Wetland Mitigation Plan
WENI Area, Smelterville, Idaho

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List of Acronyms and Abbreviations

ARAR	Applicable or Relevant and Appropriate Requirement
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
CFR	Code of Federal Regulations
cfs	cubic feet per second
CWA	Clean Water Act
ET	evapotranspiration
FAA	Federal Aviation Administration
ICP	Institutional Controls Program
IDAPA	Idaho Administrative Procedures Act
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish and Game
IDPR	Idaho Department of Parks and Recreation
ITD	Idaho Transportation Department
M&E	Monitoring and Evaluation
N	Nitrogen
NPDES	National Pollution Discharge Elimination System
O&M	Operations and Maintenance
PWWTP	Page Wastewater Treatment Plant
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
SAP/QAPP	Sampling and Analysis Plan/Quality Assurance Project Plan
SFCDR	South Fork Coeur d'Alene River
SFSD	South Fork Coeur d'Alene River Sewer District
SWPPP	Stormwater Pollution Prevention Plan
TES	Threatened and Endangered Species
TKN	Total Kjeldahl Nitrogen
TSS	Total Suspended Solids
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency

USFWS	U.S. Fish and Wildlife Service
WENI	West End Natural Infiltration
WSE	Water Surface Elevation

SECTION 1.0 INTRODUCTION

Plans are underway for expansion of Page Repository to the west into the area known as West Page Swamp. Page Repository is located west of Smelterville, in Idaho's Silver Valley. Wetlands in West Page Swamp cover 42.8 acres and include four distinct wetland classes. A high-quality potential wetland mitigation site was identified immediately adjacent to West Page Swamp in an area known as the West End Natural Infiltration or WENI Area. The site is owned by Idaho Department of Environmental Quality (IDEQ) and shares many geomorphic and hydrologic characteristics with the West Page Swamp.

This Draft Wetland Mitigation Plan sets the practical and regulatory framework for completion of the mitigation. The United States Environmental Protection Agency (USEPA) Region X and IDEQ share the lead for this project.

Lead Agencies and Contacts:

IDEQ, Bruce Schuld - Lead for Implementation

USEPA, John Olson – Lead for Regulatory Compliance; Clean Water Act (CWA) and Resource Conservation and Recovery Act (RCRA)

USEPA, Anne McCauley – Lead for Funding

SECTION 2.0 PURPOSE AND OBJECTIVES OF THE MITIGATION PLAN

The purpose of this plan is to present a framework for comprehensive wetland mitigation as compensation for wetlands lost during expansion of the Page Repository into portions of the West Page Swamp. Expansion of the repository is necessary to accommodate Institutional Controls Program (ICP) waste generated by residents of the Bunker Hill Box. Expansion justification and alternative analysis can be seen in IDEQ's application for permitting under the CWA, Section 404 (IDEQ 2008).

This proposed plan will summarize past research that has informed the biologic, geomorphic, and hydrologic conditions in both West Page Swamp and the proposed mitigation sites. Practical goals will be set for mitigation, the legal framework will be outlined, and engineering and construction requirements for meeting the mitigation goals will be introduced.

2.1 Mitigation Goals and Objectives

Mitigation goals are driven, in part, by Compensatory Mitigation Legislation (33 CFR Parts 325 and 332) which encourages a "watershed approach" to siting compensatory mitigation. The legislation reads, in part:

"Such an approach considers how the types and locations of compensatory mitigation projects will provide the desired aquatic resource functions, and will continue to function over time in a changing landscape. It also considers the habitat requirements of important species, habitat loss or conversion trends, sources of watershed impairment, and current development trends, as well as the requirements of other regulatory and non-regulatory programs that affect the watershed, such as storm water management or habitat conservation programs. [The] approach should not focus exclusively on specific functions (e.g., water quality or habitat for certain species), but should provide, where practicable, the suite of functions typically provided by the affected aquatic resource."

At Page, the impacts to aquatic and terrestrial wildlife and habitat have been intense due to the history of mining, milling, and smelting in the immediate vicinity. In addition, the risks associated with flooding are extreme due to the proximity of the Page Repository to a major river, several tributary streams, and the town of Smelterville, which contributes stormwater to the wetlands surrounding the repository (Figure 1). A goal of this mitigation project is to do no further harm to these resources, and to improve habitat where possible.

Implementation of mitigation at Page is expected to take place over a number of years as the repository expansion is constructed in phases. This plan focuses on the first phase of mitigation planned for an area immediately adjacent to the impacted wetlands, known as the WENI Area. In addition, expansion plans allow for the continued presence of some wetlands in the West Page Swamp for many years, or, perhaps, indefinitely. Therefore, hydrologic inputs into West Page Swamp cannot be completely diverted for use in the mitigation wetlands.

This mitigation plan includes an additional objective of reducing pollution loads in effluent from the Page Wastewater Treatment Plant (PWWTP) before it is discharged into the South Fork Coeur d'Alene River (SFCDR). Use of treated wastewater in this mitigation design can provide

benefit to the wetlands themselves by allowing for consistent hydrologic inputs while potentially polishing the effluent. Effluent from PWWTP is regularly high in cadmium, lead, and zinc as well as ammonia. The plant's National Pollution Discharge Elimination System (NPDES) permit allows variances on these metals, but a desirable outcome of this project is to reduce the necessity for these variances.

Specific goals for this mitigation plan are as follows:

1. Create approximately 11 acres of new, high-quality, free water surface wetland in the WENI Area.
2. Improve the quality of approximately 4 acres of low-medium quality wetlands currently found in the WENI Area.
3. New wetlands will be planned for eventual class distribution approximately as follows:
    a. 7 acres Palustrine – Emergent
    b. 3 acres Palustrine – Scrub-shrub
    c. 4 acres Palustrine – Forested
    d. 1 acre Palustrine – Aquatic Bed
4. Reduce the nutrient and metals loading of effluent from PWWTP as by at least 5% on the average.

2.2 Siting Requirements

The choice of sites for wetland mitigation is driven primarily by the potential for meeting mitigation goals and requirements and improving overall water quality. Regulatory guidance is provided, and permitting is required.

2.2.1 Watershed Approach

A watershed approach is used in siting wetland mitigation projects whenever possible. The critical features of this approach are that the mitigation wetland is both in the same watershed as the project site and it replaces as many of the functions and values as possible. To this end, the choice of the WENI Area is nearly perfect due to its immediate proximity to West Page Swamp, its similar history, and its comparable soils. Because the hydrology in West Page Swamp is controlled at both the inlet and outlet, the water depth is somewhat consistent and predictable. Likewise, the planned mitigation wetlands will be designed for a series of consistent and controlled water depths. As in West Page Swamp, seasonally high flows will modify these depths, and the design conditions can emulate those in West Page.

2.2.2 Ground and Surface Water Contamination and Monitoring

Because West Page Swamp is located in an area of heavy metals contamination there is ongoing concern about the introduction of further contamination into receiving ground and surface water bodies. Wetland design must consider the overall reduction of metals leachate into groundwater as well as improved surface water quality. Monitoring of groundwater in the area has been underway since 1997, and will be continued with the implementation of the monitoring plan associated with this project. Surface water monitoring was initiated in 2005, and three of the four sites have been sampled three times per year since. Monitoring sites in the project vicinity are

shown in Figure 1. An adaptive management approach will be critical to achieving the goals of this project overall, and especially the goal of reducing contaminant inflow to receiving waters.

2.2.3 Permitting, Hydraulic Analysis, No-rise Certification

A number of permitting requirements must be met to site this mitigation project, the most significant of which is probably under the jurisdiction of the Clean Water Act, Section 404 which requires justification for the filling of wetlands that leads to the need for this mitigation project. In addition, hydraulic analysis will be required to prove that the project will not adversely impact the 100-year floodplain allowing for certification of zero rise in water surface as a result of this project. These and other permitting requirements are discussed further in Section 5 and in an upcoming Surface Water Management Report.

