

## Executive Summary

This report is a feasibility study and consideration of options for relocating the USS Batfish, a 1940's era Balao Class submarine established as a museum run by the Muskogee War Memorial Board. The boat is to be moved from her current location, near the Port of Muskogee approximately 1 1/2 miles north of the Muskogee Turnpike and SH 62 interchange, to a new permanent location in Muskogee Oklahoma. The current location is leased from the Port of Muskogee. It is on the bank of the Arkansas River approximately 2000 feet from the Ker-McClelland Navigation Channel. The decision to relocate Batfish was based on several considerations.

- In May of 2019, the river rose to 520 feet above sea level due to a spring flood event and Batfish floated and pulled up her moorings, coming to rest as the flood water receded about 75 feet to the east on the side of an incline.
- The lease for her current location is set to expire in November of 2022.
- A new Corps of Engineers levee is planned to be constructed on the current site to control future flooding of the port area.
- The Port of Muskogee is required to update security measures to include gated entry to all port properties. This would require visitors to the current location to pass through a secure entry.

This study contains a discussion of transport methods and considerations of eight different options for final location. The options for final location are evaluated for transport methods required, land ownership and value, utility conflicts, archeological and environmental impact, access to the public, visibility from the state highways, flood potential and site layout possibilities.

Based on input from several local and national contractors and hauling companies and given the information that Batfish is 311 ft. long and weighs 3.2 million pounds, transportation of the boat was separated into two methods, 1) overland and 2) navigation channel. To use the navigation channel, the boat will have to be transported overland to the water, or a large amount of earth will have to be disturbed to float her out to the channel. Additionally, Batfish will have to be hauled out of the water using and overland haul method or floated out using a large cofferdam. The overland method without using the channel method will be the least expensive option.

Of the eight sites considered, Site X was estimated to be the least expensive, fastest to obtain, most visible, easiest access,

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## Background

In spring of 2019, the Arkansas River navigation channel in Muskogee experienced a 100+ year storm event. The USS Batfish and museum grounds were flooded to an elevation of 520 feet above sea level. The submarine previously rested approximately 500 feet above sea level. The submarine floated and the buoyancy force caused her to lift her moorings. Batfish floated from 50 to 75 feet starboard until coming to rest on higher ground at an elevation of approximately 505. After the floodwaters receded, museum volunteers secured the submarine to pine trees and began cleaning out the interior.



May 2019 Batfish Floating

In August 2019, the Muskogee War Memorial Board contracted with BKL, Inc. to produce a study of options for stabilizing the boat. The report, completed in November 2019, was used in the application for FEMA restoration funding; it is attached in Appendix A. The Muskogee War Memorial Board worked with FEMA to establish a project and address questions. FEMA selected Option 4 in the stabilization study which involved stabilizing Batfish in her current location using individual concrete cradles constructed in place beneath the boat. The FEMA funding was contingent on receiving a final Scope of Work defined as the plans and specifications for moving and stabilizing the boat.

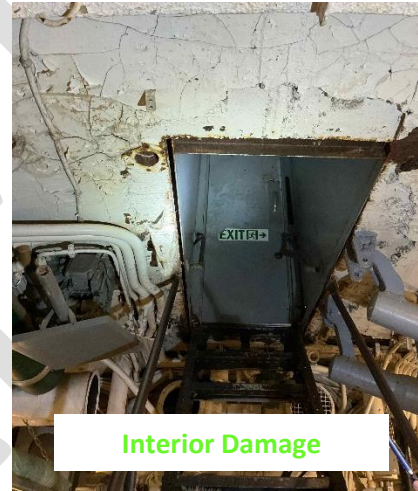
Early in 2021, BKL received a notice to proceed from the board to produce plans for stabilization of the submarine. At this time, the Muskogee War Memorial Board solicited for a Construction Manager at Risk (CMAR) to assist with project estimating and constructability. The Board contracted with Bison Civil to provide CMAR services.

While BKL was working with the War Memorial Board and FEMA to complete the Scope of Work, several changes were made to the original option that was selected for funding:

- In late January 2021, it was discovered that a scour hole located beneath the boat had begun to expand to cover nearly 1/3 of the forward section. The bow was resting on less than 18 inches of soil. It was determined that the cause of the scour was sloughing of the sand along the banks and the soil was sinking into the water table beneath the scour hole. Geotechnical and Structural Engineers determined that the boat is not located on a stable area, and she should be moved back to her original position where the sandy

soil has already been compacted under the weight of the boat for 50+ years. The FEMA project manager advised that FEMA would honor the funding if additional costs were justified by engineering decisions. The CMAR made an emergency repair to fill in the scour hole beneath the submarine at an approximate cost of \$210,000.

- BKL began construction plans to serve as the FEMA Scope of Work for relocation of Batfish. The scope consisted of constructing a berm and coffer dam and flooding the current location so the submarine would float and be guided back to her original location. A consultant from the USS Drum exhibit in Mobile Alabama shared that the Drum is placed on a series of concrete cradles that are not tied together and they have begun to settle at differing rates. Drawing on that experience, the construction plans for the Batfish included a solid concrete slab the length of the boat with 18 individual concrete cradles to support the submarine both vertically and laterally. The new estimated construction cost after these changes included \$1,289,247 for the berm and floating Batfish and \$457,848 for the pad and foundation.
- The FEMA project manager had advised the Board that repairs to damage caused to the interior and exterior of the boat by the flood would be eligible for FEMA funding, so BKL added paint, replacement of one AC unit, mattress replacement, and other interior repairs in the FEMA Scope of Work including replacement of asbestos tile damaged by the flood. The estimated construction cost of these items is \$300,000 for sandblasting and paint and \$57,000 for asbestos removal, tile replacement and AHU replacement.
- Inspection of the existing deck railing revealed that the railing does not meet the current IBC code so a new code compliant rail along with some repairs to the deck flooring was included in the Scope of Work. Additionally, there is only one means of egress being the new gangway at the aft end of the boat, so a new stair was included on the fore end. The construction cost of these items is estimated at \$110,000.



The Scope of Work was submitted to FEMA and approved for moving the Batfish approximately 75 feet to her original location, providing stabilization, interior repairs and code compliant access and egress. FEMA has asked for the final construction cost estimate breakdown and a justification for the additional items described above.

