Improving Seawater Pumping and Small Docks at the Hatfield Marine Science Center:

A Planning Workshop - May 14, 2007
Hatfield Marine Science Center
Newport, Oregon

Workshop Report and Proceedings

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Held May 14, 2007
Hatfield Marine Science Center
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Executive Summary

Seawater is the lifeblood of much of the research and education enterprise at the Hatfield Marine Science Center (HMSC), Oregon State University's marine laboratory in Newport, where over $40 million a year in state and federal agency spending is dedicated to ocean and estuarine research and resource management. The system for distributing seawater to labs and teaching facilities throughout the 49-acre campus, and the supporting infrastructure that also provides researchers with access to the estuary and beyond, are approaching the age of replacement after 40-plus years of service.

To this end, the HMSC brought together three dozen scientists, engineers, educators, and facilities managers from throughout the Pacific Northwest for a day-long workshop on May 14, 2007 to assess and prioritize infrastructure improvement needs for seawater pumping and bay/ocean access in support of the HMSC's research and education mission. Funded by a National Science Foundation institutional planning grant, the primary objectives of the workshop were to identify specific requirements and make the initial steps in designing new dock facilities that will allow a variety of activities beyond existing capabilities, including:

- a seawater pumping system with new technology, energy-efficient, computer controlled pumps;
- limited small boat moorage (presently unavailable at HMSC);
- enhanced capability to conduct research over the water, including placing *in situ* instrumentation, sampling the water column, and maintaining experimental animals in bay waters;
- enhanced ability for classes to use dock facilities for education and research internship purposes; and potentially,
- improved access for youth and public education courses to access the water to improve learning outcomes.

Presenters shared the latest knowledge on modern seawater pumping technologies and dock facilities, providing valuable input for the productive sessions that followed, including a panel discussion with facilities managers from several university and federal agency marine labs highlighting best management practices. A subgroup discussion on immediate repair needs offered specific guidance on interim infrastructure improvements, cautioning against pursuing temporary fixes and recommending new construction / replacement of those structures that presented imminent hazards: the pilings, floating dock, and access ramp at the end of the pumphouse pier.

Afternoon breakout sessions allowed participants to focus on specific topics and report back to the full workshop on:

- Evaluation of the relative merits of submersible pump systems versus floating or vaulted centrifugal pumps, including ease of maintenance issues;
- Research and instrumentation needs specific to current and projected needs of HMSC users, along with infrastructure improvements to provide small boats access to the water;
- Education-specific needs for teaching university, community college, and K-12 students

The integrating discussion that followed helped articulate design criteria considerations and priorities in planning for infrastructure improvements such as:

- Importance of monitoring instruments at different points in the seawater system to measure flow, temperature, salinity, and other data parameters used by researchers, educators, and facilities maintenance staff with differing needs for the data;
- New pump control panels that are robust enough to meet the needs of both the current seawater system and new intake / pumping systems to be installed in the future;
- Small dock facilities serving specific research and education requirements, including boat mooring and equipment loading/unloading needs, wet and dry bench space, storage needs, fresh water and raw seawater fresh supplies, access and safety considerations for various users, etc.

This executive summary, along with the full workshop proceedings / report that follows, was produced and edited by:

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INTRODUCTION

A planning workshop was held on May 14, 2007 in support of institutional planning at Oregon State University's Hatfield Marine Science Center (HMSC), with a focus on assessing and prioritizing infrastructure improvement needs for seawater pumping and access to the estuary and ocean in support of the Center's research, education, and outreach functions. The seawater system at HMSC is part of the facilities infrastructure shared by Oregon State University (OSU) and five federal and state agency programs co-located on the 49-acre campus on Yaquina Bay:

- National Oceanic and Atmospheric Administration (NOAA)
  - Alaska Fisheries Science Center
  - Northwest Fisheries Science Center
  - Pacific Marine Environmental Lab
- Oregon Department of Fish and Wildlife (ODFW) – Marine Resources Program
- U.S. Department of Agriculture (USDA) – Agricultural Research Service
- U.S. Environmental Protection Agency (EPA) – Pacific Coastal Ecology Branch
- U.S. Fish and Wildlife Service (USFWS) – Oregon Coast National Wildlife Refuge Complex

Some 36 scientists, engineers, educators, and facilities managers from throughout the Pacific Northwest attended the workshop to lend their expertise to this effort. (See Appendix 1, Workshop Agenda and Appendix 2, Participants list).

