

APPENDIX A

SS WILIAM IRVIN
Project 3178

Prepared for:
U.S. Army Corps of Engineers
Detroit District (LRE)

Prepared by:
U.S. Army Corps of Engineers
Marine Design Center (MDC)



REV 0

1 March 2017



TABLE OF CONTENTS

1.	PROBLEM STATEMENT & CONSTRAINTS.....	1
2.	COURSE OF ACTION & OPTIONS.....	1
3.	RECOMMENDATION.....	3
4.	APPENDICES.....	4

A) SITE LAYOUT

B) SS IRVIN CLEARANCE DRAWING

C) SS IRVIN CLEARANCE (1 DEGREE YAW) DRAWING

D) FENDERING IGE

E) TUG AND TRUCK RENTAL IGE

F) PLATFORM REMOVAL IGE

G) WINCH RENOVATION & GEN SET RENTAL IGE



1. **PROBLEM STATEMENT:**

The ore carrier SS William A. Irvin is located in a slip in Duluth, MN. This slip contains contaminated sediment from legacy site use. The U.S. Army Corps of Engineers (USACE), in conjunction with the City of Duluth, the State of Minnesota, and the EPA, intend to remediate the slip. In addition to the remediation efforts, the slip walls and pedestrian bridge that crosses the mouth of the slip are also undergoing rehabilitation projects. In order to allow the environmental remediation of the mooring slip and replacement of the failing dock walls, the SS William A. Irvin must be temporarily relocated outside of the slip. USACE Detroit District (LRE) tasked the USACE Marine Design Center (MDC) to develop a feasible movement plan for the SS Irvin. This report outlines and addresses the current site constraints, condition of the vessel, and identified operational risks used to develop the recommended movement plan for the SS Irvin.

2. **IRVIN CONDITION:**

The SS Irvin is a former US Steel Great Lakes Freighter built in 1937 and retired in 1978. Since its retirement, the vessel has not undergone any maintenance and has remained in the slip. A vessel inspection was conducted on 10 January 2017 and confirmed the SS Irvin to be in good structural condition. MDC personnel inspected the vessel's overall structure, onboard machinery, deck fittings, and layout. The vessel structure was found to be in adequate shape for the procedure; the deck fittings and their foundations were determined to be capable of handling the loads applied during movement. The deck winches and associating machinery are in various states of disuse; a further inspection is required to determine the extent of repairs needed to bring them up to full capacity.

3. **MOVEMENT PLAN CONSTRAINTS**

- a) **Irvin:** The Irvin is approximately 610'-9 3/4" in length. The current draft of the vessel is approximately 5' forward and 10' aft, based on visual inspection. The overall max vessel width is derived from analyzing the mid-ship section width. The calculation is outlined below. There are two access platforms that have been added to the vessel that extend beyond the clearance available in addition to the width listed below. These platforms will need to be cut off and stored while adhering to standards on lead paint abatement.

Vessel Width Calculation:

- 60'-0" Molded Beam
 - 2 x [31# (3/4")] Strake G= 1.5"
 - 2 x [26# (5/8")] Strake H= 1.25"
 - 2 x 1" thick fender on Strake H= 2"
 - 2 x .688" (rivet dome height)= 1.376"
- SUM = 60+1.5+1.25+2+1.376 = 60'-6.126"**



