100% Remedial Design Basis of Design Report

Appendix D
Section 408 Substantive Compliance Analysis

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ABBREVIATIONS

AOC	*Administrative Order on Consent*
BA	*Biological Assessment*
BODR	*Basis of Design Report*
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
contractor	Remedial Action Contractor
Ecology	Washington State Department of Ecology
ENR	enhanced natural recovery
EPA	U.S. Environmental Protection Agency
FNC	federal navigation channel
LDW	Lower Duwamish Waterway
LDWG	Lower Duwamish Waterway Group
MLLW	mean lower low water
MNR	monitored natural recovery
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
RAA	remedial action area
RAL	remedial action level
RD	remedial design
RM	river mile
RMC	residuals management cover
ROD	*Record of Decision*
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard

1 Introduction

This document presents a 33 U.S. Code (USC) Section 408 substantive compliance analysis for the proposed cleanup remedy for the upper reach of the Lower Duwamish Waterway (LDW) Superfund Site in King County, Washington (Figure D1-1). The LDW Superfund Site has been divided into three reaches (lower, middle, and upper) that are each undergoing remedial design (RD) on different timelines, with the upper reach being the first reach for which RD is being performed. The upper reach encompasses river miles (RMs) 3.0 to 5.0 of the LDW (Figure D1-2). The project is proposed to clean up sediment contamination resulting from more than a century of urbanization and industrial activity near and on the LDW.

Portions of the cleanup actions will require temporary alteration and occupation of the LDW federal navigation channel (FNC), which is a federal civil works project maintained by the U.S. Army Corps of Engineers (USACE). This report was prepared in accordance with USACE Engineering Circular guidance for Section 408 evaluations (EC 1165-2-220; USACE 2018) to assess potential impacts to the FNC. Section 12 of the guidance states that each Section 408 request will be reviewed by USACE consistent with the following:

- Impacts to the usefulness of the USACE project
- Injury to the public interest
- Legal and policy compliance

Section 9(h) of the guidance states that actions conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) do not require a permit from USACE under Section 408. This report provides information to support the U.S. Environmental Protection Agency's (EPA's) technical compliance review of the proposed cleanup actions with the substantive requirements of Section 408 as they relate to the LDW FNC.

2 Background

In September 2001, EPA formally added the LDW to the National Priorities List as a Superfund Site, and in February 2002, the Washington State Department of Ecology (Ecology) listed the LDW as a cleanup site under the Washington Model Toxics Control Act. The EPA *Record of Decision* (ROD) was issued in 2014 (EPA 2014). The ROD, and subsequent amendments, provide the EPA-selected remedy for the in-water portion of the LDW Superfund Site. EPA and Ecology have divided lead agency responsibility for addressing the site: EPA is responsible for administering the cleanup of the sediments in the waterway, and Ecology is responsible for controlling sources of pollution to the waterway.

In December 2000, the Lower Duwamish Waterway Group (LDWG) entered into an Administrative Order on Consent (AOC) with EPA and Ecology to conduct a Remedial Investigation/Feasibility Study for the LDW. Amendments to the AOC include development of the RD for the upper reach, progressing from the preliminary design phase (30%) through 60%, 90%, and final (100%) designs.

The RD has been prepared consistent with the EPA-approved *Remedial Design Work Plan for the Lower Duwamish Waterway Upper Reach* (Anchor QEA and Windward 2019) and the ROD (EPA 2014) as modified by an *Explanation of Significant Differences* (EPA 2021). The selected remedy issued by EPA is consistent with CERCLA. The State of Washington, through Ecology, has reviewed and concurs with the selected remedy.

3 Existing Conditions

The LDW upper reach includes the Turning Basin (RMs 4.6 to 4.7) and the FNC (Figure D1-2). The average width of the upper reach is 540 feet (it is wider at bends and at the Turning Basin). The FNC covers approximately 32 acres of the 76-acre subtidal area of the upper reach.

The authorized navigable depth of the FNC is -15 feet mean lower low water (MLLW) from Slip 4 to the Upper Turning Basin (RMs 2.8 to 4.7). To maintain navigation depths in the upper reach, USACE dredges the upstream portion of the FNC every 1 to 3 years. USACE typically allows for dredging up to 2 feet below the authorized depths (i.e., over depth dredging, also referred to as the maintenance depth) to account for dredging inaccuracies and to ensure that authorized depths are obtained at a minimum during a particular dredging event.

The primary contaminants exceeding remedial action levels (RALs) in the upper reach are polychlorinated biphenyls (PCBs). Other contaminants that determine the RAL cleanup areas include metals, polycyclic aromatic hydrocarbons (PAHs), phthalates, other semivolatile organic compounds (e.g., benzoic acid and phenol), and dioxins/furans, depending on the area (Anchor QEA and Windward 2022).

4 Project Description

The Preliminary (30%) RD for the upper reach identified areas of sediment that exceeded ROD-defined RALs. The RAL exceedance areas were further refined and developed during subsequent design stages into remedial action areas (RAAs). The RAAs have a larger footprint and encompass the RAL exceedance areas to account for engineering and constructability considerations, providing a greater degree of confidence for removing sediments that exceed the RALs. Figure D1-2 illustrates the RAA locations relative to the FNC, based on the Final (100%) RD *Basis of Design Report* (BODR).

4.1 Remedial Technologies

The remedial technologies that will be used within each RAA are based on ROD criteria with subsequent refinements. For each RAA, activities will include applying one or more active remedial technologies, including dredging, enhanced natural recovery (ENR), area-specific technology, and engineered capping.

The area-specific technology (amended cover) will be applied to limited locations that are adjacent to structures where dredging, ENR, or engineered capping cannot be effectively used. Figure D4-1 illustrates the activities within each RAA.

