Functional Requirements and Supporting Information
for
Drawdown Pumping System
for
Bare Hill Pond
Harvard, MA

1. Overview

On behalf of the Town of Harvard, the Bare Hill Pond Watershed Management Committee (the "Pond Committee") is requesting proposals that address:

- Design and detailed specification of an in-pond, semi-permanent (floating or submerged) system for the pumped drawdown of Bare Hill Pond (hereafter referred to as the "System") to help combat invasive weeds growing in the pond; and
- Preparation of bidding documents for use in soliciting a competitive contract for construction and 1st-year operation of the System (the "RFP")

We contemplate that the delivered RFP for construction and initial operation will contain the following essential elements:

- Construction and installation of the System per the specifications of the design
- Operation and maintenance of the System for one year encompassing the drawdown cycle of September 2005 through March 2006.
- Training of Town personnel in operation, maintenance and trouble shooting of the System

We envision that the System design will incorporate the following characteristics:

- It shall be capable of achieving and maintaining a pumped drawdown of the pond up to 8 feet below its maximum dam-controlled level, which could be up to 4.5 feet below the water level of the downstream marsh on the other side of the dam.
- It shall be designed operate annually during the drawdown seasons of September through March, and as such, the design must consider the impacts of cold temperatures and frozen, often unstable, pond surface. It should also be operated from the safety of shore.
- Once installed, it should remain in place except for needed repairs and maintenance, and hence it shall be designed to both protect for and against human, animal (e.g. fish, beavers, et. al.) or machine (motorized and non-motorized watercraft; snowmobiles: etc.) traffic during all four seasons of the year.
- It shall be designed for low cost and ease of operation and maintenance by the town DPW. Such activities, including removal of components for repair and maintenance, shall be possible with non-specialized training and equipment unless said training and equipment is supplied under the terms of this contract or the subsequent construction and operation RFP.
- Its installation and operation shall minimize impacts on abutters, pond users and the environment

The System and its design and construction shall be designed to be compliant with or address the following:

- The requirements of the Town's grant from the Massachusetts DEP (03-05/319) for a pumping station to facilitate deep drawdowns for noxious plant reduction in Bare Hill Pond. A copy is available on the Town's website for review
- The functional requirements contained within this document
- Town, state, and federal wetlands regulations

2. Background on Bare Hill Pond and Management of its Noxious Weed Problem

2.1 Pond Overview

Bare Hill Pond is a "Great Pond" located approximately 40 miles north west of Boston near the intersection of Route 111 and Interstate 495 in the Town of Harvard. The pond is bordered by approximately 100 seasonal and year round residences including some 12 island homes and a Girl Scout camp. The Town maintains a supervised swimming beach, boat ramp and anchorage. Municipally managed, Bare Hill Pond is considered an important resource for Harvard. The Town sees the goals of the pond as:

- Maximizing 4-season recreational use, particularly swimming, canoeing, sailing, rowing, motorized boating, fishing, ice-skating, cross-country skiing, snowmobiling, and ice fishing
- Maintaining a diverse native community of plants and animals.
- Maintaining water quality suitable to recreational and habitat goals

Bare Hill Pond is a relatively shallow pond of 321 acres with an average depth of 10-12 feet and maximum depth of about 25 feet. The pond is fed by springs and several small streams, and discharges to the north through Bowers Brook into the Nashua Basin.

Originally a natural 206 acre pond, the outflow was dammed in the early 1800s (with the current dam being reconstructed in 1837), flooding the surrounding farmland and pasture to its present size. The underlying geology of the pond bottom and its outlet by the dam structure is unknown.

An approximately 8 foot earthen dam controls the level of the pond with a series of stop blocks in the outlet structure. The dam discharges into a marsh. The pond level is normally maintained by the dam to a maximum of approximately 3.5 feet above the water level of the marsh, which is in turn controlled by the invert of the downstream culvert that carries Bowers Brook under Route 110 approximately 0.2 miles north of the dam. The minimum water level in the pond (when all dam stop blocks are removed) is currently limited by the same culvert to the water level of the marsh, or about 3.5 feet below its maximum dammed level. Mechanical efforts to lower the pond further will place its water level below that of the downstream marsh.

