



City of Seattle Parks & Recreation Department

# LOWMAN BEACH PARK SEAWALL CONDITION ASSESSMENT

Seattle, Washington

Nov 30, 2017  
ESA # D160292.00

PREPARED FOR



PREPARED BY

**Reid Middleton**

# City of Seattle Lowman Beach Park Seawall Condition Assessment

November 2017

---

The engineering material and data contained in this report were prepared under the supervision and direction of the undersigned, whose seal as a registered professional engineer is affixed below.



Jon A. Padvorac, P.E., C.W.I.  
Project Engineer

**Reid Middleton**

728 134th Street SW, Suite 200  
Everett, WA 98204  
www.reidmiddleton.com  
425-741-3800  
File No. 242017.015

Copyright © 2017 by Reid Middleton, Inc. All rights reserved.

# CONTENT

---

<b>1 - INTRODUCTION</b> .....	<b>3</b>
<b>BACKGROUND</b> .....	<b>5</b>
<b>2 - CONDITION ASSESSMENT</b> .....	<b>7</b>
<b>ASSESSMENT CRITERIA, PROCEDURES, AND RESULTS</b> .....	<b>7</b>
<b>MATERIAL LOSS, DIFFERENTIAL SETTLEMENT, &amp; TIPPING</b> .....	<b>9</b>
<b>STORM OUTFALL</b> .....	<b>9</b>
<b>ADJACENT FACILITIES (RETAINING WALL, SEAWALL TO THE NORTH)</b> .....	<b>9</b>
<b>UNCERTAINTIES/UNKNOWN</b> .....	<b>9</b>
<b>ON-GOING MAINTENANCE RECOMMENDATIONS</b> .....	<b>10</b>
<b>RISK OF CONTINUED OPERATIONS</b> .....	<b>10</b>
<b>NEW CONSTRUCTION - CONSIDERATIONS</b> .....	<b>10</b>
<b>3 - CONCLUSION</b> .....	<b>11</b>
<b>APPENDIX A – PHOTOS</b>	

## Tables

<b>TABLE 1. CONDITION ASSESSMENT RESULTS</b> .....	<b>8</b>
--	----------

## Figures

<b>FIGURE 1. FAILED SEAWALL (PHOTO TAKEN ON 10/18/2016)</b> .....	<b>3</b>
<b>FIGURE 2. LOWMAN BEACH PARK SITE PLAN</b> .....	<b>4</b>
<b>FIGURE 3. 1951 SEAWALL DESIGN, ZONES A-B THROUGH P-Q</b> .....	<b>6</b>
<b>FIGURE 4. 1995 SEAWALL DESIGN, ZONE R-S</b> .....	<b>6</b>



## 1 - INTRODUCTION

---

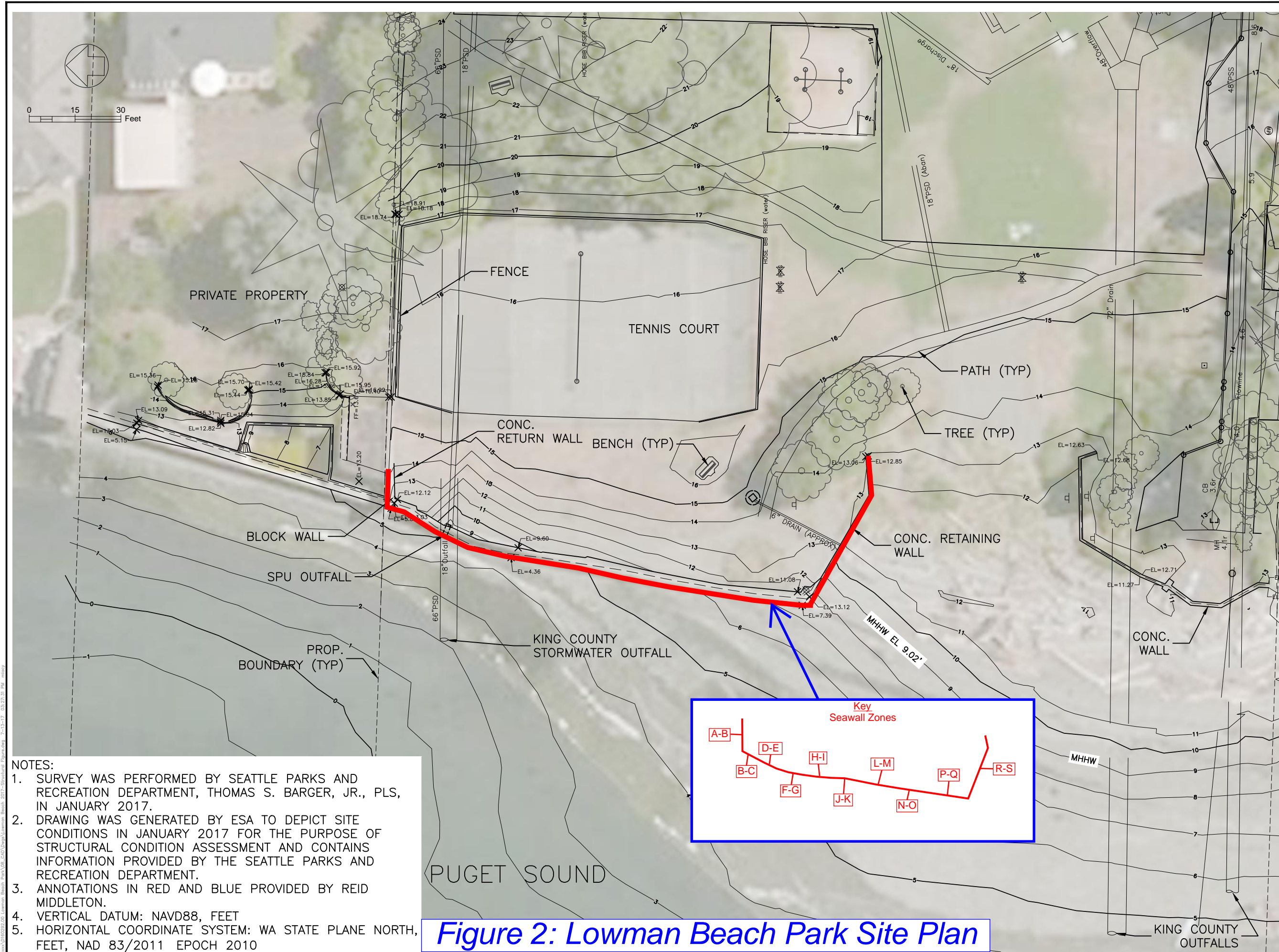
Lowman Beach Park is located within the city of Seattle, Washington, and is operated by the City of Seattle Parks and Recreation Department (Seattle Parks & Rec). The park consists of a seawall, a beach, and an uplands area containing a tennis court. The seawall had a notable failure near its northern end (see Figure 1), and Reid Middleton was asked to perform a condition assessment of the entire length of seawall.

The history of the seawall was investigated, a site visit performed, and the condition of the seawall documented by zone, as shown in Figure 2.



*Figure 1. Failed Seawall (Photo taken on 10/18/2016).*





- NOTES:
1. SURVEY WAS PERFORMED BY SEATTLE PARKS AND RECREATION DEPARTMENT, THOMAS S. BARGER, JR., PLS, IN JANUARY 2017.
  2. DRAWING WAS GENERATED BY ESA TO DEPICT SITE CONDITIONS IN JANUARY 2017 FOR THE PURPOSE OF STRUCTURAL CONDITION ASSESSMENT AND CONTAINS INFORMATION PROVIDED BY THE SEATTLE PARKS AND RECREATION DEPARTMENT.
  3. ANNOTATIONS IN RED AND BLUE PROVIDED BY REID MIDDLETON.
  4. VERTICAL DATUM: NAVD88, FEET
  5. HORIZONTAL COORDINATE SYSTEM: WA STATE PLANE NORTH, FEET, NAD 83/2011 EPOCH 2010

**Figure 2: Lowman Beach Park Site Plan**

REVISIONS		NO.	DESCRIPTION	BY	DATE
1					
2					
3					
4					
5					

PREPARED BY: **ESA**  
 5500 Shiloh Way, Suite 100  
 Seattle, WA 98148  
 P: (206) 798-8888  
 F: (206) 798-8844

PREPARED FOR: **STRUCTURAL ASSESSMENT BASEMAP**

PROJECT: **LOWMAN BEACH**

APPROVED: \_\_\_\_\_

DESIGNED: J. DARNELL  
 DRAWN: E. BARTOLOMEO  
 INCHARGE: J. DARNELL License XXXX

SCALE: AS SHOWN  
 ESA JOB #: XXXX  
 PROJECT #: D160292.00  
 DATE: \_\_\_\_\_  
 SHEET: \_\_\_\_\_

VERIFY SCALE: 1" = 30'

SEALED BY: \_\_\_\_\_  
 DATE: \_\_\_\_\_

SEALED BY: \_\_\_\_\_  
 DATE: \_\_\_\_\_

SEALED BY: \_\_\_\_\_  
 DATE: \_\_\_\_\_

SEALED BY: \_\_\_\_\_  
 DATE: \_\_\_\_\_

SEALED BY: \_\_\_\_\_  
 DATE: \_\_\_\_\_

C:\Users\jmiddleton\OneDrive\Documents\Lowman Beach Park\08\_CAD\Drawings\Lowman Beach\_2017-Structural\_Engineering\_7-13-17\_03:23:31 PM.mxd

## Background

The original seawall was constructed in the 1930's and is no longer present onsite. The northern portion failed and was replaced in the 1950's, at which point the southern portion was reinforced with concrete toe protection. In 1994 the southern portion of the seawall failed, and subsequently was converted from a seawall to a beach in 1995. During the 1995 project, wing walls were added to the remaining northern half of the seawall and the existing seawall to the south of the park. The drawings representing the current composition of the Seawall from Zones A-B through P-Q are dated 1951 (see Figure 3). The original construction is a cantilevered seawall without a footing for stability or toe protection to prevent erosion. The seawall was constructed using cast-in-place concrete by casting segments of seawall in place, with minimal to no connection between adjacent segments.

