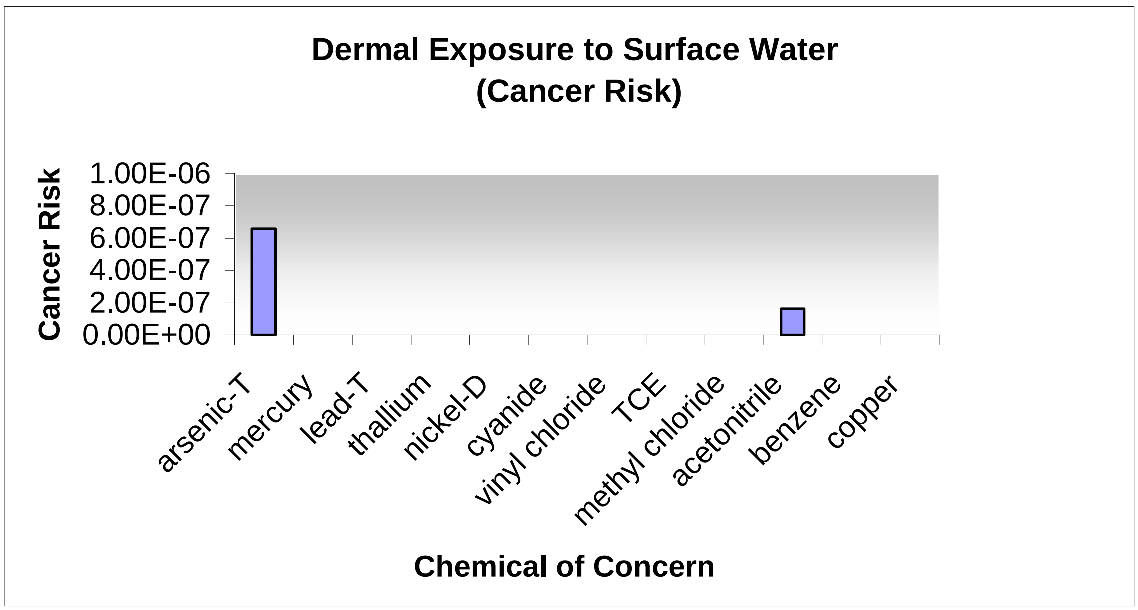
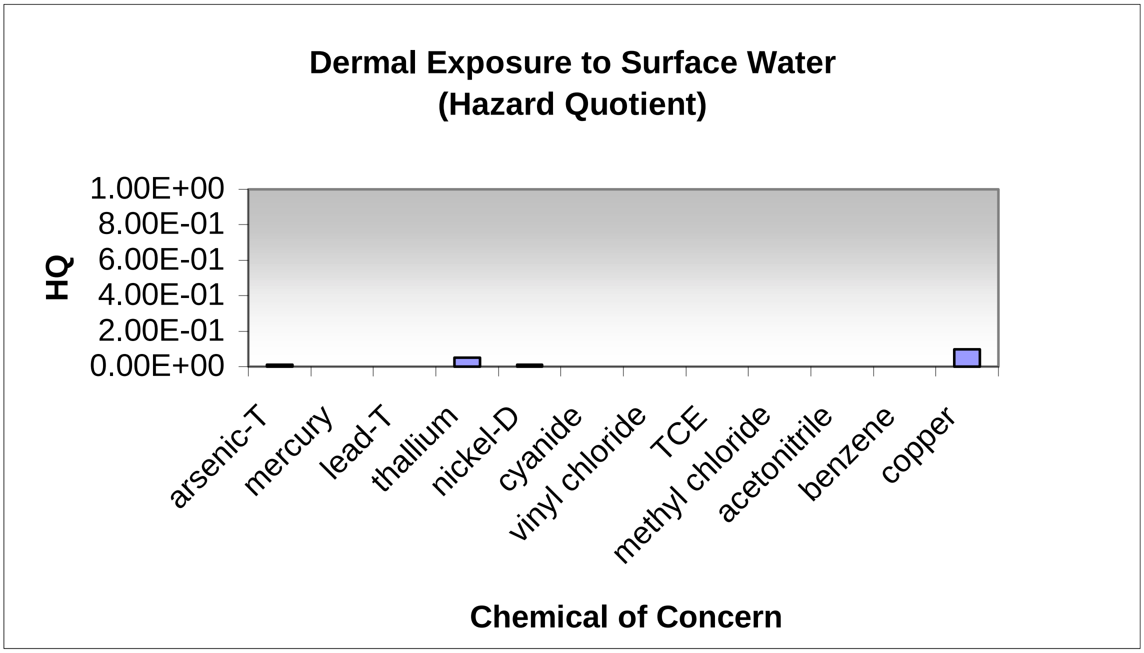
RISK ASSESSMENT APPENDIX

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6.00E-01
4.00E-01
2.00E-01
0.00E+00
arsenic-T
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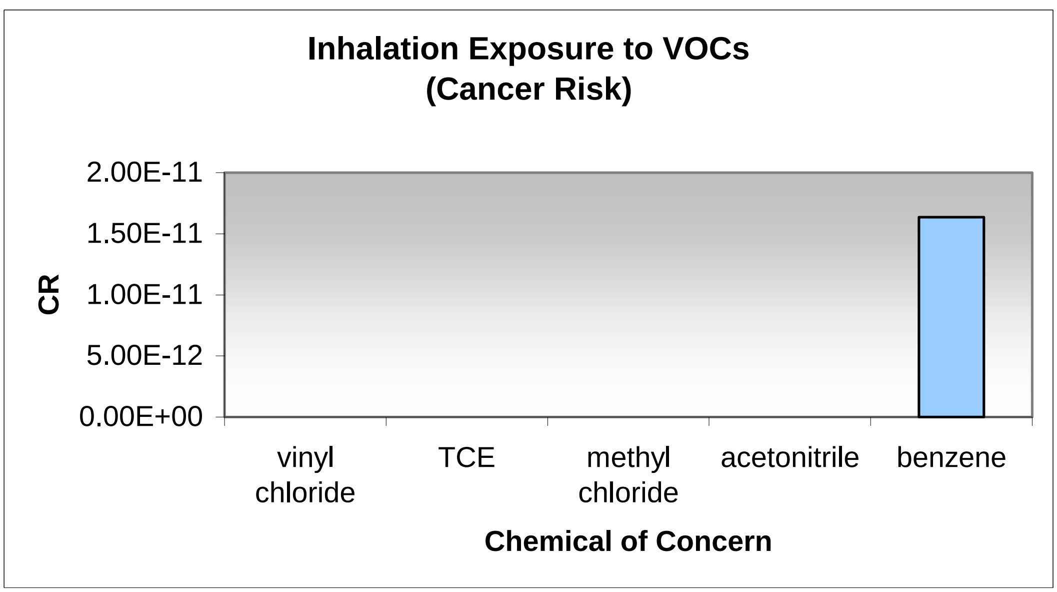
lead-T
thallium
nickel-D
cyanide
vinyl chloride
TCE
methyl chloride
acetonitrile
benzene
copper
Chemical of Concern


Inhalation Exposure to VOCs
(Cancer Risk)
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1.50E-11
1.00E-11
5.00E-12
0.00E+00
vinyl chloride
TCE
methyl chloride
acetonitrile
benzene
Chemical of Concern

Appendix B: Agency and Stakeholder Consultation Meeting Notes

Contact information and meeting notes from our consultations with the U.S. EPA, U.S. ACOE, U.S. FWS, CDFG, CB Consulting, Tetra Tech, Santa Barbara County Flood Control District, Dr. Wayne Ferren (University of California, Santa Barbara) and Holly Doremus (University of California, Davis) are included below.

B1. U.S. EPA, Region IX, San Francisco, California

Date: August 6, 2001

Contacts:
Craig Cooper
Stephanie Valentine

Location of Alternative Sites

Question: Is the B Drainage considered "onsite" or "in close proximity to"?
To address this question, Craig suggests we look up the NCP definition of what "onsite" includes. Craig also recommends that we consider a B Drainage A alternative and a B Drainage B alternative (one located above the other), but that we should use our own judgment in the decision. Again, while two ponds will definitely be drained, assume that all 5 will eventually be drained. When considering the onsite alternative, we don't have to specify the exact location (although the topographic map may be useful for this). We could potentially use the big pond after it is drained and construct an onsite wetland there.

Question: Is the surface of the wetland or the sides of the banks considered part of the wetlands when calculating the area required for compensation?

Craig doesn't know, and suggests that we'll have to make some assumptions. As an aside, Craig mentions that there will eventually have an onsite sediment basin to collect unconsolidated sediments.

Remedial Investigation Time-Line:

The last scoping meeting will be this September, which will eventually be consolidated into a work plan. The first work plan will be submitted by January or February, so we shouldn't plan on using it in this project. The mitigation process of the wetlands will occur during the ROD remedy; the remedial design follows the ROD. The final draining of the ponds may possibly occur by 2008; the species mitigation will occur earlier.

USGS Topographic Map

Pond 13 will be considered for species mitigation.
Craig suggests that we should perhaps consider three onsite alternatives, including one inside the 252 acres, one at Pond 13 (B Drainage A), and one 500 acres below Pond 13 (B Drainage B).

Acreage Estimates
Craig suggests that we make a list each for alternatives compensating for 10 acres, 50 acres, and 100 acres, but he noted that this might entail a lot of work. An alternative to the above suggestion is to simply make assumptions as to the acreage for compensation and consider mitigation options for that particular acreage (similar to our original idea).

RI/FS Guidance
Consider the nine RI/FS criteria, response actions, and the guidance document (which outlines short-term effectiveness and how it is applied). The guidance document can be located online. We should assume that with respect to the 5 ponds, the U.S. EPA will definitely select dewatering and sediment removal. The actual wetland mitigation is considered in the response action phase of the project. So, we should consider our alternatives as such, for example:

Alternative A: Dewatering and sediment removal and wetland mitigation at B Drainage A

Alternative B: Dewatering and sediment removal and wetland mitigation at B Drainage B

Alternative C: Dewatering and sediment removal and wetland mitigation offsite.

To reiterate, our role in this project is to assist the U.S. EPA by providing mitigation alternative for the wetlands—we should not be concerned with the possibility of the ponds not being drained (assume that dewatering and sediment removal will definitely occur).

Documents
Ms. Valentine sent A. Hayden a copy of the USGS Topographic map for our use in the project. We should plan to go over these notes again at our next meeting so we can reference the topographic map. In addition, a cd-rom of all significant U.S EPA documents has been provided, which is currently in the possession of M. Torrent.

B2. U.S. Army Corps of Engineers, Ventura Office, California

Date: ***November 8, 2001***

Contacts:
Jim Mace
Tiffany Welsh
Mark Cohen

Legal Concerns

Question: What parts of section 404 and what other Federal and state regulations are triggered by the drainage of the ponds besides Section 404 of the Clean Water Act?

Our discussion focused on whether our wetlands fell under the jurisdiction of Section 404 of the Clean Water Act.

It appears that under CERCLA, no Federal, state, or local permits are necessary (see copy of CERCLA 42 Section 9621.E1). An action is considered to take place under CERCLA if funding of action is provided under CERCLA. As a result, we should only concern ourselves with the regulations of U.S. EPA. In addition, since the ESA is not a permit, we could need to comply with those regulations.

These wetlands are likely not to fall under the jurisdiction of section 404 of the Clean Water Act. To determine whether a water body is included in 'waters of the United States, i.e. regulated by Army Corps, we must conduct a two-part test: are the waters 1) navigable and 2) does interstate commerce occur. If ponds don't meet these two criteria, they are 'isolated', unless they are adjacent to waters of the U.S. (i.e., Casmalia Creek). This is mainly determined by distance: 200 feet could be considered 'nearby', but the required distance depends on the size of the drainage area. Tiffany suspects that only two of our ponds (Pond A-5 and A-series) would meet the adjacency criteria. In other words, these ponds would require a permit from ACOE to drain. We should further look into Guadalupe Dunes in which there is a direct link between the rise in water in the creek and the rise in the water level in the ponds (satisfying the adjacency criteria)--do we have any such data for our site?

In addition, section 404 of the CWA focuses on the methods used to drain/dredge the wetlands. ACOE doesn't regulate incidental fallback, in which dredged sediments fall back onto the site. We would need to assume that the sediments are "pushed in stockpiles" in order for our case to be regulated by Army Corps. If the dredged materials were discharged into the ocean (which is very unlikely), then regulations would be triggered.

The "But for…" clause could increase the jurisdiction of the ACOE. In other words, "But for the issuance of the ACOE permit, the impact wouldn't occur"—If issuing the permit or not issuing it has effects that go beyond the area in concern, then the jurisdiction of the ACOE is extended to that area.

Question: Do the surface waters of the ponds plus the surrounding banks constitute 'wetlands', or should we consider the bank vegetation only?

According to Jim, the surface waters constitute wetlands.

Question: What criteria do the mitigation alternatives need to meet (size, duplicate habitat in kind, provide habitat for the endangered species)?

ACOE looks at the function of the wetlands and uses a function-based model to do so (see copy of HGM). The Hydro Geomorphic Model (HGM) is used to look at the habitat, water quality, retention and cleansing ability of the current wetland. Then HGM is used to evaluate the alternative sites to arrive at an appropriate mitigation ratio for the particular site. Mitigation banks would also have to be evaluated via HGM. ACOE recommends that we use HGM in evaluating our alternatives to ensure no net loss of function and values of wetlands.

What mitigation ratio does ACOE anticipate for the site, given the presence of endangered species? How might the ratio vary with different mitigation plans?

ACOE uses HGM independently of the presence of endangered species; it is up to us to incorporate a higher ratio to account for the endangered species.

Question: How might the Department of Fish and Game play a role in this case?

Who has jurisdiction over whom?

Department of Fish and Game plays a role when considering impacts to Casmalia Creek (stream and banks). But, if work on the creek were included under CERCLA funding, then the project would again be exempt from acquiring permits from CDFG.

Mitigation Alternatives

Question: Is the creek (C Drainage) an appropriate alternative for the mitigation of ponds? If so, can ACOE help us select suitable boundaries of the C Drainage area on a map?

First it is necessary for us to establish the limits of ACOE jurisdiction over the creek. Is there wetland fringe or habitat adjacent to the creek? If so, we could consider enhancing the current wetlands and upland areas that are within the limits of ACOE jurisdiction. In general, wetland enhancement projects are cheaper than wetland creation because of the lower mitigation ratio that is generally required

Question: Based on the topography and known groundwater depth, can ACOE help determine suitable boundary limits of the B Drainage alternative?

We will need to consider more than the topography of B Drainage; ideally, we will apply HGM to the site to determine the ratio required.

Also, we learned that we can use a combination of alternatives in final recommendation (i.e., B and C Drainage and mitigation banking).

Costs

Question: Are standard unit costs available for wetland mitigation projects (excavation costs, water pumping costs, planting costs, etc) and where can we get this information?

According to Jim and Tiffany, the estimated costs are approximately $20-$50,000 per acre. They suggest we approach consulting firms for further estimates.

Mitigation Banks

We didn't have time to go over mitigation banks in detail, but we were provided with the mitigation banking guidelines as well as the MOU signed by the U.S. EPA and ACOE. As mentioned above, we learned that HGM must be applied to the mitigation banks we consider as alternatives. We were also provided with information about In-Lieu-Fee arrangements for compensatory mitigation.

