

# River Mile 13.5 Year 7 Isolation Cap Inspection Report

ESCI #5249

Portland General Electric Company (PGE)

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A handwritten signature in blue ink, appearing to read "J. Palmer", positioned above a horizontal line.

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## Project Background

The River Mile (RM) 13.5 Study Area was one of nine (9) focus areas identified by the Oregon Department of Environmental Quality (DEQ) during the 2008 Downtown Portland Sediment Evaluation Study. The study indicated elevated concentrations of polychlorinated biphenyls (PCBs), dioxins/furans, pesticides, and some metals present in RM 13.5.

In 2011, Portland General Electric Company (PGE) prepared a Remedial Investigation (RI) Report to determine if the constituents found in surface and subsurface sediments during previous investigations were present at concentrations potentially posing an unacceptable risk to human health and ecological receptors. Based on the results of the RI, PGE prepared a Feasibility Study (FS) describing the remedial action alternatives to determine the appropriate cleanup action for RM 13.5. The FS recommended the installation of a sediment isolation cap at RM 13.5 across an area of 48,547 feet (1.11 acres). DEQ issued the Record of Decision (ROD) in April 2015 that selected isolation caps for the two areas identified in the RI: RM 13.5 and RM 13.1.

The RM 13.5 Isolation Cap was constructed in September and October 2015 per the requirements of the DEQ approved Remedial Design (RD) and Consent Order (CO). Both the RD and CO were finalized in early September 2015. The RM 13.5 Site Map is included as Figure 1 of this report.

In March 2016, the RM 13.5 Isolation Cap Six-Month Post-Construction Inspection was completed. The Six-Month Post Construction Inspection including the bathymetric survey, visual shoreline inspection, dive survey, and the evaluation of the results indicated that no follow-up action was required.

The RM 13.5 and 13.1 Cap Inspection Monitoring and Maintenance Plan (IMMP) requires a series of periodic post-construction inspections, starting with Years 1, 3, and 5 and continuing through Year 30 (see Table 1). In March 2017, the Year 1 RM 13.5 Isolation Cap Inspection and required bathymetric survey was completed and the visual shoreline inspection was later completed in November 2017.

On October 11, 2017, PGE conducted minor cap maintenance activities to replace a section of armor stone that had eroded from a small area along the shoreline. Limited armor stone thickness was remaining and proactively adding the armor stone was necessary to prevent future erosion of the underlying sand isolation material. The erosion area was identified during visual inspections during low tide in September 2017. In addition, PGE conducted a small habitat mitigation action along the shoreline, east of the southeast corner of the cap. This action involved utilizing the cap armor stone to cover the surface of the larger riverbank riprap material. A total of 52 cubic yards of material was placed over these two areas totaling 1,606 square feet.

The added cap armor material consisted of 3- to 6-inch rounded stone, placed to a thickness of approximately 12 inches over the cap maintenance area and approximately 6 to 12 inches over the habitat placement area. Further details of the 2017 maintenance activities are summarized in the River Mile 13.5 Cap Maintenance and Habitat Mitigation Summary technical memorandum dated December 2017.

Since the October 2017 cap maintenance activities, the 2019 RM 13.5 Year 3 Isolation Cap Inspection (PGE 2020) and 2022 RM 13.5 Year 5 Isolation Cap Inspection (AECOM 2022) were conducted. The inspections included a bathymetric survey and visual inspection. Evaluation of the results indicated the cap was in good condition and remains stable and protective.

Continued leveling or smoothing of localized areas of mounded cap material (high spots) was observed along the shoreline and southern edge of the cap due to ongoing wave action. Minor areas of the cap were found to have slightly less than the required 2.63 feet of cap material present, but these areas remain protective given the minimum 100-year protectiveness design criteria. The evaluation recommended continued monitoring of these areas as part of normal inspections.

The RM 13.5 Year 7 Isolation Cap Inspection was conducted in 2023. The visual inspection was conducted August 9, 2023, and a bathymetric survey and LiDAR survey were conducted on May 7, 2023 and February 16, 2023, respectively. This report summarizes the Year 7 RM 13.5 Isolation Cap Inspection activities and evaluation results.

## Inspection Objectives

Specific objectives for the cap inspection monitoring and maintenance program include:

- Ensuring cap protectiveness over time by ensuring cap thickness continues to meet established requirements of the isolation cap;
- Ensuring cap stability over time by ensuring slope design specifications continue to meet established specifications that will maintain the integrity of the armor layer; and
- Identifying and recommending any maintenance actions necessary to ensure the cap remains protective through isolation of the underlying impacted sediment.

## Inspection Requirements

The RM 13.5 and 13.1 Cap Inspection Monitoring and Maintenance Plan (IMMP) requires a series of periodic post-construction inspections. The inspections are designed to be completed during the seasonal high-water period in April. Table 1 provides a summary of the post construction inspections conducted and proposed in the future. Following the Year 10 (April 2028) inspection, additional inspections will be conducted every 10 years or as determined by the DEQ based on the results of the previous surveys.

Cap inspection surveys will also be required following the occurrence of a 100-year flood or significant seismic event. A 100-year flood event in the lower Willamette River is defined as a river stage of 32.2 feet NAVD 88 (30.1 feet City of Portland Datum) or a river discharge of 375,000 cubic feet per second (cfs). A significant seismic event is defined as an earthquake greater than Magnitude 6. If one of these events occurs, a bathymetric survey will be conducted when river levels recede, and surveying conditions are satisfactory and safe to complete within the river.

Appendix A shows the river flows from May 2022 (Year 5 inspection) through May 2023 (Year 7 inspection). No floods, high river flow, or significant seismic events have occurred since the last monitoring event.

**Table 1. Post Construction Inspections**

Cap Inspection	Due Date	Bathymetric/LiDAR Survey Status	River Elevation (ft) (gauge datum/NAVD88 <sup>(2)</sup> )	Percentage of Cap Surveyed (%)	Visual Shoreline Inspection Status	River Elevation (ft) (gauge height/NAVD88)	Required Action
Six Month	April 2016	Completed 03/23/2016	8.5/13.52	84%	Completed 04/14/2016	7.5/12.52	No maintenance activities required.
Year 1	April 2017	Completed 03/17/2017	15.9/20.92	100%	Completed 11/11/2016	3.0/8.02	During October 2017, minor cap maintenance activities to replace a section of armor stone that had eroded from a small area along the shoreline was completed.
Year 3	April 2019	Completed 04/10/2019	12.75/17.77	100%	Completed 01/31/2019	3.25/8.27	No maintenance activities required.
Year 5	May 2022	Completed 03/22/2022	6.75/11.77	99.9%	Completed 04/12/2021	2.35/7.37	No maintenance activities required.
Year 7	April 2023	Completed 05/07/2023/ 02/16/2023	11.4/16.4 3.6/8.6	100%	Completed 08/09/2023	1.54/6.56	No maintenance activities required.
Year 10 <sup>(1)</sup>	April 2028	--			--		--
Year 20	April 2038	--			--		--
Year 30	April 2048	--			--		--

- (1) As documented in Table 3 of the RM 13.5 and 13.1 IMMP, the RM 13.5 10-Year Monitoring Event was moved to 2028 to be on the same yearly schedule as RM 13.1. An additional 7-Year Monitoring Event was included at RM 13.5 so that no more than 5 years would pass before the "10-Year" monitoring event.
- (2) River elevation is obtained from the Morrison Bridge Gauge (USGS 14211720). Conversion from the USGS Morrison Bridge Gauge to City of Portland (COP) datum is +2.92 feet. Conversion from COP to the North American Vertical Datum of 1988 (NAVD88) is +2.10 feet.

Physical integrity monitoring is conducted as part of the cap inspections to detect and evaluate changes in the cap stability or cap thickness over time. This monitoring includes:

- Visual inspections of the shoreline cap area at low tide.
- Completing a high-resolution multi-beam bathymetric survey and evaluating results according to cap-specific performance criteria.
- If determined to be necessary by the Project Engineer, follow-up surveys, stability evaluations, and/or cap maintenance will be completed.

## Year 7 Isolation Cap Inspection Results

The Year 7 isolation cap inspection included visual shoreline monitoring and inspection, and a bathymetric and LiDAR survey. These are described below followed by a brief evaluation of the Year 7 inspection and survey data relative to the applicable requirements of the IMMP.

### Visual Shoreline Monitoring and Inspection

PGE completed a visual shoreline inspection on August 9, 2023, to identify changes in the cap surface and evaluate the physical integrity and stability of the sediment cap in areas visible from the shore. The IMMP requires visual inspections to be conducted at a water elevation of +5 feet NAVD88 or lower to ensure as much of the shoreline as possible is accessible. The water level at the time of the inspection was +6.56 feet NAVD88, which is slightly above the IMMP requirement.

The visual inspection evaluated the physical condition of the armor stone layer, specifically looking at the overall condition of the armor stone, areas of erosion, sloughing, or deposition, presence of vegetation, damage to the cap from debris or human activities, and visual signs of potential recontamination (i.e., sheen or staining).

The inspection was mainly conducted from the Tilikum Crossing Bridge and the US Blueback/OMSI dock, as access to the shoreline was impeded by camps occupied by unhoused people. During the inspection, the armor stone appeared to be in good to fair condition, consistent with the Year 5 observations. An algae bloom was visible at the time of the inspection. No sloughing of the armor stone was observed. No newly deposited sediment was observed over the armor stone. Some woody debris was present at the south end of the cap along the water edge, however no damage to the cap was observed due to the debris. No visible sheens or staining were observed. The shoreline inspection notes/observations for RM 13.5 are included in Appendix B of this report.

### Bathymetric Survey and LiDAR Survey

The bathymetric survey was completed on May 7, 2023, (within the specified timeframe of March–May) and when Willamette River water surface elevation exceeded +9-ft NAVD88. Prior to mobilizing, surveyors closely monitored water levels to ensure that they would remain at, or above, +9 ft NAVD88 for sufficient duration to complete the survey and achieve greater than 85% cap coverage. Industry standard quality assurance and performance tests (i.e., from the USACE Hydrographic Surveying Manual, EM 1110-2-1003) that were completed prior to surveying demonstrate that the survey data meet the IMMP specification of 0.15 feet for horizontal and vertical accuracy.