A portion of the park was reconfigured in 1995, which replaced a portion of the seawall that was constructed around 1951. The drawings representing the current composition of the Seawall at Zone R-S are dated 1995, showing the new section of cantilevered seawall with a footing for stability (see Figure 4). The toe of the new section of seawall was cast as one piece and installed well below grade.

Late in 2015 the remaining seawall failed; a portion of the seawall shifted position, tilting out towards the water. Based on comparison of photographs taken in 2015 and site visits on 10/18/2016 and 05/31/2017, the condition of the seawall appears to have continued to worsen since the 2015 failure. Based on review of historical records, over the past roughly 70 years the beach elevation has decreased approximately two to three feet in front of the northern portion of the seawall.

In summary, the history of the seawall is as follows:

- 1930's: Original seawall constructed
- 1950: Northern half of the seawall fails
- 1951: Northern half of the wall is replaced and concrete toe protection installed in front of the southern half.
- 1994: South half of the wall fails
- 1995: South half of the wall is removed and replaced with a beach, wing walls are added to the remaining north half of the seawall in the park and the existing seawall to the south of the park
- 2015: North half of the seawall fails

Structures of this type would typically be anticipated to have a thirty to fifty year design life. In the case of the Lowman Beach Seawall, the wall has aged beyond its anticipated service life. Drawings from 1951 show a few feet of beach material above the toe of the seawall which is now exposed, causing undermining at some locations. This undermining caused a loss of global stability and partial collapse. The portions of the seawall constructed around 1951 are beyond their anticipated service life, and if re-used as part of a seawall replacement project, they may have a service life less than the other new project elements.



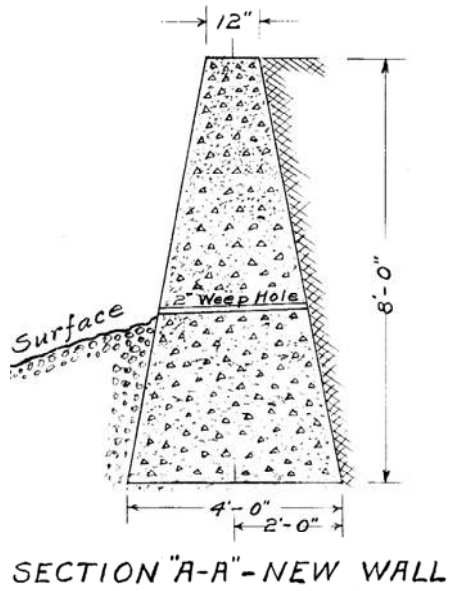


Figure 3. 1951 Seawall Design, Zones A-B through P-Q.

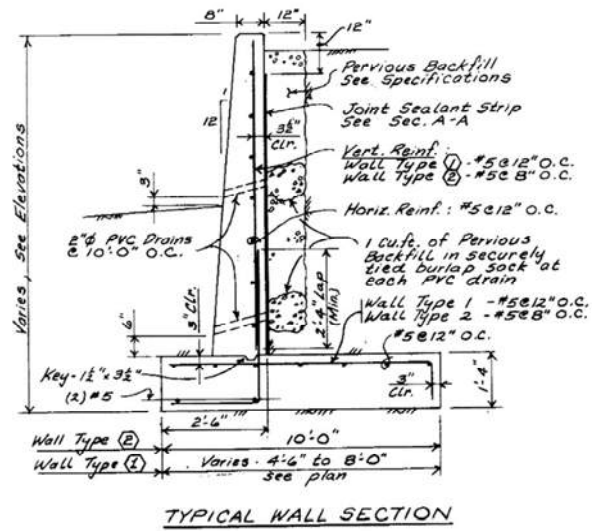


Figure 4. 1995 Seawall Design, Zone R-S.

## 2 - CONDITION ASSESSMENT

---

The conditions of the seawall were assessed by Reid Middleton during two site visits; one on October 18, 2016 and one on May 31, 2017. Results of the assessment are provided below, and photographs are provided in Appendix A.

### Assessment Criteria, Procedures, and Results

Visible structural components of the landing float were inspected, and results of the site observation are summarized in Table 1. Reid Middleton conducted a visual inspection of the overall system, including cast-in-place concrete seawall segments and the toe protection. Inspections were performed in accordance with the methods described in *ASCE Manuals and Reports on Engineering Practice No. 130 (MOP 130); Waterfront Facilities Inspection and Assessment*.

The general condition of each of the elements and specific damage conditions observed are shown in Appendix A and discussed below. The condition rating criteria follow:

Good	No visible damage or only minor damage is noted. No repairs are required.
Satisfactory	Limited minor to moderate deterioration was observed. No repairs are required.
Fair	Primary elements are sound, but minor to moderate defects or deterioration are observed. Repairs are recommended, but the priority of the recommended repairs is low.
Poor	Advanced deterioration is observed on widespread portions of the structure. Repairs may need to be carried out with moderate urgency.
Serious	Advanced deterioration or breakage may have affected the primary structural components significantly. Local failures are possible, and repairs should be carried out on a high-priority basis.
Critical	Extremely advanced deterioration or breakage has resulted in localized failure(s) of primary structural components. More widespread failures are possible or likely to occur, and repairs should be carried out on a high priority basis.



**Table 1. Condition Assessment Results.**

ITEM	PHOTO	RATING	EXISTING CONDITION
North Retaining Wall Origin: Unknown, likely 1950's	5, 6	Fair	Structural: Not much visible, no damage notes. CMU privacy wall on top of retaining wall in serious condition. Length unknown, wall terminates underground Toe: N/A Rotation & Settlement: N/A
Zone A-B Length = 5'  Origin: 1950's	5, 6, 7, 8	Fair	Structural: Some spalling <sup>1</sup> at mudline where intersects Zone B-C. Toe: Exposed, material loss beginning, not protected. Rotation & Settlement: Minimal, has return portion perpendicular to shoreline that adds stability.
Zone B-C (8') Zone D-E (15') Zone F-G (8') Zone H-I (22') Zone J-K (15') Origin: 1950's	10 - 24	Critical	Structural: Cracking and spalling <sup>1</sup> . Original seawall segments have broken full-height into smaller segments. Toe: Exposed, material loss below wall, not protected. Rotation & Settlement: Segments appear to have rotated outwards and translated away from shore. Multiple segments broken full-height due to differential settlement.
Zone L-M Length = 16'  Origin: 1950's	24, 25	Critical	Structural: Cracking and spalling <sup>1</sup> . Toe: Exposed, material loss below wall, not protected. Rotation & Settlement: Less than adjacent panels, but appears that some has occurred.
Zone N-O Length = 29'  Origin: 1950's	25, 26	Serious	Structural: Cracking and spalling <sup>1</sup> . Toe: Exposed, material loss below wall beginning, not protected. Rotation & Settlement: Appears to have slight rotation outwards and slight translation away from shore.
Zone P-Q Length = 28'  Origin: 1950's	26, 27, 28, 29	Serious	Structural: Cracking and spalling <sup>1</sup> . Multiple full-height cracks. Toe: Evidence of material loss below wall, not protected. Rotation & Settlement: Evidence of settlement observed, full-height cracking pattern.
Zone R-S Length = 50'± Origin: 1995	29, 31	Good	Structural: No visible damage. Toe: Buried, does not appear to be exposed. Rotation & Settlement: None visible.

<sup>1</sup>Cracking and spalling occurred where adjacent portions of seawall bear due to differential settlement and rotation.

## Material Loss, Differential Settlement, & Tipping

Zones B-C through P-Q of the seawall appear to have been constructed without adequate toe protection, and the toe has been exposed as the shoreline eroded over time. Evidence of soil loss under the toe were noted where the underneath side of the seawall can be visually observed from the waterward side. Cracking/spalling has occurred due to differential settlement between adjacent seawall segments, and rotation occurred due to loss of underlying bearing soil. The entirety of Zones B-C through P-Q are susceptible to failure due to loss of underlying bearing soil, and will continue to fail as bearing soil loss increases in extent and severity.

Photographs were taken during two site visits several months apart. During the second site visit erosion and associated damages were observed to have increased. Continued erosion and the associated settlement-related movements (vertical settlement and tipping) are anticipated to continue, and it is not clear how close the facility is to a global overturning failure.

## Storm Outfall

An existing storm outfall connection was disconnected within Zone D-E due to translation and rotation of the seawall. It is anticipated that soil will continue to be washed out from behind and below the existing seawall at the location of the disconnected storm outfall, accelerating the already occurring failure of the seawall.

## Adjacent Facilities (Retaining Wall, Seawall to the North)

To the north of the Lowman Beach seawall is a private residence. There is a seawall protecting this private residence roughly in-line with the existing Lowman Beach Park seawall. This private seawall appears to be concrete construction, similar to the other walls in the vicinity and presumably subject to similar failure mechanisms as the Lowman Beach seawall.

The northern portion of the Lowman Beach park is separated from the adjacent private residence by a concrete retaining wall running approximately east-west (referred to as the North Retaining Wall in Table 1). Design drawings and date of installation for the north retaining wall were not available to Reid Middleton at the time this report was written. It appears to be concrete construction, possibly matching the vintage of the seawall built around 1951.

