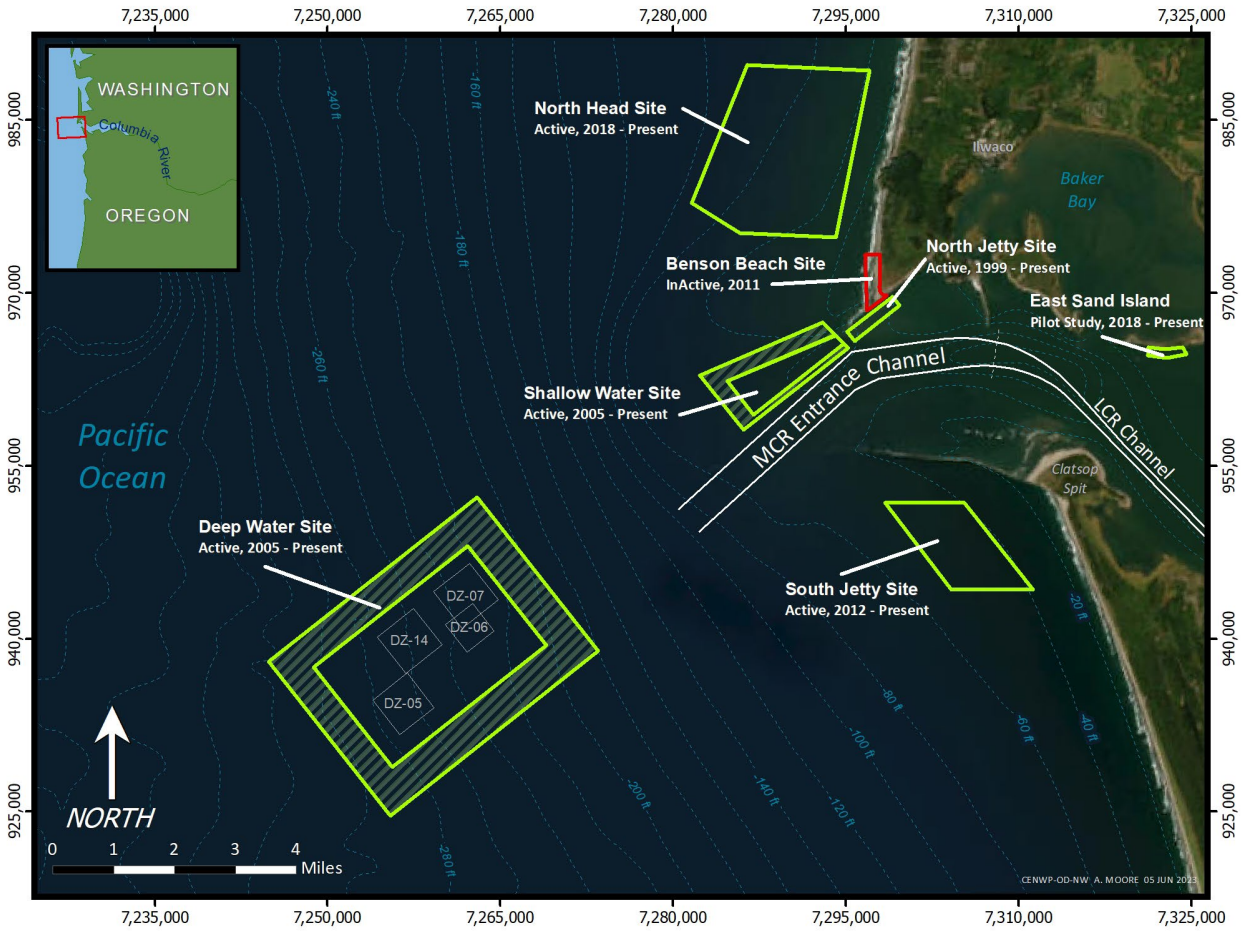
US Army Corps
of Engineers
Portland District

EPA
Region 10

2023 ANNUAL USE PLAN

Management of Open Water Dredged Material Placement/Disposal Sites
Mouth of the Columbia River, OR and WA



June 2023

EXECUTIVE SUMMARY

The Mouth of the Columbia River (MCR) federal entrance channel (River Mile [RM] -3 to RM +3) is the gateway to the Columbia-Snake River navigation system, which extends 470 river miles inland to Lewiston, ID. The U.S. Army Corps of Engineers – Portland District (CENWP) annually dredges around 3.5 million cubic yards (Mcy) of sand from the MCR. The MCR dredged material is placed in the Pacific Ocean at four nearshore sites and one offshore site that are jointly managed by CENWP and U.S. Environmental Protection Agency - Region 10 (EPA).

The year-to-year management of open water dredged material placement/disposal sites located at the MCR is controlled and documented through the preparation and adherence to an *Annual Use Plan (AUP)*. CENWP's preparation of the *AUP* and EPA's subsequent approval is a requirement of the final 2005 "Site Management/Monitoring Plan: Mouth of the Columbia River Shallow Water Site and Deep Water Site" (SMMP). The Shallow Water Site (SWS) and Deep Water Site (DWS) were designated by EPA under §102 of the Marine Protection, Research and Sanctuaries Act (MPRSA). These sites can accept dredged material from both the MCR and Lower Columbia River (LCR) federal navigation channels (FNC), or from projects permitted by CENWP's Regulatory Program. The North Jetty Site (NJS), South Jetty Site (SJS) and North Head Site (NHS) are nearshore beneficial use sites selected by CENWP under §404 of the Clean Water Act (CWA).

During the 2023 dredging season, CENWP anticipates placing approximately 3.5 Mcy in the network of MCR placement/disposal sites. Both the government and contract dredge will use a thin-layer placement strategy to distribute dredged material evenly within the nearshore sites. Work will be split between the government hopper dredge *Essayons* and the contract hopper dredge *Bayport* (operated by Manson Construction Co.). In the 2023 season the *Essayons* will dredge the Oregon side of the channel, while the *Bayport* will dredge the Washington side of the channel. This is due to the timing of renewal of the Oregon 401 Water Quality Certificate and the new turbidity conditions within the certificate. CENWP continues to work with Oregon Department of Environmental Quality (ODEQ) on requirements that provide adequate protection for the environment, but also give sufficient flexibility in the selection of a dredging approach (see Section 10.4 for details).

Based on CENWP's 2023 assessment, estimated quantities for the nearshore sites are as follows: the SWS will receive 1.845 Mcy plus a contract option for an additional 632,500 cy; the NJS will receive up to 150,000 cy; the SJS will receive up to 500,000 cy; and the NHS will receive up to 400,000 cy in the middle third (Zone 2) of the site. The DWS will be used as a foul weather backup site when safety, weather, or nearshore capacity make it necessary to transport dredged material offshore; all material transported to the DWS will be disposed in drop zone MCR-14-DWS. Since conception of the NHS, about 10% of material is placed each

year at DWS due to foul weather. Therefore, CENWP estimates 300,000 cy could be placed in MCR-14-DWS during the 2023 season. The *Essayons* will dredge approximately 1,400,000 cy and the *Bayport* will dredge approximately 1,495,000 cy plus the optional 632,500 cy, for a total of 2,127,500 cy.

All sediment placed within the MCR placement/disposal site network in 2023 will be dredged solely from the MCR FNC. No dredged material originating from the LCR FNC is expected to be placed within the sites during the 2023 dredging season. The initial Site Utilization Plans in this *AUP* were informed by the pre-placement 2023 surveys of the SWS, NJS, SJS, NHS and DWS.

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List of Acronyms and Abbreviations

404	Section 404 of the Clean Water Act
A	usable area in acres
ABMS	Argus Beach Monitoring System
AIS	Automated identification systems
ATV	all-terrain vehicle
AUP	Annual Use Plan
C&LW	Columbia & Lower Willamette
CDIP	Coastal Data Information Program
CENWP	U.S. Army Corps of Engineers - Portland District
CRD	Columbia River Datum
CRCI	Columbia River Channel Improvement project
CWA	Clean Water Act
cy	cubic yards
cy/yr	cubic yards per year
DWS	Deep Water Site
DZ	Drop Zone
EA	Environmental Assessment
Ecology	Washington Department of Ecology
ENC-HD	Engineering & Construction Division - Hydraulic and Coastal Design Section
ENC-CV	Engineering & Construction Division - Vancouver Resident Office
ESI	East Sand Island
FSM	Frequency for Site Monitoring
FONSI	Finding of No Significant Impact
ft	feet
GNSS	global navigation satellite system
H	Target Height of vertical accumulation in feet
kcy	Thousand cubic yards
LCR	Lower Columbia River
LDR	Littoral Drift Restoration
MCR	Mouth of the Columbia River
Mcy	Million cubic yards
MLLW	Mean Lower Low Water
m	meters
mm	millimeters

MPRSA	Marine Protection, Research and Sanctuary Act
NHS	North Head Site
NHSA	North Head Study Area
NJB	North Jetty Berm
NJS	North Jetty Site
NMFS	National Marine Fisheries Service
O&M	Operations and Maintenance
OD-NW	Operations Division, Channels and Harbors Project, Waterways Maintenance Section
ODEQ	Oregon Department of Environmental Quality
ODMDS	Ocean Dredged Material Disposal Sites
OSU	Oregon State University
RM	River Mile
RSM	Regional Sediment Management
SJS	South Jetty Site
SMMP	Sediment Management/Monitoring Plan
SWS	Shallow Water Site
UAS	Unmanned Aerial Systems
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
V'	Volumetric rate at which dredged material is being placed in cy per day
WQC	Water Quality Certificatation

2023 Annual Use Plan
Management of Open Water Dredged Material Placement/Disposal Sites
Mouth of the Columbia River, OR and WA

1 Introduction

The U.S. Army Corps of Engineers – Portland District's (CENWP) initiated development and implementation of a Regional Sediment Management (RSM) Program in 1999 with the objective of optimizing utilization of sediments and management of the Federal Navigation Channel (FNC). CENWP has since collaborated with resource agencies and stakeholders with the goal of managing dredged material from the Mouth of the Columbia River (MCR) FNC. The year-to-year management of open water dredged material placement/disposal sites located at the MCR is controlled and documented through the preparation and adherence to the *MCR Annual Use Plan (AUP)*. The CENWP's preparation of the *AUP* for the U.S. Environmental Protection Agency – Region 10 (EPA) review and concurrence is an annual requirement of the final 2005 "Site Management/ Monitoring Plan: Mouth of the Columbia River Shallow Water Site and Deep Water Site" (SMMP). Once CENWP receives EPA's concurrence, the AUP will be used to direct dredging and dredged material placement/disposal activities for the year.

The primary objectives of the AUP are to:

(1) Describe the dredging and placement/disposal, monitoring, and special studies performed in the last year.
(2) Describe how each available MCR dredged material placement/disposal site will be used and monitored for a given year.
(3) Provide a decision framework that allows CENWP to adaptively manage MCR dredging operations and dredged material placement/disposal across the MCR network of sites on a day-to-day basis.
(4) Define criteria under which monitoring and daily operational data are used to identify potential future problems and proactively develop solutions to avoid them.
(5) Identify any necessary coordination requirements.
(6) Present an initial Site Utilization Plan for each placement site, which will guide placement activities. As conditions change, new Site Utilization Plans will be designed throughout the 2023 dredging season.
(7) Describe special studies undertaken as necessary to address specific questions or issues that are not covered by routine monitoring.

This document is the *2023 AUP* for utilizing the EPA-designated §102 Marine Protection, Research and Sanctuary Act (MPRSA) Ocean Dredged Material Disposal Sites (ODMDS) and active §404 Clean Water Act (CWA) sites (404 sites) located at the MCR. This *2023 AUP* covers dredging and dredged material placement for the 2023 season only. Planned dredging is informed by monitoring from the 2022 season, 2023 pre-dredge hydrographic surveys (typically conducted in the spring), and hopper dredge operating parameters to evaluate the performance of the 2022 season and prepare for the 2023 season.

2 BACKGROUND

2.1 MCR DREDGING

Each year, the CENWP dredges 3 to 5 million cubic yards (Mcy) of sediment at MCR to maintain the inlet's 6-mile-long, deep-draft navigation entrance channel. Most of the dredging occurs within two primary shoal areas: between River Mile (RM) –2 and RM –1, and between RM 0 and RM 2 (shown in Figure 2-1). As noted in Figure 2-1, the Quadrants have different authorized depths. Quadrants 1 and 3 are authorized to a depth of 55 feet, while Quadrants 2 and 4 are authorized to a depth of 48 feet. The MCR dredged material is predominantly clean quartz sand with particle diameters from 0.15 to 0.25 millimeters (mm) (fine-sand-size class on the Wentworth scale) with generally less than 3% fine-grained material (particle diameters less than 0.0625 mm, passing a #230-mesh sieve). Figure 2-2 shows the location of surface sand samples collected in the MCR entrance channel.

Due to the exposed, high-energy ocean conditions at MCR, only ocean-going hopper dredges can safely perform the required dredging and placement activities. In addition, MCR dredging is typically limited each year to the months of June through October when wave conditions are more favorable for working safely at the offshore bar. Two hopper dredges are normally used to perform the maintenance dredging at MCR: a government-operated dredge and a contractor-operated dredge, each with different capacities and operating characteristics. Refer to Appendix A for additional information describing the federal navigation project and hopper dredge operating characteristics.

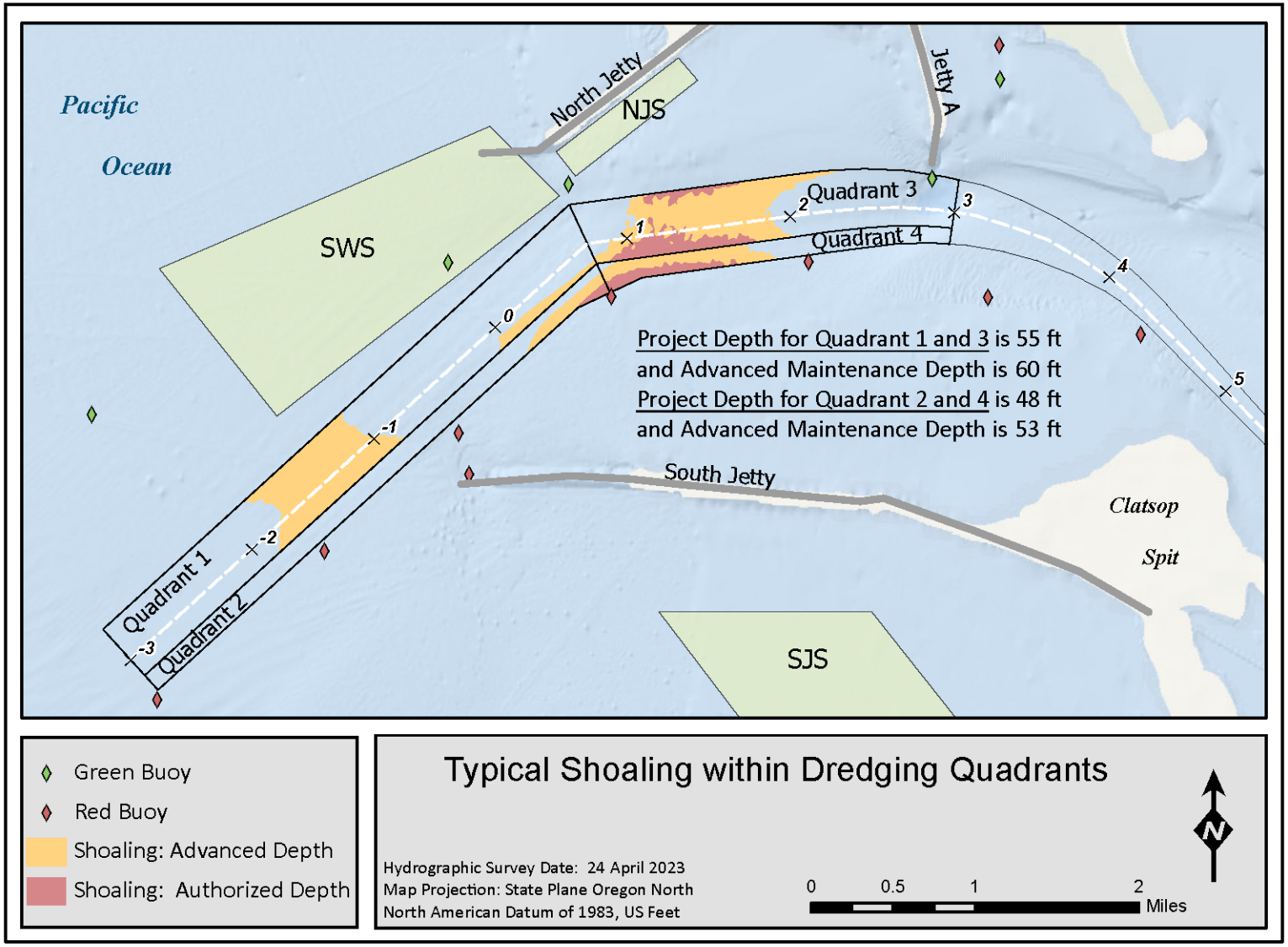

Figure 2-1. Typical Shoal Areas within the Four Dredging Quadrants of the MCR Entrance Channel between River Mile -3 and River Mile 5.

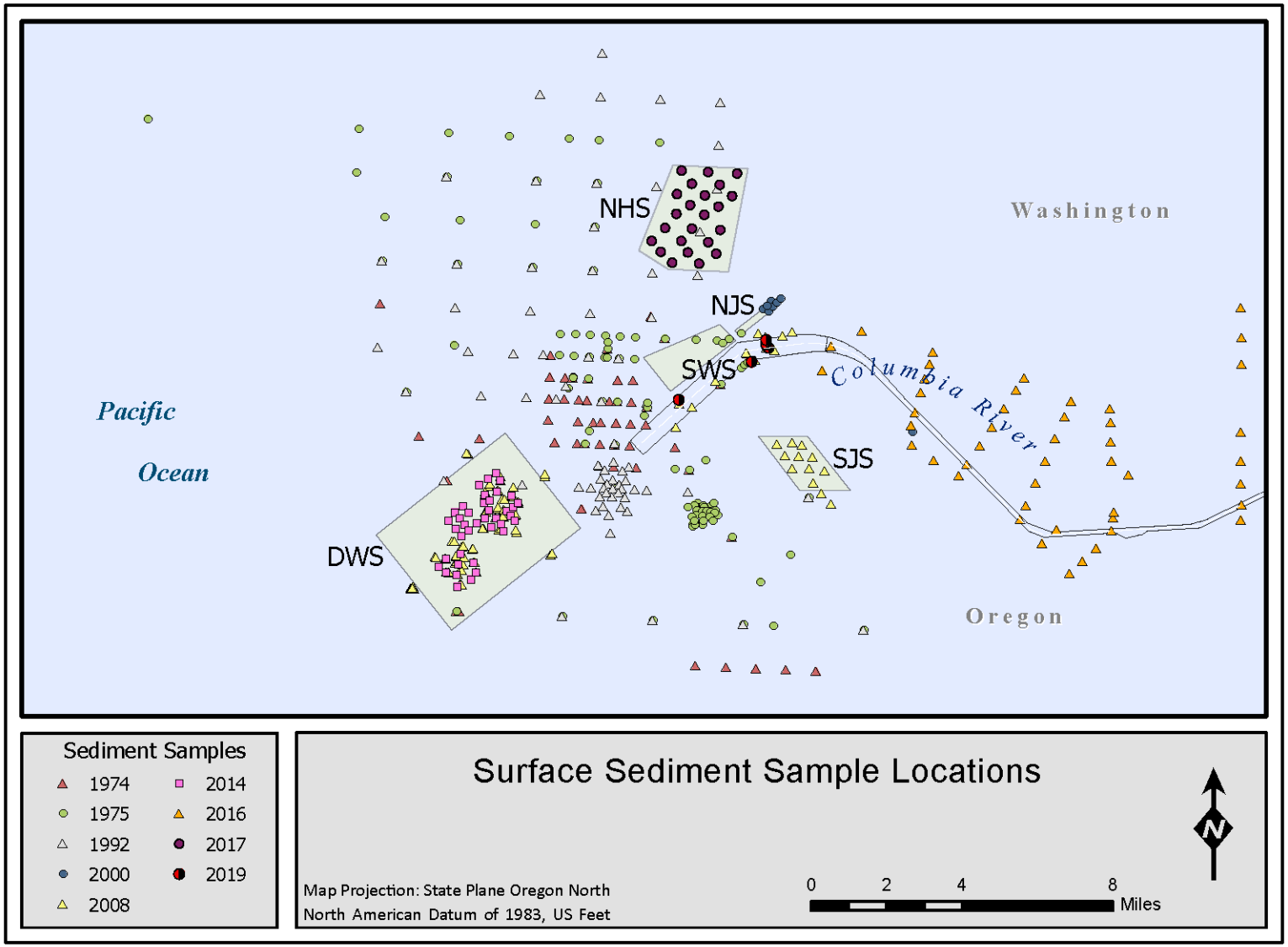

Figure 2-2. Surface Sediment Sample Locations at MCR Entrance Channel.

2.2 MCR ODMDSs and 404 Sites: Physical Description and Purpose

Dredged material placement/disposal sites actively used at MCR include the Shallow Water Site (SWS), the North Jetty Site (NJS), the South Jetty Site (SJS), the North Head Site (NHS) and the Deep Water Site (DWS), shown in Figure 2-3. The SWS and DWS are ODMDSs designated by EPA under §102 MPRSA and they can be used for the disposal of material dredged from any project within the vicinity of the MCR that meets the ocean dumping criteria. The NJS, SJS, and NHS are 404 sites that are limited to placement of dredged material from the MCR.

The CENWP has strived to develop a nearshore network of dredged material placement/disposal sites at MCR to maintain sediment within the active littoral system. Placement in these nearshore sites takes priority over sites located in deeper water outside of the active littoral system. The offshore DWS is only used when conditions at the nearshore sites do not allow for safe navigation of the dredge, or as an opportunity to "rest" the nearshore sites to allow material to disperse through natural processes.

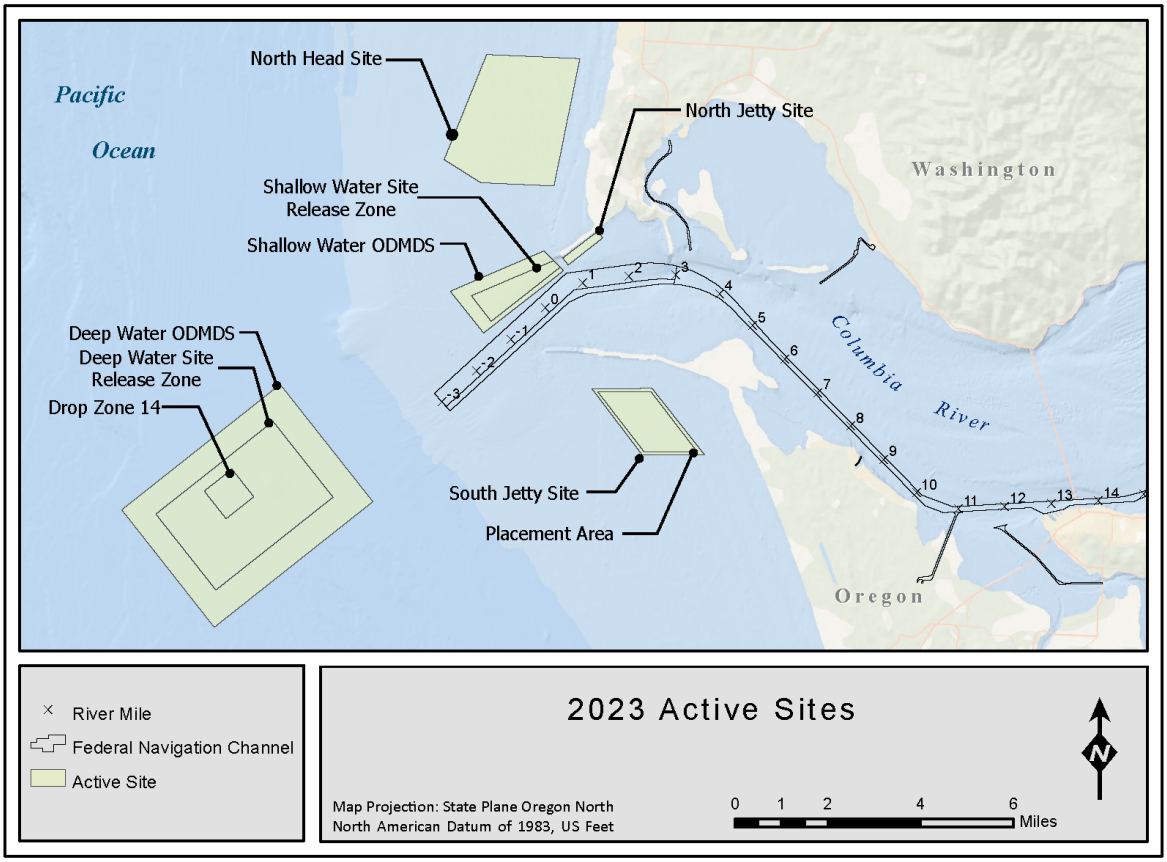

Figure 2-3. MCR Entrance Channel and Active Sites for 2023.

The sites currently in active use have evolved from a legacy of historical placement/disposal sites (Figure 2-4), and the management of dredged material placement at the MCR is

continually evolving. Following the pilot placements in the North Head Study Area (NHSA) in September 2018, September 2019, and September 2020, CENWP has made the entire NHSA an operational placement site, referred to as the NHS, since the 2021 placement season (see Section 7.9). The NHS is located north of the inlet and will provide broader coverage to restore/maintain littoral sediment supply. Informed by the 2018-2020 pilot placements and operational use beginning in 2021, CENWP is planning to place up to 400,000 cy of MCR dredged material in the middle third (Zone 2) of the NHS during 2023.

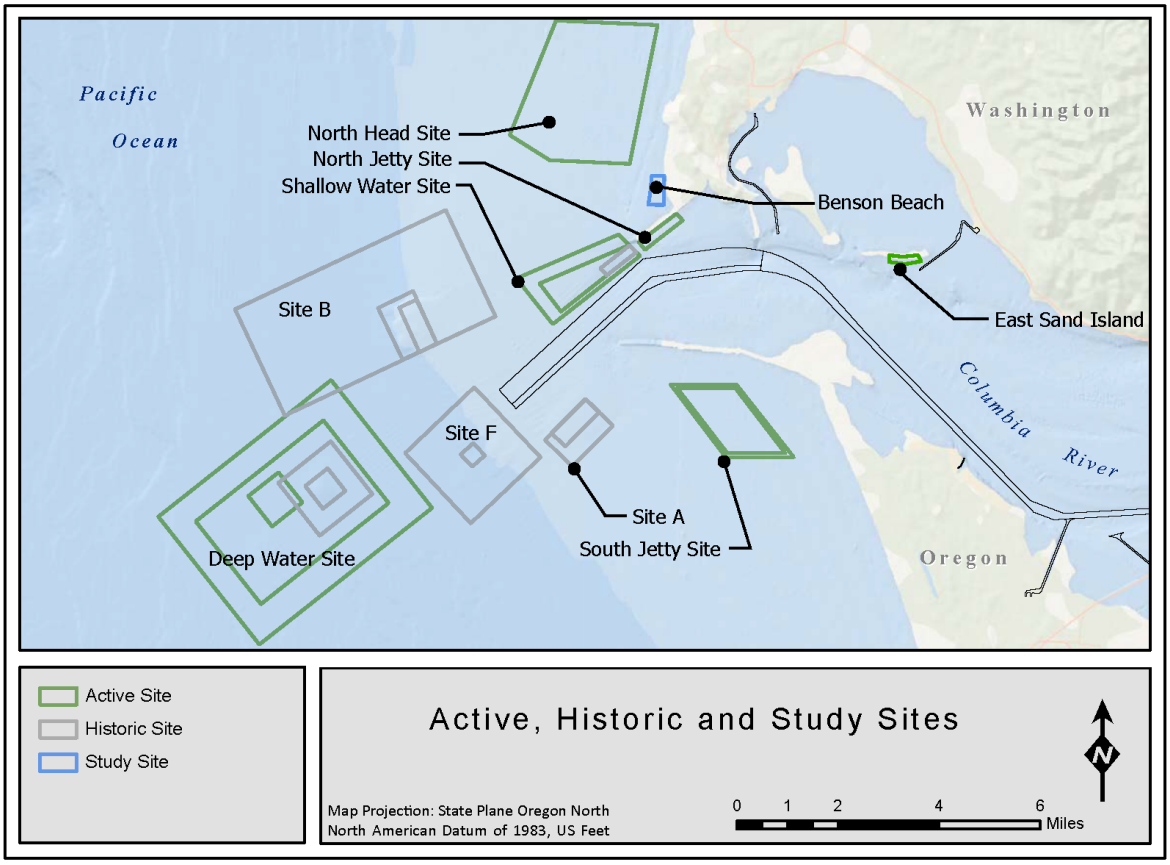

Figure 2-4. Historic, active, and potential placement/disposal sites.

East Sand Island (ESI) is a shoreline site that was first utilized during the 2018 dredging season (Figure 2-4). Approximately 82,000 cy of material was placed at this site to prevent the island from breaching through a narrow segment on its eastern end. More information on material placement can be found in the *2019 AUP*. The site is monitored approximately every six months with aerial and land-based photography to track material dispersion. No placement is planned at ESI for the 2023 season; however, placement may occur in 2026 or 2027 following the repair of the MCR Sand Island Pile Dikes and depending on how quickly material is transported off the beach over the next couple years. Material would be sourced from either the MCR or the Lower Columbia River (LCR).

2.2.1 SITE TERMINOLOGY

Terminology for the EPA designated disposal sites and the 404 placement sites differs slightly. Figure 2-3 depicts placement area/release zone, drop zone and buffer for the active sites. Note that not all these elements apply to all sites.

The extent of sea bottom that will be occupied by placed dredged material released at the water surface is referred to as a *placement area* within the *placement site* for the 404 Sites (NJS, SJS, NHS) and a *release zone* within the *ODMDS* for the EPA designated §102 sites (SWS, DWS). All the EPA designated sites and most of the 404 sites also have *a buffer*, which is the area of the sea bottom between the defined limit of the placement area/release zone and the placement/disposal site. Direct disposal into the buffer is prohibited. The last site element needing definition only applies currently to the DWS. A *drop zone* is a defined area at the water surface within the release zone and within which the release of dredged material may occur. A drop zone may be further subdivided into "cells" for more specific placement control.

Consult the SMMP for additional information [USEPA and CENWP 2005].

2.2.2 SHALLOW WATER SITE (SWS)

The SWS was designated by the EPA under §102 of the MPRSA in 2005. The entire SWS occupies a trapezoidal area of 3,100 feet to 5,600 feet wide by 11,500 feet long and lies off the tip of the North Jetty, north of the MCR Federal Navigation Channel (FNC), in water depths ranging from 45 feet to 75 feet. The SWS release zone is 1,054 feet to 3,600 feet wide by 10,000 feet long.

Although the site is an EPA-designated §102 site, it functions as a nearshore site. The SWS is of strategic importance to the surrounding coastal system because its continual use supplies Peacock Spit (north of the North Jetty) with much needed sediment. Since 1997, the SWS has been the principal site for MCR dredged material placement with ~57% of all MCR dredged material being placed within the SWS; approximately 91% of this material is dispersed by waves and currents, in a north-northwesterly direction onto Peacock Spit (Figure 2-5). Based on the SWS tracer study (completed in 2007, see Section 13.5), it is believed that less than 10% of the dredged material placed at the SWS has been transported southward into the MCR FNC. Figure 2-5 shows the bathymetry change (from 1958 and 2016 surveys) for the nearshore region at Peacock Spit including the adjacent SWS and MCR channel (green contours indicate erosion and red contours indicate deposition). If the SWS had not been used as a dredged material disposal site, then much more sediment would have been lost at Peacock Spit than is presently the case.

The MCR North Jetty Rehabilitation was completed in 2019. The combination of the fully functional North Jetty and the sediment supply from the SWS will help supply the Cape Disappointment area with sediment.

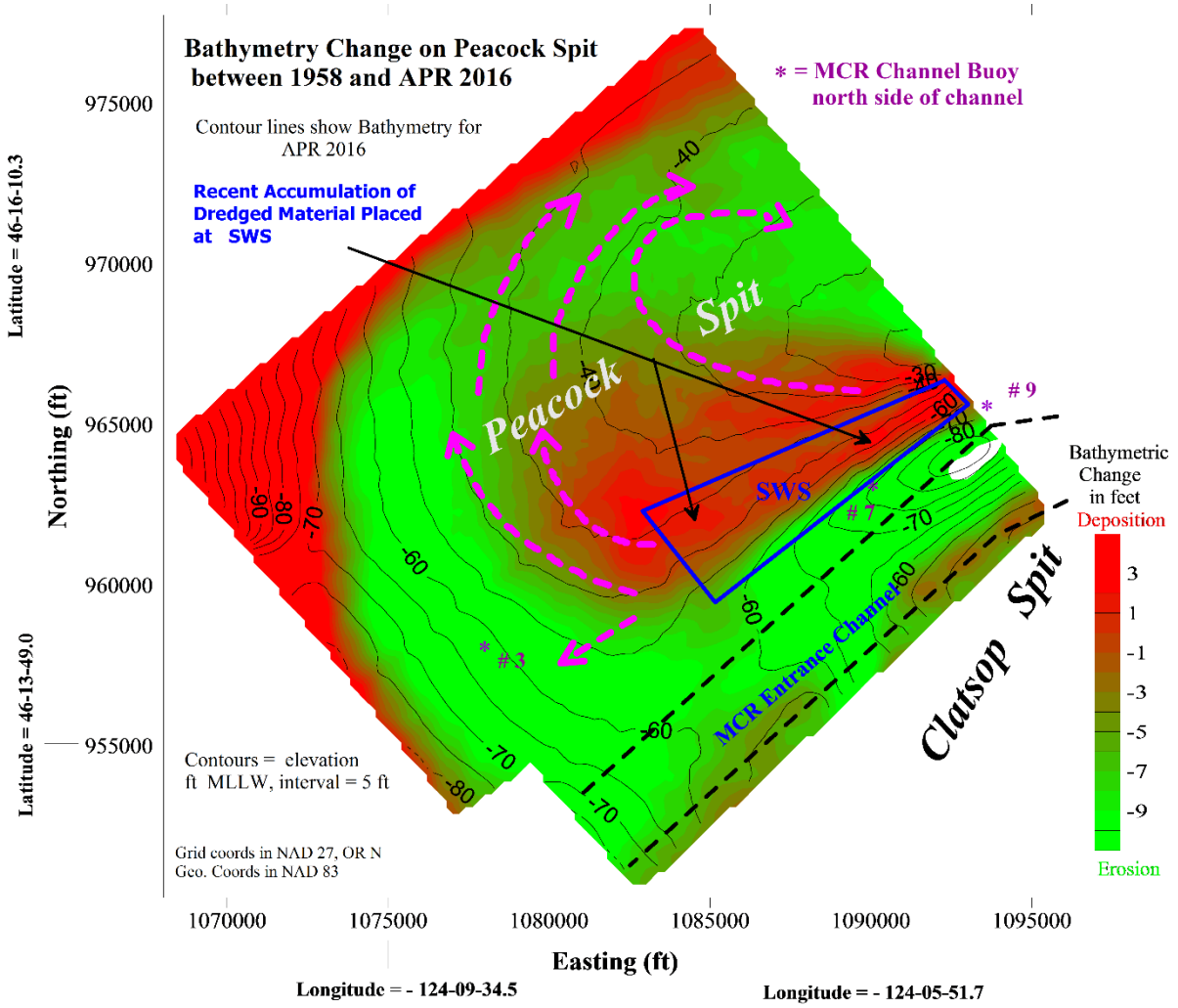

Figure 2-5. Bathymetry Change at Peacock Spit and MCR Shallow Water Site – sediment gained (red) or lost (green) between 1958 and 2016.

2.2.3 Deep Water Site (DWS)

The DWS was designated by the EPA under §102 of the MPRSA in 2005. The entire DWS occupies an area of 17,000 feet by 23,000 feet and lies 6 miles offshore from MCR in a water depth of 190 feet to 300 feet. The DWS has a defined release zone, which is inscribed within the overall site boundary by a 3,000 feet buffer, separating the DWS boundary from the DWS release zone. The DWS release zone is 11,000 feet by 17,000 feet. The DWS was designed to provide sufficient capacity for the disposal of dredged material to meet current and anticipated future ocean disposal needs at the MCR. Disposal of dredged material within the DWS is limited to specific "drop zones", which are inscribed within the DWS release zone and

redefined periodically once their intended capacity has been met. The goal is to confine the areal dispersal of dredged material placed within the "drop zone" of the DWS without promoting excessive mounding of disposed dredged material, while also reducing the areal extent of dredged material deposition. Use of the DWS occurs ONLY when the nearshore sites have been used to the maximum extent practicable or when inclement weather conditions or operational constraints temporarily preclude the safe use of the other sites.

Figure 2-6 shows four DWS drop zones (CR-05-DWS, MCR-06-DWS, MCR-07-DWS, and MCR-14-DWS). The CR-05-DWS was established in 2005 and utilized through 2009 for the disposal of dredged material from the Columbia River Channel Improvement Project (CRCI). The MCR-06-DWS was established in 2004 and used through 2006 for the disposal of dredged material from the MCR during the CRCI. The MCR-07-DWS was established in 2007 and used through 2015 for the disposal of dredged material from the MCR. The MCR-14-DWS drop zone was first used in 2014. Drop zone MCR-14-DWS is 4,000 feet by 4,000 feet, in water depth 240 to 260 feet. The capacity of MCR-14 is estimated to be 13 Mcy (for 30 feet deposition) to 17 Mcy (for 40 feet deposition). For more information on the analysis of this drop zone see the reference Moritz, H.R., (2014).

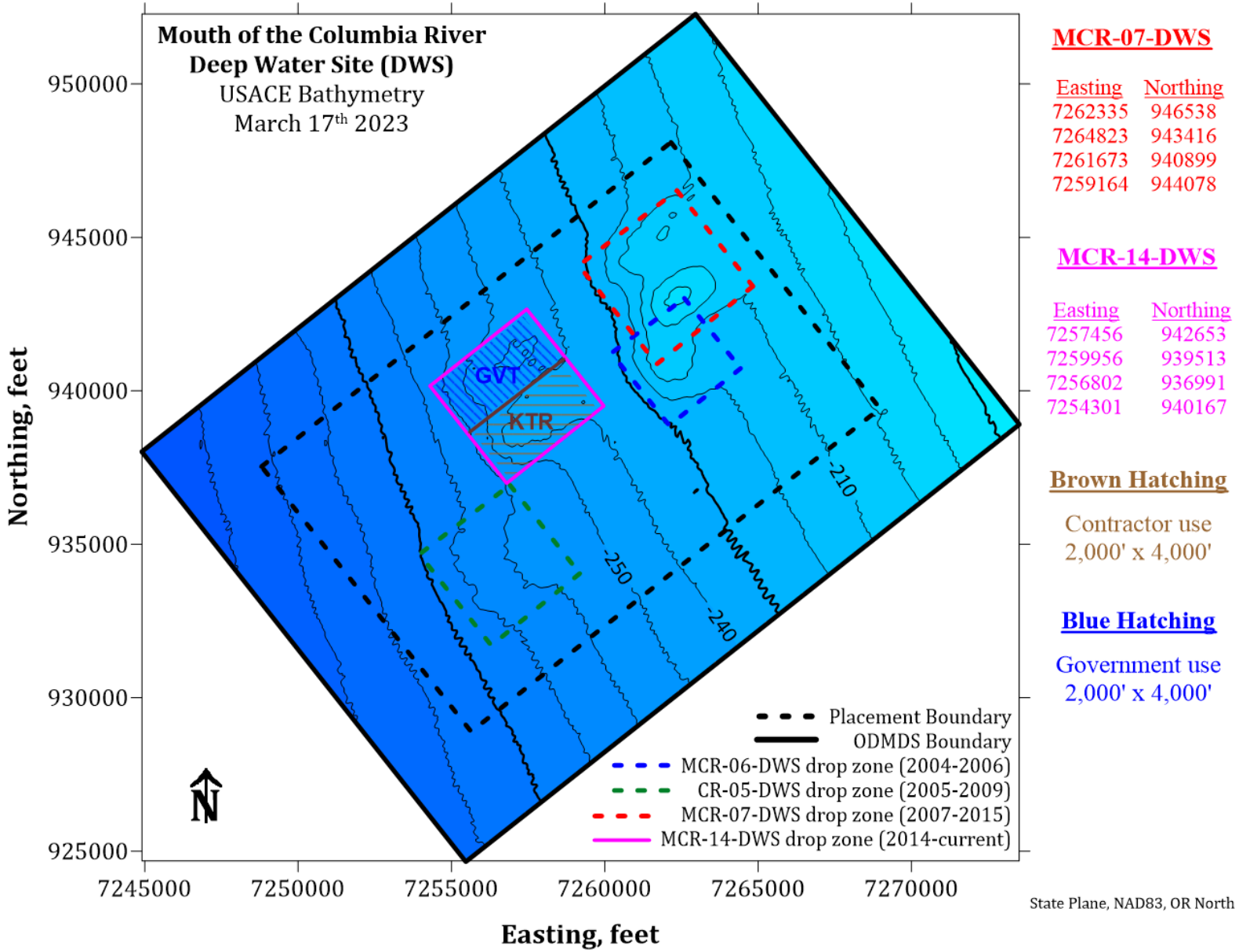

Figure 2-6. MCR Deep Water Site (DWS) Drop Zones Overview.

2.2.4 NORTH JETTY SITE (NJS)

Under their §404 CWA authority, CENWP selected the NJS in 1999. The NJS is located approximately 200 feet south of the MCR North Jetty and is located north of the MCR FNC; it occupies an area of 1,000 feet by 5,000 feet. The NJS is divided into 40 placement cells measuring 250 feet by 500 feet. The range in water depth within the NJS is -38 feet to -60 feet Mean Lower Low Water (MLLW). The NJS is not circumscribed by a buffer.

The NJS was selected for the purpose of allowing the placement of MCR dredged material along the toe of the North Jetty. This site is a nearshore site to the north of MCR channel. The NJS increases the littoral sediment budget, in conjunction with the SWS. Placing dredged material at the NJS protects the toe of the North Jetty by reducing excessive wave-induced and current-induced scour that would otherwise occur.

2.2.5 SOUTH JETTY SITE (SJS)

Under their §404 CWA authority, CENWP selected the SJS in 2012. The areal extent of the SJS is approximately 9,500 feet by 7,000 feet and the site is located 1 mile south of the MCR inlet, as shown in Figure 2-3, in water depths of 40 to 53 feet. The SJS placement area is located 500 feet inside the SJS boundaries on all four sides providing dimensions of 8,500 feet by 6,000 feet. The placement area is subdivided by placement cells with dimensions 570 feet by 605 feet. The government hopper dredge *Essayons* is the only dredge currently cleared to operate at the SJS.

The 2016 season was the first time the entire SJS placement area was put into operational use. Prior to the 2016 season, placement of material was restricted as part of a plan to research and understand the new site. Long-term use of the SJS is intended to address a chronic coastal sediment deficit while minimizing impacts to the site's benthic ecology. The 2012 environmental clearances (CWA 404) and operational use plan for the SJS were the result of active collaboration with regional stakeholders during 2003-2012, based on the need to implement Regional Sediment Management at the MCR inlet. Use of the SJS is intended to provide sand needed to mitigate a trend of gradual and continuous erosion and supplement the sediment budget in the nearshore area adjacent to the South Jetty and Clatsop Plains.

