**National Park Service**
**U.S. Department of the Interior**

**Isle Royale National Park**
**Houghton, Michigan**

# Isle Royale National Park
# *Transportation Study*

Keweenaw Waterway

Source: Volpe Center photographs (September 2013)

**PMIS No. 91108**
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The National Transportation Systems Center

U.S. Department of Transportation

## Contents

## Report notes

This report was prepared by the U.S. Department of Transportation John A. Volpe National Transportation Systems Center, in Cambridge, Massachusetts. The project team was led by Frances Fisher, of the Transportation Planning Division, and included Bob Pray and Dan Mannheim, of the Infrastructure Engineering and Deployment Division, Katie Lamoureux and Caitlin Bettisworth, of the Technology Innovation and Policy Division, and Peter Carter, of the Transportation Planning Division.

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## Definitions

The following terms are used in this report:

| | |
|---|---|
| AB | Able Bodied Seaman |
| ABS | American Bureau of Shipping |
| ADA | Americans With Disabilities Act |
| AIS | Automatic Identification System |
| ASW | Auxiliary Seawater System |
| ATS | Alternative Transportation System |
| AVGAS | Aviation Gas |
| B | Beam |
| Backcountry EIS | Wilderness and Backcountry Management Plan and Environmental Impact Statement |
| BHP | Brake Horsepower |
| BLS | Department of Labor's Bureau of Labor Statistics |
| BTU | British Thermal Unit |
| BWTS | Ballast Water Treatment System |
| CBA | Choosing By Advantages |
| $CO_2$ | Carbon Dioxide |
| COI | Certificate of Inspection |
| CPP | Controllable Pitch Propeller |
| D | Draft |
| DAB | Development Advisory Board |
| DOT | Department of Transportation |
| ECS | Engine Control System |
| EDG | Emergency Diesel Generator |
| EPA | US Environmental Protection Agency |
| ESPC | Energy Savings Performance Contract |
| FBP | Ferry Boat Program |
| FLTP | Federal Lands Transportation Program |
| FY | Fiscal Year |
| GMP | General Management Plan |
| GSA | General Services Administration |
| HAZMAT | Hazardous Material |
| HVAC | Heating, Ventilation and Air Conditioning |
| IBA | Inflatable Buoyant Apparatus |
| IMO | International Maritime Organization |
| ISO | International Organization for Standardization |
| ISRO | Isle Royale National Park |
| kW | kilowatts |
| LCM | Landing Craft Mechanized |
| LOA | Length |
| LNG | Liquefied Natural Gas |
| MDE | Main Diesel Engine |
| MDO | Marine Diesel Oil |
| Michigan Tech | Isle Royale Institute at Michigan Technological University |
| MITAGS | Maritime Institute of Technology and Graduate Studies |
| MPG | Miles per Gallon |
| NAIS | National Automatic Identification System |
| NPS | National Park Service |
| O&M | Operations and Maintenance |

| | |
|---|---|
| OCMI | Officer in Charge, Marine Inspections |
| OEM | Original Equipment Manufacturer |
| OS | Ordinary Seaman |
| OWS | Oily Water Separator |
| PA | Public Address System |
| PAMP | Park Asset Management Plan |
| park | Isle Royale National Park |
| Park HQ | Isle Royale National Park Headquarters |
| PUSO | Public Use Statistics Office |
| PUSO YTD | Public Use Statistics Office Year to Date Report |
| PV | Photovoltaic |
| RECs | Renewable Energy Certificates |
| RFI | Request for Information |
| ROM | Rough Order of Magnitude |
| RPM | Revolutions Per Minute |
| RHIB | Rigid Hull Inflatable Boat |
| SCCS | Ship Command and Control System |
| SHPO | The Michigan State Historic Preservation Office |
| SLE | Service Life Extension |
| SLEU | Service Life Extension and Upgrade Package |
| SME | Subject Matter Expert |
| SOLAS | Safety of Life at Sea |
| SSDG | Ship's Service Diesel Generator |
| SWL | Safe-Working Load |
| TLI | Tank Level Indicating |
| TV | Television |
| UPPCO | Upper Peninsula Power Company |
| USCG | US Coast Guard |
| VHF-FM | Very High Frequency – Frequency Modulation |
| Volpe | The US John A. Volpe National Transportation Systems Center |

## Executive Summary

The Island of Isle Royale, the key feature of Isle Royale National Park (ISRO; the park), is located in the northwest corner of Lake Superior, 60 miles from the park's headquarters in Houghton, Michigan and is accessible only by boat or seaplane. The park spends roughly one million dollars annually on operations and maintenance of the transportation system. Mainly due to the park's remote location, this cost represents the highest cost per visitor in the entire National Park System, over $170 per visitor. In addition, the park's primary passenger and freight vessel, *Ranger III*, is reaching the end of its useful life. Park management wishes to explore vessel upgrade or replacement alternatives, and possible alternative strategies to achieve its key missions.

This transportation study, performed by the U.S. Department of Transportation John A. Volpe National Transportation Systems Center (Volpe), analyzes current and future transportation system needs at ISRO, identifies and evaluates alternative vessels and service models to meet those needs, and identifies measures to streamline and reduce the cost of park operations. The goal of this study is not to provide a single recommendation, but instead to offer a menu of alternatives for the park to review and make decisions about. The study includes four central analyses: missions, visitation, options, and alternatives.

### *Missions Analysis*

The purpose of the missions analysis was to define the missions required to operate ISRO, and understand the manner in which they are performed, including applicable regulations and costs. Some of the key findings include:

- The key transportation missions performed by the National Park Service (NPS) for the operation of ISRO include the facilitation of passenger travel; the conveyance of cargo; and the use and transport of fuel.
- There are several boat and seaplane options for visitors to get to Isle Royale, although most arrive by ferry. Of those that arrive by ferry, an increasing proportion use the park-operated ferry service, Ranger III which carries approximately 12% of all ferry users
- Ranger III is the primary method of cargo transport and is used to transport all refrigerated and frozen food, non-perishable food, diesel fuel, propane fuel, trash, hand loaded boats (e.g., kayaks), and visitor and park power boats to and from ISRO.
- Ranger III's ability to carry personal boats is one of the unique attractions of ISRO.
- Other park vessels (e.g., Landing Craft Mechanical and Beaver) support other key missions, including intra-island transport and construction support.
- A future ISRO transportation system must be able to support all of these existing key missions, although the approach to achieving these missions does not necessarily need to be the same as it is today.

### *Visitation Analysis*

The purpose of the visitation analysis was to describe possible visitation projections for three ISRO visitation scenarios: low, moderate, and high. The lifespan for each alternative is projected to be about 30 years; therefore, there needs to be enough flexibility to accommodate expected fluctuations in visitation over this time period. Visitation has fluctuated dramatically over the last 50 years, as a result of weather, transportation options and there are a number of determinants and policy implications that could impact ISRO's future visitation. In order to account for a range of possible visitation scenarios, Volpe developed three different visitation projections:

- Low visitation: In addition to using historic low visitation rates, this scenario assumed the closing of all concessions lodging, including the Rock Harbor Lodge. This scenario projects 10,401 visitors per season.

- Moderate visitation: This scenario was developed using average historic visitation rates, and projects 14, 830 visitors per season.
- High visitation: This scenario represents the maximum carrying capacity as defined in the 1998 General Management Plan (GMP). It incorporates a high projection of day use and 80% occupancy of the concessions lodging. This scenario projects 47,471 visitors per season.

Annual visitation and associated cargo requirements were distributed seasonally to various transportation services based on historic patterns in order to determine future capacity requirements. Since the difference in vessel design requirements between the low and moderate visitation projections is relatively small and would have a minimal impact on capital and operating costs, while limiting flexibility for unanticipated demand, moderate capacity requirements were used in developing Alternatives 1-5. Alternative 6 ensures coverage for the high visitation scenario. Table ES-1 shows the design requirements used in the options and alternatives.

**Table ES-1**
**Required Capacity per Vessel Trip (2 Roundtrips per Week) for Moderate Visitation Projections**
Source: Volpe

| Cargo Type | Shoulder Season | Peak Season |
|---|---|---|
| Carts, Bags, Foods, Etc. (lbs) | 22,100 | 31,400 |
| Refrigerated Cargo (cu. ft.) | 208 | 386 |
| Trash (dumpsters) | 4 | 5 |
| Bulk Cargo (lbs) | 3,900 | 3,400 |
| Boats | 1 | 2 |
| Propane (bottles) | 65 | 0 |
| Diesel (gal) | 9,500 | 9,500 |
| Gasoline and AVGAS (trips) | 1 | 0 |
| Visitors | 58 | 58 |
| Complimentary Passengers | 16 | 16 |

## *Options Analysis*

The visitation projections were then used to evaluate the feasibility of various transportation options to perform the park's missions. Each option was analyzed independently to determine which missions it could accomplish, under which visitation level they would be most advantageous, and if it would be cost effective. Twenty-four options were analyzed, each of which is summarized in the Options Analysis. More detail on each option is provided in Appendix E.

Some options include

- Upgrading the primary park vessel, Ranger III (Option A),
- Building a new multi-use vessel, Ranger IV (Option B),
- Using a crewboat, Tug and Barge or Contract to transport cargo (Options C, D, and E)
- Purchase or use concession to transport passengers on a fast ferry (Options F and G).
- Changes to crew certifications (Option I),
- Align *Ranger III* Trips with Airline Schedules (Option M)
- Outfitting the Landing Craft Mechanized (LCM) as a work barge (P) and,
- Incinerating waste on-island (Option W).

The results of the analysis of the different options indicated that variations in the number and type of vessels had a much more significant impact on operational costs than operational changes to existing vessels, such as schedule changes.

## *Alternatives Analysis*

The most promising options were further analyzed and combined to develop six transportation alternatives, or strategies, to achieve the park's transportation-related missions (Table ES-2). Some key notes related to the alternatives analysis include:

- Alternative 1-5 assume a moderate level of visitation. Alternative 6 assumes high visitation.
- Some options, or components, such as purchasing a new tug and the use of alternative energy at Houghton to supply electrical power are included in all alternatives. Other options are unique to a given alternative.
- Alternatives do not need to be taken in their entirety and can be adjusted. For example, any solution could include relocating the dock to the end of the canal (Option N)
- The alternatives vary substantially in cost, feasibility, and departure from the status quo, which adds additional risk to implementation.

## *Conclusions*

In addition to differences in cost, each of the six alternatives presumes a substantially different way of doing business with unique considerations of feasibility and risk.

- Alternative 1, Ranger III Service Life Extension and Upgrade, is most similar to existing conditions, or "status quo"; however, it also has a high initial capital cost and high annual O&M costs.
- Alternative 2, build a new *Ranger IV,* has a higher capital cost than Alternative 1, when this cost is amortized over the life of the vessel*, but it allows more flexibility than working within the constraints of the current layout and systems of *Ranger III*.
- Alternative 3, Crew Boat with Passenger Capacity, proposes a different operating structure that separates visitor transportation from other activities; however it provides the most redundancy of systems, since the crew boat contains some passenger capacity.
- Alternative 4, Tug and Barge + Concessioner Ferry, also proposes separating visitor transportation from other activities; this alternative has the lowest capital and operating costs, but it relies on the most services being delivered by outside providers, which may be a higher risk.
- Alternative 5, Tug and Barge + Park-Operated Ferry is similar to Alternative 4 except that in this alternative the ferry is operated by the park. This alternative has moderate O&M costs, but relatively high initial costs to purchase a new barge and separate passenger ferry.
- Alternative 6, High Visitation, proposes accommodating the high visitor and cargo loads by purchasing the flexible Crew Boat as well as a high-speed passenger ferry and operating at more than twice weekly round trips during the peak season.

Table ES-2 provides more detail on the key differences among these alternatives.

There is not a single recommended alternative; instead, the National Park Service will need to carefully consider its priorities for the park moving forward, and select an alternative that best maximizes these priorities. The information provided within this report, particularly the Alternatives Analysis section, will serve as a resource for the decision making process.

### Next Steps

Given that *Ranger III* is expected to undergo its next required dry-docking in 2018, Volpe proposes that the implementation of the selected approach be in place for the 2019 season. In order to do this, planning

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* *Ranger IV* is expected to have a lifespan of 55 years, the life of *Ranger III* to date. All other major investments were estimated to have a 30-year lifespan.

and design work would need to begin in 2016. While it is technically feasible to implement a new transportation system starting in 2019, arranging funding for the significant costs of the new fleet will be challenging. Yet if funding to implement the preferred solution is not available to allow implementation of the alternative before the 2018 dry-dock, ISRO will have to absorb those additional costs.

Due to the high capital costs of the ISRO transportation system, ISRO will need to identify funding opportunities and develop a funding strategy. The NPS has a few funding sources that may be appropriate for implementation of the preferred alternative (e.g., the Transportation Fee Program). Given the size of this project, strong partnership and buy-in among the NPS Unit, Region and Headquarters, will be necessary for successful project implementation. If the project looks to non-NPS funding sources, the park will need to develop strong local and state partners as well.

**Table ES-2**
**Summary of Alternatives**
Source: Volpe

| Alternative | Capital Cost | Annual O&M Cost | Key Advantages | Key Disadvantages |
|---|---|---|---|---|
| **Alternative 1 – *Ranger III* Service Life Extension and Upgrades (SLEU)** | $18,451,000 | $1,315,500 | - Minimal changes to current operations<br>- Able to operate tug and barges with in-house crew | - High initial capital cost<br>- High O&M cost<br>- Less adaptable for changing conditions |
| **Alternative 2 – Build a New *Ranger IV*** | $26,781,000<br>($16,781,000)* | $1,315,500 | - New *Ranger IV* optimized for expected visitation and cargo levels<br>- Minimal changes to current operations<br>- Able to operate tug and barges with in-house crew | - High initial capital cost<br>- High O&M cost<br>- Less adaptable for changing conditions |
| **Alternative 3 – Crew Boat with Passenger Capacity** | $14,230,000 | $737,500 | - Faster vessel allows for shorter trip and more frequent trips when needed<br>- Provides for passenger capacity in shoulder season | - Requires contract crew for tug and barge operations<br>- Crewboat has highest expected fuel usage of all vessel options |
| **Alternative 4 – Tug and Barge + Concessioner Ferry** | $7,281,000 | $703,500 | - Includes in-house tug and barge crew to operate logistics, fuel, and work barges<br>- Concessioner passenger ferry separates logistics from passenger transportation | - Requires retraining crew to operate tug and barges<br>- Tug and barge transit would be slower than current *Ranger III*<br>- No park-operated transport for complimentary passengers |
| **Alternative 5 – Tug and Barge + Park-Operated Ferry**<br>(a) dock near end of Keweenaw Canal<br>(b) use current dock | (a) $14,581,000<br>(b) $11,981,000 | (a) $1,089,500<br>(b) $991,500 | - Includes in-house tug and barge crew to operate logistics, fuel, and work barges<br>- Park-operated ferry separates logistics from passenger transportation<br>- Park-operated ferry operates from new closer location for quicker trip to ISRO (Alternative 5a) only | - Requires retraining crew to operate tug, barges and high speed ferry<br>- Tug and barge transit would be slower than current *Ranger III*<br>- New ferry site is further away from the town with no services nearby<br>- Operating two vessels would increase the park fuel usage |
| **Alternative 6 – High Visitation** | $19,981,000 | $1,812,500 | - Faster vessel allows for quicker trip and flexibility to reduce or add trips as necessary<br>- Park-operated ferry separates logistics from passenger transportation | - Crewboat has highest expected fuel usage of all cargo vessels investigated<br>- Operating two vessels would increase the park fuel usage |

* Capital purchased for the alternatives is expected to last 30 years, except Ranger IV, which has a 55 year expected life. The second value provided is the 30-year equivalent capital layout for Alternative 2.

## Introduction

### *Background and Purpose of Transportation Study*

The Island of Isle Royale, the key feature of Isle Royale National Park (ISRO; the Park), is located in the northwest corner of Lake Superior, 60 miles from the Parks headquarters in Houghton, Michigan and is accessible only by boat or seaplane. This transportation study, performed by the U.S. Department of Transportation John A. Volpe National Transportation Systems Center (Volpe), analyzes current and future transportation system needs at ISRO, identifies and evaluates alternative vessels and service models to meet those needs, and identifies measures to streamline and reduce the cost of park operations.

There are several drivers for conducting this transportation study at this time. One motivation is the high cost at which the current transportation system is operating. The current transportation system is provided at a cost exceeding one million dollars annually. Mainly due to the Park's remote location, this cost represents the highest cost per visitor in the entire National Park System, currently over $170 per visitor. In addition, the park's primary passenger and freight vessel, *Ranger III*, is reaching the end of its useful life, and park management wishes to explore vessel upgrade or replacement alternatives, and possible alternative strategies to achieve its key missions.

The goal of this study is not to provide a single recommendation, but instead to offer a menu of alternatives for the Park to review and make decisions about. The study includes four central analyses:

- **Missions Analysis:** The purpose is to define the missions required to operate ISRO, and understand the manner in which they are performed, including applicable regulations and costs.
- **Visitation Analysis:** The purpose is to describe visitation characteristics and trends for three ISRO visitation scenarios: low, moderate, and high.
- **Options Analysis:** The purpose is to analyze various fleet options that could be used to support the missions.
- **Alternatives Analysis:** The purpose is to develop a series of alternative strategies for ISRO to accomplish its missions under the different visitation scenarios identified in the Visitation Analysis. The alternatives comprise combinations of the options developed in the Options Analysis.

### *Overview of Isle Royale National Park and Related Transportation Services*

Fourteen miles from the closest mainland and 60 miles from the park's headquarters in Houghton, MI, Isle Royale provides solitude and adventure for its visitors (Figure 1). Known for its wildlife populations, fishing and boating opportunities, visitors come for a day or may stay for a week at a time. In order to maintain the wilderness environment, development on the island is restricted by legislation.

**Figure 1**
**Map of Isle Royale**
Source: NPS


Visitor information, interpretation centers and other basic services are available at Windigo on the western end and Rock Harbor on the eastern end of the 45 mile-long island. An exclusive concessioner operates stores and marinas that provide marine fuels, at Windigo and Rock Harbor and a large lodging facility with restaurant at Rock Harbor. Mott Island, approximately four miles west of Rock Harbor, serves as the park's summer administrative headquarters and employee lodging for the majority of park employees. Additional employees are stationed at Windigo and two remote ranger stations located on the north and south shores of the park. Windigo, Rock Harbor, and Mott Island constitute the developed areas in this wilderness park. Each of these sites includes: diesel-electric power production stations, gasoline, and diesel fuel storage tanks of approximately 50,000 gallons total; potable water production; and sewage treatment facilities. Each of the remote ranger stations has a 2,000 gallon gasoline storage tank for fueling patrol boats and heating. Windigo also serves as the headquarters for the Winter Study program has storage for aviation gasoline for their needs.

Docks, coastal and inland campsites, and trails make up the additional park improved facilities. Due to the isolation of the island and the desire to maintain a wilderness environment, water-based transportation is the primary means of transit to Isle Royale and employee travel around the island. Limited motorized transportation is available at Windigo, Mott Island, and Rock Harbor to move supplies and personnel within the developed areas. Most operational needs are met around the park using workboats operated by park staff on an as-needed basis.

ISRO currently provides the majority of transportation support, including transporting suppliers from the mainland, supporting NPS operations, and transporting NPS employees and families, concession operations and employees, and researchers. Most of the marine personnel are required to be US Coast Guard (USCG) licensed or documented, and some missions require specialized training.

The main commodities transported to Isle Royale include:

- Construction equipment, building materials, and demolition waste materials;
- Petroleum products consisting of, gasoline, diesel, propane, and aviation fuel;
- Food products (dry shelf-stable, refrigerated, and frozen); and

- Solid waste, drain oil, hazardous waste products and sludge from the sewage treatment plant, which may be flammable and hazardous.

ISRO also provides passenger transportation and freight service to park employees, employee families (including household goods and watercraft), concession employees, researchers, federal and state regulators, and paying passengers during the open season from mid-April to the first of November. Approximately 12% of visitors to Isle Royale are transported by ISRO.

Two commercial marine concessioners provide most of the remaining visitor transportation operating USCG inspected vessels. One company operates two vessels from Grand Portage, Minnesota to Windigo and Rock Harbor, Michigan: the 48-passenger *Voyageur II* and the 75-passenger *Sea Hunter*. The second company operates one vessel from Copper Harbor, Michigan: the 100-passenger *Isle Royale Queen IV*. The private vessels are smaller than the park-operated *Ranger III*, primarily built for passenger service, and have limited capacity for transporting freight beyond the visitors and their personal effects. The island is also served by a five-passenger seaplane that departs from Houghton County Airport.

In order to service the logistical needs of the Park, ISRO owns and operates the following fleet of large vessels:

- *Ranger III*: a USCG inspected 165-foot, 650 ton, passenger and package freight vessel with a 3.2 ton Safe-working load (SWL) crane, and oil cargo pumps.
- *Shelter Bay*: a USCG inspected 45-foot, 25 ton tug boat.
- LCM: an uninspected 60-foot Landing Craft (modified LCM-8, 60 ton pay-load capacity).
- *Beaver*: an uninspected 110-foot steel hull work barge with an 8-ton SWL crane.
- *Greenstone II*: a USCG inspected, OPA-90 compliant, 70-foot, 34,000 gallon, double-hulled gasoline barge.

In addition, ISRO owns and operates a fleet of small boats. Due to a lack of vehicular roads on the island, most intra-island transportation is performed by ISRO's small boat fleet of workboats ranging in size from 16 feet to 32 feet. These smaller workboats and their ISRO employee operators are not subject to USCG regulations, and therefore are not listed above or referenced individually throughout this report.

## Missions Analysis

As a national park, one of ISRO's key missions is to provide opportunities for recreational uses and experience. In order for visitors to experience Isle Royale, they need to be able to access the remote island and have the staff and infrastructure to facilitate their visit. The key missions required to support public access to Isle Royale are described in this section and summarized in Figure 2. Additional details of the ISRO transportation missions are provided in Appendix A. Beyond visitor transportation, ISRO has historically completed the remaining park missions with its own fleet of vessels and trained staff. In recent years, ISRO has not had staff qualified to captain the tug and has contracted out for annual transport of the gasoline barge. A description of the applicable regulations impacting transportation operations and other systems considered for adjustment in the options are included in Appendix B.

**Figure 2**
**ISRO Transportation Missions**
Source: Volpe

**Mainland to Island Transport**

**Passengers**
- Visitor Transport (High Season)
- Visitor Transport (Shoulder Season)
- Park Staff/Families

**Boats**
- Hand Loaded Boats
- Power Boats (Visitor)
- Power Boats (NPS)

**Cargo**
- Passenger Baggage
- Refrigerated/Frozen Food
- Non-perishable Food
- General Cargo
- Construction Material

**Trash**
- General/Bagged
- Recyclables
- Grease
- Fish

**Fuel**
- Diesel
- Propane
- Gasoline
- AVGAS

**Intra-island Transport**
- Bulk Cargo
- Food
- Construction Material

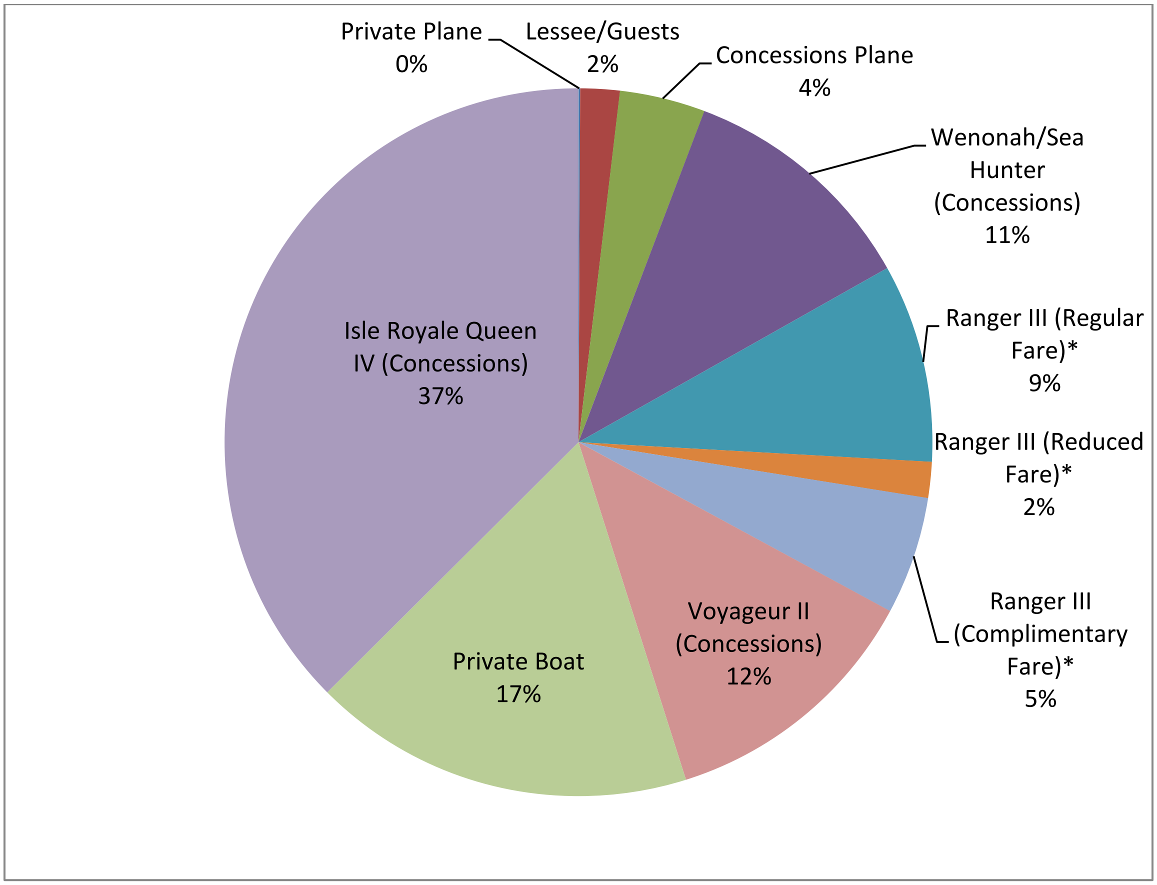
**Construction Support**
- Work Platform/Crane
- Employee Lodging

Below is a description of the current transportation missions and how ISRO is set up to complete each of the missions.

### *Passenger Travel*

ISRO is responsible for the majority of passenger travel to Isle Royale, whether through the park's own operations or concessioner agreements. There are several boat and seaplane options for visitors to get to Isle Royale, although most arrive by ferry. ISRO operates a ferry vessel, *Ranger III,* from Houghton, MI. There are also three concession-operated ferries: *Isle Royale Queen IV, Voyageur II* and *Sea Hunter*. Isle Royale is also accessible by seaplane with Royale Air Service. Figure 3 shows the distribution of passenger travel to ISRO by mode.

**Figure 3**
**Mode Share for Island Passenger Travel**
Source: NPS Public Use Statistics Office




*Ranger III data were provided by Isle Royale National Park.

### Ranger III

*Ranger III*, shown below in Figure 4, was custom-built for the park in 1958 and travels between the park's mainland based headquarters in Houghton, MI and Isle Royale with up to 128 passengers and their personal cargo. It takes *Ranger III* about five hours to reach Mott Island and an additional hour (including the stop at Mott Island) to reach Rock Harbor. At the beginning and end of each season, *Ranger III* makes a trip to Windigo for passenger and cargo conveyance and to assist in gearing up and shutting down the park.

**Figure 4**
*Ranger III* **in Houghton**
Source: Volpe


*Ranger III* Ridership statistics are recorded for three passenger categories: regular, complimentary, and reduced. Visitors without any connections to park staff or park operations are defined as regular fare passengers. Complimentary passengers include park staff, immediate family members of park staff, contractors, and researchers. Reduced fare passengers, which pay a 50% reduced rate, include the extended family of park staff and concessioner employees.

Annual totals for park visitors from 2006 to 2012 who traveled on *Ranger III* are shown below in Table 1. Since 2006, the number of visitors riding *Ranger III* has followed a generally increasing trend, with nearly 2,800 trips (or about 1,400 round trips) in 2012. The number of children and infants on *Ranger III* generally parallels adult visitation trends. In 2012, there were 220 child trips, which was about 5% of all trips, and 36 infant trips, or about 1% of all trips. Additionally, approximately 1,450 complimentary trips (725 round trips) were provided each year between 2006 and 2012. The average number of paying riders between 2008 and 2012 was 1,723, for an average of $138,000 in revenue for tickets, baggage, and small boats ($80 per paying visitor).

**Table 1**
**Annual Passenger One-Way Trips on *Ranger III***
Source: Isle Royale National Park

| | | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | Avg. |
|---|---|---|---|---|---|---|---|---|---|
| **All Passengers** | Adults | 3,735 | 4,059 | 4,334 | 3,993 | 4,002 | 4,032 | 4,336 | 4,070 |
| | Children | 193 | 199 | 268 | 174 | 227 | 239 | 220 | 217 |
| | Infants | 21 | 37 | 40 | 17 | 9 | 8 | 36 | 24 |
| **Regular Fare Passengers** | Adults | 2,038 | 2,303 | 2,392 | 2,196 | 2,321 | 2,330 | 2,613 | 2,313 |
| | Children | 88 | 106 | 168 | 89 | 75 | 93 | 90 | 101 |
| | Infants | 4 | 12 | 20 | 7 | 9 | 8 | 35 | 14 |
| **Reduced Fare Passengers** | Adults | 327 | 390 | 441 | 460 | 420 | 413 | 410 | 409 |
| | Children | 32 | 35 | 37 | 11 | 32 | 23 | 28 | 28 |
| | Infants | 3 | 8 | 1 | 5 | 0 | 0 | 0 | 2 |
| **Comp. Passengers** | Adults | 1,370 | 1,366 | 1,501 | 1,337 | 1,261 | 1,289 | 1,313 | 1,348 |
| | Children | 73 | 58 | 63 | 74 | 120 | 123 | 102 | 88 |
| | Infants | 14 | 17 | 19 | 5 | 0 | 0 | 1 | 8 |

#### Concessions Services

There are three concession-operated ferries for service to Isle Royale. These operations include *Isle Royale Queen IV* from Copper Harbor, MI, and *Voyageur II* and *Sea Hunter* from Grand Portage, MN. Between 2004 and 2013, an average of 8,400 visitors rode these ferries to and from Isle Royale per year. Isle Royale is also accessible by seaplane with the Royale Air Service. Between 2004 and 2013, an average of 565 visitors took the Royale Air Service to and from Isle Royale each year. Additional information can be in found in Appendix A.

#### Private Travel

Less than 20% of visitors travel to ISRO by private boat or private seaplane. Between 1992 and 2013 an average of 3,300 visitors arrived by private boat and only 11 visitors arrived by private seaplane. Between 2004 and 2013 the average dipped to 2,400 for boaters but stayed constant for private seaplanes. Over 90% of private boaters stay at least one night while almost 70% of visitors arriving by private seaplane come just for the day.

### *Personal Boat Transportation*

*Ranger III*'s ability to carry personal boats allows visitors to explore Isle Royale in a unique way. As shown in Table 2, the amount of hand-loaded boats (canoes and kayaks) and boats that require crane assistance have remained relatively steady between 2006 and 2012. On average, about one in 20 visitors brought a canoe or kayak, and about one in 50 had their personal watercraft transported aboard *Ranger III*. While the concessions operated vessels do have capacity to carry non-motorized canoes/kayaks, no data was available on the frequency with which they transport these boats.