Documents Provided by ACOE

- Summary of HGM Approach, US ACOE
- Federal Guidance for the Establishment, Use and Operation of Mitigation Banks, US ACOE, 1995.
- Section 404 (b) (1) Guidelines Mitigation MOA "Questions and Answers", US ACOE.
- Memorandum of Agreement Between EPA and Department of the Army Concerning the Determination of Mitigation Under the Clean Water Act Section 404 (b) (1) Guidelines, Department of Defense, 1990.
- Clarification of the Clean Water Act Section 404 Memorandum of Agreement on Mitigation, U.S. EPA and US Department of the Army, 1992.
- The National Action Plan to Implement the Hydrogeomorphic Approach to Assessing Wetland Functions, Federal Register, Vol. 62, No. 119, 1997.
- Function-Based Method for Assigning Mitigation Ratios for Impacts to Riparian Systems, PCR Services Corporation, 1999.
- Federal Guidance on the Use of In-Lieu-Fee Arrangements for Compensatory Mitigation Under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act, Federal Register, Vol. 65, No. 216, 2000.
- Final Policy on the National Wildlife Refuge System and Compensatory Mitigation Under the Section 10/404 Program, Federal Register, Vol. 64, No. 175, 1999.
- Guidance on Flexibility of the 404 (b) (1) Guidelines and Mitigation Banking, US ACOE, 1993.

B3. U.S. Fish and Wildlife Service, Ventura Office, California

Date: October 10, 2001

Contact: Steve Henry

Under the ESA, any Federal agency undertaking activities that will jeopardize/harm, (need to clarify) an endangered or threatened species will have to enter into formal consultation with the Fish and Wildlife Service. Under this process a Biological Opinion, (BO), is issued to the relevant agency which outlines terms and conditions aimed at minimizing adverse affects to the species.

Under CERCLA, the Fish and Wildlife Service act as a trustee for the Department of the Interior and are granted extra authority in the form of a Natural Resource Damage Assessment (NRDC). Under this process the Fish and Wildlife Service investigates injury done to endangered species and/or migratory birds. The Fish and Wildlife Service further have the jurisdiction to sue for monetary damages done to any endangered species/migratory bird resulting from toxic exposure and/or CERCLA cleanup (Check this).

In the Casmalia situation, contamination of the frogs may result in the Fish and Wildlife Service suing the PRPs. In all cases, recovered monetary damages are used for restoration. A restoration plan is developed with public participation and is aimed at creating and/ or buying habitat.

B4. California Department of Fish and Game, Santa Barbara, California

Date: January 8, 2002
Contact: Martin Potter

Question: Does CDFG have jurisdiction over each of the ponds, and if so, what regulations apply? Is CEQA compliance necessary since our project involves onsite mitigation?

As far as wetlands are concerned, USACOE is the only agency that requires permits. In regulating wetlands, the state (CDFG) has a much more stringent definition of wetlands compared to the Federal (USFWS) definition. CDFG has a “no net loss” policy; therefore, under CEQA, if all ponds are drained, all five ponds would require mitigation.

Question: Would CDFG be opposed to the use of HGM as a method of evaluating alternatives?

Martin doesn’t think so.

Question: In the absence of HGM, what does CDFG use to evaluate alternatives?
Not certain.

Are there case studies you would suggest?
None.

B5. CB Consulting (CBC)

Date: February 6, 2002
Contact: Corey Bertelsen, Principal

Plans for Ponds

- Don't know of anything definite till the ROD is decided and issued
- Closing 3 of the ponds (A-5, 18, 13), which were used in the past for hazardous waste management purposes.
- Plans of the other 2 ponds (RCF and A-Series) are still up in the air (U.S. EPA would like to see them closed because the ponds are not currently lined, etc.)
- Ultimately, a risk assessment will show that no action is required.
- Ecologically, it is still unknown. Probably not necessary to close the ponds.
- For A-Series, it will probably remain as is because of the presence of Sensitive Species in Pond.
- The RCF pond will ultimately probably be closed.

Ultimate Remedy

- Construction of new pond probably where RCF pond is currently located; new pond will be lined and be used as a holding pond.
- 1986 discharge order probably shouldn't have been issued; discharge directly to RCRA Canyon.
- Plans for the ponds over the next five years include 1) lowering the water level (with evaporation, etc.) down to a few feet; 2) may never discharge water to creek

Water Sources

- Should not worry about sources of water!
- 150-180 gallons of rainfall on the 252-acre site
- Additional plans to catch water on capped landfills (50 acres = 35-40 million gallons of water).
- Capped landfills already meet NPDES permit
- We should change scenarios to include: Drain All Ponds and Drain Only 4 Ponds

CEQA

- Do not have to do CEQA.
- Also looks like NEPA will not have to be met because of the equivalency reg.

Specifics of Property

- We are considering B and C Drainage alternatives because of land issues. There are 17 separate parcels on Hunter Property and each parcel can be treated differently.
- California regulation: HSC25221 states restrictions for resident/hospital developments within 2,000 acres of a site that was a former hazardous waste site.
- Hunter doesn't own the entire site
- Corey wants to put deed restrictions on property because someone will eventually own the property as a whole therefore the most logical placement for a wetland is in B and C Drainage.
- Grazing could or could not continue in the B and C Drainage. If it appears that grazing adversely affects the wetlands then the site could be deed restricted.
- We should still consider fencing costs, but if the costs turn out to be huge, then we should re-think including that cost.
- Dirt road in C Drainage is not critical.
- Ask Stephanie for digital coverage of monitoring wells, otherwise Corey will help us out.

Costs

- Corey first thought that B Drainage would be the more expensive alternative, but now he feels that other factors (besides costs) will ultimately drive the project.
- Corey thinks that when we are choosing where to place the wetland we need to assess which site allows water to get there more easily.
- More difficult to get water to C Drainage (requires pumping) compared B Drainage (gravity flow).
- 60 acres of onsite landfill will be capped and will receive clean water that could potentially (under a general permit) reach the B Drainage via gravity flow (or to C Drainage via pumping).
- Surface area is clearly important—therefore Corey agrees that we will likely have to choose both alternatives.
- Also consider RCRA Canyon delivering water into C Drainage.
- For B Drainage, it's clear that a dike could be created between the two hills, but you can't go too far south.
- Also, there's a slug of monitoring wells south of Pond 13 that may end up in the wetland, but it shouldn't be difficult to boot the wells by putting liner up and around the casing.
- Are we considering lining the ponds—we should because that will allow the ponds to hold the water for a longer period of time.

- If RCF pond closes and it becomes a holding pond then put a pond in south of Pond 13 and encompasses the monitoring wells, that's okay.
- Capped landfill of 60 acres = 30 million gallons of rainfall or 18-19 gallons if the runoff coefficient is considered to be 60%.
- RCRA Canyon of 70 acres = 30 million gallons of rainfall or 15-20 million gallons if the runoff coefficient is 40%.
- RCRA Canyon is located at the far west portion of the site (no landfills, used for Class 3 waste disposal); that's why we can look at it under a general permit as it currently flows into the A-Series pond.
- Run-off coefficient of clean-capped areas is high because of liners.

Another Alternative

- Ultimately closing RCF pond (10-12 acres) and the area north of RCF pond, known as M & T areas, which were former ponds (20-25 acres) could be another potential area to consider.
- Plans could include grading M & T area so that it could be used at an expansion area of RCF pond.

Other Information

- There is little doubt of NRDA analysis and negotiation with Trustees about Habitat Exchange.
- Corey wants to know what we think about exchange area requirements and alternatives.
- Corey also wants us to focus on developing alternatives, but not necessarily say that want to put it here or there.
- Corey doesn't think that the deciding factor will be costs especially since there are remedy issues that are still unknown.
- For instance, what happens to A-Series will totally dictate what happens in the C Drainage.

B6. Tetra Tech Environmental Consultancy, Santa Barbara, California

Exchange of contacts involved in wetland mitigation projects in Santa Barbara County.

B7. Santa Barbara County Flood Control District

Date: February 1, 2002
Contact: Maureen Spencer

Mitigation Ratio

We may want to check on this due to the fact that the frog is Federally listed *not* state-listed. Since CDFG gave us the ratio—this seems questionable and possibly worth challenging.

Excavation

Excavation: trucking costs will occur whether disposal is onsite or offsite.

Bulldozer: approximately $200/hr

Disposal of Soil: trucking soil approx. cost $60/hr for a 10 cubic yard truck

Planning: may need to hire someone to draw up grading plans (designs), consultant will cost approx. $90/hr (probably requiring 2 days to design)

C Drainage Plan: cut back banks (essentially peeling back one side to create wetland); possibly look into jute netting (natural fiber) along slopes to prevent erosion (approx. cost $0.18/squared feet for the netting and installation). Frogs prefer open water with fringe habitats of such plants as bulrush, cattail, etc.; want pool of water so that bulrush and cattail don't overtake the habitat. For C Drainage, try to have open water and shallow around the edge.

Fencing

Contact fencing company to acquire linear costs/installation

Seeding

Costs of seeds: Maureen provided list of basic seed list for emergent wetlands (also source S & S seeds for additional emergent wetland plants)

Consider approx. $4.50/plant (relatively cheap). Tree of Life in San Juan Capistrano.

Consider planting lots of Willows, clump Cottonwoods and sycamore, and perhaps including the random oak (can collect acorns from the site—can do the same for willows as well).

Spreading seeds:
Option 1: Hydroseeding (dependent on supplemental irrigation or else the vegetation will not survive and germinate) Cost approximately: $2500/acre

Option 2: Crank or Hand spread (can be labor intensive, but might be more successful) Landscaper necessary, cost approx. $19/hr (one person can plant approx. 50 plants/day); may take 3-4 guys one day to spread one acre.

Watering Plants: Install drip system, cost of system and installation and retrofitting approx. $30,000 for 4 acres (may be slightly high for our site), probably consider $20,000 for 4 acres on our site.

Maintenance/Monitoring/Replacement of Plants

Maintenance:
Wetland basins don't typically require too much maintenance
Willows will need maintenance (esp. weeding for first two years)
Water can be monitored with a timer
As a rule each plant should have 3 ft of weed-free area (willow woodland mix)
Example: Riparian corridor project she worked on had maintenance costs for 3 yrs approx. $20,000 for 4 acres

Monitoring:
5 yrs is typical for monitoring site; cost of monitor approx. $90/hr, 10 hour days, annual reporting time requires 20 hrs (final report to determine if project was successful)

1st year: flag the site for placement of plants, do a plant count, may need to hire a monitor to visit the site 4 times during the first year to coordinate plants, give okay for plant installation, qualitative look at the site

2nd yr: visit the site approx. 4 times for qualitative look at site

3rd yr: visit the site approx. 2-3 times

4th yr: visit the site approx. 2-3 times

5th yr: visit the site 1 time.

B8. Wayne Ferren, University of California, Santa Barbara

Date: November 6, 2001

Identified plants at each onsite wetland using pictures brought back from our field trip. Noted whether each species was native or not, and gave specific comments about certain species. Several of the plants (Heliotrope, Salt Grass, Spearscale, and Saltmarsh Sandspurrey) tend to be found in alkaline or chemically affected soils. **Table 1, Plant Species Present at Project Site**, lists the plant species present at the wetlands.

Date: December 3, 2001 (with Tim Carson, Casmalia Creek Habitat Restoration Plan)

Identified plants from C Drainage using clippings taken by Casmalia Creek Habitat Restoration Plan group on a field trip. **Table 2, Plant Species Present at C Drainage** lists the riparian vegetation found at C Drainage.

Hydrogeomorphic Method (HGM) is not widely accepted. In the case of our wetlands, the habitat value of such degraded, man-made habitat is pretty low. Creating anything better would be beneficial for the endangered species.

Table 1. Plant Species Present at Project Site

Scientific Name	Common Name	Ponds Present	Indicator Status	Native?
Picris echioides	Oxtongue	RCF, 13, A-series	FAC	No
Chenopodium rubrum	Red Goosefoot	All	FACU	No
Cotula coronopifolia	Brass Button	RCF, 13, A-series, A-5	FACW+	No
Heliotropium curassavicum	Heliotrope	RCF, A-series	OBL	Yes
Polypogon monspeliensis	Rabbitfoot Grass	RCF	FACW+	No
Baccharis pilularis	Coyote Brush	RCF, A-series	FACU	Yes
Cirsium vulgare	Thistle	RCF, A-series	FAC	No
Brassica nigra	Black Mustard	RCF, A-series	FACU	No
Distichlis spicata	Salt Grass	RCF	FACW	Yes
Medicago polymorpha	Bur Clover	RCF	FACU-	No
Scirpus maritimus	Prairie Bulrush	RCF, 13, A-series	OBL	Yes
Atriplex patula triangularis	Spearscale	RCF	FACW	Yes
Hemizonia incresens	Tarweed	RCF	FAC	Yes
Conyza canadensis	Horseweed	RCF	FAC	No
Salsola tragus	Russian Thistle	RCF	FACU+	No
Tamarix ramosissima	Tamarisk	RCF	FAC	No
Stephanomeria exigua	Stephanomeria	RCF	UPL	Yes
Scirpus californicus	California Bulrush	RCF, A-series	OBL	Yes
Spergularia marina	Saltmarsh Sandspurrey	A-series	OBL	Yes
Enteromorpha intestinalis	Green Algae	A-series	OBL	Yes

Table 2. Plant Species Present at C Drainage

Scientific Name	Common Name	Native?
Quercus agrifolia	Live Oak	Yes
Salix lasiolepis	Arroyo Willow	Yes
Xanthium spinosa	Spiny Cocklebur	No
Rorippa nasturtium aquaticum	Watercress	No
Sambucus mexicanus	Elderberry	Yes
Artemisia tridentata	Sagebrush	Yes
Baccharis pilularis	Coyotebrush	Yes
Nicotiana glauca	Tree Tobacco	No
Conium maculatum	Poison Hemlock	No

We need to take the acceptance of agencies and the general public into account when determining mitigation ratio. A 1:1 ratio seems too stingy when there's endangered species involved. However, 5:1 is too generous for such poor quality habitat. A 3:1 ratio would probably be the most acceptable ratio.

B9. Holly Doremus, Professor of Law, UC Davis

Date: April 27, 2001

ARARS (Applicable or Relevant and Appropriate Requirements)

- Covered under the EPA
- Need to find out how they are implemented (EPA would be a good reference)
- We are unsure as to whether ARARS override the ESA/CWA; Holly thinks that they don't, but we need to research further

Wetlands (classification, draining)

- We need to get verification from the ACOE that the ponds are in fact classified as "wetlands"
- Emily mentioned that a contact at the AC cited a flooding event that happened 5-10 yrs ago (?); thus the ponds would be characterized as wetlands because of the hydrological link
- As far as the draining of the ponds, we need to find out how the ponds are going to be drained because if earth-moving equipment are going to be used, then the draining falls under s.404 of the CWA.
- ACOE responsible for issuing permits (s.404) dredging/filling wetlands in coordination with EPA.
- Our ponds are too big (30 acres) to fall under the Nationwide permits; we need to apply for independent permits.
- We need to verify with the EPA that they *must* drain the ponds and for what reason.
- EPA's reason must be that *not* draining the ponds would be *more* damaging than draining them (i.e. polluted sediments, etc. are harmful and need to be removed)—and that the mitigation is "least damaging and practicable alternative"
- Ratio of wetlands to be replaced depends on how successful we would be at recreating them (i.e. vernal pools have a high ratio)
- Need to find out over what period of time the ponds are going to be drained
- Is it possible to drain four ponds initially and let one pond (closest to creek) remain so that the species could migrate?