2.2.6 NORTH HEAD SITE (NHS)

The North Head Study Area (now known as the NHS) was identified by the USACE and partners within the Lower Columbia Solutions Group to conduct a pilot study for dredged material thin-layer placement. CENWP received a Water Quality Certification on February 8, 2018, for maintenance dredging of the MCR, including proposed placement of material at the NHS. CENWP subsequently completed an Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) on August 6, 2018, for the addition of two sites to its network of long-term dredged material placement sites – the NHS and shoreline placement at ESI. The pilot study for NHS was conducted from 2018 to 2020. Based on favorable study results and collaborative engagement with resource agencies and stakeholders during the pilot study, it was determined that the site was suitable for long-term operational use, which commenced in 2021. CENWP selected the NHS under their §404 CWA authority and use of the NHS will be ongoing into the future. The NHS was included in the most recent Water Quality Certification by the State of Washington, issued on February 9, 2023.

The NHS is an irregular pentagon; the areal extent of the NHS is approximately 14,750 feet in length by a varying width of 8,450 feet to 10,500 feet (with a maximum width of 13,000 feet) and the site is located offshore of the North Head, near Long Beach, Washington, as shown in Figure 2-3, in water depths of 40 to 55 feet. The NHS placement area is located 500 feet inside of the formal NHS boundaries. The "buffer" surrounding the active placement area is intended to ensure containment of dredged material placement direct effect within the NHS. The placement area of the NHS has been partitioned into a system of cells (total of 496 cells at 540 by 550 feet each) providing dimensions of 13,750 feet in length by a varying width of 7,850 feet to 9,500 feet (with a maximum width of 12,000 feet) and is divided into 3 zones. The government hopper dredge *Essayons* is the only dredge currently cleared to operate at the NHS. The purpose of using the NHS for dredged material placement is to beneficially re-purpose sand dredged from the MCR FNC, that would have otherwise been placed within the DWS, to supplement the littoral sediment budget along nearshore areas north of the MCR. More information on the 2018-2020 pilot study can be found in the *2021 AUP*.

3 SITE MANAGEMENT STRATEGIES AT MCR

Site management strategies have been designed to fully utilize each available site while achieving the five following objectives, as stated in the SMMP: (1) control mounding, (2) minimize impacts to marine resources to the extent practicable, (3) minimize interference with other uses of the ocean, (4) beneficially use dredged material when practical, and (5) safe and efficient dredge operations. These general site management objectives apply to all the sites; however, owing to the different characteristics of each site, the specific management requirement to meet those objectives will be different. This section reviews

the governing site management strategies that are used to guide the development of each year's plan. See Appendix B and the SMMP for a more detailed discussion on methods.

3.1 NEARSHORE VERSUS DEEP WATER

Nearshore sites are managed as dispersive sites to encourage the maximum amount of material to enter the active littoral zone. The DWS is managed as a non-dispersive, depositional site; the significant portion of the material disposed in the site will not be transported outside the site boundaries and cannot be further managed (i.e., removed or relocated) once disposed.

3.2 NO EXCESSIVE WAVE AMPLIFICATION

The principal site management constraint for MCR is to avoid mounding of dredged material that could potentially result in excessive wave amplification. Management of dredged material sites at MCR is predicated on the need to efficiently utilize the site's capacity while meeting statutory requirements and minimizing impacts to navigation and the environment. Site capacity is defined by the volume of dredged material that can accumulate within a site's boundaries without producing unacceptable impacts to navigation or to the surrounding area (e.g., the jetties or nearby beaches). The potential for dredged material accumulation to have an adverse effect upon waves (mound-induced wave amplification) is an important site management consideration at MCR [USEPA 2005, USACE 2003 & 2005, and USACE/USEPA 2003 & 2005].

3.3 BENEFICIAL USE

The material dredged from the MCR is considered a valuable resource for the active littoral system in the area. The beneficial uses of dredged material placed at nearshore sites make utilization of these sites preferable to disposal at the DWS where the sediment is lost to the active littoral system [USEPA 2005, and USACE/USEPA 1999, 2003, and 2005]. At the MCR, the nearshore sites (currently: SWS, NJS, NHS, and SJS) are utilized to the fullest extent possible to minimize disposal at the DWS. However, due to safety restrictions (which limit nearshore site access to one dredge at a time, and under certain weather conditions) it is sometimes necessary to use the DWS before capacity of the nearshore sites is fully utilized. Limiting the use of the nearshore sites to one dredge at a time is important because it reduces the likelihood of mounding and overloading the site's capacity to disperse placed dredged material.

3.4 SJS AND BENTHIC FAUNA

Capacity restrictions for utilizing the SJS are based on the need to limit the disturbance of benthic infauna and epifauna, which is a more restrictive condition (for dredged material accumulation) than mounding limits associated with potential wave amplification. The

vertical limits for dredged material accumulation within the SJS vary between 0.25 foot (per placement event) and 1 foot (for the entire placement season). To successfully manage the SJS throughout the dredging season, the capacity of the site must be frequently assessed, and the site adaptively managed to stay within capacity limits.

4 IMPLEMENTATION OF SITE MANAGEMENT STRATEGIES AT ACTIVE SITES

The actions implemented to achieve the site management strategies outlined in Section 3 are discussed in this section.

4.1 NEARSHORE SITES

To promote even and controlled deposition of dredged material placed within the nearshore sites (i.e., SWS, NJS, SJS and NHS), each site has been partitioned into a system of grid cells (SWS: 83 cells, each measuring ~500 by 500 feet; NJS: 40 cells, each measuring ~250 by 500 feet; SJS: 150 cells, each measuring ~500 by 600 feet; NHS: 496 cells, each measuring ~540 by 550 feet). These grid cells are used to assign the number of times a loaded hopper dredge can initiate release of its load within a particular cell. These assignments are communicated via the Site Utilization Plan that includes a figure of the gridded site and operational instructions, further discussed in Section 5.

The cell assignments (dumps per cell) of a Site Utilization Plan are based on assessments of site capacity and target mound heights (elevations) for dredged material accumulation within a site. Target capacity for a given site is defined by the target mound height and area over which dredged material can accumulate with respect to a baseline condition. When reached, the target capacity for a given site defines a management condition for which an intermediate review action (decision point) occurs. At this point, the potential cumulative effects of additional site utilization are assessed in conjunction with other physical processes. Use of an active placement area/release zone may be discontinued upon reaching the specified target capacity. The target capacity is based on the need to manage dredged material accumulation such that mounded dredged material does not excessively amplify waves due to shoaling and refraction. The target capacity is different for each site.

The *AUP* presents the initial Site Utilization Plans for each active site to be used. To adaptively manage the sites, multiple Site Utilization Plans may be created throughout the season for each site. The cell assignments (dumps per cell) are periodically refined as a given site is filled. As areas of a site become filled, the filled cells are designated as Limited Capacity Zones (where fill is restricted) or Avoidance Zones (where the cell is completely closed from use). To further promote thin-layer placement of dredged material, crews are instructed to avoid "racetrack" and "spoke" patterns. Racetrack patterns are when track-lines (the trace of the load release) are close together within a short period of time. Spoke patterns are when multiple track lines cross at a common point most likely resulting in a mound at the intersection of the spokes.

4.1.1 SWS AND NJS

Placement of dredged material within either SWS or NJS will be conducted according to the following specification. The SWS and NJS shall be filled uniformly with no more than one load difference between any two cells: all cells must be filled with one load before placing a second load in any cell; all cells designated for two loads must be filled before placing a third load in any cell, etc. When recording the placement location, material shall be credited to the cell in which the placement operation is started regardless of the number of cells traversed during placement. Within the SWS, each load shall be distributed across no less than 4 cells (3 cells for NJS). For the SWS, no more than 25% of a hopper dredge load shall be placed within any given grid cell for hopper dredges with capacity of 6,000 cy per load or less, or no more than 20% of a hopper dredge load if the hopper dredge capacity is between 6,000 cy and 8,000 cy per load. For NJS, hopper dredges cannot place more than 33% of their load capacity within any given grid cell. Additional measures may be exercised to maximize capacity within the eastern half of the SWS. For instance, the filling of cells may be preferentially weighted toward the eastern half of the site. Placement within the NJS ceases by 1 October.

4.1.2 SJS

The SJS was a combination of experimental and operational zones in 2015. The 2016 season was the first year that the entire SJS was fully operational. Objectives and implementation are described in this report and will continue to be developed as the operational use of the SJS increases.

Placement of dredged material within the SJS is to commence after 15 August, at which time the commercial Dungeness crab fishing season is closed along Oregon coastal waters. Placement within the SJS ceases by 30 September. The government hopper dredge *Essayons* is currently the only dredge that works in the SJS. The objective for dredged material placement within the SJS is to supplement the deficient littoral sediment budget south of MCR with dredged sand, while minimizing impacts to benthic infauna and epibenthic community. To meet this objective, a cell-based utilization plan is used to guide even, thin-layer distribution of dredged material placement. This placement approach minimizes burial impacts on the site's benthic ecology and avoids localized mounding which could adversely impact navigability within the SJS (due to the focusing of incoming waves). The SJS is managed using the following protocols:

i. A method of thin-layer dredged material placement is used to minimize benthic impacts and promote dispersal of dredged material on the seabed of the SJS, such that maximum deposition on the seabed is 0.25 feet per placement event (load). To ensure that deposition is limited to 0.25 feet or less per load, each hopper dredge load of dredged sand is distributed along a placement track no less than 5,000 feet and no

more than 10% of a hopper dredge load is placed within any 500-feet transit distance. During active use of the SJS, placement track plots are reviewed to verify that the frequency of overlapping placement track lines is limited to once every three days between zones.

ii. The over-tracking of placement events (dump tracks) is minimized over time, to avoid overlapping of successive placement events within a given 72-hour period. To meet this objective, the SJS is split into three zones for material placement in 24-hour rotations: *Zone1*, *Zone 2*, and *Zone 3*. Prior to 2016, the zones were managed as a control zone, operational zone and experimental zone, respectively. The National Oceanic and Atmospheric Administration (NOAA) Northwest Fisheries Science Center (NWFSC) has monitored the SJS since 2012, but the focus has transitioned from studying acute effects of dredged material placement on Dungeness crab to assessing the regional cumulative effects of dredged material placement across the MCR network of nearshore sites. Starting in 2016, the government hopper dredge *Essayons* placed dredged material in all three zones. Dredged material placement rotates between the three zones on a three-day cycle. After a given zone is used for a 24-hour period, placement is not performed within that zone for 48 hours (making up the 72-hour period). For example, if the north zone (Zone 3) is used on Day 1, placement can be repeated in that zone on Day 4. Figure 4-1 displays the zone splits and operational logic for the SJS.

iii. The seasonal distribution of dredged material within the overall SJS is executed such that the total cumulative deposition within the SJS (at the conclusion of the dredging season) is 1 foot or less.

Bathymetric surveys are conducted within the SJS as needed during periods of active seasonal use and compared to the pre-placement condition to verify that physical attributes of dredged material deposition conform to management protocols. If the SJS is not being utilized within the expected thresholds, corrective action is implemented to ensure adherence to SJS management protocols.

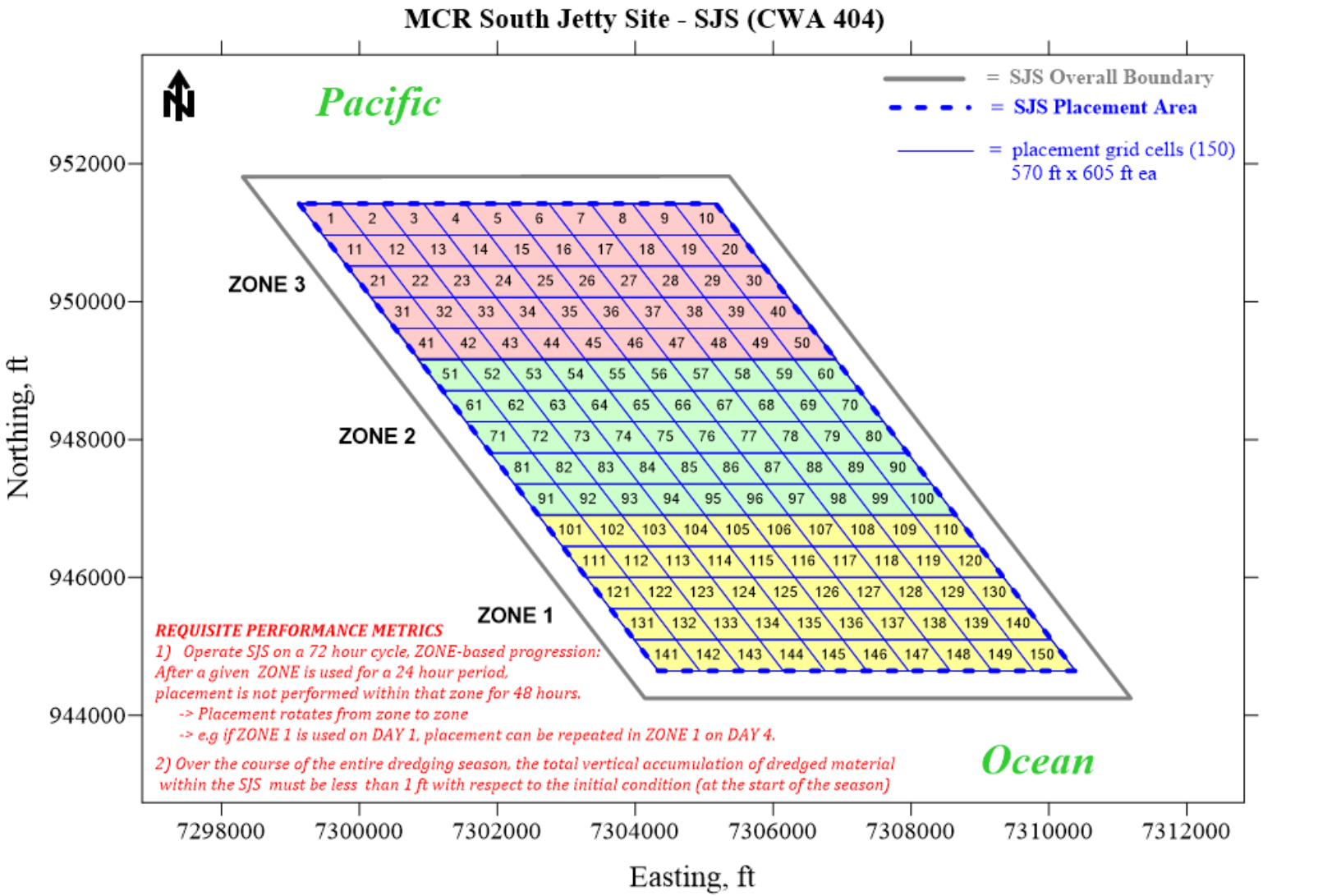

Figure 4-1. MCR South Jetty Site (SJS) Operational Logic.

4.1.3 NHS

During 2018-2020, CENWP completed three separate pilot placements within the NHS to assess the likelihood that MCR dredged material placed within the NHS would be rapidly dispersed toward shore where it could supplement the littoral sediment budget for nearshore areas north of MCR. Results from the three pilot studies helped establish the NHS as a beneficial nearshore dredged material placement site, for the purpose of supplementing the littoral budget of the southern Washington coast. Following a 10-year effort to obtain stakeholder acceptance and resource agency approval (via CWA §404), culminating with conclusion of a 3-year pilot study, the NHS was used operationally for the first time in 2021. Refer to the previous *AUPs* (2019-2021) for NHS pilot study documentation.

The objective for dredged material placement within the NHS is to supplement the littoral sediment budget of Peacock Spit and nearshore areas north of the MCR, using sand dredged from the MCR FNC. Key tenets for managing dredged material placement within the NHS are to avoid impacting benthic infauna and epibenthic community within the site and avoid affecting the wave environment within the site (due to excessive mounding). To promote dispersal of dredged material on the seabed of the NHS (and minimize benthic impacts), a method of thin-layer dredged material placement is used, such that maximum deposition thickness per load placed is less than 0.25 foot, similar to the SJS. The seasonal distribution of dredged material placement within the overall NHS is executed such that the total per season accumulation within the NHS (at the conclusion of each dredging season) will be 1 foot or less. To avoid affecting the wave environment within the NHS, long-term deposition within the site will be managed to prevent mounding exceeding 2 feet with respect to the site's baseline condition (May 2021).

The NHS is portioned into 3 zones to allow year to year distribution of dredged material placement within the overall site and avoid exceeding the 2 feet deposition criterion. A cell-based utilization plan is to be used to guide dredged material placement within the NHS, to achieve the site-use objectives described above. Figure 4-2 illustrates how the NHS is partitioned into 3 zones within a network of 496 placement cells to control the release of dredged material within the site. Dredged material placement within the NHS commences after 15 September, which is when the crab season is closed along Washington coastal waters. Only the government hopper dredge *Essayons* is to use the NHS to ensure that adherence to placement protocols.

To inform operation use of the NHS, bathymetric surveys are conducted for actively used areas of the NHS before and after each dredging season that the NHS is used. Pre- and post-placement surveys are compared to verify that physical attributes of dredged material deposition conform to management protocols.

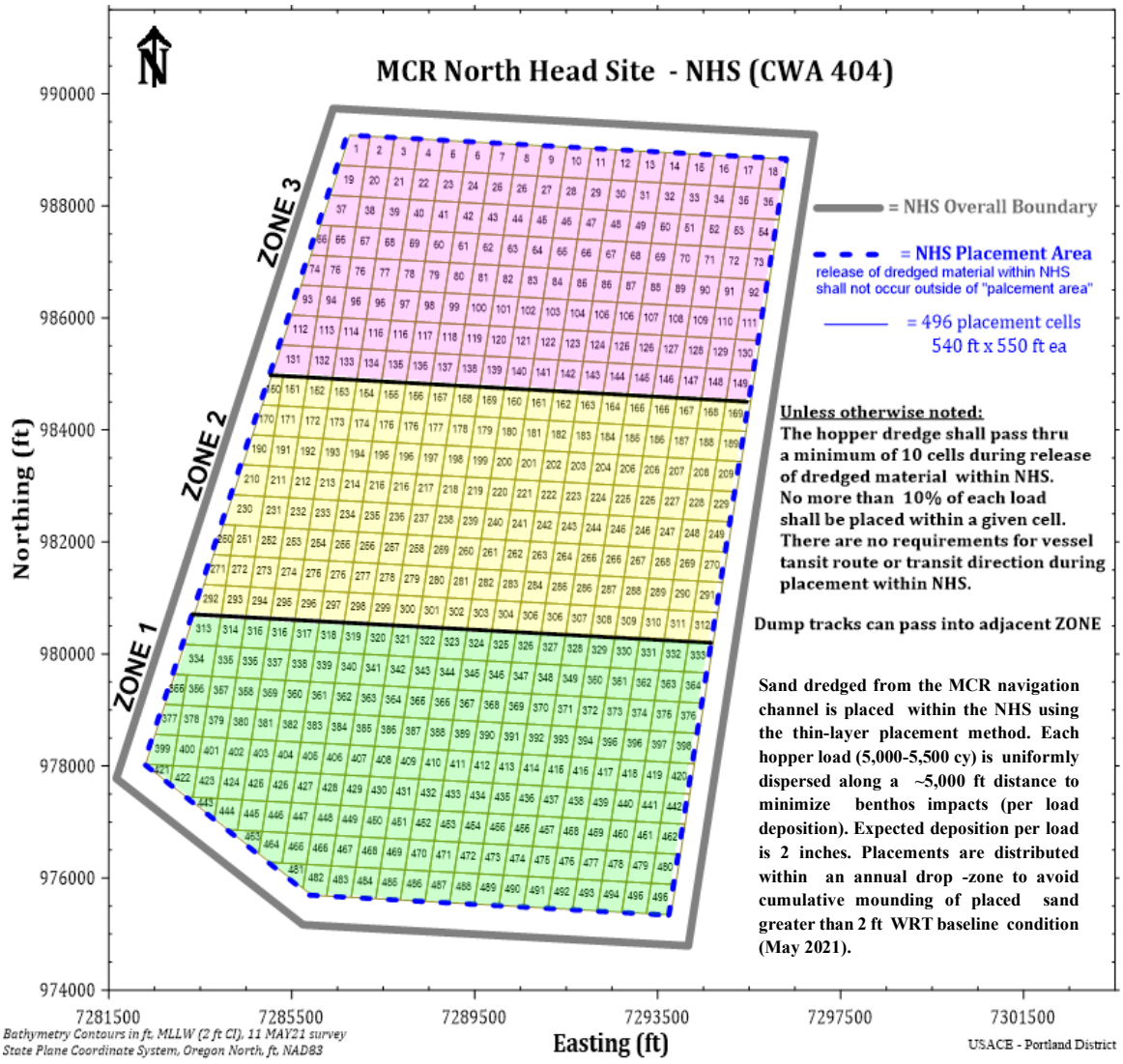

Figure 4-2. MCR North Head Site placement strategy.

Thresholds for managing dredged material accumulation within the NHS are 0.25 foot (per placement event), 1 foot (for the entire dredging season), and 2 feet of total dredged material deposition with respect to the site's baseline condition (May 2021). During active use of the NHS, placement track plots are reviewed to verify that the dredge is transiting at least 10 cells during each dump, with no more than 10% of material placed in each cell during the release of sediment. If the NHS is not being utilized within the expected thresholds, corrective action *is* implemented to ensure adherence to NHS management protocols.

During 2021 and 2022, a total of 744,000 cy of sand has been "operationally" placed within the southern third (Zone 1) of the NHS in water depths 40-50 feet, using a cell-based placement method (Figure 4-2). To date, observations at NHS indicate that this area has a higher rate of sediment transport than the SJS and dredged material that is placed within the NHS tends to move toward shore (Stevens et al 2023). The operational framework for

managing long-term use of the NHS, is based on collective lessons-learned from the SJS and pilot studies at NHS. Refer to Section 5.6 and 7.9 for details concerning the year-to-year strategy for managing operational placement of dredged material within the NHS.

5 ACTUAL UTILIZATION OF MCR ODMDSS AND 404 SITES IN 2022

This section analyzes the dredged material placement completed for the 2022 season. Figures have been created with two software programs: Surfer, version 13 and 19, from Golden Software and ArcGIS Pro, version 2.8, from ESRI. All volumes were calculated using Surfer.

For the 2022 MCR dredging season, the KTR hopper dredge was the *Bayport,* and the GVT hopper dredge was the *Essayons* (refer to Table A-1 in Appendix A, for dredge characteristics). The pre-season and post-season bathymetric surveys for 2022 are listed below. Due to severe weather conditions and a shortage of survey vessel and personnel availability, most of the post-season surveys were not collected.

Pre-season bathymetry surveys

Shallow Water Site	North Jetty Site	MCR-14-DWS	South Jetty Site	North Head Site
9 August 2022	10 August 2022	12 August 2022	17 August 2022	15 Sept 2022

Post-season bathymetry surveys

Shallow Water Site	North Jetty Site	MCR-14-DWS	South Jetty Site	North Head Site
15 November 2022	01 October 2022	N/A	21 September 2022	12 October 2022

Table 5-1 presents the initial planning for the 2022 season's dredge placement quantities and the volumes to be placed by each dredge. Quantities are taken from the *2022 AUP*. Nearshore site capacity was analyzed throughout the 2022 season, so these volumes were initial estimates. The volume not placed in nearshore sites due to weather, safety or lack of capacity was placed in the DWS. Volumes were derived from the estimated dredging need and the nearshore sites' initial capacities.

Table 5-1: Initial Plan for the 2022 Dredge-Placement Season.

	Initial Plan for the 2022 Dredge-Placement Season (estimated volumes)		
Site	AUP Estimated Site Totals	Government Dredge *Essayons*	Contractor Dredge *Bayport* (awarded amount)
	Mcy		
SWS	**≥ 1.795 (awarded)** 0.6325 (optional)	**0.5**	**≥ 1.295 (awarded)** 0.6325 (optional)
NJS	**0.2**[*]	**0**	**0.2**[*]
SJS	**0.5**[**]	**0.5**[**]	**0**
NHS	**0.4**	**0.4**	**0**
DWS	**0**[^]	**0**	**0**
Season & Dredge Totals	**3.5275**[***] (with option)	**1.4**	**2.1275**[***] (with option)

[*] Depending on how the site clears during the spring and summer, placement at the NJS is set to 0.2 Mcy to control mounding. If mounding is limited, more may be placed in the NJS throughout the season.

[**] No more than 0.5 Mcy may be placed in the SJS based on clearances, not capacity. Target placement for 2022 season is 0.5 Mcy.

[***] 2022 Contract includes an option for an additional 0.6325 Mcy to be exercised by the *Bayport*. A total of 2.1275 Mcy of dredged material would be placed by the Contract Hopper if option is exercised, which is shown in the Season & Dredge Totals estimate.

[^] A portion of the Contract and Government Dredges may go to the DWS if there are concerns over weather, safety, or lack of capacity.

Only the contractor dredge *Bayport* placed material at the NJS for the 2022 season. The *Bayport* and *Essayons* both placed material at the SWS in different time periods for the 2022 season, with *Bayport* given priority of the SWS and *Essayons* only placing material before *Bayport* reached the MCR. This is not unusual for two reasons: (1) it costs more to pay the contractor to transit out to the DWS so they are given priority at nearshore sites and (2) both

the government and contractor dredges are not permitted to operate at the same time in the SWS or NJS for safety reasons. Therefore, the government dredge only uses the SWS and NJS when all the following criteria are met: (1) the contractor dredge is done or has not begun, (2) there is enough capacity in the site, and (3) the time window for dredge-placement is open.

The aspiration of CENWP and EPA is to create a nearshore disposal site system, with a goal of targeting the nearshore sites over DWS to keep material in the littoral system. With the current network of nearshore sites, the amount of material taken to the DWS was minimal. Table 5-2 shows that the total amount delivered to the nearshore sites was approximately 91% of the planned quantity at the beginning of the season, so the DWS was not utilized much more than was necessary. Placement within the NJS had to cease by 1 October. The *Bayport* reached the MCR on 12 September. Limited mounding occurred at this site, allowing the Contractor Dredge to exceed the original placement estimate. The amount delivered to the DWS was dependent on several factors, including (1) how well material is managed and placed at the nearshore sites and (2) how well ocean currents disperse the material placed at the nearshore sites.

Table 5-2: Actual volumes placed during the 2022 season.

	2022 Dredging Season Summary		
Site	Site Totals	Government Dredge *Essayons*	Contractor Dredge *Bayport*
	Volume Placed in cy *(first-last dates of placement)*		
SWS	**1,655,269** *(19AUG-11NOV22)*	**409,812** *(19AUG-2SEP22)*	**1,245,457** *(13SEP-11NOV22)*
NJS	**321,226** *(12SEP -30SEP22)*	**0**	**321,226** *(12SEP-30SEP22)*
SJS	**310,162** *(02SEP-30SEP22)*	**310,162** *(02SEP-30SEP22)*	**0**
DWS	**267,957** *(06OCT-10NOV22)*	**74,313** *(07OCT-09OCT22)*	**193,644** *(06OCT-10NOV22)*
NHS	**396,396** *(16SEP-06OCT22)*	**396,396** *(16SEP-06OCT22)*	**0**
Season & Dredge Totals	**2,951,010** *(19AUG -11NOV22)*	**1,190,683** *(19AUG-09OCT22)*	**1,760,327** *(12SEP-11NOV22)*

5.1 Dredged Material Distribution and Placement Summary in 2022

For this discussion please refer to Figure 5-1, Table 5-3 and Figure 5-2. The pie charts on the left in Figure 5-1 highlight the distribution of dredged material placement at MCR placement/disposal sites, during the years 1956 to 2022, in terms of Nearshore, Intermediate (only before 1997) and Deep Water locations. The period was divided at the year 1997 because site use was changed at this time in response to the Columbia River Crab Fishermen's Association. From 1956 to 1996, historical sites ODMDS A and G were designated as Nearshore-South (yellow). From 1997 to 2022, the SJS was designated as Nearshore-South (yellow). During 1956 to 1996, 55% of the material dredged at MCR was placed in the nearshore, with nearly equal distribution to the north and south of the inlet (32% and 23%, respectively). During 1997-2022, 71% of the sediment dredged at MCR was placed in the nearshore; however, distribution to the north and south of the inlet has not been equal. Over 94% of material placed in nearshore sites has been placed to the north of the channel. This practice has created an imbalance in the sediment budget for the inlet. Utilization of the SJS will assist in offsetting this imbalance. Material dredged from Tongue Point in 1989 and LCR in 2005/'06/'09 Channel Deepening was not included in Figure 5-1 because these were special one-time use projects and not part of the annual maintenance dredging. Accounting for the data from these dredge sites would skew the data.

The smaller pie charts in Figure 5-1 show the annual distribution of dredged material placement at MCR placement/disposal sites for the 2017 through 2022 dredging seasons. Use of the SJS is a step toward a more even distribution of sediment on the north and south sides of the inlet. Even with an operational SJS in 2017 through 2022, only 11% to 20% of the material each year was placed in Nearshore-South while 49% to 80% was placed in Nearshore-North. Table 5-3 details the sites and volumes for each year and site from 1956-2022. Though placement in Nearshore-South is still not equal to Nearshore-North, the amount of placement has increased and should continue to increase over the next several years.

The 3-D bar chart in Figure 5-2 shows the distribution and timing of MCR site utilization during the 2022 dredging season. The 2022 dredging season at MCR began on 19 August and ended 11 November. The *Bayport* utilized the NJS, SWS and DWS. Sites available to the *Essayons* were the SJS, DWS, NHS, and SWS, with utilization of the SWS only before *Bayport* arrived at the MCR for the season. Sites were monitored throughout the season, which influenced the use of the nearshore sites. Placement in the NJS, SJS and SWS was spaced to allow for material settlement and dispersal. The nearshore sites take priority with the DWS as the last option. The DWS is used when inclement weather makes the nearshore sites unworkable or when monitoring indicates that the nearshore sites should be restricted.

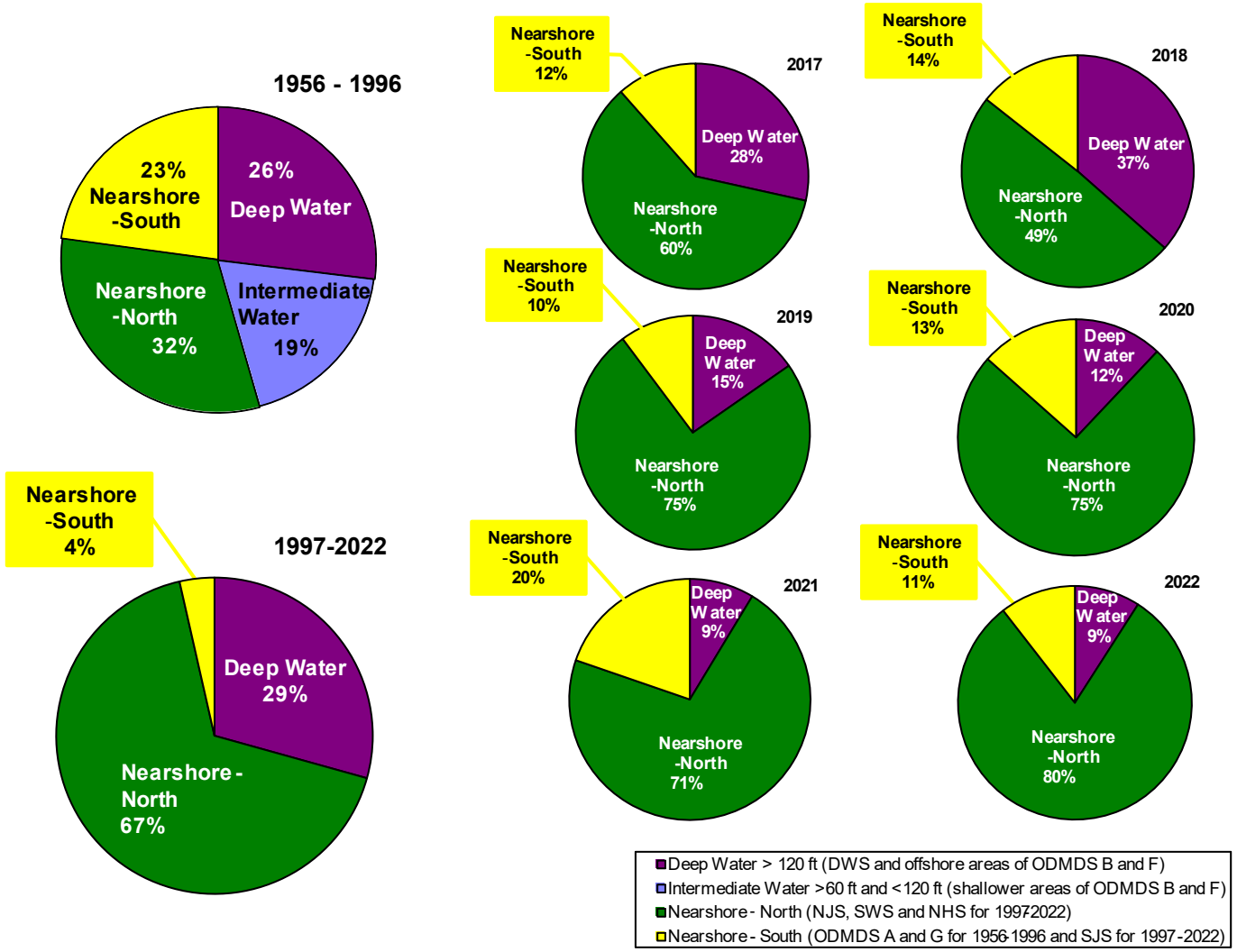

Figure 5-1: The Distribution of MCR Dredged Material Placement.

The period was divided at the year 1997 because site use was changed at this time in response to the Columbia River Crab Fishermen's Association. The two pie charts on the left show an imbalance with significantly more placement in the nearshore on the North side of the inlet since 1997. The smaller pie charts on the right depict the most recent years individually.

Table 5-3: Dredged Material Placement Volumes for Sites at the Mouth of the Columbia River (1956-2022).
Volumes listed are in cubic yards and included dredged material obtained from MCR and LCR navigation channels unless otherwise noted.

Dredged Material Placement Volumes for Placement Sites at the Mouth of the Columbia River (1956-2022)
(Volumes listed are in cubic yards and include dredged material obtained from MCR & CR navigation channels unless otherwise noted.)

Fiscal Year	MCR Placement Sites with Dredged Material Placement Volumes listed in cubic yards for 1956 - 2021												Total Volume
	Site A	Site B	NJS including old Site C*	Site D*	SWS including old Site E	Site F	DWS MCR-## drop zones	CR-05 drop zones**	SJS	NHS	ESI	Site G	
1956	12,096,000	1,296,000	504,000	504,000									14,400,000
1957	1,605,643	1,221,307	422,071	838,428									4,087,449
1958	6,135	2,274,704	0	326,753									2,607,592
1959	0	1,914,964	0	661,021									2,575,985
1960	0	1,927,208	0	612,636									2,539,844
1961	0	1,837,879	0	297,066									2,134,945
1962	0	2,322,256	2,838	632,618									2,957,712
1963	0	1,725,851	724,630	234,735									2,685,216
1964	0	514,900	1,459,186	683,151									2,657,237
1965	0	675,921	1,205,090	1,606,671									3,487,682
1966	0	2,010,673	29,891	2,437,451		215,002							4,693,017
1967	0	1,463,573	1,067	354,700		422,066							2,241,406
1968	0	1,919,199	0	109,592		0							2,028,791
1969	0	2,021,562	0	89,042		0							2,110,604
1970	0	1,489,795	0	3,060		0							1,492,855
1971	51,047	1,439,042	13,818	241,689		0							1,745,596
1972	12,995	2,579,688	0	287,646		1,886							2,882,215
1973	0	3,051,662	0	409,640	291,439	3,060							3,755,801
1974	0	994,059	0	506,711	2,168,543	29,123							3,698,436
1975	0	333,462	0	895,594	4,886,792	27,539							6,143,387
1976	2,574	1,017,100	0	758,743	4,257,150	53,250						602,895	6,691,712
1977	2,867,393	1,868,579	0	710,373	3,678,429	0							9,124,774
1978	3,060	187,704	0	312,635	3,925,986	0							4,429,385
1979	0	116,502	0	158,466	4,930,840	0							5,205,808
1980	11,142	118,686	0		2,675,722	0							2,805,550
1981	2,254,321	9,180	0		3,042,896	0							5,306,397
1982	971,209	12,240	0		3,086,514	0							4,069,963
1983	1,124,466	199,969	0		606,218	0							1,930,653
1984	4,060,853	3,864,247	0		989,600	0							8,914,700
1985	1,326,150	2,068,927	0		4,126,429	0							7,521,506
1986	2,037,455	3,387,376	0		2,926,412	0							8,351,243
1987	1,593,550	1,209,358	0		1,183,050	0							3,985,958
1988	1,447,240	4,533,756	0		478,864	0							6,459,860
1989ǂ	647,458	3,456,285	0		568,522	2,030,954							6,703,219
1990	2,729,358	1,119,663	0		507,201	0							4,356,222
1991	1,486,938	1,956,570	0		380,142	0							3,823,650
1992	874,700	2,888,028	0		796,198	0							4,558,926
1993	0	1,629,208	0		988,208	2,288,431							4,905,847
1994	408,924	1,002,668	0		397,621	1,500,407							3,309,620
1995		2,480,664	0		988,547	0							3,469,211
1996		1,693,145	0		726,336	2,205,113							4,624,594
1997		326,824	0		1,071,246	174,883							1,572,953
1998			0		3,444,656	820,722							4,265,378
1999			1,050,000		3,750,000	262,000							5,062,000
2000			504,000		2,896,000	465,500							3,865,500
2001			498,000		2,176,000	1,390,000							4,064,000
2002+			498,800		1,503,800	2,270,668							4,273,268
2003			447,000		2,847,000								3,294,000
2004			506,000		2,960,000		1,715,283						5,181,283
2005			227,000		2,629,000		1,041,000	1,228,584	34,254				5,159,838
2006			243,900		1,832,860		1,395,330	1,034,864					4,506,954
2007			200,792		1,724,629		2,305,597						4,231,018
2008+			199,016		2,354,688		647,007						3,200,711
2009			301,923		1,200,258		2,980,349	599,112					5,081,642
2010+			254,025		2,318,467		290,419						2,862,911
2011			498,417		1,485,062		1,039,929						3,023,408
2012			293,542		1,722,918		608,829		49,652				2,674,941
2013			165,381		1,833,535		1,202,954		62,902				3,264,772
2014			375,778		1,538,254		1,357,535		286,554				3,558,121
2015			413,851		1,161,206		1,570,331		284,575				3,429,963
2016			142,540		1,669,688		1,438,221		300,507				3,550,956
2017			284,320		1,282,906		743,322		300,432				2,610,980
2018			232,285		1,091,218		1,020,553		401,825	50,599	81,709		2,878,189
2019			326,175		1,652,450		427,432		285,280	100,000			2,791,337
2020			273,632		1,660,322		358,084		399,904	282,774			2,974,716
2021			66,810		1,298,306		207,076		471,649	347,951			2,391,792
2022			321,226		1,655,269		267,957		310,162	396,396			2,951,010
Totals	37,618,611	68,160,384	12,687,004	13,672,421	99,367,397	14,160,604	20,617,208	2,862,560	3,187,696	1,177,720	81,709	602,895	274,196,209

Volume of sediment placed in estuarine placement sites for 1956-2022: **26,359,425**

Volume of sediment placed in ocean placement sites for 1956-2022: ***247,836,784***

Annual Avg:	NJS	SWS	Site F	MCR_DWS	CR_DWS	SJS	NHS	ESI
(1997-2022)	**346,851**	**1,952,298**	**897,296**	**1,085,116**	**954,187**	**265,641**	**235,544**	**81,709**

MCR Annual avg. for	
1990-2022	3,603,247
1986-1989	6,375,070
1977-1985	5,478,748

ǂ Site F volume reflects a one-time placement of material dredged from Tongue Point in 1989.
+ in years 2002, 2008, and 2010, additional material was placed on the beach N of the North Jetty as follows: 387kcy; 125.4kcy; and 43.5kcy, respectively.
* Estuarine disposal sites, ** Site primarily used for Columbia River (CR) material.
Note: 1977: Sites A, B, E, F receive *Interim* designation. 1986: Sites A, B, E, F receive final Section 102 designation. 1999: Start of NJS usage since selection under CWA, Section 404 authority. 2005: Sites A, B, E, F de-designated, SWS & DWS receive final Section 102 designation. 2012: SJS selected under CWA, Section 404 authority.

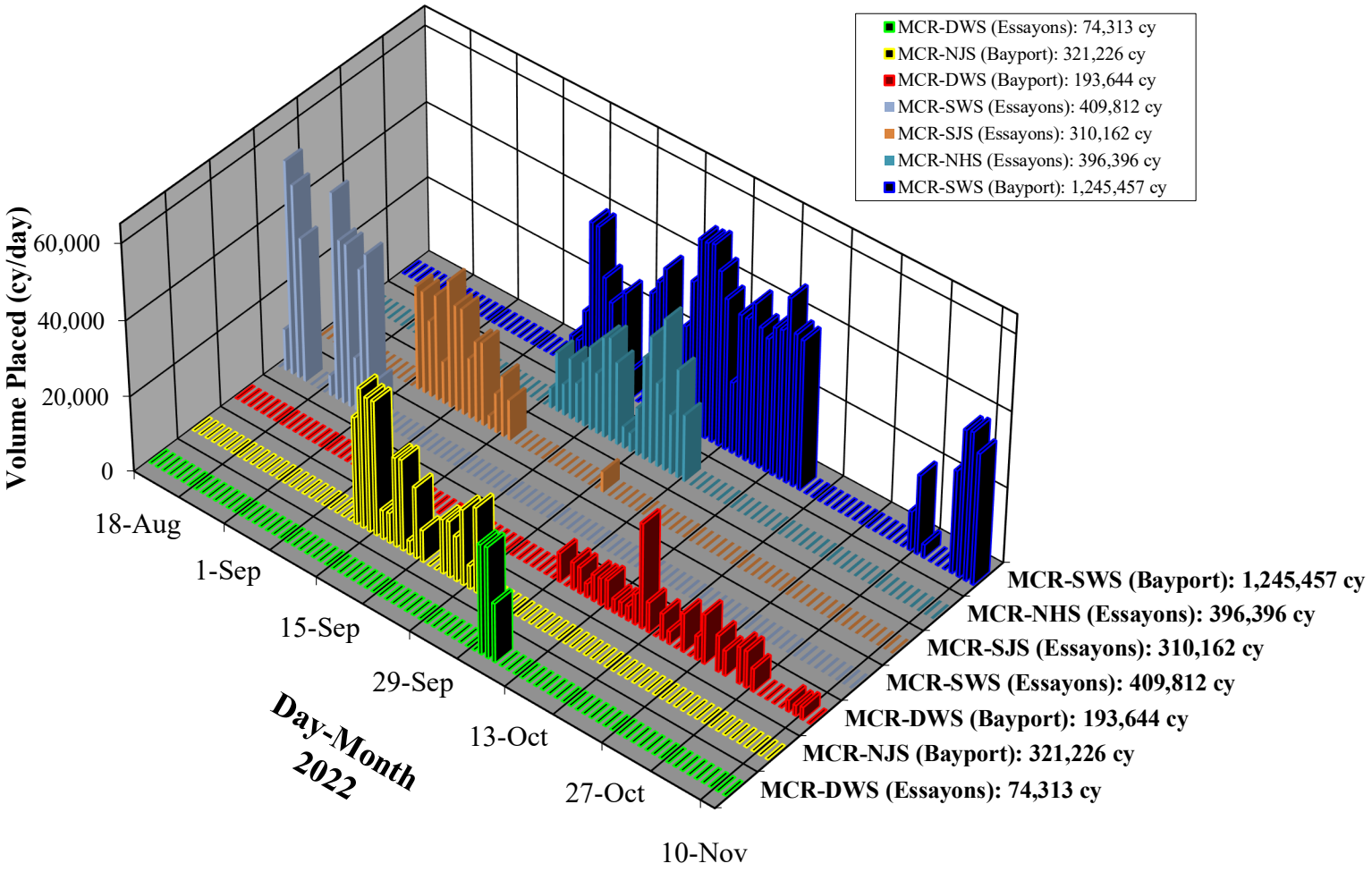

Figure 5-2: MCR Dredged Material Placement in 2022 for Dredges.

