National Park Service
U.S. Department of the Interior

Apostle Islands National Lakeshore
Bayfield, WI

Apostle Islands National Lakeshore
Alternatives Analysis for LCM Replacement

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Executive Summary

This report documents a study which analyzed various transportation options for Apostle Islands National Lakeshore (APIS) to pump toilet systems and perform construction support activities. The report presents the background of the study; describes the required missions for the transportation options; analyzes the costs and labor hours of the various transportation options; and presents the study's findings and conclusions.

Background

APIS is located in Lake Superior in Northern Wisconsin. APIS consists of 12 miles of mainland and 21 islands in Lake Superior. The park has 32 vault toilets and 6 septic systems located across the islands which need to be pumped either yearly, every two years, or every three years to comply with state and local regulations. The park also has capital improvement projects on the islands which require construction materials and equipment. APIS previously owned a landing craft which was used to transport heavy equipment and large volumes of materials to and from the park's islands, but the vessel was put out of service in 2012 due to poor condition. Currently, APIS uses a contractor with a LCM-6 landing craft (LCM) to bring materials and septic pumping equipment to the islands, but the park is beholden to the contractor's schedule and does not have a backup alternative if the vessel is not available. APIS has proposed purchasing a new aluminum landing craft to be used to transport heavy equipment, materials, and septic pumping equipment.

Transportation Options

Seven transportation options were investigated for this project:

- purchasing a new landing craft,
- purchasing a used landing craft,
- contracting for missions,
- acquiring a government excess landing craft,
- partnering with ISRO to share their LCM,
- utilizing the small fleet for the missions, and
- increasing the vault toilet tank sizes.

Results

The estimated costs for each operating model were analyzed based on the initial cost, total costs, and labor hours for the 5, 10, 15, 20, and 25 year periods. The costs were also separated to describe the operating cost to the park as well as the total ownership costs to the National Park Service. The ownership costs and labor hours are detailed in Table 1 below.

Table 1
Cumulative Cost of Ownership and Labor Hours Over 25-Year Service Life ($ in thousands)

			Initial Cost	Year 5	Year 10	Year 15	Year 20	Year 25
Purchasing a New Landing Craft		NPS Cost	$680.7	$748.5	$816.2	$884.6	$952.0	$1,020.1
		APIS Cost	$0.0	$67.9	$135.5	$203.9	$271.3	$339.4
		Labor Hrs	-	4,031	8,047	12,125	16,108	20,172
Purchasing a Used Landing Craft		NPS Cost	$550.0	$655.4	$760.4	$866.7	$971.2	$1,077.1
		APIS Cost	$0.0	$105.4	$210.4	$316.7	$421.2	$527.1
		Labor Hrs	-	4,898	9,773	14,738	19,569	24,511
Contracting for Missions		NPS Cost	$0.0	$408.1	$814.0	$1,226.4	$1,629.5	$2,040.4
		APIS Cost	$0.0	$408.1	$814.0	$1,226.4	$1,629.5	$2,040.4
		Labor Hrs	-	4,898	9,773	14,738	19,569	24,511
Government Divested LCM	Purchase in Year 0	NPS Cost	$450.0	$563.0	$675.5	$789.5	$901.5	$1,015.0
		APIS Cost	$0.0	$113.0	$225.5	$339.5	$451.5	$565.0
		Labor Hrs	-	4,898	9,773	14,738	19,569	24,511
	Purchase in Year 1	NPS Cost	$450.0	$622.5	$735.1	$849.1	$961.0	$1,074.6
		APIS Cost	$0.0	$172.5	$285.1	$399.1	$511.0	$624.6
		Labor Hrs	-	4,898	9,773	14,738	19,569	24,511
	Purchase in Year 2	NPS Cost	$450.0	$679.1	$791.7	$905.6	$1,017.6	$1,131.2
		APIS Cost	$0.0	$229.1	$341.7	$455.6	$567.6	$681.2
		Labor Hrs	-	4,898	9,773	14,738	19,569	24,511
Contracting and Sharing ISRO LCM		NPS Cost	$0.0	$349.5	$698.6	$1,049.2	$1,397.7	$1,747.8
		APIS Cost	$0.0	$349.5	$698.6	$1,049.2	$1,397.7	$1,747.8
		Labor Hrs†	-	3,899	7,784	11,723	15,581	19,507
Increasing Vault Toilet Tank Size		NPS Cost	$360.0	$762.9	$1,165.9	$1,464.8	$1,867.8	$2,270.7
		APIS Cost	$0.0	$402.9	$805.9	$1,104.8	$1,507.8	$1,910.7
		Labor Hrs	-	4,759	9,518	13,097	17,856	22,615

† Cumulative labor hours for Contracting and Sharing ISRO LCM do not include labor hours of ISRO LCM crewmembers (operator and deckhand)

Conclusions

Acquiring a large landing craft will allow APIS to perform missions more effectively and for lower costs. Over the 25 year analysis, the options which include purchasing a large landing craft have lower overall costs and have lower costs to the park than the options which include contracting. Furthermore, acquiring a large landing craft will allow the park to perform missions on their own schedule. While APIS currently has to work within Nelson Construction's schedule, owning a vessel would allow the park to pump toilet systems and support construction projects at will.

Furthermore, although purchasing a new landing craft will have the greatest initial cost, it can perform the most missions at the greatest efficiency. The new landing craft has the lowest annual operating costs and requires the fewest number of total labor hours of all of the analyzed options. This will allow the park to spend operations funding on other projects and also allow park staff to perform more tasks within the same time period. The new landing craft has the smallest draft requirements. This will allow the boat to reach the most destinations, including the currently-closed vault toilet at Stockton Island Presque Isle.

Lastly, while contracting is the least expensive option in the short term, it is much more expensive in the long term. At the end of the 25 year analysis, contracting with Nelson construction is twice as expensive as purchasing a new landing craft. Continuing to contract would add over $1,000,000 in operational costs to perform the same missions.

Introduction

Apostle Islands National Lakeshore (APIS) is located in Lake Superior in Northern Wisconsin. APIS consists of 12 miles of mainland and 21 islands in Lake Superior. The park has vault toilets and septic systems located across the islands which need to be pumped either yearly, every two years, or every three years to comply with state and local regulations. The park also has capital improvement projects on the islands which require construction materials and equipment. APIS previously owned a landing craft which was used to transport heavy equipment and large volumes of materials to and from the park's islands, but the vessel was put out of service in 2012 due to poor condition. Currently, APIS uses a contractor with an LCM to bring materials and septic pumping equipment to the islands, but the park is beholden to the contractor's schedule and does not have a backup alternative if the vessel is not available. APIS has proposed purchasing a new aluminum landing craft to be used to transport heavy equipment, materials, and septic pumping equipment.

This project provides an analysis of park uses for a landing craft, determines appropriate regulations, and identifies transportation options for park operations.

Background

APIS, located in Lake Superior in Northern Wisconsin, consists of 21 islands and 12 miles of mainland. The islands are habitats for birds and animals and are also used as recreation areas for visitors. Typical activities for visitors to the Lakeshore include sailing, hiking, fishing, and camping. Stockton Island, the most visited island, has a seasonal visitor center and a ranger station. Other islands have lighthouses, Ranger stations, and campsites. There are camping sites on 15 islands, many of which have vault toilets, while some other islands have septic systems.

The only access to the islands is by boat. Visitors can ride a concession ferry to Stockton Island, or can use their own boat, kayak, or water taxi to access any of the islands. Park staff use a fleet of workboats, typically between 21 and 28 feet, to access and transport materials and equipment to all of the islands. APIS previously owned a former military LCM-6 landing craft (LCM), the *Pelican*, which was used to transport heavy equipment and large volumes of materials to and from the park's islands, including the equipment used to pump the vault toilets and septic systems. However, the LCM condition was deteriorating and as a result APIS turned the vessel into a barge in 2011 and retired it from service in 2012.