To address USACE input on remedial technology use within the FNC and maintenance dredging, the ROD incorporated the following RD requirements into the selected remedy (Section 13.2.1.1 of EPA 2014):

- In order to avoid damage to a cap or ENR layer during federal maintenance dredging, the top of any ENR layer will be at least 2 feet below the authorized FNC depth, and the top of any cap will be at least 4 feet below the authorized FNC depth.[1]
- In RAAs to be dredged within the FNC, an additional 10 feet (lateral) of dredging outside of the FNC will be included when the RAA toe of dredge cut extends to the FNC boundary to provide stable side slopes and minimize sloughing into the channel. Where the toe of the RAA's dredge cut does not extend to the FNC boundary, no additional 10-foot buffer was included. The dredging cut was also designed with a stable 3 horizontal to 1 vertical (3:1) exterior side slope to minimize potential sloughing into the FNC.
- Shoaled areas (where the bottom elevation is currently shallower than the authorized federal navigation depth) will be dredged where contaminant concentrations exceed RALs at any depth within the shoal or the 2 feet of overdredge depth.

[1] No ENR is proposed within the FNC for the upper reach.

The selected remedy includes both active remediation and monitored natural recovery (MNR) to achieve remedial action objectives. Per the ROD (EPA 2014), MNR relies on natural processes, such as burial of low to moderately contaminated sediments by cleaner sediments from upriver of the cleanup site, to reduce ecological and human health risks to acceptable levels. MNR does not involve construction and therefore is not discussed further in this Section 408 evaluation.

4.2 Construction and Disposal Methods

Mechanical dredging will be the primary dredging method to remove contaminated sediments from the RAAs within and outside of the FNC. It will ultimately be up to the selected Remedial Action Contractor (contractor) to determine the specific dredging method(s) to be used during construction. Hydraulic dredging is unlikely to be used except potentially in small areas within difficult to access locations outside of the FNC (e.g., underpier areas).

Dredging within the FNC will be conducted to either remove the sediment exceeding RALs to at least the maintenance depth (i.e., -17 feet MLLW), or to dredge sufficiently deep to allow placement of an engineered cap, as long as the top of the engineered cap complies with the ROD requirements to address navigation and USACE maintenance dredging.

Dredged areas (both outside and within the FNC) are required to leave the surface concentrations below RALs post-construction. After dredging is completed in an RAA, clean material will be placed in the FNC to address the following considerations:

- Place residuals management cover (RMC) over the dredge footprints and additional dredge area perimeter to address residual contamination from suspended sediment so that the post-construction surface is below surface RALs (Section 10). A memorandum was submitted to USACE and EPA to discuss use of RMC within the upper reach FNC (Anchor QEA 2023) based on an earlier design phase. This memorandum indicated that there would be a net decrease in sediment volume in the FNC after the upper reach remedial action was completed (including placement of RMC) of approximately 24,000 cubic yards, reducing the quantity of future USACE maintenance dredging. The 100% RD has increased the volume of dredging within the FNC; therefore, there will be a larger net decrease in sediment volume in the FNC after the upper reach remedial action. Placing the RMC also will leave the surface sediment condition throughout the upper reach at concentrations below the surface RALs; clean imported placed materials are required to have concentrations at or below the LDW cleanup level concentrations, which are lower than the LDW RALs for PCBs, dioxin/furans, and arsenic, as well as for benthic contaminants of concern depending on recovery category.[2]

[2] RALs for benthic contaminants of concern are the same as the benthic cleanup levels in Recovery Category 1 areas and two times greater than benthic cleanup levels in Recovery Category 2 and 3 areas.

- Place an engineered cap in dredge areas where the dredge prism does not remove the vertical extent of RAL exceedances required by the ROD. The top of the engineered cap must be at least 4 feet below the FNC authorized depth. There is one location for an engineered cap within the FNC between RMs 3.55 and 3.65. USACE will be provided with as-built drawings of the engineered cap showing the channel station numbers to demarcate the location.

Dredged materials removed from the upper reach will be loaded onto haul barges and transported by tugboat over water to an upland transload facility that would be located outside of the FNC boundaries. Offloaded dredged material will be transported over land to a permitted and EPA-approved landfill facility. In addition to the contractor's primary dredging equipment (i.e., derrick barge and material haul barges), construction will include using tugboats to move dredging equipment around, small work boats to transport people and materials, small survey vessels, and monitoring vessel(s) for environmental compliance with water quality or other environmental criteria. Additional dewatering of the material will be performed if necessary. Any dredge return water generated by dewatering at the transload facility will be managed and disposed of in accordance with the facility's permits and standards for wastewater disposal. The contractor will be required to employ environmental controls and construction methods described in the project specifications to minimize material spillage, impacts on water quality, and recontamination risks.

5 Analysis of Federal Navigation Function

Construction of the selected cleanup remedy is not expected to impair the usefulness of the FNC or be injurious to the public interest.

As described in Section 4.1, the selected remedy described in the ROD (EPA 2014) was designed to maintain FNC authorized depths and allow for future maintenance dredging (including advanced dredging) by USACE. The 100% RD shows that most of the remedial activity within the FNC will be dredging, which will deepen the waterway in those dredge areas. For the one engineered cap area in the upper reach FNC (between RMs 3.55 and 3.65), the waterway will be dredged sufficiently deep to provide room to place an engineered cap with a top of cap elevation at or below -19 feet MLLW (i.e., 4 feet below the FNC-authorized depth of -15 feet MLLW). The upper reach does not have any areas designated for using ENR within the FNC.

During construction, dredging equipment will be operating in and near the FNC, temporarily occupying a portion of the FNC in the upper reach while implementing the remedial actions. The FNC is used by numerous other vessels, and the temporary presence of barge-based equipment is consistent with these uses. The contractor will be required to coordinate with the U.S. Coast Guard (USCG) to provide safe passage for vessels and will prioritize commercial vessels passing in or around the construction area. The contractor will notify USCG in accordance with USCG regulations before each construction season so USCG can issue a Notice to Mariners. The contractor will be required to move its equipment, if needed, to allow safe passage of other commercial vessels.