## Uncertainties/Unknowns

Some uncertainties and unknowns remain, and are listed below:

1. Depth of embedment of the concrete north retaining wall running approximately east-west along the northern boundary of the park.
2. Detailing of seawall protecting the private property to the north of the park.
3. Remaining life before complete collapse of seawall that is actively failing.
4. Exact extents of loss of bearing soil underneath the seawall, as it tends to settle as material is lost.



## On-going Maintenance Recommendations

Periodic inspections should be performed in accordance with the ASCE MOP 130-2015 (Waterfront Facilities Inspection and Assessment), which recommends a routine inspection in approximately one year given the advanced deterioration and localized failures observed.

We understand that Seattle Parks & Rec routinely surveys the seawall top at crack and joint locations. This data should be analyzed on a routine basis to evaluate the extent of movement, as further collapse may be precluded by a warning of additional or accelerated movement. Indications of further collapse would indicate an elevated risk to park users and may warrant more extensive use restrictions both behind and in front of the seawall. If additional or accelerated movement is observed, it is recommended that Seattle Parks & Rec increase the frequency of monitoring, and be ready to implement a plan to deal with more extensive collapse, should it occur.

## Risk of Continued Operations

The existing seawall is actively failing, and is at a high risk of collapse. The probability of failure increases the longer the system goes without repairs. The ultimate collapse may be slow and progressive, or could occur rapidly. Seattle Parks & Rec should take measures to protect the public in case of collapse, and have a plan in place to deal with a collapse should it occur.

## New Construction - Considerations

During review of the site conditions and original construction drawings, a number of considerations associated with the seawall replacement project were identified, as follows:

1. Rubble used for fill behind approximately Zone B-C through Zone H-I during original construction in the 1950's could be a pile driving obstruction.
2. The depth of the existing north retaining wall running east-west along the north portion of the park that delineates the adjacent property is unknown. Depending on the nature of upland regrading, the stresses on the wall may be increased, or the wall may be undermined. It is recommended that these risks be avoided if possible by avoiding disturbance and locating the original design drawings if possible.
3. Adjacent bulkheads on private properties to the North of the park may be currently undermined and unstable, and may be damaged by vibrations during pile driving.
4. Zone A-B (1950's era) of the existing seawall could likely be reused, though it should be secured to the concrete retaining wall running shoreward and the toe protected from further erosion.
5. Zones B-C through P-Q (1950's era) of the existing seawall are failing due to loss of bearing material and the resulting differential settlement along the wall alignment.
6. Zones B-C through L-M (1950's era) are failing due to loss of stability and substantial tipping that resulted from loss of bearing soil from underneath the existing wall.
7. Structural damage due to differential settlement may be repairable for incorporation into the replacement project. It is likely cost-prohibitive to repair segments of the seawall that

have tipped and cracked substantially due to a loss of stability and subsequent settlement, causing them to reach the end of their useful design life.

### 3 - CONCLUSION

---

The seawall is actively failing, and the complete collapse may be imminent. It is recommended that annual inspections be performed until replacement. A select few portions of the existing seawall may be incorporated into the replacement project, but the majority of the seawall has exceeded its useful life and needs to be replaced. For public safety, it is recommended that the City limit access above and below the failing seawall.

h:\24wf\2017\004 lowman beach\reports\condition assessment\bulkhead assessment\_jp.docx\jap



# APPENDIX A

## Photos

PHOTO 1. NORTH PORTION OF SEAWALL.....	2
PHOTO 2. SOUTH PORTION OF SEAWALL.....	2
PHOTO 3. SOUTHERN SEAWALL RETURN. ....	3
PHOTO 4. ADJACENT PROPERTY TO THE NORTH. ....	3
PHOTO 5. ZONES A-B & B-C, ADJACENT PROPERTY. ....	4
PHOTO 6. ZONE A-B, ADJACENT PROPERTY.....	4
PHOTO 7. ZONES A-B & B-C. ....	5
PHOTO 8. ZONE B-C, ADJACENT PROPERTY. ....	5
PHOTO 9. PRIVATE SEAWALL TO THE NORTH.....	6
PHOTO 10. ZONES B-C & C-D. ....	6
PHOTO 11. ZONES B-C & D-E, OUTFALL. ....	7
PHOTO 12. ZONES B-C & D-E.....	7
PHOTO 13. ZONES B-C & D-E, BEACH MATERIAL.....	8
PHOTO 14. ZONES B-C & D-E.....	8
PHOTO 15. ZONES D-E & F-G.....	9
PHOTO 16. ZONES D-E & F-G, BROKEN OUTFALL. ....	9
PHOTO 17. SOUTHERN VIEW FROM ZONE B-C. ....	10
PHOTO 18. ZONES F-G & H-I. ....	10
PHOTO 19. ZONES H-I & J-K. ....	11
PHOTO 20. BEACH MATERIAL AT ZONE J-K.....	11
PHOTO 21. ZONES I-J, J-K, & L-M.....	12
PHOTO 22. ZONE J-K & L-M. ....	12
PHOTO 23. ZONE J-K & L-M. ....	13
PHOTO 24. ZONE J-K & L-M. ....	13
PHOTO 25. ZONES L-M & N-O. ....	14
PHOTO 26. ZONES N-O & P-Q. ....	14
PHOTO 27. ZONE P-Q. ....	15
PHOTO 28. ZONE P-Q. ....	15
PHOTO 29. ZONES P-Q & R-S. ....	16
PHOTO 30. ZONE P-Q, LOWER BEACH MATERIAL. ....	16
PHOTO 31. ZONES P-Q & R-S, UPPER BEACH MATERIAL. ....	17
PHOTO 32. VIEW TO THE SOUTH FROM ZONE R-S.....	17

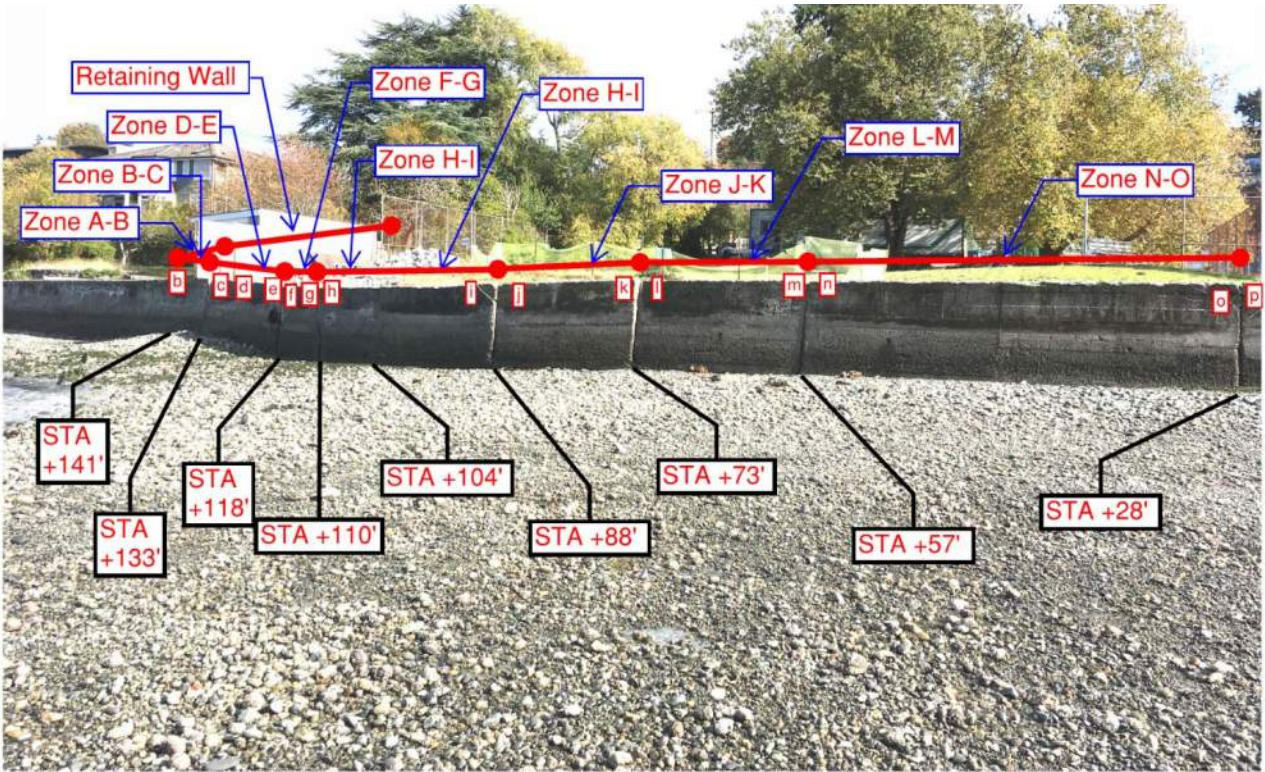


Photo 1. North Portion of Seawall.  
 Source: Reid Middleton Site Visit 10/18/2016  
 Note: Dimensions roughly field measured – for assessment purposes only.