5.2 SHALLOW WATER SITE - SWS

There were eight Site Utilization Plans used for the SWS during 2022 as shown in Figure 5-4; one plan for the *Essayons* and seven plans for the *Bayport*. The initial plan assigned most of the northwestern portion of the SWS as a *limited capacity zone,* where a hopper dredge could not initiate placement within this zone but could pass over the area after placement was initiated elsewhere within the ODMDS. As the season progressed, areas of the SWS were designated *avoidance zone*s, which prohibited placement. This was done to reduce deposition within the northwestern portion of the SWS and ensure that the height of deposition did not exceed the *limited management* threshold (i.e., *Level 4* in the decision framework for site threshold management discussed later in Section 8).

Figure 5-3 shows the level of sediment accumulation within the SWS between 9 August 2022 (ten days prior to the beginning of dredged material placement in SWS) and the 1997 baseline condition. Since 1997, 49.1 Mcy had been placed in the SWS with only 0.86 Mcy remaining at the beginning of the 2022 season. Accumulation exceeds 2 feet in the northwest area of the site. This resulted in the limited capacity zone designation for the Site Utilization Plans (Figure 5-4 and Figure 5-5).

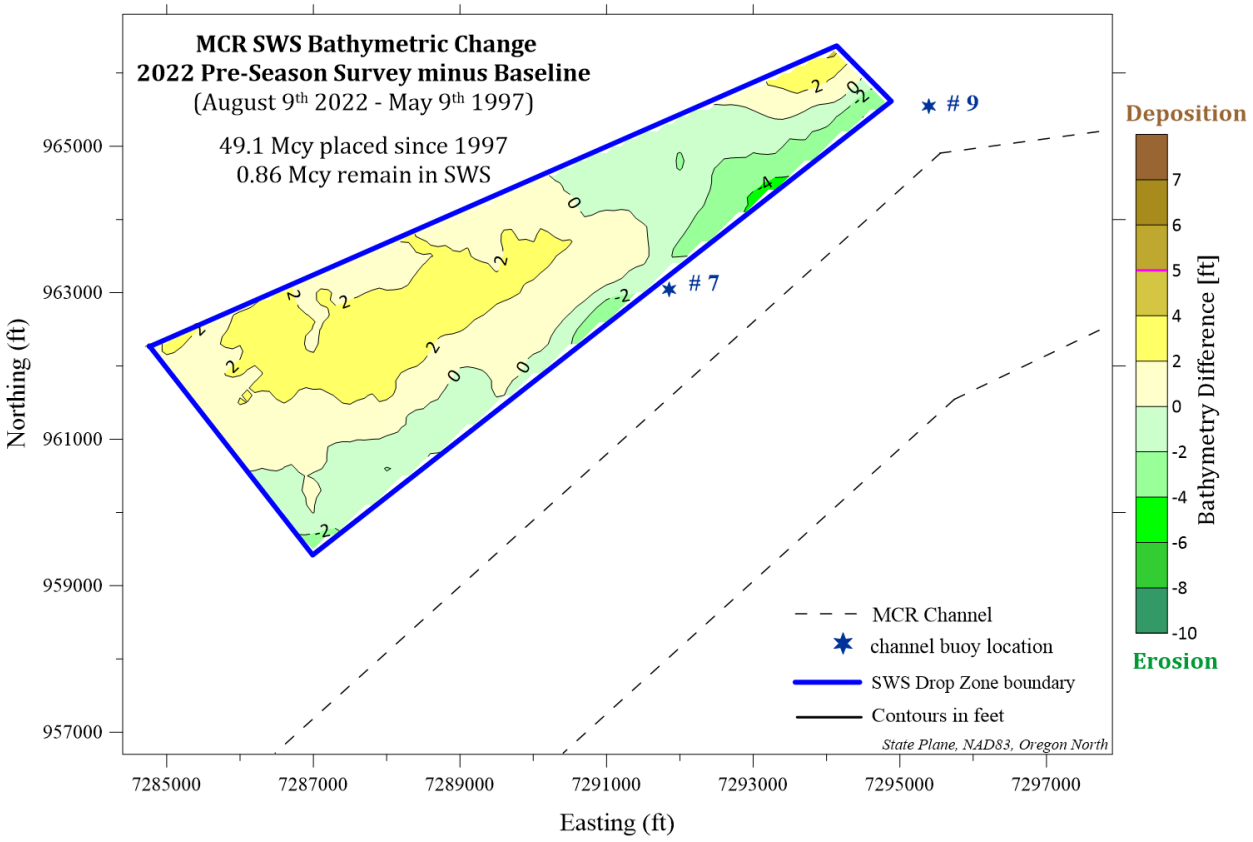

Figure 5-3: MCR Shallow Water Site (SWS) Difference between 2022 Pre-Season Survey and 1997 Base Condition.

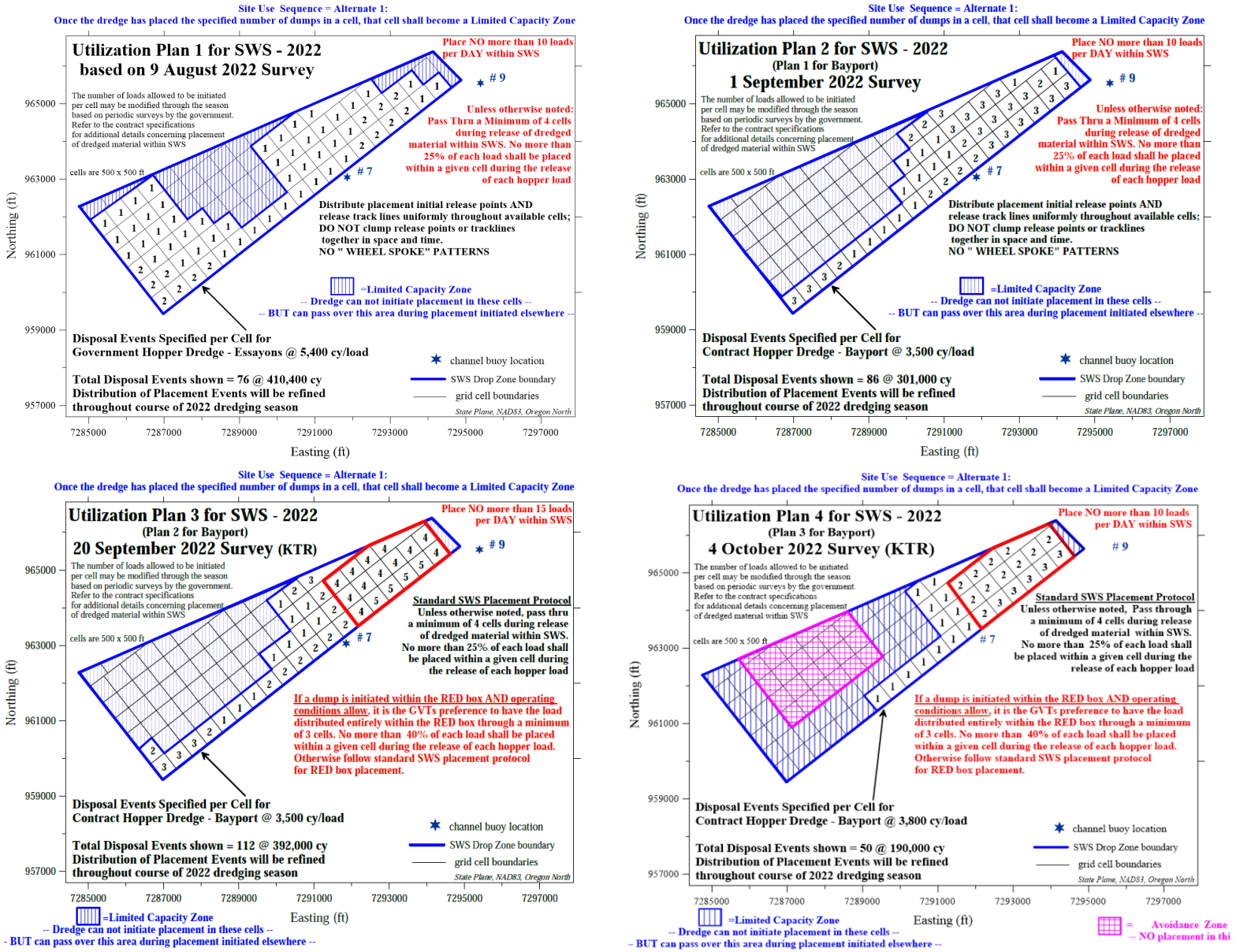

Figure 5-4: The Site Utilization Plans (1 thru 4) Used to Guide MCR Dredged Material Placement within the SWS during 2022.

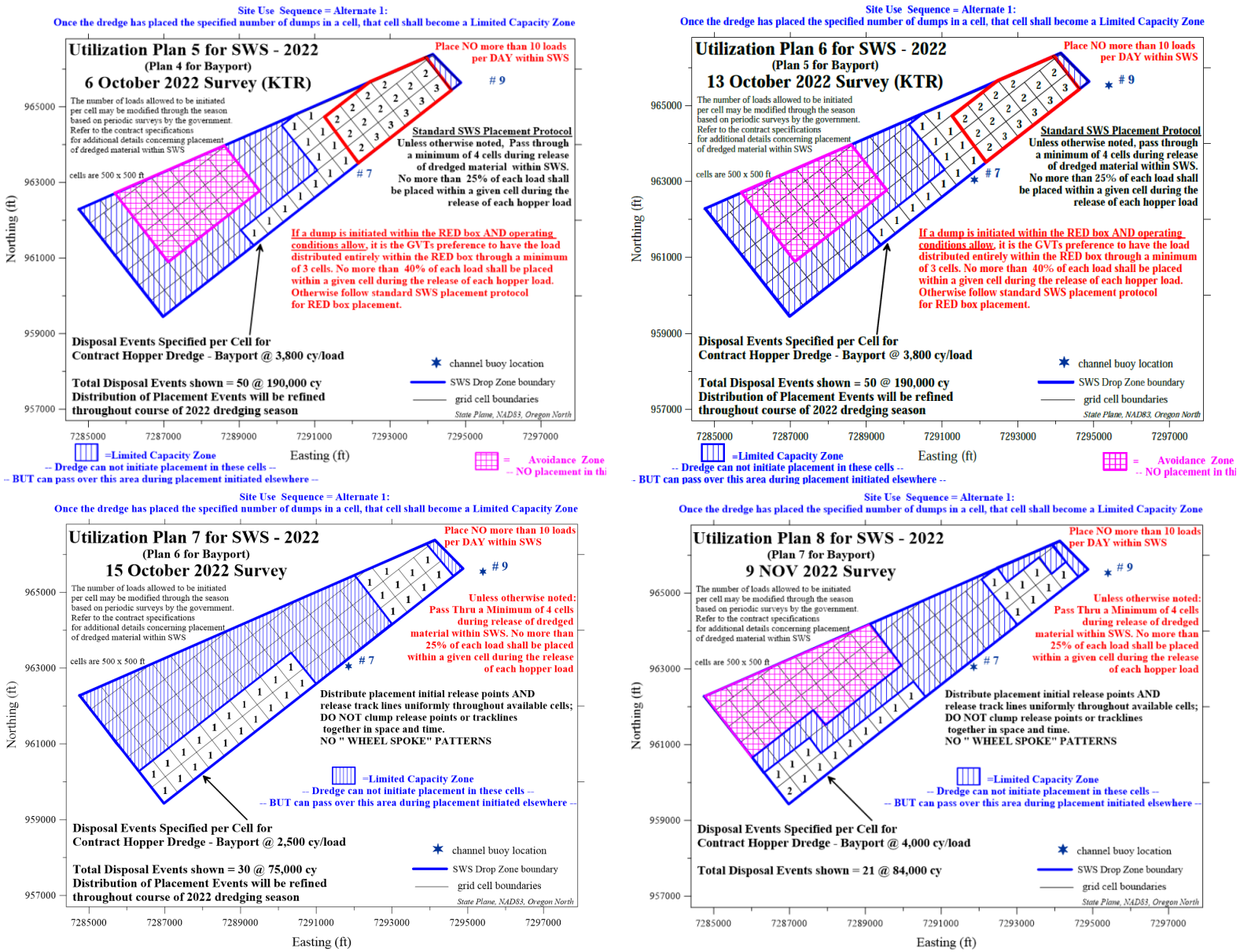

Figure 5-5: The Site Utilization Plans (5 thru 8) Used to Guide MCR Dredged Material Placement within the SWS during 2022.

Utilization Plan 1 (Figure 5-4) was developed for use by the *Essayons*, while Utilization Plans 2-8 (Figure 5-4 and Figure 5-5) were developed for the *Bayport*. The *Essayons* finished placing material on 2 September, then the *Bayport* started placing within the SWS on 13 September and placed material into November.

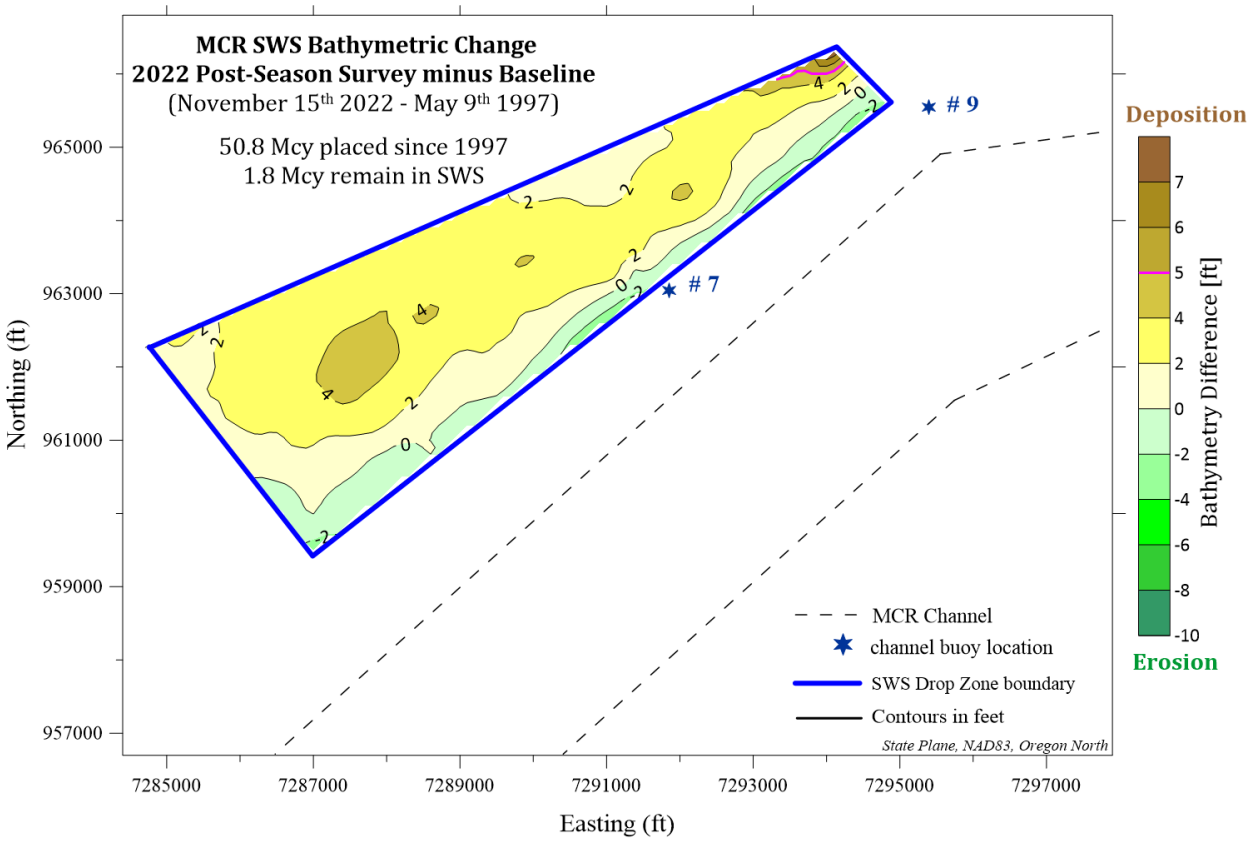

Figure 5-6: MCR Shallow Water Site (SWS) Difference between 15 November 2022 Survey and 1997 Base Condition.

Figure 5-6 shows the level of sediment accumulation within the SWS between 15 November 2022 (after SWS dredged material placement) and the 1997 baseline condition. Placement material mound height stayed below the 5 feet of depth allowed within the SWS.

Figure 5-7 shows the difference between surveys from 15 November 2022 and 9 August 2022. Total deposition for the 2022 dredge-placement season was 1.29 Mcy. Of this amount, most of the accumulation occurred in the eastern portion of the site, outside of the limited capacity and avoidance zones shown in Figure 5-4 and Figure 5-5. The eastern accumulation that reached 5 feet of depth allowed within the SWS was due to the red box method implemented in the utilization plans, as shown in Figure 5-4 and Figure 5-5. The eastern portion of the SWS will need to be watched more closely in the coming years of utilization. Note that despite the observed deposition since 1997 in the northwest corner of the SWS (Figure 5-6), additional accumulation during the 2022 season was minimal in this area

(Figure 5-7) since placement was concentrated on the eastern and southern edges of the site (Figure 5-8).

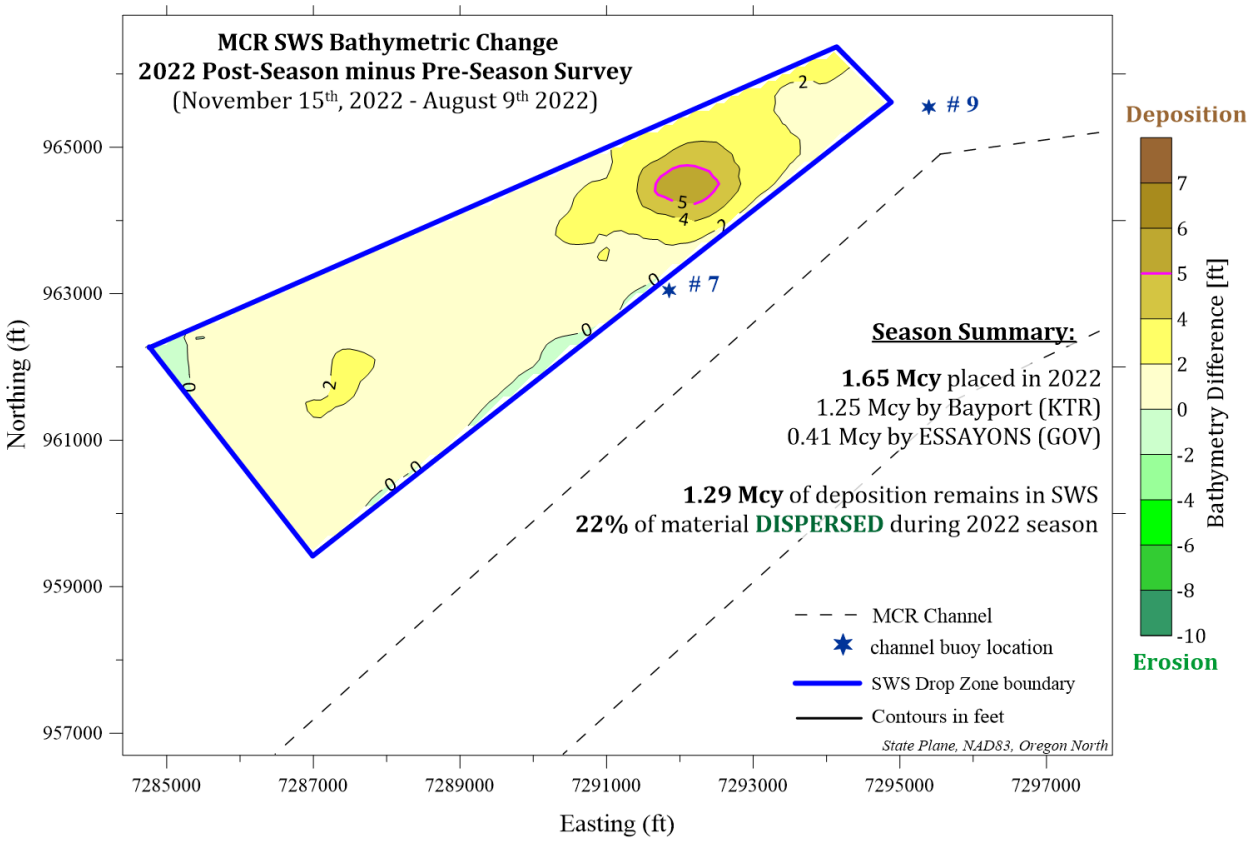

Figure 5-7: MCR Shallow Water Site (SWS) Difference between 2022 Post-Season and 2022 Pre-Season Surveys.

The SWS is of strategic importance to the region: its continual use has supplemented Peacock Spit with 99.4 Mcy since 1973, supplemented the littoral sediment budget north of MCR, protected the North Jetty from scour and wave attack, and has helped stabilize the MCR inlet. It is CENWP's position that the SWS must continue to be used to maintain the MCR inlet and supplement the sediment budget north of the MCR.

The start and end coordinate locations for each load of dredged material placed within the SWS during 2022 are shown in Figure 5-8. Note that most of the points of initial release (green circles) are located within the eastern and southern portions of the SWS. These areas of the SWS had a greater capacity to receive dredged material in 2022 than did areas within the northwestern portion of the site.

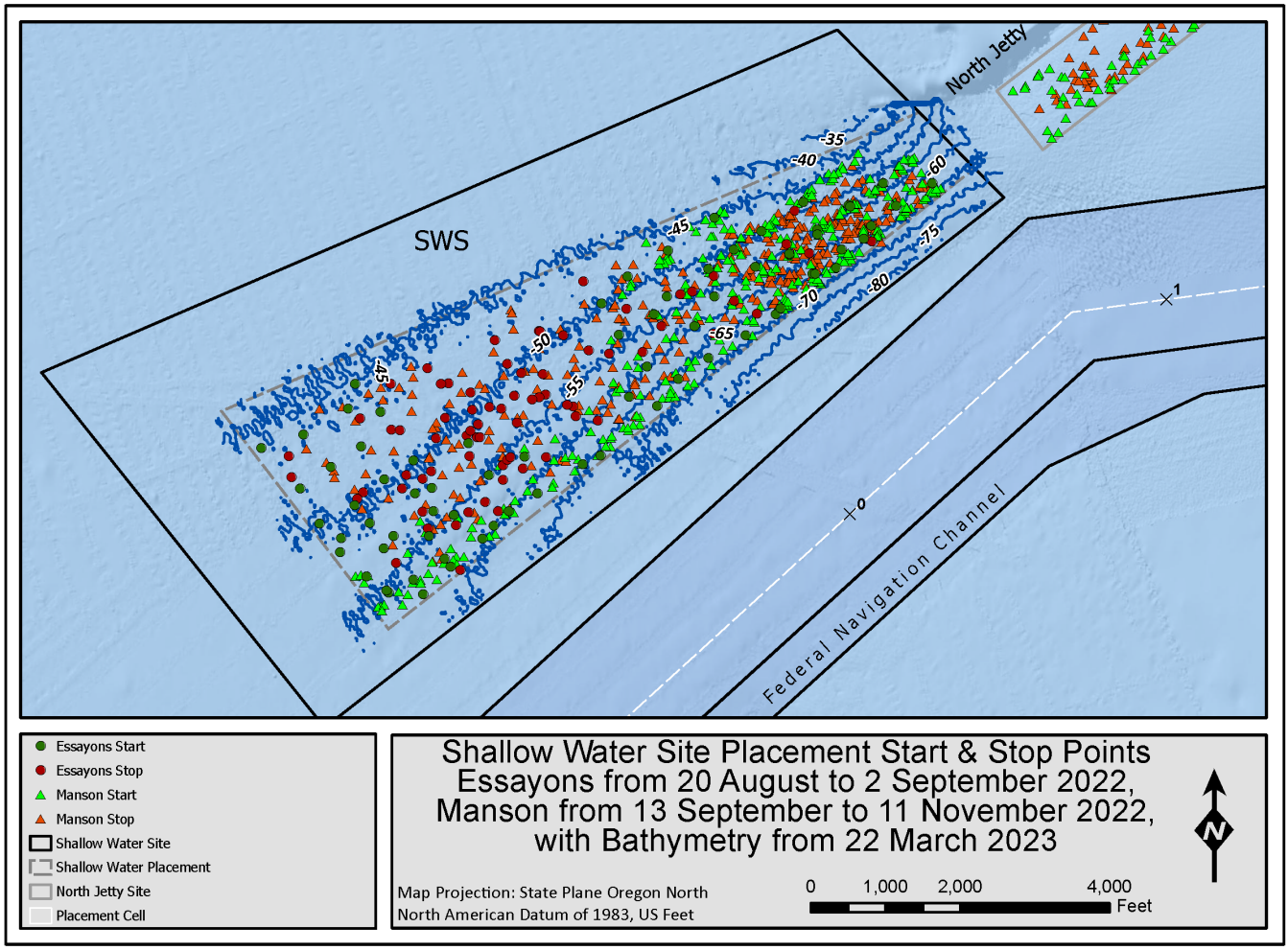

Figure 5-8: MCR Shallow Water Site (SWS) Utilization during the 2022 Dredging Season.
START & END locations of the Contractor dredge, *Bayport,* for each placement event are shown by green and red triangles, respectively. START & END locations of the Government dredge, *Essayons,* for each placement event are shown by green and red circles, respectively.

5.3 DEEP WATER SITE - DWS

During 2022 (from 6 October through 10 November) the Contract hopper *Bayport* and Government hopper dredge *Essayons* collectively placed 268,000 cy of MCR dredged material at the DWS (Table 5-3). The *2022 AUP* intended for all DWS placement to occur within the MCR-14-DWS drop zone. Figure 5-9 shows the drop zone within the DWS.

The *Essayons* placed its annual load between 7 October and 9 October. The Contract hopper *Bayport* placed material between 6 October and 10 November. The placement sequence is visualized in Figure 5-2.

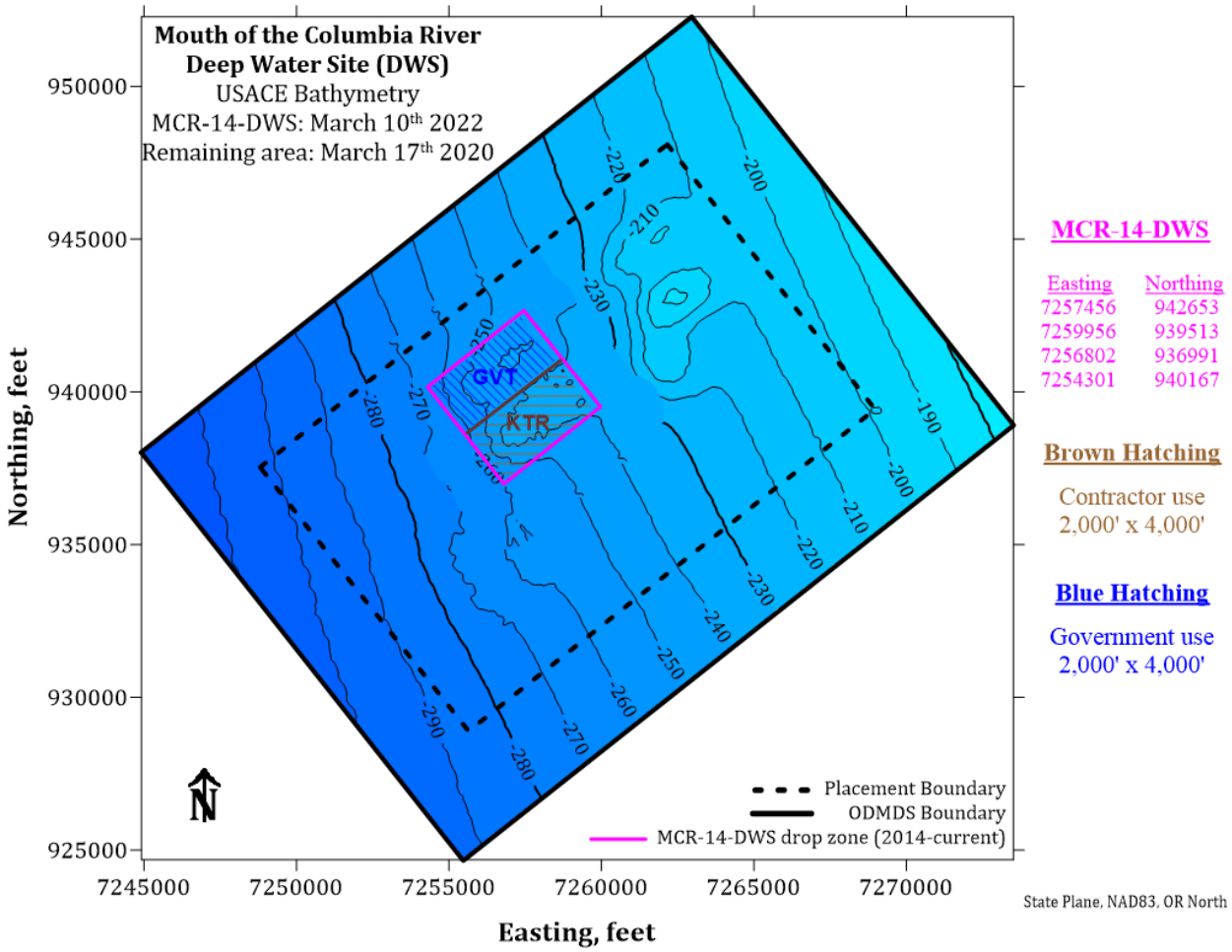

Figure 5-9: Drop Zone used at Deep Water Site in 2022: MCR-14-DWS. Map shown with March 10th 2022 bathymetry for the MCR-14-DWS zone and March 17th 2020 bathymetry for all other areas within the ODMDS.

Figure 5-10 shows the Initial Site Utilization Plan of the DWS drop zone used for the 2022 season. The contract hopper dredge was assigned the southeast portion of the drop zone, while the government dredge was assigned the northwest portion of the drop zone.

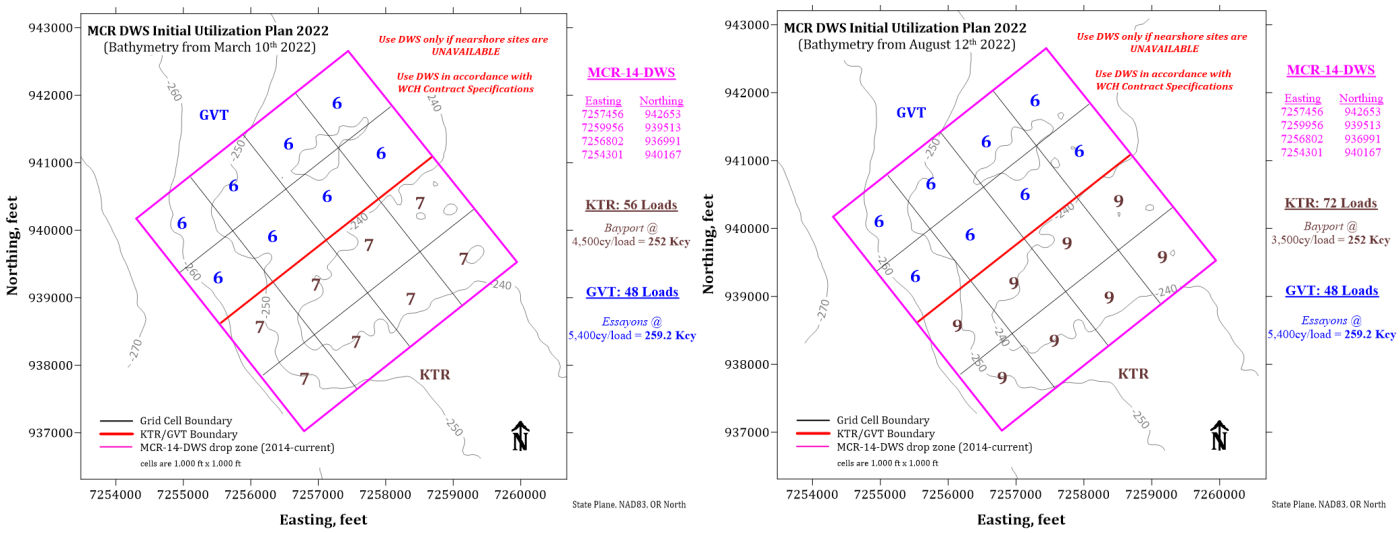

Figure 5-10: Site Utilization Plans for Deep Water Site (DWS), based on 2022 Pre-Season Survey.

Figure 5-11 displays the Start and End coordinate locations for each load of dredged material placed within the DWS during the 2022 season.

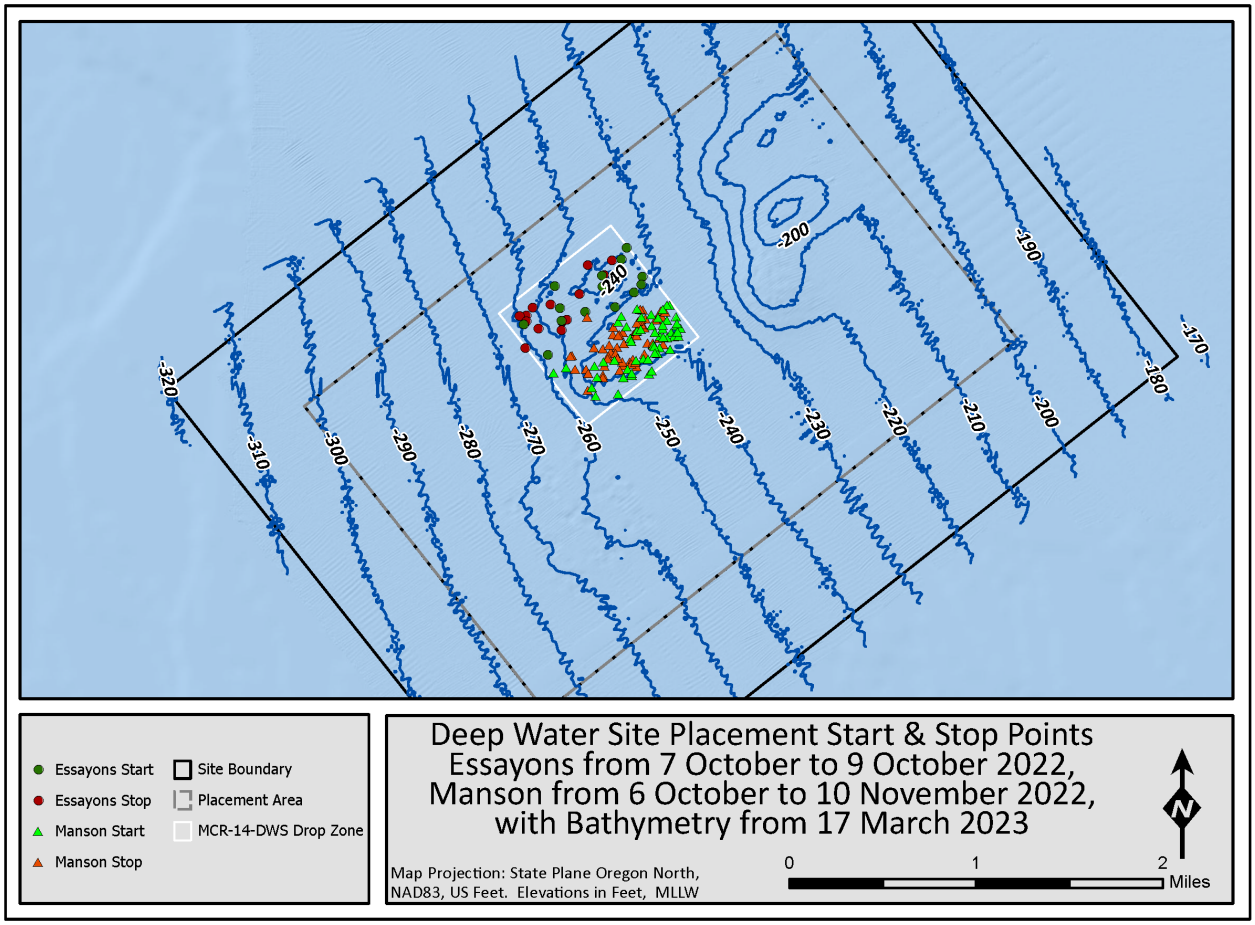

Figure 5-11: MCR Deep Water Site (MCR-14-DWS Drop Zone) 2022 Season - Utilization by Government and Contract Dredges showing START & END Placement Locations.

5.4 NORTH JETTY SITE – NJS

During 2022 (from 12 September through 30 September) the contract hopper dredge *Bayport* placed 321 thousand cubic yards (kcy) of MCR dredged material within the NJS (Table 5-3). As previously stated, placement within the NJS must cease by 1 October. With mounding not presenting an issue, the Contractor Dredge was able to place more than the originally planned 200 kcy in the site. The placement within NJS was 10.9% of the total volume (2.95 Mcy) placed at MCR in 2022. The government dredge *Essayons* did not use the NJS in 2022. Following the 2022 season, a total of approximately 8.32 Mcy of MCR dredged material had been placed within the NJS since the 1999 base condition. Figure 5-12 shows the difference between pre- and post-season surveys of 2022 and the base condition. Maximum accumulation reaches 5 feet at this site, which is below the 8 feet of depth allowed within NJS.

One Site Utilization Plan (Figure 5-13) was used by the contract dredge *Bayport* during the 2022 dredge-placement season. At the start of the season, the Limited Capacity Zone was focused at the western side and south side of the site. As the season progressed, some mounding occurred along the boundary of the limited capacity zone in the center of the site and the western side of the site, which is to be expected because it is more difficult to place at the edges of NJS. Since mounding was not found to be an issue during the season, the *Bayport* placed 321 kcy, over the allotted budget of 200 kcy of material. All placement occurred in a small window from 12 September to 30 September.

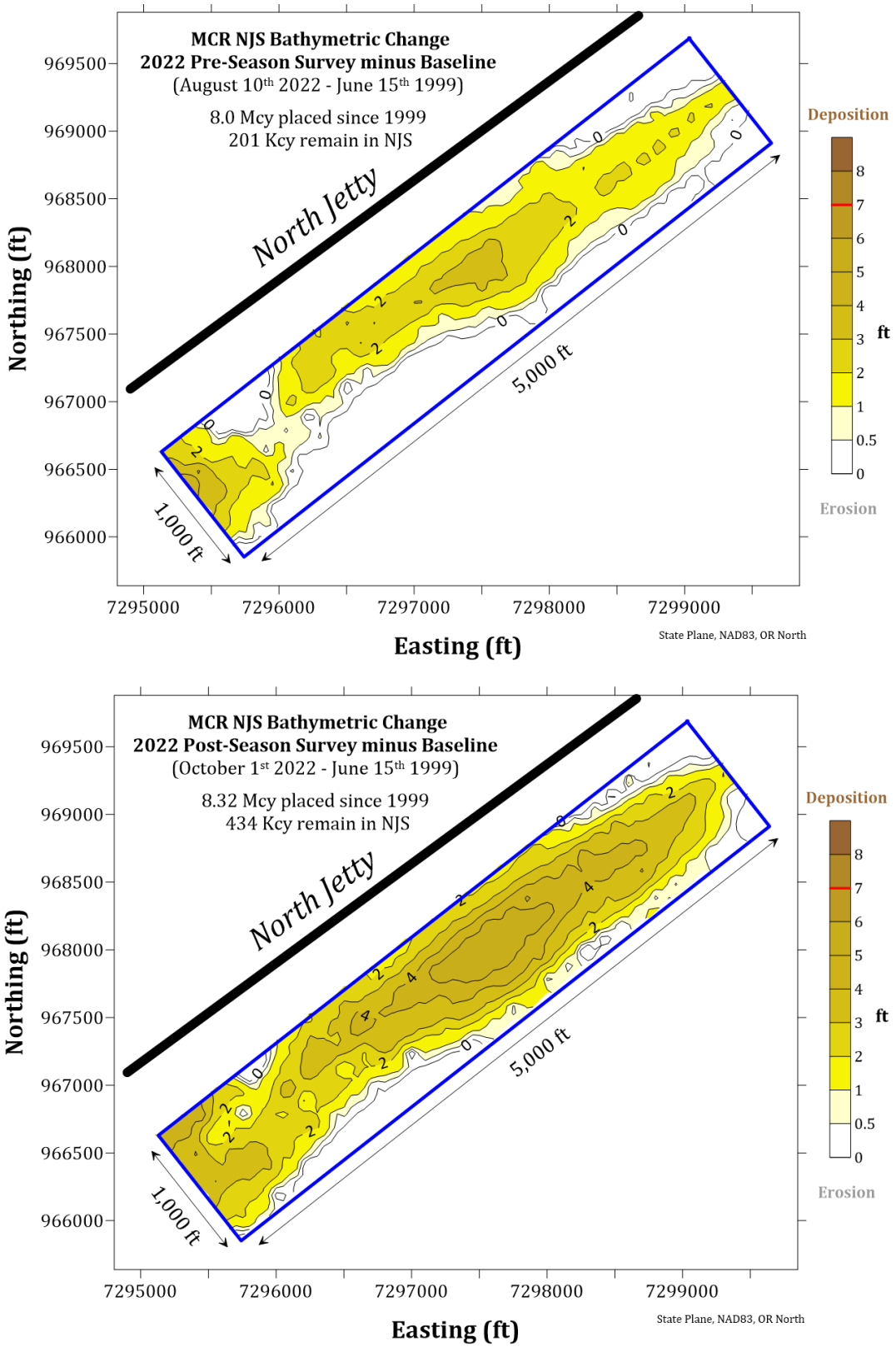

Figure 5-12: MCR North Jetty Site (NJS). Top – difference between 2022 Pre-Season and Baseline Surveys. Bottom – difference between 2022 Post-Season and Baseline Surveys.