## Decision to Relocate the Batfish

Shortly after FEMA approval, the War Memorial Board voted to relocate the Batfish for the following reasons:

- The 2019 flood caused significant damage to Port of Muskogee property including the port offices. The Corps of Engineers made the commitment to construct a new levee to protect the port and surround properties from future flooding of this extent. The new levee will be located on the current War Memorial exhibit property.
- The National Security Administration has increased the requirement for gated security for the port properties and as several industries are located on the same road as the War Memorial Museum and Batfish Exhibits, the public access would have to be under gated security.
- The Port of Muskogee holds the lease for the land where the Batfish and museum building is currently resting, and the lease expires in November of 2022. The port has added a new industry on the property to the west of Batfish Road and the buildings will obscure the view of the Batfish from the highway.

The Muskogee War Memorial board commissioned this feasibility study from BKL, Inc. The FEMA project manager stated that if the funding has been approved for the original Scope of Work, that same amount can be provided toward a “change in scope” if the request is approved. All location and new construction options are subject to approval of the governing entities that are affected by the change in location.

## Transportation Methods

This section is a discussion of the transportation methods as proposed by local and national construction and hauling companies. Specifics of the methods are not included as they vary from firm to firm and means and methods will not be disclosed until after the project is bid.

Statistics of Batfish relevant to hauling and floating are listed below. These will be included in final construction bid plans but are required to be verified by the contractor. Stability plans for a submarine of a similar class as Batfish were obtained from the USS Pompano, a Porpoise Class submarine on display in San Francisco Bay. These are included in Appendix B of this report.

- Weight is listed at 3.25 million pounds, however, the lead ballast bars in the sub-tanks have all been harvested and we have no information on how much weight that subtracts or if the bars were counted in the original weight. It is generally assumed that the ballast weight was counted in the 3.25-million-pound estimate and if they have all been removed, the location of center of gravity will be approximately the same as before their removal.
- Length is 311 feet.
- Width at the widest point is 29 feet.
- Keel length is approximately 150 feet.
- Height from the bottom of the keel to the tallest radio tower is 56 feet.
- Draft is listed as 16 feet. This is likely before the removal of the lead ballast. Batfish floated in a reported 520-foot water surface and came to rest at 505 feet above sea level so the draft without the lead ballast appears to be 15 feet.

### Overland Hauling:

The heavy haul companies that we spoke with (Emmert, J&B Heavy Haul and Mammoet) agreed that a multi-axle modular trailer with cradles designed to support the boat would be the best option for overland hauling.

Several options for loading the submarine on to the trailer were considered including lifting with several cranes on both sides of the boat, excavating the existing location to install axles and cradles or floating the submarine within a berm/cofferdam to the top of the trailer outfitted with cradles.

Several options were also considered for off-loading the submarine at the final location. All were some variations of constructing a continuous concrete slab that would be the final footing similar to the plans for the original scope of work. Once this slab is constructed, the trailer would ramp on to the slab and the axles would be removed one at a time while permanent cradles are constructed to support Batfish. Or the submarine would be lifted off the trailer with multiple cranes.

Several obstacles must be overcome during the stretch of overland haul:

- The overhead electric lines that Batfish would cross on the way to any of the eight locations are all owned by OG&E. These are shown in Figure 1. According to the map, moving the boat to potential locations 1, 2, 3, 4 or 6 will cross under the 69kV line three times and the 161kV line once. Potential locations 5, 7 and 8 will require crossing the 69kV line twice and the 161kV line once. In each of these locations, OG&E believes they will be able to raise the lines up high enough to get the load under it. This will however require them to take an outage on both lines. They won't be able to have these lines out of service for an extended period. The 69kV line feeds the Muskogee Water Plant and historically they can only be down for 4-6 hours without needing a back-up generator. The 161kV line feeds the Muskogee Port Substation and in a cool part of the year they should be able to move the load off that substation to de-energize the 161kV substation. If the boat can be moved in 1-2 days, then the cost would be approximately \$75,000-\$100,000.
- An overland haul may include railroad crossings. The railroad that serves the Port of Muskogee is Watco Rail Services. Each railroad crossing will require removing existing railroad panels for at least 16 ft. or the length of one panel, constructing a temporary crossing for the trailer, restoring the subbase after the crossing is complete and reinstalling the railroad panel to specifications. The cost of crossing one track is estimated to be \$150,000.
- Underground utilities must be evaluated on an individual basis to determine if they are deep enough that the distributed weight of the Batfish haul would not affect them, or if a land bridge must be constructed to distribute the load to either side of the utility crossing. The cost of a land bridge is estimated to be \$750,000. Most of the land bridge could be reused if the utilities are more than 175 ft. apart.
- Once the overland haul is complete, any roadway impacted by the heavy load must be repaired. The cost of each repair includes demolition, subgrade repair and replacement of paving.
- Some of the location options considered involve Crossing the Muskogee Turnpike. The width of the highway cross section is considerably less than the 300 ft. length of Batfish, so traffic would have to be detoured in both directions at the same time. The crossing would also involve removal and replacement of barrier, pavement reconstruction, traffic control to temporarily detour traffic, and structural fill to ramp across the drainage ditches and median.

The spreadsheet below is a summary of the costs associated with these overland transport items:

OVERLAND OPTION	COST
Lifting boat to trailer	\$ 1,500,000.00
Cost of haul equipment and labor	\$ 2,500,000.00
Underground utility bridge if required	\$ 750,000.00
Cost of overhead power crossing	\$ 150,000.00
Railroad crossing	\$ 300,000.00
Road repairs estimate	\$ 500,000.00
Crossing US 165, Muskogee Turnpike	\$ 1,250,000.00
Offload, including concrete foundation	\$ 3,000,000.00
<b>TOTAL</b>	<b>\$ 9,950,000.00</b>

### Navigation Channel Transport

The USS Batfish was originally transported to the Port of Muskogee from the Port of New Orleans by way of the Kerr-McClelland Navigation Channel. The channel is twelve feet deep at the shallowest point and the Batfish’s draft is 16 ft. Three barges were floated alongside the submarine, and she was lifted by wench several feet on each barge so that she drafted less than 12 ft. Batfish’s move to Oklahoma was halted at Port of Muskogee property where a channel was dug, she was tugged in, and the channel was drained. The submarine was never lifted from this spot until she floated in 2019.

