United States Department of the Interior
U.S. Fish & Wildlife Service

Bear River Migratory Bird Refuge
2155 West Forest Street
Brigham City, Utah 84302
Phone: (435) 734-6451 Fax: (435) 723-8873

May 5, 2014

Ms. Emily Bartusek
Utah Department of Environmental Quality
Division of Water Quality
PO Box 144870
Salt Lake City, UT 84114

Subject: Proposal for Willard Bay Settlement Project:
Improvements in Water Quality Management at Bear River Migratory Bird Refuge & Willard Spur

Dear Ms. Bartusek:

The United States Fish & Wildlife Service (USFWS) is pleased to provide the following proposal to develop and implement an integrated Water Quality Management Plan for Bear River Migratory Bird Refuge (BRMBR) and Willard Spur. The Willard Bay Project Proposal Form is included as Attachment 1 to this letter.

Figure 1. Area to be enhanced by the project (over 140 square miles)

As mentioned in the grant solicitation, the Division of Water Quality (DWQ) is seeking proposals that will enhance and protect waterways and environmental areas that may have been affected or related to the March 2013 release of diesel in the Willard Bay State Park. Our proposed project addresses methods to enhance the waterways and the environment directly adjacent to and downstream of this site. We have tailored our project to focus on enhancing the natural environment by integrating improvements to the wildlife habitat, native vegetation and water quality at this critical location serving as the gateway between the Bear River watershed and Great Salt Lake (GSL). The Willard Bay State Park incident highlights the vulnerability of BRMBR and Willard Spur, both receiving and filtering almost 64 percent of all surface runoff to GSL, to pollutant loads from the Bear River watershed (e.g., sediment, nutrients, metals, etc.) and inadvertent spills such as the 2013 event (see Figure 1, Arnow and Stephens, 1987). Through this grant, the USFWS and its partners propose to embrace the opportunity to evaluate water quality risks and make changes now that will protect the environmental and recreational beneficial uses of BRMBR, Willard Spur, and GSL now and into the future.

BRMBR and Willard Spur provide critical impounded and fringe wetland habitat that support recreation, vegetation, waterfowl, shorebirds, and their necessary aquatic food chain

Purpose

Water is the life blood of the wetlands that line the shores of GSL and creates and sustains invaluable habitat used by thousands of people and millions of birds every year. This same water can also transport sediment, nutrients, and other potential contaminants that puts these very same systems at risk. This dichotomy, water as both a source of life and risk, presents an increasingly complex challenge to managers of BRMBR and of other waterfowl management areas of GSL. Ongoing efforts by DWQ, USFWS, and other stakeholders illustrate how this challenge is currently being addressed in BRMBR and Willard Spur:

1. The **lower Bear River phosphorus Total Maximum Daily Load (TMDL)** project is working to identify and control sources of phosphorus in the lower Bear River. The USFWS has been collaborating with DWQ to evaluate the quality of the water delivered to BRMBR and Willard Spur by the Bear River.
2. Utah State University (USU) and USFWS have collaborated to develop the **SWAMPS (Systems model in Wetlands to Allocate water and Manage Plant Spread) systems model** that recommends how to allocate water and control invasive vegetation within the Refuge's 25 wetland unit to improve habitat performance. Results have shown BRMBR can double the area of suitable-quality habitat by more dynamically managing water levels in wetland units.
3. The USFWS and CH2M HILL are collaborating with DWQ to develop an **Assessment Framework for Impounded Wetlands of GSL**. The objective of this project is to better understand wetland processes and evaluate the condition of these wetlands at BRMBR and other areas around GSL.
4. The USFWS and CH2M HILL are working with DWQ and other stakeholders in the **Development of Water Quality Standards in Willard Spur** project. This project is evaluating sources of and impacts from nutrients on the wetlands of Willard Spur and recommending means to protect them.
5. The USFWS was a key member of the **March 2013, Willard Bay State Park diesel fuel spill** response team and assisted with the identification and control of diesel fuel before it further impacted Willard Bay State Park and the wetlands downstream in BRMBR and Willard Spur.

These efforts have made progress in controlling the sources of pollutants, habitat management, and significantly improved the understanding of GSL wetlands processes, however BRMBR's managers still need to understand the ramifications of their water management decisions on water quality. Historically, BRMBR and other GSL wetland managers have managed water with the primary objective of improving wetland habitat area. While invasive species management has become an additional objective for water management, their water management actions have typically not addressed water quality risks or leveraged the benefit their wetlands and water management actions could have on water quality. **BRMBR and other GSL wetland managers need water management solutions that simultaneously preserve both the habitat value and water quality of these important areas.**

The Need

As the "end of the line" water user on the Bear River system, the USFWS is in a position where it can only react to the water it receives and manage it to the best extent it can within BRMBR and Willard Spur. Both areas are vulnerable to spill events upstream and measures are needed to respond and contain such spills. DWQ's Willard Spur project has reinforced the need to understand how available water, both in quantity and quality, can be used to protect Willard Spur and other GSL wetlands. The USFWS is in need of practical and specific guidance, and the facilities and equipment it needs to implement them, that (1) minimize impacts from future contaminant spills, (2) bridge the sometimes conflicting goals of providing habitat for migratory birds and meeting the water quality requirements of the Clean Water Act, and (3) provide long term protection for Willard Spur. **The USFWS needs solutions it can implement** to address the water quality challenges of today and tomorrow within BRMBR and Willard Spur.

Project Objective and Goals

The objective of the proposed project is to investigate, identify, and implement specific actions to protect and improve water quality and habitat in BRMBR and Willard Spur that augment the USFWS's educational, management, and recreation goals and mandates for these waters. The project will define and provide recommendations for BRMBR that (1) minimize impacts from future spills, (2) bridge the sometimes conflicting goals of providing habitat to migratory birds and optimal water quality, and (3) provide long term protection for Willard Spur.

Specific goals are to:

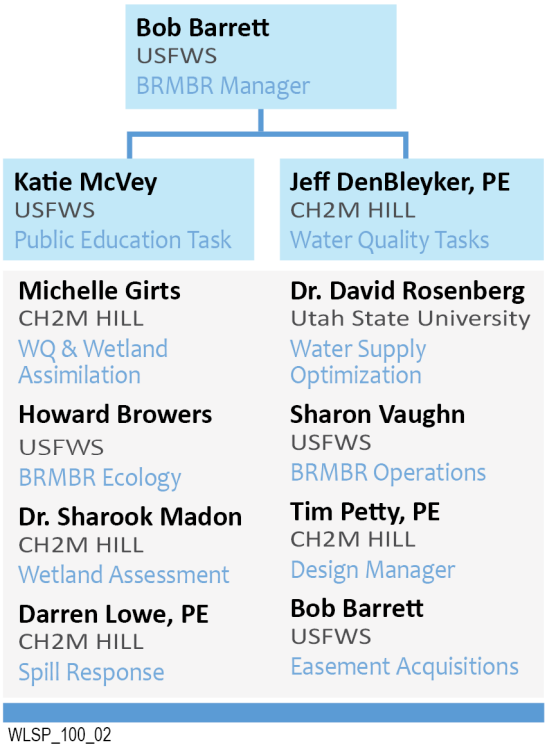
1. Augment the USFWS's ongoing public education program to enhance awareness of the value of the habitat and water quality in BRMBR and Willard Spur,
2. Enhance BRMBR's capability to respond to and limit the spread and impact of contaminants from potential future spills and accidents to BRMBR and Willard Spur,
3. Enhance capabilities at BRMBR to route water to Willard Spur,
4. Recommend how to manage water volume, sediment, and nutrients in water entering BRMBR from the Bear River to improve water quality in BRMBR and Willard Spur, and
5. Develop water management practices for BRMBR that (1) balance habitat and water quality objectives in BRMBR and Willard Spur and (2) improve water quality and increase habitat value in Willard Spur through enhanced capabilities at BRMBR to route water to Willard Spur.

Preliminary recommendations from the Willard Spur project are to acquire conservation easements to protect the eastern reaches of Willard Spur and for the USFWS to evaluate its water management practices to enhance and protect Willard Spur – this project directly addresses these recommendations

Approach

Project Team

Our project team includes technical experts and individuals who have extensive experience with public education, evaluating habitat, water supply and operations at BRMBR and Willard Spur, wetlands assessment at GSL, and the evaluation and design of wetland water quality, flow control, and treatment technologies. Additional assistance will be provided by internal office staff as needed to complete the work in a timely and cost-efficient manner. Contact information for our project team are provided in Attachment 1. Resumes are in Attachment 2. Attachment 3 includes summaries of similar projects undertaken by our project team that illustrate our team's ability to successfully complete this proposed project.



Scope of Work

The USFWS's proposed project will leverage recent (see above) and current work (see below), address recommendations currently being discussed by the Willard Spur Science Panel and Steering Committee, and involve the same stakeholders impacted by the 2013 diesel spill to complete the following tasks (a more detailed scope of work is included in Attachment 4):

Task 1 – Public Education Program

Building on BRMBR's existing educational program, the objective of this task is to provide greater Salt Lake Valley area residents access to educational programming and hands-on experiences that promote

appreciation of wildlife and an understanding of the essential links between the ecological health of habitats, water quality, and the role of humans in conservation. This task includes 4 interns to provide watershed education for more than 10,000 students; providing field-based internships for students to gain experience in natural resource careers; and increased awareness regarding BRMBR and Willard Spur trust resources through community programs and interpretive signs.

Task 2 – Spill Response

Minimizing the risk of impacts from spills of contaminants begins with preventing the spills from occurring. The BRMBR must however have contingency plans in place and be prepared for and able to respond to potential spills. This task will identify potential sources, affected areas, and recommend how BRMBR should prepare and respond to potential future spills from pipelines or other offsite sources.

Task 2.1 Define Current Water Management Practices & Drainage Patterns

This task will document existing water control facilities, drainage patterns, and operating procedures and criteria using work already completed by USU and USFWS in the development of the SWAMPS model.

Task 2.2 Identify and Evaluate Potential Spill Risks

This task includes a review of BRMBR's existing Spill Prevention, Control, and Countermeasures (SPCC) plan in relation to non-USFWS facilities that present a similar risk but are outside the control of the USFWS. Potential spill sources and potentially affected areas will be defined.

Task 2.3 Spill Response Plan

A spill response plan will be developed to summarize potential spill sources and affected areas and provide recommendations for best management practices, equipment, and facilities to respond to and minimize impacts from potential future spills from pipelines or other offsite sources.

The USFWS owns, is responsible for, and has funding for long term maintenance of the right-of-way and facilities impacted and proposed by this project.

Task 2.3 Design Water Control Upgrades

The Reeder Canal is the BRMBR's first diversion from the Bear River and presents the best opportunity to divert any free product from a spill in the Bear River away from downstream BRMBR habitat. The canal also serves as an effective barrier for spills from east of BRMBR from reaching the western portions of BRMBR (see Attachment 5 for a location map). Water from the Reeder canal flows through the 5's Drain and/or Unit 5C at the D-Line dike before entering Willard Spur. Flow through the D-Line dike is controlled by existing weir structures that require manual removal/addition of boards and that cannot effectively seal these outlets to Willard Spur. This task will retrofit these control structures with new overshot weir gates that provide more effective flow control and can be quickly closed to prevent potentially contaminated water from entering Willard Spur. The USFWS successfully replaced the L-Line water control structure in 2013 using BRMBR personnel and equipment. The USFWS will use project funds to purchase the materials required to retrofit two outlet structures while using BRMBR personnel and equipment for construction. Attachment 5 also includes drawings and specification sheets illustrating the proposed concepts as implemented on the L-Line canal at BRMBR.

The outlet structures for the 5's Drain and Unit 5C represent the last line of defense for preventing potentially contaminated waters from entering Willard Spur – new gates are critical.

Task 3 – Water Quality Management

The USFWS has been working with USU to develop the SWAMPS model for BRMBR that provides recommended water and vegetation management actions to achieve the single objective of improving wetland habitat area for waterfowl and shorebirds. While already providing significant benefits to BRMBR in optimizing habitat with available water, the USFWS proposes to complete the studies required to update the SWAMPS model to **identify habitat and vegetation management strategies that simultaneously improve both habitat and water quality objectives for BRMBR and Willard Spur**.

This will then help meet DWQ's Willard Spur projects objectives. Recommendations for achieving both habitat and water quality objectives will be documented in a Water Quality Management Plan.

Proposed work will be submitted for review by the Willard Spur Science Panel to ensure work products meet Willard Spur goals

Task 3.1 Compile Existing Data

Compile existing data that characterizes geographic, hydrologic, ecological, and water quality characteristics of the management units.

Task 3.2 Summarize Incoming Water Quality

Evaluate available water quality data for the lower Bear River to understand its characteristics and loading to BRMBR.

Task 3.3 Perform Wetland Hydro-ecological Characterization

Characterize the hydro-ecological condition of the Unit 5C and Unit 3 drainage basins (2) within BRMBR for use in subsequent analyses. This information will be critical for use in evaluating the assimilative capacity of the study areas and providing recommendations for facilities and operating criteria.

Task 3.4 Characterize Wetland Constituent Assimilative Capacity

Evaluate the capacity of the current wetland to assimilate pollutant loadings (from Task 3.2). The critical limit is assumed to be levels of loadings that might change the current ecological system. Constituents of particular concern are total suspended solids, nutrients (dominant forms of nitrogen and phosphorus), and metals.

Task 3.5 Add Willard Spur to the SWAMPS Model

The existing SWAMPS model does not include Willard Spur nor the benefit that an available water supply could represent for this valuable resource. While the USFWS cannot control outflow from Willard Spur, it does have the ability to manage its water to benefit Willard Spur in addition to the rest of BRMBR. Willard Spur will be added to the SWAMPS model as an additional management area using available bathymetry and vegetation mapping. This task will allow the USFWS to integrate Willard Spur into its water, vegetation, and habitat management plans and protect this resource into the future.

The current model considers three key indicator bird species that have varying needs through the year for shallow, medium, and deep water habitats (American avocet, Black necked stilt, and Tundra swan). USU will also add extensions to consider up to ten additional indicator species, address additional scenarios with low flows and/or changing runoff characteristics due to potential changes in climate, and create a user-friendly interface so that BRMBR managers can more readily and quickly use the model.

Task 3.6 Alternatives Analysis

Identify and evaluate alternatives, including water quality objectives, new facilities, wetland restoration, and/or operating criteria, that would result in improved assimilative capacity in the study areas, improved water quality conditions as determined by an improvement in DWQ multi-metric index score, and reduced nutrient loads to Willard Spur.

Task 3.7 Update SWAMPS Model to Address Water Quality

Update the SWAMPS model with new water quality objectives for water and vegetation management. Physical criteria will be defined for optimal water quality conditions and included in the model. A sensitivity analysis will be completed to allow managers to quantify tradeoffs between habitat and water quality objectives and inform water management decisions.

Task 3.8 Water Quality Management Plan

Summarize findings and recommendations from the proposed project in an integrated Water Quality Management Plan.

Task 4 Conservation Easement Acquisition

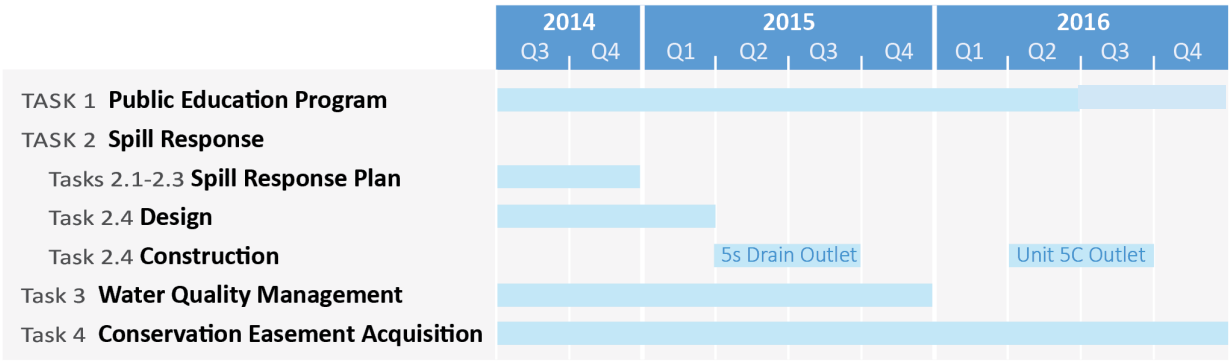
The USFWS proposes to invest $150,000 to acquire conservation easements in Willard Spur for properties bounded by Willard Bay State Park and BRMBR. This area was directly affected by the 2013 spill event and is critical for protecting the integrity of Willard Spur.

Project Support

The concept for this project was born out of discussions by the Willard Spur Science Panel and Steering Committee in January 2014 in regard to how Willard Spur can be best protected into the future. The objectives articulated DWQ's Willard Bay Settlement Request for Proposals align with the goals of USFWS and as defined by DWQ's Willard Spur project. While formal endorsement from the Willard Spur Steering Committee and Science Panel was not possible due to timing, USFWS has contacted and received support letters from key stakeholders of BRMBR and Willard Spur (see Attachment 6).

Project Schedule

Figure 2 illustrates our planned project schedule. The intent is to have all elements complete by January 2017; one year before the deadline in your request for proposals.



Project Costs

Estimated costs to complete the proposed project are included in Attachment 7. The USFWS is requesting $1,375,786 and will provide up to $447,000 in in-kind services. We would appreciate the opportunity to discuss the various elements of the project in regard to meeting your goals and objectives.

We look forward to continuing what has been a successful long-term relationship with DWQ. We are excited by the potential impact this project could have in not only addressing an important water quality challenge at BRMBR and Willard Spur but in identifying long-term solutions for GSL managed wetlands. The project will address DWQ's objectives for the Willard Spur Settlement Project, the objectives of the Willard Spur Steering Committee, and the USFWS's mandate to protect BRMBR and its waters in Willard Spur. If you have any questions, or need further information, please feel free to call myself at 435.734.6451 or Jeff DenBleyker at 801.350.5215.

USFWS has elected to retrofit existing rather than build new facilities to stretch the value of available funds. USFWS is committed to invest up to $447,000 of in-kind services to support the objectives of this project. This represents 25% of the total project budget

Sincerely,
USFWS

Bob Barrett
Bear River Migratory Bird Refuge Manager

Attachment 1. Willard Bay Project Proposal Form
Attachment 2. Project Team
Attachment 3. Related Project Experience
Attachment 4. Scope of Work
Attachment 5. Proposed Water Control Upgrades
Attachment 6. Letters of Support
Attachment 7. Cost Budget

Attachment 1
Willard Bay Project Proposal Form

UTAH DIVISION OF WATER QUALITY
195 North 1950 West
PO Box 144870
Salt Lake City, Utah 84114-4870

Willard Bay Project Proposal Form

NOTE: Proposal must be no longer than 6 pages. Supplemental documents such as letters of support, information to demonstrate previous project implementation and other relative supportive documents may be submitted in addition to this form.

Applicant Name: ***Bob Barrett***

Co-Applicant Name(s) (if applicable): *N/A*

Project Title: ***Improvements in Water Quality Management at Bear River Migratory Bird Refuge & Willard Spur***

Agency or Business Name (if applicable): ***United States Fish & Wildlife Service***

Mailing Address: ***Bear River Migratory Bird Refuge***
2155 West Forest Street
Brigham City, Utah 84302

Phone: (435) 734-6451 E-mail: bob_barrett@fws.gov

☐ Individual ☐ Non-Profit ☒ Govt. Agency ☐ Academic ☐ Commercial ☐ Other

1. Estimated Project Costs:

Labor	$915,337
Expenses (travel, per diem, etc.)	$218,793
Easement Acquisition	$150,000
Materials (equipment, construction)	$538,715
Administration	$0
Miscellaneous $ TOTAL	**$1,822,845**

Other sources of project funding:

USFWS	$ 447,059	_____	$_____
Source	Amount	Source	Amount
_____	$_____	_____	$_____
Source	Amount	Source	Amount

Total project cost including other sources of funding (i.e., total funding requested): **$ 1,375,786**
(please include bids for labor, equipment, rentals, etc.)

Note: Responses to the following items (2-10) are summarized in the USFWS's proposal letter dated May 5, 2014.

2. Describe the purpose and need of the project:
3. Estimated time frame of the project with significant milestones (Note: Project must be completed with final reports filed by January 1, 2018): _____
4. Describe the location of the project with attached location map, including details on the total area

that will be directly enhanced by the project: _____

5. Describe how the project will specifically enhance and protect waterways affected by the Willard Bay diesel release and improve the conditions of one or more of the following: wildlife, habitat, natural vegetation, water quality or emergency response:
6. Describe project's connectivity to other natural areas or projects that further enhance wildlife, habitat, natural vegetation, water quality or emergency response:
7. Describe any additional social benefits of implementing this project:
8. Project plans and details, including rights to work on specified piece of land:
9. Describe your experience in implementing projects of similar scope and magnitude:
10. Describe how ongoing maintenance of the project will be funded and carried out:
11. List consultants or agency partners that have participated in project development (below):

Jeff DenBleyker, PE CH2M HILL	215 South State Street, #1000 Salt Lake City, Utah 84111	(801) 350-5215
Dr. David Rosenberg Utah State University	4110 Old Main Hill Logan, Utah 84322-4110	(435) 797-8689

Signature B L Barnett Date 5/5/2014
Applicant

Signature _____ Date _____
Co-Applicant (if applicable)

Attachment 2
Project Team

Organization Chart

WLSP_100_02

Jeffrey S. Den Bleyker, P.E.

Water Quality Tasks

Education

M.S., Civil Engineering (Hydraulics), University of Iowa
B.S., Civil Engineering, Calvin College

Professional Registrations

Professional Engineer: Utah (No. 4804438)

Distinguishing Qualifications

- Proven leadership and integration of multidisciplinary scientific and engineering investigations with comprehensive stakeholder involvement
- Permitting specialist with 16 years of experience working with local, state, and federal agencies in Utah
- Extensive experience in ecosystem characterization and restoration—specifically in relation to the water quality and ecology of wetlands and open waters of Great Salt Lake
- Experienced in facilitating large groups of stakeholders to foster open communication, understanding, and support of controversial projects
- Specializes in the evaluation, development, and implementation of river and wetlands management alternatives

Relevant Experience

Mr. Jeff Den Bleyker is a water resources engineer and operations leader with CH2M HILL's Water Business Group in Salt Lake City, Utah. He has a proven track record of effectively listening to stakeholders to clearly define project objectives and roadmap for implementation. He develops relationships with project participants that promote partnerships that focus efforts and build consensus. He works closely with his client to integrate required disciplines and data into sustainable and consensus-driven solutions.

Representative Projects

Water Quality

Project Manager; Development of Water Quality Standards for Willard Spur; Great Salt Lake, Utah. Began working with the Utah Division of Water Quality in December 2010 to develop a strategy to engage stakeholders and complete research required to determine if changes to existing water quality standards were needed to address nutrient impacts in Willard Spur. Willard Spur is a large 45-square-mile wetland area located in the northeast corner of Great Salt Lake with extensive fringe, emergent and open water wetlands. Very little information exists regarding this ecosystem, the resources it contains, and condition it is in. Since the beginning of this effort, has worked closely with DWQ and a steering committee to establish a baseline of information in 2011 that will support a comprehensive research program to be completed in 2012 - 2014. Research will define the present condition and how proposed nutrient loading may impact this condition. Initial methods will use an existing multi-metric index for impounded wetlands condition but will broaden to look at mechanistic models, stress/response relationships, and reference conditions. Work in Willard Spur will be foundational for future evaluations and management of Great Salt Lake wetlands.

Project Manager; Development of Sampling Plan and Assessment Framework; Great Salt Lake, Utah. This important project with the Utah Division of Water Quality (UDWQ) set the framework for future management and sampling of water, sediment, and biota on Great Salt Lake. As project manager, Jeff coordinated among numerous state, federal, and academic researchers to (1) define current sampling practices on Great Salt Lake, (2) develop a sampling plan that meets the management objectives of numerous state and federal agencies for Great Salt Lake, (3) develop standard operating procedures for future sampling and analytical activities, (4) develop uniform quality standards for future sampling and analytical efforts, and (5) develop an assessment framework that links sampling results to prescribed

management decisions for Great Salt Lake. This project also outlined future research efforts required for the UDWQ to develop a comprehensive water quality model for Great Salt Lake.

Wetlands

Project Manager; Development of an Assessment Framework for Impounded Wetlands of Great Salt Lake, Utah. Worked with the UDWQ to develop an assessment framework to measure the integrity of Great Salt Lake impounded wetlands. This framework is based on the development of multimetric indices (MMIs) which assemble numerous measures of biological composition into a single measure of relative condition for each wetland site. MMIs were developed based on wetland metrics data collected from 2003 to 2008 by multiple stakeholders (UDWQ, university researchers and POTWs). Data on various metrics described submerged aquatic vegetation (SAV), algae, duckweed and benthic macroinvertebrates communities from impounded wetlands that exhibited a range of water quality conditions (relatively oligotrophic ponds to ponds with extensive nutrient enrichment). MMI scores indicated that of the 16 impounded wetland sites included in this study, only four sites (25 percent) were in relatively poor condition. In contrast, from 63 to 100 percent of these sites would be declared to be in poor condition based solely on current numeric criteria for pH and dissolved oxygen (DO). The MMI-based assessment framework provides a solid ecological basis for the identification of the relative condition of impounded wetlands of the GSL. Co-authored the resulting report published by DWQ entitled, Development of an Assessment Framework for Impounded Wetlands of Great Salt Lake. CH2M HILL is currently (2014) finalizing the validation and improvement of the assessment framework.

Project Manager; Lakepoint Restoration Project; Tooele County, Utah. Managed restoration of a 635-acre site located on the south shore of Great Salt Lake in Tooele County. Improvements designed in coordination with Kennecott Utah Copper, U.S. Fish & Wildlife Service, and The Nature Conservancy included: diversion and approximately one-mile-long pipeline to import water to the site, one-mile-long ditch with turnouts to distribute flow across site, weir boxes and berms to restore 340 acres of playa, wet meadow, and emergent and lacustrine wetlands and provide nesting islands for shorebirds. Work included significant coordination with the U.S. Army Corps of Engineers to develop the appropriate restoration and mitigation plan, sampling plan and permits required for construction. Construction was completed in March 2011.

Project Manager, Farmington Bay Ecological Characterization Study; Great Salt Lake, Utah. Managed a program (2003-2006) to characterize the wetland and open water ecosystems of Farmington Bay in the Great Salt Lake for the Utah Division of Water Quality. The information developed from this program was used as part of the UDWQ's ongoing program of protecting the designated uses of the Great Salt Lake. This initial phase of the study included intensive sampling of 30 wetlands sites that represented a cross-section of the different wetlands ecosystems along Farmington Bay, brine shrimp studies in the bay, open water quality sampling, and evaluation/reduction of data to develop useful parameters that could be used to evaluate the health of the ecosystem. The initial phase guided further research that DWQ continues today.

Streams and Rivers

Project Manager; Little Cottonwood Creek Restoration in Murray Park; Murray, Utah. Little Cottonwood Creek experienced significant flows during the 2010 spring runoff. A result of these high flows was localized flooding, bank erosion, channel scour, and deposition of sediment. The restoration design incorporates a bioengineered approach of using boulder toe protection with woody vegetation along the upper banks. Project also includes a concrete block wall, pond dredging, and sediment removal from the streambed.

Project Manager; Lower Jordan River Levee Evaluation; Salt Lake City, Utah. Questions regarding inadequate freeboard for this 2.5-mile levee system led Salt Lake County to evaluate the condition of the levee and provide recommendations for flood control improvements. As project manager, facilitated an adaptive approach where the County was provided with distinct decision points. A reconnaissance-level levee evaluation was completed to determine if additional work was warranted. Recommendations from this step led to phased geomorphic evaluation and geotechnical exploration of the corridor. Various levee options were identified and evaluated including replacing the existing levee on the river bank, hybrid options including floodwalls to minimize impacts to trees and residents, and offset levee options to minimize tree impacts, protect open space, and allow for restoration of the river corridor. A recommended

public involvement plan was deferred to future phases. CH2M HILL provided a report summarizing the analysis, recommendations, permitting requirements, and path forward including integration of public involvement and permitting in the design process.

Project Manager; Jordan River Corridor Preservation Study; Saratoga Springs, Utah. Unprecedented growth in Saratoga Springs led the City Council to proactively determine the erosion hazard the Jordan River (imposed within city boundaries), and pursue alternatives on how to manage and preserve the river corridor. Led an extensive technical evaluation of approximately 6 miles of the Jordan River. Field investigations, state-of-the-art geomorphic mapping, hydraulic and sediment transport analyses, and an extensive evaluation of historic river movement, were completed to define an erosion hazard zone for the Jordan River from the outlet of Utah Lake to 9600 North. Numerous alternatives for management of the riverine erosion hazard zone were proposed for consideration by state and federal agencies, City planners, and floodplain managers, as well as the City Council. Worked with the City to foster a partnering effort with the city of Lehi to jointly manage the river.

Project Manager; Bingham Creek Restoration Project; West Jordan, Utah. The objective of this project was to develop a management plan for the creek that identified required channel improvements and maintenance activities to allow the channel to safely convey the 100-year flood event and address in situ contaminated soils within the channel. Completed the hydrologic and geomorphic evaluation of the stream and supervised the hydraulic study and investigation of contaminated soils. A central concern the project addressed was determining the ability of the channel to convey the 100-year flood event while minimizing erosion of contaminated bank and channel sediments. A management plan was developed that includes restoration alternatives, maintenance recommendations, and a capital improvement plan for engineered structures.

Task Manager; Upper Provo River Easement Maintenance Plan; Utah. Task manager for the Upper Provo River Easement Maintenance Plan. The study required an analysis of historical flow data and environmental issues. To determine alternatives for maintenance of river capacity and minimization of impacts on the riverine environment, hydrologic, river hydraulics, and geomorphic analyses of the river were also required. Used available hydrologic data to determine and document the flow regimes for both natural flow conditions and river conditions augmented by flows from the Duchesne and Weber River diversions. Using HEC-RAS, he was able to estimate the hydraulic characteristics of the Provo River to be used in the geomorphic and environmental assessments. Based on an evaluation of these analyses, a maintenance plan has been developed along with the U.S. Army Corps of Engineers and the State of Utah for the Provo River.