**Table 2**
**Annual Amounts of Regular Fare Boats Transported by *Ranger III***
Source: Isle Royale National Park

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | Avg. |
|---|---|---|---|---|---|---|---|---|
| **Hand-loaded Boat** | 185 | 200 | 246 | 209 | 282 | 237 | 236 | 228 |
| **Boat <18'** | 59 | 70 | 66 | 65 | 74 | 69 | 62 | 66 |
| **Boat 18-20'** | 20 | 34 | 36 | 33 | 30 | 30 | 45 | 33 |
| **Boat Rescue >20'** | 6 | 4 | 4 | 5 | 8 | 5 | 7 | 6 |

## *Cargo Transportation*

Nearly everything on the island, including passenger baggage, food, construction material, fuel, and small boats have to be transported to Isle Royale from the mainland by boat. *Ranger III* is the primary method of cargo transport, and is used to transport all refrigerated, frozen, and non-perishable food; diesel fuel; propane fuel; trash; hand loaded boats (e.g., kayaks); and visitor and park power boats to and from ISRO. Table 3 details the average weight of freight by month, based on data from *Ranger III*'s bills of lading, or records, from 2010 through 2012.

**Table 3**
**Average Cargo Transported by *Ranger III* 2010-2012 (Pounds)**
Source: *Ranger III* Bills of Lading

| | April | May | June | July | August | September | Total |
|---|---|---|---|---|---|---|---|
| **Baggage** | 60,889 | 155,853 | 253,040 | 269,831 | 265,638 | 160,606 | 1,165,858 |
| **Construction** | 14,763 | 25,875 | 26,427 | 26,223 | 22,532 | 3,470 | 119,290 |
| **General Cargo** | 4,528 | 11,107 | 3,171 | 2,313 | 2,023 | 2,507 | 25,649 |
| **Refrigerated** | 3,200 | 4,543 | 8,833 | 9,346 | 11,915 | 2,950 | 40,788 |
| **Total** | 83,380 | 197,378 | 291,471 | 307,713 | 302,108 | 169,533 | 1,351,585 |

## *Trash Transportation*

All waste produced on ISRO has to be transported back to the mainland for disposal. Trash is loaded into dumpsters and transported on the upper deck of *Ranger III* back to Houghton on most trips. Trash must be regularly removed from the island to minimize odors. Recyclables are collected at Mott Island, Rock Harbor, and Windigo and shipped to Houghton at the end of the season. Table 4 details the average trash transport aboard *Ranger III* between 2010 and 2012, based on data from *Ranger III*'s bills of lading.

**Table 4**
**Average Amount of Trash Transported by *Ranger III* 2010-2012 (Pounds)**
Source: *Ranger III* Bills of Lading

| | April | May | June | July | August | September | Total |
|---|---|---|---|---|---|---|---|
| **Trash** | 2,313 | 40,163 | 86,567 | 80,763 | 86,413 | 66,933 | 363,153 |

## *Fuel Transportation*

Diesel, gasoline, aviation gas, and propane are all integral for operation of ISRO. All fuel used on Isle Royale is transported to the island on ISRO-owned vessels.

### Diesel and Propane

Power generation and water treatment on Isle Royale are both diesel-powered. Diesel is also used in the park's small fleet and sold to the concessioner for visitor boat usage. Propane is used at the concession facilities for laundry and cooking, and is also used in backcountry sites for lighting, heat, and refrigeration. *Ranger III* transports both diesel and propane fuels. Diesel is transported in *Ranger III*'s transport fuel tanks while propane is carried in cylinders on the deck. When propane is being transported, *Ranger III*'s passenger capacity is limited to 25 persons. Table 5 details the average fuel transport aboard *Ranger III* between 2010 and 2012, based on data from *Ranger III*'s bills of lading.

**Table 5**
**Average Fuel Transported on *Ranger III* 2010-2012**
Source: *Ranger III* Bills of Lading, Volpe

| | Total |
|---|---|
| **Diesel (gal)** | 55,500 |
| **Propane (cylinders)** | 190 |

### Gasoline and Aviation Gas

Twenty-eight of the park's 36 small fleet boats use gasoline. In 2012, these boats used a total of 11,851 gallons of gasoline. Gasoline is also sold to the concessioner for use by visitor boats. An average of 16,802 gallons of gasoline was sold to visitors between 2008 and 2013. Aviation gas is delivered to the island for use by the seaplane in the Winter Study, which involves multiple flights per day across the island. Gasoline and aviation gas are transported to ISRO on the park's fuel barge, *Greenstone II*.

**Table 6**
**Average Fuel Transported by *Greenstone II***
Source: Isle Royale National Park, Forever Resorts, Volpe

| | Total (gal) |
|---|---|
| **Gasoline (Park Use)** | 11,851 |
| **Gasoline (Concessioner)** | 16,829 |
| **Aviation Gas** | 2,000 |

## *Intra-Island Transport*

Supplies, materials, and equipment from Houghton or Mott Island are transported to various locations around the island using park's Landing Craft Mechanized (LCM). The LCM's open well-deck, hinged bow ramp, and flat bottom allow for transport of large cargo to and from ports on the island which cannot be reached by the larger *Ranger III*. Regular uses include transporting garbage dumpsters from Windigo to Mott Island or Houghton (three to four times per season), and transporting the floating dock to Windigo, with the help of the park's mobile crane, at the beginning and end of the season. As-needed uses include building construction, dock construction, contractor support, and other miscellaneous projects.

Park staff use ISRO's small fleet for various missions around Isle Royale. The fleet is made up 34 small boats, typically between 16 and 20 feet long. The small fleet boats missions can include intra-island personnel transport, law enforcement, and search and rescue. Groceries and other small cargo are shipped to Windigo from Mott Island with the park's small boat *Beaver*, which normally makes 16 trips to Windigo per year.

## *Construction Support*

Construction activities on Isle Royale are supported by the *Beaver* work barge, an uninspected work barge that is towed by tug boat to the island. There is a crane on the bow of the barge and a small crew quarters and a small machine shop on the stern. There is a work and storage area between the crew quarters and the crane. *Beaver* can function as a mobile work platform for construction projects, and it has a flat bottom that allows it to travel to locations inaccessible to *Ranger III*. *Beaver* can also be used to transport large volumes of bulk materials between Houhgton and Isle Royale. The barge is currently moored at the park headquarters in Houghton and has not been fully utilized for several years due to a lack of a permanent tug crew.

## *Transport of Barges*

ISRO owns a small tugboat, *Shelter Bay*, used to tow the fuel and work barges between Houghton and Isle Royale. *Shelter Bay* is a United States Coast Guard (USCG) inspected, 65-foot tugboat. The park previously had a larger tug, but it would have required costly repairs to pass its USCG inspection. Instead of making the repairs, the park replaced the old tug with the Shelter Bay in 1998. However, Shelter Bay's small size limits its usefulness. It can only make the trip between Houghton and the island in very calm weather.

ISRO does not currently have permanent tugboat crew to operate *Shelter Bay*. Instead, ISRO contracts for a tugboat crew to perform fuel barge transport. *Shelter Bay* makes an average of 1.5 gasoline runs per year with the contracted crew. The cost for this operation is approximately $30,000 for each two to three day trip. The *Beaver* work barge does not have a regular schedule and has been used very little in the past three years.

## *Summary of Transport Requirements*

Table 7 shows the historical average volumes for each of the passenger and cargo categories transported by ISRO. These historic annual passenger and cargo transportation values were used to estimate future transportation needs as discussed in the next section.

**Table 7**
**Historical Annual Amounts of Passengers and Cargo Carried**
Source: Volpe

| | Category | Historical Cargo Amount |
|---|---|---|
| **Passengers** | Fare Passengers | 2,868* |
| | Complimentary Passengers | 1,444* |
| **Concession and Visitor Cargo** | Baggage (lbs) | 126,250 |
| | Dried Food and Supplies (lbs) | 164,210 |
| | Refrigerated Cargo (cu. ft.) | 4,779 |
| | Trash (dumpsters) | 24 |
| | Boats | 73* |
| **NPS Cargo** | Dried Food and Supplies (lbs) | 875,398 |
| | Refrigerated Cargo (cu. ft.) | 7,458 |
| | Trash (dumpsters) | 157 |
| | Boats | 32* |
| | Construction Cargo (lbs) | 119,290 |
| | Operations Cargo (lbs) | 25,649 |
| **Fuel Cargo** | Diesel (gal) | 55,421 |
| | Propane (bottles) | 130 |
| | Gasoline (gal) | 26,474 |
| | AVGAS (gal) | 1,000 |

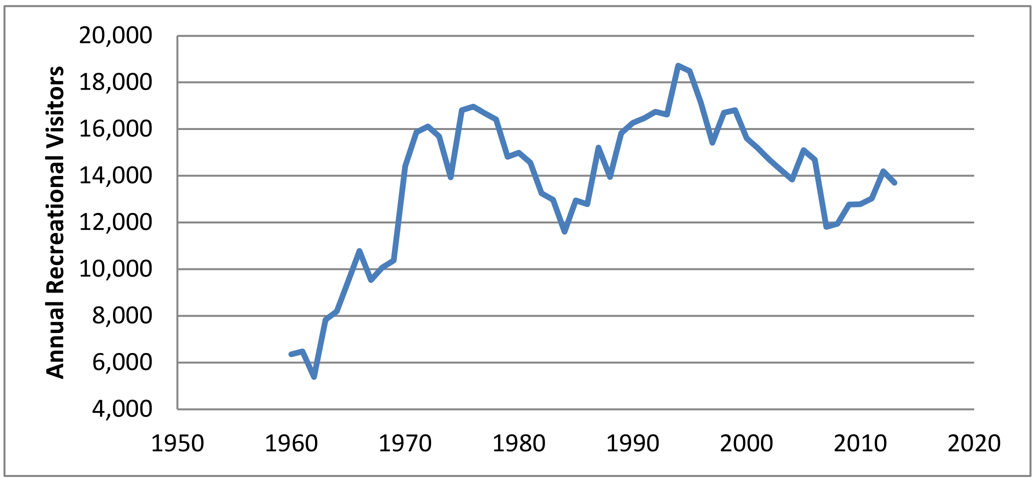
* This number is the total number of one-ways trips on *Ranger III*.

## Visitation Analysis

The purpose of conducting a visitation analysis was to better understand the effects of different future visitation scenarios on the ISRO transportation system. The lifespan for each alternative is projected to be about 30 years; therefore, there needs to be enough flexibility to accommodate expected fluctuations in visitation over this time period. Since *Ranger III* is expected to undergo its next major overhaul in 2018, that year was used as the base year for implementing the future transportation strategy.

As can be seen in Figure 5, visitation has fluctuated dramatically over the last 50 years, with some variations due to weather, fuel prices, the economy overall and changes to recreational preferences.

**Figure 5**
**Isle Royale National Park Annual Visitation 1960-2013**
Source: NPS Public Use Statistics Office Annual Park Recreation Visits




In order to account for a range of possible visitation scenarios, Volpe developed three different visitation projections, or "model seasons," which were used to analyze the feasibility of different transportation options and alternatives. The projections were based on historic patterns and possible ISRO policy changes, and include:

- **Low visitation** is based on an average of the five lowest years of visitation since 1975*. In addition the low visitation assumed closure of the concessions lodging, which includes visitors who stay at the Rock Harbor Lodge, Rock Harbor cottages, and Windigo cabins.
- **Medium visitation** was estimated based on average visitation since 1980.
- **High visitation** represents the maximum carrying capacity as defined in the 1998 General Management Plan (GMP). It incorporates a high projection of day use, 80% occupancy of the concessions lodging, and significant increases in backcountry use. The high visitation projection is 2.5 times the historic high visitation of 18,725 in 1994. This high use projection provides a benchmark from which to consider the transportation implications of future policy changes.

* Does not include 2007 & 2008 when the Wenonah, which provided daily round trip service out of Grand Portage, MN, was out of service.

Table 8 provides a summary of the different levels of use of Isle Royale in each of the three visitation scenarios. More information about the process used to develop these projections can be found in Appendix C.

**Table 8**
**Analysis of the Visitation Scenarios**
Source: Volpe

| Scenario | Annual Visitation | %Variation from Moderate | Peak Month Visitation (August) | Off-Peak Visitation (May) |
|---|---|---|---|---|
| **Low** | 10,401 | -30% | 3,916 | 396 |
| **Moderate** | 14,830 | - | 5,568 | 564 |
| **High** | 47,471 | +220% | 14,483 | 2,797 |

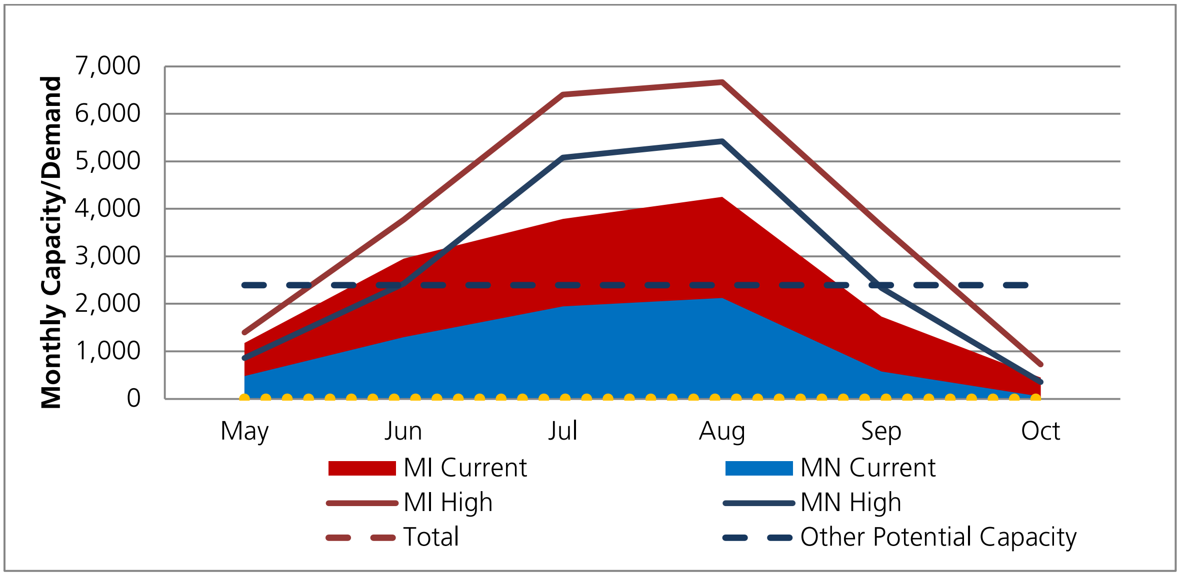
While annual visitation is a useful starting point for thinking about transportation needs, visitation and demand on the transportation network cannot be spread evenly throughout the season due to common peaked visitation during July and August. If new vessels are proposed for ISRO, they should be designed to accommodate peak demand. To aid in determining the necessary demand levels, a typical monthly visitation pattern was developed for each visitor type, including seasonal visitation patterns, travel mode, and accommodations for day and overnight visitors based on historic proportions.

While ISRO is responsible for transporting all cargo, fuel, and waste; two concessions currently operate water-borne transportation to Isle Royale in addition to the air service and visitor's personal means of reaching the island (boat or plane). The seasonal visitation analysis assigned visitors to all of the available transportation modes based on the typical distributions between the applicable transportation options (i.e., assigning day visitors to applicable modes and distributing overnight visitors based on historic choices).[*] For the most part, the distribution between commercial boat services represents generic demand for travel from a specific origin to a destination on Isle Royale, constraining day users to services that make a daily round trip. The number of visitors was not limited by the vessel size and current schedule, thus in some scenarios, some vessels may be assigned a higher capacity than their schedules currently accommodate.

Figure 6 illustrates the difference between the projected demand in the proposed high visitation scenario (solid line) and the current capacity provided from Minnesota by *Voyageur II* and *Sea Hunter* and from Michigan by *Ranger III* and *Isle Royale Queen* (area under curve). The dashed lines represent current peak period service, which is assumed could be provided throughout the season if demand warranted. It is possible that even more service could be provided with the existing fleet; however, it is likely that even with shifting some of the peak demand to the shoulder seasons, additional capacity would still be needed to manage the peak of the projected high visitation scenario.

[*] The exception to this is new day use visitors in the high visitation scenario, for which the distribution is described in the high visitation section.

**Figure 6**
**High Visitation Projections Relative to Capacity**
Source: Volpe




Except for a few trips, it is believed that the current vessel schedules meet current demand and would accommodate the demand estimated by the moderate visitation projection. *Ranger III*'s current capacity is shown as a dotted yellow line in Figure 6. Although it is one a portion of the visitor transportation system, it will be up to the park as to whether *Ranger III* needs to serve the current level of visitors or accommodate the projected future growth or whether current passenger transportation on Ranger III could be handled by a concessioner. It is expected that *Isle Royale Queen*, or another concessions boat could provide service from Michigan's Keweenaw Peninsula, as opposed to ISRO maintaining passenger service.

## *Required Cargo Vessel Capacity*

In addition to understanding the visitor transportation patterns, the amount of cargo to be transported seasonally was calculated. While concessioners provide additional passenger service, ISRO is responsible for transporting all cargo to and from Isle Royale, including that used by the concessioners. Historic averages calculated in the missions analysis (Table 7 ) were used as the basis for estimating demand for the future visitation scenarios. Concessioner and visitor cargo amounts were separated from NPS cargo to allow for a unit value of cargo per person to be calculated. The projected low, moderate, and high visitation levels were then applied to the unit cargo values to calculate a total amount of concessioner and visitor cargo transported per season per scenario. NPS staff and project cargo are assumed to be fixed as the number of staff and island infrastructure is not expected to change substantially based on visitation changes. The average amount of NPS cargo over the past few seasons was calculated and added to the fixed amount to provide future cargo transportation projections.

Expected fuel usage, including: diesel (energy and concessioner sales), propane, gasoline, and aviation gas (AVGAS), was also calculated. Diesel usage for generating electricity was calculated based on location; diesel generation at Mott Island was assumed to be constant due to minimal changes in park staffing levels, while diesel usage at Rock Harbor and Windigo was calculated as variable depending on visitation. Diesel use at Rock Harbor and Windigo was also reduced based on expected fuel savings from the newly installed alternative energy systems. Gasoline and propane use were calculated based on visitation projections, while AVGAS for the winter study was assumed to be constant.

Table 9 shows the total expected cargo amounts for each of the visitation projections.

**Table 9**
**Annual Amounts of Cargo Carried in Each Visitation Scenario**
Source: Volpe

| | Cargo Type | Low | Moderate | High |
|---|---|---|---|---|
| **Concession & Visitor Cargo** | Baggage (lbs) | 110,100 | 146,800 | 478,600 |
| | Dried Food and Supplies (lbs) | 39,500 | 187,400 | 698,300 |
| | Refrigerated Cargo (cu. ft.) | 2,300 | 5,400 | 18,700 |
| | Trash (dumpsters) | 8 | 30 | 162 |
| | Boats | 64 | 76 | 175 |
| | Diesel – Concessions (gal) | 13,400 | 13,800 | 19,500 |
| | Gasoline – Private Boats (gal) | 16,700 | 19,300 | 57,400 |
| **NPS Cargo** | Dried Food and Supplies (lbs) | 875,400 | 875,400 | 875,400 |
| | Refrigerated Cargo (cu. ft.) | 7,500 | 7,500 | 7,500 |
| | Trash (dumpsters) | 157 | 157 | 157 |
| | Boats | 16 | 16 | 16 |
| | Construction Cargo (lbs) | 119,300 | 119,300 | 119,300 |
| | Operations Cargo (lbs) | 25,600 | 25,600 | 25,600 |
| | Diesel – NPS (gal) | 32,300 | 35,300 | 45,400 |
| | Propane (bottles) | 130 | 130 | 130 |
| | Gasoline – NPS Boats (gal) | 11,900 | 11,900 | 11,900 |
| | AVGAS (gal) | 1,000 | 1,000 | 1,000 |

The expected concession and visitor cargo amounts for each visitation level were then distributed over the course of the operating season based on the visitation seasonal projection distributions to calculate a per-trip average cargo amount per month. The calculated values assume the current *Ranger III* service levels of 44 roundtrips per year, or approximately two trips per week, throughout the season.

Table 10, Table 11, and Table 12 show the required cargo capacity per trip for each of the visitation projections, assuming current service levels. The visitor passenger values account for passengers that have been assigned to *Ranger III* or its equivalent and does not capture total passenger demand. The remaining passengers would be accommodated by private or concession transportation as modeled. Shoulder season cargo requirements are based upon typical cargo transportation requirements for the month of May, while peak season cargo requirements are based upon typical transports in July and August. The transport of propane is planned for the shoulder season since transporting it limits the number of passengers allowed on board. It is expected that any new vessel within the transportation system should be designed to accommodate the peak season passenger and cargo capacities for the planned visitation level.

**Table 10**
**Required Capacity per Vessel Trip (2 Roundtrips per Week) for Low Visitation Projections**
Source: Volpe

| Cargo Type | Shoulder Season | Peak Season |
|---|---|---|
| Carts, Bags, Foods, Etc. (lbs) | 20,900 | 25,300 |
| Refrigerated Cargo (cu. ft.) | 189 | 273 |
| Trash (dumpsters) | 4 | 4 |
| Bulk Cargo (lbs) | 3,900 | 3,400 |
| Boats | 1 | 2 |
| Propane (bottles) | 65 | 0 |
| Diesel (gal) | 9,500 | 9,500 |
| Gasoline and AVGAS (trips) | 1 | 0 |
| Visitors | 43 | 43 |
| Complimentary Passengers | 16 | 16 |

**Table 11**
**Required Capacity per Vessel Trip (2 Roundtrips per Week) for Moderate Visitation Projections**
Source: Volpe

| Cargo Type | Shoulder Season | Peak Season |
|---|---|---|
| Carts, Bags, Foods, Etc. (lbs) | 22,100 | 31,400 |
| Refrigerated Cargo (cu. ft.) | 208 | 386 |
| Trash (dumpsters) | 4 | 5 |
| Bulk Cargo (lbs) | 3,900 | 3,400 |
| Boats | 1 | 2 |
| Propane (bottles) | 65 | 0 |
| Diesel (gal) | 9,500 | 9,500 |
| Gasoline and AVGAS (trips) | 1 | 0 |
| Visitors | 58 | 58 |
| Complimentary Passengers | 16 | 16 |

The difference in vessel design requirements to accommodate the capacity requirements of the low and moderate visitation projections are relatively small. Since the required passenger capacity and the weight and volume of dry and bulk cargo dominate the design requirements for a new vessel, based on the small differences in the projections, Alternatives 1 – 5 have been developed to accommodate the peak season of the moderate visitation projections. It is expected that designing a vessel specifically for the low visitation scenario would have a negligible effect on capital or operating costs and limit flexibility for unanticipated periods of high demand. During some lower visitation conditions, the extra capacity of the moderate visitation sized vessel may allow for fewer total trips if desirable, which could reduce operational costs.

**Table 12**
**Required Capacity per Vessel Trip (2 Roundtrips per Week) for High Visitation Projections**
Source: Volpe

| Cargo Type | Shoulder Season | Peak Season |
|---|---|---|
| Carts, Bags, Foods, Etc. (lbs) | 27,000 | 54,900 |
| Refrigerated Cargo (cu. ft.) | 279 | 882 |
| Trash (dumpsters) | 5 | 10 |
| Bulk Cargo (lbs) | 3,900 | 3,400 |
| Boats | 2 | 3 |
| Propane (bottles) | 65 | 0 |
| Diesel (gal) | 9,500 | 9,500 |
| Gasoline and AVGAS (trips) | 1 | 1 |
| Visitors | 151 | 151 |
| Complimentary Passengers | 16 | 16 |

The overall size of vessels accessing Isle Royale is limited by the length and draft restrictions of the Rock Harbor and Windigo docks. The size of a vessel that could accommodate the required cargo in the high visitation scenario is too large to be accommodated by the existing docks. It is recommended that ISRO increase the frequency of service rather than trying to keep operations to two roundtrips per week. The vessel size required for the moderate visitation scenario will be appropriate for use at the high visitation projection with an increase in frequency of 1-2 trips per week, depending on whether it is the shoulder season or peak season. Vessel design considerations provided in the remaining sections of this report are based carrying the cargo described in the moderate visitation scenario, as described in Table 11.

## Options Analysis

Based on the analysis of the needs of park missions and potential visitation scenarios, Volpe worked with ISRO staff to identify possible future options for meeting ISRO's key transportation missions. The options relate to large fleet improvements, intra-island transportation improvements, passenger transport efficiencies, garbage transport efficiencies, and fuel-efficiency related improvements. These options include how the currently-owned fleet could be used to perform the necessary tasks as well as adding new vessels (purchase or lease), contracting out specific missions, or potential ways to eliminate or change the transportation need associated with the mission (i.e., incinerating waste on-island). Each option was analyzed for the ability to improve upon at least one operational activity that is required to fulfill the parks missions. Where appropriate, Volpe identified existing vessels as examples. A description of these vessels is provided in Appendix D. The costs and benefits of each of the options were analyzed, as well as the impacts of visitation changes on each option.

Twenty-four options, summarized in Table 13, were analyzed in this study. The options focus on whether to upgrade the primary park vessel, *Ranger III* (Option A), build a new multi-use vessel, *Ranger IV* (Option B), or replace *Ranger III* with an alternative strategy to meet its current missions (Options C, D, E, F and G). Other options included alternate vessels for transporting cargo and visitors, changes to crew certifications, and strategies that are ancillary to *Ranger III's* missions. A complete and detailed description of each option and the full results of the analyses for each option are included in Appendix E.

In developing the options, special attention was paid to what would be needed to extend the service life of the *Ranger III*. The details of that analysis were documented in a Service Life Extension and Upgrade Report provided in Appendix F.

Cost estimates for vessels and vessel components are based on Volpe staff's strong knowledge of the maritime industry and projects completed for other operators of similarly sized vessels. Estimates of ISRO staff costs are based on proposed 2015 crew hourly wage rates (since the historic costs aren't appropriate). Other capital, operating, and maintenance costs are based on historic data from ISRO, historic data from concessioners, and other best available data. Option B, build a new *Ranger IV*, and Option N, relocating *Ranger III* dock to end of canal, have the potential for the greatest variation of cost from estimate to implementation. The design and build costs of a new *Ranger IV* are highly variable based on overall size of the vessel and options chosen for inclusion. The construction costs of a new facility at the end of the Keweenaw Canal may change because of the unknowns surrounding the current ownership, condition, and any possible contamination of the property.

The results of the analysis of the different options indicated that variations in the number and type of vessels had a much more significant impact on operational costs than operational changes to existing vessels, such as schedule changes.

**Table 13**
**ISRO Transportation Improvement Options**
Source: Volpe

| Option ID | Option | Analysis Snapshot |
|---|---|---|
| A | Complete *Ranger III* Service Life Extension and Upgrade Package | This is a safe alternative, but expensive. It may make sense in the low and moderate visitation projections; however not under the high visitation projection. |
| B | Build a New Vessel, *Ranger IV* | This option makes the most sense in the high visitation projection. |
| C | Use Crewboat for Cargo Transport | Use of a crewboat for cargo transport could significantly reduce park operating costs and still allow for complimentary transport of park staff and families. |
| D | Use Tug and Barge for Cargo Transport | This option has a lower initial cost and lower operating cost than the *Ranger III/IV*. This option does not include capacity for passenger transport. |
| E | Use Contract Services for Cargo Transport | This option is high risk and will require a request for information for vessel availability and freight rates before proceeding to implement this option. This option does not include capacity for passenger transport. |
| F | Purchase High Speed Ferry for Passenger Transport | This option requires some upfront investment, but has much lower operating costs than the *Ranger III*. This option makes the most sense under the high visitation projection, combined with *Ranger III* or alternate cargo transport option. |
| G | Use Concessioner Ferry for Passenger Transport | Under this option, the park would still need to provide for cargo transport. This option is only attractive at the low visitation projection. |
| H | Staff *Ranger III* with Contract Crew | While the contracted crew may be cost effective, it would be difficult to know the true cost without publishing a request for interest. |
| I | Optimize *Ranger III* Crew Certification Distribution | This option has a low initial investment, and relatively short payback period. |
| J | Increase *Ranger III* Crew Size | This option will be required for *Ranger III* to cover high visitation passenger and cargo requirements. However, the required breakeven ridership is higher than the high visitation projection, and thus does not make economic sense. |
| K | Make More Roundtrips with *Ranger III* | This option will be required for *Ranger III* to cover high visitation passenger and cargo requirements. However, the required breakeven ridership is higher than the high visitation projection, and thus does not make economic sense. |

| | | |
|---|---|---|
| L | Implement More Frequent Schedule of Cruises | The profit from these cruises is small and will not have a big effect on overall revenue. |
| M | Align *Ranger III* Trips with Airline Schedules | Based on the current travel time of the *Ranger III*, adjusting the schedule to accommodate the current flight schedule does not make sense. |
| N | Relocate *Ranger III* Dock to End of Canal | This option is relatively expensive, and carries a lot of uncertainty about the availability and usability of the property for the dock. |
| O | Replace Work Barge with Modular Causeway Platform | This option is expensive, but offers some flexibility and would provide redundancy. This option would not limit the availability of the LCM. |
| P | Outfit LCM as Work Barge | This option would allow access to and use of a work platform without the need for a separate tugboat operator, but would also limit the availability of the LCM to move dumpsters and heavy equipment around ISRO when not in use for construction. |
| Q | Ship Food and Cargo to Windigo on *Voyageur II* | This option is not expected to produce any cost savings. |
| R | Increase Efficiency of Small Fleet | Replacing all workboats with more efficient vessels does not make sense as the fuel savings is heavily outweighed by the capital costs of the new boats. |
| S | Install Automatic Identification System (AIS) on Small Boat Fleet | Unless existing staff could add dispatching vessels to their existing duties, the use of AIS would cost more than it would save. |
| T | Build More On-Island Gasoline Storage | Since there appears to be sufficient gasoline storage on ISRO, this option is unnecessary at the low and moderate visitation, or if *Ranger III* is used to transport gasoline. However, under the high visitation projection, if *Greenstone II* continues to transport gasoline, increasing the gasoline storage capacity at Rock Harbor could eliminate one barge trip per year. |
| U | Increase Diameter of Island Fuel Line | This option constitutes a relatively large investment for a small operational savings. |
| V | Use Alternative Energy in Houghton | Although the payback period could not be justified, this option remains prospective given the NPS' commitment to Green Energy. |
| W | Incinerate On-Island Waste | This option is not feasible because there are no incinerators which meet the requirements of a Class 1 Airshed. |
| X | Burn Waste Kitchen Oil on *Ranger III* | This option offers a small cost savings, and would require a significant level of effort to implement. |

Based on the analysis conducted and discussions with ISRO staff, these options were used to build the following section of this report, Alternatives Analysis, which combines the potential options into six transportation alternatives, or strategies, to achieve the park's transportation–related missions.

## Alternatives Analysis

Transportation alternatives were developed by combining the various transportation options, described above, into different packages. Each transportation alternative includes coverage of all key transportation related missions performed by the NPS for the operation of ISRO, as discussed earlier in the Missions Analysis section of this report. Alternatives 1 through 5 were developed to ensure adequate transportation coverage for the low and moderate visitation projections, and Alternative 6 was developed for the high visitation projection.

This chapter provides the following for each alternative:

- A summary of the alternative's components;
- An analysis of how each of the park's missions are fulfilled and redundancy considered, where applicable;
- Estimated capital and operations and maintenance (O&M) costs;
- The implication of the alternative for each visitation projection considered; and
- Implementation actions and schedule.

Since the alternatives include overlapping components, a summary of the components of the alternatives is provided prior to the detailed description of each alternative and the implementation actions and schedule for the components is provided at the end.

### *Summary of Alternatives*

Table 14, below, provides a more in depth look at each of the potential alternatives. The cost summaries include estimated capital and annual O&M costs based on the moderate visitation scenario.