2.3 Public Outreach

A Public Outreach Plan will be developed and implemented starting in Summer 2009.

SECTION 3.0 PROPOSED MITIGATION AREAS

Two potential mitigation sites were investigated in 2008: West Smelterville Flats and the WENI Area. In addition, collaboration with Idaho Department of Fish and Game (IDFG) has been proposed on the Lower St. Joe Habitat Segment of the Coeur d'Alene Wildlife Management Area and with Bureau of Land Management (BLM) on Blue Creek near Coeur d'Alene Lake.

The WENI Area mitigation site is the focus of this report. However, much of the information herein will apply to the other sites as well. West Smelterville Flats is considered the lowest priority of the three alternative sites due to the relatively high value of the existing wetlands and its proximity to Smelterville Airport.

3.1 Existing Conditions of the WENI Area

There are currently approximately 4 acres of existing Palustrine emergent wetland in the WENI Area. The quality of these wetlands varies significantly across the site. Near the east end of this site is an area that is delineated as a jurisdictional wetland but is of very low quality as it is dominated by non-native, invasive *phragmites*. The wetland areas in the remainder of this site vary in quality from low to medium. Low quality wetlands are characterized by a dominance of *phragmites* or a cattail monoculture. The medium quality wetlands show greater diversity in plant communities and higher productivity. The soil quality throughout the WENI Area site is poor as it is comprised of mine waste rock and river sediments. Very little wildlife use is noted in the area at present.

Dissolved metals results from the most recent monitoring events for which we have data (Spring and Fall, 2008) are synopsized in Table 1. Surface water samples were collected in Grouse Creek at BH-GC-0001 and in Humboldt Creek at BH-HC-0001, which both represent incoming surface waters that feed East and West Page Swamps. Metals concentrations are generally low at these sites. Groundwater samples were collected at seven groundwater monitoring wells and five piezometers in the immediate vicinity of Page Repository and the WENI Area mitigation site. Sampling locations are shown in Figure 1.

Table 1. Synopsis of key dissolved metals concentrations near Page in 2008.

Groundwater Sites			Surface Water Sites	
ARSENIC	**Concentration (µg/L)**	**Location of Maximum**	**ARSENIC**	**Concentration (µg/L)**
Average	15.1		Average	0.30
Minimum	0.1		Minimum	0.21
Maximum	59.0	BH-SF-PZ-W-01	Maximum	0.53
CADMIUM			**CADMIUM**	
Average	10.47		Average	3.15
Minimum	0.03		Minimum	0.29
Maximum	56.00	BH-SF-PZ-W-03	Maximum	4.70
LEAD			**LEAD**	
Average	5.56		Average	2.8
Minimum	0.05		Minimum	1.2
Maximum	23.70	BH-SF-PZ-W-07	Maximum	4.2
ZINC			**ZINC**	
Average	3,435		Average	634
Minimum	30		Minimum	39
Maximum	14,900	BH-SF-W-119-U	Maximum	938

3.2 Reference Sites and Indicator Species

Reference sites are used to aid the design process when a similar area is available for emulation. The reference site for this mitigation is the West Page Swamp. It is almost immediately adjacent to the mitigation site, separated only by the Trail of the Coeur d'Alenes (Trail) which sits on the abandoned Union Pacific Railroad grade. The following functions, values, and benefits are to be emulated at the mitigation site.

3.3 Functions, Values, and Benefits of West Page Swamp

Wetlands at West Page Swamp have been delineated and mapped according to classification by U.S. Fish and Wildlife Service (USFWS 2005) in 2005 and again in 2006 (TerraGraphics 2006). All are classified as Palustrine, but have subclasses of Forested, Scrub-shrub, Aquatic Bed, and Emergent. This area is valuable in the Silver Valley, where Palustrine Forested wetlands are rare. Wetland functions, values, and benefits of the West Page Swamp were demonstrated during wetland delineation and characterization (TerraGraphics 2006, 2008).

3.3.1 Native Plant Habitat

Native plants found in West Page Swamp vary by the wetland subclasses described here.

3.3.1.1 Palustrine – Forested and Scrub-shrub

This is a thin leafed alder (*Alnus incana*) forest. The trees are generally about 30 to 40 feet tall. The shrub layer is dominated by spirea (*Spirea douglasii*). The herbaceous stratum is dominated by small-fruited bulrush (*Scirpus microcarpus*) and common horsetail (*Equisetum arvense*). This

area is currently classified as Forested, but was previously classified by USFWS (2005) as Scrub-shrub. The only difference between these two subclasses is the height of the trees. The dominant tree species, *Alnus incana*, is often found as a shrub with a height less than 20 feet. However, these trees are now almost all greater than 30 feet tall. It is common for Scrub-shrub wetlands to become Forested with the passage of time. The scrub-shrub areas in West Page Swamp are found both in independent clumps and along the edges of the Forested areas.

3.3.1.2 Palustrine - Emergent

The emergent subclass is comprised of rooted, herbaceous hydrophytes and is usually dominated by perennial plants. The dominant persistent herbaceous species at this site are small-fruited bulrush (*Scirpus microcarpus*) and common cattail (*Typha latifolia*). Creeping spikerush (*Eleocharis palustris*) and common rush (*Juncus effusus*) are also common. This subclass is dispersed throughout West Page Swamp.

3.3.1.3 Palustrine - Aquatic Bed

The west end of West Page Swamp is mostly an Aquatic Bed wetland dominated by rooted vascular plants such as yellow pond-lily (*Nuphar lutea*) and grassy pondweed (*Potamogeton gramineus*).

3.3.2 Soils

Soils in the West Page Swamp are river sediments and tailings overlain by organic material accumulated since the area was inundated. Hydric soil indicators, or evidence that the soils have been in a wetland environment for an extended period, are occasionally present in the sediments.

3.3.3 Wildlife Habitat

About 140 bird species in North America are dependant on wetlands for survival (Stewart 2007). Many other birds use wetlands during some portion of their life cycle for breeding, nesting, feeding, or cover. Many species use both wetland and upland forested areas for feeding because of the abundance of insects associated with trees. Just a few of the common wetland-dependant bird species that nest in the Page region are the tree swallow, northern rough-winged swallow, savannah sparrow, marsh wren, yellow-headed blackbird, red-winged blackbird, American coot, osprey, and great blue heron. Many of these bird species have been observed in the West Page Swamp.

3.3.4 Other Wetland Functions and Values at West Page Swamp

The original intent of West Page Swamp was to provide wet sequestration of heavy metal contaminants in the extensive underlying tailings deposits. As the swamp has matured it may be helping to improve water quality. For moderate storm events, the swamp system at Page provides flood storage. Finally, West Page Swamp is a scenic area adjacent to the Trail and Interstate 90 providing opportunities for recreation and aesthetic appreciation.

3.3.5 Visual Barrier

The existing linear wetland area along the north side of Page Repository is known as the North Channel. A row of trees growing along this channel helps hide the base of Page Repository from Interstate 90 and the Trail.

3.4 Targets for Future Site Conditions

The primary goal for the future of the WENI Area is to emulate or improve upon the example of West Page Swamp on a smaller scale. The very high-value forested wetlands at West Page will take some years to duplicate in the mitigation site, so the immediate goal is to provide a successional environment that can evolve into a mature, multi-class palustrine wetland system. Greater plant diversity than that found at West Page may be achievable in the mitigation wetland.

Other values will be provided by this site if it is designed, built, and operated with these considerations in mind.

3.4.1 Invasive Plant Control

Several species of noxious or invasive plants have been found in the WENI Area. A successful mitigation design will include specific features for control of these species. Information regarding control of the species of interest is outlined here.