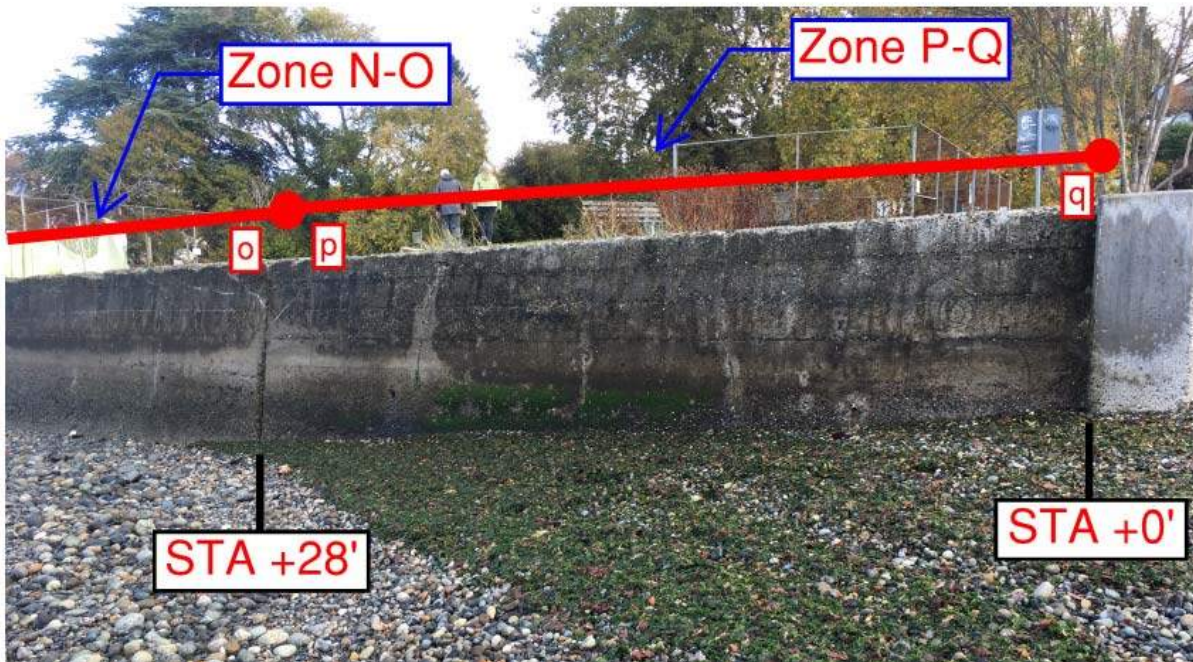


Photo 2. South Portion of Seawall.  
 Source: Reid Middleton Site Visit 10/18/2016  
 Note: Dimensions roughly field measured – for assessment purposes only.





Photo 3. Southern Seawall Return.  
Source: Reid Middleton Site Visit 10/18/2016



Photo 4. Adjacent Property to the North.  
Source: Reid Middleton Site Visit 10/18/2016



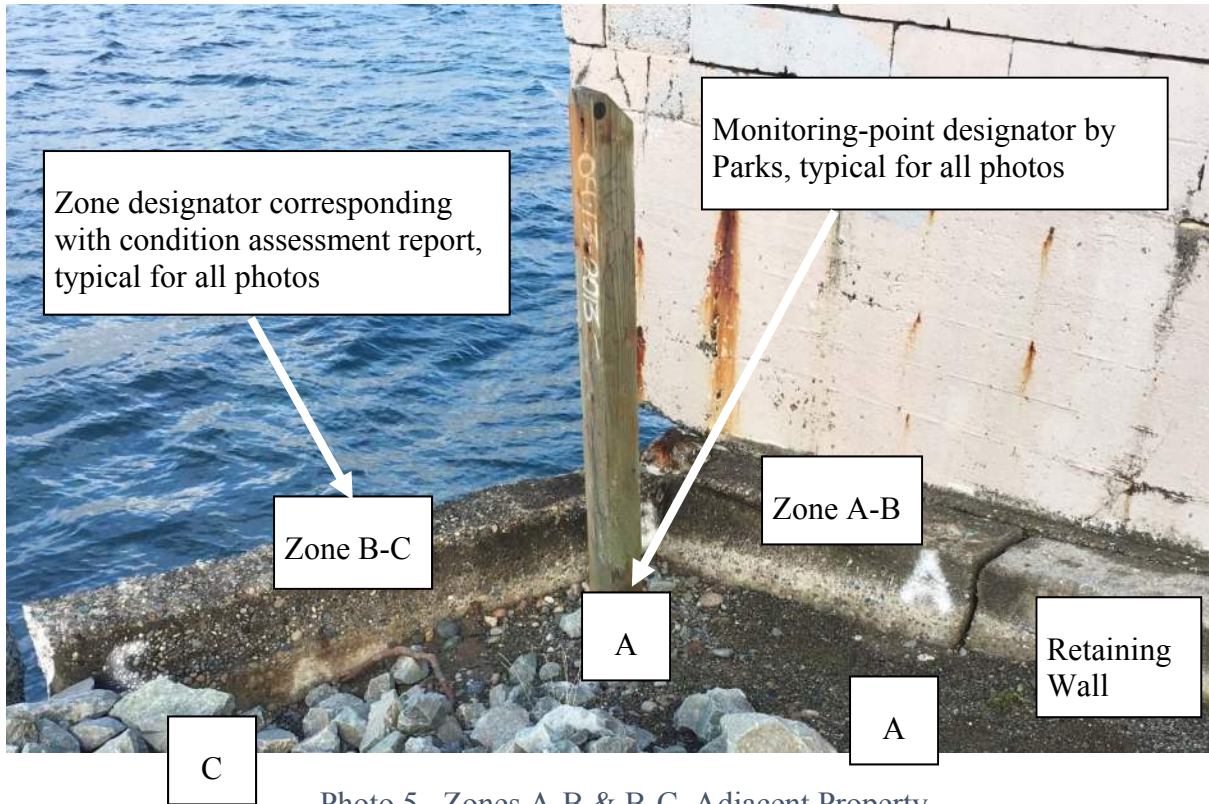


Photo 5. Zones A-B & B-C, Adjacent Property.  
 Source: Reid Middleton Site Visit 10/18/2016

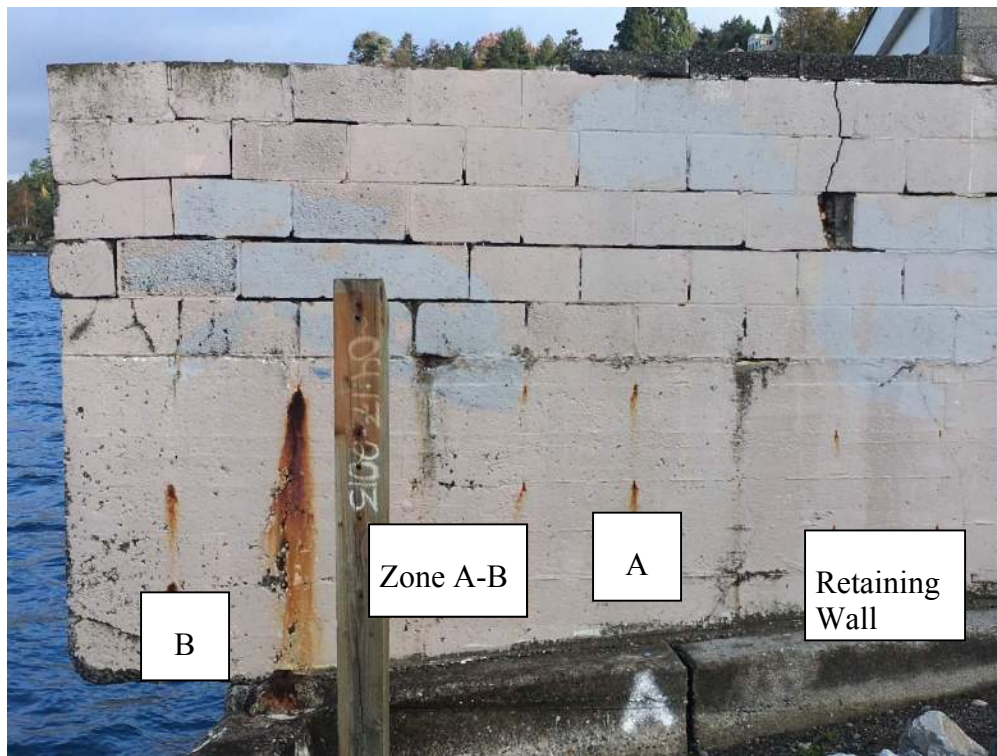


Photo 6. Zone A-B, Adjacent Property.  
 Source: Reid Middleton Site Visit 10/18/2016