**Table 14**
**Summary of Alternatives**
Source: Volpe

| Alternative | Capital Cost | Annual O&M Cost | Key Advantages | Key Disadvantages |
|---|---|---|---|---|
| **Alternative 1 – *Ranger III* Service Life Extension and Upgrades (SLEU)** | $18,451,000 | $1,315,500 | - Minimal changes to current operations<br>- Able to operate tug and barges with in-house crew | - High initial capital cost<br>- High O&M cost<br>- Less adaptable for changing conditions |
| **Alternative 2 – Build a New *Ranger IV*** | $26,781,000<br>($16,781,000)* | $1,315,500 | - New *Ranger IV* optimized for expected visitation and cargo levels<br>- Minimal changes to current operations<br>- Able to operate tug and barges with in-house crew | - High initial capital cost<br>- High O&M cost<br>- Less adaptable for changing conditions |
| **Alternative 3 – Crew Boat with Passenger Capacity** | $14,230,000 | $737,500 | - Faster vessel allows for shorter trip and more frequent trips when needed<br>- Provides for passenger capacity in shoulder season | - Requires contract crew for tug and barge operations<br>- Crewboat has highest expected fuel usage of all vessel options |
| **Alternative 4 – Tug and Barge + Concessioner Ferry** | $7,281,000 | $703,500 | - Includes in-house tug and barge crew to operate logistics, fuel, and work barges<br>- Concessioner passenger ferry separates logistics from passenger transportation | - Requires retraining crew to operate tug and barges<br>- Tug and barge transit would be slower than current *Ranger III*<br>- No park-operated transport for complimentary passengers |
| **Alternative 5 – Tug and Barge + Park-Operated Ferry**<br>(a) dock near end of Keweenaw Canal<br>(b) use current dock | (a) $14,581,000<br>(b) $11,981,000 | (a) $1,089,500<br>(b) $991,500 | - Includes in-house tug and barge crew to operate logistics, fuel, and work barges<br>- Park-operated ferry separates logistics from passenger transportation<br>- Park-operated ferry operates from new closer location for quicker trip to ISRO (Alternative 5a) only) | - Requires retraining crew to operate tug, barges and high speed ferry<br>- Tug and barge transit would be slower than current *Ranger III*<br>- New ferry site is further away from the town with no services nearby<br>- Operating two vessels would increase the park fuel usage |
| **Alternative 6 – High Visitation** | $19,981,000 | $1,812,500 | - Faster vessel allows for quicker trip and flexibility to reduce or add trips as necessary<br>- Park-operated ferry separates logistics from passenger transportation | - Crewboat has highest expected fuel usage of all cargo vessels investigated<br>- Operating two vessels would increase the park fuel usage |

* Capital purchased for the alternatives is expected to last 30 years, except Ranger IV, which has a 55 year expected life. The second value provided is the 30-year equivalent capital layout for Alternative 2.

## *Missions Attainment and Redundancy*

The key transportation related missions performed by the NPS for the operation of ISRO include: the facilitation of passenger travel, the conveyance of cargo, and the use and transport of fuel. Table 15 highlights which missions can be completed by more than one option. By providing redundancy, ISRO will still be able to complete the noted missions even if a piece of equipment were to fail.

**Table 15**
**Alternative Mission Coverage**
Source: Volpe

| Missions | | | Alternative 1 *Ranger III* SLEU | Alternative 2 Build a new *Ranger IV* | Alternative 3 - Crew Boat with Passenger Capacity | Alternative 4 - Tug and Barge + Concession Passenger Ferry | Alternative 5 - Tug and Barge + Park Operated Passenger Ferry | Alternative 6 - High Visitation |
|---|---|---|---|---|---|---|---|---|
| Mainland to Island Transport | Passengers | Visitor Transport (High Season) | No | No | Yes | No | No | Yes |
| | | Visitor Transport (Shoulder Season) | No | No | Yes | No | No | Yes |
| | | Park Staff/Families | No | No | Yes | No | No | Yes |
| | Cargo | Passenger Baggage | No | No | Yes | No | No | Yes |
| | | Refrigerated/Frozen Food | No | No | No | No | No | No |
| | | Non-perishable Food | Yes | Yes | Yes | Yes | Yes | Yes |
| | | General Cargo | Yes | Yes | Yes | Yes | Yes | Yes |
| | | Construction Material | Yes | Yes | Yes | Yes | Yes | Yes |
| | Fuel | Diesel | No | No | No | No | No | No |
| | | Propane | No | No | No | No | No | No |
| | | Gasoline | No | No | No | No | No | No |
| | | AVGAS | No | No | No | No | No | No |
| | Trash | General/Bagged | Yes | Yes | Yes | Yes | Yes | Yes |
| | | Recyclables | Yes | Yes | Yes | Yes | Yes | Yes |
| | | Grease | Yes | Yes | Yes | Yes | Yes | Yes |
| | | Fish | Yes | Yes | Yes | Yes | Yes | Yes |
| | Boats | Hand Loaded Boats | No | No | Yes | No | No | Yes |
| | | Power Boats (Visitor) | No | No | No | No | No | No |
| | | Power Boats (NPS) | No | No | No | No | No | No |
| Intra-island Transport | | Bulk Cargo | No | No | Yes | No | No | Yes |
| | | Food | Yes | Yes | Yes | Yes | Yes | Yes |
| | | Construction Material | Yes | Yes | Yes | Yes | Yes | Yes |
| Construction Support | | Work Platform/Crane | Yes | Yes | Yes | Yes | Yes | Yes |
| | | Employee Lodging | No | No | No | No | No | No |

**KEY:**

| | |
|---|---|
| (light green) | Has transportation system redundancy |
| (dark green) | Does not have transportation system redundancy |

As estimated in the visitation analysis, ISRO and concessioner vessels will be required to transport the passenger and cargo volumes shown in Table 16 for an average shoulder and peak season.

**Table 16**
**Required Capacity per Vessel Trip (2 Roundtrips per Week) for Moderate Visitation Projections**
Source: Volpe

| | Cargo Type | Shoulder Season | Peak Season |
|---|---|---|---|
| **Cargo** | Carts, Bags, Foods, Etc. (lbs) | 22,100 | 31,400 |
| | Refrigerated Cargo (cu. ft.) | 208 | 386 |
| | Trash (dumpsters) | 4 | 5 |
| | Bulk Cargo (lbs) | 3,900 | 3,400 |
| | Boats | 1 | 2 |
| **Passengers** | Paid Visitors | 58 | 58 |
| | Complimentary Passengers | 16 | 16 |
| **Fuel** | Diesel (gal) | 9,500 | 9,500 |
| | Propane (bottles) | 65 | 0 |
| | Gasoline and AVGAS | 2 barge trips per year | 0 |

## *Components for Alternatives*

Table 17 provides a list of each of the components selected to be included in each alternative, and Table 18 provides the capital and annual O&M costs for each component. Note that the purchase of a new tugboat and using alternative energy in Houghton are included in each of the six alternatives. Although these items do not directly meet the primary missions requirements, it was determined that they should be implemented in the future plan for ISRO. The current tugboat, *Shelter Bay*, is old and undersized and thus inefficient for regular travel across Lake Superior. A new, larger tugboat will improve safety while allowing for operations in worse weather conditions. Similarly, while the alternative energy options may not necessarily make economic sense based on the preliminary analysis, development of alternative energy is an important overall goal for the NPS.

**Table 17**
**Components included in Each Alternative**
Source: Volpe

| Option | Ranger III SLEU | Ranger IV | Crew Boat with Passenger Capacity | Tug and Barge + Concession Passenger Ferry | Tug and Barge + Park Ferry a | Tug and Barge + Park Ferry b | High Visitation |
|---|---|---|---|---|---|---|---|
| C1. Ranger III SLEU | ■ | | | | | | |
| C2. Ranger IV | | ■ | | | | | |
| C3. Fast Crewboat | | | ■ | | | | ■ |
| C4. Logistics Barge | | | | ■ | ■ | ■ | |
| C5. Concessioner High Speed Ferry | | | ■ | ■ | | | |
| C6. Park-Owned High Speed Ferry | | | | | ■ | ■ | ■ |
| C7. New Tug | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| C8. Optimize Certification of Seasonal Crew to Operate Tug and Barges | ■ | ■ | | | | | ■ |
| C9. Contracted Crew for Gasoline Transport | | | ■ | | | | |
| C10. Greenstone II Fuel Barge | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| C11. Beaver Work Barge | ■ | ■ | | ■ | ■ | ■ | ■ |
| C12. Shelter Bay Tugboat for Barge Transport around ISRO | ■ | ■ | | ■ | ■ | ■ | ■ |
| C13. Modular Causeway System for Construction Support | | | ■ | | | | |
| C14. Improve Houghton Dock Infrastructure | | | | ■ | | ■ | ■ |
| C15. Relocate Ferry Dock to End of Keweenaw Canal | | | | | ■ | | |
| C16. LCM | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| C17. Small Boat Beaver | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| C18. Alternative Energy at Houghton to Supply Electrical Power | ■ | ■ | ■ | ■ | ■ | ■ | ■ |

**Table 18**
**Summary of Component Costs**
Source: Volpe

| Option | Capital Cost | Annual O&M Cost |
|---|---|---|
| C1. Ranger III SLEU | $13,340,000 | $1,092,000 |
| C2. Ranger IV | $22,000,000 ($12,000,000)* | $1,092,000 |
| C3. Fast Crewboat | $9,000,000 | $564,000 |
| C4. Logistics Barge | $1,081,000 | $415,000 |
| C5. Concessioner High Speed Ferry | $0 | $90,000 |
| C6. Park-Owned High Speed Ferry | $4,700,000 | $376,000 |
| C7. New Tug | $4,500,000 | $45,000 |
| C8. Optimize Certification of Seasonal Crew to Operate Tug and Barges | $81,000 | $25,000 |
| C9. Contracted Crew for Gasoline Transport | $0 | $90,000 |
| C10. Greenstone II Fuel Barge | $0 | $45,000 |
| C11. Beaver Work Barge | $0 | $30,000 |
| C12. Shelter Bay Tugboat for Barge Transport around ISRO | $0 | $45,000 |
| C13. Modular Causeway System for Construction Support | $530,000 | $5,000 |
| C14. Improve Houghton Dock Infrastructure | $1,500,000 | $0 |
| C15. Relocate Ferry Dock to End of Keweenaw Canal | $4,100,000 | $100,000 |
| C16. LCM | $0 | $30,000 |
| C17. Small Boat Beaver | $0 | $3,500 |
| C18. Alternative Energy at Houghton to Supply Electrical Power | $200,000 | $0 |

A description of each of the components is included below. More information on most components can be found in Appendix E, the descriptions of the Transportation Options. Each alternative combines several of these components to provide sufficient coverage for ISRO to continue performing all key missions.

C1. *Ranger III* Service Life Extension and Upgrade

*Ranger III* is currently the primary means of transportation from ISRO headquarters in Houghton, MI to the island of Isle Royale. *Ranger III* transports food, fuel, building materials, trash, and other logistic supplies, and it also carries paying passengers and park employees. While the hull is in reasonably good condition, many of the individual systems on the ship are obsolete and difficult to support. Recent problems with the crane, air compressors, and aft capstan have demonstrated the problems associated with supporting old, obsolete systems.

A service life extension and upgrade package (SLEU) was developed to extend the service life of *Ranger III* by another 30 years. The SLEU breaks down the ship into individual systems, each of which is evaluated to determine how much longer it can be considered safe and reliable. A course of action to either overhaul or replace the system is made if it is not expected to last the desired time period of 30 years. An SLEU would recapitalize or upgrade existing systems, but would not substantively change the capabilities of the ship. Some additional options were investigated, which would upgrade *Ranger III* to improve operation of the vessel and passenger comfort.

A work list of 36 separate items has been developed to extend the service life of *Ranger III*. The work list calls for the recapitalization of each system either through an extensive overhaul or replacement with new equipment. Additionally, four upgrade items would be implemented, which would increase the capabilities of *Ranger III*. These upgrade items include:

- Replacing the steel hull life boats and davits;
- Installing an alarm panel and tank level indicating (TLI) system;
- Replacing all baggage carts; and
- Installing satellite internet and improve the seating.

The detailed SLEU report is provided as Appendix F.

C2. *Ranger IV*

In this component, all of the capabilities and proposed upgrades in the SLEU would be incorporated into a future vessel designed specifically for the park, *Ranger IV*. *Ranger IV* would be of similar size to *Ranger III*, but would be designed to be under 500 gross tons and have features that allow for higher fuel efficiency, better cargo handling, and smaller crew size. The expected service life of a new *Ranger IV* would be 55 years (the current age of *Ranger III),* while a SLEU would only extend the service life of *Ranger III* for 30 years. Preliminary specifications for *Ranger IV* are provided in Appendix G.

C3. Fast Crewboat

The logistics operations currently performed by *Ranger III* would be replaced by a new fast crewboat in this component. The new crewboat would be designed and built to fulfill all of ISRO's logistics missions, such as transport of dry cargo, refrigerated cargo, trash, small boats, and diesel fuel and would have capacity to carry a limited number of passengers. The crewboat would be between 150 and 175 feet in length, have a draft between 5 and 7 feet, have a cruising speed of 25 to 30 knots, and be less than 100 gross tons. The lower draft requirements of the crewboat versus *Ranger III* would allow the crewboat to access smaller ports, such as Amygdaloid and Malone Bay, and the faster speed of the crewboat would allow a roundtrip to be performed on one day as opposed to two days for *Ranger III*. The open deck space would allow the new crewboat to carry the same amount or more deck cargo than *Ranger III,* while the below deck cargo would allow for between 9,000 and 17,000 gallons of diesel, depending on overall size of the vessel. The new crewboat would also have a capacity between 60 and 80 passengers. This passenger capacity would allow park staff and families to travel to ISRO aboard the crewboat, as opposed to having to ride a concessioner ferry. Having passenger capacity on the new crewboat would also allow for shoulder season flexibility for the concessioner operators. If the concessioner only operates in the high season, mainly between Memorial Day and Labor Day, a limited amount of visitors would still be able to access ISRO by riding the new park-operated crewboat.

While *Ranger III* requires a crew of seven to nine personnel to operate between Houghton and ISRO, a new crewboat would only require a crew of two or three staff. Furthermore, compared to *Ranger III*, the less complex crewboat would require less maintenance, which would significantly reduce operating costs. The crewboat also operates at a higher speed than *Ranger III*. While this would increase fuel use, it would also allow the crewboat to depart and return on the same day, reducing overnights and saving labor costs.

C4. Logistics Barge

In this component, the logistics operations currently performed by *Ranger III* would be replaced by a new tug and barge combination. A new custom deck/tank barge would be designed and built to fulfill all of ISRO's logistics missions at moderate visitation, including transport of dry cargo, refrigerated cargo, trash, small boats, and diesel fuel. It is expected that the barge would be approximately 100 feet long and have a 30 foot beam, with a fuel capacity of at least 10,000 gallons. A new larger and more powerful tugboat would also be procured, which would be used to move the logistics barge between Houghton and the island. The tugboat would be approximately 75 feet in length, have a ten foot draft, and have twin engines and propellers with around 1,200 total horsepower. This new tugboat would also have the capability to transport *Greenstone II* between ISRO and the Lily Pond fueling station.

While *Ranger III* requires a crew of seven to nine personnel to operate between Houghton and ISRO, a new tug and barge combination for logistics movement would only require a crew of three (captain, oiler, and crane operator). Furthermore, compared to *Ranger III*, the smaller and less complex tug and barge combination would require less maintenance and would not require any year-round crew. This would significantly reduce operating costs for logistics operations. However, ISRO would lose the revenue from the approximately 1,500 visitors currently carried on *Ranger III*, and may also have to pay additional fees to a concessioner for transport of park staff and other currently complementary travelers to and from the island.

Currently, *Ranger III* crew members do not have the appropriate towing and tankerman credentials to operate the proposed new tug and barge. If some crewmembers obtained the appropriate licenses and qualifications, ISRO could retain current staff to operate the new vessels, as opposed to hiring new personnel. The captain or mate would have to be retrained for towing credentials, and an Ordinary Seaman (OS) would need to be upgraded to an Oiler with tankerman's credentials.

C5. Concessioner Services for Passenger Transport from Houghton

This component would replace the passenger transport operations currently performed by *Ranger III* with a new concessioner passenger ferry operating from the Keweenaw Peninsula. The concessioner would be expected to carry approximately as many passengers as *Ranger III* currently carries. Alternatively, some portion of *Ranger III*'s passenger load transferred could be transferred to the *Isle Royale Queen* and a smaller concession could be set up to supplement it if needed. A new concessions passenger service could be operated out of NPS's Houghton Facility, the old Coast Guard facility, or Mohawk/Eagle Harbor, MI (the closest mainland point in Michigan to Rock Harbor).

A new concessioner ferry would not be able to transport powerboats. Instead, privately-owned powerboats would have to be transported separately on the ISRO-operated logistics vessel.

C6. Park-Owned High Speed Ferry for Passenger Transport

This component would replace passenger transport operations currently performed by *Ranger III* with a new high-speed 150 passenger ferry, also operated by ISRO. The high-speed ferry would be less than 100 gross tons, only require a two-person crew, and could complete a roundtrip in one day, reducing overtime and saving labor costs. Complimentary passengers, such as park staff and families, could continue to ride a park-owned ferry for free.

The high-speed ferry would not be able to transport powerboats. Instead, privately-owned powerboats would have to be transported separately on the ISRO-operated logistics vessel.

C7. New Tug for Barge Transport

ISRO currently operates *Shelter Bay*, a small tugboat which is used to transport the *Greenstone II* gasoline barge between the mainland and the island. However, *Shelter Bay*'s small size limits its usefulness, as it can only make the trip between Houghton and the island in very calm weather. This component includes the purchase of a new tugboat to transport *Greenstone II* and *Beaver* across Lake Superior. The tugboat would be approximately 75 feet in length, have a ten foot draft, and have twin engines and propellers with around 1,200 total horsepower. The park would still retain *Shelter Bay* for barge movements around the island. *Shelter Bay*'s smaller size and draft would make it easier to move the fuel and work barges into smaller ports, such as Amygdaloid and Malone Bay.

C8. Optimize Certification of Seasonal Crew to Operate Tug and Barges

ISRO owns the *Greenstone II* gasoline barge and *Beaver* work barge that are propelled by a park-owned tug. The existing construction barge is used to carry construction material to ISRO from Houghton, MI; it also functions to transport material and workers around ISRO and is used as a work platform. There is a built-on crane to facilitate work. The existing gasoline barge is needed to transport fuel to the island. As discussed in the Missions Analysis, due to the lack of a permanent crew, the construction barge is currently not being used and an expensive contract crew has to be hired to make the current gasoline barge runs. The gasoline barge run is performed, on average, 1.5 times per year. Currently, it costs about $30,000 per run or about $45,000 per year to operate the gas barge with the contracted crew.

*Ranger III* and the existing LCM can transport some of the construction materials, but some of the larger and heavier items can't be easily transported to ISRO with these vessels. Therefore, some larger construction projects may require a contracted crew to transport material and site the construction barge, or some park operations would have to be curtailed. Currently, the construction barge is not being used due to the cost of hiring a contracted crew.

Currently, two of the *Ranger III* crew members do not work on *Ranger III* during the shoulder season, which includes the months of May and September. If they had the right licenses and qualifications, they could operate the tug and barge before or after the peak season when not serving on the crew of the *Ranger III*. In this component, one of the Able Bodied Seaman (AB) positions would be upgraded to a Third Mate with pilot credentials and one of the Ordinary Seaman (OS) would be upgraded to an Oiler with a tankerman's credentials. This would allow these two crewmembers to operate the tug to move *Greenstone II* and *Beaver* work barge during the shoulder season.

C9. Contracted Crew for Gasoline Transport

In this component, which is proposed to be used in conjunction with use of a crew boat, which would require a smaller permanent crew and not have a tugboat operator, the park would contract for barge transport services. The contracted crew would be able to operate the new tug for transport across Lake Superior and *Shelter Bay* around ISRO, which would allow *Greenstone II* to access all ports on the island.

C10. Continue to use *Greenstone II* Fuel Barge

Gasoline transport will continue to be performed by *Greenstone II* in this component. The crew would use a combination of the new tugboat and *Shelter Bay* to move *Greenstone II* to and around ISRO to refuel the island's gasoline tanks.

C11. Continue to use *Beaver* Work Barge

In this component, the *Beaver* work barge would continue to be used for construction support projects and large cargo movements. The crew would use a combination of the new tugboat and *Shelter Bay* to move *Beaver* to and around ISRO.

C12. Continue to use *Shelter Bay* Tugboat for Barge Transport around ISRO

The park would retain *Shelter Bay* for barge movements around the island. *Shelter Bay*'s smaller size and draft would make it easier to move the fuel and work barges into smaller ports, such as Amygdaloid and Malone Bay.

C13. Modular Causeway System and Crane for Construction Support

In this component, ISRO would purchase a modular causeway system. A modular causeway system is a combination of portable, interlocking sections used to create a larger floating platform, which can be used as a work barge. The modular causeway can be transported to Isle Royale in pieces and constructed into a platform on site, and then can be move around the island using the park's LCM. A portable crane would also be purchased. The portable crane can be used to construct the platform, and once the platform is put together, can be loaded onto the modular causeway to support construction projects. During the offseason, the platform can be disassembled and stored on Mott Island.

C14. Improve Houghton Dock Infrastructure

If additional assets are purchased or used, such as a separate passenger ferry, the ISRO headquarters property will require improvements to allow for the logistics vessel, ferry, and barges to all dock at the same time. In this component, the existing quay wall and dock will be extended by 400 feet towards the east side of the property, and additional utilities will be installed for the extended dock.

C15. Relocate Ferry Dock to End of Keweenaw Canal

The current *Ranger III* dock is located about six miles from the entrance to the Keweenaw Waterway. Large vessels are limited to eight miles per hour through most of the canal, including between Lily Pond and the NPS docks in Houghton. Because of their anticipated sizes, any logistics or passenger ferry will have to travel through this area at reduced speed on each trip to and from Isle Royale. This adds about an hour to the travel time each way.

There is an old abandoned Coast Guard small boat station on the east side of the Keweenaw Waterway north entrance. The Coast Guard relocated the station to south of Houghton in 1990 and decommissioned the existing station shortly after that. In this component, the ferry dock would be relocated to this location, which would reduce the transit time by nearly an hour each way, saving fuel and crew costs.

All of the buildings and the boat basin remain at this station, but are in some disrepair. A series of improvements would need to be addressed before the property could be used as a dock for a new ferry, including but not limited to:

1. Demolishing an existing boat house;
2. Removing an existing finger pier;
3. Widening the boat basin by about 25 feet;
4. Extending the length of the boat basin by nearly 100 feet;
5. Building new quay walls on three sides of the boat basin;
6. Building a new dock;
7. Running utilities to the new dock;
8. Demolishing an existing garage;
9. Demolishing an existing tool shed;
10. Renovating the existing crew quarters for NPS office space;
11. Renovating the existing station house for NPS office space and passenger services;
12. Building a new logistics support building;

13. Replacing existing fuel tanks;
14. Building a visitor parking lot; and
15. Repairing an access road.

It is expected that the park headquarters and logistics operations would remain in Houghton for ease of deliveries, but the passenger ferry would depart from the new location at the end of the canal. The new location would significantly reduce transit time to Isle Royale (expected to be approximately 3 hours each way).

C16. Continue to use LCM

The park would continue to use the LCM to perform logistics operations on the island, such as transport of dumpsters between Mott Island and Windigo.

C17. Continue to use Small Boat *Beaver*

The park would continue to use the small fleet to perform logistics operations on the island, such as using the small boat *Beaver* to bring food and supplies to Windigo.

C18. Use Alternative Energy at Houghton to Supply Electrical Power

This component includes either the installation of green energy equipment (e.g. wind turbines and/or solar panels) at the ISRO headquarters or the purchase of renewable energy credits to offset some of the energy costs from *Ranger III* and the new tugboat while they are docked in Houghton, MI.

## *Alternative 1 – Ranger III SLEU*

### Summary

In Alternative 1, ISRO would implement a SLEU package for *Ranger III*. The SLEU package would extend the service life of the vessel for another 30 years, as well as provide a modest improvement in passenger amenities (See complete SLEU Report in Appendix F). ISRO would also ensure *Ranger III* crewmembers are certified to be able to operate the tugboat and barges during the shoulder season. The capital costs are $18,451,000 and the annual O&M costs are $1,329,500 for this alternative. Because this alternative includes the minimum numbers of changes to current cargo and passenger operations while still performing the necessary extension of the useful life of *Ranger III,* this alternative is considered the baseline alternative.

The following components are included in this alternative:

C1. *Ranger III* Service Life Extension and Upgrade
C7. New Tug for Barge Transport
C8. Optimize Certification of Seasonal Crew to Operate Tug and Barges
C10. Continue to use *Greenstone II* Fuel Barge
C11. Continue to use *Beaver* Work Barge
C12. Continue to use *Shelter Bay* Tugboat for Barge Transport around ISRO
C16. Continue to use LCM
C17. Continue to use Small Boat *Beaver*
C18. Use Alternative Energy at Houghton to Supply Electrical Power

### Missions Attainment and Redundancy

The key transportation related missions performed by the NPS for the operation of ISRO include the facilitation of passenger travel, the conveyance of cargo, and the use and transport of fuel. Table 19 summarizes how Alternative 1 meets the NPS missions and where it provides for redundancy.

**Table 19**
**Alternative 1 Mission Coverage**
Source: Volpe

| Missions | | | *Ranger III* SLEU (C1) | *Greenstone II* with tugs (C7, C10, C12) | *Beaver* Work Barge with tugs (C7, C11, C12) | LCM (C16) | Small Boat *Beaver* (C18) |
|---|---|---|---|---|---|---|---|
| Mainland to Island Transport | Passengers | Visitor Transport (High Season) | | | | | |
| | | Visitor Transport (Shoulder Season) | | | | | |
| | | Park Staff/Families | | | | | |
| | Cargo | Passenger Baggage | | | | | |
| | | Refrigerated/Frozen Food | | | | | |
| | | Non-perishable Food | | | | | |
| | | General Cargo | | | | | |
| | | Construction Material | | | | | |
| | Fuel | Diesel | | | | | |
| | | Propane | | | | | |
| | | Gasoline | | | | | |
| | | AVGAS | | | | | |
| | Trash | General/Bagged | | | | | |
| | | Recyclables | | | | | |
| | | Grease | | | | | |
| | | Fish | | | | | |
| | Boats | Hand Loaded Boats | | | | | |
| | | Power Boats (Visitor) | | | | | |
| | | Power Boats (NPS) | | | | | |
| Intra-island Transport | | Bulk Cargo | | | | | |
| | | Food | | | | | |
| | | Construction Material | | | | | |
| Construction Support | | Work Platform/Crane | | | | | |
| | | Employee Lodging | | | | | |

| | | | |
|---|---|---|---|
| | Primary without a secondary option | | Secondary option |
| | Primary with a secondary option | | |

### Cost Analysis

The capital and annual operation and maintenance costs for each of the transportation components included in this alternative are in Table 20. The capital costs to acquire new equipment are shown in 2014 dollars. Annual O&M costs include labor, fuel, and annualized drydocking costs.

**Table 20**
**Alternative 1 Cost Summary**
Source: Volpe

| Transportation Component | Capital | Annual O & M |
|---|---|---|
| **Ranger III SLEU (C1)** | $13,340,000 | $1,092,000 |
| New Tug for Barge Transport (C7) | $4,500,000 | $45,000 |
| Optimize Certification of Seasonal Crew to Operate Tug and Barge (C8) | $81,000 | $25,000 |
| Continue to use *Greenstone II* Fuel Barge (C10) | $0 | $45,000 |
| Continue to use *Beaver* Work Barge (C11) | $0 | $30,000 |
| Continue to use *Shelter Bay* Tugboat for Barge Transport around ISRO (C12) | $0 | $45,000 |
| Continue to use LCM (C16) | $0 | $30,000 |
| Continue to use Small Boat *Beaver* (C17) | $0 | $3,500 |
| Use Alternative Energy at Houghton to Supply Electrical Power (C18) | $200,000 | $0 |
| **Total** | **$18,451,000** | **$1,315,500** |
| Estimated Revenue | | $184,000 |

There are no changes expected to the revenue from concessioner cargo or passengers. Because cargo amounts at moderate visitation are expected to be relatively constant and *Ranger III* would still be transporting passengers, the change in revenue from current operations is expected to be minimal.

### Implications of the Visitation Projections on Alternative 1

Table 16 describes the needed capacity of the large fleet at the moderate visitation projection. The needed capacities are calculated assuming current service levels (two roundtrips per week). For this alternative, the low and moderate visitation can be easily accommodated by the proposed transportation fleet. Adjustments to the schedule would be needed to accommodate the high visitation scenario.

*Ranger III* would continue to transport all required passengers, cargo, diesel, and propane with two roundtrips per week at both low and moderate visitation levels. Two roundtrips per week, the current service level, would provide enough capacity for concessioner and park cargo, passenger (both visitors and staff) and trash transport. *Greenstone II* would be used two times per year to bring gasoline and AVGAS to Isle Royale.

To cover higher visitation levels, *Ranger III* would be required to make additional weekly trips to cover the increased dry and refrigerated cargo, and passenger loads. Due to weekly labor hour limits, these additional trips would require supplementary *Ranger III* crewmembers to cover the increased working hours. At high visitation, the limiting factor for minimum number of roundtrips would be refrigerated cargo capacity. The refrigerated cargo capacity on *Ranger III* would be increased as part of the SLEU, but depending on the final capacity, either one or two additional roundtrips would be required.

## *Alternative 2 – Build a New Vessel, Ranger IV*

### Summary

In Alternative 2, ISRO would replace *Ranger III* with a new vessel, *Ranger IV*. *Ranger IV* would be optimized for planned visitation levels and the necessary transportation requirements as well as be able to perform all missions currently performed by *Ranger III*. ISRO would also need to ensure that the *Ranger III* crewmembers would be certified to operate the tugboat and barges during the shoulder season. The capital costs are $26,781,000 and the annual O&M costs are $1,329,500 for this alternative.

The following components are included in this alternative:

*C2. Ranger IV*
C7. New Tug for Barge Transport
C8. Optimize Certification of Seasonal Crew to Operate Tug and Barges
C10. Continue to use *Greenstone II* Fuel Barge
C11. Continue to use *Beaver* Work Barge
C12. Continue to use *Shelter Bay* Tugboat for Barge Transport around ISRO
C16. Continue to use LCM
C17. Continue to use Small Boat *Beaver*
C18. Use Alternative Energy at Houghton to Supply Electrical Power

### Missions Attainment and Redundancy

The key transportation related missions performed by the NPS for the operation of ISRO include the facilitation of passenger travel, the conveyance of cargo, and the use and transport of fuel. Table 21 summarizes how Alternative 2 meets the NPS missions.

**Table 21**
**Alternative 2 Mission Coverage**
Source: Volpe

| Missions | | | *Ranger IV* (C2) | Use *Greenstone II* with tug (C7, C10, C12) | Use *Beaver* Work Barge with tug (C7, C11, C12) | LCM (C16) | Small Boat *Beaver* (C17) |
|---|---|---|---|---|---|---|---|
| Mainland to Island Transport | Passengers | Visitor Transport (High Season) | Primary without a secondary option | | | | |
| | | Visitor Transport (Shoulder Season) | Primary without a secondary option | | | | |
| | | Park Staff/Families | Primary without a secondary option | | | | |
| | Cargo | Passenger Baggage | Primary without a secondary option | | | | |
| | | Refrigerated/Frozen Food | Primary without a secondary option | | | | |
| | | Non-perishable Food | Primary with a secondary option | | | Secondary option | |
| | | General Cargo | Primary with a secondary option | | | Secondary option | |
| | | Construction Material | Secondary option | | Primary with a secondary option | Secondary option | |
| | Fuel | Diesel | Primary without a secondary option | | | | |
| | | Propane | Primary without a secondary option | | | | |
| | | Gasoline | | Primary without a secondary option | | | |
| | | AVGAS | | Primary without a secondary option | | | |
| | Trash | General/Bagged | Primary with a secondary option | | | Secondary option | |
| | | Recyclables | Primary with a secondary option | | | Secondary option | |
| | | Grease | Primary with a secondary option | | | Secondary option | |
| | | Fish | Primary with a secondary option | | | Secondary option | |
| | Boats | Hand Loaded Boats | Primary without a secondary option | | | | |
| | | Power Boats (Visitor) | Primary without a secondary option | | | | |
| | | Power Boats (NPS) | Primary without a secondary option | | | | |
| Intra-island Transport | | Bulk Cargo | | | | Primary without a secondary option | |
| | | Food | | | | Secondary option | Primary with a secondary option |
| | | Construction Material | | | Primary with a secondary option | Secondary option | |
| Construction Support | | Work Platform/Crane | | | Primary with a secondary option | Secondary option | |
| | | Employee Lodging | | | Primary without a secondary option | | |

| | |
|---|---|
| (dark green) | Primary without a secondary option |
| (light green) | Primary with a secondary option |
| (yellow) | Secondary option |

### Cost Analysis

The capital and annual O&M costs for each of the transportation components included in this alternative are in Table 22. The capital costs to acquire new equipment are shown in 2014 dollars. Annual O&M costs include labor, fuel, and annualized drydocking costs.