The vessel-based LiDAR survey was completed February 16, 2023 during seasonally low tide in order to acquire data in the shallow exposed riverbank areas that the bathymetric survey could

not access. A laser scanner was mounted to the side of the vessel and several slow passes were made along the shoreline to acquire a dense data set in an attempt to penetrate vegetation along the shoreline. The laser scanner was attached to the same GPS positioning equipment and software system as the bathymetric survey equipment to ensure that the required IMMP specification of 0.15 feet for horizontal and vertical accuracy was met.

The laser scanning survey and bathymetric survey data were combined to depict one complete survey of the cap; results of the surveys are presented in Figure 2. The combined survey encompassed 100 percent of the isolation cap extent and data were collected at sufficient resolution to evaluate elevations and the condition of the cap.

## Evaluation of the Results

Table 2 provides a summary of the cap performance evaluation criteria identified in the IMMP and the results of the current inspection. Figure 3 presents a comparison of the 2023 cap survey to the March 2016 6-month post-construction survey to assess potential excess cap erosion or evidence of slope instability. Figure 4 presents a comparison of the 2023 cap survey to the March 2022 cap survey (completed in support of the Year 5 cap inspection) to evaluate more recent potential cap erosion or evidence of slope instability. Representative cross-sections are presented in Figures 5, 6, and 7. Figure 8 shows areas of the cap that, through elevation loss, are under the minimum cap design thickness.

In accordance with the IMMP, the area of the cap exceeding 3 inches of elevation loss was calculated using the 2016–2023 elevation difference map (Figure 3). The results indicate that an area of approximately 7.4% of the total cap surface, or 3,685 square feet, has experienced 3 inches or greater of elevation loss over the reporting period (2016–2023). This result is below the evaluation criteria of 10% of the total cap surface area. The Year 5 inspection results showed some continued movement of cap materials as the cap continued to equilibrate with the hydrodynamic conditions at the site and create a more uniform surface. Results of this Year 7 inspection support that assessment, as depicted in Figure 4, that movement of cap materials has become less over time. As shown in Figure 4, 0.1% of the cap experienced an elevation gain of 3 inches or greater between 2022 and 2023 and 0.6% of the cap experienced an elevation loss of 3 inches or greater. The results show minimal change to cap thickness over the last year as a more uniform surface has been reached.

Evaluation of time series survey data (Figures 5–7) indicates continued but limited leveling and smoothing of localized areas of mounded capping material (high spots) that remained following construction of the cap in 2015. This is consistent with the 2019 and 2022 inspection findings, although the 2023 survey results indicate a substantial reduction in material movement and almost no material loss. The 2023 elevations are essentially the same as the 2022 elevations. No new areas of concern were identified as part of the Year 7 Investigation. Previous areas of concern that were evaluated in the Year 3 and Year 5 evaluations are shown on Figure 9, along with the 2017 cap maintenance area. Those areas were evaluated again during this inspection, as discussed below.

- The area along the shoreline, as portrayed in Figure 6 (cross section B-B'), has experienced transitory movement of armor materials since cap construction, primarily materials being pushed shoreward by wave action. This is also the area where the 2017 cap maintenance took place. The recent data suggest similar, limited ongoing material movement, but no new material loss. This may indicate a stabilization of the cap profile; however, the area will continue to be evaluated during future monitoring events. A discussion on remaining cap thickness and protectiveness is provided below.

- The area in the southeastern corner of the cap, as portrayed in Figure 7 (cross section C-C'), has experienced the most elevation loss (approximately 1.7 feet) since 2015. The eastern-most portion of the cap was built up in a hump, which has been pushed shoreward by wave action. The visual inspection noted that armor material was still present in this area, so it is unclear what material has been displaced. Settlement of underlying cap materials may partially explain the elevation loss. Importantly, no additional material loss was identified between the 2022 and the 2023 surveys. This area will continue to be evaluated during future monitoring events. A discussion on remaining cap thickness and protectiveness is provided below.
- The area in the southwest corner of the cap, as portrayed in Figure 7 (cross section C-C'), that experienced greater than 1 foot of erosion between the 2016 and 2023 surveys (Figure 3) appears to have stabilized, with no additional notable erosion between the 2022 and 2023 surveys (Figures 4 and 7). This area was a high spot that has likely been leveled off due to wave action. This is primarily an area of toe armor; the current profile suggests sufficient toe armor remains to maintain slope stability, and there is no risk to the integrity of the cap. This area will continue to be evaluated during future cap inspections. As this area is outside of the required isolation cap footprint, there is no impact on environmental protectiveness.

As indicated on Figure 8, the cap thickness remains greater than the design minimum of 2.63 ft across 95.9% of the isolation cap. The cap thins to less than the design minimum of 2.63 ft in isolated locations along the shoreline and the south end of the cap; the majority of these areas are just under the 2.63 foot minimum, although one small location (shown in Figures 7 and 8) has less than 2 feet of cap thickness. As discussed above, the data indicate localized movement of cap material. The displaced material appears to be moving into adjacent depressions in the cap surface and along the shoreline. High spots along the upstream crest of the cap also continue leveling out over time due to wave and river current forces. While this movement is resulting in localized areas of decreased cap thickness, the progression is limited and has not compromised the overall integrity or performance of the cap.

Even though the cap thickness is less than the design minimum of 2.63 ft in localized areas, the isolation layer thickness was designed to be protective for a minimum of 100 years. A limited reduction in armor or isolation material thickness does not currently represent a risk to human or ecological health. However, it will be important to continue monitoring these isolated areas to ensure that the rate and extent of movement remains low, particularly along the upstream edge of the cap that is exposed to combined head-on river currents and wave forces.

**Table 2. Evaluation Criteria for Cap Integrity Monitoring**

Monitoring Parameter		Data Evaluation of the Parameter	Decision Criteria	Decision	Follow-up Proposed Actions	Outcome
Data	Bathymetric Data Quality Assurance	Review the QA/QC documentation provided by survey contractor.	Is the documentation missing any of the QA/QC requirements identified in Sections 3.2.2 and 4.1 of the IMMP or is the survey coverage less than 85 percent of the survey extents?	No	No additional action is necessary.	No documentation is missing for any of the QA/QC requirements identified in Sections 3.2.3 and 4.1 of the IMMP. The survey covered greater than 85% of the cap survey extent.
				Yes or unknown	Engineer will review the deficiency identified in the QA/QC and determine the impact of the deficiency and will recommend additional actions, if necessary. If shoreline coverage is not possible due to water depth, a visual inspection will be conducted.	
Cap Integrity	Surficial debris/large obstructions	Prepare a sun-illuminated digital terrain model figure with surface elevation contour intervals. Identify the approximate length, width, and type of any surficial objects/large obstructions.	Do the surficial objects appear to be greater than an area 10 feet by 10 feet in size and/or is the object adversely impacting the cap?	No	No additional action is necessary.	No surficial objects greater than an area of 10 feet by 10 feet are present; there is no adverse impact to the cap.
				Yes or unknown	Engineer will review to determine if a follow-up survey is needed to further characterize the object(s). Additional maintenance recommendations may be required, including debris removal, based on the Engineer's review.	
	Presence of the armor layer	Prepare a sun-illuminated digital terrain model figure with surface elevation contour intervals. Identify any anomalies that appear to be sloughing areas, areas of significant scour or accumulation at the bottom of slopes, or areas where the elevation contours appear to be anomalous compared to final as-built survey.	Are there any anomalies greater than an area 10 feet by 10 feet in size that appear to indicate a failure of cap stability, such as a sloughing event, significant deposition of material along the bottom of the cap that would indicate a sloughing event, or significant erosion of the armor stone?	No	No additional action is necessary.	
				Yes or unknown	Conduct a follow-up survey (e.g., diver or camera), if determined necessary by an engineer, to determine if the armor stone is missing and sand isolation layer exposed or if new finer-grained material has been deposited. The Engineer will review information from the follow-up survey and make additional recommendations for maintenance, if necessary. The nature of the disturbance to the cap identified during the inspection monitoring event will be the basis for any design modifications.	As noted in previous reports (2019 and 2022), limited areas (greater than 10 feet by 10 feet) along the shoreline and upstream edge of the cap have lower elevations than the post-construction elevation. The shoreline survey conducted in August 2023 indicated the armor stone was still present, although some erosion and/or movement has occurred. No new areas of erosion/movement were identified. An engineer reviewed the results of the bathymetric survey and determined that the cap remains stable. A follow-up survey is not warranted at this time. See the Evaluation of the Results section for additional detail.

Monitoring Parameter		Data Evaluation of the Parameter	Decision Criteria	Decision	Follow-up Proposed Actions	Outcome
Cap Integrity (cont'd)	Presence of the armor layer (cont'd)	Visual inspection of the shoreline armor, including photographs.	Is 3 inches or more of the armor material missing, displaced, or moving at the shoreline.	No	No additional action is necessary.	No, the visual inspection did not identify evidence of 3 inches or greater of armor material missing, displaced, or moving at the shoreline other than the identified slow movement of material within the shoreline bench area discussed above.
				Yes	The Engineer will review information from the follow-up survey and make additional recommendations for maintenance and or design modifications, if necessary.	
	Public use evaluation	Multiple lines of evidence evaluation of visual inspection and bathymetric results, notices, etc.	In the 5-year review, is there evidence that public use activities are having a significant adverse effect on the cap?	No	No additional action is necessary.	No, there is no evidence that public use activities are having a significant adverse effect on the cap.
				Yes	The Engineer will review information from the survey and make additional recommendations for maintenance or design modifications, or other actions if necessary. Discuss with DEQ.	
Slope Stability	Elevation grades across the top of the armor layer	Calculate the slope across the extent of the isolation cap (top surface).	Has the grade across the isolation cap increased to greater than the as-built slope (a maximum slope of 2.5H:1V) or changed substantially (greater than 50 percent) over an area larger than 50 feet by 50 feet in size? Is there any evidence of slope failure, such as stone accumulation at the bottom slopes?	No	No additional action is necessary.	No, there is no evidence that the grade across the isolation cap increased to greater than the as-built slope. There is also no evidence of slope failure.
				Yes or unknown	Conduct a follow-up visual or bathymetric survey to provide visual evidence of the change. Engineer will review results of the follow-up survey and additional recommendations for maintenance, if necessary.	