- b) **Slip Dock Walls:** The dock walls adjacent to the SS Irvin are of wooden construction and have deteriorated to the point of failure. The walls can no longer contain the existing backfill, resulting in numerous sinkholes between the slip dock wall and paved roadway. The slip dock walls run northwest to southeast. The slip dock wall is flush with the southern bridge concrete abutment. It was noted during the site visit that the southern slip dock wall bows out into the slip approximately 8" at a distance of 30' from the pedestrian bridge. A new slip dock wall is currently in the design phase.
- c) **Pedestrian Drawbridge:** A pedestrian drawbridge spans the only opening into the SS Irvin's slip. The limiting surveyed span width between bridge abutments is 61.9'. Perpendicular width of the abutment is as follows: Northerly End: 61.9', Middle: 62.12, & Southerly End: 62.30'. This leads to a minimum total margin of 17" for the vessel to clear the abutments without impact. Based on the survey data collected, the concrete abutment will be the controlling feature for width with 2 exceptions. First, there are navigation lights that extend from the bridge, which need to be removed. Second, the southeast top corner of the bridge's upper works extends out approximately 0.09' (approximately 1.08") over the abutment. This extension must be monitored to prevent collision with the upper sideshell or forecastle of the vessel. See Appendices B and C for available clearance of the SS Irvin as it passes through the drawbridge opening.
- d) **Slip:** The slip is approximately 150' wide and 900' long. The current depth of the slip is approximately 14'. Following the remediation of the slip, it will be able to support a maximum vessel draft of 10'. Gross under-keel clearance will be 12', maintenance dredging tolerance depth will be 13', cap safety depth will be 14', and the environmental cap with scour protection will be at a depth of 17'.
- e) **Bollards:** There are 13 existing bollards along the slip wall where the SS Irvin is moored. The bollards are capable of handling winching operations from the Irvin if the deck winches are rehabilitated.
- f) **Duluth Harbor Vessel Traffic:** Current harbor traffic includes 1000' steel freighters that may induce significant swells within the slip. The wake of all inter-harbor traffic will significantly affect the SS Irvin's movement and pose a major risk to the bridge and the vessel; the wake of a small passing vessel could shift the SS Irvin enough to cause a collision with the bridge's upper works or the concrete abutments.
- g) **Duluth Weather:** Wind will play a significant role in moving the SS Irvin because of its profile. The vessel extends more than 40' into the air and presents a large sail area. Over the course of the year typical Duluth wind speeds vary from 2 mph to 17 mph (light air to moderate breeze), rarely exceeding 25 mph (strong breeze). The *highest* average wind speed of 11 mph (gentle breeze) occurs around April 6, at which time the average daily maximum wind speed is 17 mph (moderate breeze). The *lowest* average wind speed of 8 mph (gentle breeze) occurs around July 27, at which time the average daily maximum wind speed is 14 mph (moderate breeze).



4. RISK MITIGATION METHODS:

The proposed course of action to move the SS Irvin involves using a large tug located outside the slip to provide a means of removal while using multiple other methods to stabilize the vessel and mitigate the risk involved.

The options for limiting risk are listed below in Table 1; the primary tug is required for vessel movement, while each additional option provides extra risk mitigation. See Appendix A for a layout of the site and the methods involved in the vessel removal.

Table 1 – Vessel Movement Options

OPTION	SCOPE	ROM Cost
a) PRIMARY TUG	Use large tug to remove SS Irvin from the slip	\$6,000
b) FENDERING	Line bridge abutments and dock wall with UHMW fendering	\$94,000
c) SS IRVIN DECK WINCHES	Rehabilitate deck winches to attach lines to shore	\$450,000
d) 45' SECONDARY TUGS (2)	One inside and one outside slip; provide lateral force to prevent motion away from slip wall	\$6,000 ea
e) TOW TRUCKS	Alternate for SS Irvin deck winches; use to secure the vessel to the dock wall	\$1,000 ea
f) HULL MODIFICATION	Remove external platforms, address lead paint concerns, remove bridge light	\$16,000

- a) **Primary Tug:** This is the primary driver for the movement. A tug company will be contracted to tie to the stern of the SS Irvin and maneuver it out of the slip; the primary tug will not enter the slip and will have limited control on the vessel's heel and yaw.
- b) **Fendering:** The dock wall and bridge abutments can be lined with ultra-high molecular weight fendering (UHMW), typical of locks and other areas that see high vessel traffic. These fenders prevent the vessel from rubbing directly on the dock wall or concrete abutments. In addition, they provide a small offset between the vessel and the abutment when passing through the bridge opening; this will help the vessel stay centered between the two sides of the bridge and reduce the risk of collision with the bridge's upper works.
- c) **SS Irvin Deck Winches:** There are six deck winches on the vessel located as follows: one located on the bow, one on the stern, one pair located forward of the stern deck house, and one pair located aft of the forecastle. Some of these winches are currently being used to tie the vessel to shore; however, they are not functioning at full capacity and would need to be inspected and likely rebuilt before use. In addition, a portable generator would need to be placed on the vessel's deck in order to power the winches; the vessel's power plant is non-functional. This option provides the benefit of