Tansy Ragwort (*Senecio jacobaea)* is a biennial or perennial Idaho Noxious Plant that is common in the WENI Area. Eradication of this plant is likely to be one of the greatest challenges of this project. Control can be accomplished in several ways, but care must be taken to discourage its reemergence. Herbicides can be effective against Tansy Ragwort, but are generally not recommended in wetlands due to decreased effectiveness and risks posed to wildlife. However, a critical step in eradication is to start by stopping all seed production. For this purpose, the use of a foliar herbicide in the spring before construction may be warranted. Mowing is not effective because stems can regenerate during a single growing season. Cultivation can cause increased infestation unless roots are completely removed. This removal could be prescribed as part of construction. In addition, Tansy ragwort is not thought to be tolerant of prolonged inundation, so drowning is possibly the best control option available in this case. Eradication cannot be assured until the production of seeds has been controlled for 15 years, which is the time a seed can remain viable in the soil (Burrill et al. 1994).

Reed Canarygrass *(Phalaris arundinacea)* is present but not widespread at the site, but is likely to re-infest after construction. Control is very difficult, but recent studies have shown that deep shade provided by trees and shrubs (particularly willow) help reduce infestation (Kim et al. 2006).

Common reed or phragmites (*Phragmites australis)* is common at the site. It is thought that both native and non-native genotypes are present in the WENI Area Wetlands; however, field, and possibly laboratory, verification will be required to confirm. The non-native *phragmites* should be eradicated from the site if possible. *Phragmites* is not thought to be tolerant of prolonged flooding, so construction of permanent inundation in areas now infested with *phragmites* may offer control.

3.4.2 Polishing of Wastewater

It is proposed that this pilot project use treated wastewater from PWWTP as the primary hydrologic source for the wetland mitigation. In doing so, it is hoped that some improvement of the quality of this water can be realized before release into the SFCDR. Target removals of metals and nutrients are proposed in Section 4.1.6.

3.4.3 Reuse of Wastewater

A possible additional benefit of this project is the reuse of treated wastewater at Page Repository. Consideration will be given during permitting and development of the Comprehensive Wetland Mitigation Plan for watering the repository for dust control during dry and windy seasons using treated wastewater.

3.4.4 Public Enjoyment

The proposed mitigation site is directly adjacent to the Trail and Interstate 90. Creation of a mitigation wetland will increase the aesthetic value of the site by introducing a greater diversity of plant species that will, in turn, attract wildlife, especially birds.

SECTION 4.0 PROJECT HISTORY AND TARGET CONDITIONS

4.1 Historic and Existing Site Conditions

The Page Repository and PWWTP sit atop an historical flotation tailings impoundment. The berm that contained the tailings now constitutes the lower perimeter of these two facilities (See Figure 1). Tailings were discharged in a slurry into this impoundment from 1926 until 1968. Ownership of the tailings impoundment was transferred to the South Fork Coeur d'Alene River Sewer District (SFSD) in 1972. The area to the west of the impoundment area was also historically used for the discharge of tailings. In this area, reprocessed jig tailings were deposited from about 1918 to 1929.

The property owned by SFSD is surrounded by water courses. Along the north side of the tailings impoundment runs the North Channel, a small conveyance that includes a flow control structure that holds the water surface elevation in the East Page Swamp at a consistent level through much of the year. Soil testing of sediments indicates that metals contamination is not prevalent in the substrate of East Page Swamp. To the west of the impoundment area lies the West Page Swamp which was formed in 2000 by the installation of a water control structure designed to flood the West Page area and sequester contaminants under about 2 feet of standing water. Previous to wet closure, tailings in the west end area (known as the West Bench) were measured to a depth of more than 10 feet. In the remainder of the West Page area, tailings were measured to a depth of greater than 7 feet. In 1997, tailings were removed to a depth of 2.3 feet in the west end of the site. From 1997 to 2000, soils in this region were amended with bio-solids and wood ash as part of a University of Washington research project.

The PWWTP was constructed in 1974 and consists of four aeration lagoons, a stabilization pond, access road, and a process building located on top of the tailings impoundment. The ponds are unlined and the amount of seepage loss has not been firmly established. A force main collection pipe is buried along the north slope of the impoundment.

4.1.1 Remedial Actions taken in WENI Area

In 1998, the WENI Area was created by excavation of contaminated materials to a depth of 6 feet, reshaping with clean material, and addition of 6 inches of growth media. Little evidence remains of imported top soil at this site.

4.1.2 Surrounding Land Uses

The proposed wetland mitigation site is a narrow east-west strip of property owned by IDEQ (See Figure 1). It is bordered on the north by Interstate 90 and on the south by the Trail, which is owned by Idaho Department of Parks and Recreation (IDPR). Immediately east of the site is some infrastructure for the PWWTP owned by the SFSD and a stormwater outflow culvert from the City of Smelterville. Immediately to the east are the treatment lagoons and infrastructure for the Smelterville Sewer District. The west end of the proposed mitigation site narrows to a constriction point where Old Highway 10 and the Trail pass under Interstate 90. North of Interstate 90 is the region known as Smelterville Flats which includes several hundred acres of floodplain and wetland owned by the State, the US Forest Service, Shoshone County, and others.

The Shoshone County Airport is located along the southern side of Smelterville Flats. South of the Trail lies West Page Swamp. Immediately east of West Page Swamp is Page Repository and the treatment lagoons for PWWTP. East Page Swamp lies to the east of the treatment lagoons, and the City of Smelterville is immediately east of the swamp.

The entire region has been highly impacted by over 100 years of mining activity.

4.1.3 Hydrology

The proposed mitigation site lies within the 100-year floodplain of the SFCDR. A review of hydrologic implications of the first phase of proposed repository expansion was presented in TerraGraphics (2009).

4.1.3.1 Contributing Watersheds

The Page area is regularly hydrated by two side drainages, Grouse Creek and Humboldt Creek, and potentially periodically flooded by the SFCDR and other upstream tributaries. Grouse Creek flows out of the mountains to the south and into the City of Smelterville where it has been diverted to the west and into East Page Swamp. East Page Swamp is controlled by a berm near the northeast corner of Page Repository and PWWTP, and then flows into the North Channel and into West Page Swamp. Flows in the North Channel usually fall to zero during the summer months. The channel tends to remain wet even during these no-flow months due to surface expression of groundwater. The 100-year return interval peak flow in Grouse Creek is estimated between 63 and 104 cubic feet per second (cfs) (TerraGraphics 2009).

Humboldt Creek contributes to both East and West Page Swamps. This creek also runs dry most summers. The 100-year return interval peak flow is estimated between 171 and 227 cfs (TerraGraphics 2009).

The proposed plan for the WENI Area includes construction of two or more bridges on the Trail allowing flow from the North Channel and West Page Swamp to interact at certain water levels with the WENI Area.

Humboldt Creek flows out of the south hills and into a channel along the south side of Page Repository and into West Page Swamp. Some of the discharge from Humboldt Creek flows periodically in a drainage ditch along the south side of Old Highway 10.

4.1.3.2 Water budgets for Wet, Dry, and Typical years

An optimal flow rate of 3 cfs for wetlands in the WENI Area has been calculated based on a total retention time of 6 days and a wetland surface area of 15.3 acres using Equation 1.

$$Qo = Qi + Qs + Qsm + Qc + A(P - ET - I) - Qb \qquad \textbf{Equation 1}$$

Where:

Qo = Outflow Rate (cfs)
Qi = Inflow Rate from PWWTP (cfs)
Qs = Stormwater Inflow (cfs)
Qsm = Snowmelt Rate (cfs)
Qc = Catchment Runoff Rate (cfs)

A = Wetland Surface Area (square feet)
P = Precipitation Rate (ft/s)
ET = Evapotranspiration Rate (ft/s)
I = Infiltration Rate (ft/s)
Qb = Bank Loss (cfs)

This calculation provided an estimate of flow rate on a monthly basis assuming the use of treated wastewater. Inflow rates were calculated for wet, dry, and average years from PWWTP outflow data. Stormwater inflow has not been estimated on a monthly basis, but is assumed to be zero during summer months. Snowmelt and catchment runoff rates were assumed to be zero because of the small catchment area of the WENI Area. Precipitation was provided by local gauging in Kellogg. Evapotranspiration was estimated using a pan evaporation model. A net negative infiltration rate was estimated from groundwater modeling performed in the area by CH2MHill for USEPA (Lawson 2009). Bank loss was assumed to be zero.