6 Technical Analysis and Adequacy of Design

The design of the cleanup remedy is technically feasible and was prepared by a group of expert scientists and engineers with extensive experience using standard scientific and engineering practices on the LDW and at other similar CERCLA sites in the Pacific Northwest and across the country. The remedy was designed to place the minimum amount of fill to meet the goals of the project and considered the placement precision of various types of equipment that may be used during construction. The design was developed through a standard CERCLA process of pre-design investigation followed by preliminary, intermediate, pre-final, and final design steps. The final design will require approval by EPA.

7 Real Estate Analysis

Implementation of the cleanup does not require permanent occupation or alteration of any federally owned property. The cleanup will require transient use of the FNC for equipment transport, dredging and debris removal, material transportation (by barge), and placement of clean material. Cleanup activities within the FNC in the LDW upper reach are expected to require up to three construction seasons (i.e., between October 1 to February 15 over 3 years) to complete. Construction will be conducted within agency-specified work windows to protect fisheries and wildlife resources, and the contractor will be required to coordinate with USCG and EPA to minimize potential impacts to navigation or other users of the FNC. No federally owned property is required for dredged material transloading or other cleanup activities, and the cleanup will not occur within a non-standard estate.

8 Environmental Risk

The *Biological Assessment* (BA) prepared for the LDW upper reach evaluated the effects of the remediation activities on federally listed Chinook salmon, steelhead, bull trout, yelloweye rockfish, bocaccio, southern resident killer whale, sunflower sea star, and marbled murrelet (BODR Appendix E). The project is expected to potentially have short-term impacts on some of these species as a result of underwater noise, water quality impairments, and impacts on prey species during in-water construction. Following project completion, the remedial action is expected to improve sediment quality and habitat conditions in the upper reach over the long term by removing contaminated sediments.

The construction contract documents will include requirements for the contractor to implement best management practices as noted in the BA, the Final (100%) RD BODR, and the construction contract specifications to avoid, minimize, and respond to impacts on fish, wildlife, and water quality throughout the construction period.

9 Floodplain Management Considerations

The cleanup project is located in the Zone AE floodway within the LDW (FEMA 2020). A no-rise evaluation completed for the project concluded that the base flood elevation is not expected to be affected by the LDW upper reach remedial actions and that the predicted water surface elevations within the upper reach are predicted to be slightly lower after remedial actions are completed, which would not adversely impact the floodplain or adjacent properties (BODR Appendix L).

10 Residuals Risk Analysis

A thin layer of clean RMC will be placed over all dredging areas and within an approximate 20- to 40-foot perimeter (or greater as approved by EPA) from the dredge footprint. RMC is a standard remedial technology used with dredging to address the thin layer (typically a few centimeters thick) of residual contamination that remains from sediment resuspension after required remedial dredging actions are completed.

RMC typically consists of placing a thin layer (approximately 9 inches thick) of clean sand that will cover and mix with the post-dredge residuals to bring the post-construction surface concentrations to below the surface RALs. Without use of RMC, it may not be feasible to achieve a post-dredge surface that will be below the surface RAL concentrations in all dredge areas. Re-dredging areas to remove residuals has been demonstrated at sediment remediation sites to be ineffective at reducing the surface concentrations due to the physical nature of the residual sediment (USACE 2008). RMC will be placed both within the dredge footprints and around the perimeter of the dredge footprints to cover and mix with dredging residuals that are anticipated to resuspend during dredging actions.

RMC placed within the toe of dredge cuts and within perimeter areas[3] will address the thin layer of residuals that remain after dredging and contingency re-dredging is completed. The dredging areas located within the toe of dredge cuts will not leave buried contamination because post-dredge sampling will identify the need for contingency re-dredging in the event there is deeper contamination (i.e., missed inventory) exceeding RALs. Perimeter areas outside of the RAAs had no RAL exceedances, and no dredging is required.

RMC placed on the dredge cut exterior side slopes is designed to be a thicker placement to address irregular slopes as well as to address the potential that dredging could potentially expose a band of buried contamination outside of RAAs. Buried contamination, if present, outside of the RAAs are not required to be removed per the ROD (EPA 2014). However, RD for dredging in the FNC has taken into consideration the potential for buried contamination being present along exterior side slope areas, and the design minimized this potential through the interpolation modeling working with EPA and reviewing historical dredging records to help define toe of dredge cuts.

Buried contamination in exterior side slopes (if present) outside of RAAs are expected to be below -17 feet MLLW (i.e., upper reach maintenance depth) for all RAAs due to the ROD required pre-design investigation and design methodology. The ROD required the RD to identify and remove contamination within the FNC above the maintenance depth (-17 feet MLLW in the upper reach). The ROD defined shoaling RAL intervals to assess areas within the FNC that are above the authorized

[3] Placement of RMC within the inner perimeter is required and is a minimum 20-foot width beyond the dredging footprint. An additional outer perimeter may increase the RMC perimeter placement by an additional 20 feet minimum depending upon post-dredge sampling results.

depth (-15 feet MLLW) to address contamination in the shoaling areas down to the maintenance depth (-17 feet MLLW). The RD thus identified RAAs within the FNC that require remedial action if they had RAL exceedances per Table 28 of the ROD.

The pre-design investigation data did not identify any RAL exceedances outside of the RAAs, and therefore, there should not be any contamination above -17 feet MLLW (maintenance depth) within the FNC along the RAA exterior side slopes. In addition, many of the RAA exterior side slopes on the eastern boundary of the FNC are located within LDW early action areas where contamination was previously removed to below -17 feet MLLW and backfilled with clean placement material.