Project Manager; Diversion Structures; Utah. Managed the design of diversion structures along the Duchesne River, Rock Creek near Tabiona, Utah, Strawberry River and upper and lower Provo River. These projects were implemented to provide permanent diversion structures that allows for fish passage, divert the required irrigation flows even during minimal river flows, and safely pass spring runoff. The historic location of the diversions, environmentally sensitive nature of these streams, and historical migration of the streams required extensive geomorphic analysis and coordination with state and federal agencies.

Kathlyn J. McVey

Public Education Task, U.S. Fish and Wildlife Service, Bear River Migratory Bird Refuge

Education

M.S., Raptor Biology, Boise State University, May 2011

Thesis: Trophic ecology of burrowing owls in natural and agricultural habitats and an analysis of predator communities using stable isotopes of carbon and nitrogen

B.A., Biology, Luther College, 2006

Professional Registrations

Certified Licensing Professional, Licensing Executives Society
Certified Private Pilot, Single Engine Land, US Federal Aviation Administration

Distinguishing Qualifications

- Wasatch Audubon Society member, Ogden, UT; Chapter President: January 2014-present, Board Member 2012-13
- AmeriCorps Member, Palouse Clearwater Environmental Institute: 2009-10; served at Deer Flat National Wildlife Refuge, Nampa, ID as an Environmental Education Specialist
- GK-12 Fellow: National Science Foundation and Boise State University: 2008-09; served at the Foothills Learning Center, City of Boise, Boise, ID
- Teaching Assistant: Boise State University, Boise , ID: 2006-08

Relevant Experience

- Wildlife Refuge Specialist GS-0485-09, Bear River Migratory Bird Refuge
  - Assistant Refuge Manager
  - Manage grassland habitat for wildlife and water resources
  - Coordinate and manage Refuge website and social media
  - Supervise Youth Conservation Corps program and Student Conservation Association internships.
  - Safety team member
- Park Ranger GS-0025-07, Bear River Migratory Bird Refuge
  - Teach, evaluate and modify environmental education programs on watersheds and wildlife
  - Recruit, manage, schedule, and help plan trainings for volunteers
  - Collaborate with Refuge staff to increase number of and attendance for special events
- Student Career Experience Program GS-0099-07, Bear River Migratory Bird Refuge

Manuscripts

Lui, H.P., R.M. McKay, J.N. Young, B.J. Witzke, K.J. McVey, and X. Liu. 2007. The Winneshiek Lagerstätte. Acta Palaeontologica Sinica 46:282-285.

Lui, H.P., R.M. McKay, J.N. Young, B.J. Witzke, K.J. McVey, and X. Liu. 2006. A new Lagerstätte from the Middle Ordovician St. Peter Formation in northeast Iowa, USA. Geology 34:969-972.

McVey, K.J. 2011. Trophic ecology of burrowing owls in natural and agricultural habitats and an analysis of predator communities using stable isotopes of carbon and nitrogen. M.S. Thesis, Boise State University, Boise, ID.

McVey, K.J., P.D.B Skrade, and T.A. Sordahl. 2008. Use of a communal roost by Turkey Vultures in northeastern Iowa. Journal of Field Ornithology 79:170-175.

Michelle Allen Girts, Ph.D.

WQ and Wetland Assimilation

Education

Ph.D. Coursework, Water Resources Engineering, Oregon State University
M.S., Biology, West Virginia University
B.S., Biology, Portland State University

Professional Registrations

Certified Licensing Professional, Licensing Executives Society
Certified Private Pilot, Single Engine Land, US Federal Aviation Administration

Distinguishing Qualifications

- Regulatory specialist with more than 26 years of experience in planning, permitting, and design of projects involving water quality and aquatic ecosystems throughout North America.
- Project manager and technical lead for feasibility, pre-design, design, construction, and operations plans for wetland treatment systems and wetlands receiving reclaimed effluent.
- Project manager and technical lead for regulatory planning, pre-design, design, and monitoring of constructed wetlands in reclaimed watersheds (including urbanization, mining, and atmospheric deposition-impacted areas).
- Skilled in communications with local, state, and federal resource agency decision makers, as well as political leadership, regarding policy development, compliance, and implementation, having completed numerous regulatory guidance documents regarding water management (stormwater, reclaimed effluent and wastewater, and wetlands). As an example, managed a project for Washington Department of Transportation to streamline statewide storm water management and permitting processes, and to oversee pilot projects to test the streamlined processes.
- Manager of numerous complex multidisciplinary water resource and environmental planning projects, including a 2008 initiative sponsored by the Oregon Business Plan and more than a dozen state-wide businesses to examine, improve (as needed) and fund a sustainable, long term water policy for Oregon. An authorizing and funding bill for the planning process and the first major associated project – an aquifer storage and recharge project to provide a predictable water supply in the agricultural eastern part of the state – was passed in the 2009 Legislative session.

Relevant Experience

Ms. Girts is a senior water resources and environmental scientist who specializes in the planning, design, management, and permitting of activities in natural and disturbed ecosystems. During more than 26 years of professional experience, she has managed multidisciplinary programs related to ecosystem creation, restoration, disturbance, and watershed management. Ms. Girts's field experience encompasses forest, floodplain, and wetland ecosystems (both natural and constructed) across North America.

Since 1985, Ms. Girts has managed projects and tasks to address potential use and design of wetland systems to treat a broad range of water sources: landfill leachate, mine drainage, stormwater, and agricultural, municipal, and industrial wastewater. She has organized and taught courses on wetland treatment systems and watershed management through numerous venues, including Engineering Professional Development, American Society of Chemical Engineers, Water Environment Federation, and National Ground Water Association.

From 2001-2007, Ms. Girts lead development of CH2M HILL's technology innovation and leverage program. In addition to more than a 10—fold increase in the number of patents obtained by CH2M HILL clients and associated project staff, technology licenses were negotiated with research and manufacturing partners to move promising core technology into testing, application, and commercialization.

Before joining CH2M HILL, Ms. Girts managed research projects for the U.S. Bureau of Mines as part of an Oak Ridge Research Laboratories Post-Graduate Fellowship. Projects involved characterization of wetland technologies for treatment of mine waste and drainage water in the Appalachian coal fields and evaluation of their relative treatment efficiencies. As a joint effort between the Bureau of Mines and the

National Park Service, she designed and implemented research projects to test the feasibility of treating large volumes of highly contaminated mine water in constructed wetland systems. Ms. Girts also prepared conceptual plans for constructed wetland water treatment systems at a metal-contaminated hazardous waste site (New Jersey Zinc, Pennsylvania), which has since been fully implemented. Prior employment includes managing water quality data and impact assessments for the Portland, OR Water Bureau, and Assistant Manager, Community Research Center, Oregon Museum of Science and Industry.

Representative Projects

Regulatory and Policy

Project Manager, Draft Constructed Wetlands for Municipal Wastewater Treatment Design Guidelines, Montana Department of Environmental Quality (2010-2011). Reviewed and revised draft guidelines that had been developed internally by MT DEQ, to bring broad expertise in the field to bear on potential applications (both surface flow centralized and subsurface flow distributed systems) of interest to MT regulators. Facilitated conference calls with client and review comments from North America technical team. Presented results with client at 2011 Joint Montana State American Water Works Association/Water Environment Association/American Public Works Association (AWWA/MWEA/RMC-APWA) conference in Bozeman, MT for further discussion with MT utilities.

Project manager, Reclaimed Effluent Standards, Washington Department of Ecology, (1999-2002). In keeping with Washington's 1992 Reclaimed Water Act, Ms. Girts lead a project to develop regulations to encourage discharge of reclaimed water to create or enhance wetlands. First, potentially conflicting and confusing regulatory definitions were clarified so that the regulations could be implemented. Standards, which went into effect in September 1997, aim for single-tier tests, rather than multiple-tier tests, to simplify the permitting process. Water quality standards and the reasonableness of treatment requirements were taken into consideration, to ensure beneficial use protection while encouraging reuse applications. The concept of "net environmental benefit," which had not previously been applied in Washington, was legitimized. Draft regulations - their technical basis and rationale - were presented to the Legislature's Reuse Advisory Committee for review as well as at several public workshops around the state. The resulting regulations adopted in 2007 provide predictability and compatibility with existing and future regulations, while allowing considerable flexibility to stimulate reuse. Application of the guidance in a subsequent review did not reveal any significant flaws or unintended consequences, and the regulations stand as initially adopted.

Stormwater and Nonpoint Source Treatment Wetlands

Task Manager, Johnson Creek Flood Management, Bureau of Environmental Services, City of Portland, OR (2005). Developed alternatives for the City of Portland's project, designed to increase flood storage and endangered salmon spawning and rearing habitat and improve water quality in a developing watershed. The emphasis of the alternatives was on stream and wetland restoration opportunities to achieve these ends. This was a keystone project for the City of Portland in its program to meet 2010 combined sewer overflow stipulated order requirements, Willamette River total maximum daily load (TMDL) needs, and Endangered Species Act (ESA) compliance, while managing rate increases.

Senior Reviewer, Green River Natural Resource Enhancement Area, Kent WA (1995). Provided senior review for design of the Green River Natural Resource Enhancement Area, which included stormwater treatment wetlands, detention, habitat restoration, fisheries enhancement, public access, and interpretive features developed in converting an abandoned sewage lagoon system. It provides habitat to an estimated 165 birds and 53 mammals, and serves as a nesting, feeding and brooding area for many species that use the Green River corridor as a travel route. The 304-acre GRNRA site is one of the largest man-made, multi-use wildlife refuges in the United States.

Task Manager, Prado Wetlands Restoration and Treatment Re-design and Operations Review, Orange County Water District, California (1997-98). Developed a conceptual plan, predesign, and design to construct and enhance existing wetlands for treatment of agricultural runoff containing high nitrates, by diverting the Santa Ana River through ponds previously managed for duck hunting. This project retrofit the prior design and enhanced operations protocols to maximize wetland assimilation capabilities.

Project Manager, Williamson River Wetland Restoration of Farmland, Klamath River Basin, Oregon, The Nature Conservancy (1995-1997). Projects included providing due diligence for land purchase and developing a conceptual restoration plan for 3,500-acre farmed wetlands in Klamath Marsh, the primary western migration flyway and nursery habitat for several endangered fish species. The conceptual restoration plan was developed in cooperation with a team of local community leaders, farmers, and representatives of the U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, PacifiCorp, the Klamath Tribes, and other stakeholders and regulatory agencies. In winter 2008, the berms were blasted out and water filled the wetlands to begin the restoration process. Partial funding for TNC's purchase of the land was provided by congressional mandate.

Senior Technologist, Wetland Treatment System Feasibility, Design, Expansion, and Regulatory Permitting, Kodiak Island Borough, Alaska (1996-2008). Lead regulatory negotiations, feasibility review, design, and field monitoring team for two projects: Phase 1 subsurface flow system to treat landfill leachate with consultation on operations and maintenance; and Phase 2 potential expanded system to receive additional intercepted leachate and runoff, including regulatory negotiations with two departments of Alaska Department of Environmental Conservation (ADEC) during the period leading up to and following ADEC assuming primacy from USEPA, and with community stakeholders who obtained designation of downstream natural wetlands as Protected Open Space. Wetland treatment systems represent a new technology for Alaska regulators, and this is one of a handful of installations in the state.

Task Manager; Wetland Treatment System; City of Salem, OR; 1995-2000. Developed the conceptual and preliminary designs for treatment wetlands to treat sanitary sewer overflow during high-flow months and to remove ammonia toxicity and manage temperature increases during late summer low-flow months, for Salem, Oregon, in conjunction with Willamette River TMDL requirements. Effluent from these treatment wetlands is directed to various reuse options, including mitigation wetlands to satisfy city stormwater maintenance mitigation requirements, agriculture, and stream baseflow recharge. These resulting wetland complex includes trails and interpretive signage for public access. Facilitated the identification of the project as a U.S. Environmental Protection Agency (EPA) XL project, to facilitate permitting and partial funding by the U.S. Bureau of Reclamation.

- Evaluated the feasibility and developed a conceptual plan, which included a public and political education component, for the City of Vancouver, Washington, to restore the hydrology of adjacent wetlands using reclaimed effluent. Finalized the access plan and assisted with regulatory negotiations. Managed wetland delineation and regulatory negotiations for Tidewater Barge Lines, who owned an adjacent wetland parcel.
- Evaluated the feasibility of using wetlands in water reuse planning for the Unified Sewerage Agency of Washington County, Oregon, including the use of wetlands as buffers for agricultural nonpoint source runoff.
- Evaluated the feasibility of constructed and restored wetlands to provide additional nutrient removal (polishing) while augmenting baseflow and restoring habitat along the Snake River for City of Twin Falls, Idaho. Developed a pilot treatment system and program to document treatment effectiveness and site suitability.
- Provided senior review for conceptual and final designs of wetlands using reclaimed effluent for the East Municipal Water District and Irvine Ranch Water District in California, with the object of restoring migratory bird habitat and wetlands.
- As part of facilities planning process, evaluated the feasibility of constructing wetlands adjacent to the Boise River riparian zone for reuse of Boise, Idaho, reclaimed effluent. Prepared conceptual and preliminary designs.

Technical Manager, Operational Regional Wetlands Monitoring Program, Suncor Energy Inc., Imperial Oil Resources Ltd., Shell Canada Energy, Syncrude Canada Ltd., and Total E&P Canada Ltd., Fort McMurray, Alberta (2012-2013). Developed and detailed a peer-reviewed regional wetland monitoring plan building on CEMA guidance to meet EPEA permit requirements for these 5 permit holders. Convened more than a dozen subject matter experts to build monitoring plan which would provide early-warning of any mining-related effects, while focusing on those metrics most sensitive to

stressors and drivers of such effects. Associated statistical analysis methodologies and application of the multimetric index approach were detailed to alert the need for a series of adaptive management strategies. The structure and QA/QC protocols for a geostatistics-associated database were described, along with access protocols. The role of research opportunities to complement the Program was described. Wetland stratification types were selected and wetlands identified for monitoring in the program. Wetland selection, as well as the monitoring program, took into account the importance of watershed definitions and the complexity of groundwater/surface water interactions in the region. Cost estimates to implement the field monitoring and data management aspects of the Program were also provided at client request. The Program is in regulatory review, with groundtruthing of sites to commence in 2014.

Wetland Reclamation Task Manager, Kearl Mine Operational Drainage & Reclamation Plan and Life of Mine Closure Plan, Imperial Oil Resources Limited, Fort McMurray, Alberta (2012-2013). Managed task in close coordination with landform, soils, and groundwater and surface water hydrology task leads to create wetlands that will reasonably become established and sustained as an integral part of reclamation upland/wetlands complex. Examined potential for progressive wetland reclamation, and identified where possible to maximize direct placement of valuable peat material. Identified plant communities that will establish readily in potentially saline conditions, and planting protocols to maximize adaptability of the communities as well as providing habitat for target key wildlife and foodchains. Incorporated ongoing research results and changing regulatory framework into planning objectives, design details, and monitoring requirements. Addressed water quality management using treatment wetlands, and end pit lake discharge flows in flow attenuation marshes. Applied innovative approaches to relating reclamation wetlands to regional groundwater systems and off-site aquatic, terrestrial, and wetland ecosystems.

Wetland Reclamation Task Manager, Muskeg River Mine Integrated Closure Conservation & Reclamation Plan, Shell Canada Energy, Fort McMurray, Alberta (2011-2013). Managed task in close coordination with hydrology, wildlife, and landform task leads to create wetlands that will reasonably become established and sustained as an integral part of reclamation upland/wetlands complex. Identified plant communities to be supported by the hydrology and provide habitat for target key wildlife and foodchains. Incorporated ongoing research results and changing regulatory framework into planning objectives, design details, and monitoring requirements. Addressed water quality management using treatment wetlands, and end pit lake discharge flows in flow attenuation marshes. Applied innovative approaches to relating reclamation wetlands to regional groundwater systems and off-site aquatic, terrestrial, and wetland ecosystems.

Wetland Reclamation Task Manager, Jackpine Mine Integrated Closure Conservation & Reclamation Plan, Shell Canada Energy, Fort McMurray, Alberta (2011-2013). Managed task in close coordination with hydrology, wildlife, and landform task leads to create wetlands that will reasonably become established and sustained as an integral part of reclamation upland/wetlands complex. Identified plant communities to be supported by the hydrology and provide habitat for target key wildlife and foodchains. Incorporated ongoing research results and changing regulatory framework into planning objectives, design details, and monitoring requirements. Addressed water quality management in treatment wetlands and plant selection. Responded to Significant Information Requests from ESRD, which represented a record low number of wetland items for such a Plan.

Wetland Reclamation Task Manager, Fort Hills Integrated Closure Conservation & Reclamation Plan, Suncor Energy Inc., Fort McMurray, Alberta (2011-2013). Managed task as subcontractor to Paragon Services to create wetlands that will reasonably become established and sustained as an integral part of reclamation upland/wetlands complex. Identified plant communities to be supported by the hydrology and provide habitat for target key wildlife and foodchains. Incorporated ongoing research results, especially recent results from Suncor pilot studies, and changing regulatory framework into planning objectives, design details, and monitoring requirements. Addressed water quality management in treatment wetlands and plant selection.

Wetland Treatment System Project Manager, Jacks Branch and Endurance Mines Passive Treatment Systems for Selenium Removal, Confidential Appalachian Coal Mining Client, Charleston, West Virginia (2011-2012). Managed projects through alternatives analysis through final design of wetland subsurface flow systems to remove selenium from mine drainage and valley fill

discharges, and revert to sustainable natural wetlands in the long term. All milestones of tight schedule dictated by court settlement were met. Currently under construction, services during construction and start-up will be provided, as well as an operations and long-term closure manual.

Task Manager, Feasibility Study, Conceptual, and 60% Engineering Designs Treatment Wetland and Saline Wetland Reclamation using Reclaimed Effluent, Fernley National Wildlife Refuge (central NV), Cities of Reno & Sparks, NV (1987-1992). Completed feasibility study and designs as part of upgrade and expansion of the Reno and Sparks Wastewater Treatment Plant in the water-short region of Nevada. Reclaimed effluent was to be piped 50 miles for delivery to the Fernley National Wildlife Refuge, a highly saline refuge which had experience extensive waterfowl deaths and wetland damage as a result of decreased water inflows. Designs included water polishing wetlands at inflow point and distribution to emergent and shrub/scrub wetlands most in need of flow augmentation. Worked with state and federal agencies, including US Fish and Wildlife and Nevada Fish and Game, to identify appropriate sites and to determine water quality discharge requirements, as well as to design wetland systems to provide sediment salinity remediation and wetland restoration.

Completed feasibility studies and designs for numerous constructed wetland systems to treat wastewater, including projects for the Unified Sewerage Agency (USA), Warm Springs Reservation, and the cities of Dallas, Salem, McMinnville, Portland, Waldport, Stayton, Woodburn, and Klamath Falls (all in Oregon); Pacific Beach, Chehalis, and Sequim, Washington; the Salt Lake City Wastewater Treatment Plant in Utah; Pima, Arizona; Santa Rosa, California; Santa Fe, New Mexico; and the Reno and Sparks Wastewater Treatment Plant in Nevada. Worked with state and federal agencies to identify appropriate sites and to determine water quality discharge requirements, as well as to design wetland systems.

January, 2014

David E. Rosenberg

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EDUCATION

PhD	Civil and Environmental Engineering, University of California, Davis	March 2008
MS	International Agricultural Development, University of California, Davis	September 2003
MS	Civil and Environmental Engineering, , University of California, Davis	June 2003
BSE	School of Civil & Environmental Engineering, Cornell University, Ithaca, NY. *Magna Cum Laude*	May 1998

PROFESSIONAL AND RESEARCH EXPERIENCE

1. July 2008 – present. **Assistant professor**, Dept. of Civil and Env. Engineering and Utah Water Research Laboratory, Utah State University, Logan, UT, USA.

2. August 2003 – March 2008. **Doctoral candidate,** Dept. of Civil and Env. Engineering, University of California, Davis. Fieldwork in Jordan.

3. August 2005 – September 2005. **Consultant**, Liquid Assets – Middle East Water Project.

4. July 2001 – August 2003. **Hydraulic Engineer**, Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, CA, USA.

5. February 2001 – June 2001. **Staff Engineer**, Geologic Services Corporation, Columbia, MD, USA.

6. July 1998 – October 2000. **Wetland reserve staff**, Royal Society for the Conservation of Nature, Azraq, Jordan (as U.S. Peace Corps volunteer).

FORMER STUDENTS

1. Adel Abdallah, MS, May 2012, "Heterogeneous Water and Energy End-Uses and Implications for Residential Water and Energy Conservation and Management". Now PhD student, Utah State University, Hydroinformatics.
2. Melina Santos Vanderliner, BS, May 2012, "Remotely sensing vegetation response and secondary succession to improve wetland management." Now Graduate Student, Sustainable Engineering, Rochester Institute of Technology.

3. Bereket Tesfatsion, MS, December 2011, "Managing Water Shortages in the Weber Basin Using the Water Evaluation and Planning (WEAP) System". Now at Franson Civil Engineers.
4. Francisco Suero, MS, September 2010, "Estimating and Verifying Household Potential to Conserve Water." Now at Instituto Nacional de Recursos Hidráulicos of the Dominican Republic (INDRHI) and Instituto Technologico de Santo Domingo (INTEC)

FUNDED PROJECTS

*** items are funded by Utah State University*

Environmental Water Management

- "**CAREER: Near Optimal Water Management to Improve Environmental and Ecological Decision Making**." **David E. Rosenberg**. National Science Foundation. January 2012 - December 2016. $409,985.
- "Analyzing the Spread of *Phragmites australis* over Short Time-scales Using Spatial and Genetic Tools". Karin Kettenring, Mac McKee, and **David E. Rosenberg**. USGS (104b) and Utah Mineral Lease Funds. March 2010 – February 2011. $67,387.
- "Allocating Scarce Water for Utah wetlands with Ecological uncertainties." **David E. Rosenberg**. Utah Mineral Lease Funds. August 2009 – July 2010. $52,500.**
- "Allocating scarce water to benefit wetlands and wetland plant communities at the Bear River Migratory Bird Refuge: ecological experiments and optimization modeling." Karin Kettenring, **David E. Rosenberg**. USU Water Initiative. June 2009 - May 2010. $38,300.**
- "Optimizing Water Management for Environmental Purposes." **David E. Rosenberg**. Utah Mineral Lease Funds. August, 2008 - July, 2009. $26,000.**

Systems Modeling

- "iUTAH - innovative Urban Transitions and Arid-region Hydro-sustainability". Todd Crowl, et al. National Science Foundation, Utah EPSCoR Track I. August 2012 - July 2017. $20,000,000.
- "CI-Water: Cyberinfrastructure to Advance High Performance Water Resource Modeling." Norm Jones, David Tarboton, **David E. Rosenberg**, Jeff Horsbough, et al. National Science Foundation, Utah EPSCoR Track II. October, 2011 to September 2014. $923,999 (USU portion).
- "Water Resources Modeling for Utah's Cache Valley." **David E. Rosenberg**, Leah Meeks. Utah Mineral Lease Funds. January 2011 - December 2014. $94,954.**
- "WSC-Category 1: Hydrologic and Ecological Impacts of Changes in Human Water Resources Management." Doug Jackson-Smith, Charles Sims, Jeff Horsburgh, Beth Neilson, and **David E. Rosenberg**. National Science Foundation. September 2010 – August 2011. $149,943.

Water Conservation

- "Intervening to encourage water conservation: developing an interdisciplinary urban water conservation research program at USU." **David E. Rosenberg**, Arthur Caplan, and Joanna Endter-Wada. SPARC, USU Office of the Vice President of Research. July 2009 – September 2010. $34,988.**

- "Value Landscape Engineering Lifecycle Analysis." **David E. Rosenberg**, Kelly Kopp, Heidi Kratsch, Larry Rupp, Paul Johnson, and Roger Kjelgren. Central Utah Water Conservancy District. January - September, 2009. $42,400.
- "Estimating and Verifying Situational Household Water Conservation Potentials." **David E. Rosenberg**. Utah State Allocated Funds. December 2008 - December 2009. $52,000.**

Infrastructure and Operations

- "Cache County Water Master Plan." **David E. Rosenberg**. Cache County / J-U-B Engineers. August 2012 – August 2013. $3,894.
- "Economic Impacts of Groundwater Drawdown in Jordan." **David E. Rosenberg**, Richard Peralta. U.S. Agency of International Development / International Resources Group. July – December, 2011. $34,773.
- "Drought Planning with Reservoir Carryover Storage." **David E. Rosenberg**. USGS (104b). March 2009 - February 2010. $67,600.

TEACHING ACTIVITIES

1. August 2008 – Present. Course Instructor and Advisor, Department of Civil and Environmental Engineering, Utah State University.

    - Water Resources Engineering (CEE 5460/6460)—Fall 2008, Fall 2009, Fall 2010, Fall 2011, and Fall 2012
    - Integrated River Basins/Watershed Planning and Management (CEE 6490)—Spring 2009, Spring 2010, Spring 2011, Spring 2012, Spring 2013
    - Hydroinformatics (CEE 6930)—Fall 2012
    - Water Resources Systems Analysis (CEE 6110)—Fall 2013
    - Currently major advisor for 4 PhD and 6 undergraduate students.

2. August 2012 – Present. **Director**, Bear River Fellows Program, Utah State University.

    Oversee Bear River Fellows program which offers 5 fellowships per year to 5 incoming freshmen in partnership with the USU Outdoor Recreation Program. In August, take the freshmen fellows out on the nearby Bear River for 5-day/4-nights of field data collection, meetings with water managers, canoeing, camping, and leadership development. Hire each Fellow for the subsequent Fall and Spring semesters as undergraduate research assistants to analyze, synthesize, and present the field data they collected in support of a wider NSF CAREER river basin environmental water management project. To date, results presented at three conferences.

3. July, 2013. **Co-Facilitator**, Code Camp, Utah State University.

    Oversaw the planning and implementation of a one-day code camp for high school students at USU. Toured USU's high performance computing and data storage center, gave an introduction to programming in Python, and had the students work in groups to develop and code reservoir release functions in Python for Pineview reservoir, Utah that generated hydropower, delivered water for irrigation, and protected the city of Ogden from floods.

4. Spring 2006. **Co-Instructor**, Water Resources Engineering Planning (ECI 155), Dept. of Civil and Env. Engineering, University of California, Davis.

Developed and gave 4-unit senior-level undergraduate engineering class, including lectures, assignments, field trip, exam, and term paper with co-instructor. 20 students. Topics include rational planning; regional, utility, and water user management and conservation; watershed hydrology; public participation and accountability; optimization; flood management; and hydropower.

5. February 2004 – August 2004. **Consultant,** Academy for Educational Development.

   Developed lectures and assignments for semester course (condensed into two weeks) on strategic planning for water demand management given at Jordan University of Science and Technology in Irbid, Jordan in August 2004. Topics included roles of water demand management (WDM) in a water system; WDM actions, incentives, programs, and scales of implementation; common conservation techniques for water users; communication strategies; measuring program results; paying farmers to conserve; and optimal leakage, among others.

6. Winter 2004. **Facilitator,** Seminar on Computer Support for Negotiation (ECI 299), Dept. of Civil and Env. Engineering, University of California, Davis.

   Assigned readings and facilitated weekly discussions for 1-unit graduate level seminar class. 8 students. Organized and edited a "Comment" later published in *Water International*.

LANGUAGES

- English: Native speaker
- Arabic: Listening, speaking, and reading competency. Need native speaker to proofread writing
- Programming: Matlab, Visual Basic, C, Pascal, Data System Storage, GAMS, SQL, and HEC-5

PROFESSIONAL AFFILIATIONS & ACTIVITES

- American Water Resources Association, Member (2010 through present); Utah Chapter steering committee, Member (2010 through present)
- American Geophysical Union, Member, (2008 through present)
- American Society of Civil Engineers, Associate Member (2008 through present); Environmental Water Resources Institute, member (2010 through present); Environmental Water Resources Systems Committee, Control Group Member (2010 through present)
- Friends of Jordan Association, member (2003 through present); former President (2009-2011)
- National Peace Corps Association for Returned PCVs (2000 through present)
- International Water Resources Association, Member (2003 through present)
- Reviewer for *Advances in Water Resources, ASCE-Journal of Water Resources Planning and Management, Desalination and Water Treatment, Engineering Optimization*, *Environmental Modeling & Software*, *Environmental Science and Technology*,

Hydrology and Earth System Sciences, *International Journal of River Basin Management*, *Journal of the American Water Resources Association, Journal of Environmental Management*, *Water International,* Water-*Open Access*, *Water Resources Management*, *Water Resources Research, CRC Press* (2004 – present)

PROFESSIONAL DEVELOPMENT

Proposal Writing Institute participant, Utah State University, Office of Proposal Development. Logan, UT: April 21, 2011 - June 2, 2011.

Excellence in Civil Engineering Education (ExCEEd) workshop participant, American Society of Civil Engineers. Boulder, CO: July 18, 2010 - July 23, 2010.

HONORS/AWARDS

- Quentin Martin Best Research-Oriented Paper Award, *ASCE-Journal of Water Resources Planning and Management*. May, 2013.
- **CAREER Award, National Science Foundation. January, 2012.**
- Gardner Junior Faculty Travel Fellowship Award, Utah State University, March 2011.
- Best Reviewer, *Journal of Water Resources Planning and Management-ASCE*, November, 2010.
- Best Ph.D. Dissertation in Water Policy and Socioeconomics, Universities Council on Water Resources, July, 2010.
- Graduate Research Fellowship, National Science Foundation; 2003 to 2007.
- Jastro-Shields Research Award, International Agricultural Development Graduate Group, University of California—Davis; May 2002.
- Engineer-In-Training, State of California, License #113520; December 2001.
- Jastro-Shields Fellowship, International Agricultural Development Graduate Group, University of California, Davis; April 2001
- Advanced rating in Arabic on ACTFL exam, Amman, Jordan, October 2000.