These estimates indicate that the optimal flow rate can be met or exceeded in an average or wet year in winter and spring months by flows from PWWTP but flows are lower than optimum in July-October. In addition, evapotranspiration can be expected to increase during those months causing a very small net water loss in the wetlands in May through September. The lowest average inflows of 2.2 cfs occur in September and October. During a dry year, inflows from PWWTP drop below the optimal rate in June and remain low through November. These flows cannot be expected to be augmented by stormwater, as stormflows during these summer months are generally very low. However, designs should allow for some sharing of flows from the North Channel and the West Page Swamp to ensure that minimum water depths are maintained in both the mitigation and West Page Swamp wetlands.

4.1.4 Soil type and sources

The Page repository area was historically used specifically for jig tailings impoundment. The region and its waterways have been subject to considerable contamination and alteration from their natural states by mining activities. The soils in the WENI area are comprised of river sediments and mine waste material overlain by a thin (in most places less than 4 inches) organic layer. Soil is very rocky, and orange to yellow in color. Redoximorphic features are rare, but occasionally discernible. Soil testing should be conducted to determine the fertility and contaminant concentrations in this substrate in order to inform design specifications for the import or augmentation of soils to support wetland vegetation.

Further research is required to determine best sources for imported soil for this mitigation project.

4.1.5 Needs of Selected Vegetation

4.1.5.1 Palustrine – Forest and Scrub-shrub

Thin leafed alder (*Alnus incana*) prefers moist sites along margins of ponds and creeks. This tree is not drought tolerant but will tolerate brief inundation. It grows best in well drained, moderately fertile soils.

Spirea (*Spirea douglasii*) grows in moist areas, swamps, lake margins, and damp meadows. It tolerates inundation well and prefers organic soil.

Booth's Willow (*Salix boothii*) grows well in wet sites, but has some drought tolerance. It grows in low fertility soil.

Drummond Willow (*Salix drummondiana*) grows best in medium fertility soil and prefers a wet site. Roots must be kept wet throughout the growing season.

Coyote Willow (*Salix exigua*) needs a sunny and permanently moist site.

Peachleaf Willow (*Salix amygdaloides*) needs a sunny and permanently moist site. It will tolerate flooding, but should be planted in a site where the water table varies and is, at least part of the season, below ground surface. This is a good shade tree, so it should be used heavily in areas where reed canarygrass threatens to recolonize.

Redosier dogwood (*Cornus sericia*) prefers rich, moist soils with pH range of 5.5 to 7.0 and high levels of mineral nutrients. It will tolerate flooding and is often one of the first shrubs to invade wet meadows. It can live with the roots submerged in water for most of the growing season. It is an early to mid successional species that is suppressed in shade and is not normally found in the understory of closed canopy forests. It is found in the understory of mixed open forests.

4.1.5.2 Palustrine - Emergent

Small-fruited bulrush (*Scirpus microcarpus*) will grow in shallow water. It transplants well and prefers sunny exposure, but will grow in partial shade. It will grow in most soil types and pH ranges.

Common cattail (*Typha latifolia*) is an early successional species in wetlands. It will quickly colonize, especially on exposed, permanently saturated, mineral soils of moderate fertility. As water levels fluctuate, cattail may give way to sedge and bulrush species. Cattail should not be planted extensively, but allowed to colonize in the mitigation wetlands. It can be an aggressive plant, so careful monitoring of competition by neighboring species will be important. Cattail is beneficial in the removals of nutrients in a wetland.

Creeping spikerush (*Eleocharis palustris*) will grow in permanent water up to 3 feet deep, and will survive after water table drops below ground surface in the late season. It transplants well, and plants should be spaced 1-2 ft apart. It is tolerant of a range of soil types and pH.

Common rush (*Juncus effusus*) grows in full sun to partial shade in wet, slightly acidic soils. It grows best in areas that are periodically flooded, but can withstand some drying and inundation up to about 3 inches.

Beaked sedge (*Carex rostrata*) grows in shallow water and transplants well. It is adapted to most soil types. It should be planted in independent clumps, as it will dominate within a small area.

4.1.5.3 Palustrine - Aquatic Bed

Yellow pond-lily (*Nuphar lutea*) is a submerged floating forb and requires slow-moving or standing water 3 to 5 ft deep. It is highly favored by many in the wildlife community.

Grassy pondweed (*Potamogeton gramineus*) is also a submerged floating forb that is suited to shallower standing or slow-moving water.

4.1.6 Plant Quantities

The planting requirements for successful mitigation are, in part, dependant on the planned timing for proof of efficacy. In short, the more seedlings planted, and the bigger the seedlings planted in the first two years after construction, the shorter the time to successful wetland function. Plant establishment and hydrology are the two most important factors in successful wetland mitigation. It is estimated that a minimum of 75,000 seedlings at an approximate cost of $165,000 will be required during the first two years after construction. Clump plantings of sedges, rushes, and small woody plants may also be available for harvest in the repository expansion site. This transplanting method can have a very high success rate if plants are kept well hydrated after harvest, transplanted expeditiously, and watered in well upon transplant.

Seeding and mulching of both wetland and dike areas will be required immediately after construction. Typically, an easily established annual grass seed will be mixed with seeds for persistent species and broadcast over much of the construction site for stabilization. An estimate for seeding and mulching cost after construction is approximately $13,000.

4.1.7 Wastewater constituents

The effluent from PWWTP is periodically high in nitrogen, phosphorous, and some metals. Removal mechanisms for nitrogen in wetlands include plant uptake/harvest, nitrification/denitrification, volatilization, and ion exchange. Denitrification can sometimes be achieved with the greatest impact and least cost, and results from careful design of sequential wetlands.

Phosphorus removal in wetlands follows a seasonal pattern where plants uptake and store phosphorous during the growing season and release most of it back into the water column during senescence. The mechanism for phosphorous removal is complex and involves several forms of phosphate, but generally involves vegetation and periphyton uptake and sediment accretion. The process is limited if plants are not regularly harvested as the substrate media can provide only limited adsorption. Phosphorous in the effluent of PWWTP is highest during the summer months, so it is possible that a small reduction in total phosphorous can be realized at the WENI Area during the summer months, although a total annual reduction is less likely.

Reasonable expectations for annually averaged water quality improvements as a result of wetland treatment include 10% – 50% decrease in BOD and 10% – 50% decrease in TSS. Documented removals of cadmium, lead, and zinc are highly variable, and reductions in total phosphorous may be elusive in the long run.

SECTION 5.0 REGULATORY COMPLIANCE

This section describes how various features of this mitigation plan comply with Applicable or Relevant and Appropriate Requirements (ARARs) that have been identified for this pilot project.

5.1 Compliance with ARARs

The Coeur d'Alene Basin Record of Decision (ROD) (USEPA 2002) contains ARARs that are pertinent to the Page wetland mitigation project. The following presents the substantive compliance of this project with these ARARs. Appendix A contains the list of the pertinent ARARs and for each ARAR: 1) citation, 2) a brief description, and 3) comments about where the ARAR will be addressed in mitigation documentation. In addition, the discussion below provides information about the general ARARs categories addressed.

