PROPOSAL FOR
THE ALTERNATIVES ANALYSIS FOR IMPROVEMENT OF
FISH PASSAGE AND RIVERINE ENVIRONMENT FOR
THE MIDDLE STREET DAM ON THE PEQUABUCK RIVER
BRISTOL, CT

SUBMITTED TO:
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A. CONTRACTOR INFORMATION

1. Name of Proposer: Princeton Hydro Engineering, PC*
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*a wholly owned subsidiary of Princeton Hydro, LLC, created specifically to comply the Connecticut State Board of Examiners for Professional Engineers and Land Surveyors and the Office of Professions, New York State Education Department. Princeton Hydro, LLC’s FID Number is 22-3590229.
B. PROPOSER’S REPRESENTATIVE

Authorized Representative:

1. Name of Representative: Laura Wildman, PE
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Alternate:

1. Name of Representative: Geoffrey Goll, PE
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3. Normal Hours of Work: 8:30 AM to 5:30 PM
C. ORGANIZATIONAL PROFILE

1. QUALIFICATIONS & EXPERTISE

Princeton Hydro

Princeton Hydro is a full service, Small Business Enterprise (SBE), water resource firm founded in 1998 based on the principal of innovative design solutions for water, soil and wetland resource management. Princeton Hydro specializes in the restoration of impacted rivers and streams. Our award-winning, multidisciplinary team of ecologists, fluvial geomorphologists, fisheries biologists, environmental scientists and geotechnical and water resource engineers has a wealth of experience restoring degraded ecosystems. Our goal is to restore as many natural functions as possible while balancing the many essential societal uses of rivers. Our innovative restoration designs look to create resilient self-sustaining river systems that measurably improve ecological health.

Rivers are the catchments for all of the impacts of human development within a watershed. Today, of the 5.3 million km of rivers in the coterminous United States, about 79% are affected by human activities (Palmer et al. 2007) and more than one-third are officially listed as impaired or polluted (EPA 2000). Estimates of the number of dams in the U.S. range from 83,000 to several million. When we add other stream barriers to that estimate, such as culverts, tide gates, weirs, levees, excessive sediment accumulations, and habitat or temperature barriers created through water diversions and stream channelization, the number increases dramatically. Virtually every river in the continental United States is now regulated by dams, locks, or diversions (Collier, Webb & Schmidt).

Our ecological restoration team of scientists and engineers understands these daunting odds and provides an unmatched depth of experience and understanding of complex ecosystems impacted by human development. We understand that rivers are complex, dynamic, living systems capable of responding to human touch in either a positive or negative direction. The object of river restoration is to initiate a positive trajectory that emphasizes the enhancement of riverine and riparian functions and services. We take pride in our efforts to restore these complex systems or put them on a path toward restoring themselves.

Balancing the needs of a community and the needs of riverine ecosystems can be one of the greatest challenges for restoration projects. However, there are creative solutions, yet still practical, that can be found when all of a project’s stakeholders are brought to the table and work to find common goals and interests. Princeton Hydro believes in working with local communities to promote a sound environmental stewardship ethic so that future generations can continue to benefit from healthy rivers.

In addition to Princeton Hydro’s experienced science and engineering team, we are also teaming with GM2 Associates, Inc., a legitimate minority business enterprise, also based in Glastonbury, CT, that we have teamed with in the past for multiple fish passage and barrier removal projects. GM2 will be completing all of the topographic/bathymetric survey and base mapping for the projects.

General Approach

Dam Removal

As the dams in our country age, dam owners and communities face difficult and complicated decisions as to whether they should continue to repair and maintain their dam or remove it and restore the river. And with river restoration on the rise more local watershed groups and state managers are initiating projects to either remove stream barriers or modify them such that aquatic species can regain passage to historic habitats upstream, helping to defragment these critically impacted systems. The final decision often comes down to the current use of the dam, the cost of the various options, and the potential environmental impacts and ecological benefits of each alternative.

Princeton Hydro has unparalleled experience in dam removal since the mid 1990’s, including partial dam removals and the lowering of dam crests. We understand how to balance the many
issues to help dam owners and project partners find the right solution for their particular project. Staff members have been involved in over one hundred barrier removal/modification projects nationwide since the mid-1990’s, ranging from consultation of huge dam removals in the west, to the design and removal of numerous mid- to small-sized dams throughout the east coast and the modification of barriers to allow for fish passage. Princeton Hydro has worked with many communities, dam owners, and restoration partnerships to assess critical issues and multiple options regarding dams and barriers. Our successful projects have included dam removals, culverts modifications or removals, partial barrier removals, design and installation of fishways, as well as dam repairs. Our staff’s extensive experience in field assessment, hydrology, hydraulics, ecology, fish biology and mechanics, invasive species control, sediment transport, fluvial geomorphology, wetland science, water and sediment quality, regulatory compliance, monitoring, construction management, bathymetric surveying, historic preservation, recreational usage, and community involvement all play a critical role in the success of our dam assessment and removal projects. Additionally, Princeton Hydro has in-house geotechnical expertise and a soils laboratory, which is a unique attribute among ecological restoration firms.

The removal of a barrier can be one of the single most effective river restoration techniques available. Our innovative designs and completed projects reflect our deep understanding of how to best restore complexity and dynamic function to river systems, while addressing community concerns.

**Selected Stream Barrier Removal Work:**

**Dam Removals:**
- Dunkard Creek Dams (PA) *
- Ralph Stover Dam Removal (PA)
- Watson Creek Dam Removal & Restoration (PA)
- Cold Springs Dam Removal Environmental Assessment (PA)
- Darby Creek Obstruction Removal – 3 dams (PA)
- Plymouth Crossing Dam Removal* (PA)
- Harry Pursel Dam Breach (NJ)
- Gruendyke Mill Dam Removal (NJ)
- Seber Dam Removal (NJ)
- Wigwam Pond Dam Removal (NJ)

- Plainsboro/Cranbury Dam Removal (NJ)
- Fullencamp Dam Removal (NJ)
- Removal Feasibility Study for 3 HMUA Dams (NJ)
- Finesville Dam Removal Feasibility Study (NJ)
- Anaconda Dam Removal (CT)**
- Freight Street Dam Removal (CT)**
- Union City Dam Removal (CT)**
- Platts Mill Partial Dam Removal (CT)**
- Naugatuck River - Dam Removal Assessments for Brays Buckle, Chase Brass, Tingue, and Plume & Attwood Dams (CT)**
- Coginchaug River – Dam Removal Assessments for Starr Mill Pond and Savage Mill Dams (CT)**
- Pizzini Dam Removal (CT)**
- Raymond Brook Dam Removal (CT)**
- Billington Street Dam Removal (MA)**
- Cumberland Industrial Dam Removal Feasibility Study (MD) *
- Edwards Dam Removal (ME)**

**Road Crossing Modifications:**
- Mitchell Brook Culvert (MA)*
- Trout Creek Culvert Replacement (PA)
- Depot Park Stream Restoration (NJ)
- Petty's Run Stream Restoration (NJ)
- Bridge Trestle Replacement on Tremley Creek (NJ)
- Bridge Trestle Replacement on Mantua Creek (NJ)
- Culvert Design on tributary to Royce Brook (NJ)
- Bridge Design on tributary to Lockatong Creek (NJ)
- Culvert Design on tributary to South Branch Raritan River (NJ)

Note:
*Project presently underway
**Selected dam removal experience of Project Manager, Laura Wildman
To see summary sheets of some of these project, please refer to the Appendix of this proposal.
Sediment Management for Dam Removal

When a dam is removed many concerns relating to sediment arise. The first concern commonly relates to the quality of sediment that has accumulated behind the dam. Dam removal efforts typically include some kind of initial effort to determine if the impounded sediment is contaminated. The path to determine if a dam can be removed and how to remove the dam can change significantly depending on the results, as well as the project cost. The next question often relates to the quantity of the sediment behind the dam and its mobility. If the dam is removed, how much sediment will be mobilized? Where will it deposit downstream? What will be the impacts to downstream habitats? Will it impact threatened and endangered species such as mussels? It is our job to help answer these questions and determine what management techniques should be implemented to minimize or eliminate potential impacts relating to sediment mobilization.

A full understanding of river dynamics gives our experts the insights they need to predict the less obvious. We look at the system’s threshold velocities and shear stresses, factors that could instigate bank and bed scour or undermine upstream structures such as bridges, retaining walls, and submerged utilities. We predict what the river’s pre-dam equilibrium slope was and try to replicate it in our designs. We investigate the current and pre-dam stream bed substrate and determine how best to restore natural complexity and function. Our scientists and engineers do their own field work, so they understand the site first hand and can gain an intuitive feel for how best to restore the system or place it back on a trajectory of self-restoration.

Within the impoundment, we must predict the post-project path of the river; downstream we must understand what would happen if the sediment were allowed to erode naturally post-removal. When a system has the carrying capacity to handle the mobilized volume of the sediment and the habitat downstream will not be negatively impacted and may even be improved, depending on its current sediment balance, we will promote allowing sediment to be transported downstream. However, if the system downstream cannot carry the mobilized portion because the habitat is too sensitive, we look into innovative sediment management options that will minimize impacts while still striving to obtain a self-sustaining system. Temporary stabilization in the form of deformable riffles or bioengineered stream banks can often be a good interim stabilization step as the dewatered impoundment stabilizes itself with vegetation and deep root mass.

The technical expertise of Princeton Hydro in the management of sediment for dam removal projects and within freshwater impoundments is unsurpassed in the region. Laura Wildman, the project manager for this project, is the current chair of the ASCE-EWRI Task Committee on Sediment Dynamics Post Dam Removal, is an invited participant to the Federal Interagency group working to develop sediment management standards for dam removal for the federal agencies, has written several publications and teaches courses on the topic.

Princeton Hydro is also well known for work in dredging and has completed numerous freshwater lake dredging designs, with an emphasis on the management and disposal of sediment. We have addressed sediment ranging in characteristics from fine-grained and organic materials to coarse particulates such as sands, gravels and cobbles, and from “clean” sediment to materials contaminated with heavy metals, polycyclic aromatic hydrocarbons (PAHs), PCBs and historic pesticides. We have completed studies prior to the sediment’s removal to identify disposal sites and procure agreements for acceptance of sediment. Additionally, Mr. Geoffrey M. Goll, as the Principal Professional Engineer of the firm, has extensive experience with the management of soils and sediments contaminated with PCBs, dioxin and heavy metals. Mr. Goll provided engineering and management of heavily contaminated sediment and developed stabilization plans for beneficial reuse as a landfill cap and disposal using kiln dusts and Portland cement. For this project, Mr. Goll will provide such expertise in the analysis of sediments and determine disposal alternatives consistent with PADEP regulations.

Fish Passage: Biology & Habitat

Princeton Hydro has multiple fishery experts on staff, both fishery biologists and fishery engineers. Dr. Stephen Souza, President of the firm, received his Ph.D. from the University of Connecticut in Ecology / Fishery Biology. Dr. Souza was previously employed by the Connecticut DEP working on American shad and blueback herring
migration, spawning and young-of-the-year (YOY) feeding preferences.

Laura Wildman, the Project Manager, has completed numerous fish passage alternatives analyses and has designed a wide variety of fishways, including: Denil fishways (commonly used for the passage of American shad), Alaskan Steeppass fishways (commonly used for the passage of river herring), eelways specifically designed for the passage of American eels, and nature-like fishways, and both bypass channels and rock ramp fishways (commonly used to pass a larger variety of diadromous and resident fish species). She managed a team of fishery experts looking into the passage requirements of American shad along the east coast which included state-of-the-art research into preferences for velocity, depth and length of passage, length being a commonly overlooked limitation in passage design.

In addition, Ms. Wildman wrote two papers on fish passage of diadromous and resident fish species while getting her graduate degree at Yale, looking at a cross-section of fish species commonly found within New England streams with a variety of the swimming abilities and biomechanics, as well as different preferences for location within the water column including, alewife (*alosa pseudoharengus*), blueback herring (*alosa aestivalis*), American eel (*Anguilla rostrata*), American shad (*Alosa sapidissima*), brook trout (*Salvelinus fontinalis*), brown trout (*salmo trutta*), white sucker (*Catostomus commersoni*), blacknose dace (*Rhinichthys atratulus*), and Atlantic salmon (*salmo salar*). She is currently working on another fish passage publication entitled the Illustrated Handbook of Nature-like Fishways.

Princeton Hydro has completed numerous pre- and post-ecosystem assessments of dam removal projects, conducted fish and benthic surveys, including those that assess diadromous fish species, managed sixty scientist (multiple-vessel) fishery sampling programs, carried out a number of essential fish habitat studies, and implemented projects associated with the utilization of created mitigation tidal habitat by anadromous fish.

**Fish Passage:**

Princeton Hydro staff have cutting-edge expertise in the design of fishways. The Project Manager, Laura Wildman, has designed numerous traditional and nature-like fishways, both bypass channels and rock ramp fishways, as well as hybrid nature-like fishways. Her past project experience in fish passage extends back to the mid 1990’s and includes the design and construction of a nature-like fishway at the Guilford Lakes Dam in Guilford, CT, which she worked on collaboratively with CT DEP while she was Chief Engineer at American Rivers. She completed the field investigation, initial studies and conceptual designs for traditional and nature-like fishways for the Plume and Attwood, and Brays Buckle dams. She provided the conceptual design and scope of work for the Sonnebec rock ramp in Union Maine and then provided engineering oversight through the final design and construction.

Ms. Wildman provided the conceptual concepts for the Howland bypass channel and led a team of researchers, including Alex Haro from Conte Anadromous Fish Research Center, in the investigation of the passage effectiveness of the proposed bypass channel. The study looked at the effectiveness of European nature-like fishway examples and the abilities of American Shad to pass similarly challenging river reaches in the greater Northeast, and compared the results to the proposed bypass channel design parameters. In
addition, our Project Manager has provided technical oversight on numerous other fishway designs throughout the northeast.

**Selected Fishway Work:**

- Pond Lily Alaskan Steeppass Fishway (CT)*
- Guilford Lakes Nature-like & Steeppass Hybrid Fishway (CT)*
- Sennebec Rock Ramp Fishway (CT)*
- Tingue Dam Bypass Channel – Preliminary Design & conceptual design of Denil fish ladder (CT)*
- Plume & Attwood Rock Ramp – Conceptual Design (CT)*
- Brays Buckle Dam – Conceptual design for Denil fishway (CT)*
- Howland Dam Bypass Channel – Conceptual Design & Feasibility Research (ME)*
- Billington Street Dam Removal & Rock Ramp – Preliminary Design (MA)*
- Technical Oversight on additional Technical and Nature-like Fishways in CT, NH, ME, and PA*

Note:
*Selected dam removal experience of Project Manager, Laura Wildman
To see summary sheets of many of these projects, please refer to the Appendix of this proposal.

**Hydrology and Hydraulics of River Restoration**

One of the primary functions of the water resources engineering group within Princeton Hydro is to provide hydrologic and hydraulic modeling for our many ecological restoration projects. Understanding hydrologic and hydraulic theory is of primary importance to Princeton Hydro. Prior to entering data into computer models, Princeton Hydro staff must complete several other key steps. First, staff will complete a detailed literature search of existing data. This includes a review of all existing hydrologic and hydraulic studies and construction plans for structures involved in the project. Second, Princeton Hydro conducts field visits to the project site and a “drive-thru” of the contributory watershed. During the initial field visits, Princeton Hydro will meet with the project team (including the land surveyor) to ensure that the data needed for the design is collected. Additionally, Princeton Hydro measures typical channel widths, channel heights, bank slopes, and notes vegetative features and stream features that should be preserved and those in need of attention during design. Reference cross-sections, to measure before and after construction, are typically established during the field visit. We investigate related storm sewer pipe networks. Our staff has a solid understanding of stream hydrology and hydraulics, which is essential to good stream restoration design.

Our engineering staff is fluent in open channel flow, pipe flow hydraulics, runoff hydrology, and routing analysis. Princeton Hydro regularly utilizes computer models such as the US Army Corps of Engineers Hydraulic Engineering Center’s River Analysis System (HEC-RAS), HEC-HMS (Hydrologic Modeling System), HEC-1 and HEC-2 (if older data is necessary for conversion to HEC-HMS or HEC-RAS), HydroCAD™, and Haested Methods PondPack™. Our staff is also fluent in the use of HEC-RAS unsteady flow and has instructed courses on the proper use of HEC-RAS and how to obtain an intuitive feel for the accuracy of the model results based on field observations of the site.

Where groundwater and well impacts might be an issue, Princeton Hydro employs modeling software such as Visual Modflow™ to determine impacts of groundwater inflow or outflow from a river system. For the analysis of sediment transport and scour impacts, Princeton Hydro typically employs the sediment analysis functions of HEC-RAS. The scour calculations included in HEC-RAS are typically not sufficient to complete engineering design. In these cases, supplemental scour analyses in accordance with the United States Department of Transportation Federal Highway Administration are completed.

**Ecological Restoration**

Since Princeton Hydro was formed in 1998, ecological restoration has been a core component of the firm’s services. Princeton Hydro has designed and managed the construction of numerous successful and award-winning restoration projects covering a diversity of habitat types including impoundments dewatered through dam removal, palustrine and estuarine wetlands, stream segments, riparian and floodplain communities, vernal pools, meadows, and upland forests. Less routine habitat restoration efforts have included brownfield-to-greenfield projects in urban settings and mine reclamation including sites with acid-producing soils. Our experienced team of scientists and engineers possesses the multi-
disciplinary skill sets needed to establish sustainable natural communities.

At Princeton Hydro, fulfilling our Client’s objectives for successful ecological restoration projects begins with concept designs that do not merely satisfy minimum regulatory requirements. Rather, our philosophy is to establish or enhance each site in a manner consistent with the specific landscape position and local ecological elements in order to cost-effectively maximize the natural resource values and functions.

**Invasive Species Control**

Princeton Hydro has considerable experience in the management of invasive species as a component of its ecological restoration projects which enables us to provide innovative, cost-effective designs and ecologically sensitive solutions. Our success can be directly attributed to our planning process, which is dependent upon interaction with and direct input from stakeholders. We have used GIS mapping to prioritize problem areas, facilitate restoration objectives, and develop management plans to monitor a project’s success. Our goal is to develop sustainable and cost-effective solutions that will minimize impacts to existing desirable vegetation while furthering restoration objectives.

Princeton Hydro’s wetland mitigation and restoration projects are augmented by our in-house capabilities and experience related to the management of invasive wetland and aquatic plants. Princeton Hydro’s invasive plant management specialists have worked in conjunction with our ecological staff to obtain necessary herbicide treatment permits to eradicate undesirable and non-native plants from sites prior to project construction. Also, during the follow-up monitoring phase required of every mitigation project, Princeton Hydro’s invasive plant management staff is instrumental in suppressing unwanted plants and thereby ensuring the successful establishment and growth of desirable plant species.

**Quality Assurance/Quality Control**

The day-to-day operations of the firm are conducted by the company’s three Principals (Dr. Stephen J. Souza, Mr. Geoffrey M. Goll, P.E. and Mr. Mark Gallagher) who assume the overall responsibility and liability of all work performed on behalf of clients. For this project, Mr. Goll will serve as Principle in Charge and Contract Administrator; Ms. Laura Wildman, P.E. is designation as the Project Manager; and Ms. Mary Paist-Goldman, Associate, will act as Quality Assurance/Quality Control Manager (QAQCM). As previously described, the firm manages 30+ professionals skilled in various environmental disciplines and operates four technical offices (NJ, PA and CT) and one field operations office (NJ). The Scientists and Engineers identified as Task Managers for this project are as follows; Mr. Paul Woodworth (Fluvial Geomorphologist), Mr. Jacob Helminiak, P.E. (Senior Project Engineer), Mr. Mark Gallagher (Ecological and Regulatory Specialist), and Mr. Paul Cooper (Aquatic Ecologist). These individuals are responsible for carrying out the day-to-day task and subtask project activities, including the scheduling and oversight of the Staff Engineers and Scientists utilized for the completion of tasks. As shown in the Project Organizational Chart, Ms. Paist-Golmand, the project’s QAQCM reports only to Mr. Goll and remains completely independent of any technical related project efforts. Mr. Goll and Ms. Wildman will ensure that work is conducted in compliance with the approved scope of work and that work products and deliverables have been thoroughly reviewed before being released to the Client. In this capacity they will ensure the quality of all work conducted under the contract, and ensure that all those involved in the project perform their various functions in accordance with our Quality Management Plan (QMP), published SOPs, and Quality Assurance Project Plans (QAPPs), all of which are designed to prevent erroneous and poor quality work products.
Examples of those projects for which Princeton Hydro has implemented QMPS and developed QAPPS for include:

**Project Title:** “Alexauken Creek Watershed Protection Plan”
**Grant:** 319(h) Grant # RP05-084
**Regulatory Agency:** NJDEP

Project Title: “The Wayne County Embayments Resource Preservation and Watershed Enhancement Plan”
**Grant:** USEPA Grant Number X-98299000-1
**Regulatory Agency:** Division of Environmental Science and Assessment, United States Environmental Protection Agency, Region II

Project Title: “Watershed Restoration and Protection Plan for the Whippany River Watershed”
**Grant:** 319(h) Grant # RP08-055
**Regulatory Agency:** NJDEP

Project Title: “Sidney Brook Watershed Protection Plan”
**Grant:** 319(h) Grant # RP07-003
**Regulatory Agency:** NJDEP

Project Title: “The Loantaka Brook Watershed Report”
**Grant:** USEPA Grant Number: X-97267701
**Regulatory Agency:** United States Environmental Protection Agency

For Princeton Hydro’s Quality Assurance and Quality Control Plan please see Appendix A.

2. ORGANIZATIONAL CHART

For the project team and company-wide organizational charts please see Appendix B.

3. LEGAL STATUS

Princeton Hydro is a NJ Limited Liability Company, with a subsidiary Princeton Hydro Engineering, a NJ Professional Corporation, established to comply with the CT and NY Board of Professional Engineers to conduct business in those States. We are a for-profit business. We are registered to do business in Connecticut, Delaware, New Jersey, Maryland, Pennsylvania, New York, Massachusetts, Virginia, New Hampshire, Maine, and Vermont. Our staff members hold Professional Engineering licenses in CT, DE, NJ, MD, PA, NY, MA, NH, VA, VT and ME.

4. FINANCIAL CONDITION

For copies of Princeton Hydro’s two most recent annual financial statements prepared by an independent Certified Public Accountant, and reviewed and audited in accordance with General Accepted Accounting Principles (USA), please see Appendix C.
5. REFERENCES/PAST PERFORMANCE

List of References

For Letters of Reference please see Appendix D.

Governmental References for Dam Removals

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Mr. Harry S. Pursel
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Mr. Rick Dalton
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Owner of Ralph Stover Dam
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See the project summary for the Darby Barrier Removals to see a representative project completed for this client. Contract value: $75,000

Beth Styler Barry, Executive Director
Musconetcong Watershed Association
P.O. Box 113
Asbury, NJ 08802
See the project summary for Gruendyke Mill Dam Removal to see a representative project completed for this client. Contract value: $45,000

Chet Reed, Vice President
Pequabuck River Watershed Association
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Consultants

Michael Dipple, PE
Principal
L2A Land Design, LLC
60 Grand Avenue
Englewood, NJ 07631
Telephone: (207) 227-0300
See the project summary for West Depot Park Stream Daylighting to see a representative project completed for this client. Contract value: $90,000
Past Performance

For descriptions of past projects that our firm has completed please see Appendix E.

The following are some unforeseen or difficult conditions that Princeton Hydro overcame during projects. All of these can be confirmed by the references that we have supplied for this proposal.

Harry Pursel Dam Breach, Client: Harry S. Pursel, Inc. – During the engineering and permit review period for the breach of this historic structure, the remnants of Tropical Storm Ivan in September 2004 caused over 6 inches of precipitation in the Lopatcong Creek Watershed, resulting in an overtopping and subsequent slip failure of the downstream face of the earthen embankment of the dam. As this portion of the dam was required to remain in place after the engineered breach to protect the owner’s property, Princeton Hydro immediately prepared an emergency repair design for the NJDEP Bureau of Dam Safety. The emergency permit was incorporated into the final permit for the entire project. At the same time as the emergency repair was being designed, Princeton Hydro also presented the idea to the client of applying for additional funds to from the NJDEP Dam Safety Revolving Loan Program to increase the amount approved. The emergency repair permit was incorporated into the overall permit, and the funds were approved in time for the scheduled construction. Princeton Hydro had reacted and adapted successfully to this significant unanticipated condition.

Darby Creek Obstruction Removals, Client: American Rivers – During the design and permit phase of this project, Princeton Hydro several property owner issues arose. Specifically, during the survey and tax parcel investigation, it was found that a portion of the lowest obstruction (remnant bridge piers) and the upper-most dam were owned by entities not originally anticipated. In order to keep the project design and permitting on schedule Princeton Hydro organized meetings to introduce the project and educate the owners of the benefits of the project regarding flood impact reduction, environmental protection and ecological uplift. As with any of our contracts, Princeton Hydro desires to be viewed as part of the team and not just the engineer or consultant, so for these efforts, Mr. Goll, Principal of the firm provided these services pro-bono. Mr. Goll worked with the property owners to develop access easement agreements and obtained such approvals from the lower dam. Currently, receipt of the access easement agreement for the upper dam is imminent.

The client was satisfied with our efforts as our flexibility in addressing the property owner issues, although not in our contracted scope assisted in resolving and minimizing a possible significant delay.

Gruendyke Mill Dam Removal, Client: Musconetcong (River) Watershed Association – The Gruendyke Mill Dam removal had initially been designed integrating a “W” vane and a single cross-vane (vortex vane) to overcome the change in grade from the impoundment to the downstream river reach. The “W” was chose due to a significantly wide sediment delta that was anticipated to create a braided stream following removal. During the dewatering phase of the project, whereby the dam was partially breached for two months prior to the main phase of construction, sediment mobilization was slightly higher than anticipated, narrowing the forming impoundment channel and down-cutting the impoundment bed by one foot greater than the design. Princeton Hydro immediately met with NJDEP Dam Safety and Fish and Wildlife officials and redesigned the vane to consist of a single channel (“vortex” or “cross-vane”) and have a
lower vertex for low flow and fish passage. The result of such adaptive management maintained the integrity of the design and in our professional opinion provided an improvement over the original design. The lessons learned on this dam breach were that 1) any dam removal requires close and continuous attention to allow the reaction of the mobilization of impoundment sediment during the initial breach, 2) that adaptive management is critical in providing the best results possible, and 3) close and continuous contact with regulators and natural resource officials during construction reduces delays and maintains trust and a positive working relationship for future projects.