Army Corps

- Role of agency is concern for wetland values, including wildlife
- AC has policies on mitigation/how mitigation should occur
- Holly has information regarding these policies and we should contact her if we can't locate the information ourselves
- EPA will need to get a permit from AC to "destroy" the wetlands, and in order to do so, the EPA will have to justify that the ponds need to be dug out

ESA

- FWS ensures that s.404 is consistent with the ESA
- For s.7 of the ESA, FWS would contact the ACOE regarding how likely that jeopardy or continued damage would/would not occur
- In our case, there is the option of going under s.7 or get a permit under s.9
- Need to contact FWS to determine the differences between s.7 and s.9
- Advantages of going under s.7 is that it is much less public and the regulating community prefers it to s.9
- A disadvantage of s.7 is that if there are species that are not yet listed (i.e. toad), then the species will not be considered. In order to get a new species listed, the process would have to begin again.
- We need to consider s.7 for the California Salamander
- Important to determine who designated the habitat as being "potentially suitable" for the salamander

Appendix C: Wetland Regulations in California

AGENCY	REGULATION	AUTHORITY
U.S. Army Corps of Engineers	Clean Water Act, Section 404	Regulates placement of dredged or fill material into waters of the United States
	Rivers and Harbors Act of 1899 Section 10	Regulate work in navigable waters of the U.S.
U.S. Environmental Protection Agency	Clean Water Act	Enforcement of regulations, may veto Corps permit
	CEQA, NEPA	Commenting authority
U.S. Fish and Wildlife Service	Fish and Wildlife Coordination Act	Reviews/comments on Federal actions that affect wetlands and other waters, including 404 permit applications
	Endangered Species Act	Corps must consult with USFWS if endangered species on site
	CEQA, NEPA	Commenting authority
National Marine Fisheries Service	Fish and Wildlife Coordination Act	Reviews/comments on Federal actions that affect coastal waters, including 404 permit applications
	Endangered Species Act	Corps must consult with NMFS if endangered marine species on site
	CEQA, NEPA	Commenting authority
California Department of Fish and Game	California Fish and Game Code Sections 1600-1607	Regulates activities resulting in alteration of streams and lakes
	CEQA, NEPA	Commenting authority
Regional Water Quality Control Boards	Clean Water Act, Section 401	Issues water quality certification; certification required for Section 404 permits
	Clean Water Act, section 402	Regulates discharge of waste into waters of the United States
	CEQA, NEPA	Commenting authority
California Coastal Commission	Coastal Act of 1976	Issues all coastal development permits
	Coastal Zone Management Act of 1972	Issues notice that work is consistent with state coastal management plan
	CEQA, NEPA	Commenting authority
San Francisco Bay Conservation and Development Commission	McAteer-Petris Act of 1965	Regulates work within the bay, certain creeks and a shoreline band 100 feet inland from line of highest tidal action
State Lands Commission	Public Trust Doctrine	May preclude the use of submerged lands and tidelands if this use is inconsistent with public trust

Source: Cylinder, 1994.

Appendix D: Federal Guidance for the Establishment, Use and Operation of Mitigation Banks

DEPARTMENT OF DEFENSE

Department of the Army
Corps of Engineers

ENVIRONMENTAL PROTECTION AGENCY

DEPARTMENT OF AGRICULTURE

Natural Resources Conservation Service

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

Federal Guidance for the Establishment, Use and Operation of Mitigation Banks

AGENCIES: Corps of Engineers, Department of the Army, DOD; Environmental Protection Agency; Natural Resources Conservation Service, Agriculture; Fish and Wildlife Service, Interior; and National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Commerce.

ACTION: Notice.

SUMMARY: The Army Corps of Engineers (Corps), Environmental Protection Agency (EPA), National Resources Conservation Service (NRCS), Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) are issuing final policy guidance regarding the establishment, use and operation of mitigation banks for the purpose of providing compensation for adverse impacts to wetlands and other aquatic resources. The purpose of this guidance is to clarify the manner in which mitigation banks may be used to satisfy mitigation requirements of the Clean Water Act (CWA) Section 404 permit program and the wetland conservation provisions of the Food Security Act (FSA) (i.e.,

``Swampbuster'' provisions). Recognizing the potential benefits mitigation banking offers for streamlining the permit evaluation process and providing more effective mitigation for authorized impacts to wetlands, the agencies encourage the establishment and appropriate use of mitigation banks in the Section 404 and ``Swampbuster'' programs.

DATES: The effective date of this Memorandum to the Field is December 28, 1995.

FOR FURTHER INFORMATION CONTACT: Mr. Jack Chowning (Corps) at (202) 761-1781; Mr. Thomas Kelsch (EPA) at (202) 260-8795; Ms. Sandra Byrd (NRCS) at (202) 690-3501; Mr. Mark Miller (FWS) at (703) 358-2183; Ms. Susan-Marie Stedman (NMFS) at (301) 713-2325.

SUPPLEMENTARY INFORMATION: Mitigating the environmental impacts of necessary development actions on the Nation's wetlands and other aquatic resources is a central premise of Federal wetlands programs. The CWA Section 404 permit program relies on the use of compensatory mitigation to offset unavoidable damage to wetlands and other aquatic resources through, for example, the restoration or creation of wetlands. Under the ``Swampbuster'' provisions of the FSA, farmers are required to provide mitigation to offset certain conversions of wetlands for agricultural purposes in order to maintain their program eligibility.

Mitigation banking has been defined as wetland restoration, creation, enhancement, and in exceptional circumstances, preservation undertaken expressly for the purpose of compensating for unavoidable wetland losses in advance of development actions, when such compensation cannot be achieved at the development site or would not be as environmentally beneficial. It typically involves the consolidation of small, fragmented wetland mitigation projects into one large contiguous site. Units of restored, created, enhanced or preserved wetlands are expressed as ``credits'' which may subsequently be withdrawn to offset ``debits'' incurred at a project development site.

Ideally, mitigation banks are constructed and functioning in advance of development impacts, and are seen as a way of reducing uncertainty in the CWA Section 404 permit program or the FSA ``Swampbuster'' program by having established compensatory mitigation credit available to an applicant. By consolidating compensation requirements, banks can more effectively replace lost wetland functions within a watershed, as well as provide economies of scale relating to the planning, implementation, monitoring and management of mitigation projects.

On August 23, 1993, the Clinton Administration released a comprehensive package of improvements to Federal wetlands programs which included support for the use of mitigation banks. At that same time, EPA and the Department of the Army issued interim guidance clarifying the role of mitigation banks in the Section 404 permit program and providing general guidelines for their establishment and use. In that document it was acknowledged that additional guidance would be developed, as necessary, following completion of the first phase of the Corps Institute for Water Resources national study on mitigation banking.

The Corps, EPA, NRCS, FWS and NMFS provided notice [60 FR 12286; March 6, 1995] of a proposed guidance on the policy of the Federal government regarding the establishment, use and operation of mitigation banks. The proposed guidance was based, in part, on the experiences to date with mitigation banking, as well as other environmental, economic and institutional issues identified through the Corps national study. Over 130 comments were received on the proposed guidance. The final guidance is based on full and thorough consideration of the public comments received.

A majority of the letters received supported the proposed guidance in general, but suggested modifications to one or more parts of the proposal. In response to these comments, several changes have been made to further clarify the provisions and make other modifications, as necessary, to ensure effective establishment and use of mitigation banks. One key issue on which the agencies received numerous comments focused on the timing of credit withdrawal. In order to provide additional clarification of the changes made to the final guidance in response to comments, the agencies wish to emphasize that it is our intent to ensure that decisions to allow credits to be withdrawn from a mitigation bank in advance of bank maturity be make on a case-by-case basis to best reflect the particular ecological and economic circumstances of each bank. The percentage of advance credits permitted for a particular bank may be higher or lower than the 15 percent example included in the proposed guidance. The final guidance is being revised to eliminate the reference to a specific percentage in order to provide needed flexibility. Copies of the comments and the agencies' response to significant comments are available for public review. Interested parties should contact the agency representatives for additional information.

This guidance does not change the substantive requirements of the Section 404 permit program or the FSA ``Swampbuster'' program. Rather, it interprets and provides internal guidance and procedures to the agency field personnel for the establishment, use and operation of mitigation banks consistent with existing regulations and policies of each program. The policies set out in this document are not final agency action, but are intended solely as guidance. The guidance is not intended, not can it be relied upon, to create any rights enforceable by any party in litigation with the United States. The guidance does not establish or affect legal rights or obligations, establish a binding norm on any party and it is not finally determinative of the issues addressed. Any regulatory decisions made by the agencies in any particular matter addressed by this guidance will be made by applying the governing law and regulations to the relevant facts. The purpose of the document is to provide policy and technical guidance to encourage the effective use of mitigation banks as a means of compensating for the authorized loss of wetlands and other aquatic resources.

John H. Zirschky,
Acting Assistant Secretary (Civil Works),
Department of the Army.

Robert Perciasepe,
Assistant Administrator for Water,
Environmental Protection Agency.

James R. Lyons,
Assistant Secretary, Natural Resources and Environment,
Department of Agriculture.

George T. Frampton, Jr.,
Assistant Secretary for Fish and Wildlife and Parks,
Department of the Interior.

Douglas K. Hall,
Assistant Secretary for Oceans and Atmosphere,
Department of Commerce.

Memorandum to the Field

Subject: Federal Guidance for the Establishment, Use and Operation of Mitigation Banks

I. Introduction

A. Purpose and Scope of Guidance

This document provides policy guidance for the establishment, use and operation of mitigation banks for the purpose of providing compensatory mitigation for authorized adverse impacts to wetlands and other aquatic resources. This guidance is provided expressly to assist Federal personnel, bank sponsors, and others in meeting the requirements of Section 404 of the Clean Water Act (CWA), Section 10 of the Rivers and Harbors Act, the wetland conservation provisions of the Food Security Act (FS) (i.e., ``Swampbuster''), and other applicable Federal statutes and regulations. The policies and procedures discussed herein are consistent with current requirements of the Section 10/404 regulatory program and ``Swampbuster'' provisions and are intended only to clarify the applicability of existing requirements to mitigation banking.

The policies and procedures discussed herein are applicable to the establishment, use and operation of public mitigation banks, as well as privately-sponsored mitigation banks, including third party banks (e.g. entrepreneurial banks).

B. Background

For purposes of this guidance, mitigation banking means the restoration, creation, enhancement and, in exceptional circumstances, preservation of wetlands and/or other aquatic resources expressly for the purpose of providing compensatory mitigation in advance of authorized impacts to similar resources.

The objective of a mitigation bank is to provide for the replacement of the chemical, physical and biological functions of wetlands and other aquatic resources which are lost as a result of authorized impacts. Using appropriate methods, the newly established functions are quantified as mitigation ``credits'' which are available for use by the bank sponsor or by other parties to compensate for adverse impacts (i.e., ``debits''). Consistent with mitigation policies established under the Council on Environmental Quality Implementing Regulations (CEQ regulations) (40 CFR Part 1508.20), and the Section 404(b)(1) Guidelines (Guidelines) (40 CFR Part 230), the use of credits may only be authorized for purposes of complying with Section 10/404 when adverse impacts are unavoidable. In addition, for both the Section 10/404 and ``Swampbuster'' programs, credits may only be authorized when onsite compensation is either not practicable or use of a mitigation bank is environmentally preferable to onsite compensation. Prospective bank sponsors should not construe or anticipate participation in the establishment of a mitigation bank as ultimate authorization for specific projects, as excepting such projects from any applicable requirements, or as preauthorizing the use of credits from that bank for any particular project.

Mitigation banks provide greater flexibility to applicants needing to comply with mitigation requirements and can have several advantages over individual mitigation projects, some of which are listed below:

1. It may be more advantageous for maintaining the integrity of the aquatic ecosystem to consolidate compensatory mitigation into a single large parcel or contiguous parcels when ecologically appropriate;

2. Establishment of a mitigation bank can bring together financial resources, planning and scientific expertise not practicable to many project-specific compensatory mitigation proposals. This consolidation of resources can increase the potential for the establishment and long- term management of successful mitigation that maximizes opportunities for contributing to biodiversity and/or watershed function;

3. Use of mitigation banks may reduce permit processing times and provide more cost-effective compensatory mitigation opportunities for projects that qualify;

4. Compensatory mitigation is typically implemented and functioning in advance of project impacts, thereby reducing temporal losses of aquatic functions and uncertainty over whether the mitigation will be successful in offsetting project impacts;

5. Consolidation of compensatory mitigation within a mitigation bank increases the efficiency of limited agency resources in the review and compliance monitoring of mitigation projects, and thus improves the reliability of efforts to restore, create or enhance wetlands for mitigation purposes.

6. The existence of mitigation banks can contribute towards attainment of the goal for no overall net loss of the Nation's wetlands by providing opportunities to

compensate for authorized impacts when mitigation might not otherwise be appropriate or practicable.

II. Policy Considerations

The following policy considerations provide general guidance for the establishment, use and operation of mitigation banks. It is the agencies' intent that this guidance be applied to mitigation bank proposals submitted for approval on or after the effective date of this guidance and to those in early stages of planning or development. It is not intended that this policy be retroactive for mitigation banks that have already received agency approval. While it is recognized that individual mitigation banking proposals may vary, it is the intent of this guidance that the fundamental precepts be applicable to future mitigation banks.

For the purposes of Section 10/104, and consistent with the CEQ regulations, the Guidelines, and the Memorandum of Agreement Between the Environmental Protection Agency (EPA) and the Department of the Army Concerning the Determination of Mitigation under the Clean Water Act Section 404(b)(1) Guidelines, mitigation means sequentially avoiding impacts, minimizing impacts, and compensating for remaining unavoidable impacts. Compensatory mitigation, under Section 10/404, is the restoration, creation, enhancement, or in exceptional circumstances, preservation of wetlands and/or other aquatic resources for the purpose of compensating for unavoidable adverse impacts. A site where wetlands and/or other aquatic resources are restored, created, enhanced, or in exceptional circumstances, preserved expressly for the purpose of providing compensatory mitigation in advance of authorized impacts to similar resources is a mitigation bank.

A. Authorities

This guidance is established in accordance with the following statutes, regulations, and policies. It is intended to clarify provisions within these existing authorities and does to establish any new requirements.

1. Clean Water Act Section 404 (33 U.S.C. 1344).

2. Rivers and Harbors Act of 1899 Section 10 (33 U.S.C. 403 et seq.)

3. Environmental Protection Agency, Section 404(b)(1) Guidelines (40 CFR Part 230). Guidelines for Specification of Disposal Sites for Dredged or Fill Material.

4. Department of the Army, Section 404 Permit Regulations (33 CFR Parts 320-330). Policies for evaluating permit applications to discharge dredged or fill material.

5. Memorandum of Agreement between the Environmental Protection Agency and the Department of the Army Concerning the Determination of Mitigation under the Clean Water Act Section 404(b)(1) Guidelines (February 6, 1990).

6. Title XII Food Security Act of 1985 as amended by the Food, Agriculture, Conservation and Trade Act of 1990 (16 U.S.C. 3801 et seq.).

