CITY OF PORTSMOUTH
SEAWALL INSPECTIONS

RFP# 49-07

PERFORMED BY

WATERFRONT ENGINEERS LLC
Stratham, New Hampshire

FOR

CITY OF PORTSMOUTH
Portsmouth, New Hampshire

POINT OF CONTACT:

Mr. Dave Allen, PE
Deputy Director of Public Works
Department of Public Works

EXECUTIVE SUMMARY

This project was a visual inspection and general assessment of the apparent condition of the City owned seawalls under RFP# 49-07. Repairs or replacement are recommended for the seawalls evaluated, with some of the replacements needed in the near term and some for future planning. Since all of the seawalls, except for the Pierce Island Bridge approach walls are within the Portsmouth Historical District, the replacement costs assume in-kind replacement with similar stone seawalls in the same location. The exceptions are the Pierce Island Bridge approach walls and South Mill Pond concrete wall near the Police Station where we are recommending replacement with stone riprap slopes.

The engineers opinion of probable construction cost project budgets for the following seawalls assume 2008 construction, though many of these replacements are for longer term planning and the budgets should be adjusted over time to reflect cost inflation. These budgets do not include permitting costs and fees.

- South Mill Street $222,000 Near Term Replacement
- Mechanic Street near Pickering Street $136,000 Future Replacement
- Mechanic Street near Gates Street $338,000 Near Term Replacement
- Pierce Island bridge eastern app. Walls $ 40,000 Future Replacement
- Daniel Street between Harbour Place & Memorial Bridge $ 16,000 Near Term Repairs
- Maplewood Avenue at North Mill Pond $958,000 Future Replacement (excludes arch culvert replacement cost)
- South Mill Pond adj. to Livermore Street $147,000 Future Replacement
- South Mill Pond adj. to Police Station $108,000 Future Replacement

INSPECTION SCOPE

This project was a visual inspection and general assessment of the apparent condition of the City owned seawalls under RFP# 49-07 at the following locations:

- South Mill Street
- Mechanic Street near Pickering Street
- Mechanic Street near Gates Street
- Pierce Island bridge eastern approach walls
- Daniel Street between Harbour Place & Memorial Bridge
- Maplewood Avenue at North Mill Pond
- South Mill Pond adjacent to Livermore Street
- South Mill Pond adjacent to Police Station

VICINITY AIR PHOTO

The field investigations for this study were performed in late 2007 (South Mill St partially reinspected 2008) by Duncan Mellor, PE of Waterfront Engineers LLC who has more than 20 years of experience in waterfront structure inspection and engineering.

SOUTH MILL STREET SEAWALL

The South Mill Street seawall is a stone rubble retaining wall 133 feet in length and of varying height (2 feet to 6 feet high). The wall is immediately adjacent to South Mill Street with the top of wall at street level and the toe of wall elevation varying with the westerly portion bordering salt marsh and easterly portion bordering a muddy gravel intertidal area. There is parallel parking along the street just inshore of the wall (topped with a corroded chain link fence) and utilities including buried water, sewer, gas and overhead wires with two utility poles just behind the wall. The water main should be below the toe of wall elevation; however the sewer line is near the wall with an invert just above mid tide level, so while not likely to be damaged by a wall collapse, it will need to be protected during replacement footing excavation. The proximity of the gas line will need to be checked during the wall replacement design phase. The power lines are an overhead hazard to construction equipment and the construction contractor will need to be aware and take precautions when doing this work.

The seawall borders the tidal channel which forms the inflow and outflow from South Mill Pond and is in a protected location and not exposed to significant wave action. In this protected location and with the inflow of brackish water from South Mill Pond, ice is expected to form each winter, however the site is largely protected from drifting ice floes.

The wall is a typical rubble construction stone wall, using mostly irregularly shaped broken stone with no regular coursing other than the cap stones which do typically use roughly rectangular granite blocks of the general size and shape often used for curbing. The quality of the wall stone does vary significantly from a significant amount of hard durable granite, but also mixed with local metamorphosed shale type stone which fractures easily, and a lesser amount of soft sedimentary sand stone that is deteriorating. At mid length along the wall is a short section of wall built from rounded boulders (low quality stonework) and at the western end of the wall there is some deterioration concrete on the bottom visible course of the wall.

Basic plumb bob checks along the wall did show that the face of the wall is leaning offshore to varying amounts, up to -2 Horizontal to 12 Vertical. The scope of this investigation did not include subsurface excavation to measure wall thickness; however the observation of the wall leaning offshore does suggest the wall may not have adequate thickness to act as a gravity wall under the present street loading with an adequate factor of safety. This is a fairly typical occurrence in New England when stone retaining walls originally built at a time when street traffic was horses and wagons, may now be subjected to 80,000 lbs truck loading.