The HMSC's seawater pumping system is antiquated and requires a great deal of maintenance and repair (see Appendix 3). In addition, the dock supporting the seawater pumps is beginning to fail, and will need to be repaired within the next five years. Existing research docks adjacent to the seawater pumping system are limited in capability, failing in terms of construction and current piling support, and lack the ability to support diverse research, education, and outreach requirements of a modern marine laboratory.

It is our hope to design a system which, when implemented and built, will enhance HMSC's experimental seawater system, *in situ* research capabilities, and opportunities for field learning, graduate student training, and for youth and public education classes to gain firsthand experience on the bay without the costs and difficulties of using boats. It will improve access for graduate students and researchers, not just at the Hatfield Center but from throughout the region, to conduct biological and other marine science research. The enhanced infrastructure would also help ensure long-term success of a visiting scientist program, a need that has been recognized and discussed internally, and formally articulated in the HMSC Strategic Plan. Some groundwork has already been initiated to enhance and support the visiting scientist program, such as streamlined mechanisms for requesting and reserving space, and assistance (at cost) for logistics, animal collection, maintenance, and care. The larger challenge of providing flexible lab space to accommodate the needs of visiting scientists engaged in research collaborations of varying focus and duration was one of the issues addressed by this workshop, which also provided an opportunity to probe assumptions about how well existing models at other institutions are meeting the needs of visiting scientists.

Acknowledgements: We thank the participants of this workshop for their assistance, expertise, and creativity in addressing the objectives of this workshop. We also thank the National Science Foundation for workshop funding under award DBI-0627840.

PARTICIPANTS

The goal of the workshop was to bring together people with expertise in engineering, design and operation of seawater systems, pumps, and docks with the Hatfield Marine Science Center's own facilities staff and researchers who use these systems. We included marine lab directors, facilities directors, and education directors from university and federal agency laboratories with existing systems and infrastructure that could potentially serve as models for the direction HMSC may take. Several scientists from the Pacific Northwest were invited for their familiarity with diverse marine laboratories and with the nature of the research and education enterprise at HMSC. These included scientists from Oregon State University and federal and state agency partners familiar with the Hatfield Center's existing facilities along with researchers from other institutions who have in the past, or may in the future be interested in visiting scientist opportunities and/or bringing education courses to the HMSC. Additional technical expertise came from representatives from the Port of Newport, an engineering consulting firm, and the private maritime industry. A full list of participants is provided in Appendix 2.

PROCEEDINGS

The workshop began with a welcome from Hatfield Marine Science Center program manager Ken Hall and self introductions by attendees, followed by a review of the agenda and workshop objectives by George Boehlert, Director of the HMSC. Presenters followed with an overview of best available technologies and practices related to seawater pumping and dock facilities design.

Presentations

1) Modern Seawater Pumping Technologies

Dr. John Colt, of the Northwest Fisheries Service, National Marine Fisheries Service, Seattle, spoke to design characteristics and issues unique to seawater pumping stations and seawater intakes. He placed emphasis on the components necessary for a good design. Starting with the intake screens, he discussed various system components, highlighting and explaining the performance and maintenance issues related to each part of the system. Other components covered: pumps motors and controls, filtration, degassing, storage and heating / chilling.

Dr. Colt emphasized the importance of proper engineering for a margin of safety, reliability, ease of maintenance and efficiency, noting that failures are sometimes unpredictable and can be as simple as an extreme low tide that does not adequately cover the intake screens. Achieving a high level of reliability appears to have a direct correlation to expense, and often it can cost more to achieve a high level of reliability. Time required to operate the system should be factored into the design of the system is another issue to be considered in the planning process, as well as safety of the operators. Consideration should be given to a dedicated and separate space to be used for the pumping system to allow easy access for service and repair.