7. National Environmental Policy Act (42 U.S.C. 4321 et seq.), including the Council on Environmental Quality's implementing regulations (40 CFR Parts 1500-1508).

8. Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.).

9. Fish and Wildlife Service Mitigation Policy (46 FR pages 7644- 7663, 1981).

10. Magnuson Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.).

11. National Marine Fisheries Service Habitat Conservation Policy (48 FR pages 53142-53147, 1983).

The policies set out in this document are not final agency action, but are intended solely as guidance. The guidance is not intended, nor can it be relied upon, to create any rights

enforceable by any party in litigation with the United States. This guidance does not establish or affect legal rights or obligations, establish a binding norm on any party and it is not finally determinative of the issues addressed. Any regulatory decisions made by the agencies in any particular matter addressed by this guidance will be made by applying the governing law and regulations to the relevant facts.

B. Planning Considerations

1. Goal Setting

The overall goal of a mitigation bank is to provide economically efficient and flexible mitigation opportunities, while fully compensating for wetland and other aquatic resource losses in a manner that contributes to the long-term ecological functioning of the watershed within which the bank is to be located. The goal will include the need to replace essential aquatic functions which are anticipated to be lost through authorized activities within the bank's service area. In some cases, banks may also be used to address other resource objectives that have been identified in a watershed management plan or other resource assessment. It is desirable to set the particular objectives for a mitigation bank (i.e., the type and character of wetlands and/or aquatic resources to be established) in advance of site selection. The goal and objectives should be driven by the anticipated mitigation need; the site selected should support achieving the goal and objectives.

2. Site Selection

The agencies will give careful consideration to the ecological suitability of a site for achieving the goal and objectives of a bank, i.e., that it posses the physical, chemical and biological characteristics to support establishment of the desired aquatic resources and functions. Size and location of the site relative to other ecological features, hydrologic sources (including the availability of water rights), and compatibility with adjacent land uses and watershed management plans are important factors for consideration. It also is important that ecologically significant aquatic or upland resources (e.g., shallow sub-tidal habitat, mature forests), cultural sites, or habitat for Federally or state-listed threatened and endangered species are not compromised in the process of establishing a bank. Other significant factors for consideration include, but are not limited to, development trends (i.e., anticipated land use changes), habitat status and trends, local or regional goals for the restoration or protection of particular habitat types or functions (e.g., re-establishment of habitat corridors or habitat for species of concern), water quality and floodplain management goals, and the relative potential for chemical contamination of the wetlands and/ or other aquatic resources.

Banks may be sited on public or private lands. Cooperative arrangements between public and private entities to use public lands for mitigation banks may be acceptable. In some circumstances, it may be appropriate to site banks on Federal, state, tribal or locally-owned resource management areas (e.g., wildlife management areas, national or state forests, public parks, recreation areas). The siting of banks on such lands may be acceptable if the internal policies of the public agency allow use of its land for such purposes, and the public agency grants approval. Mitigation credits generated by banks of this nature should be based solely on those values in the bank that are supplemental to the public program(s) already planned or in place, that is, baseline values represented by existing or already planned public programs, including preservation value, should not be counted toward bank credits.

Similarly, Federally-funded wetland conservation projects undertaken via separate authority and for other purposes, such as the Wetlands Reserve Program, Farmer's Home Administration fee title transfers or conservation easements, and Partners for Wildlife Program, cannot be used for the purpose of generating credits within a mitigation bank. However, mitigation credit may be given for activities undertaken in conjunction with, but supplemental to, such programs in order to maximize the overall ecological benefit of the conservation project.

3. Technical Feasibility

Mitigation banks should be planned and designed to be self- sustaining over time to the extent possible. The techniques for establishing wetlands and/or other aquatic resources must be carefully selected, since this science is constantly evolving. The restoration of historic or substantially-degraded wetlands and/or other aquatic resources (e.g., prior-converted cropland, farmed wetlands) utilizing proven techniques increases the likelihood of success and typically does not result in the loss of other valuable resources. Thus, restoration should be the first option considered when siting a bank. Because of the difficulty in establishing the correct hydrologic conditions associated with many creation projects and the tradeoff in wetland functions involved with certain enhancement activities, these methods should only be considered where there are adequate assurances to ensure success and that the project will result in an overall environmental benefit.

In general, banks which involve complex hydraulic engineering features and/or questionable water sources (e.g., pumped) are most costly to develop, operate and maintain, and have a higher risk of failure than banks designed to function with little or no human intervention. The former situations should only be considered where there are adequate assurances to ensure success. This guidance recognizes that in some circumstances wetlands must be actively managed to ensure their viability and sustainability. Furthermore, long-term maintenance requirements may be necessary and appropriate in some cases (e.g., to maintain fire-dependent plant communities in the absence of natural fire; to control invasive exotic plant species).

Proposed mitigation techniques should be well-understood and reliable. When uncertainties surrounding the technical feasibility of a proposed mitigation technique exist, appropriate arrangements (e.g., financial assurances, contingency plans, additional monitoring requirements) should be in place to increase the likelihood of success. Such arrangements may be phased-out or reduced once the attainment of prescribed performance standards is demonstrated.

4. Role of Preservation

Credit may be given when existing wetlands and/or other aquatic resources are preserved in conjunction with restoration, creation or enhancement activities, and when it is demonstrated that the preservation will augment the functions of the restored, created or enhanced aquatic resource. Such augmentation may be reflected in the total number of credits available from the bank.

In addition, the preservation of existing wetlands and/or other aquatic resources in perpetuity may be authorized as the sole basis for generating credits in mitigation banks only in exceptional circumstances, consistent with existing regulations, policies and guidance. Under such circumstances, preservation may be accomplished through the implementation of appropriate legal mechanisms (e.g., transfer of deed, deed restrictions, conservation easement) to protect wetlands and/or other aquatic resources, accompanied by implementation of appropriate changes in land use or other physical changes as necessary (e.g., installation of restrictive fencing).

Determining whether preservation is appropriate as the sole basis for generating credits at a mitigation bank requires careful judgment regarding a number of factors. Consideration must be given to whether wetlands and/or other aquatic resources proposed for preservation (1) perform physical or biological functions, the preservation of which is important to the region in which the aquatic resources are located, and (2) are under demonstrable threat of loss or substantial degradation due to human activities that might not otherwise be expected to be restricted. The existence of a demonstrable threat will be based on clear evidence of destructive land use changes which are consistent with local and regional land use trends and are not the consequence of actions under the control of the bank sponsor. Wetlands and other aquatic resources restored under the Conservation Reserve Program or similar programs requiring only temporary conservation easements may be eligible for banking credit upon termination of the original easement if the wetlands are provided permanent protection and it would otherwise be expected that the resources would be converted upon termination of the easement. The number of mitigation credits available from a bank that is based solely on preservation should be based on the functions that would otherwise be lost or degraded if the aquatic resources were not preserved, and the timing of such loss or degradation. As such, compensation for aquatic resource impacts will typically require a greater number of acres from a preservation bank than from a bank which is based on restoration, creation or enhancement.

5. Inclusion of Upland Areas

Credit may be given for the inclusion of upland areas occurring within a bank only to the degree that such features increase the overall ecological functioning of the bank. If such features are included as part of a bank, it is important that they receive the same protected status as the rest of the bank and be subject to the same operational procedures and requirements. The presence of upland areas may increase the per-unit value of the aquatic habitat in the bank. Alternatively, limited credit may be given to upland areas protected within the bank to reflect the functions inherently provided by such areas (e.g., nutrient and sediment filtration of storm water runoff, wildlife habitat diversity) which directly enhance or maintain the integrity of the aquatic ecosystem and that might otherwise be subject to threat of loss or degradation. An appropriate functional assessment methodology should be used to determine the manner and extent to which such features augment the functions of restored, created or enhanced wetlands and/or other aquatic resources.

6. Mitigation Banking and Watershed Planning

Mitigation banks should be planned and developed to address the specific resource needs of a particular watershed. Furthermore, decisions regarding the location, type of wetlands and/or other aquatic resources to be established, and proposed uses of a mitigation bank are most appropriately made within the context of a comprehensive watershed plan. Such watershed planning efforts often identify categories of activities having minimal adverse effects on the aquatic ecosystem and that, therefore, could be authorized under a general permit. In order to reduce the potential cumulative effects of such activities, it may be appropriate to offset these types of impacts through the use of a mitigation bank established in conjunction with a watershed plan.

C. Establishment of Mitigation Banks

1. Prospectus

Prospective bank sponsors should first submit a prospectus to the Army Corps of Engineers (Corps) or Natural Resources Conservation Service (NRCS)**\1** to initiate the planning and review process by the appropriate agencies. Prior to submitting a prospectus, bank sponsors are encouraged to discuss their proposal with the appropriate agencies (e.g., pre-application coordination).

\1 The Corps will typically serve as the lead agency for the establishment of mitigation banks. Bank sponsors proposing establishment of mitigation banks solely for the purpose of complying with the ``Swampbuster'' provisions of FSA should submit their prospectus to the NRCS.

It is the intent of the agencies to provide practical comments to the bank sponsors regarding the general need for and technical feasibility of proposed banks. Therefore, bank sponsors are encouraged to include in the prospectus sufficient information concerning the objectives for the bank and how it will be established and operated to allow the agencies to provide such feedback. Formal agency involvement and review is initiated with submittal of a prospectus.

2. Mitigation Banking Instruments

Information provided in the prospectus will serve as the basis for establishing the mitigation banking instrument. All mitigation banks need to have a banking instrument as documentation of agency concurrence on the objectives and administration of the bank. The banking instrument should describe in detail the physical and legal characteristics of the bank, and how the bank will be established and operated. For regional banking programs sponsored by a single entity (e.g., a state transportation agency), it may be appropriate to establish an ``umbrella'' instrument for the establishment and operation of multiple bank sites. In such circumstances, the need for supplemental site-specific information (e.g., individual site plans) should be addressed in the banking instrument. The banking instrument will be signed by the bank sponsor and the concurring regulatory and resource agencies represented on the Mitigation Bank Review Team (section II.C.2). The following information should be addressed, as appropriate, within the banking instrument:

a. Bank goals and objectives;

b. Ownership of bank lands;

c. Bank size and classes of wetlands and/or other aquatic resources proposed for inclusion in the bank, including a site plan and specifications;

d. Description of baseline conditions at the bank site;

e. Geographic service area;

f. Wetland classes or other aquatic resource impacts suitable for compensation;

g. Methods for determining credits and debits;

h. accounting procedures;

i. Performance standards for determining credit availability and bank success;

j. Reporting protocols and monitoring plan;

k. Contingency and remedial actions and responsibilities;

l. Financial assurances;

m. Compensation ratios;

n. Provisions for long-term management and maintenance.

The terms and conditions of the banking instrument may be amended, in accordance with the procedures used to establish the instrument and subject to agreement by the signatories.

In cases where initial establishment of the mitigation bank involves a discharge into waters of the United States requiring Section 10/404 authorization, the banking instrument will be made part of a Department of the Army permit for that discharge. Submittal of an individual permit application should be accompanied by a sufficiently- detailed prospectus to allow for concurrent processing of each. Preparation of a banking instrument, however, should not alter the normal permit evaluation process timeframes. A bank sponsor may proceed with activities for the construction of a bank subsequent to receiving the Department of the Army authorization. It should be noted, however, that a bank sponsor who proceeds in the absence of a banking instrument does so at his/her own risk.

In cases where the mitigation bank is established pursuant to the FSA, the banking instrument will be included in the plan developed or approved by NRCS and the Fish and Wildlife Service (FWS).

3. Agency Roles and Coordination

Collectively, the signatory agencies to the banking instrument will comprise the Mitigation Bank Review Team (MBRT). Representatives from the Corps, EPA, FWS, National Marine Fisheries Service (NMFS) and NRCS, as appropriate given the projected use for the bank, should typically comprise the MBRT. In addition, it is appropriate for representatives from state, tribal and local regulatory and resource agencies to participate where an agency has authorities and/or mandates directly affecting or affected by the establishment, use or operation of a bank. No agency is required to sign a banking instrument; however, in signing a banking instrument, an agency agrees to the terms of that instrument.

The Corps will serve as Chair of the MBRT, except in cases where the bank is proposed solely for the purpose of complying with the FSA, in which case NRCS will be the MBRT Chair. In addition, where a bank is proposed to satisfy the requirements of another Federal, state, tribal or local program, it may be appropriate for the administering agency to serve as co-Chair of the MBRT.

The primary role of the MBRT is to facilitate the establishment of mitigation banks through the development of mitigation banking instruments. Because of the different authorities and responsibilities of each agency represented on the MBRT, there is a benefit in achieving agreement on the banking instrument. For this reason, the MBRT will strive to obtain consensus on its actions. The Chair of the MBRT will have the responsibility for making final decisions regarding the terms and conditions of the banking instrument where consensus cannot otherwise be reached within a reasonable timeframe (e.g., 90 days from the date of submittal of a complete prospectus). The MBRT will review and seek consensus on the banking instrument and final plans for the restoration, creation, enhancement, and/or preservation of wetlands and other aquatic resources.

Consistent with its authorities under Section 10/404, the Corps is responsible for authorizing use of a particular mitigation bank on a project-specific basis and determining the number and availability of credits required to compensate for proposed impacts in accordance with the terms of the banking instrument. Decisions rendered by the Corps must fully consider review agency comments submitted as part of the permit evaluation process. Similarly, the NRCS, in consultation with the FWS, will make the final decision pertaining to the withdrawal of credits from banks as appropriate mitigation pursuant to FSA.

4. Role of the Bank Sponsor

The bank sponsor is responsible for the preparation of the banking instrument in consultation with the MBRT. The bank sponsor should, therefore, have sufficient opportunity to discuss the content of the banking instrument with the MBRT. The bank sponsor is also responsible for the overall operation and management of the bank in accordance with the terms of the banking instrument, including the preparation and distribution of monitoring reports and accounting statements/ledger, as necessary.

5. Public Review and Comment

The public should be notified of and have an opportunity to comment on all bank proposals. For banks which require authorization under an individual Section 10/404 permit or a state, tribal or local program that involves a similar public notice and comment process, this condition will typically be satisfied through such standard procedures. For other proposals, the Corps or NRCS, upon receipt of a complete banking prospectus, should provide notification of the availability of the prospectus for a minimum 21-day public comment period. Notification procedures will be similar to those used by the Corps in the standard permit review process. Copies of all public comments received will be distributed to the other members of the MBRT and the bank sponsor for full consideration in the development of the final banking instrument.

6. Dispute Resolution Procedure

The MBRT will work to reach consensus on its actions in accordance with this guidance. It is anticipated that all issues will be resolved by the MBRT in this manner.

a. Development of the Banking Instrument

During the development of the banking instrument, if any agency representative considers that a particular decision raises concern regarding the application of existing policy or procedures, an agency may request, through written notification, that the issue be reviewed by the Corps District Engineer, or NRCS State Conservationist, as appropriate. Said notification will describe the issue in sufficient detail and provide recommendations for resolution. Within 20 days, the District Engineer or State Conservationist (as appropriate) will consult with the notifying agency(ies) and will resolve the issue. The resolution will be forwarded to the other MBRT member agencies. The bank sponsor may also request the District Engineer or State Conservationist review actions taken to develop the banking instrument if the sponsor believes that inadequate progress has been made on the instrument by the MBRT.

b. Application of the Banking Instrument

As previously stated, the Corps and NRCS are responsible for making final decisions on a project-specific basis regarding the use of a mitigation bank for purposes of Section 10/404 and FSA, respectively. In the event an agency on the MBRT is concerned that a proposed use may be inconsistent with the terms of the banking instrument, that agency may raise the issue to the attention of the Corps or NRCS through the permit evaluation process. In order to facilitate timely and effective consideration of agency comments, the Corps or NRCS, as appropriate, will advise the MBRT agencies of a proposed use of a bank. The Corps will fully consider comments provided by the review agencies regarding mitigation as part of the permit evaluation process. The NCRS will consult with FWA is making its decisions pertaining to mitigation.