Figure series D10-1 show side by side maps to illustrate areas above and below -17-feet MLLW before and after the LDW upper reach remedial action. The top panel of the figures show the existing areas within the FNC and RAA footprints (plus perimeter areas) that are currently above -17 feet MLLW. These areas (shown in green) are approximately 6.6 acres. The bottom panel of each figure shows the post-RMC placement areas (placed after remedial dredging) that are expected to be above -17 feet MLLW. The light blue and dark blue areas are approximately 2.7 and 0.8 acres, respectively (a total of 3.5 acres). As shown in the figures, the risk of exposing potential buried contamination within the FNC only occurs along the RAA exterior side slopes, but as discussed previously, there is low risk that any side slope area will have buried contamination above the maintenance depth (-17 feet MLLW) due to the pre-design investigation results and RAA design to minimize this potential. Placing RMC will not preclude USACE from maintaining the upper reach FNC and RMC can improve the sediment concentration condition on the surface compared to dredging without RMC. With RMC in place, residual risks of recontamination within the upper reach FNC are anticipated to be minimal. Dredging of RMC materials during future maintenance dredging will not impact the effectiveness of the remedial action because RMC is not acting as a cleanup technology but is placed to address dredge residuals.

11 Impacts to USACE Operations and Maintenance

No impacts to USACE operations and maintenance of the FNC are anticipated as a result of the project. As previously discussed, the project is expected to result in a net decrease in sediment volume in the FNC after the upper reach remedial action is completed (including placement of RMC and engineered cap materials), reducing the quantity of future USACE maintenance dredging. The project design will not restrict USACE maintenance dredging within the upper reach of the FNC.

12 Summary and Conclusions

Implementation of the cleanup remedy will result in only temporary occupation of the LDW FNC in the upper reach and is not expected to adversely affect the usefulness or functionality of the FNC.

13 References

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Figures

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Figure D1-1. LDW Superfund Site vicinity map and identification of upper reach

100% Remedial Design Basis of Design Report for the LDW Upper Reach

NOVEMBER 7, 2023

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N

0 650 1,300 Feet

0 100 200 Meters

Figure D1-2. Remedial action areas within the upper reach

100% Remedial Design Basis of Design Report for the LDW Upper Reach

NOVEMBER 7, 2023

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River mile
Federal navigation channel
Remedial Action Area (RAA)
Proposed Remedial Activities
Dredging
ENR
Partial dredge and cap
RMC inner perimeter

2.8
2.9
3.0
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4.0
4.1
4.2
4.3
4.4
4.5
4.6
4.7
4.8
4.9
1/2/3
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14/15/16
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19/20
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24/25/26
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33/34/35
30
31
cPAH-only RAA

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N

0 650 1,300 Feet
0 100 200 Meters

Figure D4-1. Proposed remedial activities by remedial action area

100% Remedial Design Basis of Design Report for the LDW Upper Reach
NOVEMBER 7, 2023

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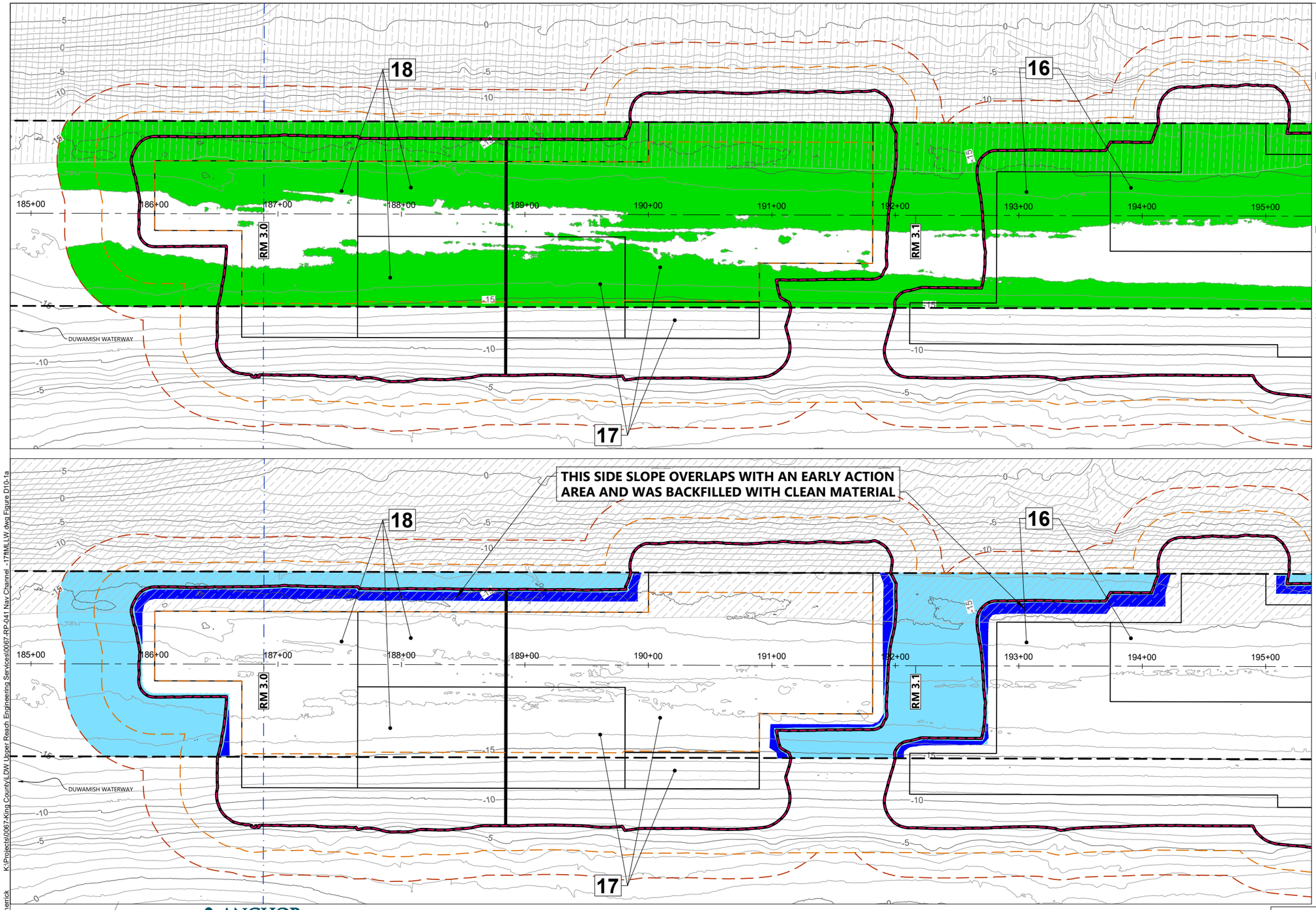