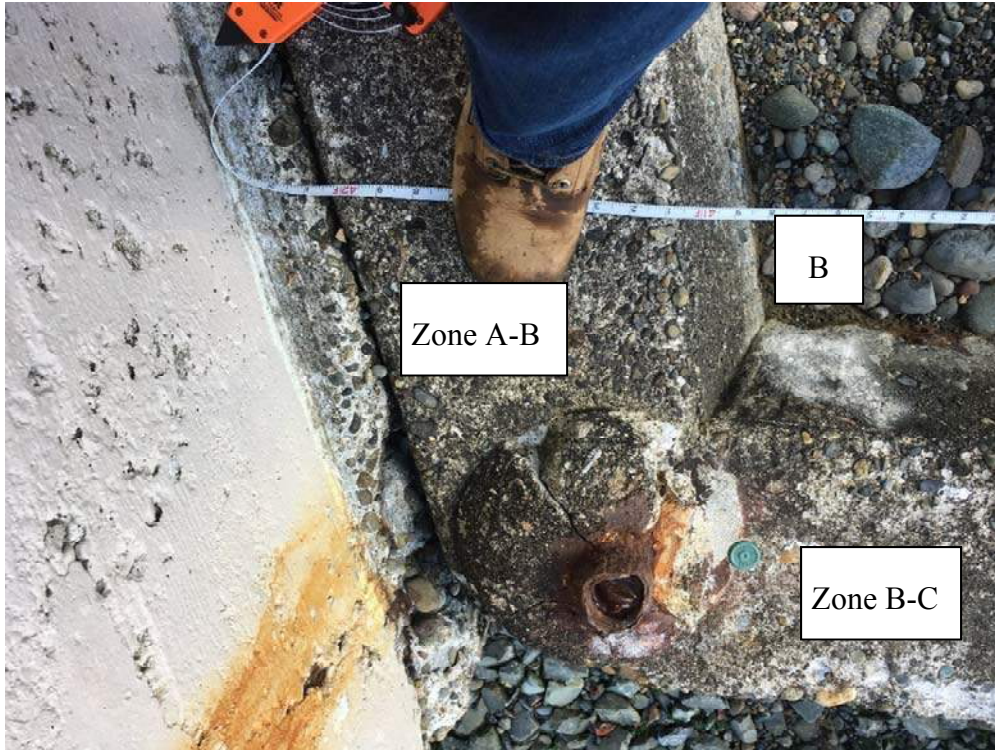


Photo 7. Zones A-B & B-C.  
Source: Reid Middleton Site Visit 10/18/2016



Photo 8. Zone B-C, Adjacent Property.  
Source: Reid Middleton Site Visit 10/18/2016





Photo 9. Private Seawall to the North.  
 Source: Reid Middleton Site Visit 10/18/2016

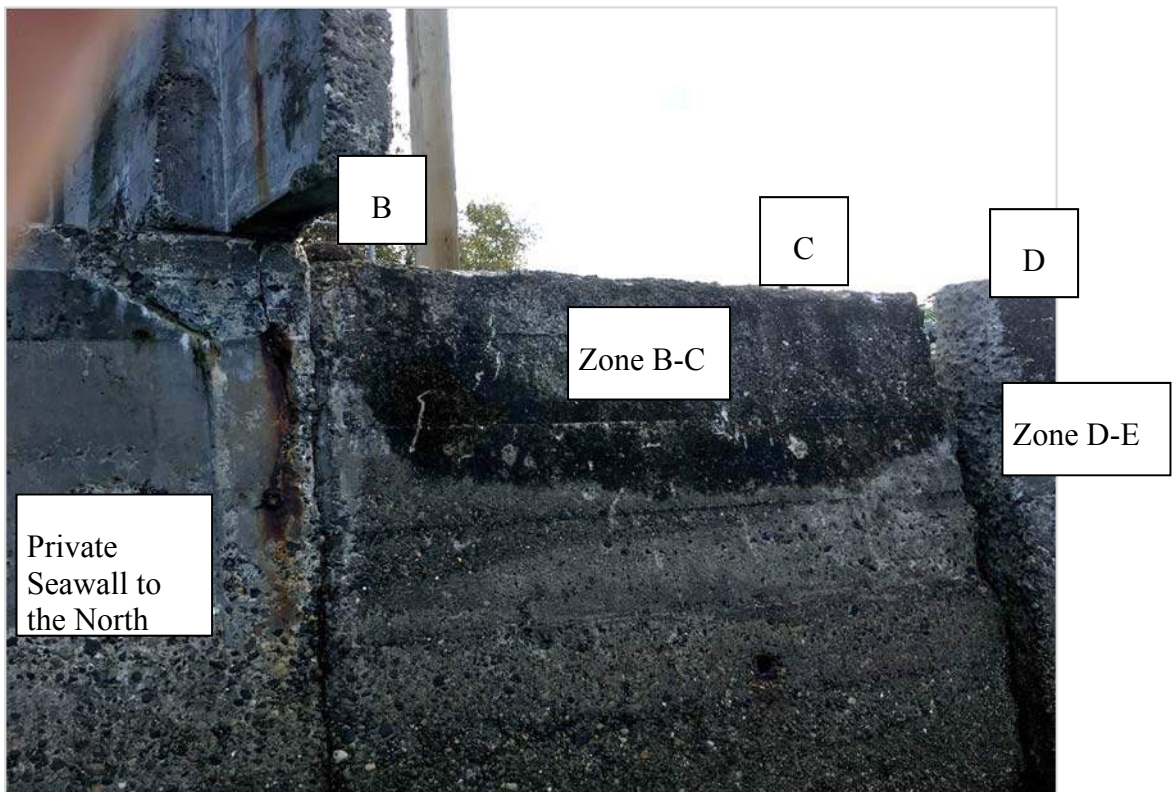


Photo 10. Zones B-C & C-D.  
 Source: Reid Middleton Site Visit 10/18/2016

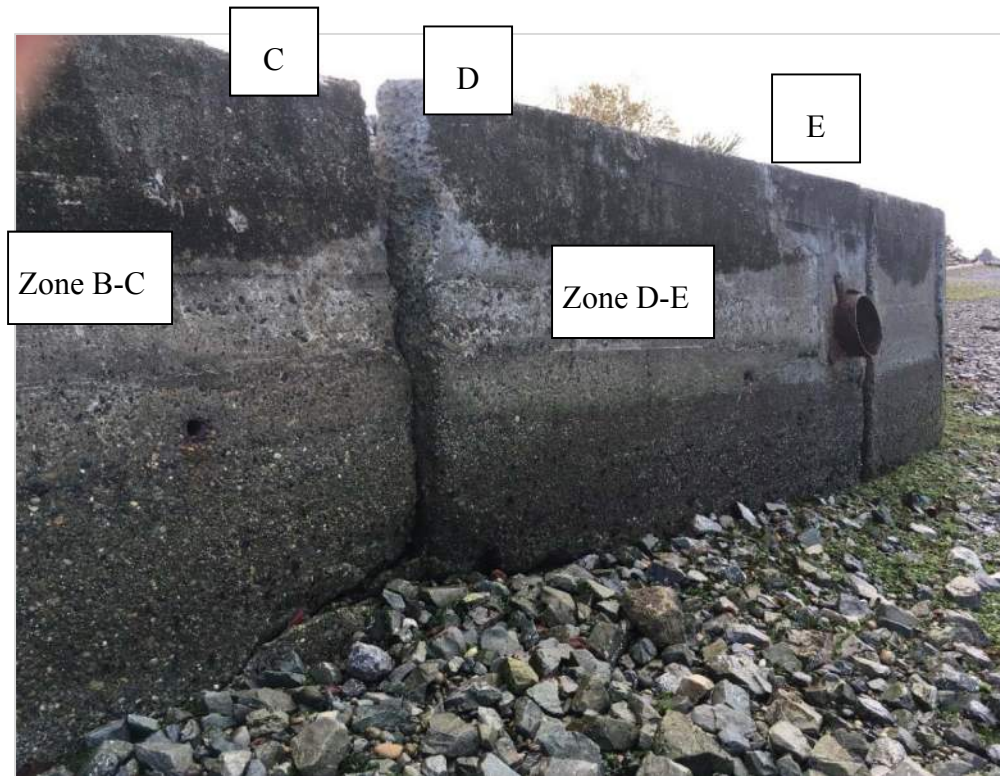


Photo 11. Zones B-C & D-E, Outfall.  
Source: Reid Middleton Site Visit 10/18/2016

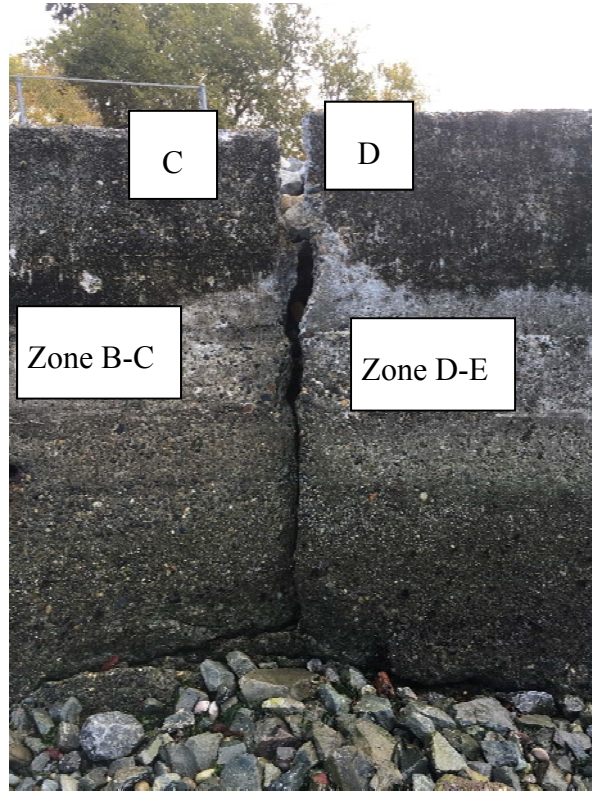


Photo 12. Zones B-C & D-E.  
Source: Reid Middleton Site Visit 10/18/2016





Photo 13. Zones B-C & D-E, Beach Material.  
 Source: Reid Middleton Site Visit 10/18/2016