Since 2012, APIS has contracted with Nelson Construction, a local construction company with an LCM, to transport the large equipment to the island. Because of the added cost of contracting, the number of LCM trips has been reduced, significantly limiting the availability for maintenance and capital improvement projects on the islands. Some projects have been postponed for several years while waiting for availability and funding. Furthermore, the reduced number of trips has led APIS to utilize their small fleet more often. As an example, APIS currently uses their small fleet to bring hoses and small equipment to the islands and sets up the sites prior to the LCM arriving, which reduces the number of hours and overall costs for the contracted LCM. However, these additional runs increase the fuel use of the small fleet, which add to the park's operating costs. Additionally, Nelson Construction's LCM is the only other large landing craft in the vicinity of APIS. If its LCM has to be shut down for maintenance, APIS has no backup vessel to transport heavy equipment, materials, and septic pumping equipment.

Missions

This section provides an overview of the key missions performed by the landing craft at APIS. These missions include the transport of septic system pumping equipment, heavy construction equipment, and bulk cargo. The landing craft is also used as a construction support platform.

Toilet and Septic System Pumping

APIS owns a waste trailer used to pump the vault toilets and septic systems. The waste trailer has a 1,000 gallon sewage capacity. The trailer weighs 7,000 pounds empty and can weigh up to 16,000 pounds full. The park also contracts for a septic pumping service which has a large capacity tank, when needed. The park uses the landing craft to transport the sewage pumping equipment to the various islands.

Pumping Frequency Regulations

The pumping frequency of septic systems is covered by both state and county regulations. Wisconsin state legislature requires that septic systems be pumped at least once every three years.[*] Similarly, Bayfield County, WI requires the same three year pumping frequency.[†]

There are no current regulations which cover the pumping frequency requirements for vault toilets. The frequency is driven solely by usage and capacity.

Vault Toilet Tanks

There are 32 vault toilets located on 13 islands. A capital improvement project is currently ongoing to replace many of the vault toilet tanks, which will increase most tank capacities to 750 gallons each or greater. One toilet with the heaviest usage, on Stockton Island, fills to capacity over the course of a season, while other less-used toilets only require pumping every second or third year. The vault toilet tanks, the one-way distance from the park headquarters to the tank locations, and the pumping frequencies are shown below in Table 2.

[*] Wisconsin Legislature SPS 383.54(4)(d)(1), Private Onsite Wastewater Treatment Systems, Management Requirements, Existing POWTS.
[†] Bayfield County Septic Tank Maintenance Agreement. http://www.bayfieldcounty.org/DocumentCenter/View/345

Table 2
APIS Vault Toilet Tanks

Island	Quantity	One-Way Distance (miles)	Pumping Frequency (year)
Basswood Island	2 x 750 gallons	4	3
Devils Island	1 x 750 gallons 1 x 250 gallons	21	3
Manitou Island	1 x 250 gallons	12	3
Michigan Island	1 x 750 gallons	16	2
Oak Island	1 x 750 gallons 3 x 250 gallons	10	2
Otter Island	1 x 250 gallons	15	3
Outer Island	1 x 750 gallons	22	3
Raspberry Island	3 x 750 gallons	13	2
Rocky Island	3 x 750 gallons	19	3
Sand Island	3 x 750 gallons	19	2
S. Twin Island	3 x 250 gallons	19	3
Stockton Island	1 x 1000 gallons	14	1
	5 x 2000 gallons		2
	1 x closed		Closed*
York Island	1 x 750 gallons	17	2

*The vault toilet at Stockton Island Presque Isle is currently closed. The park cannot access the vault toilet with the contracted LCM-6 due to low water levels.

Septic Systems

In addition to the vault toilets, there are also septic systems located on 6 islands. Per state and local regulations, septic systems are required to be pumped at least every three years. The septic system locations, the one-way distance from the park headquarters to the tank location, and the pumping frequencies are shown below in Table 3.

Table 3
APIS Septic Systems

Island	One-Way Distance (miles)	Pumping Frequency (year)
Devils Island	21	3
Oak Island	10	3
Raspberry Island	13	3
Rocky Island	19	3
Sand Island	19	3
Stockton Island	14	3

Heavy Construction Equipment & Bulk Cargo

APIS conducts Historic Structures Preservation (HSP) and Buildings and Utilities (B&U) projects on the islands every year, such as repairing docks and building trailheads. The landing craft is the primary means of transporting construction equipment and large volumes of materials to and from the islands for these projects. Examples of the construction equipment transported include

bulldozers, tractors, and lifts. Furthermore, the landing craft hauls large amounts of building materials (e.g. wood) and bulk materials (e.g. sand and gravel) to the islands, and then hauls demolition materials back to the mainland.

In addition to bring equipment and supplies to the islands, the landing craft is used to support construction and installation projects. Projects such as rebuilding and replacing docks can benefit from having a mobile platform alongside the construction zone. The landing craft can be used as this mobile platform to support the projects.

A typical year will include approximately 12 trips to support the heavy construction equipment, bulk transport, and construction support projects, while a busy year can include up to 18 trips for projects.

Options & Analysis

Seven transportation options were investigated for this project:

- purchasing a new landing craft,
- purchasing a used landing craft,
- contracting for missions,
- acquiring a government excess landing craft,
- partnering with ISRO to share their LCM,
- utilizing the small fleet for the missions, and
- increasing the vault toilet tank sizes.

Transportation Scenario

To evenly compare all options, a standard transportation scenario was created and analyzed. This scenario was created using the destinations and pumping frequencies of the vault toilets and septic systems. Additional setup, construction, and shutdown trips were added as well. As a number of the vault toilets have recently been upgraded, a set pumping cycle has not yet been established. The highest use vault toilet at Stockton Island requires pumping every year, while lesser used toilets require pumping every two or three years. The standard transportation scenario establishes a pumping cycle which repeats every six years.

Table 4 describes the standard transportation scenario analyzed for all transportation options.

Table 4
Standard Transportation Scenario

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Vault Toilet Tanks					
Stockton Is. 1	Stockton Is. 1	Stockton Is. 1	Stockton Is. 1	Stockton Is. 1	Stockton Is. 1
Stockton Is. 2	Oak Is. 1	Stockton Is. 2	Oak Is. 1	Stockton Is. 2	Oak Is. 1
Stockton Is. 3	Oak Is. 2	Stockton Is. 3	Oak Is. 2	Stockton Is. 3	Oak Is. 2
Stockton Is. 4	Oak Is. 3	Stockton Is. 4	Oak Is. 3	Stockton Is. 4	Oak Is. 3
Stockton Is. 5	Oak Is. 4	Stockton Is. 5	Oak Is. 4	Stockton Is. 5	Oak Is. 4
Stockton Is. 6	Raspberry Is. 1	Stockton Is. 6	Raspberry Is. 1	Stockton Is. 6	Raspberry Is. 1
Michigan Is. 1	Raspberry Is. 2	Michigan Is. 1	Raspberry Is. 2	Michigan Is. 1	Raspberry Is. 2
Sand Is. 1	Raspberry Is. 3	Sand Is. 1	Raspberry Is. 3	Sand Is. 1	Raspberry Is. 3
Sand Is. 2	York Is. 1	Sand Is. 2	York Is. 1	Sand Is. 2	York Is. 1
Sand Is. 3	Manitou Is. 1	Sand Is. 3	Basswood Is. 1	Sand Is. 3	Otter Is. 1
Basswood Is. 1	Rocky Is. 1	Otter Is. 1	Basswood Is. 2	Manitou Is. 1	Outer Is. 1
Basswood Is. 2	Rocky Is. 2	Outer Is. 1	Devils Is. 1	Rocky Is. 1	S. Twin Is. 1
Devils Is. 1	Rocky Is. 3	S. Twin Is. 1	Devils Is. 2	Rocky Is. 2	S. Twin Is. 2
Devils Is. 2		S. Twin Is. 2		Rocky Is. 3	
Septic Systems					
Devils Is.	Raspberry Is.	Sand Is.	Devils Is.	Raspberry Is.	Sand Is.
Oak Is.	Rocky Is.	Stockton Is.	Oak Is.	Rocky Is.	Stockton Is.
Setup/Construction/Removal Trips					
Avg 12 Trips	Avg 12 Trips	Avg 12 Trips	Avg 12 Trips	Avg 12 Trips	Avg 12 Trips
Total Mileage					
836 miles	782 miles	890 miles	742 miles	876 miles	796 miles

Assumptions

The following assumptions were made in the analysis:

1. The analysis was performed assuming a 25-year period of use for the vessel. At this point, an LCM-6 or LCM-8 will be between 60 and 90 years old, depending on year of manufacture, and will have exceeded their designed service life.
2. The options were analyzed in 2014 dollars (inflation is not included).
3. Capital costs for a vessel or capital improvement project would be provided by the Midwest Region (MWR), while operating and contracting costs would continue to be paid for by APIS.
4. Vessel operating hours are calculated by dividing the total mileage by the speed of the vessel. Per-person labor hours for vault toilet or septic system pumping trips are calculated by adding three hours of setup, pumping, and shutdown time to the transit time. Per-person labor hours for the setup/construction/removal trips are estimated to be eight hours per day based on the existing LCM operations, but using a faster vessel would reduce the transit time and overall labor hours accordingly.
5. Preventative maintenance and component renewal costs are averaged into a yearly maintenance cost, and this cost is used as an average expenditure for the life of the vessel.
6. The fuel cost is estimated to be $4.10 per gallon, based on the contract with Nelson Construction. If the cost of diesel rises, both the contract cost and APIS direct purchasing cost will go up the equivalent amount.