ELEVATION LEGEND:

- AREAS IN THE FNC ABOVE -17 FT MLLW WITHIN SMAS AND PERIMETERS BEFORE CONSTRUCTION
- AREAS IN THE FNC ABOVE -17 FT MLLW WITHIN SMAS AND PERIMETERS AFTER ALL DREDGING AND RMC PLACEMENT (DREDGE TOE AND INNER/OUTER PERIMETERS)
- AREAS IN THE FNC ABOVE -17 FT MLLW WITHIN SMAS AND PERIMETERS AFTER ALL DREDGING AND RMC PLACEMENT (DREDGE SIDE SLOPES)

NOTES:

1. PRE- AND POST-CONSTRUCTION ELEVATION AREAS ARE APPROXIMATE.
2. NO DREDGING WILL BE PERFORMED OUTSIDE OF THE REMEDIAL DREDGE PRISMS SHOWN (I.E., NUMBERED SEDIMENT MANAGEMENT AREAS).
3. PLEASE NOTE THAT THERE WERE NO RAL EXCEEDANCES IN ANY SHOALING RAL INTERVAL (DOWN TO -17 FT MLLW) OUTSIDE OF THE DREDGE PRISMS. THEREFORE, SIDE SLOPE AREAS ALONG DREDGE PRISM BOUNDARIES LOCATED WITHIN THE FNC ARE NOT EXPECTED TO HAVE ANY RAL EXCEEDANCES ABOVE -17 FT MLLW.

LEGEND:

- 250+00 — USACE CHANNEL CENTERLINE AND STATIONING
- FEDERAL NAVIGATION CHANNEL
- RM 3.0 — RIVER MILE LABEL
- EARLY ACTION AREA
- LDW UPPER REACH APPROXIMATE BOUNDARY
- EXISTING GRADE MERGED DATA SET CONTOURS (1' & 5' INTERVALS)
- ESTIMATED DREDGE PRISM
- SEDIMENT MANAGEMENT AREA BOUNDARY
- 14 — SEDIMENT MANAGEMENT AREA NUMBER
- INNER RMC PERIMETER BOUNDARY
- OUTER RMC PERIMETER BOUNDARY

0 40 80
SCALE IN FEET

DATUM NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD83 (2011), U.S. SURVEY FEET
2. VERTICAL DATUM: MLLW

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Figure D10-1a. Impact of RMC placement within the FNC compared to existing conditions, RMs 2.95 to 3.15

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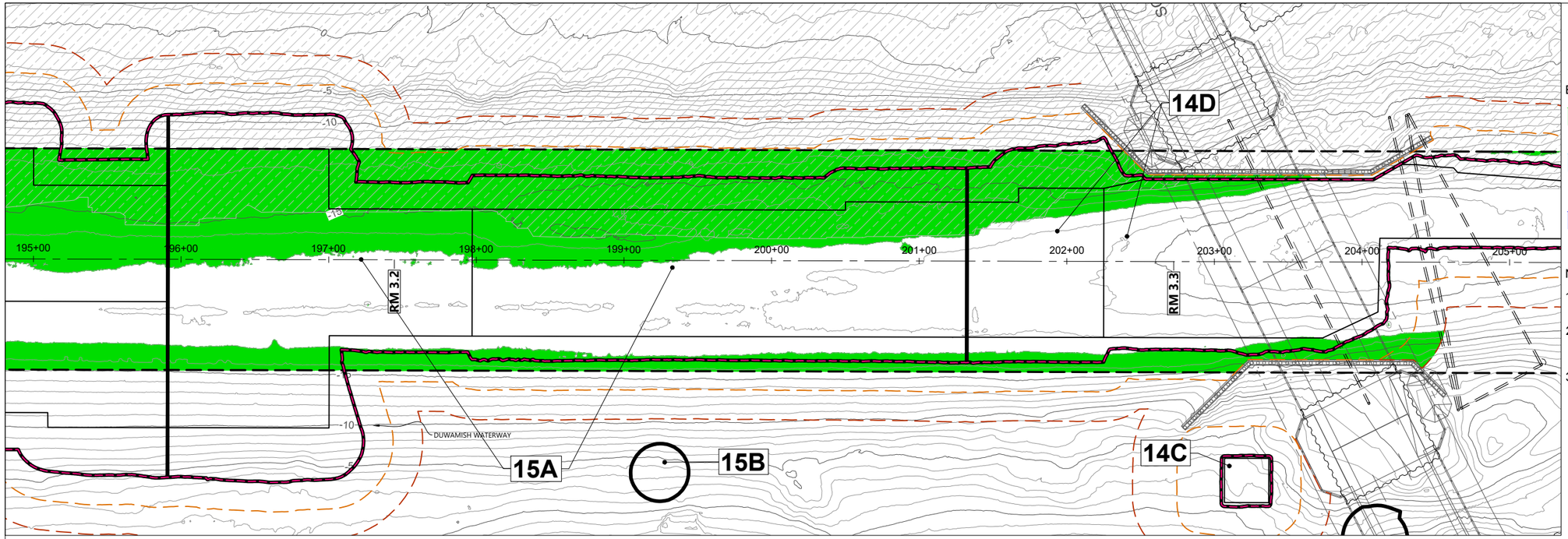