2.2 Noxious Weed Problem

Bear Hill Pond is subject to encroachment by invasive aquatic plants, predominantly water chestnut and milfoil. The volume of the biomass generated by invasive aquatic species each season and its death and decay has accelerated the ponds' eutrophication. In addition the weeds are aesthetically unpleasant and constitute a nuisance to boaters and swimmers.

In general, the greatest weed density in the pond has been observed in areas of 0-8 feet of depth. This zone of weed profusion is thought to be related to nutrient loading and water turbidity. It is thought that below a certain depth the dearth of sunlight will not support lush weed growth.

In shallower areas the weed colonies thrive. The seasonal growth death and decay of the lush weed population is detrimental for several reasons. Decomposition of the biomass depletes the dissolved oxygen content of the water. Low dissolved oxygen levels limit the diversity of aquatic animal species. The decomposed organic matter deposited on the pond bottom fertilizes the growth substrate encouraging weed growth the following season. The sedimentation decreases pond depth over time and contributes to a larger area of shallow water in which the invasive aquatic species thrive thus accelerating adverse impacts on the pond's ecosystem.

The pond weed density and spread adversely impacts the aesthetic and recreational enjoyment of the pond. Weed spread annoys swimmers even at the Town Beach. The density of weeds make navigation, both powered and un-powered (rowing, paddling and sailing), difficult and less enjoyable. Rotting and dying weeds on the shoreline are a nuisance. The ponds gradual depth reduction and increase in water temperatures limits the types of fish that the pond will support.

2.3 Past Efforts at Weed Control

Numerous strategies have been implemented to control pond weeds with varying results but no long term success. These have included:

- Herbicides
- Dredging
- Anti weed fabric
- Weed harvesting
- Manual weed pulls and raking
- Gravity drawdowns

In the 1960's the pond was dosed with various herbicides. The herbicides available at that time were an effective but temporary measure. While weeds were killed, they reestablished themselves over time. The present belief is that herbicides are too expensive to use as a temporary measure, and in addition may pose a health threat to pond users through contact, and a contamination threat to nearby town wells. In addition, there is an increasing prevalence of invasive species such as fanwort which are more resistant to chemical treatment, making the efficacy of herbicides more uncertain.

The Town has dredged and sanded the Town beach several times over the years. It has been suggested that removal of the nutrient rich bottom sediments and weed colonies and replacement by comparatively sterile sands have the longest-term impact on weed encroachment, even though the weeds eventually reestablish themselves. The Town has not attempted dredging across the pond as a whole due to the prohibitive cost and the uncertainty of habitat impact.

Fifteen years ago, the Town installed a fabric layer over the pond bottom in the public swimming area. The fabric was designed to hinder the reestablishment of weed colonies in the newly dredged and sanded swimming area. By the summer of 2003, however, people reported that the weeds were at least as bad as they had ever been.

Since the 1970s, the Town has operated an aquatic weed harvester. This machine severs weeds below the surface and removes the cuttings from the water, depositing them on shore for removal and composting. The process has the advantage of both temporarily reducing weed congestion in the harvested area and removing the biomass so that it does not contribute to the eutrophication process. In general, however, it does not kill the weeds, leaving the roots in place. Moreover, cuttings which escape entrainment re-root themselves and actually proliferate the weeds.

Several times a year the Town organizes manual weed pulls. Volunteers in small craft deploy to specific areas of the pond and manually pull targeted species, particularly water chestnuts. The weeds collected are removed and composted. Similarly, numerous pond abutters rake the pond bottom adjacent to their property, pulling up existing weeds while preventing others from taking root. Both of these manual efforts are effective, but are by definition too labor-intensive and small-scale in nature to be effective pond-wide against all invasive species.