5.1.1 Water Quality ARARs

To ensure that there are no adverse effects on the SFCDR, a Stormwater Pollution Prevention Plan (SWPPP) will be developed based upon the sediment and erosion Best Management Practices (BMPs); Stormwater discharges into the SFCDR will be minimal because the final mitigation design will include sediment and erosion controls to prevent discharge of sediment during and after construction. Inflows to the system can be almost completely regulated by regulation of wastewater inputs, so the system can be rewatered after construction in a manner that promotes revegetation and controls erosion and sedimentation. Stormwater during construction will be managed on-site using temporary berms and stormwater collection areas within the construction zone. The SWPPP will provide compliance with the Idaho Non-Point Source Management Plan as well as USEPA administered water quality permit programs.

The mitigation is not expected to impact metals concentrations in groundwater beneath the site. Because groundwater contamination is not expected to occur, liners are neither necessary to comply with these ARARs, nor desirable from an ecological standpoint. The monitoring activity that will be performed at groundwater wells in and surrounding the site is outlined in Section 6.2, and a comprehensive Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP) will be developed and approved before monitoring activities are started.

5.1.2 Wetlands and Floodplains

Regulated wetland areas were delineated within the mitigation project boundary. Incorporation of existing wetlands into the final mitigation design will require the implementation of stormwater BMPs during construction to minimize the potential for sediment runoff to the existing regulated wetland areas. Some existing wetlands in the WENI Area may be altered for optimal design. These alterations will be addressed in the Stream Channel Alteration permit.

5.1.3 Stream Channel Alteration

The wetlands, channels, and floodplains associated with existing and design conditions at the WENI Area have been modeled and will be finalized in a Surface Water Management Report.

The report will include potential impacts during flooding events and as a result of changes in base flow when treated wastewater is introduced into the WENI Area.

If approved, the mitigation plan may require diverting Grouse Creek from the North Channel into the WENI Area, and then back into the West Swamp. The designs for this diversion will be submitted to the US Army Corps of Engineers, Idaho Department of Water Resources and the IDPR for the appropriate approvals.

5.1.4 Native American and Cultural Resource Protection

Cultural Resources protection will be addressed as part of the Public Outreach Plan. Idaho State Historic Preservation Office will be included as one of the interested entities in the Public Outreach Plan.

5.1.5 Encroachment Permits and Access Agreements

Idaho Transportation Department has established an encroachment permitting process for approaches or other proposed encroachments which may be required for any work adjacent to Interstate 90 and Old Highway 10.

IDPR must be contacted to determine the extent of the Trail right of way in the WENI Area before final design is commenced. In addition, IDPR will be engaged to obtain access agreements to cross the Trail during construction and to install bridges.

Access agreements must be secured with Smelterville Sewer District and SFSD for temporary and permanent access from K Street to the site.

5.1.6 Threatened and Endangered Species (TES)

No TES will be impacted by construction of this mitigation wetland. Critical bulltrout habitat does not extend into the SFCDR, and negative impacts to downstream water quality are not expected. It may be necessary to consult with USFWS for concurrence. This process will serve to comply with Idaho Administrative Procedures Act (IDAPA) Rules Governing Classification and Protection of Wildlife.

5.1.7 Migratory Bird Treaty

USFWS will be notified when migratory bird nest(s) are identified in areas that are planned to be cleared. If a nest is observed, the site will be flagged and USFWS will be notified. During the active nesting season, if clearing is planned, coordination will be done with USFWS. Reasonable efforts will be made to schedule construction with minimal impacts to nests during the nesting period by scheduling clearing activities in consultation with USFWS. The mitigation will be implemented in a manner that avoids the taking or killing of protected migratory bird species, whether individual birds or their nests or eggs, including Tundra Swans.

5.1.8 Control of Air Pollution in Idaho

Dust control measures during construction will be included in construction BMPs. No air pollution impacts are anticipated as a result of the completed project.

5.1.9 Hazardous Wildlife Attractants Near Airports

It is the responsibility of the public-use airport operators to follow procedures for wildlife hazard management. However, as a matter of policy, the Federal Aviation Administration (FAA) encourages operators of public-use airports and/or proponents of land-use changes (including wetlands) to notify the FAA as early in the planning process as possible if the proposed land use practice change may attract hazardous wildlife within 5 statute miles of the airport. Since the proposed mitigation site is within 1,000 ft of the Shoshone County Airport, it is recommended that IDEQ notify the appropriate FAA Regional Airports Division Office of the proposed land-use change. This can be done using FAA Form 7460-1, Notice of Proposed Construction or Alteration. Included in this notification should be a 15-minute quadrangle map of the area identifying the location of the proposed activity as well as information regarding specific details of the proposed land-use change.

SECTION 6.0 COMPONENTS OF THE COMPREHENSIVE MITIGATION PLAN

A comprehensive mitigation plan will be developed and will include wetland system design, monitoring and evaluation (M&E) planning, operations and maintenance (O&M) planning, a project timeline, and task-specific cost estimates. This Following is a list of steps required to complete the comprehensive mitigation plan.

6.1 Conceptual Design

A conceptual plan for this mitigation project has been developed and will be followed with detailed design drawings and specifications. Included will be concepts for hydrologic conditions and controls, grading and dike construction, bridges, soils, planting, control of invasive plant species, public access and restriction, construction BMPs, and construction scheduling and oversight.

6.1.1 Hydrologic Modifications

The preliminary design for mitigation wetlands at the WENI Area can be seen in Figure 2. The plan consists of three wetland cells separated by berms designed to control flow rates and water surface elevations during varying runoff events and to facilitate flow measurement. If necessary after monitoring, these inter-cell berms can be modified for management of hydraulic retention and flow.

Two options are proposed for hydration of the WENI Wetlands. The preferred alternative is to use treated wastewater from PWWTP to maintain a minimum water surface profile throughout the year. An alternative proposal is to allow flow between the West Page Swamp and the WENI Area. This alternative will be more subject to seasonal variation, and will not provide as much water overall as the preferred alternative. Preliminary modeling exercises have shown that either alternative is viable. In both cases, most of the flow from the North Channel (Grouse Creek) will be diverted under the Trail and into the WENI Wetlands.

6.1.2 Preliminary Wetland Configuration

Flow from Grouse Creek, storm water and/or treated wastewater enter the first cell through an inlet structure designed to distribute the flow across the width of the wetland. The inlet will feed directly into an aquatic bed wetland in the first cell. The aquatic bed in the first cell is approximately one acre in area and will support standing water up to 6 ft deep throughout the year. The primary purposes for this standing water are to support settling of solids and to inhibit the common reed (*Phragmites*) that now grows extensively in this portion of the site. This aquatic bed wetland will be sparsely populated with floating vascular plants such as yellow pond-lily (*Nuphar lutea*) and grassy pondweed (*Potamogeton gramineus*). Moving westward, the grading will become considerably shallower in order to establish emergent wetlands planted with herbaceous wetland plants such as small-fruited bulrush (*Scirpus microcarpus*) and creeping spikerush (*Eleocharis palustris*). This area will also support some common cattail (*Typha latifolia*) and hardstem bulrush (*Scirpus acutus*) which are highly effective for metals and nutrient removals. Areas where reed canarygrass is likely to re-infest should be heavily planted

with leafy shrubs such as native willow species (*Salix boothii, S. drummondiana, S. exigua, S. amygdaloides*), redosier dogwood (*Cornus sericia*), and spirea (*Spirea douglasii*) to provide heavy shade.

The margins of the emergent subclass will be shallower and will be managed to support scrub-shrub and forested subclasses. The scrub-shrub areas will be planted primarily with S*pirea*, thin leafed alder (*Alnus incana*), and willow (*Salix spp.*). The forested class will be planted with thin leafed alder and willow species. It is expected that these two wetland classes will share many characteristics, and, as time goes by, the understory in the forest will become more vegetated with several species of bulrush (*Scirpus spp*.), and the alder in the scrub-shrub wetland will mature into forest.