If, in the view of an agency on the MBRT, an issued permit or series of permits reflects a pattern of concern regarding the application of the terms of the banking instrument, that agency may initiate review of the concern by the full MBRT through written notification to the MBRT Chair. The MBRT Chair will convene a meeting of the MBRT, or initiate another appropriate forum for communication, typically within 20 days of receipt of notification, to resolve concerns. Any such effort to address concerns regarding the application of a banking instrument will not delay any decision pending before the authorizing agency (e.g., Corps or NRCS).

D. Criteria for Use of a Mitigation Bank

1. Project Applicability

All activities regulated under Section 10/404 may be eligible to use a mitigation bank as compensation for unavoidable impacts to wetlands and/or other aquatic resources. Mitigation banks established for FSA purposes may be debited only in accordance with the mitigation and replacement provisions of 7 CFR Part 12.

Credits from mitigation banks may also be used to compensate for environmental impacts authorized under other programs (e.g., state or local wetland regulatory programs, NPDES program, Corps civil works projects, Superfund removal and remedial actions). In no case may the same credits be used to compensate for more than one activity; however, the same credits may be used to compensate for an activity which requires authorization under more than one program.

2. Relationship to Mitigation Requirements

Under the existing requirements of Section 10/404, all appropriate and practicable steps must be undertaken by the applicant to first avoid and then minimize adverse impacts to aquatic resources, prior to authorization to use a particular mitigation bank. Remaining unavoidable impacts must be compensated to the extent appropriate and practicable. For both the Section 10/404 and ``Swampbuster'' programs, requirements for compensatory mitigation may be satisfied through the use of mitigation banks when either onsite compensation is not practicable or use of the mitigation bank is environmentally preferable to onsite compensation.

It is important to emphasize that applicants should not expect that establishment of, or purchasing credits from, a mitigation bank will necessarily lead to a determination of compliance with applicable mitigation requirements (i.e., Section 404(b)(1) Guidelines or FSA Manual), or as excepting projects from any applicable requirements.

3. Geographic Limits of Applicability

The service area of a mitigation bank is the area (e.g., watershed, county) wherein a bank can reasonably be expected to provide appropriate compensation for impacts to wetlands and/or other aquatic resources. This area should be designated in the banking instrument. Designation of the service area should be based on consideration of hydrologic and biotic criteria, and be stipulated in the banking instrument. Use of a mitigation bank to compensate for impacts beyond the designated service area may be authorized, on a case-by-case basis, where it is determined to be practicable and environmentally desirable.

The geographic extent of a service area should, to the extent environmentally desirable, be guided by the cataloging unit of the ``Hydrologic Unit map of the United States'' (USGS, 1980) and the ecoregion of the ``Ecoregions of the United States'' (James M. Omernik, EPA, 1986) or section of the ``Descriptions of the Ecoregions of the United States'' (Robert G. Bailey, USDA, 1980). It may be appropriate to use other classification systems developed at the state or regional level for the purpose of specifying bank service areas, when such systems compare favorably in their objectives and level of detail. In the interest of the integrating banks with other resource management objectives, bank service areas may encompass larger watershed areas if the designation of such areas is supported by local or regional management plans (e.g., Special Area Management Plans, Advance Identification), State Wetland Conservation Plans or other Federally sponsored or recognized resource management plans. Furthermore, designation of a more inclusive service area may be appropriate for mitigation banks whose primary purpose is to compensate for linear projects that typically involve numerous small impacts in several different watersheds.

4. Use of a Mitigation Bank vs. Onsite Mitigation

The agencies' preference for onsite mitigation, indicated in the 1990 Memorandum of Agreement on mitigation between the EPA and the Department of the Army, should not preclude the use of a mitigation bank when there is no practicable opportunity for onsite compensation, or when use of a bank is environmentally preferable to onsite compensation. On-site mitigation may be preferable where there is a practicable opportunity to compensate for important local functions including local flood control functions, habitat for a species or population with a very limited geographic range or narrow environmental requirements, or where local water quality concerns dominate.

In choosing between onsite mitigation and use of a mitigation bank, careful consideration should be given to the likelihood for successfully establishing the desired habitat type, the compatibility of the mitigation project with adjacent land uses, and the practicability of long-term monitoring and maintenance to determine whether the effort will be ecologically sustainable, as well as the relative cost of mitigation alternatives. In general, use of a mitigation bank to compensate for minor aquatic resource impacts (e.g., numerous, small impacts associated with linear projects; impacts authorized under nationwide permits) is preferable to onsite mitigation. With respect to larger aquatic resource impacts, use of a bank may be appropriate if it is capable of replacing essential physical and/or biological functions of the aquatic resources which are expected to be lost or degraded. Finally, there may be circumstances warranting a combination of onsite and offsite mitigation to compensate for losses.

5. In-kind vs. Out-of-kind Mitigation Determinations

In the interest of achieving functional replacement, in-kind compensation of aquatic resource impacts should generally be required. Out-of-kind compensation may be acceptable if it is determined to be practicable and environmentally preferable to in-kind compensation (e.g., of greater ecological value to a particular region). However, non-tidal wetlands should typically not be used to compensate for the loss or degradation of tidal wetlands. Decisions regarding out-of-kind mitigation are typically made on a case-by-case basis during the permit evaluation process. The banking instrument may identify circumstances in which it is environmentally desirable to allow out-of-kind compensation within the context of a particular mitigation bank (e.g., for banks restoring a complex of associated wetland types). Mitigation banks developed as part of an area-wide management plan to address a specific resource objective (e.g., restoration of a particularly vulnerable or valuable wetland habitat type) may be such an example.

6. Timing of Credit Withdrawal

The number of credits available for withdrawal (i.e., debiting) should generally be commensurate with the level of aquatic functions attained at a bank at the time of debiting. The level of function may be determined through the application of performance standards tailored to the specific restoration, creation or enhancement activity at the bank site or through the use of an appropriate functional assessment methodology.

The success of a mitigation bank with regard to its capacity to establish a healthy and fully functional aquatic system relates directly to both the ecological and financial stability of the bank. Since financial considerations are particularly critical in early stages of bank development, it is generally appropriate, in cases where there is adequate financial assurance and where the likelihood of the success of the bank is high, to allow limited debiting of a percentage of the total credits projected for the bank at maturity. Such determinations should take into consideration the initial capital costs needed to establish the bank, and the likelihood of its success. However, it is the intent of this policy to ensure that those actions necessary for the long-term viability of a mitigation bank be accomplished prior to any debiting of the bank. In this regard, the following minimum requirements should be satisfied prior to debiting: (1) banking instrument and mitigation plans have been approved; (2) bank site has been secured; and (3) appropriate financial assurances have been established. In addition, initial physical and biological improvements should be completed no later than the first full growing season following initial debiting of a bank. The temporal loss of functions associated with the debiting of projected credits may justify the need for requiring higher compensation ratios in such cases. For mitigation banks which propose multiple-phased construction, similar conditions should be established for each phase.

Credits attributed to the preservation of existing aquatic resources may become available for debiting immediately upon implementation of appropriate legal protection accompanied by appropriate changes in land use or other physical changes, as necessary.

7. Crediting/Debiting/Accounting Procedures

Credits and debits are the terms used to designate the units of trade (i.e., currency) in mitigation banking. Credits represent the accrual or attainment of aquatic functions at a bank; debits represent the loss of aquatic functions at an impact or project site. Credits are debited from a bank when they are used to offset aquatic resource impacts (e.g. for the purpose of satisfying Section 10/404 permit or FSA requirements).

An appropriate functional assessment methodology (e.g., Habitat Evaluation Procedures, hydrogeomorphic approach to wetlands functional assessment, other regional assessment methodology) acceptable to all signatories should be used to assess wetland and/or other aquatic resource restoration, creation and enhancement activities within a mitigation bank, and to quantify the amount of available credits. The range of functions to be assessed will depend upon the assessment methodology identified in the banking instrument. The same methodology should be used to assess both credits and debits. If an appropriate functional assessment methodology is impractical to employ, acreage may be used as a surrogate for measuring function. Regardless of the method employed, the number of credits should reflect the difference between site conditions under the with-and without-bank scenarios.

The bank sponsor should be responsible for assessing the development of the bank and submitting appropriate documentation of such assessments to the authorizing agency(ies), who will distribute the documents to the other members of the MBRT for review. Members of the MBRT are encouraged to conduct regular (e.g., annual) onsite inspections, as appropriate, to monitor bank performance. Alternatively, functional assessments may be conducted by a team representing involved resources and regularly agencies and other appropriate parties. The number of available credits in a mitigation bank may need to be adjusted to reflect actual conditions.

The banking instrument should require that bank sponsors establish and maintain an accounting system (i.e., ledger) which documents the activity of all mitigation bank accounts. Each time an approved debit/ credit transaction occurs at a given bank, the bank sponsor should submit a statement to the authorizing agency(ies). The bank sponsor should also generate an annual ledger report for all mitigation bank accounts to be submitted to the MBRT Chair for distribution to each member of the MBRT.

Credits may be sold to third parties. The cost of mitigation credits to a third party is determined by the bank sponsor.

Party Responsible for Bank Success

The bank sponsor is responsible for assuring the success of the debited restoration, creation, enhancement and preservation activities at the mitigation bank, and it is therefore extremely important that an enforceable mechanism be adopted establishing the responsibility of the bank sponsor to develop and operate the bank properly. Where authorization under Section 10/404 and/or FSA is necessary to establish the bank, the Department of the Army permit or NRCS plan should be conditioned to ensure that provisions of the banking instrument are enforceable by the appropriate agency(ies). In circumstances where establishment of a bank does not require such authorization, the details of the bank sponsor's responsibilities should be delineated by the relevant authorizing agency (e.g., the Corps in the case of Section 10/404 permits) in any permit in which the permittee's mitigation obligations are met through use of the bank. In addition, the bank sponsor should sign such permits for the limited purpose of meeting those mitigation responsibilities, thus confirming that those responsibilities are enforceable against the bank sponsor if necessary.

E. Long-Term Management, Monitoring and Remediation

1. Bank Operational Life

The operational life of a bank refers to the period during which the terms and conditions of the banking instrument are in effect. With the exception of arrangements for the long-term management and protection in perpetuity of the wetlands and/or other aquatic resources, the operational life of a mitigation bank terminates at the point when (1) Compensatory mitigation credits have been exhausted or banking activity is voluntarily terminated with written notice by the bank sponsor provided to the Corps or NRCS and other members of the MBRT, and (2) it has been determined that the debited bank is functionally mature and/or self-sustaining to the degree specified in the banking instrument.

2. Long-term Management and Protection

The wetlands and/or other aquatic resources in a mitigation bank should be protected in perpetuity with appropriate real estate arrangements (e.g., conservation easements, transfer of title to Federal or state resource agency or non-profit conservation organization). Such arrangements should effectively restrict harmful activities (i.e., incompatible uses \2\) that might otherwise jeopardize the purpose of the bank. In exceptional circumstances, real estate arrangements may be approved which dictate finite protection for a bank (e.g., for coastal protection projects which prolong the ecological viability of the aquatic system). However, in no case should finite protection extend for a lesser time than the duration of project impacts for which the bank is being used to provide compensation.

\2\ For example, certain silvicultural practices (e.g. clear cutting and/or harvests on short-term rotations) may be incompatible with the objectives of a mitigation bank. In contrast, silvicultural practices such as long-term rotations, selective cutting, maintenance of vegetation diversity, and undisturbed buffers are more likely to be considered a compatible use.

The bank sponsor is responsible for securing adequate funds for the operation and maintenance of the bank during its operational life, as well as for the long-term management of the wetlands and/or other aquatic resources, as necessary. The banking instrument should identify the entity responsible for the ownership and long-term management of the wetlands and/or other aquatic resources. Where needed, the acquisition and protection of water rights should be secured by the bank sponsor and documented in the banking instrument.

3. Monitoring Requirements

The bank sponsor is responsible for monitoring the mitigation bank in accordance with monitoring provisions identified in the banking instrument to determine the level of success and identify problems requiring remedial action. Monitoring provisions should be set forth in the banking instrument and based on scientifically sound performance standards prescribed for the bank. monitoring should be conducted at time intervals appropriate for the particular project type and until such time that the authorizing agency(ies), in consultation with the MBRT, are confident that success is being achieved (i.e., performance standards are attained). The period for monitoring will typically be five years; however, it may be necessary to extend this period for projects requiring more time to reach a stable condition (e.g., forested wetlands) or where remedial activities were undertaken. Annual monitoring reports should be submitted to the authorizing agency(ies), who is responsible for distribution to the other members of the MBRT, in accordance with the terms specified in the banking instrument.

4. Remedial Action

The banking instrument should stipulate the general procedures for identifying and implementing remedial measures at a bank, or any portion thereof. Remedial measures should be based on information contained in the monitoring reports (i.e., the attainment of prescribed performance standards), as well as agency site inspections. The need for remediation will be determined by the authorizing agency(ies) in consultation with the MBRT and bank sponsor.

5. Financial Assurances

The bank sponsor is responsible for securing sufficient funds or other financial assurances to cover contingency actions in the event of bank default or failure. Accordingly, banks posing a greater risk of failure and where credits have been debited, should have comparatively higher financial sureties in place, than those where the likelihood of success is more certain. In addition, the bank sponsor is responsible for securing adequate funding to monitor and maintain the bank throughout its operational life, as well as beyond the operational life if not self-sustaining. Total funding requirements should reflect realistic cost estimates for monitoring, long-term maintenance, contingency and remedial actions.

Financial assurances may be in the form of performance bonds, irrevocable trusts, escrow accounts, casualty insurance, letters of credit, legislatively-enacted dedicated funds for government operate banks or other approved instruments. Such assurances may be phased-out or reduced, once it has been demonstrated that the bank is functionally mature and/or self-sustaining (in accordance with performance standards).

F. Other Considerations

1. In-lieu-fee Mitigation Arrangements

For purposes of this guidance, in-lieu-fee, fee mitigation, or other similar arrangements, wherein funds are paid to a natural resource management entity for implementation of either specific or general wetland or other aquatic resource development projects, are not considered to meet the definition of mitigation banking because they do not typically provide compensatory mitigation in advance of project impacts. Moreover, such arrangements do not typically provide a clear timetable for the initiation of mitigation efforts. The Corps, in consultation with the other agencies, may find there are circumstances where such arrangements are appropriate so long as they meet the requirements that would otherwise apply to an offsite, prospective mitigation effort and provides adequate assurances of success and timely implementation. In such cases, a formal agreement between the sponsor and the agencies, similar to a banking instrument, is necessary to define the conditions under which its use is considered appropriate.

2. Special Considerations for ``Swampbuster''

Current FSA legislation limits the extent to which mitigation banking can be used for FSA purposes. Therefore, if a mitigation bank is to be used for FSA purposes, it must meet the requirements of FSA.