Since Batfish was originally brought to Oklahoma, in the 1970’s, the navigation channel has been shifted to align more directly with the Verdigris River, leaving a small stretch of the Arkansas River between the War Memorial Park and the navigation channel. The Arkansas River has also shifted to about 1000 feet away from the boat’s bow. This distance between the boat and the Arkansas river is now mostly sdy land and the stretch of the Arkansas River between the park and the navigation channel has almost completely silted in. Today, to float Batfish back to the navigation channel would require more than 2000 ft. of excavation at 16 ft. deep and at least 40 ft wide. A Corps of Engineers permit would be required for this amount of alteration of the flood plain area. This stretch of property has been identified as archeologically sensitive so exploration, testing and observation would be required for any excavation. Because of these considerations, floating Batfish to the navigation channel was not considered feasible.

Loading and overland transport to the navigation channel would look similar to the overland transportation described above with the addition of obtaining permission to cross private property with the trailer carrying Batfish.

Most of the discussion about launching in the navigation channel involved construction of a new ramp, ramping the trailer down to the water until Batfish floats and floating the submarine with the assistance of barges or pontoons so the draft will be less than the 12ft deep channel. Excavation of the riverbank for the ramp would require permission of the Corps of Engineers.

Floating Batfish, once launched, may be aided by coordination with the Corps of Engineers to raise the water level. Flotation devices or barges will still be required because the water level cannot be raised enough to accommodate the boat’s 15-16 ft. draft. The Corps has indicated that the best time of year to raise the water level would be from April through June. The navigation channel move would also require coordination with all three ports, the Coast Guard, and the Corps of Engineers to minimize the effect to navigation.

Pulling Batfish from the navigation channel would again require the construction of a ramp at a maximum one percent grade or lifting with the use of two to three cranes. The cranes are not considered feasible because the three locations considered across the navigation channel from her current location do not have space for the structure required to support cranes lifting 3.2 million pounds. The space required for a ramp for those three locations may be located along the highway right of way for SH-62 to the north of Three Fork Harbor.

The spreadsheet below breaks down the costs of navigation channel transport items:

NAVIGATION CHANNEL	COST
Construct Ramp to launch	\$ 1,500,000.00
Coordination to raise water l	\$ 750,000.00
Pontoons or barges	\$ 1,500,000.00
Cost of equipment, labor, coast guard, downtime for ports	\$ 2,000,000.00
Construct ramp along SH-62 drainage ditch	\$ 1,500,000.00
Cost of equipment and labor form moving batfish on land at three Forks	\$ 2,500,000.00
<b>TOTAL</b>	<b>\$ 9,750,000.00</b>

## New Location Options

Figure 1 shows eight new location options for Batfish. For each option, we evaluated the hauling requirements including utility, railroad and highway crossings, environmental and archeological considerations, permissions or buyout of existing landowners, visibility from a highway, access for the public, future flood impacts and site layout considerations.

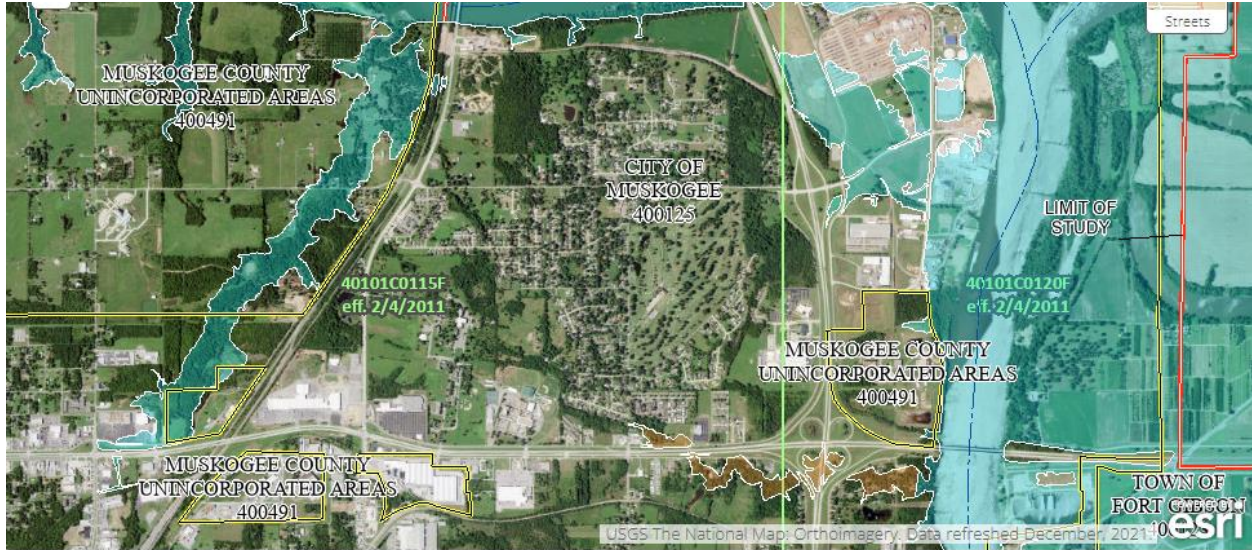
The cost of a new museum building, parking and outdoor exhibit space is estimated at approximately \$10,000,000. This cost was not used for comparative purposes on each option because it was considered to be the same for each location.

The locations are labeled 1-8 in Figure 1. Possible haul routes are indicated by red lines and arrows overland and yellow lines and arrows in the navigation channel. Overhead transmission lines are shown in blue (69kW) and light green (161kW).

Site layout sketches are provided for Options 1-3 to show that the Batfish and accompanying museum and parking will fit on the sites. Locations 4-8 are much larger areas and several of these are wooded, and the ground elevations are unknown until they can be surveyed so no site layouts are provided.

Since the 2019 flood event, the Corps of Engineers is considering a FEMA Flood Map change with higher flows in the navigation channel. They are also planning the construction of a levee along the west bank of the navigation channel to protect port industries from higher flood levels. Below is the current FEMA flood map of the area encompassing options 1-8. Shaded in light blue are “Zone A, Special Flood Hazard Areas”. After the Corps of Engineers flood map update, we expect the areas in Zone A on the east side of the river to increase and the areas in Zone A including the port industry properties on the west side of the river to decrease.