PEER-REVIEWED JOURNAL PUBLICATIONS

Melina Santos Vanderliner, Christopher Neale, **David E. Rosenberg**, Karin M. Kettenring (in press). "Use of remote sensing to assess changes in wetland plant communities in response to large-scale disturbance and management – a case study from the Bear River Migratory Bird Refuge, Great Salt Lake, UT." *Western North American Naturalist*.

David E. Rosenberg and Kaveh Madani (in press). "Water Resources Systems Analysis: A Bright Past and a Challenging but Promising Future." *ASCE-Journal of Water Resources Planning and Management*.

Adel Abdallah and **David E. Rosenberg** (in press). "Heterogeneous Residential Water and Energy Linkages and Implications for Conservation and Management." *ASCE-Journal of Water Resources Planning and Management*. doi:10.1061/(ASCE)WR.1943-5452.0000340.

Abdelhaleem Khader, **David E. Rosenberg**, and Mac McKee (2013). "A decision tree model to estimate the value of information provided by a groundwater quality monitoring network." *Hydrology and Earth System Sciences,* 7(5), 1797-1807. doi:10.5194/hess-17-1797-2013.

Omar Alminagorta, Bereket Tesfatsion, **David E. Rosenberg**, Bethany Neilson (2013). "Simple Optimization Method to Determine Best Management Practices to Reduce Phosphorus Loading in Echo Reservoir, Utah." *ASCE-Journal of Water Resources Planning and Management*, 139(1), 122-125. doi:10.1061/(ASCE)WR.1943-5452.0000224.

Francisco Suero, Peter Mayer, **David E. Rosenberg** (2012). "Estimating and Verifying United States Households' Potential to Conserve Water." *ASCE-Journal of Water Resources Planning and Management*, 138(3), 209-306. doi:10.1061/(ASCE)WR.1943-5452.0000182. **Quentin Martin Best Research-Oriented Paper Award-2013**.

Ahmed Al-Juaidi, **David E. Rosenberg**, Jagath Kaluarachchi (2011). "Water Management with Wastewater Treatment and Reuse, Desalination, and Conveyance to Counteract Future Water Shortages in the Gaza Strip." *International Journal of Water Resources and Environmental Engineering*. 3(12): 266 - 282. doi:10.5897/IJWREE10.030.

David E. Rosenberg, Kelly Kopp, Heidi Kratsch, Larry Rupp, Paul Johnson, Roger Kjelgren (2011). "Value Landscape Engineering: identifying costs, water use, labor, and impacts to support landscape choice." *Journal of the American Water Resources Association*. 47(3), pp. 635–649. doi:10.1111/j.1752-1688.2011.00530.x.

David E. Rosenberg (2011). "Raising the Dead without a Red Sea-Dead Sea project? Hydro-economics and governance." *Hydrology and Earth System Sciences*. 15, 1243-1255. doi:10.5194/hess-15-1243-2011.

David E. Rosenberg (2010). "Residential Water Demand under Alternative Rate Structures: a simulation approach." *ASCE-Journal of Water Resources Planning and Management*. 136(3), pp. 395-402. doi:10.1061/(ASCE)WR.1943-5452.0000046.

Julien Harou, Manuel Pulido-Velazquez, **David E. Rosenberg**, Josue Medellin-Azuara, Jay Lund, Richard Howitt (2009). "Hydro-economic Models: Concepts, Design, Applications, and Future Prospects." *Journal of Hydrology*. 375(3-4), pp. 627-643. doi:10.1016/j.jhydrol.2009.06.037.

David E. Rosenberg (2009). "Integrated Water Resources Management and Modeling at Multiple Spatial Scales in Jordan. *Water Policy*. 11(5), 615-628. doi:10.2166/wp.2009.064.

David E. Rosenberg (2009) "Shades of Grey: a critical review of grey-number optimization." *Engineering Optimization*. 41(6), pp. 573 - 592. doi:10.1080/03052150902718125.

David E. Rosenberg and Jay Lund (2009). "Modeling Integrated Water Utility Decisions with Recourse and Uncertainty: Amman, Jordan." *Water Resources Management*, 23(1), pp. 85-115. Doi:10.1007/s11269-008-9266-4.

David E. Rosenberg, Samer Talozi, and Jay Lund (2008) "Intermittent Water Supplies: Challenges and Opportunities for Residential Water Users in Jordan." *Water International*. 33(4), pp. 488-504.

David E. Rosenberg, Richard Howitt, and Jay Lund (2008). "Water Management with Water Conservation, Infrastructure Expansions, and Source Variability in Jordan." *Water Resources Research*, 44, W11402. doi:10.1029/2007WR006519.

David E. Rosenberg, Tareq Tawarneh, Rania Abdul-Khaleq, Jay Lund (2007). "Modeling Integrated Water-User Decisions in Intermittent Supply Systems." *Water Resources Research*. 43, W07425. doi:10:1029/2006WR005340.

David E. Rosenberg (2007) "Probabilistic Estimation of Water Conservation Effectiveness." *Journal of Water Resources Planning and Management*. 133(1), pp. 39-49.

David E. Rosenberg (2006) "The Yarmouk River Agreements: Jordan-Syrian transboundary water management, 1953–2004." *Arab World Geographer*. 9(1), pp. 23-39.

David E. Rosenberg and Jay Lund (2006) "Derived Operating Rules for Storage and Recovery in Multiple, Unconnected Aquifers." *Journal of Water Resources Planning and Management*: 132(1), pp. 25-34.

David E. Rosenberg and Travis Marcotte (2005) "Land-use system modeling and analysis of shaded cacao production in Belize." *Agroforestry Systems* 64 (2), pp. 117-129.

Stacy K. Tanaka, **David E. Rosenberg**, Paul Haans, Belen Marti Cardona, Julien Harou, and Fauwaz U. Hanbali (2004) "Comments on 'Computer Support for Implementation of a Systemic Approach to Water Conflict Resolution' by V. Rajasekaram, S. Simonovic, and K. Nandalal." *Water International* 29(3), pp. 402-404.

Conjunctive Use for Flood Protection (2001) PR-41. U.S. Army Corps of Engineers. Hydrologic Engineering Center, Davis, CA.

Sarah Allendorf, David Ottenson, **David E. Rosenberg**, and Gary Hubbard (Nov 16, 1999) "Method and Apparatus for Off-Gas Composition Sensing." U.S. Patent No. 5,984,998.

BOOK CHAPTERS

Bereket Tesfatsion, **David E. Rosenberg** (2013). "Evaluating Storage Carryover in the Weber River Basin using the Water Evaluation and Planning (WEAP) System". *In Water Resources Systems Analysis through Case Studies: Data and Models for Decision Making*, Watkins, David W, Jr. (ed). American Society of Civil Engineers: Alexandria, VA, Chapter 9.

SELECT CONFRENCE PRESENTATIONS

Adel Abdallah, **David E. Rosenberg** (2013). "A Relational Data Model for Water Management Data." CUASHI Conference on Hydroinformatics and Modeling, Logan, UT: July 17-19, 2013.

Steven Burian, Jeff Horsburgh, **David E. Rosenberg**, Dan Ames (2013). "Using Interactive Video Conferencing for Multi-Institution, Team-Teaching." 120th American Society of Engineering Education Annual Conference and Exposition, Atlanta, GA: June 23-26, 2013.

Adel Abdallah, **David E. Rosenberg** (2013). "Identifying Collaborative City-Wide Residential Water and Energy Conservation Programs." Environmental Water Resources Institute of the American Society of Civil Engineers, Cincinnati, OH: May 19 - 23, 2013.

Omar Alminagorta, **David E. Rosenberg**, Karin M. Kettenring (2012). "System Modeling to Improve the Hydro-Ecological Performance of Diked Wetlands". American Geophysical Union Annual Fall Conference, San Francisco, CA, Dec 3-7, 2012. H31I-1234.

David E. Rosenberg, Mark F. Roark, Brian Shirley (2012). "River-Based Experiential Learning: The Bear River Fellows Program," American Geophysical Union Annual Fall Conference, American Geophysical Union, San Francisco, CA: Dec 3-7, 2012, ED43C-0740.

David E. Rosenberg (2012) "Near-optimal water management to improve multi-objective decision making." 2012 International Congress on Environmental Modelling and Software: Managing Resources of a Limited Planet, Sixth Biennial Meeting, July 1-5, 2012: Leipzig, Germany.

Melina Vanderlinder, Christopher Neale, **David E. Rosenberg**, Karin Kettenring, Omar Alminagorta (2011). "Classifying Wetland Vegetation with Remote Sensing Techniques at Bear River Migratory Bird Refuge, Utah". National Conference - Society of Hispanic Professional Engineers: Anaheim, CA, October 26 - 29, 2011.

Omar Alminagorta, Bereket Tesfatsion, **David E. Rosenberg**, Bethany Neilson (2011). "Simple Optimization Method to Determine Best Management Practices to Reduce Phosphorus Loading n Echo Reservoir, Utah." Planning for Tomorrow's Water: Snowpack, Aquifers, and Reservoirs, Universities Council on Water Resources: Boulder, CO, July 11-14, 2011.

Bereket Tesfatsion, **David E. Rosenberg** (2011). "Managing water shortages in the Weber Basin using WEAP". Utah Section of the American Water Resources Association 39th Annual Water Resources Conference –Water Conservation: the Keystone of Sustainable Water Management, Salt Lake City, Utah, May 10, 2011.

Adel Abdallah, **David E. Rosenberg** (2011). "Water system Water and Energy Linkages and Implications for Household and City-Scale Systems Modeling." Spring Runoff Conference: Utah State University, Logan, Utah, March 29-30, 2011.

Melina Vanderlinder, Christopher Neale, **David E. Rosenberg**, Karin Kettenring, Omar Alminagorta (2011). "Classifying Wetland Vegetation Coverage with Remote Sensing Techniques at the Bear River Migratory Bird Refuge, Utah." Spring Runoff Conference: Utah State University, Logan, Utah, March 29-30, 2011.

David E. Rosenberg, Joanna Endter-Wada, Arthur Caplan, Diana Glenn, Guy Ballard, Katie Henderson (2011). "Building an interdisciplinary research program in water conservation: preliminary findings, approach, and next steps." The Sixth IWA Specialist Conference on Efficient Use and Management of Water-Water Demand Management: Challenges & Opportunities, Dead Sea, Jordan, March 29-April 2, 2011

David E. Rosenberg (2010). "Raising the Dead without a Red Sea-Dead Sea Canal? A hydro-economic-institutional analysis." American Geophysical Union Annual Fall Conference: San Francisco, CA, Dec 13-17. 2010.

David E. Rosenberg (2010). "Integrated Water Resources Modeling and Management at Multiple Spatial Scales." HydroFutures: Water Science, Technology, and Communities, UCOWR/NIWR Annual Conference: Seattle, WA, July 13-15, 2010.

Julien Harou, **David E. Rosenberg**, Amoury Tilmant, and Didrik Pinte (2010) "Promoting Water Resource Systems Analysis Models with Generic Software Platforms" World Environmental and Water Resources Congress 2010: Providence, RI, May 16-20, 2010.

Francisco Suero and **David E. Rosenberg** (2010) "Estimating and Verifying Household Potential to Conserve Water" World Environmental and Water Resources Congress 2010: Providence, RI, May 16-20, 2010.

David E. Rosenberg (2010) "7 recycled ideas to better model and manage water resources in a changing world" USU Spring Runoff Conference, Logan, UT, April 20-21, 2010.

Ahmed Al-Juaidi, Jagath Kalaruchchi, and **David E. Rosenberg** (2009) "Managing water and salinity with desalination, conveyance, conservation, waste-water treatment and reuse to counteract climate variability in Gaza." American Geophysical Union Annual Fall Conference, San Francisco, CA, December 14 - 18, 2009.

Nancy Hardman, Fred Liljegren, Kelly Kopp, **David E. Rosenberg** (2009). "Value Landscape Engineering: spreadsheet and web tools for planning cost-effective, water-efficient, and resource-conserving landscapes." Water Smart Innovations Conference, Las Vegas, NV, Oct 7-9, 2009.

David E. Rosenberg. (2009). "Price and Rate-Structure Modifications as Drought and Climate Variability Management Tools for an Urban Water Utility." American Water Resources Association, Managing Water Resources and Development in a Changing Climate, Anchorage, Alaska, May 4-6, 2009.

Ahmed Al-Juaidi, Jagath Kalaruchchi, and **David E. Rosenberg**. (2009). "Water and salinity management with blending, desalination, conveyance, conservation, waste-water treatment and reuse to counteract climate variability in Gaza." American Water Resources Association, Managing Water Resources and Development in a Changing Climate, Anchorage, Alaska, May 4-6, 2009.

Ahmed Al-Juaidi, Jagath Kalaruchchi, and **David E. Rosenberg** (2009). "Water management with wastewater treatment and reuse, desalination, and conveyance to counteract climate change in the Gaza Strip." Spring Runoff Conference, Utah State University, Logan, Utah, April 2-3, 2009.

David E. Rosenberg. (2008). "Designing a Hydro-Economic Collaborative Computer Decision Support System: Approaches, Best Practices, Lessons Learned, and Future Trends." American Geophysical Union Conference, San Francisco, CA, December 15-19, 2008.

Julien Harou, Didrik Pinte, **David E. Rosenberg**, Amaury Tilmant, Kristiana Hansen, Josué Medellin-Azuara, Arnaud Reynaux, Manuel Pulido-Velazquez, and Sebastian Vicuna. (2008). "www.HydroPlatform.org: An open-source interface for water management models." American Geophysical Union Conference, San Francisco, CA, December 15-19, 2008.

Julien Harou, Manuel Pulido-Velazquez, Josué Medellin-Azuara, **David E. Rosenberg**, and Jay Lund. (2008). "Hydro-Economic Models - Insights for Integrated Management and Adaptation to Climate Change, Agriculture", World Water Congress, Montpelier, France, September 1-4, 2008.

Jay Lund and **David E. Rosenberg** (2006) "Modeling Integrated Water User Decisions in Intermittent Supply Systems". American Geophysical Union Conference. San Francisco, CA, December 11 – 15, 2006.

Jay Lund and **David E. Rosenberg** (2004) "Optimization for Integrated Water Demand Management Activities." International Water Demand Management Conference. Dead Sea, Jordan, May 30 – June 3, 2004.

Jay Lund, **David E. Rosenberg**, Mary Anne Dickenson (2004). "Strategic Planning for Water Demand Management." International Water Demand Management Conference. Dead Sea, Jordan, May 30 – June 3, 2004.

SUBMITTED PAPERS

David E. Rosenberg. "Near-Optimal Management to Improve Water Resources Decision Making." *Water Resources Research*. August, 2013.

Omar Alminagorta, **David E. Rosenberg**, Karin M. Kettenring. "System Modeling to Improve the Hydro-Ecological Performance at of Diked Wetlands." *Water Resources Research*. February, 2013.

Leah Meeks, **David E. Rosenberg**. "Network Analysis using Parallel Coordinates." *ASCE-Journal of Water Resources Planning and Management*. February, 2013.

KEYWORDS

Integrated planning; modeling; water resources; water conservation; demand management; systems analysis; optimization; simulation; uncertainty; hydro-economic engineering.

Sharon Denise Vaughn

BRMBR Operations, U.S. Fish and Wildlife Service

Education

B.S., Fisheries and Wildlife Biology, Michigan State University

Distinguishing Qualifications

- Over 28 years of USFWS experience

Training

- Quality Performance Awards 2010, 2008, 1991, on-the spot Award 1996, 1997 and 1998.
- 2010 – Advanced Refuge academy, NCTC 8/10
- 2010 – The Leadership Challenge, NCTC 4/10
- 2009 – Law Enforcement for Supervisors, NCTC
- Friends for the Future Conference, April 4-6, 2008 – USFWS National Conservation Training Center, Shepardstown, WV
- Arthur Carhart National Wilderness Training Center National Wilderness Stewardship Training, June 22-27, 2008 – Missoula, MT
- Applied Supervision, July 21-25, 2008, USFWS National Conservation Training Center, Shepardstown, WV

Relevant Experience

U.S. Fish and Wildlife Service, Bear River Migratory Bird Refuge. Brigham City, Utah, Deputy Project Leader, 0485/13; 10/2008 – Present. Deputy Project Leader for a complex, high-profile National Wildlife Refuge. Deputy responsibilities involve: extensive infrastructure and maintenance; variety of high priority wildlife species; high public use and public use facilities; environmental education; active acquisition and easement programs including planning the Bear River Watershed Conservation Area (approved PPP); controversial land disputes; water rights and water flow controversies; conflict of urban and agricultural use surrounding Refuge; contaminant and pollution issues; political sensitivity; supervision of large staff of multiple disciplines. Major duties include:

- Deputy Project Leader with full scope and authority of the GS-14 Project Leader. Plan, execute and evaluate wildlife habitat development, maintenance, protection and enhancement work.
- Manage a diverse complex of wetlands and grasslands; including evasive species, grazing and prescribed fire programs.
- Serve as Service's representative to State, Federal, University and other organizations involved in the conservation and management of the Bear River Watershed. Co-writer and editor of the Preliminary Project Proposal (PPP) for the Bear River Watershed Conservation Area.
- Plan and direct an integrated law enforcement program.
- Recruit, train, supervise, counsel, motivate and mentor a diverse professional and technical staff. Personnel recruitment and responsibilities executed with aggressive support of Service Equal Employment Opportunity goals.
- Develop annual and project future needs for budgets, program schedules and staffing proposals. Develop relationships and cooperative agreements with other Refuges, Federal and State agencies, local governments and non-profit groups.

Member "Relevance to a Changing America" Core Team for NWRS Vision Process; "Conserving the Future – Wildlife Refuges and the Next Generation"; Detail to Region 4 USFWS, January 12-28, 2011: Chassahowitzka National Wildlife Refuge Complex; U.S. Fish and Wildlife Service, Cabeza Prieta National Wildlife Refuge; Ajo, Arizona; Wildlife Refuge Specialist, 0485/11; 7/2007–10/2008. Wildlife Refuge Specialist for Cabeza Prieta National Wildlife Refuge; responsible for both Biological and Public Use programs of Refuge. Duties include planning, directing and implementation of station programs as well as supervision and mentoring program staff. Other duties and accomplishments include:

- Participated in planning, direction, and implementation of all Refuge programs.
- Participated in the development of long-range plans, work advice, guidance and budgets.
- Developed work schedules of staff and volunteers. Was Service/Refuge representative and coordinated with state and other Federal agencies, interest groups and Refuge partners in the formation of long-range plans for management of the Refuge and Wilderness resources with committees and working groups such as the Borderlands Task Force and Sonoran Pronghorn Recovery Team.
- Planned, adapted and implemented Refuge management programs for Federal and state threatened or endangered species and for species of special concern.
- Directed, planed and administered Refuge public use program: developed and implemented comprehensive youth programs including Youth Conservation Corps and "No Child left Inside" initiative. Provided outreach opportunities on the National Wildlife Refuge System and National Wilderness System. Performed as Refuge liaison for the Cabeza Prieta National History Association, a Refuge "friends" group.
- Planned and oversaw the reporting results of wildlife surveys, recreational and educational public use programs, as well as other outputs and documentation (RAPPS).
- Planned and implemented a comprehensive public relations and outreach programs to various organizations and groups.

Sharook P. Madon, Ph.D.

Wetland Assessment

Education

Ph.D., Aquatic Ecology/Zoology, Ohio State University, 1993

M.S., Environmental Sciences, State University of New York, College of Environmental Science and Forestry, 1988

M.S., Biotechnology, St. Xavier's College, Bombay University, 1984

B.S., Life Sciences, St. Xavier's College, Bombay University, 1982

Distinguishing Qualifications

- Expertise in coastal and freshwater wetlands and ecosystems restoration; large-scale research on wetland restoration designs and methods for both treatment and habitat-based wetlands
- Broad experience in physical, chemical and biological processes in freshwater, estuarine, and marine ecosystems, including large floodplain rivers, and restoration of these ecosystems.
- Expertise in wetlands ecology
- Expertise in invasive species dynamics, impacts and controls
- Expertise in environmental assessments and impact analysis for terrestrial and aquatic systems
- Expertise in biological and ecological modeling, especially bioenergetics models to evaluate species responses to environmental stressors
- Oil and gas industry experience

Relevant Experience

Dr. Sharook Madon is a Senior Principal Technologist in the Water Business Group at CH2M HILL, San Diego, California, U.S.A, and also serves as the firm-wide Global Technology Leader for the Ecosystem Planning and Restoration technology area in the Water Resources & Environmental Management Services at CH2M HILL. He comes to CH2M HILL from the Pacific Estuarine Research Laboratory at San Diego State University, where he served as the Associate Director of the laboratory. His research on physical, chemical and biological processes in coastal and freshwater wetlands, estuarine, marine and large river ecosystems impacted by environmental stressors is nationally recognized and widely published in the peer-reviewed literature. Dr. Madon has led several ecosystem restoration, monitoring and assessment projects for both natural treatment and habitat-based wetlands and has conducted important NSF-supported research at the Model Marsh, an unique 20-acre experimental wetland at the Tijuana River National Estuarine Research Reserve, where various designs, restoration methods and techniques are being tested in replicated tidal creek systems at multiple habitat and trophic levels. Dr. Madon is an invited member of several Science Advisory Panels dedicated to the preservation and restoration of coastal habitats and ecosystems. He has experience working with local, state, and federal agencies and stakeholders on multiple wetland issues. Broadly trained as an ecologist, Dr. Madon has also conducted research in a variety of freshwater, estuarine and marine ecosystems in the U.S.A, Middle East and Asia. Before joining CH2M HILL in 2003, Dr. Madon served on the faculty of the University of Maryland, Pace University and San Diego State University, and continues to serve as adjunct professor at San Diego State University, California, USA.

Representative Projects

Coastal Restoration and Wetlands Design and Restoration Projects – Natural Treatment Systems and Habitat Wetlands

Senior Principal Ecologist, Remediation and Restoration of Coastal Ecosystems Impacted by 1991 Gulf War Oil Spill, Presidency of Meteorology and Environment, Kingdom of Saudi Arabia and United Nations Compensation Commission (June 2009 – present). The oil spills related to the 1991 Gulf War remain the largest in history. Over 11,000,000 barrels of oil (40 times the size of the *Exxon Valdez* spill) impacted approximately 800 km of Saudi Arabia's shoreline between the Kuwait Border and

Abu Ali Island. Providing technical direction on the management of the coastal and marine restoration it has embarked upon during the 3-year period beginning in 2009. Specific key tasks include assessment of ecosystems impacts, the review/evaluation of the remediation and restoration designs, technical meetings with stakeholders, field validation surveys, development of remediation and restoration objectives, prioritization of coastal remediation and restoration projects, design of pilot, demonstration and large-scale remediation/restoration projects, overall implementation of these projects, and development and implementation of monitoring protocols, metrics and assessment framework including indices of biotic integrity and multi-metric indices to evaluate remediation and restoration success.

Senior Principal Ecologist, Biological and Ecological Characterization of Jeddah Sewage Lake, National Water Company, Kingdom of Saudi Arabia (June 2010 – January 2011). The purpose of this project was to develop the Jeddah Sewage Lake (Lake) Evacuation and Sediment Reuse/Disposal Plan, a component of which included surveys of wetlands habitat and wildlife around the lake. This planning project was initiated in July 2010 by the National Water Company (NWC) concurrent with a contract being approved for the evacuation of the lake water, removal of the dam, and cleanup or removal of organic sediment deposited in the Lake. This planning project was tasked to examine several specific issues related to the lake water evacuation performed by Huta Hegerfeld Saudi Ltd. (Lake Contractor), including the flooding potential associated with the removal of the dam; alternatives for sediment cleanup or disposal; potential impacts to water use, agricultural uses dependent on water, ecological features (wildlife and habitat) associated with the Lake; and regulatory issues and international best practices associated with the applicable lake water and sediment management issues.

Project Manager, Inventory and Study of Urban and Treatment Wetlands in Southern California, Southern California Coastal Water Research Project (December 2004 – September 2007). Developed an inventory and database consisting of preliminary design, operations, maintenance, and site history information on 40 urban and treatment wetland sites in southern California. This study is providing valuable insights into pollutant treatment effectiveness and habitat values provided by stormwater treatment wetlands and whether treatment effectiveness of these wetlands is compatible with habitat goals. Field studies on vegetation and habitat mapping at each of the 40 wetlands sites commenced in February 2006, and intense biological surveys of macroinvertebrates, fish and birds were completed by summer 2006 in addition to other physical and chemical constituents.

Wetland Design Task Leader, Conceptual Design of the Managed Marsh Ecosystem, Imperial Irrigation District. (January 2005 – December 2006). Developing conceptual-level designs for approximately 650-1,200 acres of wetlands to be constructed as mitigation for impacts of IID's construction and seepage recovery activities on wetlands habitat. Follow-on phase is likely to involve the engineering design and construction of the wetlands area for habitat and incidental treatment of water quality.

Wetlands Design Task Leader, Conceptual Design of Treatment Wetlands for Control of Thermal and Nutrient Pollution: A Component of the City of Tracy Master Plan, City of Tracy. (January 2006 – December 2006). Developing conceptual designs for up to 1,200 acres of treatment wetlands to be constructed as part of the City of Tracy's Masterplan to develop integrated natural treatment systems and passive recreational facilities. The wetlands will be designed with the goal of treating the effluent temperature and high nutrient loads from the City of Tracy's Wastewater Treatment plant before the effluent is discharged to the Old River. This phase of the study involves the development of conceptual plans for a 100 acre pilot treatment wetlands site as well as the larger 1,200 acre site.

Principal Wetlands Ecologist and Task Lead, Physical, Chemical and Ecological Characterization of Farmington Bay and the Great Salt Lake Wetlands and Development of a Bioassessment Framework for Impounded Wetlands, Utah Department of Water Quality. (June 2004 –present). Conducted a detailed field study, including the development of extensive monitoring designs to characterize saline, brackish and freshwater wetlands around Farmington Bay and the Great Salt Lake, Utah. The project is identifying sensitive wetland indices and metrics and their responses to environmental gradients including salinity, nutrients, temperature and algal mats and other stressors, with the goal of defining beneficial uses of these wetlands. Analyzed data for development of multimetric indices.

Principal Wetlands Ecologist QA/QC Reviewer, Matagorda Bay Health Evaluation Project, Lower Colorado River Authority (LCRA) and San Antonio Water System (SAWS) (June 2004 – June 2009). Provided senior QA/QC reviews of all documents/data associated with the evaluation of the health of Matagorda Bay, Texas. Studies evaluated included Flow needs in tidal and freshwater sections of the Lower Colorado River and its tributaries, wetland characterization, water quality analysis, biostatistical analysis, habitat assessments, hydrological and salinity analysis and modeling, and bay food web analysis.

Science Advisory Panel Leader, Pond A4 Tidal Wetland Restoration Project, Santa Clara Valley Water District (July 2003 – December 2005). Provided senior science reviews of preliminary reports of opportunity and constraints analysis and draft environmental assessment reports (EARs) of biology and water quality sections, and guidance of the alternatives screening process of the 304-acre Pond A4, a former Cargill Salt evaporator pond located in the south San Francisco Bay area, set aside for restoration to tidal wetlands.

Task Leader, Design, Construction and Maintenance Guidance for the Maine-Yankee Forebay Wetland, Maine Yankee Atomic Energy Plant (July 2003 – December 2003). Developed and wrote a white paper describing various physical, chemical and biological processes in Maine coastal wetlands, and provided restoration methods and design guidance for 1.2 acres of the decommissioned forebay.

Principal Ecologist, Upper San Joaquin River Conceptual Restoration Plan – Phase II, San Joaquin River Management Coalition (September 2003 – October 2005). Developed scope of work and complex water needs, water supply options and alternatives for restoration of the Upper San Joaquin River to support riverine biota and riparian wetlands while adequately addressing the needs of the multiple water users in the region.

Principal Ecologist, Ecological Assessments of Impacted Coastal Wetlands, Earth Island Institute & Coastal Environments (September 1998 – July 2003). Many coastal wetlands in southern California are tidally-restricted because of roadways and/or railroads that bisect the inlet or other tidal areas of the lagoons and estuaries. As a result, salt water supply to these wetlands is often restricted, while increasing freshwater runoff from developed upstream areas changes the salinity, sediment and nutrient profiles of these systems, often along environmental gradients. These water quality changes have resulted in dramatic shifts in vegetation patterns and biological interactions in the food webs of these wetlands. I have conducted research and led monitoring and assessment efforts to characterize the ecological condition of these wetlands (Los Penasquitos Lagoon, Sweetwater Marsh and Tijuana Estuary), in relation to various environmental stressors (salinity, nutrients, sediment). Such assessments are being used to propose various enhancements, restoration projects, and beneficial uses in these systems.

Principal Ecologist, Ecological Patterns and Processes in Coastal Wetlands, Earth Island Institute (September 1998 to July 2003). I designed and led research efforts to evaluate structural and functional patterns and processes in coastal wetlands. Led research and monitoring of salt marshes (hydrology, geomorphology, biotic, and abiotic factors). Developed quality assurance/quality control (QA/QC) procedures to improve site selection (both reference and target sites), experimental, sampling, and monitoring (physical, chemical, and biological parameters) procedures and protocols as part of restoration and ecological projects in southern California wetlands. Conducted bioenergetics modeling and experimental evaluation of the importance of salt marshes to fish feeding and growth.

Principal Ecologist, Tijuana Estuary Tidal Restoration Program, National Science Foundation and California Coastal Conservancy (October 2001 – July 2003). Led restoration research and monitoring efforts at the 20-acre Model Marsh, a newly created, tidally influenced coastal wetland in the Tijuana River National Estuarine Research Reserve, San Diego County. Conducted large-scale experiments and caging experiments to assess the effects of topographic heterogeneity (tidal creek designs and multiple salt marsh habitats) on coastal wetland ecosystem development and functional attributes of salt marsh plants, invertebrates, and fish. This study is providing new scientific information on restoration designs and methods.

