Safe Harbor: Berth Expansion to Support New Bedford's Growing Commercial Fishing Fleet

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ABSTRACT

Once the world's most famous whaling-era seaport, New Bedford now stands as the number one fishing port in the nation based on total value of catch. With a fleet of over 470 commercial fishing vessels and only 160 public berths, New Bedford is challenged with increasing demand for adequate space to safely accommodate the fleet. Overcrowding of commercial fishing vessels at the docks is common, and captains will often raft their vessels together up to six (or more) abreast at the piers during storms. Not only does overcrowding of the facilities pose obvious threats to the safety of vessels and crew; but also the associated pier structures, which were not designed to handle the berthing loads to which they are currently subjected.

In 2007, the City explored engineering alternatives to relieve the congestion at its five public commercial docking facilities. The study analyzed the current berthing situation and provided a cost-effective engineering "action plan" that would provide additional berths for the fleet within the next three to five years. Establishing these alternatives was accomplished through both correspondence with members of the fishing community, city officials and industry stakeholders and the analysis of the current berthing situation. The proposed alternatives were a result of the evaluation of various layouts, including (1) the construction of new facilities, (2) establishment of mooring fields, (3) floating dock systems and (4) fixed pier expansion.

The final recommendation from the study included the installation of a concrete floating dock extension to one of the existing piers, in conjunction with a partial de-authorization of an obsolete maneuvering area within the harbor's US Army Corps Federal Navigation Project to accomodate the expansion.

INTRODUCTION

The Port of New Bedford, Massachusetts has ranked No. 1 in the United States in terms of the value of catch for the past nine (9) years, landing approximately 146 million pounds of stock valued at $241 million in 2008 alone (NOAA, 2009). Over the past several years, recreational and commercial development has continued to diminish fishing ports along the east coast resulting in an increased demand for

adequate berthing space in New Bedford, which has become one of the last remaining full-service fishing ports in the region. In addition, stringent federal regulations which limit both the quantities of catch and days at sea, have forced vessels to remain in port for longer periods of time.

New Bedford's fishing fleet consists of more than 470 vessels that use the publicly managed berthing facilities. Approximately 350 of these vessels are home-ported in New Bedford, while the remaining 120 are transient vessels that visit the port on a seasonal basis. Over the course of a year, the typical fishing vessel berths in the port an average of 226 days (8 months) (OCC, 2008). According to the New Bedford Harbor Development Commission (HDC), approximately half of the fleet is in port at any given time. During storms, the number of vessels seeking berthing space further increases as vessels seek safe harbor.

The City of New Bedford operates five public berthing facilities, which can accommodate a total of approximately 160 vessels at maximum capacity. Boats often raft together four to six vessels deep, causing challenges for navigation, provisioning, and safe access for the crews. Overcrowding of the berthing facilities poses serious threats to the safety of vessels, crew and the associated facilities.

The scope of this study focused on evaluating engineering alternatives to relieve commercial fishing vessel congestion in the Port. Proposed solutions, however, were required to accommodate the needs of the fishing fleet, provide options which were cost effective, and could be implemented within the next three to five years. Several alternatives were evaluated, including use of new facilities, mooring fields, floating systems, and fixed pier expansion. Interviews and public meetings were conducted with city officials, local fishermen, state and local regulatory agencies, and various other industry stakeholders to gain a better understanding of the needs and concerns of the fleet and other property and business owners impacted by the fishing industry. The most pressing issues being the ability to increase the number of berths, and the ability to allow/maintain vehicular access to the piers.

SITE DESCRIPTION

New Bedford is located in southeastern Massachusetts, at the mouth of the Acushnet River in Buzzard's Bay. The port is protected by a US Army Corps of Engineers hurricane barrier, providing an ideal location for fishing vessels working along the eastern seaboard from Nantucket to the Georges Bank. The Corps also maintains a 200 foot wide by 30 foot deep navigation channel, and a 20-acre, 30 foot deep maneuvering area designed to accommodate vessels actively using the facilities along the central waterfront.