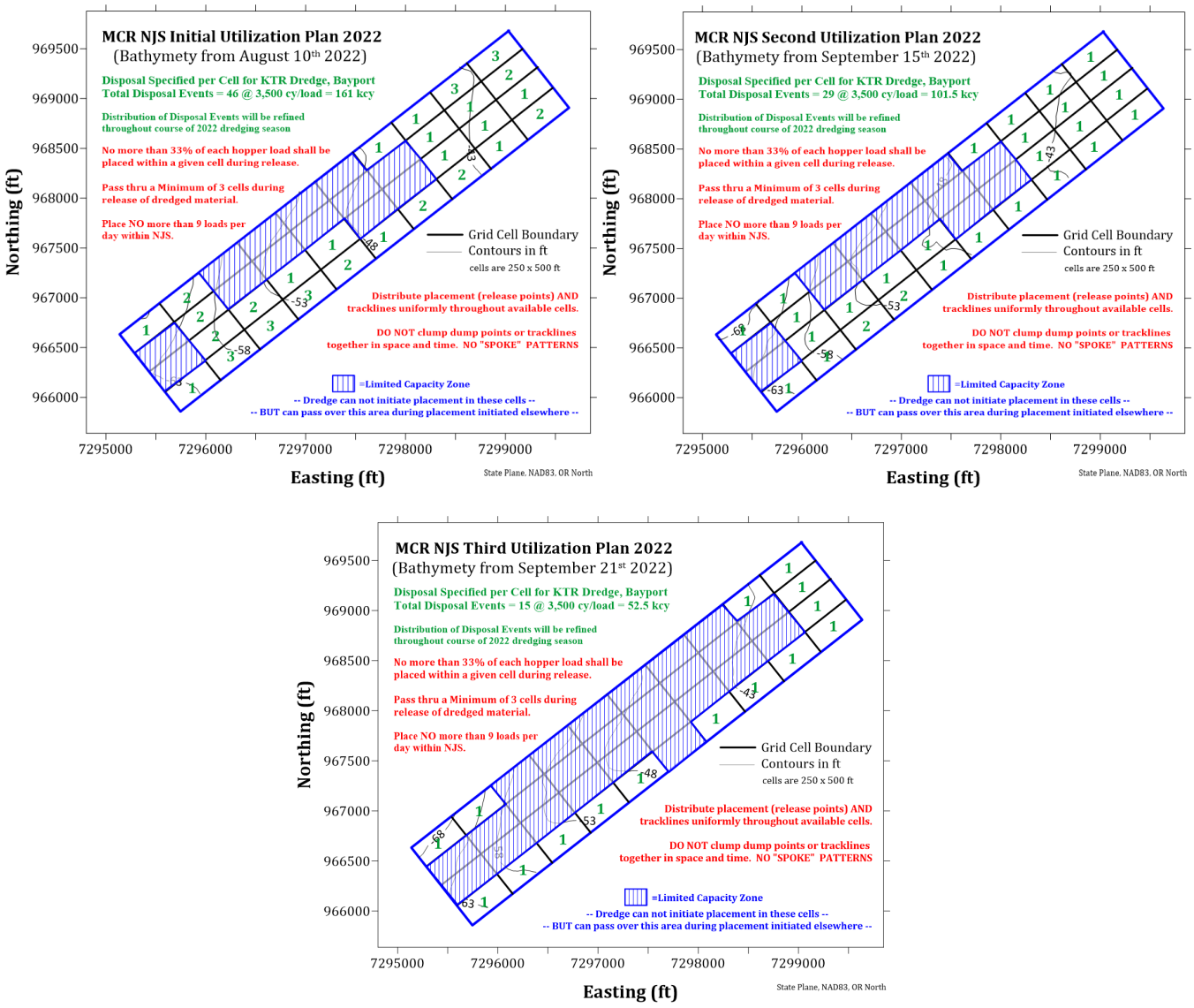

Figure 5-13: The site utilization plans used to guide MCR dredged material placement within the NJS during 2022. Numbered cells identify the number of times the loaded hopper dredge can initiate release of its load within the cell boundaries.

Start and End points for the individual dredge-load release actions throughout the season are shown in Figure 5-14. Note that the available (numbered) cells in Figure 5-13 correspond well with the Start locations (green dots) in Figure 5-14. Thus, indicating successful implementation of the 2022 Site Utilization Plans by the Contract dredge.

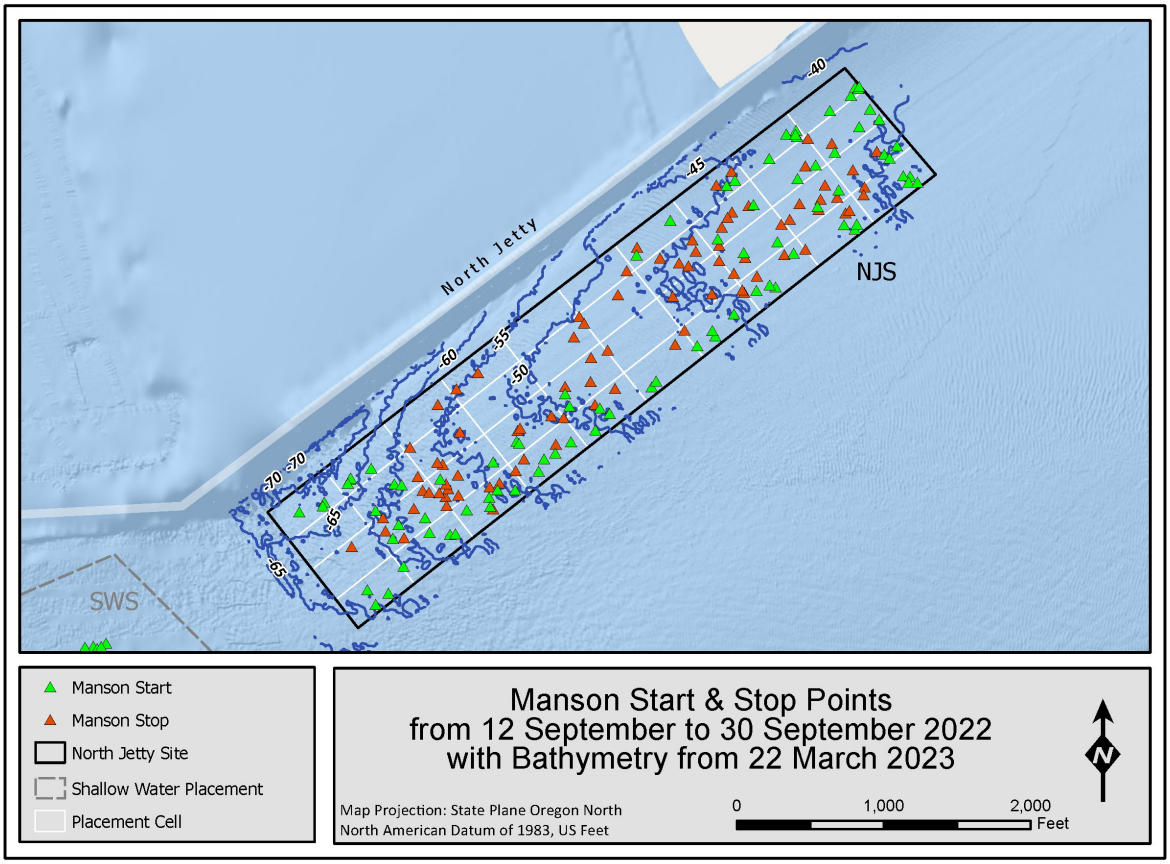

Figure 5-14: North Jetty Site (NJS) Utilization during 2022 Dredging Season showing START & END locations of contract dredge *Bayport* for each placement event on Post-Season bathymetry.

Figure 5-15 shows the difference between 1 October 2022 and 15 September 2022, which are surveys after and before the placement season, respectively. Total deposition during the 2022 dredge-placement for the NJS was 183 kcy. The *Bayport* placed 321 kcy in the NJS indicating 138 kcy of the material (43%) was transported out of NJS during the placement and fall season. Deposition of up to 4 feet occurred within the southwest edge of the site, with widespread mounding of about 1 foot occurring through much of the site in 2022.

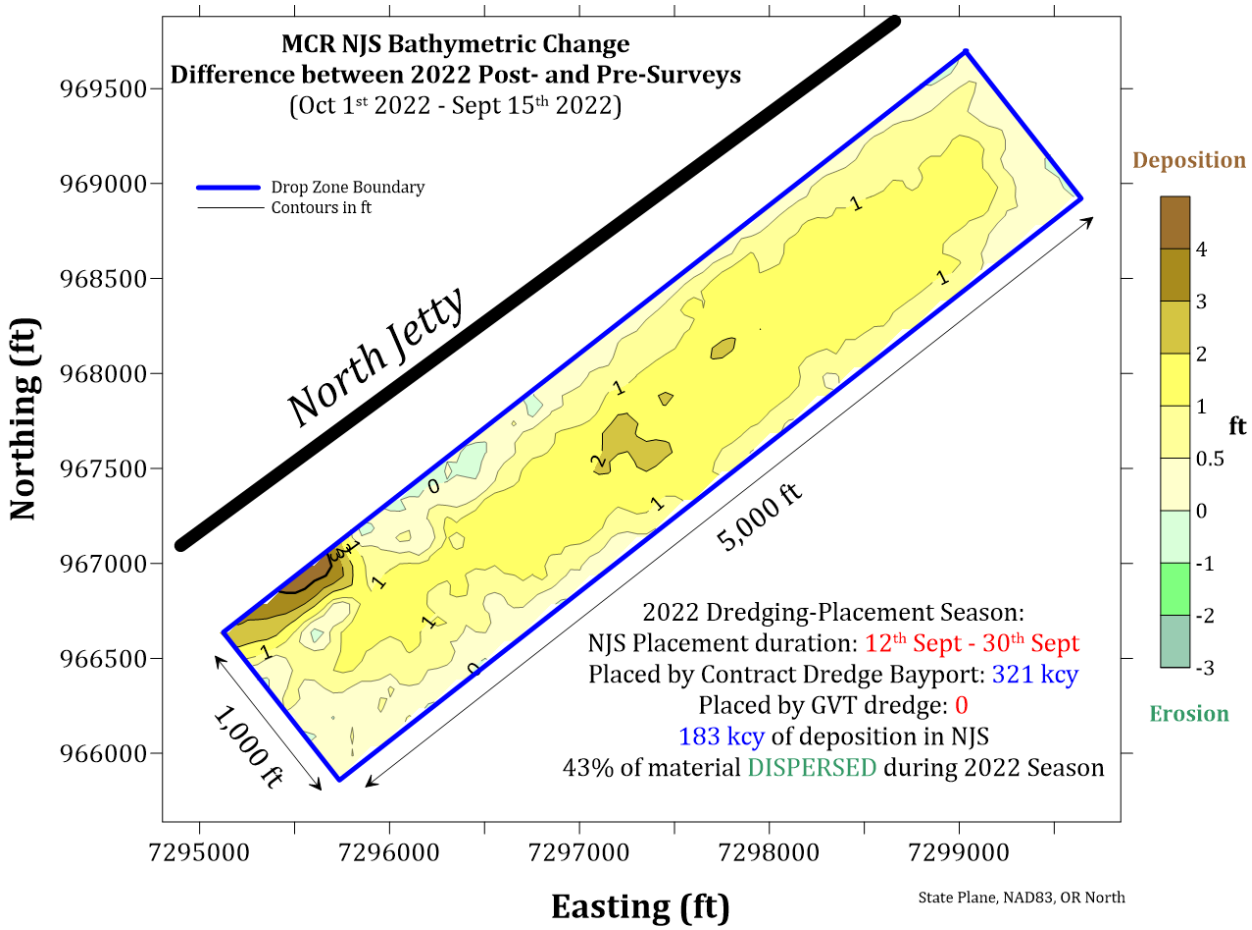

Figure 5-15: MCR North Jetty Site (NJS) Difference between 2022 Post-Season and 2022 Pre-Season Surveys.

5.5 South Jetty Site – SJS

Utilization of the SJS is of strategic importance to the region. Prior to 2012, the SJS and adjacent nearshore was identified as the area around the MCR with the greatest need of dredged material. The scouring of the seabed on the south side of the jetty, already observed for many years, was expected to accelerate without the input of sand into the littoral zone. Placement within the SJS is intended to reverse this trend and reduce wave damage to the jetty and foredunes along the root of the jetty.

Since its initial use, a conservative utilization plan has been implemented at SJS limiting placement to 0.5 Mcy and mounding to 4 feet. Furthermore, a method of thin-layer dredged material placement (deposition thickness per load less than 0.25 feet) is specified to promote dispersion and minimize benthic impacts. Cell-based placement guidance (see Figure 5-16) further mitigates against any potential risks to adversely affect the surrounding area associated with new site utilization (e.g., unintended wave shoaling).

The Utilization Plan for SJS in 2022 distributed placement cells uniformly across Zone 1, 2 and 3 (Figure 5-16). During 2022 (from 2 September through 16 September, with one

additional placement event on 30 September), the government dredge *Essayons* placed approximately 310 kcy of MCR dredged material within the SJS (Table 5-2). A total of approximately 3.2 Mcy of MCR dredged material has been placed within the SJS since the 2012 base condition (Table 5-3).

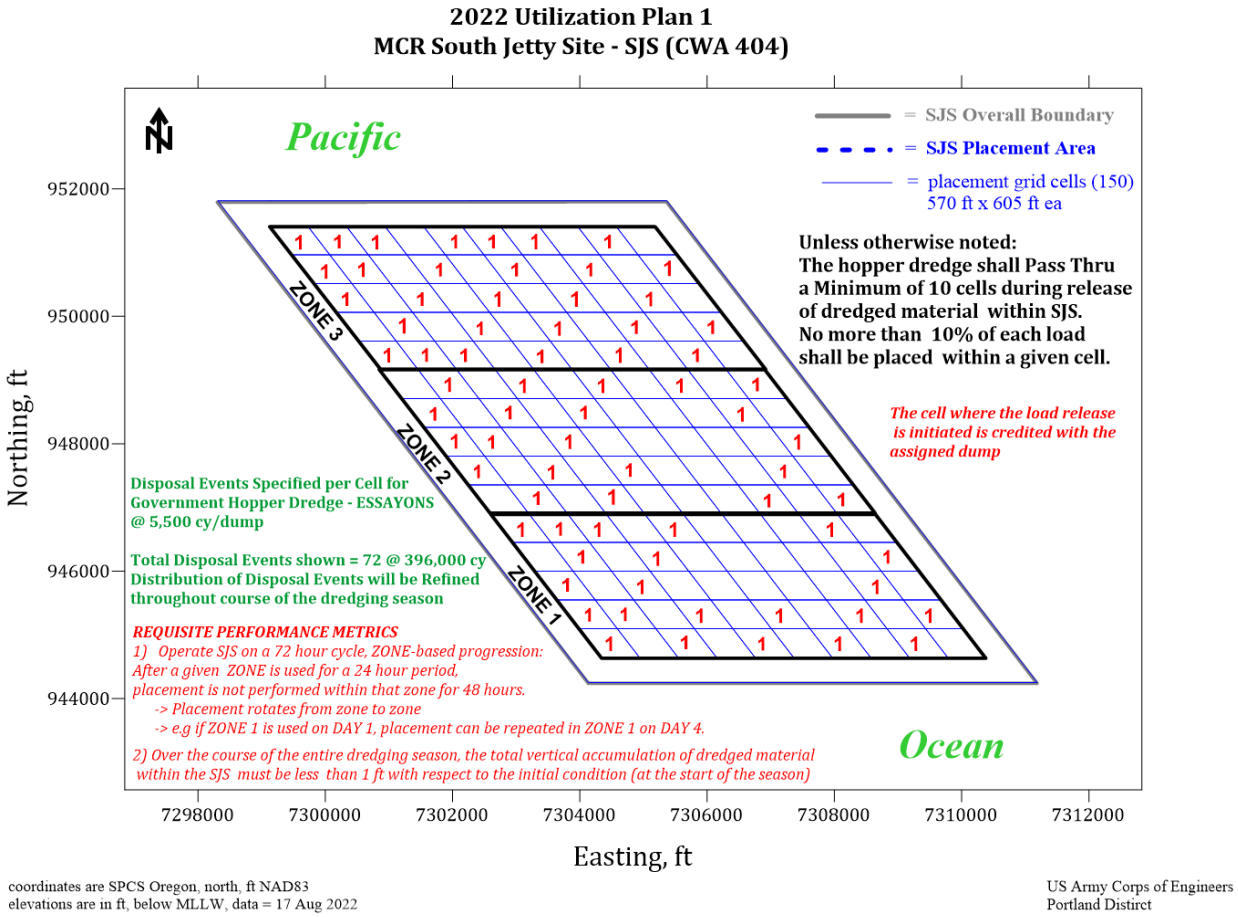

Figure 5-16: South Jetty Site Initial Utilization Plan for 2022.

Figure 5-17 shows the level of sediment accumulation within the SJS between 17 August 2022, prior to the beginning of the 2022 dredging season, and the 2012 baseline condition. At the beginning of the 2022 season, 253 kcy remained of the 2.9 Mcy of material that had been placed in the SJS since 2012. Accumulation reached approximately 0.5 foot in the center of Zone 1, 2 and 3. This is well below the maximum allowable accumulation of 4 feet.

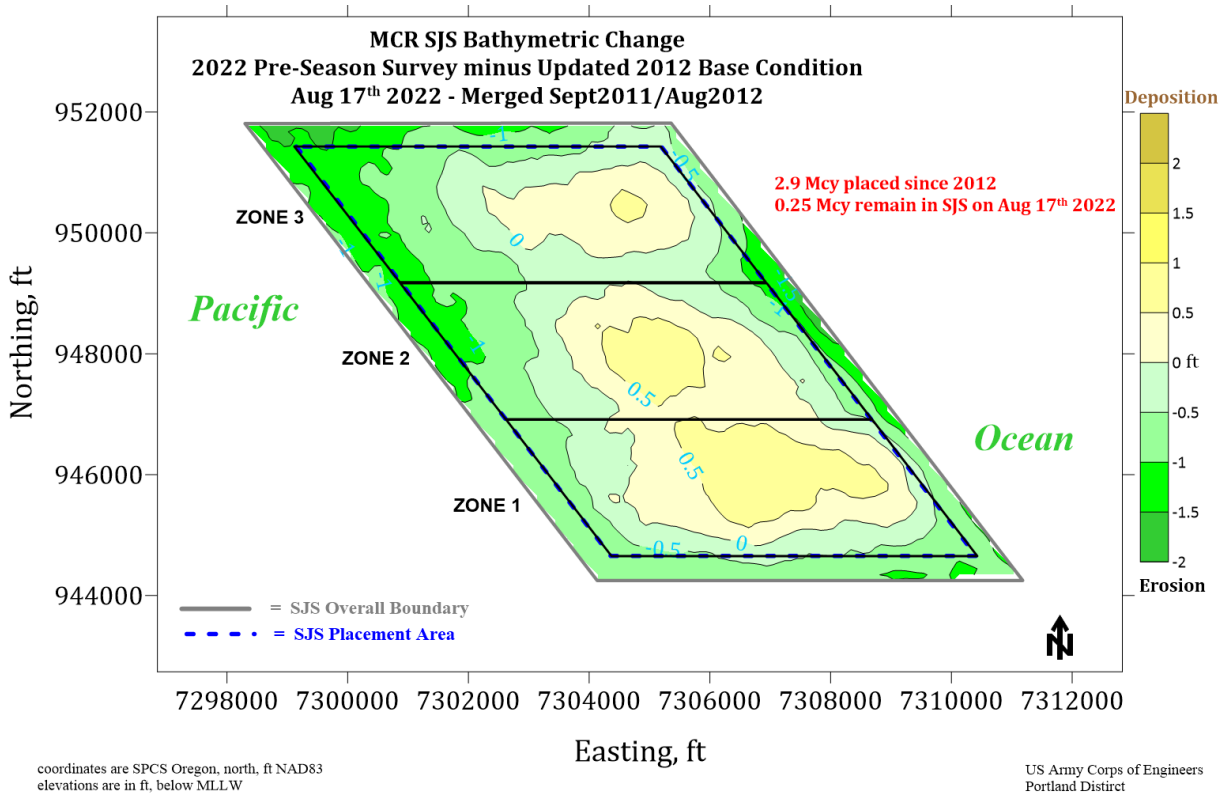

Figure 5-17: MCR SJS Bathymetric Change 2022 Pre-Season Survey - 2012 Baseline.

Figure 5-18 shows the level of sediment accumulation within the SJS between 21 September 2022, after the majority of placement for the 2022 season, and the 2012 baseline condition. The accumulation within the southern and central zones (Zone 1 and Zone 2) exceeds 1 foot of height above the baseline survey. This is well below the maximum allowable accumulation of 4 feet. At the end of the 2022 season, 450 kcy remained of the 3.2 Mcy of material that had been placed in the SJS since 2012.

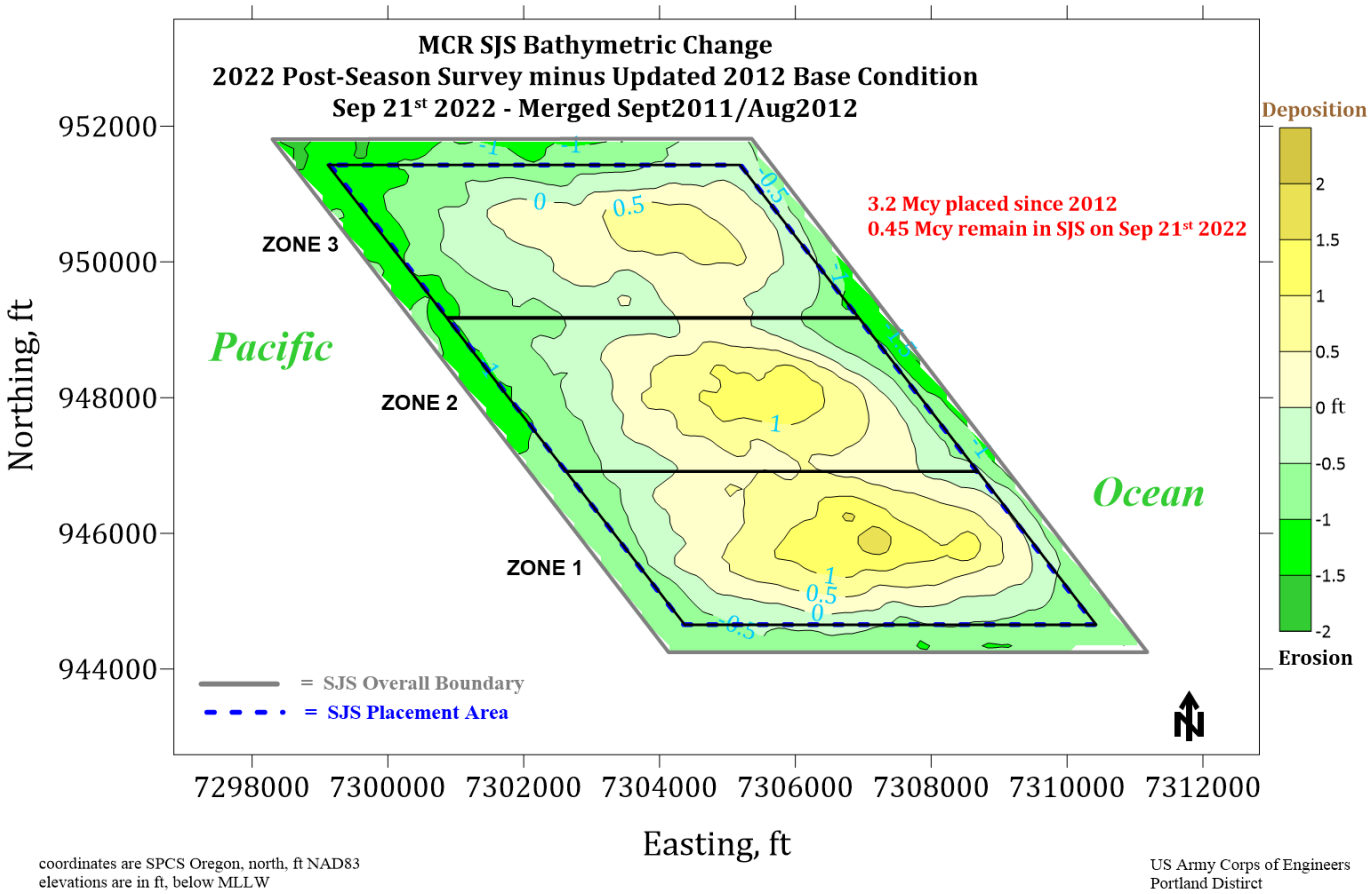

Figure 5-18: MCR SJS Bathymetric Change 2022 Post-Season Survey - 2012 Baseline.

Figure 5-19 shows the level of sediment accumulation within the SJS between pre- and post-season surveys (17 August to 21 September 2022). The accumulation within the SJS continues to stay below the protocol for total cumulative deposition within the SJS (at the conclusion of the dredging season) to not exceed 1 foot. Through the season, the SJS accumulated more material than was placed, but this material is expected to disperse through the 2022/2023 winter season, before placement begins in 2023. The 2023 season will be discussed in Section 7.

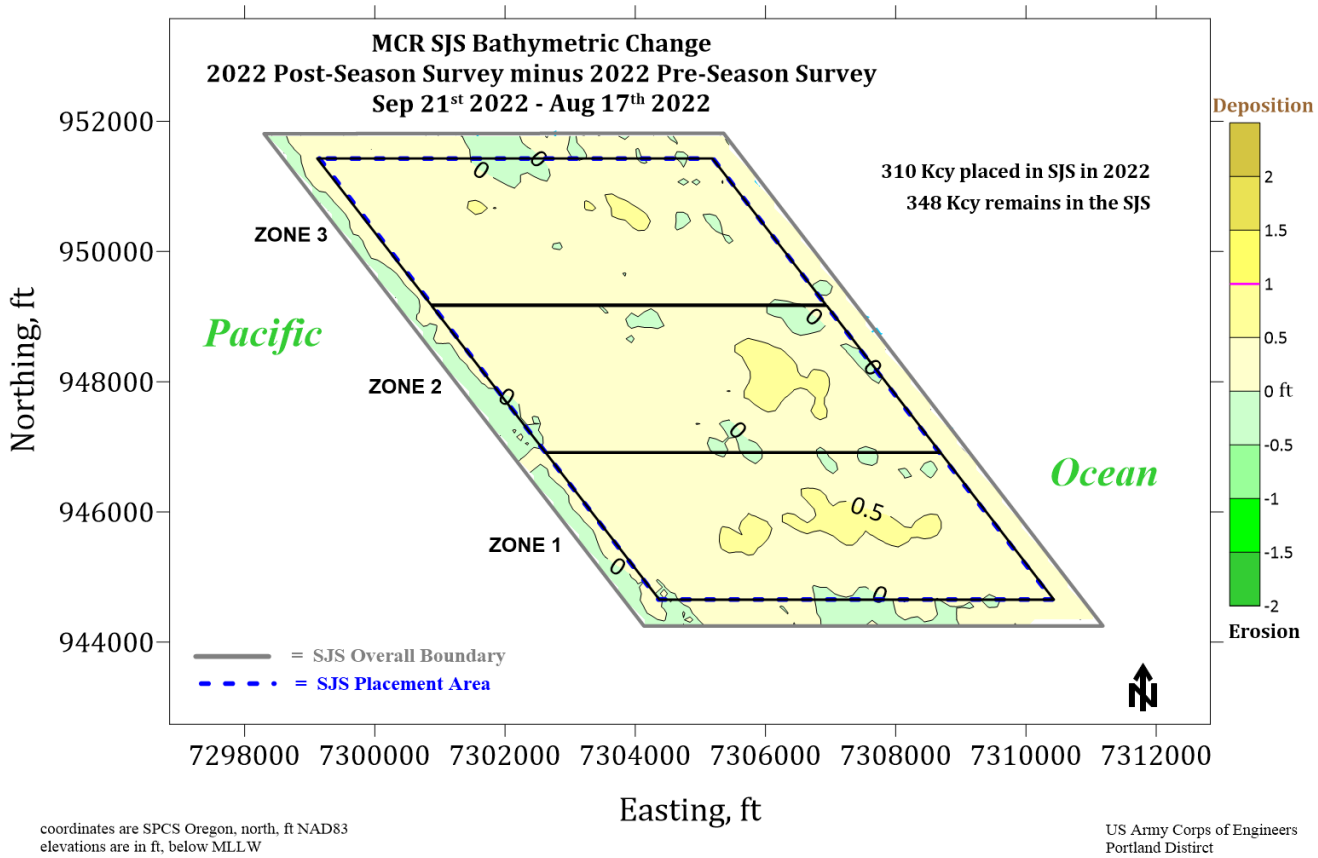

Figure 5-19: MCR SJS Bathymetric Change 2022 Post-Season Survey – 2022 Pre-Season Survey.

Start and End points for the individual dredge-load release actions throughout the season are shown in Figure 5-20.

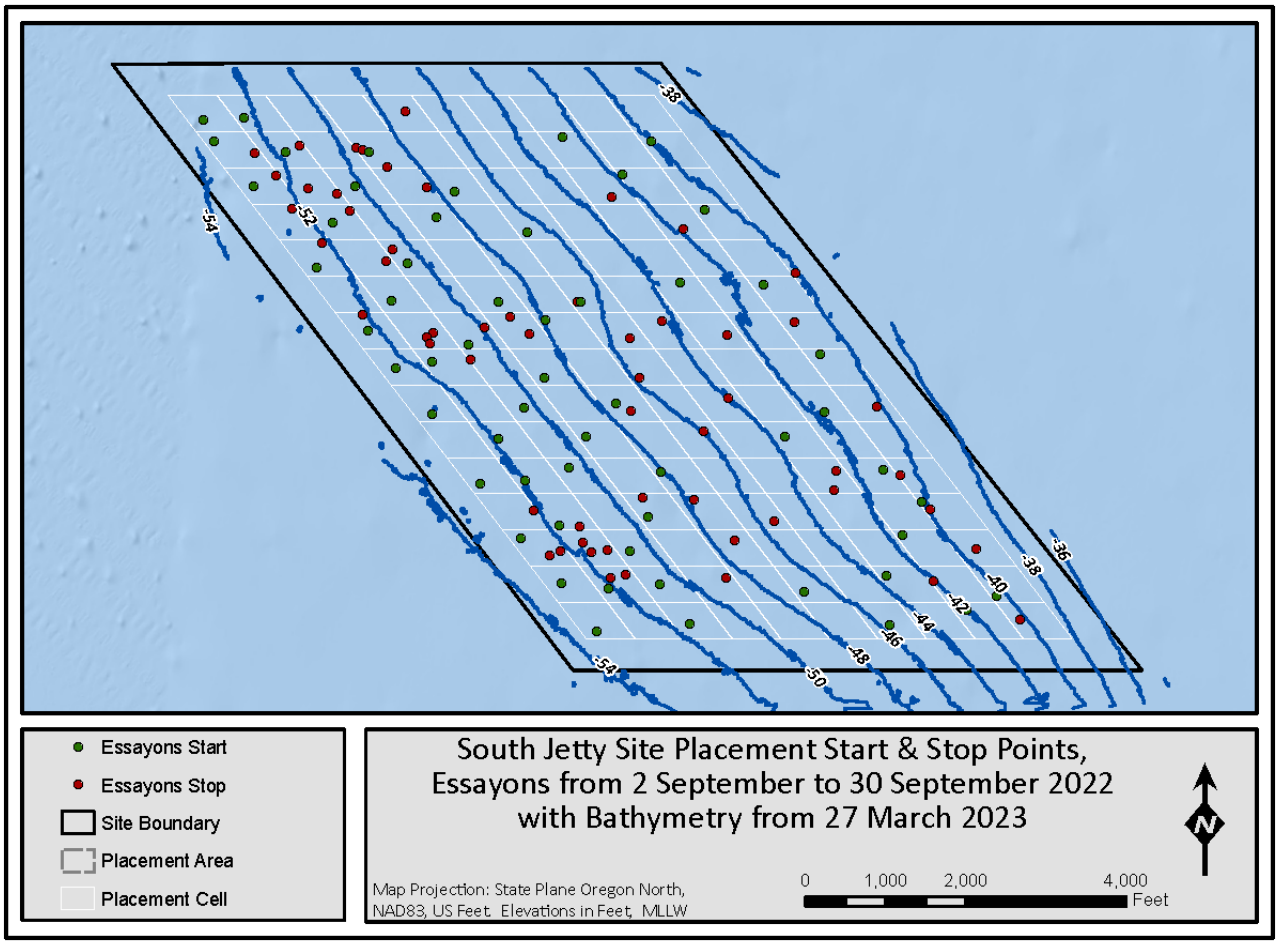

Figure 5-20: START & END Points for individual loads of the *Essayons* at the SJS.

5.6 North Head Site – NHS

The NHS was first used "operationally" during 15 to 25 September 2021. This section of the AUP reviews operational use of the NHS during 2022, as illustrated by the bathymetry change within the site in response to dredged material placement. The NHS is managed in terms of cumulative bathymetry change with respect to the site's baseline condition as expressed in May 2021. The total volume of dredged material placed within NHS during 2021 and 2022 was 744,000 cy, with both placement events occurring within the southern third of the NHS (Zone 1).

Figure 5-21 illustrates bathymetry change within zone 1 of the NHS during 11 May 2021 to 15 September 2022, showing the effects of dredged material placement during September to October 2021 and the ensuing effects of "natural" bathymetry change processes during post-2021 placement (12 October 2021) and pre-2022 placement (15 September 2022). The 15 September 2022 survey documented the 2022 pre-placement condition of NHS-Zone 1.

Results in Figure 5-21 indicate that a significant volume of ambient sediment was transported into zone 1 of the NHS during May 2021 to 15 September 2022; almost 4 times the amount of dredged material placed during 15 to 25 September 2021. The conclusion from Figure 5-21 is that the seabed within the NHS (Peacock Spit) is not static, as natural sediment transport processes that can exceed the volume of dredged material placed within the site on a year to year basis (400,000 cy). This assessment is consistent with bathymetry change results shown *AUPs* from 2021 and 2022. Although the seabed within NHS-Zone 1 is active, the cumulative effect of adding 400,000 cubic yards per year (cy/yr) of dredged sand to Peacock Spit (via placement within the NHS) will augment the sediment budget of the MCR nearshore. Over time, the 400,000 cy/yr "supplement" will provide significant benefit to the littoral budget of Peacock Spit and Long beach peninsula. The year-to-year management of the NHS will need to account for the dynamic nature of this placement site, as some years the site may appear to be "full" due to natural sediment transport processes.

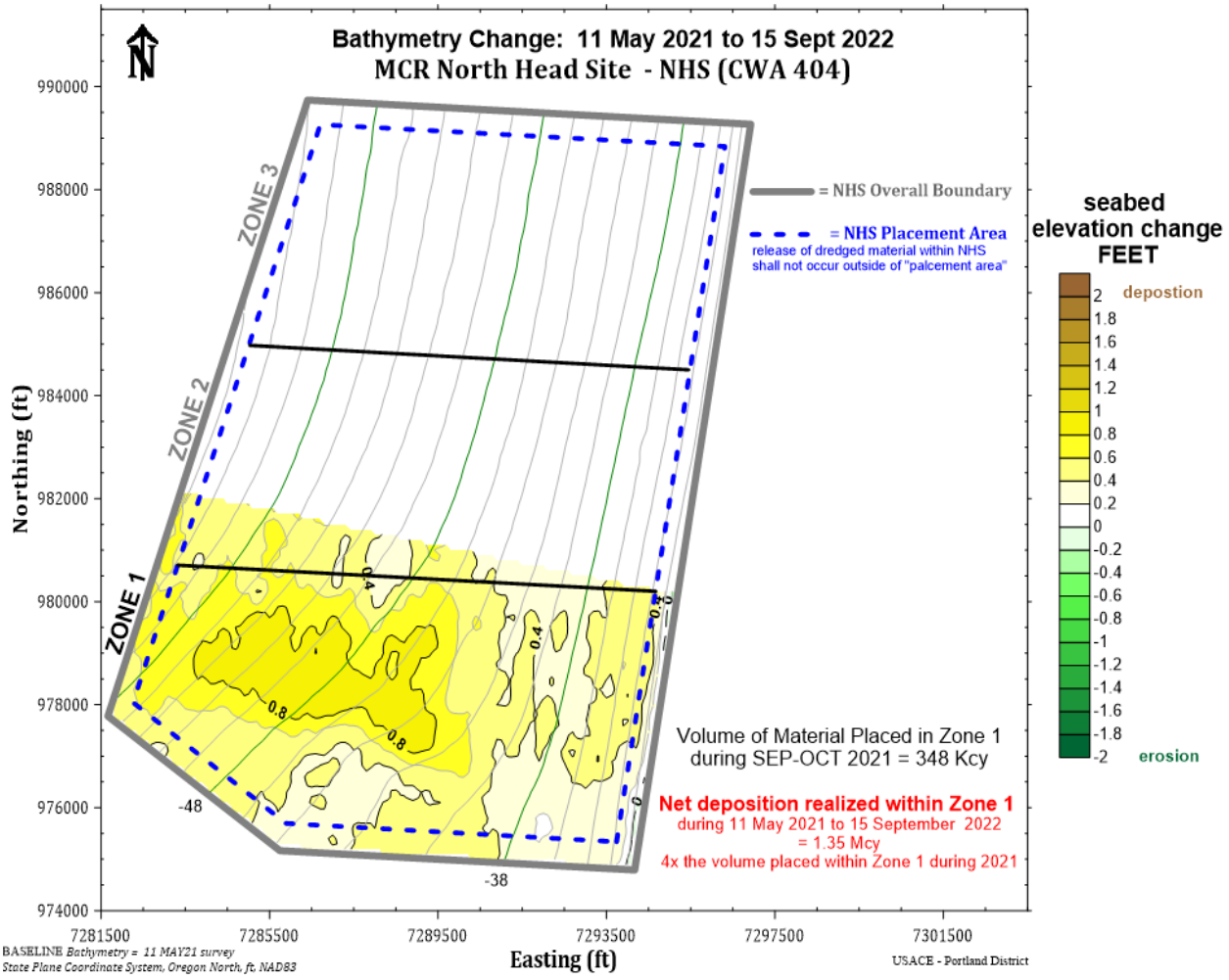

Figure 5-21: North Head Site bathymetry change from May 2021 baseline condition to September 2022.

Based on Figure 5-21, there was 0.8 to 1 foot of deposition realized within Zone 1 of the NHS during May 2021 to September 2022, meaning that there was 1 foot of deposition "capacity" remaining within Zone 1 for the 2022 placement season. Figure 5-22 shows the Utilization Plan that was used for the NHS during 2022. Placement of dredged material within the NHS during 2022 commenced on 16 September and was performed by the government hopper dredged *Essayons*. During 16 September to 6 October 2022, 73 loads (5,400 cy/ea) of sand dredged from the MCR FNC was placed within the southern third (Zone 1) of the NHS, totaling 396,000 cy.

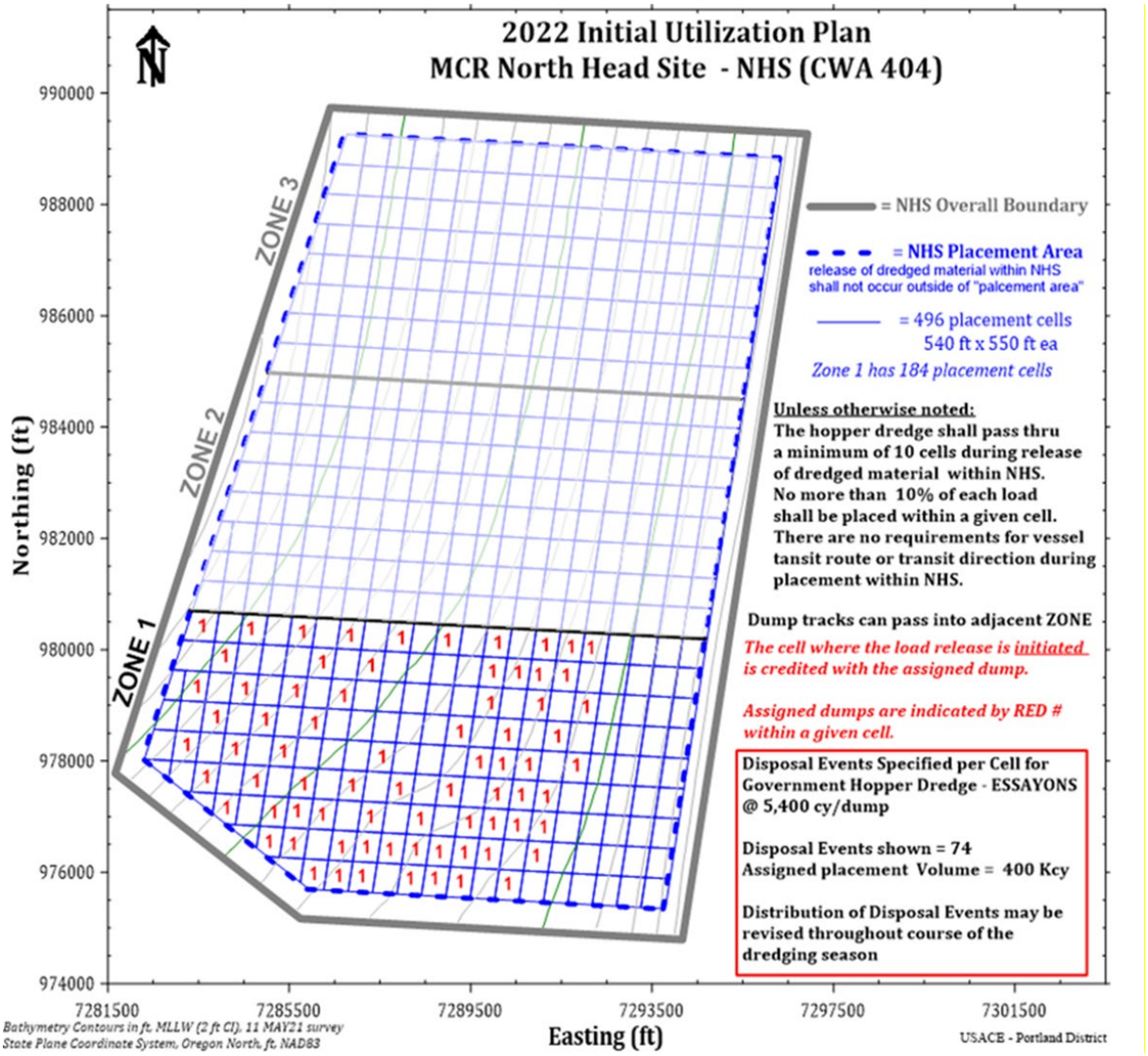

Figure 5-22: 2022 utilization Plan for the North Head Site.

Figure 5-23 shows bathymetry change within NHS-Zone 1 resulting from the 2022 placement of 396,000 cy by the *Essayons*; or the difference between pre-placement survey of 15 September 2022 and post-survey of 12 October 2022. The 12 October 2022 survey did not span the entire area of Zone 1 due to deteriorating weather conditions during the survey.

Survey coverage was sufficient to document maximum deposition realized within the site due to 2022 dredged material placement (0.5 foot). However, the 12 October 2022 survey coverage was not sufficient to provide reliable confirmation of the volume deposited on the seabed within Zone 1. During September to October 2022, there was 0.1-0.3 foot of seabed lowering (erosion) within the eastern third of Zone 1, a similar trend as realized within the southern extent of Zone 2. The area of deposition within Zone 1 due to 2022 dredged material placement is evident by the area of positive bathymetry difference (seabed elevation increase). Based on the deposition aspects shown in Figure 5-23, use of NHS during 2022 did not exceed the 1 foot deposition criterion for single season deposition (Section 4.1.3).