Senior Ecologist, Ormond Beach Tidal Wetland Restoration Project, California Coastal Conservancy (March to June 2003). Participated as lead ecologist in preparing a detailed study approach and work plan in response to a Request for Proposal (RFP) for the Ormond Beach Tidal Wetland Restoration feasibility study, a 750-acre coastal site in Ventura County, California.

Biological Reviews and Assessments

Senior Technical Consultant, Technical Evaluations of the Programmatic Environmental Impact Statement/Review for the San Joaquin River Restoration Program, Exchange Contractors, California. (May – July 2011). Provided detailed technical evaluations and biological opinions on the Draft PEIS/R for the San Joaquin River Restoration Program, specifically focusing on restoration of the T&E salmonid species and aquatic resources.

Senior Technical Consultant, Biological Resources Evaluations, AES-Southland (May 2011 – present). Providing technical guidance and on-site evaluations of biological resources present on AES sites, including descriptions of general settings and surrounding land use, protected areas and conservation lands, special status plants and wildlife species, and wetlands and aquatic resources on site. AES-Southland (AES-SL) owns and operates approximately 4,200 megawatts (MW) of electrical generation capacity located at three natural gas powered generating stations (Alamitos, six units; Huntington Beach, four units; and Redondo Beach, four units). To meet the requirements of the State Water Resources Control Board (SWRCB) new Once Through Cooling (OTC) Policy requiring the reduction in use of ocean water in power plant operations, support the electrical system's needs, and meet the expected Long-Term Procurement Process (LTPP) and new source solicitation timelines, AES-SL plans to implement a comprehensive, phased repowering program of its entire generation fleet at these three facilities.

Senior Technical Consultant, Third-Party EIS Reviews, Port of Gulfport Restoration Program, Mississippi State Port Authority, Gulfport, MS. (May – September 2010). Provided evaluations of detailed proposals and input on selection of contractors for preparations of the Third Party EIS triggered due to the Port's rebuilding mandated after damages suffered from Hurricane Katrina. As part of this program, also provided technical input on impact assessments to T&E species including the Gulf Sturgeon.

Large Estuaries Projects

Senior Scientist, Population and Energy Dynamics of an Invasive Species in the Hudson River Estuary, Scholarly Research Grants of the Pace University Foundation (May 1997 to March 1999). Led a study that included biochemical analyses and field and laboratory experimentation to assess seasonal energetic and population dynamics of zebra mussels in the Hudson River. This study provided insights into the patterns of exotic species invasions and their potential environmental impacts in a tidal, freshwater river.

Senior Scientist, Trophic Interactions in the Chesapeake Bay and Associated Tidal Systems, Environmental Protection Agency (September 1994 to September 1995). Used mesocosm experiments, bioenergetics, and population models to assess the role of planktivorous and benthivorous fish in mediating trophic interactions among pelagic, benthic, and salt marsh invertebrate communities in the Chesapeake Bay and associated tributaries. Data were used in a larger study investigating environmental processes and human impacts in this estuary, including restoration efforts associated with the bay and its tidal tributaries.

Project Scientist, Predatory Impacts of Invertebrates in the Chesapeake Bay, Environmental Protection Agency (September 1994 to September 1995). Developed and used bioenergetics and population models for the sea-nettle medusae, *Chrysaora quinquecirrha,* to quantify its environmental impact on zooplankton population dynamics in the Chesapeake Bay.

Timothy S. Petty, P.E.

Design Manager

Education

M.S., Civil Engineering, Utah State University, 2002
B.S., Civil Engineering, Utah State University, 2000

Professional Registrations

Professional Engineer: Utah (No. 501399-2203); Oregon (No. 75161PE)

Distinguishing Qualifications

- More than 12 years experience providing structural evaluation and design of water storage and conveyance facilities
- Structural design of hydraulic structures, including prestressed concrete water tanks and reinforced concrete basins (circular and rectangular)
- Structural design in areas of high seismicity
- Structural design for buildings using a variety of construction materials
- Seismic evaluation, retrofits, and upgrades using Federal Emergency Management Agency (FEMA) guidelines
- Structural design of buildings to resist blast loads
- Condition assessments for a broad range of facilities including concrete reservoirs and tanks and treatment facilities

Relevant Experience

Mr. Petty is a structural engineer with CH2M HILL's Water Business Group in Salt Lake City, Utah. He has broad experience providing structural design for a wide variety of projects, including water and wastewater treatment plants and storage facilities, building structures, military facilities (including blast resistance design), and seismic retrofit upgrades. In addition to design work, Tim also provides structural condition assessments and rehabilitation plans for existing facilities.

Representative Project Experience

Water Storage

Structural Engineer; Magna Reservoir; Kennecott Utah Copper Corporation; Murray, Utah; 2008 to 2010. Provided condition assessment for existing concrete reservoir constructed in 1906. Provided alternatives and recommendations for the rehabilitation or replacement of the reservoir. Operational requirements dictated that repair or rehabilitation work be performed without taking the existing reservoir out-of-service for an extended time period. The selected alternative included the construction of a new reservoir adjacent to the existing reservoir, followed by rehabilitation of the existing reservoir. This allowed the downtime of the existing reservoir to be minimized.

Structural Engineer; Pepperwood Water Tank; City of Sandy; Sandy, Utah; 2007. Performed structural condition assessment of the 3-MG Pepperwood Water Tank. The tank was constructed in 1975 and has experienced significant leakage and deterioration issues over the life of the tank. The inspection included an onsite inspection in addition to a review of the original construction documents and documentation of previous repair.

Structural Engineer; Tanks GC-3 and GC-4; City of Logan; Logan, Utah; 2007. Performed structural condition assessment of twin 1-MG tanks. The tanks are constructed of conventionally reinforced concrete and are partially buried. The inspection of the tank included a detailed inspection of the underside of the roof slab from an inflatable raft.

Structural Engineer; Military Reservoir; Salt Lake City Department of Public Utilities; Salt Lake City, Utah; 2007. Performed structural condition assessment of Military Reservoir, a 30-year-old, buried, 12-MG prestressed concrete tank, including ongoing monitoring and repair recommendations.

Lead Structural Engineer; 152nd Avenue Reservoir; Clackamas River Water District; Clackamas County, Oregon; 2005. Provided structural design of new 8-MG, 135-foot-diameter prestressed concrete water storage tank.

Structural Designer; Williams Creek Pump Station Forebay—Southern Delivery System; Colorado Springs Utilities; Colorado Springs, Colorado; 2004. Provided structural design of new 2.6-MG, 135-foot-diameter prestressed concrete water storage tank.

Structural Resident Inspector; Albany-Millersburg Joint Water Treatment Plant; Cities of Albany and Millersburg; Oregon; 2004. Provided onsite construction inspection for the construction of a new water treatment plant including in-water intake structure, pump station, filter building, settling basins, and 5.7-MG prestressed concrete water storage tank.

Structural Designer; Meridian Reservoir No. 1; City of Olympia; Olympia, Washington; 2003. Provided structural design of new 4.0-million-gallon (MG), 190-foot-diameter prestressed concrete water storage tank.

Structural Engineer; Grant Butte Reservoir; Gresham, Oregon. Provided seismic evaluation of existing 10-MG Reservoir and provided recommendations for rehabilitation.

Conveyance

Structural Engineer; Central Utah Project; Central Utah Water Conservancy District; Utah; 2007. Provided structural design of metering and control structures for multiple phases of the Central Utah Project pipeline projects including the following:

- Provo Reservoir Canal Enclosure; Provo River Water Users Association; Provo, Utah
- Spanish Fork Pipeline Reach 1, 96-inch pipeline; Central Utah Water Conservancy District
- Dewitt Pipeline Rehabilitation/Replacement; City of Logan; Logan Utah
- Wemlinger Blending Pipeline, City of Aurora; Aurora, Colorado
- Replace and Expand—South Davis Secondary Water Distribution System, Weber Basin Water Conservancy District
- Mapleton Springville Pipeline; Central Utah Water Conservancy District
- 800 North Pipeline—Phase 1 and Phase 2; Central Utah Water Conservancy District
- North Shore Aqueduct—West and North Segments; Central Utah Water Conservancy District
- 3200 West Pipeline Phase 1; Jordan Valley Water Conservancy District

Structural Engineer; DeWitt Pipeline Rehabilitation and Replacement; City of Logan, Utah. Responsible for structural design of the project, which included 2 miles of new 36-inch welded steel pipe in a new alignment; 3 miles of rehabilitation of appurtenances on a 24-inch reinforced concrete pipe (RCP); cast-in-place turbine and meter vault; rehabilitation of 6 air valves; design and construction of 4 air valves; three river crossings; and tank site piping design.

Structural Engineer; DeWitt Springs Hydropower Project; City of Logan; Utah. Completed structural modification design to facilitate the installation of a 220-kW hydro-turbine at a flow control station on the City's culinary water supply pipeline.

Darren Lowe, P.E.

Spill Response

Education

M.S., Chemical Engineering, University of Utah, 2011
M.S., Civil and Environmental Engineering, Brigham Young University, 2000
B.S., Biological Sciences, University of Lethbridge, 1994

Professional Registrations

Professional Engineer, Utah

Distinguishing Qualifications

- Project Manager for DOD facility RCRA permit compliance and management involving multiple permit modifications and updates
- Extensive experience in planning and design of remediation systems for groundwater, soil, and surface water cleanup (heavy metals, petroleum products, volatile organic compounds) for regulatory support
- Extensive experience in hydraulic and kinetic (biological) modeling
- Proficient in environmental compliance/permitting for air quality, groundwater, hazardous waste, leaking underground storage tanks, and solid waste

Relevant Experience

Mr. Lowe has worked as an environmental scientist and petroleum technologist for over 20 years with experience with conducting, designing and fabricating bench-scale simulations such as water, steam, gas floods; acid/base stimulations; fracture-fluid leakoffs. He has experience with reservoir engineering which included: down-hole water control using heat activated polymers to prevent coning; use of enzymes/surfactants to treat heavy oils to promote reservoir flow; testing of heat activated emulsifiers/polymers to improve production; use of heat activated fractionation gels to promote reservoir flow. Mr. Lowe is also knowledgeable in property evaluation of materials such as chemical analysis, density, miscibility, viscosity, permeability, porosity, interfacial tension, formative volume, saturation pressure, compressibility. He worked as a laboratory technician in the mass production of cultured media selected to bioaugment large scale bioremediation efforts for hydrocarbon contamination clean-up. As a field technician and a manager for field sampling operations, Mr. Lowe is experience in the following: air, soils, surface water, groundwater, logging core, off-gases, waste pits, sumps, baker/frac/mud/separator/waste tanks, well heads, etc. In addition, Mr. Lowe has operated and maintained laboratory analytical equipment including MS/GC/FID, HPLC, NMR, spectrophotometers, viscometers, etc.

Representative Projects

Project Manager; RCRA Permitting; Utah Test and Training Range; Utah. Project Manager for the Resource Conservation and Recovery Act Permit program at the Utah Test and Training Range (UTTR). The project involved supporting the Air Force in maintaining compliance with the RCRA Permit; negotiating with the Utah Department of Environmental Quality – Division of Solid and Hazardous Waste in modifying the Permit to reflect changes in operational procedures; coordinating and working with the Title V Permit to maintain overall permit continuity at the UTTR; conducting annual soil sampling the open burn/open detonation operation areas in coordination with Explosive Ordinance Disposal (EOD) and UnExploded Ordinance (UXO) personnel; managing the munitions throughput inventory; and preparing ecological risk and human health risk assessments. The project also involved the implementation of a new soil sampling protocol for characterizing explosive residues in the Utah West Desert currently under review of the EPA for possible incorporation into the RCRA program.

Project Manager/Lead Engineer; Munitions Recycling; Utah Test and Training Range (UTTR). Project Manager/Lead Engineer for a bomb recycling project involving the recycling of over 25,000 tons of spent munition items at the UTTR North Gate Recycle Facility. Due to the explosive nature of the materials associated with the project, considerable time and effort was spent focused on the safe handling of these materials that required a coordinated effort among several DOD agencies. The project involved

daily reviews with the onsite EOD and UXO site safety coordinator and daily tabulations of demilitarized items. Weekly and monthly reports were generated following both the RCRA and DOD protocols for such operations and submitted to the DOD, the client, and the State. All demilitarized items required strict quality control/quality assurance and required a rigorous certification/verification process. Successfully delivered the project without incident and under budget despite the discovery of live munition in the stockpile and the addition of munition items from another DOD facility.

Project Manager/Lead Engineer; UST Consulting; Department of Defense. Project Manager/Lead Engineer for a DOD Leaking Underground Storage Tank (LUST) program. The project involved designing and conducting ongoing remediation efforts and preparing reports to maintain compliance with the LUST program. The project involved the design of multiple remediation systems including enhanced bioremediation, soil-vapor extraction, bioventing, and automated free-product recovery. During his four year tenure as Project Manager 1 of the 4 sites in the program was successfully closed by the State.

Project Manager/Lead Engineer; Petroleum Cleanup. Project Manager/Lead Engineer for a private client involving the remediation of petroleum contamination at a large processing/transfer facility in the state of Wyoming. The project entailed supervising semi-annual groundwater sampling, preparing annual reports, detailing remediation progress, conducting subsurface investigations, conducting feasibility studies, and negotiating with the State over the active ongoing effort to remediate the site. The project involved the study of groundwater fluctuations using remote monitoring to determine whether a nearby stream was receiving or gaining water from the site; a pilot study to determine the viable use of an insitu commercial oxidizer; and a feasibility study evaluating multiple treatment options for remediating BTEX contamination.

Support Engineer; Title V; Hill Air Force Base, Utah. Support engineer for air compliance services to the environmental management compliance division for Hill Air Force Base, Utah. The project entailed building emission inventories, developing algorithms for air emission calculations, generating emission data from empirical data, Title V permit preparation, Title V development and compliance, developing a cost of compliance out-year funding, operation and maintenance of a remote ambient air monitoring network, conducting annual OB/OD alternative options review, conducting feasibility studies for remote emission monitoring, emission gas testing, and rocket motor testing and evaluations.

Project Engineer; Air Monitoring; Tinker Air Force Base; Oklahoma. Project engineer for the installation of a remote paint booth monitoring system at the AWACS maintenance facility located at Tinker Air Force Base, Oklahoma. The project involved designing the pressure differential monitoring system and installing it in over 20 different buildings located on Base. The remote monitoring system enabled the environmental management group to track and monitor paint booth operations from one location and reduce man hours in the operation and maintenance of each paint booth. In addition, the system collected data used in the annual air emission inventory.

Howard Browers

BRMBR Ecology

Wildlife Biologist June 2010 – Present
US Fish and Wildlife Service
Bear River Migratory Bird Refuge
Brigham City, UT

I serve as the Refuge Wildlife Biologist and am responsible for overseeing the refuge biology program. I advise refuge managers on the habitat needs of migratory birds with an emphasis on 14 priority waterbird species inhabiting the refuge. I prepare annual habitat management plans that include recommendations for water and invasive species management. I conduct refuge wildlife and plant monitoring surveys. I conduct surveys of regional or national importance including two Breeding Bird Surveys and the annual Winter Waterfowl and Bald Eagle survey. I collect data for the Pacific Flyway by participating in pre-season waterfowl banding. I oversee invasive species management on the refuge which includes an integrated approach utilizing cattle grazing, mechanical methods such as mowing and burning and pesticide application. I prepare Environmental documents such as NEPA Environmental Assessments and Pesticide Use Proposals as necessary in preparation for habitat management. I work with researchers from local universities in planning and conducting wildlife and habitat research projects to benefit refuge management. I collaborate with other land managers and biologists around the Great Salt Lake on research and monitoring projects that benefit migratory birds using the Great Salt Lake Ecosystem. I give oral presentations on refuge management to local universities and professional or civic groups.

Wildlife Biologist April 1999 – June 2010
US Fish and Wildlife Service
Mid-Columbia River Refuge Complex
Burbank, Washington

I served as the Refuge Biologist for a complex of eight National Wildlife Refuges in southeast Washington and northeast Oregon. I advised refuge managers on habitat needs for migratory birds inhabiting the refuges. I supervised 1-4 wildlife biologists or biological technicians. I conducted refuge wildlife and plant inventories. I coordinated and conducted surveys of regional or national importance including the Oregon Mourning Dove Survey and the annual Winter Waterfowl and Bald Eagle survey.
I prepared Environmental documents such as NEPA Environmental Assessments and Pesticide Use Proposals as necessary in preparation for habitat management. I was part of a team preparing a 15 year Comprehensive Conservation Plan for management of several of the refuges in the Complex. I worked with researchers from local universities in planning and conducting wildlife and habitat research projects to benefit refuge management. I collaborated with other land managers and biologists in the Columbia Basin on research and monitoring projects that benefit migratory birds using the Columbia Basin Ecosystem. I gave oral presentations on refuge management to local universities and professional and civic groups.

Fish and Wildlife Biologist November 1996 – April 1999
US Fish and Wildlife Service
Upper Columbia Fish and wildlife Office
Spokane, Washington

I performed pre-project review and planning regarding potential impacts to migratory birds and threatened and endangered species, associated with Federally-owned, licensed and authorized

developments. I made recommendations to mitigate for losses associated with hydropower projects, wetland fill permits, and other types of developments. I also reviewed proposed projects and developments and provided recommendations to county planning departments in eastern Washington and northern Idaho for avoiding or minimizing impacts to fish and wildlife species and their habitats.

Fish and Wildlife Biologist July 1989 – November 1996
US Fish and Wildlife Service
Pacific Regional Office
Portland, Oregon

I served as the Assistant Regional Wetland Coordinator working on the National Wetlands Inventory for the Pacific Region of the US Fish and Wildlife Service. Duties primarily involved overseeing and performing quality control of contractor-prepared wetland delineations using a mirror stereoscope and high altitude color infrared photography. I field verified draft wetland maps using hydrology indicators and identifying wetland plants. I also performed jurisdictional field delineations of wetlands.
I provided technical assistance to natural resource professionals regarding wetlands identification and mapping. I gave oral presentations on wetland ecology and management to local universities and professional and civic groups.

Research Associate October 1983 – July 1989
Department of Wildlife and Fisheries Sciences
South Dakota State University
Brookings, South Dakota

As part of a team contracted by the US Fish and Wildlife Service, I performed wetland delineations in North and South Dakota, Minnesota, Nebraska, Iowa, and Missouri using a mirror stereoscope and high altitude aerial photography. I field verified draft wetland maps using hydrology indicators and identifying wetland plants. I supervised 3-4 Research Assistants and managed an annual budget. I prepared, and edited correspondence and reports, and manuscripts for publication. I gave oral presentations on wetland ecology and management to local universities and professional and civic groups.

Education

MS in Wildlife and Fisheries Science - 1982
South Dakota State University
Brookings, South Dakota

Title of Thesis: Dispersal and Harvest of Sage Grouse Utilizing the Test Reactor Area of the Idaho national engineering Laboratory.

BS in Wildlife Ecology - 1979
Oklahoma State University
Stillwater, Oklahoma

Attachment 3
Related Project Experience

Attachment 3: Related Project Experience

Bear River Environmental Education in Action Project 3-1

Development of Water Quality Standards for Willard Spur, Great Salt Lake, Utah 3-5

Characterization of Great Salt Lake Wetlands 3-6

Restoration of Lake Point Wetlands Site 3-7

Program Management, Engineering, and Environmental Documentation – Refuge Water Supply Conveyance Project, Sacramento and San Joaquin Valleys, California U.S. Bureau of Reclamation, Sacramento, California 3-8

Modeling to Improve Wetlands Management 3-9

This is an example of the past and ongoing commitment by BRMBR towards environmental education and hands-on experiences that promote appreciation of wildlife and an understanding of the essential links between the ecological health of habitats, water quality, and the role of humans in conservation.

Bear River Environmental Education in Action Project

Bear River Migratory Bird Refuge, Brigham City, Utah

Project Description

The overarching goal of the program titled *Bear River Environmental Education in Action Program* (BREEAP) is to provide Greater Salt Lake Valley area students access to educational programming and field experiences that promote appreciation of wildlife and an understanding of the essential links between the ecological health of habitats, conservation of the species, and the role of humans in conservation. The developed curriculum and materials integrate hands-on scientific exploration into understanding the wetland ecosystem and the role of the Bear River Migratory Bird Refuge (MBR) and citizens in its conservation.

Objectives:

The Bear River Environmental Education in Action Program will achieve the following objectives:

1. Engage students, teachers, scouts and parents in hands-on conservation and restoration education experiences that promote wildlife education and nurture an appreciation of nature;
2. Provide ~10,000+ students with hands-on educational programs that fulfill current state curricular mandates (pre-school through college;
3. Provide preparatory training sessions for teachers, docents, and parents who will assist in the program delivery process;
4. Develop a "Teacher Education Workshop Trunk" for use in providing preparatory training and workshops for teachers, docents, parents, and scout/youth leaders who assist in student program delivery;
5. Develop associated teaching materials and activities for use in providing student programs;
6. Serve as a training ground for future conservation leaders; BREEAP trains student interns (high school / college) who wish to investigate careers in natural resources.

Effective and Proven Strategies

Bear River MBR applies proven and effective EE methods and strategies to advance environmental literacy and affect stewardship values and skills. Activities are planned within a spiral model curriculum whereby each field-trip to the Refuge builds upon those previously experienced. Ideally, students will visit the Refuge at least 3 times in their school careers: (1) Pre-K/K, (2) Fourth grade, and (3) Ninth grade or other high school grade level. The spiral model ensures that students build knowledge, skills, and abilities in a sequential manner relative to age appropriateness that promotes specific learning outcomes. Further, our environmental education programs provide structured activities that occur in the outdoor classroom on refuge lands, focus on the natural environment, and are based on an approved course of study with identified learner outcomes. Evaluative assessments are applied following every field study at both the teacher and student levels to identify areas which need improvement. Teacher trainings additionally strengthen Bear River MBR's programming, as teachers who are well prepared to assist with field trips exhibit a heightened sense of enthusiasm about topics and share a greater passion with their students, often translating in a greater application of knowledge subsequent to field trip experiences.

Educational Outcomes

Outcomes of BREEAP are three-fold: (1) Provide quality hands-on field and classroom experiences that correlate highly with Utah core curriculum standards while facilitating an understanding of the wetland ecosystem, the Bear River watershed, and the Bear River MBR; (2) Provide workshops for teachers and scout leaders with the training, materials and methods needed to enrich associated school and scout / youth curricula; and (3) Provide field-based internships for students to gain experience in natural resource careers.

Specifically, BREEAP will facilitate the instruction of the Pre-K/K, Fourth Grade, High School, and Scout curricula, specifically focusing on Utah's Core Curricular Science themes, highlighting the wetlands, watershed, and wildlife of the Bear River MBR.

Common learning themes across targeted grade levels within Utah's Core Curriculum include the following:

- Understand the physical characteristics of Utah's wetlands, forests, and deserts and identifying common organisms for each environment.
- Describe the common plants and animals found in Utah environments and how these organisms have adapted to the environment in which they live.
- Apply classification schemes, (i.e., dichotomous keys) for identification of plants and animals native to Utah.
- Learn threats to Utah plants and animals and describe steps being taken to protect threatened and endangered species.
- Observe and record the behavior of Utah animals.
- Understand function of water quality, water cycle, and water management within Utah's water systems.
- Learn function, role, and responsibilities of natural resource professionals through internship opportunities.

Demographics and Geographic Location

The learning population itself will be comprised of students and scouts from within the Greater Salt Lake Valley. Five Utah school districts (i.e., including Box Elder, Cache-Logan, Weber, Davis, and Salt Lake) will be invited to participate in the Bear River environmental education field-based programs. Educational programming will be primarily offered at the Bear River MBR with enrichment activities possible at a partner sites, including the following: (1) Hardware Ranch Wildlife Management Area, (2) Ogden Nature Center, (3) the Nature Conservancy, or (4) Farmington Bay Wildlife Management Area.

The Bear River Migratory Bird Refuge is located ~60 miles north of Salt Lake City and lies at the northeast arm of the Great Salt Lake. The delta region comprises the largest fresh water marsh in the lake's ecosystem and provides nesting, resting, and staging area for globally significant populations of water birds, (i.e., American avocet, black-necked stilt, marbled godwit, Wilson's phalaropes, numerous duck species and the world's largest nesting colonies of white-faced ibis). As one of 555 Refuges within the National Wildlife Refuge System, the Bear River MBR serves to protect and enhance habitats that sustain 270+ species of migratory birds of the Pacific and Central Flyways.

The unique combination of large freshwater wetlands/river delta, our flagship wildlife education center, and abundant wildlife serve to provide a range of exploration and investigative activities, engaging students in outdoor skills, sound science, and stewardship opportunities.

Background and History

The U.S. Fish and Wildlife Service, through its National Wildlife Refuge System policy (U.S. Fish and Wildlife Service Manual; Recreational Uses Policy; Chapter 6; Part 605), provides guidance for establishing the scope, management objectives, and appropriate materials for a credible environmental education program on Refuge lands. Bear River MBR develops programming that builds on knowledge, skills and abilities about wildlife-related topics while sharing conservation expertise with the community's schools, government agencies, private groups and individuals.

Oversight for program effectiveness is derived from multiple sources. Bear River MBR shares a common vision for EE with its Friends group, "to develop and implement a program which (1) provides hands-on conservation programming for Pre-K through College students; (2) trains the conservation leaders of the future through career preparatory internship experiences; and (3) shares training and expertise with inter- and intra-agency entities.

Program conceptual support comes from the Service's Regional Education and Visitor Services Department and its National Conservation Training Center (NCTC) through guidance for planning, implementing, and evaluating EE programs. A Regional Environmental Education Coordinator assists in connecting stations with existing and effective curriculum to adapt to specific Refuge needs. The NCTC offers extensive courses to strengthen the EE planning, management, and evaluation at the station level. The Office of the Chief, National Wildlife Refuge System, is responsible for overall guidance and management of EE within the National Wildlife Refuge System.

Key Partnerships

Project success is built on existing and effective resources with key partners, including the U.S. Forest Service, Utah Department of Natural Resources, Utah Division of Water Resources, Utah State University Water Quality Extension, Ogden Nature Center, Stokes Nature Center, Utah Society for Environmental Education, Utah Wetlands Interpretive Network, Utah Wetlands Foundation, Brigham City Corporation, Box Elder County Tourism, and State of Utah Department of Tourism. The resulting in-kind materials, services, and other contributions facilitate leveraging state, federal, and other cash support averaging a 3:1 match.

Outcomes and Evaluation

Outcomes

It is anticipated that through hands-on field experiences and pre-, post- field activities, and teacher preparatory workshops, the program will enhance participants' understanding of how humans affect natural ecosystems by increasing the following conceptual areas: (1) Awareness; helping students acquire an awareness and sensitivity to the watershed and wildlife; (2) Knowledge; helping students acquire a basic understanding of the relationship of the watershed/wetlands/riparian zones to wildlife and how people impact their rivers and Great Salt Lake Ecosystem; (3) Attitudes; helping students acquire a set of values and feelings of concern about the wildlife and motivation and commitment to participate in environmental maintenance and improvement; (4) Skills; helping students acquire the skills needed to identify, investigate and contribute to the monitoring of natural systems; and (5) Participation; helping students acquire experience in using their knowledge and skills in taking thoughtful, positive action toward the protection of the aquatic ecosystems and wildlife.

Further, the Bear River Environmental Education Program will provide the following benefits to the community:

- Increased community awareness of management objectives regarding Refuge protection of threatened trust resources and their habitats, (i.e., protection of migratory birds along the Pacific/Flyways, and restoration / recovery of wetland habitat, etc.);
- Increased positive public relation opportunities with community leaders;
- Heightened community awareness of local and Refuge conservation issues through media attention to youth activities;
- Creation of long-lasting conservation/restoration projects that involve the citizenry; and
- Personal ownership in the conservation/restoration of the refuge.

Evaluative Assessment

Formative evaluation will occur through the programming phase assessing achievement of education objectives (i.e., program outcomes and satisfaction will be assessed through pre- and post- evaluations completed by teachers and scout leaders). Student learning outcomes will be assessed through pre- and post- assessments of conceptual knowledge and values awareness.

Summative evaluation will be conducted quarterly through the program year, October 1, 2011 to September 30, 2012 and will assess the project relative to the overall program goals, (i.e., program reach, effectiveness of methods, and timeframe constraints). The final report will reflect the accomplishments of the program and will be submitted by October 30, 2012 following the completion of the program year.

Benchmarks of success will include an increase of 25% in student knowledge as evidenced by a measure of pre- field trip to post- field trip testing. Further, it is hoped that students' values-based questions will

reflect a heightened sense of awareness about the relationships of aquatic environments to wildlife and human's role in stewardship.

Timeline and Partner Responsibility

The Bear River MBR environmental education program will span 2 calendar year periods allowing for the 2012-13 school year. A four-tiered approach will be used to achieve stated program objectives: (1) Phase one will see the planning phase with partners; (2) Phase two will include materials development and teacher / docent training; (3) Phase three will see the implementation of field-trips; and (4) Final phase will include evaluative assessments and report submissions. All phases will be coordinated by Education Program Manager.

Financial Information

The Friends of Bear River Refuge (FOBRR) are in the process of extending fundraising efforts beyond the current state of available resources through endowment fund-building efforts. The endowment fund would allow for program sustainability through the management of annual income and program scaling accordingly.

Bear River MBR's environmental education program to date has been largely sustained through federal and state grant funding sources. However, with the current declining fiscal climate, FOBRR seeks to expand its annual support.