**Table 22**
**Alternative 2 Cost Summary**
Source: Volpe

| Transportation Component | Capital | Annual O & M |
|---|---|---|
| **Ranger IV (C2)** | $22,000,000 ($12,000,000)* | $1,092,000 |
| New Tug for Barge Transport (C7) | $4,500,000 | $45,000 |
| Optimize Certification of Seasonal Crew to Operate Tug and Barge (C8) | $81,000 | $25,000 |
| Continue to use *Greenstone II* Fuel Barge (C10) | $0 | $45,000 |
| Continue to use *Beaver* Work Barge (C11) | $0 | $30,000 |
| Continue to use *Shelter Bay* Tugboat for Barge Transport around ISRO (C12) | $0 | $45,000 |
| Continue to use LCM (C16) | $0 | $30,000 |
| Continue to use Small Boat *Beaver* (C17) | $0 | $3,500 |
| Use Alternative Energy at Houghton to Supply Electrical Power (C18) | $200,000 | $0 |
| **Total** | **$26,781,000 ($16,781,000)*** | **$1,315,500** |
| Baseline (*Ranger III* SLEU) | $18,451,000 | $1,315,500 |
| Estimated Revenue | | $184,000 |

* Capital purchased for the alternatives is expected to last 30 years, except Ranger IV, which has a 55 year expected life. The second value provided is the 30-year equivalent capital layout for Alternative 2.

There are no changes expected to the revenue from concessioner cargo or passengers. Because cargo amounts at moderate visitation are expected to be relatively constant and *Ranger IV* would still be transporting passengers, the change in revenue from current operations should be minimal.

### Implications of the Visitation Projections on Alternative 2

Table 16 describes the needed capacity of the large fleet at the moderate visitation projection. The needed capacities are calculated assuming current service levels (two roundtrips per week). For this alternative, the low and moderate visitation can be easily accommodated by the proposed transportation fleet. Adjustments would be needed to accommodate the high visitation scenario.

*Ranger IV* can be designed with the physical capacity to transport all required passengers, cargo, diesel, and propane with two roundtrips per week at low and moderate visitation levels. Two roundtrips per week, the current service level, would provide enough capacity for concessioner and park cargo, passenger (both visitors and staff) and trash transport. *Greenstone II* would be used two times per year to bring gasoline and AVGAS to Isle Royale.

Because of the length and depths of the docks on ISRO, *Ranger IV* would be limited in overall size. Even if *Ranger IV* is designed to maximize capacity with high visitation levels in mind, *Ranger IV* would not be able to carry the required cargo and passenger loads in two trips per week. Instead, *Ranger IV* would still be required to make additional weekly trips to cover the increased loads. Due to weekly labor hour limits, these additional trips would require supplementary *Ranger IV* crewmembers to cover the increased working hours.

## *Alternative 3 – Crew Boat with Passenger Capacity*

### Summary

Alternative 3 includes the purchase of a new fast crewboat to replace *Ranger III*, which could be used for both logistics and passenger transport. The crewboat would be able to haul bulk material, dry and refrigerated cargo, trash, and fuel in the same capacity as *Ranger III*. The crewboat would also be able to transport between 60 and 80 passengers, which would mainly accommodate park staff and families. In this alternative, a new concessioner passenger ferry would be operated from the mainland[*]. The capital costs are $14,230,000 and the annual O&M costs are $737,500 for this alternative.

The following components are included in this alternative:

C3. Fast Crewboat
C5. Concessioner Services for Passenger Transport from Houghton
C7. New Tug for Barge Transport
C9. Contracted Crew for Gasoline Transport
C10. Continue to use *Greenstone II* Fuel Barge
C12. Continue to use *Shelter Bay* Tugboat for Barge Transport around ISRO
C13. Modular Causeway System and Crane for Construction Support
C16. Continue to use LCM
C17. Continue to use Small Boat *Beaver*
C18. Use Alternative Energy at Houghton to Supply Electrical Power

### Missions Attainment and Redundancy

The key transportation related missions performed by the NPS for the operation of ISRO include the facilitation of passenger travel, the conveyance of cargo, and the use and transport of fuel. Table 23 summarizes how Alternative 3 meets the NPS missions.

[*] A park-owned ferry could be purchased to provide additional visitor transportation services. The costs and benefits would be similar to those described in Alternative 5.

**Table 23**
**Alternative 3 Mission Coverage**
Source: Volpe

| Missions | | | Fast Crewboat (C3) | Concessioner High Speed Ferry (C5) | Use Contracted Crew for Gasoline Transport (C7, C9, C10, C12) | Purchase Modular Causeway System and Crane (C13) | Use LCM (C16) | Use Small Boat *Beaver* (C17) |
|---|---|---|---|---|---|---|---|---|
| Mainland to Island Transport | Passengers | Visitor Transport (High Season) | Secondary option | Primary with a secondary option | | | | |
| | | Visitor Transport (Shoulder Season) | Primary with a secondary option | Secondary option | | | | |
| | | Park Staff/Families | Primary with a secondary option | Secondary option | | | | |
| | Cargo | Passenger Baggage | Secondary option | Primary with a secondary option | | | | |
| | | Refrigerated/Frozen Food | Primary without a secondary option | | | | | |
| | | Non-perishable Food | Primary with a secondary option | | | | Secondary option | |
| | | General Cargo | Primary with a secondary option | | | | Secondary option | |
| | | Construction Material | Secondary option | | | Primary with a secondary option | Secondary option | |
| | Fuel | Diesel | Primary without a secondary option | | | | | |
| | | Propane | Primary without a secondary option | | | | | |
| | | Gasoline | | | Primary without a secondary option | | | |
| | | AVGAS | | | Primary without a secondary option | | | |
| | Trash | General/Bagged | Primary with a secondary option | | | | Secondary option | |
| | | Recyclables | Primary with a secondary option | | | | Secondary option | |
| | | Grease | Primary with a secondary option | | | | Secondary option | |
| | | Fish | Primary with a secondary option | | | | Secondary option | |
| | Boats | Hand Loaded Boats | Secondary option | Primary with a secondary option | | | | |
| | | Power Boats (Visitor) | Primary without a secondary option | | | | | |
| | | Power Boats (NPS) | Primary without a secondary option | | | | | |
| Intra-island Transport | | Bulk Cargo | Secondary option | | | | Primary with a secondary option | |
| | | Food | Secondary option | | | | Secondary option | Primary with a secondary option |
| | | Construction Material | Secondary option | | | Primary with a secondary option | Secondary option | |
| Construction Support | | Work Platform/Crane | | | | Primary with a secondary option | Secondary option | |
| | | Employee Lodging | | | | Primary without a secondary option | | |

| | |
|---|---|
| Dark green | Primary without a secondary option |
| Light green | Primary with a secondary option |
| Yellow | Secondary option |

This alternative adds additional redundancies into the transportation system compared to the status quo. By having passenger transport capabilities on the new crewboat combined with a new concessioner service, there is redundancy in transporting visitors and park staff to the island. Furthermore, the faster speed and lower draft requirements of the crewboat would allow the vessel to be used to access the smaller ports and transport supplies between locations on the island, if needed. However, there remains no redundancy for transport of *Greenstone II*, as ISRO would continue to rely on a contract tugboat crew.

### Cost Analysis

The capital and annual O&M costs for each of the transportation components included in this alternative are in Table 24. The capital costs to acquire new equipment are shown in 2014 dollars. Annual O&M costs include labor, fuel, and annualized drydocking costs.

**Table 24**
**Alternative 3 Cost Summary**
Source: Volpe

| Transportation Option | Capital | Annual O & M |
|---|---|---|
| **New Fast Crewboat (C3)** | $9,000,000 | $564,000 |
| Concessioner Services for Passenger Transport from Houghton (C5) | $0 | $0 |
| New Tug for Gasoline Transport (C7) | $4,500,000 | $0 |
| Contracted Crew with New Tugboat, Shelter Bay, and Greenstone II for Gasoline Transport (C9, C10) | $0 | $135,000 |
| Modular Causeway System and Crane for Construction Support (C13) | $530,000 | $5,000 |
| Continue to use LCM (C16) | $0 | $30,000 |
| Continue to use Small Boat *Beaver* (C17) | $0 | $3,500 |
| Use Alternative Energy at Houghton to Supply Electrical Power (C18) | $200,000 | $0 |
| **Alternative #3 Total** | **$14,230,000** | **$737,500** |
| Baseline (*Ranger III* SLEU) | $18,451,000 | $1,315,500 |
| Estimated Revenue | | $38,000 |

While no changes are expected to the revenue from concessioner cargo, revenue from ticketed passengers is expected to decrease significantly. In this alternative, most passengers would ride the new concessioner ferry to ISRO, as opposed to a park-owned vessel, and therefore most of the passenger revenue would go to the concessioner. However, the concessioner would pay ISRO a percentage of its revenue and a small number of passengers would still be expected to ride the crewboat in the shoulder season, providing some revenue to the park.

### Implications of the Visitation Projections on Alternative 3

Table 16 describes the needed capacity of the large fleet at the moderate visitation projection. The needed capacities are calculated assuming current service levels (two roundtrips per week). For this alternative, the low and moderate visitation can be easily accommodated by the proposed transportation fleet. Adjustments would be needed to accommodate the high visitation scenario.

*Cargo and Complimentary Passenger Transportation*

At low and moderate visitation levels, the crewboat can be designed with the physical capacity to transport all required complimentary passengers, cargo, diesel and propane with two roundtrips per week. With careful cargo planning, it may be possible to reduce the number of weekly trips to one at quieter times during the season. However, the limiting factors on reducing the number of crewboat roundtrips would be the schedule for park staff trips and the transport of trash dumpsters. One roundtrip per week may not provide enough scheduled service for complimentary passengers to go to and from Isle Royale although they could ride the concessioner ferry for a fee. Similarly, the odors and trash storage requirements on Isle Royale may require more frequent transport to Houghton.

To cover higher visitation levels, the crewboat would be required to make a minimum of two trips per week due to cargo capacity. The faster speed of the crewboat would also allow for supplementary weekly trips during high visitation periods, if needed, without requiring additional crewmembers. Additional refrigerated cargo capacity, either permanently or temporary, would have to be installed to cover the increased transport load. Because the number of complimentary passengers is not expected to increase, the crewboat would still be able to transport all park staff and families.

*Greenstone II* would be used two times per year to bring gasoline and AVGAS to Isle Royale. Since this option uses a contracted crew to move *Greenstone II*, the cost would increase incrementally.

*Concessioner Passenger Transportation*

At low and moderate visitation levels, a small concessioner ferry (USCG Subchapter T ferry, typically between 100 and 150 passengers) would have enough capacity to carry all passengers at current service levels, two roundtrips per week. In order to accommodate all passengers at high visitation, a larger ferry or more frequent passenger service would be required from the concessioner, particularly during peak visitation weekends. At high visitation, an average of 151 passengers is expected per trip at the current service level of two roundtrips per week, while peak weekends would see even higher demand.

## *Alternative 4 – Tug, Barge, Concession Passenger Ferry*

### Summary

In Alternative 4, ISRO would continue to perform all logistics transport for the island operations using a new tug and logistics barge. The new tug and barge would be able to haul bulk material, dry and refrigerated cargo, trash, and fuel as currently hauled by *Ranger III*. Additionally, a new concessioner passenger ferry would be operated from the mainland. The capital costs are $5,781,000 and the annual O&M costs are $703,500 for this alternative.

The following components are included in this alternative:

C4. Logistics Barge
C5. Concessioner Services for Passenger Transport from Houghton
C7. New Tug for Barge Transport
C10. Continue to use *Greenstone II* Fuel Barge
C11. Continue to use *Beaver* Work Barge
C12. Continue to use *Shelter Bay* Tugboat for Barge Transport around ISRO
C14. Improve Houghton Dock Infrastructure
C16. Continue to use LCM
C17. Continue to use Small Boat *Beaver*
C18. Use Alternative Energy at Houghton to Supply Electrical Power

### Missions Attainment and Redundancy

The key transportation related missions performed by the NPS for the operation of ISRO include the facilitation of passenger travel, the conveyance of cargo, and the use and transport of fuel. Table 25 summarizes how Alternative 4 meets the NPS missions.

**Table 25**
**Alternative 4 Mission Coverage**
Source: Volpe

| Missions | | | Tug and Logistics Barge (C4, C7, C14) | Concessioner Ferry from Houghton (C5, C14) | Use *Greenstone II* with Tugs (C10, C12, C4) | Use *Beaver* Work Barge with Tugs (C11, C12, C4) | Use LCM (C16) | Use Small Boat *Beaver* (C17) |
|---|---|---|---|---|---|---|---|---|
| Mainland to Island Transport | Passengers | Visitor Transport (High Season) | | Primary without a secondary option | | | | |
| | | Visitor Transport (Shoulder Season) | | Primary without a secondary option | | | | |
| | | Park Staff/Families | | Primary without a secondary option | | | | |
| | Cargo | Passenger Baggage | | Primary without a secondary option | | | | |
| | | Refrigerated/Frozen Food | Primary without a secondary option | | | | | |
| | | Non-perishable Food | Primary with a secondary option | | | | Secondary option | |
| | | General Cargo | Primary with a secondary option | | | | Secondary option | |
| | | Construction Material | Secondary option | | | Primary with a secondary option | Secondary option | |
| | Fuel | Diesel | Primary without a secondary option | | | | | |
| | | Propane | Primary without a secondary option | | | | | |
| | | Gasoline | | | Primary without a secondary option | | | |
| | | AVGAS | | | Primary without a secondary option | | | |
| | Trash | General/Bagged | Primary with a secondary option | | | | Secondary option | |
| | | Recyclables | Primary with a secondary option | | | | Secondary option | |
| | | Grease | Primary with a secondary option | | | | Secondary option | |
| | | Fish | Primary with a secondary option | | | | Secondary option | |
| | Boats | Hand Loaded Boats | | Primary without a secondary option | | | | |
| | | Power Boats (Visitor) | Primary without a secondary option | | | | | |
| | | Power Boats (NPS) | Primary without a secondary option | | | | | |
| Intra-island Transport | | Bulk Cargo | | | | | Primary without a secondary option | |
| | | Food | | | | | Secondary option | Primary with a secondary option |
| | | Construction Material | Secondary option | | | Primary with a secondary option | Secondary option | |
| Construction Support | | Work Platform/Crane | | | | Primary with a secondary option | Secondary option | |
| | | Employee Lodging | | | | Primary without a secondary option | | |

| | |
|---|---|
| (dark green) | Primary without a secondary option |
| (light green) | Primary with a secondary option |
| (yellow) | Secondary option |

### Cost Analysis

The capital and annual O&M costs for each of the transportation options included in this alternative are in Table 26. The capital costs to acquire new equipment are shown in 2014 dollars. Annual O&M costs include labor, fuel, and annualized drydocking costs.

**Table 26**
**Alternative 4 Cost Summary**
Source: Volpe

| Transportation Option | Capital | Annual O & M |
|---|---|---|
| **New Tug and Barge for Cargo Transport (C4, C7)** | $5,581,000 | $460,000 |
| Concessioner Services for Passenger Transport from Houghton (C5) | $0 | $90,000 |
| Continue to use *Greenstone II* Fuel Barge (C10) | $0 | $45,000 |
| Continue to use *Beaver* Work Barge (C11) | $0 | $30,000 |
| Continue to use *Shelter Bay* tugboat for barge transport around ISRO (C12) | $0 | $45,000 |
| Improve Houghton Dock Infrastructure (C14) | $1,500,000 | $0 |
| Continue to use LCM (C16) | $0 | $30,000 |
| Continue to use Small Boat *Beaver* (C17) | $0 | $3,500 |
| Use Alternative Energy at Houghton to Supply Electrical Power (C18) | $200,000 | $0 |
| **Total** | **$7,281,000** | **$703,500** |
| Baseline (*Ranger III* SLEU) | $18,451,000 | $1,315,500 |
| Estimated Revenue | | $30,000 |

While no changes are expected to the revenue from concessioner cargo compared to existing conditions, there would no longer be revenue generated from ticketed passengers. In this alternative, all passengers would ride the new concessioner ferry to ISRO, as opposed to a park-owned vessel, and therefore all of the passenger revenue would go to the concessioner. Furthermore, the park may be charged for previously complimentary passengers riding the concessioner ferry, further increasing costs. However, the concessioner would pay ISRO a percentage of its revenue, providing a small amount of revenue to the park.

### Implications of the Visitation Projections on Alternative 4

In order to support the transportation needs of the park in the future, Table 16 describes the needed capacity of the large fleet at the moderate visitation projection. The needed capacities are calculated assuming current service levels (two roundtrips per week). For this alternative, the low and moderate visitation can be easily accommodated by the proposed transportation fleet. Adjustments would be needed to accommodate the high visitation scenario.

*Cargo Transportation*

At low and moderate visitation levels, the barge can be designed with the physical capacity to transport all required cargo, diesel, and propane with two roundtrips per week. With careful cargo planning, it may be possible to reduce the number of weekly trips to one at quieter times during the season. However, the limiting factor on reducing the number of barge roundtrips would be the transport of trash dumpsters. One roundtrip per week throughout the season may not provide enough scheduled service for trash movement; the odors and trash storage requirements on ISRO may require more frequent transport to Houghton.

To cover higher visitation demand, the barge would be required to make a minimum of two trips per week due to cargo capacity, with the possibility of additional trips during the peak season. Additional refrigerated cargo capacity, either permanently or temporary, may have to be installed to cover the increased transport load.

*Greenstone II* would be used two times per year to bring gasoline and AVGAS to Isle Royale in the high visitation scenario.

*Concessioner Passenger Transportation*

At low and moderate visitation levels, a small concessioner ferry (USCG Subchapter T ferry, typically between 100 and 150 passengers) would have enough capacity to carry all passengers at current service levels, two roundtrips per week. In order to accommodate all passengers at high visitation, a larger ferry or more frequent passenger service would be required from the concessioner, particularly during peak visitation weekends.

## *Alternative 5 – Tug, Barge, and Park Operated Passenger Ferry*

**Summary**

In Alternative 5, ISRO would continue to perform all logistics transport for the island operations using a new tug and logistics barge. The new tug and barge would be able to haul bulk material, dry and refrigerated cargo, trash, and fuel as currently hauled by *Ranger III*. Additionally, the park would purchase and operate a high speed ferry. The ferry would be used to transport park staff, families, and visitors from Houghton to ISRO. This alternative is similar to Alternative 4, except a park-operated ferry would provide jobs for existing staff and less risk for the park. Within this alternative, there are two options for operating locations for the new ferry. The ferry could operate from a relocated dock at the end of the Keweenaw Canal (Alternative 5a) [*] or could continue to operate from an improved dock at the current ISRO Headquarters (Alternative 5b). Operating the ferry from a relocated dock at the end of the Keweenaw Canal would significantly reduce transit time to Isle Royale from five hours to three hours each way. This would allow for day trips to the island and may increase visitor interest in service from Houghton relative to the other maritime options. However, operating a second facility will add to ISRO's O&M costs due to the added labor, maintenance, heat, and electricity requirements.

The following components are included in this alternative:

C4. Logistics Barge
C6. New Park-Owned High Speed Ferry for Passenger Transport
C7. New Tug for Barge Transport
C10. Continue to use *Greenstone II* Fuel Barge
C11. Continue to use *Beaver* Work Barge
C12. Continue to use *Shelter Bay* Tugboat for Barge Transport around ISRO
C14. Improve Houghton Dock Infrastructure (5b) –or–
    C15. Relocate Ferry Dock to End of Keweenaw Canal (5a)
C16. Continue to use LCM
C17. Continue to use Small Boat *Beaver*
C18. Use Alternative Energy at Houghton to Supply Electrical Power

[*] Moving the dock to end of Keweenaw Canal could be considered for Alternative 4 as well.

## Missions Attainment and Redundancy

The key transportation related missions performed by the NPS for the operation of ISRO include the facilitation of passenger travel, the conveyance of cargo, and the use and transport of fuel. Table 27 summarizes how Alternative 5 meets the NPS missions.

**Table 27**
**Alternative 5 Mission Coverage**
Source: Volpe

| Missions | | | New Tug and Logistics Barge (C4, C7) | Park-Owned High Speed Ferry (C6) | Use *Greenstone II* with Tugs (C10, C12) | Use *Beaver* Work Barge with Tugs (C11, C12) | Use LCM (C16) | Use Small Boat *Beaver* (C17) |
|---|---|---|---|---|---|---|---|---|
| Mainland to Island Transport | Passengers | Visitor Transport (High Season) | | | | | | |
| | | Visitor Transport (Shoulder Season) | | | | | | |
| | | Park Staff/Families | | | | | | |
| | Cargo | Passenger Baggage | | | | | | |
| | | Refrigerated/Frozen Food | | | | | | |
| | | Non-perishable Food | | | | | | |
| | | General Cargo | | | | | | |
| | | Construction Material | | | | | | |
| | Fuel | Diesel | | | | | | |
| | | Propane | | | | | | |
| | | Gasoline | | | | | | |
| | | AVGAS | | | | | | |
| | Trash | General/Bagged | | | | | | |
| | | Recyclables | | | | | | |
| | | Grease | | | | | | |
| | | Fish | | | | | | |
| | Boats | Hand Loaded Boats | | | | | | |
| | | Power Boats (Visitor) | | | | | | |
| | | Power Boats (NPS) | | | | | | |
| Intra-island Transport | | Bulk Cargo | | | | | | |
| | | Food | | | | | | |
| | | Construction Material | | | | | | |
| Construction Support | | Work Platform/Crane | | | | | | |
| | | Employee Lodging | | | | | | |

| | |
|---|---|
| Primary without a secondary option | Secondary option |
| Primary with a secondary option | |

### Cost Analysis

The capital and annual O&M costs for each of the transportation options included in this alternative are in Table 28 (5a) and Table 29 (5b). The capital costs to acquire new equipment are shown in 2014 dollars. Annual O&M costs include labor, fuel, and annualized drydocking costs.

**Table 28**
**Alternative 5a Cost Summary – Relocating the Dock to the End of the Canal**
Source: Volpe

| Transportation Option | Capital | Annual O & M |
|---|---|---|
| **New Tug and Barge for Cargo Transport (C4, C7)** | $5,581,000 | $460,000 |
| Park-Owned High Speed Ferry for Passenger Transport (C6) | $4,700,000 | $376,000 |
| Continue to use *Greenstone II* Fuel Barge (C10) | $0 | $45,000 |
| Continue to use *Beaver* Work Barge (C11) | $0 | $30,000 |
| Continue to use *Shelter Bay* Tugboat for Barge Transport around ISRO (C12) | $0 | $45,000 |
| Relocate Ferry Dock to End of Keweenaw Canal (C15) | $4,100,000 | $100,000 |
| Continue to use LCM (C16) | $0 | $30,000 |
| Continue to use Small Boat *Beaver* (C17) | $0 | $3,500 |
| Use Alternative Energy at Houghton to Supply Electrical Power (C18) | $200,000 | $0 |
| **Total** | **$14,581,000** | **$1,089,500** |
| Baseline (*Ranger III* SLEU) | $18,451,000 | $1,315,500 |
| Estimated Revenue | | $184,000 |

**Table 29**
**Alternative 5b Cost Summary – Dock Improvements in Houghton**
Source: Volpe

| Transportation Option | Capital | Annual O & M |
|---|---|---|
| **New Tug and Barge for Cargo Transport (C4, C7)** | $5,581,000 | $460,000 |
| Park-Owned High Speed Ferry for Passenger Transport (C6) | $4,700,000 | $378,000 |
| Continue to use *Greenstone II* Fuel Barge (C10) | $0 | $45,000 |
| Continue to use *Beaver* Work Barge (C11) | $0 | $30,000 |
| Continue to use *Shelter Bay* Tugboat for Barge Transport around ISRO (C12) | $0 | $45,000 |
| Improve Houghton Dock Infrastructure (C14 ) | $1,500,000 | $0 |
| Continue to use LCM (C16) | $0 | $30,000 |
| Continue to use Small Boat *Beaver* (C17) | $0 | $3,500 |
| Use Alternative Energy at Houghton to Supply Electrical Power (C18) | $200,000 | $0 |
| **Total** | **$11,981,000** | **$991,500** |
| Baseline (*Ranger III* SLEU) | $18,451,000 | $1,315,500 |

There are no changes expected in the revenue from concessioner cargo or passengers. Because cargo amounts at moderate visitation are expected to be relatively constant and passengers would be transported on a park-owned ferry, the change in revenue from current operations is expected to be minimal.

### Implications of the Visitation Projections on Alternative 5

In order to support the transportation needs of the park in the future, Table 16 describes the needed capacity of the large fleet at the moderate visitation projection. The needed capacities are calculated assuming current service levels (two roundtrips per week). For this alternative, the low and moderate visitation can be easily accommodated by the proposed transportation fleet. Adjustments would be needed to accommodate the high visitation scenario.

*Cargo Transportation*

At low and moderate visitation levels, the barge can be designed with the physical capacity to transport all required cargo and fuel with two roundtrips per week. With careful cargo planning, it may be possible to reduce the number of weekly trips to one at quieter times during the season. However, the limiting factor on reducing the number of barge roundtrips would be the transport of trash dumpsters. One roundtrip per week throughout the season may not provide enough scheduled service for trash movement; the odors and trash storage requirements on ISRO may require more frequent transport to Houghton.

To cover higher visitation levels, the barge would be required to make a minimum of two trips per week due to cargo capacity, with the possibility of additional trips during the peak season. Additional refrigerated cargo capacity, either permanently or temporary, may have to be installed to cover the increased transport load.

*Greenstone II* would be used two times per year to bring gasoline and AVGAS to Isle Royale in the high visitation scenario.

*Passenger Transportation*

At low and moderate visitation levels, a small high-speed ferry (USCG Subchapter T ferry, typically between 100 and 150 passengers) would have enough capacity to carry all passengers at current service levels, two roundtrips per week. In order to accommodate all passengers at high visitation, a larger ferry or more frequent passenger service would be required, particularly during peak visitation weekends.

## *Alternative 6 – Accommodating High Visitation Rates*

### Summary

As opposed to Alternatives 1 – 5, which are designed to accommodate the moderate and low visitation projections, Alternative 6 was developed to accommodate the high visitation projection. In Alternative 6, the projected high visitation levels would be covered by a combination of new equipment and a more frequent schedule. ISRO would continue to perform all logistics transport for the island operations using a new crewboat. The crewboat would be able to haul bulk material, dry and refrigerated cargo, trash, and fuel in the same capacity as *Ranger III*, but because of the faster speed, the crewboat can make more trips each week to cover the larger cargo requirements. With the increased cargo load at high visitation, the crewboat would have to make at least four roundtrips per week, compared to the two roundtrips per week currently made by *Ranger III*. A three person crew would be able to make four roundtrips per week with minimal overtime. The crewboat would also be able to transport between 60 and 80 passengers, either park staff and families or a small percentage of the visitors, providing primary transport in the shoulder-season or supplemental visitor transportation during peak periods.

Additionally, a new park-operated high speed passenger ferry would be operated from the mainland. To ensure adequate passenger transport capacity, the ferry would make at least four roundtrips per week at high visitation.

The capital costs are $18,481,000 and the annual O&M costs are $1,812,500 for this alternative.

The following components are included in this alternative:

- C3. Fast Crewboat
- C6. Park-Owned High Speed Ferry for Passenger Transport
- C7. New Tug for Barge Transport
- C8. Optimize Certification of Seasonal Crew to Operate Tug and Barges
- C10. Continue to use Greenstone II Fuel Barge
- C11. Continue to use Beaver Work Barge
- C12. Continue to use Shelter Bay Tugboat for Barge Transport around ISRO
- C14. Improve Houghton Dock Infrastructure
- C16. Continue to use LCM
- C17. Continue to use Small Boat *Beaver*
- C18. Use Alternative Energy at Houghton to Supply Electrical Power

### Missions Attainment and Redundancy

The key transportation related missions performed by the NPS for the operation of ISRO include the facilitation of passenger travel, the conveyance of cargo, and the use and transport of fuel. Table 30, on the following page, summarizes how Alternative 6 meets the NPS missions.

**Table 30**
**Alternative 6 Mission Coverage**
Source: Volpe

| Missions | | | Fast Crewboat (C3) | Park-Owned High Speed Ferry (C6) | Use *Greenstone II* with tugs (CC7, 10, C12) | Use *Beaver* Work Barge with tugs (C7, C11, C12) | Use LCM (C16) | Use Small Boat *Beaver* (C17) |
|---|---|---|---|---|---|---|---|---|
| Mainland to Island Transport | Passengers | Visitor Transport (High Season) | Secondary option | Primary with a secondary option | | | | |
| | | Visitor Transport (Shoulder Season) | Secondary option | Primary with a secondary option | | | | |
| | | Park Staff/Families | Primary with a secondary option | Secondary option | | | | |
| | Cargo | Passenger Baggage | Secondary option | Primary with a secondary option | | | | |
| | | Refrigerated/Frozen Food | Primary without a secondary option | | | | | |
| | | Non-perishable Food | Primary with a secondary option | | | | Secondary option | |
| | | General Cargo | Primary with a secondary option | | | | Secondary option | |
| | | Construction Material | Secondary option | | | Primary with a secondary option | Secondary option | |
| | Fuel | Diesel | Primary without a secondary option | | | | | |
| | | Propane | Primary without a secondary option | | | | | |
| | | Gasoline | | | Primary without a secondary option | | | |
| | | AVGAS | | | Primary without a secondary option | | | |
| | Trash | General/Bagged | Primary with a secondary option | | | | Secondary option | |
| | | Recyclables | Primary with a secondary option | | | | Secondary option | |
| | | Grease | Primary with a secondary option | | | | Secondary option | |
| | | Fish | Primary with a secondary option | | | | Secondary option | |
| | Boats | Hand Loaded Boats | Secondary option | Primary with a secondary option | | | | |
| | | Power Boats (Visitor) | Primary without a secondary option | | | | | |
| | | Power Boats (NPS) | Primary without a secondary option | | | | | |
| Intra-island Transport | | Bulk Cargo | Secondary option | | | | Primary with a secondary option | |
| | | Food | Secondary option | | | | Secondary option | Primary with a secondary option |
| | | Construction Material | Secondary option | | | Primary with a secondary option | Secondary option | |
| Construction Support | | Work Platform/Crane | | | | Primary with a secondary option | Secondary option | |
| | | Employee Lodging | | | | Primary without a secondary option | | |

| | |
|---|---|
| (dark green) | Primary without a secondary option |
| (light green) | Primary with a secondary option |
| (yellow) | Secondary option |

### Cost Analysis

The capital and annual O&M costs for each of the transportation options included in this alternative are in Table 31. The capital costs to acquire new equipment are shown in 2014 dollars. Annual O&M costs include labor, fuel, and annualized drydocking costs. Annual O&M costs in this alternative are higher than in the other alternatives because of the higher labor, fuel and maintenance costs associated with more frequent service.