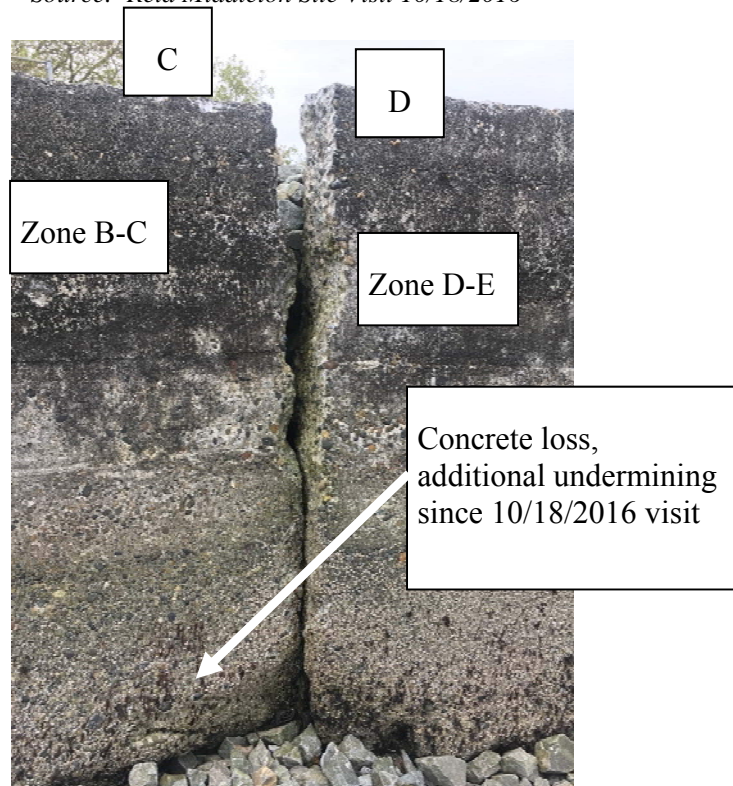


Photo 14. Zones B-C & D-E.  
 Source: Reid Middleton Site Visit 5/31/2017

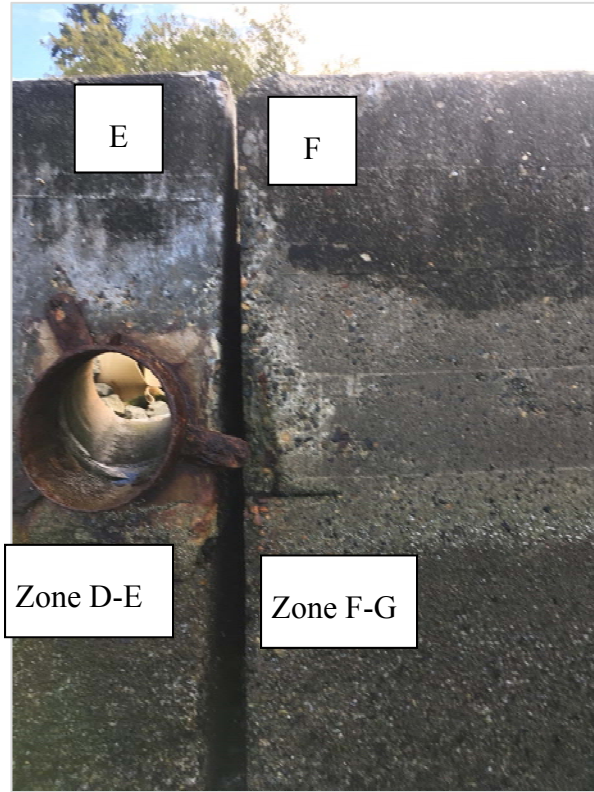


Photo 15. Zones D-E & F-G.  
Source: Reid Middleton Site Visit 10/18/2016

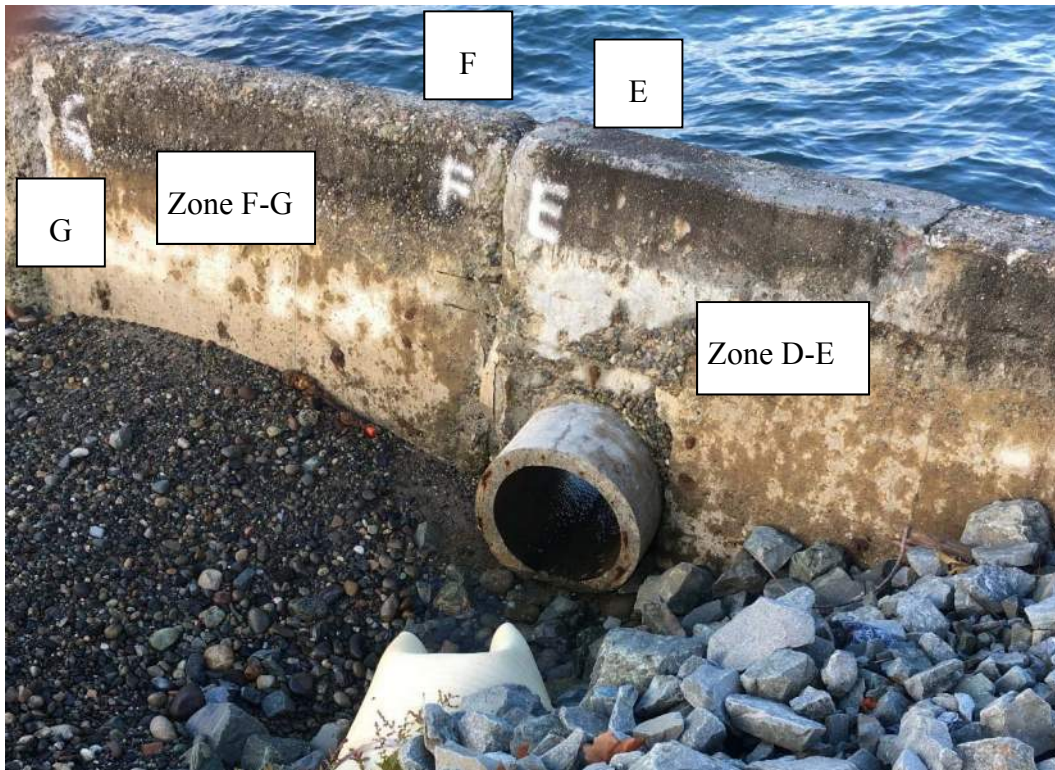


Photo 16. Zones D-E & F-G, Broken Outfall.  
Source: Reid Middleton Site Visit 10/18/2016





Photo 17. Southern View from Zone B-C.  
Source: Reid Middleton Site Visit 10/18/2016

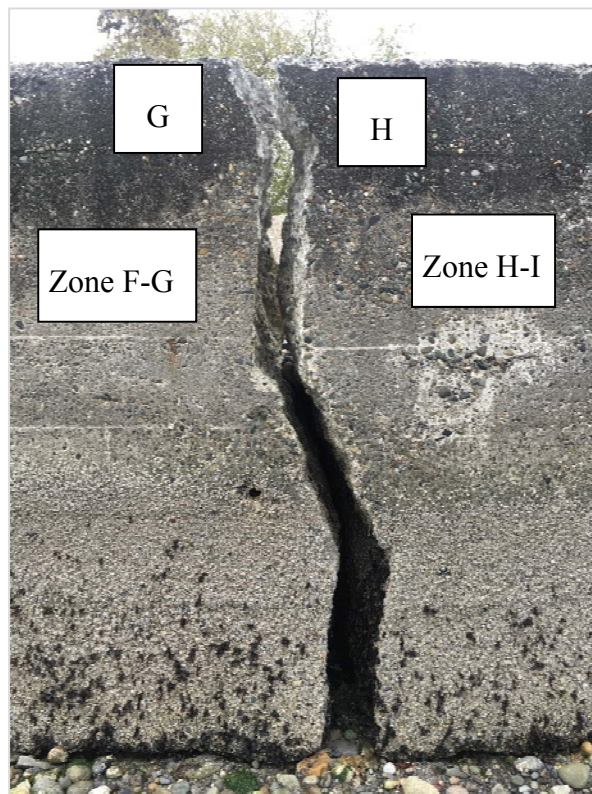


Photo 18. Zones F-G & H-I.  
Source: Reid Middleton Site Visit 05/31/2017

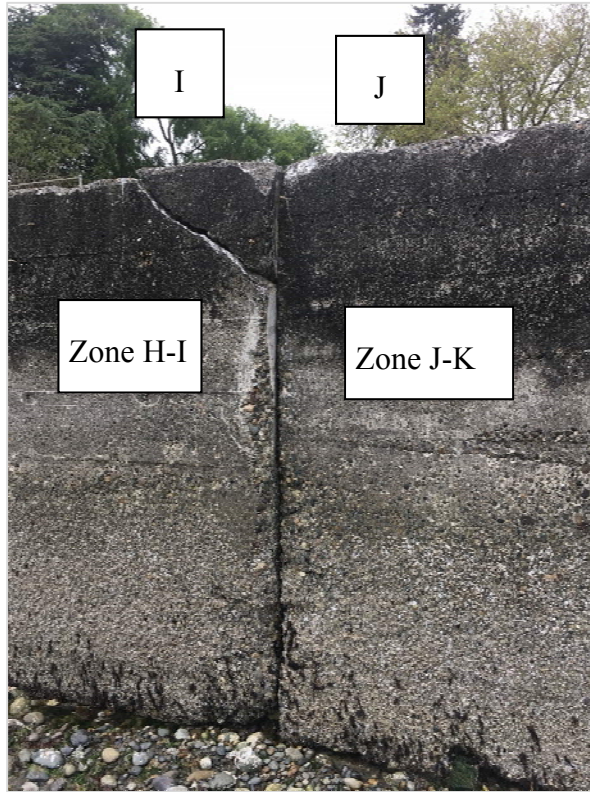


Photo 19. Zones H-I & J-K.  
Source: Reid Middleton Site Visit 5/31/2017



Photo 20. Beach Material at Zone J-K.  
Source: Reid Middleton Site Visit 10/18/2016