7. The landing craft and associated missions require a crew of 5. For options which include purchasing a vessel, the operator and deckhand of the vessel will be able to support the pumping operations. However, for options which include contracting or sharing of a vessel, the operator and deckhand of the contracted vessel will not assist with pumping or construction operations. Thus, five APIS staff members are still required to perform the pumping operations on the islands.
8. This study analyzed the labor hour s required for each option, as opposed to the labor costs of each option. Because the crews will be working the same total number of yearly hours for APIS, a faster vessel will not change the overall salaries of the crewmembers. However, using a faster boat or requiring fewer trips could reduce the number of labor hours tied up in the boat operations, allowing staff to perform other tasks while the overall salary remains constant.
9. Calculations for Option 1: Purchasing a New Landing Craft use the specifications and cost of the proposed Munson 47' x 17' Packman Landing Craft. Full specifications for the Munson Landing Craft are included in Appendix A.

Option 1: Purchase a New Landing Craft

For this option, a new landing craft would be purchased to support tank pumping, heavy equipment transportation and material hauling missions. This new vessel has a 22 mph speed at light ship and a 12 mph speed when fully loaded. The boat is powered by twin diesel engines and propelled using waterjets, and has a 2.5 foot draft. The shallow draft will allow the proposed vessel to access more areas, such as the Stockton Island Presque Isle campground and vault toilet site which has been closed for several years due to low water levels. APIS currently owns other newer landing crafts and is familiar with the maintenance and operations of this type of craft. Purchasing a new landing craft may allow for some parts commonality and configuration control opportunities.

Initial Costs

As specified by APIS, the proposed LCM and trailer have an initial purchase price of $680,663.[*] This price also includes shipping from the manufacturer to APIS.

Maintenance

APIS currently owns and operates several Munson landing crafts. The fleet asset repair history was used to look at yearly maintenance costs on these other crafts. Between 2010 and 2012, the park spent $56,173 on two larger Munson boats, for an average of $9,632 per year per vessel.[†] This analysis assumes the maintenance cost for a new landing craft will be similar, and used this average expenditure for the life of the vessel.

Operations

At lightship (no load), the new landing craft can reach 22 mph. When operating with a moderate load (empty waste trailer), it is estimated that the boat can run at 18 mph. When fully loaded (full waste trailer), the boat can operate at 12 mph. Based upon data from similar LCM, the average fuel use rate of the proposed landing craft at those speeds will be approximately 17.8 gallons per hour.

Because the vessel comes with a trailer, the park will be able to remove the boat from the lake and winterize the vessel using previously-owned equipment. This eliminates the need to pay the local marina to haul out the boat and winterize the vessel. Furthermore, the proposed landing craft only

[*] Specification and Quotation for One 47' Packman Landing Craft for Apostle Islands National Park
[†] APIS Fleet Asset Repair History

requires wage grade (WG) 9 captains, while an LCM requires WG-10 captains. While the park currently has several licensed boat captains which can operate both size vessels, the lower wage grade requirements could allow additional personnel or personnel with lower labor rates to operate the landing craft in the future.

Costs

The initial capital costs for a new landing craft and the repeating costs from Year 1 to Year 6 are shown below in Table 5.

Table 5
Option 1 (New Landing Craft) Costs from Year 0 to Year 6 ($ in thousands)

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Engine Hours		58.1	54.3	64.4	51.5	60.8	57.9
Fuel Consumption (gal)		1032	965	1145	916	1081	1029
Labor Hours (5 Persons)		810.3	776.6	857.2	762.7	824.2	809.6
Initial Purchase Cost	$680.7						
Initial Maintenance Cost	$0						
Yearly Maintenance Cost		$9.4	$9.4	$9.4	$9.4	$9.4	$9.4
Fuel Cost		$4.2	$4.0	$4.7	$3.8	$4.4	$4.2
Haul-Out Cost		$0	$0	$0	$0	$0	$0
Cost to NPS	$680.7	$13.6	$13.3	$14.1	$13.1	$13.8	$13.6
Cost to APIS	$0	$13.6	$13.3	$14.1	$13.1	$13.8	$13.6

The total cost to NPS and the operating costs paid for by APIS are shown below in Table 6.

Table 6
Option 1 (New Landing Craft) Total Cumulative Cost of Ownership over 25 Year Service Life ($ in thousands)

	Year 0	Year 5	Year 10	Year 15	Year 20	Year 25
Total Cost to NPS	$680.7	$748.5	$816.2	$884.6	$952.0	$1,020.1
Total Cost to APIS	$0	$67.9	$135.5	$203.9	$271.3	$339.4

Option 2: Purchase a Used Landing Craft

For this option, a used landing craft would be purchased to support the specified missions. It is anticipated that a used LCM-6 would be purchased, the same style vessel as *Pelican* and Nelson Construction's landing craft. This used vessel would be able to complete all missions to the same extent they are currently being performed. An LCM-6 has a 4 foot draft and can access most island locations, but APIS would still be unable to pump the Stockton Island Presque Isle campground and vault toilet site due to low water levels. When purchasing a used landing craft, it can be expected that the boat may require some reconditioning and customization.

Initial Costs

Used LCM-6s are available for purchase in various conditions. Vessels which have recently been completely overhauled are available, but the initial purchase cost is high. Based on market research, an LCM-6 in excellent condition with upgrades, such as a crane, is estimated to cost

around $425,000. Additionally, shipping costs of $100,000 and an initial maintenance/customization cost of $25,000 can be expected. Thus, the total initial price would be approximately $550,000.

Maintenance

Between 2007 and 2011, the park spent $57,463 on general maintenance for *Pelican*, for an average of $11,493 per year.[*] This analysis assumes the maintenance cost for another LCM-6 will be similar, and used this average expenditure for the life of the vessel.

Operations

LCM-6s have a running speed of 9 mph at both empty and full load, due to hull speed limitations. The average fuel use rate of an LCM-6 is approximately 20 gallons per hour.

Because of the larger size of the LCM-6, the park will not be able to remove the boat from the lake each winter. Instead, APIS will have to pay a local marina to pull out, winterize, and store the LCM-6 every winter at an estimated cost of $2,000 per year.

Costs

The initial capital costs for a used landing craft and the repeating costs from Year 1 to Year 6 are shown below in Table 7.

Table 7
Option 2 (Used Landing Craft) Costs from Year 0 to Year 6 ($ in thousands)

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Engine Hours		92.9	86.9	103.1	82.4	97.3	92.7
Fuel Consumption (gal)		1857.8	1737.8	2062.2	1648.8	1946.6	1853.4
Labor Hours (5 Persons)		984.5	939.5	1050.6	917.2	1006.7	983.4
Initial Purchase Cost	$425.0						
Shipping Cost	$100.0						
Initial Maintenance Cost	$25.0						
Yearly Maintenance Cost		$11.5	$11.5	$11.5	$11.5	$11.5	$11.5
Fuel Cost		$7.6	$7.1	$8.5	$6.8	$8.0	$7.6
Haul-Out Cost		$2.0	$2.0	$2.0	$2.0	$2.0	$2.0
Cost to NPS	$550.0	$21.1	$20.6	$21.9	$20.3	$21.5	$21.1
Cost to APIS	$0	$21.1	$20.6	$21.9	$20.3	$21.5	$21.1

The total cost to NPS and the operating costs paid for by APIS are shown below in Table 8.