Monitoring Parameter		Data Evaluation of the Parameter	Decision Criteria	Decision	Follow-up Proposed Actions	Outcome
Cap Thickness	Changes in surface elevation (evaluate deposition and scour processes)	Prepare bathymetric figure comparing the post-construction surface elevations and the current survey event surface elevations.	Is there a negative elevation change of greater than 3 inches across 10 percent or more of the cap area that has not already been identified and addressed during previous monitoring assessments? The total isolation cap square footage is: 49,786 square feet.	No	No additional action is necessary.	The total area with greater than 3 inches of decreased cap elevation is 3,685 SF <sup>1</sup> , which is 7.4% of the cap area; this is a culmination of smaller isolated areas primarily along the shoreline and upstream edge of the cap. The shoreline survey conducted in August 2023 indicated the armor stone was still present. An engineer reviewed the results of the bathymetric survey and determined that the cap remains stable. See the Evaluation of the Results section for additional detail.
				Yes or unknown	Compare current surface elevation to pre-construction elevations to verify the minimum cap thickness is met, including the thickness for the isolation layer and the armor layer. The Engineer will review the results to determine if the extent of the decrease in thickness adversely impacts the effectiveness of the cap.	
				If minimum cap thickness is not maintained	Conduct a follow-up survey to visually characterize the condition of the cap if needed for the evaluation. The Engineer will review results to determine if the change represents an unacceptable level of scour. The Engineer will make additional recommendations for maintenance, if necessary.	There are limited, isolated areas where the minimum cap thickness is not met due to movement of cap material. An engineer reviewed the results of the bathymetric survey and determined that the cap remains stable and protective. See the Evaluation of the Results section for additional detail.

<sup>1</sup> The accuracy of the bathymetric survey is limited to +/-0.15 ft, this error may be compounded when comparing two bathymetric surveys. Therefore, the exact square footage of cap experiencing a net elevation loss of 3 inches or greater may vary.

## Conclusions

Based on review of the bathymetric and LiDAR survey data from April 25, 2016 to May 7, 2023, the in-water portion of the RM 13.5 isolation cap was found to be in good condition and remains stable and protective. Approximately 3,685 square feet, or 7.4% of the total cap surface area, exhibited a reduction of 3 inches or greater in elevation over the reporting period (2016–2023). This total area is less than the IMMP evaluation criteria (10%). It was assessed that this movement of cap materials reflects the erosion (smoothing and leveling) of localized high spots (mounds) of cap material that remained following construction of the cap. This material is, in turn, moving into adjacent shallow depressions in the cap surface and does not represent a risk to the integrity or protectiveness of the cap. A few isolated areas of the cap along the shoreline have experienced sufficient elevation loss to fall below the minimum cap design thickness of 2.63 feet. Even though the cap thickness is less than the design minimum of 2.63 ft in localized areas, the isolation layer thickness was designed to be protective for a minimum of 100 years. A limited reduction in armor or isolation material thickness does not currently represent a risk to human or ecological health.

It is expected that the cap will continue to experience minor localized movement and episodic thinning and infilling, as the cap surface materials adjust to prevailing hydrodynamic conditions. Accordingly, PGE will continue to monitor these areas during future events and coordinate with DEQ on when and if any future maintenance actions are required.

## Follow-up Action

The Year 7 RM 13.5 Isolation Cap Inspection consisting of the LiDAR survey in February 2023, the bathymetric survey in May 2023, the visual shoreline inspection in August 2023, and the evaluation of the results show that no follow-up action is required at this time. The cap remains intact and protective. Areas identified in this report for ongoing focused monitoring will be revisited during the 2028 inspection event to confirm the ongoing stability and protectiveness of the cap.

The Year 10 RM 13.5 Isolation Cap Inspection will be completed in April 2028 as required under the ROD and IMMP.

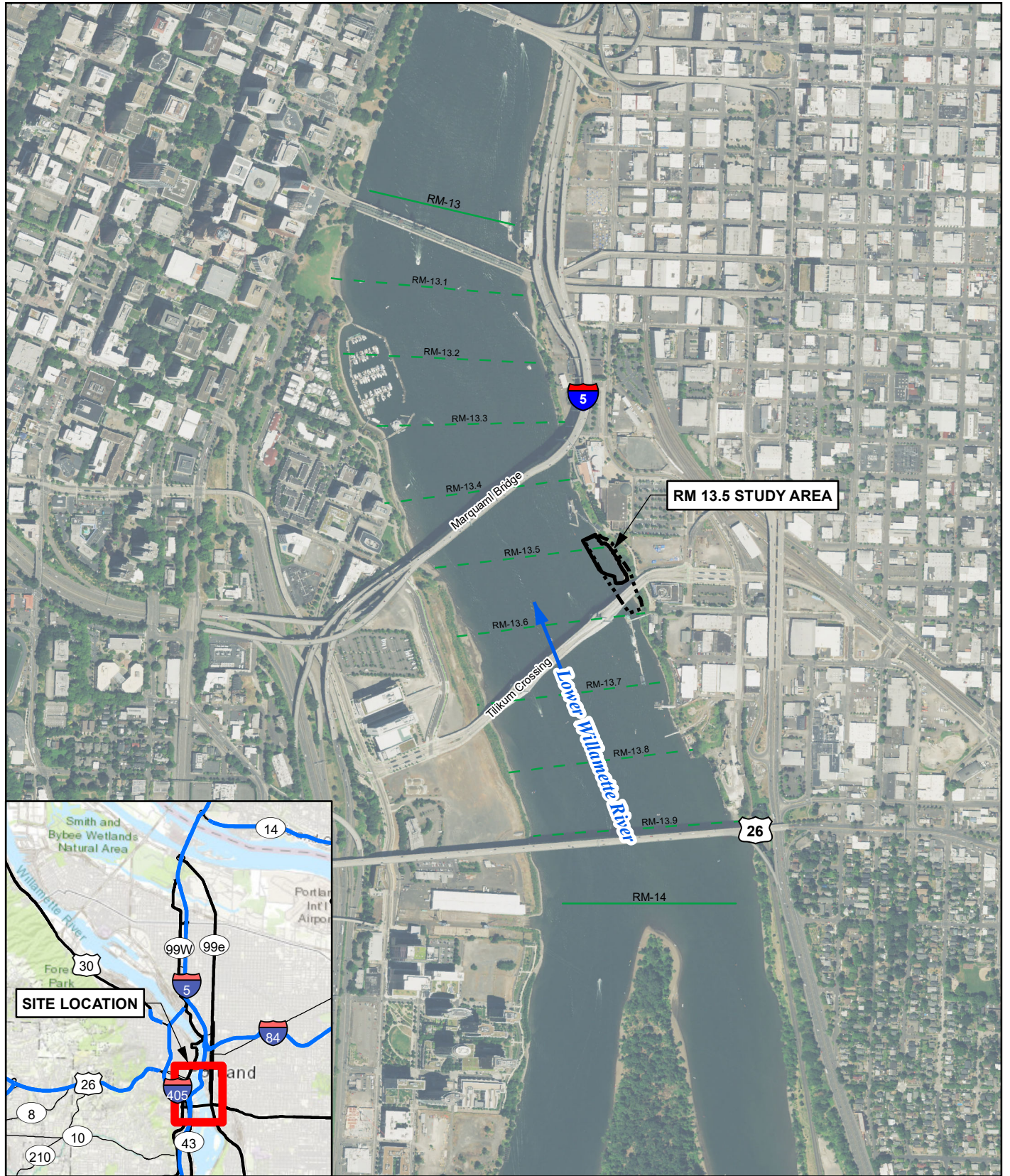
## References

AECOM. 2018. River Mile 13.5 and 13.1 Cap Inspection, Monitoring, and Maintenance Plan. Prepared for Portland General Electric Company, Portland, Oregon, June 22, 2018.

AECOM 2022. River Mile 13.5 Year 5 Isolation Cap Inspection Report. November 2022.

DEQ. 2015. Record of Decision, Selected Remedy for PGE Willamette River Sediment Sites. Prepared by Oregon Department of Environmental Quality, Northwest Regional Office, April 2015.

PGE. 2020. River Mile 13.5 Year 3 Isolation Cap Inspection Report. March 2022.



Sources: PGE0163389 (ArcGIS Data Basemaps, 06/25/2019); Functional Facilities, 5/26/2020 (DC 736);  
 Willamette River Mileage (1/10th mile), 3/25/2012 (DC 727);  
 PGE0243696 (Geospatial Data Gateway - NAIP Download, 05/05/2020);

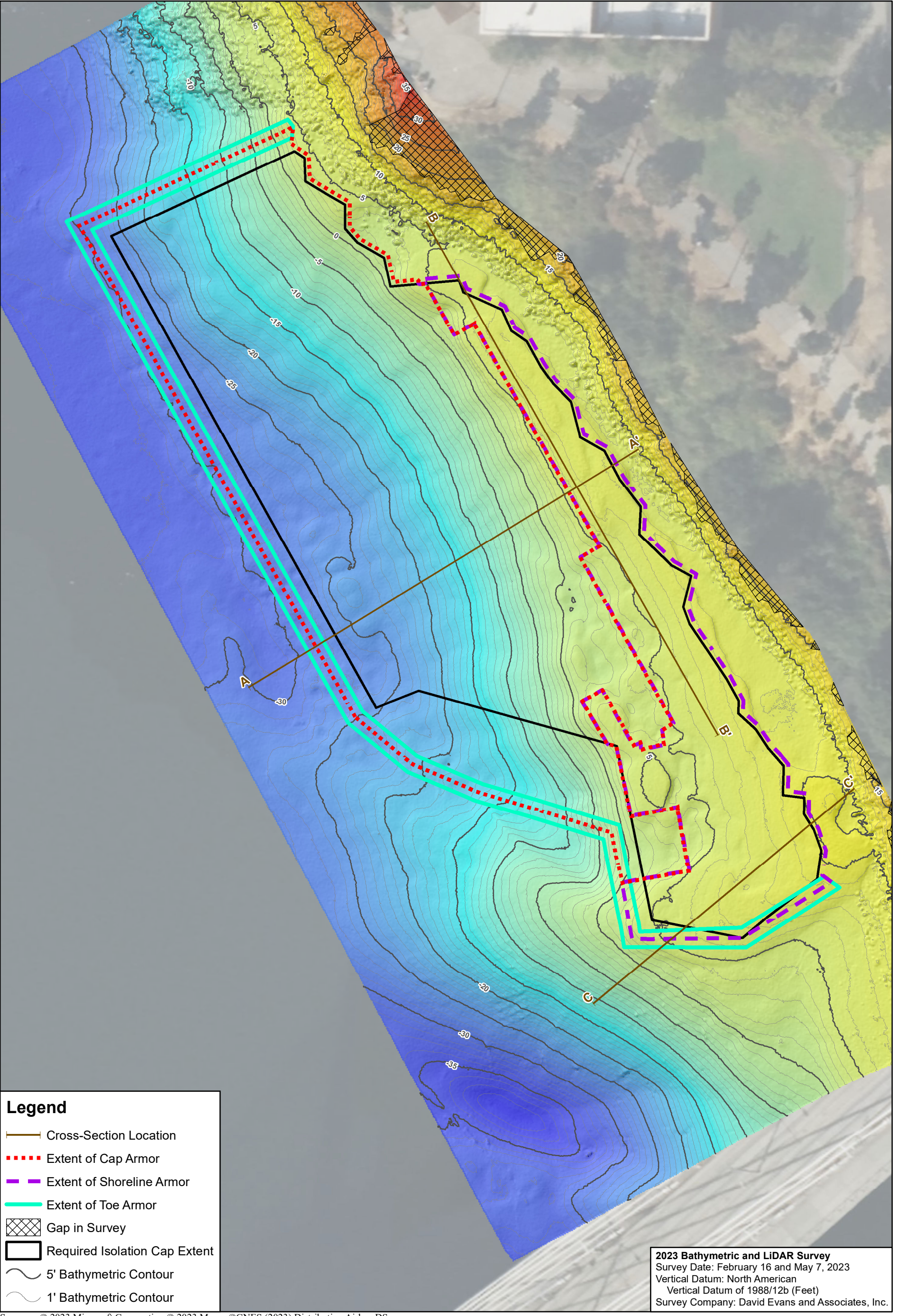
- Legend**
- Final Cap and Armor Extent
  - Study Area
  - River Mile Marker