As seawater quality is a primary issue for the HMSC, care should be taken in selecting a site for the seawater intake. Various means of collection are possible: pumps that float on a dock, submersible pumps, vaulted pumps, and stationary dock mounted pumps are all viable options for HMSC. Dr. Colt emphasized the difference in cost between the several types, and positive and negative issues associated with each type of pumping system. Dr. Colt ended his presentation with a brief explanation of the importance of net positive suction head and the correlation to efficient and effective operation.

2) Dock Facilities

Walt Jackson, Manager of Project Development at Bellingham Marine in Ferndale, Washington, presented information about concrete float designs. Modern construction design standards for floating docks serving larger vessels typically require 4000 to 8000 psi concrete with low water-cement ratios and use of air entrainment, super-plasticizers and sealers to form barriers inhibiting water and salt intrusion. Details were provided on the "unifloat" design -- a solid, rigid floating dock with a 50-60 year useful life. Its construction includes a foam core and metal rods running through the internal structure, with adjustable finger attachments.

3) Research and Instrumentation Needs for HMSC Dock Facilities

Chris Langdon, OSU Professor of Fisheries and Wildlife and Director of the Molluscan Broodstock Program, presented information gathered from diverse HMSC and OSU research users regarding dock infrastructure needs for current and future seawater-dependent research at HMSC. Current uses of the existing pumphouse dock and floating platforms include access to rafts and "sink float" pens of the oyster broodstock repository; instrumentation to measure currents and flow, seawater chemistry and biological sampling; small boat loading and unloading; diving; and provision of reliable, high-quality seawater supply to HMSC research and teaching labs and aquaria. There is an urgent need for a stronger, more stable and reliable dock infrastructure, as existing facilities are pushing the limits of their expected life, presenting safety risks and threatening research investments.

Other needed improvements to support current uses include easier access, improved safety, expanded work space, electrical power, freshwater supply, a ladder for divers, and secure storage. Future needs envisioned include a small lab for *in situ* and remote monitoring with flexible space (dry separate from wet activity), a direct supply of estuarine water, electric power and a network connection, security mechanisms, and infrastructure for boat access and mooring, including davits and hoists for loading and unloading equipment.

Issues to consider in planning for improvements include safety for users, security and public access questions, impacts from boat wakes, currents, high water levels and debris from storms (logs and trees in Yaquina Bay), durability, and versatility for a wide range of potential users. Other important considerations relate to the types of materials and chemicals used in construction materials that could potentially leach toxics into the bay in close proximity to the HMSC's seawater intake, and potential impacts from accidental spills of chemicals used for dockside research or education activities.

4) Potential Education Needs
Itchung Cheung, Academic Program Coordinator at the Hatfield Marine Science Center, presented the benefits of being able to use dock facilities for academic instruction and research internship purposes, which would enhance opportunities for field learning, for graduate and undergraduate student training, and for youth and public education classes to gain first-hand experience on the bay without the costs and difficulties of using boats.

Elements of various proposed infrastructure investments for educational uses were discussed, including observation windows for viewing submerged components of seawater pumping system and design features of a "floating" lab for teaching and research purposes. Requirements for a more basic floating platform capable of providing safe access for classes of 20-25 students were discussed, with the following deemed as important features: adjustable railings or variable railing heights, storage space for sampling equipment, and mooring capability for small boats.

Subgroup discussion on immediate repair and interim infrastructure improvements
(George Boehlert, Michael Davis, Lowell Fausett, Walt Jackson, Walt Nelson, Randy Walker, Stephen Webster)

This subgroup was convened to examine current facilities and to recommend short term actions. Some of the present concerns are described in Appendix 3. Stephen Webster cautioned against pursuing a temporary fix to address repairing these facilities (pumphouse, pier and docks) because they have largely reached end of their useful life; instead, he recommended that the focus should be on pursuing new construction right away. Walt Jackson offered a cost estimate of $47 per square foot based on recent heavy duty dock construction projects in the Puget Sound region, approximately 10-12 feet wide and 60 feet long. Adding cost of transport of materials, the estimate was $60-$65 per sq. ft.