[*] APIS Fleet Asset Repair History

Table 8
Option 2 (Used Landing Craft) Total Cumulative Cost of Ownership over 25 Year Service Life ($ in thousands)

	Year 0	Year 5	Year 10	Year 15	Year 20	Year 25
Total Cost to NPS	$550.0	$655.4	$760.4	$866.7	$971.2	$1,077.1
Total Cost to APIS	$0	$105.4	$210.4	$316.7	$421.2	$527.1

Option 3: Contracting for Missions

This option would keep the status quo. APIS would continue to contract to Nelson Construction for the use of their landing craft. Nelson Construction is based on Madeline Island, approximately an hour trip from the park headquarters. Nelson Construction's LCM-6 would be able to complete all missions to the same extent they are currently being performed. In this option, the park would not be liable for any boat maintenance on the landing craft, but availability for missions would be based on the contractor's schedule. There would also be no backup plan. There is no other landing craft in the area with the capability to haul the sewage pumping equipment. If the Nelson Construction LCM has to be shut down for maintenance, there would be no way to haul the necessary equipment or materials to the islands.

Initial Costs

Contracting for landing craft services will not require any equipment purchases from APIS. Therefore, there are no initial purchasing costs for contracting.

Maintenance

Nelson Construction is responsible for the maintenance of their vessel. APIS is not responsible for any yearly maintenance costs.

Operations

Nelson Construction charges APIS $325 per hour for use of the landing craft. That price includes the captain, deckhand, and fuel (assumed to be 20 gallons per hour). The hourly charge starts when the craft leaves its home port on Madeline Island and ends when the craft returns to its home port. Because the park headquarters are located approximately one half-hour away from Madeline Island and there will be additional loading and unloading time, a total of two additional working hours are added to each trip (one from Madeline Island to the park headquarters plus loading, and one unloading and returning).

Costs

The repeating costs from Year 1 to Year 6 for contracting are shown below in Table 9.

Table 9
Option 3 (Contracting) Costs from Year 0 to Year 6 ($ in thousands)

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
APIS Labor Hours (5 Persons)		984.5	939.5	1050.6	917.2	1006.7	983.4
Total Contracting Hours		252.9	241.9	266.1	237.4	257.3	250.7
Cost to NPS	$0	$82.2	$78.6	$86.5	$77.2	$83.6	$81.5
Cost to APIS	$0	$82.2	$78.6	$86.5	$77.2	$83.6	$81.5

The total cost to NPS and the operating costs paid for by APIS are shown below in Table 10.

Table 10
Option 3 (Contracting) Total Cumulative Cost of Ownership over 25 Year Service Life ($ in thousands)

	Year 0	Year 5	Year 10	Year 15	Year 20	Year 25
Total Cost to NPS	$0	$408.1	$814.0	$1,226.4	$1,629.5	$2,040.4
Total Cost to APIS	$0	$408.1	$814.0	$1,226.4	$1,629.5	$2,040.4

Option 4: Acquiring a Government Excess Landing Craft

For this option, a used landing craft would be acquired when divested from another government agency, such as the Army or Navy. This option is the same as purchasing a used landing craft, although the purchase price may be less expensive. A divested landing craft will likely need significant reconditioning. However, there is no set schedule for divesting of government craft. While there is a possibility that crafts could become available within the next year, there is also a possibility that they may not become available for ten or fifteen years.

While the US Army and Navy used to own and operate LCM-6 landing crafts, all of those boats were divested in the past. Currently, both agencies only operate the larger LCM-8 landing crafts. Thus, if the Army or Navy divests a landing craft in the next few years, it could only be an LCM-8. The LCM-8 is a larger landing craft than the LCM-6, with longer length, wider beam, and deeper draft (up to 5.25 feet loaded). While the LCM-8 has more hauling capability than the LCM-6, the deeper draft may also limit the ability to access certain sites with lower water levels.

Initial Costs

In October 2013, two Army LCM-8s were liquidated. One vessel in moderate condition was sold for $175,000, while the second vessel in poor condition was sold for $76,000. This analysis assumed that a government excess craft could be purchased at price of $100,000.

Government excess vessels usually require significant reconditioning and upgrading to operate safely and reliably and to complete all required missions. Items needing to be addressed will likely include repairing the hull, installing new running gear and controls, new safety gear, and installing a crane. Additionally, shipping costs of $100,000 and an initial repair and upgrade cost of $250,000 can be expected, for a total initial price of $450,000.

While waiting for a government excess landing craft to become available, APIS will have to continue to contract with Nelson Construction for use of their landing craft. While the specific

cost for contracting will change year-to-year depending on the schedule, a cost between $77,000 and $86,000 can be expected for each year waiting for a government excess craft to be divested. If the government excess vessel does not become available until the second or third year, the cost savings of the government excess boat will be significantly impacted by the added contracting costs.

Maintenance

Between 2007 and 2011, the park spent $57,463 on general maintenance for *Pelican*, for an average of $11,493 per year.[*] Even though an LCM-8 is larger than an LCM-6, the equipment and upkeep items are similar, and maintenance costs are not expected to be significantly different. Thus, this analysis used the average LCM-6 expenditure as the maintenance cost for the life of an LCM-8.

Operations

When operating at either empty of full load, LCM-8s have a running speed of 9 mph. The average fuel use rate of an LCM-8 is approximately 24 gallons per hour.

Because of the larger size of the LCM-8, the park will not be able to remove the boat from the lake each winter. Instead, APIS will have to pay a local marina to pull out, winterize, and store the LCM-8 every winter at an estimated cost of $2,000 per year.

Costs

The initial capital costs for a government excess landing craft and the repeating costs from Year 1 to Year 6 are shown below in Table 11.

Table 11
Option 4 (Government Excess) Costs from Year 0 to Year 6 ($ in thousands)

	Year of Purchase	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Engine Hours		92.9	86.9	103.1	82.4	97.3	92.7
Fuel Consumption (gal)		2229.4	2085.4	2474.6	1978.6	2335.9	2224.1
Labor Hours (5 Persons)		984.5	939.5	1050.6	917.2	1006.7	983.4
Initial Purchase Cost	$100.0						
Shipping Cost	$100.0						
Initial Maintenance Cost	$250.0						
Yearly Maintenance Cost		$11.5	$11.5	$11.5	$11.5	$11.5	$11.5
Fuel Cost		$9.1	$8.6	$10.1	$8.1	$9.6	$9.1
Haul-Out Cost		$2.0	$2.0	$2.0	$2.0	$2.0	$2.0
Cost to NPS	$450.0	$22.6	$22.0	$23.6	$21.6	$23.1	$22.6
Cost to APIS	$0	$22.6	$22.0	$23.6	$21.6	$23.1	$22.6

The total cost to NPS and the operating costs paid for by APIS are shown below in Table 12.

[*] APIS Fleet Asset Repair History

Table 12
Option 4 (Government Excess) Total Cumulative Cost of Ownership over 25 Year Service Life ($ in thousands)

		Initial Cost	Year 5	Year 10	Year 15	Year 20	Year 25
Purchase in Year 0	Total Cost to NPS	$450.0 (in Year 0)	$563.0	$675.5	$789.5	$901.5	$1,015.0
	Total Cost to APIS	$0	$113.0	$225.5	$339.5	$451.5	$565.0
Purchase in Year 1	Total Cost to NPS	$450.0 (in Year 1)	$622.5	$735.1	$849.1	$961.0	$1,074.6
	Total Cost to APIS	$0	$172.5	$285.1	$399.1	$511.0	$624.6
Purchase in Year 2	Total Cost to NPS	$450.0 (in Year 2)	$679.1	$791.7	$905.6	$1,017.6	$1,131.2
	Total Cost to APIS	$0	$229.1	$341.7	$455.6	$567.6	$681.2

Option 5: Partnering with ISRO to share LCM

In this option, APIS would partner with ISRO to share use of their landing craft. ISRO's craft, *Angelique*, is an LCM-8. When ISRO is open, their LCM is usually either located at the park headquarters on Mott Island or in Houghton, MI. The distance from Mott Island to APIS is approximately 150 miles, and the distance from Houghton to APIS is approximately 120 miles. At a speed of 9 miles per hour, the one-way trip would take up to 17 hours nonstop. Additionally, the weather on Lake Superior can be unpredictable which can cause a rough ride and delays on either end of the trip.