JULY 2023  
 60659447

**FIGURE 1 - SITE VICINITY MAP**

PORTLAND GENERAL ELECTRIC  
 RIVER MILE 13.5 STUDY AREA  
 PORTLAND, OREGON





**Legend**

- Cross-Section Location
- Extent of Cap Armor
- Extent of Shoreline Armor
- Extent of Toe Armor
- Gap in Survey
- Required Isolation Cap Extent
- 5' Bathymetric Contour
- 1' Bathymetric Contour

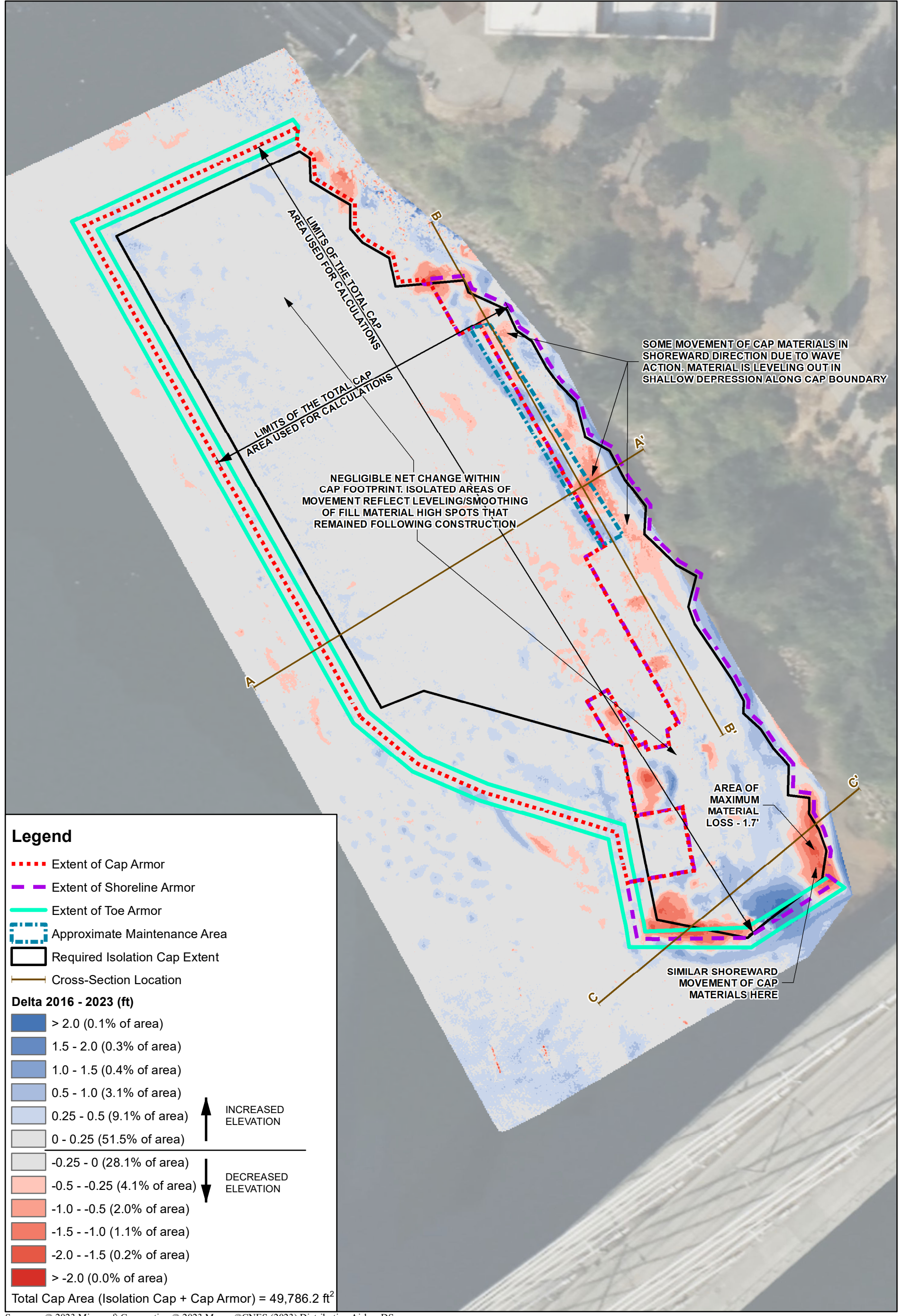
**2023 Bathymetric and LIDAR Survey**  
 Survey Date: February 16 and May 7, 2023  
 Vertical Datum: North American  
 Vertical Datum of 1988/12b (Feet)  
 Survey Company: David Evans and Associates, Inc.

Sources: © 2023 Microsoft Corporation © 2023 Maxar ©CNES (2023) Distribution Airbus DS

20      0      20      40  
 ────┬───┬───┬───┬───  
 SCALE IN FEET

Note: Data within the survey gap interpolated by surveyor.

K:\PGE\RM13\_5\_Design\MXD\2023\_Cap\_Evaluation\Fig 2 - RM13.5 2023 Bathymetric Survey.mxd



**Legend**

- - - Extent of Cap Armor
  - - - Extent of Shoreline Armor
  - - - Extent of Toe Armor
  - Approximate Maintenance Area
  - Required Isolation Cap Extent
  - Cross-Section Location
- Delta 2016 - 2023 (ft)**
- |                             |                       |
|-----------------------------|-----------------------|
| > 2.0 (0.1% of area)        | ↑ INCREASED ELEVATION |
| 1.5 - 2.0 (0.3% of area)    |                       |
| 1.0 - 1.5 (0.4% of area)    |                       |
| 0.5 - 1.0 (3.1% of area)    |                       |
| 0.25 - 0.5 (9.1% of area)   |                       |
| 0 - 0.25 (51.5% of area)    | ↓ DECREASED ELEVATION |
| -0.25 - 0 (28.1% of area)   |                       |
| -0.5 - -0.25 (4.1% of area) |                       |
| -1.0 - -0.5 (2.0% of area)  |                       |
| -1.5 - -1.0 (1.1% of area)  |                       |
| -2.0 - -1.5 (0.2% of area)  |                       |
| > -2.0 (0.0% of area)       |                       |
- Total Cap Area (Isolation Cap + Cap Armor) = 49,786.2 ft<sup>2</sup>

Sources: © 2023 Microsoft Corporation © 2023 Maxar ©CNES (2023) Distribution Airbus DS



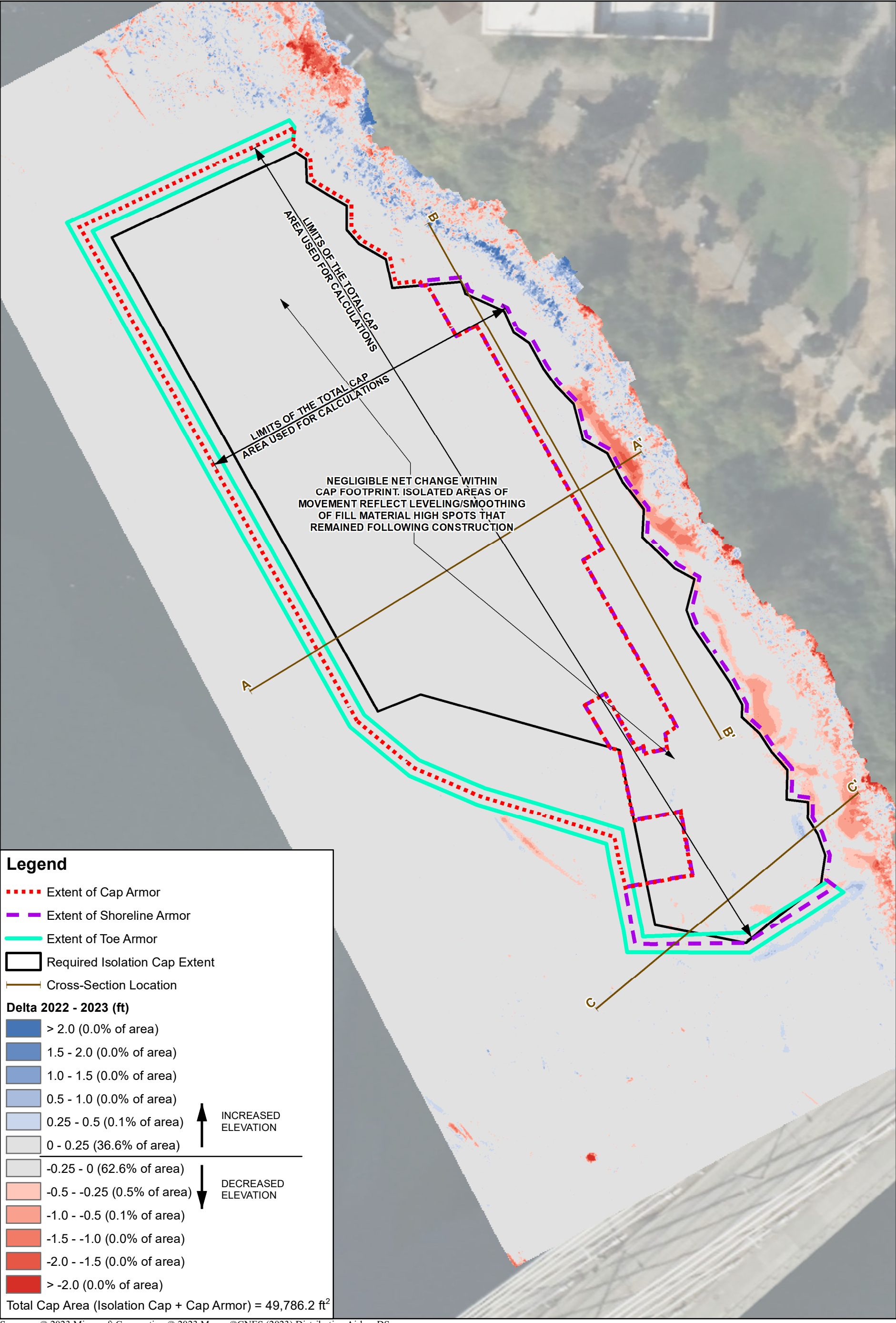
**FIGURE 3 - RM 13.5 2016-2023 CUT/FILL ANALYSIS**