**Table 31**
**Alternative 6 Cost Summary**
Source: Volpe

| Transportation Option | Capital | Annual O & M |
|---|---|---|
| **Fast Crewboat (C3)** | $9,000,000 | $952,000 |
| **Use Park-Owned High Speed Ferry for Passenger Transport (C6)** | $4,700,000 | $547,000 |
| New Tug for Barge Transport (C7) | $4,500,000 | $55,000 |
| Optimize certification distribution of crew to operate tug and barge (C8) | $81,000 | $105,000 |
| Continue to use *Greenstone II* Fuel Barge (C10) | $0 | $45,000 |
| Continue to use *Beaver* Work Barge (C11) | $0 | $30,000 |
| Continue to use *Shelter Bay* tugboat for barge transport around ISRO (C12) | $0 | $45,000 |
| Improve Houghton Dock Infrastructure (C14) | $1,500,000 | $0 |
| Continue to use LCM (C16) | $0 | $30,000 |
| Continue to use Small Boat *Beaver* (C17) | $0 | $3,500 |
| Use Alternative Energy at Houghton to Supply Electrical Power (C18) | $200,000 | $0 |
| **Total** | **$19,981,000** | **$1,812,500** |
| Baseline (*Ranger III* SLEU) | $18,451,000 | $1,315,500 |
| Estimated Revenue | | $510,000 |

Because of the higher visitation and increased service levels, revenue is expected to increase from both concessioner cargo and passengers. The increased concessioner cargo requirements for food, fuel, and supplies would increase the transport fee paid by the concessioner, and the increased ticket sales of passengers riding the park-owned ferry would provide additional revenue to the park.

### Implications of the Visitation Projections on Alternative 6

In order to support the high visitation transportation needs of the park in the future, Table 32 describes the needed capacity of the large fleet at the high visitation projection. This alternative assumes similar fleet and crew as Alternative 3, but requires more labor hours by the crew. Instead of performing the current two roundtrips per week, this alternative assumes both the crewboat and high speed ferry would make four roundtrips per week to cover the increased cargo and passenger demand. For this alternative, the low and moderate visitation can also be easily accommodated by the proposed transportation fleet by adjusting the frequency of trips.

**Table 32**
**Alternative 6 Required Capacity for High Visitation (4 Roundtrips per Week)**
Source: Volpe

| Vessel | Cargo Type | Shoulder Season | Peak Season |
|---|---|---|---|
| **New Crewboat** | Carts, Bags, Foods, Bulk Cargo, Etc. | 8 tons | 14 tons |
| | Refrigerated Cargo | 140 cu. ft. | 441 cu. ft. |
| | Trash | 3 dumpsters | 5 dumpsters |
| | Boats | 1 boat | 2 boats |
| | Propane | 65 bottles | 0 bottles |
| | Diesel | 9,500 gallons | 9,500 gallons |
| | Complimentary Passengers | 16 passengers | 16 passengers |
| *Greenstone II* | Gasoline and AVGAS | 1 trip | 1 trip |
| **New High Speed Ferry** | Visitors | 28 passengers | 73 passengers |
| | Baggage | 2 tons | 2 tons |

*Cargo Transportation*

At high visitation levels, the crewboat can be designed with the physical capacity to transport all required cargo, diesel, and propane with four roundtrips per week. With careful cargo planning, it may be possible to reduce the number of weekly trips at quieter times during the season. However, the limiting factor on reducing the number of crewboat roundtrips would be the transport of trash dumpsters. Fewer roundtrips per week may not provide enough scheduled service for trash movement; the odors and trash storage requirements on ISRO may require more frequent transport to Houghton.

*Greenstone II* would be used two times per year to bring gasoline and AVGAS to Isle Royale.

*Passenger Transportation*

At high visitation levels, a small high-speed ferry (USCG Subchapter T ferry, typically between 100 and 150 passengers) would have enough capacity to carry all passengers with four roundtrips per week.

## *Implementation of Components*

The following implementation considerations assume that the alternative would be fully in place for the 2019 park season. This would allow a plan to be in place for the upgrade or replacement of R*anger III* prior to its five-year required drydocking at the end of the 2018 park season.

### Ranger III SLEU (Alternative 1 only)

If the SLEU is to be undertaken, the ideal time would be during the next drydocking in the fall of 2018. To accommodate this schedule, the specifications would need to be submitted to the contracting officer by January 2018. Assuming that it would take approximately two years to develop the conceptual design, the preliminary specifications would need to be completed by early 2016. The specifications should be of sufficient detail that a shipyard could create a conceptual design of modifications and upgrades taking place. Based on the SLEU package, the proposed design engineering costs are estimated to be approximately $3,100,000.

### Ranger III Replacement (Alternatives 2, 3, 4, 5, and 6)

Before building a new vessel, preliminary specifications for the vessel would have to be prepared. The specifications should be of sufficient detail that a design firm could create a conceptual design of the new vessel. The specifications should include items such as the approximate size of the vessel, speed requirements, crew size and housing requirements, minimum cargo capacity to support each mission, and a preliminary list of appropriate regulations. The costs to prepare preliminary specifications and conceptual design are estimated to be 10% of the capital costs of the new vessel.

The estimated construction period of a new vessel is 18 months. To accommodate this schedule, the conceptual design for any vessel would need to be completed by Summer 2017. Assuming that it would take approximately two years to develop the conceptual design, the preliminary specifications would need to be completed by Summer 2015.

*Ranger III* would also have to be decommissioned and either transferred to another group or re-purposed. It is unlikely that another government agency would have use for *Ranger III*; however, *Ranger III* may serve well as a museum ship or as a training vessel at a maritime school. A potential museum opportunity may be the Door County Maritime Museum in Sturgeon Bay, WI, which is across the river from Bay Shipbuilding, the current operator of the shipyard that originally built *Ranger III*. The Great Lakes Maritime Academy in Traverse City, MI may also have interest in acquiring *Ranger III* as a second large training vessel. A plan should be in place to coordinate the decommissioning of *Ranger III* with the delivery of the new tug and barge.

### Prepare Plans to Accommodate a Separate Ferry (Alternatives 3, 4, 5, and 6)

If ISRO decides to use a dedicated high-speed ferry, either park-owned or concessioner operated from Houghton, the park will have to upgrade its docking facilities to allow for the new vessel. The two main options for docking the ferry are improving the Houghton Dock or relocating the ferry dock to the end of Keweenaw Canal. The implementation considerations of each of these options are detailed below.

<u>Improve Houghton Dock</u>

The park should determine the condition of the unimproved property and any environmental issues with the property (e.g., contamination). If the park decides to move forward with improving the Houghton dock, plans should be developed for all modifications, upgrades, and new structures to be built in Houghton.

The estimated construction period for all of the modifications is approximately 12 months; however, this schedule is subject to unforeseen constraints that may be revealed during the more detailed site investigation. To accommodate this estimated schedule, the conceptual design would need to be completed by Winter 2017. Assuming that it would take a year to develop the conceptual design, the preliminary specifications would need to be completed by Winter 2016.

<u>Relocate Ferry Dock to End of Keweenaw Canal</u>

A more detailed examination of the Coast Guard property should be conducted. The park should determine the current owner of the property, the condition of all structures, and any environmental issues with the property (e.g., contamination, asbestos, lead paint). A Keweenaw Canal North Entry wave action study should be performed to ensure that the location of the new dock will not be subject to storm waves and damage. If the park decides to move forward with this option, plans should be developed for all modifications, upgrades, and new structures to be built at the facility.

The estimated construction period for all of the modifications is approximately 18 months; however, this schedule is subject to unforeseen constraints that may be revealed during the more detailed site investigation. To accommodate this estimated schedule, the conceptual design would need to be completed by Summer 2017. Assuming that it would take a year to develop the conceptual design, the preliminary specifications would need to be completed by Summer 2016.

#### Concessioner Ferry (Alternative 3 and 4)

If ISRO decides to replace park-operated passenger services with a new concessioner, a request for information (RFI) should be developed to determine interest in a concessioner opportunity for passenger transport from Houghton. Coordination would also be necessary with the existing passenger concessioner services. When opening up the actual opportunity, negotiations may be required to ensure reduced or complimentary trips are offered for ISRO staff or families. The contract would need to be in place for the 2019 season.

#### New Tugboat (Alternatives 1, 2, 3, and 6)

Preliminary specifications for the new tugboat would have to be prepared prior to starting construction. The specifications should be of sufficient detail that a design firm could create a conceptual design of the new tugboat. The specifications should include items such as the approximate size of the vessel, approximate horsepower requirements, crew size and housing requirements, and a preliminary list of appropriate regulations. The costs to prepare preliminary specifications and conceptual design are estimated to be 10% of the capital costs of the new tug, or $450,000.

The estimated construction period of the tug is 15 months. To accommodate this schedule, the conceptual design would need to be completed by Fall 2017. Assuming that it would take approximately two years to develop the conceptual design, the preliminary specifications would need to be completed by Fall 2015.

#### Certify Crewmembers for Tugboat Operations (Alternatives 1, 2, 4, 5, and 6)

The two crewmembers that would operate the tugboat and barges would have to undergo training. The AB can attend training at the Maritime Institute of Technology and Graduate Studies (MITAGS) in Baltimore, MD for a ten week course. The tankerman could also attend training at MITAGS for one week. However, the tankerman license also requires nine weeks of on-the-job training. This could be gained on *Ranger III* or *Shelter Bay* during the season or it could be gained through the Tankerman's course at the Tankerman Career Academy. The crewmembers would get the trainee work on a tanker ship for nine weeks during the winter season. The cost to retrain crewmembers, including labor hours during on-the-job training, is estimated to be $81,000.

Training of *Ranger III* crewmembers could take place at any time. Once the crewmembers gain licensure to operate the tugboat and barges, ISRO would no longer be required to contract for transport services.

#### Modular Causeway System (Alternative 3 only)

If a modular causeway system is chosen to be acquired, the causeway sections can be purchased directly from the manufacturer in standard sizes. Construction of the sections is estimated to take approximately six months.

A portable crane can be purchased from several distributors through the General Services Administration (GSA). Delivery time is typically between four and six months after order.

The work barge *Beaver* would also have to be decommissioned. It is unlikely that another government agency would have use for *Beaver*; however, *Beaver* may be sold to a private entity or re-purposed.

### Continue Regular Maintenance on Existing Fleet (All Alternatives)

ISRO shall continue to perform in-house regular maintenance on its other assets to ensure that they are in optimal operating condition should this alternative be implemented. Regularly scheduled maintenance should be programmed into the Park Asset Management Plan (PAMP).

### Install Alternative Energy Equipment or Purchase Alternative Energy Credits (All Alternatives)

An alternative energy analysis for Houghton should be performed. This would best determine the appropriate methods of obtaining alternative energy, either by generation through wind turbines or solar panels, or through purchasing alternative energy credits.

## Conclusions

This transportation study identifies six distinct alternatives to achieve ISRO's transportation-related missions over the next 30 or more years. Table 33 provides a summary of the relative costs for each alternative. In addition to differences in cost, each alternative presumes a substantially different way of doing business with unique considerations of feasibility and risk. Some key risks include the long-term availability and cost of contracting or relying on concessioners to provide key park missions. Other risks may be tied to designing and constructing a unique vessel/vessel components, such as those needed for Alternative 1 and 2. The ability for the park (or concessions services) to hire, train and keep staff with the required skills and training to complete the parks missions is another consideration. Historically, the park has had trouble finding adequately trained staff.

**Table 33**
**Costs of Alternatives**
Source: Volpe

| Alternative | Capital Cost | Annual O&M Cost | Annual Revenue | Total Cost of Facility Ownership |
|---|---|---|---|---|
| Alternative 1 – *Ranger III* Service Life Extension and Upgrades (SLEU) | $18,451,000 | $1,315,500 | $184,000 | $57,916,000 |
| Alternative 2 – Build a New *Ranger IV* | $26,781,000 ($16,781,000)* | $1,315,500 | $184,000 | ($56,246,000)* |
| Alternative 3 – Crew Boat with Passenger Capacity | $14,230,000 | $737,500 | $38,000 | $36,355,000 |
| Alternative 4 – Tug and Barge + Concessioner Ferry | $7,281,000 | $703,500 | $30,000 | $28,386,000 |
| Alternative 5 – Tug and Barge + Park-Operated Ferry | (a) $14,581,000 (b) $11,981,000 | (a) $1,089,500 (b) $991,500 | (a) $184,000 (b) $184,000 | (a) $47,266,000 (b) $41,726,000 |
| Alternative 6 – High Visitation | $19,981,000 | $1,812,500 | $510,000 | $74,356,000 |

* Capital purchased for the alternatives is expected to last 30 years, except *Ranger IV*, which has a 55 year expected life. The second value provided is the 30-year equivalent capital layout for Alternative 2.

Alternative 1, a Service Life Extension and Upgrade of *Ranger III*, is most similar to existing conditions, or "status quo"; however, it also has a high initial capital cost and high annual O&M costs.

While Alternative 2, building a new *Ranger IV*, has a higher capital cost, when this cost is amortized over the life of the vessel*, it makes a compelling case for replacement of *Ranger III*. A new vessel allows more flexibility than working within the constraints of the current layout and systems of *Ranger III*, similar to the difference between remodeling a house and building from scratch.

The remaining alternatives require ISRO to develop a different operating structure, separating visitor transportation from other activities. In many cases current ISRO maritime staff's job duties may change significantly and in some cases additional training may be required. For example, Alternative 3, use of a

* *Ranger IV* is expected to have a lifespan of 55 years, the life of *Ranger III* to date. All other major investments were estimated to have a 30-year lifespan.

Crew Boat, and Alternative 4, Tug and Barge with Concession Ferry, reduce the number of NPS maritime staff, relying on concessioners to provide passenger service.

That said, Alternative 3 provides the most redundancy of systems since the Crew Boat does have some passenger capacity. Alternative 3 also includes purchase of a modular causeway for on-island construction projects increasing options for work in and around Isle Royale. Conversely, it is the only option that does not use ISRO staff to operate the tug, leaving fuel transport as a contracted service into the future.

Alternative 4, using a Concessioner Ferry with a Tug and Barge, is similar to Alternative 5, in which ISRO owns and operates the ferry. It has the lowest capital and operating costs, but also relies on the most services being provided by outside providers, which is typically seen as a higher risk.

The high speed ferry Alternatives 5a and 5b have moderate O&M costs but relatively high initial costs as they include purchase of a new barge as well as a separate passenger ferry. Alternative 5a involves moving the ferry dock to a new location closer to the opening of the canal, which cuts the travel time from five hours to three hours, compared to 5b, which upgrades the existing dock in Houghton. While moving the dock has significant travel benefits for visitors, it is high risk because of the uncertainty surrounding acquisition and construction of a new property and the need to operate two facilities. If the new dock location is considered, the shorter travel time may increase the proportion of visitors who want to use that service. Especially if day visitation is expected to increase, passenger demand may need to be revisited to ensure an appropriately sized ferry is procured.

Length and draft restrictions of the Rock Harbor and Windigo docks limit the size of vessels that can be considered in order to meet the high visitation scenario. Alternative 6, proposes accommodating the high visitor and cargo loads by purchasing the flexible Crew Boat as well as a high-speed passenger ferry and operating at more than twice weekly round trips during the peak season. Since this alternative builds on alternatives that work at lower visitation levels, the park could make the capital investments as visitation grows.

There is not a single recommended alternative; instead, the National Park Service will need to carefully consider its priorities for the park moving forward, and select an alternative that best maximizes these priorities. The information provided within this report, particularly the Alternatives Analysis section, will serve as a resource for the decision making process.

## *Next Steps*

Given that *Ranger III* is expected to undergo its next required dry-docking in 2018, Volpe proposes that the implementation of the selected approach be in place for the 2019 season. In order to do this, planning and design work would need to begin in 2016. While it is technically feasible to implement a new transportation system starting in 2019, arranging funding for the significant costs of the new fleet will be challenging. Yet if funding to implement the preferred solution is not available to allow implementation of the alternative before the 2018 dry-dock, ISRO will have to absorb those additional costs.

Due to the high capital costs of the ISRO transportation system, ISRO will need to identify funding opportunities and develop a funding strategy. In addition, given the size of this project, strong partnership and buy-in among the NPS Unit, Region and Headquarters, will be necessary for successful project implementation. If the project looks to non-NPS funding sources, the park will need to develop strong local and state partners.

### Analysis and Selection of an appropriate Alternative

The park should consider organizing a value analysis workshop that incorporates Choosing By Advantages (CBA) to define the preferred alternative. Since the alternatives include significant differences in operating characteristics, CBA will allow the implications of these to be valued in addition to the financial factors. A risk analysis should be incorporated into the decision-making process. Due to the expected cost, the park should reach out to the Development Advisory Board (DAB), to determine if the project will have to be reviewed by the DAB. Based on the required effort to go through the review and approval process, ISRO should begin outreach and establish a timeline for decision-making and procurement as soon as possible.

### Research and Secure Funding

Regardless of which alternative is selected, funding will be a primary concern. The NPS Washington Office Park Facilities Management Division specifically identifies the need to replacement *Ranger III* in its Long Range Transportation Plan and in its surface transportation bill reauthorization resource paper.

NPS has two funding sources that may have the money available for implementation of the preferred alternative, the Line Item Construction Program and the Transportation Fee Program. The Line Item Construction Program spends approximately $60 million annually and is a highly competitive program as it spans all major infrastructure needs, and focuses on addressing the highest priority requirements based on a combination of the Capital Investment Strategy and Department of Interior's project scoring/priority setting guidance. Historically, transportation projects across all parks have captured $11 million annually from Line Item Construction[*]. The Recreation Fee Program is another opportunity to fund major capital investments. In past approximately $175million has been collected nationally through the Fee program, with approximately 80% reserved for those parks collecting fees, leaving approximately $35 million for projects ranked and chosen by the Director. Of the 20% available to all parks, an average of $4.5 million has been spent on transportation projects although since 2008, this value has steadily declined[†]. The operating budget of ISRO is $4.1 million, little of which is available for capital projects, particularly of this magnitude.

Federal Highway Administration also has funding sources that may be available for use for replacement of *Ranger III*. Within NPS, the Federal Lands Transportation Program (FLTP) would define replacement of *Ranger III* as an alternative transportation system (ATS) project, or "Category 3" project. Category 3 encompasses all modes of surface transportation beyond traditional roadways and private vehicles, including motorized and non-motorized land and water-based transportation systems. FLTP funds, including Category III funds are allocated by formula to regions. Recently, the MWR has received $1.4 million in Cat III funds. The region's total annual budget would make a small dent in ISRO's total capital need. In addition, ISRO is eligible for formula funds for the Ferry Boat Program (FBP), which allocated just under $0.24 million to ISRO in 2014. For more information on this program, see the *National Park Service Primer on the Construction of Ferry Boats and Ferry Terminal Facilities Program*[‡].

Finally, the White House proposed transportation bill, the GROW AMERICA Act, allocates $150 million to fund Nationally Significant Federal Lands and Tribal Projects. If this program becomes law, it may be a source of funding for replacement of Ranger III as it has been identified by NPS as a currently unfunded necessary large project. In addition, the President's 2016 budget proposal sets aside $1.5 billion through 2020 for Centennial activities, the details of which have not yet been made clear.

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[*] Based on 2006-2012 data collected for the National Long Range Transportation Plan.

[†] Based on 2006-2012 data collected for the National Long Range Transportation Plan.

[‡] http://www.nps.gov/transportation/pdfs/NPS_WASO_2014_Ferry_Boat_Program.pdf

## Appendix A Detailed Missions Analysis

NOTE: A summary of the key findings of this Appendix is provided in the body of this report.

As a national park, one of ISRO's key missions is to provide opportunities for recreational uses and experience. In order for visitors to experience ISRO, they need to be able to access the remote island and have the staff and infrastructure to facilitate their visit. This appendix provides additional detail beyond those provided in the Missions Analysis on the key transportation missions performed by the ISRO for the operation of the park. These missions include the facilitation of passenger travel, the conveyance of cargo, and the use and transport of fuel. The key missions are shown in Figure A-1.

**Figure A-1**
**ISRO Transportation Missions**
Source: Volpe

**Mainland to Island Transport**

**Passengers**
Visitor Transport (High Season)
Visitor Transport (Shoulder Season)
Park Staff/Families

**Cargo**
Passenger Baggage
Refrigerated/Frozen Food
Non-perishible Food
General Cargo
Construction Material

**Fuel**
Diesel
Propane
Gasoline
AvGas

**Trash**
General/Bagged
Recyclables
Grease
Fish

**Boats**
Hand Loaded Boats
Power Boats (Visitor)
Power Boats (NPS)

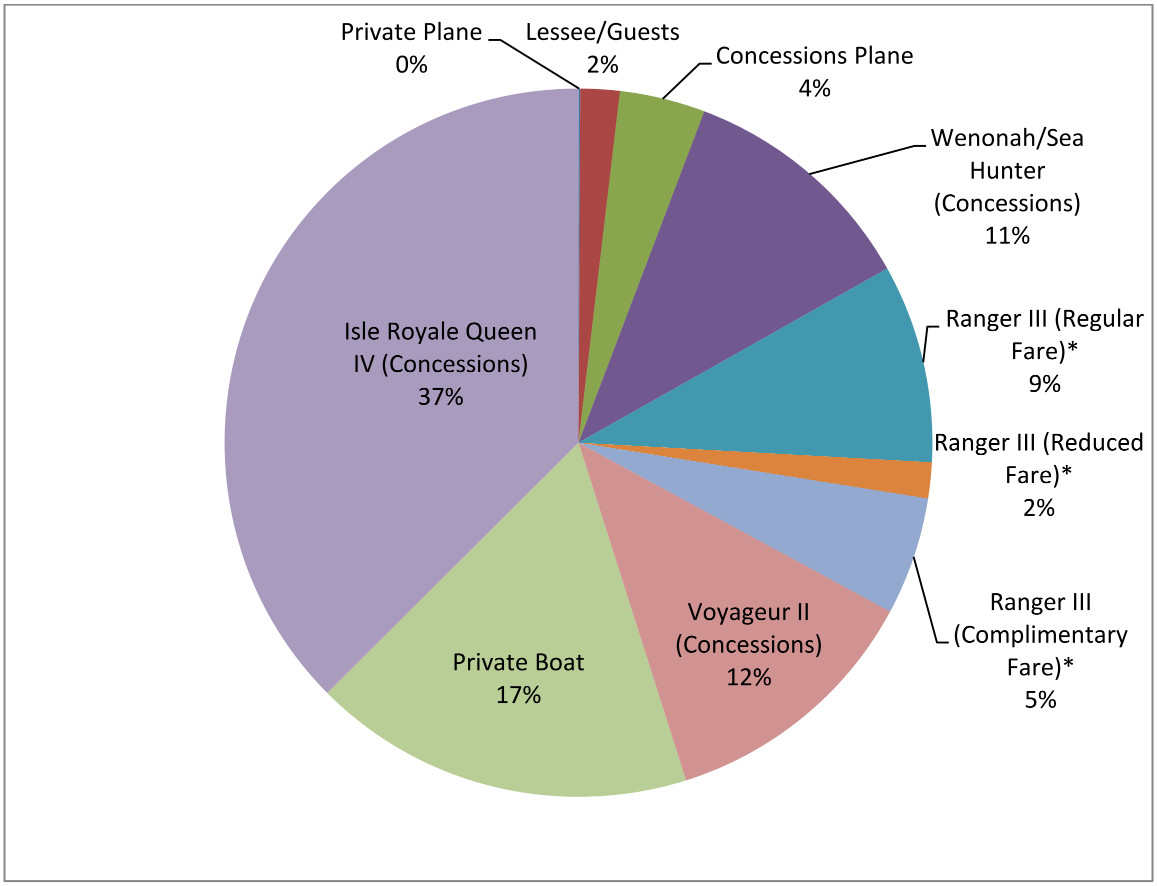
**Intra-island Transport**
Bulk Cargo
Food
Construction Material

**Construction Support**
Work Platform/Crane
Employee Lodging

### *Passenger Travel*

There are seven ways for passengers to get to Isle Royale. From the water, there is the park-operated *Ranger III*, concessioner-operated *Isle Royale Queen IV*, *Voyageur II*, and *Sea Hunter*, and the option of private boat. From the air, passengers can arrive by private seaplane or charter a flight with the Royale Air Service. Each of these options is described below. Figure A-2 shows the distribution of passenger travel to ISRO by mode.

**Figure A-2**
**Mode Share for Island Passenger Travel**
Source: NPS Public Use Statistics Office

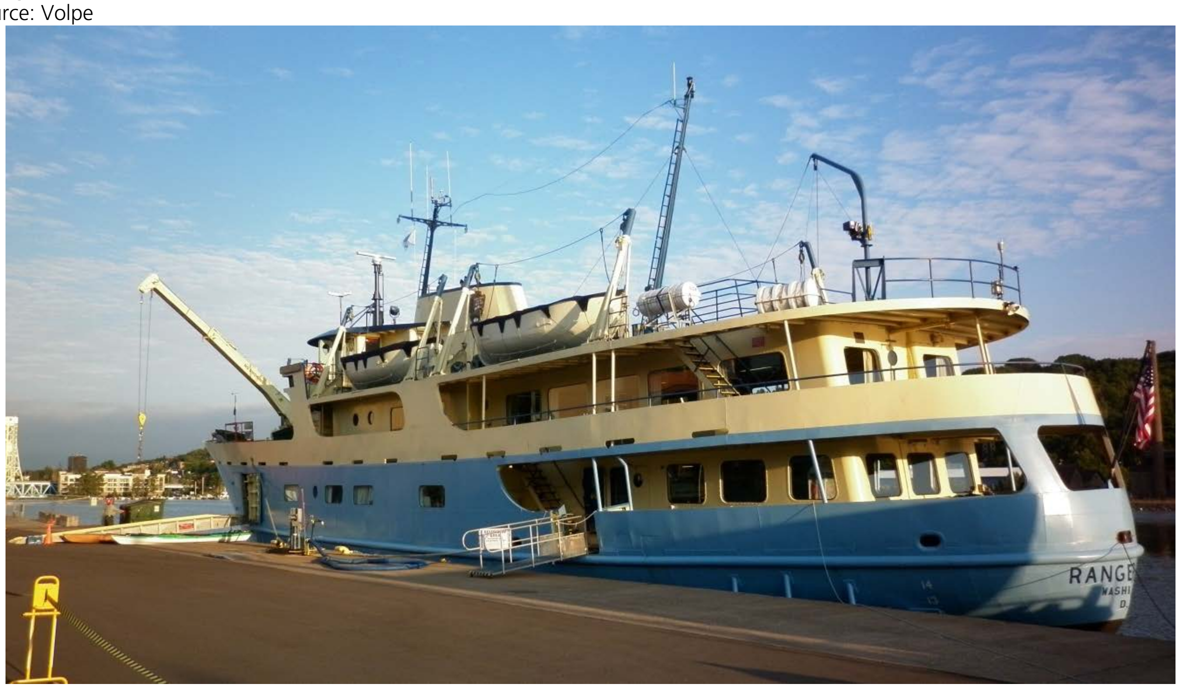



*Ranger III data were provided by Isle Royale National Park.

### Ranger III

*Ranger III*, shown in Figure A-3, was custom-built for the park in 1958 and travels between the park's mainland based headquarters in Houghton, MI and Isle Royale with up to 128 passengers and their personal cargo. It takes *Ranger III* about five hours to reach Mott Island and an additional hour (including the stop at Mott Island) to reach Rock Harbor. At the beginning and end of each season, *Ranger III* makes a trip to Windigo for passenger and cargo conveyance and to assist in gearing up and shutting down of the park.

**Figure A-3**
***Ranger III* in Houghton**
Source: Volpe



*Ranger III*'s schedule runs from late April through mid-September with trips two days per week, making about 44 round trips throughout the season. In 2013, *Ranger III* season lasted from April 28th through September 14th with trips leaving the mainland on Tuesday and Friday and trips leaving the island on Wednesday and Saturday. The high season was defined as July 9th through August 24th. Fare rates as of 2014 are shown below in Table A-1.

**Table A-1**
***Ranger III* Fee Schedule (2014)**
Source: Isle Royale National Park, The *Greenstone* Newsletter

| | High Season | Low Season | Group (7+) | Ranger Birthday Special |
|---|---|---|---|---|
| | Jul 9-Aug 24 | Before Jul 9 or After Aug 24 | Year-round | June 11-June 22 |
| Adult | $63 one-way | $53 one-way | $53 one-way | $63 round trip |
| Child (ages 7-11) | $23 one-way | $23 one-way | $23 one-way | $23 round trip |
| Child (under 7) | $0 | $0 | $0 | $0 |

*Ranger III* is also used for public and private cruises along the Keweenaw Waterway. In 2013, *Ranger III* made two public cruises and was rented for three private cruises. For the purposes of these analyses, cruise statistics were separated from the island-serving statistics of *Ranger III*. According to the park, these cruises were operated at a profit of a few hundred dollars each.

*Ridership*

Ridership statistics are recorded for three passenger categories: regular, complimentary, and reduced. Visitors without any connections to park staff or park operations are defined as regular fare passengers.

Complimentary passengers include park staff, immediate family members of park staff, contractors, and researchers. Reduced fare passengers, which pay a 50% reduced rate, include the extended family of park staff and concessioner employees.

Annual totals for park visitors from 2006 to 2012 who traveled on *Ranger III* are shown in Table A-2. Since 2006, the number of visitors riding *Ranger III* has followed a generally increasing trend, with nearly 2,800 trips (or about 1,400 round trips) in 2012. The number of children and infants on *Ranger III* generally parallels adult visitation trends. In 2012, there were 220 child trips, which was about 5% of all trips, and 36 infant trips, or about 1% of all trips. Additionally, approximately 1,450 complimentary trips (725 round trips) were provided each year between 2006 and 2012. The average number of paying riders between 2008 and 2012 was 1,723, for an average of $138,464 in revenue ($80 per paying visitor).

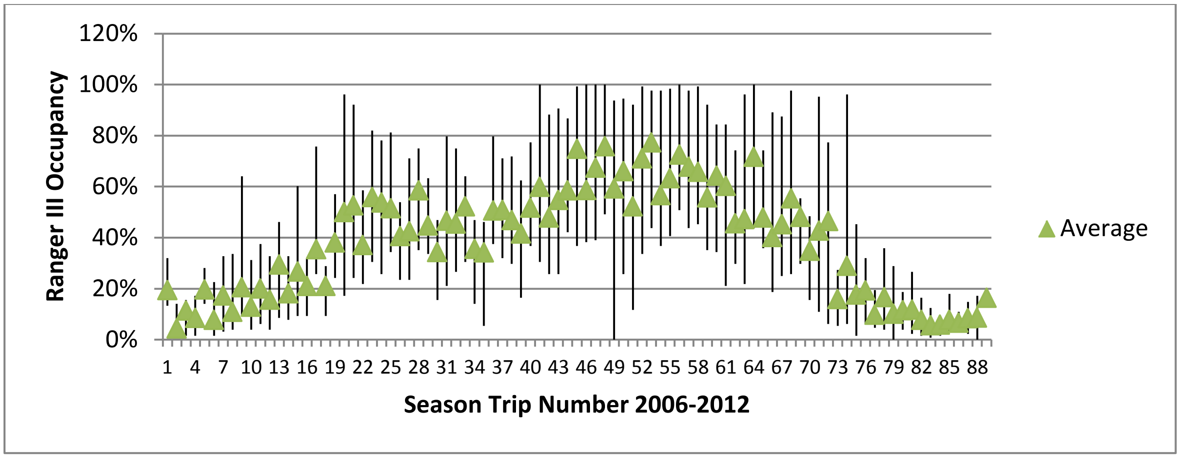
**Table A-2**
**Annual Passenger One-Way Trips on *Ranger III***
Source: Isle Royale National Park

| | | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|
| All Passengers | Adults | 3,735 | 4,059 | 4,334 | 3,993 | 4,002 | 4,032 | 4,336 |
| | Children | 193 | 199 | 268 | 174 | 227 | 239 | 220 |
| | Infants | 21 | 37 | 40 | 17 | 9 | 8 | 36 |
| Regular Fare Passengers | Adults | 2,038 | 2,303 | 2,392 | 2,196 | 2,321 | 2,330 | 2,613 |
| | Children | 88 | 106 | 168 | 89 | 75 | 93 | 90 |
| | Infants | 4 | 12 | 20 | 7 | 9 | 8 | 35 |
| Reduced Fare Passengers | Adults | 327 | 390 | 441 | 460 | 420 | 413 | 410 |
| | Children | 32 | 35 | 37 | 11 | 32 | 23 | 28 |
| | Infants | 3 | 8 | 1 | 5 | 0 | 0 | 0 |
| Comp. Passengers | Adults | 1,370 | 1,366 | 1,501 | 1,337 | 1,261 | 1,289 | 1,313 |
| | Children | 73 | 58 | 63 | 74 | 120 | 123 | 102 |
| | Infants | 14 | 17 | 19 | 5 | 0 | 0 | 1 |

While there are occasions that *Ranger III* is at its maximum passenger capacity, on average, trip occupancies are generally below 80%. Shoulder season totals are understandably affected by pre- and post-summer schedules as well as staff-only trips or trips where capacity is limited by regulation because of propane shipment (as discussed below in the Fuel section). m the island from 2006 to 2012.