Author and Contact

Kathi Stopher, Visitor Services Manager
Bear River Migratory Bird Refuge
Brigham City, Utah

Development of Water Quality Standards for Willard Spur, Great Salt Lake, Utah

Utah Division of Water Quality (UDWQ), Great Salt Lake, Utah

CH2M HILL is serving as Project Manager for this important effort to characterize and protect Willard Spur. Willard Spur is a large wetlands area (>45 sq miles) in the Bear River Bay of Great Salt Lake (GSL). A proposed discharge from a wastewater treatment plant to Willard Spur sparked an outcry from stakeholders to better and more proactively protect this important bird resource. UDWQ brokered an agreement with stakeholders to pay for further treatment of the wastewater effluent to minimize potential risks from increased nutrient loads and complete research studies required to characterize the current condition of Willard Spur, determine if the new discharge will be detrimental to its condition, and determine if and what modifications to water quality standards are needed to ensure this resource is protected. As Project Manager, CH2M HILL has been responsible for facilitating stakeholder interaction, defining objectives and strategy for the research effort, developing necessary agreements with stakeholders, preparing annual sampling and monitoring plans (2011-2013), overseeing field and analytical efforts, forming and leading a Science Panel to identify research objectives and projects that address the overall objective, and ensuring successful attainment of UDWQ's objectives.

In addition to serving as Project Manager, CH2M HILL was responsible for the hydrology element of the project. CH2M HILL designed a network of 33 flow gauging and water level monitoring stations that were deployed by UDWQ from 2011-2013. This information has been instrumental in understanding the sources of water and nutrient loads but also the hydrodynamics of the Willard Spur ecosystem itself.

Key Attributes Applicable to Willard Bay Settlement Project

1. Successful design and implementation of a complex and dynamic research program intended to understand critical issues and develop recommendations for long term protection
2. Intimate understanding of the geography, hydrology, and ecology of a critical habitat directly adjacent and downstream of the 2013 Willard Bay State Park diesel spill event
3. Project highlighted the important role the properties adjacent to the 2013 spill event play in the annual dynamics of Willard Spur
4. The work proposed by USFWS directly addresses key recommendations being discussed by the Willard Spur Science Panel and Steering Committee:
   - Protection of adjacent properties
   - Preventing future upstream spills from entering Willard Spur
   - Managing BRMBR to provide the quality and quantity of water required to protect Willard Spur

Results to date indicate the important role Willard Spur plays in providing habitat for the waterfowl and shorebirds that rely on GSL and "filtering" much of the streamflow that enters GSL from the Bear River. Willard Spur has proven to be an extremely resilient ecosystem that while adapting to dynamic flow conditions, is completely dependent upon the quality and quantity of water it receives. Preliminary recommendations discussed by the Willard Spur Science Panel and Steering Committee include protecting adjacent lands via conservation easements, changing Willard Spur's beneficial use classification to protect the fishery, and evaluating the means for the Bear River Migratory Bird Refuge to contain and remove contaminants and provide the requisite hydrology upon which Willard Spur depends.

Characterization of Great Salt Lake Wetlands

Utah Division of Water Quality, Great Salt Lake, Utah

CH2M HILL's work from 2004 through 2006 was largely focused upon analysis of field data obtained by UDWQ and its contractors. CH2M HILL worked with UDWQ initially in 2004 to define project objectives, identify reference and target wetland sites, and develop sampling and analytical protocol. UDWQ's contractors spent the subsequent four years collecting field data describing the chemical, biological, and physical characteristics of wetlands around the lake. CH2M HILL completed the initial analyses (2005-2006) to evaluate the data and identify potential metrics that could be used to describe the characteristics and condition of the wetlands.

Key Attributes Applicable to Willard Spur Settlement Project

1. Successful development of an assessment framework that is critical for evaluating the relative condition of GSL's wetlands and how to provide long term protection
2. Intimate understanding of the stressors and responses to contaminants in GSL wetlands systems
3. Highlighted the need to evaluate how water quantity affects water quality in the highly managed impounded wetlands

UDWQ's data collection efforts culminated in 2009 with a team effort with assistance from CH2M HILL to develop a bioassessment framework to measure the integrity of one class of wetlands – impounded (open-water) wetlands. The numerous measures of biological composition were assembled into a single measure of relative condition for each wetland site called a multi-metric index (MMI). The MMI described submerged aquatic vegetation, algae, duckweed, and benthic macroinvertabrates for a wide range of water quality conditions. MMI scores indicated that of the 16 impounded wetland sites included in this study, only 4 sites (25 percent) were in relatively poor condition. In contrast, from 63 to100 percent of these sites would have been declared to be in poor condition based solely on current numeric criteria for pH and dissolved oxygen (DO). CH2M HILL's work with UDWQ led to a revision of state numeric water quality standards for wetlands in 2010.

Starting in 2011, CH2M HILL has been working with UDWQ to validate the bioassessment framework for GSL impounded wetlands. This included the design of a sampling plan that targeted over 50 GSL impounded wetland sites by UDWQ. CH2M HILL used this extensive 2012 dataset to validate the MMI using rigorous statistical tests and make improvements that further enhance this tool's ability to assess the condition of GSL impounded wetlands. CH2M HILL is currently working with UDWQ to develop a similar bioassessment framework to assess the condition of GSL's fringe class of wetlands.

Restoration of Lake Point Wetlands Site

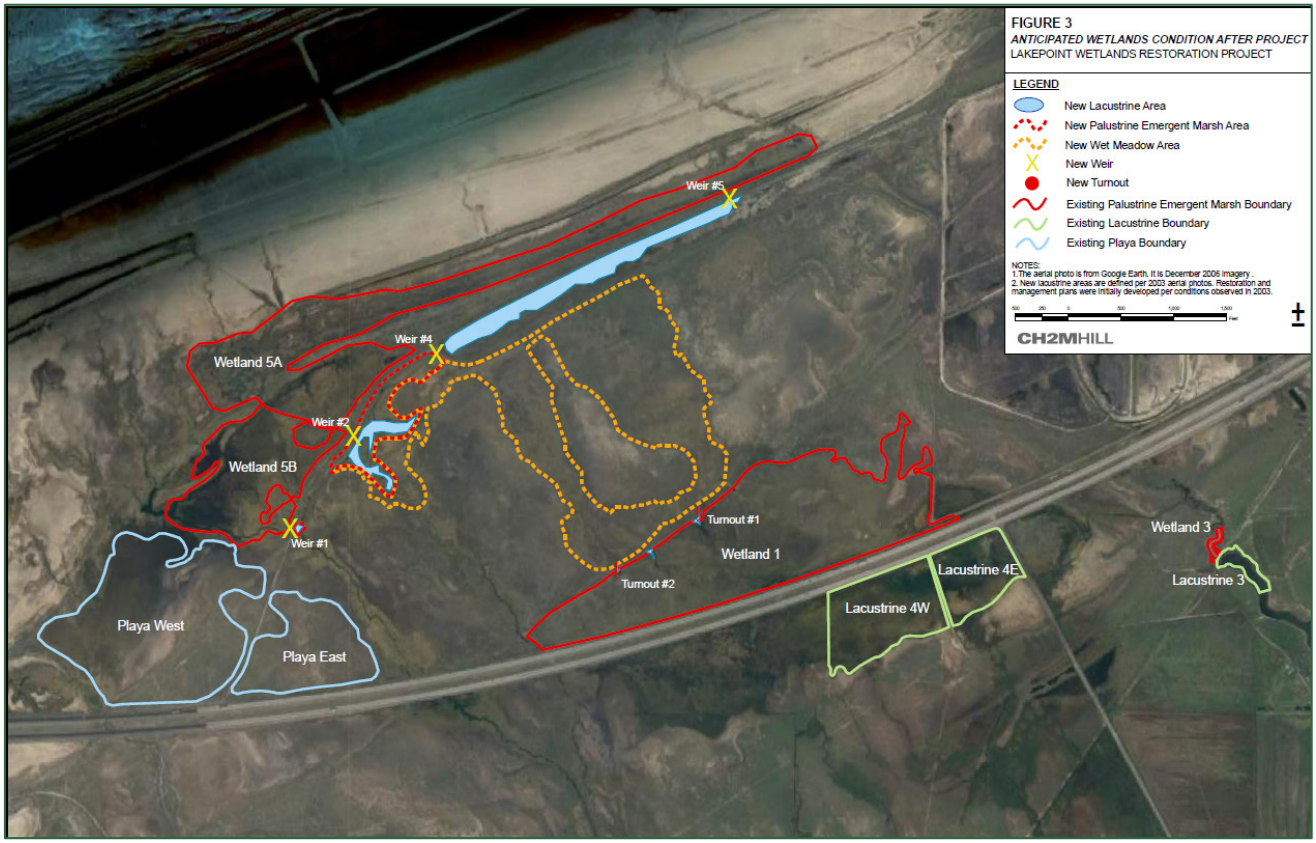
Kennecott Utah Copper Corporation, South Shore Great Salt Lake, Utah

Kennecott completed this project under a Consent Decree in cooperation with the U.S. Fish & Wildlife Service and The Nature Conservancy. The objective of this project was to restore and improve wetlands habitat at a 635-acre parcel on the south shore of Great Salt Lake. Once the project was completed, Kennecott turned management and control of the site to The Nature Conservancy to protect the site into the future. Key improvements include:

- New structure to divert a consistent supply of water from Factory Springs, Tooele County
- Nearly 1 mile pipeline with flow control and measurement facilities
- 1 mile ditch with turnouts to distribute water across site
- Weir boxes and berms to facilitate creation of wetlands habitat
- Nesting islands for shorebirds

Key Attributes Applicable to Willard Spur Settlement Project

1. Successful site evaluation, design, permitting, and construction of a 635-acre wetland restoration project on the south-shore of GSL
2. Although a reliable water quantity was essential for site restoration and maintenance of the habitat, CH2M HILL also evaluated the impacts of water quality on long term project success
3. Successful in restoring wetlands and shorebird habitat



Program Management, Engineering, and Environmental Documentation – Refuge Water Supply Conveyance Project, Sacramento and San Joaquin Valleys, California
U.S. Bureau of Reclamation, Sacramento, California

U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, California Department of Fish and Wildlife, various irrigation/water districts

Range of Issues Addressed

Water supply reliability, water quality, alternative feasibility, cost estimating, construction management, institutional constraints, groundwater pumping and local effects, biological resources, permitting, environmental documentation

Key Attributes Applicable to Willard Spur Settlement Project

1. Comprehensive evaluation of water supply and management for seven national wildlife refuges in California
2. Significant effort to link water supply with habitat requirements to meet legal mandate
3. Required detailed environmental evaluation and engineering design to address wide spectrum of issues, concerns, and requirements

Description of Services

CH2M HILL assisted the U.S. Bureau of Reclamation (Reclamation) in the implementation of the Refuge Water Supply program. Increased water supplies for the seven refuges are mandated by the Central Valley Project Improvement Act (CVPIA) to provide for the optimal use of each of the refuge areas. Each of the refuge areas is within the Pacific Flyway and provides valuable habitat for waterfowl within a region that once supported vast areas of wetland habitat. The project, which began in 1994, has required close coordination with Reclamation, the U.S. Fish and Wildlife Service, the CDFG, and numerous water districts and companies throughout the Central Valley. Proposed facilities ranged from weirs and diversion dams to pipelines and canals of less than 1 mile to over 10 miles in length.

CH2M HILL has provided assistance with respect to program planning; alternative feasibility and cost estimation; environmental analysis, documentation, and permitting; and mitigation site design and development. CH2M HILL assisted Reclamation in developing an implementation plan to allow for the construction of all necessary facilities by the required time frame identified in the CVPIA. Given the complexity of the project and ongoing studies being conducted by the Service, the proposed alternatives were revised a number of times in response to changing operational assumptions and agency/public concerns. CH2M HILL provided valuable input to assist in developing final alternatives and exercised tight cost control as the project changed and evolved. CH2M HILL worked with each of the refuge managers to identify water supply patterns and conveyance alternatives. The alternatives were developed for ultimate management plans for the refuges to use water supplies from the Central Valley Project and from purchased water supplies.

CH2M HILL is currently assisting Reclamation with the environmental compliance for the conveyance facilities associated with the Mendota Wildlife Area in the San Joaquin valley. Major environmental issues assessed by CH2M HILL included impacts to existing water users, water quality, and biological resources. We conducted biological studies to identify potential impacts in terms of potential habitat loss to federal or state listed species, such as the giant garter snake, Valley elderberry longhorn beetle, and Swainson's hawk, and to develop appropriate mitigation strategies. Each of the EA/IS documents included a broad range of potential conveyance alternatives to avoid the need to prepare additional environmental documentation.

CH2M HILL facilitated and supported public workshops throughout the program to obtain input from other agencies, local duck clubs, and other interest groups, including Ducks Unlimited and The Nature Conservancy.

Modeling to Improve Wetlands Management

Omar Alminagorta[1] and David E. Rosenberg
Utah State University
Utah Water Research Laboratory

January 8, 2014

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Overview

We developed three models to inform water and vegetation management at the Bear River Migratory Bird Refuge, Utah. The first model processes and classifies satellite images (Landsat) and estimates vegetation cover as well as the extent of flooding in wetland units over ten year period. The second model simulates the spread of invasive *Phragmites australis* as a function of water level changes and the reproduction mechanism (seed or rhizomes). The third systems model embeds results from the first and second models (Fig.1) and recommends vegetation control actions and water allocations among wetland units that will improve wetland habitat. Model results yield several important insights and recommendations to better manage water and vegetation at the Refuge.

Insights and Recommendations

1. Remote sensed Landsat images can help monitor vegetation and flooded areas in wetlands. These images are released every 16 days and freely available at glovis.usgs.gov/.

2. To reduce invasive vegetation spread, manage water levels according to the biological state of vegetation.

3. Detect invasive vegetation early, respond rapidly, and eradicate small patches completely rather than partially control larger patches.

4. Two-fold potential to improve wetland performance as measured by the performance metric of suitable habitat area for priority bird species.

5. More dynamically adjust water levels in wetland units. Install and use an automatic system to control gates/weirs or assign more personnel to adjust gates.

6. Protect the Refuge's water right to prevent drastic decline in wetland performance.

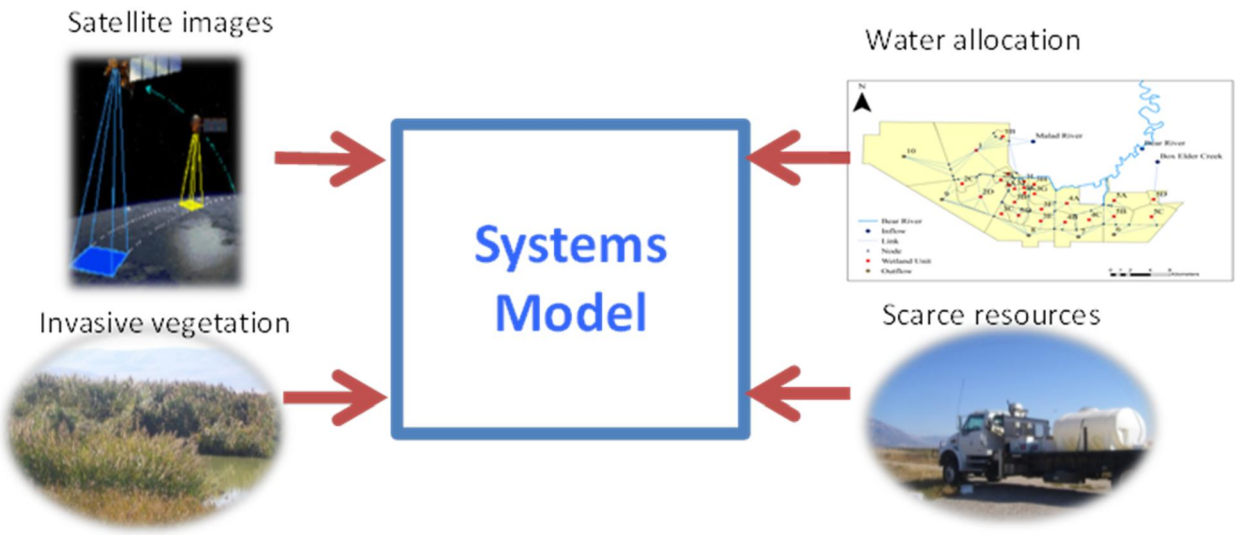


Fig.1. A systems model connects hydrological and ecological data to identify the efficient water allocation and vegetation management actions to improve wetland performance as measured by the suitable habitat area for priority bird species.

Attachment 4
Scope of Work

Attachment 4: Scope of Work

The following scope of work represents the planned effort to achieve project objectives. Tasks 2, 3 and 4 were designed to address recommendations specifically discussed by the Willard Spur Science Panel and Steering Committee at their January 2014 meetings. The USFWS proposes to have this scope of work reviewed by both committees prior to the next Science Panel meeting to ensure this work and deliverables meet the Willard Spur program's objectives in addition to the objectives listed in the USFWS's proposal.

Task 1 – Public Education Program

Task Lead: Katie McVey/USFWS. The USFWS will complete all work associated with this task in conjunction with the Student Conservation Association (SCA) and Friends of Bear River Migratory Bird Refuge (BRMBR).

Objective: The overarching goal of the program titled Bear River Environmental Education in Action Program (BREEAP) is to provide Greater Salt Lake Valley area students access to educational programming and field experiences that promote appreciation of wildlife and an understanding of the essential links between the ecological health of habitats, water quality, conservation of the species, and the role of humans in conservation. The developed curriculum and materials integrate hands-on scientific exploration into understanding the wetland ecosystem, water quality, and the role of BRMBR and citizens in its conservation. To this end, **BRMBR will hire and work with four interns as part of this project who will learn and, in turn, share with others, the management strategies to protect BRMBR wildlife, habitats, and watershed**.

The BREEAP will achieve the following objectives:

1. Engage students, teachers, scouts and parents in hands-on conservation and restoration education experiences that promote wildlife education and nurture an appreciation of nature;
2. Provide ~10,000+ students with hands-on educational programs that fulfill current state curricular mandates (pre-school through college;
3. Provide preparatory training sessions for teachers, docents, and parents who will assist in the program delivery process;
4. Develop associated teaching materials and activities for use in providing student programs;
5. Serve as a training ground for future conservation leaders; BREEAP trains student interns (high school / college) who wish to investigate careers in natural resources.
6. Provide four college-aged youth access to educational programming and field experiences on BRMBR; promote appreciation of wildlife conservation and an understanding of the essential knowledge and skills sets necessary to pursue a career in natural resources.

Further, **BRMBR will design and place up to 12 interpretive signs at public access points at BRMBR and Willard Spur** to illustrate where the sign is in relation to BRMBR and Willard Spur and increase awareness of water quality and the resources these ecosystems provide. Many people may see these systems from roads; the objective of these signs is to inform the public of what they are viewing and the value it provides.

Activities:

1. The USFWS will hire four SCA interns to participate in the ongoing BREEAP described above as well as acquire education and skills necessary to pursue a career in natural resources. Internships will be staggered to provide year-long educational programing: September-June 2014-2015 and 2015-2016: February-November 2015 and 2016. The USFWS will provide in-kind housing and training for each intern including: environmental/interpretation educational methods; first aid/CPR; Leave No Trace certification, hand-tools and other on-the-job training.

2. The USFWS will design, manufacture, and install up to 12 interpretive signs at common public access points at BMRBR and Willard Spur. These signs will define the viewer's location in relation to these resources, a water quality educational message, describe the value of the resource, and provide contact information if a spill, dumping or other vandalism is observed.

Effective and Proven Strategies: BRMBR applies proven and effective environmental education (EE) methods and strategies to advance environmental literacy and affect stewardship values and skills. Activities are planned within a spiral model curriculum whereby each field-trip to the Refuge builds upon those previously experienced. Ideally, students will visit BRMBR at least 3 times in their school careers: (1) Pre-K/K, (2) Fourth grade, and (3) Ninth grade or other high school grade level. The spiral model ensures that students build knowledge, skills, and abilities in a sequential manner relative to age appropriateness that promotes specific learning outcomes. Further, our environmental education programs provide structured activities that occur in the outdoor classroom on refuge lands, focus on the natural environment, and are based on an approved course of study with identified learner outcomes. Evaluative assessments are applied following every field study at both the teacher and student levels to identify areas which need improvement. Teacher trainings additionally strengthen BRMBR's programming, as teachers who are well prepared to assist with field trips exhibit a heightened sense of enthusiasm about topics and share a greater passion with their students, often translating in a greater application of knowledge subsequent to field trip experiences.

Educational Outcomes: Outcomes of BREEAP are three-fold: (1) Provide quality hands-on field and classroom experiences that correlate highly with Utah core curriculum standards while facilitating an understanding of the wetland ecosystem, water quality, the Bear River watershed, and BRMBR; (2) Provide workshops for teachers and scout leaders with the training, materials and methods needed to enrich associated school and scout / youth curricula; and (3) Provide field-based internships for students to gain experience in natural resource careers.

Demographics and Geographic Location: The learning population itself will be comprised of students and scouts from within the Greater Salt Lake Valley. Five Utah school districts (i.e., including Box Elder, Cache-Logan, Weber, Davis, and Salt Lake) will be invited to participate in the Bear River environmental education field-based programs. Educational programming will be primarily offered at the Bear River MBR with enrichment activities possible at a partner sites, including the following: (1) Hardware Ranch Wildlife Management Area, (2) Ogden Nature Center, (3) the Nature Conservancy, or) Farmington Bay Wildlife Management Area.

Task 2 – Spill Response

Task Lead: Jeff DenBleyker/CH2M HILL. CH2M HILL will complete tasks in conjunction with USFWS, Utah State University (USU), and other stakeholders.

Task 2.1 Define Current Water Management Practices and Drainage Patterns

Objective: The objective of this task is to document existing water control facilities and operating procedures and criteria to inform subsequent analyses.

Activities:

1. Retrieve and review available hydrologic data and water operating criteria from USFWS files and USU's SWAMPS (**S**ystems model in **W**etlands to **A**llocate **W**ater and **M**anage **P**lant **S**pread) model. It is assumed that the model already defines the flow capacity and characteristics of each diversion and outlet structure.
2. Create a map of diversion and outlet structures, canals, and management units using available BRMBR base mapping. The map will be consistent with the version of GIS the USFWS is using for BRMBR.
3. Define drainage basins and patterns within BRMBR and areas that could contribute runoff and contaminants onto BRMBR from offsite. The goal is to define potential affected areas where a spill might flow toward. It is assumed that this evaluation will only include BRMBR property and areas bounded by Interstate 15 on the east and highway 83 on the north.

4. Obtain a "typical" annual hydrograph for each of the five major BRMBR river diversions for three flow regimes (drought, normal, and wet) from the SWAMPS model. These "typical" hydrographs will be representative of USFWS operations throughout the year for Bear River flows for each of the flow regimes.

Deliverable: Technical memorandum summarizing existing water control and conveyance facilities and drainage patterns

Task 2.2 Identify and Evaluate Potential Spill Sources

Objective: Review the USFWS's existing Spill Prevention, Control, and Countermeasures (SPCC) Plan, location of diesel fuel pipeline, and identify other potential facilities where a spill of contaminants could impact water quality at BRMBG and Willard Spur.

Activities:

1. Retrieve and review the USFWS SPCC plan for BRMBR. It is assumed that this task does not include an update of the existing SPCC plan. Query utility owners to identify pipelines and other sources located within the BRMBR and immediately to the east of BRMBR that could pose a spill and contamination risk to BRMBR and Willard Spur. Identify the contents of pipelines and storage facilities and the owner's spill response plan. CH2M HILL cannot guarantee that private facilities will provide details. If not available, CH2M HILL will make reasonable assumptions in conjunction with USFWS.
2. Develop a map that locates potential spill sources and affected areas. Overlay map with map of drainage basins and water control and conveyance facilities. It is assumed that the primary risks will be from a spill flow in the Bear River, the diesel fuel pipeline, and USFWS oil storage areas.

Deliverable: Technical memorandum summarizing locations of potential spill sources and affected areas.

Task 2.3 Recommendations

Objective: Develop a spill response plan that enables the USFWS to effectively respond to potential spills of contaminants at or adjacent to BRMBR.

Activities:

1. Identify, evaluate, and make recommendations for best management practices, facilities, equipment and resources to have in place to minimize the risk of impacts, and recommendations for response. Results will be summarized in a draft and final spill response plan. It is assumed that two general scenarios will be evaluated: 1) a spill in the Bear River and 2) a spill from a buried pipeline.

Deliverable: Draft and Final Spill Response Plan

Task 2.4 Design Water Control Upgrades

Objective: Retrofit up to two existing water control structures by replacing wooden weir boards with overshot weir gates to enable rapid flow control within high-risk management units and to provide better containment of spills and protect Willard Spur in the event of a spill. It is assumed that these improvements will be completed for the outlet structures in the D-Line dike for the 5's Drain and Unit 5C.

Task 2.4 will be delivered in three phases and the subtasks as described below:

Phase I – Preliminary Design

Task 2.4.1 – Data Collection and Mapping

Objective: Compile and review existing data and information to identify BRMBR operational requirements, historical flows, and flood characteristics. Complete a site survey to obtain required facility dimensions and mapping.

Activities: The activities for this task will include the following:

1. CH2M HILL will hold a two-hour kickoff workshop at the beginning of the project. It is assumed that this will be attended by CH2M HILL's Project Manager and Structural Engineer. The purpose of this workshop is to review the project objective, scope of improvements to be addressed, scope of work, design reviews, project budget, and schedule.
2. Conduct a site visit with BRMBR personnel to review the existing and anticipated configurations of the intake structure. It is assumed that the site visit will be attended by two staff from CH2M HILL.
3. Obtain hydrologic and hydraulic data for each outlet from BRMBR records to confirm the operating criteria of the existing structure. It is assumed that the existing structure (side walls, floor, bridge deck) and flow characteristics will not change and that the foundation is sound.
4. Obtain mapping of existing structures and utilities. It is assumed that there are no buried or overhead utilities at each structure. It is recognized that unforeseen or changed conditions may exist in the field or existing utilities may exist that are unknown due to lack of existing information.
5. Survey Investigation:

   This task will be used to provide survey and mapping that will be required for the design of the project. Drawings and mapping will be prepared using the datum and coordinate system approved by USFWS. The scope of this task may not be required if USFWS has digital CAD files of the existing structures.

   Survey control points for the base map will be identified by USFWS. These control points, and other known monuments in the area, will be included on the contract documents and provide the horizontal and vertical control. The control diagram will list all the monuments used and set in the control survey, their respective descriptions, and point numbers in the coordinate system approved by USFWS.

   A digital CAD file of the surveyed locations of utilities and other major surface features will be provided for inclusion into the design.

   The site survey will include the installation of a minimum of three horizontal and vertical control bench marks at each outlet structure (2), located so as to not be affected by construction or high water levels.
6. Geotechnical Investigation: It is assumed that the existing structures or foundations will not be altered and that a geotechnical investigation of foundation materials is not required.

Deliverables:

- Base map of each existing structure site in AutoCAD 2013 at 1"=40' scale full size (1"=20' on sheets reduced to 11"x17").

Task 2.4.2 – Engineering Analysis and Design Criteria

Objective: Determine engineering design criteria to be used for design of the new gates.

Activities: The activities for this task will consist of the following:

1. Establish flow characteristics to be used in facility design (e.g., low flow, seasonal flows, etc).
2. Determine operational criteria desired by USFWS (it is assumed that there will be no automation, control system or supervisory control).
3. Develop one site layout configuration for each structure based upon site restrictions and hydraulic design criteria. It is assumed that an overshot gate, similar in function, size, and configuration as installed at L-Line canal in 2013 will be implemented at both structures.
4. Facilitate a 2-hour workshop at BRMBR with two CH2M HILL engineers to review engineering design criteria and site layouts. It is assumed that the design criteria and conceptual site layout will be finalized after this meeting.

Deliverables: Draft and Final Basis of Design Memorandum summarizing data collected design criteria, features, and site layouts.

Task 2.4.3 – Preliminary Design

Objective: Develop a preliminary design (approximately 30 percent complete level) and estimate of probable construction cost.

Activities: The activities for this task will include the following:

1. CH2M HILL will complete a hydraulic analysis to determine structural dimensions and elevations for the structure. The site layout selected in Task 2.4.2 will be developed to a 30-percent level design including layout of each structure. It is assumed that there will be approximately 10 drawings for each structure (20 total). This anticipated sheet count is in reference to the final set of drawings. The 30 percent deliverable may not include all drawings.
2. Develop a list of anticipated specifications for this project. This list of specifications will consist of CH2M HILL's technical specifications only (based on the assumption that USFWS will self-perform all construction, eliminating the need for general specifications and bidding documents). For the technical specifications, CH2M HILL's standard specifications will be used and amended to meet USFWS's needs.
3. It is assumed that USFWS will identify, apply for, and obtain any required permits for construction of improvements. It is assumed that no environmental analysis or documentation will be required.
4. Develop a Class 3 cost estimate, as defined by the Estimate Classification system of the Association for the Advancement of Cost Engineering International (AACE International, Inc.), formerly known as the American Association of Cost Engineers (AACE). The typical expected accuracy range for this class estimate is –10 to –20 percent on the low side and +10 to +30 percent on the high side.
5. Facilitate a 2-hour workshop at BRMBR with USFWS and two CH2M HILL engineers to review the 30 percent level design drawings and list of specifications.

Deliverables: 30 percent drawings including a plan view and cross-section details illustrating facility features.

Phase 2 – Final Design

It is assumed that USFWS will serve as Construction Manager, General Contractor, and will self-perform all construction. It is assumed that no bidding documents are required other than technical specifications for the work.

Task 2.4.4 – Final Design and Construction Documents

Objective: Prepare final design drawings and construction documents for the improvements.