The three wetland cells will be separated by earth berms designed to control water surface elevations and flow rates. Wetland margins will be irregular in shape and will include surface features to prevent short circuiting of water through the system.

6.1.3 Grading

It is important for grading plans for the wetlands, dikes, and flow control berms to include a lot of diversity in shape and depth. It is critical that the grading plan be designed to avoid short-circuiting of flow as well as establishment of highly variable margins for optimal wetland health and diversity.

6.1.4 Inlet and Outlet Control Structures

Three or four control structures are required in this wetland: an inlet, an outlet, and flow control within the wetland. This conceptual design includes two flow control berms within the wetland to provide more management opportunities and options. The undulating surface of the flow control berms will provide various water pathways for different flow rates and water stages during runoff events.

The inlet control structure should allow for dispersal of the inflow across the width of the wetland. Flow bypass should be provided to divert excess flow to an alternative path.

An existing culvert under I-90 is planned for use as the outflow conveyance and will discharge the flow into the SFCDR. Flow measurement capability at the discharge location will greatly enhance effectiveness monitoring allowing for long-term assessment of losses to evapotranspiration and seepage and gains from groundwater inflow.

6.1.5 Bridges

Bridges in the Trail may be provided to allow water from Grouse Creek in the North Channel into the WENI Area and to allow flow at various stages between the WENI Area and West Page Wetlands. Proposed bridge locations are shown in Figure 2.

6.1.6 Soils

The capacity of the soil substrate to remove and retain nitrogen, phosphorus, and metals contamination is a function of both the redox potential of the soil and the extent of soil-water contact in the wetland. Silt or loam soils have a finer texture and lower porosities than soils high

in sand or gravel promoting longer contact times. A silty loam soil high in well decomposed organic matter is essential for plant growth, microbial activity, and pollutant removals. If only low-fertility topsoil is available for construction, it should be amended with compost during construction of the wetland.

6.1.7 Planting Plan

Planting is a critical element for successful wetland establishment. Generally, the more plants introduced initially, the better opportunity the wetland will have for quick success. Ideally, planting should be conducted in the spring to early summer and water levels appropriate for early development introduced as soon as possible. However, construction schedules rarely allow for this luxury, and planting is often completed in the fall. In this case, it will be necessary to use erosion control fabric on all planted slopes and high-quality mulch on flat planted surfaces. Irrigation may be recommended during the first season after plantings. Reintroduction of water should be controlled and closely monitored to avoid adverse impacts to plants and water quality.

A final planting plan will be included in construction plans and specifications. It will likely include harvest and transplant of sedge and woody clumps from West Page Swamp, broadcast or hydromulch seeding, hand mulching, and planting of nursery stock sized from 20 cubic inches to 2 gallons. Specific plant and seed species will be specified in relation to water surface elevation and wetland type. A second year of planting will be planned to account for mortality during the first year after construction.

6.1.8 Plans to Control Invasive and Noxious Species

The final design must include the elements necessary to discourage the re-establishment of noxious species. Methods may include mowing, scalping, cultivation, hydration and flooding, and shade from over-story vegetation.

6.1.9 Public Access/Restriction Plan

Direct public access to the mitigation site will be restricted by fencing. However, public enjoyment is an important value of this site as it will provide improved scenery and wildlife viewing from the adjacent section of the Trail.

6.1.10 Construction BMPs

All earth work should be done during the driest part of the year. Standing water should be avoided in areas where high-quality wetlands are already established, but should be drained or pumped from ditches and low quality areas before earthwork commences. Areas subject to storm runoff must be protected appropriately as outlined in the SWPPP.

6.1.11 Construction Schedule

A construction window may be established by permitting agencies. The best conditions for minimal disturbance of existing wetlands will be found during the summer months. Earthwork and plumbing should be completed as early in the summer as possible in order to allow plants maximum establishment time before senescence.

6.1.12 Construction Oversight

Many contractors do not have experience building wetlands. The earthwork has considerations that are not typical in the construction industry. For this reason, it is critical that a wetlands expert with experience in construction oversight and a clear understanding of the project goals and objectives be on site during construction activities. Construction plans, specifications, and field layout must portray to the contractor the desired work. However, if appropriate oversight is available for the extent of the construction, plans and specifications can be less detailed allowing for modifications as conditions dictate. This situation lends itself well to a time and materials contract avoiding costly and time-consuming change orders.

6.2 Monitoring and Evaluation (M&E)

The goal of monitoring should be to review efficacy of the desired systems, functions, and values of the mitigation site, and to provide guidance for O&M to apply adaptive management techniques for adjustment and fine tuning the system for maximum performance. As this is proposed as a pilot project, the M&E Plan must include criteria for evaluation of both efficacy of the wetland mitigation and wastewater treatment. In addition, impacts on surrounding surface and groundwater bodies must be evaluated for quality and quantity changes. Finally, monitoring of the hydrologic and hydraulic functions of the mitigation site is required to make any adjustments necessary for improving performance of the wetlands. Goals for monitoring are to:

- provide data for improved operations,
- identify problems, and
- determine compliance with regulatory requirements.

6.2.1 M&E Plan

An M&E Plan will be developed during the design phase and will designate each of the program features outlined above. In addition, the plan will outline required analysis and reporting of the results from these events. To evaluate the performance of the system the following metrics for optimal wetland performance will be determined:

- hydraulic loading rates,
- inflow and outflow volumes,
- water quality changes between inflow and outflow, and
- excursions from normal operating conditions.

In addition, the monitoring plan will delineate criteria for success and efficacy of the project, measureable performance standards, and schedules and durations for monitoring and evaluation events.

6.2.1.1 Monitoring of Wetland Mitigation

The primary performance standard for mitigation will be how well the functions and values of wetlands in West Page Swamp are emulated in the WENI Area. Three monitoring activities are proposed for this standard:

- Photo points established before construction and monitored periodically at the same location, angle, and resolution,
- Qualitative periodic survey for weed infestation, sparsely vegetated areas, and vegetation health, and
- Wetland delineation and classification mapping should be done periodically, but less often than the other two activities to determine whether the target wetland species and hydrologic regimes are dominating for designed wetland classes.

6.2.1.2 Water Quality

Monitoring of nutrient and metals loading of inflows and outflows will indicate the performance of surface water treatment benefits of the wetland system. These data will also be required to prove regulatory compliance. In addition, it will be important to monitor long and short term changes in groundwater at and near the wetland site to determine whether groundwater quality is being impacted and to determine any changes in near-surface recharge.

There are currently eight groundwater monitoring wells and four surface water monitoring sites in and around the WENI Area (Figure 1). In addition, there are five temporary groundwater piezometer installations, three of which are within the proposed WENI Wetland boundary. These piezometers are currently planned for decommissioning in the near future. The Page Group has requested that they be continued for long-term monitoring at this site. The monitoring wells have been monitored at least semi-annually for the last several years for depth to water, an array of total and dissolved metals, hardness, and some field parameters such as Temperature, pH, and Dissolved Oxygen (DO).

The following constituents are being monitored at the outfall of PWWTP for compliance with the plant's NPDES permit.

- BOD5
- TSS
- pH
- E. coli
- Total Ammonia (as N)
- Total Residual Chlorine
- Cadmium (total recoverable)
- Copper (total recoverable)
- Lead (total recoverable)
- Zinc (total recoverable)
- Hardness as $CaCO_3$
- Temperature
- Nitrate-Nitrite as N

- Total Kjeldahl Nitrogen (TKN)
- Total Phosphorous
- Toxicity

The monitoring plan for this wetland mitigation will propose that these constituents (except Toxicity) as well as Depth to Water be monitored periodically at the surrounding monitoring wells and surface water sites, as well as at an additional surface water site established at the outfall of the WENI Wetlands. It is also recommended that the piezometers (three in the WENI Area and two in the top of Page Repository) not be decommissioned so monitoring for these constituents can be continued at those sites, too. In addition, water quality monitoring is proposed for storm water flows from Smelterville and flow will be measured in the SFCDR at the Theatre Road Bridge.