A question was raised as to whether replacement of wood pilings (creosote-soaked) would be allowed under current regulations, or whether steel or concrete pilings would be required. In addition, the gangway may need to meet ADA compliance standards, which would require a minimum 80-foot length at an estimated cost of $50,000. It is possible that ADA requirements do not apply if there is no public access, in which case a shorter, steeper ramp could likely be built for around $13,000.

Regarding the replacement seawater pumping system being considered, Michael Davis advocated for the submersible pump or fixed (pier mounted) vertical turbines.

Panel discussion; marine lab facilities managers

The Facilities Managers Forum served as a valuable opportunity for sharing practices that worked well, and those practices that are best avoided. This discussion started with an acknowledgment that the first thing HMSC needed was an assessment and determination of what specific problem(s) exist with the current pump control system. It was suggested, that the Gould Pump company could be invited to Newport to evaluate the controls and offer their recommendations, or see if there was a panel that could be added now and still used later to control new pumps when installed.

As the discussion continued, facilities managers shared information on problems they have encountered with the systems they operate. These challenges ranged from cavitation, to not having enough water to pump at extreme low tide. The personal perspectives of the various participants offered valuable insights to the discussion, including the cautionary advice not to overlook the superior design and simplicity of the current intake screen system in evaluating pumping system alternatives for the HMSC, The majority of panelists thought that a vertically mounted turbine on pilings in the bay would be the best practice for HMSC, although submersible pumps were also discussed.

The challenges of funding such a large undertaking was discussed. A panel member from a private laboratory talked about how clients paid a certain charge per unit of seawater, and if changes are made to the system for the benefit of that client, those charges are billed to them, as well. Others explained how they charged per unit, while others had no charges at all because they served only their own staff. This discussion was useful as HMSC explores ways to fund this project and see it through to fruition.

Summary reports from breakout sessions

1.) Seawater pumping systems (breakout group report)
During this session, several types of pumping systems were discussed. The group recommended against using pumps that require priming. In the end, there were a few ideas that were considered viable and worth exploring:

A. A centrifugal pump that would be placed on a float with a foot valve that would keep the volute of the pump full of water was considered. It was thought that the short suction line was a favorable approach. It was also considered to be a plus that with the foot valve the pump could have very simple controls. On the negative side, there is some concern that the foot valve could eventually become compromised by marine fouling. In addition, this type of system would require a different screening system than currently used and may present a problem for cleaning screens.

B. A centrifugal pump mounted in a vault below the high tide level. This type of system would give HMSC the ability to pump without having to maintain a complicated priming system as the volute of the pump would be below high tide. This system would require a vault that would likely be a confined space requiring a permit. There always is the chance the vault that houses the pump could leak and flood.

C. Submersible pumps lack complicated controls, as the pump would be underwater during times of operation, which is a positive feature. Primary concerns center on how to clean the screens and retrieve the pumps for maintenance and service.

Of the three systems, the submersible seems to have an advantage because this type of pump has no suction loss, and that makes it considerably more efficient than the other types of pumps that were considered. The submersible also would have the smallest footprint and not require a pump house.

2.) Instrumentation and research needs, including small boats (breakout group report)
The breakout group on instrumentation and research needs started with a discussion of priorities relevant to the seawater pumping system. First, a web-based monitoring system for inflow, source points, and outflow is needed to provide well-characterized source information and understanding of what is coming in so that researchers can design around known parameters (salinity, temperature, turbidity, pH, and dissolved oxygen). A larger seawater storage capacity was also deemed important to allow greater mixing and reserve in case of breakdown. Third, a subsystem providing access to raw seawater (versus filtered stored seawater) is needed, primarily at the dock.