The client was satisfied as our approach to adaptive management and maintaining regulatory program relationships would facilitate future dam removal projects on the Musconetcong River.
1. PRELIMINARY STUDY DESIGN PROPOSAL

A. PROJECT UNDERSTANDING

A.1 Familiarity with the Pequabuck River and Middle Street Dam

Princeton Hydro’s staff has over ten years of experience working on the Middle Street Dam (aka Bristol Brass Dam) fish passage effort. Our Project Manager, Ms. Laura Wildman, was first introduced to the project in 1999, when she met with Mr. Chet Reed of the Pequabuck River Watershed Association (PRWA) at a presentation he attended on the subject of dam removal. Mr. Reed requested that Ms. Wildman assist the PRWA with investigating the removal of the Middle Street Dam. As a result of the PRWA’s request Ms. Wildman oversaw the limited scope effort to prepare a CT DEP approved sediment Sampling Plan, perform chemical and physical sediment testing and review the testing results against the DEP’s Remediation Standards for Soils, both the Direct Exposure Criteria and the Pollutant Mobility Criteria. Later, as Chief Engineer for American Rivers, a national environmental advocacy group, Ms. Wildman remained involved in the effort and assisted in directing the PRWA to potential funding sources. Ms. Wildman worked with PRWA to try to build a partnership with CT DEP Fisheries, the NOAA Restoration Center and the Farmington River Watershed Association. In addition, Ms. Wildman was one of the reviewers of the American Rivers-NOAA Community Based Restoration Program Partnership grant application that was submitted by the PRWA to American Rivers in 2005. Ms. Wildman has attended numerous site visits over the last 10 years with a wide variety of project partners in order to help further progress this highly beneficial effort.

Another Princeton Hydro staff member familiar with the Pequabuck River is Mr. Paul Woodworth, Staff Scientist and fluvial geomorphologist. He became familiar with the Pequabuck River as a project coordinator for the Connecticut River Watch Program (CRWP) while working at the Connecticut River Coastal Conservation District. Mr. Woodworth worked with CCRPA staff and Pequabuck River Watershed Association volunteers to survey the watershed and identify water sampling locations on the Pequabuck River, Copper Mine Brook and Poland River. In addition, Mr. Woodworth helped recruit, train and equip volunteers for water sampling during the summers of 2002, 2003, and 2004 and helped compile and interpret data in CRWP summary reports that were used to develop the State of the Watershed Report and the Pequabuck River Watershed Management Plan.

Princeton Hydro’s staff has also worked throughout the greater Farmington River Watershed, including projects assessing recreational access, restoring streambanks, conducting field research linking hydro-modification to decreased geomorphic complexity, setting monumented cross-sections, completing pebble counts, and inventorying large woody debris (LWD) accumulations. Princeton Hydro was recently selected to complete design of two fish passage restoration efforts on the Farmington River by the Farmington River watershed Association.

Princeton Hydro is fully familiar with the Pequabuck River the Bristol Brass Dam, and intimately understands the needs for fish passage and local issues regarding this project.

A.2 The Dam & Its Impoundment

The Middle Street Dam, aka the Bristol Brass Dam as identified by the CT DEP Dam Safety’s inventory of dams, is a seven (7) foot high concrete ogee spillway that extends 95 feet, from bank to bank, across the Pequabuck River just upstream of the Middle Street Bridge in Bristol, Connecticut. The dam’s impoundment has entirely filled with coarse grained sediment and the impoundment typically only has water depths of 1 to 2 feet. Although under low flow conditions it appears the impoundment only extends upstream 360 feet, a closer investigation of the existing FEMA water surface profile model for this reach of the river shows that the dam’s backwater impact may reach the Downs Street or Memorial Boulevard bridges under higher flows and flood conditions. However, confirmation of these conditions will require additional hydraulic modeling to confirm this observation. A paper copy of the FEMA water surface profile along with our initial assessment of the maximum potential reach of impact due to dam removal is attached to this proposal.
A.3 Impounded Sediment

The primary issues at the Middle Street Dam relate to the quality of the impounded sediment, as well as its potential mobility if the dam were to be removed possibly impacting infrastructure within backwater area. An earlier sediment sampling effort behind the dam completed in 1999, lead by our proposed Project Manager, revealed that multiple polycyclic aromatic hydrocarbon (PAH) compounds exceeded the Pollutant Mobility criteria for GA, GAA, and GB areas and the Direct Exposure criteria for residential areas as per the CT DEP’s Remediation Standards for Soils. These criteria can be used to determine proper disposal sites and as an indicator of the extent of contamination. PAH compounds are formed when organic material burns, and in materials such as asphalt, coal tar pitch and creosote. In addition to PAH’s, the Total Petroleum Hydrocarbons (TPH), which is a test procedure to detect petroleum based products in general also exceeded the Pollutant Mobility criteria for GA, GAA, and GB areas and where found in levels in excess of the Direct Exposure criteria for industrial areas. The contaminant levels found during the mass-based analysis for metals led DEP to request additional TCLP testing, which concluded that both Cadmium and Lead exceeded the Pollutant Mobility criteria for GA and GAA areas. These results are not especially surprising given the industrial history of the Pequabuck River and its highly developed watershed in the area of the dam.

Additional consultation will now be needed with CT DEP to see if they wish to have CCRPA further sample and analyze the impounded sediment, before a sediment management plan can be developed for the project if the dam is to be removed.

In addition to the potential mobility of contaminated sediment, the quantity of sediment that could potentially be mobilized still needs to be determined, both to estimate the quantity of material that may require dredging/excavation prior to dam removal, but also to determine the extent of scour that could impact adjacent infrastructure, such as the existing retaining walls along the streambank.

Multiple sediment management options will need to be investigated if the dam is removed including full and partial dredging, stabilization of sediments in place, natural erosion downstream, a staged sediment release, on-site disposal, and off-site disposal. A fishway option will eliminate many of the sediment management issues, but will have additional issues relating to fish passage efficiency, structural stability against this highly dynamic system which transports very large sediment and debris, and long term maintenance of both the fishway and the dam.

A.4 Bedrock

The 1999 borings showed depths of impounded sediment 2 to 3 feet below the surface upstream of the dam. The dam is 7 feet high. We plotted the 1999 sediment borings on the FEMA water surface profile and believe there is a high likelihood that there is a bedrock ledge below the dam. This is further supported by the two bedrock outcrops visible along the two road cuts on both sides of the dam, as seen on the aerial mapping used to delineate our areas of survey. The existence of bedrock will mean that fish passage post-dam removal will need to be carefully assessed, but also that there is likely less impounded sediment behind...
the dam than originally thought. If confirmed by our further proposed borings/test pits, this will help to significantly reduce the cost of the project.

A.5 Infrastructure

Infrastructure stability post dam removal is a critical issue that will need to be addressed in order to assess the feasibility of removing the Middle Street Dam. The infrastructure most likely impacted by potential dam removal includes the existing retaining wall along the northern stream bank just upstream of the dam, the extension of this retaining wall upstream currently under construction, and the concrete encased gas line upstream of the dam (that currently acts as another small dam). In addition, there are three (3) bridges within the potential area of impact that will need to be investigated, as well as multiple outfalls, and the concrete abutments of the dam that are continuous with the abutments of the downstream Middle Street Bridge. However, it is less likely that these structures will be impacted than the retaining walls against the roadway. The bridge immediately downstream of the dam appears to already act under submerged orifice conditions during high flow, as is evident from the debris observed on the bridge and out conversations with nearby residents. Removal of the dam will not alleviate this existing bridge capacity issue.

The existing “floating foundation” retaining wall upstream of the Middle Street Dam.

The foundation system of the retaining wall was previously unknown in the past experience of the proposed Project Manager, Ms. Wildman; however during the pre-proposal site meeting for this project, she was able to view a full cross-section of the retaining wall, as a result of the ongoing road work in the area. Following the pre-proposal site visit, Ms. Wildman spoke with the site foreman from Manafort Brothers and visited their central command field office for the Route 72 road work. Ms. Wildman obtained the depth of the existing retaining walls base, as well as design plans and details for the retaining wall currently under construction. The existing wall is a “floating” retaining wall with little footing at a relatively shallow depth compared to the streambed elevation. This retaining wall will likely require additional stabilization if the dam is removed. The retaining wall under construction is a precast T-WALL construction. This more modern design is supported by stems extending into the earth below Riverside Ave, and will likely need rock or rip rap scour protection at its toe.

In addition to this rare opportunity to see the full cross-section of the existing retaining wall, our Project Manager also learned through the Manafort Brothers’ site foreman that the concrete encased gas line was to be capped and decommissioned. If this gas line is decommissioned, then there is a possibility that the CCRPA work with the gas company to remove this gas line, within the banks of the river, prior to a dam removal or fish passage at the Middle Street Dam. If not, we have included an optional task to provide modification or removal of the gas line as part of the Preliminary Design for this project. The gas line crossing has become an increasingly larger barrier to fish passage throughout the 10 years that we have been watching this site. It is likely that it was further exposed during the large flush of sediment through the system during the October 2005 and May 2006 flooding events in Connecticut. Evidence of this is suggested by a site visit to the Middle Street Dam that our proposed Project Manager attended following the 2005 flood. During that visit it was noted that the sediment/cobble deposited below the Middle Street Bridge had significantly increased in size. That deposited sediment load has persisted since 2005 and does not appear to have diminished in size in recent years.
The concrete encased gas line upstream of the Middle Street Dam.

The Route 72 design plans, that we were able to obtain for the area, also include one boring that was conducted along Riverside Ave on the stream bank in our project reach, and multiple test pits. We were able to obtain the boring log and have a request into Manafort Brothers for the test pit logs. The boring was relatively shallow although blow counts, strata changes, and visual soil characteristics were logged.

A-6. Site Access

Access to the site may also provide a challenge. The retaining wall along the northern bank likely precludes access to the dam, other than by crane. The southern bank is the more likely access route, however, it is dominated by a CL&P right of way and overhead wires. It is also the only bank that is fully vegetated, and the design will have to ensure that removal of any streambank vegetation is kept to an absolute minimum, to help preserve in stream habitat and the vegetative riparian buffer.

A.7 Fish Passage

A wide variety of resident and diadromous fish have the potential to get to the base of the Middle Street Dam, including sea lamprey, American shad, alewife, blueback herring, American eel, and resident trout. This means that multiple riverine and diadromous fish species will benefit from the removal of the Middle Street Dam or the construction of a Denil fishway on the dam. No other dams exist on the Pequabuck River downstream of the Middle Street Dam, however two partial obstructions to fish passage exist and one large dam with a working fish ladder on the Farmington River downstream of its confluence with the Pequabuck. The large dam is the Rainbow Dam and it is the first dam on the Farmington River. Its fishway is actively maintained and managed by the CT DEP. The second structure on the Farmington is the breached Spoonville Dam, which is passable under many flows, however, may be a partial or full barrier to some migratory fish under certain flows. The final structure before the Farmington River’s confluence with the Pequabuck River is the Winchell-Smith Dam, which is a low head dam and likely only creates a partial barrier to fish passage. Princeton Hydro is currently working with the FRWA and CT DEP to fully restore unobstructed fish passage at the Spoonville and Winchell-Smith Dams and it is likely that these two downstream fish passage enhancement projects will be fully constructed prior to the removal or modification of the Middle Street Dam, ensuring full unobstructed access to the site.

Princeton Hydro has extensive background in fish passage throughout the greater northeast and specifically in Connecticut. We have multiple fisheries biologists and fisheries engineers on staff, including the proposed project manager, who specializes in fish passage restoration projects. Ms. Wildman, the proposed Project Manager has completed multiple successful fish passage and dam removal projects in Connecticut, working closely with the CT DEP Fisheries Division on all of them, and leading the projects through the required Connecticut and Federal permitting. She has been an active member of the Connecticut Riverine Migratory Corridor Team, lead by CT DEP, since its inception in 2001, and has provided input on numerous fish passage and barrier removal projects throughout the state, while Chief Engineer with American Rivers.

All assessment of target fish species swimming abilities, passage assessment, and layout of a fishway of dam removal is not feasible will be closely coordinated with CT DEP Fisheries Division, as have been all of our previous Connecticut fish passage projects.

A.8 Hydrology & Hydraulics

Princeton Hydro has reviewed the existing FEMA water surface profiles for the Pequabuck River, as well as the flow data for the recently decommissioned Pequabuck River USGS gage, located just 1.5 miles downstream of the Middle Street Bridge, with a record extending from 1941 to March of 2009. The stream reach within the potential area of impact is steep and the flows are highly impacted by watershed development.
Princeton Hydro has proposed using the existing USGS gage record, StreamStats, and the existing FEMA water surface profile model to assess the feasibility of dam removal and investigate fish passage options, in order to keep the cost of this Alternatives Analysis to a minimum for the CCRPA.

A-9 Coordination with DOT, CL&P, & Gas Company

Transparent and regular communication with the dam owner, CT DOT, as well as CL&P and the gas company will be critical to the success of this project. Princeton Hydro regularly manages complex dam removal and fish passage projects with multiple project partners, regulatory agencies, concerned stakeholders and cautious dam owners. We fully understand the issues involved and can assist the dialogue greatly by giving similar examples from other successfully completed projects to help address the concerns of all stakeholders. With past involvement in well over 100 dam removal and fish passage projects across the country our experience and insight is unparalleled in this field.

A.10 Funding Opportunities

Princeton Hydro has regularly assisted our clients in identifying and obtaining funding from numerous state and federal funding sources for ecological restoration. We have secured over $300,000 for individual dam removal projects. Our project team is very familiar with the wide variety of funding opportunities available and their granting requirements. Our Project Manager lead the AR-NOAA Community Based Restoration Program Partnership Grant effort throughout New England and lead the Northeast Stream Barrier Task Force for 8 years, as the Chief Engineer at American Rivers. She has multiple close contacts within the federal granting agencies, and can easily direct the CCRPA to suitable grant sources and their primary contacts.

We have already forwarded along multiple potential funding sources to CCRPA in an e-mail sent directly after the pre-bid meeting, however we have also summarized some of the more likely potential funding sources for this project below.

- NOAA Open Rivers Initiative: funding range $30,000 to $1,000,000
- American Rivers River Restoration Grants: funding range $75,000 for study & design and $100,000 for construction (can apply for multiple dam removal project phases)
- American Sportfishing Association's FishAmerica Foundation Grants: funding range $5,000 to $50,000
- NFWF Long Island Sound Futures Fund Grants: funding range $1,000 to $150,000
- WHIP funding through NRCS
- Coastal America
- Corporate Wetland Partnership
- Military Readiness Initiative – provides complementary construction services

The Middle Street Dam (aka the Bristol Brass Dam) on the Pequabuck River in Bristol, CT

CCRPA is in a unique position of having already procured a large state grant to initiate the Middle Street Dam fish passage and riverine environment enhancement project. 100% of that state grant should be eligible for federal match if applications for federal grants are submitted promptly. Therefore, it is our opinion that CCRPA would qualify for at least another $90,000 for this project.

It is also our opinion that the Middle Street Dam project would also rank very high for most Federal fish passage and dam removal linked grant sources because of the diadromous fish species that would benefit from the project, and the strong support for this project from the, CT DEP Fisheries Division.
B. SCOPE OF WORK

The following scope has been organized in to four sections as defined by the RFP, including a Draft Alternatives Analysis, a Final Alternatives Analysis, an Engineering Design of the Preferred Alternative, and a Final Report and Transfer of Data. In addition a task for Sampling Event(s) is included, as requested in the RFP, but has been designated an Optional Tasks on a per sample basis, since at this early stage it is not yet certain whether additional sediment collection and testing will be required by CT DEP. Upfront coordination, field work, survey, and analysis will be required in order to complete all four sections of the scope of work and has therefore been included under the first scope section, Draft Alternatives Analysis.

1.0 Draft Alternatives Analysis

1.1 Coordination

1.1.a Kick Off Meeting

It is anticipated that the Project Manager from Princeton Hydro will attend one (1) kickoff meeting with representatives of the Central Connecticut Regional Planning Agency (CCRPA), Pequabuck River Watershed Association (PRWA), Farmington River Watershed Association (FRWA), the Connecticut Department of Environmental Protection (CT DEP), and the Connecticut Department of Transportation (CT DOT), to discuss and confirm the understanding of the project requirements and to establish the following information for the successful completion of the project:

- Goals and objectives of the project
- Establish points of contact
- Review project schedule & deliverables
- Obtain any existing information from the client that may be available

Princeton Hydro will gather all relative project data and mapping from the project partners, the City of Bristol, and the Department of Transportation (CT DOT), the owners of the dam. Princeton Hydro will obtain a digital copy of the existing FEMA HEC-RAS model. In an effort to keep project costs down Princeton Hydro will make all efforts to use already existing data where possible.

**Deliverables:** The deliverables for this task will include requested changes to the project schedule.

1.1.b Project Coordination

Princeton Hydro will coordinate the field work, site access, sediment collection (if needed), alternative analysis and design process closely with CCRPA, CT DOT, the City of Bristol, CT DEP, and the other project partners. It is anticipated that Princeton Hydro will participate in four (4) progress conference calls with the client, as well as make ourselves available for consultation by e-mail or phone. The conference calls will be conducted at key points identified during the project duration and update the project partners on the projects progress, in addition to the designated in-person project meetings listed in this scope of work. Feedback from these calls will be incorporated into the alternatives analysis, design plans, and design report.

All efforts will be made to regularly communicate with the designated contact person at CCRPA. Critical issues and design concepts will be discussed prior to forming any final recommendations or design plans. Princeton Hydro believes in making our projects a team effort, utilizing the expertise of the project partners, and providing strong project management and flexibility in our project approach, such that the best possible solution can be implemented for the project.

1.2 Field Work and Survey

1.2.a Field Investigation

Princeton Hydro will complete a geomorphic stream investigation on the Middle Street Dam site, extending from 390 feet below the Middle Street Dam to just above the Downs Street and Memorial Boulevard Bridges. Princeton Hydro’s fluvial geomorphologist will wade the entire length of the reach, while characterizing the
observed substrate, conducting pebble counts, investigating the large area of sediment/cobble deposition downstream of the Middle Street Bridge, taking project photographs, identifying any potential project issues, investigating probable paths of fish migration downstream of the dam, and identifying infrastructure that may become subject to scour if the dam was removed.

1.2.b Topographic and Bathymetric Survey

GM2 will perform topographic and bathymetric survey and prepare a base map for a 3.5 acre strip of river corridor extending from 390 feet below the dam to the downstream face of the Downs Street Bridge, at the upper-most likely end of the Middle Street Dam’s impoundment. The width of the surveyed corridor will range from 85 feet (downstream of the Middle Street Bridge) to between 150 and 190 feet upstream of the Middle Street Bridge, as seen on the Area of Proposed Survey Map included in this proposal. The area of survey was selected such that current area of downstream deposition can be investigated, the full length of the potential impoundment during storm flow events can be investigated, the gas line obstruction can be included in the preliminary design, and the existing retaining walls and retaining walls currently-under-construction along the northern streambank can be assessed for scour. In addition, we included the potential Brownfield site along Downs Street, in the event that the riverside Memorial Boulevard Park may someday be extended to encompass this site.

The topographic and bathymetric contours will be at 1 foot intervals, and the mapping will include observed utilities and infrastructure within the survey limits. Wetland flagging will be delineated if the wetland delineation task is selected from the list of optional tasks included in this proposal.

**Deliverables:** The client shall be entitled to one (1) round of review and edits of the project base mapping. The client shall receive one (1) reproducible hard copy and one (1) electronic copy via email or CD of the project base mapping.

1.3 Sediment Analysis and Management

1.3.a Coordination Meeting with CT DEP

Princeton Hydro will coordinate a meeting with Water Planning and Standards at CT DEP to discuss the potential need for additional sediment testing, and, if needed, their preferred procedures to include in the Sediment Sampling Plan. In addition, potential methods for determining impounded sediment depth and depth to bedrock within the impoundment will be discussed, such as the use of a tripod mounted mechanical hammer or excavated test pits.

If after consultation with the CT DEP it is determined that further qualitative sediment testing be conducted, Princeton Hydro can prepare a DEP approved Sediment Sampling Plan, conduct chemical testing on a DEP specified number of additional sediment samples, and provide analysis of the testing results, as described in Optional Task 1, a though e, on a per sample basis.

1.3.b Mechanical Sediment Probes

Princeton Hydro will characterize and quantify the extent of impounded sediment behind the Middle Street Dam, and determine the depth to original channel bed or underlying bedrock. The Middle Street Dam is currently filled to capacity with impounded sediment. Only a shallow, one (1) to two (2) foot, pool of water exists above the dam. The majority of impounded sediment is coarse material with sands and gravels imbedded within extensive large cobbles. Our Project Manager’s previous experience probing and sampling sediment at this site confirm that hand probes are not possible within this impoundment. Princeton Hydro proposes to investigate impounded sediment depths by probing the material with a tripod mounted, mechanical drop hammer or by excavating test pits along the impoundment length with a small mechanical excavator. The final preferred method will be selected after consultation from CT DEP, Water Planning and Standards. For the purpose of this proposed scope we have estimated one (1) full work day of sediment depth investigation utilizing mechanical probing equipment and/or a small excavator.
1.3.c  Physical Sediment Characterization

In the previous Sediment Sampling Report prepared for the Middle Street Dam in 1999, one sample was obtained with a grain size analysis conducted. For this contract, during the mechanical probing and/or test pits task, Princeton Hydro will collect two (2) additional sediment samples for further sediment testing, to better assess the physical character of the impounded sediment, such as composite grain size distribution, organic content, and moisture content. These sediment samples will be forwarded to Princeton Hydro’s in-house AASHTO certified and ASTM compliant geotechnical laboratory for testing. These results will be utilized in conjunction with the results of our geomorphic assessment of the site to better assess the potential for mobility, channel stability, and the potential for scour on upstream and downstream infrastructure such as bridges and the stream-side retaining walls. The results will also help us determine likely consolidation rates if on-site disposal is utilized and the viability of the sediment for vegetation growth following removal of the dam.

1.3.d  Assessment of Scour for Retaining Walls and Bridges

Princeton Hydro will utilize the flow quantity, water surface elevation, velocity and shear stress results of the hydrologic and hydraulic analysis of proposed conditions along with the results of our physical sediment testing/characterization and geomorphic assessment to assess the potential for increased scour as a result of dam removal and to prepare preliminary design of channel and infrastructure remediation measures, if needed, to minimize scour to infrastructure if the dam removal option proves to be the preferred alternative. Structures likely to be assessed include the existing stream-side, floating foundation, retaining wall just upstream of the dam, the precast T-Wall retaining wall currently under construction just upstream of the existing stream-side retaining wall, the Middle Street Bridge just downstream of the bridge, and the Downs Street and Memorial Boulevard Bridges upstream of the dam, if determined to be within the area of impact for dam removal. To assess dam removal feasibility and for the purpose of estimating the fee for this scope of work, it is anticipated that a formal, DOT approved, scour analysis of each of these structures will not be needed at this time.

In addition to the assessment of the potential for increased scour at critical infrastructure, Princeton Hydro will investigate the potential for dam removal to impact the existing sediment/cobble deposit condition downstream of the Middle Street (Route 229) Bridge, as requested in the RFP.

1.3.e Sediment Management and/or Disposal Plan

Princeton Hydro will prepare a Sediment Management and/or Disposal Plan discussing the impounded sediment quantity, physical characteristics, likelihood for downstream impact if allowed to mobilize downstream, sediment quality (if tested), and options for sediment management and/or disposal, such as downstream mobilization, full or partial dredging, stabilization of sediment in-place, on-site disposal or dewatering, and off-site disposal. The Sediment Management Plan will be incorporated into the final Preliminary Design Report, as prepared for Task 4.0.

1.3.f  Follow-up Meeting with CT DEP

Upon completion of the geomorphic assessment, physical sediment testing, mechanical probes/test pits, initial scour assessment, and additional chemical sediment testing, if determined necessary by DEP and included in the scope of work, Princeton Hydro will coordinate a second meeting with Water Planning and Standards at CT DEP to discuss the results of the sediment investigation and our recommendations for sediment management/disposal, before finalizing the Sediment Management/Disposal Plan.

1.4 Hydrology and Hydraulics

1.4.a Hydrologic Analysis

In preparing this proposal Princeton Hydro completed a review of the available hydrologic and hydraulic data for the Pequabuck River in or near the reach of interest. There is no active gage on the Pequabuck, however there was a long term USGS flow gage that functioned from 1941 to March of 2009 (gage no. 01189000 - Pequabuck R at Forestville, CT). Princeton Hydro will utilize the data from this gage along with USGS StreamStats to determine the flows suitable to assess this fish passage project. Additionally, Princeton Hydro

StreamStats is a Web-based Geographic Information System (GIS) tool that allows users to obtain streamflow statistics, drainage-basin characteristics, and other information for user-selected sites. StreamStats estimates the 2-, 5-, 10-, 50-, 100-, and 500-year recurrence interval floods, which have the probability of exceedance in any single year of 50, 20, 10, 2, 1, and 0.2 percent, respectively. Equations also are included for estimating the 7-day 10-year; 7-day 2-year; 30-day 10-year; 30-day 2-year; and the 90-day 10-year low flows, the 10-year, 25-year, and 50-year base flows, and the harmonic mean flow, and the mean annual flow. The results of the hydrologic analysis will be included in the final Preliminary Design Report, as prepared for Task 4.1.

1.4.b Hydraulic Analysis

Princeton Hydro reviewed the available FEMA data for the subject area and determined that a previous water surface profile model has been prepared for this stream reach. We therefore recommend utilizing the existing FEMA water surface profile model to analyze changes in water depth, channel width, velocity, and shear stress/scour associated with dam removal. We have assumed for the purpose of our cost estimate that this model is digitally available and is in HEC-2 or HEC-RAS format. If the FEMA model is in HEC-2 format it will be converted to HEC-RAS prior to running the existing and proposed conditions. The results of the hydraulic analysis will be included in the final Preliminary Design Report, as prepared for Task 4.1.

Deliverables: The client shall be entitled to one (1) round of review and revisions to the water surface profile model. The client shall receive one (1) electronic copy of the final HEC-RAS model.