6.2.1.3 Hydrology

A flow control and measurement structure at the outlet of the WENI Area will provide continuous discharge and water surface elevations (WSE) measurements. Inflows will be comprised of a combination of treated wastewater from PWWTP, storm flows from Smelterville, some flow from Grouse Creek, contact with West Page Swamp, and surface accumulations of rain and snow. The dominant flow will normally be the PWWTP effluent, which is monitored by the plant operator. A gauge will be established to monitor continuous storm water discharge from Smelterville.

6.2.1.4 Regulatory Compliance

Any additional monitoring required by permits will be outlined in the M&E Plan.

6.3 Operations and Maintenance (O&M)

Management of the constructed wetlands is essential to good performance and accomplishment of long-term mitigation goals. The overall focus of management should be on:

- providing necessary contact between water with the microbial community, litter, and sediment substrate,
- assuring that flows reach all parts of the wetland and detention times are adequate, and
- maintaining a healthy environment for vigorous growth of vegetation.

6.3.1 O&M Plan

O&M will be fully described in an O&M Plan written during the design phase of the wetland mitigation project. The plan will include a provision for periodic updates to reflect specific system characteristics learned and altered during operation and monitoring. The plan will provide a schedule for routine cleaning of distribution systems and weirs, dike mowing and inspection, and system monitoring. The plan will specify those individuals responsible for performing and paying for maintenance. The plan will also address:

- appropriate criteria and methods for setting of water depth control structures,

- a schedule for cleaning and maintaining inlet and outlet structures, valves and monitoring devices, if needed,
- a schedule for inspecting embankments and structures for damage,
- depth of sediment accumulation before removal is required,
- operating range of water levels, including acceptable ranges of fluctuation in discharges to or from the wetland,
- criteria for revegetation during establishment or after unusual events,
- maintenance methods,
- provisions for erosion, drought, and flooding, and
- processes for adaptive management; considerations and responses to undesirable impacts of implementation.

6.3.1.1 Hydrology

Flows and water levels in the mitigation wetlands should be checked periodically to ensure that water is moving through all parts of the wetland, that buildup of debris has not blocked flow paths, and that stagnant areas have not developed. The importance of assuring adequate water depth and movement cannot be over-emphasized. Stagnant water decreases removal and increases the likelihood of mosquitoes and unsightly conditions. Any deviations from optimal noted during monitoring events should be corrected.

6.3.1.2 Vegetation

Water level management is one key to the success of vegetation. While wetland plants can tolerate temporary changes in water depth, care should be taken not to exceed the tolerance limits of desired species for extended periods of time. Water depth can be increased during the cold months to increase retention time and to protect against freezing. Alternating flows and drawdown may help to oxidize organic matter and to encourage the recruitment of new plants into the wetland. Vegetative cover on dikes should be chosen for minimum maintenance needs, however, mowing and fertilizing or liming may be required. Frequent mowing encourages grasses to develop a good ground cover with extensive root systems that resist erosion, and prevents shrubs and trees from becoming established. The roots of shrubs and trees can create channels and subsequent leakage through the dike.

Vegetation should be inspected regularly and invasive species should be removed. Herbicides should not be used except in extreme circumstances, and then only with extreme care, since they can severely damage emergent vegetation.

6.3.1.3 Structures

Dikes, spillways, and water control structures should be inspected on a regular basis and immediately after any unusual flow event or after rapid ice break-up. These events can scour substrates, and cause other damage to structures. Any damage, erosion, or blockage should be corrected as soon as possible to prevent catastrophic failure and expensive repairs.

6.3.1.4 Burrowing Animals

Muskrats and other burrowing animals can damage dikes and control structures. If upon inspection it is determined that burrowing animals are causing damage to dikes, wire screening or a thick layer of gravel, rock, or bentonite over trouble spots may inhibit burrowing. If damage continues, the animals may have to be trapped and removed for temporary relief until wire screen can be installed. Burrows can also be sealed by placing bentonite clay in the entryway and adding water to the bentonite to seal the opening.

6.3.1.5 Mosquitoes

Mosquitoes are common in natural wetlands and can be expected in constructed wetlands. The best approach to avoiding mosquito problems in constructed wetlands is to create conditions in the wetland that are not attractive to mosquitoes or are not conducive to larval development. Open, stagnant water creates excellent mosquito breeding habitat, and stagnant, high nutrient water is ideal for larval development. Flowing water and a covered water surface minimize mosquito development. Control methods include unblocking flows to eliminate stagnant backwaters, shading the water surface (females avoid shaded water for egglaying), and dispersing floating mats of duckweed or other floating plants. Swallows and bats can eat thousands of adult mosquitoes every day, so providing swallow perches, and bat boxes will reduce the number of mosquitoes. It may be possible to introduce mosquito-eating fish species to the aquatic bed wetlands. However, more research will be required to ensure that the chosen species are suited to this environment and do not pose any undesired impacts. Some control is provided by insects such as dragon-flies, which prey on mosquito larvae.

The control of mosquitoes with insecticides, oils, and bacterial agents such as BTI (*Bacillus thuringiensis isroelensis*) is often difficult in constructed wetlands. The use of insecticides in constructed wetlands, which have large amounts of organic matter present, is ineffective because the insecticides adsorb onto the organic matter and because they are rapidly diluted or degraded by the water traveling through the wetland. Chemical treatment is poorly understood and runs the risk of contaminating both the wetland and the receiving waters. Before beginning any involved control procedures, every aspect of the wetland system and the surrounding area should be carefully inspected, perhaps with the aid of a good vector control specialist. The inspection should include such minor components as old cans, discarded tires, un-drained depressions, hollow stumps, water control structures, open piping, and any other location where standing water can accumulate. Mosquito problems often originate from some small pocket of standing water rather than from the wetland as a whole.

6.4 Mitigation Timeline

A timeline must be included in the comprehensive mitigation plan showing the steps required to permit, design, and construct the mitigation wetlands. The timeline should also include monitoring through demonstration of efficacy of the project.

6.5 Cost Projections

Detailed task-specific cost projections must be developed for the life of the project and included in the comprehensive mitigation plan.

6.6 Next Steps

This document represents an outline for the comprehensive mitigation plan required for initiation of wetland mitigation at Page. Included here is a list of steps required to complete this process.

- Contact the FAA and Shoshone County Airport regarding proposed land use changes
- Contact IDPR on right-of-way and bridge issues
- Contact and establish relationships with all appropriate permitting agencies
- Prepare final design drawings and specification of wetland site, grading, headworks, tailworks, and flow path to SFCDR
- Write Monitoring Plan and SAP/QAPP
- Write O&M Plan
- Complete cost projections
- Write Public Outreach Plan
- Collect baseline monitoring data for water quality, flow rates, and soil fertility and contamination
- Research local soil sources
- Prepare project timeline