**Option 1:**

Location Option 1 is the property of the Corps of Engineers. It was initially proposed as a location for the War Memorial Museum because of its proximity to the Muskogee Port office and Three Forks Harbor, a public access harbor. The view from SH 62 and the port’s conference room and patio were also cited as reasons for this location. The evaluation of this site described below:

**Hauling requirements:** The submarine would have to be transported across the Arkansas River to reach location option 1. This would involve:

- Loading on overland trailer - \$1,500,000
- Overland transport to the navigation channel approximately 8600 feet - \$2,500,000
- Crossingover head transmission lines four times - \$150,000.
- Bridging underground utilities - \$750,000
- Crossing two railroad tracks - \$300,000
- Permission to cross industry land owned by Port of Muskogee
- Launching into channel – 1,500,000
- Coordination to raise water - \$750,000
- Channel transport for 4800 feet. – \$3,500,000
- Pulling from channel – \$1,500,000
- Overland haul to final destination approximately 5000 feet - \$2,500,000
- Offloading at the destination - \$3,000,000.
- Permission from OG&E to cross property

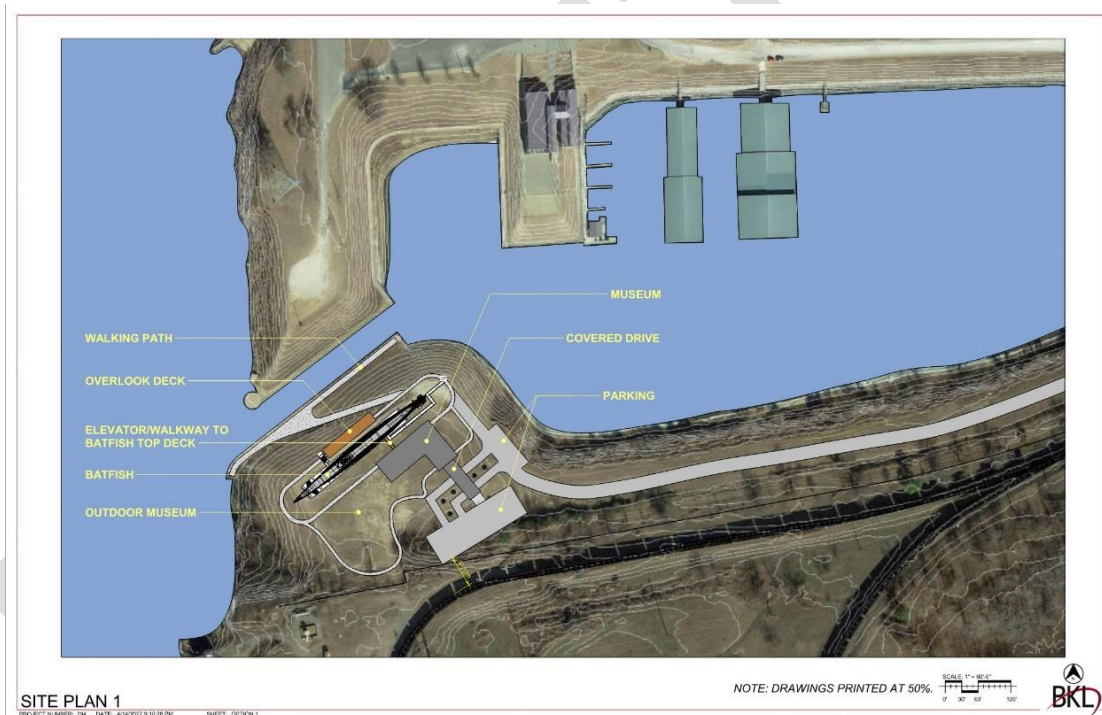
**Land Ownership:** As stated above this property is owned by the Corps of Engineers. To occupy this location, the museum board must obtain permission from the Corps of Engineers. The location is adjacent to the property occupied by OG&E at the Port of Muskogee. The OG&E electric plant is partially coal generation with coal dust affecting the adjacent site. Use of the Corps of Engineers property for a public use museum is not expected to have a cost associated.

**Archeological Impact:** Location Option 1 is on a property that has been improved to accommodate the entrance to the Three Forks Harbor and the railroad serving OG&E. Because of the improvements, it is unlikely that the property still has archeological significance.

**Public Access:** Access to Location Option 1 would be from Three Forks Harbor Road. A new road would be paved from Three Forks Harbor Road to the east of the harbor and turning to run the length of the harbor on the south bank. Approximately 3000 LF of new paving is estimated to cost \$900,000 for a 26-foot wide open-graded asphalt road.

**Visibility:** The USS Batfish, from this location, would be very visible from SH -62 beginning from the apex of the bridge crossing the Arkansas River to the end of the harbor.

**Site Layout:** The usable area on this site is approximately 1.75 acres. The image below shows the layout for a possible museum configuration and access road.



**Flood Risk:** Location Option 1 is in the FEMA Zone A, Special Hazard Area and this is not expected to change after the new levee is constructed.

**Design and CMAR cost:** With coordination with Corps of Engineers, utilities and Muskogee Port Authority and minimal environmental impact, the final design including survey and geotechnical investigation is expected to be approximately \$800,000. CMAR cost is expected to be \$1,900,000.

**Option 1 Total Cost to Relocate:** \$21,550,000.

**Add 30% contingency:** \$28,015,000.

## Option 2:

Location Option 2 is the also the property of the Corps of Engineers. It was proposed as an optional location for the War Memorial Museum for the same reasons as Option 1, because of its proximity to the Muskogee Port office and Three Forks Harbor. But removal of the boat from the water was easier in this location than with Option 1. Option 2 location is still visible from SH 62 and the port's conference room and patio, but it shares the peninsula shown in the site layout sketches with an OG&E transmission tower. The evaluation of this site is described below:

**Hauling requirements:** The submarine would have to be transported across the Arkansas River to reach location option 2. This would involve:

- Loading on overland trailer - \$1,500,000
- Overland transport to the navigation channel approximately 8600 feet - \$2,500,000
- Crossing overhead transmission lines four times - \$150,000.
- Bridging underground utilities - \$750,000
- Crossing two railroad tracks - \$300,000.
- Permission to cross industry land owned by Port of Muskogee
- Launching into channel - \$1,500,000.
- Coordination to raise water - \$750,000
- Channel transport for 4800 feet. – \$3,500,000
- Pulling from channel – \$1,500,000
- Overland haul to final destination approximately 2500 feet - \$1,000,000.
- Offloading at the destination - \$3,000,000.