1.5 Draft Sequential Alternative Analysis

1.5.a Outline of Alternatives Analysis Process

Princeton Hydro will prepare a Study Design which details the process for the Alternative Analysis, as requested in the RFP, and submit the study outline to the CCRPA for review and approval by the project partners. The Alternatives Analysis will assess the critical project issues such as sediment quantity, quality, and management, infrastructure scour, potential fish passage concerns with the upstream gas line crossing (if still in existence by the time of the analysis), the underlying bedrock configuration, comparative costs, the site construction and testing access, the presence of threatened or endangered species within the impoundment or downstream reach, the potential for historic concerns, dam owner concerns, and the pass ability of the proposed site configuration for the targeted fish species. These critical issues will be discussed in the Alternatives Analysis and compiled into a summary table, highlighting the projects potential pros and cons, which will assist the CCRPA and project partners in coming to a final decision as to whether dam removal is feasible. If determination is made by Princeton Hydro, CCRPA, and the project partners that dam removal is not feasible, then the Preliminary Design will focus on the Denil fish ladder option.

Deliverables: The client shall be entitled to one (1) round of review and revisions to the Study Design and to one (1) hard copy and one (1) electronic copy of the revised Study Design.

1.5.b Endangered, Threatened & Special Concern Species Presence Determination

Princeton Hydro will consult with CT DEP’s Natural Diversity Data Base (NDDB) to request a determination as to the presence of state and federal listed endangered, threatened and special concern species within the dam’s impoundment or in the river reach below the dam.
1.5.c Relative Cost Comparison

Princeton Hydro will complete a relative cost comparison, reflective of the feasibility level of analysis, for the alternatives proposed in the Alternatives Analysis. These general costs will be completed to compare the proposed alternatives based on relative costs, at a level of detail commensurate with the level of assessment. The cost comparison will be included in the Alternative Analysis. A more detailed opinion of cost will be prepared for the proposed alternative and included in the Preliminary Design Report, Task 4.1.

1.5.d Draft Sequential Alternatives Analysis

Princeton Hydro will prepare sequential alternatives analysis that first looks to assess whether full dam removal is feasible, before further investigating other alternatives for fish passage at the site, such as partial dam removal or the installation of a Denil fishway. If full dam removal is determined to be feasible then the other options will not be investigated in any depth, and we will proceed with the Preliminary Design of the dam removal option. If full dam removal is not feasible, then a partial-width dam removal or dam crest lowering will be investigated. If no form of dam removal is feasible, then a Denil fishway will be investigated and proceed to Preliminary Design. In addition the “no action” alternative will be discussed for comparison purposes.

As previously described, the Alternatives Analysis will assess the critical project issues such as sediment quantity, quality, and management, infrastructure scour, potential fish passage concerns with the upstream gas line crossing (if still in existence by the time of the analysis), the underlying bedrock configuration, comparative costs, the site construction and testing access, the presence of threatened or endangered species within the impoundment or downstream reach, the potential for historic issues, public safety, dam owner concerns, and the passability of the proposed site configuration for the targeted fish species. The critical issues will be discussed and compiled into a summary table, highlighting the projects potential pros and cons. Assessment of feasibility will be analyzed based on the potential for the alternative to meet all of the project goals, at a projected project cost that CCRPA feels they could “reasonably” find funding for.

**Deliverables:** The client shall be entitled to one (1) hard copy and one (1) electronic copy of the Draft Sequential Alternative Analysis, for their review.

1.5.e Alternatives Analysis Review Meeting

Upon completion of the Draft Alternative Analysis, Princeton Hydro will coordinate an alternatives analysis review meeting with CCRPA, the project partners and the dam owner (CT DOT). The goal of this meeting will be to review the findings of the Draft Alternatives Analysis and determine the project partners’ views on the feasibility of dam removal at the Middle Street Dam, before conducting the Public Stakeholder Meeting. In addition the format for the Public Stakeholders Meeting will be discussed, along with a strategy on how to proceed.

2.0 Final Alternatives Analysis

2.1 Public Stakeholder Meeting

Princeton Hydro will prepare for and participate in one (1) in-person meeting in which project stakeholders other than CCRPA, PRWA, FRWA, CT DEP, and DOT can review the results of the Draft Sequential Alternatives Analysis (or dam removal feasibility assessment if dam removal is determined feasible) and voice questions or comments for response. Reasonable feedback from the meeting will be incorporated into the Final Alternative Analysis and the Preliminary Design Plans.

The recommendations for inclusion and subsequent changes to the conceptual and engineering design plans, as requested by the stakeholders and project partners, shall be limited to the hours and costs anticipated and presented in this proposal.

2.2 Final Alternative Analysis

The Final Alternative Analysis will be prepared to summarize the findings of the draft sequential alternatives analysis and will include recommendations as a result of public and partner input, however, the
recommendations for inclusion and subsequent changes to the sequential Alternative Analysis, shall be limited to the hours and costs anticipated and presented in this proposal, or negotiated prior to initiation of tasks outside of this scope.

With any dam removal feasibility there is the potential for unknowns that cannot be anticipated at the time of proposal and before discussion has been initiated with project partners, the community and the appropriate regulatory agencies. As such, we have included a list of potential Optional Tasks that CCRPA and project partners may wish to consider for inclusion in the project scope of work.

Deliverables: The client shall be entitled to one (1) hard copy and one (1) electronic copy of the revised Final Alternative Analysis.

2.3 Alternative Selection Meeting

Upon completion of the Final Alternative Analysis, Princeton Hydro will coordinate one (1) in-person meeting with CCRPA, the project partners, and the dam owner (CT DOT) to make a final determination of which alternative will proceed to preliminary design based on the results and recommendations in the Final Alternatives Analysis.

2.4 Determination of Future Permit Needs

Once a determination of the preferred method for fish passage has been agreed upon for the Middle Street Dam site, Princeton Hydro will consult with CT DEP and the City of Bristol to determine the future permitting needs for the selected approach. The results of this determination will be included in the final Preliminary Design Report, as prepared for Task 4.1.

3.0 Engineering Design of Preferred Alternative (Preliminary)

3.1 Preliminary Design for Dam

Princeton Hydro will prepare preliminary engineering design plans of the preferred alternative and provide the plans to CCRPA, the project partners, and DOT for one (1) round of review and make any revisions required by CCRPA, if in accordance with our best engineering professional judgment and within the scope of work.

If dam removal is feasible, it is anticipated that the preliminary design plans will include plan sheets for: existing conditions; proposed conditions, and will include a plan view, a profile, cross-sections (as needed), site access, staging areas, construction sequencing, extent of dam removed, sediment management, and proposed scour protection for impacted infrastructure, such as the upstream retaining walls and/or the bridges. Potential design recommendations for the modification or removal of the upstream gas line have been included as Optional Task 3, since it is hoped that CCRPA might be successful in having the Gas Company remove the gas line from the river as part of their decommissioning of the line, prior to the actual construction of this fish passage project.

If a Denil fishway is the preferred alternative, it is anticipated that the preliminary design plans will include plan sheets for: existing conditions; proposed conditions, and will include a plan view, a profile, cross-sections (as needed), site access, staging areas, construction sequencing, entrance and exit details.

The Preliminary Design Plans will be prepared with enough detail to allow for a preliminary engineering estimate of project construction costs, however it is anticipated that the Preliminary Design Plans will need to be further refined (i.e. wetland boundaries added, water control procedures determined with CT DEP regulatory input, etc.) in a future contract for the purpose of obtaining permits for the project. It is part of Princeton Hydro’s design philosophy to create user-friendly design plans, easily read and understood by clients, partners and regulators.

Deliverables: A Preliminary Design Plan set in digital format with one (1) iteration of a review and edits of the preliminary design.
3.2 Preliminary Design Review Meeting

Upon completion of the project partner review of the Preliminary Design Plan set and the Preliminary Design Report and Cost Opinion prepared for Task 4.1, Princeton Hydro will coordinate one (1) final in-person review meeting with CCRPA, the project partners, and the dam owner (CT DOT) to discuss the Preliminary Design Plans and Report.

3.3 Finalized Preliminary Design Plans

The Preliminary Design Plans will then be revised and finalized based on the comment and recommendations received by CCRPA, project partners, and DOT at the preliminary design review meeting.

**Deliverables:** Upon completion of the revisions to the Preliminary Design Plans, eight (8) hard copies of the finalized Preliminary Design Plan set will be provided to CCRPA for distribution to project partners and DOT, and one (1) digital copy of the plan set via FTP site or CD.

4.0 Final Report and Transfer of Data

4.1 Preliminary Design Report

A final Preliminary Design Report will be prepared to summarize the field work, sediment testing, hydrologic and hydraulic analysis, assessment of scour, and sequential alternatives analysis that went into the preparation of the Preliminary Design Plans. In addition Princeton Hydro will transfer the collected and developed project data to the CCRPA in a format (either hard copy and electronic form) agreed upon between CCRPA and Princeton Hydro.

The report will include:

- An executive summary describing the background, scope, purpose, study design, field methods and results of the study.
- An introduction including project background, scope, the purpose and objectives of the study and a description of how the study was conducted.
- A description of the study design and how it was developed, including methods used, final sampling locations and number of samples, explanation of any differences between the final sampling and the Sediment Sampling Plan (if required), and any significant problems or findings in the study design.

If any additional analysis outside of this Scope of Work is needed to implement final design and obtain permits, such as ecological inventories or more detailed hydrology and hydraulic analyses, Princeton Hydro can prepare a scope and fee estimate for the additional work for FRWA and complete the work upon request.

**Deliverables:** Eight (8) paper copies and one (1) electronic copy of a Draft Preliminary Design Report as requested by the Request for Proposal, with one (1) iteration of review and edits, as discussed at the preliminary design review meeting. After revisions have been completed, eight (8) hard copies of a finalized Preliminary Design Report will be provided to CCRPA for distribution to project partners and DOT, and one (1) digital copy via ftp site or CD. In addition any remaining project data will be transferred to the CCRPA, in either hard copy or electronic format.
OPTIONAL TASKS:

Optional Task 1: Sampling Event (per sample)

Opt.1.a DEP Approved Sediment Sampling Plan (per sample)

Princeton Hydro will develop a Sediment Sampling Plan in coordination with CT DEP Water Planning and Standards. The Sediment Sampling Plan will describe the proposed locations, collection, testing and analysis methods, and quality control protocols for the qualitative sediment sampling. In addition it will describe the type, format and content of the analysis to be developed in report format upon completion of the analysis. It will describe how the data will be organized and formatted into spreadsheets compatible with Microsoft Office system software, along with item description descriptions, and any special characteristics of the dataset. The Sediment Sampling Plan will also describe the proposed method of coordination with the CT DEP and the proposed method of receiving agency approval of the plan.

Deliverables: Two (2) hard copies and one (1) electronic copy of a Sediment Sampling Plan to be given to CT DEP Water Planning and Standards and CCRPA, with one (1) iteration of review and edits of Sediment Sampling Plan. Two (2) copies and one (1) electronic copy of a finalized Sediment Sampling Plan to be given to CT DEP Water Planning and Standards and CCRPA.

Opt.1.b Sediment Sampling Collection (per sample)

If requested, Princeton Hydro will collect sediment samples while conducting the mechanical probes and/or test pits proposed in Task 1.3.b Mechanical Sediment Probes. The samples will collected and preserved in accordance with standard testing protocols, the CT DEP approves Sediment Sampling Plan prepared for Optional Task 1.a. All efforts will be made to take the samples from the finer grained sediment contained behind the dam.

The previous sampling of the dam site in 1999 found multiple polycyclic aromatic hydrocarbon (PAH) compounds, total petroleum hydrocarbons (TPH), and Cadmium (Cd) and Lead (Pb). It is anticipated that additional sampling will find the same and potentially related contaminants within the impoundment. These pollutants appear to be typical constituents of urban and industrial stormwater runoff. If CT DEP requires additional sampling, Princeton Hydro will recommend that a subsurface downstream sample be taken in an area with fine deposits, to better compare the impounded sediment quality with background contaminant levels within the river.

Opt. 1.c Sediment Sampling Chemical Testing (per sample)

The sediment samples will forwarded to a Connecticut certified laboratory for contaminant testing. It is anticipated, for the purpose of our estimated fee for this task, that the samples will require a mass-based analysis for volatile organic compounds, semi-volatile compounds, inorganic (metals), pesticides, PCB’s, and total petroleum hydrocarbons (TPH); similar to the 1999 sediment samples analyzed for the Middle Street Dam site (aka Bristol Brass Dam).

The specific chemical parameters and testing methods likely to require testing based on CT DEP’s regulations concerning remediation standards for direct exposure criteria and pollutant mobility criteria for soil, and the 1999 sediment sampling approved by the DEP for this site are:

- Mass-Based Analysis for 15 DEP Metals (Prep: EAP Method 3050; Analysis: EAP Methods 6000, 7000, and 471)
- Hexavalent Chromium (EAP Method 218.4)
- Cyanide (EAP Method 3352)
- Total Petroleum Hydrocarbons (EAP Method 8015B)
- Semi-volatile Organics (EAP method 8270B)
- Volatile Organic Compounds (EAP Method 8260)
- Pesticides (EAP Methods 8081)
- Herbicides (EAP Method 8151)
- PCB’s (EAP Method 8082)

However, since previous testing has already narrowed down the likely contaminants within this reach of the Pequabuck system, there is a chance that consultation with CT DEP may result in further narrowing the suite of contaminants that need to be tested on future samples, if additional testing is required. In that case, Princeton Hydro will work with CCRPA to revise our scope and fee for this task.

**Opt.1.d TCLP/SPLP Testing (per sample)**

For the 1999 sediment sampling, previously conducted on this site, CT DEP had required TCLP (Toxicity Characteristic Leaching Procedure) analysis be conducted on the sediment sample with the highest concentrations of contaminants based on the initial mass-based analysis of the samples, if the initial mass-based analysis for the 15 DEP metals caused concern. The TCLP analysis measures the leachability of the substances in the sample. The TCLP analysis identified Cadmium (Cd) and Lead (Pb) levels in excess of the Pollutant Mobility Criteria for areas with type GA or type GAA groundwater.

Due to the fact that the TCLP analysis did further identify inorganic contamination in the 1999 testing, Princeton Hydro believes that CT DEP will request that TCLP analysis be conducted along with mass-based analysis, if further sediment testing is required. We have therefore included this optional task for TCLP (Toxicity Characteristic Leaching Procedure) or SPLP (Synthetic Precipitation Leaching Procedure) testing, even though it was not requested in the RFP.

**Opt.1.e. Sediment Testing Analysis**

Once the data results from the chemical testing are received, Princeton Hydro will review the results of the laboratory analyses. This will include an evaluation of the analytical sample-specific method detection limits (MDL) and reporting limits (RL) as provided by the lab. Data will be evaluated against both human and ecological risk-based media standards. Human health risk standards will be evaluated compared to the CT DEP Remediation Standard via Regulated Criteria Summary Table to determine if the sediment must be disposed of at a regulated disposal facility. The results of the mass-base analysis will be compared to the Direct Exposure Criteria and the Pollutant Mobility Criteria, for all parameters other than inorganic substances and PCB’s. If TCLP or SPLP testing is completed, this analysis will be compared to the Pollutant Mobility Criteria. Regarding ecological impacts, the analytical evaluation will involve assessing corresponding ecological hazard identification using the USEPA Draft Sediment Quality Criteria and USEPA Sediment Quality Benchmarks.

The results of the qualitative sediment testing analysis will be included in the Alternative Analysis prepared for Tasks 1.0 and 2.0, as well as in the final Preliminary Design Report, prepared for Task 4.0.

**Optional Task 2: Develop New HEC-RAS Model**

Princeton Hydro will prepare a new HEC-RAS water surface profile model for the project reach extending from just upstream of the Memorial Boulevard bridge to just below the sediment/cobble deposit downstream of the Middle Street Bridge. If selected, this Optional Task would eliminate the need to complete Task 1.4.b, Hydraulic Analysis (using the existing FEMA model). An updated water surface profile model would better reflect the current streambed conditions, for this highly mobile reach of the Pequabuck River.

In order to prepare a new HEC-RAS water surface profile model additional survey will be required. GM2 will prepare eighteen (18) cross-sections within the previous detailed survey limits based on topographic survey results of Task 1.2.b and will survey nine (9) new cross-sections outside on the survey limits, such that the Downs Street and Memorial Boulevard bridges can be fully incorporated into the new HEC-RAS model.
Optional Task 3: Preliminary Design for Fish passage at Gas Pipeline Crossing
Princeton Hydro will prepare preliminary design recommendations for the modification or removal of the gas pipeline crossing upstream of the Middle Street Dam, for inclusion on the Preliminary Design Plans as prepared for Task 3.0, Engineering Design of Preferred Alternative, in the event that the Gas Company does not fully remove the gas line as part of their planned decommissioning of the gas line.

Optional Task 4: Additional Meetings
Princeton Hydro proposes this optional per meeting task, such that additional project meetings can easily be added to our final project fee without renegotiation of the meeting cost.

Optional Task 5: Photo-rendering for Public Stakeholder Meeting
Although not requested in the scope, CCRPA and the project partners may wish to have Princeton Hydro prepare photo-renderings of the proposed fish passage alternative for the dam site for the public stakeholder meeting. Photo-renderings are an excellent way to help communities visualize an alternative future and become comfortable with anticipated changes to the sites aesthetics.

Optional Task 6: Grant Identification and Writing Assistance
Princeton Hydro staff has extensive experience identifying grant funding sources for dam removal and fish passage projects and writing grant applications for our clients. We have secured over $300,000 for individual restoration projects.

Upon request, Princeton Hydro can prepare a fee estimate to assist the CCRPA in identify grant funding sources and prepare the grant applications for the CCRPA.

Optional Task 7: Pre-Project Monitoring
Upon request Princeton Hydro can prepare a fee estimate to prepare a monitoring plan for the Middle Street Dam Fish Passage Project and initiate the pre-project monitoring for the project. Princeton Hydro staff are highly familiar with the Gulf of Maine Stream Barrier Removal Monitoring Standards, which have become a nation standard for monitoring small dam removals. If requested, pre-project monitoring is best initiated at the inception of a project such that a representative sample of the surveyed cross-sections can be monumented during the initial survey of the site.

Additional Optional Tasks

Upon request, Princeton Hydro can prepare scope write-ups and fee estimates for the following additional optional tasks, if CCRPA wishes to proceed further with design, permitting, and construction for the Middle Street Dam Fish passage Project:

- Delineation of Wetlands
- Endangered, Threatened, and Species of Concern Management Plan
- Additional Biological/Ecological Inventories, as requested during permitting
- Historic/Archeological Assessment (Section 106)
- Permitting
- Final Design Plans
- Construction Bid Document/Specification Preparation
- Construction Bidding Assistance
- Construction Oversight
### C. SCHEDULE

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<tr>
<th>Milestones</th>
<th>Estimated Months to Accomplish</th>
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<tr>
<td>1.0 Draft Alternatives Analysis</td>
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<td>2.0 Final Alternatives Analysis</td>
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<td>3.0 Engineering Design of Preferred Alternative (Preliminary)</td>
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<td>4.0 Final Report and Transfer data</td>
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<td><strong>Total</strong></td>
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2. DELIVERABLES

1.1.a Kick Off Meeting
   Deliverables: The deliverables for this task will include requested changes to the project schedule.

1.2.b Topographic and Bathymetric Survey
   Deliverables: The client shall be entitled to one (1) round of review and edits of the project base mapping. The client shall receive one (1) reproducible hard copy and one (1) electronic copy via email or CD of the project base mapping.

1.4.b Hydraulic Analysis
   Deliverables: The client shall be entitled to one (1) round of review and revisions to the water surface profile model. The client shall receive one (1) electronic copy of the final HEC-RAS model.

1.5.a Outline of Alternatives Analysis Process
   Deliverables: The client shall be entitled to one (1) round of review and revisions to the Study Design and to one (1) hard copy and one (1) electronic copy of the revised Study Design.

1.5.d Draft Sequential Alternatives Analysis
   Deliverables: The client shall be entitled to one (1) hard copy and one (1) electronic copy of the Draft Sequential Alternative Analysis, for their review.

1.5.e Alternatives Analysis Review Meeting

2.2 Final Alternative Analysis
   Deliverables: The client shall be entitled to one (1) hard copy and one (1) electronic copy of the revised Final Alternative Analysis.

3.1 Preliminary Design for Dam
   Deliverables: A Preliminary Design Plan set in digital format with one (1) iteration of a review and edits of the preliminary design.

3.3 Finalized Preliminary Design Plans
   Deliverables: Upon completion of the revisions to the Preliminary Design Plans, eight (8) hard copies of the finalized Preliminary Design Plan set will be provided to CCRPA for distribution to project partners and DOT, and one (1) digital copy of the plan set via FTP site or CD.

4.1 Preliminary Design Report
   Deliverables: Eight (8) paper copies and one (1) electronic copy of a Draft Preliminary Design Report as requested by the Request for Proposal, with one (1) iteration of review and edits, as discussed at the preliminary design review meeting. After revisions have been completed, eight (8) hard copies of a finalized Preliminary Design Report will be provided to CCRPA for distribution to project partners and DOT, and one (1) digital copy via ftp site or CD. In addition any remaining project data will be transferred to the CCRPA, in either hard copy or electronic format.

Optional Task 1.a DEP Approved Sediment Sampling Plan (per sample)
   Deliverables: Two (2) hard copies and one (1) electronic copy of a Sediment Sampling Plan to be given to CT DEP Water Planning and Standards and CCRPA, with one (1) iteration of review and edits of Sediment Sampling Plan. Two (2) copies and one (1) electronic copy of a finalized Sediment Sampling Plan to be given to CT DEP Water Planning and Standards and CCRPA.
1. STAFFING PLAN

Staff Plan for Princeton Hydro

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<th>Hours Allocated to Each Task</th>
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AED – Amy DeBuck – Junior Water Resource Engineer  
CM – Chris Mikolajczyk – Environmental Scientist  
PW – Paul Woodworth – Fluvial Geomorphologist  
MR – Michael Rehman  
JH – Jacob Helminiak – Ecological Restoration Engineer  
MPG – Mary Paist-Goldman – Senior Water Resource Engineer  
KM – Keith Merl – Senior Geotechnical Engineer  
LW – Laura Wildman – Project Manager & Senior Ecological Restoration Engineer  
GG – Geoff Goll – Principal-in-Charge & Senior Water Resource Engineer
2. Key Personnel

Princeton Hydro’s ecological restoration team represents a depth of knowledge and experience not commonly found in consulting firms, especially our background in the assessment and removal of dams. All of the team members have worked on critical aspects of dam removal projects and are well versed in the science and implementation of ecological restoration projects. Our team works closely together, with each individual handling aspects of the project that best suit their expertise and education. As you will see from our organization chart, we do not focus on a top down structure but work as a team of highly qualified professionals all brainstorming together to determine the best approach for your project.

Our team approach includes making sure that the key personal all are involved in the initial field work. It is at this crucial time in a project where critical project issues are identified and a conceptual framework for the design is initiated. Often we find that after the detailed initial site investigation with a diverse group of engineers and scientists, we can often predict the project outcome. A solid conceptual design, based on field investigation and an investigation into the site’s history, is the cornerstone of a successful, smoothly implemented ecological restoration project.

Princeton Hydro:

Project Manager:
Laura Wildman, P.E. – Project Manager – Ecological Restoration and Fisheries Engineer

Ms. Wildman will be the Project Manager heading up this project and will provide critical oversight on all aspects of the project. Ms. Wildman has a civil Engineering degree from the University of Vermont (1989), a Masters in Environmental Management from Yale (2004), and has been a licensed Professional Engineer in the State of Connecticut since 1994. Ms. Wildman has managed and designed multiple successful fish passage and dam removal projects in Connecticut, working closely with the CT DEP Fisheries Division on all of them, and leading the projects through the required Connecticut and Federal permitting. She has been an active member of the Connecticut Riverine Migratory Corridor Team, lead by CT DEP, since its inception in 2001, and has provided input on numerous fish passage and barrier removal projects throughout the state, while Chief Engineer with American Rivers.

A sample of our Project Manager’s completed projects flows, with dates, client, and Ms. Wildman’s responsibilities on that project listed, as required in the RFP.

Selected Stream Barrier Removal Work:

Dam Removals:
- Dunkard Creek Dams (PA) 2009: for American Rivers – Project Manager
- Plymouth Crossing Dam Removal (PA) 2009: for American Rivers – Project Manager
- Anaconda Dam Removal (CT):1999 – for City of Waterbury – Project Manager & Engineer
Selected Fishway Work:

- Pond Lily Alaskan Steeppass Fishway (CT) 2000 – for New Haven Land Trust & CT DEP – Technical oversight of design
- Guilford Lakes Nature-like & Steeppass Hybrid Fishway (CT) 2002 – for Guilford Lakes Association – Engineering design & construction oversight
- Sennebec Rock Ramp Fishway (CT) 2003- for River Rehab & TU – Conceptual design concept and technical oversight during design and construction
- Tingue Dam Bypass Channel (CT) 1999 – for CT DEP – Project Manager & engineer for Preliminary Design & conceptual design of Denil fish ladder
- Plume & Attwood Rock Ramp (CT) 1999 – for CT DEP – Project Manager and engineer for Feasibility & Conceptual Design
- Brays Buckle Dam (CT) 1999 – for CT DEP – Project Manager and engineer for Feasibility & Conceptual Design of Denil fishway
- Howland Dam Bypass Channel (ME) 2002 – for Penobscot Restoration Trust - Conceptual Design & Feasibility Research

Other Team Members:

Geoffrey M. Goll, P.E. – Principal-in-Charge – Water Resource Engineer

Mr. Goll is Vice President and founding Principal of Princeton Hydro, LLC. With his business partners, he has grown the business to forty professionals since 1998. In his nineteen years of experience, Mr. Goll has been involved in geotechnical and water resource engineering for projects varying from sediment management and dredging to dam engineering. He has manages the day-to-day business aspects of Princeton Hydro while also managing the multi-disciplinary water resource and geotechnical engineering groups within the company. With regard to dam removals, Mr. Goll was in responsible charge of the first dam breach in New Jersey specifically designed for purpose of fish passage: the Pursel Mill Dam on the Lopatcong Creek. He has been in responsible charge of a number of subsequent dam removal designs in Pennsylvania and New Jersey, including the Gruendyke Mill Dam in Hackettstown, NJ, Ralph Stover Dam in Tinicum, Bucks County, PA, and has recently completed the design of four simultaneous obstruction removals (three dams and one set of bridge piers) on the Darby Creek in Delaware County, PA. He has also taught two training courses on dams to NJDEP Dam Safety, NRCS and the NJ Division of Fish and Wildlife. Mr. Goll has extensive experience in the management of lake and harbor dredged material, has served as an expert witness for dredging disputes, and holds a license to practice Professional Engineering in five states.