Dockside facilities to facilitate monitoring and experiments should include access to basic core parameters that can be measured reliably, hoists, dry lab space with electric power for computers and other instruments, and fresh water. Raw seawater for estuarine experiments should be drawn from variable depths, by valving or separate pumps. Primary use of dock facility should be research, separate from public and K-12 education functions, though occasional tours could be accommodated.

With regard to small boats, launching vessels from the research dock is not considered a priority. However, temporary moorage for 2-4 boats is needed to provide access for loading or unloading equipment. Construction/acquisition cost estimates for an appropriately sized floating dock with gear storage and safety equipment is in the range of $75,000.

Suggestions for operational efficiency include coordination of floating lab use and small boat moorage (using system similar to space/facilities use requests currently in place) and issuing a boat manifest every time a boat goes out. Two designs were discussed and further developed for the docks. The first (Fig. 1) shows a suggested short-term dock replacement approach that could address immediate safety issues. The second (Fig. 2) shows a longer-term solution that will meet the objectives identified above. It can be completed by adding on to the first structure.

3.) Educational uses/needs (breakout group report)
First and foremost, it is important to address the differences (and similarities) between K-12, community college and university education needs and the needs of HMSC researchers. Ultimately, this team feels that there is a significant value to interaction between these groups, particularly if there is an opportunity to secure any research equipment after use. In addition, we see a need for a scheduling process for usage and time slots. This will require personnel time to coordinate the various groups' schedules.

The incorporation of education programs (as opposed to research alone) is a key to funding. Many granting agencies and individual donors like to see multiple uses and audiences benefiting from their support. In addition, the training of young scientists and opportunities for student research projects can be seen as a unique benefit. Some 'buzz words' that may help in the fundraising process – as it relates to youth, family and higher education – are 'citizen science' 'hands-on-learning', 'experiential learning' and 'curriculum enhancement'.

The first priority (from this team) relates to the dock. At a bare minimum, it is critical that we have a sturdy platform for boat mooring and instrument deployment. Ideally, the new dock would include storage space (for equipment, life jackets, etc.), work/counter space, safety railings, access to running saltwater and a freshwater cleaning station.

The second priority is the pumping system itself. Guided tours (following a reservation process) for the general public would serve us well. This would require plexiglass or similar shielding in front of the pumps for safety, interpretive signs, and a computer monitor illustrating real-time data. An attached, small meeting room would be a helpful addition with the viewing window between the meeting room and pump room.

Our final priority is for a lab-based classroom. This does not have to be anything fancy, but could serve as a storage space, a staging area and/or a shelter for approximately 10-25 students at any given time. This facility could be mobile (a floating platform) or could be on land.

Education activities performed at these new facilities include: water sampling, plankton tows, organism examination, use of fouling plates, pumping system education, special events, boat access, ability to test ROV's, OSU student experiments/projects and research diving. NOTE: An underwater camera and ability to collect long-term data would be valuable additions to the plan.

Important questions/issues that arose from our session included:

1. Need for discussions with Ship Operations re: educational opportunities at their existing docks/facilities.
2. Is the building/classroom a critical component of this plan (our group began to recognize that while this would be useful, it may not be critical).
3. What are the insurance issues, generally, and specifically around student (under 18 years of age) use?

Integrating discussion: design criteria considerations

1) Priorities in planning for infrastructure improvements

It is important to have monitoring instruments at different points in the seawater system to provide data on characteristics of seawater (at intake, from reservoir to lab, and outflow). **Flow** data is important for tracking usage, planning for increases in demand, and for troubleshooting and evaluating performance of individual pumps. It is also useful in some cases for post- evaluation of experimental results. **Temperature** and **salinity** data are also important, as these are critical variables in maintaining live organisms and designing/monitoring research experiments. **Turbidity**, **pH** and d**issolved oxygen** were also mentioned as data measures worth monitoring for certain research and education uses.