Although hurricanes are fairly uncommon in New England, high winds, waves and storm surge from nor'easter storms provide an equal or greater threat due to their longer duration and greater frequency. With strong storm conditions lasting throughout several tidal cycles, nor'easter storms can place a great deal of stress on vessel mooring structures in the harbor, particularly with 4 to 6 commercial fishing

vessels tied off to a single cleat; as often happens under the overcrowded conditions at the City's commercial fishing docks.

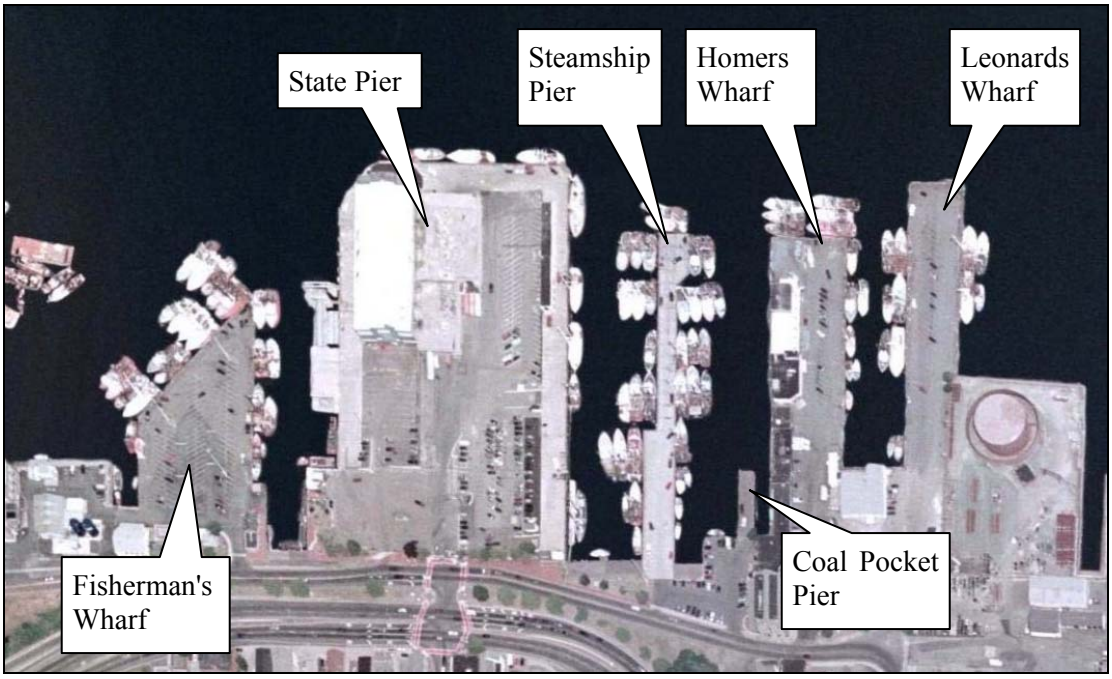

Figure 1: Aerial view of the public berthing facilities for New Bedford's commercial fishing fleet.

Wind conditions in the harbor typically blow between 9 and 13 miles per hour, with the strongest winds during the winter months. The mean tidal range in the harbor is approximately 3 feet, with a maximum spring high tide of approximately 5 feet. Waves within the harbor are typically between 0 and 3 feet high, with 3 feet being a typical maximum during storms. The vessels utilizing the public berthing facilities typically range between 25 to 137 feet long. The average commercial fishing vessel size however, is between 72 and 75 feet long.

EXISTING CONDITIONS

The five (5) primary public berthing facilities controlled by the City are located in the central harbor area and include Fishermen's Wharf, Steamship Wharf, Coal Pocket Pier, Homer's Wharf, and Leonard's Wharf. The table below summarizes the total length of dockage and the vessel capacity of each facility.

Facility	Dock Length (Feet)	Vessel Capacity
Fisherman's Wharf	940	30
Steamship Wharf	1300	50
Coal Pocket Pier	260	10
Homer's Wharf	850	30
Leonard's Wharf	950	40

Fishermen's Wharf

Overcrowded conditions are present at each location, and not every facility is able to accommodate expansion. Fishermen's Wharf, currently used for the larger scallop boats, provides the most sheltered area for vessel berthing. While an ideal location, expansion in this area is limited by the proximity of Fish Island and space required for vessels to access the fuel dock and ice facilities located north of the wharf. Expansion on the south face of the wharf is restricted by the proximity to State Pier.