Dr. Stephen Souza, PhD – Ecologist/Fisheries Biologist

Dr. Souza is the President of Princeton Hydro and received his Ph.D. from the University of Connecticut in Ecology/Fishery Biology. He is a NJDEP Qualified Fishery Specialist, Marine Biologist, and Aquatic Biologist. Dr. Souza manages the Aquatic Resources group of the Company, which is charged with the execution of all of Princeton Hydro’s fish and benthic surveys. Over his 25-year professional career, Dr. Souza has designed, implemented and managed numerous fishery studies, many of which were involved with the assessment of anadromous fish species. This includes work conducted while employed by the Connecticut DEP on Connecticut River shad and blueback herring migration,
spawning and young-of-year (YOY) feeding preferences. In the mid-1980s, he served as the field manager for the Westway Fisheries Sampling Program which involved managing a team of over sixty scientists and four research vessels engaged in the assessment of the lower Hudson River’s use by migrating striped bass. Since forming Princeton Hydro, he has conducted a number of essential fish habitat studies in the lower Hudson River, Newark Bay and Delaware River estuary systems and has implemented related projects associated with the utilization of created mitigation tidal habitat by anadromous fish species. Most recently he oversaw staff scientists engaged in the pre- and post-ecosystem assessments of dam removal projects conducted in streams located in eastern Pennsylvania and western New Jersey.

Paul Cooper – Senior Aquatic Ecologist – Bivalves/Macroinvertebrates/Fisheries

Mr. Cooper has in excess of eight years of professional experience designing and conducting ecological and hydrologic assessments of river systems. This work has been associated with an array of projects including watershed protection plans, river restorations, and dam removals for a variety of clients including non-profits such as Trout Unlimited and American Rivers as well as municipalities and regional partnerships. These characterization studies include multi-year water quality monitoring and biological surveys for fish, mussels and other bivalve mollusks, benthic macroinvertebrates, periphyton and macrophytes, herptiles, and subsequent statistical analysis and evaluation of the collected data. In addition to these components, he regularly conducts other evaluations including visual habitat assessments, fish and mussel salvage operations, sediment and substrate characterization, stream bank and bed stability, and bathymetric surveys, as well as in-situ hydrologic and hydraulic studies with automated sampling technology. Mr. Cooper is participating in continuing education related to the restoration field and has taken professional development courses in fluvial geomorphology and river restoration. His areas of concentration include limnology/aquatic ecology, statistics, fishery biology, pollutant load modeling, hydrology modeling, and outreach.

Mary Paist-Goldman, P.E. – Water Resource Engineer

Ms. Paist-Goldman has worked for more than nine years as a professional water resource engineer focusing on hydrology and hydraulics, stormwater management, wastewater management, and dam removal and river restoration. She has been involved in seven dam removal projects throughout New Jersey and Pennsylvania and has worked on all aspects of the projects from design through construction. In modeling dam, bridge, culvert, and river hydrology and hydraulics, Ms. Paist-Goldman has utilized USACE’s HEC-2 and HEC-RAS and BOSS International’s RiverCAD and BOSS RMS. Using HEC-RAS, she has developed dam inundation studies, established floodplain limits, including floodway and floodplain delineations along numerous watercourses, as well as determined waterway openings for new and replacement bridges and culvert crossings. Ms. Paist-Goldman has extensive experience using the unsteady flow analysis features within HEC-RAS. Further, Ms. Paist-Goldman has utilized HEC-RAS to determine scour at bridges and to determine overall channel stability for streambank stabilization, dam removal, and bridge replacement projects. Ms. Paist-Goldman’s modeling experience includes hydrologic modeling with ESRI ArcMap Geographic Information Systems (GIS) software as well as BOSS International’s WMS, the United States Army Corps of Engineers’ HEC-HMS, and USACE’s HEC-1. Ms. Paist-Goldman’s hydrologic and hydraulic modeling experience also includes SWMM, PondPack, HydroCAD, TR-20, TR-55, and the Rational Method. Ms. Paist-Goldman received her Bachelor of Science degree in Civil Engineering from the University of Maryland - College Park in 2000.

Jacob Helminiak, P.E. – Ecological Restoration Engineer

Mr. Helminiak has more than six years of professional experience as a water resource engineer, specifically focusing on hydrology and hydraulics, floodplain management, dam removal and river restoration, and is a licensed Professional Engineer in the State of New Jersey. While at Princeton Hydro, he has been involved in all aspects, from concept to construction, for seven dam removals in both Pennsylvania and New Jersey. For these projects, he was responsible for
the hydrologic and hydraulic modeling, and coordination and preparation of design plans and specifications. Proficient in the use a variety of modeling software, including USACE HEC-HMS and HEC-RAS, Mr. Helminiak has applied his strong background in open channel and floodplain hydraulics to develop floodplain and floodway limits, analyze and predict scour, determine channel and bank stability, and guide development of proposed stream channel dimension, pattern, and profile for dam removal, river restoration, fish passage, and bank stabilization designs. Mr. Helminiak has taken professional development courses in fluvial geomorphology and river restoration and has applied a variety of river restoration practices to his projects. He has applied his knowledge and training in the classification and geomorphic assessment of rivers to identify and prioritize potential restoration opportunities on a watershed scale. Mr. Helminiak has also employed a variety of bio-engineering techniques to stabilize eroding banks adjacent to structures and utilities on small creeks to larger rivers, as well as lake and pond shorelines. Mr. Helminiak received his Bachelor of Science degree in Civil Engineering, with focus in hydrology and hydraulics, from the Pennsylvania State University.

Paul Woodworth – Fluvial Geomorphologist

Mr. Woodworth earned a Master’s degree focused on fluvial geomorphology from the University of Connecticut, Department of Geography. For his thesis, Mr. Woodworth employed a two-dimensional hydrodynamic model (River 2D) to predict the potential impacts of a dam removal on stream flow and hydraulic habitat of the native adult brook trout (Salvelinus fontinalis). The project informed an alternatives analysis that enabled dam owners to consider geomorphic and ecologic impacts of removal. To replicate two representative reaches in the computational modeling environment, Mr. Woodworth used a variety of methods to collect and analyze extensive geomorphic data including stream channel topography, velocity, discharge and substrate particle size. As a part of Princeton Hydro, Mr. Woodworth applies fluvial geomorphology to all phases of dam removal and stream restoration projects from initial field assessment to final construction. He has designed restoration plans with appropriate channel cross-section, slope, sinuosity, pool-riffle features and adjacent floodplains. In the construction phase, Mr. Woodworth has worked with contract operators to guide the removal of dams, stabilization of banks and installation of natural riffle features and engineered structures like vortex boulder weirs. In the planning stages, Mr. Woodworth has written permits and reports for state environmental protection and dam safety agencies and has collected and analyzed hydrologic data to inform hydrologic and hydraulic modeling. His knowledge of fluvial geomorphology helps in addressing sediment concerns, bank erosion and bed stability as well as responding to in-field construction complications that resulted in design modification. Mr. Woodworth is also a member of the NJAWRA Stream Restoration Committee and has presented two dam removal projects at the 2009 joint conference of the Mid-Atlantic Chapters of the Ecological Society of America and Society for Ecological Restoration.

Keith Merl, P.E. – Senior Geotechnical Engineer

Mr. Merl has more than twelve years of experience in the field of geological/hydrogeological engineering, working on projects throughout the greater northeast. Mr. Merl is a licensed Engineer in five states and is a Certified Professional in Erosion and Sediment Control (CPESC). He has been involved in dozens of dredge materials disposal projects, as well as completed numerous geologic and hydrogeologic studies. Mr. Merl has worked on projects including dam reconstruction and repair, commercial developments, and municipal water allocation projects, all from inception through engineering design and construction. He is the current Chair of the Groundwater Subcommittee of the New Jersey Chapter of the American Water Resources Association. Mr. Merl has a thorough knowledge of the effect water conditions have on hydraulic structures as well as the hydrogeologic effects of the creation and removal of impoundments. Mr. Merl also has a strong background in wastewater effluent disposal, geotechnical engineering, geologic hazard identification and studies, subsurface investigation testing and monitoring, erosion and sedimentation control, water quality related to erosion, sedimentation control, and soil resource assessment.
GM2 Associates, Inc.

Robert Sterling, L.S. - Director of Land Surveying

Mr. Sterling has more than 36 years experience in land surveying first as a surveying assistant and then working his way to Project Manager and finally as principle of his own firm. Mr. Sterling joined GM2, a minority business enterprise, in 2006 as its new Director of Land Surveying to manage and direct the company’s 2 full time crews. As Principal of Robert C. Sterling Land Surveying, LLC. Mr. Sterling provided numerous boundary surveys throughout Litchfield County, Topographic Surveys and Boundary Surveys for land developers, municipalities, and consultants. Mr. Sterling ran the operation for 9 years. As Project Manager for Berglund Land Surveyors, Mr. Sterling worked as a surveyor and then as a project manager for 20 years conducting survey and managing operations. Prior to joining Berglund, Mr. Sterling was employed by the City of Torrington as a Surveyors Assistant for 7 years.

Equipment

The following is a list of equipment needed to perform the proposed scope of services and its availability:

- The mechanical equipment needed to perform the sediment collection, probes, and/or test pits for this project will be rented from a local boring contractor, and will come with a trained operator. This equipment may include a small excavator or a split spoon sample attached to a tripod-mounted mechanical drop hammer.

- Princeton Hydro has an in-house geotechnical laboratory where we have all of the equipment we need to perform the physical sediment testing. The chemical testing will be completed at a CT certified solid laboratory.

- For the geotechnical field work Princeton Hydro will utilize a hand held GPS, hand probing equipment if needed, filed sediment sieves, a digital camera, and waders.

- GM2 will provide all of the topographic and bathymetric survey equipment needed.

- Princeton Hydro has all of the computer equipment, software, and plotters needed to perform the Hydrologic and Hydraulic analysis, and complete AutoCAD engineering design plans.

3. Contract Compliance Requirements

Princeton Hydro is teaming with GM2, a legitimate minority business enterprise, to complete this project. GM2 will be preparing all topographic and bathymetric survey and base mapping. Princeton Hydro and GM2 often team on restoration projects in this manner and both offices are located in Glastonbury, Connecticut, within close proximity to one another which facilitates the teaming process.
F. PROPOSED COST

Princeton Hydro and its surveying subcontractor, GM2 are pleased to submit the following fee to complete the scope of work as outlined in this proposal for the Alternatives Analysis and Preliminary Design for Improvement of Fish Passage and Riverine Environment for the Middle Street Dam on the Pequabuck River. We would be happy to discuss our proposed scope and fee and further refine it to meet the needs of the CCRPA and your project partners.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 Draft Alternatives Analysis</td>
<td></td>
</tr>
<tr>
<td>1.1 Coordination</td>
<td>$3,783.00</td>
</tr>
<tr>
<td>1.2 Field Work &amp; Survey</td>
<td>$10,796.00</td>
</tr>
<tr>
<td>1.3 Sediment Analysis &amp; Management</td>
<td>$9,288.00</td>
</tr>
<tr>
<td>1.4 Hydrology &amp; Hydraulics</td>
<td>$4,840.00</td>
</tr>
<tr>
<td>1.5 Draft Sequential Alternatives Analysis</td>
<td>$10,928.00</td>
</tr>
<tr>
<td>2.0 Final Alternatives Analysis</td>
<td>$2,925.00</td>
</tr>
<tr>
<td>Option 1 Sampling Event(s)*</td>
<td>See Optional Task 1</td>
</tr>
<tr>
<td>3.0 Engineering Design of Preferred Alternative (Preliminary)</td>
<td>$11,018.00</td>
</tr>
<tr>
<td>4.0 Final Report and Transfer data</td>
<td>$6,000.00</td>
</tr>
<tr>
<td><strong>Total (without optional sediment sampling)</strong></td>
<td><strong>$59,578.00</strong></td>
</tr>
</tbody>
</table>

* The sediment sampling task, has been included in the preceding Optional Tasks Table, as Optional Task 1, as per the CCRPA’s request in the pre-bid meeting. The sediment sampling fee is based on a per sample basis and can be estimated in the total, if preferred, by assuming an amount of samples and multiplying the per sample fees by the number of samples. Optional tasks 1a and 1e are not on a per sample basis and will remain the same regardless of the number of samples requested by CT DEP.
<table>
<thead>
<tr>
<th>Optional Tasks</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1 Sampling Event(s)*</td>
<td></td>
</tr>
<tr>
<td>Opt. 1a DEP Approved Sediment Sampling Plan</td>
<td>$1,750.00</td>
</tr>
<tr>
<td>Opt. 1b Sediment Sample Collection (per sample)</td>
<td>$115.00</td>
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<tr>
<td>Opt. 1c Sediment Sample Chemical Testing (per sample)</td>
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<tr>
<td>Opt. 1d TCLP/SPLP Testing (per sample)</td>
<td>$1,175.00</td>
</tr>
<tr>
<td>Opt. 1e Sediment Testing Analysis</td>
<td>$1,800.00</td>
</tr>
<tr>
<td>Option 2 Develop New HEC-RAS Model</td>
<td>$17,040.00</td>
</tr>
<tr>
<td>Option 3 Preliminary Design for Modification or Removal of Gas Pipeline Crossing</td>
<td>$2,090.00</td>
</tr>
<tr>
<td>Option 4 Additional Meetings (in-person)</td>
<td>$658.00</td>
</tr>
<tr>
<td>Option 5 Photo-Rendering for Public Stakeholder Meeting (each)</td>
<td>$1,000.00</td>
</tr>
<tr>
<td>Option 6 Grant Identification &amp; Writing Assistance</td>
<td>Upon Request</td>
</tr>
<tr>
<td>Option 7 Pre-Project Monitoring</td>
<td>Upon Request</td>
</tr>
</tbody>
</table>
Appendix A

Quality Assurance/Quality Control Plan
PROJECT QUALITY MANAGEMENT PLAN

For

PRINCETON HYDRO, LLC

Prepared by:
Princeton Hydro, LLC
1108 Old York Road
Suite 1, PO Box 720
Ringoes, New Jersey 08551
908-237-5660

Updated as of: January 1, 2009
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1.0 INTRODUCTION

1.1 Background and Purpose

Princeton Hydro, LLC and Princeton Hydro Engineering, PC (both hereinafter referred to as Princeton Hydro) requires that all plans, reports, data collected as required by a particular Client comply with controlled procedures to assure quality of the company’s service and products. The procedures used by to assure the quality of service and products are described in this Quality Management Plan, and follows the organizational and content guidelines.

The Quality Management Plan (QMP) is a statement of Princeton Hydro’s policy concerning Quality Assurance (QA) and Quality Control (QC), and reflects current quality principles and practices. Quality is defined herein as the degree to which an item or process meets or exceeds the user's requirements and expectations. Quality Assurance (QA) constitutes those actions, which when carried out provide confidence that quality has been achieved. Quality Control (QC) is the project-specific inspection system implemented within the QA framework to ensure that quality work is performed.

The QMP will provide guidance to all Princeton Hydro staff. It defines QA Program goals, methods for attaining those goals, and explains basic and general responsibilities. This document is one of several documents designed to provide a controlled system for all aspects of work performed under the contract; and, to ensure that all work assigned to Princeton Hydro ultimately meets the intended objectives. Additional documents that are tools of Princeton Hydro’s QMP include work plans, project-specific quality assurance project plans (QA Project Plans, QAPPs), and standard operating procedures (SOPs).

1.2 Definitions and Terms

QA/QC Manager - corporate level manager responsible for overseeing all QA/QC activities of Princeton Hydro programs, implementing the overall QA/QC program, reviewing Quality Management Plans and QAPPs, and providing oversight to ensure quality of data and deliverables generated by a program.

Corporate Quality Management Plan (Corporate QMP) - central QA plan that details monitoring and auditing functions to ensure consistent adherence to established quality assurance requirements, and provides mechanisms for the identification of nonconformance and implementation of corrective measures.

Data Quality Objectives (DQOs) - statements of the level of uncertainty that a decision-maker is willing to accept in results derived from environmental data, when the results are going to be used in a programmatic or regulatory decision.

Field Sampling Plan (FSP) - plan developed and implemented to ensure measurements or samples collected at field sites are free from sampling bias and provide an accurate representation of the plot (sampling unit).

Project Manager (PM) - Princeton Hydro manager responsible for oversight of all on-site activities associated with Contract PR-CI-07-10375.
Quality Management Plan (QMP) - a QA plan that details how a program will implement and assess the effectiveness of its QA and QC operations at the contract level of organization.

Quality Assurance (QA) - all actions taken to ensure that the results and conclusions produced in the course of any task are accurate, reliable, and satisfy the intended objectives of the contract scope of work (SOW) and work assignments.

Quality Assurance Program (QA Program) - corporate activity endorsed by senior management, to maintain and continually improve QA/QC to ensure that project oversight and the generation of data, reports, and reviews meet the requirements of a Client as embodied in a contract SOW and/or work assignment.

Quality Assurance Project Plan (QAPP) - a plan, which documents the planning, implementation, and assessment of how specific QA/QC activities will be applied for a particular project.

Quality Assurance Unit (QAU) - an organizationally independent group which is integrated into the technical and management work flow to assure that for each project the personnel, facilities, equipment, methods, practices, records, and controls are in conformance with the applicable contract or regulations.

Quality Control (QC) - the project-specific inspection system implemented within the QA framework to ensure that quality work is performed.

Standard Operating Procedure (SOP) - documented method for performing a routine and/or repetitive task, which standardizes the way a task is performed.

Statement of Work (SOW) – a comprehensive statement defining the legitimate work elements and the acceptable implementation parameters for a particular contract.

Task Manager (TM) - Princeton Hydro employee that reports directly to the Project Manager and coordinates or provides day-to-day oversight for a task or function across multiple tasks (e.g., data collection and evaluation, technical analysis, modeling, report preparation, within a work assignment work plan). Also, reporting directly to the Project Manager, the TM provides knowledge and expertise required addressing the day-to-day technical, staffing, and management requirements associated with his/her work assignment(s).

2.0 QUALITY MANAGEMENT AND ORGANIZATION

Princeton Hydro is committed to providing Clients with deliverables (e.g., plans, reports, measurement data, reviews, and evaluations) of optimum quality and will implement a comprehensive QA Program based on established QA philosophy and procedures to ensure the provision of quality deliverables and products. Princeton Hydro recognizes that QA is an interdisciplinary responsibility involving all organizational components and ultimately each individual employee.
Princeton Hydro’s QA policy statement and objectives, as well as Princeton Hydro’s QA organization and levels of responsibility within the organization, are presented in the following subsections.

2.1 Quality Assurance Policy Statement and Objectives

Princeton Hydro firmly believes that quality products result from systematic processes that begin when a task is received and then are carried through every step of the development, implementation and review processes. Therefore, the responsibility for QC rests largely with the Princeton Hydro Project Manager and QA/QC Manager as they manage the development and application of strict criteria for acceptable deliverables, from planning the work through final review. The QA function is an oversight function also provided by the QA/QC Manager ensuring that the systems are in place to manage the integrity of all work. Princeton Hydro’s QMP provides a controlled foundation for the development, review, and reporting of technical information.

This QMP is developed as part of the overall QA Program. The plan specifies the QA objectives of the program and defines the procedures used to document those objectives. Therefore, Princeton Hydro issues the necessary guidance and sets forth the requirements for accomplishing the following quality objectives:

- To ensure the overall quality effectiveness of program management and technical support services.
- To ensure that measurements, calculations and conclusions are of known quality, thoroughly documented, complete, verifiable, and scientifically and legally defensible.
- To ensure the application of SOPs employing nationally recognized standards, techniques, guidelines, and accepted analytical protocols.
- To ensure an acceptable level of project work performance through quality assessment and review of product deliverables.
- To maintain adequate documentation of all work assignment activities to provide traceability of all data and technical information.
- To ensure that the processing, as well as the validity, of all data and information be monitored, documented and controlled.
- To ensure the documentation of precision, accuracy, representativeness, comparability, and completeness of any sampling, analytical system, and data collection and evaluation activity (including computer-generated activities).
- To ensure the recognition of deficiencies in a timely manner to provide a mechanism for corrective action.
- To ensure provisions for scheduling independent reviews and audits of all technical products and to ensure that the resulting documentation provides complete, accurate, and...
To ensure the development of project-specific plans as an integral part of sampling or other analytical efforts involving the actual collection and analysis or review of samples.

2.2 Organizational Responsibilities

Princeton Hydro's general organizational structure for projects allows for an independent Quality Assurance Unit (see Figure 1) that is integrated into the technical and management work flow. This independence provides assurance to management that each project or task is in conformance with all acceptable contract and regulatory requirements. The Quality Assurance Unit is responsible for all quality overviews on technical and management work flow with the supervision of the QA/QC Manager.

2.2.1 Principal

QA is supported at the highest corporate level by a Princeton Hydro Principal for a designate contract, who is responsible for the technical and administrative direction of all work activity being managed within the company and program, respectively. The Principal of Princeton Hydro provides recognition and support of QA at such a level is paramount to ensuring its overall effectiveness. The Principal retains the overall responsibility for implementation of the Corporate QMP through interaction and coordination with the Corporate QA/QC Manager.

2.2.2 QA/QC Manager (QAQCM)

The QA/QC Manager (QAQCM) is the individual responsible for day-to-day oversight of all program QA activities and for overseeing the implementation of the Program Quality Management Plan. The QAQCM reports directly to the Principal on all QA/QC matters for directions in carrying out specific QA/QC duties. The QAQCM also communicates directly with the Project Managers and Field Crew Leaders to discuss QA issues and to relay QA findings. The Princeton Hydro QAQCM will rely on the expertise of the Corporate Quality Assurance Unit to provide assistance towards a contract, as needed.

The authority of the QAQCM includes:

- Implement corrective actions to preserve the integrity of work in progress
- Report non-compliance occurrences/activities to the Principal/Project Manager
- Schedule audits of work in progress
- Prepare/update the Quality Management Plan
- Review work plans to ensure that appropriate QA/QC processes and procedures are incorporated for the conduct of work
- Provide guidance and assistance to Task Managers and technical staff in preparing QA Project Plans and SOPs, where required
- Review and approve QA Project Plans and SOPs
- Recommend and initiate QA activities within the program
- Conduct internal QA audits in the program
- Follow-up on QA problems and corrective actions
- Maintain QA records
Prepare periodic quality reports to management of Princeton Hydro

2.2.3 Project Manager (PM)

QA/QC responsibilities include:
- Review and approve work plans to ensure completeness and appropriate level of technical content, and to ensure that references to appropriate QA Project Plans and SOPs are incorporated and that other QA/QC considerations are addressed
- Provide QC oversight at the program level to ensure submission of high quality work plan deliverables through active communication with the Task Manager
- Assign QA/QC responsibilities to Task Manager
- Review and approve SOPs and QAPPs
- Meet quarterly (or more frequently) with the Task Managers and Program QAM to review and discuss QA/QC issues at the program level
- Report to corporate management all QA problems encountered and corrective actions taken
- Prepare or review position descriptions and qualifications, as well as employee performance evaluations, to ensure that employees with appropriate skills are assigned to work plans
- Provide QC oversight to ensure submission of high quality work plan deliverables through active communication with the Task Managers.

2.2.4 Task Managers (TM)

Task Manager QA/QC responsibilities are assigned by the Project Manager and include:
- Implement tasks and subtasks on a project.
- Discuss all QA problems encountered and development of corrective actions with the QAM
- Report to the Project Manager all QA problems encountered and develop a corrective action plan.
Figure 1: Princeton Hydro Program Quality Assurance Organization
2.2.5 Field Staff

All Princeton Hydro field staff are responsible for conducting work in accordance with the PQMP, SOPs, QAPPs and other standards and guidance as required. QA/QC responsibilities are assigned by the Task Managers and include:

- Implement QC activities for a particular task or function, including monitoring and documentation
- Follow established procedures, such as SOPs and QAPPs, and document any deviations
- Perform and document preventive maintenance, as necessary
- Maintain up-to-date notebooks and/or other appropriate record-keeping systems
- Report to the Task Manager all QA problems encountered, recommend corrective actions to be taken, and implement the corrective action plan

3.0 QUALITY SYSTEM AND DESCRIPTION

Princeton Hydro’s comprehensive QA Program is made up of numerous components which, when incorporated together compile the overall function of the Corporate Quality Management Plan (Corporate QMP). Specific components that comprise the Princeton Hydro Corporate Quality Management Plan and system include:

- Work Plans
- Quality Control Program
- Quality Assurance Project Plans
- Data Quality Objectives
- Standard Operating Procedures
- Audit Program
- Corrective Action Plan
- Employee Training Program
- Procurement Program
- Health and Safety Program

A copy of the PQMP will be provided to Team subcontractors who are required to follow the QA/QC procedures described herein. A brief description of the programs and plans that make up Princeton Hydro's Corporate Quality Assurance Program are presented below. Other procedures and/or plans will be prepared as necessary depending on project requirements.

3.1 Corporate Quality Management Plan

Princeton Hydro's Corporate Quality Management Plan identifies the corporate philosophies and responsibilities on how quality is implemented throughout the company. Established QA philosophy and procedures are essential for consistent production of valid data and documentation in support of all projects performed by Princeton Hydro. A comprehensive Corporate Quality Management Plan ensures that all information collected and/or reviewed, and all subsequent reports
are interpreted and produced by qualified personnel in appropriate scientific and engineering fields, and are in compliance with corporate standards.

3.2 Quality Management Plan

Princeton Hydro’s Quality Management Plan (QMP) is tailored to identify how corporate philosophies and responsibilities on quality are implemented for contracts. This comprehensive Quality Management Plan ensures that all information collected and/or reviewed, as well as subsequent reports are in compliance with program standards. The Quality Management Plan is prepared by the QAQCM. The Quality Management Plan will be reviewed annually by the QAQCM and revised as needed. The PM and Principal will approve all revisions.

3.3 Work Plans

Princeton Hydro is tasked to provide services and products through an executed contract or purchase order. A contract or purchase order presents specific technical support activities (i.e., tasks) and associated deliverables requested for completion by Princeton Hydro.

After receipt of a work assignment, Princeton Hydro prepares a corresponding work plan describing its approach to accomplish the requested tasks and associated deliverables. The work plan also references the relevant QA Project Plans, SOPs, and other documents, which will be followed to accomplish the work. Princeton Hydro adheres to the methods and procedures described in existing EPA-approved QA Project Plans and SOPs, unless tasked through a work assignment to prepare new or revised QA Project Plans and/or SOPs. If Princeton Hydro is tasked through a contract or purchase order to prepare a QA Project Plan and/or a SOP, the applicable Project Manager with the assistance of the Program QAQCM will:

- Designate the appropriate individual(s) to prepare the document
- Arrange for review of the document
- Reconcile the review comments
- Oversee incorporation of any revisions
- Acquire approval for the document by the EPA QAQAO, and
- Issue the approved document using accepted document control criteria.