restoring the capability of the winches, allowing them to be used in assisting vessel movement in the future. This would also ensure the vessel can be secured once moored in the slip.

- d) **Secondary Tugs:** Another option is to use secondary tugs to provide lateral support for the vessel. One small tug, approximately 45' in length, can be located inside the slip near the bridge. Another similarly sized tug can be located outside the slip. These tugs would push the SS Irvin against the dock wall, ensuring it does not sway or drift. The tugs serve as a redundancy in the event that the winches or tow trucks fail to control the vessel.
- e) **Tow Trucks:** As an alternative to using the SS Irvin's deck winches, tow trucks could be used to provide winching capabilities from the shore. This would be a lower-cost alternative to rebuilding the winches, but the services of the trucks would have to be retained each time the vessel is moved.
- f) **Hull Modification:** In order for the SS Irvin to be moved through the bridge opening, the passenger embarkation platforms on the port side of the vessel must be removed. In addition, vessels of this age typically have lead paint; lead paint abatement would be required to comply with health and safety standards. This additional cost is accounted for in the estimate provided. An overhanging light on the bridge's upper works must also be removed to avoid collision.

5. COURSE OF ACTION & RECOMMENDATION:

Per discussion with industry experts, examination of the available clearances using CAD software, and economic feasibility of the options, MDC recommends the following configuration:

Passing vessels may pose a significant risk to both the SS Irvin and the bridge. Prior to maneuvering the SS Irvin, all vessel traffic within the area must be temporarily restricted or halted for the duration of vessel movement. The day of the operation must be selected carefully with consideration to wind conditions.

All external access platforms must be removed prior to any vessel movement.

A large primary towing vessel should be positioned outside of the slip. The towing vessel will be connected to the stern of the SS Irvin via a mooring line. The primary tow will be used to pull the Irvin along its longitudinal axis out of the slip.

The SS Irvin center line must be parallel with the bridge abutment in order to maintain proper clearance between the bridge and vessel. See Appendices B and C for a comparison of the no-yaw condition and the 1-degree yaw condition. Typical total available clearance is approximately 16.5 inches between the bridge and the widest midship section; however, a yaw of one degree will diminish the total clearance available, as seen in Appendix C.



To prevent any vessel yaw, the vessel must be stabilized using a secondary means. MDC recommends lining the dock walls and bridge abutment with a UHMW fender to allow the SS Irvin to slide against the wall with minimal damage to the hull and dock wall.

The transverse force to hold the SS Irvin to the wall can be provided via the onboard winches, smaller tug boats, tow trucks, or a combination of the three.

The 60' width of the SS Irvin and the 150' slip width limits the available tugboats that can maneuver within the slip; a small tug boat approximately 45 ft in length can be used to position the vessel against the dock wall while the larger primary tug pulls the SS Irvin out of the slip. However, due to the large air draft of the SS Irvin, it will be difficult for the smaller tug boats to control the vessel in the event of a wind gust. Despite this limitation, MDC recommends a minimum of one smaller tug to control the SS Irvin's lateral movement and yaw.

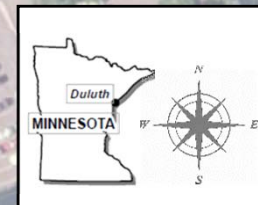
The onboard winches can be used to secure the SS Irvin to the dock wall; however, the winches are the original equipment installed on the SS Irvin in 1937. The winches would require an inspection and likely need to be rebuilt before they can be used. The winches are DC powered, and with an industry shift towards AC powered winches, a rebuild would likely require custom components and parts.