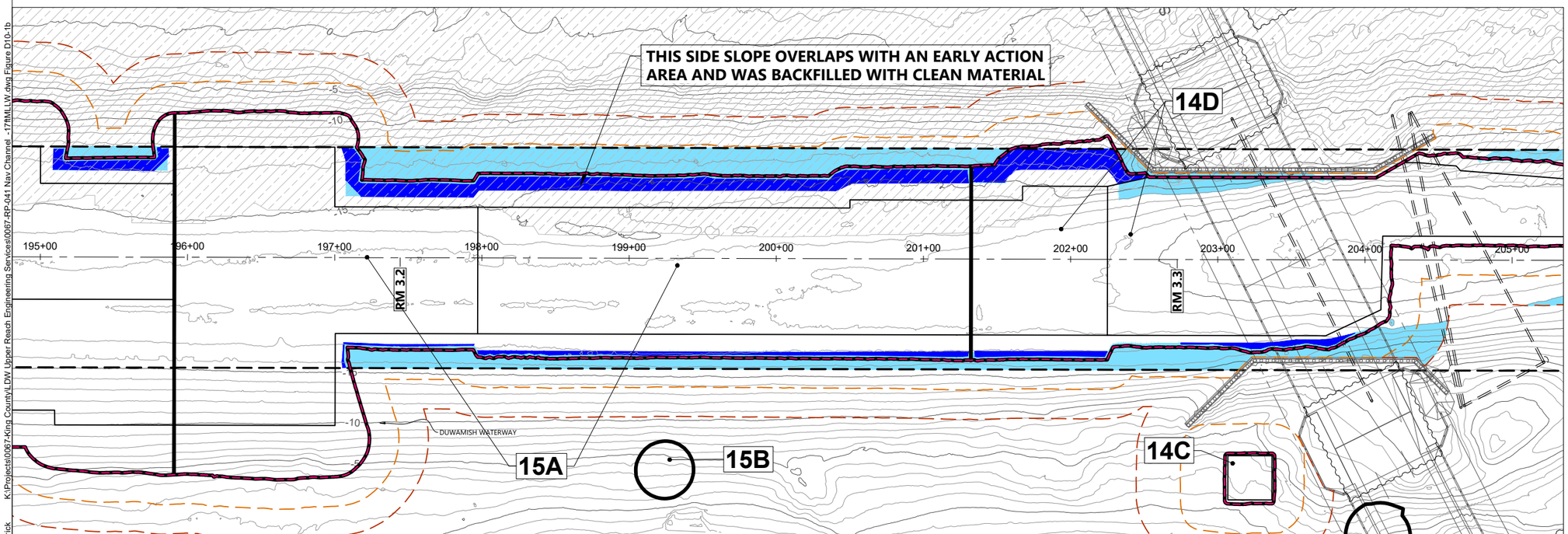

ELEVATION LEGEND:

- AREAS IN THE FNC ABOVE -17 FT MLLW WITHIN SMAS AND PERIMETERS BEFORE CONSTRUCTION
- AREAS IN THE FNC ABOVE -17 FT MLLW WITHIN SMAS AND PERIMETERS AFTER ALL DREDGING AND RMC PLACEMENT (DREDGE TOE AND INNER/OUTER PERIMETERS)
- AREAS IN THE FNC ABOVE -17 FT MLLW WITHIN SMAS AND PERIMETERS AFTER ALL DREDGING AND RMC PLACEMENT (DREDGE SIDE SLOPES)

NOTES:

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2. NO DREDGING WILL BE PERFORMED OUTSIDE OF THE REMEDIAL DREDGE PRISMS SHOWN (I.E., NUMBERED SEDIMENT MANAGEMENT AREAS).
3. PLEASE NOTE THAT THERE WERE NO RAL EXCEEDANCES IN ANY SHOALING RAL INTERVAL (DOWN TO -17 FT MLLW) OUTSIDE OF THE DREDGE PRISMS. THEREFORE, SIDE SLOPE AREAS ALONG DREDGE PRISM BOUNDARIES LOCATED WITHIN THE FNC ARE NOT EXPECTED TO HAVE ANY RAL EXCEEDANCES ABOVE -17 FT MLLW.

LEGEND:

- 250+00 — USACE CHANNEL CENTERLINE AND STATIONING
- FEDERAL NAVIGATION CHANNEL
- RM 3.0 — RIVER MILE LABEL
- EARLY ACTION AREA
- LDW UPPER REACH APPROXIMATE BOUNDARY
- EXISTING GRADE MERGED DATA SET CONTOURS (1' & 5' INTERVALS)
- ESTIMATED DREDGE PRISM
- SEDIMENT MANAGEMENT AREA BOUNDARY
- 14 — SEDIMENT MANAGEMENT AREA NUMBER
- INNER RMC PERIMETER BOUNDARY
- OUTER RMC PERIMETER BOUNDARY