A work plan is prepared by the applicable Project Manager, reviewed and then approved by a Principal, Associate, or Senior Project Manager, if different from these personnel.

3.4 Quality Control Program

Princeton Hydro’s QC program is implemented using appropriate QA Project Plans, SOPs, Field Sampling Plans, assessments and audits, and subsequent corrective action measures.

3.5 Quality Assurance Project Plans (if applicable)

Some projects require a Quality Assurance Project Plan (QAPP) to document the planning, implementation, and assessment procedures of how specific QA/QC activities will be applied during a particular project. This is accomplished, in part, by presenting detailed data quality objectives (DQOs) to define the quality of calculations, plan preparation, sampling, laboratory testing, data analysis, and procedures to ensure that quantitative objectives are accomplished. Each QAPP will consist of QA/QC procedures appropriate to the project’s specifications.
Princeton Hydro will prepare a QAPP as requested and negotiated with the Client. The applicable Project Manager will be responsible for overseeing the preparation and revision of the Princeton Hydro generated QAPPs. Guidance and assistance will be provided by the QAQCM. When a draft is prepared, it is reviewed and approved by the QAQCM and the Project Manager. Project-specific QAPP will be prepared in document control format.

Upon determining that a QAPP is required, the Project Manager and TM will work with the Client to identify or develop project specific DQOs. Princeton Hydro will then prepare a QAPP consistent with the specified or negotiated requirements for QAPPs. The QAPP will be reviewed and approved according to Princeton Hydro’s QMP and then will be submitted to the Client for review and approval.

QAPPs will be reviewed by the QAQCM and submitted to the Client within 21 days of receipt of the and fully executed contract or purchase order. QAPPs provide project- or task-specific blueprints showing how QA and QC are applied and how QA and QC integrate all technical and quality aspects for the project life cycle. Criteria used for assessing quality and appropriate corrective action procedures will be summarized in the QAPP for each activity. Applicable QAPPs prepared by others must be reviewed and accepted by the Project Manager prior to the start of the project.

For those tasks using secondary data, a QAPP will be prepared to include: the purpose of the study; the project objectives; identification of the secondary data needed to satisfy project objectives, requirements related to the type of data, age of the data, geographical representation, temporal representation, and technological representation, as applicable; the planned approach for evaluating project objectives including formulas, units, definitions of terms, and statistical analysis, if applicable; the responsibilities of all project participants; the sources of the secondary data; the quality requirements of the secondary data; the procedures for determining the quality of the secondary data; and data reporting, data reduction and data validation procedures. If primary data will also be generated as part of the task, then the information above can be incorporated into the associated QAPP to address the secondary data.

### 3.6 Data Quality Objectives

Data Quality Objectives (DQOs) are qualitative and quantitative statements that:

- Clarify the intended use of the data
- Define the type of data needed to support the decision
- Identify the conditions under which the data should be collected
- Specify tolerable limits on the probability of making a decision error due to uncertainty in the data

Princeton Hydro will specify any DQOs in QA Project Plans, as required. In most cases, Princeton Hydro will use precision, accuracy, completeness, comparability, and representativeness to describe data quality.
3.7 Standard Operating Procedures

Standard Operating Procedures (SOPs) are documented methods for performing certain routine or repetitive tasks. Each SOP standardizes the way a task is performed, to reduce variability when the task is performed repeatedly; and, SOPs will be written in sufficient detail and clarity to be used as a method for the persons performing the procedure. The SOPs may involve such operations as sampling, analysis, instrument or method calibrations, preventive and corrective maintenance, integral QC, and data reduction and analysis.

Princeton Hydro will prepare new SOPs or revise current SOPs as requested through contracts or purchase orders. The applicable Project Manager will be responsible for overseeing the preparation and revision of Princeton Hydro-generated SOPs. Guidance and assistance will be provided by the QAQCM. When a draft is prepared, it is reviewed and approved by the QAQCM and the Project Manager. Project-specific SOPs will be prepared in document control format.

The SOPs will consist of the following sections:

- Scope and Application
- Summary of Method
- Definitions
- Health and Safety Warnings
- Cautions
- Interferences
- Personnel Qualifications
- Equipment and Supplies
- Procedure
- Data and Records Management
- QA/QC Application and Documentation
- References

If a section is not applicable, the words "Not Applicable" will be inserted beside the appropriate section, with a brief statement explaining the reason why the section is not applicable to the SOP.

3.8 Audit Program

Audits are independent, systematic checks to determine the quality of operation of some function or activity and fall into two general categories:

- Performance audits in which quantitative data are independently obtained for comparison with routinely obtained data in a measurement system.
- System audits of a qualitative nature that consist of an on-site review of an organization's QA system and physical facilities for sampling, calibration, and measurement.

Audits are the principal means used by Princeton Hydro to determine compliance with the Quality Management Plan, QA Project Plans, and SOPs. Princeton Hydro will use three (3) types of audits to verify that measurement systems are operating properly, determine that data quality information is adequately documented, and evaluate management of the QA Program. The audit types include:
➢ Technical system audits
➢ Data quality audits
➢ Management systems review

3.8.1 Technical System Audits
A technical systems audit is a qualitative on-site evaluation of a total measurement system. Technical system audits are used to verify the existence and the adequacy of all equipment, facilities, supplies, personnel, and procedures that are either used directly for or in support of the collection and interpretation of data on a specific environmental variable. A technical system audit may be used to routinely verify that measurement systems are being operated properly or may be used to investigate problems first identified in a performance audit. The QAQCM will conduct technical systems audits on an annual basis.

3.8.2 Data Quality Audits
A data quality audit is an evaluation of the documentation associated with data quality indicators of measurement data to verify that the data are of known quality. This type of audit is conducted to verify the availability of quantitative and qualitative indicators of data quality. Availability of data quality indicators depends upon the proper collection, interpretation, and reporting of information required, characterizing the quality of the data. The QAQCM will conduct data quality audits on a regular basis for work assignments that generate analytical data reports.

3.8.3 Management Systems Reviews
A management system review is an on-site review of an organization used to verify the existence and evaluate the adequacy of internal management systems and documents necessary for the implementation of the QA program. The management systems review is conducted to determine the extent to which QA is being implemented within an organization and to recommend actions, which are necessary to correct deficiencies. The QAQCM will conduct management systems reviews at the project (work plan) level. The Principal or his/her designee(s) will conduct management systems reviews at the project level. If the project requires, these system audits will be conducted annually.

3.9 Peer Review
All deliverables will receive an in-house technical and editorial peer review prior to Client submittal. The Princeton Hydro PM and/or author will be responsible for initiating the review process and obtaining documentation of review. Discrepancies between the author and reviewer will be resolved by the Princeton Hydro Project Manager.

3.10 Corrective Action Plan
Princeton Hydro ensures organizational freedom to assign responsibilities of identifying corrective actions and, upon identifying any problem that affects performance or work product quality, developing a solution that is consistent with accepted scientific practices.

To develop a suitable solution, the root cause of the problem(s) will first be determined. Then the effects of the problem will be identified for subsequent analysis of the effectiveness of the
corrective action. The applicable Project Manager and knowledgeable technical staff will work with the QAQC to develop a plausible corrective action. The applicable Project Manager will be responsible for the implementation of the corrective action and will assess its effectiveness after implementation is complete.

If the situation has affected compliance with any of the DQOs, the applicable EPA Work Assignment Manager will be notified and the proposed corrective action discussed with him/her prior to proceeding with the corrective action.

3.11 Employee Training Program

Princeton Hydro’s Employee Training Program enables Princeton Hydro to provide and assign qualified personnel to conduct appropriate tasks and activities. The Employee Training Program includes QA/QC orientation and basic training. Additional details about the Employee Training Program are provided in Section 4.0 (Personnel Qualification and Training) of this Program Quality Management Plan.

3.12 Procurement Program

Princeton Hydro’s Procurement Program establishes policies and procedures for procurement of items and services. These policies and procedures are contained in the Princeton Hydro Procurement Manual. Additional details about the Procurement Program are provided in Section 5.0 (Procurement of Services and Items) of this Program Quality Management Plan.

3.13 Health and Safety Program (if applicable)

Occupational Safety and Health Administration (OSHA) regulation 29 CFR 1910.120 (1) requires that "employers shall develop and implement a written safety and health program for their employees involved in hazardous waste operations." The Princeton Hydro HASP describes the corporate health and safety program, which is required by OSHA. The HASP addresses all relevant standards, describes all health and safety training requirements, is specific to the types of activities Princeton Hydro staff will perform, and is consistent with Princeton Hydro policies.

Princeton Hydro’s personal protection training program is extensive. All employees, managers and field staff who conduct activities that require personal protection will complete a 40-hour OSHA-certified course unless exempted from this requirement based on an evaluation of equivalent work experience and training. Employees must complete this training or have equivalent credit approved prior to the first day of site work of any type.

Health and safety training includes the following topics:
- Government regulations (OSHA)
- Medical monitoring programs
- Characteristics of site hazards (chemical and physical)
- Toxicology
- Monitoring equipment and hazard identification
- Engineering and administrative hazard control
- Personal protective equipment
- Decontamination procedures
- Respiratory protection principles
• Respiratory protection workshop and respirator fit testing
• Handling, storage and transportation of samples and other hazardous materials
• Rules and regulations for working on or around mobile equipment and vehicles
• Risk assessment
• Site-specific HASP and organization
• Site operations and responsibilities
• Sampling methods
• GPS Equipment
• Confined space entry
• Procedural development for necessary protection level (i.e., levels A, B, C, and D)
• Handling emergencies and self-rescue
• Community relations

4.0 PERSONNEL QUALIFICATION AND TRAINING
Princeton Hydro is committed to providing the necessary training to ensure that Princeton Hydro employees are adequately prepared to perform their assigned responsibilities with the desired degree of quality awareness and proficiency. Princeton Hydro also encourages professional development beyond internal training, which can add proficiency and confidence in all areas of application.

4.1 Responsibilities
The PM delegates responsibility to the Task Managers for assuring that each employee has the necessary qualifications and job proficiency for performing assigned work. The Task Managers will provide the PM assurance through discussion and in writing that staff possesses appropriate qualifications and job proficiency for performing assigned work. The President annually reviews employee position descriptions and prepare performance evaluations with the appropriate TMs.

The PM delegates responsibility to the Task Managers for confirming that responsible project personnel have received training in administering applicable SOPS, QA requirements, and project-specific procedures and guidelines. The Task Managers provide written documentation that training has been completed to the PM with a copy to the QAQCM. The QAQCM will maintain a file for training records.

The QAQCM will provide employees with basic QA/QC orientation.

4.2 Requirements
Only personnel well-trained and adequately educated in their technical areas and in QC procedures can accomplish accurate and precise planning, data collection, data interpretation, health and safety plan implementation, and preparation of documentation.

The PM, Task Managers, QAQCM are required to be experienced scientists, engineers, and training specialists, who are trained in subjects relating to environmental engineering, science, and training. All are expected to follow Princeton Hydro and OW QA policies to facilitate technical support to
the EPA under Contract PR-CI-07-10375. Other technical staff are: trained engineers, scientists, regulatory policy specialists, trainers and technicians, and are expected to follow the QA direction provided in the work plans, Quality Management Plan, QA Project Plans, SOPs, and other relevant documents.

4.3 Employee Training

Before an employee is assigned to perform work under the contract (e.g., research, collection and data evaluation, data validation, modeling, report preparation), the designated employee will be trained as to that work's purpose, scope, methods of implementation, and associated QA/QC procedures. At a minimum, Princeton Hydro personnel assigned to a project will read the relevant sections of the applicable Work Plan, associated QA Project Plan(s), and SOPs. In addition, Princeton Hydro personnel will attend applicable orientation sessions for those activities for which they are or will be responsible. These sessions are conducted by appropriate Project or Task Managers and will typically address the basic operational procedures to follow, associated QA/QC practices, technical staff responsibilities, nonconformance reporting, and corrective actions. The Task Managers will submit employee training documentation to the QAQCM with a copy to the Project Manager; the QAQCM will maintain the training records as well as provide them to the President. The Task Managers will routinely meet with staff assigned to their work plan(s) to communicate any task changes and to provide opportunities for discussion of issues and/or to provide clarification for procedures and schedules. Annual refresher or in-service training is conducted by the QAQCM to ensure that all staff involved in the QA process maintain a high level of current knowledge and techniques.

The QAQCM and possibly other selected staff will participate in QA-related seminars, workshops, and professional meetings to further enhance the awareness and applicability of the QA Program.

4.4 Training Implementation and Documentation

If necessary, training will be administered to personnel in conjunction with their assigned responsibilities. This determination shall be made by the applicable Task Manager. The method of administering training will depend on the complexity of the procedure, the experience of the individual to receive training, and the availability of qualified trainers. The Task Manager will determine the method, the subject material, and scheduled date for training to be administered in consultation with the PM and QAQCM, as required. The need for additional or refresher training will be determined by the applicable Task Manager in consultation with the PM. These needs will be identified during reviews, assessments, and audits. Training will be documented and maintained in the employee's personnel file, as well as a formal, comprehensive file maintained by the QAQCM.

4.5 Assessment of the Training Program

The training program will be reviewed through quality measures (e.g., data validation, performance evaluations, audits) and updated as deemed necessary by any and all levels of management. When any job requirements change, the need for retraining will be evaluated.
5.0 PROCUREMENT OF SERVICES AND ITEMS

Princeton Hydro procures items and services through in a careful and methodical manner to ensure that such services and items will meet the project’s goals and objectives.

Procurement control criteria are applied to assure the quality and traceability of procured quality-related items and services whose specifications could affect the quality of Princeton Hydro’s services. This includes such quality-related items as the calibration of instruments by outside laboratories, purchases of chemical reagents and standards, and technical service agreements. Both on-site and corporate Princeton Hydro managers are involved with the approval and review of purchasing documentation to ensure that items and services satisfy all requirements and specifications of Princeton Hydro’s internal QA Program, as well as the Client's intended need.

It is the responsibility of the purchase requisitioner to provide the first level of assurance. When documenting the order, all applicable regulatory requirements, industry codes, and standards must appear on the purchase requisition. Each procurement requisition is reviewed and approved by two levels of on-site management and Principal, ensuring a complete review of the items or services.

For procurement of services, Princeton Hydro utilizes subcontractor agreements, which specify all areas of performance requirements, including quality. This passes on a level of confidence to Princeton Hydro’s customers to verify that suppliers are committed and responsible for the quality of items and services provided by their suppliers and how this quality is being assured. A copy of the subcontractors QA/QC documentation will be obtained and reviewed by the QAQCM to ensure subcontractor compliance with requirements of the Princeton Hydro QMP. This action will guarantee quality from the outset and result in a smooth flow of information and services to the EPA.

The requisitioner and/or end user of the procured item is responsible for assuring that the correct item and anticipated certifications were received, inspecting the item for obvious flaws or problems, reviewing accompanying certifications to confirm the suitability of the item, and to monitor the item's performance during use. The applicable Task Manager and the Purchasing Department are notified of any irregularities; the relevant EPA Work Assignment Manager also is notified if the completion of a work plan task(s) will be adversely affected.

Any change to a previously procured item or service must follow the same review and approval cycle as the initial procurement document. A complete reference for internal tracking will be made on the change order to reference any and all initial document control numbers and requirements specified on the procurement document. All changes on procured goods or services must be acknowledged by the supplier.
6.0 QUALITY DOCUMENTS AND RECORDS

6.1 Document Control System

6.1.1 Introduction

A system of document control will be used to identify by number and date each original and revised version of the Quality Management Plan, QA Project Plans, SOPs, and other quality-related documents identified by the QAQCM and Project Manager. This document control system will ensure that all recipients of the documents are issued the latest revisions in a timely manner. The system will also be useful in troubleshooting if it becomes necessary to determine which procedures were in effect at a specific time. The following subsections detail responsibility for the preparation of QA documents or QA document revisions, approval mechanisms, numbering scheme, distribution, responsibility for system maintenance, and general maintenance procedures.

Any document issued prior to the approval of this Quality Management Plan is considered to be "grandfathered" and need not be changed solely to comply with these requirements. When it becomes necessary to change a grandfathered document for other reasons, however, the revision to that document should comply with all of the current document control systems.

The required level of documentation will be specified in QA Project Plans and SOPs. The authors, reviewers, and approval process for each specific document or protocol are different, depending on the technical or administrative purpose and content.

6.1.2 Preparation, Revision, and Approval of Documents

Responsibilities for preparing and revising QA documents and the approval mechanism for each QA document are described in the following subsections.

6.1.3 Program Quality Management Plan

The QAQCM is responsible for preparing and revising the Program Quality Management Plan. The Program Quality Management Plan is submitted to the President for review and approval with a copy to the Project Manager. Both the PM and the President must approve the Program Quality Management Plan and any subsequent revisions.

6.1.4 Quality Assurance Project Plans

The applicable Task Manager is responsible for overseeing the preparation and revision of Princeton Hydro-generated QA Project Plans. Guidance and assistance will be provided by the QAQCM. When a draft is prepared, it will be reviewed and approved by the QAQCM and the Project Manager.
6.1.5 Standard Operating Procedures

The applicable Task Manager is responsible for overseeing the preparation and revision of Princeton Hydro-generated SOPs. Guidance and assistance will be provided by the QAQCM. When a draft is prepared, it will be reviewed and approved by the QAQCM and the Project Manager.

6.1.6 Numbering System

A consistent document numbering system will be required for the Princeton Hydro-generated Program Quality Management Plan, QA Project Plans, and SOPs. The following information will be included in the upper right-hand corner on each page of a Princeton Hydro-generated QA document:

- Project Number (e.g. 0605.004)
- Document Title (e.g., SOP for ...; QAPP for ...; Program Quality Management Plan)
- Document Revision Date (e.g. revised 12/01/2008)
- Page Number (Page x of X format)

Any Client document numbering requirements will supercede the Princeton Hydro requirements.

6.1.7 Maintenance and Distribution of Documents

New or revised QA documents that have been approved will be distributed to all recipients by the person responsible for the document's preparation and maintenance, as follows:

- The Program Quality Management Plan - QAQCM
- Work Plan – Project Manager
- QA Project Plan – Project Manager
- SOP – Project Manager

The responsible person will maintain the current hard copy master, a current distribution list, and all previous versions of the document. The master also will be maintained electronically for revision.

The QAQCM will maintain a central QA "library" for official (signature approved) copies of the Quality Management Plan, Princeton Hydro-generated QA Project Plans and SOPs, other QA documentation, and substantive deliverables (i.e., training modules, EPA peer-reviewed reports, substantive internal reports). Princeton Hydro also will keep copies of QA Project Plans, and SOPs, which are utilized by Princeton Hydro to provide technical support to the EPA and which are relevant to particular work plans. The PM will maintain custody of the official copies of work plans. A deliverable tracking system will be maintained by the Project Manager and Task Managers; the TMs will maintain the file containing the deliverable action form for each deliverable along with a copy of the first page of each deliverable. The Task Managers will also keep copies of technical direction memos.

Project Managers will keep copies of work plans, technical direction memos, Princeton Hydro-generated QA Project Plans and SOPs, along with audit reports, corrective action documentation, and communications regarding QA. Task Managers also will keep copies of EPA-generated
memoranda and plans, QA Project Plans, and SOPs, which are relevant to their particular work plan(s). Project Managers will provide the QAQCM with a copy of work assignments, work plans, QA Project Plans, SOPs, corrective action documentation, and communications regarding QA. The QAQCM will maintain a file of QA documents (i.e. reports, audits, corrective actions, and approved procedures). Electronic copies of these documents and reports will be maintained on specified network file servers.

When a QA document is revised, a change sheet will be attached to the transmittal letter to indicate where and what changes have been made. Deletions will be denoted using “strikethrough” format and additions will be denoted using “bold italics”. These conventions may be used directly in the final documents, too, as appropriate (e.g., work plan revisions). In this way, recipients of documents can compare the previous revision to the current one and easily see what was changed.

### 6.2 Record Keeping Practices

#### 6.2.1 Introduction

Records that document the steps taken to assess quality are an essential part of a QA plan. The act of performing a QC check does not assure all concerned parties that it was performed unless there are records that show what was done, when it was done, who did it, and what the results were. The purpose of a good record keeping system is to allow tracing of data from its origin as raw information, through all transformations, to its reduced format in a final report. This section presents the practices necessary for correctly preparing legible, permanent, and retrievable records in laboratory notebooks, on standard data forms and checklists, and on computer or instrument printouts and electronic media. The required level of documentation will be specified in work plans, QA Project Plans, and SOPs.

#### 6.2.2 Project Notebooks and Logbooks

Project notebooks and logbooks will be bound and the pages numbered consecutively. If the page numbers are not preprinted, the numbers will be written with black, permanent ink. Pages will be designated in the front of the notebook for a table of contents. Entries in the table of contents will be made as work progresses.

An appropriate title that describes the type of information to be recorded in the notebook or logbook will be written on the front cover. In addition, the title, the project or study (if appropriate), date started, date completed, and the name of the person responsible for the notebook or logbook will be clearly written on the first page of the notebook or logbook. All personnel who make an entry into the notebook will write their full name, followed by written initials (include middle initial) in the notebook or logbook for identification purposes.

Data will be entered directly into the notebooks or logbooks and not transcribed from notes. Information will be recorded in sufficient detail that a knowledgeable co-worker could continue the work by reading the notebook. Dates will be recorded with the month either spelled out or abbreviated to avoid confusing numbered months with numbered days. Zeros (0) and sevens (7) will be slashed to differentiate them from the letter O and number 2, respectively.
All entries will be made in permanent ink to ensure that entries can be photocopied. All entries will be signed or initialed except when all entries are made on the same day by the same person. In this case, a date at the top of the entries and a signature or initials after the entries is sufficient. Space will be provided at the bottom of each page for a Task Manager signature and the date to indicate that the entries have been reviewed. Applicable Task Managers will periodically review and approve data entries in the laboratory notebooks and logbooks so that all notebooks and logbooks associated with a project are reviewed at least twice per year.

Entries will never be written over to correct errors. Errors will be corrected by crossing them out with a single line so that the error can be clearly read. Erasers or correction fluid will not be used. The correction will be written clearly, initialed, dated, and the reason for the correction indicated.

Personnel will neither sign nor initial entries for someone else. In addition, personnel will not change someone else's entries. However, if mistakes are found and/or comments need to be added during data review, the Task Manager may make corrections following the procedure for corrections described above. The Task Manager will notify the researcher/technician of any changes.

If a data-gathering activity is not completed, a reason will be recorded. If any data are deleted at later stages, a reason for the deletion will be recorded in the notebook. Unused spaces between entries will be crossed out.

Data printouts may be used in a notebook instead of hand-recorded data if the printouts are permanent (i.e., will not fade over time). Printouts will be taped or glued (not stapled) into the notebook and signed.

Notebooks and logbooks will not be removed from the work site to minimize opportunity for loss. Copies of materials will be made if it is necessary to refer to them elsewhere.

Notebooks and logbooks will be returned to the applicable Project Manager upon request, transfer, or termination of employment.

6.2.3 Standard Data Forms and Checklists

Standard forms are strongly recommended for repetitive manual data recording. They provide a consistent format for pertinent data, ensure that the same items are recorded each time, shorten the recording time, and ensure that data are properly labeled and identified. In the same manner, checklists serve as a systematic reminder of all items that need to be observed/serviced for a particular operation. By initialing each item, as it is observed/serviced, the checklist also serves as documentation that all tasks have been completed.

The procedures prescribed for notebooks and logbooks also apply to standard data forms and checklists. The following rules also apply to standard data forms and checklists.

Entries on standard data forms and checklists for field use may be made in pencil rather than black ink in situations where exposure to rain and/or other sources of water might cause the ink to run. If a pencil is used to make entries on field data forms or checklists, the forms or checklists will be
photocopied or electronically scanned immediately upon return from the field to provide a more permanent record.

If corrections are required on standard data forms, the reason for the correction may be written on the back of the form so that the data remain clearly discernable. Alternatively, standard letter codes may be developed for a project or study within a project. If a code system is used, the key for the code system will be written in the appropriate notebooks and logbooks.

On checklists, use initials instead of a check mark on each item checked. Leave space at the bottom of each form for the Task Manager signature and the date to indicate that the entries have been reviewed.

If a QA Project Plan does not require that data sheets be bound and the pages consecutively numbered prior to data entry, the completed loose-leaf forms will be stored in a folder or binder. The sheets will be numbered as they are used. It is recommended that the data sheets be permanently bound together at the end of the project or task.

### 6.2.4 Computer/Instrument Printouts and Electronic Media

Laboratory or field automation reduces the amount of manual record keeping that is necessary to document a project or task. Computer printouts, strip charts, chromatograms, and other printed output provide neat, legible documentation. Electronic media are capable of storing large amounts of data in a small space. Careful planning is required with records of these kinds to ensure that all necessary data are included to eliminate traceability problems. The following considerations will help ensure complete data.

Each printout or electronically-stored data set will, at a minimum, contain the following:

- **Date:** The date the task was performed.
- **Operator:** The person operating the instrument or computer.
- **Identification:** A description of the information being recorded.
- **Information:** The information itself, or an explanation of why it is not recorded.

The following items may also be essential, depending on the information being recorded:

- **Instrument ID:** Type, model number, serial number, etc.
- **Study ID:** A description of the study for which the information is being recorded.
- **Time:** The time of day the task was performed.
- **Units of Measure:** The units that are used for each type of measurement that is recorded.
- **Coding:** An explanation of any special codes that are recorded.

Printouts will use media that will not fade over time, or will be photocopied onto a medium that will not fade, and will be signed in permanent ink.

Raw data should be screened immediately after data collection for obvious potential data outliers (e.g., numerical range outside typical data expectation, decimal point error, and incorrect units).
Raw data that are manually entered into a computer from an original document will be checked for accuracy against a computer printout of the raw data. It will be noted on the printout that the raw data were checked, and the printout will be dated and signed. It also will be noted in the electronic file that the data were verified. Data from standard data forms and checklists can be scanned to create an electronic copy of the data; and, if so, the electronic copy will be checked for accuracy against the standard data forms and checklists.

Electronic data files maintained on PCs and Work Stations will be backed-up daily. Therefore, critical data files will routinely be copied by the person generating/using the files from the hard drive to the appropriate network file server to ensure that records are permanent; and, that if any computer problem occurs, there is minimal loss of work. If a computer is not on the Princeton Hydro network, files will be copied to two separate CDs to provide data back up. Similarly, data files will be archived on network file servers (preferred) or CDs. It is recommended that completed files and/or files ready for archive be placed as "Read Only" files in common folders on network servers.