The vessel's switchboard features the original fuses and knife blade switches which present a safety hazard to operations. The onboard generator is inadequately sized to run all of the winches. A portable generator would need to be rented to power the onboard winches and a new switch board would need to be installed, with new wiring routed to the winches. The cost of rebuilding the original winches and renting a generator is prohibitive; MDC recommends using this option only in the event that alternative methods are exhausted.

As an alternative to refurbishing the onboard winches, a land based towing system using large tow trucks can be incorporated. The tow trucks may tie off to the vessel's deck fittings and maintain a constant tension to keep the vessel pulled against the dock wall and prevent lateral movement. The smaller tow boats and trucks address the same risk; they can be used in conjunction to more effectively control the vessel.

MDC recommends use of one primary tug, a minimum of one secondary tug, slip wall fendering, and truck-mounted winches with the removal of the platforms on the side of the Irvin. This combination of options leads to the greatest risk mitigation based on the available data.

3178: SS IRVIN SITE LAYOUT



Temporary generator set ICW
ancillary electrical equipment
to supply winches

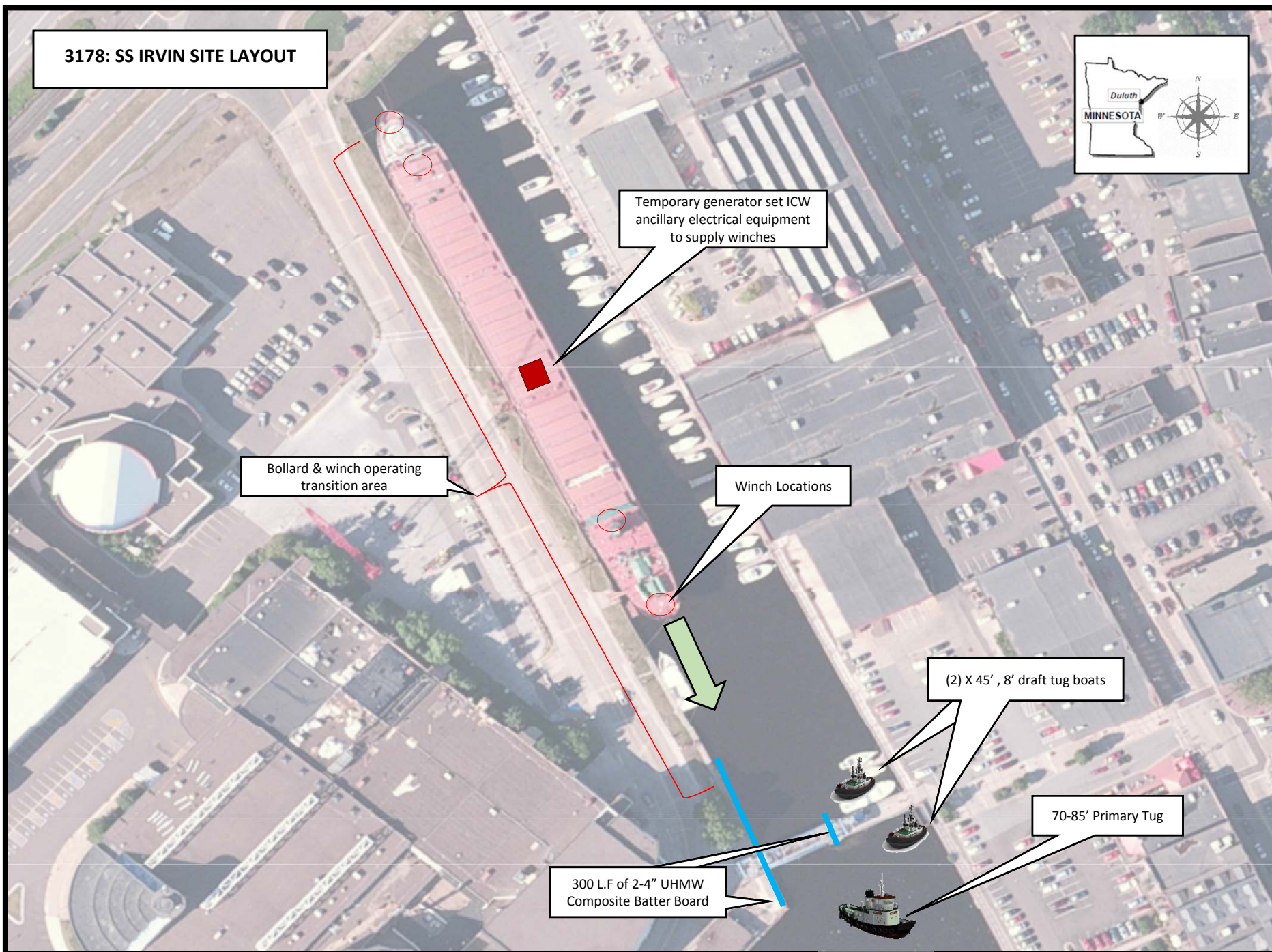
Bollard & winch operating
transition area