0 40 80
SCALE IN FEET

DATUM NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD83 (2011), U.S. SURVEY FEET
2. VERTICAL DATUM: MLLW

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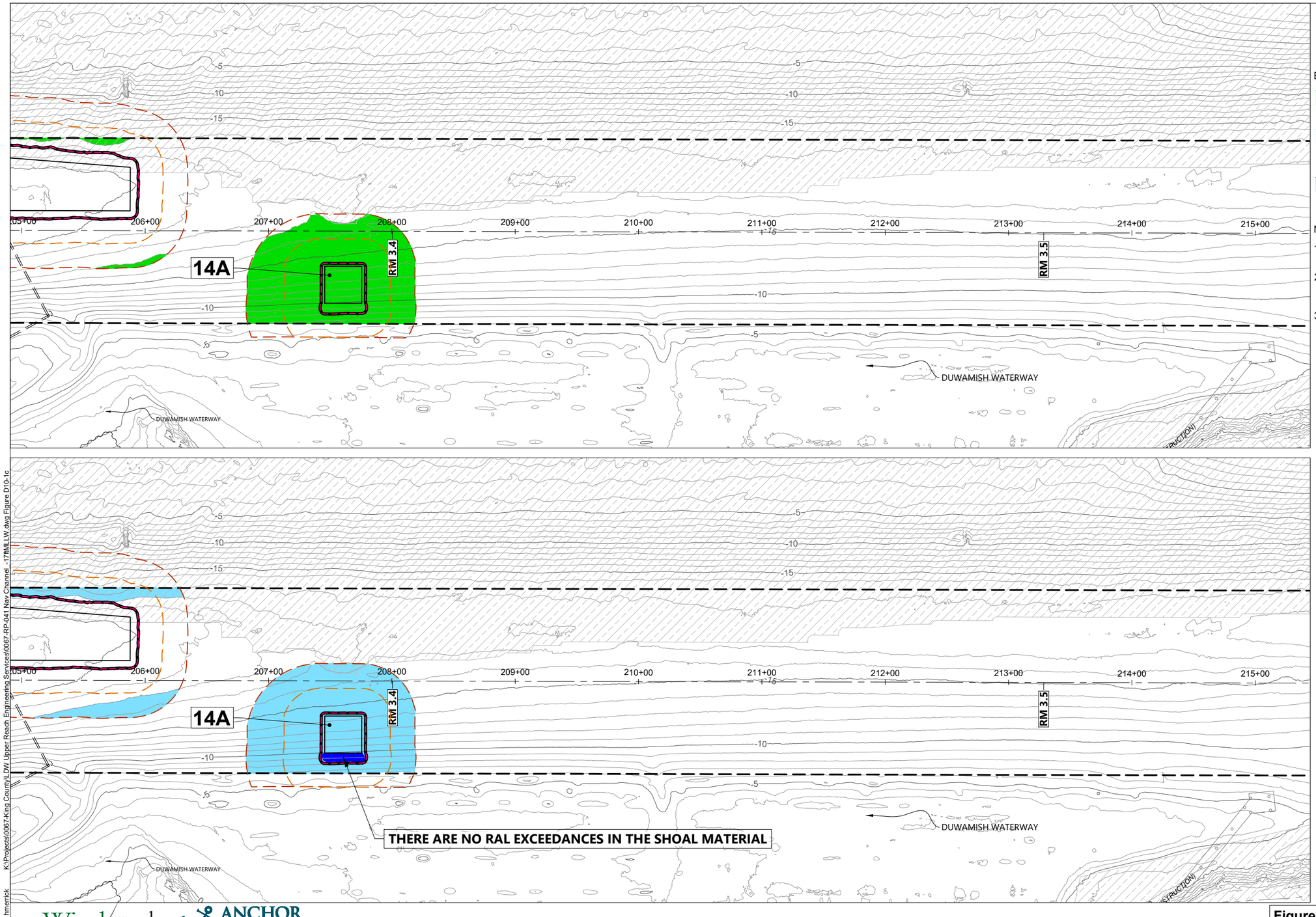
Figure D10-1b. Impact of RMC placement within the FNC compared to existing conditions, RMs 3.15 to 3.35

100% Remedial Design Basis of Design Report for the LDW Upper Reach

NOVEMBER 7, 2023

K:\Projects\0067-King County\LDW Upper Reach Engineering Services\0067-RP-041 Nav Channel - 17RM LLW.dwg Figure D10-1b
Nov 02, 2023 12:31pm hmerrick



ELEVATION LEGEND:

- AREAS IN THE FNC ABOVE -17 FT MLLW WITHIN SMAS AND PERIMETERS BEFORE CONSTRUCTION
- AREAS IN THE FNC ABOVE -17 FT MLLW WITHIN SMAS AND PERIMETERS AFTER ALL DREDGING AND RMC PLACEMENT (DREDGE TOE AND INNER/OUTER PERIMETERS)
- AREAS IN THE FNC ABOVE -17 FT MLLW WITHIN SMAS AND PERIMETERS AFTER ALL DREDGING AND RMC PLACEMENT (DREDGE SIDE SLOPES)

NOTES:

1. PRE- AND POST-CONSTRUCTION ELEVATION AREAS ARE APPROXIMATE.
2. NO DREDGING WILL BE PERFORMED OUTSIDE OF THE REMEDIAL DREDGE PRISMS SHOWN (I.E., NUMBERED SEDIMENT MANAGEMENT AREAS).
3. PLEASE NOTE THAT THERE WERE NO RAL EXCEEDANCES IN ANY SHOALING RAL INTERVAL (DOWN TO -17 FT MLLW) OUTSIDE OF THE DREDGE PRISMS. THEREFORE, SIDE SLOPE AREAS ALONG DREDGE PRISM BOUNDARIES LOCATED WITHIN THE FNC ARE NOT EXPECTED TO HAVE ANY RAL EXCEEDANCES ABOVE -17 FT MLLW.

LEGEND:

- 250+00 — USACE CHANNEL CENTERLINE AND STATIONING
- FEDERAL NAVIGATION CHANNEL
- RM 3.0 — RIVER MILE LABEL
- EARLY ACTION AREA
- LDW UPPER REACH APPROXIMATE BOUNDARY
- EXISTING GRADE MERGED DATA SET CONTOURS (1' & 5' INTERVALS)
- ESTIMATED DREDGE PRISM
- SEDIMENT MANAGEMENT AREA BOUNDARY
- 14 — SEDIMENT MANAGEMENT AREA NUMBER
- INNER RMC PERIMETER BOUNDARY
- OUTER RMC PERIMETER BOUNDARY

0 40 80
SCALE IN FEET

DATUM NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD83 (2011), U.S. SURVEY FEET
2. VERTICAL DATUM: MLLW

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Figure D10-1c. Impact of RMC placement within the FNC compared to existing conditions, RMs 3.35 to 3.55

100% Remedial Design Basis of Design Report for the LDW Upper Reach

NOVEMBER 7, 2023

Nov 02, 2023 12:33pm hmerrick K:\Projects\0067-King County\LDW Upper Reach Engineering Services\0067-RP-041 Nav Channel -17MLLW.dwg Figure D10-1c