6.3 Record Retention, Transfer, and Disposition

After records are generated, they are retained for a period of time and then either transferred to the custody of others or disposed of. This subsection discusses general policies and procedures for record retention, transfer, and disposition.

Each Project Manager will prepare and maintain a list of documents and records indicating the type of record and its storage location for documents and data records, which are associated with the applicable work plan. The list of documents and records will include:

- Work Plan
- QA Project Plans
- SOPs
- Technical Direction Memos
- Deliverable Action Forms along with Cover Letter and First Page of Deliverable
- Deliverables (e.g., reports, memorandums, technical document, training modules)
- Database Documentation
- QC Records
- QA Correspondence (e.g., audit reports, corrective action documentation)
- Filename, directory, folder

Each Project Manager will provide the QAQCM with a copy of the list.

Records will be stored in a manner, which precludes deterioration, larceny, and vandalism. The original data may be in hard copy, electronic copy, or both.

Records needed for reference on a routine basis may be stored in office files. Official records of the projects that are not needed on a routine basis shall be retired and stored. Prevention of damage to special records (i.e., photographs, negatives, microfilm, and magnetic media) from excessive light, dust, stacking, and electromagnetic fields will be of prime consideration when placing these special records in long-term storage facilities.
The retention, transfer, and disposition procedures contained in the Princeton Hydro Quality Management Plan are followed for Princeton Hydro internal records.

7.0 COMPUTER SOFTWARE AND HARDWARE

The Princeton Hydro Corporate Information Systems Supervisor is responsible for the development of requirements, procurement, implementation, testing, training, and maintenance of computer software and for the compatibility of systems hardware, methods, and programs used for support of Princeton Hydro’s program, analytical, and administrative operations. The Princeton Hydro Corporate Information Systems Supervisor will classify all software, developed or procured, as one of the following categories:

Category 1: This category includes software developed or modified to support research or development activities, which may lead to licensing. Category 1 software must include documentation, testing, and controlled revisions. The program must be approved by the Princeton Hydro Corporate Information Systems Supervisor before use and implementation.

Category 2: Purchased software, which is a commercial off-the-shelf item.

All computer hardware and software will be procured according to Princeton Hydro procurement control guidelines.

8.0 QUALITY PLANNING

8.1 Introduction

Quality planning encompasses all of the preparations that are necessary to achieve a quality objective. The Program Quality Management Plan, work plans, QA Project Plans, SOPs, Field Sampling Plans, and Health and Safety Plans are tools used in the quality planning process. Each of these documents provides information and guidance needed to provide quality technical support to the EPA through production of quality deliverables.

The following aspects of quality planning are addressed below:
- Chain of Command
- Data Quality Objectives
- Documentation
- Health and Safety

8.2 Chain of Command

The Princeton Hydro contact for direct communication with the Client is the PM. The Princeton Hydro contacts for direct communication with the Client for task or project related issues may also be the corresponding Task Manager.
The PM also is the focal point for all Princeton Hydro internal contact. The Princeton Hydro internal contact will follow a chain of command within the individual sections of the organization. The QAQCM has a direct line of communication with the President. These lines of communication and chain of command are shown in the organizational chart (Figure 1).

**8.3 Data Quality Objectives**

Data Quality Objectives (DQO) specify the level of quality required for a particular process and/or task within a project. The DQO process consists of the following five (5) steps:

1) State the problem - specifically and clearly define the problem, identify the planning team, and examine budget and schedule constraints.

2) Identify the decision - state decision, identify study questions, and define alternative actions. (In Step 2, the key question that the study attempts to address is identified along with alternative actions that may be taken, depending on the answer to the key study question. These two elements are then combined to develop a decision statement.)

3) Identify inputs to the decision - identify the information needed for the decision.

4) Define the boundaries of the study - specify sample characteristics, define spatial/temporal limits, and identify units of decision making.

5) Optimize the design for obtaining data - select resource-effective sampling and analysis plan that meets the performance criteria.

Princeton Hydro will prepare QA Project Plans documenting development of DQOs and their application to relevant methodologies, as requested. The QA Project Plan will then be implemented either directly to complete the tasks or will be used to enhance/modify any working SOPs to complete the requested tasks. The DQOs will include the following elements necessary to satisfy the objectives to the particular project: 1) the scope of the project or task; 2) the level of data specification, quality, and documentation; 3) the quantitative goals of sensitivity, precision, accuracy, and completeness; and 4) the qualitative goals of representativeness and comparability.

The required levels of data specification, quality, and documentation are defined for these parameters to develop a QA Project Plan, which will meet the intended needs of the project. The type of data to be collected often specifies the collection and analytical methods, which are used. Data quality and documentation are related. If there is adequate documentation (e.g., detailed logbooks, deviations, corrective actions), then the project will inherently contain the corresponding degree of assurance of the quality. The data sensitivity level, on the other hand, will be determined by the QC parameters, which are defined in the QA Project Plans and/or the SOP(s) used to obtain the data.

**8.4 Documentation**

The required level of documentation will be specified in QA Project Plans, and SOPs. As stated above, documentation is important in order to validate the quality of the data collected. Also, any documentation procedures to be implemented will structure the type of quality achievable. Documentation can be implemented for organizational and project information. Organizational documentation includes the documented roles and responsibilities associated with a function of the
organization. Project information documentation includes all aspects related to a project. These aspects can be generalized into technical and non-technical documentation.

Technical documentation includes all documentation created or completed in relation to a specific data-collecting task. This includes both the development of the appropriate documentation schemes to attain a specified quality level and the actual implementation of, maintenance of, and compliance with these schemes. The documentation schemes will be specified in the QA Project Plans. Logbook entries and chain-of-custody completion are examples of such forms of documentation. The actual implementation of, maintenance of, and compliance with the documentation procedures will be through the Work Plan, the Program Quality Management Plan, the QA Project Plans, and the associated SOPs.

Non-technical project documentation comprises all related documentation that is not directly associated with data analysis, calculations, reports and plans. Examples can include documentation of any deviations, problems encountered, and/or condition modifications. Such documentation will indicate when problems arise and permit prompt resolution/acceptance of results and will proceed through the chain of command in an orderly fashion to allow all necessary authorities involved to be notified.

### 8.5 Health and Safety

Health and safety precautions will be determined and documented during the planning process for a project or task and incorporated as appropriate into Health and Safety Plans, Work Plans, QA Project Plans, and SOPs.

### 9.0 QUALITY IMPLEMENTATION

Princeton Hydro utilizes the Quality Management Plan, Work Plans, QA Project Plans, and SOPs as the primary tools for quality implementation. Procedures described in these documents are developed and implemented for appropriate routine, standardized, special, or critical operations. Procedures or documents that specify technical requirements are reviewed for adequacy by Princeton Hydro’s technical staff before use. Implementation of any work process includes routine measurements of performance against established technical and quality specifications. As an ongoing practice, all work is monitored to ensure continued satisfactory compliance against the quality implementation documents for a particular project.

When project-specific and/or unique requirements result in the need to deviate from SOPs or other quality implementation documents, such deviations will be documented and approved in the applicable work plan or through a Technical Direction Memo from the assigned Task Managers with a copy to the QAQCM and Project Manager.

Princeton Hydro periodically reviews quality implementation documents. Reviews are conducted by the QAQCM, and other qualified technical staff as needed, and will include, but not be limited to, incorporation of quality measures and identification of acceptance criteria. The Program Quality Management Plan will be reviewed annually by the QAQCM. As part of work plan preparation, any relevant EPA-generated QA Project Plans and SOPs are reviewed for applicability.
Hydro-generated QA Project Plans and SOPs are similarly reviewed. Reviews will be conducted by the QAQCM and designees. Items identified during the reviews that require modification will be discussed with the Task Managers and Project Manager prior to modifications. Quality implementation documents will be formally amended as needed as part of the review process.

10.0 QUALITY ASSESSMENT AND RESPONSE

Assessment is defined as a learning process intended to increase the user's understanding of the project or system being assessed, and to provide a basis for improving such projects or systems. Princeton Hydro ensures that its systems are planned, implemented, and evaluated to measure their effectiveness. The tools utilized at Princeton Hydro for assessing work performed include, but are not limited to:

1. Review of Analytical and Technical Documents
2. Evaluation of Data Quality Objectives
3. Data validation
4. Audits
   - Data quality audits
   - Management systems reviews
   - Technical system audits
5. Reports to management

10.1 Review of Analytical and Technical Documents

Princeton Hydro reviews all reports of work, data, and documentation generated or acquired by staff assigned to work plans. At a minimum, the applicable Project Manager reviews all deliverables, such as data reports, enlists the assistance of other knowledgeable technical staff and/or the QAQCM to provide additional independent review of deliverables and other work.

10.2 Evaluation of Data Quality Objectives

The goal of any environmental measurement project is to produce data of known and acceptable quality, suitable for its intended use. Princeton Hydro will assess all measurements for precision, accuracy, representativeness, comparability, and completeness based upon the DQOs established by the particular QA Project Plan. During project and task implementation, all activities and analyses will be conducted using SOPs so that the levels of accuracy, precision, completeness, representativeness, and comparability can be documented. Experimental data submitted by Princeton Hydro to the Project Manager will be accompanied by associated QC data for precision and accuracy. Statements on completeness, representativeness, and comparability shall also be included as appropriate.

Although specific QC procedures will be used to meet the needs of each individual project, the general Princeton Hydro objectives are as follows:

- **Accuracy** - Data are considered accurate if a measurement (or an average of measurements of the same thing) agrees with an accepted reference or true value within prescribed limits.
- **Precision** - Data are considered precise if repeated individual measurements of the same
property, usually under prescribed similar conditions, agree within prescribed limits.

- Completeness - Data are considered complete if a prescribed percentage of the total possible measurements are present.
- Comparability - Data are considered comparable if they are in consistent units corrected to standard conditions. Comparability is most useful when evaluating data collected by different organizations.
- Representativeness - Data are considered representative if they typify the condition intended to be measured.

10.3 Data Validation

Data validation is the process whereby data are determined to be of acceptable or unacceptable quality based on a set of predefined criteria. Depending on the type(s) of data involved and the purpose(s) for which the data are collected, data validation can consist of procedures that range from a cursory scan to a detailed statistical analysis. Data will be validated using the guidance provided in the document Guidance for Data Quality Assessment (EPA QA/G-9). Specific data validation methods to be used to assess data quality for each project are prescribed in each QA Project Plan.

General data validation procedures will be routinely applied. Raw data will be screened immediately after data collection for obvious potential data outliers (e.g., numerical range outside typical data expectation, decimal point error, incorrect units). Raw data that are manually entered into a computer from an original document will be checked for accuracy against a computer printout of the raw data. Raw data screening will be performed, whenever possible, by someone other than the original data preparer.

After data reduction into tables or arrays, the Task Manager will review the data set(s) again for detection of anomalous values. As part of the data review process, the Task Manager will check that spreadsheet cell formulas are accurate and are performing calculations correctly. Any inconsistencies discovered will be resolved immediately, if possible, by seeking clarification from the personnel responsible for data collection, by performing the measurement again, and/or correcting spreadsheet cell formulas.

Data validation also is accomplished through routine audits of the data collection, procedural flow, and by monitoring QC sample results through: dated and signed entries by analysts and managers on the worksheets and logbooks used for all samples; the use of sample tracking and numbering systems to track the progress of samples from sample collection through laboratory analysis; and the use of QC criteria (DQOs) to reject or accept specific data.

10.4 Audits

Princeton Hydro will administer performance evaluations, management systems reviews, technical system audits, and data quality audits to determine compliance with the Program Quality Management Plan, QA Project Plans, and SOPs. The audits form a basis for corrective action requirements and constitute a permanent temporal record of the conformance of activities to QA
requirements. An individual audit plan will be developed to provide a basis for each audit. Princeton Hydro will consult the document Guidance on Technical Audits and Related Assessments for Environmental Data Operations (EPA QA/G-7) to help design and implement effective audits.

10.4.1 Management Systems Reviews

A management systems review is an on-site evaluation of an organization in order to verify the existence and adequacy of internal management systems and documents necessary for the implementation of the QA program. The management systems review is conducted to determine the extent to which QA is being implemented within an organization and to recommend actions, which are necessary to correct discovered deficiencies.

10.4.2 Technical System Audits

A technical systems audit is a qualitative on-site evaluation of a total measurement system. Technical system audits are used to verify the existence and adequacy of all equipment, facilities, supplies, personnel, and procedures that are either used directly for or in support of the collection and interpretation of data on a specific environmental variable. A technical system audit may be used to routinely verify that measurement systems are being operated properly or may be used to investigate problems first identified in a performance audit.

10.4.3 Data Quality Audits

A data quality audit is an evaluation of the documentation associated with data quality indicators of measurement data to verify that the data are of known quality. This type of audit is conducted to verify the availability of quantitative and qualitative indicators of data quality. Availability of data quality indicators depends upon the proper collection, interpretation, and reporting of information required characterizing the quality of the data.

10.4.4 Responsibility

Technical system and data quality audits of projects will be conducted by the QAQCM. Reports of performance audits will be reviewed and monitored by the PM and President. Management systems reviews of the program will be conducted by the President or his/her designee(s). Technical system and data quality audits will be planned by the QAQCM with cooperation and assistance from the applicable Task Managers and PM. The QAQCM will enlist the assistance of technical specialists who are independent of the activities audited, as needed. The QAQCM serves as audit team leader and is responsible for the selection and preparation of the team, coordination of the audit process, communications with the group or organization being audited, participation in the audit, coordination of the preparation and issuance of audit reports, and evaluation of audit responses. Checklists will be used by the QAQCM and audit team to conduct all auditing.

10.4.5 Frequency

Audits will be scheduled by the QAQCM in consultation with the President and the PM. Audits will be administered within the constraints of QA program resources. At a minimum, the QAQCM will
conduct an audit each quarter of the year. Audits will alternate between technical system and data quality audits. These audits will be conducted to verify that all program personnel follow the basic requirements specified in the Program Quality Management Plan, the applicable QA Project Plans, and SOPs. Each audit will not be required to cover all tasks and activities performed by Princeton Hydro under all work plans, but will involve sufficient activities to allow an evaluation of the quality of the work and compliance with the Program Quality Management Plan. Management systems reviews will be conducted annually.

10.4.6 Reporting

Following completion of an audit, the QAQCM with the assistance of the audit team will prepare and submit an audit report to the President with copies to the PM and the applicable Task Managers. The PM and applicable Task Managers will coordinate a management review of any deficiencies noted. Corrective actions are then implemented to preclude the reoccurrence of the deficiency. After acceptance and verification of all corrective actions, an audit closure is issued by the QAQCM to the same individuals receiving the post-audit report.

10.5 Reports to Management

A QA section will be included in the monthly report on the status of work plans, which is prepared by the Princeton Hydro Task Manager and PM and provided on a monthly basis to the EPA Project Officer and the EPA Work Assignment Managers. These monthly reports will provide an opportunity to alert the EPA to any potential data quality problems, to propose viable solutions, and to procure additional resources, if necessary. The QA section of the monthly report will describe and discuss the results of any audit activities conducted during the reporting period.

10.6 Client Feedback

Princeton Hydro relies on feedback from the EPA to verify the usability and quality of Princeton Hydro’s services and work products. Senior Princeton Hydro technical and quality managers will respond to EPA feedback by developing and implementing steps to address negative feedback and to reinforce practices that yield positive feedback.

11.0 QUALITY IMPROVEMENT

The evaluation of quality is a continuous process, which should result in a more responsive and effective QA Program. The primary objective of quality improvement is to act progressively on a condition adverse to quality. By implementing a positive corrective action, lessons will be learned and another step toward quality compliance will be achieved. The primary tools to evaluate the need for quality improvement are:

- Nonconforming Data Reports
- Audits
- Corrective Actions

The QAQCM will have primary responsibility for the evaluating and planning for the
effectiveness of quality improvement.

11.1 Nonconforming Data Reports

A Nonconforming Data Report will be prepared by the applicable Task Manager if questions should arise about a data set or its data quality. The Nonconforming Data Report documents the issues raised in reference to the data. The Task Manager also will notify the Project Manager and the QAQCM about the data quality concerns. With the help of the QAQCM or designee(s), the Task Manager will investigate the issues until a justifiable response is obtained. The Task Manager will notify the applicable Project Manager when data quality problems are discovered in either historical or active data files after discussing the data quality issues with the Task Manager and QAQCM.

11.2 Audits

As previously stated, the primary focus of audits is to validate compliance against a set of criteria. Any deficiencies in conforming to established requirements (e.g., sampling, analytical, project nonconformance) should be identified as the result of an audit. At the completion of an audit, the QAQCM will evaluate the findings to determine which, if any, corrective actions need to be initiated. Audit reports will be submitted to the President, with copies sent to the PM and applicable Task Manager.

11.3 Corrective Actions

Corrective actions are taken to preclude recurrence of conditions adverse to quality. Project personnel are responsible for performing established procedures to identify and correct non-compliance conditions in their work areas and reporting to the applicable Task Manager all quality problems and corrective actions taken. After a quality problem is identified and brought to the Task Manager’s attention, corrective actions will be implemented by appropriate technical staff under the oversight of the Task Manager. Quality problems—not resolvable by the Task Manager will be referred to the next highest level of authority for resolution according to the following hierarchy:

- PM
- QAQCM
- President

Corrective Actions will be documented and tracked until all deficiencies are satisfied. The QAQCM will track the progress of corrective actions for all major quality problems (e.g., problems noted during audits). If the supporting evidence satisfies the cited conditions of the corrective actions, the QAQCM will close the corrective action.

A closed-loop system will be used for corrective action. Elements of the system include:

- Definition of problem
- Assignment of responsibility to investigate problem
- Investigation of problem
➢ Determination of corrective action
➢ Implementation of corrective action
➢ Verification of problem correction
➢ Implementation/dissemination of procedural changes, if any

Corrective action documentation will be submitted to the President with copies sent to the PM, applicable Task Manager, and other Princeton Hydro personnel as appropriate. The QAQCM will maintain a historical file that describes major quality problems and their solutions for all projects of the program.
Appendix B

Organizational Charts
Project Organizational Chart

CCRPA
Francis R. Pickering

Project Manager
Laura Wildman

Principal & Contract Manager
Geoff Goll

Project Partners
- PRWA
- FRWA
- CT DEP

Other Critical Parties
- CT DOT
- CL&P
- Gas Company

Water
Design, Engineering, Construction
- Mary Paist-Goldman
- Keithe Merl
- Jacob Helminiak

Hydrologic & Hydraulic Modeling
- Mary Paist-Goldman
- Jacob Helminiak

Nature
Fisheries Biology & Passage
- Dr. Stephen Souza
- Laura Wildman

Ecosystem Assessment & Monitoring
- Mark Gallagher
- Paul Cooper

Environmental Permitting
- Michael Rehman

Soil
Sediment Testing & Assessment
- Paul Cooper
- Geoff Goll

Fluvial Geomorphology
- Paul Woodworth

Geotechnical & Hydrogeology
- Keith Merl

Specialty Support
Survey
- Robert Sterling of GM2*

* GM2 is a legitimate minority business enterprise.
Princeton Hydro Organizational Chart

Note: Not all junior staff members are represented on this company-wide organizational chart.
Appendix C

Financial Statements
Appendix D

Letters of References
September 3, 2009

Geoffrey M. Goll, P.E.
Vice President
Princeton Hydro, LLC
1108 Old York Road, P.O. Box 720
Ringoes, New Jersey 08551

Re: Letter of Reference

Dear Mr. Goll:

As requested, we are providing this letter of reference regarding the work you recently completed for the Musconetcong Watershed Association for the removal of the Gruendyke Mill Dam and Seber Dam, and the feasibility study for the removal of the Finesville Dam; all of which are located on the Musconetcong River in New Jersey.

The work you completed on the above mentioned projects was performed in accordance with and beyond our expectations, with all work completed within the budget allotted for the work performed. Princeton Hydro was attentive to detail, provided excellent customer service, and took a personal interest in all MWA projects on the river.

The Musconetcong River is a part of the National Wild and Scenic River System, it is classified as a Category One water body under the New Jersey Department of Environmental Protection Stormwater Regulations and it is a Delaware River Basin Commission Special Waters Protection river. As such, all work in the river is done under much scrutiny.

We would recommend Princeton Hydro for any water resource work and river restoration, particularly for their understanding of dam removals, with their social, ecological, and engineering complexities.

Sincerely,

[Signature]

Beth Styler Barry
Executive Director

P.O. BOX 113, ASBURY, NEW JERSEY 08802 (908) 537-7060
September 8, 2009

Geoffrey M. Goll, P.E.
Vice President
Princeton Hydro, LLC
1108 Old York Road, P.O. Box 720
Ringoes, New Jersey 08551

Re: Letter of Reference

Dear Mr. Goll:

As requested, we are providing this letter of reference regarding the work you recently completed for American Rivers in Pennsylvania. To date you have completed the removal of the Ralph Stover Dam in Bucks County and are working to complete the design and permitting for five other blockages for us in eastern PA.

My experience working with Princeton Hydro on dam removal projects has been very positive. Princeton Hydro has been responsive to my feedback on dam removal design approaches, has successfully acquired permits for dam removals in Pennsylvania and New Jersey, has conducted positive public meetings in support of dam removal and has worked through several social and technical complexities on my projects. I have been very happy with the quality of work I have received from Princeton Hydro. I have especially appreciated the firm’s client responsiveness, dam removal design approach and demeanor in public and permitting situations.

In 2008, American Rivers conducted a Request for Qualifications process to solicit firms with river restoration expertise for our project work, which is largely focused on dam removal and floodplain restoration. Princeton Hydro submitted a qualifications packet for river restoration services and was selected by American Rivers as one of 10 firms with which we have established Master Service Agreements for our dam removal and restoration work in the Middle-Atlantic States and the greater Northeast.

Sincerely,

Sara Strassman
Associate Director, River Restoration Program
September 3, 2009

Princeton Hydro, LLC
1108 Old York Road
P.O. Box 720
Ringoes, New Jersey 08551

Attn: Geoffrey M. Goll, P.E.
Vice President

Re: Letter of Reference

Dear Mr. Goll:

As we understand, Princeton Hydro, LLC is preparing to submit a proposal for a dam removal project in Bristol, CT. It is our opinion that such a water resource project would benefit from your consultation and engineering expertise.

In addition to the dozens of water resource and geotechnical engineering projects completed for our clients, of particular quality was the 400 foot long culvert daylighting design and permitting that you recently completed in Englewood, NJ. You completed this project in a timely manner and within budget. Your expertise in water resources and river restoration created an innovative design and your understanding of fluvial geomorphology, ecology, and hydraulic engineering facilitated the procurement of permits for this project.

It is our opinion that Princeton Hydro has the knowledge, expertise and excellent customer service that would make any project a success.

Very truly yours,

L2A Land Design, LLC

Michael E. Dipple, PE
Principal
Appendix E

Summaries of Recent Dam Removal & Fish Passage Work
In 2001, Princeton Hydro was contracted by Harry Pursel, the owner of a local agricultural and garden supply store, to inspect the Harry S. Pursel dam. This dam was a remnant structure of the historic Morris Canal and part of a historic gristmill complex. The canal is protected under the National Historic Preservation Act and is registered under the National Register of Historic Places. Our dam inspection found that the cost to bring the dam into compliance with current regulations would be between $500,000 to $600,000. To provide a more cost-effective option, Princeton Hydro recommended breaching the dam and its subsequent deregulation.

Because the dam is located on the Lopatcong Creek, a protected C-1 waterway and trout production stream, Princeton Hydro was able to identify and secure over $132,000 in grants and a NJDEP low-interest loan to fund the project. The company then prepared an initial dam breach design which included the partial removal of the concrete ogee spillway. To protect the area from flooding, it was necessary to preserve the steep earthen embankments around the dam. Therefore, Princeton Hydro also designed a step pool system to transition the stream elevation while providing fish passage for local species. The team then developed a hydrologic and hydraulic analysis of the watershed to ensure that the designs for the dam breach would not affect property owners downstream.

Princeton Hydro then assisted in the permit application process and provided construction supervision. In addition to the design and permitting of this dam, Princeton Hydro also worked with local groups to preserve the historic aspects of this dam through the use of signage, local rock and the preservation of the major components of the historic Morris Canal. The dam was breached in April 2006 and continues to be used by the NJDEP, USFWS, and NRCS as an example of a successful dam removal, where dam safety compliance, ecological restoration, and historic preservation can all be achieved.
The Ralph Stover Dam, located on the border of Plumstead and Tinicum Townships in Bucks County, Pennsylvania is a remnant dam of an 18th century grist mill. It was designed as a “run of the river” dam, and therefore, provided no flood storage. Due to its deteriorating condition and its anticipated repair costs, Princeton Hydro was contracted by American Rivers, a national nonprofit river conservation organization, to prepare the necessary plans and apply for permits to remove the dam.

Princeton Hydro engineers inspected the dam, drafted plans to remove the 155-foot primary spillway, and ran hydrologic and hydraulic models. To enhance the area around the dam, Princeton Hydro developed plans to use the recycled stone to stabilize the stream banks and to create a fish habitat upstream.

In addition to the design, Princeton Hydro worked with local stakeholders and the Department of Conservation and Natural Resources (DCNR), the owner of the dam, to conduct public outreach. As part of the public outreach, Princeton Hydro prepared concept photographs to help residents and park users better understand the ecological and recreational benefits of the dam removal.

Following the obtaining of permits, the dam was removed under the construction management and administration of Princeton Hydro in December 2007.
Edwards Dam Removal

City of Augusta
Kennebec River in Maine

The Edwards Dam was a 24 foot high and 917 foot long dam extending across the width of the Kennebec River in Augusta, Maine. The dam was built in 1837 to facilitate upstream navigation and provide mechanical power to a saw mill. The dam was a rock-filled timber crib structure with some concrete sections along its spillway. The dam abutted an old factory building and a hydro-electric generating facility along the two river banks.

The Edwards Dam removal was a nationwide precedent setting case in which the Federal Energy Regulatory Commission (FERC), for the first time ever, ruled that the benefits of a free-flowing river, outweighed the benefits of the dam, and ordered the removal of the Edwards Dam.

The dam was removed in two stages, using mechanical methods (i.e. large excavators). Since there was very little impounded sediment behind this dam and no contaminated sediment present, no upstream sediment was removed prior to the dam’s breaching. The dam was fully removed in 1999 for a total cost, inclusive of engineering and permitting, of approximately $3 million dollars.