Design of the system for seawater data collection and storage should consider the needs of different users. For public education and student research purposes, it is important to have this information in a web-based format that is easy to access and download. From an operations standpoint, salinity readings both at the dock and in the reservoir are important for making daily decisions about taking in seawater, especially during periods of heavy rains and high seasonal freshwater flows into the estuary. Temperature data are used to make decision about operating seawater chillers around HMSC. Long term storage of seawater data records is also important for operations and maintenance and should be kept separately from data gathered for research/education/public use.

2) Seawater intake / pumping system

Synthesis of previous discussion on seawater intake and pumping systems focused on the need for a well-designed control panel to simplify operation, and how best to achieve this objective. The idea of utilizing a "vendor assist" from a pump manufacturer like Gould was suggested. While this approach can provide useful guidance in the initial planning stages, moving forward would require (by Oregon State Administrative Rules) hiring an engineering firm to come up with a design. This would likely be done using the request for proposal (RFP) method.

Discussion on the urgency of new pump controls highlighted the objective of having a system that could be put into use now and also serve for the new intake system to be installed later. Any new system should preserve the ease of maintaining screens at the intake point. This will be a challenge with the two design choices outlined in the workshop, as both the submersible and direct drive turbine traditionally have the intakes bellow the pumps, making it hard to get the screens past the pump body. Regarding the need for raw seawater (separate from large scale intake/distribution system), it was determined that this would be at the dock only.

3) Small dock facilities – research and education needs

Expanding on the earlier discussion of dockside facilities, participants noted specific needs for research, including:

- Supply of raw seawater at the dock (smaller volume than main seawater pumping system) for experiments, e.g. sampling from different points in the tidal cycle
- Sea tables e.g. fiberglass tables/trunks
- Wet and dry bench space
- Space for continued operation of MBP oyster repository
- Infrastructure for deploying instruments into bay
- Davits and winches
- Storage space for safety equipment, boating supplies (ropes, engines), loading cart, estuary sampling gear
- Ladder for divers
- Electric power for lights, computers, logging instruments
- Freshwater for rinsing, washing down equipment
- Covered staging space
- Mooring for small boats (2-4 boats, up to 24' each)
- Hoist for unloading heavy loads, e.g. fish totes

For educational program activities, the following needs were highlighted:

- Dock or floating platform space for sampling (separate from research facility)
- Safety considerations for K-12 users

- Storage space for safety gear and sampling equipment
- Work bench / table space
- ROV / underwater camera? - various possible locations

Final wrap-up included a discussion of challenges and constraints such as funding, finding consensus on immediate needs versus long term wishes, and potential research and education uses of the existing OSU Ship Operations dock to avoid conflict with operating cranes, forklifts, etc.

Recommendations

Recognizing the importance of seawater to various heavily invested research programs at HMSC, and potential impacts of system failure, first priority should be to evaluate and choose a seawater pumping system to ensure the integrity of current operations, with design and build specifications to incorporate consideration of other needs. With regard to the funding challenge, a recommendation was made to approach HMSC community partners (internal and external) to collaborate on investment in infrastructure upgrades, underscoring the current and potential economic development value of HMSC operations to the region.

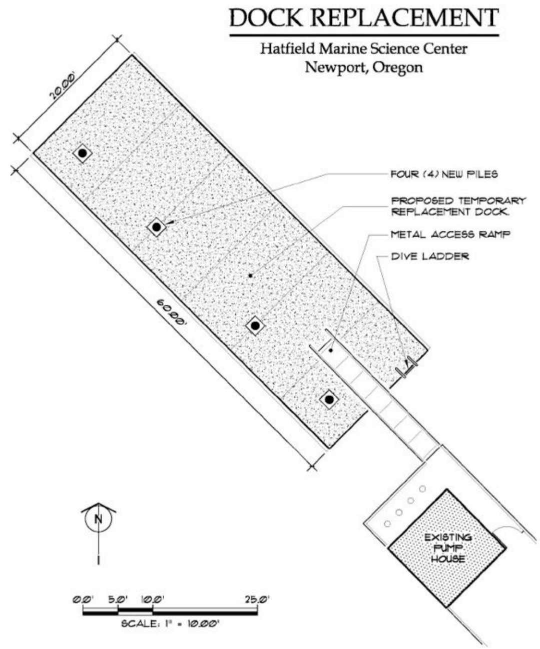

Figure 1: Suggested short-term replacement for HMSC seawater dock addressing immediate safety concerns.