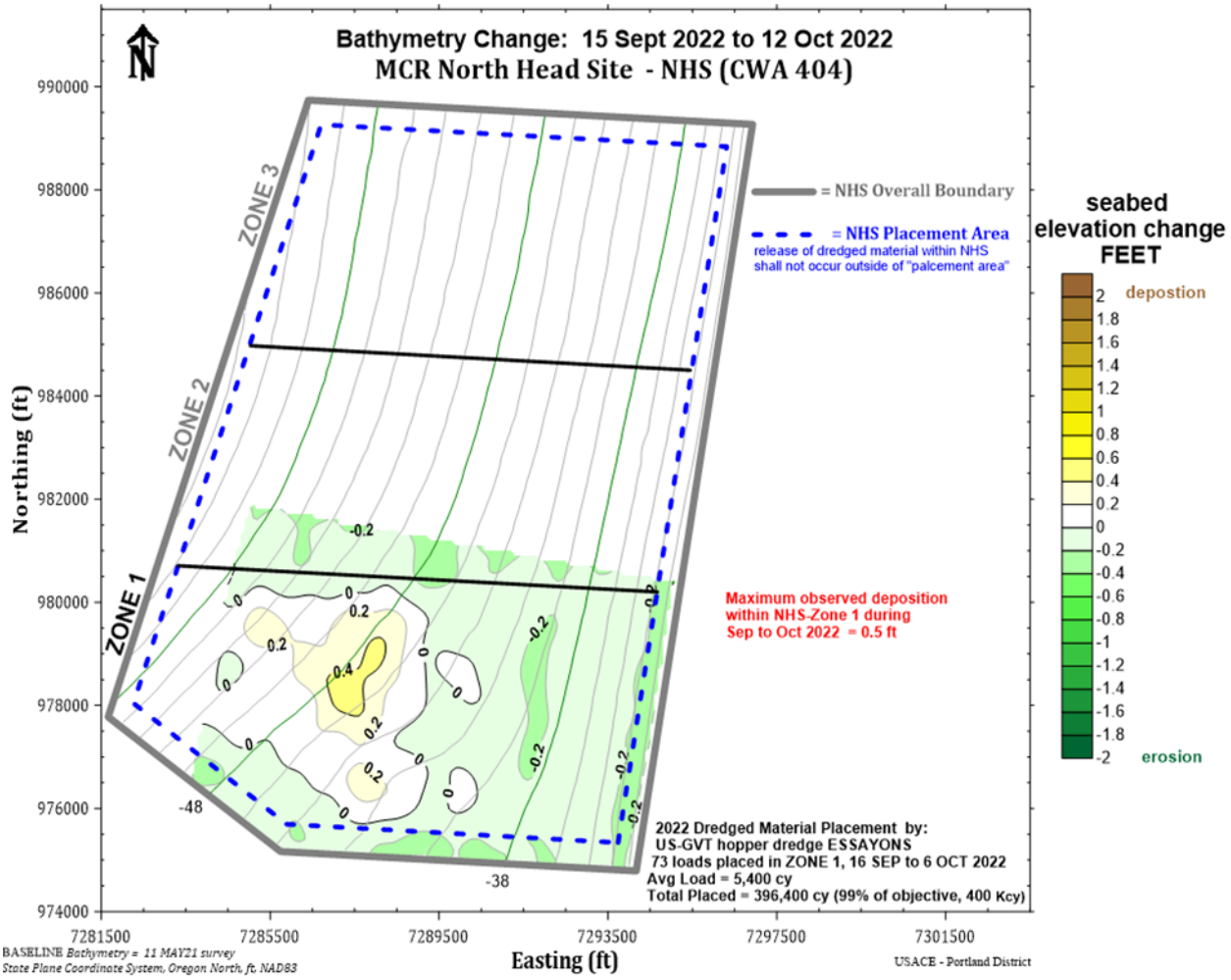

Figure 5-23: North Head Site bathymetry change from 15 September 2022 to 12 October 2022.

Figure 5-24 shows the cumulative bathymetry change observed within NHS-Zone 1 during May 2021 and 12 October 2022, accounting for dredged material placement during 2021 and 2022 (744,000 cy total placed). During 2021 and 2022, dredged material placement within NHS was confined within Zone 1 according to assigned placement cells and resulting dredge

placement-tracklines. Bathymetry change outside of Zone 1 was due to "natural" sediment transport processes either re-distributing dredged material previously placed on the seabed or depositing new ambient within the NHS. The height of cumulative deposition realized within Zone 1 since acquisition of the 11 May 2021 baseline survey is 1.2 feet; which is a less than the total deposition criterion of 2 feet (site management limit). To avoid exceeding the 2 feet deposition limit during 2023 NHS placement operations, Zone 2 will be used during 2023. See Section 7.9 for the 2023 NHS placement plan.

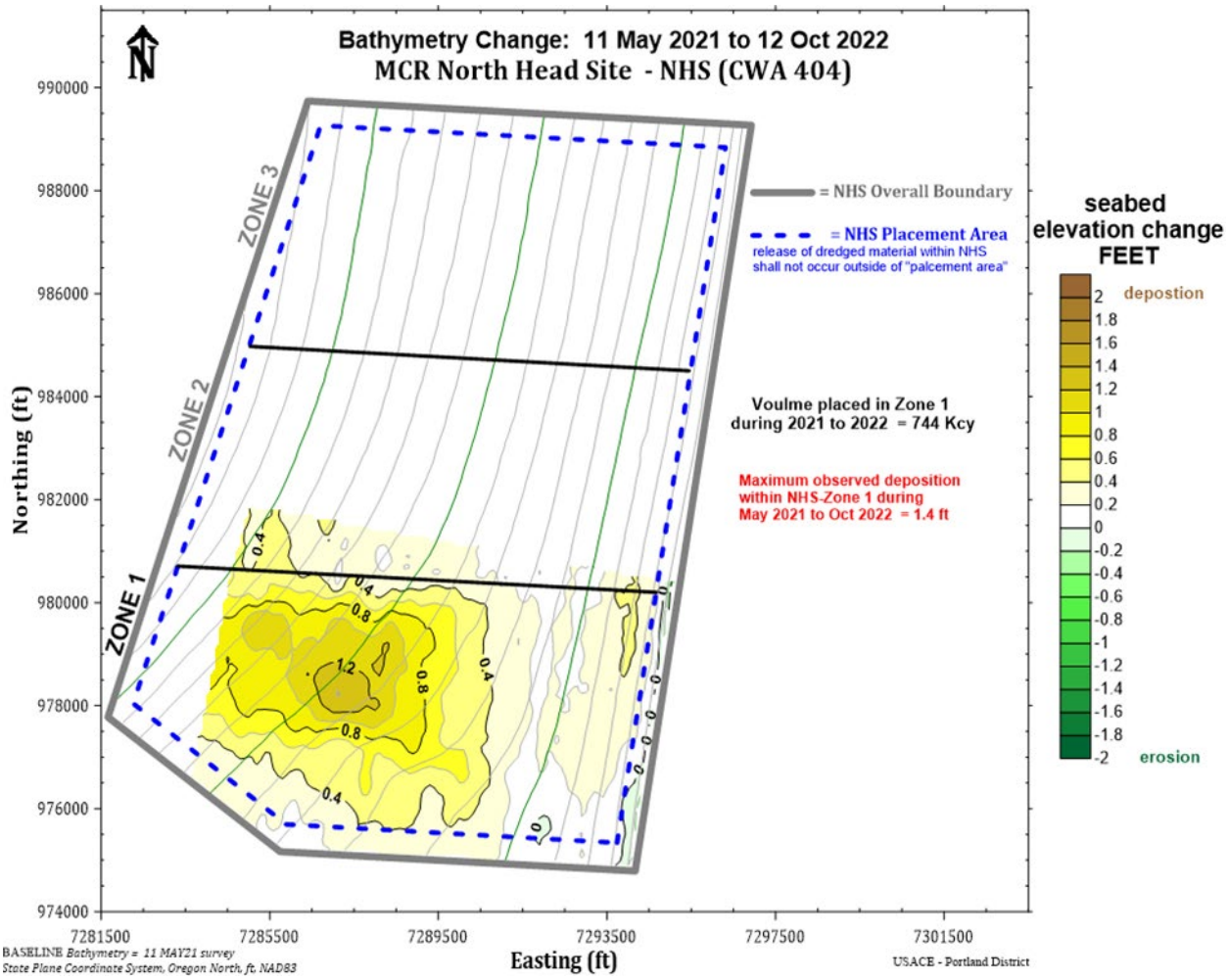

Figure 5-24: North Head Site bathymetry change from May 2021 baseline condition to Oct 2022.

Figure 5-25 summarizes bathymetry change within the entire NHS during May 2021 to April 2023. During this time overall net volume change within the NHS was 3.8 million cy, with total deposition of 4.3 Mcy and total erosion of 0.5 Mcy. The height of deposition ranged from 1.6 feet (Zone 2) to 2 feet (Zone 3). These bathymetry change effects were due to natural sediment transport processes within the NHS, as no dredged material was placed in Zone 2 or 3 during May 2021 to April 2023. For Zone 1, the net volume of seabed change shown in Figure 5-25 (during May 2021 to October 2022) was 1.1 Mcy; recall that 0.74 Mcy

was placed within NHS-Zone 1 during this time. The height of deposition within zone 1 during May 2021 to April 2023 was 1.2 feet.

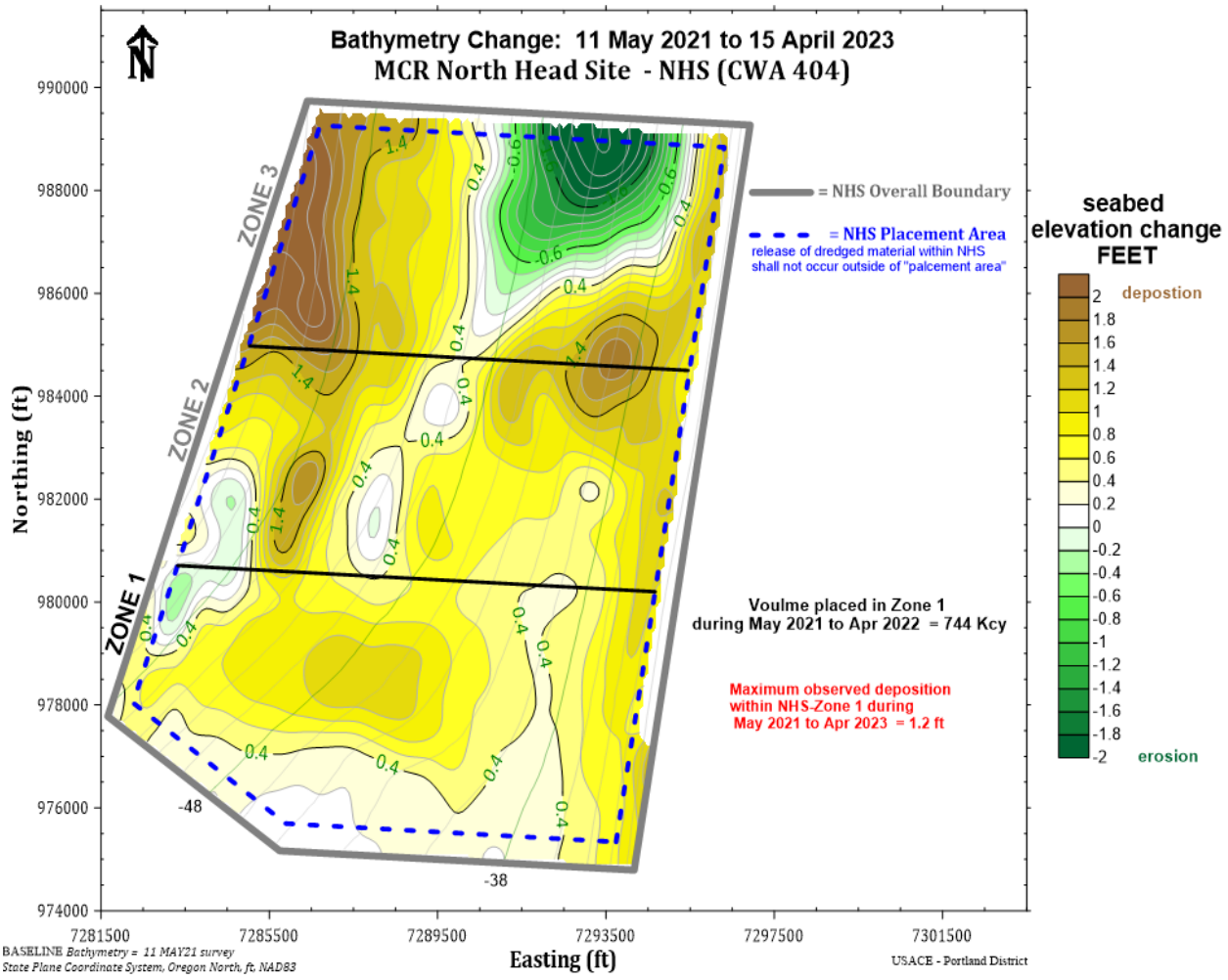

Figure 5-25: North Head Site bathymetry change from May 2021 baseline condition to April 2023.

6 MONITORING COMPLETED IN 2022

CENWP's goal is to maximize nearshore dredged material placement and limit offshore disposal at the DWS. Under our §404 Clean Water Act authority, we have selected three nearshore beneficial use sites: the NJS, SJS, and NHS; the NHS became fully operational in 2021. These beneficial use sites, along with the EPA-designated SWS, provide us with the opportunity to place all MCR dredged material nearshore. CENWP's monitoring program at the MCR is essential to evaluate the potential impacts and benefits of nearshore dredged material placement. This monitoring program also informs dredged material management decisions across the MCR disposal site network.

In 2022, four sets of monitoring activities were performed at the MCR:

- Beach nearshore bathymetry and beach profile topographic data collection and analysis north and south of the MCR jetties by the U.S. Geological Survey (USGS), Washington Department of Ecology (Ecology), and Oregon State University (OSU).
- Nearshore bathymetry data collection and analysis on the backside (interior) of Clatsop Spit and West Sand Island by USGS.
- Hydrodynamic and sediment transport modeling by USGS.
- Benson Beach-North Jetty dynamic revetment design and evaluation by Ecology.
- Seasonal unmanned aerial system (UAS) surveys of Benson Beach at low-low tide by USACE.

6.1 MCR NEARSHORE BATHYMETRY AND BEACH TOPOGRAPHY (USGS, ECOLOGY, & OSU)

Between July and October, the USGS, Ecology, and OSU continued the annual baseline nearshore monitoring at Benson Beach, North Head, and South Jetty (Figure 6-1). The USGS collected nearshore bathymetric survey data and Ecology collected topographic data along beaches immediately north and south of the mouth of the Columbia River. These data were collected along a series of shore-perpendicular transects spaced at 50 m to 200 m intervals. Nearshore bathymetry data were collected using personal watercraft equipped with global navigation satellite system (GNSS) receivers and single beam echosounders. Topographic profiles were collected on foot with backpack mounted GNSS receivers. Additional topographic data were collected between survey lines using all-terrain vehicles (ATV) equipped with GNSS receivers to better characterize the morphology of the beach.

Ecology also continued seasonal baseline topographic monitoring at Benson Beach, North Head, South Jetty, and Clatsop Spit. Ecology collected supplemental beach surface and transect data to further document seasonal conditions at the MCR. These surveys continue to quantify seasonal beach changes to identify trends and possible influences from CENWP's

strategic nearshore placement of dredged material. Ecology collected three-dimensional surface maps at each site with an ATV from low water (0 feet NAVD88) to the upper beach at the dune toe or vegetation line, extending as shown in Figure 6-2 (from the Long Beach to the North Jetty) and Figure 6-3 (from the South Jetty and southward along Clatsop Spit). The beach profiles extend landward of the foredune crest to sufficient distance as to capture the backshore elevation.

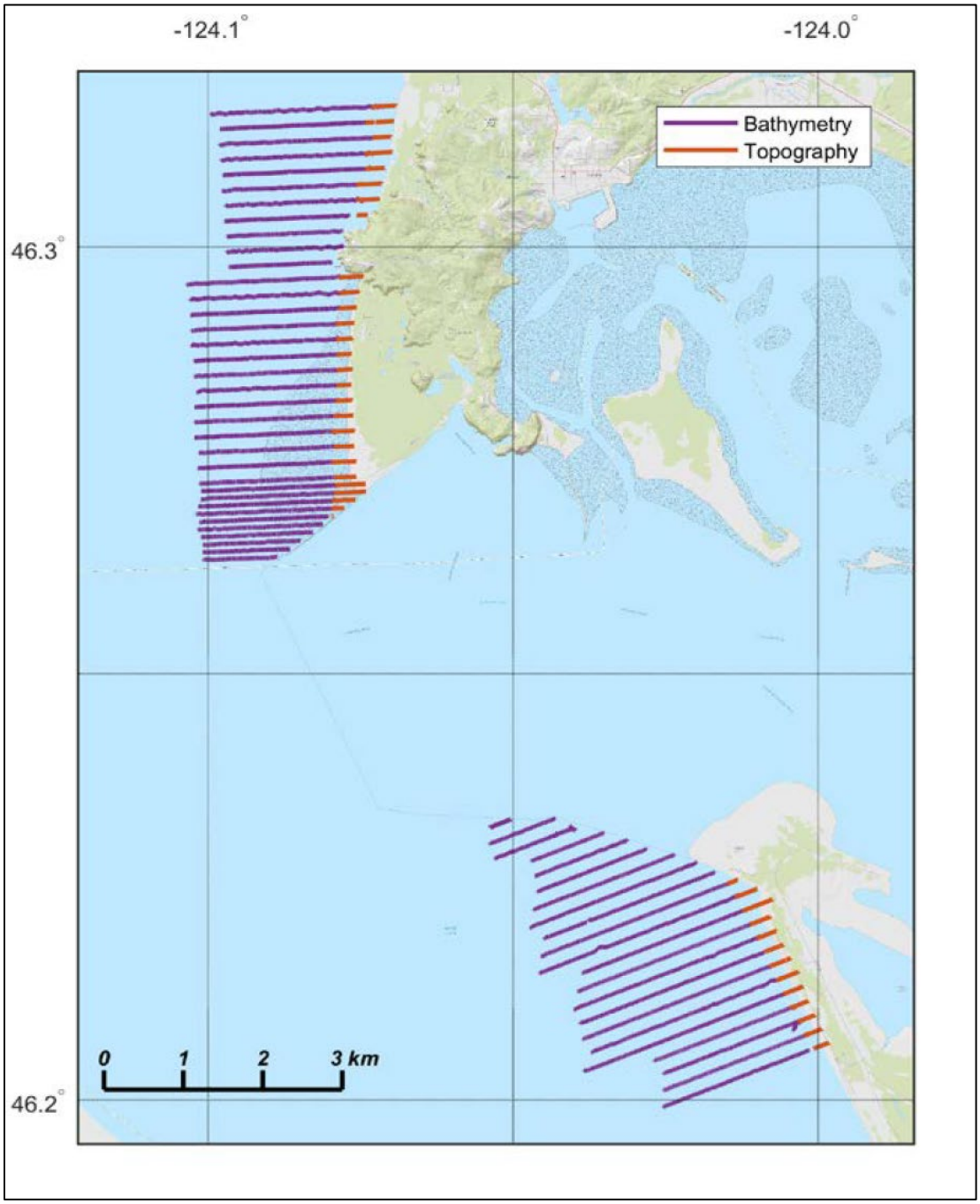

Figure 6-1. Nearshore bathymetry and beach profile topography transects along the Long Beach Peninsula and Clatsop Spit, Washington/Oregon.

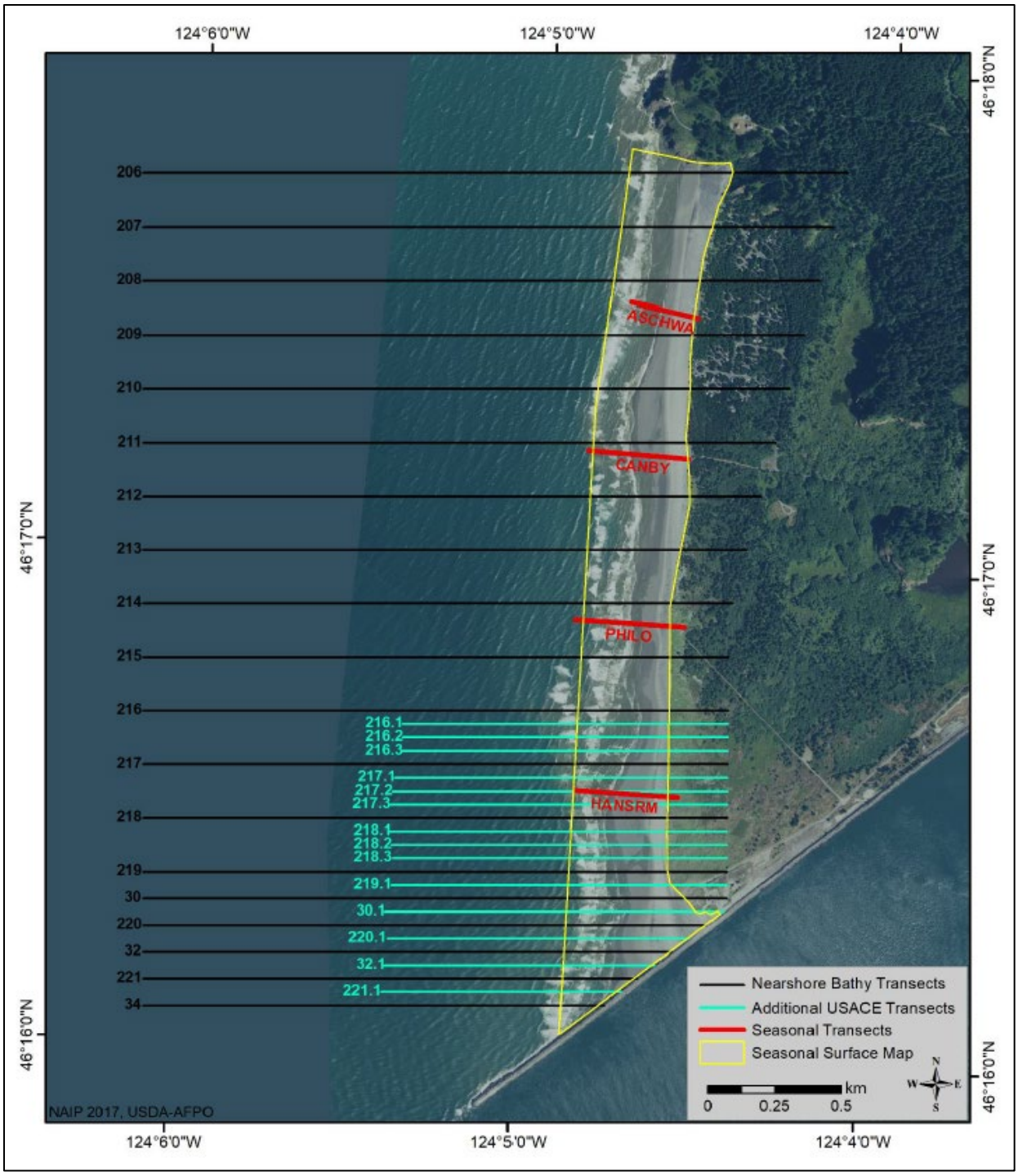

Figure 6-2. North Head topographic beach profiles, surface map, and nearshore bathymetric transects.

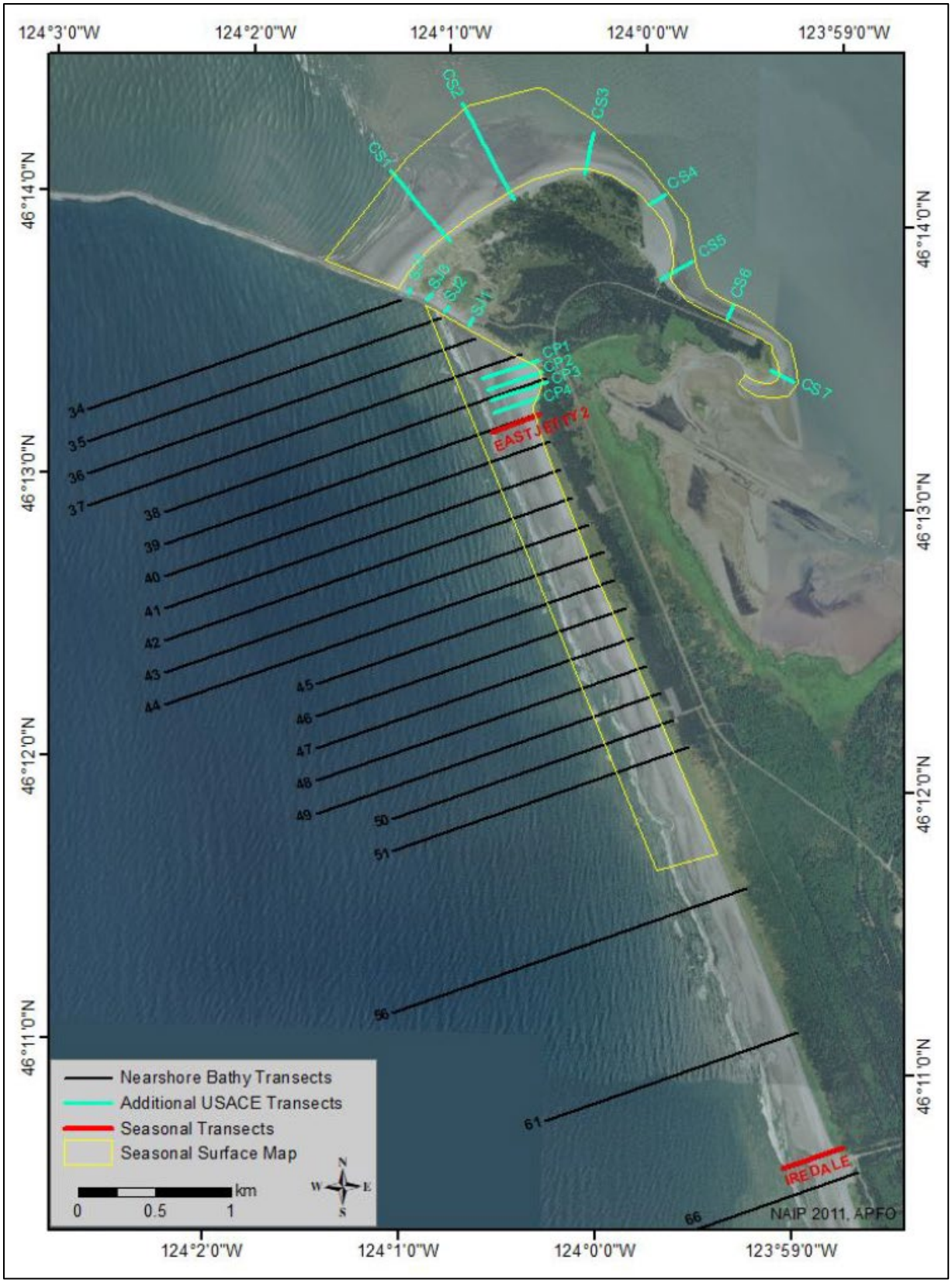

Figure 6-3. Clatsop Spit topographic beach profiles, surface maps, and nearshore bathymetric transects.

6.2 CLATSOP SPIT AND WEST SAND ISLAND BATHYMETRIC SURVEYS (USGS)

Bathymetric surveys at Clatsop Spit and West Sand Island will be performed annually during the summer months using similar methodologies described in Section 7.10.1. USGS performed the first round of bathymetric surveys of Clatsop Spit and West Sand Island in July 2022. The goal of these additional transects is to annually to assess coastal change hazards and support adaptive management strategies in the lower Columbia River estuary.

The Clatsop Spit survey area extends approximately 1,500 m on the northeastern end of the peninsula and includes 28 survey lines spaced at roughly 70-meter (m) intervals along the shoreline (Figure 6-4). Bathymetric soundings were collected along each survey line between water depths of about 10 m and the shoreline.

The West Sand Island survey area is located on the southwestern portion of the island and covers approximately 2,300 m (Figure 6-5). The survey consisted of 40 cross-shore transects that extended between the shoreline and 10-m water depth spaced at 70-m intervals.

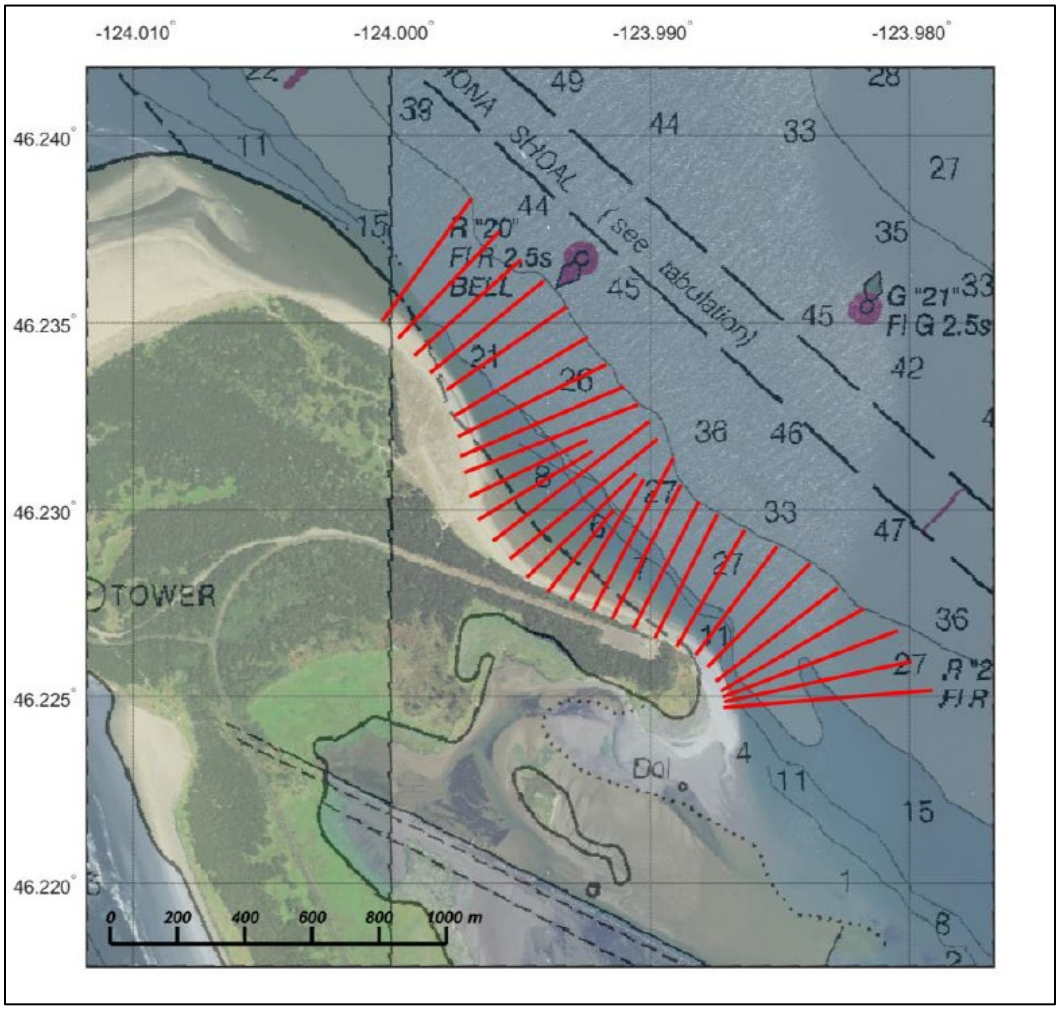

Figure 6-4. Backside of Clatsop Spit surface map and nearshore bathymetric transects.

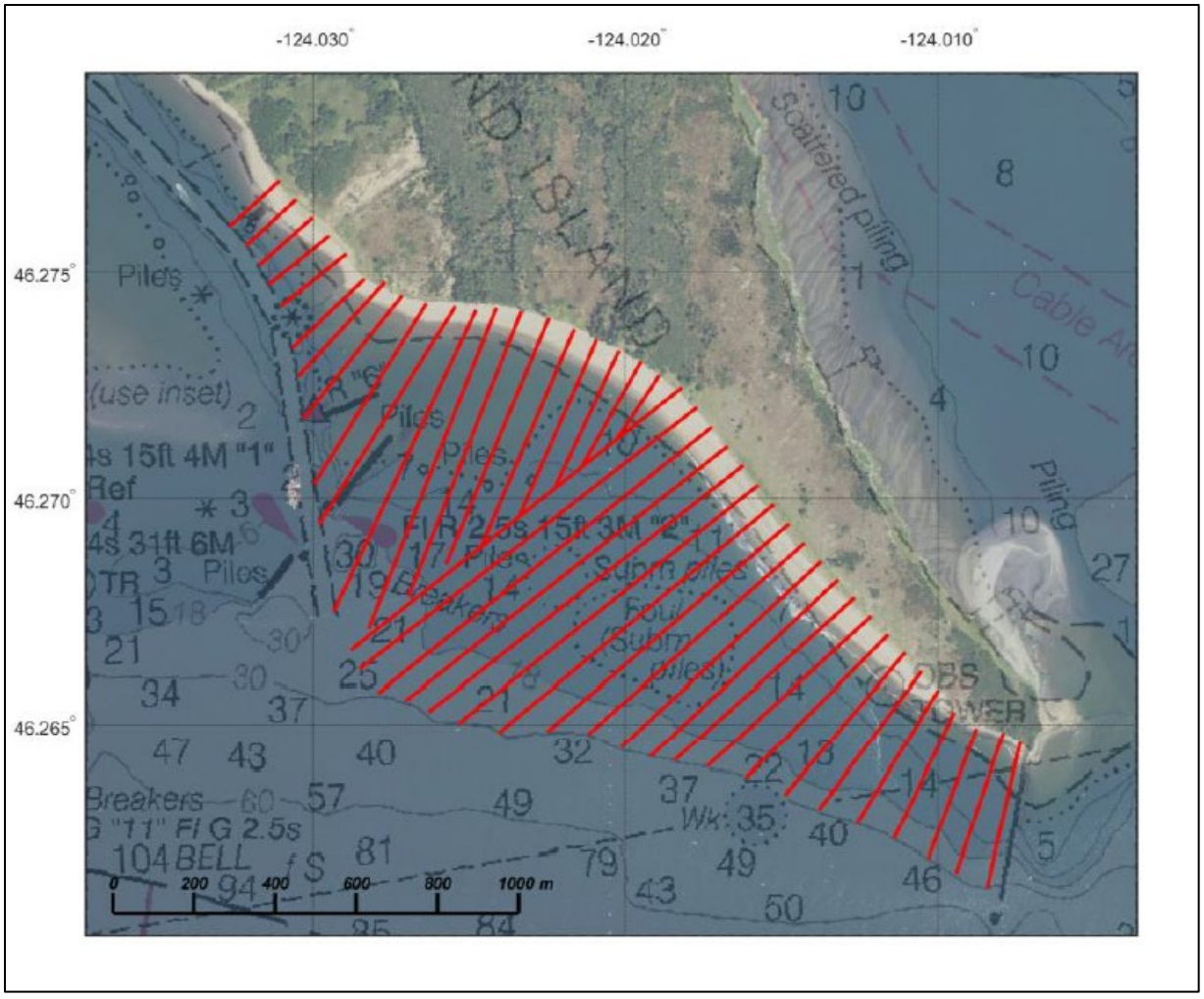

Figure 6-5. West side of West Sand Island, adjacent to Baker Bay West (Ilwaco) Channel – surface map and nearshore bathymetric transects.

6.3 Hydrodynamic and Sediment Transport Modeling (USGS)

The USGS began development of a new transport model to predict morphology change along eroding shorelines and continued their numerical modeling of sediment transport pathways around the MCR to predict the fate of sediment placed in nearshore placement sites. The USGS is working to quantify sediment connectivity between dredge placement areas and adjacent coastlines to evaluate the relative impact of different management scenarios on coastal sediment budgets, at Benson Beach in particular. This work builds upon the modeling performed under the 2020-2022 interagency agreement between the USGS and USACE.

The USGS performed hindcast simulations of the 2020 (phase 3 pilot) and gathered data necessary to simulate the fate of dredged material placement at the North Head Site during 2021 (first year of operational use). Available information on the locations, timing, and volumes of sediment placed in the network of nearshore placement areas will incorporated

into these simulations. Sediment transport pathways between nearshore dredge placement areas and onshore locations were predicted to assess performance of the dredge placements. Model predictions were compared to actual sequences of bathymetric surveys to illustrate a net flux of dredged material placed in the NHS Site towards Benson Beach (Stevens et al., 2023).

The USGS also began evaluating a new Delft3D-FM surf zone sediment transport model; most of 2022 was devoted to setting up the model. The Delft3D-FM model includes physics that better characterize wave transformation and resulting sediment transport in the surf zone.

6.4 Benson Beach-North Jetty Dynamic Revetment Design & Evaluation (Ecology)

The Benson Beach Dynamic Revetment project has not yet launched, but Ecology has acquired baseline imagery at established photo points in the last year (Figure 6-6). This is in addition to USACE's efforts to collect seasonal aerial photography and videos via UAS. Surveys will be performed during all four seasons to include supplemental beach profiles and topographic mapping in the project area. Ecology will make recommendations for adaptive management such as cobble replenishment, vegetation, and sand fencing to enhance long-term project resilience and protection of the North Jetty trunk and root.

6.5 Benson Beach Seasonal UAS Surveys (USACE)

The Benson Beach UAS surveys represent an important data set in a section of the Washington coastline that is undergoing long-term change and is the focus of recent Columbia River littoral cell work by numerous agencies. The goal of the UAS flights is to monitor the beach and nearshore dynamics at Benson Beach, Washington, immediately to the north of the MCR North Jetty. Quarterly surveys were initiated in spring 2022; USACE performed these UAS surveys seasonally (4 times per year) to track accretion and erosion along the shoreline in the area of interest outlined in Figure 6-7. These surveys were flown at low-low tide when nearshore sandbars and spits are exposed. This is a long-term effort (at least three years) to be funded by the MCR project.

This USACE effort follows-on from OSU's North Head Argus camera station, which collected time-series panoramic photographs of the Benson Beach strand to the North Jetty, from 2004 to 2016 and from 2017 to 2019. A detailed summary of this work appears in the *2022 AUP*.

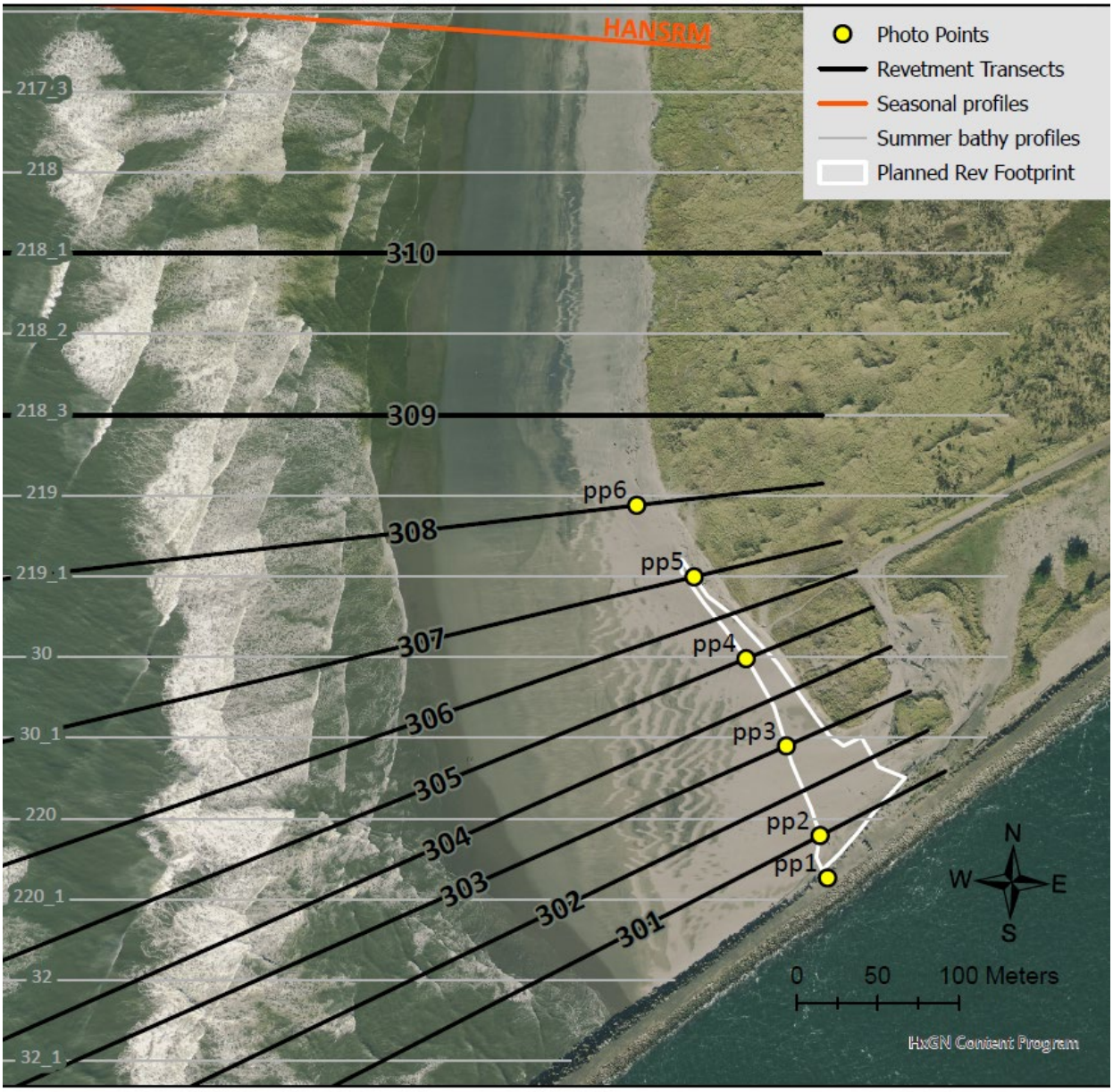

Figure 6-6. Proposed Benson Beach dynamic revetment (white polygon) with beach and nearshore surface monitoring transects (numbered black lines) and photo monitoring points (yellow dots).

Figure 6-7. Benson Beach UAS survey area; surveys are performed quarterly at low-low tide.

7 PLANNED UTILIZATION OF MCR ODMDS AND 404 SITES IN 2023

A primary objective of this AUP is to leave the areas of the SWS, NJS, SJS, NHS, and DWS, as they are utilized during 2023, in a post-season condition that does not adversely affect navigation conditions, the surrounding environment, or other uses of the ocean within or adjacent to each site. This section will discuss the actions planned for the 2023 season to meet this objective. All quantities are preliminary estimates and subject to change—the system is very dynamic and dredged material amounts and placement plans will be reanalyzed throughout the dredging season. Figures and volume calculations have been generated with Surfer.

During the 2023 dredging season at MCR, there will be two hopper dredges used to perform maintenance dredging: a government operated dredge (*Essayons*) and a contractor operated dredge (*Bayport*), each with different capacities and operating characteristics. The *Bayport* and the *Essayons* are expected to begin dredging at MCR in August.

Dredged material placement/disposal at the MCR during 2023 is planned to take place within the SWS, NJS, NHS, and SJS; the DWS MCR-14-DWS drop zone will be used as a foul weather backup site (Figure 2-3). During 2023, the dredged material that is to be placed within these sites will originate exclusively from the MCR Federal Navigation Entrance Channel. Figure 2-1 shows the general location from which sediment is to be dredged from the MCR entrance channel between RM –3 and +3 during 2023. Based on prior years of experience, the total volume of dredged material is expected to be approximately 3,527,500 cy. No dredged material originating from the LCR FNC (RM 3 to 29) is expected to be placed within dredged material sites at the MCR during the 2023 dredging season.

7.1 DEFINITION OF TERMS

The following discussion will benefit from a brief summary of the key terms used to define the utilization plans (see Appendix B for further information).

BASELINE CONDITION

The precedent bathymetric configuration of the placement/disposal site to which recent and potential placement activities are compared. Each site has a distinct baseline condition:

Shallow Water Site	North Jetty Site	Deep Water Site	South Jetty Site	North Head Site
May 1997	June 1999	August 2004	Sept 2011/ Aug 2012	May 2021

TARGET MOUND HEIGHT

A mounding threshold is defined for each site to limit placement-related, adverse impacts to nearby navigation infrastructure. Values are determined with the aid of the RCPWAVE model, and are distinct for each site:

Shallow Water Site	North Jetty Site	Deep Water Site	South Jetty Site	North Head Site
5 feet	8 feet	30 feet/40 feet[1]	4 feet/1 foot[2]	2 feet/1 foot

[1] After the entire DWS release zone is filled to 30 feet deposition, then the drop zones could be finished out with a 10-feet added lift to produce 40 feet of total accumulation.
[2] Accumulation in the South Jetty Site must be less than 4 feet when compared to baseline and less than 1 foot when compared to preseason conditions.

TARGET ELEVATIONS

Bathymetric configuration defined as the target height of accumulation added to baseline condition:

Target Elevation = Baseline Condition + Target Mound Height

The target elevations define the point at which intermediate review action occurs during the dredging season. Once site conditions near or reach the target elevations, the potential cumulative effects of additional site utilization are assessed in conjunction with other physical processes.

TARGET HEIGHT OF ACCUMULATION

Target height of accumulation defines the allowable accumulation/deposition at any given point within a site to achieve the target mound height (or to reach the target elevation).