**Land Ownership:** This property is owned by the Corps of Engineers. To occupy this location, the museum board must obtain permission from the Corps of Engineers. Use of the Corps of Engineers property for a public use museum is not expected to have a cost associated.

**Archeological Impact:** Location Option 2 is on a property that has been improved to accommodate public access to Three Forks Harbor and the Port of Muskogee office. Because of the improvements, it is unlikely that the property still has archeological significance.

**Public Access:** Access to Location Option 2 would be from Three Forks Harbor Road along the same route as used for the port office. New access paving will be required from the harbor parking lot to the museum location and around the museum to facility traffic in the tight space. Approximately 2000 linear feet of new access paving will be required at an estimated cost of \$600,000.

**Visibility:** The USS Batfish, from this location, would be very visible from SH -62 beginning from the apex of the bridge crossing the Arkansas River to the end of the harbor. The boat can also be seen from the port office patio.

**Site Layout:** The site is constrained by the OG&E tower at the end of the peninsula and by the narrow width. The usable area is approximately 2.75 acres. The site layout below shows possible museum configuration and access road.



**Flood Risk:** Location Option 2 is in the FEMA Zone A, Special Hazard Area. This is not expected to change after the levee construction.

**Design and CMAR cost:** With coordination with Corps of Engineers, utilities and Muskogee Port Authority and minimal environmental impact, the final design including survey and geotechnical investigation is expected to be approximately \$800,000. CMAR cost is expected to be \$1,700,000.

**Option 2 Total Cost to Relocate:** \$ 19,550,000.

**Add 30% contingency:** \$25,415,000

### Option 3:

Location Option 3 overlaps with Location Option 2 and is also the property of the Corps of Engineers. It was proposed because it has the same advantages of proximity to the Muskogee Port office and Three Forks Harbor as Options 1 and 2 but does not encroach as far on the peninsula with the OG&E tower. The evaluation of this site is described below:

**Hauling requirements:** The submarine would have to be transported across the Arkansas River to reach location option 3. This would involve:

- Loading on overland trailer - \$1,500,000
- Overland transport to the navigation channel approximately 8600 feet - \$2,500,000
- Crossing overhead transmission lines four times - \$150,000.
- Bridging underground utilities - \$750,000
- Crossing two railroad tracks - \$300,000.

- Permission to cross industry land owned by Port of Muskogee
- Launching into channel - \$1,500,000.
- Coordination to raise water - \$750,000
- Channel transport for 4800 feet. – \$3,500,000
- Pulling from channel – \$1,500,000
- Overland haul to final destination approximately 2500 feet - \$1,000,000
- Offloading at the destination - \$3,000,000.

**Land Ownership:** This property is owned by the Corps of Engineers. To occupy this location, the museum board must obtain permission from the Corps of Engineers. The location is adjacent to the property occupied by OG&E at the Port of Muskogee.

**Archeological Impact:** Location Option 3 is on a property that has been improved to accommodate the entrance to the Three Forks Harbor and the railroad serving OG&E. Because of the improvements, it is unlikely that the property still has archeological significance.

**Public Access:** Access to Location Option 3 would be from Three Forks Harbor Road similar to access to the harbor. An additional loop road could be provided around the OG&E peninsula. An estimated 2000 LF of access road would cost approximately \$600,000.

**Visibility:** The USS Batfish, from this location, would be very visible from SH -62 beginning from the apex of the bridge crossing the Arkansas River to the end of the harbor.

**Site Layout:** The site area is approximately 3.4 acres, with additional square footage available for outdoor exhibits along the peninsula. Below is a sketch showing a possible museum configuration on this site.



**Flood Risk:** Location Option 3 is in the FEMA Zone A, Special Hazard Area. This is not expected to change with the new levee.

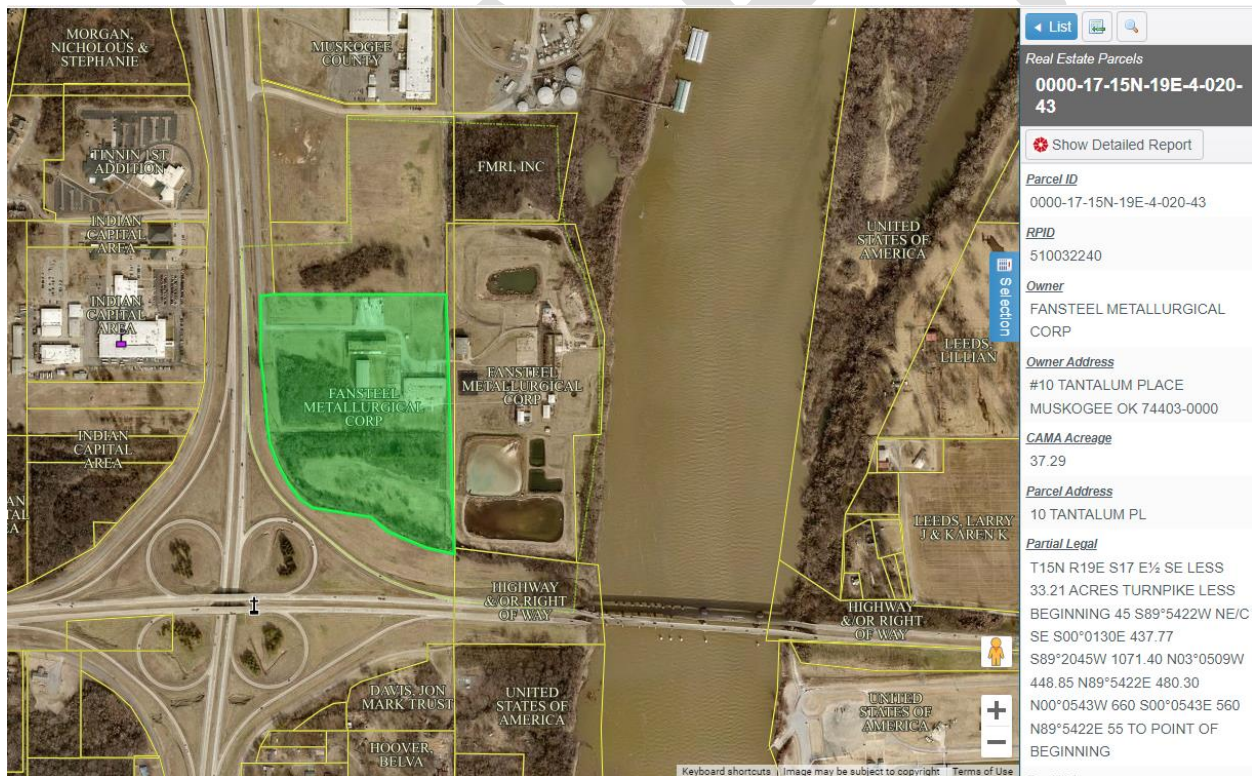
**Design and CMAR cost:** With coordination with Corps of Engineers, utilities and Muskogee Port Authority and minimal environmental impact, the final design including survey and geotechnical investigation is expected to be approximately \$800,000. CMAR cost is expected to be \$1,700,000.