PHOTO 1 Overall view of South Mill St Seawall.

PHOTO 2 South Mill St Seawall looking east – note wall bulge and lean offshore.

PHOTO 3 (left) South Mill St Seawall looking west – note wall leaning offshore.
PHOTO 4 (right) South Mill St Seawall collapse area at western end.

PHOTO 5 South Mill St Seawall eastern end.

PHOTO 6 South Mill St Seawall – note sewer manhole close to wall.

Based on these observations, it is recommended that this wall be rebuilt on a priority basis. Since this seawall is located in the city historic district, it is expected that the replacement seawall will need to be rebuilt using stone, in a manner consistent with historical seawalls in this area. An engineers opinion of probable construction cost has been prepared for a replacement stone seawall, assuming adequate bearing capacity soils are found below the existing wall to utilize a concrete spread footing and that a pile foundation will not be required. Due to the proximity of the intertidal and salt marsh resource areas, it is also expected that the replacement wall will need to be built along the existing alignment with no additional encroachment seaward, thus requiring removal of the existing wall. Since South Mill Street is narrow and in a low traffic neighborhood, we have assumed that the street will be closed to traffic during the excavation and wall reconstruction. We did note that much of the existing wall stone is small or of poor quality and therefore have assumed the existing stone can only be reused for 50% of the new wall construction(to proper thickness) and imported stone will be needed. Other cost items include vehicular guard rail to meet modern design standards and a

steel picket fence designed to meet current building code guard requirements and historical district aesthetic standards. An engineers opinion of probable construction cost has been prepared for these recommended repairs and the estimate including allowances for subsurface soil investigation, design engineering, bid document preparation and construction phase services, for the wall replacement is expected to cost on the order of $222,000 and take approximately 6 weeks to complete after permits and the construction contract are awarded (street closure time will be less). The costs for environmental permitting and permit fees have been excluded as these services may be provided by City staff and the permit fees due the state are not known at this time.

MECHANIC STREET NEAR PICKERING STREET

The Mechanic Street seawall near Pickering Street is a stone block retaining wall approximately 90 feet in length and of varying height (2.5 feet to 5 feet high). The wall is immediately adjacent to Mechanic Street with the top of wall at street level and the toe of wall elevation varying and bordering a gravel intertidal area. There is parallel parking along the street just inshore of the wall (topped with a railroad rail fence) and utilities including buried water, sewer just behind the wall. The sewer line has an invert near mid tide level, below the toe of the wall, and is not expected to be impacted by a possible wall collapse, however depending on its proximity to the wall footing excavation, temporary excavation stabilization may be required. A nearby archive soil boring indicates bedrock may be only about 6 feet below street level.

The seawall borders the back channel, across from the Pierce Island boat ramp and is in a protected location and not exposed to significant wave action.

PHOTO 7 Mechanic St Seawall.

The wall is of unusual construction, using former granite curbing and granite blocks, stacked vertically without overlap interlocking and with discrete vertical joints filled with cobblestones.

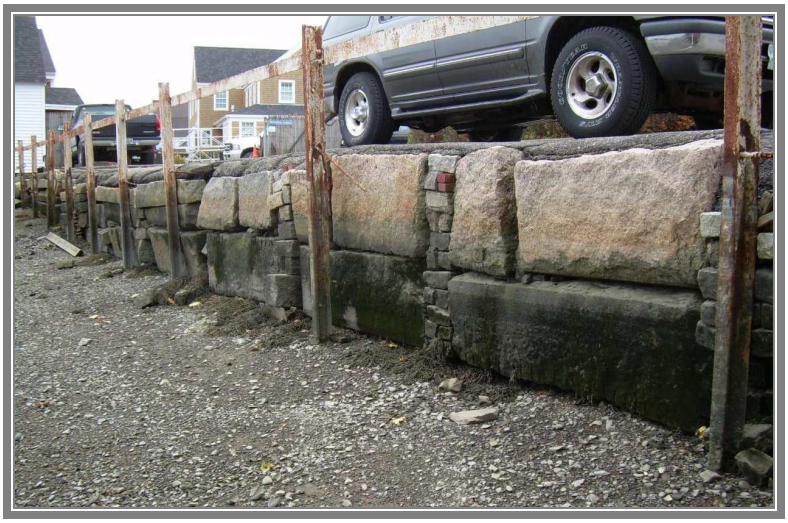

PHOTO 8 A&B Mechanic St Seawall – note unusual vertical joint construction

This wall does include vertical railroad rail posts that are tied-back with bent rebar tie-rods, however the tie-rods are severely corroded where they enter the backfill and some are completely failed.