7.2 AVAILABLE SITE CAPACITY

At the time of the 2023 pre-season bathymetry surveys (Table 7-1), the target (static) capacities of the SWS and NJS were estimated to be approximately 2.6 Mcy and 1.29 Mcy, respectively. Although the effective capacity at SWS is 3.1 Mcy, the static target capacity assigned to the SWS for 2023 will be limited to 1.845 Mcy, or potentially up to 2.4775 Mcy if the optional dredge volume for the Contract Dredge is exercised (see Section 7.5). The SWS may be used for more than 2.4775 Mcy through the course of the 2023 dredging season, provided that the capacity is available at the time. This *wait & see* approach is intended to minimize the potential of overloading the SWS, by not relying exclusively on the site for most of the capacity at MCR.

During 2023, the SJS may receive up to 500,000 cy and the NHS may receive up to 400,000 cy of MCR dredged material using a thin-layer placement method. The initial capacity of the SJS and the NHS are not based on target elevations but rather an effort to minimize potential burial or other adverse disturbance of epibenthic fish, invertebrates, and infauna. It is anticipated that the accumulation of dredged material will not exceed 0.25 foot per placement event, and that total accumulation within the SJS and the NHS will not exceed 1 foot over the duration of a dredging season.

The available capacity of the SWS, NJS, SJS and NHS will be continually monitored so the sites can be fully utilized throughout the 2023 season and thus maximize the amount of material retained in the littoral system. Note that the capacity of the MCR-14-DWS drop zone exceeds the anticipated dredging requirements for the MCR (see Appendix B, Table B-1), and any material that cannot be placed within the nearshore sites (due to weather or site capacity, for example) will be placed at that location.

Table 7-1: Pre-season bathymetry surveys used to define capacity at each site.

Shallow Water Site	North Jetty Site	MCR-14-DWS	South Jetty Site	North Head Site
22 March 2023	22 March 2023	17 March 2023	27 March 2023	April/May 2023

7.3 Special Considerations for the SWS

The SWS requires focused monitoring during dredged material placement to ensure that the site is fully utilized without exceeding the site's management target. Although the SWS may have the capacity to receive 100% of the material to be dredged from the MCR in 2023 (see Section 7.4), precautions will be taken not to over-utilize this site. The overriding objective for utilizing the SWS is to not adversely affect navigation due to excessive mounding of placed dredged material. Using the NJS, SJS, DWS, and SWS as a concurrent system reduces the rate at which material is placed within the SWS, which allows the site to disperse the material being placed within it more completely.

Note that the configuration of dredged material accumulation within the SWS can be affected as much by the currents transporting the dredged material (during and after placement), as by the assigned placement strategy itself. Wave and current-induced circulation within the SWS are spatially variable such that sediment placed within the eastern half of the site may be transported more quickly than sediment placed within the northwestern quarter of the site. An additional consideration is that sediment placed within the eastern half of the SWS tends to be transported toward the west before leaving the site. Non-uniform sediment transport at the SWS can lead to areas that have a higher level of deposition, even if most of the dredged material is not placed in those respective areas.

The continued deposition observed within the northwestern quarter of the SWS illustrates the complexity of managing material placement at the site. Less than 20% of the material placed within the SWS is placed within the northwestern quarter of the site, yet this area is annually affected by 3-5 feet of deposition. The northwestern quarter of the SWS provides a transport pathway out of the site for dredged material placed within the eastern half of the SWS, and access is essential if the SWS is to be used at its current level. Adaptive management of the SWS, through development of multiple Site Utilization Plans during the dredging season, accounts for the variable behavior of dredged material placed within the site and avoids excessive accumulation of dredged material within the SWS.

7.4 Initial Utilization Summary

Within the collective constraints of available MCR sites, preference is given to using nearshore sites (SWS, NJS, SJS and NHS) over the DWS. While the nearshore sites have adequate capacity to accommodate approximately 136% (2.6 Mcy, 1.29 Mcy, 0.5 Mcy, and 0.4 Mcy, respectively) of the anticipated 3,527,500 cy planned for MCR dredging in 2023 (Table 7-2), the DWS is still required to supplement nearshore capacity because site conditions may change from when the bathymetry survey was completed in Spring 2023 to the start of dredging. At this time, the DWS is designated as a foul weather backup site and is not assigned a placement quantity. Note also that as of Spring 2023, less than 30% of the SWS was in a Level 2 status of limited capacity conditions as defined in Section 8 of this *AUP*. Despite having 1,290,000 cy of capacity, placement at NJS will initially be limited to 150,000 cy to control impacts to the Federal Navigation Channel and the North Jetty, but more capacity may be utilized if conditions allow.

The contract hopper dredge, *Bayport*, is expected to dredge up to 2,130,000 cy from the MCR channel. The *Bayport* will begin dredging operations in early September and continue (intermittently) as late as October. Based on present contract options and initial capacity estimates for the SWS and NJS, the contract hopper dredge is expected to place up to 2,130,000 cy in the SWS and NJS (Table 7-2). Material may be redirected to the DWS, MCR-14-DWS drop zone, as needed; this is dependent on weather and capacity conditions at the nearshore sites. The *Bayport* will likely utilize the SWS and NJS in a concurrent manner. The NJS will not be used after 1 October. At times, it may be necessary to use the DWS when wave or tidal conditions at MCR preclude use of the nearshore site options. Placing dredged material within the SWS at a lower rate over a longer period will allow the placed material to be more effectively dispersed out of the site compared to placement at a higher rate over a shorter time interval.

The government hopper dredge, *Essayons*, is expected to begin dredging up to 1,400,000 cy at MCR in August and continue intermittently through October. The *Essayons* will be utilizing the SJS for placement of 500,000 cy and will utilize the SWS before the *Bayport* arrives at

MCR, or when the *Bayport* is done, if capacity is available. Access to the SJS will be restricted to 15 August through 1 October. The *Essayons* will also be placing up to 400,000 cy in the NHS (see Section 7.9 for more information). When capacity is limited at the nearshore site options, the *Essayons* may dispose of material in the DWS, MCR-14-DWS drop zone.

Both dredges will follow the most recent Site Utilization Plan developed for each site. The capacity of the SWS and NJS may be fully used by the contract dredge. New bathymetry surveys of the SWS and NJS (during the 2023 season) may show increased erosion within these areas, which may result in additional nearshore capacity for dredged material placement. This would effectively reduce the volume of MCR dredged material that would need to be placed at the DWS (MCR-14-DWS drop zone), with a goal of disposing no material in the DWS.

To improve capacity utilization within the nearshore sites during 2023, they may not be used for **1-2 weeks** following placement to allow waves and currents to disperse recently placed dredged material out of the site. If needed, the DWS may be used concurrently to avoid overloading the nearshore sites, thereby extending the time for which the nearshore sites can be used.

Nearshore site capacity will be analyzed throughout the 2023 season. The volumes provided in this AUP are initial estimates and will most likely change throughout the season, especially the SWS. Material that is not placed in the nearshore sites due to weather, safety, or lack of capacity will be disposed at the DWS.

Table 7-2: Initial Plan for the 2023 Dredge-Placement Season.

Site	Initial Plan for the 2023 Dredge-Placement Season (estimated volumes)		
	AUP Estimated Site Totals	Government Dredge *Essayons*	Contractor Dredge *Bayport* (awarded amount)
	Mcy		
SWS	**≥ 1.845 (awarded)** 0.6325 (optional)	**0.5**	**≥ 1.345 (awarded)** 0.6325 (optional)
NJS	**0.15**[*]	**0**	**0.15**[*]
SJS	**0.5**[**]	**0.5**[**]	**0**
NHS	**0.4**	**0.4**	**0**
DWS	**0**[^]	**0**	**0**
Season & Dredge Totals	**3.5275**[***] (with option)	**1.4**	**2.1275**[***] (with option)

[*] Depending on how the site clears during the spring and summer, placement at the NJS is set to 0.15 Mcy to control mounding. If mounding is limited, more may be placed in the NJS throughout the season.

[**] No more than 0.5 Mcy may be placed in the SJS based on clearances, not capacity. Target placement for 2023 season is 0.5 Mcy.

[***] 2023 Contract includes optional additional quantity of 0.6325 Mcy to be exercised by the *Bayport*. A total of 2.1275 Mcy of dredged material would be placed by the Contract Hopper if option is exercised, which is shown in the Season & Dredge Totals estimate.

[^] A portion of the Contract and Government Dredges may go to DWS, if there are concerns over weather, safety, or lack of capacity. Based on historical data, up to 300,000 cy may be disposed of at DWS.

7.5 Dredged Material Placement at SWS

7.5.1 Target Elevations

Figure 7-2 shows the target contour *elevations* for the SWS. These contours account for a 5-feet accumulation added on to the site's baseline (1997) bathymetry shown in Figure 7-1. To avoid exceeding the management target for dredged material accumulation within the

SWS (with respect to the baseline condition - May 1997), dredged material will be placed such that it accumulates uniformly throughout the site, both in space and time. This means that the entire site will be utilized to the maximum extent practicable.

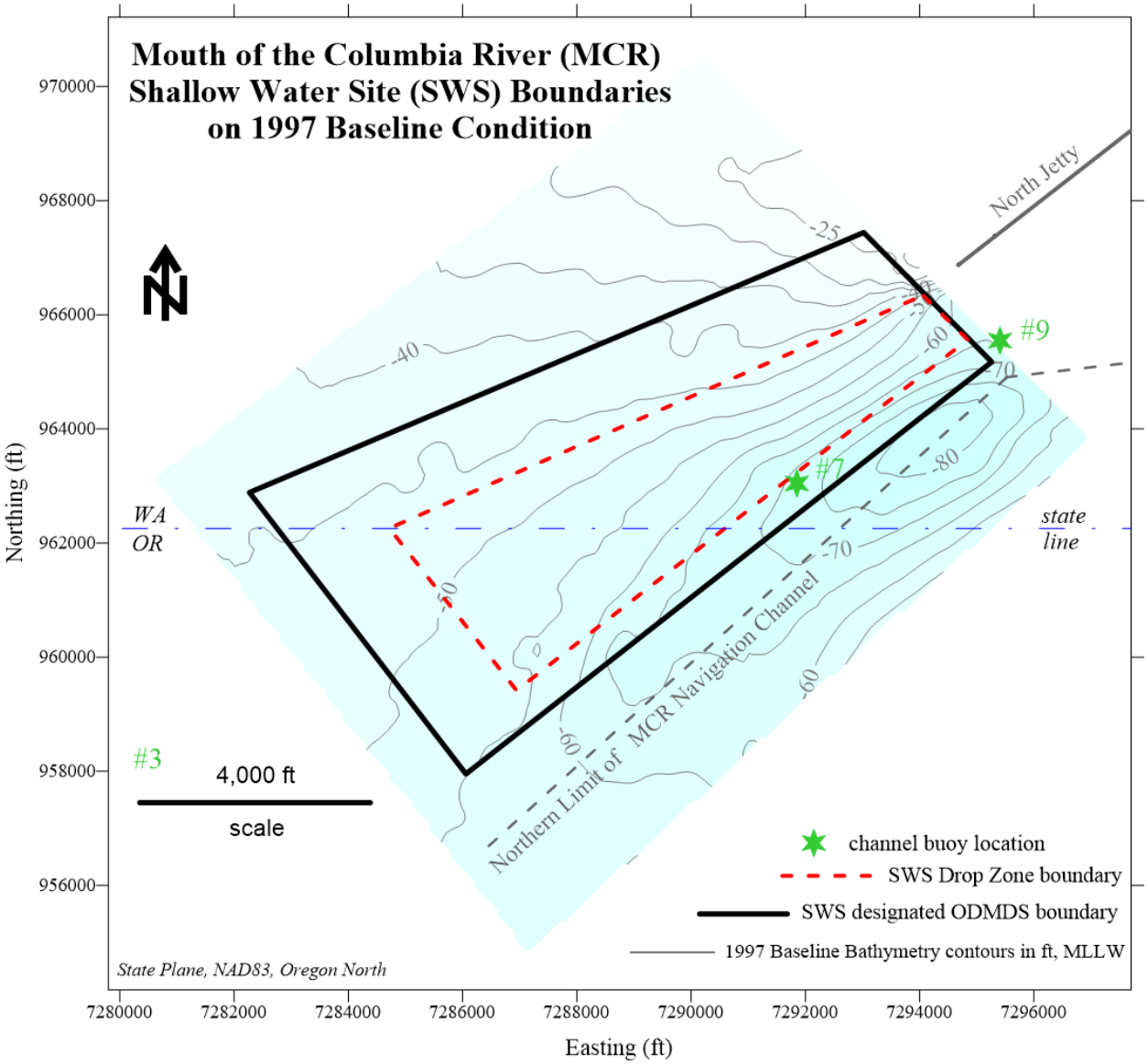

Figure 7-1: MCR Shallow Water Site (SWS) and Drop Zone Boundaries on the Baseline Condition – May 1997 Bathymetry.

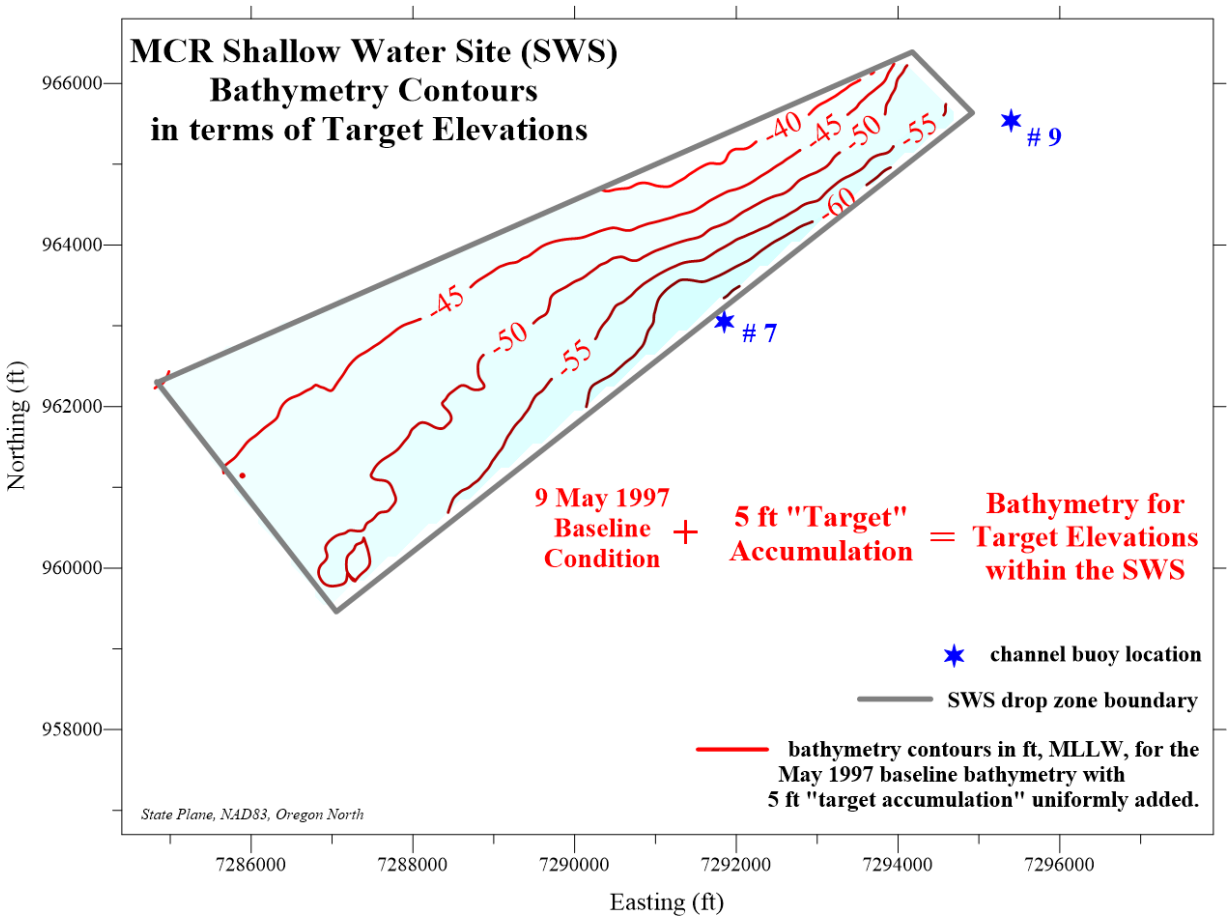

Figure 7-2: MCR Shallow Water Site (SWS) Bathymetry in terms of Target Elevations (based on 1997 Base Condition plus 5 feet).

7.5.2 STATIC TARGET CAPACITY

The *static* target capacity is the available volume of material to fill a given location within a site to the target height of accumulation. When reached, the target capacity for a given site defines a management condition for which an intermediate review action (decision point) occurs. At this point, the potential cumulative effects of additional site utilization are assessed in conjunction with other physical processes. Refer to Section 13.1 (Appendix B) for more detailed information on the decision point process.

Using the March 2023 bathymetry survey, the present *static* target capacity for the SWS is 2.6 Mcy. The static target capacity is the available volume to be filled up to the target mound height (5 feet for the SWS), not including the dispersion of placed dredged material during the dredging season. Although dispersion during the season is not considered, ocean currents during the winter months and the deposition/dispersion trends of dredged material over the years have also shaped the bathymetry of the SWS, leading to the western half of the site having more mounding at the start of a season. Given this trend, the following

approximations are made when calculating the static target capacity: 75% of the available volume on the west side of the SWS and 90% of the available volume on the east side of the SWS account for non-uniform operational utilization.

7.5.3 Effective Target Capacity

The initial *effective* target capacity within the SWS for the 2023 dredging season is estimated to be 3.1 Mcy. The effective target capacity is equal to the static capacity (2.6 Mcy) of the SWS plus its dispersive capacity (20% of the static capacity). Between 20-50% of the material placed within the SWS is dispersed out of site's drop zone during the dredging season (June-October), based on site monitoring during 1997-2022 (see Table 7-3). The effective target capacity within the SWS drop zone can increase or decrease, depending upon prevailing wave-current conditions. Thus, the conservative value of 20% of the static capacity is used for SWS dispersive capacity. Active monitoring of the SWS bathymetry during the dredging season is conducted to evaluate the current capacity of the SWS.

7.5.4 Initial Utilization Plan

Throughout the following discussion for the 2023 plan for the SWS, please refer to Figure 7-3 through Figure 7-6 and Table 7-3.

Since 1997, the SWS has been the principal site for MCR dredged material placement with 57% of all MCR dredged material being placed within the SWS, and with approximately 91% of this material being dispersed by waves and currents, in a north-northwesterly direction onto Peacock Spit (Figure 2-5). Figure 7-4 demonstrates the dispersive properties of the SWS for 2022/2023. Based on the SWS tracer study (completed in 2007), it is believed that less than 10% of the dredged material placed at the SWS has been transported southward into the MCR navigation channel. Based on Figure 7-4, through the 2022 season and over the 2022/2023 winter, 59% of material placed in the SWS during the 2022 season dispersed from the SWS (Table 7-3). Continued use of SWS as a primary site is of strategic importance to the MCR federal project and surrounding environment [USACE 2003].

The western half of the SWS drop zone has been slowly accumulating dredged material since its initial use in 1997 (Figure 7-3). Management of the SWS has taken this into account by preferentially placing dredged material at the highly dispersive eastern half of the site and minimizing placements within the western half of the site. The net result is to achieve uniform accumulation throughout the SWS with respect to the baseline condition (1997), without exceeding the site's target height of accumulation.

Although the SWS may have 3.1 MCY of effective capacity (based on the March 2023 bathymetry survey), the initial capacity assigned to the SWS for 2023 will be limited to 2.4775 Mcy (1.345 Mcy placed by the *Bayport*, with an optional additional quantity of 0.6275 Mcy, and 0.5 Mcy placed by the *Essayons*). The SWS may be used for more than 2.4775 Mcy

through the course of the 2023 dredging season, provided that the capacity is available at the time. This *wait & see* approach is intended to minimize the potential of overloading the SWS by not relying exclusively on the site for most of the site capacity at MCR.

The capacity assessment in Figure 7-5 depicts contour *heights* at which dredged material can accumulate within the SWS, without exceeding the site's management target (with respect to the May 1997 baseline bathymetry survey), based on the March 2023 pre-season bathymetry survey. To put simply, Figure 7-5 is a visual depiction of the amount of space available to place material in the SWS based on the March 2023 bathymetry survey. The initial estimates for the average height of accumulation that can be achieved during 2023 without exceeding the target contour elevations for the eastern and western areas of SWS are 6 feet and 3 feet, respectively. The initial capacity assessment for 2023 suggests that the SWS has a lot of capacity as of March, when the bathymetry survey was completed.

Figure 7-6 provides the Initial Utilization Plan for the SWS in 2023. The plan is developed from the Capacity Assessment provided in Figure 7-5. The level to which the SWS can be used for dredged material placement is related to the capacity available within the site and the effectiveness of the site utilization plan used to guide placement events. Regardless of the capacity available within the site, full utilization of SWS capacity can be achieved by promoting even deposition of dredged material throughout the site's placement area, with respect to the baseline condition. This means that the dredged material would be placed throughout the entire site using a regimented procedure to produce a uniform continuous layer on the seabed, avoiding the formation of localized mounding.

Refer to Appendix B for additional information concerning dredged material deposition within the SWS.

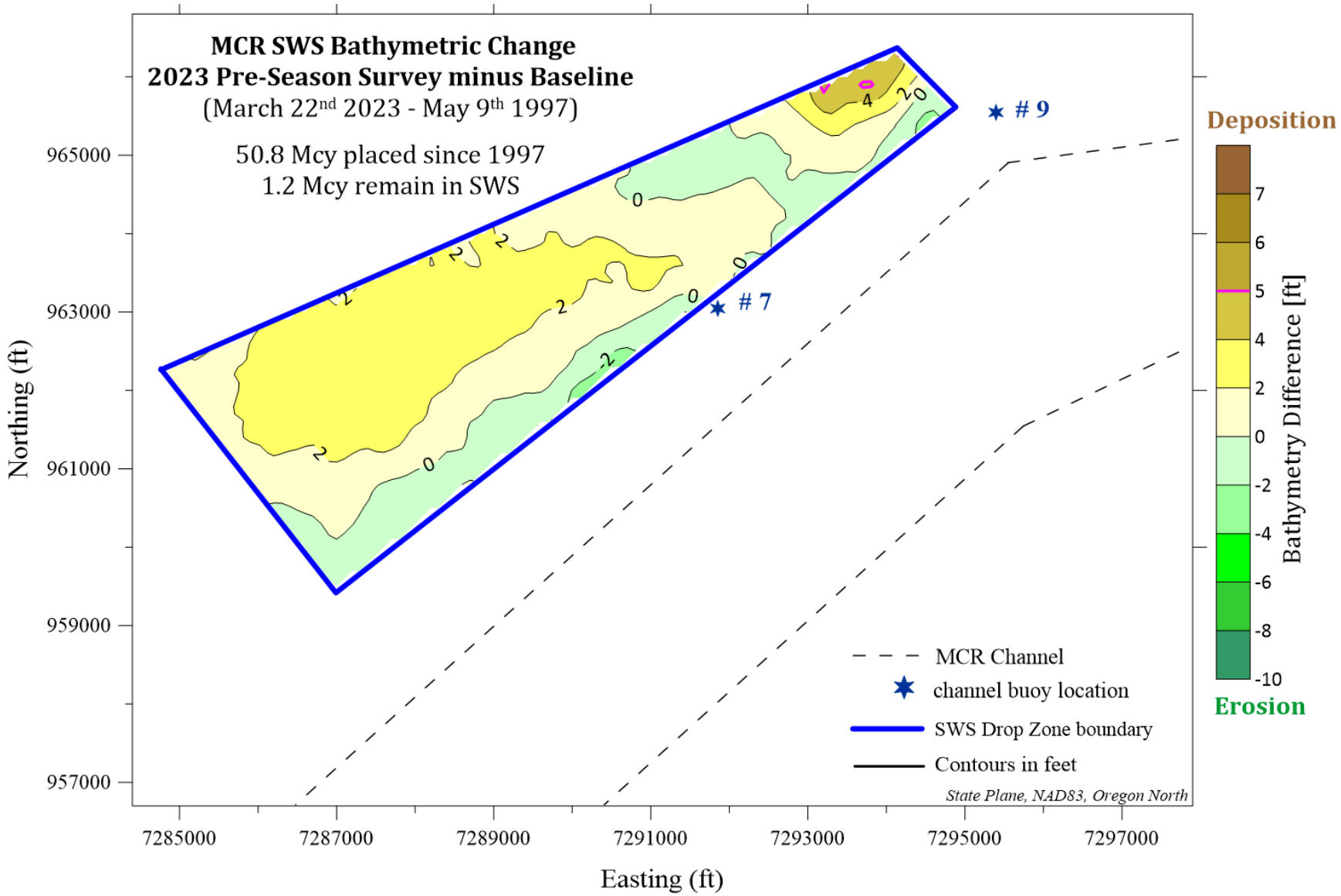

Figure 7-3: Bathymetric Change from 2023 Pre-Season to the Baseline for the SWS.

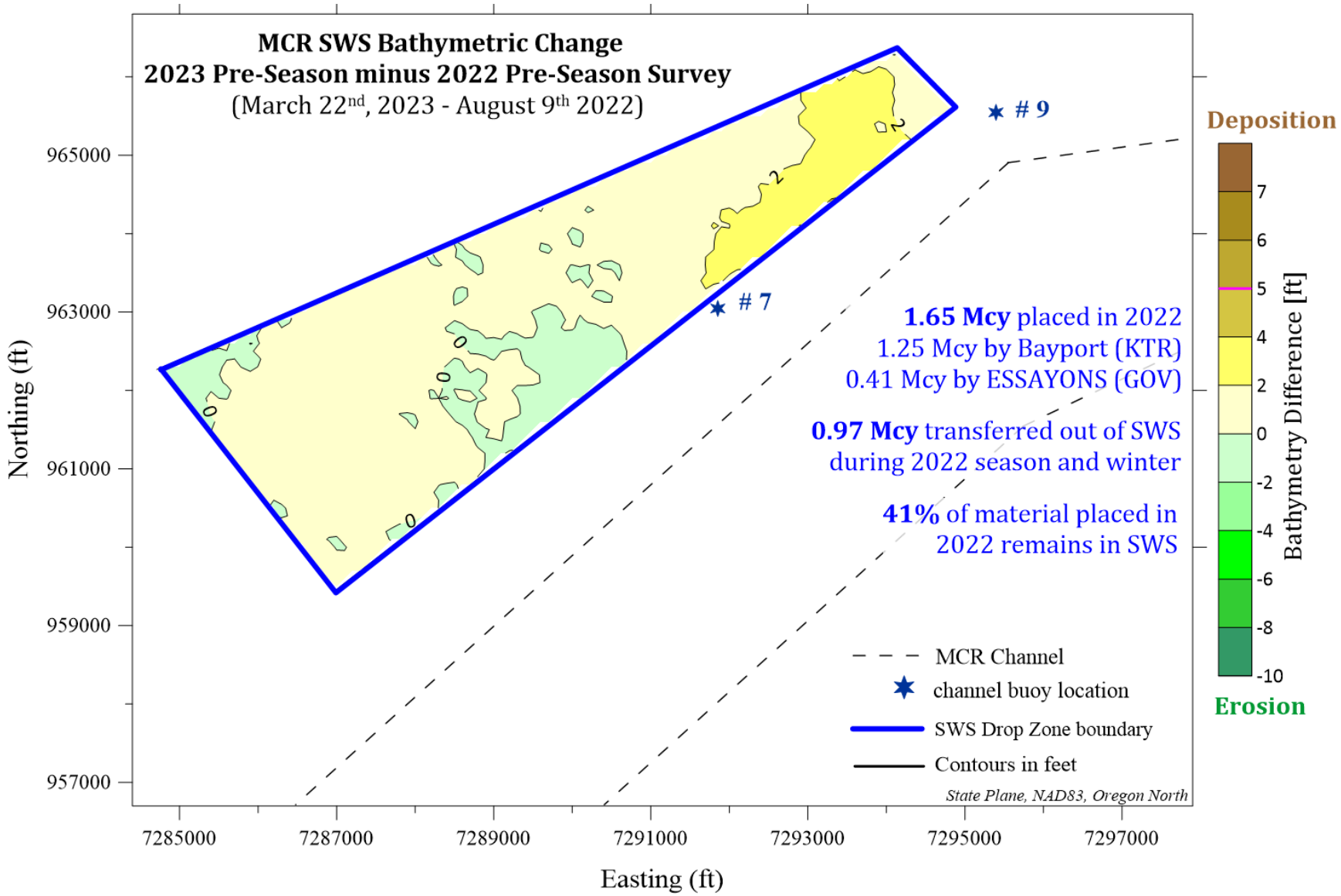

Figure 7-4: Bathymetric Change for the SWS during the 2022 Dredging Season and the 2022/2023 winter.

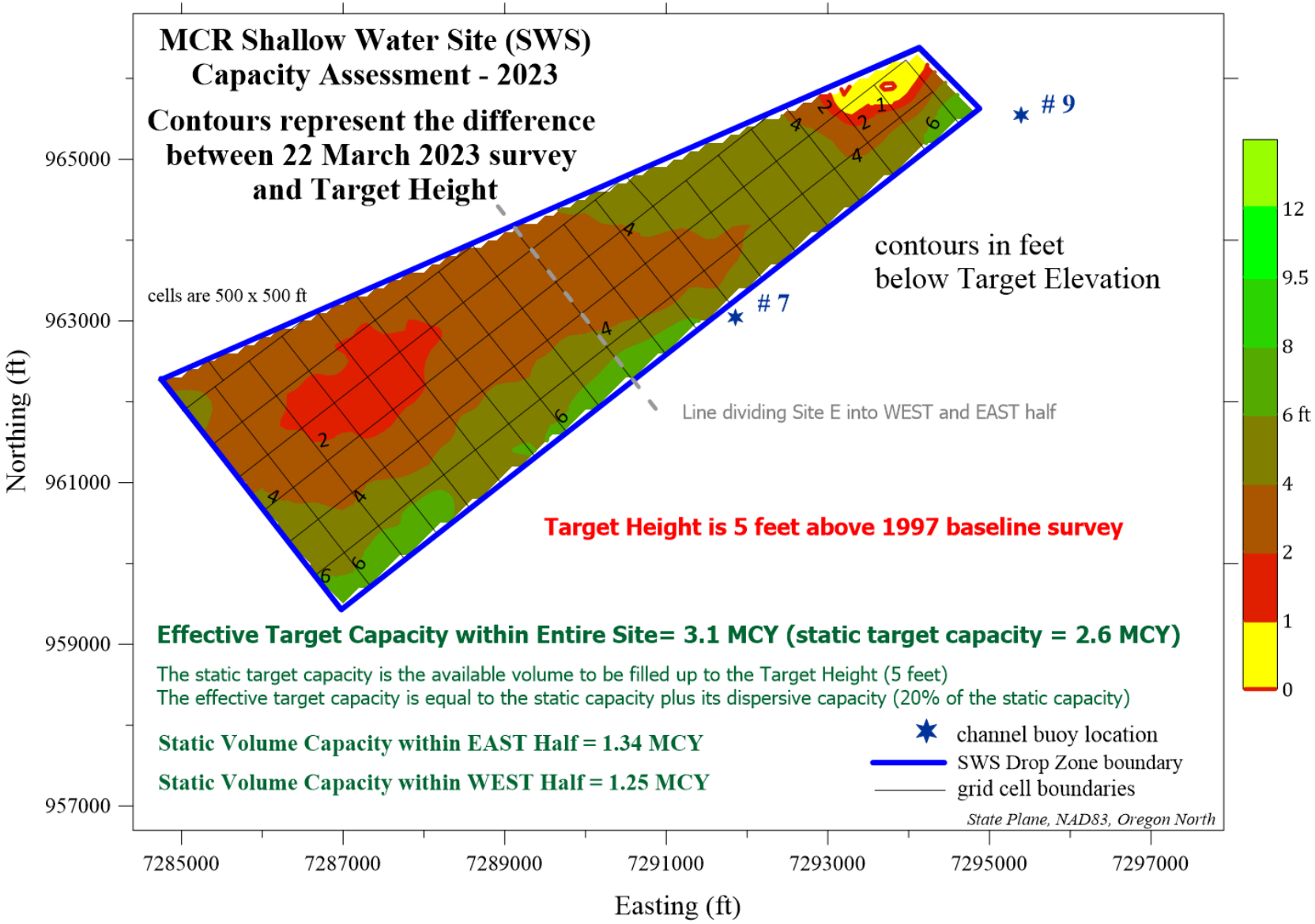

Figure 7-5: MCR SWS 2023 Capacity Assessment—this figure shows the available volume in the SWS from the 2023 pre-season planning bathymetry survey completed on 22 March 2023, to inform the Initial Utilization Plan.

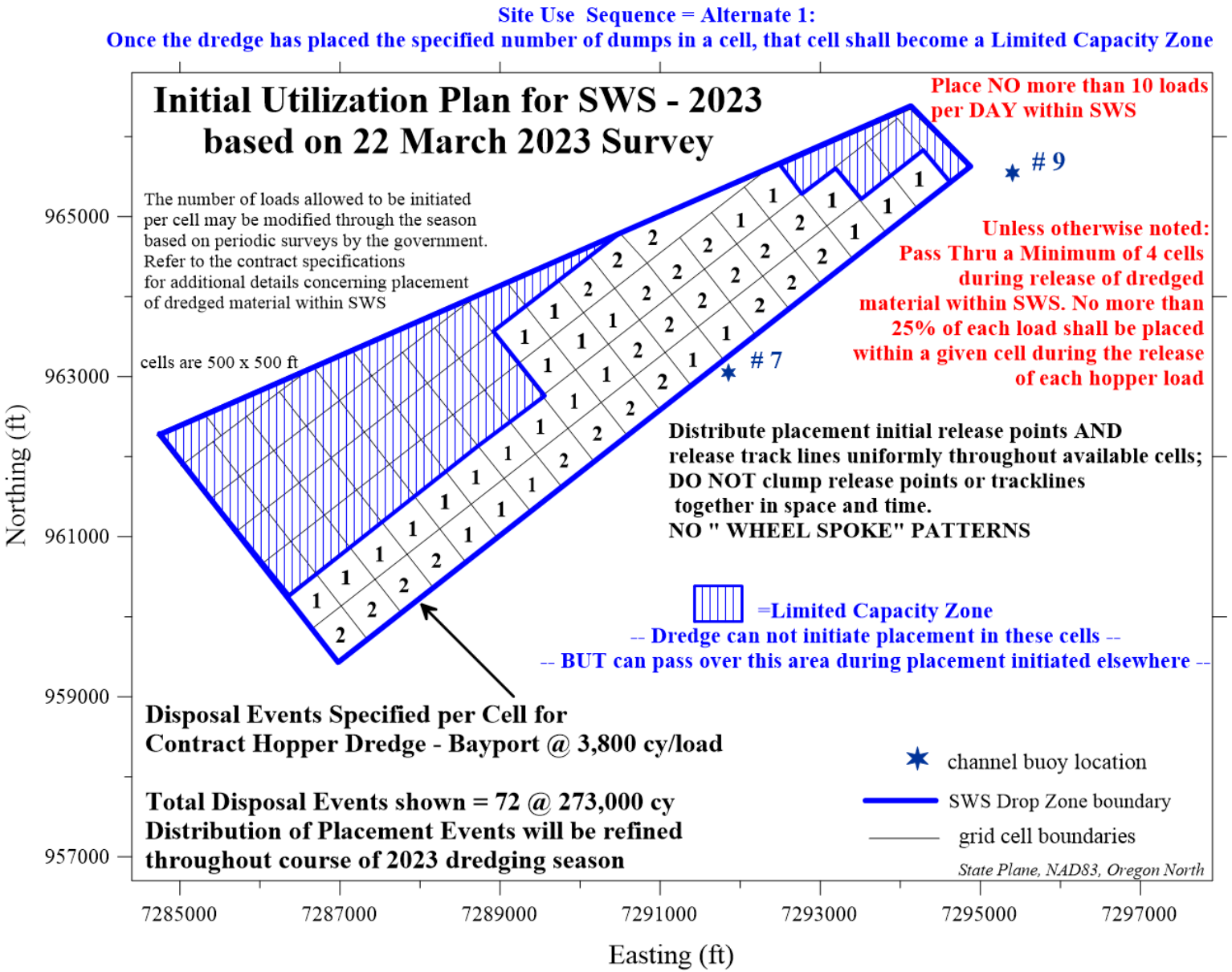

Figure 7-6: 2023 SWS Initial Utilization Plan.

Table 7-3: Summary of SWS ODMDS Utilization and Dispersal Properties of the Site.

Dredge Season	Sediment Volume Placed in SWS	Specificied Placement Method ^	Dredging Season Final Mound Height*	Effectiveness of Using Entire SWS to Disperse Dredged Material	Sediment Dispersed OUT of SWS during Dredging Season**	Sediment Dispersed OUT of SWS during the following Winter**	Sediment Dispersed OUT of SWS Annually: Spring to Spring**
Year	Mcy % of total vol. placed at MCR	(C)=contractor (G)=government	Avg. Range *Peak Occurrence*	% of the Site that was used	Mcy % of Volume Placed	Volume, Mcy % of Volume Placed	Volume, Mcy % of Volume Placed
2010	2.3 81%	Grid Cells (C) Grid Cells (G)	2-6 ft *Peak = 6 ft*	95%	0.72 32%	1.27 55%	1.99 87%
2011	1.5 49%	Grid Cells (C) Grid Cells (G)	2-6 ft *Peak = 6 ft*	90%	-0.11 (deposition) -7% (deposition)	2.1 140%	2.02 136%
2012	1.7 64%	Grid Cells (C) Grid Cells (G)	2-6 ft *Peak = 6 ft*	95%	1.21 68%	0.49 28%	1.7 99%
2013	1.83 56%	Grid Cells (C) Grid Cells (G)	2-6 ft *Peak = 6 ft*	95%	1.42 78%	-0.12 (deposition) -7% (deposition)	1.3 70%
2014	1.54 43%	Grid Cells (C) Grid Cells (G)	2-6 ft *Peak = 6 ft*	85%	0.77 50%	1 65%	1.77 115%
2015	1.16 34%	Grid Cells (C) Grid Cells (G)	2-6 ft *Peak = 6 ft*	95%	0.64 55%	1.6 138%	1.06 91%
2016	1.67 47%	Grid Cells (C) Grid Cells (G)	2-6 ft *Peak = 6 ft*	93%	0.27 16%	1.25 75%	0.94 56%
2017	1.28 49%	Grid Cells (C) Grid Cells (G)	2-3 ft *Peak = 4 ft*	85%	0.41 32%	0.77 60%	1.18 92%
2018	1.09 38%	Grid Cells (C) Grid Cells (G)	0-2 ft *Peak = 3 ft*	85%	0.96 88%	0.43 39%	1.38 127%
2019	1.65 59%	Grid Cells (C) Grid Cells (G)	0-2 ft *Peak = 3 ft*	85%	N/A^^ N/A	N/A^^ N/A	1.04 63%
2020	1.66 56%	Grid Cells (C) Grid Cells (G)	0-2 ft *Peak = 4 ft*	85%	0.85 51%	0.43 26%	1.27 77%
2021	1.3 54%	Grid Cells (C) Grid Cells (G)	0-2 ft *Peak = 3 ft*	85%	N/A^^ N/A	N/A^^ N/A	0.88 68%
2022	1.65 56%	Grid Cells (C) Grid Cells (G)	1-3 ft *Peak = 4 ft*	90%	0.36 22%	0.62 37%	0.97 59%
AVG. values	1.9 57%	Grid Cells the preferred method	2-5 ft *Peak = 6 ft*	81%	42%	56%	91%

^ Methods used to manage dredged material placement within the SWS & enhance uniform distribution of the material.
Disposal Lanes: lanes through the SWS were assigned a limiting elevation above which accumulation of placed dredged material was restricted.
Grid Cells: START points for each placement are assigned to a given grid cell & the END point lies 500-1,500 ft away; each cell is assigned a finite number of placement STARTs to control vertical accumulation of placed dredged material. Grid Cell method to minimize vertical accumulation of placed dredged material is considered the superior placement method.

^^ Cannot complete these values because there was no post survey completed in the 2019 and 2021 dredging seasons.

* These heights are with respect to baseline condition (May 1997), peak maximum vertical accumulation of placed dredged material may have occurred before the end of the dredging season.

** Vol. amount dispersed (% of total placed): 100% dispersal indicates dispersal volume equals placement volume for a zero net volume change for the specified duration; >100% indicates the SWS experienced net erosion; negative dispersal values are shown as positive accumulation values in () for volumes of sediment accumulation in the SWS greater than volume placed.

7.6 DREDGED MATERIAL DISPOSAL AT DWS

Material disposal during 2023 at DWS will be limited to the MCR-14-DWS drop zone, which measures 4,000 feet on each side (367 acres) and resides in water depths of ~240-270 feet MLLW, see Figure 7-7. The DWS will only be used by the government dredge, *Essayons*, and the contractor dredge, *Bayport*, when safety, weather or nearshore-capacity limitations make it necessary. The limited amount of material to be disposed within DWS by the *Essayons* and *Bayport* for the 2023 season helps to limit deep water disposal and encourage nearshore placement. A survey of the full DWS area was captured in spring 2023. Based on this survey, there have not been significant changes within the DWS between spring 2022 and 2023.

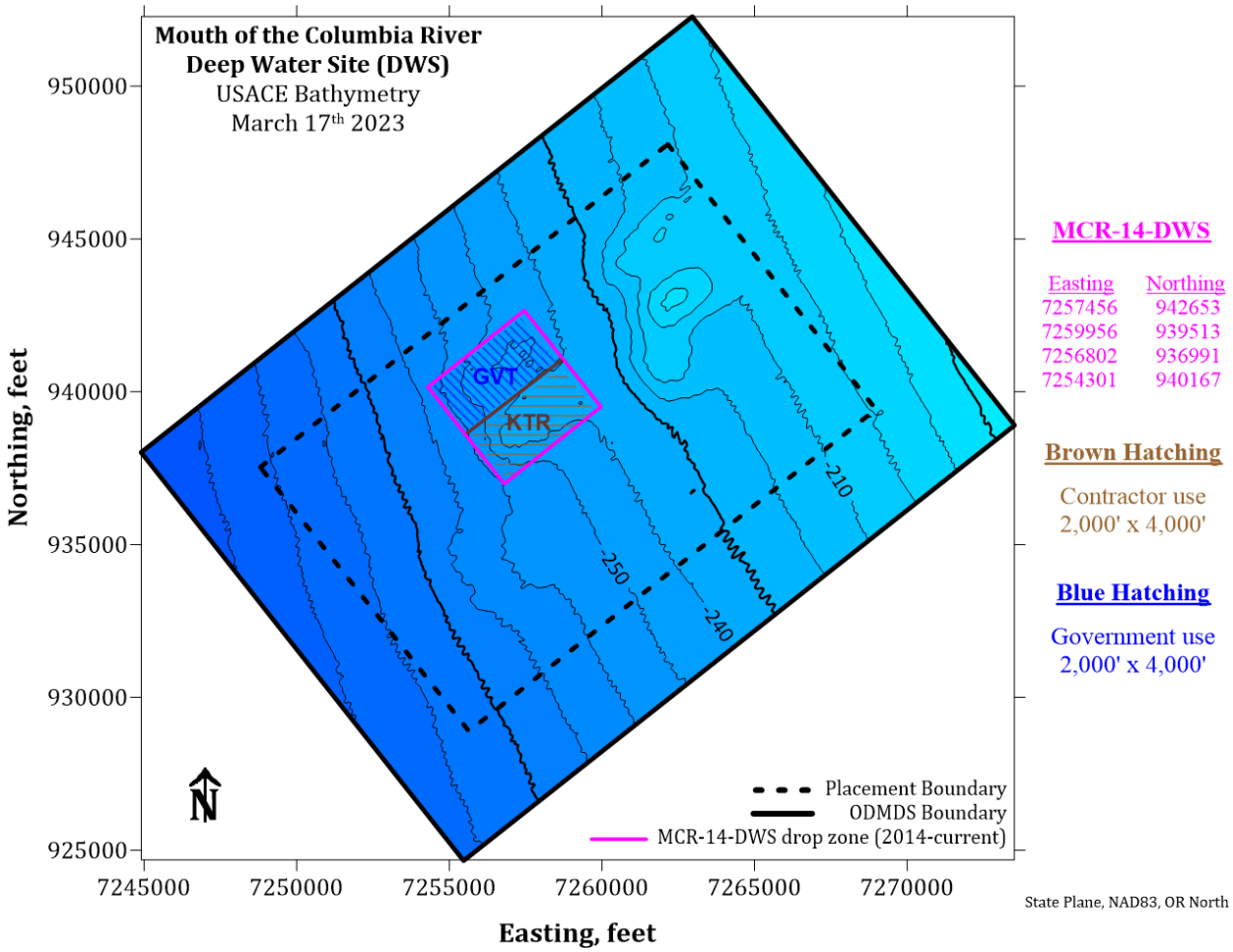

Figure 7-7: DWS and the Drop Zone that will be used in 2023, MCR-14-DWS.