**Total Cost Estimate for Option 3:** \$19,550,000.

**Add 30% contingency:** \$25,415,000

**Option 4:**

Location Option 4 is the property of Fansteel Corporation. This option was considered because of the overland haul location and the exceptional view from both the Muskogee Turnpike and SH-62. The Fansteel property is currently undergoing remediation efforts for chemical and radioactive contamination. It is a site of high public interest and therefore this report does not recommend pursuing this location any further.



### Option 5:

Location Option 5 is in the northwest corner of the Muskogee Turnpike and SH-62 cloverleaf. It is owned primarily by Indian Capital Area Vo-Tech. The area of greatest interest is two cleared strips of land running east and west, just south of the school. This area would be visible from the Muskogee Turnpike and from the SH-62 bridge over the turnpike. Location 5 was considered because of its visibility from the turnpike and because the move would be all overland.

**Hauling requirements:** The submarine would have to cross the Muskogee Turnpike to reach destination 5. There are two options for crossing the turnpike: crossing the E. Harris Road bridge over the turnpike or constructing a land bridge across the turnpike.

As stated above, the submarine weighs approximately 3.25 million pounds. Assuming the keel length of about 150 feet would be the support length, the distributed weight over the trailer would be about 22,000 pounds per foot. The closest axle spacing is five feet so the axle weight would be at least 110,000 pounds each. The bridge is four lanes across or about 48 usable feet. This calculates to 27.5 kips per lane per axle if the axles can be lengthened to 48 feet across. With the axles spaced only 5 feet apart, this exceeds the Oklahoma overload truck and is unlikely to be approved for crossing.

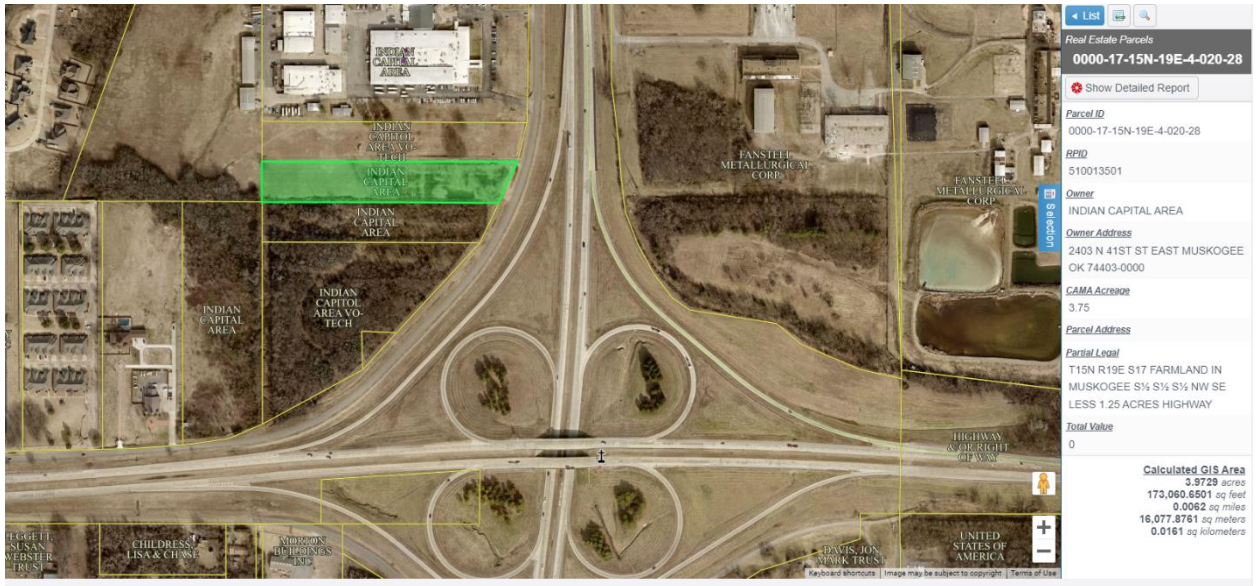
Crossing the Muskogee Turnpike with a land bridge will almost certainly require stopping traffic in both directions on the turnpike. The submarine is 310 feet long and the width of both lanes on the turnpike is only about 90 feet. Crossing with a land bridge just south of the gore points of the E. Harris Road ramps as shown in Figure 1 would require:

- Rerouting traffic in both directions from the Muskogee Turnpike. This will likely be along SH-16 and SH-62 with port traffic directed along E. Harris Road.
- Earth fill for three ditches.
- Temporary removal of cable barrier.
- Repair of pavement on the turnpike.

This costs for hauling the submarine to Option 5 location are listed below:

- Loading on overland trailer - \$1,500,000
- Overland transport to the Location 5 - \$2,500,000
- Crossing Muskogee Turnpike - \$1,250,000.
- Crossing over head transmission lines three times - \$120,000.
- Bridging underground utilities - \$750,000.
- Crossing one railroad track - \$150,000.
- Offloading at the final destination - \$3,000,000.

**Land Ownership:** The triangle of property fronting OTA/ODOT right-of-way is owned by the Indian Capital Area Vo-Tech. The strip of land highlighted in the image below is of greatest interest because it is already cleared, and batfish would reach her final destination before frontage road curves around the cloverleaf. Due to the expense of relocating Batfish, this report recommends a land purchase instead of a lease. The value of the property is unknown at this time, and it is not considered in the cost comparison.