Repeated water level drawdowns during winter months are effective in many ponds and lakes in killing aquatic weeds exposed to adequate freezing conditions. The efficacy of this approach is

related in large part to the degree of drying of the exposed bottom and the amount of exposed bottom that is subject to freezing temperatures. Gravity drawdowns have been singularly tried at various times in Bare Hill Pond over the years, but only to a limited depth and never on a regular basis. Even so, we have seen some short-term impact on weed reduction with each isolated attempt. It is believed that a program of regular drawdowns at deeper levels offers the most cost-efficient approach to effectively controlling the weeds. This is the driving force behind this DEP-supported proposal to build a capability to extend the drawdown below its current gravity-driven depth of 3.5 feet to a pump-driven depth of 8 feet.

3. Drawdown Pumping Platform Design Requirements

3.1 The Drawdown Cycle

The pattern of the drawdown cycle is governed by the Order of Conditions issued by the Town's Conservation Commission. Currently, drawdown commences no sooner than the beginning of September and must reach its maximum depth no later than the middle of November, in order to allow all animal life to adjust to the lowered depth before colder temperatures come. The rate of drawdown must be sufficient to achieve the desired depth within this 10-week period, but may never exceed an average daily rate of 2 inches of depth, when measured over a 3-day period. The desired drawdown depth is then maintained until the maximum freezing effect has been achieved, but no later than the middle of February, in order to allow sufficient time for natural refill of the pond by the middle of April. During the period of drawdown, the water level in the pond must not fluctuate more than +/- 2 inches/day, when measured over a 3-day period. In addition a minimum flow rate of 1000 gallons/minute from the pond to the downstream wetlands must be maintained during drawdown to maintain the watershed. This may also be necessary to keep components in the System such as discharge pipes from freezing. This suggests that the System will have to operate in a different mode for each of 5 phases of the drawdown cycle. It is anticipated that each phase will require a substantially different pumping rate and degree of system control. The five phases of the drawdown cycle are described as follows:

Phase 1 - At the onset of the drawdown the System shall work in concert with the gravity lowering of the pond (i.e. removal of stop blocks) to maximize the drawdown rate within the specified limits, compensating for the ever-decreasing contribution of the gravity feed, and changes in water inflow due to precipitation.

Phase 2 - Once the maximum gravity drawdown level is achieved and the stop blocks are replaced, the System will continue to lower the pond level at the maximum drawdown rate, within specified limits, until the desired drawdown level is achieved, up to 8 feet below the maximum dammed water level of the pond.

Phase 3 - Once the desired drawdown level is achieved, the System will be required to maintain this level within established limits (compensating for varying water inflows due to precipitation and temperature), while also maintaining a minimum discharge flow rate into the downstream wetlands.

Phase 4 - At the end of the drawdown period when the pond is to be refilled, the System will be required to continue maintaining the minimum discharge flow rate into the downstream wetlands, until the pond recharges back to the level of the wetlands.

Phase 5 - At this point, the pumps may be shut down, as pond recharge and downstream flow requirements can be handled by managing the stop blocks in the dam.

3.2 Design Considerations

Various system configurations have been explored in the past (copies of reports are available on the Town's website). Based on a conceptual level review of these alternatives by the Pond Committee and Harvard Conservation Commission, it is currently believed that an offshore-based pumping system is the preferred alternative given cost and impact considerations. This conceptual approach assumes the following elements:

- A submerged or floating platform for mounting the pumps and intake structure, located in an area of sufficient depth to keep the intake structure below ice level, yet high enough to minimize any effects of bottom turbulence. This may require the platform to be positioned as much as 800 feet from its final discharge point at the marsh behind the dam. The conditions of the pond bottom will have to be surveyed as part of final location determination. A floating platform design must address the issues of positional stability in the face of constantly varying depth, and the forces of wind, water and ice around it; a submerged platform design must address the issues of installation and removal if necessary for repair. In both cases, the platform must present minimal obstruction to year-round use of the pond area it occupies.
- Multiple pumps to permit a wide range of pumping capacity during the varying phases of the drawdown cycle. This would also offer redundancy for level maintenance during the winter months should one of the pumps fail.
- Intake structures that minimize bottom disturbance, are maintenance-free for blockage (including efforts by the pond's very active beaver population), and offer protection to and from humans and other animals swimming in the area.
- Shore mounted electrical controls with convenient and safe year-round access, and protected from the elements and from meddling and vandalism. The control system should offer the flexibility required to meet the varying pumping requirements of the multi-phase drawdown, yet be simple enough for the Town's DPW personnel to operate with a reasonable amount of training.
- Submerged electrical, control and instrumentation wiring from the shore mounted control panel to the pump platform. These cables must be protected from human, animal, and machine traffic, especially if exposed on the bottom surface during drawdown. Three-phase power will be made available at the dam under separate contract.
- Discharge hoses that are immune to the elements, and protected from human, animal, and machine traffic.
- A simple and non-intrusive discharge and energy dissipation system to eliminate any erosive effects of water being pumped to the marsh on the downstream side of the dam.
- Access to all offshore components for periodic maintenance and necessary repair must be addressed (particularly during the winter months of operation when access is impaired by inclement weather and unsafe ice conditions), with a minimum of external specialized equipment such as flotation devices, tenders, etc. It is HIGHLY desirable for the system to be designed so that all offshore components normally require NO maintenance during the duration of drawdown operation.
- Noise level during operation must be sufficiently unobtrusive so as not to disturb abutters.
- Compliance with all OSHA standards.

3.3 Meetings and Design Review Procedures

The Design Engineer will be minimally responsible for presenting design work for review and comment by the Town as follows:

- Conceptual Design
- 70% Design Review
- 90% Design Review

At these review sessions the Design Engineer will be prepared to explain their design rational, and solicit and respond to comments and criticism. In order to make these meetings most

productive, the Designer will provide, one week prior to the Design Review session and in electronic format, a two-page summary of the information they plan to present.

In addition the Design Firm should provide a cost, on a per meeting basis, to attend and participate in Town Meetings to assist the Pond Committee in presenting the project and responding to inputs and concerns. For planning purposes the Design Firm should assume two meetings with a time commitment of 11/2 hours per meeting.

3.4 Permitting

The Town's objective is to install and operate the System in compliance with all applicable permitting requirements. The Town currently expects to obtain an Order of Conditions from the Conservation Commission but believes it is entitled to an exemption from MEPA as well as the Massachusetts Water Management Act as a "non-consumptive use".

The design should consider and identify any permitting requirements that the Town may be required to comply with. Furthermore the design, to the extent practical, must ensure that the System can be installed, operated and maintained in accordance with the applicable permit requirements and Order of Conditions, without the need to file for other permits.

4.0 RFP for Construction, Operation and Maintenance

As part of this proposal, the design firm will prepare a completed set of bidding documents (the "RPF") for use in soliciting a competitive contract for construction, installation and 1st-year operation and maintenance of the System through the first drawdown cycle, September 2005 through March 2006. This year shall be used to ensure the System complies with the performance criteria put forth in the RFP, and to familiarize Town personnel with the System's operation and maintenance. We are committed to employing qualified MBE and WBE firms whenever possible to meet our "Fair Share" goals for the overall program, and accordingly look for you to do the same on this proposal.

4.1 Construction and Maintenance of Pumping Platform

The construction and maintenance portion of the RFP should minimally specify the following requirements:

- Construction, installation, and testing of the pumping platform
- Demonstration of adherence and performance to design specification. Specific criteria for acceptance testing should be delineated.
- Schedule consistent with full-time operation during the pumped drawdown of Bare Hill Pond between September 2005 and March 2006, including time allotted for pre-testing and tuning the platform in its final location before formal drawdown commences. The schedule should include formal construction and installation progress reviews
- Construction budget that fits inside the total budget of $130,000 for design, construction, and 1st year operation. At a minimum the budget should specify staffing costs, outside services (e.g. consultants, engineers, etc), equipment costs, supply and material costs, administration costs and other (please specify) as applicable. The budget should include all assumptions for each budget line item, and clearly identify expenses attributed to M/WBE firms.
- Delivery of training, detailed documentation and any specialized equipment necessary for maintenance, troubleshooting and repair of the construction platform. A minimum of 80

hours of an instructor's time shall be provided for the specific purpose of conducting an operation and maintenance Training Program during 10 consecutive working days or as scheduled by DPW personnel. Three copies of an Operation and Maintenance manual shall be provided to the Town on termination of the Training Program. Prior to acceptance, three copies of the Draft O&M manual shall be submitted for review and comment by the Pond Committee and the Harvard DPW. Comments from these entities shall be addressed and incorporated in the second draft O&M manual submission and approved by the Town prior to final submittal and acceptance.