If a partnership was made, the sharing schedule would have to be agreed to between both parks. Both APIS and ISRO require use of a landing craft at the beginning and end of the season, to gear up and open the parks in May and to shut down and remove equipment in October. Furthermore, both parks also have requirements for use during the open season: APIS requires the vessel for toilet pumping and supporting construction projects, and ISRO requires the vessel for moving equipment and supplies around the island and between ISRO and Houghton. Additionally, details for sharing the costs for operations (labor, maintenance, and fuel) would have to be worked out.

Because both APIS and ISRO require use of a landing craft to gear up and open the parks in May and to shut down and remove equipment in October, it doesn't appear that the craft could be shared at the beginning and end of the season. During the operating season, however, it may be possible to share the craft. For this analysis, it was assumed that the landing craft could be loaned from ISRO for a one-month period during the summer. This time period would be sufficient for APIS to pump all vault toilet tanks and septic systems. It is also assumed that the contract vessel will still be used at the beginning and end of the season for the 12 gearing up and shutting down trips.

Initial Costs

Contracting for landing craft services will not require any equipment purchases from APIS. Similarly, ISRO already owns their LCM-8. Therefore, there are no initial purchasing costs for this option.

Maintenance

Nelson Construction is responsible for the maintenance of their vessel. APIS is not responsible for any yearly maintenance costs.

ISRO is responsible for maintenance on their LCM-8. However, because APIS will be using the vessel for a month, it is expected that APIS will contribute funds for maintenance. The yearly maintenance contribution because of the added usage is estimated to be $2,000.

Operations

During the time when the landing craft is on loan, it is assumed that the ISRO crew would still operate the vessel, but APIS would pay labor costs and per diem. The labor costs are estimated to be $12,000 and the per diem is estimated to be $7,740, based on a 30-day operating period. The cost for the transit of the LCM from ISRO to APIS is estimated to be an additional $4,000 for fuel and labor.

An LCM-8 can operate at 9 mph, and the fuel rate of an LCM-8 is approximately 24 gallons per hour.

Costs

The costs from Year 1 to Year 6 for contracting and sharing ISRO's LCM are shown below in Table 13.

Table 13
Option 5 (Contracting and Sharing ISRO LCM) Costs from Year 0 to Year 6 ($ in thousands)

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Contracting							
Total Contracting Hours		120.0	120.0	120.0	120.0	120.0	120.0
Contracting Cost		$39.0	$39.0	$39.0	$39.0	$39.0	$39.0
ISRO LCM							
Engine Hours		52.9	46.9	63.1	42.4	57.3	52.7
Fuel Consumption (gal)		1269.4	1125.4	1514.6	1018.6	1375.9	1264.1
Labor Hours		100.9	91.9	114.1	87.4	105.3	100.7
Yearly Maintenance Cost	$0	$2.0	$2.0	$2.0	$2.0	$2.0	$2.0
Fuel Cost	$0	$5.2	$4.6	$6.2	$4.2	$5.6	$5.2
ISRO Personnel Labor Cost	$0	$12.0	$12.0	$12.0	$12.0	$12.0	$12.0
ISRO Personnel Per Diem Costs	$0	$7.7	$7.7	$7.7	$7.7	$7.7	$7.7
ISRO LCM Transit Costs	$0	$4.0	$4.0	$4.0	$4.0	$4.0	$4.0
Total ISRO LCM Costs	$0	$30.9	$30.4	$32.0	$30.0	$31.4	$30.9
Total							
Total Labor Hours		984.45	939.45	1050.55	917.20	1006.65	983.35
APIS Labor Hours		782.67	755.67	822.33	742.32	795.99	782.01
Cost to NPS	$0	$69.9	$69.4	$71.0	$68.9	$70.4	$69.9
Cost to APIS	$0	$69.9	$69.4	$71.0	$68.9	$70.4	$69.9

The total cost to NPS and the operating costs paid for by APIS are shown below in Table 14.

Table 14
Option 5 (Contracting and Sharing ISRO LCM) Total Cumulative Cost of Ownership over 25 Year Service Life ($ in thousands)

	Year 0	Year 5	Year 10	Year 15	Year 20	Year 25
Total Cost to NPS	$0	$349.5	$698.6	$1,049.2	$1,397.7	$1,747.8
Total Cost to APIS	$0	$349.5	$698.6	$1,049.2	$1,397.7	$1,747.8

Option 6: Utilizing Small Fleet for Missions

For this option, the park would utilize the existing fleet of smaller landing crafts to perform the assigned missions. The smaller boats have less capability than a larger landing craft, which would require several trips of smaller boats instead of one trip with a large boat. Thus, while using the small fleet could eliminate the need for APIS to have a larger landing craft, using these smaller boats to support the missions would increase the fuel use and maintenance of the existing fleet.

APIS currently owns several Munson landing crafts, including one 28 foot boat, two 25 foot boats, and one 21 foot boat. While these boats can be used to move some smaller equipment and construction materials, they cannot support all required missions. The largest of these boats, the 28 foot craft, has a hauling capacity of 4,000 pounds. This capacity is less than the 7,000 pound weight of the empty waste trailer and significantly less than the 16,000 pound weight of the full waste trailer. Furthermore, while the small tractors can physically fit on the 28 foot craft, the location and weight of the tractors within the boat cargo deck upsets the stability and handling characteristics to the point where operating the boat is unsafe.

It does not appear that utilizing the existing small fleet for the missions is a viable option.

Option 7: Increasing Vault Toilet Tank Size

In this option, the park would increase the size of the vault toilets while continuing to contract with Nelson Construction. A capital improvement project is currently ongoing to replace most of the vault toilet tanks, which will increase most tank capacities to 750 gallons each or greater. One toilet with the heaviest usage, on Stockton Island, fills to capacity over the course of a season, while other less-used toilets only require pumping every second or third year. If the tank capacities were increased further, all vault toilets could be put on a three-year pumping schedule. This reduces the frequency of need for a landing craft to pump the toilets and reduce the overall number of contracted LCM trips needed to move the toilet pumping equipment.

However, increasing the vault toilet tank sizes does not eliminate the need for a large landing craft during the other two years. While the pumping frequency would be reduced, the need for a landing craft to gear up on the islands and to shut down at the end of the season. An average of 12 trips for set up, construction projects, and shut down could still be expected.

Initial Costs

At the end of the capital improvement project, it is expected that eight vault toilet tank sizes will still have to be increased to allow for a three-year pumping cycle. At an average capital and installation cost of $45,000 per toilet, the initial cost for the capital improvement project is estimated to be $360,000.

Maintenance

Nelson Construction is responsible for the maintenance of their vessel. APIS is not responsible for any yearly maintenance costs.

Operations

This option was analyzed assuming that Nelson Construction's landing craft will be contracted to perform all trips. In this option, it is assumed that all vault toilet tanks and septic systems would be pumped every third year in the same year, and that 12 gearing up and shutting down trips would happen every year.

Nelson Construction charges APIS $325 per hour for use of the landing craft. That price includes the captain, deckhand, and fuel (assumed to be 20 gallons per hour). The hourly charge starts when the craft leaves its home port on Madeline Island and end when the craft returns to its home port. Because the park headquarters are located approximately one hour away from Madeline Island, two additional working hours are added to each trip (one from Madeline Island to the park headquarters, and one returning).

During operations, the operator and deckhand of the contract vessel do not assist with pumping or construction operations. Thus, five APIS staff members are still required to perform operations on the islands.

Costs

The initial capital costs to increase the size of the vault toilet tanks and the repeating costs for contracting from Year 1 to Year 6 are shown below in Table 15.

Table 15
Option 7 (Increasing Vault Toilet Tank Size) Costs from Year 0 to Year 6 ($ in thousands)

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Labor Hours (5 Persons)		1659.5	480.0	480.0	1659.5	480.0	480.0
Total Contracting Hours		439.9	120.0	120.0	439.9	120.0	120.0
Initial Purchase Cost	$360.0						
Cost to NPS	$360.0	$143.0	$39.0	$39.0	$143.0	$39.0	$39.0
Cost to APIS	$0	$143.0	$39.0	$39.0	$143.0	$39.0	$39.0

The total cost to NPS and the operating costs paid for by APIS are shown below in Table 16.