Steamship Wharf

Steamship Wharf, located just south of State Pier, currently supports the greatest number of vessels of the public facilities. While additional expansion of this facility is technically possible, the location is not favored as the size of ferries and other vessels accessing State Pier vary tremendously and the addition of new structures in this area may impede maneuvering capabilities.

Coal Pocket Pier

Coal Pocket Pier is a small timber pier located between Steamship Wharf and Homer's Wharf. The size and orientation of this pier make expansion impossible at this location. The pier has limited berthing space; accommodating vessels less than 40 feet in length. Berthing is restricted to the north of the structure as the area to the south is generally occupied by vessels loading and unloading to businesses located on the north side of Homer's Wharf.

Homer's and Leonard's Wharves

Homer's Wharf, located just south of Coal Pocket Pier consists of a solid fill pier protected by a steel bulkhead. Vessels tie off to 32-inch cleats which are mounted to the concrete pads along the deck. Buildings occupy approximately 20% of the total deck area and approximately 80% of the area along the north side of the facility.

Leonard's Wharf, located to the south, has a similar construction to Homer's Wharf. While these two facilities are similar in size, the more spacious water area south of Leonard's Wharf allows for the berthing of 40 vessels whereas Homer's Wharf can only accommodate 30 vessels.

SUGGESTED ALTERNATIVES

NEW FACILITES: The opportunities for development of new berthing facilities in New Bedford Harbor are extremely limited due to the lack of available waterfront real estate. Properties which are owned and operated by the City are currently either utilized as berthing facilities or are tied up in lease agreements making the conversion to public berthing use impossible in the near-term.

One City-owned property that might be considered for new commercial berths includes the Pope's Island Marina which is located on the south side of Pope's Island.

This 200 slip facility, reserved for recreational boater use during the summer months, is mostly vacant during the winter months, a time when the commercial fleet relies heavily on the harbor for protection from stormy conditions.

Water depths in this location are approximately 15 feet at low tide, which would be sufficient for the fishing vessels that could berth in the area. In order to utilize this location for berthing the larger commercial vessels, the dock would need to be upgraded or replaced. Properly upgraded, the facility could provide up to 800 linear feet available for vessel berthing. This would support 18 additional vessels if the vessels were rafted two abreast.

Disadvantages to this alternative include the restriction of seasonal use; the increased wear and tear resulting from the larger commercial fishing vessels both berthing at the dock and utilizing the deck for the loading and offloading of equipment.

MOORINGS/FLOATS: While the City already has a harbor moorings policy in place for both commercial and recreational vessels individually, an established mooring field has not been created in New Bedford Harbor. A mooring field for commercial vessels would provide a 'reserved' parking area that would utilize vacant water areas of the harbor. Although individual vessel moorings are relatively inexpensive (~$12,000 each) as compared to other alternatives, there are substantial negatives that deter its use. The primary concern is the large amount of space required for a single mooring. A mooring field with dimensions of 800 feet by 800 feet would only accommodate 16 vessels. Through interviews with various fishermen, OCC noted the concerns regarding boat access, lack of security, and the availability of loading and offloading equipment and goods.

At present, loading and offloading of commercial vessels has been limited to a small area adjacent to the ice and fueling docks. Therefore, moored vessels may be required to transport equipment via a personally owned dinghy or City-operated shuttle to access shore facilities. Depending on the system used boat owners would have difficulty monitoring their vessels on a regular basis, thus sacrificing security.

Traditional moorings would provide practically no protection to vessels during storms, creating the possibility of vessels breaking free and damaging other vessels or structures in the harbor. While there are a number of open water areas available throughout the harbor, the number of vessels would be limited as each single vessel requires a large swing circle area to eliminate interference with other vessels. Another possible consequence is a strong likelihood that the number of abandoned and derelict vessels in the harbor would increase. The City has established mooring regulations, and plans a pilot project to add moorings at selected locations in the harbor. Each commercial vessel will be responsible for installing and maintaining its own mooring. Given the established mooring regulations which allow for commercial fishing vessels to use this type of system, it appears evident that if this were a viable alternative to the congestion problem that fishermen would be inquiring about such systems. Currently the use of the congested facilities ranks higher than the existing opportunity to utilize moorings.