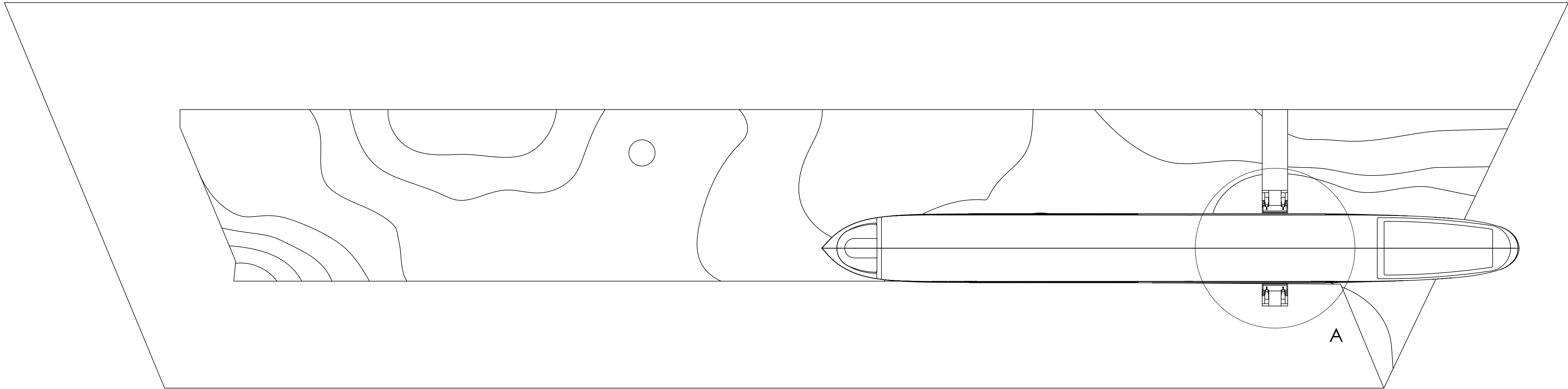
Winch Locations

(2) X 45' , 8' draft tug boats

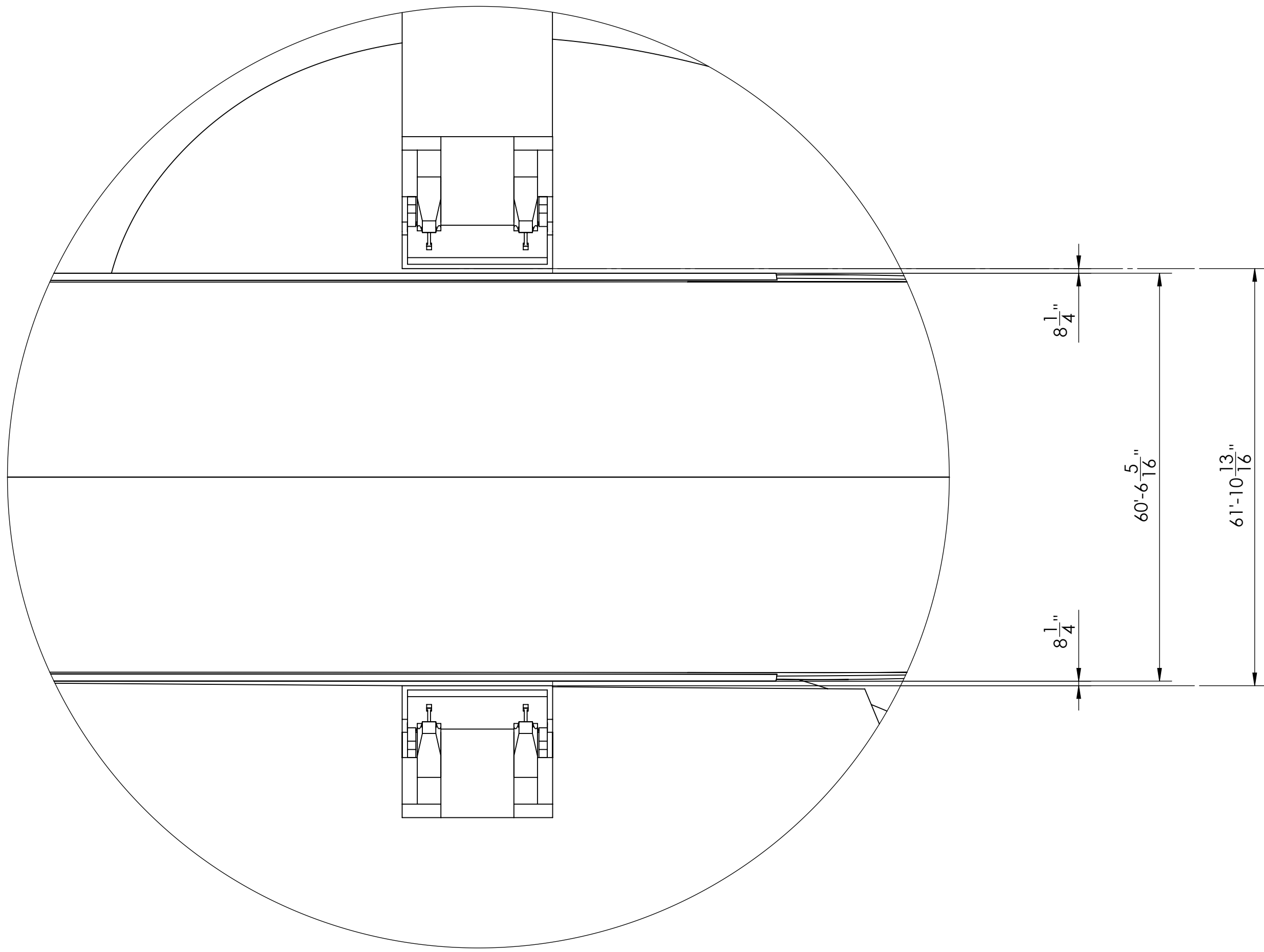
70-85' Primary Tug

300 L.F of 2-4" UHMW
Composite Batter Board