Laura Wildman, a senior engineer with Princeton Hydro, while under different employment, was hired by the Kennebec Coalition to help select the appropriate engineering firm to complete the design and permitting for the project. In addition, she played a vital technical oversight role to ensure that the project was designed, estimated and completed in a manner that complemented the restoration goals of the Kennebec Coalition. The group made up of environmental, non-governmental organizations (NGOs) such as American Rivers, the Atlantic Salmon Federation, the Natural Resources Council of Maine, and Trout Unlimited and its Kennebec Valley Chapter.

In subsequent work, as Chief Engineer for American Rivers, Ms. Wildman continued to play an active engineering oversight role for other significant dam settlement efforts in Maine, on both the Penobscot and Presumpscot Rivers.
Gruendyke Mill Dam Removal and River Restoration

Musconetcong Watershed Association
Hackettstown, NJ

Princeton Hydro worked closely with the owner of this dam since 2002. This dam on the Musconetcong River once provided power to a saw mill in the 19th century. Due to years of neglect and erosion, the abutments, dam face and spillway became structurally unsound. The dam had been repaired repeatedly over the years, leaving very little of the original dam remaining. The Musconetcong Watershed Association worked with the dam owner to select Princeton Hydro to remove this aging structure.

Princeton Hydro researched past dam inspection records and designed plans for the removal of the seven foot high and ninety six foot wide structure. As required by NJDEP Dam Safety regulation, we also completed hydrologic and hydraulic analysis to ensure that downstream flooding was not increased. Working with the client, Princeton Hydro secured over $180,000 in funding from the US Fish & Wildlife Services, NRCS, Warren and Morris Counties, and the North Jersey Resource Conservation and Development Council. Princeton Hydro also worked with regulators on local, state and federal levels to secure all the necessary permits.

To restore the wild and scenic nature of the river, Princeton Hydro designed two vortex rock weirs that stabilize sediment, allow fish passage and blend in with the character of the waterway. This option was selected to avoid significant in-channel dredging which would have significantly increased the costs for the removal. Project partners acquired boulders from a nearby area, while Princeton Hydro staff worked closely with contractors to supervise boulder placement and rock weir construction during low-flow periods. The project was approved by the NJDEP and County Conservation District in the spring of 2008 and the completed in June and July of the same year.

For more information about this and other Princeton Hydro projects, please contact us at info@princetonhydro.com.
The Restoration of Diadromous Fish

Passage on the Naugatuck River

_Cities of Waterbury & Naugatuck_

The Naugatuck River Restoration Project included the investigation of dam removal and fish passage around eight obsolete industrial dams on the Naugatuck and Mad Rivers. The project sought to improve water quality, increase public access to the river and restore the historic diadromous fish runs to the Naugatuck River Watershed.

The project dams included the Anaconda Dam, the Union City Dam, the Platts Mill Dam, the Freight Street Dam, the Tingue Dam, Chase Brass Dam, the Plume & Atwood Dam, and the Bray’s Buckle Dam, all ranging in size from 100 to 300 ft long and 4 to 20 ft high. Five of the eight dams investigated were removed and an innovative bypass channel was designed to circumvent another.

This multimillion dollar restoration effort was one of the first of its kind in the country and targeted the restoration of American shad, blueback herring, alewife, American eel, and sea-run brown trout to the watershed. Investigation of the dams began in 1996. Four of the dams were removed by 1999, and a fifth was removed a few years later. The final step in diadromous fish restoration will be the completion of the bypass channel in 2010. Fish passage alternatives were prepared for all of the dams which included the investigation of full removal, partial removal, fish ladders and nature-like fishways, both bypass channels and rock ramp fishways. Detailed sediment testing and quality/mobility analyses were completed as part of the sediment management plans for each dam.

Laura Wildman, a senior engineer with Princeton Hydro, while under different employment, was the engineering Project Manager for the project and led the fish passage feasibility assessments, the hydrologic/hydraulic analyses, the dam removal designs, and the engineering cost estimates for the project, as well as provided full-time construction oversight for four of the five dams removed.

The project will reintroduce diadromous fish to this once heavily polluted industrial river and has already started to turn the attentions of the surrounding communities back toward the river, as they realize that the restored river has the potential to become a valuable community asset. In 2008 the communities along the river celebrated their first ever Naugatuck River Fest. It is anticipated that annual runs of 23,000 American shad could be restored, making the Naugatuck River the third largest American shad sport fishery in Connecticut.

For more information about this and other Princeton Hydro projects, please contact us at info@princetonhydro.com.
Princeton Hydro was contracted by L2A Land Design, LLC, a respected Civil Engineering firm in northern New Jersey to investigate and design the day-lighting of 200 feet of 16’x8’ culvert ran removing 200 feet of 16’x8’ rectangular channel. Since the early 1900s Overpeck Creek and its floodplain has been the subject of in-filling, channelization and culverting to accommodate development and urbanization of the watershed, however, such activities have led to the creation of man-made flood hazards due to the overtopping of channels and overflowing of culverts in the system.

To design the day-lighting and de-channelization, Princeton Hydro developed the hydrology of the watershed and prepared hydraulic models of the existing conditions. The existing condition modeling illustrated that during flood events as low as the 10-year event, overwhelmed the culvert and overtopped via of the local streets and adjacent building structures. Subsequent to understanding the existing problems, Princeton Hydro developed a conceptual model of a removed culvert and channel, replaced by a stream channel and overbank area that mimics a natural systems. The purpose of a replicated channel and overbank area was modeled to assist in the reduction of local flood elevations and the creation of storage to attenuate downstream impacts.

The final design included a meandering stream channel and several overbank benches to allow flood attenuation and create ecological habitat. Due to the urbanized nature of the area and existence of significant structural (i.e. road, bridges) and environmental infrastructure (sanitary sewer) in close proximity to the site, it was required to reinforce the design with stone and reinforced slopes to maintain a fixed channel.

The project was permitted and scheduled for construction in the fall of 2009.
Princeotn Hydro was contracted to investigate, analyze and design the removal of obstructions on the Darby Creek. Through the funding by the National Fish and Wildlife Foundation and PA Growing Greener funds, the objective of the project was to remove remnant bridge piers in Colwyn/Sharon Hill Boroughs, a failed dam in Darby Borough, a mill dam in Landsdowne/Clifton Heights Borough, and a dam in Upper Darby Township/Clifton Heights Borough.

Princeoton Hydro coordinated the development of land surveys for the projects and completed the initial tax parcel research and layout. Using the Delaware County Stormwater Management Plan hydrologic model, peak flows were developed for various flood events. Field surveys were complete to assess the geomorphic characteristics of the stream including pebble counts and measurement of bank fill benches in stable reaches downstream or upstream of the obstruction’s impoundments.

Once all field and hydrologic modeling work was complete, hydraulic models were developed, channel sizes developed and conceptual models developed. The concepts were presented to the public at two meetings to obtain comment and input. The suggestions of the public were evaluated and where appropriate were included in the final design.

The final designs were completed and submitted to the various permitting agencies for review, including PADEP Dam Safety, US Army Corps of Engineers, and the County Soil Conservation District.

Construction of the project is anticipated to be initiated and completed in the first half of 2010.
Guilford Lakes Fishway

Town of Guilford

West River in Connecticut

The Guilford Lake community consists of 240 homes around a 6 acre upper lake and a 14 acre lower lake. The dam on the lower of the two impoundments has two spillways. The primary spillway is 12 feet in high, and the secondary spillway is 2 feet high with an additional 4 foot of head to overcome within the steep bedrock ledge bypass channel, downstream of the lower spillway. Both spillways are concrete structures and were recently reconstructed. The CT DEP ordered the Lake Association to install a fishway on the lower dam when it was reconstructed and a technical fishway estimated at $70,000-$100,000 was designed by others for the larger of the tow spillways.

Ms. Laura Wildman, while Chief Engineer with American Rivers, now an associate engineer with Princeton Hydro was asked to investigate other fish passage options at the site that might help to reduce the cost of the fish passage work. Ms. Wildman enrolled the help of some graduate students at Yale to start investigating the option of constructing a nature-like fishway, bypass channel, within the downstream bypass channel below the smaller of the tow spillways. Ms. Wildman’s final fish passage design consisted of two sections of rock step-pool nature-like fishway and two small sections of Alaskan Steeppass fishway at a cost of $31,000, for which two grants were obtained through the American Rivers-NOAA Community-Based Restoration Program Partnership and USFWS.

The step-pools were designed to mimic a naturally occurring steep step-pool system and provide streaming flow between the gaps of the boulders such that alewife could pass up the river into the lower lake. With this nature-like system in-stream habitat was created as well as diadromous fish passage, in an aesthetically pleasing fishway design. Within the first migratory season after construction of the fishway alewife were seen jumping in the lower lake. A detailed fish tagging analysis was later completed by a UMASS graduate student that showed alewife were utilizing the fishway to pass into the lower lake. In addition Ms. Wildman completed a separate study on this site and another site that she had done the conceptual design work for, entitled “Hydraulics of Nature-like Fishways: Velocity Cross-Section Analyses of Sennebec and Guilford Lakes Nature-Like Fishways” as part of her masters work at Yale. The Yale study investigated the complex velocity pathways available to a wide variety of fish species and life stages when using the nature-like fishway approach.

In the end the nature-like fishway option cost significantly less than the technical fishway proposed by others and by applying for and receiving restoration grants the entire project was done at no cost to the Lake Association.
Fish Passage and River Continuity

General Experience

Princeton Hydro has multiple fishery experts on staff, both fisheries biologists and fisheries engineers. Dr. Stephen Souza, President of the firm, received his Ph.D. from the University of Connecticut in Ecology/Fishery Biology and was previously employed by the Connecticut DEP working on American shad and blueback herring migration, spawning and young-of-the-year (YOY) feeding preferences.

Laura Wildman, fisheries engineer and Princeton Hydro Associate, under previous employment, completed numerous fish passage alternatives analyses at stream barriers and has designed a wide variety of fishways, including: Denil fishways commonly used for the passage of American shad, Alaskan Steeppass fishways commonly used for the passage of river herring, eelways and eelavators specifically designed for the passage of American eels, and nature-like fishways, and both bypass channels and rock ramp fishways and commonly used to pass a larger variety of diadromous and resident fish species. She managed a team of fishery experts looking into the passage requirements of American shad along the east coast which included state-of-the-art research into preferences for velocity, depth and length of passage.

Princeton Hydro has extensive experience removing barriers to reestablishing passage for the full suite of aquatic species present within a riverine system. In addition, we have completed numerous pre- and post-ecosystem assessments of restoration projects, conducted fish and benthic surveys, managed sixty scientist (multiple-vessel) fishery sampling programs, carried out a number of essential fish habitat studies, and implemented projects associated with the utilization of created mitigation habitat by fish.


Ms. Wildman, as former Chief Engineer at American Rivers, also established and led the Northeast Stream Barrier Task Force for 8 years, organizing meetings that focused on networking barrier removal and fish passage efforts in the northeast, including compiling data on the ongoing barrier inventories, assessments and prioritization currently underway in the greater northeast.
Appendix F

Team Resumes
Laura A.S Wildman, PE
Director, New England Regional Office

Education:
- Masters of Environmental Management, 2004. Yale University, New Haven, CT.
- B.S., 1989. Civil Engineering, University of Vermont, Burlington, VT.

Areas of Expertise:
- Involved in over 100 dam removal & fish passage projects
- Design, implementation and management of river restoration projects
- National expert & lecturer on barrier removal & alternative fish passage
- Restoration grant preparation and review
- Identification of funding opportunities for restoration
- Expertise in fluvial geomorphology & advanced water resource modeling
- Instructor for courses in dam removal, fish passage, river restoration and hydraulic modeling.
- Coordination and implementation of public outreach and education
- Development of critical project partnerships for river restoration projects (NGO, government, & private)
- Construction administration

Professional Certifications & Awards:
- Professional Engineer: Connecticut
- Awards: NOAA Restoration Center Award for Leadership in Restoration for service in Fish Passage Engineering; Coastal America 2002 Spirit Award
- Certified scuba diver

Professional Affiliations:
- Established & Chair of the Northeast Stream Barrier Task Force, 2001-2008
- 2000-2008 Instructor & Coordinating Committee for Engineering Professional Development Courses on Dam Removal, Fish Passage & River Restoration, Univ. of WI
- Co-instructor for River Processes & Restoration Masters Course at Yale University, School of Forestry and Environmental Science.
- Chairman EWRI/ASCE Task Committee on Sediment Dynamics Post Dam Removal 2004-current
- 2008 Federal Interagency Advisory Subcommittee on Sedimentation - Sediment Management & Dam Removal
- Aspen Institute's National Policy Dialogue on Dam Removal, 2000-02
- Current Member: ASCE, EWRI, ASDSO, ASFPM, ASF
- AFS, Bioengineering Section, Fluvial Ecological Engineering Curriculum Working Group
- Aspen Institute Roll-out Committee establishing UC Berkley Dam Removal Clearinghouse

Summary of Qualifications:
Laura Wildman established and leads Princeton Hydro, LLC’s New England Regional Office and is a professional environmental/water resource engineer who specializes in restoring rivers. Prior to working at Princeton Hydro, Ms. Wildman initiated and ran the Northeast Office of American Rivers for 8 years, providing project coordination and engineering oversight for the American Rivers-NOAA Community Based Restoration Grants program throughout New England. Ms. Wildman has 20 years of experience managing river restoration projects. She is professionally well known on the topic of dam removal, speaking regularly around the nation on this subject and has helped to develop and instruct courses at Yale and the University of Wisconsin in dam removal, fish passage and river restoration. She is the chairman of the ASCE Task Committee on sediment dynamics post dam removal and has been involved in well over 100 dam removal and fish passage efforts across the country. Ms. Wildman has a strong background in fluvial geomorphology, fisheries habitat/flow analysis, dam modification/repair, open channel hydraulics, grant coordination, and advanced hydraulic and sediment transport modeling.

Laura has also focused on public outreach and education. During her 8 years with American Rivers, Ms. Wildman helped to create transparent efforts that lead to successful projects by creation of diverse teams of dam owners, local concerned citizens, community leaders, environmental non-profit organizations, educational institutions, research laboratories, resource managers and other state and federal agencies, that collect and analyze information, learn and make decisions together. Ms. Wildman has success in ensuring that restoration efforts she has lead are publicized through local and national newspapers as well as on television. She takes particular pride in her work to educate future generations and illustrated a children’s book on fluvial geomorphology entitled “Why Are the River Rocks Round?”, developed a mock river restoration exercise for the Girl Scouts where they were able to help clean up a river, create a vegetative buffer, and remove a cardboard dam. In 2008 she initiated, found funding for and participated in the Art for the Sky project with the Penobscot Tribal School.
Laura A.S. Wildman, PE  
Director, New England Regional Office

Courses Instructed
- Succeeding with a Dam Removal Project – Univ. of Wisconsin/ Madison, WI, 2000 - 2008.
- Engineering Innovative Fish Passage: Dam Removal and Nature-like Fishways – Univ. of WI, 2002 & 2003
- Sustainable Flood Management – Organized course and instructed, NJ, 2008
- Advanced Training for River Geeks Series – Organized/Instructed courses on Sediment Mobility & HEC-RAS
- Academic Guest Lecturer: Tufts University; Bucknell University.; Connecticut College; Wesleyan; UCONN, Yale, Mt. Holyoke, Univ. of Montana’s River Center

Publications
- Gravel Streambed Dynamics Post Dam Removal: Geomorphology 2005
- 10 Dam Removals, 10 Years Later – ASDSO National Conference Proceedings 2008
- Stream Barrier Removal Monitoring Guidelines – Coordinating Committee
- Cross-section of Swimming Performance and Biomechanics of 5 Fish Species in a New England Stream - 2003
- Hydraulics of Nature-Like Fishways: 2004
- Sediment Transport & Management Relating to Dam Removal - 2003
- Dam Removal – A Tool for River Restoration on the Naugatuck River – 2000
- Dam Removal: One Size Does Not Fit All! - 2003
- Why Are The River Rocks Round – Completed 2004
- Sediment Transport Relating to Dam Removal - 1997
- Engineering: Exploring the Human Dimension - 1989
- Cursed on Both Ends and Dammed in the Middle – 2003
- Exploring the Human Dimensions in the Efforts to Remove Dams and Restore Rivers - 2003
- Avoiding Dam Breach Through Preemptive Dam Removal & Public Awareness - 2006

Invited Lecturer & Presentations
Fish Passage – Fishways at: CT Watershed Conservation Network, 2005; River Management Interagency Workshop, WV, 2003; Bear Mountain, NY, 2002; NJ Dam Safety, 2002; Massachusetts’s Audubon, 2003; Academy of Natural Sciences, 2002; National AFS Conference 2002; ASDSO Annual Conf. 2002; Western District AFS Annual Conference 2000; CT Association of Wetland Scientists, 2001; AFS 2000


Geoffrey M. Goll, P.E.
Vice President, Principal Engineer

Education:
- B.S. Civil Engineering, Rutgers University, 1990

Areas of Expertise:
- Design and implementation of dam restoration and removal
- Development of stream and river restoration projects
- Innovative stormwater management systems design
- Flood hazard area and floodplain modeling
- Geotechnical engineering and subsurface investigations
- Expert witness/forensic investigation of water resource related litigation
- Coordination and implementation of public outreach and education
- Facilitator of assembling project partners for water resource restoration projects
- Wetland mitigation project design and implementation
- Regulatory permitting for state and Federal waterways and land use regulation permitting
- Construction administration

Professional Certifications:
- Professional Engineer:
  - Maryland
  - New Jersey
  - Pennsylvania
  - Vermont
  - Virginia
- Nuclear Regulatory Commission, Certified Radiation Safety Officer and Soil Density and Moisture Content Gauge Operator
- NJDEP Certified Subsurface Evaluator – 15852 Closure Subsurface

Professional Training:
- Rosgen Level I

Professional Affiliations:
- Continuing Education Instructor
  - Rutgers Office of Continuing Education
- American Society of Civil Engineers
- Association of State Dam Safety Officials

Summary of Qualifications:

In addition to his position as a founding Partner of Princeton Hydro, Mr. Goll has extensive experience in soils, stormwater management, hydrology, lake management, mine and quarry reclamation, floodplain hydraulics, environmental assessments, and environmental permitting.

He has provided support for environmental organizations and communities, municipalities on a variety of projects including residential developments, casinos, solid waste transfer stations, correctional facilities, and wastewater treatment plants. These reviews were typically focused on the environmental, geotechnical and stormwater impacts associated with land development.

Geotechnical and Soils Engineering

Mr. Goll is has extensive experience in subsurface investigations, geotechnical design, and soils classification and engineering. His experience in the areas of subsurface investigation includes test borings in soil, bedrock and in-lake and harbor sediment. Mr. Goll has designed and implemented over 100 subsurface investigation programs ranging from foundation investigations to septic system design. He has designed engineered steep slopes (greater than 2:1) and retaining walls, performed slope stability analysis and has provided on-site earthwork and compaction monitoring services. With regard to subsurface sewage disposal, Mr. Goll has progressed subsurface investigations for residential developments of up to 100 units.

Mr. Goll has provided extensive subsurface investigations within the New Jersey coastline, the Coastal Plain, Piedmont, Highlands and Ridge and Valley geologic provinces. Mr. Goll has also provided forensic subsurface investigations to
Geoffrey M. Goll, P.E.  
Vice President, Principal Engineer

determine the origins of historic fills and determine original ground surface elevations to determine appropriate bearing locations for structure footings.

Dredging Engineering

Mr. Goll has extensive experience in the quantification and analysis of accumulated sediment within freshwater lakes and rivers. Mr. Goll is well versed in the processes of sediment transport and accumulation and has been in responsible charge for the design of over 500,000 cubic yards dredging project and over 1,000,000 cubic yards of sediment quantification in lakes and rivers throughout the metropolitan NY and Philadelphia areas. His experience extends also to harbor dredged materials where he was in responsible charge of the stabilization of dioxin, PCB and heavy metal contaminated dredged materials for a Brownfield redevelopment contractor in the late 1990s. Mr. Goll’s most important value to dredging projects is through his understanding of the spatial distribution of sediment types throughout a waterbody’s environment and his ability to create technical and bidding specifications that ensures cost control of projects and eliminates the open interpretation of vertical and horizontal project excavation limits via strict survey control.

Dam Removal and Restoration

Mr. Goll has pioneered dam removals for the purposes of fish passage in the State of New Jersey. He was in responsible charge of the first dam removal in NJ funded by American Rivers, NOAA, NRCS and the US Fish and Wildlife Service. Mr. Goll has coordinated multiple grants sources to fund such removals as well brought different parties together to create momentum for projects. Mr. Goll has prepared public presentations to educate local communities regarding the benefits of dam removal and providing conceptual photographic images of post-removals. His understanding of sedimentation mechanisms and management of sediment behind impoundments has been instrumental in managing the mitigation of environmental impacts during and after demolition of river and streams obstructions.

Mr. Goll has also been in responsible charge of the restoration of Low to High Hazard Potential dams. He has provided design and construction management services for a number of clients in the States of New Jersey and Pennsylvania. He has run hydrologic and hydraulic modeling, and inundation mapping; prepared Emergency Action Plans and Operation and Maintenance Manuals; progressed geotechnical investigations and stability analysis; and prepared technical and bidding specifications.

Expert Testimony

Mr. Goll has been accepted as an expert witness by the Superior Court of New Jersey (Morris and Gloucester Counties) in the areas of stormwater management and soils. Mr. Goll has provided consultation to municipalities (Planning and Zoning Boards of Adjustment) and regional planning board commissions with regard to land development applications. Municipal and regional planning board clients include Bethlehem Township, NJ, Princeton Township, Readington Township, NJ, Montgomery Township, NJ, Wayne Township, NJ, East Amwell Twp., NJ, Tinicum Township, PA, the Lake Hopatcong Commission, and Lake Musconetcong Regional Planning Board. Projects reviewed include residential, commercial, and industrial developments, wastewater treatment plants, solid waste facilities, and golf courses. The applications were reviewed with regard to adherence to township development ordinances, state and federal environmental regulations, as well as the overall impact to natural resources. In addition, Mr. Goll also provided geotechnical guidance to municipalities. Following the review process, Mr. Goll presented his findings at planning board and site plan meetings.

Mr. Goll has also provided expert testimony on behalf of applicants in front of Planning Board and Zoning Board of Adjustments and governing committees and council. Projects included mining applications, residential developments, and golf courses.
**Paul M. Woodworth**  
Staff Scientist

**Areas of Expertise:**
- Fluvial Geomorphology
- Hydrodynamic Modeling
- Hydraulic Habitat Modeling
- Geomorphic Assessment
- Stream Restoration
  - Site Investigation
  - Field Data Collection
  - Channel Design
- Dam Removal
  - Feasibility Study
  - Restoration Design
  - Construction Oversight
- Regulatory Compliance
  - NJDEP
  - PADEP
  - Soil Conservation Districts

**Education:**
- Bachelor of Arts, Biology and Environmental Studies, Middlebury College, 1999.

**Professional Certifications:**

**Professional Affiliation:**
- Association of American Geographers.

**Summary of Qualifications:**

Paul Woodworth applies fluvial geomorphology to Princeton Hydro’s dam removal and stream restoration projects. He has participated in all phases of project development from initial field assessment to final construction. In the early project stages, he has helped identify problems, underlying causes, and appropriate, realistic solutions. He has written permits and reports for environmental protection and dam safety agencies in Pennsylvania and New Jersey. He has experience collecting hydrologic data to improve hydrologic and hydraulic modeling. Mr. Woodworth has also designed restoration plans with appropriate channel cross-section, slope, sinuosity, pool-riffle features and adjacent floodplains for multiple dam removal and stream restoration projects. In the construction phase, Mr. Woodworth has overseen and guided the removal of dams and installation of rock weirs. His knowledge of fluvial geomorphology helped in addressing sediment concerns, bank erosion and bed stability as well as responding to in-field construction complications that resulted in design modification.

For his Master’s work, Mr. Woodworth employed a 2-dimensional hydrodynamic model (River 2D) to predict the potential impacts of a dam removal on stream flow and hydraulic habitat of the native adult Brook Trout (*Salvelinus fontinalis*). The small, run-of-river dam was built on a third order stream in the Long Island Sound watershed. The project provided important information to the owners of the dam who were weighing the costs and potential benefits of its removal. Mr. Woodworth surveyed stream channel topography, measured discharge and collected particle size information to replicate two representative reaches in the computational modeling environment. The model quantified trout habitat based on the suitability of estimated water velocities and depths and measured substrate size. Results showed little change in flow rate, flow pattern and hydraulic habitat in the dam removal scenario. This unique study successfully demonstrated the use of computer modeling to make informed decisions in dam removal studies.

Prior to graduate studies, Mr. Woodworth worked for the Connecticut River Coastal Conservation District in central Connecticut. His primary duty was to coordinate an EPA-funded, long-term water quality monitoring program that encompassed five major tributary watersheds of the lower Connecticut River. Mr. Woodworth developed water quality surveys, refined sampling protocols, and recruited, trained, equipped and coordinated nearly 100 volunteers for water sampling, visual assessment and biomonitoring. He also conducted grab
Paul M. Woodworth  
Staff Scientist

sampling, visual assessment and optical brightener detection methods to track down sources of water pollution.

Mr. Woodworth was also tasked with implementing a management plan for the Mattabesset River watershed spanning 45,000 acres and 10 municipalities in central Connecticut. He worked with municipal governments, state agencies, and other watershed stakeholders to carry-out multiple tasks addressing public awareness and education, sustainable land use, habitat restoration, wetland protection, and identifying and correcting pollution problems. Example projects included replanting riparian buffers, repairing stormwater outfalls, delivering public presentations on protecting water resources, developing and distributing educational materials, and installing road signage for named streams. In addition, Mr. Woodworth applied GIS to manage and analyze water quality data with respect to land use and land cover and other spatial data layers.

Mr. Woodworth’s GIS skills were utilized in a variety of natural resource protection projects including vernal pool identification surveys and open space management plans. He also mapped and analyzed natural resources for the feasibility and eligibility studies behind the Wild & Scenic designation of the Eightmile River in Connecticut. Mr. Woodworth responded to numerous landowner requests for assistance with pond and stream problems related to stormwater, failing septic systems and yard care practices. In addition, he led multiple presentations and workshops on stream ecology, water quality monitoring and water resource protection to citizen groups, college classes and municipal commissions.