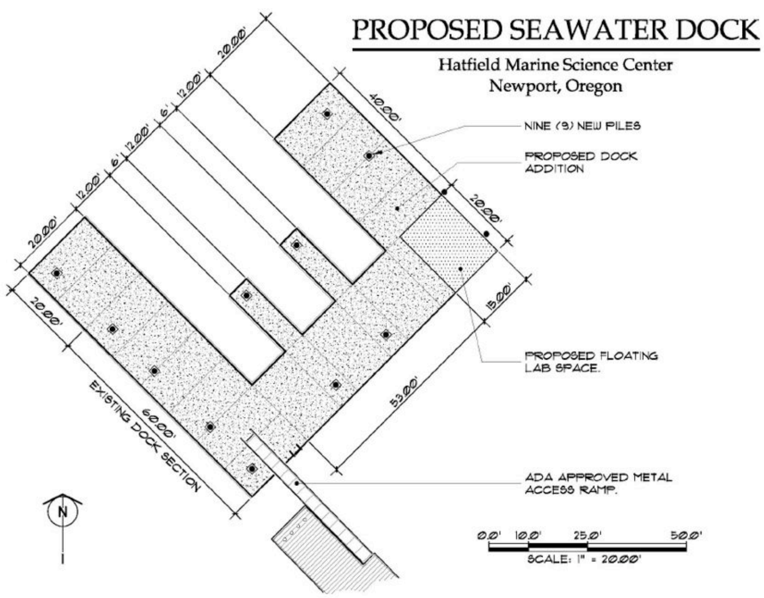

Figure 2: Suggested seawater dock configuration to address longer-term objectives.

Appendix 1: Workshop Agenda

Improving seawater pumping and estuary access facilities at HMSC
A planning workshop

Monday, May 14, 2007
Hatfield Marine Science Center - Newport, Oregon
Guin Library Seminar Room

Workshop Agenda

8:15 a.m.	Welcome and introductions: *Ken Hall, HMSC Program Manager*
8:30 a.m.	Review agenda and workshop objectives: *George Boehlert, HMSC Director*
8:45 a.m.	Presentations: Overview of best available technologies and practices • Modern seawater pumping system technologies: *John Colt, NOAA-NMFS Seattle* • Dock facilities: *Walt Jackson, Manager of Project Development, Bellingham Marine* • Instrumentation and research infrastructure for HMSC: *Chris Langdon, Coastal Oregon Marine Experiment Station (COMES)* • Potential Education needs *Itchung Cheung, HMSC Academic Program Coordinator*
10:00 a.m.	Break and tour of HMSC pump house and small dock facilities (coffee served in NOAA Barry Fisher Building – conference room 101) Subgroup discussion: immediate repair and interim infrastructure improvements
11:00 a.m.	Panel discussion with marine lab facilities managers: lessons learned
12:15 pm	Lunch
1: 15 pm	Breakout sessions: • Seawater pumping systems • Instrumentation and research needs, including small boats • Education needs
2:30 pm	Reports from breakout groups
3:30pm	Break: coffee, cookies served in LSR lounge
3:45 pm	Integrating discussion of design criteria considerations
5:00 pm	Closing remarks: *George Boehlert, HMSC Director*

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Appendix 3: Current HMSC Seawater Pumps and Docks

HMSC's seawater system pumps from intakes in Yaquina Bay. Our pump house (Figure 1) contains four 50-hp pumps (Figure 2), two of which are used at any one time. Water is drawn from a depth of 22' below high water. To maintain high salinity seawater for experimental use, pumping is conducted 90 min before and after slack high water twice each day. The pumps provide up to 4000 GPM through a 10-inch pipe to a seawater reservoir which holds 800,000 gallons. The system, with existing storage capability, is designed for a maximum seawater use throughout HMSC of 1000 GPM round the clock. More complete information on the seawater system is available at: *http://hmsc.oregonstate.edu/seawater.html*

Figure 1: HMSC's seawater pump house and dock (right).