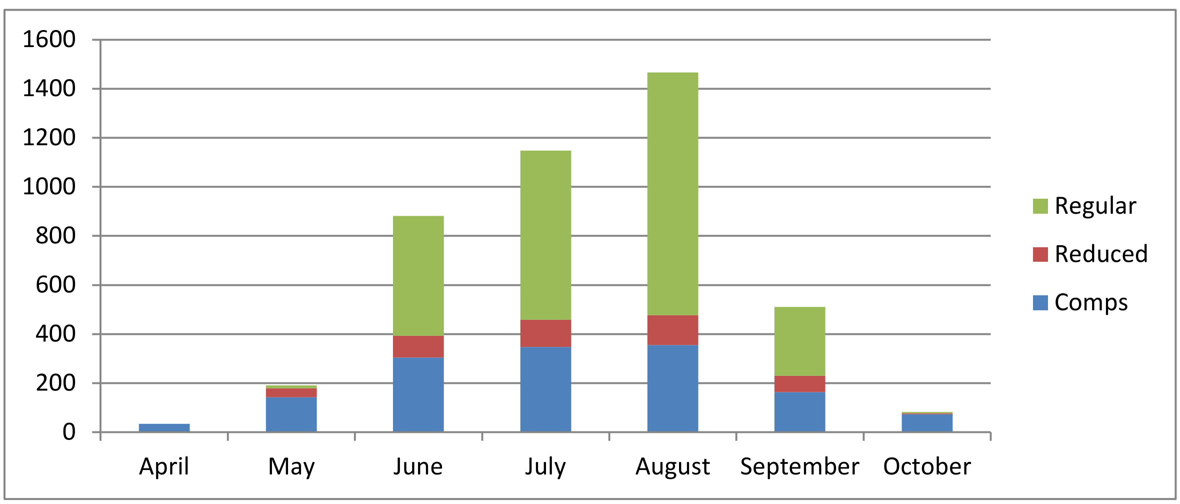
Figure A-4 shows the percentage of all passenger seats filled on *Ranger III* making trips both to and from the island from 2006 to 2012.

**Figure A-4**
***Ranger III* Occupancy by Trip Number 2006-2012**
Source: Isle Royale National Park




Although visitor ridership is strong through the summer, there is a significant and consistent share of complimentary trips throughout the season. A chart of the average number passenger trips by month (2006-2012) appears in Figure A-5. During the primary visitation months of June, July, and August, regular fare visitors averaged 55%, 60%, and 67% of all passengers. These percentages reflect the seasonality of visitor ridership, since there are many fewer visitors compared to complimentary and reduced fare passengers during the months of April and May.

**Figure A-5**
**Average Monthly Passenger Trips by Fare Type**
Source: Isle Royale National Park




*Employees*

Although employees occasionally make trips on concessioner transport if they're traveling around the island or from Minnesota, the primary mode of employee transport is *Ranger III*. The number of workers and families transported to and from the island on *Ranger III* can be estimated from *Ranger III* trip log, as shown in Table A-3. The trip log includes complimentary fare visitor trips, and of these trips, some are classified as researchers and can be subtracted out. For years 2006 through 2012, the average number of trips made by employees, their immediate family, and contractors, was 1,264.

Concessioner employees are not recorded differently from other reduced fare passengers. As a result, their trips cannot be precisely counted, although the concessioner estimates that there are about 12 concessioner employee trips per month, with a slightly higher level of 15 trips per month at the beginning and end of the season.

*Researchers*

ISRO supports scientific efforts on the island by providing transport to researchers. In the summer, researcher trips have generally ranged between 50 – 100 per season, as shown in Table A-3. Winter research trips have ranged from about 12 to 40. According to the Isle Royale Institute at Michigan Technological University (Michigan Tech), research on the island primarily consists of studying "wolf-moose dynamics, boreal chorus frogs, nutrient cycling, and climate change as well as… prehistoric mining, commercial fishing, resort era, and lake shipping (shipwrecks)[*]."

**Table A-3**
***Ranger III* Complimentary Trips 2006-2012**
Source: Isle Royale National Park

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | Average |
|---|---|---|---|---|---|---|---|---|
| Total Complimentary Visitor One-Way Trips | 1,370 | 1,366 | 1,501 | 1,337 | 1,261 | 1,289 | 1,313 | 1,348 |
| Researcher One-Way Trips | 97 | 96 | 99 | 116 | 76 | 49 | 58 | 84 |
| Park Worker/Family One-Way Trips | 1,273 | 1,270 | 1,402 | 1,221 | 1,185 | 1,240 | 1,255 | 1,264 |

### Private Travel and Transportation Concessioners

In addition to *Ranger III*, there are six other ways to reach Isle Royale. 88% of visitors use private modes to reach Isle Royale. At 39%, the *Isle Royale Queen IV* brings the largest share of visitors to the island each year. The second most popular mode is private boat at 18%, followed by the *Voyageur II* at 13%, and then both *Ranger III* and the Sea Hunter (previously the Wenonah) at 12%.

As shown in Table A-4, ridership on private and concessioner modes has remained relatively constant from 2006 through 2012. Low visitation for the Wenonah in 2007 and 2008 was caused by low water levels on Lake Superior that halted travel and an engine fire at the beginning of the 2008 summer season, which put the Wenonah out of service. Private boats and planes are charged a small fee for park use. Concessioners pay a franchise fee and agree to contract terms set by the park. Concessioners take on liability for operations, maintenance, and direct costs. If demand declines, fuel costs escalate, or weather conditions in a given season are unfavorable, the park assumes no liability for costs or services. Concessioner modes are described in greater detail below.

**Table A-4**
**Transportation Concessioner and Private Visitors**
Source: Isle Royale National Park

[*] http://iri.mtu.edu/research/index.html

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | Average |
|---|---|---|---|---|---|---|---|---|
| Isle Royale Queen IV | 5,474 | 4,875 | 5,246 | 5,044 | 4,952 | 4,808 | 5,096 | 5,071 |
| Wenonah/ Sea Hunter | 2,861 | 393 | 634 | 1,646 | 1,374 | 1,846 | 2,089 | 1,549 |
| Voyageur II | 1,195 | 1,845 | 1,633 | 1,590 | 1,523 | 1,652 | 2,068 | 1,644 |
| Royale Air | 709 | 637 | 174 | 487 | 560 | 606 | 565 | 534 |
| Private Plane | 0 | 1 | 4 | 2 | 37 | 19 | 10 | 10 |
| Private Boat | 2,726 | 2,263 | 2,216 | 2,208 | 2,399 | 2,276 | 2,493 | 2,369 |

*Isle Royale Queen IV*

The *Isle Royale Queen IV* departs from Copper Harbor, Michigan, about 47 miles north of Houghton, and it takes about three hours and fifteen minutes to arrive at Rock Harbor. The *Isle Royale Queen IV* completes a round trip on sailing days and does not overnight at Isle Royale. In 2013, The *Isle Royale Queen IV* service began May 13th with trips twice a week, gradually increasing in frequency. The peak of the *Isle Royale Queen IV* service was July 1st through September 1st, with trips departing daily. After September 1st, service continued for the remainder of the month operating twice per week. Fare rates as of 2013 are shown below in Table A-5.

**Table A-5**
***Isle Royale Queen IV* Fee Schedule (2013)**
Source: Isle Royale National Park, The *Greenstone* Newsletter

| | July 15-Aug 15 | Before July 15 or After Aug 15 |
|---|---|---|
| Adult | $65 | $60 |
| Child (ages 1-11) | $32.50 | $30 |

*Voyageur II*

*Voyageur II* provides service from Grand Portage, Minnesota to Isle Royale. *Voyageur II* has a maximum capacity of 48 passengers and takes about two hours to travel to Windigo. After Windigo, the *Voyageur II* circumnavigates the island clockwise to get to Rock Harbor, three hours later. From Windigo to Rock Harbor along the north side of the island, *Voyageur II* stops at McCargoe Cove and Belle Isle. From Rock Harbor to Windigo, along the south side of the island, there are stops at Daisy Farm, Chippewa Harbor, and Malone Bay, an approximately four hour voyage. In 2013, *Voyageur II* operated between May 4th and October 3rd. During the peak season, from the end of May through the middle of September, there were three trips per week from Grand Portage to Rock Harbor. Before the peak season, there were two trips per week to Rock Harbor, and after the peak season there was one trip a week to Rock Harbor. Fare rates as of 2013 are shown below in Table A-6.

**Table A-6**
***Voyageur II* Fee Schedule (2013)**
Source: Isle Royale National Park, The *Greenstone* Newsletter

| | Grand Portage to Windigo | From/to Grand Portage, to/from Non-Windigo Stop | Inter-island |
|---|---|---|---|
| Adult | $67 | $80 | $50-62 |
| Child (ages 4-11) | $46 | $54 | $34-43 |

*Sea Hunter*

This service was previously provided by the *Wenonah*, which was replaced by the *Sea Hunter* in 2011. Like *Voyageur II*, *Sea Hunter* leaves from Grand Portage, Minnesota, although it travels exclusively to and from Windigo and makes the trip in about an hour and a half. Maximum capacity on the *Sea Hunter* is 75 passengers. During its peak season in 2013, from July 17th through August 18th, the *Sea Hunter* operated five days per week, excluding Monday and Tuesday. During the off-peak season, between June 12th and August 31st, *Sea Hunter* provided three trips per week: Wednesday, Friday and Saturday. Fare rates as of 2014 are shown below in Table A-7.

**Table A-7**
***Sea Hunter* Fee Schedule (2013)**
Source: Isle Royale National Park, The *Greenstone* Newsletter

| | June 12-Aug 31 |
|---|---|
| Adult | $67 |
| Child (ages 4-11) | $46 |

*Royale Air Service*

The Royale Air Service operates a seaplane that takes 30 minutes to fly to the island and carries up to four passengers. Flights leave from the Houghton County Airport and drop off or pick up passengers from either Rock Harbor or Windigo. Seaplane trips are generally available from mid-May through mid-September.

The Royale Air Service operates on-demand rather than by a set schedule. Typically, the seaplane operates three roundtrips per day, five days per week. In August, their busiest month, the Royale Air Service will reach a maximum of six days per week and five round trips per day. In May and September, there may be only one or two roundtrips per day. Fare rates as of 2013 are shown below in Table A-8.

**Table A-8**
**Royale Air Service Fee Schedule (2013)**
Source: Isle Royale National Park, The *Greenstone* Newsletter

| Round Trip | One Way | Inter-island |
|---|---|---|
| $299 | $199 | $100 |

*Franchise Fees*

The park currently maintains 10-year contracts with each of its concessioners. As shown in Table A-9, the fees paid by the concessioners are 4-6% of their total gross receipts from ticket sales.

**Table A-9**
**Concessioner Franchise Fees**
Source: Isle Royale National Park, The *Greenstone* Newsletter

| Concessioner | Service | Duration | Term | Franchise Fee % and Amount Paid in 2012 |
|---|---|---|---|---|
| Isle Royale Line | Isle Royale Queen IV | 10 years | 2010-2019 | 4%, $23,009 |
| Royale Air | Seaplane | 10 years | 2004-2013 | 6%, $10,318 |
| Grand-Portage-Isle-Royale Line | Voyageur II, Sea Hunter | 10 years | 2008-2017 | 4%, $17,327 |

## Cargo Transportation

This section describes cargo shipped for both employees and visitors on *Ranger III* and concession services. Cargo includes food and supplies for staff and their families, as well as boats, concessioner deliveries, trash, and construction materials. Fare rates as of 2013 are shown below in Table A-10. While the concessions operated vessels do have capacity to carry non-motorized canoes/kayaks, no data was available on the frequency with which they transport these boats. For the most part, Ranger III and other NPS-owned vessels provide the bulk of cargo transportation.

**Table A-10**
**Isle Royale Cargo Rate Schedule**
Source: Isle Royale National Park, The *Greenstone* Newsletter

| | Ranger III | Isle Royale Queen IV | Voyageur II | Sea Hunter | Seaplane |
|---|---|---|---|---|---|
| Boat (less than 18'1") | $90 | -- | -- | -- | -- |
| Boat (18'1"-20'0") | $140 | -- | -- | -- | -- |
| Disabled Boat (20'1"-24'0") | $350 | -- | -- | -- | -- |
| Canoe/Kayak | $22 | $25 single; $40 double | $36 | $36 | -- |
| Canoe/Kayak (>20'0, 90 lbs.) | $50 | $25 single; $40 double | $36 | $36 | -- |
| Outboard Motor | $15 | $5 under 5hp; $15 over 5hp | -- | -- | -- |
| Gear (free) | first 100 lbs. free | first 70 lbs. free | first 40 lbs. free | first 40 lbs. free | first 40 lbs. free |
| Gear (additional) | $9.50/100wt | price on request | $36/100 lbs. | $36/100 lbs. | not allowed |

Nearly all island cargo is transported by *Ranger III,* and for each *Ranger III* trip, cargo is described in a bill of lading. Figure A-6 and Table A-11 show the average weight of freight by month, based on data from *Ranger III*'s bills of lading from 2010 through 2012. The shipped goods have been aggregated into eight categories—trash, refrigerated cargo, propane, park operations, diesel, construction (including debris), boats, and baggage.

**Figure A-6**
**Average *Ranger III* Cargo 2010-2012**
Source: *Ranger III* Bills of Lading

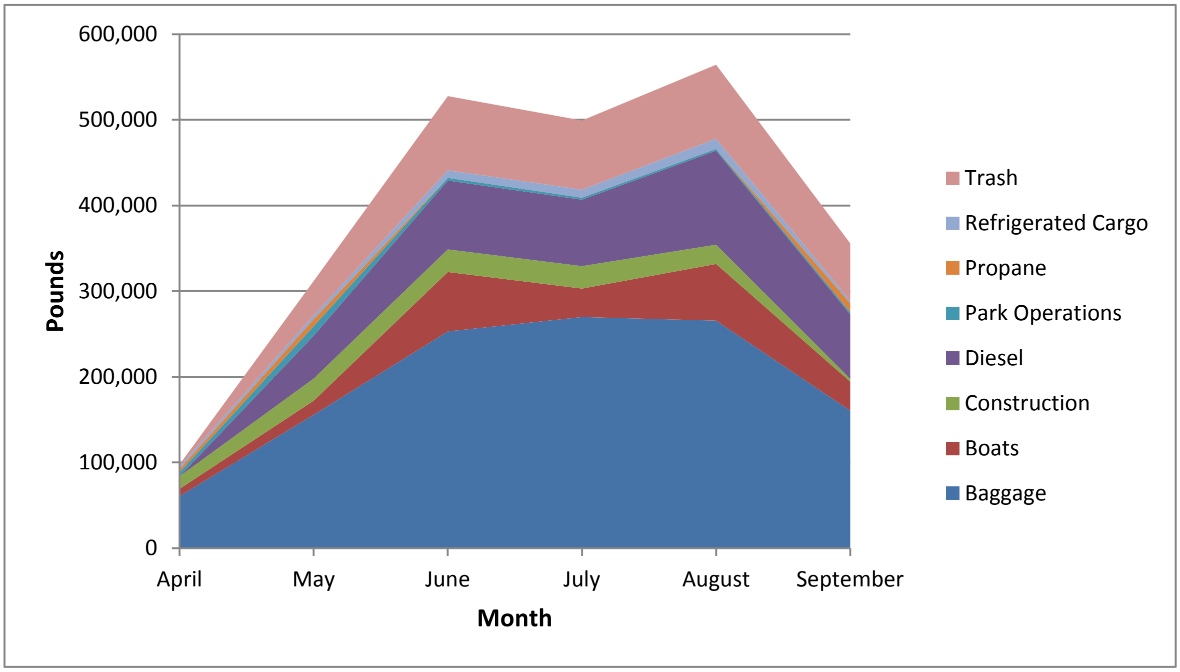



**Table A-11**
**Average *Ranger III* Cargo 2010-2012 (Pounds)**
Source: *Ranger III* Bills of Lading

| | April | May | June | July | August | September | Total |
|---|---|---|---|---|---|---|---|
| **Baggage** | 60,889 | 155,853 | 253,040 | 269,831 | 265,638 | 160,606 | 1,165,858 |
| **Boats** | 8,400 | 16,350 | 69,320 | 33,203 | 66,123 | 33,747 | 227,143 |
| **Construction** | 14,763 | 25,875 | 26,427 | 26,223 | 22,532 | 3,470 | 119,290 |
| **Diesel** | 0 | 50,031 | 80,338 | 77,571 | 109,683 | 75,033 | 392,657 |
| **Park Operations** | 4,528 | 11,107 | 3,171 | 2,313 | 2,023 | 2,507 | 25,649 |
| **Propane** | 3,740 | 8,071 | 0 | 0 | 0 | 10,584 | 22,394 |
| **Refrigerated** | 3,200 | 4,543 | 8,833 | 9,346 | 11,915 | 2,950 | 40,788 |
| **Trash** | 2,313 | 40,163 | 86,567 | 80,763 | 86,413 | 66,933 | 363,153 |
| **Total** | 97,834 | 311,993 | 527,696 | 499,252 | 564,327 | 355,830 | 2,356,932 |

### Boats

From 2006 to 2012, over 70% of crane-loaded boats and nearly 80% of hand-loaded boats came from regular fare visitors (see Table A-12). The amount of hand-loaded boats (canoes and kayaks) and boats that require crane assistance have remained relatively steady between 2006 and 2012. In 2012, there were 236 hand-loaded boats, 62 boats under 18 feet in length, and 45 boats between 18 and 20 feet in length.

**Table A-12**
**Annual Totals for Regular Fare Boats on *Ranger III***
Source: Isle Royale National Park

| | | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|
| All Boats | Hand-loaded Boat | 185 | 200 | 246 | 209 | 282 | 237 | 236 |
| | Boat <18' | 59 | 70 | 66 | 65 | 74 | 69 | 62 |
| | Boat 18-20' | 20 | 34 | 36 | 33 | 30 | 30 | 45 |
| | Boat Rescue >20' | 6 | 4 | 4 | 5 | 8 | 5 | 7 |
| Regular Fare Boats | Hand-loaded Boat | 150 | 153 | 184 | 179 | 229 | 177 | 167 |
| | Boat <18' | 44 | 52 | 43 | 46 | 46 | 46 | 42 |
| | Boat 18-20' | 18 | 29 | 32 | 23 | 18 | 21 | 28 |
| | Boat Rescue >20' | 5 | 3 | 3 | 3 | 2 | 2 | 2 |
| Compli-mentary Boats | Hand-loaded Boat | 35 | 47 | 62 | 30 | 53 | 60 | 69 |
| | Boat <18' | 15 | 18 | 23 | 19 | 28 | 23 | 20 |
| | Boat 18-20' | 2 | 5 | 4 | 10 | 12 | 9 | 17 |
| | Boat Rescue >20' | 1 | 1 | 1 | 2 | 6 | 3 | 4 |

Figure A-7 shows a boat being loaded aboard *Ranger III* at Rock Harbor. Figure A-8 shows the upper deck of *Ranger III* returning to the mainland.

**Figure A-7**
**Loading the Upper Deck of *Ranger III* with Boats at Rock Harbor**
Source: Volpe

**Figure A-8**
**Boats on the Upper Deck of *Ranger III***
Source: Volpe

*Ranger III Dry Cargo Space*

There are 3,000 cubic feet of cargo space below main deck of *Ranger III* and 7,750 cubic feet of storage on main deck. Figure A-9 shows park staff loading cargo on wheeled carts in the main deck cargo hold. Figure A-10 shows the main deck cargo hold from the inside, with hand-loaded boats atop cargo carts.

**Figure A-9**
**Loading Cargo onto *Ranger III***
Source: Volpe

**Figure A-10**
**Cargo on *Ranger III***
Source: Volpe

Carrying cargo requires balancing weight in all parts of the ship, including areas for cargo, fuel storage, ballast water, and potable water. A typical maximum load at the beginning of the season might include 23 tons[*] (6,500 gallons) of diesel fuel, 2-3 tons in the lower hold, 18 tons on the main deck, and 15 tons on the upper deck. Alternately, *Ranger III* could carry 100 tons of cargo and 25 tons of oil, as long as the 100 tons of cargo were in the lower hold; with all four fuel tanks full, very little ballast would be needed. Or, if all of the cargo was on the upper deck and required substantial ballast for stability, the ship could reach its maximum capacity with only 20 tons.

*Ranger III Refrigeration Space*

Refrigeration space is significantly limited on *Ranger III*. There are 88 cubic feet of space in the freezer room and 434 cubic feet of space in the cooler room. When needed, up to four roll-on/roll-off freezers on carts have been brought onto *Ranger III* to expand refrigerated storage. Each of these freezers provides about 30 cubic feet of additional space.

### Food and Materials

The greatest share of freight aboard *Ranger III* is baggage, and there is ample space in the below deck storage area for personal cargo. There is no separation or reported breakdown between baggage carried for staff and other types of travelers. Although they comprise much less of the total weight, there are greater constraints on the shipment of trash and refrigerated goods because these items require special storage areas that are limited on the ship. The two peaks in freight weight depicted in Figure A-6 are a result of additional personal boats in June and August. Most personal boats, both staff- and visitor-owned, are transported at the beginning and the end of the season, with a lull in the middle month (July) while the boats are kept on the island.

Groceries and other small cargo are shipped to Windigo from Mott Island with the park's small fleet boats. *Ranger III* also makes trips to Windigo at the beginning and end of the season, and the LCM makes deliveries to Windigo from Mott Island on an infrequent basis.

### Concessioner Deliveries

Freight delivered to the lodging concessioner, *Forever Resorts*, including groceries and supplies, is shown in Figure A-11. Grocery shipments for the concessioner once per week, and on average, the chart shows a fairly consistent delivery rate from year to year. Supply needs are highest at the beginning of the season in May, and then in August when visitation peaks. At the end of the season, the need for supplies predictably lessens.

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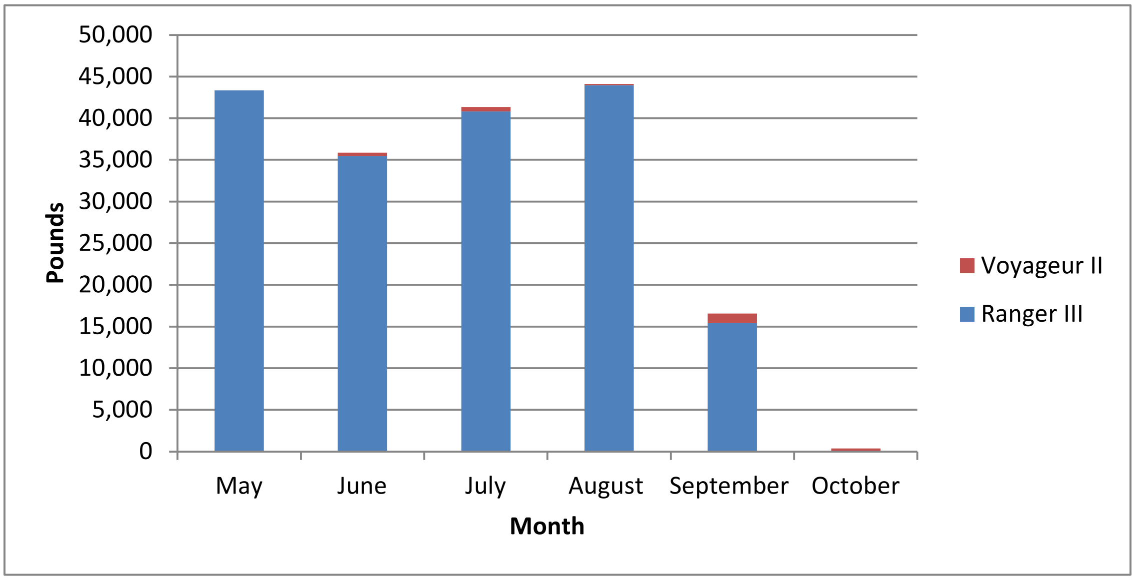
[*] Diesel #2 has a density of 7.08 pounds/gallon. The conversion between gallons and tons would be as follows: (6,500 gallons) x (7.08 pounds/gallon) x (1 ton/2000 pounds) = 23 tons.

**Figure A-11**
**Chart of Concessioner Freight**
Source: Forever Resorts




The cargo shipped to the island concessioner by *Ranger III* provides revenue for the park. Annual freight revenues collected by the park were $18,230 in 2010, $17,294 is 2011, and $19,609 in 2012.

Although its cargo capacity is limited, *Voyageur II* makes deliveries for *Forever Resorts* to Windigo one to three times per season. Cargo capacity is dependent on how many passengers are on-board. With a full load of passengers, the *Voyageur II* can transport 4,000-5,000 pounds of cargo. *Voyageur II* also provides mail delivery service to the island.

### Waste Management

As shown in Figure A-12 and Table A-13, the amount of recyclable waste in glass, aluminum, cardboard, steel, and plastic produced by the concessioner is relatively small compared to bagged trash. Although a detailed breakdown of NPS trash is not available, it is estimated to be similar to what is produced by the resort. Since most trash is not eligible for recycling on the mainland, it is an ideal candidate for on-island disposal. As previously shown in **Error! Reference source not found.**, the average amount of total trash carried on *Ranger III* from April through September each year is 363,153 pounds. As shown in **Error! Reference source not found.**, an average of 48,374 pounds or 13% of this total comes from the concessioner, so the park is responsible for the difference (314,779 pounds or 87%). Debris from construction is counted separately from trash. **Error! Reference source not found.** shows dumpsters on the upper deck of *Ranger III*. The dumpsters, like other large freight items, are carried on the upper deck because of their size and weight.

**Figure A-12**
**Average Concessioner Trash**
Source: Forever Resorts

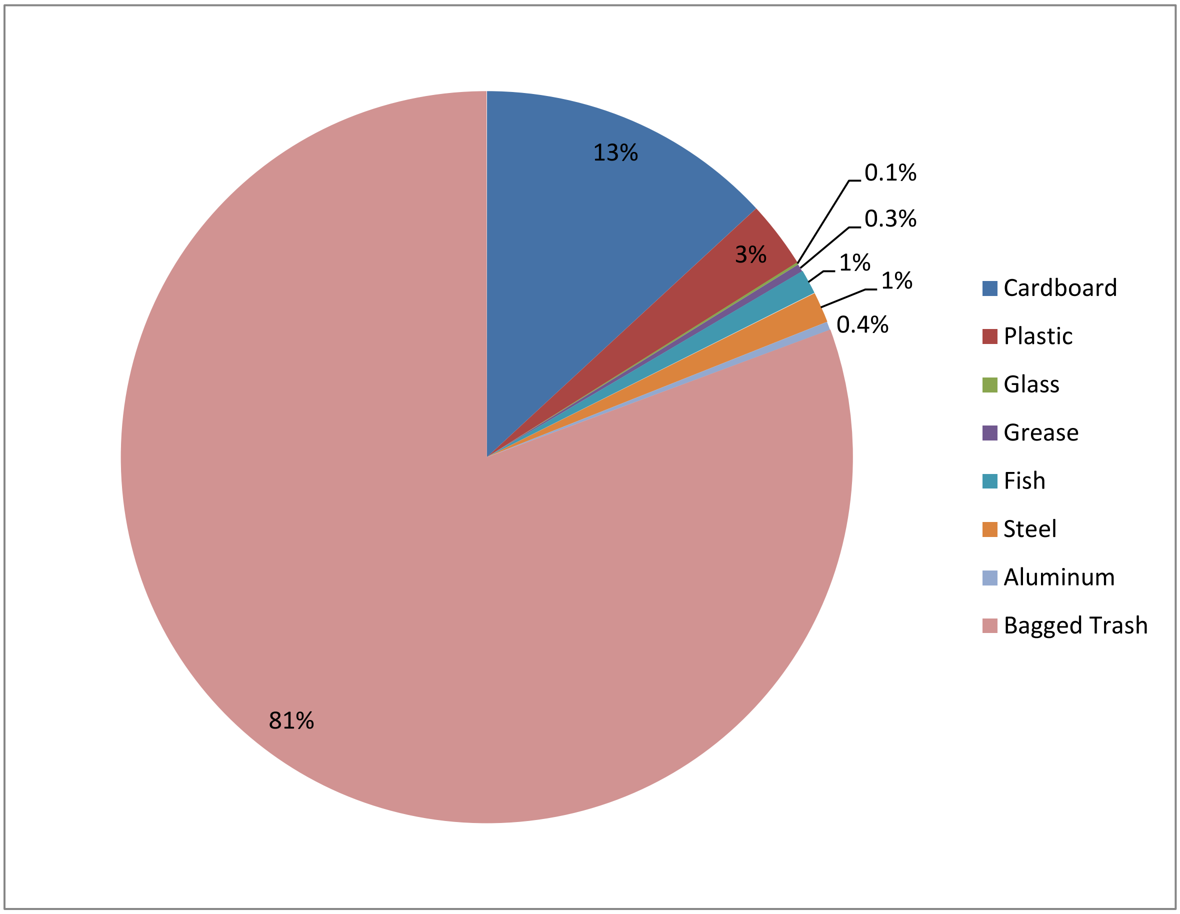



**Table A-13**
**Concessioner Waste (Pounds)**
Source: Forever Resorts

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | Average |
|---|---|---|---|---|---|---|---|---|
| Cardboard | 5,725 | 5,425 | 6,200 | 3,500 | 3,425 | 7,000 | 11,250 | 6,353 |
| Plastic | 1,375 | 1,225 | 1,900 | 975 | 1,325 | 1,650 | 1,800 | 1,422 |
| Glass | 0 | 20 | 0 | 140 | 180 | 60 | 0 | 53 |
| Grease | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 |
| Fish | 840 | 700 | 735 | 385 | 175 | 350 | 455 | 525 |
| Steel | 455 | 1,190 | 1,680 | 245 | 105 | 525 | 665 | 661 |
| Aluminum | 140 | 0 | 640 | 80 | 200 | 280 | 60 | 180 |
| Bagged Trash | 51,170 | 47,005 | 44,905 | 29,785 | 24,920 | 27,860 | 52,395 | 39,016 |
| Total | 59,870 | 55,730 | 56,225 | 35,275 | 30,495 | 37,890 | 66,790 | 48,374 |

**Figure A-13**
**Empty Dumpsters on the Upper Deck of *Ranger III* Traveling to Isle Royale**
Source: Volpe

*Waste Disposal*

Incinerators were installed at Rock Harbor, Mott Island, and Windigo in 1974. In 1995, when it was found that the incinerators did not meet the standards of the Federal Clean Air Act or the Michigan Natural Resources and Environmental Protection Act, a report was commissioned to study alternative disposal options. The Solid Waste Study report[*] reviewed options for incineration, composting, recycling, on-site landfill, dumpsters and off-site disposal, compaction and off-site disposal, and baling and off-site landfilling. The primary recommendation from the study was the approach currently being used by the park: off-site disposal facilitated by dumpsters. The Solid Waste Study report also recommended the initiation and expansion of recycling, composting, and waste minimization.