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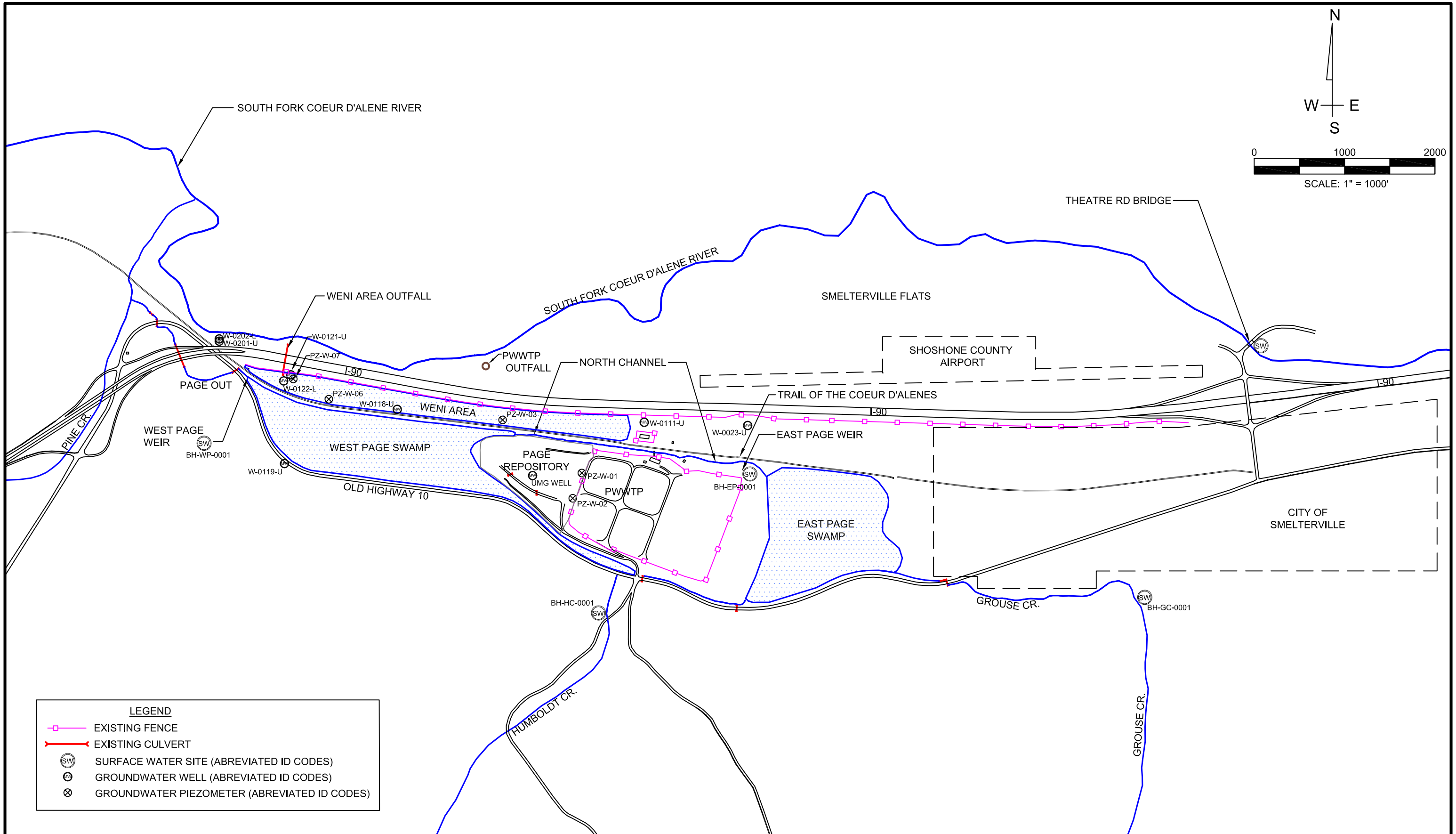
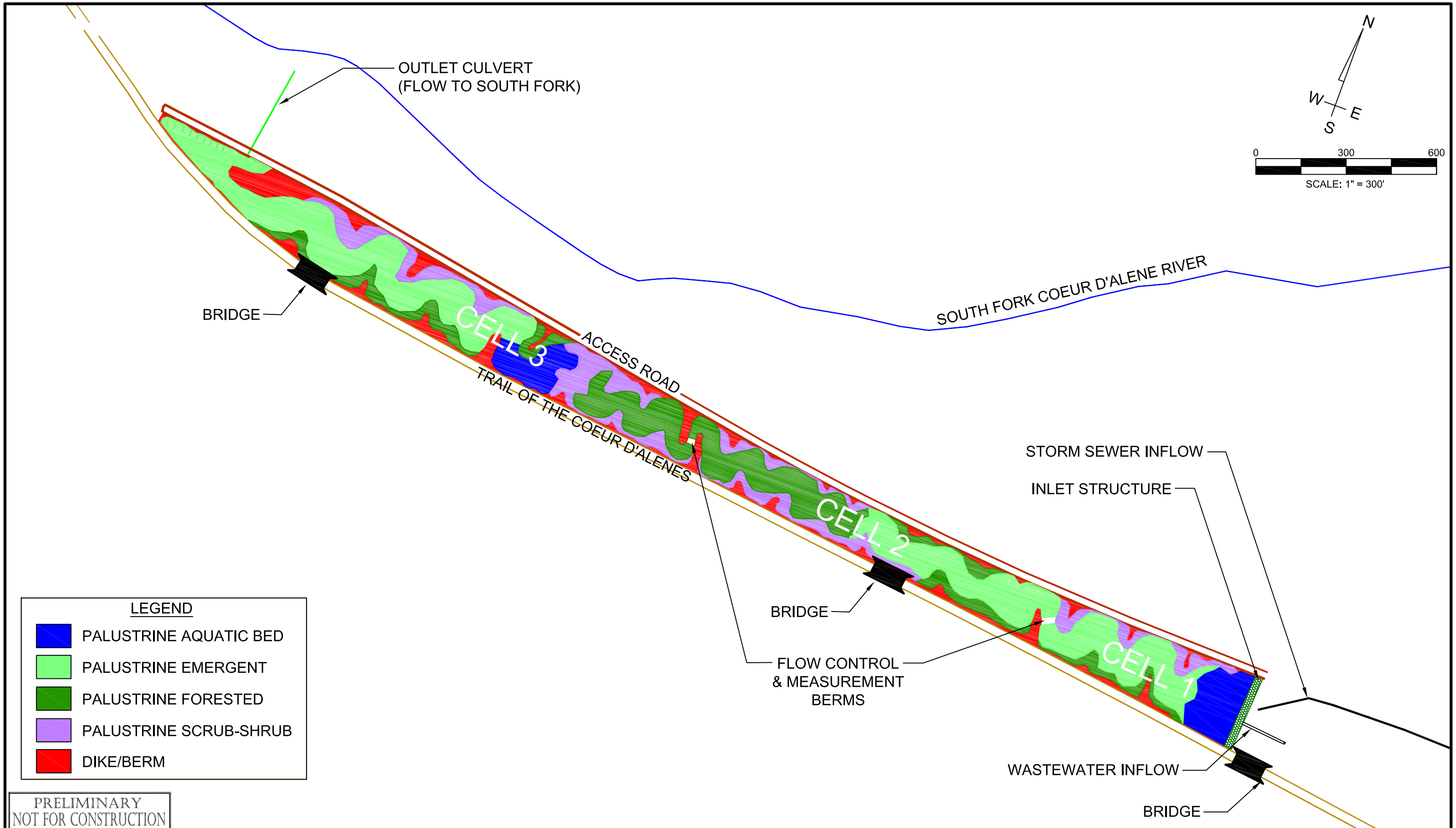


TerraGraphics
Environmental Engineering, Inc.

DRAWN: C.HALEY	PROJECT NO.: 2005-4060	PAGE REPOSITORY AREA	FIGURE 1. VICINITY MAP
ENGINEER: S.FIROR	SCALE: 1" = 1000'	SMELTERVILLE, IDAHO	
CHECKED:	APPROVED:		
	DATE: 8/20/2009		

COORDINATE SYSTEM: ISP, ZONE WEST, NAD 83, NAVD 88, FT
DATE: ARPIL 28, 2009
SHEET: 1 OF 1



PRELIMINARY
NOT FOR CONSTRUCTION

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ENGINEER: S.FIROR	SCALE: 1" = 300'		SMELTERVILLE, IDAHO
CHECKED:	APPROVED:		
DATE:	DATE:		

FIGURE 2.
WETLAND MITIGATION CONCEPTUAL DESIGN

COORDINATE SYSTEM:	LOCAL
DATE:	08/11/2009
SHEET:	1 OF 1