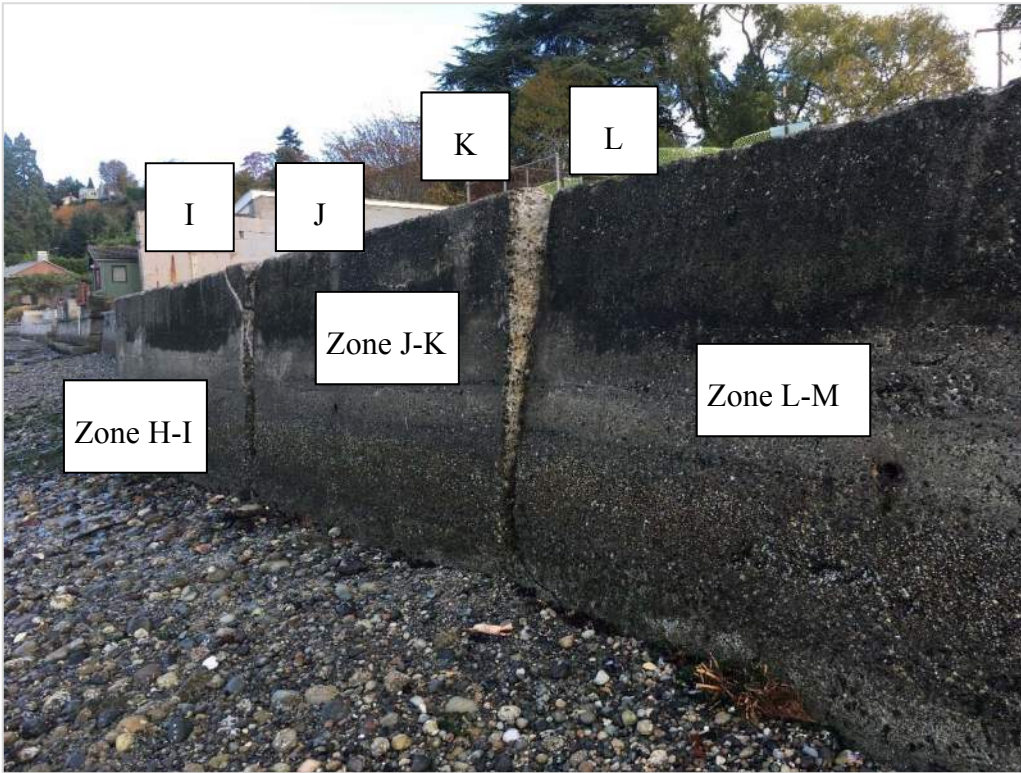
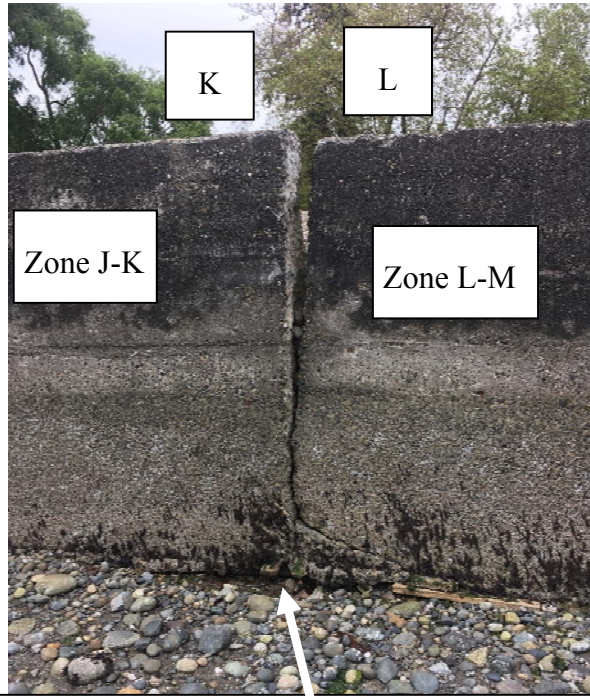