**Archeological Impact:** Location Option 5 fronts state highway property and has been cleared. Archeological impact is expected to be low on the portion of the property that is already cleared.

**Public Access:** Access to Location Option 5 would be from N. 41<sup>st</sup> St. E. (Vo-Tech Road). This road is already used frequently by Vo-Tech students and staff. It has two-way traffic and continues west around the highway frontage to become E. Shawnee Road. No additional paving other than that required by the museum building and parking is anticipated for this site.

**Visibility:** The USS Batfish, from this location, would be visible from the Muskogee Turnpike and from the west-bound lanes of SH-62 as it is crossing the turnpike.

**Site Layout:** The area of one strip of land is 3.9 acres. The strip of land is about 150 feet wide. Batfish could be turned diagonally from the direction of the turnpike for a better view from the road or the adjacent strip of land could be considered as an additional purchase or a partial purchase.

**Flood Risk:** Location Option 5 is not in the FEMA Zone A area and the addition of the new levee will likely protect this location from a higher flood level than the current maps indicate.

**Design and CMAR cost:** With coordination with utilities and minimal environmental impact, the final design including survey and geotechnical investigation is expected to be approximately \$500,000. CMAR cost is expected to be \$920,000.

**Total Anticipated Cost of Option 5:** \$10,690,000 + land purchase

**Add 30% Contingency:** \$13,897,000 + land purchase



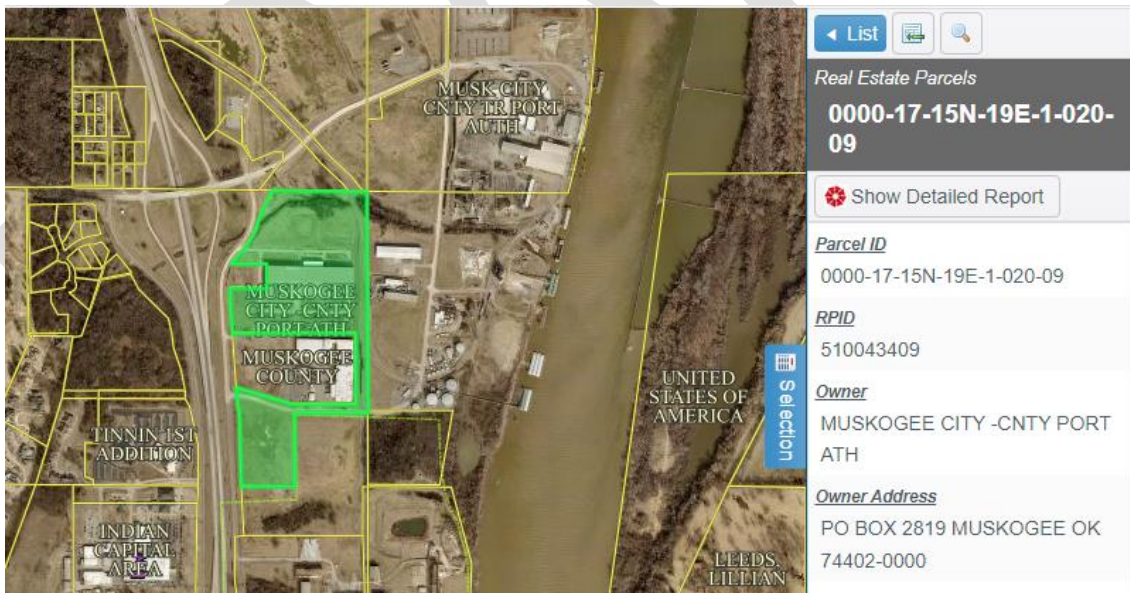
Option 6:

Location Option 6 is the property of The Port of Muskogee. This option was considered because the port is the landowner, the transportation method could be all overland, and it is already cleared. It also affords a direct view from the Muskogee Turnpike similar to the existing location. The evaluation of this site described below:

**Hauling requirements:** As stated above, the submarine could be hauled completely over land. This would involve:

- Loading on overland trailer - \$1,500,000
- Overland transport to the Location 6 - \$2,500,000
- Crossing overhead transmission lines three times - \$150,000.
- Bridging underground utilities (estimated) - \$750,000
- Crossing one railroad track - \$150,000
- Offloading at the destination - \$3,000,000.

**Land Ownership:** This property is owned by the Port of Muskogee. To occupy this location, the museum board must obtain permission from the Port of Muskogee Board of Directors. The existing location is land owned by the Port of Muskogee provided at a no-cost lease for 50 years. Due to the expense of relocating Batfish, this report recommends a land purchase instead of a lease. The Option 6 property has land access but currently has no navigation channel access. It is a viable income generating property for the Port of Muskogee, but it is currently unused.



**Archeological Impact:** Location Option 6 fronts state highway property and has been cleared with port industries on both sides. Archeological impact is likely to be low on the portion of the property that is close to the Muskogee Turnpike. The property closer to the river will require further Archeological study if used.

**Public Access:** Access to Location Option 6 would be from N. 43<sup>rd</sup> St. E. This road dead ends south of the property before reaching the cloverleaf intersection of the Muskogee Turnpike with SH-62. It would require another 1000 feet of road to connect to the SH-62 west-bound to the turnpike north-bound ramp, making it a frontage road. The existing road running from E. Harris Road south, is two-way traffic and two lanes. If maintained by the City of Muskogee, it would be adequate for public access to the museum. No additional paving other than that required by the museum building and parking is anticipated for this site.

**Visibility:** The USS Batfish, from this location, would be very visible from the Muskogee Turnpike.

**Site Layout:** The portion of this property under consideration is approximately 8.5 acres. We anticipate locating the submarine as close to the road frontage as possible to provide the turnpike view and minimize hauling overland.

**Flood Risk:** Location Option 6 is not in the FEMA Zone A area and it is not expected to be in the flood plain after the levee is installed and new flood maps are created.