JULY 2023  
60659447

PORTLAND GENERAL ELECTRIC  
RIVER MILE 13.5 STUDY AREA  
PORTLAND, OREGON



K:\PGE\RM13\_5\_Design\MXD\2023\_Cap\_Evaluation\Fig 3 - RM13p5 2016 - 2023 Cut-Fill Analysis.mxd



**Legend**

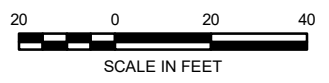
- - - Extent of Cap Armor
- - - Extent of Shoreline Armor
- - - Extent of Toe Armor
- Required Isolation Cap Extent
- Cross-Section Location

**Delta 2022 - 2023 (ft)**

	> 2.0 (0.0% of area)	↑ INCREASED ELEVATION
	1.5 - 2.0 (0.0% of area)	
	1.0 - 1.5 (0.0% of area)	
	0.5 - 1.0 (0.0% of area)	
	0.25 - 0.5 (0.1% of area)	
	0 - 0.25 (36.6% of area)	↓ DECREASED ELEVATION
	-0.25 - 0 (62.6% of area)	
	-0.5 - -0.25 (0.5% of area)	
	-1.0 - -0.5 (0.1% of area)	
	-1.5 - -1.0 (0.0% of area)	
	-2.0 - -1.5 (0.0% of area)	
	> -2.0 (0.0% of area)	

Total Cap Area (Isolation Cap + Cap Armor) = 49,786.2 ft<sup>2</sup>

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**FIGURE 4 - RM 13.5 2022-2023 CUT/FILL ANALYSIS**

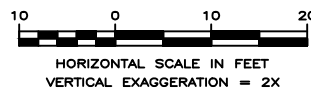
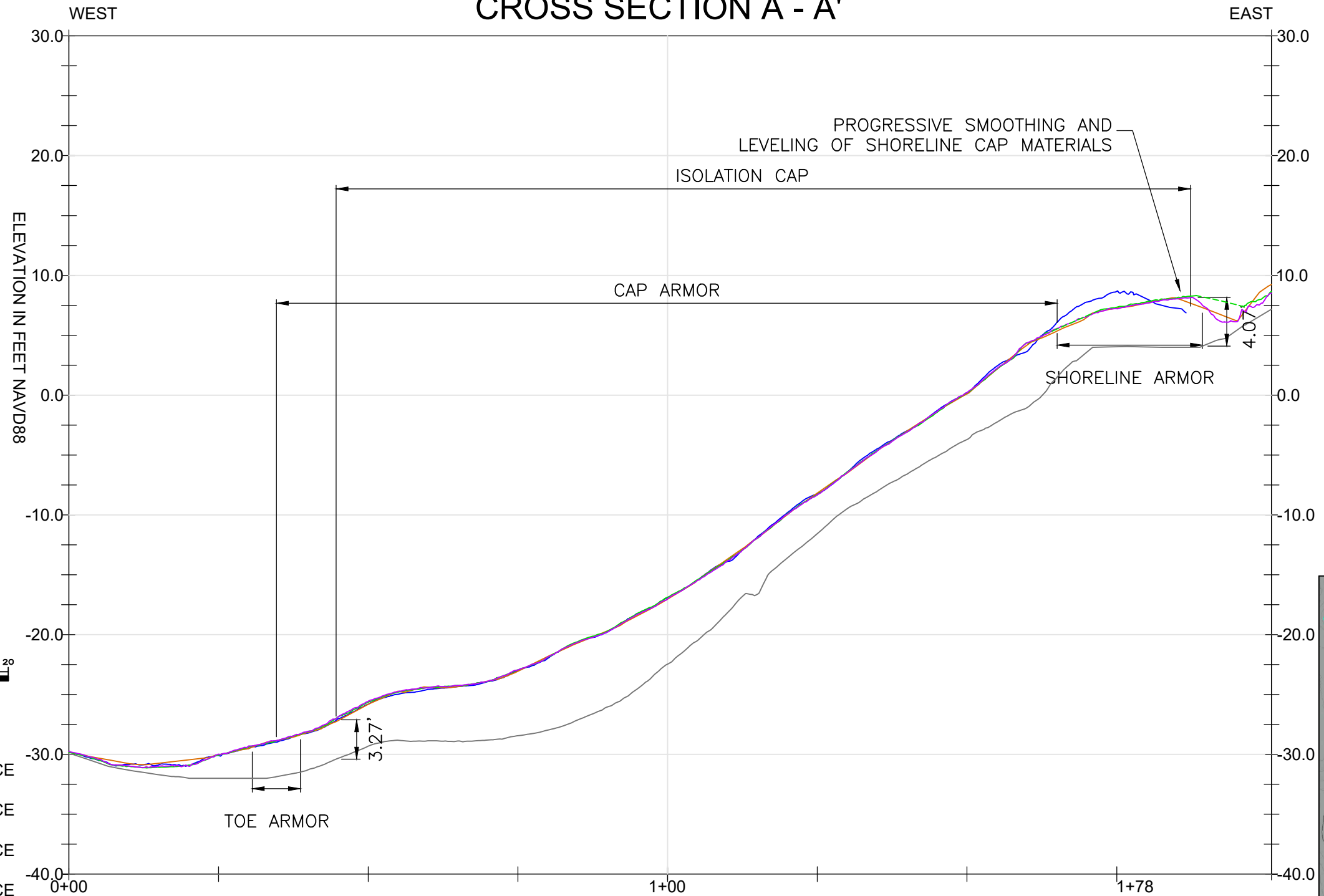
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RIVER MILE 13.5 STUDY AREA  
PORTLAND, OREGON

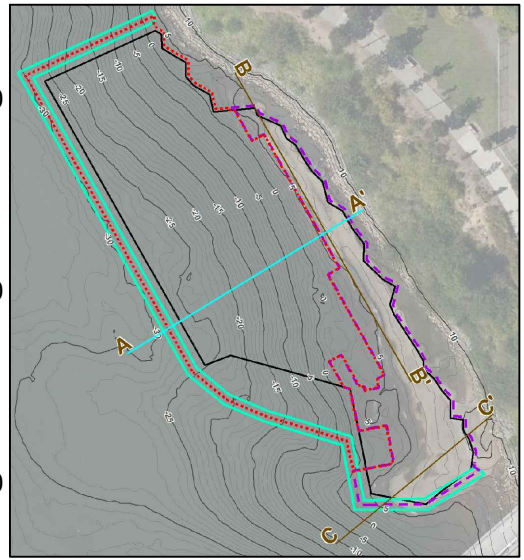


K:\PGE\RM13\_5\_Design\MXD\2023\_Cap\_Evaluation\Fig 4 - RM13p5 2022 - 2023 Cut-Fill Analysis.mxd

# CROSS SECTION A - A'



- LEGEND**
- 2015 SURFACE
  - 2016 SURFACE
  - 2019 SURFACE
  - 2022 SURFACE (DASHED WHERE INFERRED)
  - 2023 SURFACE
  - 3.27' — APPROXIMATE CAP THICKNESS (MARCH 2022)



**FIGURE 5 - RM 13.5 CAP SECTION A - A'**

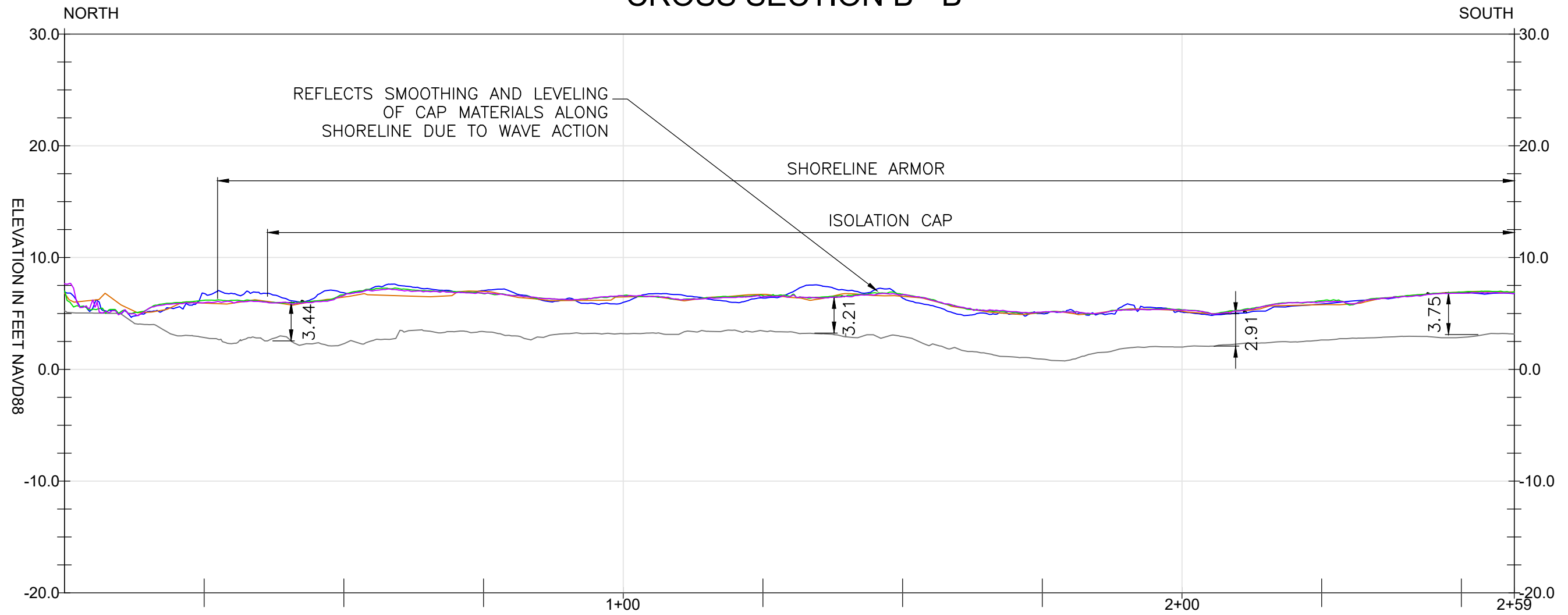
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PORTLAND GENERAL ELECTRIC  
RIVER MILE 13.5 STUDY AREA  
PORTLAND, OREGON