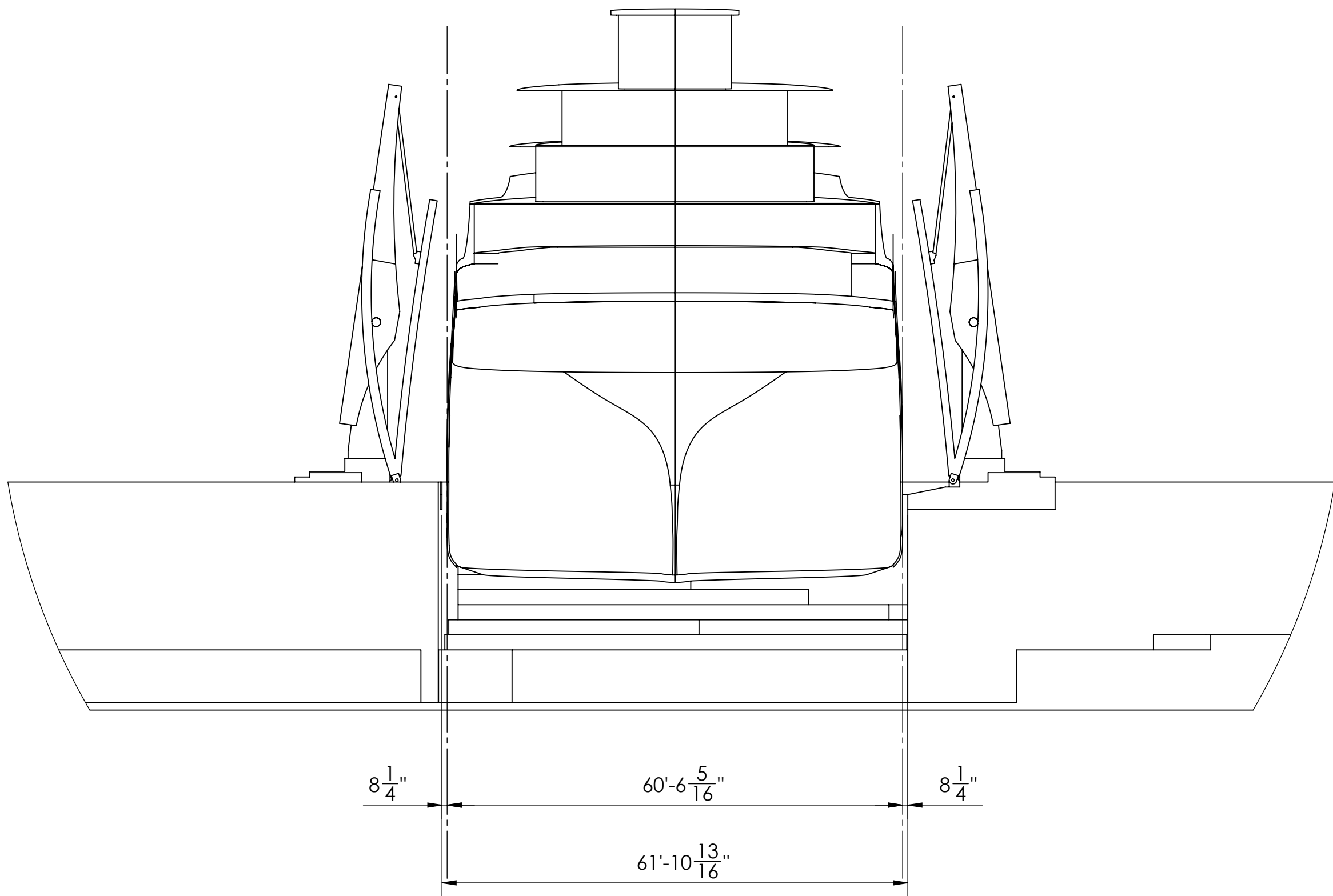




PLAN VIEW
SCALE 1 : 600



DETAIL A
SCALE 1 : 175



PROJECTED VIEW
SCALE 1 : 175



DEPARTMENT OF THE ARMY
MARINE DESIGN CENTER
CORPS OF ENGINEERS