Table 16
Option 7 (Increase Vault Toilet Tank Size) Total Cumulative Cost of Ownership over 25 Year Service Life ($ in thousands)

	Year 0	Year 5	Year 10	Year 15	Year 20	Year 25
Total Cost to NPS	$360.0	$763.0	$1,165.9	$1,464.8	$1,867.8	$2,270.7
Total Cost to APIS	$0	$403.0	$805.9	$1,104.8	$1,507.8	$1,910.7

Summary

The estimated costs for each operating model were analyzed based on the initial cost and the total costs for the 5, 10, 15, 20, and 25 year periods. The costs were also separated to describe the

operating cost to the park as well as the total ownership costs to the National Park Service. The ownership costs are detailed in Table 17 below.

Table 17
Total Cumulative Cost of Ownership over 25 Year Service Life ($ in thousands)

			Initial Cost	Year 5	Year 10	Year 15	Year 20	Year 25
Purchasing a New Landing Craft		NPS Cost	$680.7	$748.5	$816.2	$884.6	$952.0	$1,020.1
		APIS Cost	$0.0	$67.9	$135.5	$203.9	$271.3	$339.4
Purchasing a Used Landing Craft		NPS Cost	$550.0	$655.4	$760.4	$866.7	$971.2	$1,077.1
		APIS Cost	$0.0	$105.4	$210.4	$316.7	$421.2	$527.1
Contracting for Missions		NPS Cost	$0.0	$408.1	$814.0	$1,226.4	$1,629.5	$2,040.4
		APIS Cost	$0.0	$408.1	$814.0	$1,226.4	$1,629.5	$2,040.4
Government Divested LCM	Purchase in Year 0	NPS Cost	$450.0	$563.0	$675.5	$789.5	$901.5	$1,015.0
		APIS Cost	$0.0	$113.0	$225.5	$339.5	$451.5	$565.0
	Purchase in Year 1	NPS Cost	$450.0	$622.5	$735.1	$849.1	$961.0	$1,074.6
		APIS Cost	$0.0	$172.5	$285.1	$399.1	$511.0	$624.6
	Purchase in Year 2	NPS Cost	$450.0	$679.1	$791.7	$905.6	$1,017.6	$1,131.2
		APIS Cost	$0.0	$229.1	$341.7	$455.6	$567.6	$681.2
Contracting and Sharing ISRO LCM		NPS Cost	$0.0	$349.5	$698.6	$1,049.2	$1,397.7	$1,747.8
		APIS Cost	$0.0	$349.5	$698.6	$1,049.2	$1,397.7	$1,747.8
Increasing Vault Toilet Tank Size		NPS Cost	$360.0	$762.9	$1,165.9	$1,464.8	$1,867.8	$2,270.7
		APIS Cost	$0.0	$402.9	$805.9	$1,104.8	$1,507.8	$1,910.7

The total labor hours for each operating model were also analyzed over the 5, 10, 15, 20, and 25 year periods. The cumulative labor hours are detailed in Table 18 below.

Table 18
Total Cumulative Crew Labor Hours over 25 Year Service Life (labor hours in thousands)

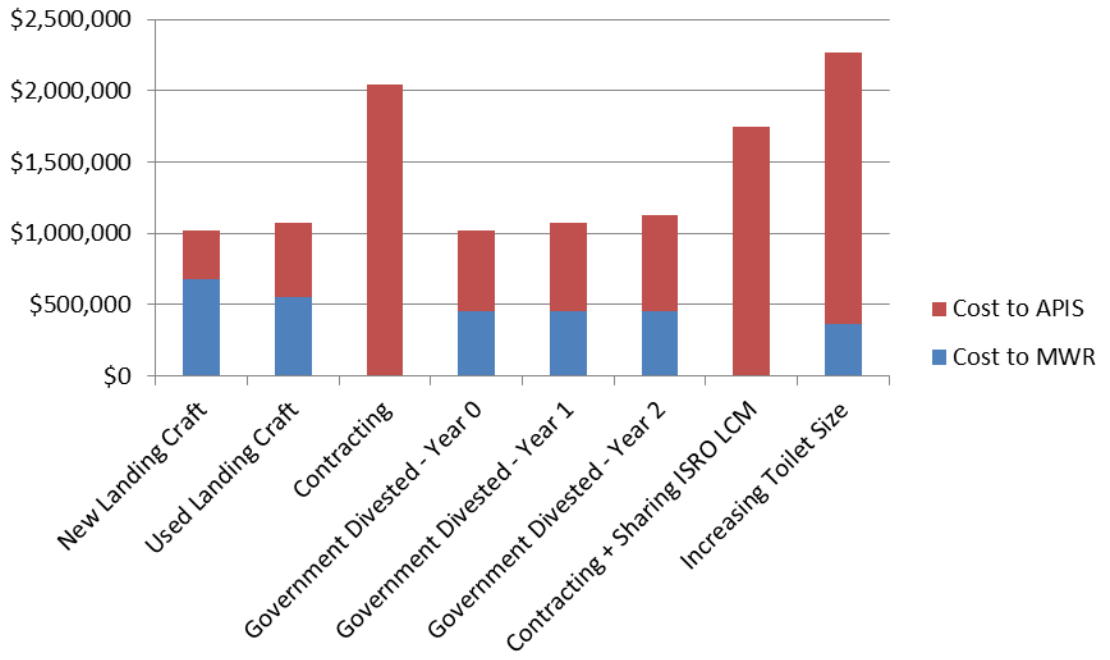
		Year 5	Year 10	Year 15	Year 20	Year 25
New Landing Craft		4,031	8,047	12,125	16,108	20,172
Used Landing Craft		4,898	9,773	14,738	19,569	24,511
Contracting		4,898	9,773	14,738	19,569	24,511
Government Divested LCM	Purchase in Year 0	4,898	9,773	14,738	19,569	24,511
	Purchase in Year 1	4,898	9,773	14,738	19,569	24,511
	Purchase in Year 2	4,898	9,773	14,738	19,569	24,511
Contracting and Sharing ISRO LCM†		3,899	7,784	11,723	15,581	19,507
Increasing Vault Toilet Tank Size		4,759	9,518	13,097	17,856	22,615

† Cumulative labor hours for Contracting and Sharing ISRO LCM do not include labor hours of ISRO LCM crewmembers (operator and deckhand)

Results

The total 25-year costs for MWR and APIS are shown in Figure 1 below.

Figure 1
Total 25-Year Costs for Transportation Options



Cost to NPS

Initially, the options which continue to use contracting have the least expensive costs for NPS. Because the contracting options do not require an initial capital investment, the cumulative costs are lower than the other options. However, the contracting options have a much higher annual operating cost than the options which include purchasing a vessel.

Contracting and sharing ISRO's LCM is the least expensive option for Years 1-9, if a sharing agreement could be worked out with ISRO. Continue to contract with Nelson Construction for all movements is the next least expensive option for Years 1-7. However, after Year 10, contracting becomes the most expensive option.

In Year 10, the least expensive option switches from contracting and sharing ISRO's LCM to acquiring a government excess LCM-8. Of the options which include purchasing a vessel, the acquiring a government excess LCM-8 option has the smallest initial capital cost. Conversely, of the options which include purchasing a vessel, the yearly operating costs are the highest, as the LCM-8 has the highest fuel rate of the compared vessels. This option also assumes that a government excess LCM-8 will become available immediately; however, there are no public plans to divest any LCM-8s, and the time period cannot be predicted. If APIS waits for a vessel to become available, the park will have to continue contracting in the meantime. These contracting costs will quickly offset any savings on purchasing costs.

If a government excess vessel does not become available, purchasing a used LCM-6 will become the least expensive option in Year 12. The lower purchase cost of a used LCM-6 as compared to a

new landing craft makes the cumulative costs less expensive through Year 17. Volpe performed market research of used LCM-6s on the internet to estimate purchase prices, but did not contact dealers to inquire if the vessels found were still for sale. Note that the yearly operating costs of an LCM-6 are higher than a new landing craft, due to the higher fuel use.

If a government excess vessel does not become available, purchasing a new landing craft will become the least cumulatively expensive option in Year 18.