PHOTO 9 Mechanic St Seawall – severely corroded tie-rods

Basic plumb bob checks along the wall did show that the face of the wall is typically leaning offshore to varying amounts, up to -1.3H:12 V. The scope of this investigation did not include subsurface excavation to measure wall thickness; however the observation of the wall leaning offshore does suggest the wall may not have adequate thickness to act as a gravity wall under the present street loading with an adequate factor of safety. Also of note, a cap stone has fallen off the wall near the Pickering

Marine office and there is a sinkhole about 6 inches in diameter and a foot deep at the southern end of the wall.

Based on these observations, it is recommended that this wall be rebuilt. Since this seawall is located in the city historic district, it is expected that the replacement seawall will need to be rebuilt using stone, in a manner consistent with historical seawalls in this area. An engineers opinion of probable construction cost has been prepared for a replacement stone seawall, assuming adequate bearing capacity soils are found below the existing wall to utilize a concrete spread footing and that a pile foundation will not be required. Due to the proximity of the intertidal resource area, it is also expected that the replacement wall will need to be built along the existing alignment with no additional encroachment seaward, thus requiring removal of the existing wall. Since Mechanic Street is narrow and in a low traffic neighborhood, we have assumed that the street will be closed to traffic during the excavation and wall reconstruction. We have assumed the existing stone can only be reused for 50% of the new wall construction (to proper thickness) and imported stone will be needed. Other cost items include vehicular guard rail to meet modern design standards and a steel picket fence designed to meet current building code guard requirements and historical district aesthetic standards. An engineers opinion of probable construction cost has been prepared for these recommended repairs and the estimate including allowances for subsurface soil investigation, design engineering, bid document preparation and construction phase services, for the wall replacement is expected to cost on the order of $137,000 and take approximately 5 weeks to complete after permits and the construction contract are awarded (street closure time will be less). The costs for environmental permitting and permit fees have been excluded as these services may be provided by City staff and the permit fees due the state are not known at this time.

MECHANIC STREET NEAR GATES STREET

The Mechanic Street seawall near Gates Street, historically called the “City Pier”, is primarily a stone rubble retaining wall about 110 feet in length, in three sections, and of varying height (6.5 feet to 12.5 feet high). The wall is adjacent to the Mechanic Street sewage pumping station with the top of wall typically at or near street level and the toe of wall elevation varying and bordering a gravel intertidal area. There is gravel parking/waterfront access area behind this wall (presently used for lobster trap storage) and the mid portion of this wall is located over a 30” diameter former combined sewage overflow outfall (shown on 1963 archive drawing).

The seawall borders the back channel, near the Pierce Island Bridge and is in a protected location and not exposed to significant wave action, but exposed to significant tidal current. Archive drawings indicate that at least a portion of this wall may have be the western abutment of the previous Pierce Island Bridge, however at least a portion of the wall may have been removed and rebuilt circa 1963 when the CSO pipe was installed.

PHOTO 10 Mechanic St Pump Sta. Seawall – note missing cap stone to the right of the orange buoy – outfall is to the left of the orange buoy.

The outer section of wall parallel to the channel is missing a cap stone at the southeastern corner of the wharf area, and can be seen underwater. Since the loss of these cap stones does not appear to have been caused by wall instability, it is possible that this was caused by vehicle impact, by vandalism, or from boat mooring lines. There is a relatively large shallow soil depression in this same corner, which appears to be caused by backfill washing out through the wall, which has large irregular joints in this area. A few of the rubble stone joints are open 2 to 6 inches (possibly due to lost chinking stones) and there are a few holes in the face of the wall below the lost cap stone including a hole 12”Wx18”Hx18”D and 14”Wx32”x50”D. There are also several bottom stones along this section of wall that appear to have rotated offshore.

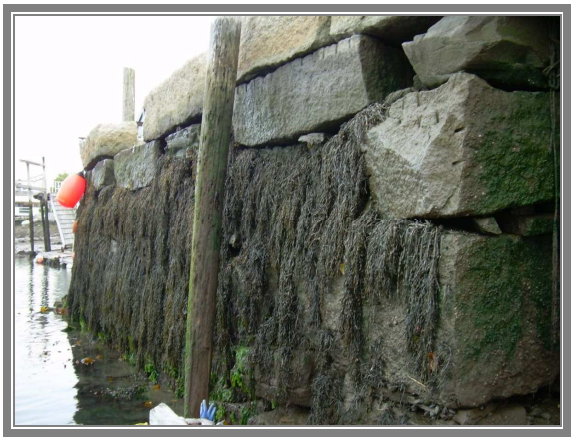

PHOTO 11 A&B Mechanic St Pump Sta. Seawall – outer wall.