As with the other sites, MCR-14-DWS has been divided into cells for dredged material placement for the initial 2023 Site Utilization Plan (Figure 7-8). The northern half of the site is for the government dredge, *Essayons,* and the southern half is for the contractor dredge, *Bayport*. Note that in previous years the designated halves for the government and contractor dredges were switched (i.e., the northern half was used by the contractor dredge

and the southern half was used by the government dredge). Since the government dredge tends to use the DWS more, every several years it is best management practice to switch the designated halves of the DWS in order to use MCR-14-DWS for more dredging seasons. Based on the spring 2023 survey, material height within MCR-14-DWS has reached approximately 20 feet above baseline in the peak area of deposition and there is still ample capacity for placement within MCR-14-DWS. Each dredge is allowed a limited number of placement events per cell. Thin layer placement is not required at the DWS, so each placement event can be released as rapidly as the crew requires. This type of placement is known as a "point dump." When recording the placement location within each drop zone, material shall be credited to the cell in which the placement operation is started regardless of the number of cells transited.

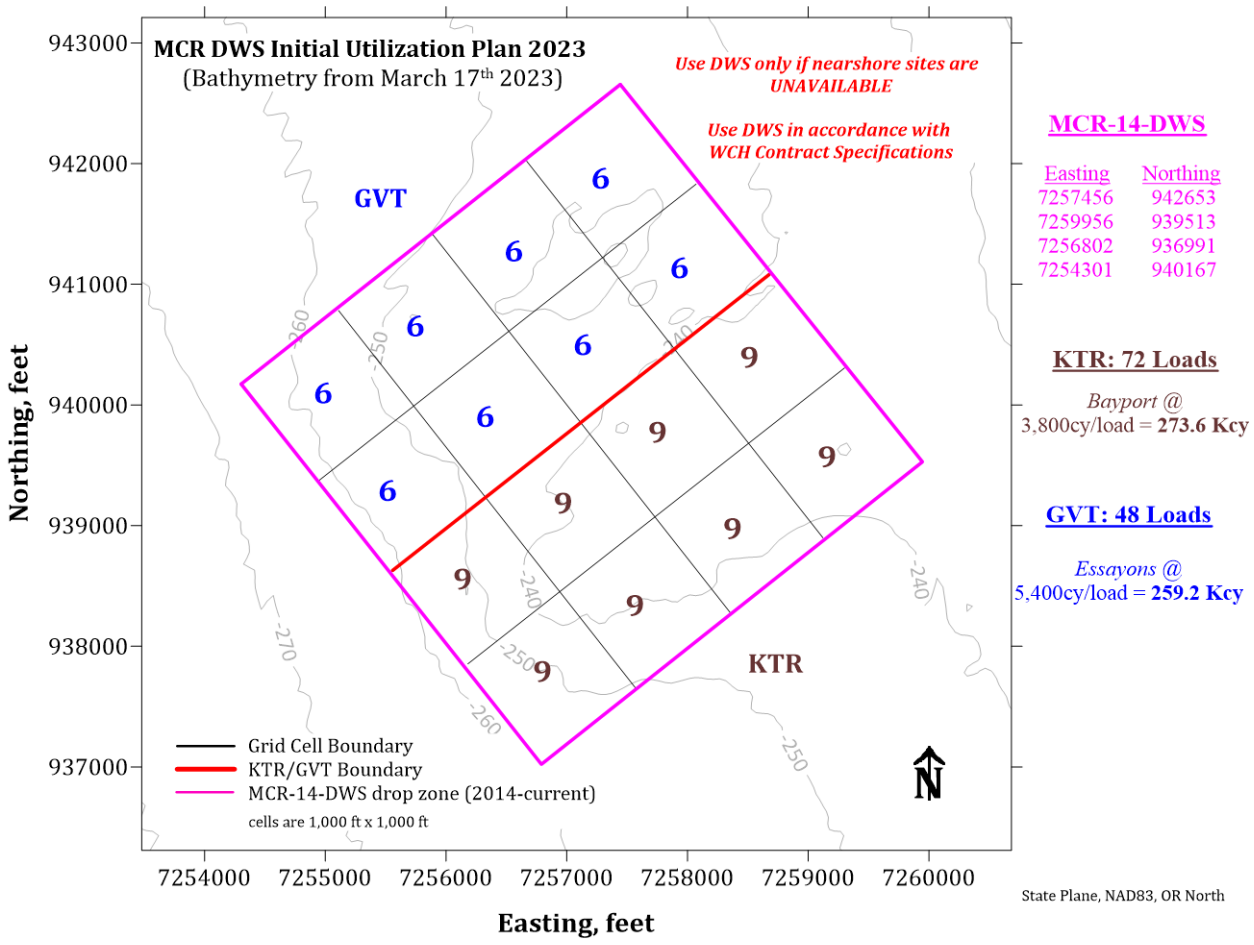

Figure 7-8: Initial Utilization Plan for Deep Water Site (DWS), based on 2023 Pre-Season Survey. Distribution of placement subject to change throughout the 2023 dredging season.

Monitoring of the DWS, combined with efficient placement methods and the addition of nearshore sites, is expected to prolong the life of the larger DWS beyond the 50 years that were previously estimated. It is difficult to estimate the duration added to the life of the site,

as this is dependent on annual dredging quantities, weather conditions, and level of nearshore placement.

7.7 Dredged Material Placement at NJS

Since the 1999 baseline bathymetry survey for the NJS 8.32 Mcy of material has been placed at the site. As of March 22nd, 2023, only 256 kcy of material remains in the NJS (see Figure 7-9).

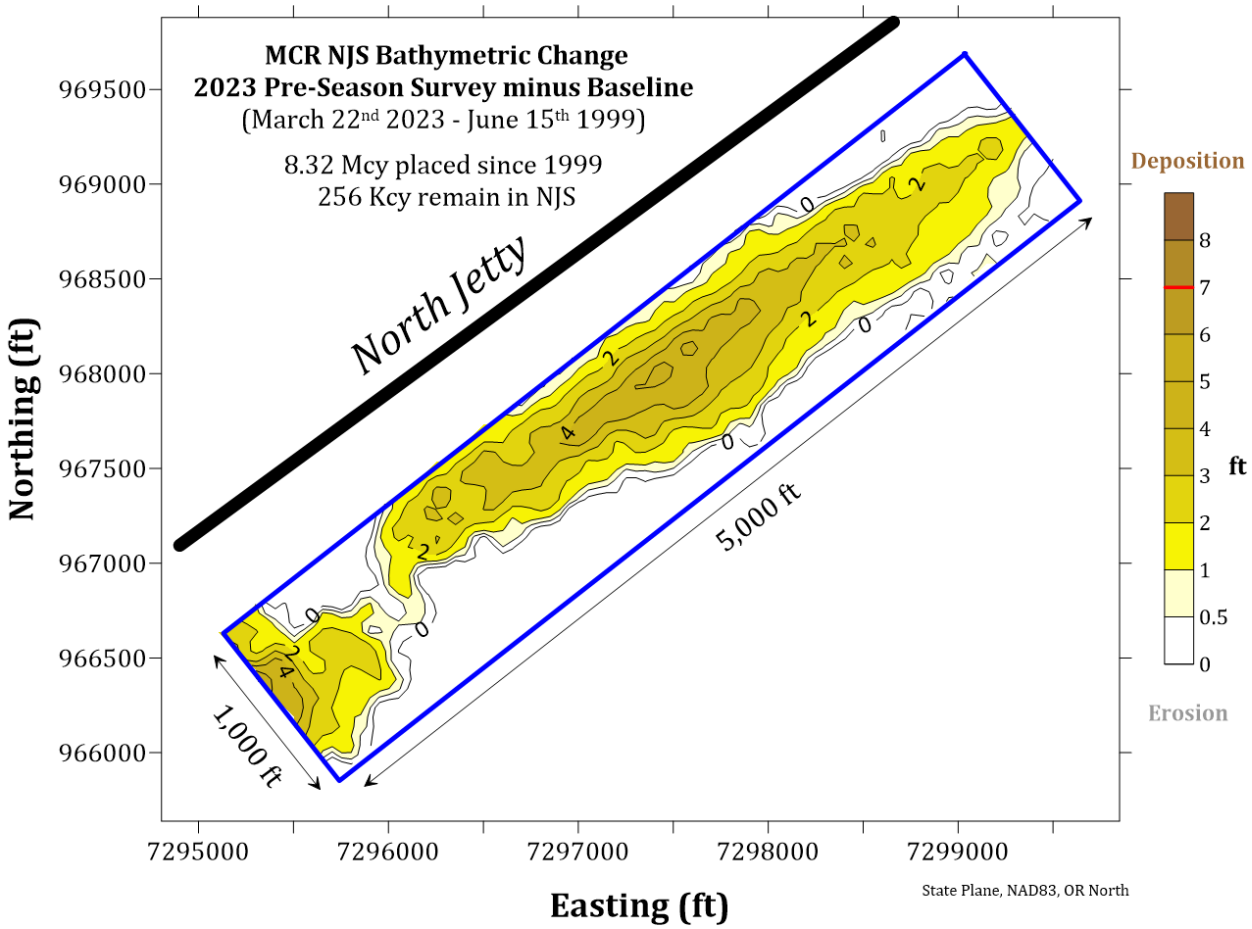

Figure 7-9: MCR North Jetty Site (NJS) Difference between 2023 Pre-Season Bathymetric Survey and 1999 Base Condition (March 22nd 2023 and June 15th 1999 Surveys).

The initial capacity assessment for the NJS shows 1.29 Mcy site capacity (Figure 7-10). However, it is acknowledged that some of the dredged material placed at the NJS is transported toward the navigation channel so the full site capacity will likely not be utilized during the 2023 season. Note that so long as the amount transported from the NJS to the channel per year is small (less than 30% of the amount placed), the value of reducing scour along the north jetty outweighs the cost of re-handling the dredged material placed at the

NJS. To control mounding, the NJS is allocated an initial capacity of 0.15 Mcy for the start of the 2023 season. The initial plan includes 148.2 kcy of placement with one to three placement events per cell, distributed throughout the site, except for the cells designated as limited capacity zone (Figure 7-11). Additional quantity can be placed if mounding is manageable, as determined by post-placement bathymetric surveys.

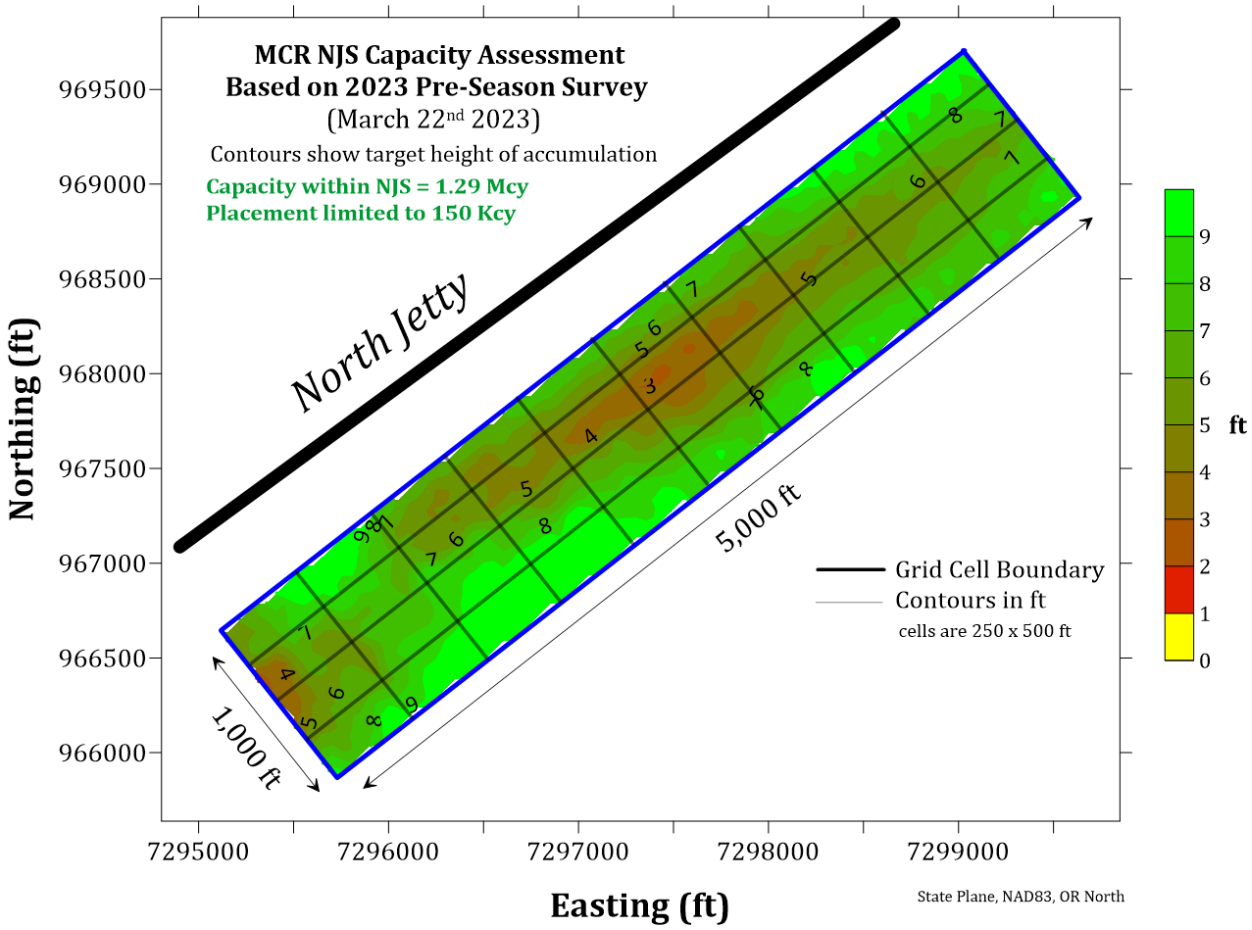

Figure 7-10: MCR North Jetty Site (NJS) 2023 Pre-Season Capacity Assessment (based on March 22nd 2023 Bathymetric Survey) showing Target Height of Accumulation for Dredged Material Placement up to the Target Mound Height, 8 feet.

The fully loaded draft of the contractor dredge, *Bayport,* is 18.5 feet (Table A-1), which provides enough depth to account for tide, swell and deposition of material without grounding the dredge. According to the most recent bathymetric survey, the shallowest depth of the NJS is 40 feet (Figure 7-11), so vessel draft will not be a concern during placement in 2023. The *Essayons* does not use the NJS, so draft concerns were not investigated for the government dredge.

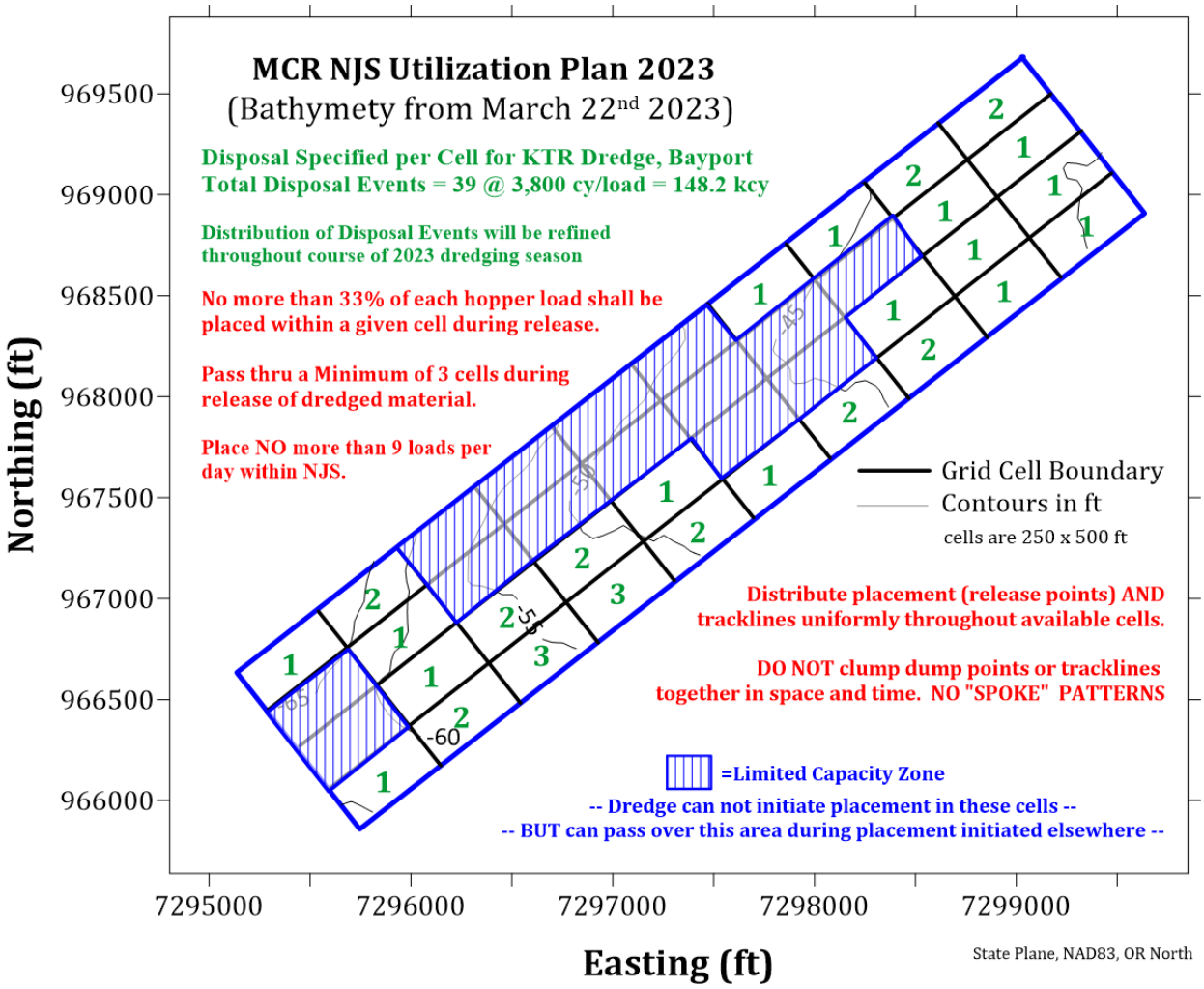

Figure 7-11: Initial Utilization Plan for North Jetty Site (NJS), based on 2023 Pre-Season Bathymetric Survey. Distribution of placement subject to change throughout the 2023 dredging season.

7.8 Dredged Material Placement at SJS

Placement of dredged material within the SJS will commence after 15 August, which is when the crab season is closed along Oregon coastal waters. Only the government hopper dredge *Essayons* will use the SJS during 2023. Use of the SJS is expected to continue incrementally until 1 October. The objective for dredged material placement within the SJS is to supplement the deficient littoral sediment budget south of MCR with dredged sand, while minimizing impacts to benthic infauna and epibenthic community of the SJS. To promote dispersal of dredged material on the seabed of the SJS (and minimize benthic impacts), a method of thin-layer dredged material placement will be used, such that maximum deposition thickness per load placed is less than 0.25 foot. Additionally, the overlapping of placement events (track lines) will be minimized to avoid overlapping of successive placement events within a given 72-hour period (see Section 4.1.2). The seasonal

distribution of dredged material placement within the overall SJS will be executed such that the total season accumulation within the SJS (at the conclusion of the 2023 dredging season) will be 1 foot or less.

A cell-based utilization plan will be used to guide dredged material placement within the SJS, to achieve the site-use objectives described above. The placement area of the SJS will be partitioned into a system of cells (150 cells at 570 by 605 feet each) divided into three zones as shown in Figure 4-1**.** A total of five loads are placed within one zone before the dredge can move on to place in a different zone. Dredged material is not to be placed within any given zone until 48 hours has elapsed since previous placement within the zone. When recording the placement location, material will be credited to the cell in which the placement operation is started regardless of the number of cells traversed during placement. Within the SJS, each load shall be distributed across no less than 10 cells, and no more than 10% of a hopper dredge load shall be placed within any given grid cell.

Figure 7-12 displays the 2023 Capacity Assessment for the SJS. The management target for inter-annual accumulation from the 2012 baseline is 4 feet. The accumulation at the center of the site is to be expected after placement from previous seasons. Nearly the entire site has full capacity up to 4 feet, and the SJS will be utilized for up to 500,000 cy in 2023. Thin layer placement to avoid mounding will be promoted by requiring that the maximum deposition thickness per load placed is less than 0.25 foot.

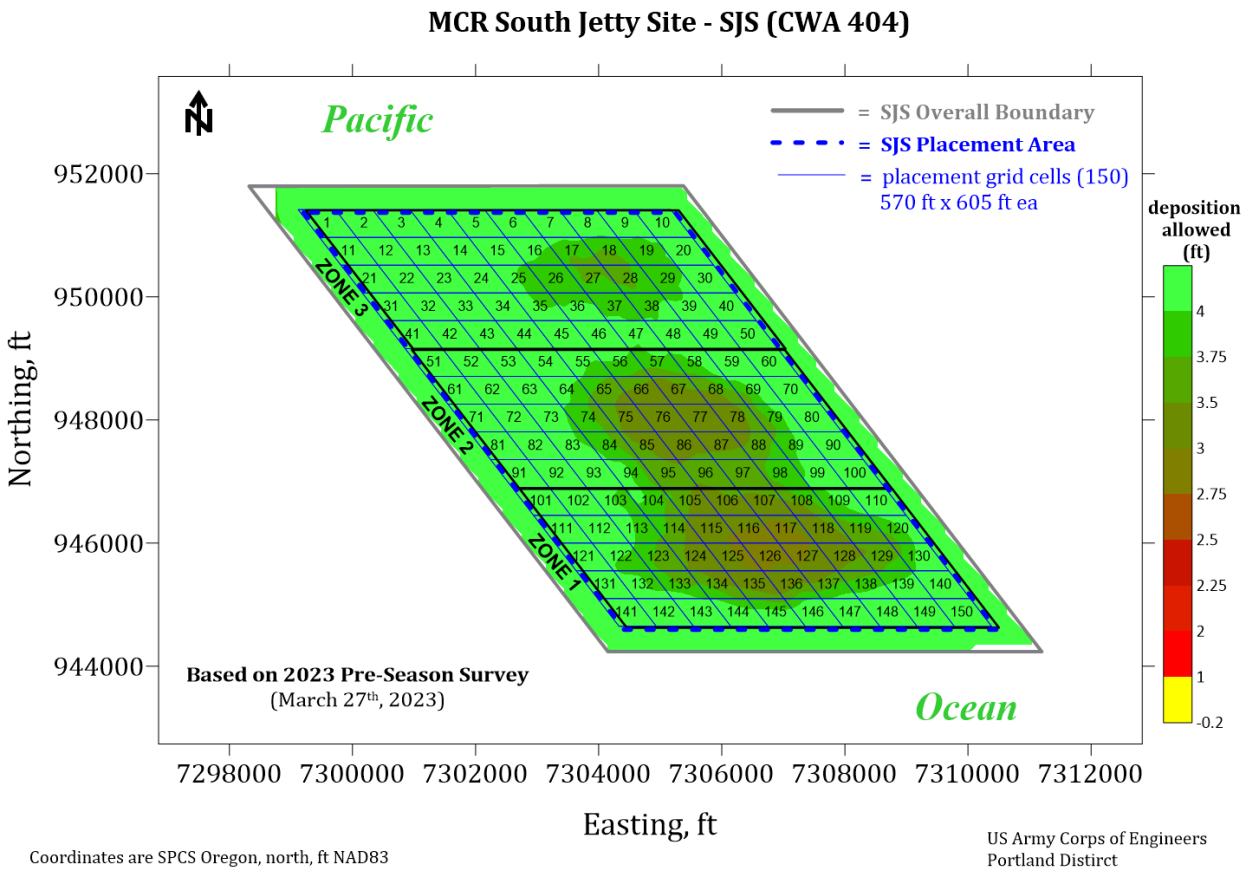

Figure 7-12: South Jetty Site (SJS) 2023 Pre-Season Capacity Assessment showing the Target Height of Accumulation for Dredged Material Placement.

Bathymetric surveys will be conducted within the SJS during periods of active seasonal use and compared to the pre-placement condition to verify that physical attributes of dredged material deposition conform to management protocols. Thresholds for managing dredged material accumulation within the SJS are 0.25 foot (per placement event) and 1 foot (for the entire dredging season). During active use of the SJS, placement track plots will be reviewed to verify the following: (1) that 10 cells, with no more than 10% of material placed in each cell, are transited during the release of sediment, and (2) that any given zone is rested for 48 hours after each 24-hour placement period (72-hour cycle). If the SJS is not being utilized within the expected thresholds, corrective action will be implemented to ensure adherence to SJS management protocols. Figure 7-13 shows the 2023 Initial Utilization Plan for the SJS.

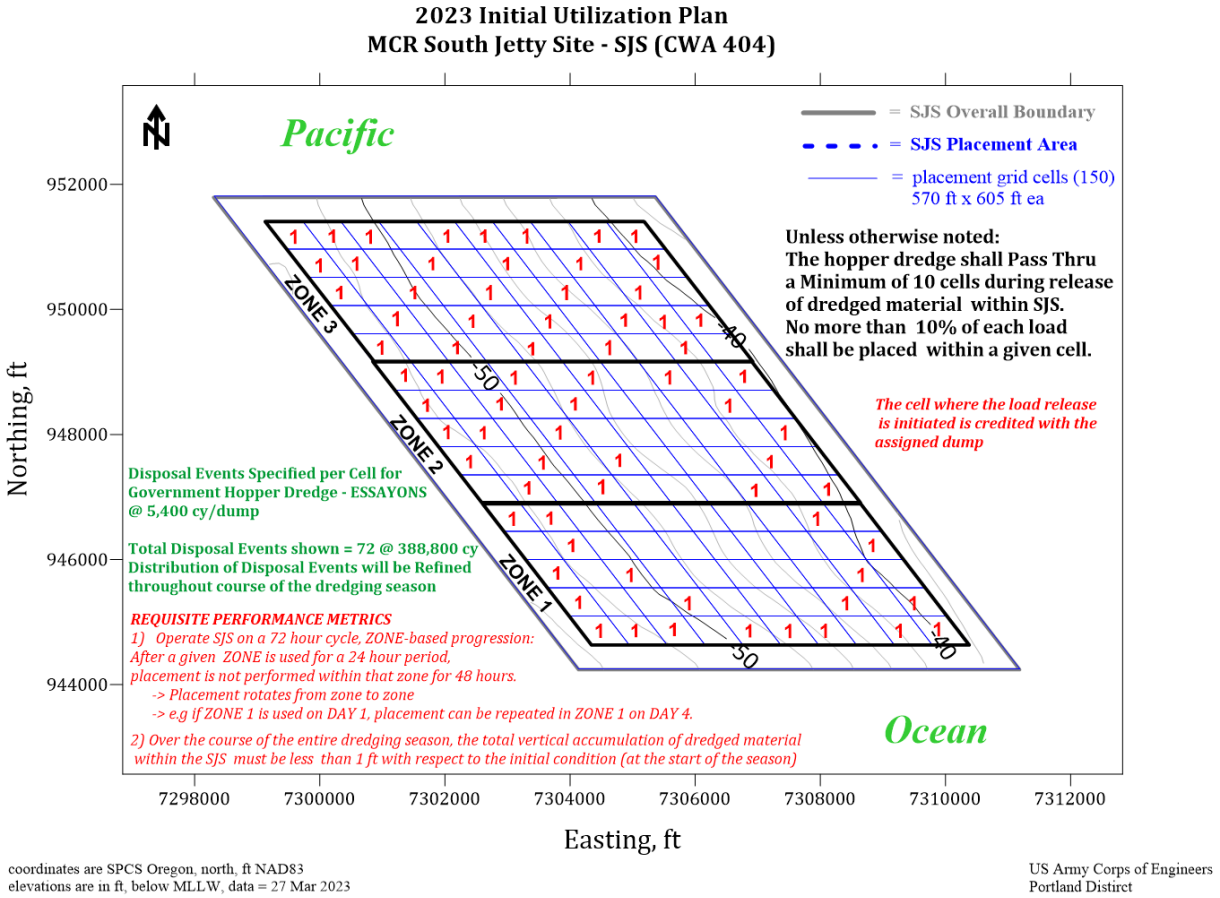

Figure 7-13: Initial Utilization Plan for MCR Dredged Material Placement at the South Jetty Site (SJS).

7.9 Dredged Material Placement at NHS

The NHS will be used operationally for the third time during the 2023 MCR dredging season. Refer to Section 4.1.3 for the site use management protocols that are used to guide the annual use of the NHS and development of dredged material placement plans. An April 2023 NHS survey (Figure 7-14) was used to document pre-placement conditions within the site for the 2023 dredging season and guide development of the 2023 NHS placement plan. Section 5.6 discuses bathymetry change withing the NHS observed during May 2021 and April 2023.

The NHS objective for 2023 is to place 400,000 cy within the middle third of the NHS (Zone 2). Zone 2 is being used for 2023 dredge material placement within the NHS to avoid exceeding 2 feet of cumulative deposition within Zone 1, as 744,000 cy had been placed within Zone 1 during 2021 and 2022. No dredged material is expected to be placed north of latitude 46^0-18'-45" N during 2023. Placement of dredged material within the NHS will commence after 15 September, which is when the crab season is closed along Washington coastal waters. Only the government hopper dredge *Essayons* will use the NHS during 2023,

placing approximately 74 loads (5,400 cy per load) of sand dredged from the MCR FNC. Use of the NHS is expected to continue incrementally until mid-October.

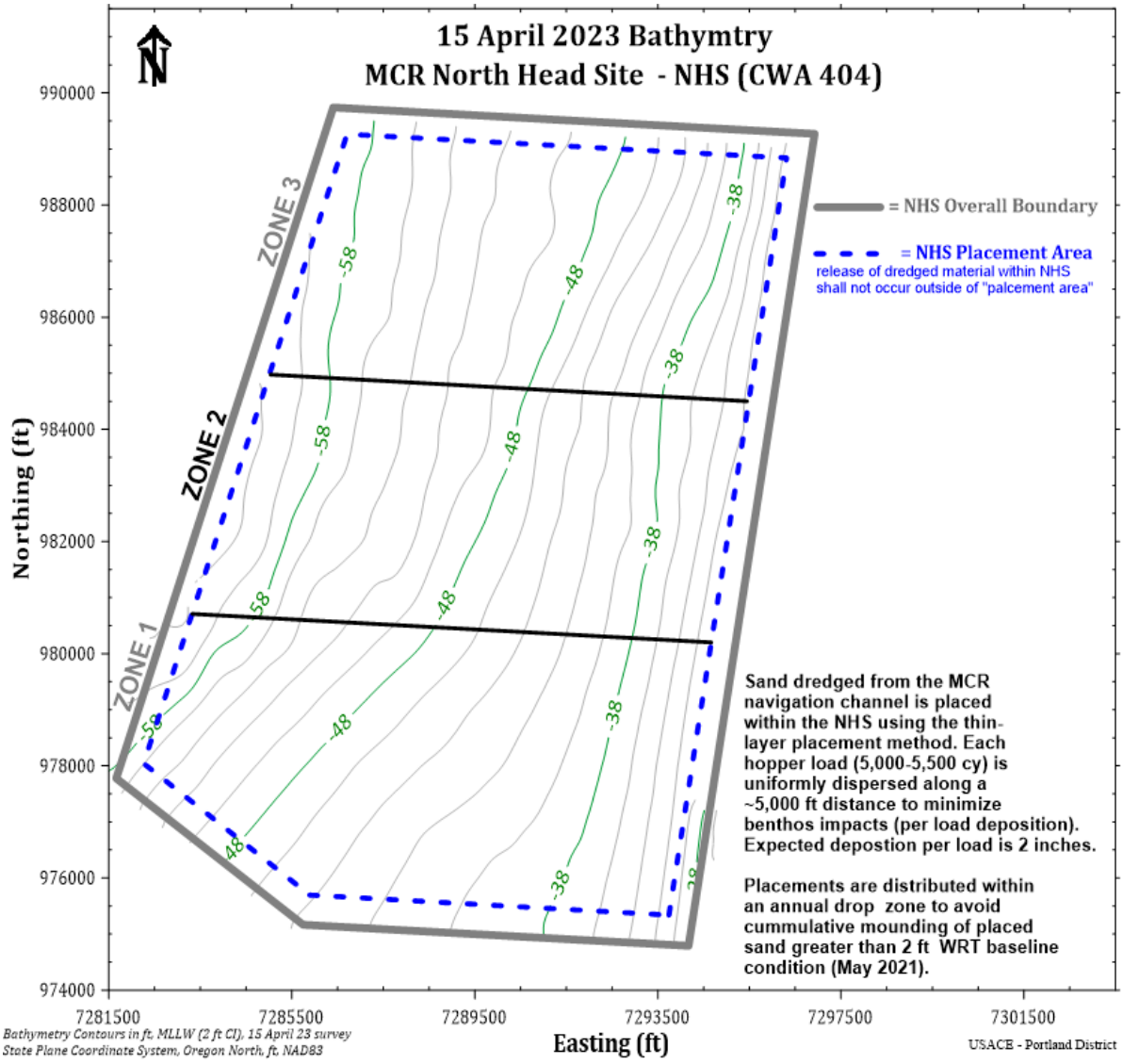

Figure 7-14: North Head Site-Zone 1 baseline bathymetry condition April 2023.

Figure 7-15 shows the 2023 Initial Utilization Plan for the NHS. The distribution of placement events within Zone 2 for 2023 was developed to avoid direct additional placement within Zone 1, where deposition of 1.2 feet had been realized during 2021 to 2022. In summary, the 2023 NHS placement plan is intended to avoid adding more material to the deposition area within Zone 1, while ensuring that dredged material placement within Zone 2 conforms with thin-layer placement protocols. Zone 1 may be used again in subsequent

years, after the deposition realized to date has been reduced to less than 0.5 foot, relative to May 2021 baseline conditions.

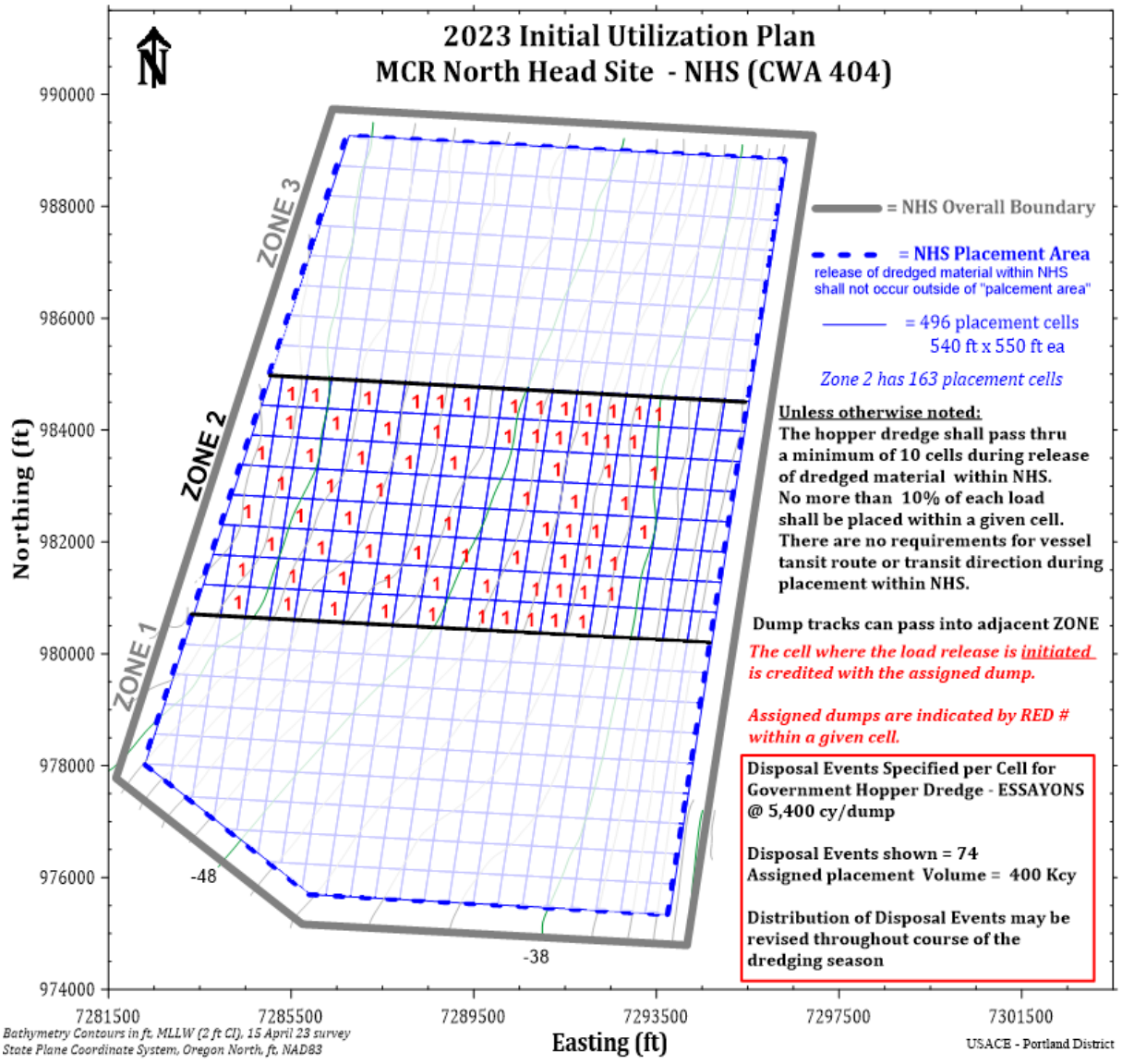

Figure 7-15: 2023 Initial Utilization Plan for the North Head Site.

7.10 Monitoring Planned for 2023

7.10.1 MCR Nearshore Bathymetry and Beach Topography (USGS, Ecology, & OSU)

During the summer of 2023, USGS, Ecology, and OSU will perform beach topographic and nearshore bathymetric surveys north of the North Jetty (Benson Beach/Long Beach peninsula) and south of the South Jetty (Clatsop Spit). Survey methods and locations are identical to those performed in 2022; a description of these activities can be found in section 6.1.

7.10.2 Clatsop Spit and West Sand Island Bathymetric Surveys (USGS)

During the summer of 2023, the USGS shall perform bathymetric surveys of Clatsop Spit and West Sand Island annually to assess coastal change hazards and support adaptive management strategies in the lower Columbia River estuary. Survey methods and locations are identical to those performed in 2022; a description of these activities can be found in section 6.2.

7.10.3 Hydrodynamic and Sediment Transport Modeling (USGS)

In 2023, the USGS will begin runs of the Delft3D-FM surf zone sediment transport model; most of 2022 was devoted to setting up the model. The Delft3D-FM model includes physics that better characterize wave transformation and resulting sediment transport in the surf zone. USGS will analyze the model results to predict how sediments placed in nearshore dredged material placement sites affect beach erosion along coastlines adjacent to the inlet.

7.10.4 Benson Beach-North Jetty Dynamic Revetment Design & Evaluation (Ecology)

Ecology will support design and evaluation of the proposed dynamic revetment on the north side of the North Jetty at Benson Beach and subsequent monitoring of the constructed dynamic revetment to evaluate seasonal performance within the context of adjacent changes of the beach and dune. Seasonal surveys will be collected during all four seasons to include supplemental beach profiles and topographic mapping in the project area. Ecology will make recommendations for adaptive management such as cobble replenishment, vegetation, and sand fencing to enhance long-term project resilience and protection of the North Jetty trunk and root. Ecology's survey transects and photo points for revetment monitoring appear in Figure 6-6.

7.10.5 Benson Beach Seasonal UAS Surveys (USACE)

USACE will continue to perform these UAS surveys seasonally (4x per year) for at least the next two years to track changes to shoreline features along Benson Beach (Figure 6-7). These surveys will be flown at low-low tide when nearshore sandbars and spits are exposed.

7.11 Planned Utilization for MCR

Benson Beach lies along the 7,500-foot-long ocean shore of Cape Disappointment State Park immediately north of MCR in Pacific County, Washington. Benson Beach (and most of Cape Disappointment State Park) is in part protected and wholly retained by the MCR North Jetty. The sand spit on which Benson Beach is founded has been eroding since 1940, with the rate of erosion accelerating in the past decade. In recent years, state and local interests have requested that the CENWP place sand dredged from the MCR Federal navigation channel

directly onto Benson Beach to offset beach erosion and supply sand to the littoral system of the Long Beach peninsula.

In 2010, the CENWP placed material from the entrance channel directly onto Benson Beach through a hopper dredge with pump ashore capability. Currently there is strong regional and local support to repeat this action and pump approximately 300,000 CY of material directly onto Benson Beach. While this is the most effective way to get material directly onto the beach and protect the beach from continued erosion, it is not as cost effective as placing material within the nearshore disposal sites, mainly the SWS and the NHS. Not being as cost effective, the State of Washington is responsible for the incremental cost difference of placement. The CENWP and the State of Washington are currently considering if funds are available in the near future to pump material directly onto Benson Beach. If funds are identified, the earliest this could occur would be in fiscal year 2025. Placement would need to occur using the West Coast Hopper Contract and would need to be identified early enough in the fiscal year to incorporate into the contract, which is typically awarded in January. The CENWP and State of Washington will continue to pursue funding and environmental clearances to accommodate this placement in the future.

8 DECISION FRAMEWORK FOR SITE THRESHOLD MANAGEMENT

The decision framework for adaptive management of the placement/disposal sites at MCR is comprised of 6 levels. Each level describes specific conditions and the required actions to be taken in the event that these conditions are met. The conditions are described with respect to the target mound height thresholds that are defined at each site (Table B-1 and Appendix B). The 6 action levels comprising the decision framework are:

Level 1: Normal Conditions.

Description: Sediment accumulation is not close to (not within 2 feet of) the target mound height in every part of the drop zone.

Action: Proceed as planned.

Level 2: Limited Capacity Conditions.

Description: Sediment accumulation is within 1-2 feet of the target mound height in some part of the drop zone.

Action: Minimize placement in affected location.

Level 3: Threshold Conditions.

Description: Sediment accumulation reaches or marginally exceeds the target mound height within a localized extent (less than 500 by 500 feet).

Action: Assess accumulation in surrounding cells and overall site capacity.

Avoid or minimize placement in the affected location of accumulation. Continue to use adjacent areas within site appropriately.

Level 4: Limited Adaptive Management Conditions.