- Clear identification of the construction project manager, describing the experience of such an individual and whether: (a) the project manager is committed to serve for the life of the project; and (b) the Town of Harvard has the right to approve the successor in the event the project manager becomes unavailable to serve.

The Town will own the System and its Department of Public Works (DPW) will operate it. As such, maintenance design of the System must comply with the following:

- All activities related to maintenance and repair, operation and trouble shooting shall be possible with non-specialized training and equipment such as that typically possessed by Harvard's DPW and its personnel.
- Any specialized equipment or training required as described above shall be provided under the terms of this contract unless equipment or personnel having these specialized capabilities would typically be rented or contracted such as cranes or divers.

4.2 1st Year Contracted Operation

This portion of the RFP should minimally specify the following requirements:

- Clear identification of the person or persons responsible for operation and for maintenance of the system ("Operators"), describing the experience of such individual(s) and whether: (a) the Operators are committed to serve for the life of the operation and maintenance contract; and (b) the Town of Harvard has the right to approve successors in the event any Operator becomes unavailable to serve. The Operators shall provide the Town DPW their full-year O&M schedule four weeks prior to pump platform installation. The Operators shall also notify the Town of any planned work at least one week prior to conducting the work so that the Town may send personnel to observe. Notification of unscheduled repair work will be provided as time allows but at any rate prior to work having commenced. However, the Town's observation of such work will not constitute fulfillment or any part of the aforementioned training requirement and shall not constitute a payment item.

- During the Drawdown cycle the Operator will maintain operation and maintenance logs. The purpose of these logs will be to help determine the optimum method of conducting the drawdown, characterize the pond level response as a function of pumping rate, provide a reference document to aid in subsequent operation and maintenance by Town personnel, and identify special procedures or irregularities in system performance. Maintenance logs shall be kept separately from operations logs and shall include the time, date and substance of all work completed with special demarcation of repair work or unscheduled maintenance. It should include any comments on unusual circumstances or insights that might facilitate future maintenance tasks. Operation logs will note the time, date, weather conditions and substance of all operations tasks. This should include logging flow rate, alteration in number of pumps running, adjustment and any tricks, aids or rules of thumb that could aid future operators or streamline the process.

- 1st year operation and maintenance budget that fits inside the total budget of $130,000 for design, construction, and 1st year operation/maintenance. At a minimum the budget should

specify staffing costs, outside services (e.g. consultants, engineers, etc), equipment costs, administration costs and other (please specify) as applicable. The budget should include all assumptions for each budget line item. The types, numbers and cost of routine operation and maintenance items and disposables such as filters, and lubricants for one year's operation should be estimated, documented and included in the proposal as a line item. However this shall not constitute a payment item under the terms of the contract. Rather, the contractor shall receive payment for these items by directly billing the Town.

The Pond Committee is currently operating a data logging station which records rainfall and pond water level. This data can be made available to the Operators, and may also be useful during operations to record and monitor the drawdown rate, and make adjustments as necessary to the pumping process.

5.0 Warranty

The proposal must address what warranties will be offered by the design contractor, the construction contractor, and contractor supplying the 1st year of operation and maintenance.

As a minimum the composite warranty shall protect the Town for 2 years (1st year of operation by the contractor and the 2nd year of operation by the Town DPW) against the following:

- Failure to meet the intent of the specification provided herein
- Design errors such as, but not limited to, improperly selected or applied components or materials
- Fabrication errors or defects
- Failure due to component manufacturers' or material defects
- Failure due to operational errors in the 1st year of contracted operation, and in the 2nd year due to incomplete or erroneous training

In all warranty matters the responsible contractor will provide the labor to correct or replace defects to the satisfaction of the Town DPW. This shall include any negotiations with suppliers of manufacturers of components in addition to removal and replacement of the affected part or parts.