Recyclables are collected at Mott Island, Rock Harbor, and Windigo and shipped to Houghton on *Ranger III*. All labor for collecting and hauling to the recycling center transfer station is done by ISRO staff and no revenue is generated from the recycled materials. A single-stream method is used by the recycler so that it's not necessary for the park to separate different material types at any point in the process.

The park has experimented with composting and has six composting units on Mott Island for resident use. In the park's experience, composting has not worked well because of the short summer season and the cold climate during the off-season.

### Researcher Support

Summer researchers sometimes require additional logistical support to reach their research sites around the island. For example, in 2012, eight research teams of between two and four people each needed transport, including their scientific gear and backcountry equipment. These trips generally consisted of a drop-off and pick-up and were conducted by the only park vessel large enough to accommodate these needs, the diesel-powered Minong. Apart from park-owned transport, three researchers operate their own bass-boat-style vessels on the island.

[*] "Solid Waste Study for Isle Royale: Technical Report," U.P. Engineers & Architects, Inc., 1995.

### Construction Supplies

Nearly everything on the island must come from the mainland, including construction supplies. In 2013, for example, the park built a dormitory for the families of park staff. All debris from the previous facility had to be shipped out on *Ranger III*, and all new building materials had to be shipped in on *Ranger III*. While campsites and trails on the island do not require construction on a regular basis, the construction materials in the bills of lading from 2010 through 2012 suggest that there is a steady stream of construction projects that require logistical support.

The *Beaver* work barge, shown in Figure A-14, is an uninspected work barge that is towed by tug boat to the island to support construction activities. There is a crane on the bow of the barge and a small crew quarters and a small machine shop on the stern. There is a work and storage area between the crew quarters and the crane. The *Beaver* can function as a mobile work platform for construction projects, and it has a shallower draft and flat bottom that allows it to travel to locations inaccessible to *Ranger III*. It is moored at the park headquarters in Houghton and has not been fully utilized for several years due to a lack of a permanent crew.

**Figure A-14**
***Beaver* Work Barge and *Shelter Bay* Tug Boat in Houghton**
Source: Volpe

*Shelter Bay*, shown alongside the *Beaver* in Figure A-14, is a United States Coast Guard (USCG) inspected, 65-foot tugboat used to tow the fuel and work barges between Houghton and Isle Royale. The park had a larger tug, but it would have required costly repairs to pass its USCG inspection. Instead of making the repairs, the park replaced the old tug with the *Shelter Bay* in 1998. However, *Shelter Bay*'s small size limits its usefulness. It can only make the trip between Houghton and the island in very calm weather.

The park's Landing Craft Mechanical (LCM) is self-propelled and uninspected, and it does not require a licensed crew. The LCM is currently operated by the park's head boat mechanic, and it is used to transport supplies, materials, and equipment from Houghton or Mott Harbor to various locations around the island. Regular uses include transporting garbage dumpsters from Windigo to Mott Island or Houghton (three to four times per season), and transporting the floating dock to Windigo, with the help of the park's mobile crane, at the beginning and end of the season. As-needed uses include building construction, dock construction, contractor support, and other miscellaneous projects. When not in use, the LCM is stored at Mott Island. Figure A-15 shows the LCM at Mott Island.

**Figure A-15**
**LCM at Mott Island**
Source: Volpe

## *Fuel*

Fuel must be shipped to the island to operate boats, vehicles, airplanes, power generators, heaters, and stoves. This section describes the use of propane, diesel, gasoline, and aviation gas on the island, as well as recent and planned programs for energy efficiency and photovoltaic energy production.

### Fuel Storage

Fuel storage facilities at Isle Royale are summarized in Table A-14. The table includes the type of fuel, the container capacity in gallons, the tank construction type, the size of the containment dike in gallons, the year the facility was built, and the tenant currently using the tank. All tanks are made of steel and located in above-ground fuel farms. The fuel farm at Mott Island is shown in Figure A-16. The single-walled tanks at Rock Harbor and Mott Island are due to be replaced within the next few years.

**Table A-14**
**Isle Royale Fuel Storage Facilities**
Source: Isle Royale National Park

| | Fuel | Capacity (gal) | Construction | Dike (gal) | Built | Current User |
|---|---|---|---|---|---|---|
| **Rock Harbor** | Gasoline | 20,000 | Single-walled | 35,000 | 1980 | Forever Resorts |
| | Diesel | 10,000 | Single-walled | 35,000 | 1980 | Forever Resorts |
| | Diesel | 20,000 | Single-walled | 35,000 | 1980 | NPS |
| **Mott Island** | Gasoline | 20,000 | Single-walled | 45,000 | 1979 | NPS |
| | Gasoline | 5,000 | Single-walled | 45,000 | 1979 | NPS |
| | Diesel | 20,000 | Single-walled | 45,000 | 1979 | NPS |
| | Diesel | 10,000 | Single-walled | 45,000 | 1979 | NPS |
| **Windigo** | Gasoline | 10,000 | Double-walled | 25,000 | 1994 | Forever Resorts |
| | Gasoline | 10,000 | Double-walled | 25,000 | 1994 | Forever Resorts |
| | Gasoline | 6,000 | Double-walled | 17,000 | 1994 | NPS |
| | AVGAS | 6,000 | Double-walled | 17,000 | 1994 | NPS |
| | Diesel | 20,000 | Double-walled | 25,000 | 1994 | NPS |

**Figure A-16**
**Mott Island Fuel Farm**
Source: Volpe

### Fuel Transportation

*Greenstone II,* shown in Figure A-17, is a 70-foot, double-hulled fuel barge used for transport and storage of gasoline and AVGAS, and it is moored in a cove approximately one mile from Mott Island. Built in 2004, *Greenstone II* is USCG-inspected and OPA-90-compliant. It can hold approximately 34,000 gallons of fuel in five separate fuel tanks, which is helpful for carrying gasoline and AVGAS at the same time. With the assistance of the *Shelter Bay*, *Greenstone II* typically makes one roundtrip per year to the island to fill fuel tanks at Rock Harbor, Mott Island, and Windigo. The fuel barge refuels at Lily Pond in Hancock, near the entrance to the Keweenaw Waterway canal.

**Figure A-17**
*Greenstone II*
Source: Volpe

Because of recent staff retirements, the park service has been short of mariners. The tug and barges have not had permanent crews in several years. The tug and fuel barge require a crew licensed for both navigation and fuel transfer operations. For the last few years, the park has hired a special contract crew for each fuel run. Each run costs approximately $30,000 in contract crew wages for the 2-3 day trip.

### Propane

Propane shipments are typically made two to three times a year on *Ranger III*. The park reported that on average, it uses 4,000 pounds of propane each year. It is typically stored in 100-pound bottles and used in back country sites for lighting, heat, and refrigeration. The concessioner uses 8,000-10,000 pounds of propane each year from 100-pound bottles. For the concessioner, propane is a less expensive option than electricity for operating island laundry and cooking facilities. According to *Ranger III* bills of lading, in 2012, there were over 100 propane cylinders transported to and from the island.

Coast Guard regulations limit passenger transport when certain gases are being transported as cargo, and as a result, propane is carried by *Ranger III* at the beginning and end of the season when visitor demand is lower. As stated in *Ranger III*'s USCG Certificate of Inspection:

> "IAW 49 CFR 172.101, When carrying palletized white gasoline (NAPTHA) including camp stove or lantern fuel, and/or liquefied petroleum gas as cargo, the vessel is limited to 25 passengers or less."

Separate from ISRO propane usage, smaller 20-pound propane bottles for personal use by staff and their families can be carried on the upper deck of *Ranger III* and jettisoned in the event of an onboard fire. Like small backpacking fuel containers, this size propane bottle is categorized as personal use and its shipment on *Ranger III* does not require limiting passenger capacity. As reflected in the bills of lading, these propane shipments occur throughout the season.

### Diesel

Diesel fuel powers *Ranger III* and boats in the park's small fleet, is sold to the concessioner, and is used for power generation and water purification on the island.

*Ranger III*

For *Ranger III*, there are two seasons of fuel usage: the sailing season and the winter lay-up. Based on a 95% fill of available capacity, *Ranger III*'s maximum diesel capacity is estimated to be 9,871 gallons[*]. In 2012, *Ranger III* received a total of 109,017 gallons of ultra-low sulfur diesel fuel for the April-October sailing season.[†] Of this amount, *Ranger III* used 27,267 gallons for freight and passenger operations. The bulk of the remaining 76,750 gallons transported by *Ranger III* was used by the park for power generation and small boats. Eight of the park's 36 small fleet boats use diesel fuel. The remainder use gasoline. In 2012, these diesel fuel powered boats used a total of 10,931 gallons during the operating season from April through October. A small amount of diesel fuel (5,000 gallons) was carried as cargo for the resort concessioner, *Forever Resorts*. In advance of the 2012 sailing season, *Ranger III* re-fueled for the winter lay-up. Heating and power generation required for the winter layup between mid-October 2011 and the beginning of April 2012 required 6,848 gallons of fuel.

Because the park has not had a tug boat captain for the past two years, some cargo that would have been shipped on the barge or LCM has been carried aboard *Ranger III*. To recover time for off-loading these shipments on Mott Island and stay on schedule, *Ranger III* was operated at 300, 305, 315, or 325 revolutions per minute (rpm), up from a normal speed of 295 rpm. According to the captain, the estimated additional fuel usage from operating at high speeds was 500-700 gallons per year, roughly the amount of fuel used on one round trip between Houghton and Rock Harbor, at a cost of about $2,000.

*Ranger III* cruises are about 25 miles round trip. When traveling the southern route, the cruises require about 110 gallons of fuel; when traveling the northern route, they require about 80-90 gallons of fuel. The majority of cruises travel the southern route. In 2012, 100% of cruises traveled south; in 2013, 80% of cruises traveled south.

*Concessioner Diesel*

Because diesel is delivered by *Ranger III*, it can be shipped to the concessioner at any time during the season. As reported in the Superintendent's Annual Report, the park receives $0.65 per gallon from the concessioner for transporting diesel. There are approximately 7.37 pounds of diesel per gallon[‡]. Concessioner diesel shipments are shown in Table A-15, and concessioner diesel sales are shown in Table A-16.

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[*] 95% of the total double bottom volume = (3,940 gal + 3,940 gal + 1,273 gal + 1,238 gal)*95% = 9,871 gal

[†] Superintendent's Annual Report, 2012.

[‡] *www.epa.gov/p2/pubs/resources/GallonsPoundsConversion.xls*

**Table A-15**
**Concessioner Diesel Freight (in Gallons)**
Source: Forever Resorts

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | Average |
|---|---|---|---|---|---|---|---|---|---|
| June | 5096 | -- | 2446 | -- | 4077 | 4077 | 5096 | 5096 | 4315 |
| July | -- | 6115 | -- | 4077 | -- | -- | -- | 6829 | 5674 |
| August | -- | -- | -- | 4077 | 4077 | 4077 | -- | -- | 4077 |
| September | 4077 | 4128 | -- | -- | -- | -- | -- | -- | 4102 |
| Total | 9173 | 10243 | 2446 | 8154 | 8154 | 8154 | 5096 | 11925 | 7918 |

**Table A-16**
**Visitor Diesel Sales (in Gallons)**
Source: Isle Royale National Park

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | Average |
|---|---|---|---|---|---|---|---|
| Rock Harbor | 3,188 | 2,357 | 2,419 | 2,252 | 2,183 | 2,529 | 2,488 |

*Power Generation and Water Treatment*

Power generation and water treatment on Isle Royale are both diesel-powered. 2012 power generation and total diesel fuel use are included in Table A-17 and Table A-18. On average, one gallon of diesel fuel on the island produced 9.6 kilowatts in 2012.

**Table A-17**
**Power Generation by Location (in kilowatt hours) (FY 2012)**
Source: Isle Royale National Park Utility System Statistics FY 2012

| Location | October | April | May | June | July | August | Sept. | Total |
|---|---|---|---|---|---|---|---|---|
| Rock Harbor | 2,480 | 160 | 25,640 | 39,520 | 46,040 | 47,640 | 23,520 | 185,000 |
| Mott Island | 38,880 | 20,480 | 46,640 | 34,610 | 27,920 | 27,920 | 31,600 | 228,050 |
| Windigo | 7,200 | 4,800 | 18,240 | 14,880 | 13,920 | 12,000 | 11,520 | 82,560 |
| Monthly Totals | 48,560 | 25,440 | 90,520 | 89,010 | 87,880 | 87,560 | 66,640 | 495,610 |

**Table A-18**
**Generator Diesel Fuel Usage by Location (in gallons) (FY 2012)**
Source: Isle Royale National Park Utility System Statistics FY 2012

| Location | October | April | May | June | July | August | Sept. | Total |
|---|---|---|---|---|---|---|---|---|
| Rock Harbor | 487 | 19 | 2,576 | 3,936 | 4,448 | 4,773 | 2,592 | 18,832 |
| Mott Island | 4,061 | 1,917 | 4,724 | 3,727 | 3,349 | 3,432 | 3,647 | 24,857 |
| Windigo | 1,228 | 692 | 2,244 | 1,966 | 1,844 | 1,519 | 1,431 | 10,924 |
| Monthly Totals | 5,777 | 2,628 | 9,545 | 9,629 | 9,640 | 9,724 | 7,670 | 54,613 |

Lake Superior serves as the drinking water source for Isle Royale, and there are potable water and wastewater treatment plants at Rock Harbor, and potable water treatment plants and septic systems at Mott Island and Windigo. These systems are powered through on-site, diesel-powered electric generators. On average, it takes 6.6 kilowatts to produce 1,000 gallons of potable water. To treat 1,000 gallons of wastewater at Rock Harbor, the treatment plant uses about 29.3 kilowatts. 2012 water production is shown in Table A-19.

**Table A-19**
**Gallons of Potable Water Produced by Location (FY 2012)**
Source: Isle Royale National Park Utility System Statistics FY 2012

| Location | October | April | May | June | July | August | Sept. | Total |
|---|---|---|---|---|---|---|---|---|
| Rock Harbor | 0 | 0 | 189,910 | 276,070 | 366,510 | 404,230 | 135,780 | 1,372,500 |
| Mott Island | 46,565 | 60,383 | 71,072 | 95,011 | 135,558 | 124,555 | 83,376 | 616,520 |
| Windigo | 0 | 0 | 29,100 | 33,600 | 42,300 | 50,850 | 29,100 | 184,950 |
| Monthly Totals | 46,565 | 60,383 | 290,082 | 404,681 | 544,368 | 579,635 | 248,256 | 2,173,970 |

### Gasoline

Twenty-eight of the park's 36 small fleet boats use gasoline. In 2012, these boats used a total of 11,851 gallons of fuel. Gasoline is also used by visitor boats. Gasoline shipments received by the island concessioner for sale to visitors are shown in Table A-20.

**Table A-20**
**Concessioner Gasoline Freight (in gallons)**
Source: Forever Resorts

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | Average |
|---|---|---|---|---|---|---|---|---|---|
| May | 30,000 | -- | -- | -- | -- | -- | -- | -- | 30,000 |
| June | -- | -- | -- | -- | -- | -- | -- | -- | |
| July | -- | 18,000 | 26,500 | -- | -- | -- | 8,500 | 17,835 | 17,709 |
| August | -- | -- | -- | -- | 8,300 | 25,500 | -- | -- | 16,900 |
| Total | 30,000 | 18,000 | 26,500 | 0 | 8,300 | 25,500 | 8,500 | 17,835 | 16,829 |

Because of the infrequency of gasoline shipments, extra gasoline beyond the storage capacity of the tank farm is stored on the fuel barge. In 2013, the concessioner ran out of gas at Windigo and Rock Harbor, because of a delay in the annual arrival of the fuel barge. This complication resulted from the absence of a full-time tug boat captain. To meet the fuel needs of visitor boats, the concessioner borrowed gas from the park. Table A-21 shows gasoline sales to visitors from the concessioner at Rock Harbor and Windigo from 2008 through 2012. The park made the following collections for gasoline shipped by *Greenstone II* to the concessioner: $6,182 in 2010, $22,962 in 2011, and $8,424 in 2012.

**Table A-21**
**Visitor Gasoline Sales (in gallons)**
Source: Isle Royale National Park

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | Average |
|---|---|---|---|---|---|---|---|
| Rock Harbor | 11,602 | 11,499 | 13,806 | 12,511 | 13,675 | 10,492 | 12,264 |
| Windigo | 5,398 | 3,878 | 4,187 | 4,064 | 5,097 | 4,603 | 4,538 |
| Total | 17,000 | 15,378 | 17,992 | 16,575 | 18,772 | 15,095 | 16,802 |

### Aviation Gas

During the winter, two planes are used as part of the seven-week Winter Study. The survey plane is contracted by Michigan Tech, and apart from the two-hour trip from and to the mainland at the beginning and end of the study, it is stored on the island while the research is conducted. During the seven week period, the survey plane logs 100-175 hours of flight time, or about 20 hours per week. Fuel consumption by the survey plane is about 6.6 gallons per hour. Aviation gas (AVGAS) is shipped to Windigo each year for the sole purpose of fueling the plane used for the Winter Study. The capacity of the survey plane tank is about 40 gallons. In recent years, the research team has been comprised of two permitted researchers, a NPS representative, and a pilot. Additional team members have included research assistants and media crew.

In addition to the survey plane, the researchers contract with the Forest Service out of Ely, Minnesota to make plane shipments of people and cargo during the winter study. The Forest Service typically makes five to eight trips during the study.

AVGAS is delivered to the island each summer for use by the seaplane used for the Winter Study. About 2,000 gallons of AVGAS are delivered once per year by the fuel barge and stored at Windigo.

### Energy Savings

In 2011, NPS hired a consultant to develop an Energy Savings Performance Contract (ESPC) for Isle Royale[*]. The planned improvements at Rock Harbor and Windigo were divided into three phases. Phase 1 included lighting upgrades, hot water tank insulation, solar thermal hot water systems, water conservation, and appliance replacement. The estimated cost of Phase 1 was $526,419, with an annual savings of $44,294 and a simple payback period of 11.88 years. Improvements from this phase of the plan were implemented on the island in 2013.

Phase 2 consisted of bringing photovoltaic (PV) power to Rock Harbor and Windigo. The solar array at Rock Harbor is designed to produce 91.8 kilowatts (kW), and is paired with a new 45kW Caterpillar generator. The solar array at Windigo is designed to produce 42.1 kW, and is paired with two new 36kW

[*] "Energy Savings Performance Contract: Final Proposal for Isle Royale National Park," Johnson Controls, September 2012.

Caterpillar generators. Ideally PV power would replace fuel-powered generators during daylight hours, although the ESPC notes that because there are two periods of peak demand, at the beginning and end of the day, some generator runtime will likely be required. The implementation cost of Phase 2 is $1,613,294, and the PV improvements are expected to save $83,196 annually with a simple payback period of 19.39 years. The implementation of Phase 2 will occur on the island in 2014. Phase 3 is not described in the ESPC proposal.

While not described in detail in the ESPC, Phase 3 will consist of a series of improvements on Mott Island: energy-efficient lighting; hot water tank insulation; PV-powered generators, hot water systems, and ceiling fans; transformer replacements; water and sewer related energy conservation; and appliance replacement. Phase 3 is estimated to cost $1,234,757 and save $71,866 per year with a simple payback period of 17.18 years.

## *Revenues*

Although information on commerce revenues is not consistently available, the revenue data that are summarized in Table A-22 suggest that the magnitude of revenue derived from cargo transport on *Ranger III* is minimal. Total commerce revenue is comprised of passenger commerce revenue (revenue from passengers and passenger cargo), freight revenues (revenues from carrying freight for the island concessioner), and oil transfer revenues (revenue from carrying fuel for the concessioner).

**Table A-22**
**Transportation Commerce Revenues**
Source: Isle Royale National Park *Ranger III* Operations Summaries

| | Revenue Type | 2008 | 2009 | 2012 |
|---|---|---|---|---|
| **Transportation** | Passenger Commerce Revenues | $161,000 | $153,437 | $159,881 |
| | Freight Revenues | $29,000 | $24,740 | $19,609 |
| | Oil Transfer Revenues | N/A | $5,200 | $3,247 |
| **Concessioner Franchise Fees** | Forever Resorts | $40,608 | $17,332 | $20,715 |
| | Isle Royale Line | $10,926 | $10,870 | $23,009 |
| | Grand Portage-Isle Royale Line | $10,624 | $14,005 | $17,327 |
| | Royale Air Service | $4,220 | $7,599 | $10,318 |
| | Total Revenues | $256,378 | $233,183 | $254,106 |

# Appendix B Summary of Regulations

This section provides a summary of considerations required for ISRO to complete its current missions.

## *Ranger III Construction and Operation*

*Ranger III*'s current missions include:

- Passenger ferry service for visitors to ISRO;
- Cargo transport for supplies to ISRO; and
- Diesel fuel transport to ISRO.

*Ranger III* is currently classified by the USCG as a 648 gross ton ferry, cargo vessel, and tank vessel operating on the Great Lakes and Inland Waters. To cover the *Ranger III*'s many missions, the construction and operations of the ship must comply with USCG regulations set forth in the Code of Federal Regulations (CFR) as described below.

### Navigation

All vessels operating on the United States inland waters and Canadian waters of the Great Lakes are required to comply with the regulations in 33 CFR § 83-90 (Navigation and Navigable Waters, USCG Subchapter E, Inland Navigation Rules). Additionally, all oil-carrying vessels operated under the authority of the United States and certified for coastwise service beyond three nautical miles from land are required to comply with the International Convention for the Prevention of Pollution from Ships (MARPOL), which is implemented in 33 CFR § 151 (Navigation and Navigable Waters, USCG Subchapter O, Pollution, Vessels Carrying Oil, Noxious Liquid Substances, Garbage, Municipal or Commercial Waste, and Ballast Water).

### Passenger Ferry Regulations

All ferry vessels greater than 100 gross tons that carry at least one passenger are required to comply with the regulations in 46 CFR § 70-89 (Shipping, USCG Subchapter H, Passenger Vessels).

### Cargo Vessel Regulations

All vessels greater than 15 gross tons carrying freight for hire are required to comply with the regulations in 46 CFR § 90-105 (Shipping, USCG Subchapter I, Cargo and Miscellaneous Vessels).

### Tank Vessel Regulations

All vessels carrying combustible or flammable liquid cargo in bulk are required to comply with the regulations in 46 CFR § 30-39 (Shipping, USCG Subchapter D, Tank Vessels). Furthermore, tank vessels are also required to comply with the regulations in 33 CFR § 155 (Navigation and Navigable Waters, USCG Subchapter O, Pollution, Oil or Hazardous Materials Pollution Prevention Regulations for Vessels) and 33 CFR § 157 (Navigation and Navigable Waters, USCG Subchapter O, Pollution, Rules for the Protection of the Marine Environment Relating to Tank Vessels Carrying Oil in Bulk).

### Transportation of Hazardous Materials

All vessels carrying hazardous materials, such as propane, are required to comply with the regulations in 49 CFR § 171-177 (Transportation, Federal Motor Carrier Safety Administration, Subchapter C, Hazardous Materials Regulations) as follows:

- 49 CFR § 171 – General Information, Regulations, and Definitions

- 49 CFR § 172 – Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans
- 49 CFR § 176 – Carriage By Vessel

#### Personnel and Passenger Safety

All commercial vessels are required to comply with the International Convention for the Safety of Life at Sea (SOLAS), which ensures that all ships comply with minimum safety standards in construction, equipment, and operation. These regulations are implemented in 46 CFR § 199 (Shipping, USCG Subchapter W, Lifesaving Appliances and Arrangements).

#### Fuel Transfer

Fuel and Hazardous Material transfer operations occurring on the navigable waters or contiguous zone of the United States to, from, or within each vessel with a capacity of 250 barrels or more must follow regulations set forth in 33 CFR § 156 (Navigation and Navigable Waters, USCG Subchapter O, Pollution, Oil and Hazardous Material Transfer Operations).

### *Ranger IV Construction*

In addition to the construction, operation, and safety regulations described above, a new *Ranger IV* would have to be designed and built in accordance with the American Bureau of Shipping (ABS) ship construction rules. The expected rules applicable to *Ranger IV* include:

- ABS Rules for Building and Classing Steel Vessels Under 90 Meters (295 Feet) in Length;
- ABS Rules for Building and Classing Steel Vessels, Part 5C, Chapter 2 – Vessels Intended to Carry Oil in Bulk (Under 150 meters (492 feet) in Length);
- ABS Rules for Building and Classing Steel Vessels, Part 5C, Chapter 7 – Vessels Intended to Carry Passengers; and
- ABS Rules for Building and Classing Steel Vessels, Part 6, Chapter 1 – Strengthening for Navigation in Ice.

### *Manning of ISRO's Large Fleet*

The manning requirements of ISRO's large fleet are ultimately determined by the USCG Officer in Charge, Marine Inspections (OCMI). The OCMI is delegated to perform, within their jurisdiction, functions on behalf of the USCG such as inspection of vessels and shipyards, licensing and certification of seamen, and enforcement of vessel inspection, navigation, and seamen's laws in general. However, there is some staffing information included in the following regulations:

- 46 CFR § 15 – Shipping, USCG Subchapter B, Merchant Marine Officers and Seamen, Manning Requirements (*Ranger III, Shelter Bay)*
- 46 CFR § 31 – Shipping, USCG Subchapter D, Tank Vessels, Manning of Tank Vessels (*Ranger III, Greenstone II)*
- 33 CFR § 155 – Navigation and Navigable Waters, USCG Subchapter O, Pollution, Oil or Hazardous Material Pollution Prevention Regulations (*Ranger III, Greenstone II)*
- 46 USC Part F – United States Code, Shipping, Manning of Vessels (*Ranger III, Shelter Bay, Greenstone II)*
- USCG Directive CIM 16000.8B – Marine Safety Manual, Volume III, Marine Industry Personnel (*Ranger III, Shelter Bay, Greenstone II)*

## *Fuel Farm Construction and Operation*

The construction and operation of fuel farms at Mott Island, Rock Harbor, and Windigo are regulated by the USCG, Environmental Protection Agency (EPA), and the Michigan Department of Environmental Quality. The following regulations govern the storage and transfer of fuel oil:

- 33 CFR § 154 - Navigation and Navigable Waters, USCG Subchapter O, Pollution, Facilities Transferring Oil or Hazardous Material in Bulk
- 40 CFR § 112 – Protection of Environment, Environmental Protection Agency, Water Programs, Oil Pollution Prevention
- Michigan Department of Environmental Quality – Storage and Handling of Flammable and Combustible Liquids

## *Air Quality*

The Clean Air Act Amendments of 1977 designates Federal Class I Airshed areas, where the Environmental Protection Agency (EPA) determined visibility to be an important value. A Class 1 Airshed is the highest designation under federal standards, and essentially equates to pure air. The Clean Air Act tolerates no degradation of visibility in Class 1 Airsheds, including any visible smoke from incinerators. The following regulation identifies mandatory Class I Federal areas:

- 40 CFR § 81 Subpart D – Protection of Environment, Environmental Protection Agency, Air Programs, Designation of Areas for Air Quality Planning Purposes, Identification of Mandatory Class I Federal Areas Where visibility Is an Important Value

# Appendix C Visitation Analysis

NOTE: A summary of the key findings of this Appendix is provided in the body of this report.

## *Introduction*

The purpose of this visitation analysis was to better understand the effects of different future visitation scenarios on the ISRO transportation system. Because Ranger III is expected to need a major overhaul in 2018, which would extend the ship's service life for 30 years, Volpe projected visitation to the year 2048.

Based on guidance from the park, Volpe staff developed three visitor use scenarios for this analysis:

(1) a low visitation scenario that assumes a low overall visitation trend and no concessioner lodging;
(2) a moderate visitation scenario that is a reasonable estimate of future visitation based on past projections; and
(3) a high visitation scenario that considers maximum increases in visitation that conform to the 1998 General Management Plan (GMP) and 2011 Wilderness and Backcountry Management Plan and Environmental Impact Statement (Backcountry EIS).

Looking at historic visitation data dating back to 1960 (shown starting in 1975 in Figure C-4), Isle Royale's visitation tends to cycle in 20-25 year periods. It is believed that these cycles are driven more by exogenous societal trends that the park is not able to control. Partially because it is impossible to estimate where these outside factors are headed in a 35-year timeframe, Volpe has chosen not to incorporate societal trends into the visitation projections. Some trends that were considered include national population trends, population trends for Michigan and the surrounding states, fuel prices, and boat ownership rates.

Annual visitation and associated cargo requirements were distributed seasonally to various transportation services based on historic patterns in order to determine future capacity requirements.

## *Data Availability and Analysis*

Visitation records for ISRO have been kept in a variety of ways since the park opened in 1940. Volpe staff reviewed data from a number of sources.

- NPS Public Use Statistics Office (PUSO)
  - "Annual Park Recreation Visits" Report (1940 – 2013)
  - "Recreation Visitors by Month" (1979 – 2013)
  - "Year To Date Report" for December (PUSO YTD) (1992-2013).
- Park provided
  - Visitor Statistics Summary: 1960 - 2001[*]
  - Bills of lading (2006-2012)
  - Data provided by the lodging concessioner (2006-2013).

The PUSO YTD report describes which accommodations overnight visitors use as well as how they arrived; however, there is no explicit link between accommodations and travel modes. One exception is that day users' travel modes are recorded separately from visitors who stay overnight. Since the variations associated with the low and high visitation projections relate to accommodations (backcountry permits

[*] Visitor Statistics Summary: 1960-2001, A Yearly Comparison of Total Island Visitation, Boating Use, and Backcountry Overnight Stays. Emailed by Mark Romanski, 1/13/2014.

and concessions lodging), this report was important for considering the transportation implications of the different visitation projections.

While there are slight discrepancies between the data sources, for the most part they show similar trends. Since these data sources cover different time periods and provide different ways of connecting overnight stays to transportation needs, they are all used in this analysis. When there are discrepancies in the data, the source used is cited. These data sources were used to develop low, moderate and high annual visitation projections.

#### Seasonal Use Trends

In order to better understand the demand on the transportation system, visitation was analyzed on a monthly basis for each scenario. Volpe looked at the PUSO report "Recreational Visitors by Month" for 1992-2013 and identified 1998 and 1999 as most closely matching the average monthly distribution for this time period. Detailed visitation estimates from the PUSO YTD report for each month were averaged for 1998 and 1999 to develop a typical monthly distribution of each visitor type, including travel mode and accommodations for day and overnight visitors[*].

These monthly visitation estimates were applied to each visitor type (as discussed in the sections that follow) and then visitors were assigned to transportation modes based on the typical distributions between the transportation options (i.e., distributing overnight visitors between *Ranger III*, *Isle Royale Queen* and services out of Minnesota)[†]. For the most part, the distribution between commercial boat services represent generic demand for travel from a specific origin to a destination on ISRO, with day users constrained to those services that make a daily round trip. The number of visitors was not limited by the vessel size and current schedule, so in some scenarios, some vessels may be assigned more passengers than their schedules can currently accommodate.

### *Visitor Use Types*

The ISRO transportation system transports visitors and the food and supplies needed to support them during their visit. Therefore, it is important to understand the total number of people visiting, their activities, and their length of stay. For example, some of the specific considerations that have been factored into this analysis include:

- whether visitors come for the day or stay overnight;
- what transportation mode they choose, and specifically whether they:
    - use commercial services, which include *Ranger III* and boat and plane concessions, and
    - if they travel by or bring a private boat; and
- which type of lodging visitors use, specifically whether they stay in concessions-operated lodging.

This section will provide background on how different user types affect the transportation requirements of the visitation projections and how they were determined.

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[*] A large number of day users arriving by private boat were recorded as arriving in December, when the island is closed. With concurrence from ISRO staff, these visitors were distributed over the high season proportional to the seasonal distribution of all other day visitors.