Photo 21. Zones I-J, J-K, & L-M.  
 Source: Reid Middleton Site Visit 10/18/2016



Photo 22. Zone J-K & L-M.  
 Source: Reid Middleton Site Visit 10/18/2016





Additional undermining since 10/18/2016 visit

Photo 23. Zone J-K & L-M.  
Source: Reid Middleton Site Visit 5/31/2017

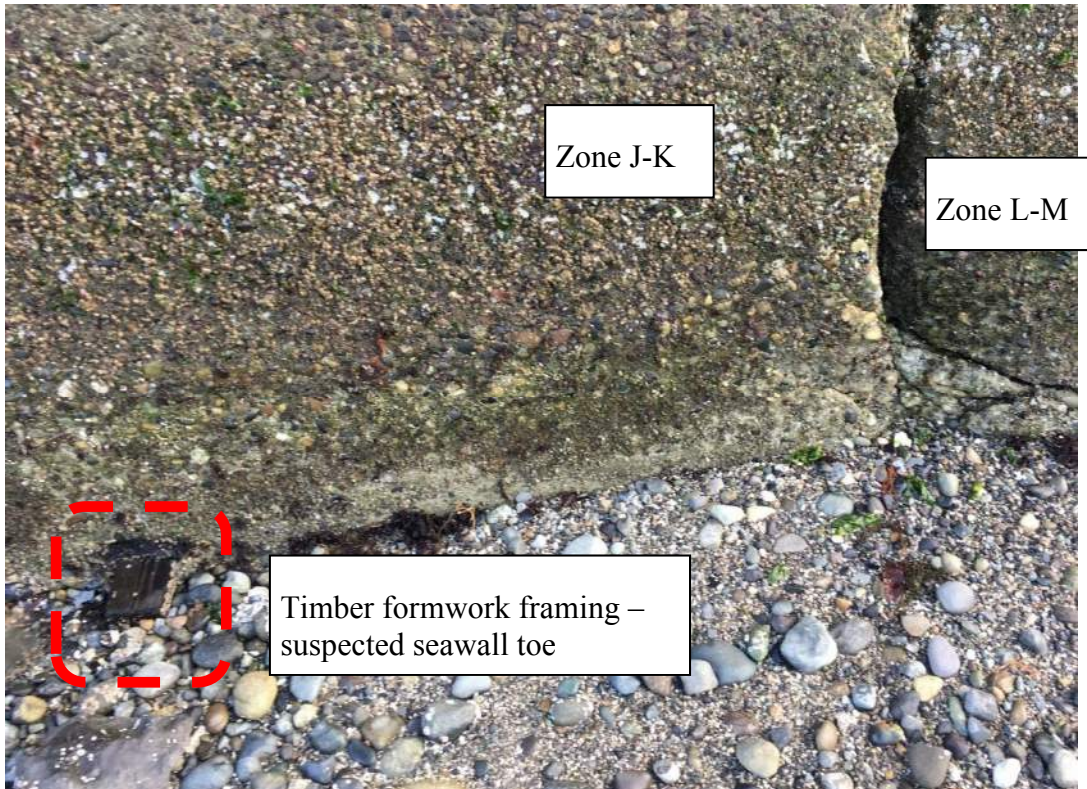


Photo 24. Zone J-K & L-M.  
Source: Reid Middleton Site Visit 10/18/2016



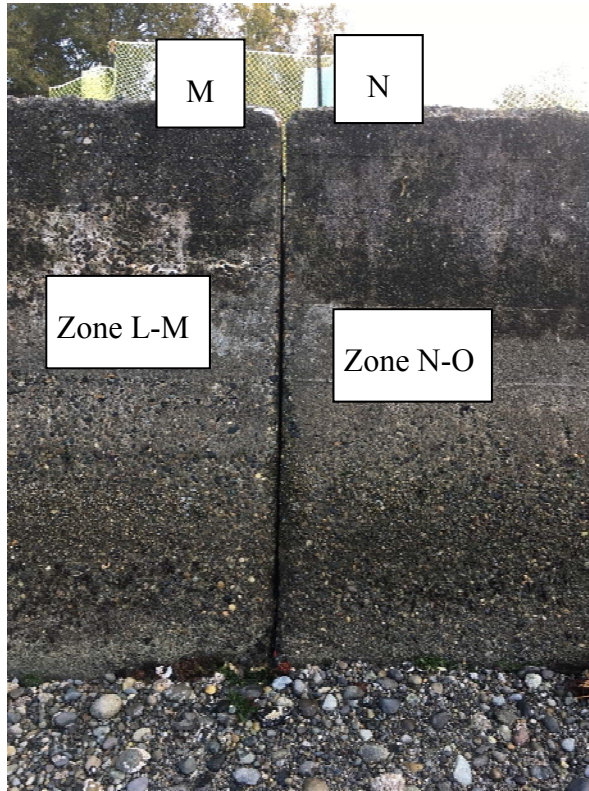


Photo 25. Zones L-M & N-O.  
Source: Reid Middleton Site Visit 10/18/2016

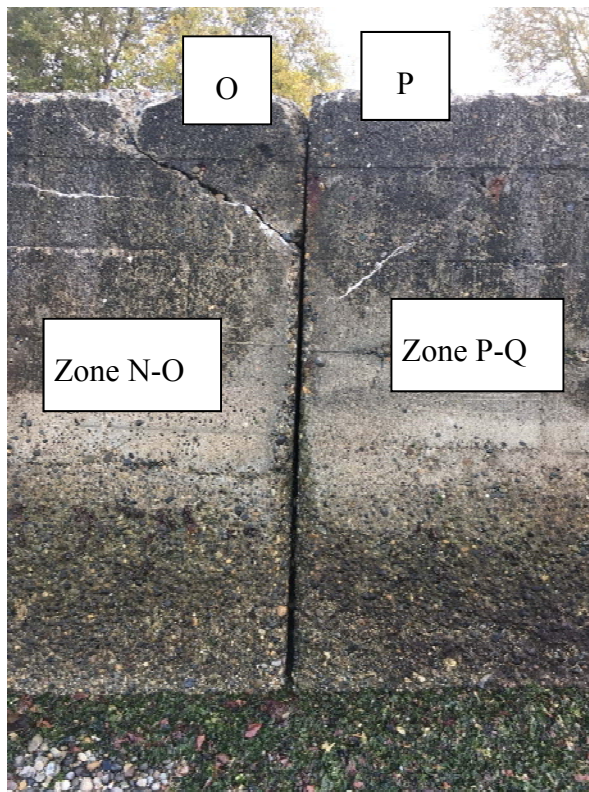


Photo 26. Zones N-O & P-Q.  
Source: Reid Middleton Site Visit 10/18/2016



Photo 27. Zone P-Q.  
Source: Reid Middleton Site Visit 5/31/2017



Photo 28. Zone P-Q.  
Source: Reid Middleton Site Visit 10/18/2016



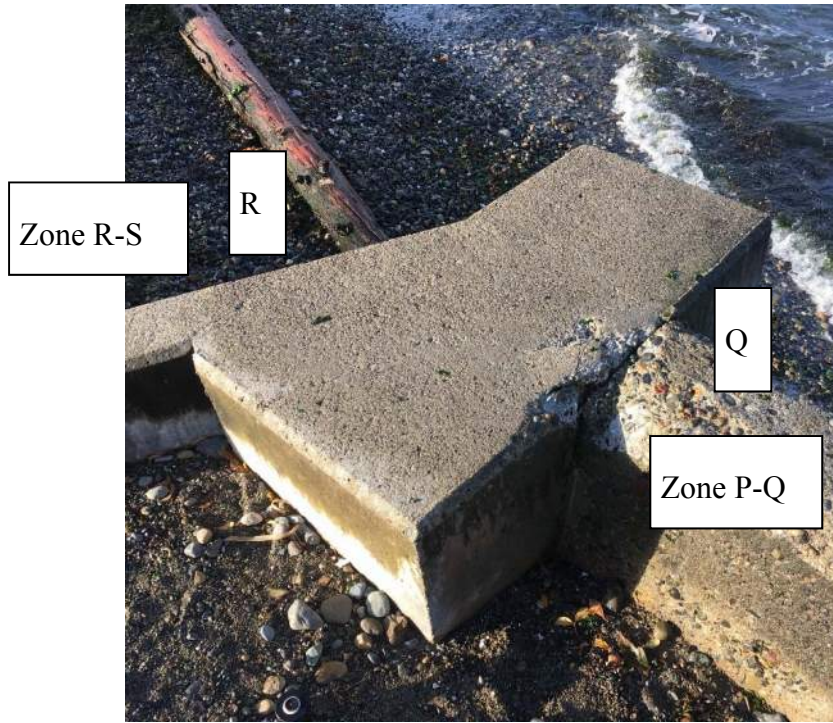


Photo 29. Zones P-Q & R-S.  
 Source: Reid Middleton Site Visit 10/18/2016

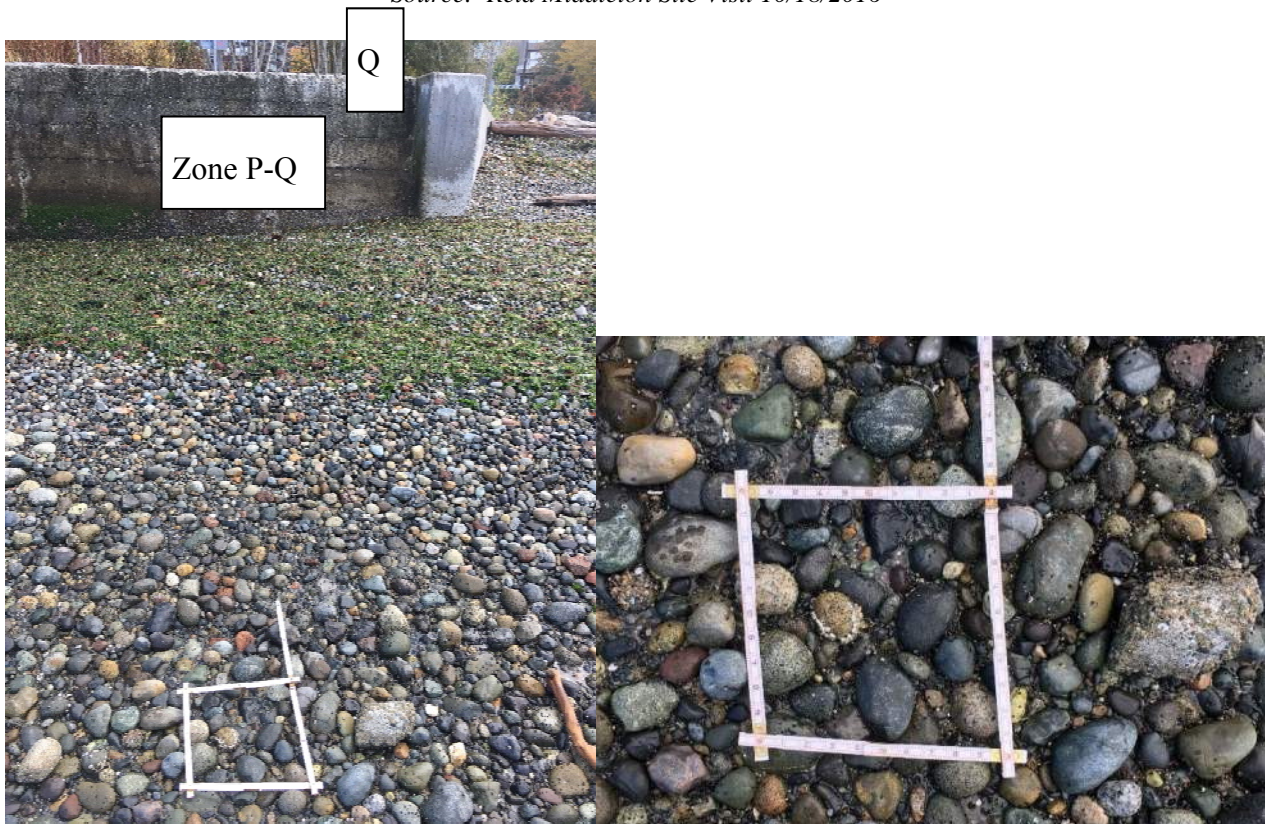


Photo 30. Zone P-Q, Lower Beach Material.  
 Source: Reid Middleton Site Visit 10/18/2016



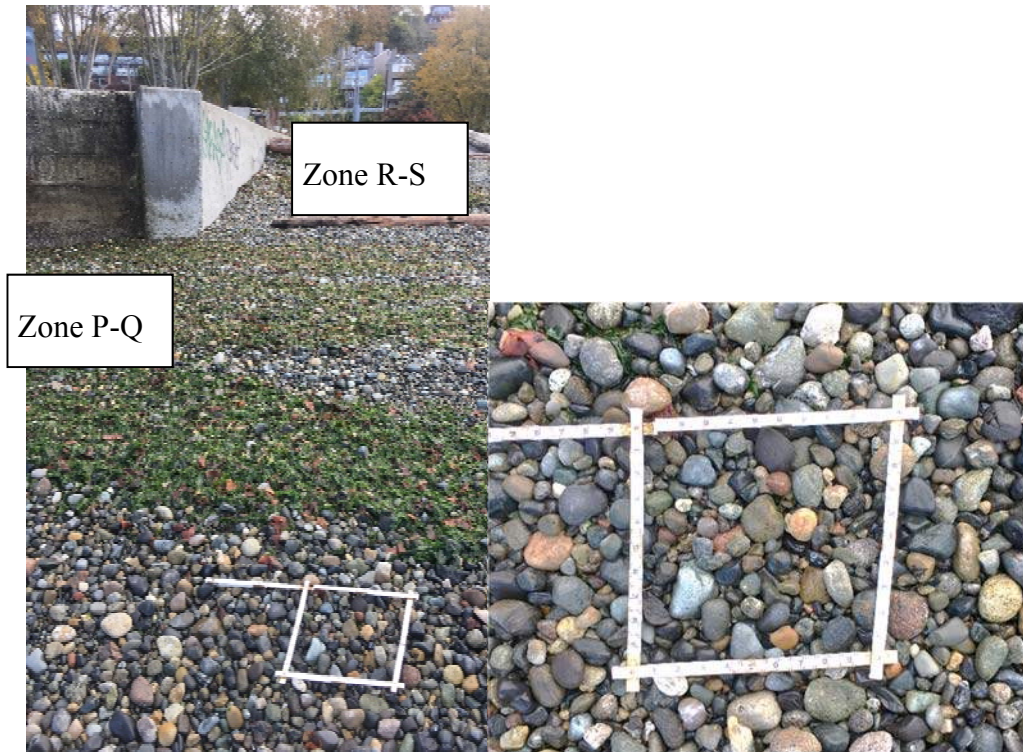


Photo 31. Zones P-Q & R-S, Upper Beach Material.  
 Source: Reid Middleton Site Visit 10/18/2016



Photo 32. View to the South from Zone R-S.  
 Source: Reid Middleton Site Visit 10/18/2016



728 134th Street SW, Suite 200  
Everett, WA 98204-5322  
(425) 741-3800  
[www.reidmiddleton.com](http://www.reidmiddleton.com)  
File No. 242017.004