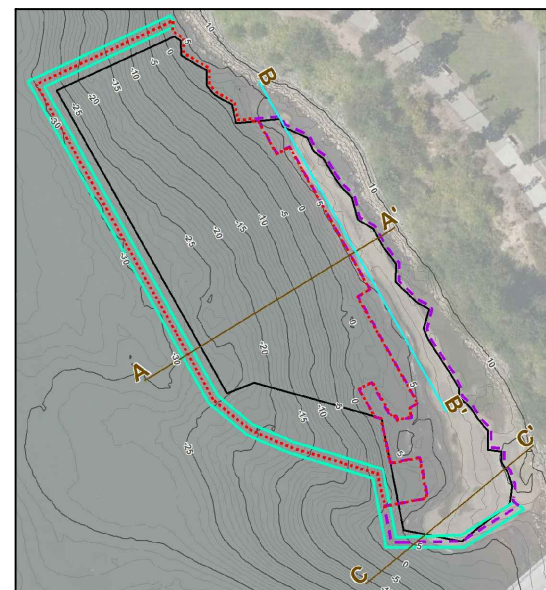
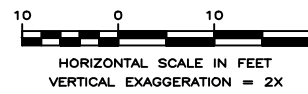
K:\PGE\RM13.5\_Design\WKO\2023\_Cap\_Evaluation\RM13p5\_Cross Section\_2023.dwg Jan 04, 2024 - 8:27am

# CROSS SECTION B - B'



## LEGEND

- 2015 SURFACE
- 2016 SURFACE
- 2019 SURFACE
- 2022 SURFACE
- 2023 SURFACE
- APPROXIMATE CAP THICKNESS (MARCH 2022)



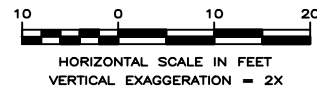
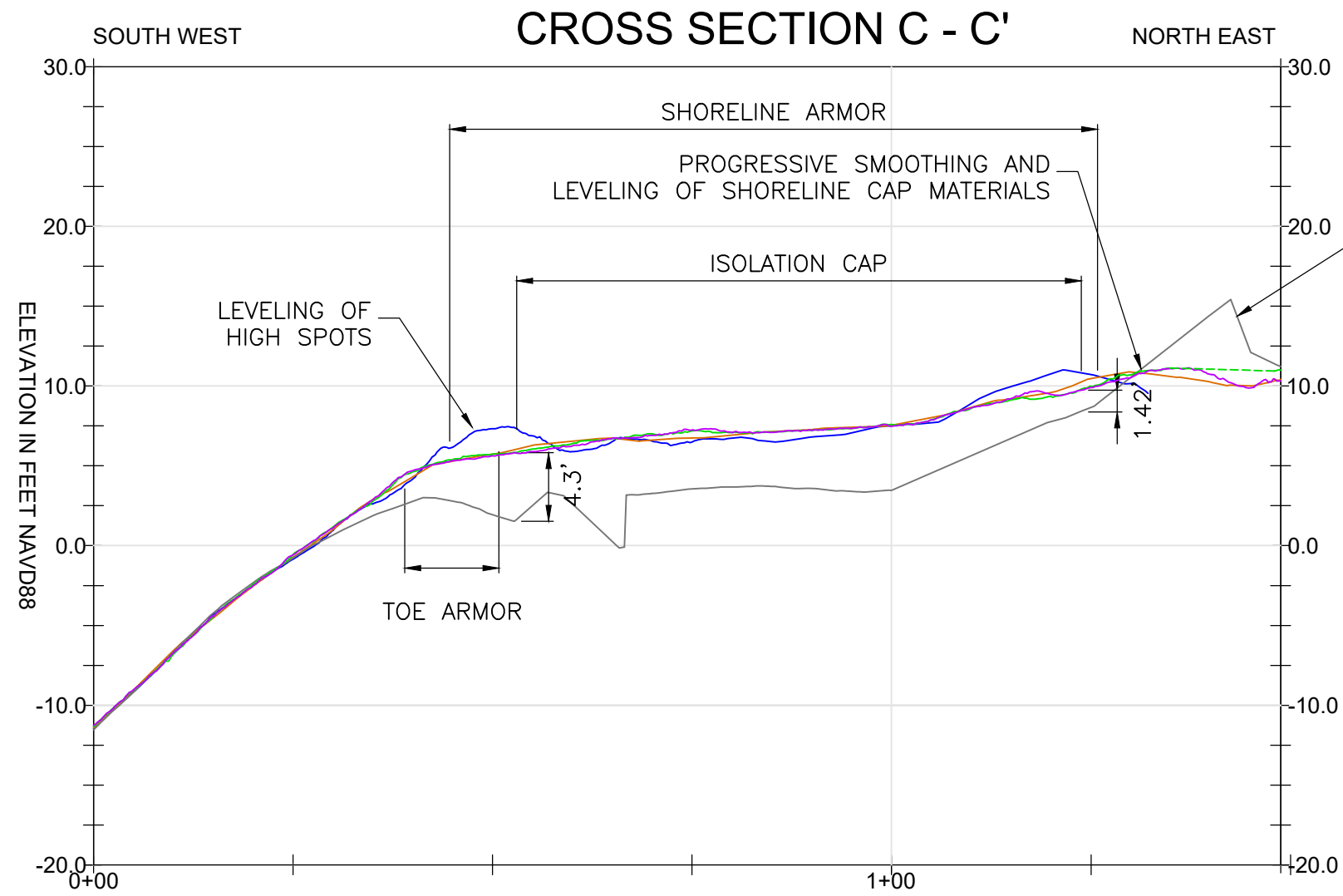
**FIGURE 6 - RM 13.5 CAP SECTION B - B'**

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RIVER MILE 13.5 STUDY AREA  
PORTLAND, OREGON

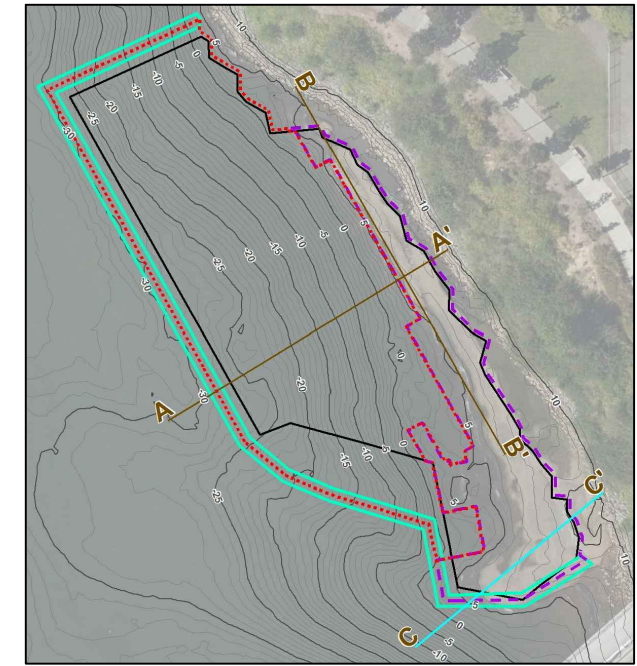


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**LEGEND**

- 2015 SURFACE
- 2016 SURFACE
- 2019 SURFACE
- 2022 SURFACE (DASHED WHERE INFERRED)
- 2023 SURFACE
- 3.27' APPROXIMATE CAP THICKNESS (MARCH 2022)