III. Definitions

For the purposes of this guidance document the following terms are defined:

A. Authorizing agency. Any Federal, state, tribal or local agency that has authorized a particular use of a mitigation bank as compensation for an authorized activity; the authorizing agency will typically have the enforcement authority to ensure that the terms and conditions of the banking instrument are satisfied.

B. Bank sponsor. Any public or private entity responsible for establishing and, in most circumstances, operating a mitigation bank.

C. Compensatory mitigation. For purposes of Section 10/404, compensatory mitigation is the restoration, creation, enhancement, or in exceptional circumstances, preservation of wetlands and/or other aquatic resources for the purpose of compensating for unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved.

D. Consensus. The term consensus, as defined herein, is a process by which a group synthesizes its concerns and ideas to form a common collaborative agreement acceptable to all members. While the primary goal of consensus is to reach agreement on an issue by all parties, unanimity may not always be possible.

E. Creation. The establishment of a wetland or other aquatic resource where one did not formerly exist.

F. Credit. A unit of measure representing the accrual or attainment of aquatic functions at a mitigation bank; the measure of function is typically indexed to the number of wetland acres restored, created, enhanced or preserved.

G. Debit. A unit of measure representing the loss of aquatic functions at an impact or project site.

H. Enhancement. Activities conducted in existing wetlands or other aquatic resources which increase one or more aquatic functions.

I. Mitigation. For purposes of Section 10/404 and consistent with the Council on Environmental Quality regulations, the Section 404(b)(1) Guidelines and the Memorandum of Agreement Between the Environmental Protection Agency and the Department of the Army Concerning the Determination of Mitigation under the Clean Water Act Section 404(b)(1) Guidelines, mitigation means sequentially avoiding impacts, minimizing impacts, and compensating for remaining unavoidable impacts.

J. Mitigation bank. A mitigation bank is a site where wetlands and/ or other aquatic resources are restored, created, enhanced, or in exceptional circumstances, preserved expressly for the purpose of providing compensatory mitigation in advance of authorized impacts to similar resources. For purposes of Section 10/404, use of a mitigation bank may only be authorized when impacts are unavoidable.

K. Mitigation Bank Review Team (MBRT). An interagency group of Federal, state, tribal and/or local regulatory and resource agency representatives which are signatory to a banking instrument and oversee the establishment, use and operation of a mitigation bank. L. Practicable. Available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

M. Preservation. The protection of ecologically important wetlands or other aquatic resources in perpetuity through the implementation of appropriate legal and physical mechanisms. Preservation may include protection of upland areas adjacent to wetlands as necessary to ensure protection and/or enhancement of the aquatic ecosystem.

N. Restoration. Re-establishment of wetland and/or other aquatic resource characteristics and function(s) at a site where they have ceased to exist, or exist in a substantially degraded state.

O. Service area. The service area of a mitigation bank is the designated area (e.g., watershed, county) wherein a bank can reasonably be expected to provide appropriate compensation for impacts to wetlands and/or other aquatic resources.

Appendix E: Costs

The following table (**Table 1**) outlines the assumptions used to calculate costs for wetland creation for the onsite alternative locations and for mitigation for the offsite bank alternative.

Table 1. Assumptions for Wetland Creation Costs

PARAMETER	COST	COMMENTS
Site Preparation		
E (excavation)	$\$1.96/m^3$	Excavation to average depth of 1.83 meters.
SD (soil disposal)	$\$2.56/m^3$	Hauling soil with 20 cubic yard truck, 1,000 feet round trip to onsite disposal area.
Wetland Construction		
L (liner)	$\$9.69/m^2$	High Density Polyethylene (HDPE) liner
V (vegetation layer)		2-foot depth
MW (monitoring wells)	1-5% of liner	Conservative estimate of liner to cover existing monitoring wells.
JN (jute netting)	$\$2.19/m^2$	Soil erosion control
EWV (emergent wetland vegetation)	$/acre	General seed mix of emergent wetland vegetation.
WWV (willow/woodland vegetation)	$/acre	General seedling mix of willow/woodland vegetation.
HS (hand seeding)	$608/acre	One worker at $19/hour with 8-hour work day takes 4 days to hand seed one acre.
D (dike)	$24.61/m	8-inch wide concrete dike
WP (water pipe)	$22.54/m	4-inch slotted PVC pipeline
V (valve)	$251 each	4-inch PVC ball valve
P (pump)	$852 each	10 gpm 1/2 hp, centrifugal pump
Maintenance		
F (fencing)	$21.60/m	Chain-link fence
W (weeding)	$5,000/acre	Conservative estimate for woodland vegetation
DI (drip irrigation)	$7,500/acre	
Monitoring		
Y1 through Y5	$3,600/year	Four visits per year plus annual report = $90/hour * 40 hours
Y6 through Y7	$2,800	Three visits per year plus annual report = $90/hour * 32 hours
Y8 through Y9	$2,160	Two visits per year plus annual report = $90/hour * 24 hours
Y10	$720	One visit per year = $90/hour * 8 hours
FR (final report)	$2,880	One report = $90/hour * 32 hours

Source: Spencer (2002), Bertelson (2002), CH2MHill (1999) and RS Means (2000), S&S Seeds (2002).

E1. SITE PREPARATION COSTS

Site preparation involves both soil excavation and soil disposal (**Equation 1**).

For the B Drainage South and C Drainage Alternatives, excavation of soils was calculated for an average depth of 1.83 meters (6 feet), given that the wetland would have gradual bank slopes to a maximum depth of 2.4 meters (8 feet). Excavated soil would be disposed onsite in the PCB landfill area, minus a 0.61-meter (2-foot) layer of backfill to be placed over the lined and excavated pond. For the B Drainage North Alternative, excavation of soil was calculated for an average depth of 0.61 meters (2 feet) for the placement of the liner, given that the natural depression within the central portion of this alternative site would not require extensive excavation and the alternative site would be diked to establish the maximum water depth of 1.83 meters. No disposal of soil for this alternative would be required given that the excavated soil would be used as backfill. The offsite mitigation bank alternative would not require soil excavation or disposal. Site preparation costs are summarized in **Table 2**.

Equation 1.

Site Preparation Cost = (Excavated Soil Volume * E) + (Hauled Soil Volume * SD)

Table 2. Site Preparation Costs

MITIGATION ALTERNATIVE	EXCAVATION		DISPOSAL		COST ($)
	Volume (m^3)	Unit Price ($\$/m^3$)	Volume (m^3)	Unit Price ($\$/m^3$)	
B Drainage North	1,567	1.96	0	2.56	**$3,071**
B Drainage South	70,456	1.96	46,971	2.56	**$258,512**
C Drainage	19,032	1.96	12,688	2.56	**$69,831**
Mitigation Bank	-	-	-	-	**$0**

E2. WETLAND CONSTRUCTION COSTS

The costs for wetland construction considered the lining of the ponds, the protection (i.e., "booting") of existing monitoring wells, connection to onsite surface water source(s), application of jute netting for erosion control, and the purchase and hand-seeding of wetland vegetation seeds/seedlings.

LINER AND MONITORING WELL PROTECTION

The liner and monitoring well protection costs were calculated using the surface area of pond water for each onsite alternative (**Equations 3 and 4**).

Pond water surface area was determined from the conceptual wetlands using the program Arc GIS 8.1, under two constraints 1) a 15-30 meter vegetation buffer and 2) approximately 70:30 ratio of wetland vegetation to pond water. The liner was assumed to be a 60-mil high-density polyethylene (HDPE) liner and would be applied to all onsite mitigation alternative sites. Booting was assumed to 1-5% additional liner cost, depending on the number of existing wells. The mitigation bank alternative would not require lining or monitoring well protection. **Table 3** summarizes liner and monitoring well protection costs for all the alternatives.

Equations 3 and 4.

Liner Costs = (Water Surface Area * L)

Monitoring Well Protection Costs = % Liner Cost

Table 3. Liner and Monitoring Well Protection Costs

MITIGATION ALTERNATIVE	Water Surface Area (m^3)	Liner Unit price ($\$/m^3$)	Boot Monitoring Wells (% liner cost)	COST ($)
B Drainage North	2,568	9.69	5%	**$26,123**
B Drainage South	38,500	9.69	1%	**$376,705**
C Drainage	10,400	9.69	1%	**$101,758**
Mitigation Bank	-	-	-	**$0**

SURFACE WATER CONNECTION

Conservative estimates for the distances from available water sources to the onsite alternative sites were determined using Arc View GIS 8.1 (**Table B2, Distances to Water Source**). Surface water connection costs were calculated using distance to available water sources, length of PVC pipeline needed to transport the water, a pump for uphill pumping where required, a valve, and dike construction (**Equation 5**).

The B Drainage North Alternative would receive water via gravity flow from the proposed 17-acre storm water pond to be built in the RCF Pond footprint (no pumping required) as well as the capped landfills area (which would be collected in the new storm water pond). The B Drainage North Alternative would also involve construction of a concrete dike between the two hills flanking the alternative site. The B Drainage South Alternative would receive water from the new storm water pond and the capped landfills via gravity flow as well as active pumping from the RCRA Canyon area; no dike would be constructed for this alternative. The C Drainage Alternative site would receive water via gravity flow from the RCRA Canyon area; no dike would be constructed. The mitigation bank alternative would not require connection to an onsite water source. **Table 4** summarizes surface water connection costs for all the alternatives.

Equation 5.

Surface Water Connection Costs = (Water Distance * WS) + V + D + P

Table 4. Surface Water Connection Costs

MITIGATION ALTERNATIVE	Pipe Unit Price ($/m)	Valve ($)	Dike ($)	Pump ($)	Cost ($)
B Drainage North	22.54	251	355	-	**$9,917**
B Drainage South	22.54	251	-	852	**$43,949**
C Drainage	22.54	251	-	-	**$19,179**
Mitigation Bank	-	-	-	-	**$0**

JUTE NETTING

Jute netting costs were considered for alternative sites that could potentially require erosion control measures. An erosion control area was calculated using ARC GIS 8.1, considering areas adjacent to steep slopes (i.e., undercut creek banks, exposed hillsides). The jute netting costs were determined from the erosion control area and unit costs for a 200-pound tensile strength geotextile fabric (**Equation 6**).

Erosion control was determined to be necessary for B Drainage North Alternative because of the steeply-sloping, exposed hillsides flanking the site and for the C Drainage Alternative because of the proximity to the incised creek channel. No erosion control would be required for the B Drainage South Alternative or the offsite mitigation bank alternative. **Table 5** summarizes jute netting costs for all the alternatives.

Equation 6.

Jute Netting Costs = (Erosion Control Area * JN)

Table 5. Jute Netting Costs

MITIGATION ALTERNATIVE	Erosion Control Area (m^2)	Unit Price ($/m)	Cost ($)
B Drainage North	1,130	2.19	**$2,473**
B Drainage South	-	2.19	**$0**
C Drainage	2,500	2.19	**$5,472**
Mitigation Bank	-	-	**$0**

WETLAND VEGETATION AND HAND SEEDING

Wetland vegetation costs include the costs of purchasing the emergent wetland seed mix (**Table 6**), purchasing the willow/woodland seedlings **(Table 7)**, and the hand seeding of the wetland vegetation. The ratio of emergent vegetation to willow/woodland vegetation was assumed to be approximately 80%:20% of the total vegetation area within each alternative. **Equations 7 through 9** describe the cost calculations for the wetland vegetation seed/seedlings and the hand seeding.

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The onsite alternatives would all be hand-planted with the 80:20 ratio of emergent wetland to willow/woodland vegetation. The offsite mitigation bank alternative would not require wetland vegetation or hand seeding. **Table 8** summarizes wetland vegetation and hand seeding costs for all the alternatives.

Table 6. Emergent Wetland Seed Mix

Plant Name	$/lb/acre
broad leaved cattail	1.50
narrow-leaved cattail	0.75
umbrella sedge	0.75
California bulrush	5.00
salt marsh bulrush	2.50

Source: Spencer (2002) and Ferren (2002)

Table 7. Willow Woodland Seedling Mix

Plant Name	Unit Price ($/plant)	$/acre
Willow	4	4,000
Sycamore	4	200
Cottonwood	4	280
Elderberry	4	800
Blackberry	4	6,960
Oak	4	200

Source: Spencer (2002)

Equations 7, 8 and 9.

Emergent Wetland Vegetation = Vegetation Surface Area * EWV

Willow/Woodland Vegetation = Vegetation Surface Area * WWV

Hand Seeding = Vegetation Surface Area * HS

Table 8. Wetland Vegetation and Hand Seeding Costs

MITIGATION ALTERNATIVE	Vegetation Area (m^2)	Emergent Wetland Mix ($/lb)	Woodland Mix ($)	Hand Seeding ($)
B Drainage North	5,430	14	4,040	$987
B Drainage South	84,499	212	62,860	$15,361
C Drainage	28,460	71	21,172	$5,173
Mitigation Bank	-	-	-	-

E3. MAINTENANCE COSTS

The maintenance costs include the fencing for protection against cattle grazing activities (**Equation 10**), weeding of the woodland vegetation (**Equation 11**), and drip irrigation of vegetation (**Equation 12**).

The perimeter fencing costs assume the installation of a 6-foot chain link fence to protect created wetlands from cattle grazing. All onsite alternatives would require fencing; the offsite mitigation bank alternative would not require fencing. The weeding costs assume that only the willow/woodland area of each onsite alternative would be weeded for the first year; as mentioned above, the willow/woodland area = 20% of the total vegetated area within each alternative site. The offsite mitigation bank alternative would not require weeding. With respect to drip irrigation costs, it was assumed that only the vegetated area of each alternative site would be irrigated using a timer. No drip irrigation would be required under the offsite mitigation bank alternative. **Table 9** summarizes the maintenance costs for all the alternatives.

Equations 9, 10 and 11.

Fencing Costs = Perimeter * F

Weeding Costs = Willow/Woodland Vegetation Area * W

Drip Irrigation = Vegetation Surface Area * DI

Table 9. Maintenance Costs

MITIGATION ALTERNATIVE	Vegetation Area (m^2)	Fencing Unit Price ($/m)	Weeding Unit Price ($/$m^2$)	Drip Irrigation Unit Price ($/$m^2$)	Cost ($)
B Drainage North	5,430	21.16	1.49	2.24	$25,484
B Drainage South	84,499	21.16	1.49	2.24	$249,855
C Drainage	28,460	21.16	1.49	2.24	$97,841
Mitigation Bank	-	-	-	-	-

E4. MONITORING COSTS

Monitoring costs incorporate both visits to the site and report writing over a 10 year period, beginning 10 years from now (i.e., the projected timeframe through the completion of the cleanup activities on the site). Costs assume four visits/year to the alternative site at $90/hr for years 1 through 5, three visits/year for years 6 and 7, two visits/year for Y8 and Y9 and one visit/year for Year 10 (2002 dollars). It is also assumed that annual reports are written following each monitoring visit. The present value of the monitoring and reporting costs were calculated using a discount rate of 5% per EPA guidelines (U.S., 1988) and over a time period of ten years beginning in 2012.

Assumes one report at the end of each year that requires 8 hrs and a final report that requires 32 hrs (2002 dollars).

Appendix F: Geographic Information System (GIS)

The primary tool used to map the existing onsite wetlands and the wetland mitigation alternatives was ArcView GIS and ArcGIS 8.1. The GIS was used not only in delineating the existing onsite ponds and the extent of vegetation within each pond, but in delineating the wetland mitigation alternatives.