Mr. Woodworth gained unique international experience as a Peace Corps volunteer in the Republic of Macedonia, a nascent democracy in the often conflicted Balkan region. He applied his undergraduate degree to teach environmental science in a secondary school in the native Slavic language – Macedonian. Specifically, he initiated and led an environmental monitoring program (Global Learning and Observation to Benefit the Environment) focused on water quality and climate.
Mary L. Paist-Goldman, P.E.,
Senior Project Manager

Education:
- B.S. 2000. Civil Engineering, Univ. Maryland College Park, College Park, MD

Professional Certifications:
- Professional Engineer, State of New Jersey, 2005.
- Sewage Enforcement Officer, Pennsylvania, 2006.
- Rosgen Level I – Applied Fluvial Geomorphology Certification

Professional Affiliations:
- New Jersey American Water Resources Association (NJ AWRA)
- New Jersey Society of Women Environmental Professionals (NJSWEP)
- Association of State Dam Safety Officials (ASDSO)

Summary of Qualifications:
Ms. Paist-Goldman has more than nine years experience in the fields of stormwater management, regulatory compliance, hydrology, hydraulics, wetland mitigation, and wastewater management. She has designed stormwater management and wastewater management facilities and maintenance plans for municipal, commercial, industrial and residential projects.

Areas of Expertise:
- Management of diverse project teams
- Stormwater management design
- Hydrologic and hydraulic modeling
- Pollutant loading analyses and water quality modeling
- NPS and TMDL modeling
- Streambank stabilization
- Dam removals and stream restoration
- Dam inspections and inundation/breach analyses
- Regulatory compliance – including NJDEP Flood Hazard Rules, NJPDES Rules, and Stormwater Management Rules
- Onsite wastewater disposal system design – including alternative wastewater treatment systems
- Wastewater and watershed management planning

Since joining Princeton Hydro, Ms. Paist-Goldman has performed municipal reviews for subdivisions and land developments, designed stormwater management systems for various residential projects, modeled stream hydrology in HEC-RAS to determine floodplain conditions, designed dam removal projects, designed subsurface sewage disposal systems, performed dam inspections and prepared inspection reports, conducted dam inundation analyses, designed an onsite infiltration system, and prepared erosion and sedimentation control calculations for various projects.

Ms. Paist-Goldman has been actively involved in regulatory compliance since the beginning of her career. She is an expert at navigating the New Jersey Department of Environmental Protection’s (NJDEP) Land Use Regulation Program’s permitting process for Stream Encroachment and demonstrating compliance with the Flood Hazard Area Control Act. Ms. Paist-Goldman has extensive experience in dealing with the NJDEP Division of Watershed Management, Bureau of Nonpoint Pollution Control, and the Dam Safety program. Also, Ms. Paist-Goldman actively provides comments on proposed regulations including the recently adopted stormwater management rules (N.J.A.C. 7:8) and the recently proposed watershed management rules (N.J.A.C. 7:15).

She served on the Hunterdon County Stormwater Ordinance Review Committee, was an active participant in the preparation of the Hunterdon County model ordinance, and has given presentations to municipalities and colleges and universities throughout the State of New Jersey on the impacts and requirements of the new Stormwater Management Rules (N.J.A.C. 7:8). She prepared Stormwater Management Plans for Hopewell Borough and Delaware Township and the City of Asbury Park.
Paist-Goldman also prepared the Stormwater Pollution Prevention Plan for Bergen Community College and provided assistance to UMDNJ. She also provided assistance to Princeton Township, Princeton Borough, and West Amwell Township as they prepared their plans. Ms. Paist-Goldman also serves as a primary reviewer for Bergen County for all municipal stormwater management plans.

She has analyzed and designed storm sewers, culverts, detention basins, constructed wetlands, infiltration systems, and bioretention swales for multiple projects. Several of these included large roadway projects for the NJDOT. In addition, she has worked to identify site-specific water quality retrofits for existing roadway networks, park improvements, colleges and universities, and municipal projects.

Ms. Paist-Goldman’s modeling experience includes hydrologic modeling with ESRI ArcMap Geographic Information Systems (GIS) software as well as BOSS International’s WMS, the United States Army Corps of Engineers’ (USCE) HEC-HMS, and USACE’s HEC-1. Utilizing ArcMap or WMS, she was able to determine hydrologic conditions for various watersheds. Ms. Paist-Goldman’s stormwater management modeling experience also includes TR-20, TR-55, and the Rational Method. In modeling stream hydrology and bridge/culvert hydraulics, Ms. Paist-Goldman has utilized USACE’s HEC-2 and HEC-RAS and BOSS International’s RiverCAD and BOSS RMS. Using HEC-RAS, she has developed floodplain limits, including floodway and floodplain delineations along numerous watercourses as well as determined waterway openings for new and replacement bridges and culvert crossings. Further, Ms. Paist-Goldman has utilized HEC-RAS to determine scour at bridges and culverts and to determine streambank stability for bridge replacement projects for Somerset, Monmouth and Warren Counties. She also has experience using Haested Methods PondPack for stormwater facility design and analysis, particularly with the interconnected basin module.

Additionally, Ms. Paist-Goldman has designed multiple wetland mitigation sites for large projects throughout the State of New Jersey. She has extensive wetland mitigation design experience on projects ranging from small mitigation sites to large sites (>20 acres of mitigation) that are planned for use as mitigation banks. The larger sites are located on the Arthur Kill, Newark Bay, Raritan River, and Hudson River. Working closely with the wetland scientists of Princeton Hydro, Ms. Paist-Goldman has designed a variety of wetland habitats through the use of check dams and detailed grading. These include subtidal channels, wetland pools, intertidal marsh, and upland island habitats for both freshwater and estuarine systems.

For dam breach analyses and dam removal design, Ms. Paist-Goldman has experience utilizing the Army Corps of Engineers HEC-1 model, BOSS International’s DAMBRK, and the HEC-RAS unsteady flow feature. For these projects, Ms. Paist-Goldman has also prepared inundation mapping, Emergency Action Plans, Operation and Maintenance Manuals and Dam inspection reports.

Ms. Paist-Goldman has extensive experience using WinSLAMM. This model is used to determine the effects that various BMP retrofits can have on the overall particulate and nutrient load generated. She has used WinSLAMM for multiple projects, including a study for a large water purveyor to determine impacts to the drinking water supply from surrounding drainage areas. This project also involved modeling various BMPs to determine reductions in overall pollutant load to the water supply. Further, Ms. Paist-Goldman has experience designing onsite wastewater treatment systems including onsite treatment plants outfitted with drip irrigation, spray irrigation, or other alternative effluent discharge measures. She has utilized the Sunada groundwater mounding software and USGS MODFLOW to determine groundwater mounding conditions for onsite septic systems and drip irrigation systems. Further, Ms. Paist-Goldman has utilized the GSR-32 groundwater recharge model as well as the NJDEP and Pinelands Commission Nitrate Dilution Models.
Prior to joining Princeton Hydro, Ms. Paist-Goldman worked as a senior environmental engineer at Schoor DePalma, Inc., a New Jersey based civil and environmental consulting firm. While there she was responsible for the design of stormwater management systems for various projects including sizing bridge and culvert waterway openings, stormwater runoff control and management design, water quality treatment design, onsite wastewater disposal system design, and watershed and site specific New Jersey Executive Order 109 pollutant loading analyses.

Prior to joining Schoor DePalma, Inc., she worked with Limno-Tech, Inc. as an engineering assistant. She modeled combined sewer overflows for several large municipalities using the USEPA’s SWMM and several proprietary models. She also prepared public information documents on combined and sanitary sewer overflows for the US Environmental Protection Agency. Further, Ms. Paist-Goldman worked with various municipalities to ensure that the Nine Minimum Controls were implemented.

Publications and Presentations


M. Paist-Goldman. 2006. Guest lecturer for Landscape Design Course at Delaware Valley College, 16 November 2006, Doylestown, PA.


Jacob E. Helminiak, P.E.
Senior Project Engineer

Education:
- B.S. Civil Engineering, concentration in Water Resources, Pennsylvania State University, University Park, PA, 2002

Professional Certifications:
- Professional Engineer, State of New Jersey, 2007
- Rosgen Level I – Applied Fluvial Geomorphology
- Rosgen Level II – River Morphology and Applications

Professional Affiliations:
- Association of State Dam Safety Officials
- American Water Resource Association, New Jersey Chapter
- Association of State Floodplain Managers
- New Jersey Association for Floodplain Management
- Trout Unlimited, Bucks County, Pennsylvania Chapter

Summary of Qualifications:
Mr. Helminiak has over six (6) years experience in the fields listed. He has prepared and managed the preparation of complete engineering design plans, construction specifications, and design reports for commercial, institutional, and residential, at the local, municipal, and state agency levels for a variety of Water Resource projects.

Mr. Helminiak’s modeling experience includes hydrologic modeling with ESRI ArcMap Geographic Information Systems (GIS) software as well as the United States Army Corps of Engineers (USACE) HEC-HMS. Utilizing ArcMap, he has experience determining hydrologic conditions for numerous watersheds, ranging in size from small to large. Mr. Helminiak’s hydrologic modeling experience also includes TR-55, and the Rational Method. In modeling stream and culvert hydraulics, dam breach and inundation analyses, and dam removal and stream restoration design, Mr. Helminiak is proficient in the use of USACE HEC-RAS. Using HEC-RAS, he has developed floodplain limits, including floodway and floodplain delineations along numerous watercourses, as well as determined waterway openings for new and replacement bridges and culvert crossings. Further, Mr. Helminiak has utilized HEC-RAS to analyze and predict scour at bridges and culverts and to determine streambank stability for bridge replacement projects. Mr. Helminiak has also utilized HEC-RAS extensively to guide development of proposed stream channel dimension, pattern, and profile for stream restoration, fish passage, and bank stabilization designs. He is also proficient with use of the HEC-GeoRAS module within the GIS platform to utilize digital data for import to and export from HEC-RAS. Mr. Helminiak is also proficient with the use of the legacy USACE programs HEC-1 and HEC-2.

Mr. Helminiak has extensive experience with a variety of stream restoration and streambank stabilization practices and techniques. He is Rosgen Level II certified. He has extensive knowledge of fluvial geomorphic processes associated with natural stream channel design methodologies and has utilized such approaches in post-dam removal scenarios, as well as wetland mitigation designs. He has both training and experience with the classification and geomorphic assessment of streams, and has utilized such to identify and prioritize
potential restoration opportunities on a watershed scale. Mr. Helminiak also has extensive experience with a variety of bio-engineering and stream bank stabilization technologies and has implemented such technologies to stabilize eroding banks on small creeks to larger rivers, as well as lake and pond shorelines.

Mr. Helminiak has extensive wetland mitigation design experience, both freshwater and estuarine, on numerous projects ranging from small mitigation sites to large sites (>20 acres of mitigation) that are planned for use as mitigation banks. The larger sites are located on the Arthur Kill, Newark Bay, Raritan River, and Hudson River. Working closely with the wetland scientists of Princeton Hydro, Mr. Helminiak has designed a variety of wetland habitats through the use of innovative control structures and detailed grading. These include subtidal channels, wetland pools, intertidal marsh, and upland island habitats for both freshwater and estuarine systems.

Mr. Helminiak’s dam engineering experience includes the preparation of Inundation Mapping and Hazard Classification, Emergency Action Plans, Operation and Maintenance Manuals and Dam inspection reports, Spillway Adequacy Analyses, ranging in size from small run-of-the-river dams to larger concrete and masonry High Hazard Class structures. He has experience progressing Dam Removal Feasibility Studies, and detailed Dam Removal Design for a number of Dams throughout New Jersey and Pennsylvania.

Mr. Helminiak is proficient in the use of 3D modeling within the AutoCAD platform. He has modeled dam systems (both pre- and post- removal), spillway structures, drainage structures, and inlet and outlet structures. Mr. Helminiak has extensive experience in the geophysical survey of ponds and lakes to determine the bathymetric qualities and quantities of sediments and hypsographic features. This includes the operation, configuration, and calibration of hydrographic survey equipment including acoustic sounders and differential global positioning systems. He has designed and conducted such studies on various sized water bodies from small unnamed farm ponds, to large lakes (Greenwood Lake, NJ) and bays (Sodus Bay, NY). Following the field survey, Mr. Helminiak has extensive experience in the post processing (reduction) of raw sounding data using Hypack software, the analyses and production of top and bottom of sediment contouring, and the final production of bathymetric mapping using ArcGIS.

Mr. Helminiak has extensive experience performing calculations and designing temporary controls to limit soil erosion and to capture and treat sediment-laden stormwater with respect to disturbed construction, as well as permanent erosion prevention devices, including swales, rip-rap placement, and check dams.
Keithe J. Merl, PE, CPESC, Associate, Senior Geotechnical Engineer

**Education:**
- 2001, Bachelors of Science, Civil Engineering, Drexel University.

**Professional Certifications:**
- Professional Licensed Engineer: Pennsylvania, New Jersey, Delaware, Maryland, New Hampshire.
- ACI Concrete Testing Technician – Grade I
- Nuclear Regulatory Commission HAZMAT – Operation and Transportation of a Nuclear Compaction Gage.
- New Jersey Subsurface Evaluator

**Professional Affiliations:**
- New Jersey Branch of the American Water Resources Association (AWRA) – Vice Chair and former Vice Chair of the Groundwater sub-committee
- American Society of Civil Engineers (ASCE)
- Association of Engineering Geologist (AEG)
- Affiliate Member American Society of Dam Safety Officials (ASDSDO)
- Technical adviser to the NJDEP Stormwater Management Committee
- International Erosion Control Association (IECA)
- American Association of State Highway and Transportation Officials (AASHTO)
- American Concrete Institute (ACI)

**Areas of Expertise:**
- Geotechnical Engineering Investigation and Analysis.
- Design and construction of civil, hydraulic, commercial, industrial, and residential structures.
- Management and specification of subsurface investigations for geotechnical, hydrogeologic, and stormwater related projects.
- Design, implementation, forensic investigation, and repair of infiltration stormwater facilities.
- Forensic geotechnical engineering investigation and analysis.
- Geologic hazard determination and mitigation; including regional assessments.
- Erosion and Sedimentation Control Compliance and Peer/Professional Review.
- Water Resources Engineering and hydrogeologic Studies.

**Summary of Qualifications:**

Mr. Merl has extensive experience in soils; geology, hydrogeology, geologic hazards, mineral extraction studies; geotechnical site investigations, geotechnical related building construction and modeling for commercial, heavy industrial, light industrial, residential, and heavy commercial (high-rise); environmental assessment, environmental permitting; and forensic foundation and structure stability analysis and engineering.

**Geotechnical Engineering** – design, implementation, and management subsurface investigation and characterization for engineering design parameters for residential (coastal, inland), residential subdivision, commercial, industrial, high load (high rise structures, parking garage), civil, and hydraulic structures; geotechnical analysis of site conditions; earthen/rock slope modeling; retaining structures; concrete design; geotextiles; gravity dam design; foundation failure remediation; forensic investigation and engineering analysis.

**Engineering Geology** – subsurface investigation and characterization of geologic formations; lithologic description; site specific geologic mapping; structural geology; geologic hazards including sinkholes, abandoned mines, historic fill, landslides, exposed rock cuts, earthquake response of soils and structures; rock rippability; surface water / groundwater interactions; hydrologic modeling; hydrogeologic modeling; erosion and sedimentation control plans.

**Environmental Engineering** – ACT 2 Remediation, Brownfields; Underground/Above-Ground Storage Tanks; Phase I Site Assessment (All Appropriate Inquiries) (ASTM Standard); Phase II, Site Remediation Plans; Groundwater Modeling, Contaminant, Transport, Mounding Analysis (Stormwater Infiltration Basins and Wastewater Treatment Systems); Acid producing formations.
Keith J. Merl, PE, CPESC, Associate, Senior Geotechnical Engineer

Software Competence:
Microsoft v 98, 2000, XP, Vista; Microsoft Office v 98, 2000, XP, 2003, 2007; Microsoft Server v 2000, 2007; Linux, MacOS, BSD; Open Office (V 1.9, 2.0, 3.0); GRASS GIS (Windows, Linux); Visual Modflow V4; Groundwater Vistas V3; MODFLOW 1996, 2000; AutoCAD; MathCAD, ArcView GIS v3.x; ArcGIS, v 8.x, 9.x (ArcView, ArcCatalog, ArcTool Box); CADAM Software; PASTABL; XSTABL; Flex PDE; Soil Vision; Interactive Groundwater v 3.x & 4.x; Map Window GIS; LaTex; Python Programming; Bash scripting; VS2D.

Professional Background:
Mr. Merl’s responsibilities include the management and direction of daily operations in the Southern New Jersey office. Mr. Merl represents Princeton Hydro as the main point of contact for projects in Southern New Jersey and writes/submits proposals for all engineering, geologic, and groundwater related projects. The southern New Jersey office includes the company’s full service physical soils testing laboratory, managed by Mr. Merl.

Geotechnical Engineering – Mr. Merl has provided engineering design and review for new construction projects including single family residential developments of 100 units and over for septic, structure, and pavement design; commercial facilities such as small malls and outlet malls; and industrial facilities. These include subsurface investigations, determination of geologic materials properties, specification of engineered fill, mitigation and engineering of steep slopes, characterization and ubiquity of historic fill (solid waste, construction debris) and engineering recommendations for the design of foundations and structures including shallow and deep foundations; retaining structures; underground structures; coastal structures; and dams. Many of these projects included the mitigation and engineering of steep slopes (including stability analysis and erosion mitigation), and historic fill (including solid waste) extent and characterization.

Engineering Geology – Mr. Merl has provided clients with hydrogeologic assessments of production wells for single use facilities and entire municipalities. This includes the logging and documentation of historic wells, permitting of unregistered wells with NJDEP, completion of drawdown analysis of wells, hydrogeologic modeling of aquifers and the reaction to proposed pumping, submission of Water Use Registration Permits (WUR) and Water Allocation Permits (WAP) in New Jersey, and the installation and long term testing of production wells.

Expert Testimony – Mr. Merl has been accepted as an expert witness by several municipalities in New Jersey in the fields of Geotechnical Engineering, Engineering Geology, and Stormwater Management. Some municipalities include Princeton Township, Wyckoff Township, Barrington Borough, Logan Township, Monmouth Beach Borough, Franklin Lakes Township, and Rumson Borough. I have provided testimony for clients to Planning and Zoning Boards related to projects including dams, residential developments, mixed use developments, bulkheads, tidelands claims, industrial and commercial developments, slope stability, steep slopes, and stormwater facilities related to infiltration.

Soil Physical Testing Laboratory – Mr. Merl is responsible for managing the soils laboratory in the Southern New Jersey office. This includes ASTM and ASHTTO standard testing of construction materials and certifications related to those testing procedures. These services include grain size analysis, atterberg limits, organic content, erodibility of soils testing, strength parameter determination, and permeability. These services also include a full range of on-site construction monitoring services; soil compaction monitoring, collection of concrete and masonry samples, IBC2006 special inspection services, spray-applied fire-proofing inspection, and foundation bottom certification.

Publications and Presentations:
Rutgers – Cooke College, “Lake Management”; Dam Management, Inspection, and Repair portion.”
STEPHEN J. SOUZA, Ph.D.  
President

Education:
B.S. 1974. Marine Biology, Univ. Mass./ Dartmouth

Certifications:
OSHA Health and Safety for Hazardous Waste Site Investigation, No. 300631
Lake Management and Restoration, University of Wisconsin-Madison
Course Coordinator and Faculty, Cook College, Rutgers Univ., Continuing Professional Ed.
NJDEP Qualified Fishery Specialist, Marine Biologist, & Aquatic Biologist
Category V Cert Applicator NJ, NY, MD, DE

Affiliations:
North American Lake Management Society, Past President
Golf Course Superintendents of America Association
Pennsylvania Lake Management Society, Past President
American Water Resources Association

Fields of Competence:

Professional Experience:
Dr. Souza has designed, managed and conducted a wide array of ecological investigations for public and private sector clients. Many of these studies have focused on the evaluation of changes to fish and benthic communities caused by construction related environmental impacts, the discharge of effluent, alteration or loss of habitat, or the degradation of water quality. He has conducted such surveys throughout the Metropolitan NJ/NY/PA region as well as in the Acushnet River (MA), Connecticut and Thames Rivers (CT), Suisun Bay (CA), the Susquehanna and Potomac Rivers (MD), and Chesapeake Bay.

As a NJ State-qualified specialist in marine biology, aquatic biology, and freshwater ecology, Dr. Souza has developed numerous DPCC plans for facilities throughout New Jersey. This has included the development of spill response guidelines for sensitive aquatic receptors, and spill containment / habitat protection protocols. Dr. Souza has frequently provided expert testimony and technical guidance on the impact of storm runoff and industrial effluent on the water quality and biota of receiving waterbodies. He has developed water quality and aquatic biota monitoring programs, mitigation strategies, and biota relocation programs. His experience with the impacts assessment of waterfront development projects includes work conducted on Cape May Harbor (NJ), Davids Island (NY), Hempstead Harbor (NY) Atlantic City (NJ) and various projects proposed for the Hudson River, Newark Bay, Raritan Bay and East River ecosystems.
Dr. Souza’s fishery related expertise includes the analysis and of impacts to Essential Fish Habitat and the assessment of direct and indirect impacts to shellfish and shellfish habitats. Work of this nature has been conducted in the Navasink River, Shrewsbury River, Manasquan River, Lower Hudson River Estuary, Delaware River and Brigantine Inlet. Most of these projects were stimulated by development related interests associated with the construction of marinas, the dredging of waterways or other waterfront development activities that resulted in the filling, dredging or alteration of intertidal habitat.

Some of Dr. Souza’s other project experience includes: chief liaison for field studies conducted for the Baltimore District ACOE; field manager for the 1984 Westway Fisheries Sampling Program; field investigation project manager for the Marathon Battery Superfund Study, (Cold Springs, NY); field and/or project manager of environmental risk assessments, including projects associated with hazardous waste cleanups of such specific contaminants as dioxin (Passaic River, NJ), heavy metals (Hackensack River and Passaic River, NJ) and PCB's (Niagara River, NY).
AMY E. DeBUCK
Staff Engineer

Areas of Experience:
- Flood Hazard and Soil Erosion Permits
- Construction Oversight
- Well Installation and Groundwater Sampling
- Soil Erosion and Sediment Control Plan Preparation
- Preparation of Site Plans
- Site Surveys
- GPS sites
- Groundwater Hydrology
- General Permitting
- Media skills AutoCAD, HydroCAD and ArcGIS

Education:
- B.S., 2006. Environmental Science, Delaware Valley College

Certifications
- OSHA 8-hour Refresher and Renewal (2006-2008)
- Nuclear Gage Safety

Summary of Qualifications:
Ms. DeBuck joined Princeton Hydro in May 2008 as a Staff Engineer and provides a wide range of environmental and civil engineering services to the company. Ms. DeBuck’s responsibilities include plan preparation, permit submittals, drainage area analysis, preparation of bid specifications and construction oversight. Ms. DeBuck has submitted Flood Hazard Applications and Soil Erosion and Sediment Control Applications which have been issued.

Ms. DeBuck has completed bid specifications, cost estimates, site plans and maintenance plans. Ms. DeBuck prepares engineering plans and submits all permits, including Flood Hazard, County Soil Conservation District, and any other local permits.

Prior to joining Princeton Hydro, Ms. DeBuck was employed by TriState Environmental Management, as an environmental scientist. Ms. DeBuck completed home owner insurance investigations of under ground storage tanks including soil borings, soil and groundwater sampling. Ms. DeBuck provided administration and observation for the installation of groundwater monitoring wells. Also, Ms. DeBuck interned at Gilmore and Associates where she completed soil compaction test and concrete testing for new construction.

Specific Professional Project Experience includes:

Crossing Replacement, Germantown, MD, 2008-present
- Preparation of Engineering Plans and Specifications
- Preparation of Erosion and Sediment Control Plan
- Preparation of materials for Floodplain study including tax, zoning, land use, and soils maps
- Cut/fill analysis
- Submission of all necessary permits; including Montgomery County Sediment Control, Floodplain study and permit

Tremley Bridge Replacement, City of Linden, NJ, 2008-present
- Preparation of Soil Erosion and Sediment Control Plans
- Preparation of Cross-Sections and Floodplain study plans
- Submission of all necessary permits; including NJDEP Flood Hazard and Union County
Conservation District

New Jersey Water Supply Authority, Somerset County, NJ, 2008-present
- Preparation of Schematic Design Report and Plans

Lake Hopatcong NJDEP 319H Grant and EPA Targeted Watershed Grant FRL, NJ, 2008-present
- Preparation of Engineering Plans
- Hydrologic calculations
- Preparation bid specifications
- Preparation of Erosion and Sediment Control Plan
- Construction oversight and coordination with contractors

Greenwood Lake NJDEP 319H Grants, West Milford, NJ, 2008-present
- Preparation of Engineering Plans
- Hydrologic calculations
- Preparation bid specifications
- Preparation of Erosion and Sediment Control Plan
- Construction oversight and coordination with contractors

Union Township Septic Witnessing, Union Township, NJ, 2008-present
- Preparation soil logs
Appendix G

Figures and Plans
Middle Street Dam
In Bristol, Connecticut
On the Pequabuck River

FIGURE 1: AREA OF
DETAILED TOPOGRAPHY
AND BATHYMETRY

Note exposed bedrock ledge on both sides of the dam (in the areas of the road cut), pointing to the likelihood of a bedrock outcrop below the dam itself.

~3.5ac to survey & provide topographic/bathymetric base map

PRINCETON HYDRO, LLC.
20 BAYBERRY ROAD
GLASTONBURY, CT 06033
Middle Street Dam
In Bristol, Connecticut
On the Pequabuck River

FIGURE 2: CROSS SECTIONS NEEDED IF NEW HEC-RAS IS PREPARED

Cross-sections within detailed area of 1-foot topography & bathymetry
Cross-sections outside of detailed area of 1-foot topography & bathymetry

PRINCETON HYDRO, LLC.
20 BAYBERRY ROAD
GLASTONBURY, CT 06033
Middle Street Dam

Figure 3: Existing FEMA Water Surface Profile for the Middle Street Dam

- Shortest impoundment estimate
- Longest impoundment estimate
- Smallest extent of impoundment sediment
- Maximum extent of impoundment sediment

Ex: Floating retaining wall (no footing)
New precast T-wall retaining wall (1'X1' concrete leveling pad as footing)
Gas line

Middle Street Dam

1999 depth to refusal

Ripples observed in field under lower flows

Provision Hydro

On the Pequabuck River in Bristol, Connecticut
Middle Street Dam

The Middle Street Dam
Route 72 Relocation Plans – Boring & Test Pit Location Plan
T-Wall Retaining Wall Cross-section, Plan View and Profile