**Design and CMAR cost:** With coordination with utilities and Muskogee Port Authority and minimal environmental impact, the final design including survey and geotechnical investigation is expected to be approximately \$450,000. CMAR cost is expected to be \$800,000,

**Total Anticipated Cost of Option 6:** \$9,300,000 + land purchase.

**Additional cost of extending the frontage road 1000 linear feet at 500/ft:** \$500,000

**Add 30% contingency:** \$12,740,000.

#### Option 7:

Location Option 7 is part of a larger section of land belonging to a private owner. This option was considered because the transportation method could be all overland. It also affords a direct view from the Muskogee Turnpike similar to the existing location. The evaluation of this site described below:

**Hauling requirements:** As stated above, the submarine could be hauled completely over land but would require crossing the turnpike in one of the two methods described in option 5. This would involve:

- Loading on overland trailer - \$1,500,000
- Overland transport to the Location 7 - \$2,500,000
- Crossing Muskogee Turnpike - \$1,250,000.
- Crossing over head transmission lines three times - \$120,000.
- Bridging underground utilities - \$750,000
- Crossing one railroad track - \$150,000.
- Offloading at the final destination - \$3,000,000.

**Land Ownership:** This property is privately owned. The property is heavily wooded so the terrain is unknown but it appears to drain toward a creek on the northern side. It fronts E. 41<sup>st</sup> S. or Vo-Tech Road. Due to the expense of relocating Batfish, this report recommends a land purchase instead of a lease.

**Archeological Impact:** Location Option 7 is uncleared and privately owned. There is a creek on the property. An Archeological study and Environmental will likely be required to convert the land to public use.

**Public Access:** Access to Location Option 7 would be from N. 41<sup>rd</sup> St. E. (Vo-Tech Road). The road is two -way and is used by Vo-Tech students and staff. No additional paving other than that required by the museum building and parking is anticipated for this site.

**Visibility:** The USS Batfish, from this location, would be very visible from the Muskogee Turnpike.

**Site Layout:** The site area south of the creek is approximately 8 acres. We anticipate locating the submarine as close to the road frontage as possible to provide the turnpike view and minimize hauling overland.

**Flood Risk:** Location Option 7 is not in the FEMA Zone A area and the new levee is expected to add additional protection to this area.

**Design and CMAR cost:** With coordination with landowner and utilities and with expected archeological and environmental impact studies, the final design including survey and geotechnical investigation is expected to be approximately \$600,000. CMAR cost is expected to be \$920,000.

**Total Anticipated Cost of Option 7:** \$10,790,000.

**Add 30% Contingency:** \$14,027,000

#### Option 8:

Location Option 8 is owned by the Port of Muskogee. This option was considered because the transportation method could be all overland and it is a short distance from the existing location. It also affords a direct view from the Muskogee Turnpike similar to the existing location. The evaluation of this site described below:

**Hauling requirements:** The submarine could be hauled completely over land but would require crossing the turnpike in one of the two methods described above in option 5. However, the haul route would not cross any overhead transmission lines or railroads. The transportation would involve:

- Loading on overland trailer - \$1,500,000
- Overland transport to the Location 8 - \$2,500,000
- Crossing Muskogee Turnpike - \$1,250,000.
- Bridging underground utilities (estimated) - \$750,000
- Offloading at the final destination - \$3,000,000.

**Land Ownership:** As stated above, this property is owned by the Port of Muskogee. It is currently unused land. Due to its location on the west side of the Turnpike, we do not expect it to be encompassed in the Port secure perimeter. We recommend a purchase rather than lease from the Port.

**Archeological Impact:** Location Option 8 is cleared but there is no known development activity in the last 50 years so we anticipate an archeological study will be required. This property also abuts the Arkansas River so we do anticipate that observation of all excavation activity will be required.

**Public Access:** Public access to Location Option 8 will not be possible without purchasing right-of-way from private owners or using turnpike right-of-way. The turnpike right-of-way is wider in the area leading up to Location 8 but it appears to be there to encompass a drainage way so a road would not be feasible. A new road, approximately 2500 feet long, is anticipated to cost \$750,000, not including the cost of land.

**Visibility:** The USS Batfish, from this location, would be very visible from the Muskogee Turnpike.

**Site Layout:** The primary site area is approximately 15 acres. We recommend locating the submarine on the south edge of the property to minimize the length of access road required and avoid flood plain area.

**Design and CMAR cost:** With coordination with Corps of Engineers, utilities and Muskogee Port Authority and archeological studies, the final design including survey and geotechnical investigation is expected to be approximately \$585,000. CMAR cost is expected to be \$970,000.

**Total Anticipated Cost of Option 4:** \$11,305,000 + Land purchase from the Port of Muskogee and from two private owners for an access road.

**Add 30% Contingency:** \$14,696,500 + Land purchase for access road

## Recommended Process for Relocation

This study recommends that the War Memorial Board adopt the following steps toward relocating the Batfish and museum to a new property:

- Secure FEMA funding for the original Scope of Work to use as seed money for additional grants/donations.
- Assess probability of additional funding through grants and pledges.
- Choose a location based on probable funding and begin required approval process which may consist of:
  - ✚ Corps of Engineers approval for land use.
  - ✚ Port of Muskogee approval for land use.
  - ✚ Desktop environmental studies including archeological studies to determine the extent of mitigation if any
- Finalize grant applications and fund raising around the new location and associated costs estimated in this report.
- Buy relocation property and simultaneously:
  - ✚ Survey the property
  - ✚ Obtain geotechnical report for entire site that can be used for the submarine exhibit as well as the museum building.
  - ✚ Begin environmental and archeologic clearance – mitigation requirements will be included in the final construction plans

- Produce plans, specifications, and estimate (PS&E) for moving and housing the Batfish exhibit at the chosen location. The following items may be included:
  - ✚ Masterplan site layout for the museum building, outdoor exhibits, public access road, site grading and outbuildings.
  - ✚ Phase I construction plans for:
    - Site clearing and grading for Batfish and outdoor exhibits,
    - Access road and parking for Batfish and outdoor exhibits,
    - Structure supporting the Batfish,
    - Interior Batfish repairs,
    - Batfish electrical and HVAC,
    - Gangway and egress, and
    - Site grading.
  - ✚ Phase II construction for museum building and additional parking, site grading and landscaping.
- Secure funding for relocation and PS&E for Phase I construction.
- CMAR advertise transporting the boat and Phase I construction.
- Preliminary construction to accept the boat
- Move the boat
- Final construction and grading

End

Attachments:

Figure 1: Aerial with Location Options and Routes

Appendix A: Batfish Stabilization Report 2019

Appendix B: Pampanito Data