Figure 2: Inside the pumphouse showing two of the four seawater pumps.

The dock and pumping system was built over the years as needs of HMSC grew. The dock and pumping system received a sizable renovation in the early 90's, with upgrades to the pump system, pump house and dock. As a system, the best descriptor of the docking and pumping system would be "eclectic." The equipment was installed at different times, using different technology and often surplus materials or those available at the least cost. Early in the 90's, the acting Facilities Manager built the pumping system and controls that are currently in use today. Many of the parts were scavenged and no professional engineering was conducted. While the system has functioned reasonably well for the past 15 years, its technology is dated and many of the parts are no longer available. The main pumps are some 16' above the water surface, requiring vacuum pumps to draw water into the main pumps and an excess of non-computerized controls. In fact, much of the control wire used in the pumping system is made of surplus telephone wire, causing periodic connection problems. Currently, only two of the HMSC facilities staff and the facilities manager are capable of trouble-shooting the system. The main pumps were opened up and inspected three years ago; at that time, 25% of the impellers were worn away and the titanium coating of the volutes was showing wear. The pumps that HMSC uses are not the industry standard for seawater acquisition.

Failure of the seawater system would have catastrophic results for many researchers at HMSC, including mortality of experimental research animals and interruption in research until the

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pumping system can be brought back on line. Planning for design and implementation of the next generation seawater pumping system is clearly needed.

We also have concerns for the associated dock system. A small dock, added in the early 1990s, is accessed through the pump house and down a ramp (Figure 3). This dock is the principal access point for HMSC researchers needing bay access and the ability to conduct *in situ* research. While OSU's ship support facility is adjacent to the HMSC, current security restrictions severely limit its use for experimental, research, or educational purposes. There are no small boat docking facilities; instead, researchers must use the Port of Newport's boat ramp, requiring trailering small boats to launch them.

The docking system including the float and sliding ramp are in danger of being condemned and taken out of service. Winter storms and boat wakes have taken their toll over the years, and a piling that supports the floating dock snapped off less than a month ago. History and observation tells us that other pilings will be failing soon. A recent dive by OSU and NOAA divers indicated that at least two additional pilings are at the point of failure. Other issues that are problematic for the dock are the lack of ADA accessibility, lack of useable space for scientific research

Figure 3: HMSC's seawater pump house from the small dock.

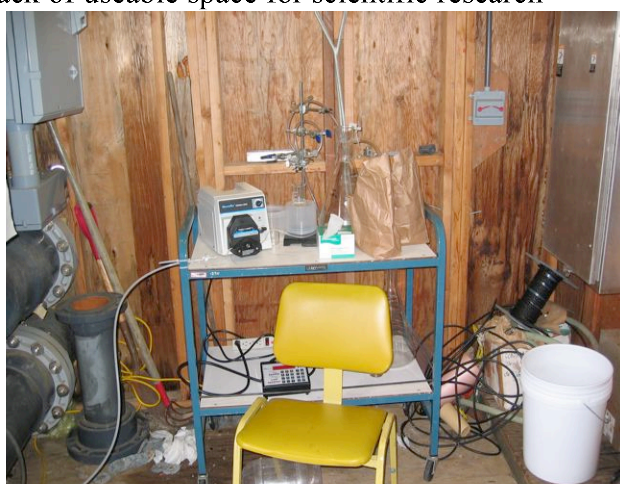

Figure 4: Inside the pump house; the only enclosed space available for instrumentation.

equipment, and the inability to use the dock facilities for student and course use. HMSC receives far more requests for space than can be accommodated, and several requests for use are turned down due to safety considerations. The only space available for experimental use is a corner of the pump house (Figure 4), adjacent to (and partially blocking) the electrical panels that operate the seawater system.