FLOATING MOORING BARGES: As options to provide new berths were explored, the concept of a 'long term parking lot' for minimally active vessels was considered. The new facility could be located on the north side of Pope's Island, or in the same vicinity of the existing piers in the central harbor. Either location would require the City to implement specific management procedures for both ensuring vessel security, transporting fishermen back and forth from the mooring to the shore, and providing a designated area along the existing facilities for vessel loading and repair.

The mooring would likely consist of 40 foot by 10 foot by 5 foot steel barges which could be pinned together in a variety of orientations. The general industry rule-of-thumb is that the length of a mooring structure should be 80% of the length of the vessel so, in order to accommodate vessels larger than 50 feet in length, more than one barge would need to be interconnected. The mooring barges would likely be secured with an elastic mooring system connected to large helical anchors.

The benefits of this mooring configuration include the potential for relocation and expansion at a later time, and the possibility of using solar energy to provide the boats with trickle charge electricity to power batteries. Despite these advantages, the fishermen are generally against such a system because of security concerns and the inconvenience of having to transport goods and equipment via boat to the landside harbor facilities. Additionally, many fishermen expressed concerns that the mooring could become a 'dumping' ground for derelict vessels.

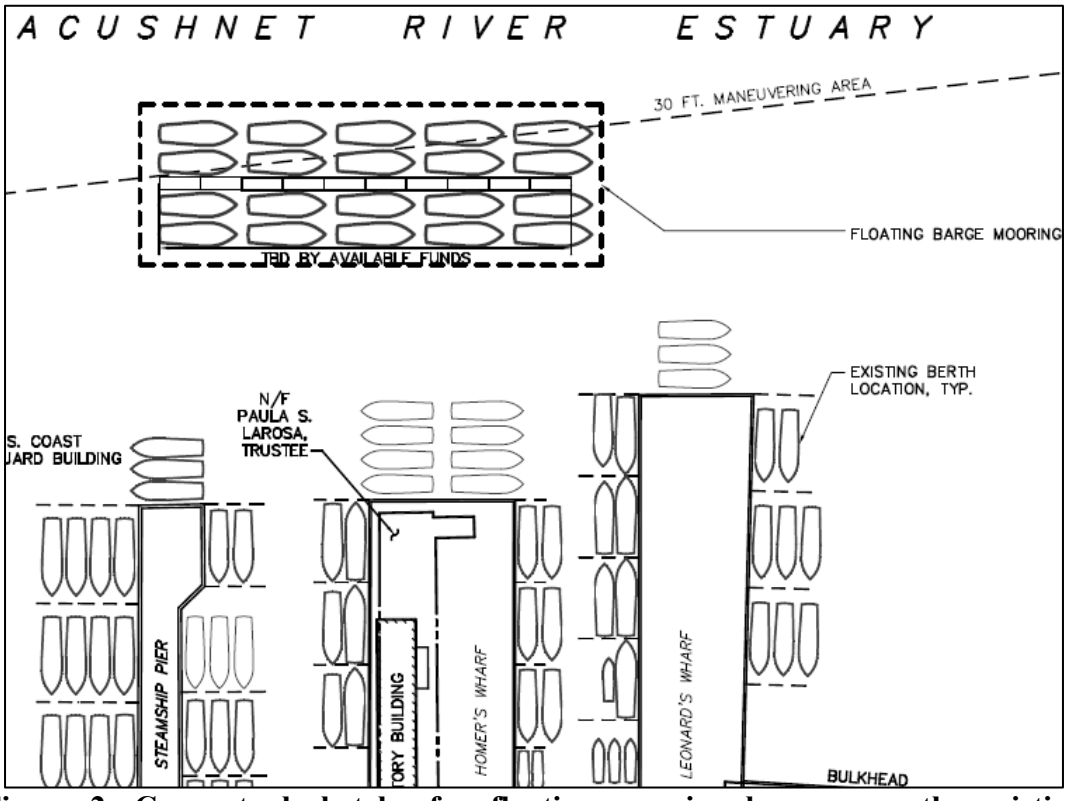

Figure 2: Conceptual sketch of a floating mooring barge near the existing commercial fishing berth facilities (Ocean and Coastal Consultants, 2008).