Description: Sediment accumulation exceeds target mound height by 1-2 feet over an area greater than a grid cell, as defined for the disposal site.

Action: Assess accumulation in surrounding cells and overall site capacity. Avoid or minimize placement in the affected location of accumulation and in adjacent areas. Continue to use areas not affected; adopt early exit strategy for site.

Level 5: Moderate Adaptive Management Conditions.

Description: Sediment accumulation exceeds target mound height by more than 2 feet over an area greater than 4 adjacent grid cells.

Action: Assess accumulation in surrounding cells and overall site capacity. Stop using the area of the site exhibiting accumulation until natural processes disperse the sediment and reduce the accumulation (restored site capacity).

Level 6: General Adaptive Management Conditions.

Description: Sediment accumulation exceeds target mound height by more than 2 feet over an area greater than 16 adjacent grid cells.

Action: Assess accumulation in surrounding cells and overall site capacity. Stop using the area of the site exhibiting accumulation. Assess potential wave impacts using STWAVE and determine appropriate action based on results.

9 MONITORING AND DATA REPORTING REQUIREMENTS

9.1 SITE MONITORING

Two methods will be employed to monitor the placement of dredged material within each site and prevent mounding beyond the management target:

1) The first monitoring method focuses on tracking the placement of dredged material within each site on a daily basis, by plotting the dredge location for each load placed (i.e., the hopper dredge track line). Frequent plotting of the hopper dredge track lines will provide a continuous knowledge base of how dredged material is being deposited within a given site. Daily tracking of hopper dredges during dredged material

placement activities has significantly enhanced the successful management of site capacity since 2003 [USACE 2004].

2) The second monitoring method involves frequent bathymetric surveys of the sites throughout the dredging season. Comparison of recent surveys with a site's historical baseline condition identifies the deposition/erosion of material within a given site with respect to the baseline condition, and it quantifies the volume of placed dredged material that remains within the site boundaries.

Timely use of this information improves management of dredged material accumulation within a given site.

9.2 Field Data to be Provided to CENWP

The CENWP (specifically the Operations Division's Waterways Maintenance Section [OD-NW] and Engineering & Construction Division's Vancouver Resident Office [ENC-CV]) will collect operational dredging and placement data at MCR on a daily basis. The hopper dredge track-lines with Start & End coordinates for each placement event are of primary interest. The data will be transferred to Engineering & Construction Division's Hydraulic and Coastal Design Section (ENC-HD) and OD-NW for compilation, plotting and evaluation. Figure 11-1 shows the flow diagram describing the procedure of processing monitoring data and using the processed data to manage site capacity in response to dredge-related actions. Necessary revisions to the Site Utilization Plans will be identified and implemented within 1-2 days, as necessary.

Use of an active site (or portion thereof) may be temporarily discontinued based on metrics that indicate: A) the potential for exceeding the target capacity within the site, B) limited capability or location of the dredges and hydro-survey vessels, or C) other requirements for priority use of sites, or other site use constraints. Recommendations may address revision of monitoring needs (i.e. site bathymetry surveys) or the collection of additional operational data to be used for the purpose of improving the assessment of site capacity. Data required to monitor the progress of site utilization includes: bathymetry surveys, analysis of surveys (plotting, differencing, or other processing), tracking of placement locations within each site, and other pertinent information provided by the dredge operators.

9.3 Updates from CENWP to EPA

Coordination meetings will be conducted among different CENWP offices and EPA to discuss dredging and placement management. The *AUP* will be submitted, reviewed and approved by EPA before the start of the dredging season each year. Active dredged material placement/disposal sites will be managed according to the thresholds listed in Section 8 *Decision Framework for Site Threshold Management* and coordinated with EPA. Periodically during the dredging season, updates will be furnished via email to EPA and the members of

the MCR Update Distribution List maintained by the MCR Channel Operations and Maintenance (O&M) project manager (OD-NW).

9.4 UPDATES FROM CENWP TO PUBLIC

The Portland District (MCR Project Manager) will provide updates to collaborating agencies and interested stakeholders periodically during the dredging and placement season. Other data may be sent as adaptive site management requirements dictate.

9.5 CONTINGENCY PLAN FOR PRE- AND POST-PLACEMENT MONITORING

Due to previous issues with in-house survey boat/crew availability, Portland District has an Indefinite Delivery Indefinite Quantity (IDIQ) contract in place with Solmar Hydro as a contingency to ensure that bathymetry survey needs are met. The contract covers routine bathymetric surveys. This contract should alleviate some of the issues with missed surveys, and allow the government survey vessels more time to work on non-routine MCR work. The surveys at MCR are typically more robust than those conducted further upstream on the Columbia River, and require specialized vessels and additional processing to account for movement of the salt wedge in certain areas.

10 COMMUNICATION AND COORDINATION OF DREDGING ACTIVITIES EACH SEASON

Steps that are taken to increase awareness of dredge locations and site utilization plans at the beginning and throughout the dredging season include the following:

10.1 STATE/LOCAL GOVERNMENT AND PUBLIC

- The *AUP* is communicated with State Agencies and is available to the public once it is formally approved by EPA Region 10 via letter to the Portland District.
- The approved *AUP* is also posted on the USACE website at the following link: http://www.nwp.usace.army.mil/Missions/Navigation
- Notice to Mariners released prior to the start of dredging and placement activities.
- The Columbia River Crab Fishermen's Association (CRCFA), who fish in the area of the Deep Water Site, Shallow Water Site, North Head Site, South Jetty Site and the North Jetty Site, are notified via email in advance of the dredging season start.
- A pre-dredge notification is sent to Oregon Department of Environmental Quality and Washington Department of Ecology 14 days prior to the start of dredging at MCR.

10.2 U.S. Coast Guard (USCG)

- The USCG is informed when dredging will start, and they include this information in their Notice to Mariners. As Dredge Orders are prepared for the Federal dredges, a copy is furnished to the USCG via email for posting in the Notice to Mariners. USACE contract dredges are responsible for notifying the USCG of dredging activities, as specified in the dredging contract.
- Hopper dredges are required by the USCG to employ an intermittent blast from the ship's horn during foggy and low visibility conditions. Hopper dredges are also required by the USCG to display the *ball-diamond-ball* pattern atop her bridge to symbolize her limited ability to maneuver within a navigation channel.
- Hopper dredges are required by the USCG to display automated identification systems (AIS) information, which indicates the position, heading, speed, ship length, beam, and type.
- Nighttime dredging operations require USCG navigation lights mounted at each cardinal location of a dredge.

10.3 Dredge Captains and Crew

- If two dredges are scheduled to concurrently work the MCR project, the two vessels coordinate accordingly to avoid conflict.
- If a contract dredge is assigned to use the SWS or NJS for dredged material placement, an extensive briefing and tutorial is given to the bridge crew of the contract dredge by NWP to ensure that the contract dredge performs dredging and dredged material placement according to the requirements set forth in the dredging contract plans and specifications. The plans and specifications for the dredging contract dealing with dredged material placement at MCR are based on AUP requirements.

10.4 Oregon Department of Environmental Quality (ODEQ)

CENWP has been working with Oregon Department of Environmental Quality (ODEQ) since July 2021 to receive a new 10-year Oregon 401 Water Quality Certification (WQC). In late January 2022, ODEQ released the draft WQC for a 35-day public comment period; this was the first time CENWP had the opportunity to see the WQC, which included new turbidity monitoring conditions. The new conditions called for metered turbidity monitoring during dredging and placement every two hours. In ODEQ's prior WQC, consistent with Ecology's WQC and the National Marine Fisheries Service (NMFS) Biological Opinion, visual monitoring at a compliance point of 900 feet four times a day with no stop-work requirement was sufficient.

ODEQ issued a final WQC to USACE on 4 March 2022 that included the option for visual monitoring for channels that are comprised of 95% or more of sand/gravel. The MCR project is comprised of 98-99% sand; under the new WQC it is eligible for visual monitoring. However, the visual monitoring requirement includes a compliance point of only 600 feet at a 2-hour interval for reporting. The WQC states a plume seen at 600 feet is considered an exceedance and dredging must stop and ODEQ must be notified. The reduced compliance distance and stop-work requirement puts a large risk on CENWP's ability to fully maintain the MCR FNC. Annual dredging at MCR is limited to three months of workable weather before conditions become too dangerous for dredging operations. Dredging 3-4 million cubic yards out of the FNC requires two Hopper dredges working the channel, frequently at the same time. This dredging is needed to maintain a reliable and safe channel for the users at MCR.

The conditions in the new 10-year WQC impose constraints that would limit dredging operations and USACE's ability to dredge the full channel to the authorized depth, leading to safety and economic impacts. The stop-work requirement, 2-hour frequency and 600 feet compliance distance cause unnecessary limitations to already challenging operations when CENWP already abides by all know BMPs. Therefore, CENWP continues to work with ODEQ on requirements that provide adequate protection for the environment, but also give sufficient flexibility in the selection of a dredging approach. CENWP plans to obtain turbidity plume data in 2023 to assist with further discussions with ODEQ. The goal is to have consistent conditions across the FNC and include dredging in Oregon waters in the 2024 West Coast Hopper Dredge Contract, which was removed in 2022 and 2023 due to contract risk.

11 SITE UTILIZATION DURING MONITORING AND BAD-WEATHER CONTINGENCIES

Under certain conditions, placement at active sites may be suspended and directed to other sites. This means, for example, that when the SWS is being surveyed to assess remaining site capacity, the government or contract dredge may use another site until the SWS remaining capacity has been assessed. This will typically last 1-2 days (see Figure 11-1) when the SWS is nearing its site capacity, which may occur near the end of the dredging season. During each SWS assessment period, the dredges may use the NJS (if available) or the DWS.

During periods of rough seas at the offshore bar, the SWS, NJS, NHS or SJS may not be available for use; in which case the DWS may be used. At times during the 2023 dredging season, both contract and government dredges may relocate to other work areas.

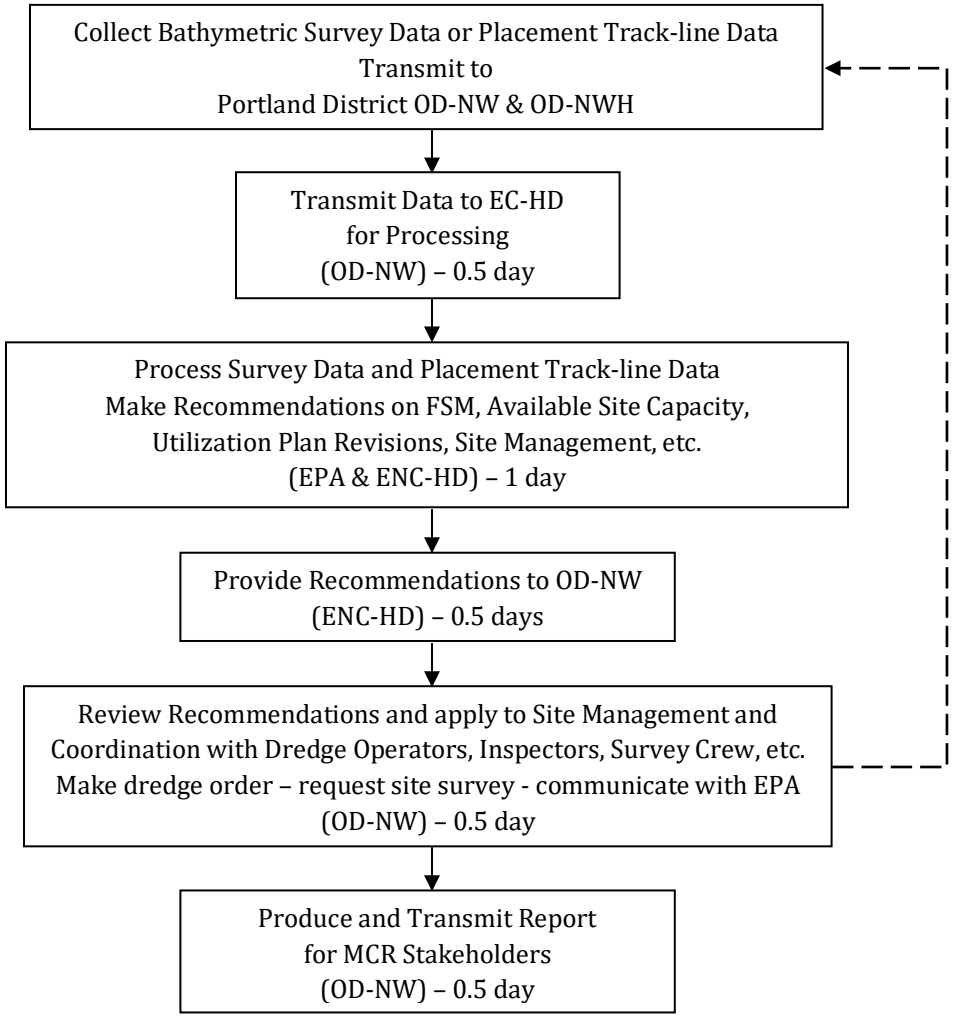

Figure 11-1: Flow Diagram of Adaptive Management of Site Capacity describing Sequence and Timing for Processing Monitoring Data and Incorporating Results into Actions. *NOTE: (responsible parties indicated in parentheses) – followed by expected duration of task.*

12 APPENDIX A—FEDERAL NAVIGATION PROJECT AND DREDGE OPERATIONS

12.1 MOUTH OF THE COLUMBIA RIVER NAVIGATION PROJECT

The MCR is the ocean gateway for maritime navigation to and from the Columbia/Snake River navigation system. The federal navigation project at MCR is authorized by the Rivers and Harbors Act of 1884, 1905, 1954, and by Public Law 98-63. The CENWP is responsible for the O&M of this federally authorized deep-draft navigation channel. The MCR entrance channel lies between RM -3 to +3. The authorized project provides for a 2,640-foot-wide, deep-draft navigation channel extending across the inlet's offshore bar (i.e., ebb shoal). The northerly 2,000 feet of the entrance channel is maintained at -55 feet MLLW (plus an additional 5 feet for advanced maintenance), and the southerly 640 feet of the channel is

maintained at -48 feet MLLW (plus an additional 5 feet for advanced maintenance). To achieve the 5 feet of advanced maintenance, in some locations, an additional 1 to 2 feet of material may be disturbed or removed during the dredging process.

12.2 Columbia River and Lower Willamette River Navigation Project

Since 1962, the Columbia and Lower Willamette (C&LW) FNC has been maintained at a depth of 40 feet, and width of 600 feet, from RM 3.0 to 106.5. This channel configuration was authorized by the Rivers and Harbors Act of 1962 and by Public Law 87-874. Historically, much of the sediment dredged from RM 3 to 29 has been placed within estuarine sites. Due to projected future capacity limitations of existing estuarine sites, long-term planning efforts were conducted, which identified sandy material as far upstream as RM 29, that is potentially suitable for placement at designated MCR ocean sites [USACE 1998]. Sediment located within the LCR channel is predominantly comprised of fine-to-medium sand-sized particles (0.20-0.28 mm in diameter) with less than 3% fine-grained material (particle diameters less than 0.0625 mm, passing a 230-mesh sieve), which would be considered suitable for placement in the ocean. Given the authorizations for such use of the EPA-designated SWS and DWS was provided many years ago, prior to use of either of EPA's sites, the USACE and EPA would need to review the environmental documentation to ensure that the MPRSA designated sites could be still used, or if additional review and public comment would be needed.

In December 1999, Congress authorized the deepening of the C&LW FNC to 43 feet [Section 101(b)(13) of the Water Resource Development Act of 1999]. The existing 600-feet-wide, 40-feet-deep navigation channel was deepened to -43 feet Columbia River Datum (CRD), from RM 3 to RM 106.5. The construction phase of the C&LW channel deepening included advanced maintenance dredging and required over-width & over-depth dredging. The C&LW deepening project was completed in 2010. During the construction phase of the C&LW deepening project, approximately 2.6 Mcy of the sediment was dredged from the LCR channel via hopper dredge from 2005 through 2009. Approximately 2.5 Mcy of this material were placed within the MCR-06-DWS drop zone and 2.58 Mcy were placed in the CR-05-DWS drop zone of the DWS ODMDS, located 7 miles offshore of MCR. Within the estuarine reach of RM 3 to 29, the long-term O&M plan for the deepened 43-feet project will be to place the maintenance material in the ocean, when estuarine sites reach capacity. No dredged material from RM 3 to 29 will be placed within MCR ODMDSs during 2023.

A 20-year Dredge Material Management Plan (DMMP) is in development for the Columbia and Lower Willamette Rivers from Vancouver, Washington and Portland, Oregon to Astoria, Oregon. The plan will include coordination with the appropriate Federal, State, and local agencies leading to a recommendation for construction of additional dredged material placement sites.

12.3 HOPPER DREDGE OPERATING CHARACTERISTICS

A hydraulic hopper dredge is a self-propelled seagoing ship with sections of its hull compartmentalized into one or more holds or *hoppers*. It is normally configured with two drag arms, one on each side of the dredge. During dredging, bottom sediment is pulled into the drag arm with hydraulic pumps and deposited into the dredge's hoppers. The dredged material enters the hoppers in slurry form and settles to the bottom as excess water flows over the top of the hoppers. Once the hoppers are full, the drag arms are lifted, and the dredge transits to the placement area. Multiple placement methods are available depending on the vessel type. The following placement methods have been used at MCR: bottom doors, split hull and pump-ashore. Table A-1 lists some of the operating parameters for several dredges that have been used at MCR.

Dredges designed with *bottom doors* utilize a series of doors located on the hull bottom to release each load of dredged material. The bottom doors are sequentially opened during placement until the entire load of dredged material is released from the vessel resulting in a gradual release of dredged material from the vessel.

A *split-hull* hopper dredge releases its load of dredged material by opening (splitting) the entire hull of the vessel. The split-hull method of placement is more rapid (time-efficient) than bottom-door hopper dredges. While the use of split-hull hopper dredges reduces the time required for material placement, they also reduce the dispersal of dredged material on the seabed during placement, which tends to increase the amount and extent of accumulation per placement event.

With the *pump-ashore* method, the hopper dredge can use its pump to discharge the dredged material directly overboard or thru a pipeline to a site not accessible by the hopper dredge (e.g., beach, upland, or shallow nearshore locations). This type of placement occurred at MCR in 2010 with 20 kcy going to the North Jetty Berm (NJB) and 376 kcy going to the Littoral Drift Restoration, then again in 2018 with 82 kcy going to ESI to prevent a breach of ESI that could negatively impact safe transit through adjacent navigation channels.

Table A-1: Operating characteristics for hopper dredges commonly used at MCR.

DREDGE	Ownership	VESSEL type	OVERALL VESSEL DIMENSIONS				CAPACITY	TIME TO PLACE LOAD (minutes per load)	
			length	beam	draft (ft)		(cy)		
			(ft)	(ft)	fully loaded	empty	load-average	open-water placement	pump-out
Essayons	GVT	bottom doors	350	68	30	15	5400	6 to 15	120 to 140
Newport	KTR	split-hull	300	55	20	10	3000	4 to 8	N/A
Dodge Island	KTR	split-hull	281	52	19	8	2300	4 to 8	40 to 100
Terrapin Island	KTR	split-hull	340	68	22	10	3400	4 to 8	60 to 120
Bayport	KTR	split-hull	303	54	18.5	10	3800	4 to 10	60 -120
Stuyvesant	KTR	bottom doors	372	72	29	17	8000	6 to 15	130 to 160

Hopper dredges are used mainly for dredging in wave-exposed or high-current areas where navigation traffic and operating conditions preclude the use of more stationary dredges operating with pipeline or scows. Hopper dredges are effective working offshore and in entrances where sea and weather conditions preclude the use of extensive dredge pipe (associated with pipeline or cutter-head/hydraulic dredges). Most hopper dredges are capable of operating in ocean swell 8-10 feet high (which is required for ocean inlet dredging in the NW) and accessing sites many miles from the dredging location.

13 APPENDIX B—SITE MANAGEMENT STRATEGIES & PROCEDURES, ADDITIONAL INFORMATION

13.1 SITE MANAGEMENT CRITERIA - TARGET MOUND HEIGHT

The level to which any site can be used for dredged material placement is related to the capacity available within the site and the effectiveness of the placement strategies followed. Site capacity increases when the dredged material is distributed uniformly throughout the entire site. Uniform placement exposes more of the newly placed material to transport processes (increases the surface area of the deposited material that is exposed to hydrodynamic forcing), and, thus, increases the dispersion of the material out of the site during the season. Placement activities therefore follow a regimented procedure that produces a uniform continuous depositional layer on the seabed and avoids the formation of any localized mounding.

Target capacity for a given site is defined by the target mound height and area over which dredged material can accumulate with respect to a baseline condition. When reached, the target capacity for a given site defines a management condition for which an intermediate review action (decision point) occurs. At this point, the potential cumulative effects of additional site utilization are assessed in conjunction with other physical processes. Use of an active placement area may be discontinued upon reaching the specified target capacity.

The target capacity is based on the need to manage dredged material accumulation such that mounded dredged material does not excessively amplify waves due to shoaling and refraction. The target capacity is generally different for each site.

Target values, given in Table B-1, for managing the accumulation of dredged material were obtained using the RCPWAVE model as discussed in USACE/USEPA [1999, 2001, and 2003]. RCPWAVE is a numerical model that simulates the behavior of waves as they interact with spatially variable bathymetry (underwater mounds in this case). It must be noted that wave height results obtained using RCPWAVE can be 10-50% higher than the actual case: RCPWAVE overestimates how waves interact with variable bathymetry (the model is conservative). The target mound heights given in Table B-1 are conservative and are intended to provide a safe operational limit to define an intermediate review action for adaptive site management.

A detailed analysis of various scenarios for dredged material placement (deposition and related wave effects) within the SWS was conducted by USACE/USEPA in 2003. The analysis concluded that the *target mound height* for dredged material accumulation presently being used for site management is 2-3 feet below the level that would begin to affect waves passing over the SWS. The difference between the *target mound height* and the mound height that would begin to affect waves over the SWS translates into additional incremental placement volume of 1-2 Mcy. This volume is the marginal capacity of the SWS that is NOT being realized in order to manage the site at a very conservative level. A supplemental wave analysis was conducted in 2007 to investigate the behavior of wind-wave and swell associated with the Fall 2007 nearshore bathymetry condition at the Mouth of the Columbia River. Results of the wave analysis indicated that wave amplification potential within the SWS (at the end of the 2007 dredging season) was within the target protocol of 10% with respect to the 1997 baseline bathymetry condition. Refer to the 2008 MCR AUP for additional information. During 2012, several different wave models were applied at MCR to compare the model-to-model results. Additionally, the model results were compared to data observed at the Clatsop Spit CDIP buoy (#62). A summary of the 2011 modeling activity was provided in the *2012 AUP*. Table B-1 presents the target mound heights applicable for MCR placement/disposal sites and, because of the need to assign capacity and concern for navigation safety, thresholds for increasing the level of monitoring intensity and management responses have been identified (see Section 8). The *target mound height* values shown in Table B-1 are intended to be used only as an ODMDS management guide (a screening tool to identify site management thresholds for concern). Dredged material placement events that produce total accumulation levels less than or equal to the *target mound height* throughout the site are acceptable. (Note: the values shown in Table B-1 apply to a mound feature that occupies an area of 2,000 by 2,000 feet). Little or no wave amplification would be expected for smaller mound features that are equal to or marginally

higher than the *target mound height* values in Table B-1 [USACE 2003]. As dredged material accumulation approaches the *target mound height*, efforts are enacted to minimize additional dredged material accumulation within the affected area and subsequent dredged material would be placed uniformly within other areas of the site.

The target mound height in Table B-1 that corresponds to the present site condition (column 3 in Table B-1) applies to the utilization of available sites at the beginning of the dredging season. This 'present' target mound height will be redefined throughout the season as subsequent bathymetry surveys show changes in the bathymetry. Note in Table B-1 that the 'baseline' and 'present' target mound heights can be different values for the same site. This difference reflects the current difference in bathymetry between the baseline bathymetry and present conditions. For example, the western area of the SWS is persistently shallower than the baseline condition established in 1997.

Sites are monitored throughout the dredging season to establish the level of mounding within each site and to determine the corresponding management *action level* (see Section 8). Concern associated with dredged material mounding within a given site, should arise only if the level of accumulation significantly exceeds the target height and/or the area of accumulation exceeding the target value becomes greater than 2,000 by 2,000 feet. Detailed examination of wave amplification potential will be conducted if dredged material accumulates to levels that substantially exceed the *target mound height* and/or covers an area larger than 2,000 by 2,000 feet. Should this occur, the STWAVE model [Smith 2001] will be used to assess whether the area of accumulation may potentially affect waves in or near the site. Although RCPWAVE is considered an appropriate model for establishing conservative target mound heights, STWAVE is more accurate and considered to be better suited for predicting actual conditions (see Section 13.3).

Table B-1: Target Mound Heights based on RCPWAVE model results. Values to be used for interim review of disposal site capacity. SWS & DWS: designated under Section 102 of MPRSA, 1 April 2005 (40CFR, Part 228). NJS & SJS: selected under Section 404 of CWA, 1999 & 2013.

Site	Target Mound Height (ft) with respect to		Available Drop Zone Area^ (acres)	Volume of Present Static Capacity (Mcy)
	Baseline Condition+	Present Condition'		
SWS drop zone - East half	5	5	170	1.34
SWS drop zone - West half	5	3	180	1.25
NJS*	8	4	105	0.15
SJS**	4 / 1	4 / 1	1,184	0.5
DWS drop zone (MCR-14-DWS)	30	10	360	5.1
NHS (Zone 2)***	2/1	2/1	964	0.4

* The North Jetty Site (NJS) is not subject to the same target mound geometry criteria as SWS & DWS. For initial assessment of 2023 dredging season, NJS capacity has been set at 0.15 Mcy to minimize potential transport to areas near the MCR channel.

** For Minimizing impacts to the ambient wave environment, the SJS is subject to similar target mound geometry criteria as SWS. Total Target inter-annual accumulation for SJS = 4 feet. However, the SJS is also subjected to added restrictions for minimizing the intra-seasonal dredged material accumulation to 1 foot or less.

***Same as SJS except the inter-annual and intra-seasonal values for deposition apply as shown in Table B-1

+ Baseline Condition: May 1997 for SWS, June1999 for NJS, August 2004 for MCR-DWS, and 2012 for SJS.

' Height of material that can be deposited and accumulated based on present conditions.

^ Drop zone area that is not restricted from initiating dredged material placement (total acreage of cells within disposal site that can be assigned dredged material placement).

13.2 Routine Site Monitoring of Dredged Material Accumulation

Site monitoring of active ODMDSs at MCR is required based on the site designation statute of MPRSA. Both management and monitoring are described in the 2005 USEPA/USACE SMMP for the Mouth of the Columbia River. Monitoring as described in the SMMP includes routine monitoring and special studies when triggered. Typically, routine periodic monitoring consists of bathymetric surveys of both the SWS and DWS. The intensity of these surveys is greater for the SWS than the DWS and is described in the following section on Frequency of Site Monitoring (FSM). For the DWS, the routine monitoring consists of a pre- and post-placement survey of those areas proposed for placement of dredged material as well those portions of the site used the previous year.

Minimum site monitoring requirements for each active site at MCR are a pre-placement bathymetry survey (beginning of season) and post-placement survey (end of season). Present operational strategy requires that the SWS and the NJS be surveyed at least once a month during the MCR dredging season. The MCR-14-DWS will be the DWS drop zone used during 2023 and will be surveyed at the end of the dredging/placement season, weather permitting. For active sites, the survey frequency may differ from the minimum requirements, as specified in Table B-2.

For all active sites, an alternative FSM will be based on: the volumetric rate (**V'**) at which dredged material is being placed, the usable area (**A**) over which the dredged material is being placed, and the safe target height (**H**) of vertical accumulation for placed dredge material. As a given site (or portion thereof) is *filled* with dredged material, the reported value for **H** will decrease (become less with time). The FSM may need to increase as a site is being filled. FSM will be re-assessed each time an active site is surveyed. Each monitoring survey does not need to cover the entire placement area; bathymetry surveys only need to include the parts of the site receiving dredged material and adjacent areas (within approximately 1,000 feet of placement activity). If the FSM becomes too frequent, then the placement area may be considered *filled* and closed to placement activities until sufficient dredged material dispersion has occurred (as determined by site monitoring).

Equation 1 is used to estimate bathymetry survey frequency for each site. FSM (Equation 1) assumes: The survey will be conducted at the midpoint of a site's total remaining capacity (i.e., at **H**/2 days); dredged material is continuously placed at the site; and 20% of the site's area is not used (i.e., days when 0.8**A** is used). Table B-2 specifies the initial FSM for each site based on initial conditions for 2023 and other parameters as shown. Note that the FSMs in Table B-2 will require revision as the capacity (allowable accumulation height) of each site is reduced by dredged material placement.

$$\boldsymbol{FSM} = \left(\frac{\boldsymbol{H}}{\mathbf{2}}\right)\left(\frac{\mathbf{0.8}\boldsymbol{A}}{\boldsymbol{V'}}\right) \qquad \text{(Equation 1)}$$

FSM = Frequency of Site Monitoring [days to next monitoring bathymetric survey]
H = safe target Height [feet]
V' = daily Volumetric rate at which dredged material is placed [cy/day]
A = usable Area [feet^2]
1 acre = 43560 feet^2

Example:
Initial FSM for the Eastern half of the SWS drop zone (DZ) for contractor dredge is:

$$\left(\frac{5ft}{2}\right)(0.8)(190\ acres)\left(\frac{43560\ ft^2}{1\ acre}\right)\left(\frac{1}{\left(27\frac{ft^3}{yd^3}\right)(35000\frac{yd^3}{day})}\right) = 17days$$

NOTE: This value, 17 days, is halfway through the total time expected to fill the site.

As a given site is used, the interval between successive bathymetry surveys will become smaller. Table B-3 shows an estimated schedule for surveying MCR sites during 2023 assuming dredged material is placed uniformly within the available area. The values shown in parentheses are the revised FSMs, following the initial value. An example of how to read Table B-3 is given for the SWS, and assumes that dredged material is continuously and evenly placed, from day one, using a contract hopper dredge with a production rate of 50,000 cy/day:

1) 15 days after commencement of the placement operation, the site would be surveyed and remaining capacity assessed.
2) After 11 additional days, the site would be re-surveyed and re-assessed. The total time for placement would be 26 days.
3) After 5 additional days, the site would be re-surveyed and re-assessed. The total time for placement would be 31 days.
4) After 3 additional days, the site may be filled. The total time for placement would be 34 days. At this point, the site's capacity would be re-evaluated. If there was additional capacity remaining within the site, the site may continue to be used.

Table B-2: Values Used to Estimate Initial Frequency of Site Monitoring (FSM).

Site	Target* Mound Height, **H** (ft)	Usable** Site Area, **A** (acres)	Daily Volumetric Rate^ of Placement, **V'** (cy/day)		**FSM**** (days to next bathymetry survey)	
			GVT dredge	KTR dredge	GVT dredge	KTR dredge
SWS drop zone - East half	5	170	40,000	45,000	12	10
SWS drop zone - West half	3	180	40,000	45,000	5	3
SWS drop zone - total	4	230	40,000	45,000	15	12
NJS	3	105		13,000 +		21
SJS ^^	1	1,180	20,000		2	
DWS drop zone (MCR-14-DWS)	20	½(360)	30,000	40,000	80	60

* From column 3, based on present values; will be updated as site conditions change in subsequent site surveys.
** From column 4, note DWS acreage reflects that only half the site is assigned to each dredge.
+ Based on need to distribute dredged material placement over multiple sites, the daily rate of placement within the NJS will be ~3 loads per day.

^ Based on typical average production rates; values to be updated if production rates are higher.
*** Frequency for Site Monitoring (FSM): days between first successive surveys, assuming site is continuously used and that dredged material is placed evenly throughout available placement area.
^^ The surveying interval for the SJS is based on the need to seabed accumulation document per "disposal event". The objective of using the SJS is for each load of dredged material to have a vertical accumulation of < 0.25 feet.

Table B-3: Estimated Frequency for Site Monitoring (FSM) during the dredging season based on dredge production rates.

Site	1st FSM	2nd FSM	3rd FSM	4th FSM	Capacity at last FSM
	days from site's first use' (days from previous FSM")				% filled -- total capacity
SWS	15	26 (11)	31 (5)	34 (3)	50% filled—2.6 Mcy
NJS	7	10 (3)	12 (2)		100% filled--0.3 Mcy
SJS *	1	3 (2)	7 (4)	15 (6)	100% filled-- 0.4 Mcy
DWS (MCR-14-DWS)	>40, Survey DWS drop zone at beginning and end of dredging-disposal season.**				

'Values indicate number of days for which site is used during the dredging season.
"Values in ( ) indicate number of days the site can be used between successive surveys.
When the FSM becomes less than 3 days, use of the site may be temporarily halted while site capacity is evaluated.
* The FSM for the SJS is based on the need to document seabed accumulation per placement event.
The objective of using the SJS is for each load of dredged material to have a vertical accumulation of < 0.25 feet.
** Post-Season survey of DWS occurs only if the site has been used during that season.

13.3 Wave Model Application for Assessing Dredged Material Mounding at MCR

Numerical computer models can be used to simulate the behavior of waves (wind, waves, and swell) as the waves approach the shore and become modified by limiting water depth, wind, and currents. These numerical wave models can be used to evaluate the effect that dredged material mounding will have on waves by comparing wave simulations conducted with- and without-mounding. Utilization of the SWS is predicated upon limiting dredged material accumulation within the site so as to avoid negatively affecting waves passing across the site. Numerical wave modeling has been used to ensure that SWS utilization complies with this wave-related operational requirement.

RCPWAVE is a monochromatic wave model used to simulate modification of nearshore waves associated with shoaling (wave height change due to water depth change) and refraction (wave height and direction change due to spatial variation in water depth change) [Ebersole, 1986]. Because RCPWAVE is a monochromatic wave model (all waves are assumed to be identical in period, height, and direction), it can overestimate nearshore wave evolution by as much as 50%. Since RCPWAVE tends to overestimate nearshore wave height,

it was used to establish a conservative target level for dredged material mounding. Due to the inherent nature of RCPWAVE to over predict nearshore weave height, it is no longer used by USACE to quantify nearshore wave evolution where engineering applications require accurate determination of wave parameters needed to achieve optimized (least cost) coastal design.

STWAVE is a steady-state spectral wave model developed for simulating nearshore wave transformation and is presently the standard USACE wave model for estimating wave refraction and shoaling. STWAVE uses the wave energy conservation equation, solved in the frequency domain using phase averaging to simulate wave propagation and estimate wave height, period, and direction at a given location (x,y). Time-varying information describing the changes in wave phase and superposition of waves having different phases is not presented. Phase-averaging limits this model from directly solving for wave diffraction and reflection caused by very steeply-sloped bathymetric features and surface piercing structures. However, approximation methods have been incorporated into STWAVE to indirectly account for wave diffraction and reflection [Smith 2003]. STWAVE has been extensively applied, calibrated, and verified throughout the US and the world. Refer to Moritz et al [2006] for a discussion of STWAVE application at MCR. The physics affecting waves in the nearshore area of Peacock Spit, including the SWS, are limited to shoaling and refraction; processes for which the STWAVE model was developed to simulate [USACE-USEPA 2003]. There are essentially no diffraction or reflection effects occurring within the SWS or nearshore areas of Peacock Spit, west of the offshore of the MCR jetties. In this regard, the STWAVE model is appropriate for assessing wave modification on Peacock Spit and within the SWS due to mounding of placed dredged material. The gradual varying bottom gradient (slope) of the bathymetry and mounding within the SWS is compatible with STWAVE applications; i.e. the bottom gradient within the SWS is not so rapidly changing as to invalidate STWAVE simulations. Should mounding within the SWS exceed specified management thresholds, as described in Section 8 of this *AUP*, the STWAVE model will be used to evaluate the effects of dredged material (mounding) upon the wave environment of Peacock Spit. STWAVE results for the post-2007 dredging season assessment are summarized in the *AUP* for 2008.

Detailed supplemental wave model studies were performed in 2011 and are summarized in the *2012 AUP*. These studies compared the STWAVE and CMS-WAVE model results for a March 2010 simulation time period. At this time USACE has no immediate plans to conduct further wave modeling for placement at the nearshore sites—the results obtained in previous investigations are still applicable today. However, as the North Head Site is being utilized the *AUP* will be refined for future use (see Section 7.10), and the need to model mound-wave interactions will be re-evaluated.

13.4 SPECIAL STUDIES

Special studies are non-routine studies of specified duration that are intended to address specific questions or issues that are not covered by routine monitoring or that arise from questions or issues identified through routine monitoring. Designation, of the SWS and DWS by USEPA in 2005, required additional site monitoring studies to be completed within 3 years of designation. These additional monitoring actions were required to include biological, chemical, and physical special studies. Proposals for ODMDS monitoring and special studies were submitted to EPA Region 10 for review and approval. Special studies for 2005 included sediment profile imaging, benthic infauna and physical sediment analysis, bottom trawls, detailed bathymetry surveys, modeling, and crab pot deployment. Sampling protocols were similar to those applied in 2002 for the DWS Biological Baseline survey but focused on the area of the 2005 placement with suitable reference areas. Results of the physical, biological, and numerical modeling analyses conducted during 2005 were summarized in the *2006 AUP*.

The special studies discussed in the SMMP for the SWS have either been completed (sediment transport and fate) or have not been triggered (placement of material other than sand in large quantities). Two of the three special studies identified for the DWS have been completed. Placement at the DWS has not triggered the third study. See Section 7.10 for additional information on the special studies planned for 2023.

A physical sediment monitoring study was conducted in 2008 triggered by the 2005 SMMP routine monitoring requirement for physical monitoring upon the placement of more than 500,000 cy/year of dredged material at the DWS. Based upon the 2008 sediment report, EPA Region 10, by letter in 2009, waived the 500,000 cy/year trigger and agreed to delay grain size sampling until 2014, reserving the right to change this date if site use or conditions warranted. EPA also recommended the SMMP be revised to require grain size sampling every 5 years thereafter.

Both the SWS and DWS were configured based on hopper dredge operating characteristics. The DWS is large enough that barge-placement of material would not be a problem. At the SWS, dredged material placed using a barge/scow would likely not disperse as readily as material placed by a hopper dredge. Due to less control and maneuvering limitations of a barge and tow, placement of material in the SWS by this equipment may not be possible. *Before any non-hopper dredged material may be discharged at the Shallow Water Site, a specific evaluation (potentially including sophisticated modeling) must be completed and submitted for approval by the USEPA-R10* [USACE 2005].

13.5 CWA 404 SITE MONITORING

The current portfolio of MCR CWA sites includes the NJS, SJS, and NHS; these nearshore sites were all selected by Portland District using our authority found at 33 CFR 336.0(b). Dredged material placement sites at Benson Beach and ESI were also selected under this authority. To support the selection of these sites and their continued use, Portland District has performed a host of monitoring activities alone and in collaboration with partnering agencies. The following table summarizes monitoring activities performed by Portland District and others.

Table B-4. Summary of CWA monitoring activities at the MCR.

Year	Site	Responsible Agency(ies)	Description
2004	Benson Beach	USACE, USGS, & WDOE	First time USACE pump-ashore project for 42,000 cy to demonstrate operational capability. Monitoring revealed that dredged material placed along upper beach near NJ remained within intertidal zone > several months.
2004 to 2019	SWS, NJS, NHS, & North Jetty	USACE Contract; OSU	Argus beach monitoring system (ABMS) at the North Head lighthouse. Time series panoramas provide information on wave break patterns (relative to the dredged material placement sites) and nearshore sandbar morphology. Argus camera data indicate that wave breaking occurs outside of the SWS on Peacock Spit (and along the North Jetty).
2005	Mega-Transect	USACE & USGS	Intensive oceanographic data collection program along transect that crossed the MCR inlet. Data were simultaneously collected at 5 underwater tripods and 2 CTD arrays through water column for continue 6 week period. Collected data enabled new science to be performed at MCR using Delft, ADCIRC, and AdH models
2006 to 2010	SWS, SJS	USACE Contract	Sediment tracer studies: sand tracer particles (fluorescing, engineered particles) were placed at the SWS (2006-2007) and SJS (2008-2010) and tracked for a 4 year period. The study showed that a portion of the dredged material placed at the SWS and SJS is transported onto the adjacent beaches. A detailed summary appears in Appendix B of the *2012 AUP*.
2009 to Present	MCR entrance	USACE Contract	A single CDIP wave rider buoy was deployed to provide real-time operational details of the wave environment at the MCR entrance. Data stream is at: https://cdip.ucsd.edu/m/products/?stn=162p1
2010	SJS	USACE & OSU & PSU	USACE collaborated with OSU to have OSUs X-Band radar was deployed at the SJS to provide short term wave observations. Data showed how waves interact with SJ and affect the adjacent shorelands. USACE collaborated OSU to perform SWAN wave modeling to evaluate wave breaking characteristics offshore Benson Beach and wave transformation within the prospective SJS in response to different bathymetry change scenarios. USACE collaborated with Portland State University to evaluate the utility of SAR imagery at MCR for assessing wave transformation offshore and into the inlet.

Table B-4. Summary of CWA monitoring activities at the MCR.

Year	Site	Responsible Agency(ies)	Description
2009-2012	Benson Beach	USACE, USGS, WDOE	In 2009 approximately 90k cy was placed using the *pump-a-shore* method onto an upland beach area called the North Jetty Berm (NJB) to protect the NJ root until the jetty could rehabilitated in 2015-19. In 2010, 367 kcy was placed at a littoral drift restoration (LDR, intertidal beach) site 1500 ft north of the NJ, along Benson beach. Monitoring results are described in detail in the *2013 AUP*. The LDR project was cost-shared with USACE and the state of WA.
2012 to 2021	SJS, NHS	NOAA	Large-scale, before-after/control-impact (BACI) study of dredged material disposal impacts to the Dungeness crab fishery. Multiple investigations were performed, including video from epibenthic video sled tows, baited camera pods placed in the hopper dredge disposal to evaluate crab impacts and mortality, and acoustic tagging of crabs to evaluate mortality and crab motility. No statistical difference was found in crab mobility between impact and control sites. NOAA is scheduled to provide a report synthesizing all crab studies by summer 2023. Monitoring results are briefly summarized in the *2014-2022 AUPs*.
2003 to present	Beach and Nearshore areas adjacent to MCR	USGS, Ecology, OSU	Nearshore bathymetric and beach topographic surveys from the North Head to the North Jetty, and from the South Jetty 3 miles south along the Clatsop Spit and Clatsop Plains
2017	NHS	USACE Contract	USACE staff and contractor, ANAMAR, performed the baseline survey of the North Head study area, which included: sediment grain size and total organic carbon content analysis, benthic infauna ID and density, epibenthic trawls, and commercial crab pot survey. Final survey report is available upon request.
2019	NHS	USACE Contract	A single, telemetered wave rider buoy with integrated acoustic Doppler current profiler and CTD meter were deployed by USACE contractor, SOLMAR Hydro, Inc., to accurately define the wave and current environment off the North Head and facilitate understanding of the morphological response of Peacock Spit and Benson Beach. Final report and data available upon request.
2009 to present	MCR area	USGS	Periodic Modeling effort performed by the USGS, using the Delft3D-SWAN hydrodynamic and sediment transport model. Most recent modeling work is described in Section 6.3 of this document.
2022 to present	Clatsop Spit; West Sand Is.	USGS	Nearshore bathymetric monitoring program on the backside of Clatsop Spit and west side of West Sand Island was initiated to measure changes at sensitive locations in the lower estuary.
2022 to present	Benson Beach	USACE	Seasonal UAS (drone) surveys of the Benson Beach-North Jetty area at low-low tide to track major changes to the foredune, beach and intertidal spits and sandbars.

This table will be maintained and updated in subsequent *AUPs*.

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