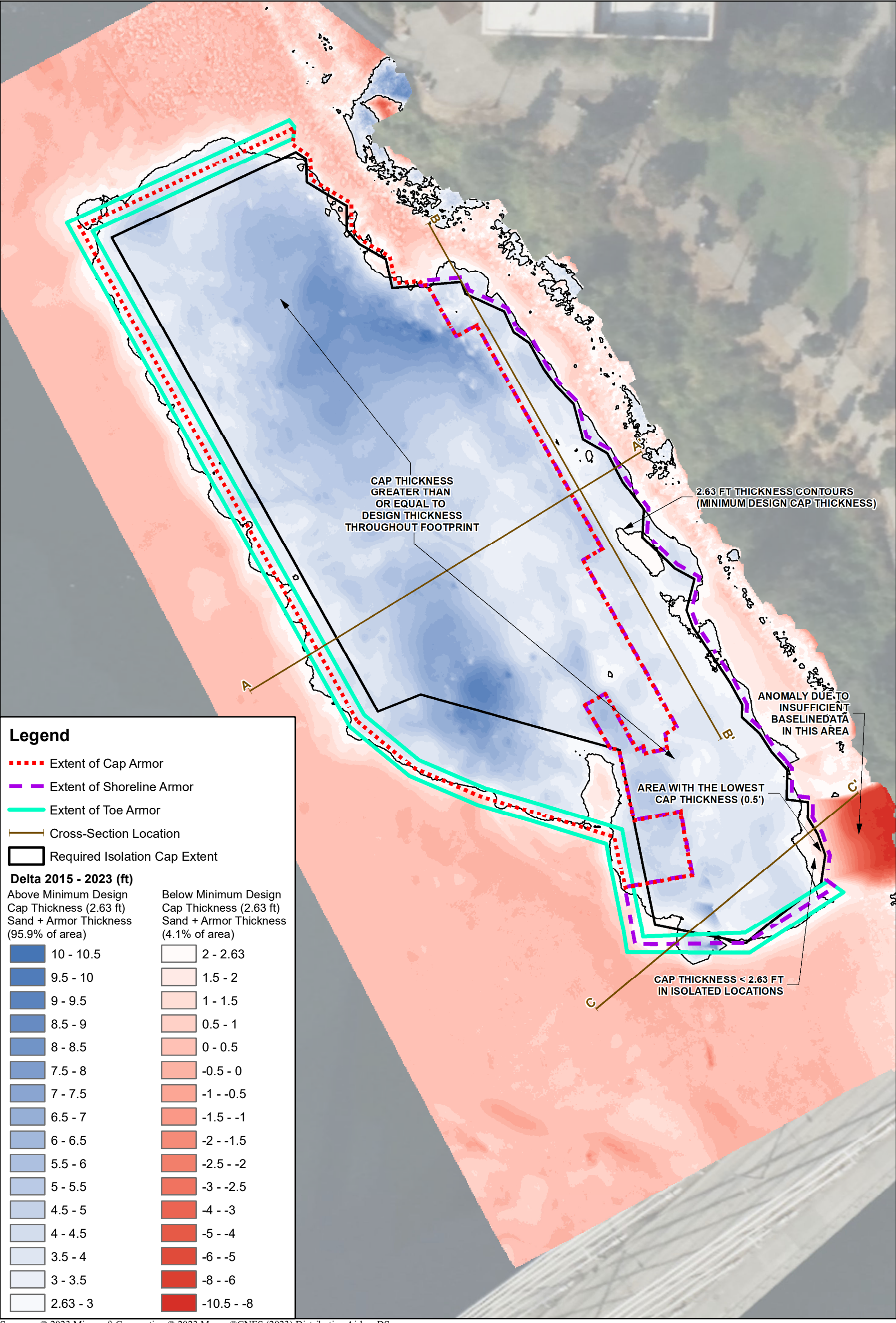


**FIGURE 7 - RM 13.5 CAP SECTION C - C'**

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RIVER MILE 13.5 STUDY AREA  
PORTLAND, OREGON





**Legend**

- - - Extent of Cap Armor
- - - Extent of Shoreline Armor
- - - Extent of Toe Armor
- - - Cross-Section Location
- Required Isolation Cap Extent

**Delta 2015 - 2023 (ft)**

<p>Above Minimum Design Cap Thickness (2.63 ft) Sand + Armor Thickness (95.9% of area)</p> <ul style="list-style-type: none"> <li><span style="background-color: #003366; width: 15px; height: 15px; display: inline-block;"></span> 10 - 10.5</li> <li><span style="background-color: #004080; width: 15px; height: 15px; display: inline-block;"></span> 9.5 - 10</li> <li><span style="background-color: #005499; width: 15px; height: 15px; display: inline-block;"></span> 9 - 9.5</li> <li><span style="background-color: #0066b3; width: 15px; height: 15px; display: inline-block;"></span> 8.5 - 9</li> <li><span style="background-color: #0077c4; width: 15px; height: 15px; display: inline-block;"></span> 8 - 8.5</li> <li><span style="background-color: #0088d5; width: 15px; height: 15px; display: inline-block;"></span> 7.5 - 8</li> <li><span style="background-color: #0099e6; width: 15px; height: 15px; display: inline-block;"></span> 7 - 7.5</li> <li><span style="background-color: #00a9f7; width: 15px; height: 15px; display: inline-block;"></span> 6.5 - 7</li> <li><span style="background-color: #00b9f8; width: 15px; height: 15px; display: inline-block;"></span> 6 - 6.5</li> <li><span style="background-color: #00c9f9; width: 15px; height: 15px; display: inline-block;"></span> 5.5 - 6</li> <li><span style="background-color: #00d9fa; width: 15px; height: 15px; display: inline-block;"></span> 5 - 5.5</li> <li><span style="background-color: #00e9fb; width: 15px; height: 15px; display: inline-block;"></span> 4.5 - 5</li> <li><span style="background-color: #00f9fc; width: 15px; height: 15px; display: inline-block;"></span> 4 - 4.5</li> <li><span style="background-color: #00f9fd; width: 15px; height: 15px; display: inline-block;"></span> 3.5 - 4</li> <li><span style="background-color: #00f9fd; width: 15px; height: 15px; display: inline-block;"></span> 3 - 3.5</li> <li><span style="background-color: #00f9fd; width: 15px; height: 15px; display: inline-block;"></span> 2.63 - 3</li> </ul>	<p>Below Minimum Design Cap Thickness (2.63 ft) Sand + Armor Thickness (4.1% of area)</p> <ul style="list-style-type: none"> <li><span style="background-color: #f0f0f0; width: 15px; height: 15px; display: inline-block;"></span> 2 - 2.63</li> <li><span style="background-color: #f8d7da; width: 15px; height: 15px; display: inline-block;"></span> 1.5 - 2</li> <li><span style="background-color: #f5c6cb; width: 15px; height: 15px; display: inline-block;"></span> 1 - 1.5</li> <li><span style="background-color: #f4cccc; width: 15px; height: 15px; display: inline-block;"></span> 0.5 - 1</li> <li><span style="background-color: #f4cccc; width: 15px; height: 15px; display: inline-block;"></span> 0 - 0.5</li> <li><span style="background-color: #f4cccc; width: 15px; height: 15px; display: inline-block;"></span> -0.5 - 0</li> <li><span style="background-color: #f4cccc; width: 15px; height: 15px; display: inline-block;"></span> -1 - -0.5</li> <li><span style="background-color: #f4cccc; width: 15px; height: 15px; display: inline-block;"></span> -1.5 - -1</li> <li><span style="background-color: #f4cccc; width: 15px; height: 15px; display: inline-block;"></span> -2 - -1.5</li> <li><span style="background-color: #f4cccc; width: 15px; height: 15px; display: inline-block;"></span> -2.5 - -2</li> <li><span style="background-color: #f4cccc; width: 15px; height: 15px; display: inline-block;"></span> -3 - -2.5</li> <li><span style="background-color: #f4cccc; width: 15px; height: 15px; display: inline-block;"></span> -4 - -3</li> <li><span style="background-color: #f4cccc; width: 15px; height: 15px; display: inline-block;"></span> -5 - -4</li> <li><span style="background-color: #f4cccc; width: 15px; height: 15px; display: inline-block;"></span> -6 - -5</li> <li><span style="background-color: #f4cccc; width: 15px; height: 15px; display: inline-block;"></span> -8 - -6</li> <li><span style="background-color: #f4cccc; width: 15px; height: 15px; display: inline-block;"></span> -10.5 - -8</li> </ul>
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Note: Data within the survey gap interpolated by surveyor.

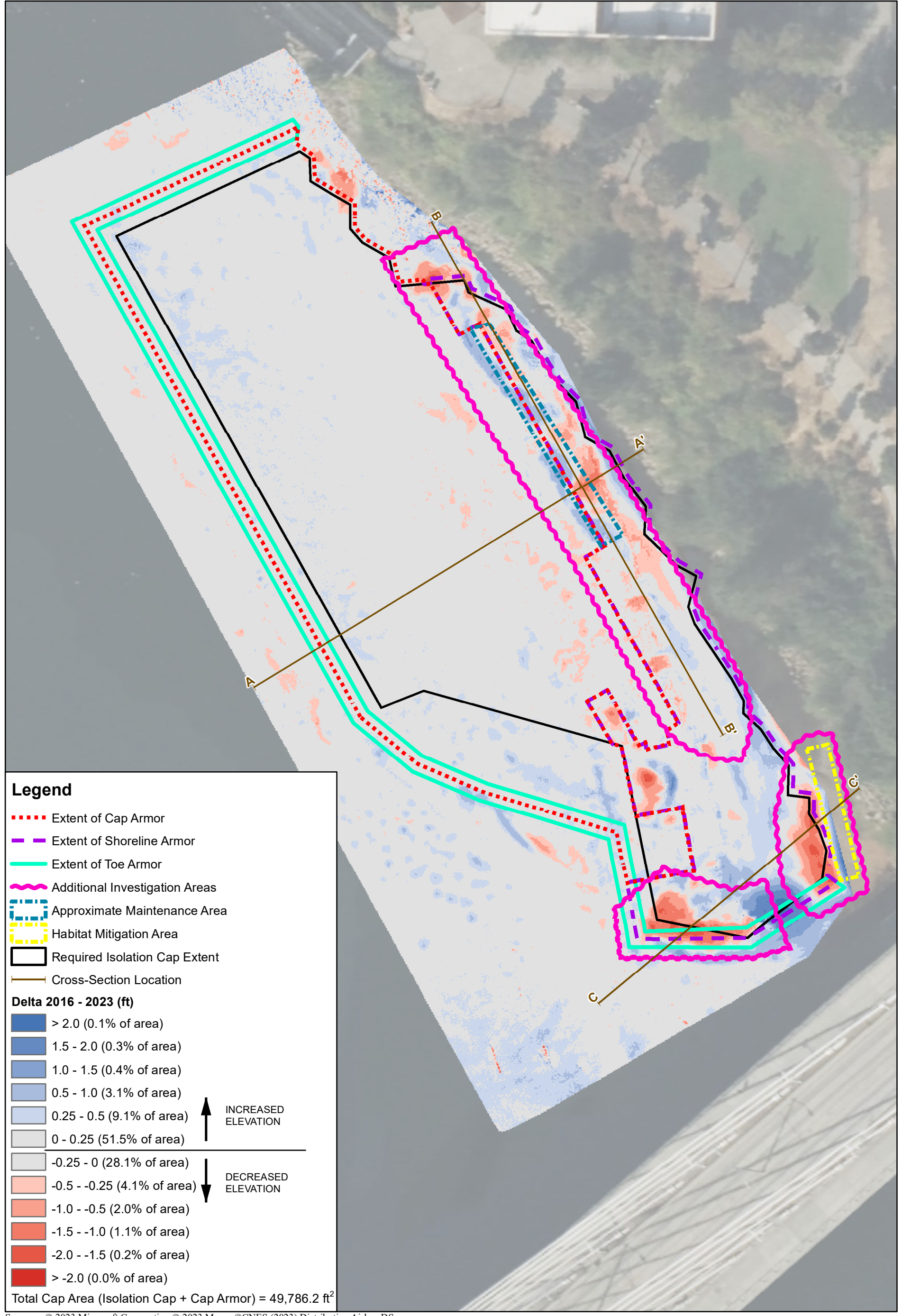
**FIGURE 8 - RM 13.5 2023 CAP THICKNESS ASSESSMENT**