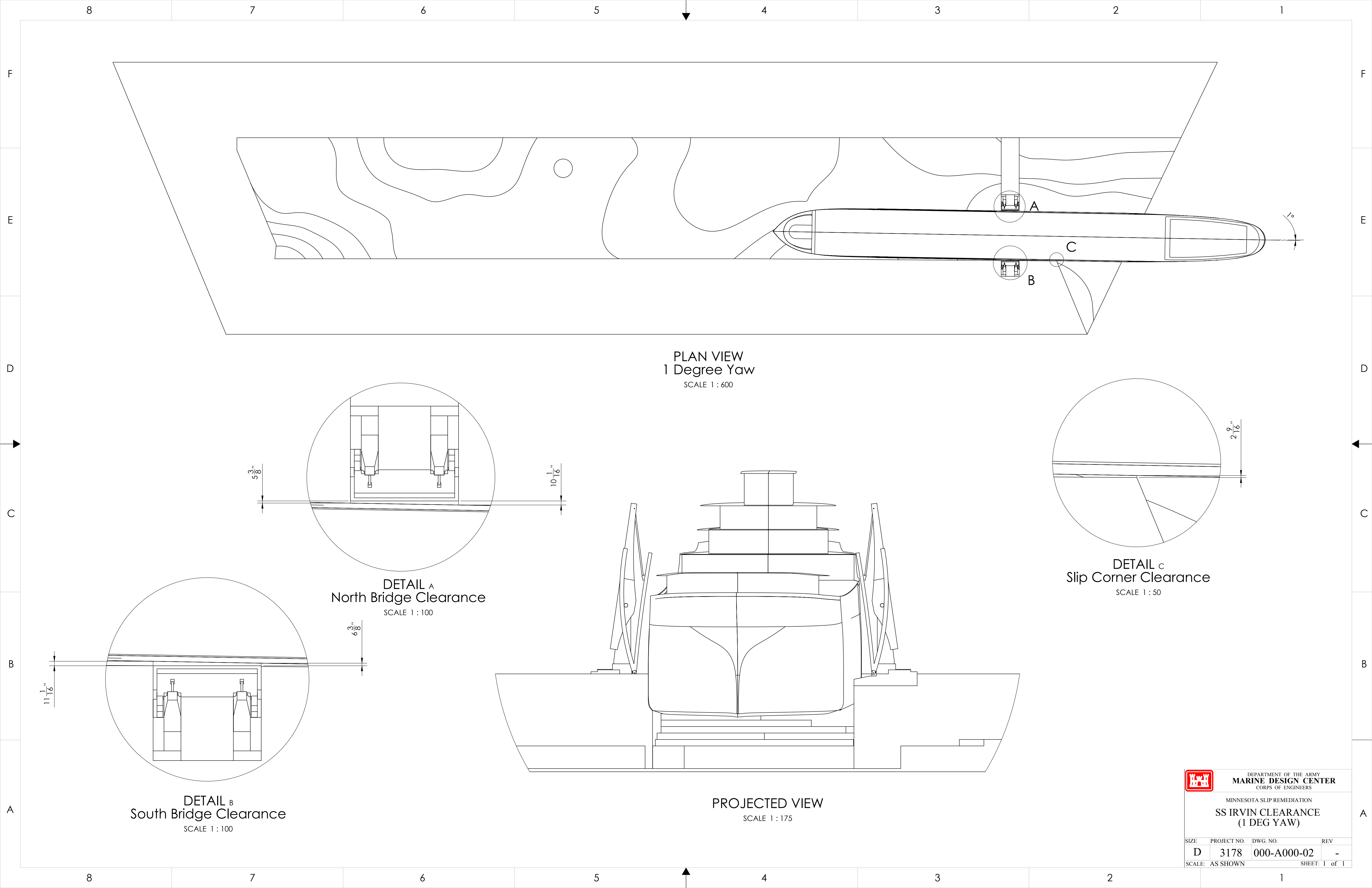
MINNESOTA SLIP REMEDIATION

**SS IRVIN
CLEARANCE**

SIZE	PROJECT NO.	DWG. NO.	REV
D	3178	000-A000-01	-

SCALE: AS SHOWN

SHEET: 1 of 1



DEPARTMENT OF THE ARMY
MARINE DESIGN CENTER
CORPS OF ENGINEERS

MINNESOTA SLIP REMEDIATION

SS IRVIN CLEARANCE
(1 DEG YAW)

SIZE	PROJECT NO.	DWG. NO.	REV
D	3178	000-A000-02	-
SCALE: AS SHOWN			SHEET: 1 of 1