The section of wall perpendicular to the channel does have an obvious bulge mid length and is leaning offshore varying amounts, suggesting this section of wall is not stable. As this is close to the large outfall pipe, this could be related to soil movement during and following outfall construction, or soil loss associated with outfall water flow (if there are unsealed pipe joints or pipe breaks), or it could have been caused by wall overload by vehicles or the stacked lobster traps observed in this location. This section of wall also contains holes, with the largest hole about 6 feet from the outer corner, at the toe of

the wall measuring 24”Wx12”Hx22”D. Another hole near the inshore corner measures 18”Wx14”Hx30”D.

PHOTO 12 Mechanic St Pump Sta. Seawall – perpendicular wall with pronounced bulge.

The inshore section of wall parallel to the channel also has an offshore bulge with stone joints open as much as 6 inches and the mid height stone blocks overhang the toe stones. There are a few small minor sinkholes along the cap stones of the section of wall closest to the pump station, which is also attributed to backfill washing out through the wall.

Based on these observations, it is recommended that this wall be monitored to see if the observed wall movement is active, and at least the perpendicular section of wall should be rebuilt in the near term. The two sections of wall parallel with the channel also have signs of past movement and voids and should be repaired or these sections also be rebuilt. The soil behind the wall at the outer corner erosion area and in the area behind the bulging portion of wall were both observed to be wet from flooding at a time of spring high tides, so some additional backfill soil will be needed in these areas to restore backfill elevations. The relatively low level of this wall does indicate that the rebuilt seawall and backfill may need to be higher if periodic tidal flooding will be an issue with planned uses.

Since this seawall is located in the city historic district, it is expected that the replacement seawall will need to be rebuilt using stone, in a manner consistent with historical seawalls in this area. An engineers opinion of probable construction cost has been prepared for a replacement stone seawall, assuming adequate bearing capacity soils are found below the existing wall to utilize a concrete spread footing and that a pile foundation will not be required. Due to the proximity of the intertidal resource area, it is

also expected that the replacement wall will need to be built along the existing alignment with no additional encroachment seaward, thus requiring removal of the existing wall.

We have assumed the existing stone can only be reused for 33% of the new wall construction (to proper thickness) and imported stone will be needed. Other cost items include vehicular guard rail to meet modern design standards and a steel picket fence designed to meet current building code guard requirements and historical district aesthetic standards. An engineers opinion of probable construction cost has been prepared for these recommended repairs and the estimate including allowances for subsurface soil investigation, design engineering, bid document preparation and construction phase services, for the wall replacement is expected to cost on the order of $338,000 and take approximately 8 weeks to complete after permits and the construction contract are awarded. The existing CSO pipe has the top of pipe just below low tide level, so the wall footing may be cast around the pipe, or the pipe removed at the wall if it is abandoned. The budget estimate does not include pipe removal costs and if pipe removal is desired, a budget allowance should be added for this additional work. The costs for environmental permitting and permit fees have been excluded as these services may be provided by City staff and the permit fees due the state are not known at this time.

PIERCE ISLAND BRIDGE EASTERN APPROACH WALLS

The eastern approach walls are adjacent to the abutment and wingwalls of the Pierce Island Bridge. The bridge abutment and wingwalls are cast in place concrete walls, probably supported by foundation piles, which function to support the bridge and retain approach fill soils. The eastern approach walls inspected in this study are separate small walls on both the north and south sides of the eastern bridge abutment that are not part of the bridge structure, but do help retain soils on the side slopes of the approach fill. It does appear that these approach walls are informal structures added after bridge construction, likely as an interim repair for a soil erosion problem, caused by the lack of returns or angled back wingwalls on the bridge abutment.

The southern approach wall is comprised of a small irregular stack of granite curb sections. As shown in photo 13, the erosion problems at this abutment are caused by wave action above the existing riprap stone and with the steep nature of the slope just behind the bridge abutment wing wall, the erosion has progressed up behind the wingwall. Photo 14 shows how the adjacent abutment wingwall has been undermined by wave erosion and/or riprap movement. The recommended repair for this area is addition of stone riprap above the existing riprap, including the small area behind the wingwall, up to the guardrail.