The GIS process began by acquiring the appropriate data layers from the UCSB Map and Imagery Library. These data included a digital orthophoto quad (DOQ) or aerial photo of the site and a thirty-meter digital elevation model (DEM). Themes for the site boundary, existing pond boundaries, and Casmalia Creek were created by digitizing, using the aerial photo as a guide. A vegetation theme of the ponds was added after acquiring and downloading coordinates from a global positioning system (GPS).

Polygons of each wetland mitigation alternative were also added after GPS coordinates were recorded and downloaded after a site visit. By overlaying these polygons to the DEM, it was confirmed that the alternative sites were located in ideal areas of topographic lows. The measuring tool was used to approximate the area and perimeter of each alternative. Based on parameters specifying the appropriate ratio of 70% vegetation to 30% pond habitat, pond polygons were digitized within each alternative and the measuring tool was used to place a vegetation buffer of approximately 15-30 meters around each pond. Finally, the measuring tool was helpful in determining the distance from each alternative to each onsite water source. Themes representing access roads to each of the alternatives was also created using the aerial photo as a guide.

The GIS was used primarily as a tool to aid in the conceptual representation of the wetland mitigation alternatives. While several measurements were derived via this method, those measurements should be considered rough estimates. Furthermore, while the primary data layers used in this analysis were geographically referenced and in the same projection of Universal Transverse Mercator (UTM) nad83, there may be some error associated with our measurements.

Appendix G: Analytic Hierarchy Process (AHP)

Analytic Hierarchy Process, or AHP, is a method for decision-making using pairwise comparisons among criteria at several different levels. Developed over 20 years ago by Dr. Thomas Saaty, it is still a powerful and widely used decision-making tool today. AHP works by breaking decision-making down into many smaller components: goal, criteria, subcriteria, and alternatives. The criteria and subcriteria can then be compared within the same level (i.e. subcriteria are evaluated relative to other subcriteria) based on their individual merits. The comparison itself is designed to reflect the way people actually think in a decision making process, and involves judging if two criteria are equal, or if one is better, and the degree to which one is better than another (weakly better, moderately better, strongly better, absolutely better, etc.)

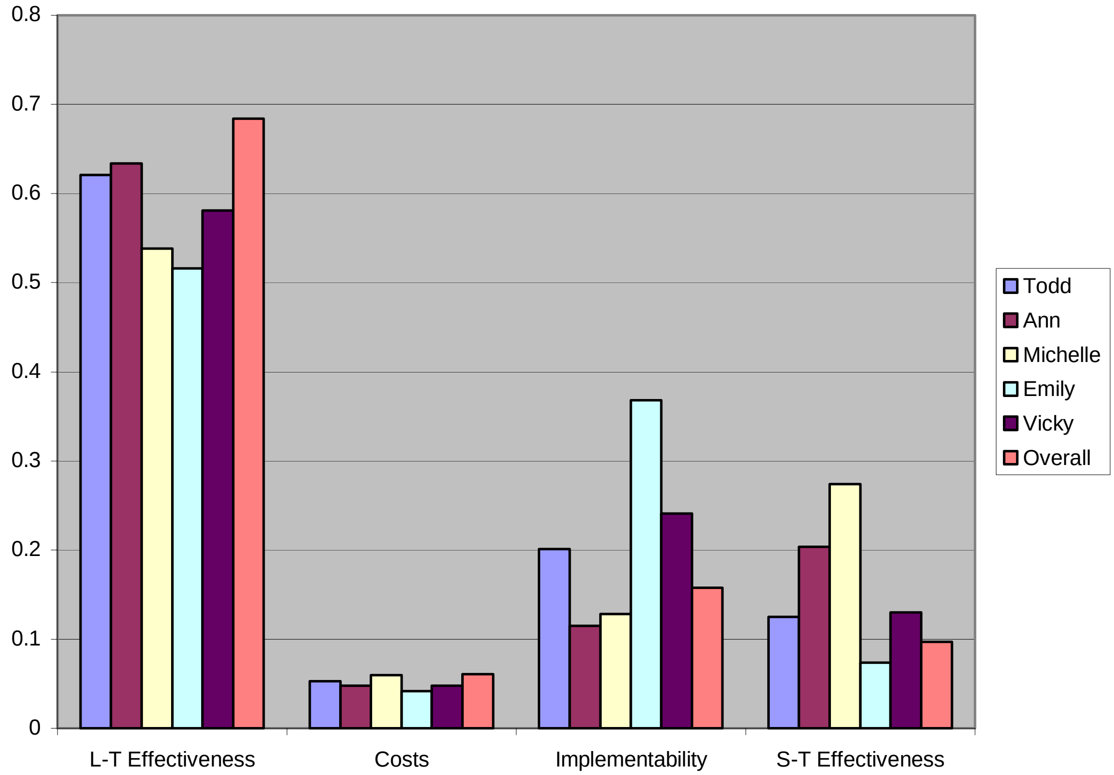
Once the evaluation has been completed, the AHP program synthesizes the weightings of each criteria and how well each alternative performs under those criteria (all determined by the user) to suggest the best suited alternative for meeting the preordained goal. The end results of AHP are defensible, since the decision makers are able to evaluate different aspects of the program to determine how the scoring of each alternative is determined. This provides a clear rationale that the selected alternative truly is the best alternative, based on the user's evaluation of the criteria.

For further information regarding AHP and the Criterium DecisionPlus software used in this project, please refer to the following websites:

http://www.expertchoice.com

http://www.infoharvest.com

Appendix H: AHP Results



Appendix I : CDFG Mitigation Ratio Requirements

Appendix D

California Department of Fish and Game, South Coast Region; Guidelines for Wetland Mitigation

Contributed by William E. Tippets,
Habitat Conservation Supervisor, California Department of Fish and Game, South Coast Region

These ratios should be considered as general guidelines for mitigation for impacts to streams and associated habitat.

1:1	Low-value habitat	E.g., isolated freshwater marsh, unvegetated streams.
2:1	Medium-value habitat	E.g., disturbed mulefat scrub, highly disturbed willow riparian.
3:1	High-value habitat	E.g., willow riparian, possibly with some exotics, rare/unique habitats.
5:1	Endangered species habitat	E.g., mature willow riparian with least Bell's vireo.
5:1	Impacts beyond permitted in the SAA/violations	This can vary, depending on the quality, temporal loss, location, etc., but should have a compensatory factor in addition to the above guidelines of 1:1 to 5:1.

Other considerations:

It is important to consider "no net loss to wetlands." Streams should be considered under this no-net-loss policy to ensure that adequate creation is represented (rule of thumb, a minimum of 1:1 of their mitigation for permanent impacts should include creation). Creation, restoration,

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and/or enhancement could make up the balance of the mitigation measures. Preservation is usually looked at as a recommended avoidance measure, but preservation and protection of significant wetlands can be part of the entire project's measures to be considered. Instances involving lower-quality habitat impacts may be mitigated by nonnative exotic plant removal.

Freshwater marsh restores more successfully than a multilayered willow riparian community, which may have a significant temporal loss component in its mitigation requirements.

Temporary impacts should preferably be restored on-site and should account for mitigation for the temporal loss.

The above ratios consider acreage of impact. Individual tree ratios/requirements can be incorporated as part of the plan to ensure sufficient mitigation. Also, guidelines for impacts to individual mature oak and sycamore trees are mitigated based on the size of tree impacted, at appropriate planting centers and with appropriate native understory. This may require the applicant to obtain additional land beyond that required for the habitat acreage requirement as described above.

Appendix J: Pond Water Quality Measurements

Table J-39

Detected Compounds in the Pond Samples – July 2000

	Station Number: Sample Date: Sample Depth (feet): Sample Number: Lab Batch:	A-Series Pond 07/14/00 30557 200008177		Pond 13 07/13/00 30556 200008106		Pond 18 07/14/00 30558 200008177		Pond A-5 07/20/00 30595 200008447		RCF Pond 07/13/00 30555 200008106	
Test Method/Analyte Name	Units	Value	Qual	Value	Qual	Value	Qual	Value	Qual	Value	Qual
E160.1											
Dissolved Solids @ 180 C	µg/l	8,950,000.	/D	7,550,000.	/D	11,900,000.	/D	12,400,000.	/D	8,900,000.	/D
E300.0											
Bromide	µg/l	129,000.	/D	70,000.	/D	70,000.	/D	142,000.	/D	70,000.	/D
chlorine anion (chloride)	µg/l	2,660,000.	/D	3,490,000.	/D	3,200,000.	/D	3,750,000.	/D	2,640,000.	/D
Nitrate (as NO3)	µg/l	ND(4400)	/UD	ND(4400)	/UD	3,000.	/JD	ND(8800)	/UD	ND(4400)	/UD
Nitrate as N	µg/l	ND(1000)	/UD	ND(1000)	/UD	670.0	/JD	ND(2000)	/UD	ND(1000)	/UD
Sulfate	µg/l	2,880,000.	/D	2,010,000.	/D	3,890,000.	/D	4,370,000.	/D	2,820,000.	/D
E310.1											
Alkalinity as CaCO3	µg/l	95,000.		144,000.		91,000.		82,000.		134,000.	
Bicarbonate Alkalinity as CaCO3	µg/l	70,000.		117,000.		68,000.		49,000.		69,400.	
Carbonate Alkalinity as CaCO3	µg/l	25,000.		27,000.		23,000.		33,000.		30,000.	
E340.2											
Fluoride	µg/l	1,800.	/D	660.0	/B	580.0		890.0		920.0	/B
SM3114B											
Arsenic-D	µg/l	2.0		4.10		ND(2)	/U	ND(2)	/U	3.70	
Arsenic-T	µg/l	2.40		4.50		ND(2)	/U	1.0	/J	4.20	
Selenium-D	µg/l	1.60	/J	3.0		14.0		4.30		1.60	/J
Selenium-T	µg/l	2.20		3.80		17.0		4.50		2.70	
SW3510											
(Z)-9-Octadecenamide	µg/l	NT		NT		25.0	/ND	NT		NT	
3,4-Dichlorobenzoic acid	µg/l	NT		NT		10.0	/ND	NT		NT	
Hexadecanoic acid	µg/l	NT		NT		6.50	/ND	NT		NT	
SW6010											
Barium-D	µg/l	40.0	/JD	400.0	/D	200.0	/D	80.0	/JD	370.0	/D
Barium-T	µg/l	40.0	/JD	80.0	/JD	30.0	/JD	20.0	/JD	50.0	/JD
Chromium-T	µg/l	ND(50)	/UD	ND(50)	/UD	ND(50)	/UD	20.0	/JD	ND(50)	/UD
Copper-D	µg/l	100.0	/D	100.0	/D	330.0	/D	700.0	/D	200.0	/D

Footnotes are at the end of the report

Harding ESE

Table 3-39

Detected Compounds in the Pond Samples – July 2000

Test Method/Analyte Name	Units	A-Series Pond Value	Qual	Pond 13 Value	Qual	Pond 18 Value	Qual	Pond A-5 Value	Qual	RCF Pond Value	Qual
Station Number:		A-Series Pond		Pond 13		Pond 18		Pond A-5		RCF Pond	
Sample Date:		07/14/00		07/13/00		07/14/00		07/20/00		07/13/00	
Sample Depth (feet):											
Sample Number:		30557		30556		30558		30595		30555	
Lab Batch:		200008177		200008106		200008177		200008447		200008106	
Copper-T	µg/l	320.0	/D	290.0	/D	540.0	/D	800.0	/D	330.0	/D
Nickel-D	µg/l	200.0	/JD	310.0	/D	200.0	/JD	200.0	/JD	200.0	/JD
Nickel-T	µg/l	300.0	/JD	300.0	/D	200.0	/JD	200.0	/JD	100.0	/JD
SW7041											
Antimony-D	µg/l	5.0	/JD	ND(8)	/UD	ND(8)	/UD	4.0	/JD	ND(8)	/UD
SW7140											
Calcium-D	µg/l	550,000.	/D	490,000.	/D	600,000.	/D	570,000.	/D	570,000.	/D
SW7421											
Lead-D	µg/l	ND(20)	/UD	ND(5)	/UD	ND(5)	/UD	2.0	/JD	ND(5)	/UD
Lead-T	µg/l	ND(20)	/UD	ND(10)	/UD	ND(100)	/UD	3.0	/JD	ND(10)	/UD
SW7450											
Magnesium-D	µg/l	520,000.	/D	400,000.	/D	760,000.	/D	910,000.	/D	480,000.	/D
SW7470											
Mercury-T	µg/l	ND(0.2)	UJ/BU	ND(0.2)	UJ/U	ND(0.2)	UJ/BU	0.10	/J	ND(0.2)	UJ/U
SW7610											
Potassium-D	µg/l	25,000.	/D	13,000.		51,000.	/D	58,000.	/D	22,000.	/D
SW7770											
Sodium-D	µg/l	1,500,000.	/D	1,400,000.	/D	1,800,000.	/D	1,800,000.	/D	1,500,000.	/D
SW7841											
Thallium-D	µg/l	3.0	/JD	ND(4)	/UD	6.0	/D	ND(4)	/UD	ND(4)	/UD
SW8015											
Diesel Range Organics (C12 - C24)	µg/l	130.0	/JD	91.0	/JD	ND(300)	/UD	75.0	/J	350.0	/JD
SW8260											
(E)-1-Chloro-1-propene	µg/l	NT		NT		NT		1.30	/N	NT	
1,1 Dichloroethane	µg/l	ND(0.5)	/U	ND(0.5)	/U	ND(0.5)	/U	1.10		ND(0.5)	/U
1,1 Dichloroethene	µg/l	ND(0.5)	/U	ND(0.5)	/U	ND(0.5)	/U	0.76		ND(0.5)	/U
1,2-Dichloro-1,1,2-trifluoroethane	µg/l	NT		NT		NT		1.40	/N	NT	
Acetone	µg/l	ND(10)	R*/U	ND(10)	R*/U	ND(10)	R*/U	16.0	J*	ND(10)	R*/U

Footnotes are at the end of the report
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Table 3-39