EXPANSION OF EXISTING FACILITES: The two basic methods for expansion of existing facilities include the use of floating docks, or construction of fixed pier extentions. The two primary locations available for expansion include Homer's and Leonard's Wharves. Leonard's Wharf, the southern-most structure, would support expansion off either the south side or the east side of the facility. The major concern with the southern extension would be infringement on the use of the watersheet by the abutting industrial facility.to the immediate south of Leonard's Wharf.

While both Homer's and Leonard's Wharf appear to be ideal locations for expansion, there are federal regulations in place regarding the 30 foot maneuvering area which is located approximately 350 feet from the end of Homer's Wharf and 270 feet from the end of Leonard's Wharf. Currently this Federal Navigation Project (FNP) maneuvering area is regulated and maintained by the US Army Corps of Engineers who restore the area to authorized project water depth (30 feet). The last major dredging within this Maneuvering Area occurred in 1953, and has accumulated no more than 3 feet of sediment since that time. In order to infringe upon any portion of this FNP, the affected segment must be de-authorized. De-authorization surrenders the Federal role in maintaining adequate water depths within the area. In the case at hand, it appears that maintenance of the area has been minimal over the past 50 years, and if the accumulation rate remains the same, the City would not be required to dredge this area for another 200 years.

Floating Concrete Pier Expansion: Attached floating concrete piers would consist of a metal gangway leading to floating concrete sections interconnected with stainless steel or galvanized thru rods. The piling system would employ two piles for every 40 feet of deck length. These floating systems, which are composed of a solid polystyrene core and a concrete shell, have the ability to be robustly designed to accommodate a number of different load requirements, including limited vehicular traffic. In addition, the systems can be fabricated in different lengths and widths with various pile schematics and cleat and fender orientations. If desired, the floats may also be equipped with PVC utility conduits integrated within the floats. Other features include modular flexibility, durability, wave and wind resistance, salt-tolerance, short installation period with minimal impacts to adjacent operations, and ease of reconfiguration as the needs of the harbor change. Since floating structures are "temporary" systems which minimize filling and impact in the resource area, they are generally easier to permit, thus reducing costs associated with this portion of the project. This option is the most practical solution with limited funds available.

Fixed Pier Expansion: Would be the preferred option should the City be able to obtain sufficient state and/or federal funding assistance for the project. Although structurally more stable than floating systems, the cost and time required to implement a fixed pier extension would have significant impacts to vessel utilization of the facilities during construction period. Obtaining federal and state regulatory approvals for a permanent structural expansion would also be more complex than that

for temporary floating dock configurations. A fixed pier extension would also allow vehicle access for loading and unloading of provisions on vessels and vessel repair.

RECOMMENDED PLAN

REPAIR RECOMMENDATIONS: While berthing facility expansion in New Bedford Harbor is essential to accommodate the growing fishing fleet, ensuring that the existing facilities are routinely inspected and maintained is also of critical importance. During the study, it was noted that the last significant repair work at the City's facilities was completed more than 10 years ago. ASCE recommends that marine structures undergo routine inspections, above and below water, on a maximum interval of every five years. It was recommended that the City conduct a full underwater investigation of each facility. This assessment is not only important to verify the existing conditions, but also for determining if these structures are fit for expansion and, if not, where allotted maintenance funds should be prioritized to be spent most effectively. Underwater inspections were performed at each of the five (5) City berthing facilities in 2008, resulting in the discovery of nearly $4 million in recommended repairs to maintain and extend the service life of the existing facilities (Pare Corporation, 2009).

FLOATING EXTENSIONS AT LEONARD'S WHARF: The recommended alternative includes the installation of floating concrete dock extensions at Leonard's Wharf. Two locations presenting opportunities for expansion include the east and south sides of the pier. The recommended plan requires a partial de-authorization of the FNP to accommodate sufficient vessels to make the alternative cost effective.