Activities: The activities for this task will include the following:

1. CH2M HILL will incorporate the 30 percent review comments into the drawings and specifications and develop 90 percent level design drawings and specifications for USFWS review. It is assumed that following incorporation of the 30 percent review comments from USFWS, the features and dimensions of the improvements will be fixed to allow for completion of the design. It is assumed that all USFWS review comments for the 30 and 90 percent submittals will be consolidated by USFWS and submitted to CH2M HILL as one package.
2. Drawings will be completed in AutoCAD. Sheet templates, borders, legends, nomenclature, abbreviations, etc., to be established by CH2M HILL. Final electronic deliverables will be in AutoCAD.
3. Upon receiving review comments from USFWS on the 90 percent submittal, CH2M HILL will prepare the final submittal of construction documents.
4. Develop an estimate of probable cost of construction for the 100 percent complete contract documents. The estimate will be in accordance with the AACE International, Inc. guidelines for estimates for this level of effort.

5. Permitting: It is assumed that USFWS will identify and obtain any permits required for construction and will complete any environmental evaluation and documentation that is required for the work.

Deliverables:

1. Five hard copies of 90 percent complete design drawings and specifications for review.
2. Five hard copies of the final, 100 percent complete design drawings and specifications.
3. Construction cost estimate for the 100 percent design.

Phase 3 – Services during Construction

Construction management, observation, inspection, document management, and materials testing services will be provided by USFWS. CH2M HILL will provide limited services during construction (SDC) as defined below. CH2M HILL's SDC are based upon the schedule or duration of construction anticipated at the time that these services are agreed. Deviations from the anticipated schedule or duration of construction will materially affect the scope of these SDC and CH2M HILL's compensation for SDC.

CH2M HILL will not be responsible for the means, methods, techniques, sequences or procedures of the Contractor (i.e., USFWS), nor shall CH2M HILL be responsible for the Contractor's failure to perform in accordance with the contract documents. It is assumed that USFWS will serve as both Construction Manager and Contractor and will be responsible for procurement of all materials and equipment. No bidding services are required or included herein.

Task 2.4.5 – Shop Drawing Review

Objective: USFWS will maintain project files and correspondence and be responsible for managing the shop drawing and submittal review process. CH2M HILL will provide technical review of shop drawings and submittals as requested by USFWS.

1. **Activities:** The activities for this task will include the following: Provide review of an assumed 5 project submittals or re-submittals for each structure (10 total). When provided by the USFWS, CH2M HILL will review USFWS and/or Contractor submittals, consisting of shop drawings, diagrams, illustrations, catalog data, schedules and samples, the results of tests and inspections, and other data that the USFWS and/or Contractor is required to obtain and submit for the Project. Submittal review will be for general conformance with the design concept and general compliance with the information in the plans and specifications. CH2M HILL's review will not relieve the USFWS, vendor or Contractor from their responsibility of meeting the requirements of the Contract Documents. USFWS shall be responsible for the overall construction documentation management of submittals and transmitting submittals between CH2M HILL and the USFWS and contractors (if applicable). USFWS shall also be responsible for obtaining the schedule of submittals.
2. USFWS shall have sole authority to authorize any minor variations in the work, whether or not they involve an adjustment in the Contractors contract price or time for construction, or are consistent with the intent of the contract documents.
3. CH2M HILL has budgeted 25 hours of submittal review time. This assumes 10 submittals/re-submittals at an average of 2.5 hours per submittal review. Once the USFWS and/or Contractor has submitted his preliminary and final schedule of submittals, CH2M HILL will re-evaluate the estimated time required to review submittals based on the USFWS and/or Contractor's submittal review schedule and the number of USFWS and/or Contractor submittals. After reviewing the schedule of submittals CH2M HILL will notify USFWS if sufficient time has been budgeted for submittals reviews.

Task 2.4.6 – Site Visits

Objective: CH2M HILL will provide limited site visits subject to the assumptions listed below. CH2M HILL's site visits do not replace the daily responsibilities of USFWS's field inspector to determine if the project is being constructed in accordance with the Construction Documents but are intended to help address questions or issues that need to be discussed in the field or support USFWS with clarifications to the design that need to be resolved in the field.

Activities: The activities for this task will consist of the following:

1. Construction duration is assumed to be 16 weeks in 2015 and 16 weeks in 2016. Twenty four hours have been allocated for site inspection and visits. This represents two trips during each construction period (4 trips total). It is assumed that USFWS will communicate progress and provide site photographs to CH2M HILL to keep CH2M HILL informed of progress or any issues or questions.
2. Record drawings are not included in this scope of work at this time.

Safety. CH2M HILL will manage the health, safety and environmental activities only of its own staff. CH2M HILL will coordinate its health, safety and environmental program with the responsibilities for health, safety and environmental compliance specified in the contracts for construction. CH2M HILL will coordinate with responsible parties to correct conditions that do not meet applicable federal, state and local occupational safety and health laws and regulations, when such conditions expose CH2M HILL staff to unsafe conditions. CH2M HILL will notify affected personnel of any site conditions posing an imminent danger to them which CH2M HILL observes. CH2M HILL is not responsible for health or safety precautions of construction workers. CH2M HILL is not responsible for the Contractor's compliance with the health and safety requirements in the contract for construction, or with federal, state, and local occupational safety and health laws and regulations. CH2M HILL will not be responsible for safety of any personnel not employed directly by CH2M HILL.

Task 3 Water Quality Management

Task Lead: Jeff DenBleyker/CH2M HILL. CH2M HILL will complete tasks in conjunction with USFWS, USU, and other stakeholders. USU will be responsible for all activities regarding the SWAMPS model as defined below.

Objective: The objective of this task is to evaluate how water management could be optimized to simultaneously achieve habitat, vegetation, and water quality objectives. Special attention will be placed upon how management activities could improve water quality and quantity to Willard Spur and water quality within BRMBR. The goal is to address the issues and recommendations discussed at the January 2014 Willard Spur meetings.

Task 3.1 Compile Existing Data

Objective: Compile existing data that characterizes geographic, hydrologic, ecological, and water quality characteristics of the management units.

Activities:

1. Existing data will be obtained from USFWS, USU and Utah Division of Water Quality (UDWQ) that characterize geographic, hydrologic, ecological, and water quality characteristics of BRMBR's management units; focus will be upon Unit 5C and Unit 3A-3D. Data sources include existing government and other public databases and reports, including historical reports that might document changing conditions in these systems, maps, and photos.
2. Data and references will be compiled on a protected file server for reference and access by the project team. Work effort includes brief review (scan) of material for relevance and validity, and identifying, locating, and accessing key data. Activities to set up, support, and communicate access and security protocols to team members who will need to access the data are included.

Deliverables:

- Working reference library of data and references, secure, operational, and accessible by team members.

Task 3.2 Characterize Incoming Water Quality

Objective: Evaluate available water quality data for the lower Bear River to understand its characteristics and loading to BRMBR. No new water quality samples will be collected.

Activities:

1. Evaluate, analyze, and characterize available water quality data for the lower Bear River to understand its characteristics and loading to BRMBR.

2. Review available water quality data summaries from UDWQ for the lower Bear River TMDL. It is assumed that this task will rely heavily upon data collected by UDWQ and USFWS from 2011 – 2013 as part of the TMDL.
3. Summarize results of statistical analysis to characterize the time series trends, parameter averages, and variance of the system, and to develop loading estimates. These statistics allow identification of risk levels necessary for developing and rating management alternatives.
4. Synthesize available lower Bear River water quality data into two water quality scenarios (e.g., high and low concentrations). Each water quality scenario will have a representative concentration for total suspended solids (TSS), total dissolved solids (TDS), nutrients (total nitrogen [TN] and total phosphorus [TP], and metals.
5. Using the "typical" annual flow hydrograph for each of the three flow regimes at each BRMBR river diversion, estimate an annual loading rate for each parameter for each of the two water quality scenarios and three flow regimes. The result will be a matrix of six loading scenarios at each of the five major BRMBR river diversions.

Deliverables:

1. Technical memorandum evaluating and summarizing water quality parameters and quantifying loading to BRMBR, with maps, tables and figures.
2. Spreadsheet data summary.

Task 3.3 Characterize Wetland Hydro-ecological Systems

Objective: Characterize the hydro-ecological condition of two drainage basins (Unit 5C and Unit 3A-D) within BRMBR for use in subsequent analyses. Unit 5C and Unit 3A-D were selected as representative of the majority of management units at BRMBR.

Activities:

1. Evaluate, analyze, and characterize available ecological data assembled in Task 3.1 for the Unit 5C and Unit 3 drainage basins to understand the active elements, their functionality, and the existing condition of current ecosystems. Multi-metric indices (MMI) and available data from UDWQ's impounded wetland project will be reviewed for these basins. Summarize results of statistical analysis to characterize parameter averages and variability of the systems, and trends. Compare and contrast the two drainage basins.
2. CH2M HILL will interview USFWS staff to understand where sediment and water quality problems have historically been observed and document how sediment and water quality is currently being managed in the two study areas.
3. Available historical aerial photographs from Google Earth (1993-2013) will be reviewed to discern changes in operation and habitat over time.
4. Typical open water water levels for each of the management units will be defined from available operating criteria and corroborated in the field. Associated water storage volumes will be estimated for various water levels to develop an elevation/storage rating curve for each of the units in the study area. Water levels monitored as part of the Willard Spur project (2011 – 2013) will be used to corroborate defined operating criteria.
5. It is assumed that USFWS will be able to characterize seasonal groundwater levels in each management unit. No monitoring wells will be installed as part of this project.
6. Evaluate available wetland assessment data from UDWQ for BRMBR management units. Identify how wetland condition has changed since 2009 via UDWQ's MMI. It is assumed that UDWQ's MMI for impounded wetlands will be used as a measure of wetland condition.
7. CH2M HILL will interview USFWS ecologists and review available literature to characterize the dominant wetland vegetation communities (species, areal coverage), dominant soil types and depths in the wetland and adjacent uplands, extent of water coverage and depth, degree of disturbance, and corroborate results of Task 3.1. Based on the results of Task 3.1, detailed review of available data in

this task, and familiarity with similar systems, refine assumptions regarding additional data collection that takes place in a field survey conducted during the growing season (preferably at its height). For the sake of budget estimates, we assume that a comprehensive field monitoring effort will be required, but as a survey rather than repeated sampling a project timeperiod. Implement field survey, sample, and data analysis consistent with methodologies applied in reference data, such that the resulting data might be included to provide an entire picture of ecosystem functioning related to hydrologic conditions and nutrient loading in these two drainage basins. Media that might be included in field sampling at inflow points and selected locations with the drainage basins include: surface water (chemical and physical parameters), groundwater (from existing wells or piezometers, chemical and physical parameters) aquatic biology (including insects), fish, amphibians, vegetation (species, abundance, productivity, density/percent cover), sediment/soils (texture, percent organics, chemistry), and wildlife use. Summarize results of statistical analysis to characterize parameter averages and variability of the systems, and trends. Compare and contrast the two drainage basins, relative to field data results. This information will be critical for use in evaluating the assimilative capacity of the study areas and providing recommendations for facilities and operating criteria, and allow identification of risk levels necessary for rating management alternatives.

Deliverables:

1. Technical memorandum summarizing results of background data analysis and field monitoring results characterizations, with maps, tables and figures.
2. Spreadsheet data summary.

Task 3.4 Characterize Wetland Constituent Assimilative Capacity

Objective: Evaluate the capacity of the current wetland to assimilate pollutant loadings (Task 3.2) using models of assimilation rates.

Activities:

1. Evaluate the capacity of the current wetland to assimilate pollutant loadings, based on results from Tasks 3.2 and 3.3. The critical limits are assumed to be levels of constituent loadings that might change the status and functioning of the current ecological system. Constituents of particular concern are total suspended solids, nutrients (dominant forms of nitrogen and phosphorus), and metals, which will have been documented in background data and field monitoring. Models of wetland assimilative capacity will be run using values and based on assumptions provided in Tasks 3.2 and 3.3, including regional multi-metric index models.
2. Results will be reviewed for relationship to estimated assimilative capacity.
3. Recommendations will be made to be considered in Task 3.6 regarding actions and investments to avoid exceeding drainage basins' assimilative capacity.

Deliverables:

1. Technical memorandum summarizing results of assimilative capacity analysis and model runs, including tables and figures.
2. Spreadsheet data summary.

Task 3.5 Add Willard Spur to SWAMPS Model

Objective: Add Willard Spur as a management unit in BRMBR's SWAMPS model to allow USFWS to actively incorporate Willard Spur into its water, habitat, and vegetation management plans.

Activities:

1. **Add the Willard Spur as an additional unit in the model.** Presently, SWAMPS includes the Refuge's 25 wetland units that cover 118 square km. USU will add the Willard Spur as a 26th wetland unit. USU will use existing data for the Willard Spur that describes the water depth-surface area-storage volume relationship, classified imagery showing current native and invasive coverage, and sources of inflow to the Spur.

2. **Expand indicator species.** The SWAMPS now considers three key indicator bird species that have varying needs through the year for shallow, medium, and deep water habitat (American avocet, Black necked stilt, and Tundra swan). USU will add an extension that will allow wetland managers to specify a much larger number of indicator species such as the 10 bird species for which the Refuge currently manages.
3. **Investigate effects of changing climate.** To date, the modeling has used Bear River flows measured at the Corinne station between 1997 and 2010. USU will add an extension that will identify preferred water management strategies for future flow scenarios such as under water shortages or climate change when more precipitation occurs as rain and snowpack melts earlier.
4. **More user-friendly interface.** SWAMPS currently uses Excel, the General Algebraic Modeling System (GAMS), and Matlab to enter input data, optimize, and visualize results. USU will add an extension that will consolidate the user-friendly interface and produce a user's manual so wetland managers can more readily and quickly enter/modify model inputs, run for habitat and water quality objectives, view model results, and identify appropriate water and vegetation management strategies.

Deliverables:

- Updated SWAMPS model.

Task 3.6 Alternatives Analysis

Objective: Identify and evaluate alternatives, including water quality objectives, new facilities, wetland restoration, and/or operating criteria, that would result in improved assimilative capacity in the study areas, improved water quality conditions as determined by an improvement in UDWQ MMI score, and reduced nutrient loads to Willard Spur.

Activities:

1. Identify and evaluate alternatives, including new facilities, wetland restoration, and/or operating criteria, that would result in improved assimilative capacity in the study areas, improved water quality conditions as determined by an improvement in DWQ multi-metric index score, and reduced nutrient loads to Willard Spur.
2. Evaluate which sites/facilities are critical to managing flows to eastern units of BRMBR and Willard Spur. Evaluate alternatives for providing additional flows to Willard Spur during low flow years.
3. CH2M HILL will draft alternatives based on project results to date and partner suggestions. These alternatives will be summarized in a draft Technical Memorandum with rationale, and presented in a workshop with project partners and stakeholders to select preferred alternatives. Workshop input will be incorporated into a final technical memorandum documenting results of alternatives analysis (workshop notes will be an appendix).

Deliverables:

- Draft and Final Technical Memorandum summarizing results of alternative analysis and partners/stakeholders workshop, including maps, tables, figures, and matrix overview summary.

Task 3.7 Update SWAMPS Model to Address Water Quality

Objective: Update the SWAMPS model with new water quality objectives for water and vegetation management.

Activities:

1. **Add water quality objectives to the SWAMPS model.** Currently, SWAMPS recommends water and vegetation management actions to achieve the single objective of improving wetland habitat area. USU will add an extension that will add water quality objectives that are quantified using physical metrics such as water residence time in wetland units and that are derived from existing model state variables such as water flow, storage volume, and water depth in wetland units. This addition will show managers how to manage water and vegetation to simultaneously improve both wetland habitat *and* water quality objectives. Further, the addition will allow managers to quantify tradeoffs between the two objectives such as the habitat area lost to improve water quality or vice-versa.

2. A sensitivity analysis will be completed to allow managers to quantify tradeoffs between habitat and water quality objectives and inform water management decisions.

Deliverables:

1. Updated SWAMPS model
2. Technical memorandum summarizing sensitivity analysis and results.

Task 3.8 Water Quality Management Plan

Objective: Summarize findings and recommendations from the proposed project in an integrated Water Quality Management Plan.

Activities:

Summarize findings and recommendations from the proposed project in an integrated Water Quality Management Plan, for which the Technical Memoranda produced in this project will be provided in appendices. This document will provide the roadmap for capital investments and operations changes needed to achieve project objectives for improved water quality, ecosystem health, and ecosystem resilience in the BRMBR. As such, it will be organized in an easy-to-reference on-line as well as hard copy format. A draft will be provided for review, and based on written comments received in a specified period, the Plan will be finalized. Background data and spreadsheets in support of recommendations and appendices will be provided in digital format.

Deliverables:

- Draft and Final Water Quality Management Plan summarizing findings and results, including maps, tables, and figures.

Task 4 Conservation Easement Acquisition

Task Lead: Bob Barrett/USFWS will lead this task. USFWS is responsible for all activities to be completed as part of this task.

Objective: Secure conservation easements along the east border of Willard Spur.

Activities:

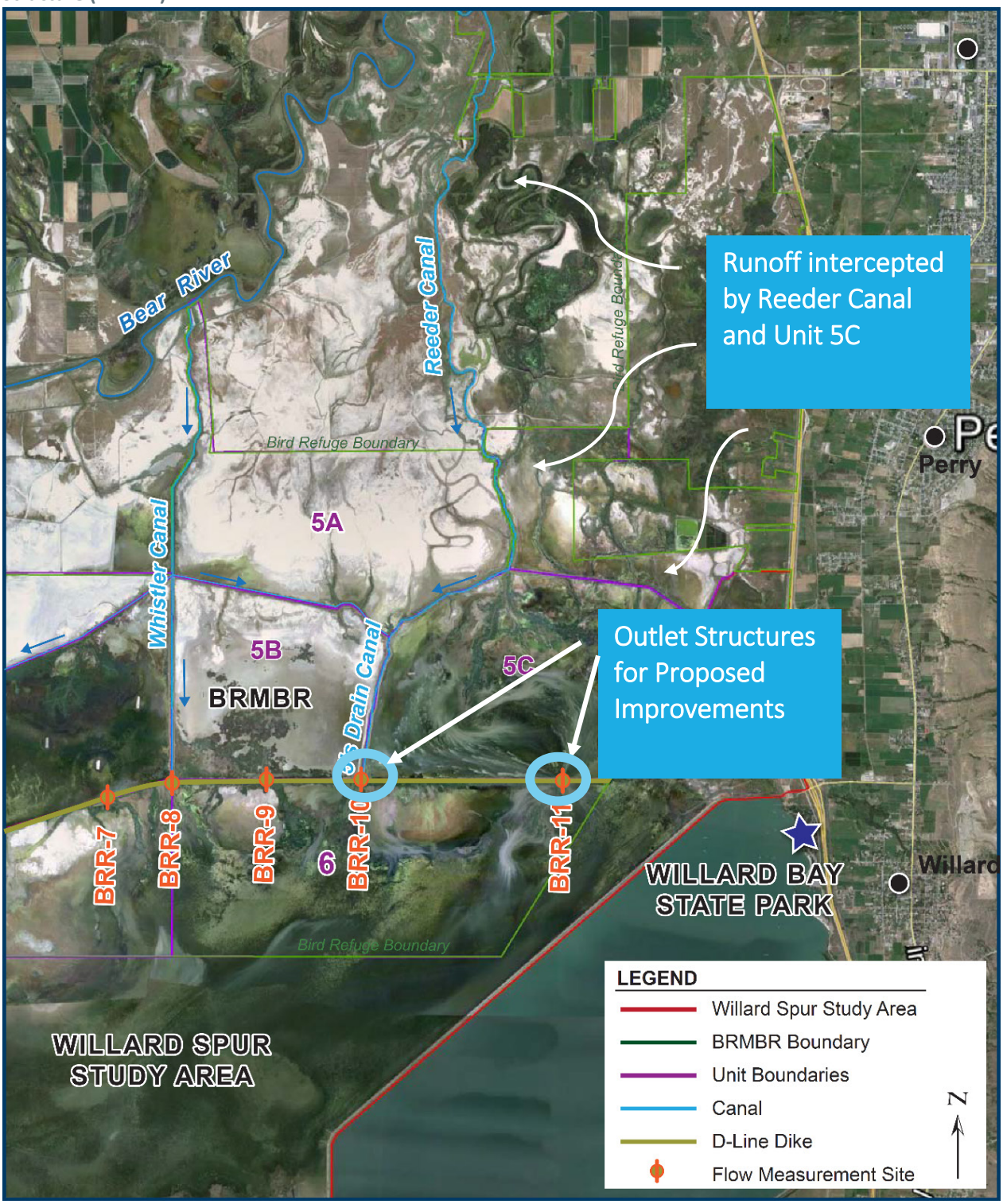
The USFWS will investigate and identify opportunities to acquire conservation easements in the area bounded by Willard Bay State Park on the south, Interstate 15 on the east and BRMBR on the north. Efforts will be coordinated with other members of the Willard Spur Steering Committee to meet this group's objectives. USFWS will complete all responsibilities required to obtain conservation easements in this area with these funds.

Attachment 5
Proposed Water Control Upgrades

Attachment 5: Proposed Water Control Upgrades

The United States Fish & Wildlife Service (USFWS) proposes to retrofit the existing outlet works for the 5's Drain and Unit 5C with new overshot gates. Figure 1 illustrates the location of these gates, BRR-10 and BRR-11, in relation to the Reeder Canal. This attachment provides backup materials to describe the proposed improvements.

Figure 1. Vicinity Map Illustrating the Location of the 5's Drain Outlet Structure (BRR-10) and the Unit 5C Outlet Structure (BRR-11)



Existing Structures

Both BRR-10 and BRR-11 are each composed of a series of 5.5-foot-wide, inclined stop-log weirs. The weir level is adjusted by manually removing or adding stop-logs (i.e., boards) to the weir. The weirs have been found to have a propensity to leak and require a significant effort to make adjustments in weir level or to attempt to stop flow.

BRR-10

The BRR-10 weir drains water from the 5's Drain through the D-line dike to Willard Spur. BRR-10 has six 5.5-foot-wide bays.

Figure 2. View of BRR-10 looking east along D-line Dike

Figure 3. View of BRR-10 Looking West

BRR-11

The BRR-11 weir drains water from Unit 5C through the D-line dike to Willard Spur. BRR-11 has twelve 5.5-foot-wide bays.

Figure 4. View of BRR-11 Looking East along D-line Dike

Figure 5. View of BRR-11 Looking West (Left) and Looking Upstream at Inclined Weir while Dry (Right)

Need and Objective

The Reeder Canal is BRMBR's first diversion on the Bear River and is typically used to convey peak spring runoff flows through Bear River Migratory Bird Refuge (BRMBR) to Willard Spur. The canal captures all surface runoff from the east and south of the Bear River and directs it to Unit 5C and Willard Spur (see Figure 1). A preliminary evaluation by USFWS of lessons learned from the 2013 Chevron diesel pipeline spill resulted in a recommendation to evaluate where a possible spill along this pipeline could occur in the future and might put BRMBR at risk, identify the potentially affected areas, and provide the capability to prevent downstream migration of contaminants toward Willard Spur. The existing outlet structures for the 5's Drain and Unit 5C are difficult to adjust and cannot be completely closed; thus, the existing structures cannot be used to protect Willard Spur from potential spills upstream. The USFWS needs the capability to not only better control flows through these structures but also stop all flow. Replacement of the existing weirs with mechanical overshot gates that can accomplish this need

will not only benefit the USFWS's mandate for habitat and vegetation management but also will be indispensable during a potential spill event.

Proposed Improvements

The USFWS replaced the L-Line Canal water control structure on the west side of BRMBR in 2013. The old structure had the same dimensions and type and number of weirs (6) as the 5's Drain outlet structure (BRR-10) and was replaced with a new structure with four 8-foot overshot gates (see Figure 6). The new gates can be operated with a wheel or can be actuated with a power drill. The new structure allows the USFWS to respond quickly to calls for water where and when needed as well as prevent any flow from passing down the L-Line canal when needed. See Exhibit 1 for plan drawings for the L-Line water control structure and Exhibit 2 for literature describing the overshot gates that were used.

Figure 6. Photographs of New Overshot Gates at the L-Line Canal Water Control Structure, BRMBR

The USFWS proposes to retrofit the existing outlet structures for the 5's Drain and Unit 5C by replacing the existing inclined stop-log gates with new 8-foot overshot gates. The work will include demolition of existing piers and stop-log weirs, construction of new piers that will support new overshot gates, and the purchase and installation of new overshot gates similar to those used for the L-Line water control structure.

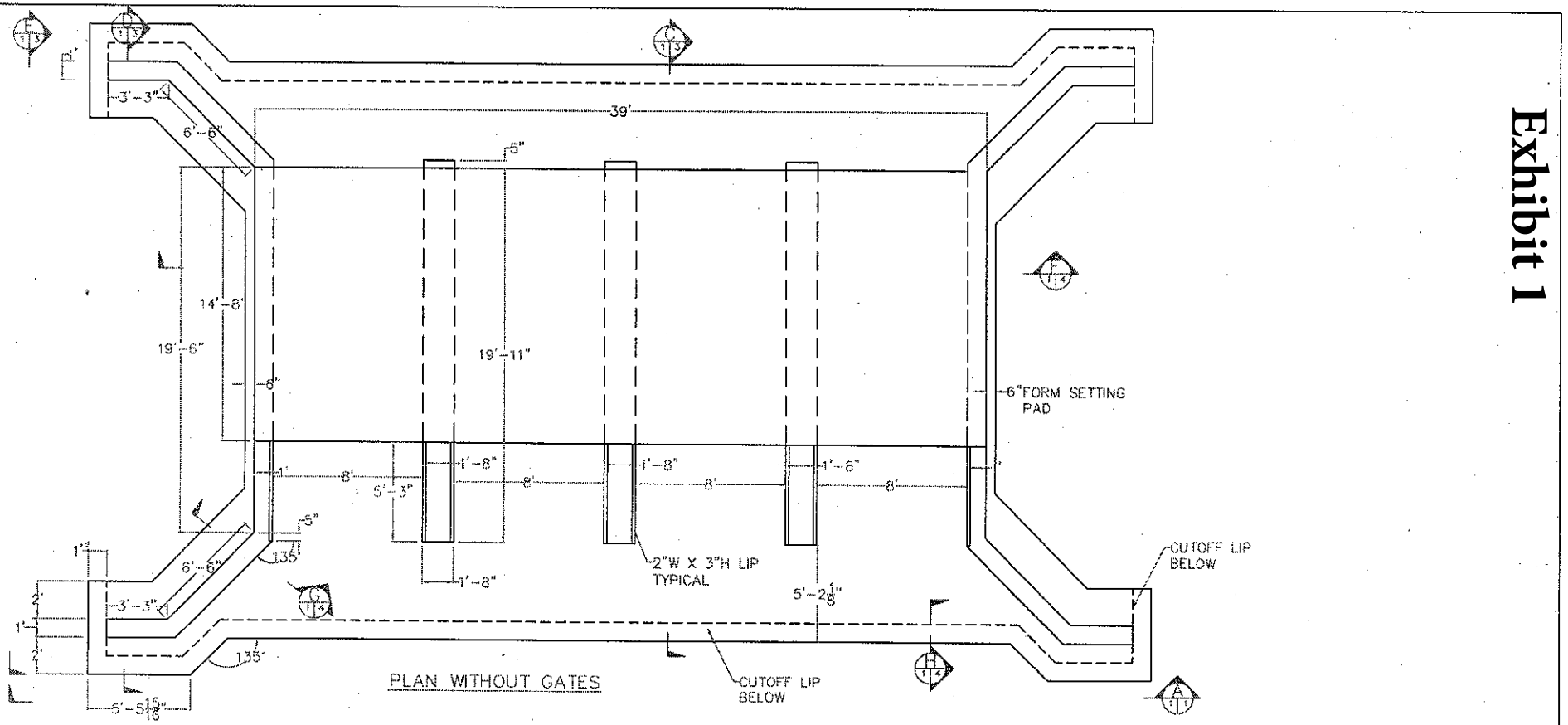
USFWS proposes to use USFWS personnel to complete the construction and installation of the improvements. Design services will be provided by CH2M HILL as defined in Task 2.4 in the USFWS's Willard Bay Project Proposal. Table 1 below provides a Class 5 cost estimate, as defined by the Estimate Classification system of the Association for the Advancement of Cost Engineering International (AACE International, Inc.), formerly known as the American Association of Cost Engineers (AACE), for construction of the improvements. Exhibits 3 and 4 provide further detail of construction cost estimates prepared per concepts discussed. They include a 25 percent contingency, assume no contractor markups, and subtract in-kind services the USFWS will provide (labor and equipment for construction). Construction cost estimates will be revised at the 30 percent design level.