Detected Compounds in the Pond Samples – July 2000

	Station Number:	A-Series Pond		Pond 13		Pond 18		Pond A-5		RCF Pond	
	Sample Date:	07/14/00		07/13/00		07/14/00		07/20/00		07/13/00	
	Sample Depth (feet):										
	Sample Number:	30557		30556		30558		30595		30555	
	Lab Batch:	200008177		200008106		200008177		200008447		200008106	
Test Method/Analyte Name	**Units**	**Value**	**Qual**	**Value**	**Qual**	**Value**	**Qual**	**Value**	**Qual**	**Value**	**Qual**
Acetonitrile	µg/l	ND(20)	/U	ND(20)	/U	ND(20)	/U	280.0		ND(20)	/U
Benzene	µg/l	ND(0.5)	/U	ND(0.5)	/U	ND(0.5)	/U	0.30	/J	ND(0.5)	/U
Cis 1,2 Dichloroethene	µg/l	ND(0.5)	/U	ND(0.5)	/U	ND(0.5)	/U	0.43	/J	ND(0.5)	/U
Dimethyl sulfide	µg/l	NT		NT		NT		3.0	/N	NT	
Freon 113	µg/l	ND(0.5)	/U	ND(0.5)	/U	ND(0.5)	/U	2.30		ND(0.5)	/U
Isopropanol	µg/l	ND(100)	R*/U	ND(100)	R*/U	ND(100)	R*/U	31.0	J*/J	ND(100)	R*/U
Methyl Chloride	µg/l	ND(0.5)	/U	ND(0.5)	/U	ND(0.5)	/U	0.14	/J	ND(0.5)	/U
Trichloroethene	µg/l	ND(0.5)	/U	ND(0.5)	/U	ND(0.5)	/U	1.50		ND(0.5)	/U
Vinyl Chloride	µg/l	ND(0.5)	/U	ND(0.5)	/U	ND(0.5)	/U	0.18	/J	ND(0.5)	/U
SW8270											
1,1-oxybis_2-Methoxy_ethane	µg/l	4.90	/ND	5.50	/ND	NT		4.50	/N	NT	
1,5-dimethyl-Cyclopentene	µg/l	NT		NT		NT		9.60	/N	NT	
3,4-Dichlorobenzoic acid	µg/l	7.20	/ND	40.0	/ND	NT		NT		NT	
9-Hexadecenoic acid	µg/l	NT		NT		NT		NT		24.0	/N
Benzoic acid	µg/l	3.0	/JD	ND(10)	/UD	ND(20)	/UD	ND(10)	R*/U	2.80	/J
bis(2-Ethylhexyl) phthalate	µg/l	3.80	/JD	1.30	/JD	0.68	/JD	0.36	/J	5.40	
cis-2-Bromocyclohexanol	µg/l	NT		NT		NT		11.0	/N	NT	
Heptadecane	µg/l	5.60	/ND	5.10	/ND	NT		NT		7.60	/N
Hexadecanoic acid	µg/l	10.0	/ND	NT		NT		6.10	/N	37.0	/N
Sulfur, mol (S8)	µg/l	NT		NT		NT		NT		170.0	/N
SW8290											
OCDD	pg/l	ND(0.01)	/U	ND(4.23)	/U	ND(7.79)	/U	7.56		ND(14.5)	/U
SW9012											
Cyanide (Free)	µg/l	ND(20)	/U	ND(20)	/U	7.50	/J	ND(20)	/U	ND(20)	/U
SW9030											
Sulfide	µg/l	ND(200)	/UD	ND(100)	/U	ND(200)	/UD	3,200.		ND(400)	/UD
SW9040											
pH		8.60		8.66		8.46		8.69		8.78	

Footnotes are at the end of the report
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Table 3-39
Detected Compounds in the Pond Samples – July 2000

Comparison Criteria: Casmalia MCL/PRG

Note: Source documents listed in References, Section 5.0

Analyte	Cas Number	MCL/PRG	Units
Acetonitrile	75-05-8	79.000	ug/L
bis(2-Ethylhexyl) phthalate	117-81-7	4.802	ug/L
Nickel-D	7440-02-0-D	100.000	ug/L
Nickel-T	7440-02-0	100.000	ug/L
Thallium-D	7440-28-0-D	2.000	ug/L

Boxed Values: Compound detected at a concentration exceeding criteria

Data qualifiers are shown on Table 3-46.

ND = Not Detected at the specific reporting level shown in parentheses

NT = Not Tested

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Appendix K: Project Brief

CASMALIA WETLAND MITIGATION ALTERNATIVES

By: Emily Bosanquet, Todd Cooper, Ann Hayden, Vicky Krikelas, and Michelle Torrent[12]

PROBLEM STATEMENT

The goal of this project is to provide the U.S. EPA with preliminary wetland mitigation alternatives to compensate for wetlands lost during the Superfund cleanup of the Casmalia Resources Disposal site.

SIGNIFICANCE

The Superfund Program, established to identify and clean up America's most hazardous waste sites and recover cleanup costs from owners and operators of these sites, is currently experiencing an uncertain future due to proposed budget cuts.[13] The Casmalia Site, a former hazardous waste disposal site, is unique due to its environmental value in supporting wetlands with the presence of sensitive species. Therefore, cleanup of this site demonstrates the important need for continued Superfund funding and cleanup implementation.

What is Casmalia?

- **A 252-acre former hazardous waste facility in Santa Barbara County.**
- **Listed as a Superfund site and currently undergoing cleanup activities.**
- **Contains five onsite wetlands (approximately 23.8 acres) that provide wetland function and habitat.**
- **Cleanup activities would destroy onsite wetlands, requiring mitigation under the Clean Water Act and other wetland regulations.**

SITE HISTORY

Located north of Santa Maria in Santa Barbara County, CA., the Casmalia Resources Disposal facility (**Figure 1**) is a Superfund site currently undergoing cleanup activities under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Between 1973 and 1989, the primary owner/operator of the site accepted more than 5.5 billion pounds of hazardous waste, which was treated, disposed, and stored in storage ponds. After operations ceased due to contamination of onsite soil and groundwater, the U.S. EPA initiated cleanup activities, which could potentially involve the draining and removal of sediments from the aforementioned ponds.

[12] Professors Trish Holden and Michael McGinnis, Faculty Advisors.
[13] Seelye, Katharine Q. "Bush Proposing to Shift Burden of Toxic Cleanups to Taxpayers." *New York Times*, February 23, 2002.

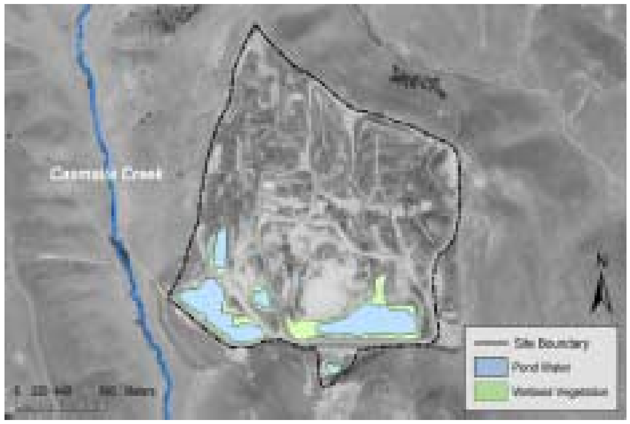

Figure 1. Existing Wetlands of the Casmalia Site
Source: Casmalia Wetland Mitigation Group, 2001

The cleanup activities would effectively destroy the onsite ponds, identified as functional wetlands providing habitat for Federally-listed species and state-listed species (California red-legged frog and western spadefoot toad, respectively), thereby triggering mitigation requirements under the Clean Water Act (CWA) and the national "no net loss" of wetlands policy. Therefore, given the regulatory complexity of the site, an approach was necessary to address the conflict between CERCLA and CWA and other wetland regulations.

APPROACH

The approach taken to address the problem statement is illustrated in the following work flow model (**Figure 2**).

MITIGATION GOAL

The mitigation goal of this project was to create wetlands of similar type, characteristics, functions and values as those of the existing Casmalia site wetlands. Specifically, our goal included creating freshwater emergent wetlands to support the listed species of concern. In addition, the created wetlands would be compensated at a 3:1 mitigation ratio (i.e., 3 acres of wetlands created for every acre lost).

What is the Mitigation Goal?

- **Create freshwater emergent wetlands**
- **Provide habitat for sensitive species**
- **Compensate for wetlands lost at 3:1 ratio (i.e., 3 acres created for 1 acre lost)**

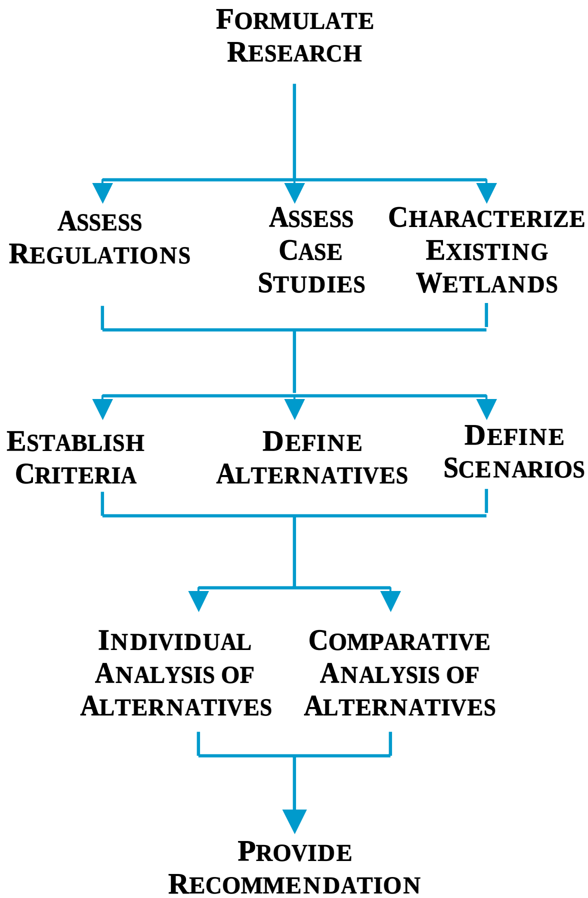

Figure 2. Project Approach

WETLAND MITIGATION ALTERNATIVES

Consultation with project stakeholders resulted in the identification of a no mitigation alternative and three onsite and one offsite mitigation alternatives. The three onsite alternatives are located south of the project site (Figure 3). An environmental characterization and conceptual determination of the available area of each alternative site were performed through a number of site visits and integrated into a Geographic Information System (GIS).[14] The total acreage of each alternative, as well as the description of mitigation within each alternative is summarized in **Table 1**.

SCENARIOS

Given the possibility that one of the five onsite ponds may not need to be remediated, a range of realistic mitigation scenarios was selected. The scenarios range from not draining or mitigating of the wetlands (Scenario 1); the draining and mitigation of four wetlands (Scenario 2); and the draining and mitigation of five wetlands (Scenario 3). No acreage would be mitigated under Scenario 1, while the required mitigation acreage would be 21.1 and 54.4 acres for Scenario 2 and Scenario 3, respectively.

[14] ArcGIS v. 8.1 Software.

Alternatives	Description of Mitigation
No Mitigation Alternative	Existing Casmalia site wetlands are drained but not mitigated.
Onsite B Drainage North Alternative (2 acres)	Wetland creation via diked surface water runoff, planting of emergent wetland and willow/woodland vegetation.
Onsite B Drainage South Alternative (30.4 acres)	Wetland creation via shallow excavation using surface water runoff, planting of emergent wetland and willow/woodland vegetation.
Onsite C Drainage Alternative (9.6 acres)	Wetland creation via shallow excavation near Casmalia Creek using surface water runoff, planting of emergent wetland and willow/woodland vegetation.
Offsite Mitigation Bank (as required)	Purchase of necessary credits at offsite mitigation bank.

Table 1. Description of Wetland Mitigation Alternatives

EVALUATION CRITERIA

To evaluate these alternatives, a set of criteria was developed from a review of wetland mitigation case studies and consultation with relevant agencies. The criteria were adapted from the Remedial Investigation and Feasibility Study criteria under CERCLA, as well as criteria outlined in case studies.

The specific criteria consist of overall protection of human health and the environment, regulatory compliance, short-term effectiveness, long-term effectiveness (e.g., biological, hydrological, and geological components), implementability and cost. These criteria were subdivided into two categories: threshold criteria and primary balancing criteria. Alternatives had to meet the threshold criteria before further analysis under the primary balancing criteria could occur.

Evaluation Criteria

The alternatives were evaluated as to how well they met the following criteria:

Threshold Criteria

- **Overall protection of human health and the environment (OPHH& E); and**
- **Compliance with applicable or relevant and appropriate regulations (ARARs)**

Primary Balancing Criteria

- **Short-term effectiveness**
- **Long-term effectiveness**
- **Implementability**
- **Cost**

ANALYSIS

The six evaluation criteria were used to analyze each wetland mitigation alternative within each of the three mitigation scenarios. After each alternative was qualitatively analyzed, a comparative analysis was conducted to compare the five alternatives against each other. The two-step comparative analysis involved a qualitative comparative analysis and a numerical ranking of alternatives. This analysis served as the basis for assessment through a pair-wise ranking system using the Analytical Hierarchy Process (AHP),[15] illustrating the relative preference for each alternative.

RESULTS

The results of the analytical process provided the sequence of alternatives that best met the criteria critical for successful wetland mitigation (Figure 4). Specifically, the order the alternatives were ranked was: B Drainage South, B Drainage North, C Drainage, and Mitigation Banking. These results reflect the relative importance of each criteria from the AHP, with long-term implementability having the greatest weight and cost having the lowest weight.

RECOMMENDATION

Our analysis highlighted the advantages and disadvantages associated with each alternative within each scenario. In the case of Scenario 2, the B Drainage South Alternative most successfully met the criteria, including the mitigation size requirement. In the case of Scenario 3, the inclusion of all onsite and offsite alternatives would be necessary for the mitigation size requirement to be met. The following sequence of mitigation alternatives is therefore recommended: create wetlands first at B South Alternative, followed by B North

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[15] Criterium DecisionPlus 3.0 Software.

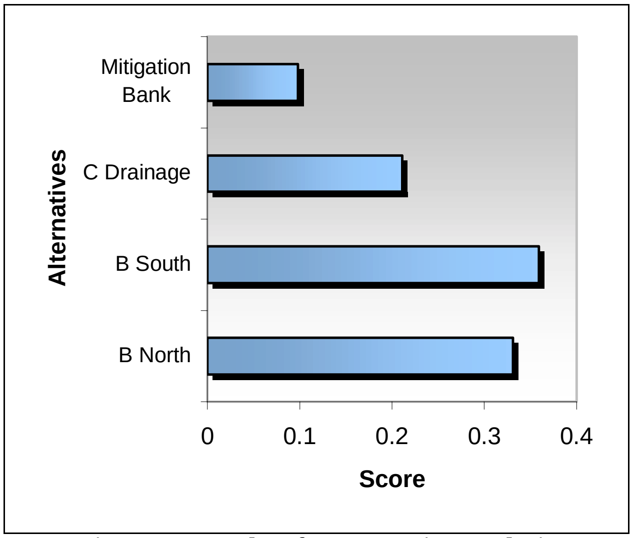

Figure 4. Results of Comparative Analysis

Alternative, and finally C Drainage, with the remainder of any acres to be purchased from the Santa Ynez Mitigation Bank.

FUTURE OUTLOOK

The existing Casmalia wetlands are located on a Superfund site, demonstrating that wetlands can develop in unexpected environments. Currently, wetlands in the United States are being lost at an unprecedented rate.[16] Therefore, in light of the vulnerability of wetlands in general and impending cuts to the Superfund budget for site remediation, compensating for the loss of these particular wetlands is more important now than ever.

This project focused on creating wetlands based on a conservative mitigation size requirement of 3:1. It should be noted there are limitations to such regulatory requirements that were not thoroughly addressed in our analysis. For instance, wetland mitigation regulations often overemphasize quantity over quality, neglecting to adequately replace the functional value of wetlands. Consequently, stakeholders should focus on the importance of wetland function when proceeding with this project.

CONTACT INFORMATION

For additional information on this project, please visit our website:
http://www2.bren.ucsb.edu/~wetlands/.
Comments and questions can be directed to the following e-mail address:
wetlands@bren.ucsb.edu.

[16] Dahl, Thomas E. and Gregory J. Allord. 1994. *Technical Aspects of Wetlands: History of Wetlands in the Conterminous United States.* USGS Water Supply Paper 24-25.