The east extension would consist of an L-shaped floating concrete pier extension running 210 feet east and approximately 500 feet north of Leonard's Wharf (see Figure 3b). This orientation would require moving the harbor line approximately 140 feet to the east, and would support a total of 26 additional vessels. Finger docks oriented at 60 feet on center would provide each vessel with direct access to the main dock without having to cross over adjacent boats. The fingers would also be equipped with cleats for providing additional locations for tying vessel lines, thereby decreasing the loads on the main dock cleats. This configuration will also enable easier and safer loading/offloading of personnel and equipment.

An L-extension off of the south side of Leonard's Wharf could extend 210 feet south and 625 feet west, resulting in enough capacity for an additional 20 vessels. The extension would require dredging of approximately 10,000 cubic yards of material to meet the draft requirements of the commercial fishing vessels.

It was also recommended that the City designate a loading/unloading area on the south side of Fishermen's Wharf for easier vessel access. The floating concrete systems will not provide the same deck space or heavy equipment access (i.e. cranes) as the existing fixed facilities. Therefore, an area that remains available at all times for such operations would be needed to accommodate additional vessels.

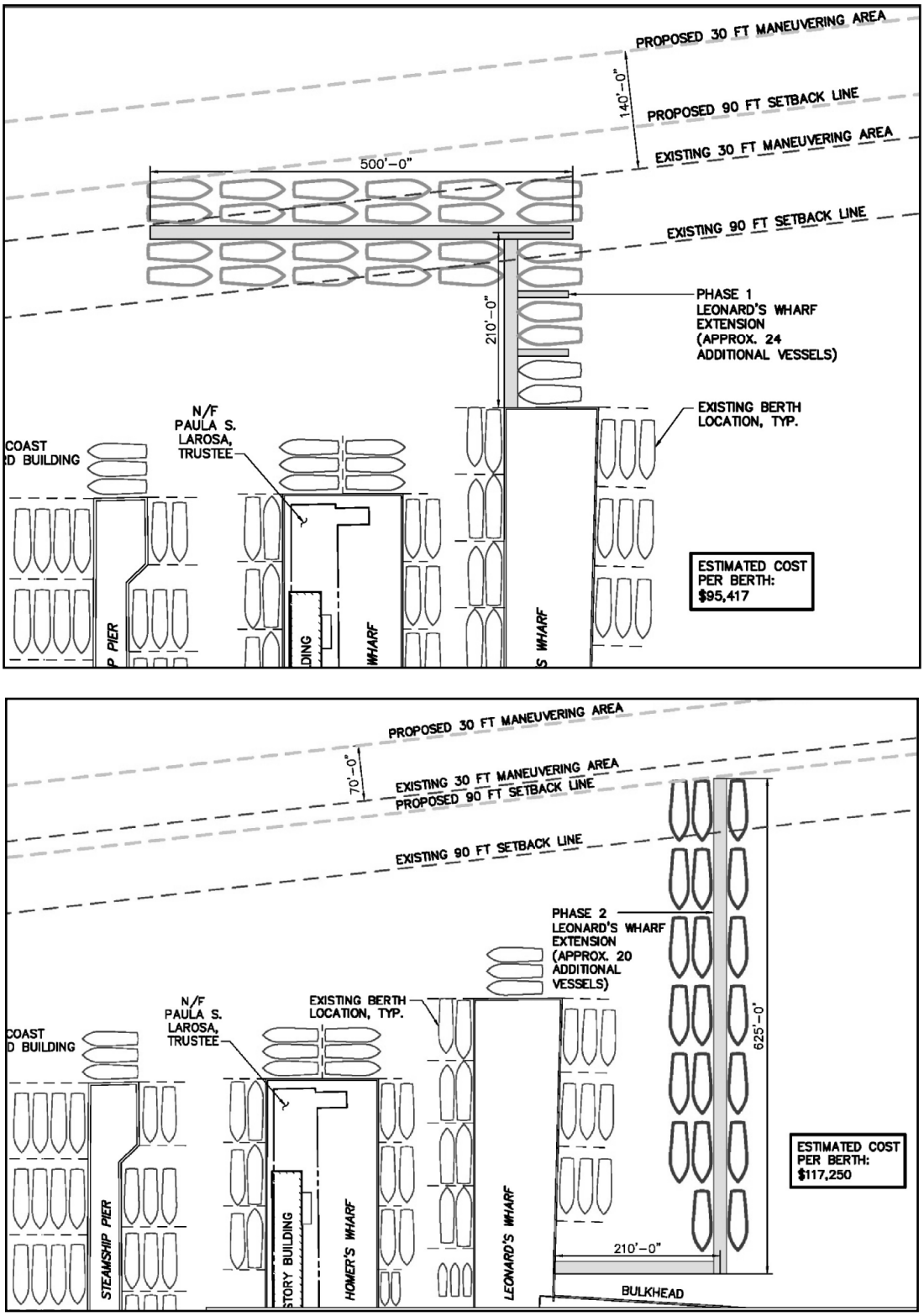

Figure 3 (a) and (b): Proposed floating concrete dock extensions at Leonards Wharf. The schemes are not mutually exclusive, and could be phased to suit budget and demand. Both require partial de-authorization of the outdated federal maneuvering area (Ocean and Coastal Consultants, 2008).

CONCLUSIONS

A cost summary of the alternatives explored in this study is provided in the table below. These represent initial costs only. An analysis of the life-cycle costs for the recommended alternatives were outside the scope of this study, but should be considered as part of any final analysis and decision-making by the City.

Description	Total Cost	Vessel Capacity	Cost per Vessel
Mooring Field (800 ft x 800 ft)	$192,000	16	$12,000
Steel Mooring Barges (400 ft x 10 ft)	$1,053,000	20	$53,000
Fixed Pier Extension (100 ft x 30 ft)	$750,000	6	$125,000
Concrete Float Extension Alternatives (RECOMMENDED):			
Leonard's Wharf – East Extension *(partial FNP deauthorization required)*	$1,847,000	26	$71,000
Leonard's Wharf – South Extension *(partial FNP deauthorization required)*	$1,826,000	20	$91,000
Homer's Wharf Extension	$1,171,000	12	$98,000
Note: Dredging costs excluded.			