TABLE 1

Estimated Costs for Concept Improvements to Outlet Structures

Description	Estimated Total Cost for Retrofit Concept	In-Kind USFWS Labor and Equipment	Grant Request
5's Drain Outlet Structure	$256,909	$80,000	$176,909
Unit 5C Outlet Structure	$486,806	$160,000	$326,806
TOTAL	**$743,715**	**$240,000**	**$503,715**

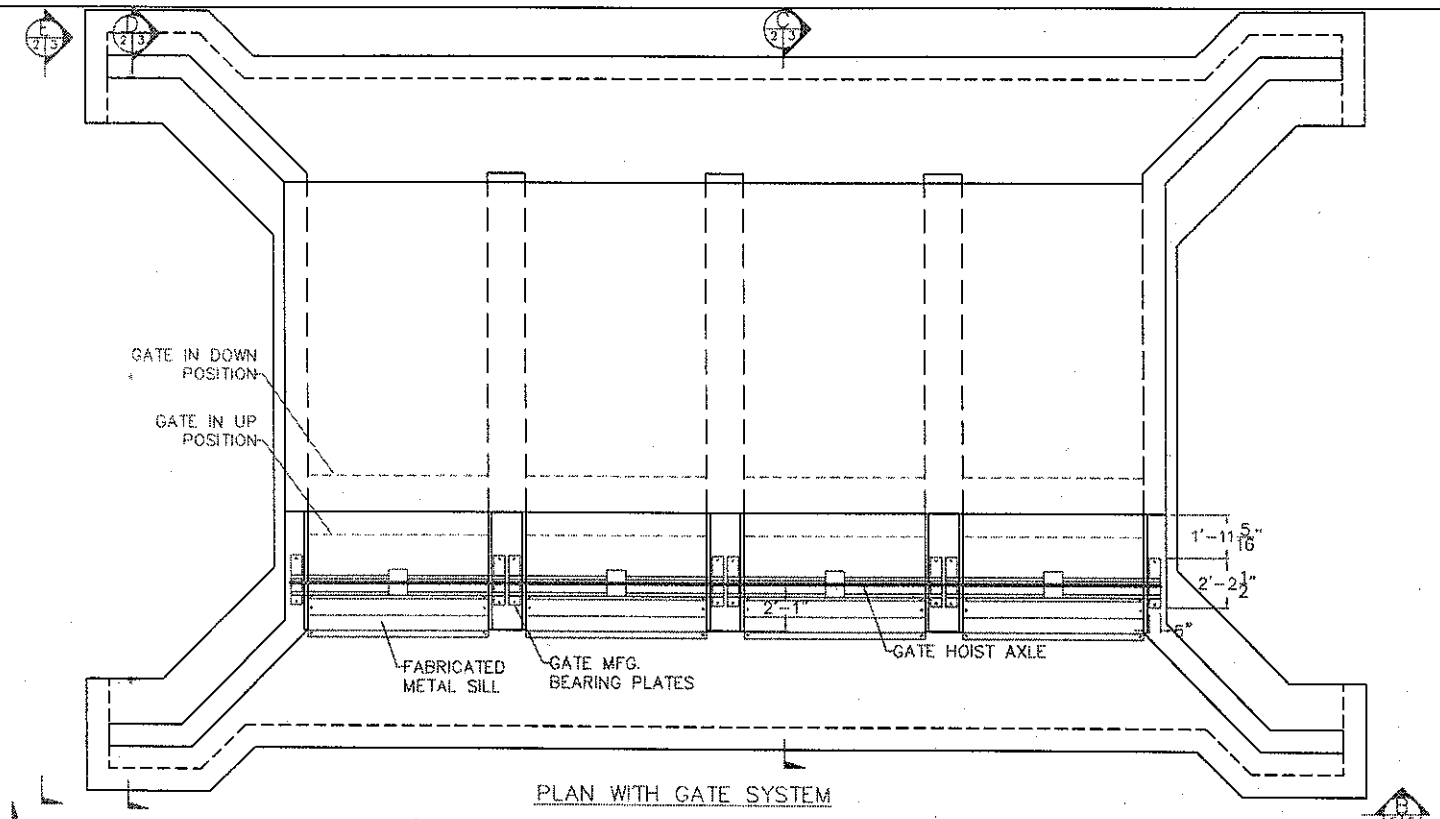
Exhibit 1



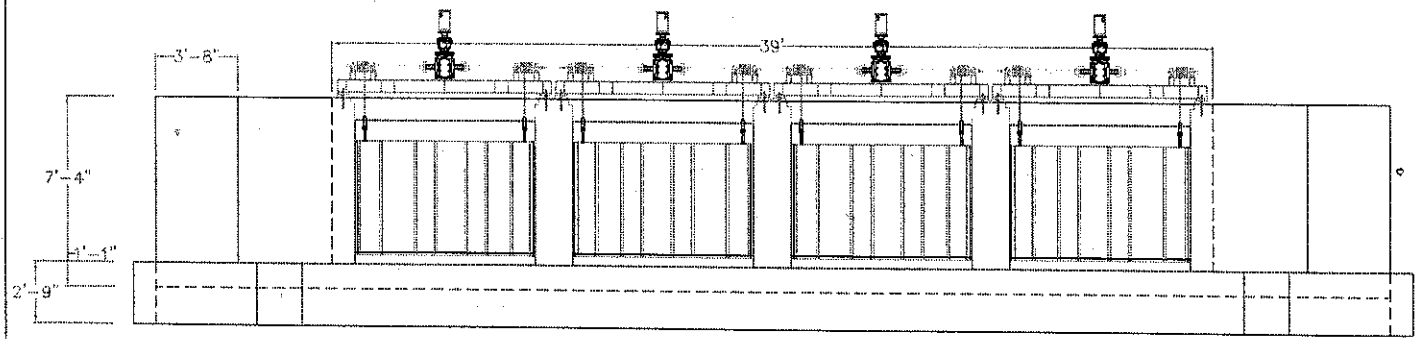
UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE
DIVISION OF ENGINEERING
BEAR RIVER MIGRATORY BIRD REFUGE
BOX ELDER COUNTY UTAH

BRIDGE & L-LINE WCS 2013
PLAN & ELEVATION
WITHOUT GATE SYSTEM

DESIGN: JOHNS	DRAWN: JOHNS	CHECK: SPOTTS
DRAWING FILENAME AND NUMBER: BOX PLANS SECTIONS.DWG		DATE: MAR. 7, 2013
	SHT. NO. 1	SEQ. NO. 1 OF 4



PLAN WITH GATE SYSTEM



(B) 2 | 2 INLET ELEVATION WITH GATE SYSTEM

0 2' 4' 8'
SCALE: 3/16" = 1'-0"

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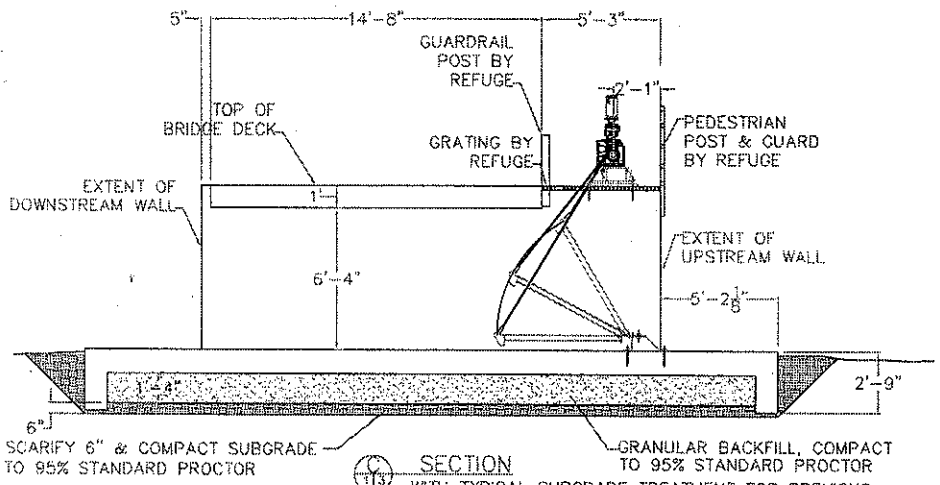
BEAR RIVER MIGRATORY BIRD REFUGE
BOX ELDER COUNTY UTAH

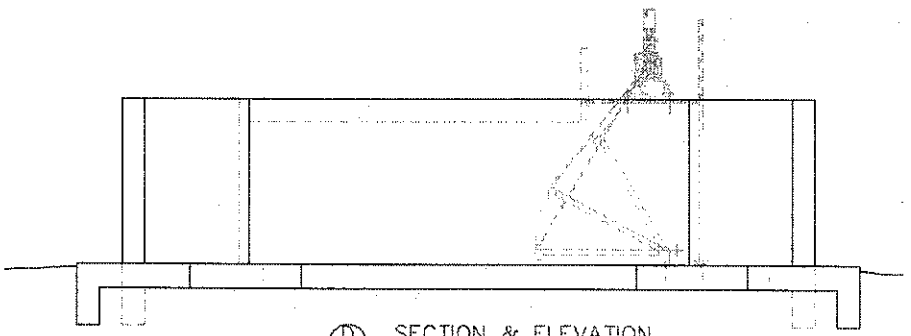
BRIDGE & L-LINE WCS 2013
PLAN & ELEVATION
WITH GATE SYSTEM

DESIGN: JOHNS	DRAWN: JOHNS	CHECK: SPOTTS
DRAWING FILENAME AND NUMBER: BOX PLANS SECTIONS.DWG		DATE: MAR. 7, 2013
	SHT. NO. 2	SEQ. NO. 2 OF 4

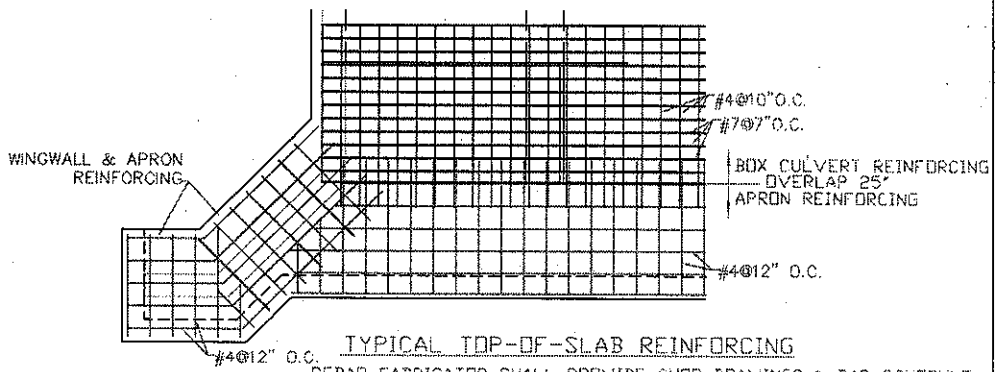


C 1/3 SECTION

WITH TYPICAL SUBGRADE TREATMENT FOR PREVIOUS UNDISTURBED AREAS. FOR PREVIOUS CONSTRUCTION AREAS, SCARIFY & COMPACT SUBGRADE & ADD COMPACTED GRANULAR BACKFILL IF NEEDED TO BRING TO GRADE.

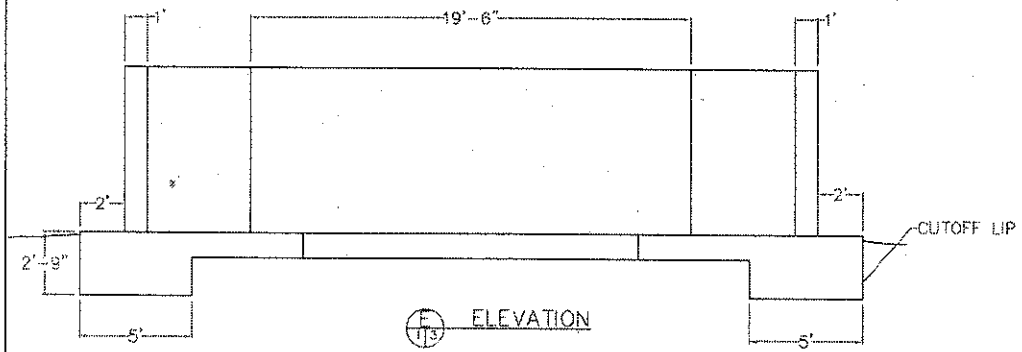


D 1/3 SECTION & ELEVATION

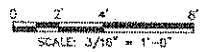


TYPICAL TOP-OF-SLAB REINFORCING

REBAR FABRICATOR SHALL PROVIDE SHOP DRAWINGS & BAR SCHEDULE TO CONFORM WITH PLANS AND SPECIFICATIONS



F 1/3 ELEVATION



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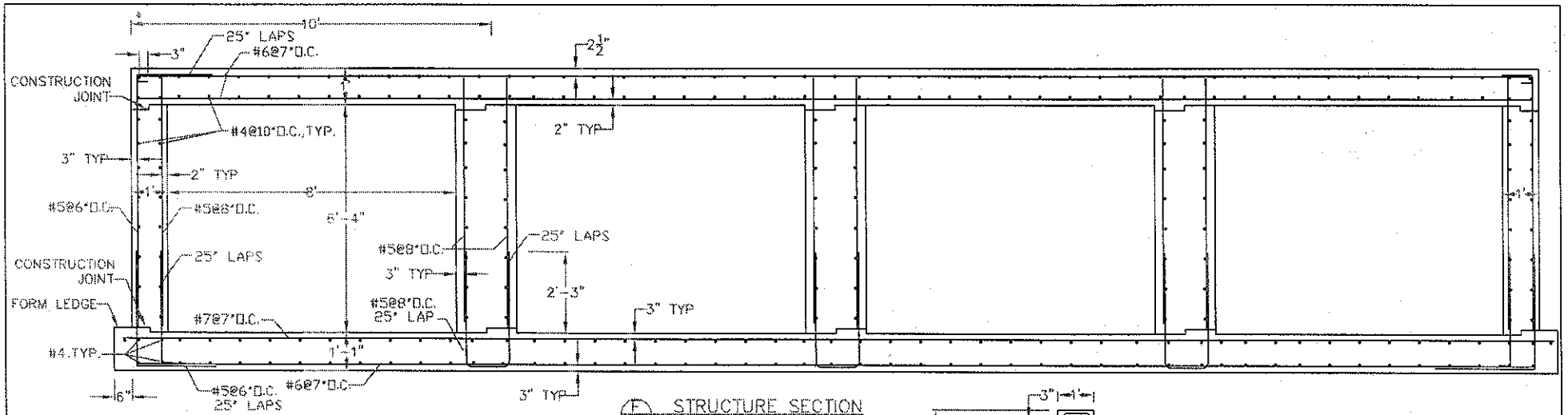
U.S. FISH AND WILDLIFE SERVICE
DIVISION OF ENGINEERING

BEAR RIVER MIGRATORY BIRD REFUGE
BOX ELDER COUNTY UTAH

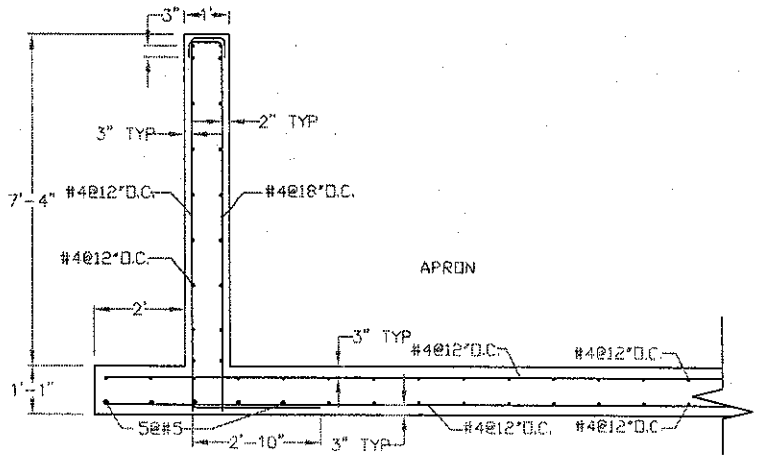
BRIDGE & L-LINE WCS 2013
SECTIONS & ELEVATIONS
TYPICAL REBAR PLAN

DESIGN: JOHNS	DRAWN: JOHNS	CHECK: SPOTTS
DRAWING FILENAME AND NUMBER: BOX PLANS SECTIONS.DWG		DATE: MAR. 7, 2013
	SHT. NO. 3	SEQ. NO. 3 OF 4



F 1/4 STRUCTURE SECTION

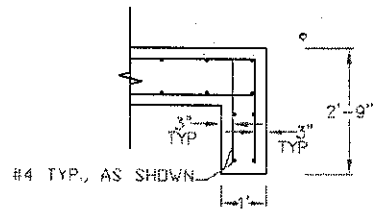
NOTES:
1. CONCRETE SHALL BE 4000 PSI, 5-7% AIR ENTRAINMENT, 4" SLUMP, PER ACI & IBC STANDARDS. PROVIDE ¾" CAMFERS ON ALL EXPOSED CONCRETE EDGES, UNLESS NOTED OTHERWISE.
2. GRANULAR BACKFILL SHALL BE FREE FROM ORGANIC OR OTHER DELETERIOUS MATERIALS, AN AGGREGATE DURABILITY INDEX GREATER THAN OR EQUAL TO 30, WELL GRADED WITH 100% PASSING 3" SIEVE, 90-100% PASSING 1", 0-45% PASSING NO. 40, & 0-10% PASSING NO. 200.
3. GRATING, GUARD RAIL & PEDESTRIAL RAIL DESIGN & CONSTRUCTION ARE TO BE DONE BY THE REFUGE PER MUTUAL AGREEMENT.
4. REBAR SHALL BE ASTM A615 GRADE 60 AND BE DETAILED ACCORDING TO ACI MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURE, ACI 315. LAP ALL REB 40 DIAMETERS MINIMUM AND AS NOTED ON THE DRAWINGS. REBAR SHALL BE SECURELY TIED IN PLACE WITH #16 ANNEALED IRON WIRE. REBAR FABRICATOR SHALL SUBMIT SHOP DRAWINGS AND MATERIALS LIST FOR APPROVAL PRIOR TO CONSTRUCTION.
5. GATE SYSTEM MANUFACTURER SHALL INDICATE LOCATIONS FOR ANCHOR BOLTS TO BE EPOXIED INTO COMPLETED CONCRETE STRUCTURE.



G 1/4 WINGWALL STRUCTURE SECTION

0 1' 2' 4'

SCALE: 3/8" = 1'-0"



H 1/4 CUTOFF LIP STRUCTURE SECTION

UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE
DIVISION OF ENGINEERING
BEAR RIVER MIGRATORY BIRD REFUGE
BOX ELDER COUNTY UTAH

BRIDGE L-LINE WCS 2013
STRUCTURAL
SECTIONS & NOTES

DESIGN: JOHNS	DRAWN: JOHNS	CHECK: SPOTTS
DRAWING FILENAME AND NUMBER: BOX PLANS SECTIONS.DWG	DATE: MAR. 7, 2013	SHT. NO. 4 / SEQ. NO. 4 OF 4

Exhibit 2

INSTREAM
WATER CONTROL PROJECTS LTD.

Latest
9-24-15

Overshot Gate Installation Instructions

Note: The Following is a **suggested** procedure only. Contractor should apply what ever installation procedure that corresponds to the equipment and labor pool in hand.

Gate leaf Installation

1) Lower the fully assembled overshot gate leaf c/w fabricated sill into the existing concrete channel. Place the unit to the **Dimensions and elevations** as described in your contract drawings. Also use the set of installation drawings (SO1-124596-04409-01 Rev 0 – total of 8 drawings) supplied by Instream as reference.

2) Use the **fabricated sill as a template** for the installation of the stainless steel anchors. Drill the anchor hole to the stated embedded depth then properly clean and use a concrete adhesive (We suggest using Hilti Hit HY-150) to properly secure the anchors. Use a leveling nut between the sill and the concrete floor if required. YOU will have to apply grout to any **VOIDS** between fabricated sill and concrete floor after all adjustments have been made. Adjust anchors on the sill assembly so as to ensure that the sill is **level and square** to the structure.

3) Before you tighten the nuts securely, check to make sure that you have an equal space between gate and concrete structure on either side – Gate leaf can be adjusted by the use of a pry bar. **(note – make sure to use anti-seize on all the anchors)**

4) **Adjust the side rubber seals** on the gate leaf (By first loosening the steel adjusting angle (see detail E on sheet 6 of 8) which is located directly below the rubber J-seal). Bump the adjusting angle so it is approx. ¼" from the concrete wall. Tighten the adjusting angle and then bump out the J-seal so that there is sufficient compression against the concrete structure side walls.

5) NOTE: The **side seals must be in contact** with the concrete structure. **NO DAYLIGHT can be present between gate leaf and concrete structure** throughout the full open /close gate cycle.

Hoist Installation

6) Using the Cable **Hoist Deck as a template**, locate and position hoist anchor bolts on concrete piers as per Drawing SO1-124596-04409-01 Rev 0, attach one nut and washer to each anchor 1" from T.O.C. Note the **C/L of the hinge on the gate leaf is 8 ¾" to the C/L of the hoist cross shaft.**

7) Install the locking washer and top nut of the anchor after you have ensured that the hoist deck is **aligned and square to the gate** leaf all as per dimensions stated on the construction drawings.

8) **Level the hoist deck** using the adjustment nuts. After adjustment is completed, tighten all mounting bolts. (both lower and upper nut of each hoist deck anchor)

9) **Attach cables** to lifting point on gate leaf.

10) Pull cables tight and wrap around drum and apply locking screws. Make sure cables are **lifting the gate leaf equally** by appling a carpenter's level to the upper end of the gate leaf. Adjust cable length by pulling or pushing cable thought the drums. Ensure cable has 2.5 to 3.0 dead wraps on the drum and have equal tension with the gate fully lowered.

11) Ensure that the cables are **wrapping inwards from center** of hoist as the gate is being raised.

12) Open the gate a few inches. **Check for any binding** between side seals and rubbing plates. Reverse direction of travel and lower gate. If gate will not move downward under its own weight there is probably too much compression of the side seals.

13) **Operate gate for a full cycle in the dry** to determine that gate is indeed lifting level with no binding of the cables and that correct alignment is ensured of all components thought full gate travel. Make necessary adjustment as required

Final Check

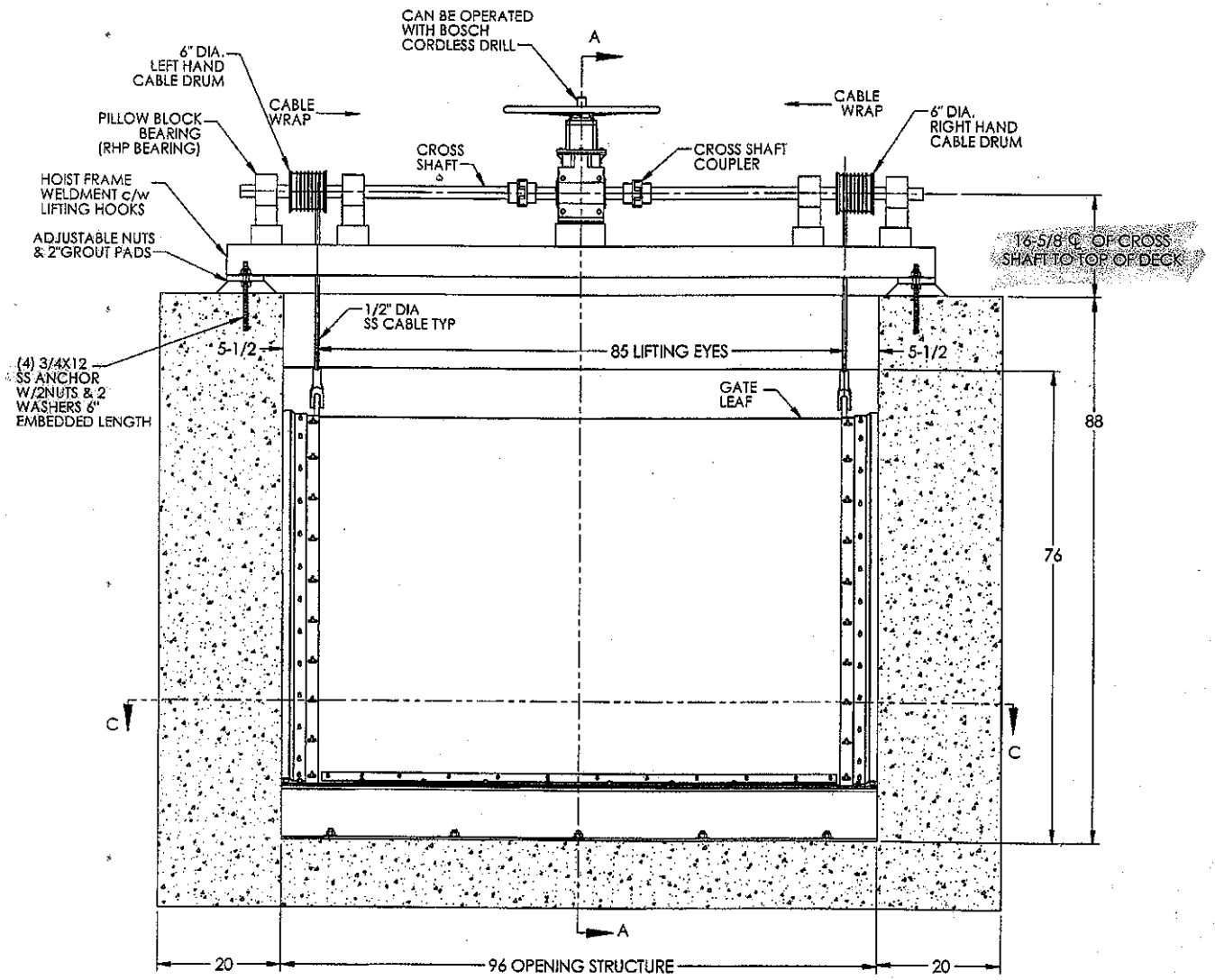
Clean all concrete debris in and around all the gate components, so as to ensure that no debris will interfere with gate operation. Check that all bolts and anchors are securely tightened and that no visual deficiencies are determined. If deficiencies are noticed make proper adjustment and or corrections prior to further cycling.

NOTE: Do not operate the cable hoist under load until prior to grout being placed under the hoist deck pads and that the grout properly set. Hoist can be operated using the supplied 18VDC Dill c/w adaptor.

OVERSHOT GATE AND HOIST ARE NOW READY FOR FINAL COMMISSIONING AND WET TESTING.

Contact Frank Stang - either by email: fstang@instreamwcp.com

Or Cell phone # 403-330-9218 if you require additional information and or clarification on this procedure.



FRONT VIEW
LOOKING DOWNSTREAM

NOTES:
1) ALL DIMENSIONS ARE IN INCHES UNLESS NOTED OTHERWISE
2) DO NOT SCALE DRAWING
3) MATERIAL:
316SS - STAINLESS STEEL TYPE 316
STL - STEEL ASTM A36 MINIMUM
DRUMS - AISI 1018 ROUND BAR MINIMUM
CABLES - STAINLESS STEEL WIRE ROPE, 6 X19 CLASS E.I.P.S TYPE 302/304
CROSS SHAFT - C1045 CARBON STEEL
FASTENERS - 316SS -ASTM F593, F594 STAINLESS STEEL TYPE 316
4) HOIST TO BE PAINTED WITH **AMERLOCK 400 EPOXY PAINT**, LIGHT GREY IN COLOR.
5) DO NOT OPERATE HOIST UNDER LOADS PRIOR TO GROUT SETTING
6) ENSURE CROSS SHAFT AND GEARBOX ARE IN LINE AND LEVEL BEFORE OPERATING
7) ENSURE CABLE HAS 3 DEAD WRAPS ON DRUM WITH THE GATE IN THE OPEN POSITION
8) CONTRACTOR TO VERIFY ALL DIMENSIONS AND ELEVATIONS
9) DO NOT LIFT GATE UNDER ANY CIRCUMSTANCES WITH ONLY ONE HOIST CABLE ATTACHED TO GATE.

10) COATING FOR LEAF AND SILL:
10 MIL MINIMUM LIGHT GRAY HI-BUILD EPOXOLINE II SERIES V69 UNLESS OTHERWISE SPECIFIED.

11) CENTERLINE OF CABLE RUNS ON THE 6"DIA. OF THE DRUM, ADD HALF THE WIDTH OF THE CABLE FOR OUTER EDGE OF CABLE.