Cost to APIS

In this analysis, Volpe assumed that capital costs for purchasing a vessel would be provided by MWR, while operating costs (including contracting costs) would be paid for by APIS. In this situation, the least expensive option for APIS for all years is purchasing a new landing craft. This is largely because the new boat has the lowest fuel use rate of all of the boats. Further savings are realized by being able to haul out and store the vessel using currently-owned equipment, as opposed to paying a local marina for those services.

APIS Labor Hours

Of the analyzed options, contracting and sharing ISRO's LCM option requires the fewest number of APIS labor hours per year. This is because this analysis assumed that ISRO will provide the LCM-8 operator and deckhand, and that these crewmembers will support the pumping operations. Having two ISRO personnel will reduce the number of APIS personnel needed during those trips, which saves APIS labor hours. However, this number is slightly misleading, as the analysis also includes APIS paying the salary for the ISRO crewmembers. The total crew of five persons will end up having more labor hours, but only three of those crewmembers will be APIS personnel.

Purchasing a new landing craft requires the next fewest number of labor hours. The faster speed of the new boat allows transits to be completed quicker, which saves labor hours and allows staff to perform other tasks. Over the 25 year service life of the vessel, the new landing craft would save over 4,000 labor hours from the reduce transit times.

Conclusions

Acquiring a large landing craft will allow APIS to perform missions more effectively and for lower costs.

- Over the 25 year analysis, the options which include purchasing a large landing craft have lower overall costs and have lower costs to the park than the options which include contracting.
- Acquiring a large landing craft will allow the park to perform missions on their own schedule. While APIS currently has to work within Nelson Construction's schedule, owning a vessel would allow the park to pump toilet systems and support construction projects at will.
- Acquiring a large landing craft will provide redundancy for the various missions described above. If the vessel has to be put out of service for maintenance, the park can contract with Nelson Construction for support. However, if the park does not acquire a vessel, there will be no redundancy, as Nelson Construction's LCM is the only craft available to perform the various missions.
- If the park acquires a landing craft with a crane (to be included on the new landing craft, and could be included on an upgraded LCM-6 or LCM-8), the landing craft will be able to perform additional tasks for construction support. The crane will make loading materials easier, and also give additional capabilities, such as removing large rocks in way of new dock construction. Neither Nelson Construction's LCM-6 nor ISRO's LCM-8 have a crane onboard.
- Acquiring a large landing craft will reduce the use of the small fleet back to pre-contracting levels, lowering the fuel use of the small fleet.

Although the new landing craft has the highest initial cost, it can perform the most missions at the greatest efficiency.

- In Year 18 of the 25 year service life, the new landing craft becomes the least cumulatively expensive transportation option.
- The new landing craft has the lowest annual operating costs and requires the fewest number of total labor hours of all of the analyzed options. This will allow the park to spend operations funding on other projects and also allow park staff to perform more tasks within the same time period.
- The new landing craft has the smallest draft requirements. This will allow the boat to reach the most destinations, including the currently-closed vault toilet at Stockton Island Presque Isle.
- Of the options investigated, the new landing craft uses the least amount of fuel. Acquiring the new boat would best support the NPS mission of environmental stewardship.
- The new landing craft has lower wage grade requirements for operators. The new boat only requires WG-9 captains, while an LCM requires WG-10 captains. While the park currently has several licensed boat captains which can operate both size vessels, the lower wage grade requirements could allow additional personnel to operate the landing craft in the future.
- At the end of the 25 year analysis, an LCM-6 or LCM-8 will be between 60 and 90 years old, and will have exceeded their service life. A new boat will only be 25 years old and should still have many more years of service life remaining.

While contracting is the least expensive option in the short term, it is much more expensive in the long term.

- Contracting and sharing ISRO's LCM is the least expensive option for Years 1-9, assuming a sharing agreement could be worked out with ISRO. If a sharing agreement cannot be made, continuing to contract with Nelson Construction for all movements is the next least expensive option for Years 1-7. However, by Year 11, continuing to contract with Nelson Construction becomes the most expensive option.
- At the end of the 25 year analysis, contracting with Nelson construction is twice as expensive as purchasing a new landing craft. Continuing to contract would add over $1,000,000 in operational costs to perform the same missions.

Appendix A
Specifications for the Munson Landing Craft

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www.munsonboats.com jon@munsonboats.com

March 20, 2014
Specification & Quotation
For One
47' Packman Landing Craft
For
St Apostle Islands National Park
Bayfield, Wisconsin
Contact: Mathew Frank Ph: 330 468 2500 Ext. 306

OVERVIEW:
The following describes a Munson 2014 Model 47' x 17' welded aluminum Packman Landing Craft to be used by the Apostle Island National Park. Design drawings will be submitted for approval prior to construction.

GENERAL SPECIFICATIONS:

1. Hull Length _____ 47 feet
2. Length Overall _____ 47 feet 6 inches
3. Beam _____ 17 feet
4. Transom Deadrise _____ 16 Degrees
5. Bow Deadrise _____ 35 Degrees
6. Bow Door Opening _____ 9 feet
7. Engines _____ Twin Yanmar 6LY3M-STC 430 HP
8. Propulsion _____ Hamilton Jet 322 (Twin)
9. Fuel Capacity _____ 300 gallon
10. Performance _____ (Light Ship) 22 MPH
11. Performance _____ (Fully loaded-30,000 cargo, 2 crew, full fuel) 12 MPH
12. Maximum Capacity _____ (Persons and Cargo) 33,000 lbs.
13. Bottom Plating _____ 5/16" 5086-H116
14. Transom Plating _____ 5/16" 5086-H116
15. Side Plating _____ ¼" 5086-H116
16. Wheelhouse and Main Deck Plating _____ ¼" 5052-H116

HULL DESIGN:

1. 2014 Model 47' x 17' Packman mono hull incorporating 16 degree modified vee hull. Hull plating shall be 5/16" bottom, transom and bow door. ¼" sides, main cargo decks. Wheelhouse, and engine room deck plating to be 3/16". The hull is fitted with 5 watertight bulkheads for 6 compartment voids. Access hatches shall be provided for all hull compartments. The depth of the main cargo deck to the gunnel shall be 32" vertically. Hull is outfitted with 8" wide gunnel decks.

WELDING:

1. All welding shall comply with the requirements as represented in American Welding Society (AWS) and standard aluminum welding practices. All weldments shall be properly fused displaying proper penetration and professional finish. Weld sizes shall be equal to the thickness of the least of the joined plates.

HULL OUTFITTING:

1. Eight 12" welded cleats shall be installed on ¼" doubler plates (4 port and 4 strb.)
2. Bow forefoot is outfitted with 1/4" x 6" beaching wear plate.
3. 1" x 6" aluminum pick eyes installed with SS wear inserts. Aft picking eyes attached to transom and fwd picking eyes are split by rib16. ABS certified.
4. 1.25" Sch 40 pipe handrails installed on the gunnel. Hand rails alongside the cabin deck shall be 36" tall with two tiers.
5. Appropriate sized open scuppers are installed on cargo deck, minimum five per side, to comply with ABYC H-4 standard for drainage.
6. 2½" sch 40 pipe shall be installed on the perimeter of the gunnel.
7. 16 flush mounted tie down pockets with 5/8" SS pins installed on cargo deck.
8. The main decks shall be structurally designed and framed to accommodate a 30,000 lbs rolling load. There will be 2" high x 24" wide x 3/8" thick channels welded 100% directly to the main decks to provide accurate repeat alignment of the fuel truck. The main deck will be stantioned below deck a-joining the hull structure to the main decks.

ENGINE ROOM:

1. The engine room shall be one compartment and shall included two flush and guttered engine hatches on the aft deck.
2. Engine hatches shall be large enough to easily remove the engines, shall both hinge outboard and be electric over hydraulic assisted. Hatches will be lockable in the open position. Handles shall be inset and flush to the deck.
3. The engine room shall incorporate two air intake boxes on the aft deck for engine room natural ventilation and combustion air intake. The air intake boxes shall include water gutters to prevent water ingestion into the engine room.
4. Engine stringers shall be 1/2" welded aluminum plate and shall include gussets under the engine mounts.
5. The transom shall have two 3/8" welded aluminum plate doublers where the Hamilton Jet attaches.