ELEVATION LEGEND:

- AREAS IN THE FNC ABOVE -17 FT MLLW WITHIN SMAS AND PERIMETERS BEFORE CONSTRUCTION
- AREAS IN THE FNC ABOVE -17 FT MLLW WITHIN SMAS AND PERIMETERS AFTER ALL DREDGING AND RMC PLACEMENT (DREDGE TOE AND INNER/OUTER PERIMETERS)
- AREAS IN THE FNC ABOVE -17 FT MLLW WITHIN SMAS AND PERIMETERS AFTER ALL DREDGING AND RMC PLACEMENT (DREDGE SIDE SLOPES)

NOTES:

1. PRE- AND POST-CONSTRUCTION ELEVATION AREAS ARE APPROXIMATE.
2. NO DREDGING WILL BE PERFORMED OUTSIDE OF THE REMEDIAL DREDGE PRISMS SHOWN (I.E., NUMBERED SEDIMENT MANAGEMENT AREAS).
3. PLEASE NOTE THAT THERE WERE NO RAL EXCEEDANCES IN ANY SHOALING RAL INTERVAL (DOWN TO -17 FT MLLW) OUTSIDE OF THE DREDGE PRISMS. THEREFORE, SIDE SLOPE AREAS ALONG DREDGE PRISM BOUNDARIES LOCATED WITHIN THE FNC ARE NOT EXPECTED TO HAVE ANY RAL EXCEEDANCES ABOVE -17 FT MLLW.

LEGEND:

- 250+00 USACE CHANNEL CENTERLINE AND STATIONING
- FEDERAL NAVIGATION CHANNEL
- RM 3.0 RIVER MILE LABEL
- EARLY ACTION AREA
- LDW UPPER REACH APPROXIMATE BOUNDARY
- EXISTING GRADE MERGED DATA SET CONTOURS (1' & 5' INTERVALS)
- ESTIMATED DREDGE PRISM
- SEDIMENT MANAGEMENT AREA BOUNDARY
- 14 SEDIMENT MANAGEMENT AREA NUMBER
- INNER RMC PERIMETER BOUNDARY
- OUTER RMC PERIMETER BOUNDARY

0 40 80
SCALE IN FEET

DATUM NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD83 (2011), U.S. SURVEY FEET
2. VERTICAL DATUM: MLLW

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Figure D10-1d. Impact of RMC placement within the FNC compared to existing conditions, RMs 3.55 to 3.75

100% Remedial Design Basis of Design Report for the LDW Upper Reach

NOVEMBER 7, 2023

Nov 02, 2023 12:35pm hmerrick K:\Projects\0067-King County\LDW Upper Reach Engineering Services\0067-RP-041 Nav Channel - 17RMLLW.dwg Figure D10-1d

TOP OF CENTER OF CUTOFF PILE (TYP)

225+00 226+00 227+00 228+00 229+00 230+00 231+00 232+00 233+00 234+00 235+00

DUWAMISH WATERWAY

RM 3.8

RM 3.9

11A

9

8

-10 -5 0 5

CP 44 RC

4' WIRE FENCE

THERE WERE NO SHOALING RAL EXCEEDANCES IN THIS STRETCH OF THE FNC

ELEVATION LEGEND:

- AREAS IN THE FNC ABOVE -17 FT MLLW WITHIN SMAS AND PERIMETERS BEFORE CONSTRUCTION
- AREAS IN THE FNC ABOVE -17 FT MLLW WITHIN SMAS AND PERIMETERS AFTER ALL DREDGING AND RMC PLACEMENT (DREDGE TOE AND INNER/OUTER PERIMETERS)
- AREAS IN THE FNC ABOVE -17 FT MLLW WITHIN SMAS AND PERIMETERS AFTER ALL DREDGING AND RMC PLACEMENT (DREDGE SIDE SLOPES)

NOTES:

1. PRE- AND POST-CONSTRUCTION ELEVATION AREAS ARE APPROXIMATE.
2. NO DREDGING WILL BE PERFORMED OUTSIDE OF THE REMEDIAL DREDGE PRISMS SHOWN (I.E., NUMBERED SEDIMENT MANAGEMENT AREAS).
3. PLEASE NOTE THAT THERE WERE NO RAL EXCEEDANCES IN ANY SHOALING RAL INTERVAL (DOWN TO -17 FT MLLW) OUTSIDE OF THE DREDGE PRISMS. THEREFORE, SIDE SLOPE AREAS ALONG DREDGE PRISM BOUNDARIES LOCATED WITHIN THE FNC ARE NOT EXPECTED TO HAVE ANY RAL EXCEEDANCES ABOVE -17 FT MLLW.

LEGEND:

- 250+00 USACE CHANNEL CENTERLINE AND STATIONING
- FEDERAL NAVIGATION CHANNEL
- RM 3.0 RIVER MILE LABEL
- EARLY ACTION AREA
- LDW UPPER REACH APPROXIMATE BOUNDARY
- EXISTING GRADE MERGED DATA SET CONTOURS (1' & 5' INTERVALS)
- ESTIMATED DREDGE PRISM
- SEDIMENT MANAGEMENT AREA BOUNDARY
- 14 SEDIMENT MANAGEMENT AREA NUMBER
- INNER RMC PERIMETER BOUNDARY
- OUTER RMC PERIMETER BOUNDARY

0 40 80
SCALE IN FEET

DATUM NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD83 (2011), U.S. SURVEY FEET
2. VERTICAL DATUM: MLLW

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Figure D10-1e. Impact of RMC placement within the FNC compared to existing conditions, RMs 3.75 to 3.95

100% Remedial Design Basis of Design Report for the LDW Upper Reach

NOVEMBER 7, 2023

Nov 02, 2023 12:36pm hmerrick K:\Projects\0067-King County\LDW Upper Reach Engineering Services\0067-RP-041 Nav Channel - 17RMLLW.dwg Figure D10-1e