MAJOR HOIST COMPONENTS
-GEARBOX'S BY SEW EURODRIVE (S-87 c/w 110.40:1 RATIO)
-BOSCH HAND DRILL RATED AT 650 IN LBS (MODEL HDH181-01)

HOIST DESIGN NOTES
-HOIST DESIGNED FOR LOAD OF 7,000 LBS
-CABLE DESIGNED FOR A MIN OF 5:1 SAFETY FACTOR (BREAKING STRENGTH)
-CABLE TO DRUM RATIO OF 12:1
-FULLY ASSEMBLED HOIST WEIGHT = 1600 LBS EST

OPERATING NOTE
-HOIST LIFTING SPEED = 8.5"/MIN WHEN HANDWHEEL SPINS AT 50 RPM

FVC# F124596

BEAR RIVER MIGRATORY BIRD REFUGE
CHECK STRUCTURE – CABLE & HOIST

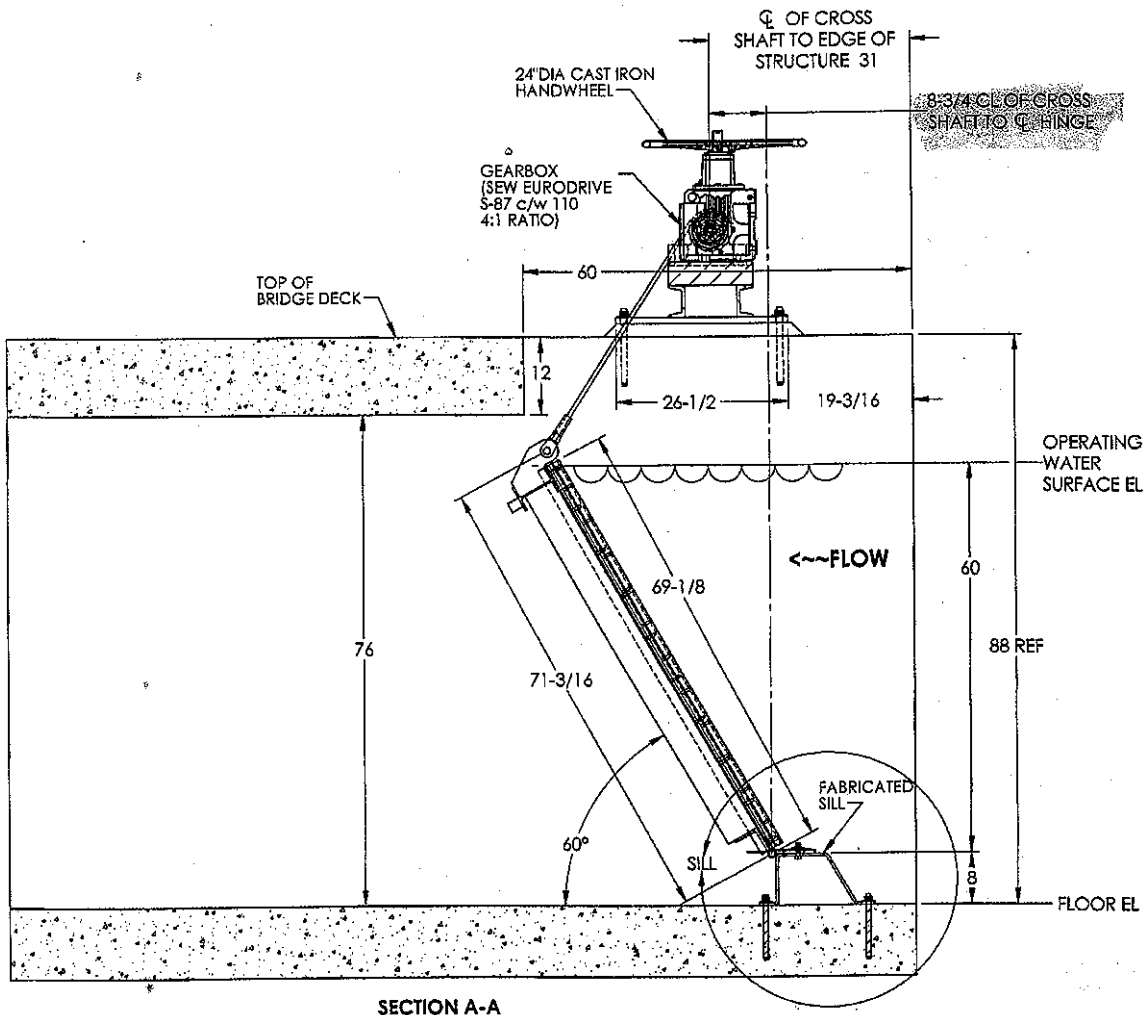
SERIES 7900 FABRICATED GATES
OVERSHOT 96"WIDE
60"HIGH WATER LEVEL
INSTALLATION DRAWINGS

DATE	10JULY13
DRAWN	JAR
CHECKED	–
REVIEWED	–
SCALE	NTS
ORDER NO.	F124596
TAG NO.	–
QUANTITY	4
WT	xxx KG
DRAWING NO.	S01-124596-04409-01
REV	0
SHEET	1 OF 8

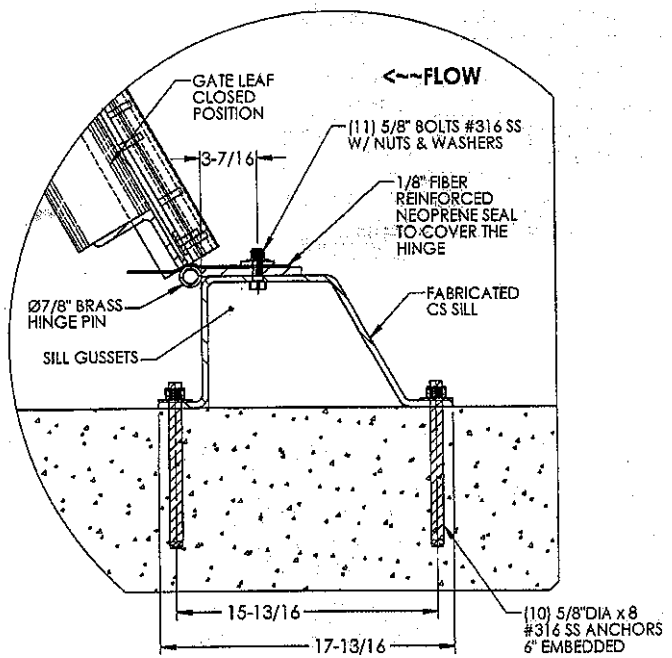
INSTREAM WATER CONTROL PROJECTS LTD.

R:\Solidworks\7900 Series, Overshot\OvershotGates\HR\S01-124596-04409-01\S01-124596-04409-01.slddrw

Created on 07/10/13



SECTION A-A
GATE IN CLOSED POSITION



SILL DETAIL

FVC# F124596

BEAR RIVER MIGRATORY BIRD REFUGE
CHECK STRUCTURE – CABLE & HOIST

SERIES 7900 FABRICATED GATES
OVERSHOT 96"WIDE
60"HIGH WATER LEVEL
INSTALLATION DRAWINGS

DATE	10JULY13
DRAWN	JAR
CHECKED	–
REVIEWED	–
SCALE	NTS
ORDER NO.	F124596
TAG NO.	–
QUANTITY	4
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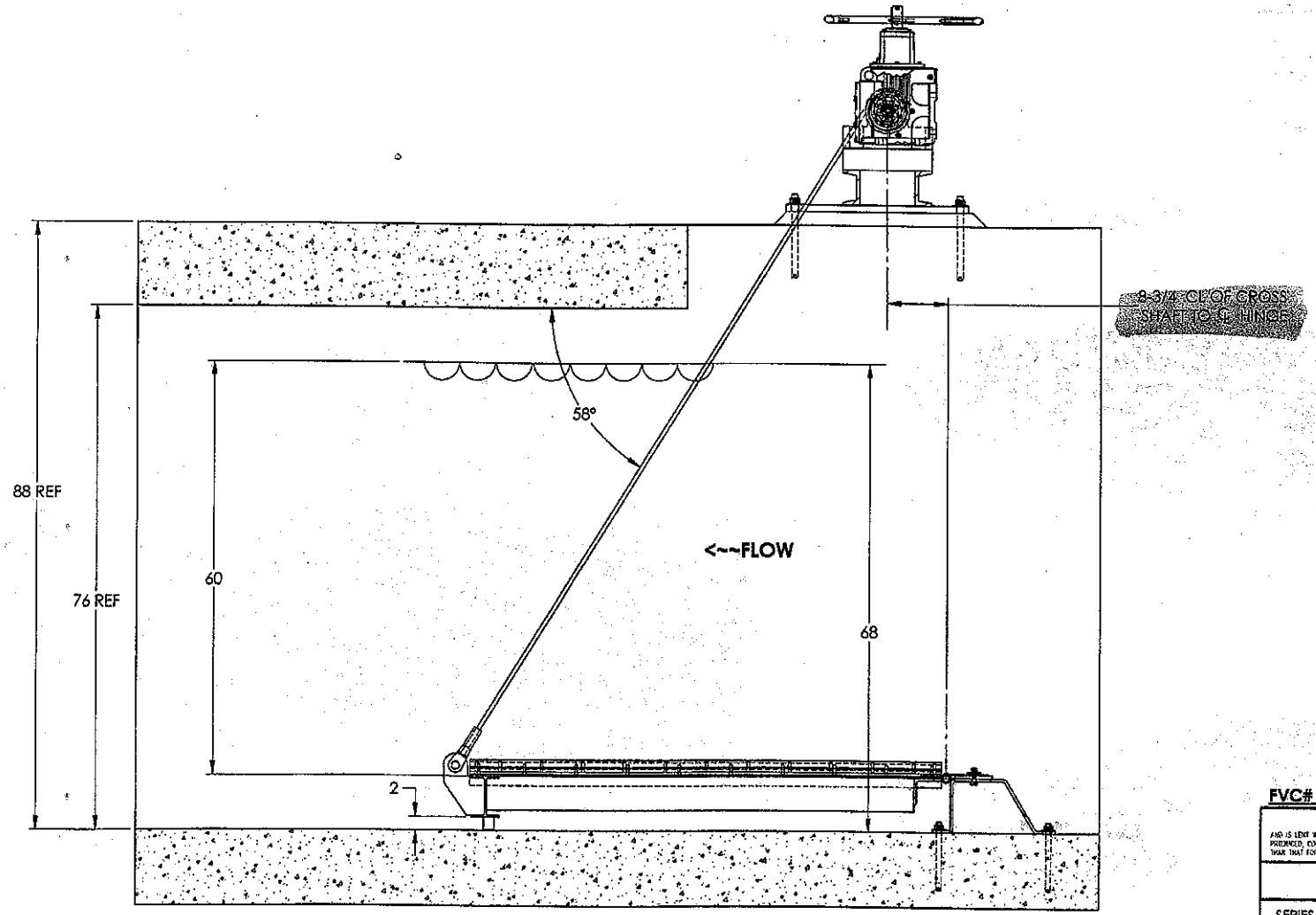
DRAWING NO.	S01-124596-04409-01
REV	0
SHEET	2 OF 8

INSTREAM WATER CONTROL PROJECTS LTD



SECTION G-G

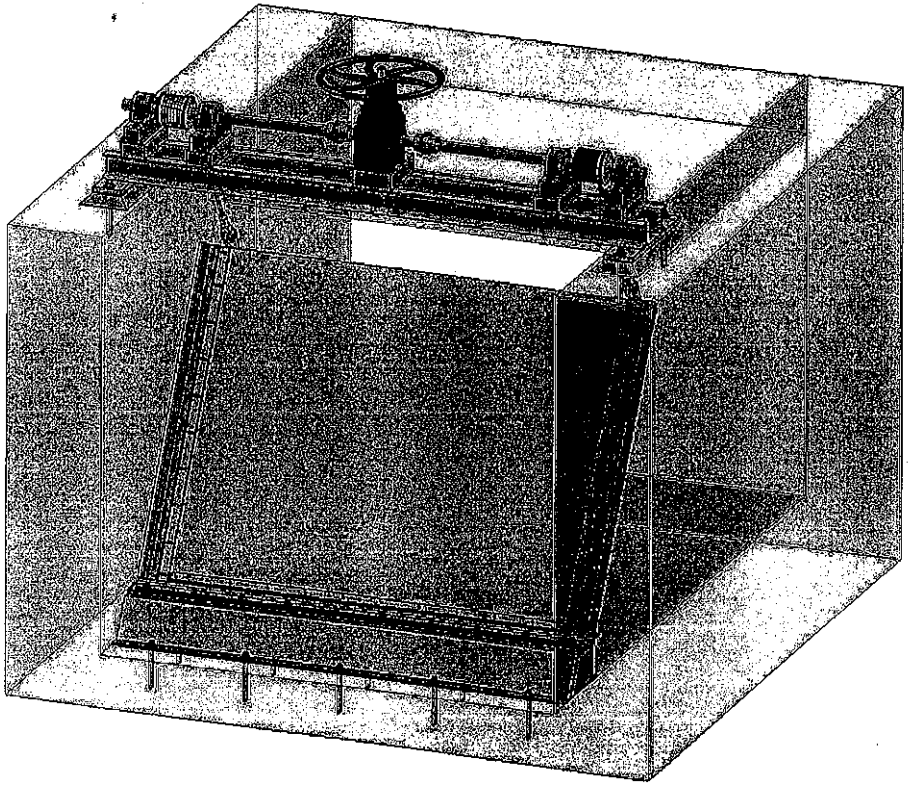
FVC# F124596

BEAR RIVER MIGRATORY BIRD REFUGE
CHECK STRUCTURE – CABLE & HOIST

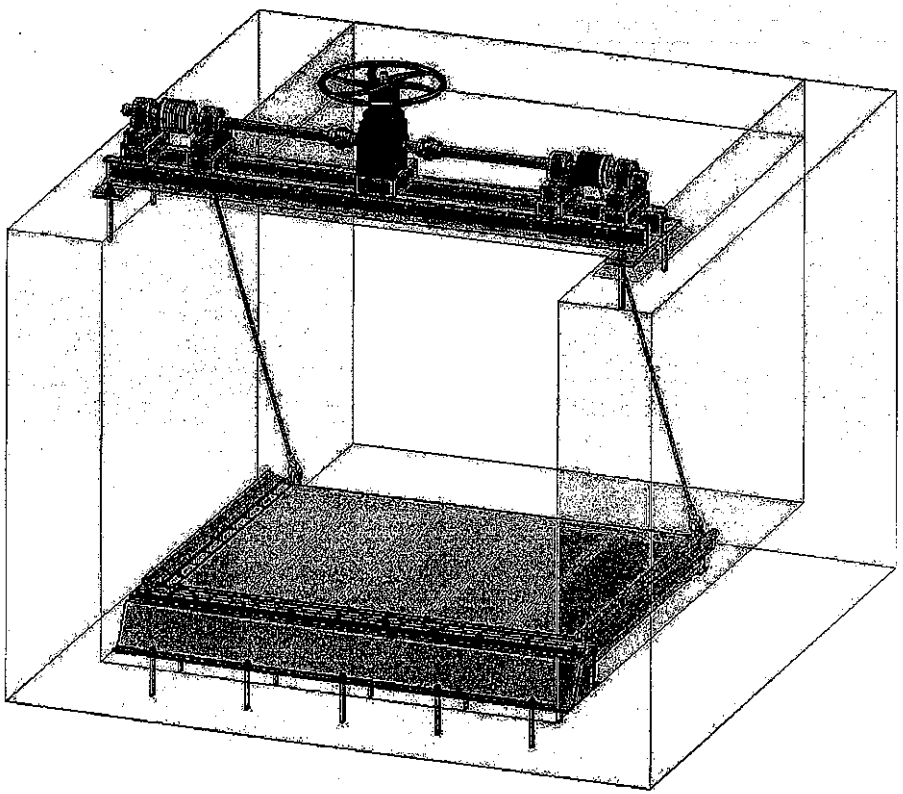
SERIES 7900 FABRICATED GATES
OVERSHOT 96"WIDE
60"HIGH WATER LEVEL
INSTALLATION DRAWINGS

DATE	10JULY13
DRAWN	JAR
CHECKED	–
REVIEWED	–
SCALE	NTS
TAG NO.	–
ORDER NO.	F124596
QUANTITY	4
WT	xxx KG
DRAWING NO.	S01-124596-04409-01
REV	0
SHEET	3 OF 8

INSTREAM WATER CONTROL PROJECTS LTD.



GATE CLOSED
LOOKING DOWNSTREAM



GATE OPEN
LOOKING DOWNSTREAM

BEAR RIVER MIGRATORY BIRD REFUGE
CHECK STRUCTURE – CABLE & HOIST

SERIES 7900 FABRICATED GATES
OVERSHOT 96"WIDE
60"HIGH WATER LEVEL
INSTALLATION DRAWINGS

DATE	10.JULY13
DRAWN	JAR
CHECKED	–
REVIEWED	–
SCALE	NTS
ORDER NO.	F124596
DRAWING NO.	S01-124596-04409-01
REV	0
SHEET	4 OF 8

TAG NO. –

FVC # F124596

INSTREAM WATER CONTROL PROJECTS ltd.

QUANTITY 4

WT xxx KG

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Exhibit 3
Conceptual Cost Estimate for USFWS BRMBR 5s Drain Outlet Retrofit (+50% -30%)

Description	Quantity (English)	Unit (English)	$/Unit	Total Cost	Comment
DEMOLITION:					
Old Intake Structure Demolition:					
Existing piers	360	CF	$7.50	$2,700	4 existign piers estimated at 1.5*6*10ft = 3.3CY/EA
Intake Structure Equipment	1	LS	$5,000.00	$5,000	
Haul Cost	13	CY	$10.00	$133	
Dump Charge	13	CY	$50.00	$667	
Allowance for Misc Items	5%		$8,500.00	$425	
Subtotal				**$8,925**	
SITEWORK :					
Gravel road Repair	250	SY	$50.00	$12,500	
Allowance for Misc Items	5%		$12,500.00	$625	
Subtotal				**$13,125**	
CONCRETE:					
New piers	22	CY	$700.00	$15,540	5 new piers estimated at 2X6X10ft - 4.4CY EA
Allowance for Misc Items	5%		$15,540.00	$777.00	
Subtotal				**$16,317**	
METALS:					
Walk Way (grating and support system, 6' wide)	240	SF	$130.00	$31,200	
Guard Rail	100	LF	$80.00	$8,000	
Allowance for Misc Items	5%		$39,200.00	$1,960	
Subtotal				**$41,160**	
EQUIPMENT:					
Overshot Gate + misc	4	EA	$30,000.00	$120,000	
Equipment Installation	5%		$120,000.00	$6,000	
Subtotal				**$126,000**	
Facility Subtotal				**$205,527**	
CONTRACTOR MARKUPS:					
Overhead	0%		$205,527.00	$0	
Subtotal				$205,527	
Profit	0%		$205,527.00	$0	
Subtotal				$205,527	
Mob/Bonds/Insurance	0%		$205,527.00	$0	
Subtotal				$205,527	
SUBTOTAL with Markups				$205,527	
CONTINGENCY	25.0%		$205,527.00	$51,382	
SUBTOTAL with Contingency				**$256,909**	
Escalation	0.0%		$256,908.75	$0	
SUBTOTAL Construction Cost with Escalation				**$256,909**	
Tax	0%		$256,908.75	$0	
TOTAL Construction Cost with Escalation & Tax				**$256,909**	
In-kind USFWS Construction Labor and Equipment				$80,000	
TOTAL Construction Cost				**$176,909**	estimated $223k using USFWS Lline data with 20% contingency, thus $121k for labor

Exhibit 4
Conceptual Cost Estimate for USFWS BRMBR Unit 5C Outlet Retrofit (+50% -30%)

Description	Quantity (English)	Unit (English)	$/Unit	Total Cost	Comment
DEMOLITION:					
Old Intake Structure Demolition:					
Existing piers	720	CF	$7.50	$5,400	8 existing piers estimated at 1.5*6*10ft = 3.3CY/EA
Intake Structure Equipment	1	LS	$5,000.00	$5,000	
Haul Cost	27	CY	$10.00	$267	
Dump Charge	27	CY	$50.00	$1,333	
Allowance for Misc Items	5%		$12,000.00	$600	
Subtotal				**$12,600**	
SITEWORK :					
Gravel road Repair	250	SY	$50.00	$12,500	
Allowance for Misc Items	5%		$12,500.00	$625	
Subtotal				**$13,125**	
CONCRETE:					
New piers	40	CY	$700.00	$28,000	***9 new piers estimated at 2X6X10ft - 4.4CY EA***
Allowance for Misc Items	5%		$28,000.00	$1,400.00	
Subtotal				**$29,400**	
METALS:					
Walk Way (grating and support system, 4' wide)	480	SF	$130.00	$62,400	
Guard Rail	200	LF	$80.00	$16,000	
Allowance for Misc Items	5%		$78,400.00	$3,920	
Subtotal				**$82,320**	
EQUIPMENT:					
Overshot Gate + misc	8	EA	$30,000.00	$240,000	
Equipment Installation	5%		$240,000.00	$12,000	
Subtotal				**$252,000**	
Facility Subtotal				**$389,445**	
CONTRACTOR MARKUPS:					
Overhead	0%		$389,445.00	$0	
Subtotal				$389,445	
Profit	0%		$389,445.00	$0	
Subtotal				$389,445	
Mob/Bonds/Insurance	0%		$389,445.00	$0	
Subtotal				$389,445	
SUBTOTAL with Markups				$389,445	
CONTINGENCY	25.0%		$389,445.00	$97,361	
SUBTOTAL with Contingency				**$486,806**	
Escalation	0.0%		$486,806.25	$0	
SUBTOTAL Construction Cost with Escalation				**$486,806**	
Tax	0%		$486,806.25	$0	
TOTAL Construction Cost with Escalation & Tax				**$486,806**	
In-kind USFWS Construction Labor and Equipment				$160,000	
TOTAL Construction Cost				**$326,806**	

Attachment 6
Letters of Support

JON J. BUNDERSON, ATTORNEY AT LAW

102 SOUTH 100 WEST
BRIGHAM CITY, UT 84302
Tele: (435) 734-9464
Fax: (435) 734-9151
email: pbundy6@msn.com

May 1, 2014

Ms. Emily Bartusek
Utah Department of Environmental Quality
Division of Water Quality
PO Box 144870
Salt Lake City, UT 8411

The Mission for Friends of the Bear River Refuge is to promote, appreciate, and conserve the wildlife, birds, and habitat of the Bear River Migratory Bird Refuge. Officially established as a not-for-profit charitable organization in 1998, we are partners with the U.S. Fish and Wildlife Service.

The FOBRR have been an integral partner in the Refuges public use program; especially involved in the growth of its extemporary Environmental Education curriculum. This grant proposal builds on BRMBR's existing educational program, providing greater Salt Lake Valley area residents access to educational programming and hands-on experiences that promote appreciation of wildlife and an understanding of the essential links between the ecological health of habitats, water quality, and the role of humans in conservation. This proposal includes watershed education for more than 10,000 students; providing field-based internships for students to gain experience in natural resource careers; and increased awareness regarding BRMBR and Willard Spur trust resources through community programs and interpretive signs. The Friends of Bear River Refuge wholeheartedly supports this proposal and will be partnering with BRMBR to achieve these goals.

Sincerely,

John Bunderson

President, Friends of Bear River Refuge

PERRY CITY

3005 South 1200 West • Perry, Utah 84302 • 435-723-6461

May 1, 2014

Ms. Emily Bartusek
Utah Department of Environmental Quality
Division of Water Quality
PO Box 144870
Salt Lake City, UT 84114

The City of Perry is pleased to support the U.S. Fish and Wildlife Service, Bear River Migratory Bird Refuge proposal for development and implementation of an integrated Water Quality Management plan for the BRMBR and Willard Spur.

The objective of the proposed project is to investigate, identify, and implement specific actions to protect and improve water quality in BRMBR and Willard Spur that augment the USFWS's educational, habitat, and recreation goals and mandates for these waters.

The City of Perry, as a vital part of the Willard Bay community and environment, supports the BRMBR proposal for the future health of the Willard Spur.

Sincerely,

Karen Cronin

Karen Cronin

Mayor, Perry City

Attachment 7
Cost Budget

Cost Summary

USFWS Proposal for Willard Bay Settlement Project

Improvements in Water Quality and Habitat Management at Bear River Migratory Bird Refuge & Willard Spur

Task No.	Task Description	Labor	Expenses (travel, per diem, lab, etc.)	Easement Acquisition	Materials, Equip, Construction	Admin.	TOTAL Project Cost	In-Kind USFWS Contribution	Requested Funds
1	Public Education Program	$ 119,806	$ 145,240	$ -	$ 25,000	$ -	$ 290,046	$ 184,458	$ 105,588
2	Spill Response	$ 401,646	$ 14,467	$ -	$ 503,715	$ -	$ 919,828	$ 240,000	$ 679,828
3	Water Quality Management	$ 371,284	$ 59,086	$ -	$ 10,000	$ -	$ 440,370	$ -	$ 440,370
4	Conservation Easement Acquisition	$ 22,600	$ -	$ 150,000	$ -	$ -	$ 172,600	$ 22,600	$ 150,000
TOTAL		$ 915,337	$ 218,793	$ 150,000	$ 538,715	$ -	**$ 1,822,845**	**$ 447,059**	**$ 1,375,786**

Note:

1. USFWS has a 6% administrative markup if USFWS receives the funds lump sum. This markup will not apply if USFWS can invoice DWQ on a time and materials basis. It is assumed that USFWS will invoice project costs on a time and materials basis.
2. All project team members will contract directly with USFWS to eliminate any need for markup.
3. USFWS labor was estimated at market rates and is considered an in-kind contribution. USFWS labor for construction services is based upon actual construction costs for the L-Line water control structure in 2013.
4. CH2M HILL labor rates are per General Services Administration Contract GS-10F-0132K
5. USFWS will provide labor for construction of improvements in Task 2 as indicated in in-kind contributions.

Exhibit 1 - Detailed Cost Estimate for USFWS

USFWS Proposal for Willard Bay Settlement Project

Improvements in Water Quality and Habitat Management at Bear River Migratory Bird Refuge & Willard Spur

			Key Staff		Labor Hour & Fee Summary				
Task	Sub-Task	Description	Bob Barrett, Project Manager	Katie McVey, Task Manager	Labor Hours	Direct Labor Costs	Intern Labor Costs	Estimated Expenses	Total
PROJECT Task									
1		**Public Education Program**	**32**	**204**	**236**	**$ 39,218**	**$ 80,588**	**$ 170,240**	**$ 290,046**
		2 Interns (41 weeks, year 1)	8	82	90	$ 14,956	$ 40,294	$ -	$ 55,250
		In-kind support for 2 interns (year 1)			0	$ -	$ -	$ 72,620	$ 72,620
		2 Interns (41 weeks, year 2)	8	82	90	$ 14,956	$ 40,294	$ -	$ 55,250
		In-kind support for 2 interns (year 2)			0	$ -	$ -	$ 72,620	$ 72,620
		Interpretive Signs	16	40	56	$ 9,306		$ 25,000	$ 34,306
4		**Conservation Easement Acquisition**	**56**	**80**	**136**	**$ 22,600**	**$ -**	**$ 150,000**	**$ 172,600**
		Easement Research	16	40	56	$ 9,306	$ -	$ -	$ 9,306
		Easement Acquisition	40	40	80	$ 13,294	$ -	$ 150,000	$ 163,294
Project Total			**88**	**284**	**372**	**$ 61,819**	**$ 80,588**	**$ 320,240**	**$ 462,647**

Exhibit 2 - Detailed Cost Estimate for CH2M HILL

USFWS Proposal for Willard Bay Settlement Project

Improvements in Water Quality and Habitat Management at Bear River Migratory Bird Refuge & Willard Spur

			Key Staff											Support Staff			Labor Hour & Fee Summary			
Task	Sub-Task	Description	Jeff DenBleyker, Sr. Project Manager	Michelle Girts, Sr. Consultant (WQ and Wetlands Assimilation)	Sharook Madon, Sr. Consultant (Wetlands Assessment)	Jim Bays, Sr. Consultant (Senior Review)	Darren Lowe, Sr. Eng./Scientist/Specialist (Spill Response)	Tim Petty, Sr. Eng./Scientist/Specialist (Engineering Design Manager)	Ryan Willeitner, Project Engineer	Associate Eng./Scientist/Specialist	Ed Meyer, Sr. Consultant (Cost Estimator)	Associate Eng./Scientist/Specialist	Chris Hoggard, Associate Eng./Scientist/Specialist (CAD)	Contracts Manager	Administrative Assitant	Administrative Assistant (Accounting)	Labor Hours	Direct Labor Costs	Estimated Expenses	Total
PROJECT Task																				
2		**Spill Response**	**140**	**0**	**0**	**0**	**138**	**172**	**352**	**0**	**24**	**0**	**192**	**36**	**40**	**40**	**1134**	**$ 161,646**	**$ 14,467**	**$ 176,113**
	2.1	Define Drainage Patterns	26	0	0	0	16	0	88	0	0	0	32	0	12	8	182	$ 23,938	$ 1,169	$ 25,108
	2.2	Identify & Evaluate Potential Spill Risks	14	0	0	0	14	0	76	0	0	0	20	0	4	8	136	$ 17,889	$ 767	$ 18,655
	2.3	Recommendations	16	0	0	0	40	0	40	0	0	0	8	12	8	8	132	$ 19,314	$ 48	$ 19,362
	2.4	Water Control Upgrades	84	0	0	0	68	172	148	0	24	0	132	24	16	16	684	$ 100,505	$ 12,482	$ 112,988
3		**Water Quality Management**	**190**	**408**	**136**	**128**	**0**	**0**	**276**	**344**	**40**	**156**	**80**	**0**	**152**	**48**	**1958**	**$ 301,263**	**$ 58,486**	**$ 359,749**
	3.1	Compile Existing Data	8	8	0	0	0	0	24	24	0	0	0	0	8	8	80	$ 10,699	$ 1,070	$ 11,769
	3.2	Summarize Incoming Water Quality	8	32	56	8	0	0	20	20	0	0	8	0	12	8	172	$ 28,576	$ 2,858	$ 31,434
	3.3	Perform Wetland Hydro-ecological Char.	48	192	80	68	0	0	40	260	0	156	8	0	44	8	904	$ 137,399	$ 41,220	$ 178,618
	3.4	Characterize Assimilative Capacity	10	40	0	32	0	0	64	24	0	0	8	0	12	8	198	$ 30,403	$ 3,040	$ 33,443
	3.5	Add Willard Spur to the SWAMPs Model	16	0	0	0	0	0	0	0	0	0	0	0	0	8	24	$ 3,826	$ 300	$ 4,126
	3.6	Alternatives Analysis	56	80	0	0	0	0	32	16	40	0	32	0	28	8	292	$ 47,668	$ 7,150	$ 54,818
	3.7	Update SWAMPs Model to Address WQ	24	32	0	0	0	0	40	0	0	0	0	0	8	0	104	$ 17,206	$ 300	$ 17,506
	3.8	Water Quality Management Plan	20	24	0	20	0	0	56	0	0	0	24	0	40	0	184	$ 25,487	$ 2,549	$ 28,035
Project Total			**330**	**408**	**136**	**128**	**138**	**172**	**628**	**344**	**64**	**156**	**272**	**36**	**192**	**88**	**3092**	**$ 462,909**	**$ 72,953**	**$ 535,862**

Note: Expenses for Task 2.4 include subcontracted work by professional surveyor.

Exhibit 3 - Detailed Cost Estimate for USU

USFWS Proposal for Willard Bay Settlement Project

Improvements in Water Quality and Habitat Management at Bear River Migratory Bird Refuge & Willard Spur

Tasks	Description	Labor Costs	Estimated Expenses	Total
PROJECT Task				
3.5 & 3.7	**Updating SWAMPS model**	**$ 70,021**	**$ 10,600**	**$ 80,621**
Project Total		**$ 70,021**	**$ 10,600**	**$ 80,621**

Exhibit 4 - Detailed Cost Estimate for Construction (Task 2.4)

USFWS Proposal for Willard Bay Settlement Project

Improvements in Water Quality and Habitat Management at Bear River Migratory Bird Refuge & Willard Spur

5's Drain Outlet		
Facility Subtotal with Labor	$	389,445
Contingency (25%)	$	97,361
SUBTOTAL with Contingency	$	486,806
USFWS In-Kind Contribution for Labor	$	(160,000)
Total Project Cost for Willard Bay Project Grant Funds	$	326,806

Unit 5C Outlet		
Facility Subtotal with Labor	$	205,527
Contingency (25%)	$	51,382
SUBTOTAL with Contingency	$	256,909
USFWS In-Kind Contribution for Labor	$	(80,000)
Total Project Cost for Willard Bay Project Grant Funds	$	176,909

Total Facility Cost with Contingency and no contractor markups	**$**	**743,715**
USFWS In-kind contrinbution for labor	**$**	**240,000**

TOTAL REQUEST FOR GRANT FUNDS	**$**	**503,715**