ENGINE ROOM SOUND / VIBRATION INSULATION:

1. Engine room overhead and aft side of engine room bulkhead are vinyl shield sound insulated.

D-RUBBER FENDERING:

1. 4" D rubber installed around the perimeter of the hull at the gunnel.
2. Hull is outfitted with 4" D rubber side stiffener located above the rested waterline.

OPERATION / PASSENGER WHEELHOUSE:

1. Operator's wheelhouse will be offset to Strb. and measure 4' wide x 6' long with a full width console. Steering / controls will be located on centerline of main console. The pilot console will be outfitted with a storage compartment with access hatch. Wheelhouse to be fully welded and fabricated of 3/16" material. The interior height shall be no less than 80" tall.
2. The wheelhouse will be outfitted with port side sliding door fwd complete with window and lock. The door shall have a latch to secure it in the open position.
3. The windshield shall incorporate two upper spotting windows. Two forward windshield windows are outfitted with the bottom 6" "tip out" vented, port and strb. side sliding windows. All windows to be ¼" safety glass.
4. One fixed leaning post back rest will be outfitted for the operator. The wheelhouse back will be outfitted with a leaning post backrest below the aft window.

FUEL SYSTEM:

1. A single 300 gallon non-integral fuel tank is installed. Fuel tank shall be built to USCG standards using ¼" plate, pressure tested to 4 PSI, and shall be bolted to the hull framing below deck using stainless steel fasteners.
2. A 12V fuel sender and fuel level gauge shall be mounted on the control console.
3. Fuel fill and vent shall be routed to top of port gunnel. Fuel fill installed with overflow dam.
4. Fuel capacity shall provide sufficient fuel for not less than 250 mile range at cruising speed.
5. Fuel system will be outfitted with positive shut off valves located on the tank.

BOW DOOR OUTFITTING:

1. Manuel 2000 Thern stainless steel bow door winch shall be installed to open/close the bow door.
2. Bow door outfitted with safety locks port & stbd.
3. Double wall bow door interior with ¼" plating outfitted with 2" x 2" angle iron welded "up-side down" to provide as traction bars for loading and un-loading equipment.

HATCHES:

1. Access shall be provided to all voids, using latching "T" handle aluminum access hatches.
2. Four Baier 15" x 24" aluminum deck hatches are installed on the main cargo deck.

STERN / JET GUARD:

1. Full width swim step / Jet drive guard installed on transom. The perimeter of the swim step will be built from 2" pipe, 3/16" plated will be installed port, strb. and centerline leaving access to the Hamilton jet drives. Plate sections will be non skid coated. 2" pipe supports installed on the underneath side.

ANCHORING :

1. 12V anchor winch with pulpit installed port side fwd corner. Lewmar 1000 windlass outfitted with 30' of 5/16" chain, 150' of 9/16" anchor line and a 45 lb. Rocna anchor. Installed complete with pulpit rollers and rode locker.
2. The stern will be outfitted with a stern Kedging winch with custom storage bracket.

12V DC ELECTRICAL:

1. One 8 position 12V breaker panels installed on console.
2. Two 12V self-parking wipers installed on windshield.
3. One 12V SS trumpet air horn installed on roof with button on console.
4. Four 12V 4000 GPH bilge pumps installed with auto/manual float switches.
5. Two LED red/white dome lights installed in wheelhouse.
6. Aqua Signal LED Series 25 navigation lights installed to USCG requirements.
7. Two 12V power outlets installed in cabin (at main console).
8. Two deck LED flood lights installed one fwd and one aft.

ELECTRONICS:

1. Raymarine E-120W chart plotter installed at the main console.
2. Raymarine Digital Radar RD418 installed on 3" radar pipe mount.
3. Raymarine Raystar 125 GPS sensor installed on stainless steel lilly mount.
4. Raymarine DSM 30 Digital Sounder module.
5. Ritchie 5" lighted compass is to be installed.
6. VHF Icom IC-504.

MAIN ENGINES:

1. Twin Yanmar 6LY3M-STC 430 HP @ 3300 RPM commercial rated inboard turbo diesel engines complete with single station controls, fuel management system, hydraulic power steering.
2. Main engines are outfitted with ZF 280-1 Parrallel offset marine transmissions with 1.514:1 gear ratio. Marine gears are fitted with electric shift and oil coolers.
3. Engines to be installed complete with seawater cooling system, thru-transom wet exhaust (Vernatone) fiberglass mufflers outfitted with anti-splash deflectors at the transom. 12VDC starting system.
4. Engines shall meet EPA Tier II marine emission requirements at time of manufacture.
5. Engines shall be equipped with flexible mounts.
6. Engine instrumentation shall include tachometers, volt meters, oil pressure, temperature, hour meters, fuel consumption, and start/stop panels.
7. All gauges and instrumentation shall be adequately illuminated for nighttime operation.
8. Controls shall be installed on starboard side of the helm and located so the operator can conveniently steer while both sitting and standing.

PROPULSION:

1. Munson shall supply two (2) Hamilton HJ 322 water jets.
2. Impeller selection to insure that maximum engine rpm is attainable.
3. Hamilton Jet to approve the location of the main engine raw water suctions to insure there is no interference with the jets intake flow.
4. The gear box should allow for temporary reverse operation of the water jet to allow for back flush of foreign objects.

FIRE SYSTEM:

1. Automatic C02 fire suppression system installed.
2. Heat activated @ 165 degrees and has automatic main engine shutdown feature

TRAILER:

1. Tuff Trailer 32,000 lb load capacity galvanized four (4) axle trailer custom built to match boat. Trailer includes lights, brakes, tongue jack, two (2) spare tires w/ carrriers and bow stand w/ manual winch. Trailer to to be outfitted with pintle hitch.
2. Boat and trailer shall be matched by builder prior to shipping to ensure proper fit and alignment of hull on trailer.
3. Trailer shall be of such dimensions that it can be towed upon a roadway without and special requirements when NOT laden with the vessel.
4. Trailer shall meet all highway requirements (while empty).
5. All trailer brakes required shall be standard electric type.
6. Ship trailer (separate of boat) to Bayfield WI, Boat and trailer cannot be shipped on the same transport truck

EXTERIOR FINISH:

1. The exterior of the vessel will be bare aluminum. No paint or coatings are part of this specification.

DECK CRANE:

1. MaxiLift M-260 4,290 lb capacity hydraulic boom crane shall be installed on the port side of the forward gunnel. Crane will include 3 hydraulic extensions, hydraulic drum winch and marine grade paint system.
2. The total overall reach of the MaxiLift M260 boom crane is 17.70 feet at full extension.
3. Crane shall be installed on the gunnel deck at least 6' back from the bow
4. The crane and winch hydraulic systems shall be powered by a hydraulic power pack.
5. Amsteel Blue synthetic rope in place of stainless steel wire rope will be used for hydraulic drum winch on deck crane. Hoist winch shall have 100' of 5/16" Amsteel Blue synthetic rope.
6. The boom crane and winch shall have a remote pendant control to allow it to be activated from the bow ramp in the lowered position.

MAXILIFT MODEL 260 SPECIFICATIONS:

REACH:		CAPACITY:
Closed	4'3"	4,290 lbs.
1ST Extension	7'7"	2,420 lbs.
2ND Extension	10'10"	1,672 lbs.
3RD Extension	14'4"	232 lbs.
4TH Extension	17'7"	990 lbs.

TESTING AND SHIPPING:
1. Launch and test boat (seatrials)
2. Shipping to Apostle Island Nation Park Service Bayfield WI.

DELIVERY:
12 Months ARO

TOTAL PRICE FOB BAYFIELD WI, $692,787.00

GSA DISCOUNT 1.75% $12,123.77

TOTAL PRICE ALL THE ABOVE $680,663.23

For The William E. Munson Co Inc.

Jon Wise, President

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14. ABSTRACT

This report documents a study which analyzed various transportation options for Apostle Islands National Lakeshore (APIS) to pump toilet systems and perform construction support activities. The report presents the background of the study; describes the required missions for the transportation options; analyzes the costs and labor hours of the various transportation options; and presents the study's findings and conclusions.

The estimated costs for each operating model were analyzed based on the initial cost, total costs, and labor hours for the 5, 10, 15, 20, and 25 year periods. The costs were also separated to describe the operating cost to the park as well as the total ownership costs to the National Park Service.

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