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RIVER MILE 13.5 STUDY AREA  
PORTLAND, OREGON



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**FIGURE 9 - RM 13.5 ADDITIONAL INVESTIGATION AREAS**

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60659447

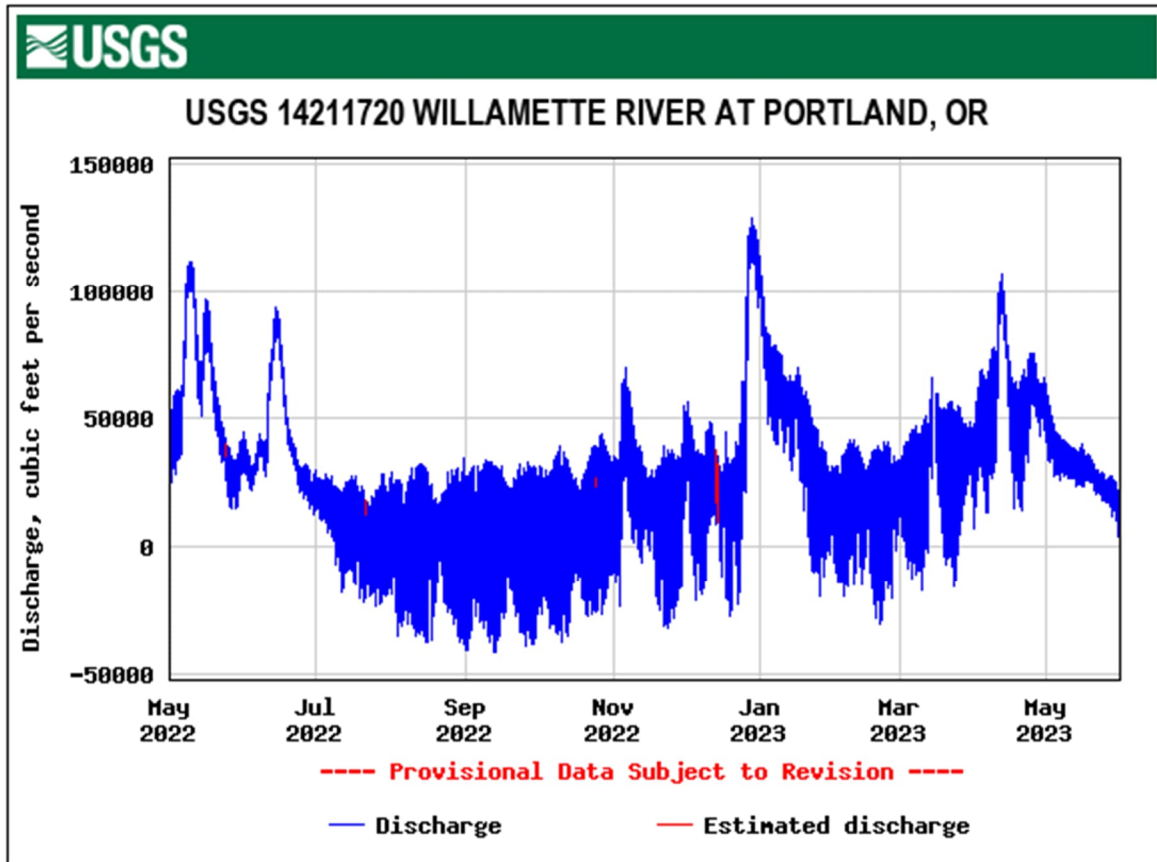
PORTLAND GENERAL ELECTRIC  
RIVER MILE 13.5 STUDY AREA  
PORTLAND, OREGON



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# Appendix A USGS Water Discharge (Mean)

Willamette River at Portland  
Oregon May 2022 to May 2023 Graph



A 100-year flood event in the lower Willamette River is defined as a discharge of 375,000 cubic feet per second (cfs) (URS 2014).

# **Appendix B River Mile (RM 13.5) Sediment Cap Visual Shoreline Inspection**

**Portland General Electric Company (PGE)  
River Mile (RM) 13.5 Sediment Cap Visual Shoreline Inspection  
Year 7 Cap Monitoring Survey  
Field Notes & Observations  
August 9, 2023**

**Portland General Electric Company**  
**River Mile (RM) 13.5 Sediment Cap Visual Shoreline Inspection**  
**Year 7 Cap Monitoring Survey**  
**Field Notes & Observations**

August 9, 2023

**Inspection performed by:** Brandy Domina  
Portland General Electric Company  
Environmental Specialist

**Others present:** Wesley Thomas, P.E.  
Oregon Department of Environmental Quality  
Project Manager/Environmental Engineer

**Field Conditions**

Date: August 9, 2023

Time: 1:26 pm

River Elevation: 1.54 ft (gauge datum) and 6.56 ft (NAVD88 datum) at USGS locations 14211720 at the Morrison Street Bridge.

Weather: Mostly Sunny & Muggy / 78°F

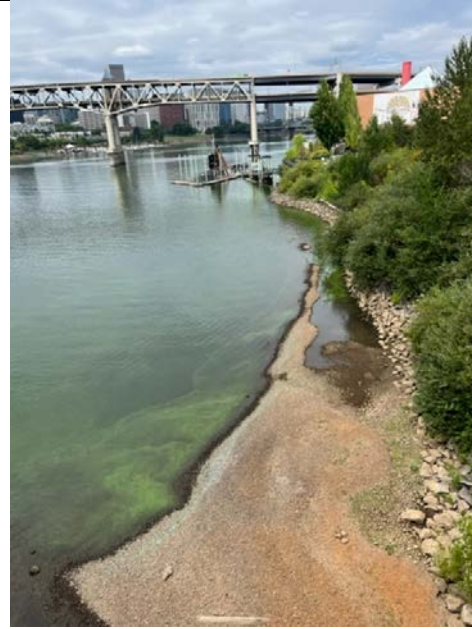
**General Field Notes**

- Began visual inspection south (downriver) from the RM 13.5 isolation cap looking north to the RM 13.5 from the Tilikum Crossing Bridge.
- Due to activity of unhoused people and accessibility issues in the area, was not comfortable walking down closer to the shoreline or into the bushes above the shoreline of the armor stone.
- There was no visible safe access to the shoreline. The inspection was completed mainly from the Tilikum Bridge and US Blueback/OMSI Dock.
- The riprap and some armor stone could be observed and looked in fair condition.
- Some pieces of woody debris were observed on south bank of the armor stone.
- The visual inspection was completed at 2:55 pm from the US Blueback/OMSI Dock looking from north to south at the RM 13.5 sediment cap location.

**Photo Log**



April 12, 2021



August 9, 2023

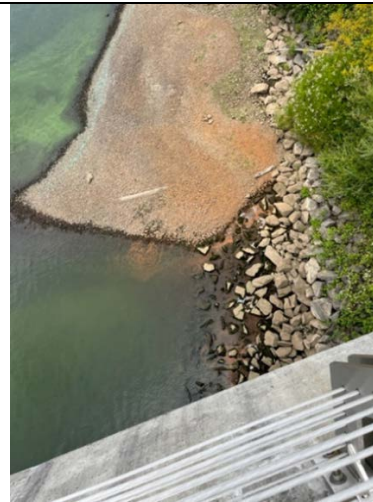
*View looking south to north of the RM 13.5 sediment cap shoreline from the Tilikum Crossing Bridge showing the visible armor stone, riprap and vegetation.*

*Some potential settlement of sand observed in the south portion of the Armor Stone on April 12, 2021.*

*Algae Bloom visible at the time of the visual inspection on August 9, 2023.*



April 12, 2021



August 9, 2023

*Closer (zoomed in) view of the RM 13.5 sediment cap area looking south to north from the walking path just north of Tilikum Crossing Bridge on April 12, 2023.*

*Another view of the Algae Bloom visible at the time of the visual inspection looking down from the Tilikum Crossing Bridge on August 9, 2023.*



April 12, 2021



August 9, 2023

*Observed camping activities by unhouse people along walking path during both inspections on April 12, 2021.*

*Photos taken from Springwater Trail above cap and riprap area due accessibility issues to the river level on August 9, 2023.*

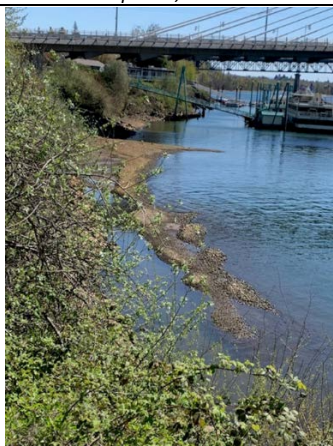


April 12, 2021



August 9, 2023

*Photos taken looking north to south at the RM 13.5 shoreline from the OMSI Submarine Dock.*



April 12, 2021



August 9, 2023

*Photo looking north to south at the RM 13.5 shoreline from top of OMSI Submarine dock entrance.*

## **Inspection, Monitoring and Maintenance Plant (IMMP) Monitoring Observations**

1. *General coverage of armor stone and areas of inconsistent cover (slumping, mounding, loss).*

Comments: The armor stone was visible and appeared to be in good condition and consistent with Year 5 observations from 2021. No sloughing or erosion was observed.

2. *Areas of newly deposited sediment within the interstitial spaces of the armor stone or on top.*

Comments: At the time of the visual inspection, the armor stone continued to appear to be in good condition and effectively meeting the requirements. No newly deposited sediment was observed.

3. *Any apparent loss of sediment cap material (stone armor or sand).*

Comments: At the time of the visual inspection, the armor stone continues to be in good condition and is consistent with the Year 5 visual inspection monitoring in 2021.

4. *Presence of significant debris that could undermine the physical integrity of the cap.*

Comments: Some woody debris was present at the south end of the cap along the water edge. No damage to the physical integrity of the cap was observed due to any significant river debris.

5. *Presence of vegetation.*

Comments: During the visual inspection of the shoreline, heavy vegetation along the riverbank and shoreline was observed. The vegetation was mainly consisted of blackberry bushes. No vegetation was observed on the cap.

6. *Visible signs or indicators of potential recontamination (i.e., sheen or staining) on the surface of the cap.*

Comments: No visible signs of recontamination were observed on the surface of the cap.

AECOM  
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Portland, OR 97204