The recommended plan was to implement the concrete float extensions for Leonards Wharf. Although this was not the lowest cost alternative, it was felt that the proposed system best met the needs of the fishermen and provided the greatest flexibility for reconfiguration in changing markets. Advantages included: direct access to vessels for provisioning and maintenance; the extensions could be phased based on demand and budget; floats were configurable (could add or subtract berths as needed); and finger piers could be added for greater safety/access to vessels.

Disadvantages of the recommended system included the relocation of the FNP boundary to fit the extension; negotiation and purchase of additional watersheet "rights" from abutters; and no direct vehicle access to the vessels.

Sustainability is an important consideration for waterfront infrastructure due to the harsh marine environment. Owners must strike a balance between the higher initial construction costs of "robust" design versus the higher operation and maintenance costs over the project life for structures comprised of less heavy materials or structural framing. The findings from the underwater inspections of the existing berthing facilities provided the following insights which, if incorporated into the design, may extend the service life of the proposed pier expansions:

1. Pile design should incorporate steel pipe piles (concrete-filled), as they have a more efficient section and are more corrosion resistant than H-piles.

2. Fusion bonded epoxy coatings on steel components tend to provide better corrosion protection than traditional coal tar epoxy coatings.

3. Cathodic protection should be provided on steel structures in areas where high corrosion rates are expected, such as pier heads or areas with a large amount of electrical infrastructure.

4. Deterioration of concrete can be minimized by using a denser mix design which impedes chloride ion penetration, and ensuring adequate cover over reinforcement steel for concrete pile caps, decks and curbs.

5. Avoid pre-cast concrete deck slabs on piers with large lateral loadings. Cast-in-place slabs provide greater diaphragm strength and are therefore subject to less deflection and wracking over repeated lateral loads.

6. Rubber fender units are subject to less wear and tear than timber pile fenders, but at greater initial costs.

7. Timber fender piles should be Greenheart timber piles in lieu of standard southern yellow pine, due to their hardness and resistance to damage from marine borers.

8. Deck runoff and stormwater drainage systems should use corrosion resistant materials where possible.

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