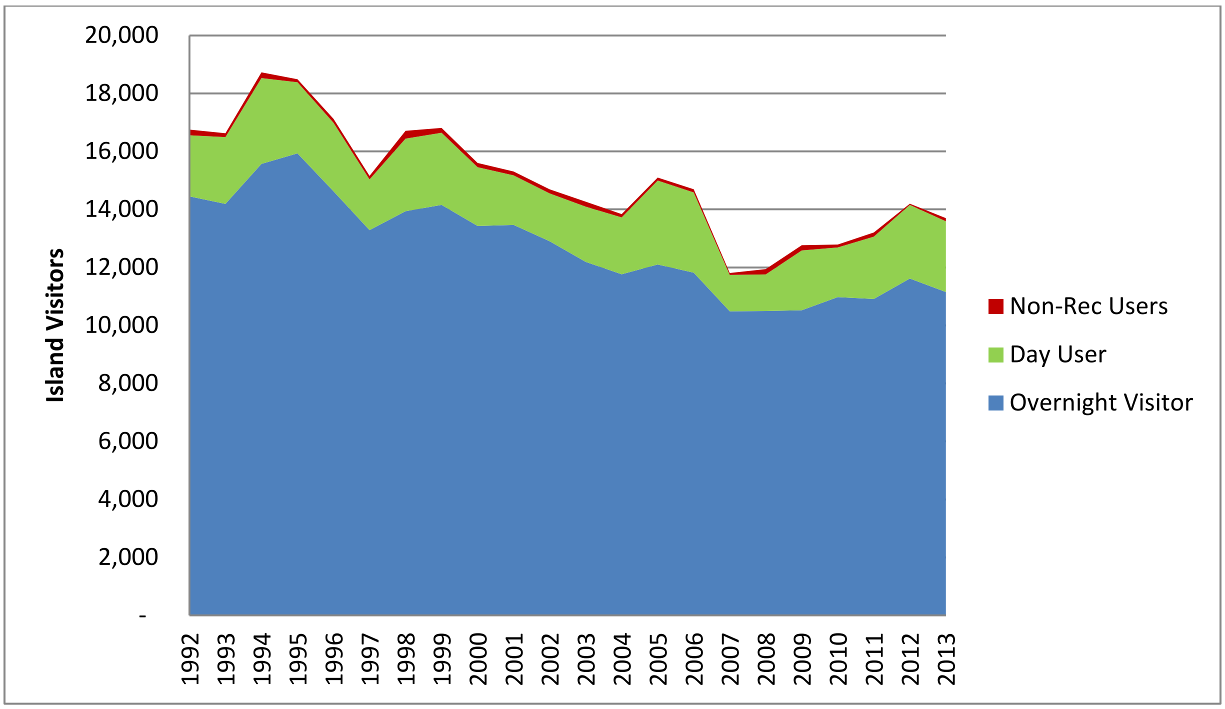
[†] The exception to this is new day use visitors in the high visitation scenario, for which the distribution is described in the high visitation section.

### Day Use

As shown in Figure C-1, the majority of island visitation is overnight stays. However, variations in day use have an effect on the resources required to provide for the on-island needs of visitors. Between the years 1992 and 2013, day use peaked in 1994 with 2,959 visitors, and was lowest in 2007 and 2008, due primarily to the Wenonah being out of service.

Day use has been relatively steady since 2008 when the schedule of the Wenonah was modified to better accommodate day users. Operated out of Grand Portage, MN, the Wenonah attracts many of the day-use visitors due to its short travel time. Since 2009, day use has varied from 1,713 in 2010 to 2,539 in 2012, ranged from 13-18% of total island visitation, and averaged 16.3% of total island visitation. Of the day users during this time period, between 86 and 257 per year have arrived by private boat, an average of 6.6% of the total annual day users or 1.1% of all island visitors.

**Figure C-1**
**Isle Royale Annual Island Visitation**
Source: NPS Public Use Statistics Office YTD Report




### Private Boaters

Private boaters have a different transportation need profile than other visitors to ISRO, particularly since most have their own means of transportation. This allows them to transport larger volumes of personal goods than a backpacker or concession lodger. Private boaters also require on-island sources of gasoline or diesel fuel, and tend to create large amounts of waste including fish guts, which ISRO is generally responsible for transporting from the island. While there are some differences between visitors who travel to ISRO on their own boat or transport their motorized boats via *Ranger III*, their impact on transportation of fuel, cargo and trash are presumed to be similar. Overall, travel to ISRO by private boat has ranged from 16%- 33% since 1992, averaging 22% overall, with approximately another 0.5% (60-80 boats) who have their boats transported by *Ranger III*.[*]

### Overnight Lodging

For this analysis, overnight visitors were characterized by lodging type in order to better understand user profiles and their demands on the transportation system. However, this proved difficult given the type of available data. For example, PUSO provides data about mode of transportation to the island as well as the number of nights for each type of accommodation, but it does not link travel mode to accommodation type. One can make the assumption that most visitors staying in the NPS Marina, or anchored there, have arrived by private boat; however, many boaters may also choose to stay in campgrounds or the backcountry. Therefore, it was challenging to distribute different lodger types to various transportation modes.

Volpe determined that data regarding number of nights stayed could be used to better link lodging types with travel mode.
Figure C-2 illustrates the distribution of overnight stays for each type of accommodation. Data provided by the concessioner, PUSO and the 2011 Backcountry EIS were used to estimate the average number of nights for each accommodation, which was then used to try to identify travel mode. Data provided by the concessioner for 2006 – 2012 demonstrate that concessioner lodging visitors stay an average of 2.5 nights. Therefore, the number of recorded overnights provided by PUSO has been converted into a number of visitors staying in concession lodging by dividing the total overnights by 2.5. Based on the park-provided data[†] from 1986-2001, boaters typically stayed 3.2 nights. PUSO data from 1992 to 2013 shows that overnight visitors overall stay an average of 4.3 nights. Since concessions lodgers and boaters have shorter average stays than the overall average, it is assumed from the PUSO data that backpackers have a slightly longer than average trip length. The 2011 Backcountry EIS confirms the longer stay of backpackers, which states as being 5.3 nights. The 2011 Backcountry EIS relies on data collected from 1974 to 2001 and provides similar statistics for overall visitation, backpackers, and boaters, but does not include concession lodgers. The estimate of the average overnight stay for boaters (4.5 nights) is about a day longer in the Backcountry EIS as compared to the average overnight stay for boaters calculated using park data (3.2); however the overall average overnight stays are similar (Table C-1). It is acknowledged that some visitors mix and match their lodging accommodations. For example, based on concessioner data from 2011 and 2012, approximately 8% of lodge visitors have spent a previous night backpacking[‡]. However, for the purposes of this analysis, visitors are characterized as staying in either one lodging type or another. Volpe has estimated the number of nights stayed by each of the visitor types, although the temporal variation of the data has made this challenging.

**Figure C-2**
**Distribution of Overnight Stays (average of 2004-2013)**
Source: NPS Public Use Statistics Office YTD Report

[*] Based on Ranger III bills of lading from 2006 to 2012.

[†] Romanski, 1/13/2014

[‡] From e-mail with Richard Moore, 4/15/2014.

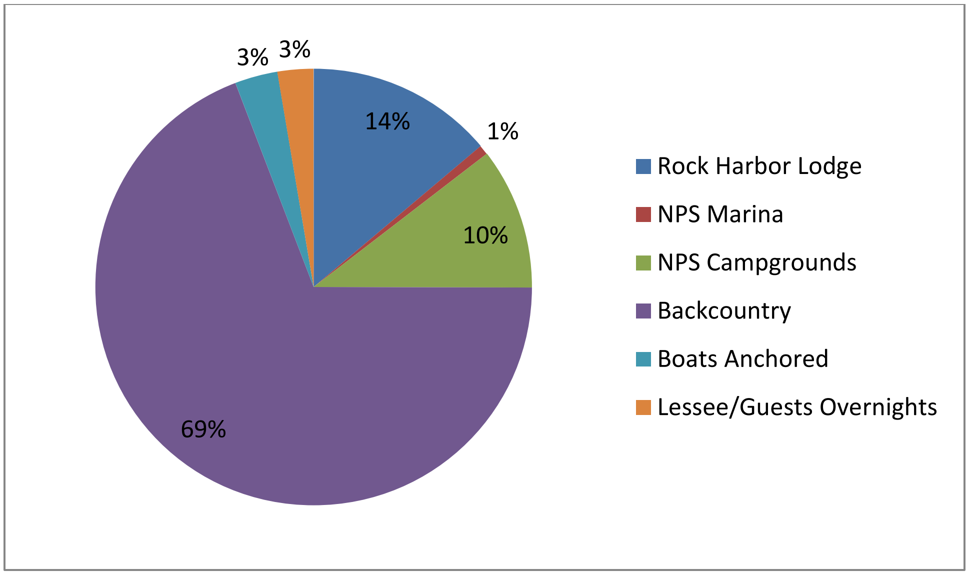



**Table C-1**
**Overnights in Concessioner Lodging Relative to Visitation**
Source: The 2011 Wilderness and Backcountry Management Plan and Environmental Impact Statement, NPS Public Use Statistics Office YTD Report, Park-Provided Data

| | Backcountry EIS | Volpe Calculated |
|---|---|---|
| Concessions Lodging | | 2.5 (2006-2012) |
| Boater | 4.5 | 3.2 (1986-2001) |
| Backpacker/Other | 5.3 | |
| All Overnight Visitors | 4.5 | 4.3 (1992-2013) |

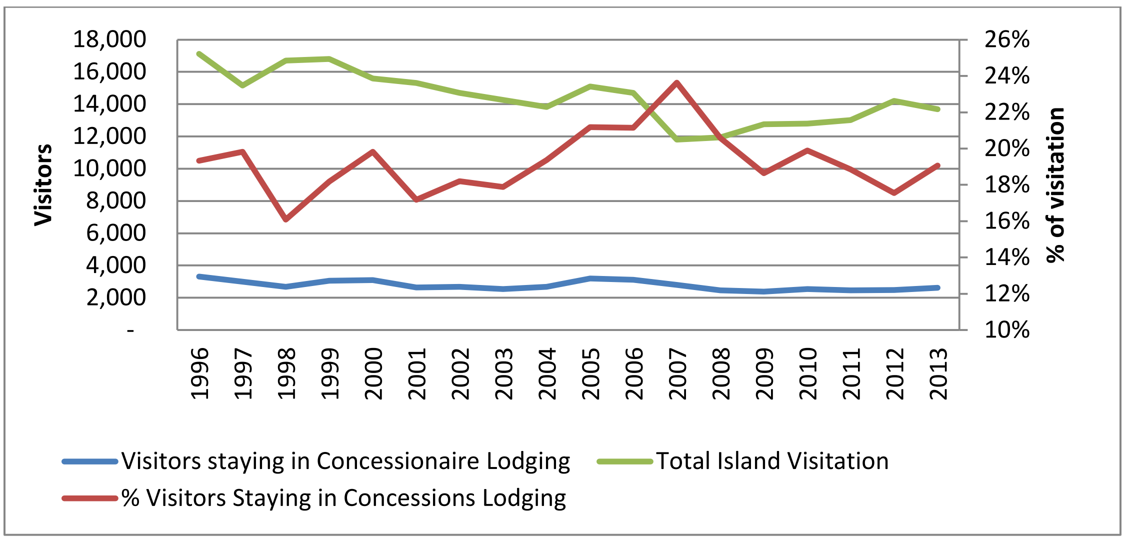
Visitors staying in commercial lodging have a unique impact on the transportation system relative to visitors staying in other types of accommodations. Island lodging includes the Rock Harbor Lodge, Rock Harbor cottages, and Windigo cabins[*]. These visitors bring less of their own food and rely on the concessioner for most meals. These lodgers also tend to use more water and electricity than other ISRO lodgers, such as those staying in the NPS campgrounds and backcountry.

In order to estimate the impact of concessions lodging on the visitation projections, the proportion of visitors staying in concessions lodging was needed. Since there were inconsistencies among data provided by PUSO and the concessioner, PUSO-provided lodge visitation data after 1996 was used to determine the proportion of visitors staying in concessions lodging. Figure C-3 shows the number of visitors staying in concessions lodging relative to overall visitation. Between 1996 and 2013, the proportion of visitors to ISRO that stayed in concessioner lodging ranged from 18% to 21% with an average of 19.2%. The fact that approximately one fifth of visitors stay in concessions lodging while they make up only 15% of overnight stays (

[*] Visitor stays at Rock Harbor Lodge, Rock Harbor cottages and the Windigo cabins are aggregated together and reported as Rock Harbor Lodge by NPS or concessions lodging in this report.

Figure C-2) illustrate what's found in Table C-1, that visitor who stay in concessions lodging typically stay fewer nights than other overnight visitors.

**Figure C-3**
**Overnights in Concessioner Lodging Relative to Visitation**
Source: NPS Public Use Statistics Office YTD Report




## *Visitation Projections*

As discussed above, three visitation projections were developed: low, moderate and high visitation projections. An annual projection was developed for each scenario and then visitors were distributed by month as described in the sections that follow.

### Low Visitation

The low visitation projection assumes low overall use and the closure of all concessions lodging (as a result of low overall use) on ISRO, and is estimated at 10,401 annual visitors. Overall low use was estimated based on the average historic low visitation.

The historic low visitation years were selected as the five years with the lowest visitation since 1975. Although PUSO data are available from 1960, annual visitation was much lower between 1960 and 1975 and in 1976, 99% of ISRO was designated as Wilderness as defined by the Wilderness Act which significantly changed the use and attractiveness of ISRO to visitors. While societal trends are not being incorporated in the projections, it is believed that a return to pre-1975 visitation is unlikely. For this reason, data from 1975 – 2013 were considered in estimating future low visitation. The years 2007 and 2008 were eliminated from the dataset, since they correlated to years that the Wenonah was out of service. While 1984 was significantly lower than other low years, no justification as an outlier was identified, and therefore it was included in the dataset. An estimate of low visitation has been made by averaging the low five years, for 12,580 island visitors (Table C-2)[*].

**Table C-2**
**Overnights in Concessioner Lodging Relative to Visitation**
Source: NPS Public Use Statistics Office YTD Report

| Visitation | Year |
|---|---|
| 11,608 | 1984 |
| 12,765 | 2009 |
| 12,788 | 1986 |
| 12,788 | 2010 |
| 12,951 | 1985 |
| **12,580** | **Average** |

The low visitation projection is also characterized by closure of concessioner lodging. It was estimated that the average proportion of lodge users, 19.2%, or 2,421 lodgers per year would be affected by the closure. Based on feedback from the park, an assumption of 10% of expected lodge visitors, or 242 per year, would continue to visit ISRO either by making day trips or using alternate accommodations[†]. This includes the 8% of lodge users who currently mix and match their lodging accommodations would continue to visit ISRO. Based on these assumptions, 10,401 visitors are expected each year in the low visitation scenario. Table C-3 shows how these visitors would be distributed into the different visitor types based on historic average visitor use distributions.

**Table C-3**
**Low Visitor Annual Projection Breakdown**
Source: Volpe

| Visitor Type | # Visitors Projected | % of Visitation |
|---|---|---|
| Day Use Commercial Transport | 1,918 | 18.4% |
| Day Use Private Boat | 139 | 1.3% |
| Overnight Private Boat | 1,993 | 19.2% |
| Ranger III Boats | 50 | 0.5% |

[*] These five years represent 14% of the years analyzed. (1975 – 2013, minus 2007 & 2008).

[†] It is assumed that the 242 visitors will distribute themselves across the various user types in a similar fashion to other non-lodge visitors.

| | | |
|---|---|---|
| Overnight Commercial Transport | 6,050 | 58.2% |
| Lessees/Guests | 252 | 2.4% |
| Total Island Visitors | 10,401 | 100.0% |

These visitors were then distributed seasonally to specific transportation options according to the methodology described in the Seasonal Use Trends section above. Table C-4 summarizes the low visitor monthly projections for the various visitor types.

**Table C-4**
**Monthly Low Visitation Projection**
Source: Volpe

| Transportation Choice | Visitors | % | May | Jun | Jul | Aug | Sep | Oct |
|---|---|---|---|---|---|---|---|---|
| Grand Portage - Windigo (Wenonah/Sea Hunter) | 2,696 | 26% | 91 | 365 | 915 | 1057 | 261 | 7 |
| Grand Portage - Windigo (Voyageur II) | 960 | 9% | 37 | 178 | 301 | 358 | 80 | 7 |
| Copper Harbor - Rock Harbor (Isle Royale Queen) | 2,868 | 28% | 110 | 523 | 903 | 1071 | 241 | 21 |
| Houghton - Rock Harbor (Ranger III) | 1,028 | 10% | 38 | 191 | 324 | 383 | 85 | 7 |
| Concession Plane | 466 | 4% | 18 | 86 | 146 | 173 | 39 | 4 |
| Private Plane | 0 | 0% | 0 | 0 | 0 | 0 | 0 | 0 |
| Private Boat | 2,132 | 20% | 92 | 294 | 791 | 779 | 167 | 8 |
| Lessee/Guests | 252 | 2% | 7 | 35 | 85 | 96 | 24 | 5 |
| **Total Visitors** | **10,401** | | **392** | **1,672** | **3,464** | **3,916** | **898** | **60** |
| **Seasonal Distribution of Visitors (%)** | | **100%** | **4%** | **16%** | **33%** | **38%** | **9%** | **1%** |

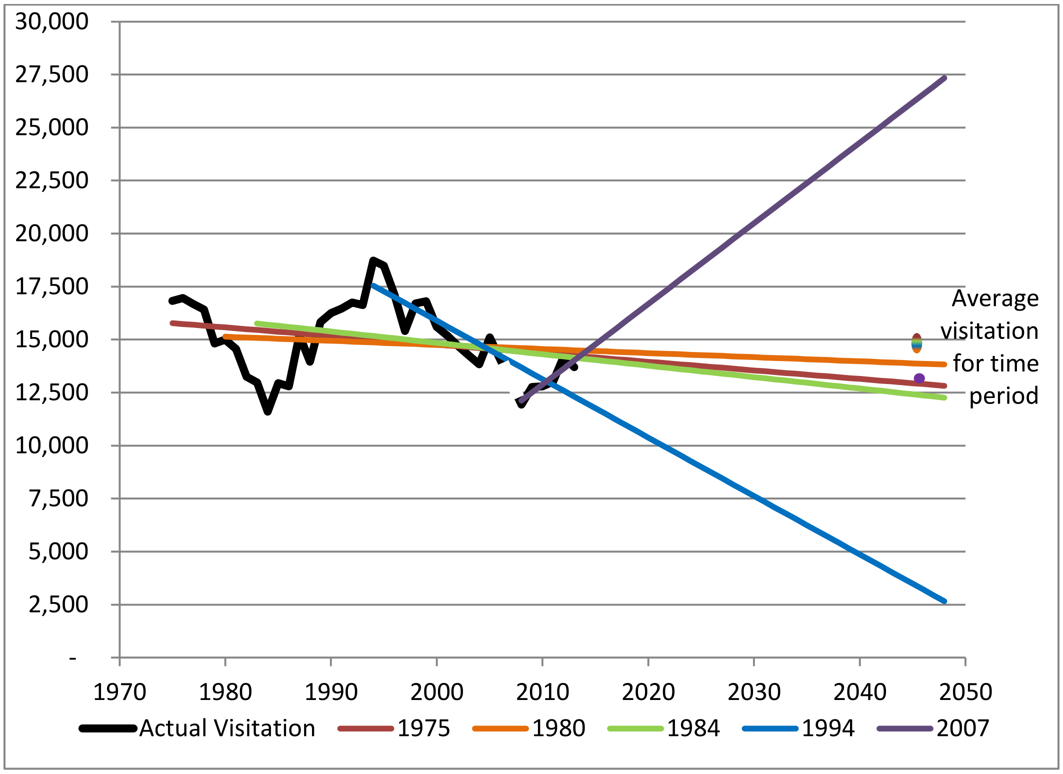
### Moderate Visitation

Due to the cyclical nature of visitation to Isle Royale, determining a moderate visitation level for 35 years out proved to be a challenge. Volpe looked at a number of averages and linear projections of visitation based on different starting years as shown in Table C-5 and illustrated in Figure C-4. Visitation for 2007 and 2008 was not included due to the impact of the Wenonah being out of service.

**Table C-5**
**Visitation Analysis Based on Differential Time Periods**
Source: Volpe

| Period of Analysis | Average | Trend Projected to 2048 |
|---|---|---|
| 1975 - 2013 | 15,034 | 12,820 |
| 1980 -2013 | 14,830 | 13,823 |
| 1984 -2013 | 14,957 | 12,262 |
| 1994 - 2013 | 15,019 | 2,660 |
| 2007 - 2013 | 13,069 | 27,330 |
| Median | 14,957 | 12,820 |

**Figure C-4**
**Trend Lines and Averages Based on Years Data Considered**
Source: Volpe




In conjunction with ISRO staff, the average visitation since 1980 of 14,830 visitors was used as the basis of the moderate visitation projection. It provides almost 35 years of visitation data to project a further 35 years into the future. Table C-6 shows how, from where, and when future visitors are expected to arrive. Historic distributions were used to distribute visitors to specific modes of transportation. Those visitors were then distributed based on the typical year as defined in the Seasonal Use Trends section.

**Table C-6**
**Moderate Visitor Monthly Projection Distribution by Travel Mode**
Source: Volpe

| Transportation Choice | Visitors | % | May | Jun | Jul | Aug | Sep | Oct |
|---|---|---|---|---|---|---|---|---|
| Grand Portage - Windigo (Wenonah/Sea Hunter) | 3,454 | 23% | 117 | 482 | 1,165 | 1,349 | 331 | 10 |
| Grand Portage - Windigo (Voyageur II) | 1,437 | 10% | 55 | 266 | 450 | 535 | 120 | 11 |
| Copper Harbor - Rock Harbor (Isle Royale Queen) | 4,262 | 29% | 163 | 780 | 1,340 | 1,590 | 357 | 31 |
| Houghton - Rock Harbor (Ranger III) | 1,538 | 10% | 57 | 286 | 485 | 573 | 127 | 11 |
| Concession Plane | 697 | 5% | 27 | 129 | 218 | 259 | 58 | 5 |
| Private Boat | 3,146 | 21% | 136 | 436 | 1,166 | 1,148 | 246 | 13 |
| Lessee/Guests | 297 | 2% | 8 | 41 | 100 | 113 | 29 | 6 |
| **Total Visitors** | **14,830** | | **564** | **2,419** | **4,924** | **5,568** | **1,268** | **87** |
| **Seasonal Distribution of Visitors (%)** | | **100%** | **4%** | **16%** | **33%** | **38%** | **9%** | **1%** |

### High Visitation

A high visitation projection of 47,471 visitors per season was developed to understand the potential transportation needs under significantly increased visitation levels. This value was calculated by considering historic high use of marinas and campgrounds, increased backcountry permits as discussed in the Backcountry EIS, a sustainable capacity of the concessions lodging, and increased day use. ISRO staff guided the development of the specific values for the last three items. A more detailed discussion of each category is provided below.

Table C-7 provides the summary of total projected visitation by activity for the high use scenario. Although the high use projection was developed as the highest reasonable amount of expected visitors, it is important to note that the 47,471 projected visitors is 2.5 times the historic high. This high use projection provides a benchmark from which to consider the transportation implications of future policy changes.

**Table C-7**
**High Visitor Projection Breakdown**
Source: Volpe

| Visitor Type | High Projection |
|---|---|
| Backcountry Visitors | 13,137 |
| Concession Lodging Visitors | 18,559 |
| Lessee/Guest | 760 |
| Other Overnight Visitors | 3,015 |
| Day Visitors | 12,000 |
| Total | 47,471 |

*Backcountry*

In looking at high visitation, the Backcountry EIS provides a limit to the number of visitors allowed in the backcountry of ISRO over the course of a season. Daily potential permit allowances (with an average of 3 people per permit) are shown in Table C-8. An assumption was made that by centralizing permitting, an additional 10% capacity could be accommodated, allowing a total of 13,137 backcountry visitors annually. For the purposes of this analysis, these visitors are estimated to arrive at ISRO through the same mix of transportation access to the island as used by current overnight visitors. Historically, 1996 had the highest number of backpackers, with 46,645 permits distributed. With visitors staying an average of 5.3 nights (Table C-1), that would equate to an historic high of 8,800 backcountry visitors.

**Table C-8**
**Potential Backcountry Permit Allowances**
Source: Mark Romanski, 4/8/14 e-mail correspondence

| Overnight Backcountry Season | | | Days | Permits per day | Permits Total | Visitors |
|---|---|---|---|---|---|---|
| May 1, 2014 | to | June 15, 2014 | 45 | 9 | 405 | 1,215 |
| June 16, 2014 | to | September 15, 2014 | 91 | 36 | 3,276 | 9,828 |
| September 15, 2014 | to | October 15, 2014 | 30 | 10 | 300 | 900 |
| | | Total | | | 3,981 | 11,943 |
| | | 110% Total | | | 4,379 | 13,137 |

*Concessions Lodging*

From 2000 to 2013, between 2,300 and 3,200 visitors and have stayed in concessions lodging each summer. This follows a general decline in use starting in the 1970's when approximately 4,000 visitors stayed per season. Additional use is needed to keep the concessions lodging sustainable. With the assumption that they can attract more visitors, ISRO has requested that 18,559 lodgers per season, or approximately 80% capacity, be used for the high visitation projection[*]. Visitors staying in concession lodging under the high visitation scenario were originally distributed based on the average historic distribution of visitors staying in concession lodging. However, when analyzing visitors on a seasonal basis, it was noted that the peak season visitation under the high visitation scenario exceeded the lodging capacity for those months. As a result, it was estimated that these overnight visitors would need to be more evenly distributed across the season. As such, the backcountry distribution curve was used to recalculate the monthly distribution factors for the overnight visitors under the high visitation projection scenario.

*Lessee/Guests*

Lessees/guests and visitors arriving by private boat are not expected to increase at the same rate as visitors relying on other modes. Lessees/guests have been capped at their historic high levels from 2001 and private boat use has been held to the historic high from 1995.

*Other Overnight Visitors*

In addition to visitors staying in concessions lodging and via backcountry permit, other visitors find overnight accommodations at the NPS Marina, NPS Campgrounds, staying in anchored boats or at inholdings (Lessee/Guests). The high projections for these overnight accommodations have been

[*] E-mail from Richard Moore 4/15/2014.

calculated using the historic high for each accommodation type between the years 1992 and 2013 (Table C-9). It has been presumed that visitors using these accommodations stay an average of 4.3 nights, which is the average stay for all overnight visitors (Table C-1)[*].

**Table C-9**
**Historic Highs for Other Overnight Accommodations**
Source: PUSO

| Accommodation | High Overnights | High Visitation | Year |
|---|---|---|---|
| Lessee/Guest | 3270 | 760 | 2001 |
| NPS Marina | 1,628 | 379 | 1994 |
| NPS Campground | 8,665 | 2,015 | 1994 |
| Anchored Boats | 2,669 | 621 | 1995 |
| Total | 16,232 | 3,775 | |

*Day Users*

The park has requested the high visitation projection to include higher day use with a total of 12,000 day users. This value represents an additional 4,000 people (40 per day x 100 day season) in Rock Harbor, and an additional 6,000 people (60 per day x 100 day season) in Windigo above the current approximately 2,000 people per season[†]. Average day use between 1992 and 2013 has been 2100 visitors. Historically, fewer than 5% of day users coming by commercial transport arrive in Rock Harbor while 83% of day visitors arrive at Windigo via the *Sea Hunter* (formerly the *Wenonah*). This is most likely because the *Sea Hunter*'s 1.5 hour travel time is half that of the *Isle Royale Queen*. The remaining 12% arrive by private boat or plane. The projected shift in distribution of day visitors to Rock Harbor is significant.

To calculate how day use visitors would be distributed across travel modes, day use visitors were divided into the current 2,000 visitors and 10,000 new future visitors. It is estimated that the current 2,000 day visitors will continue to travel to ISRO under the same distribution as their historic averages, and therefore have been allocated as such. The 10,000 new day visitors were distributed differently to simulate a significant increase in use of Rock Harbor by day visitors. The proportion of visitors traveling by private plane was projected to remain constant (0.3%). The number of day users traveling by private boat was based on the historic (1995) high. The remaining portion of the 10,000 future visitors (9,458) was split, with 40% traveling to Rock Harbor and 60% traveling to Windigo. While the number of days in the season was used to estimate the number of day visitors for the season, they have been distributed throughout the season based on the typical pattern of day use, as described in the Seasonal Use Trends section. Based on current schedules, neither the *Isle Royale Queen* nor the *Sea Hunter* has adequate capacity to carry the proposed demand during the peak season. Table C-10 shows how, from where, and when future visitors are expected to arrive.

[*] Since there is a significant variation in average stay for boaters between the two data sources, the generic nights per visitor will be used for boaters.

[†] E-mail from Mark Romanski 4/24/2014.

**Table C-10**
**High Visitor Monthly Projection Distribution by Travel Mode**
Source: Volpe

| Transportation Choice | Visitors | % | May | Jun | Jul | Aug | Sep | Oct |
|---|---|---|---|---|---|---|---|---|
| Grand Portage - Windigo (Wenonah/Sea Hunter) | 11,681 | 25% | 534 | 1,567 | 3,799 | 4,108 | 1,505 | 168 |
| Grand Portage - Windigo (Voyageur II) | 4,797 | 10% | 325 | 860 | 1,283 | 1,313 | 830 | 186 |
| Copper Harbor - Rock Harbor (Isle Royale Queen) | 17,728 | 37% | 1,066 | 2,900 | 5,098 | 5,332 | 2,796 | 537 |
| Houghton - Rock Harbor (Ranger III) | 4,885 | 10% | 331 | 876 | 1,307 | 1,337 | 845 | 189 |
| Concession Plane | 2,326 | 5% | 158 | 417 | 622 | 637 | 403 | 90 |
| Private Plane | 62 | 0% | 3 | 8 | 20 | 21 | 8 | 1 |
| Private Boat | 5,232 | 11% | 328 | 883 | 1,470 | 1,527 | 852 | 173 |
| Lessee/Guests | 760 | 2% | 52 | 136 | 203 | 208 | 132 | 29 |
| **Total Visitors** | **47,471** | | **2,797** | **7,647** | **13,801** | **14,483** | **7,370** | **1,374** |
| **Seasonal Distribution of Visitors (%)** | | **100%** | 6% | 16% | 29% | 31% | 16% | 3% |

# Appendix D Search for Existing Ships to Perform ISRO Missions

*Ranger III*'s mission and design is very unique in the world of shipping. While most vessels built today are specialized to either carry one type of cargo or to carry passengers, *Ranger III* is used to carry both cargo and passengers. Furthermore, *Ranger III* carries multiple types of cargo at once, including bulk cargo on deck using a crane, roll-on/roll-off (Ro/Ro) cargo using carts, and diesel fuel in tanks for use on the island.

A comprehensive search was performed to find existing ship designs built in the United States which could perform or be adapted to perform each of the missions currently completed by *Ranger III* or as required by the other alternatives. Maritime publications, naval architecture firm and shipyard websites, and cargo and passenger ship fleet listings were used to find vessels which could meet the missions. Initially, the search concentrated around vessels which could replace *Ranger III* with few design changes. The search looked for existing vessels which were designed to carry both passengers and cargo, and were built within the last 10 years, to ensure that the ships would require minimal changes to meet current U.S. Coast Guard training ship requirements, U.S. Environmental Protection Agency standards, and classification society build standards. As the search progressed, other ships with similar missions and those which would easily lend themselves to adaptation were also included, even if they don't currently perform the missions required by the Park. Other vessels which could meet the requirements of the other alternatives, such as ferries and crew boats, were also included in the search.

Eleven ships of various types were found which have similar mission, passenger capacity, size, or would lend themselves to a conversion to be used as *Ranger IV* or to support the logistics or passenger transport missions as described in the alternatives in this report. Table D-1 below lists the names and general specifications of these ships.

**Table D-1**
**Vessel Search Findings**
Source: Volpe

| **Ship Name** | Operator | Type | Dimensions | Primary Missions |
|---|---|---|---|---|
| *Stikine* | Alaska Interisland Ferry | Monohull Ro/Ro Ferry | 198' L x 51' B x 11' T | Passengers (160) Vehicles |
| *Lituya* | Alaska Marine Highway | Monohull Ro/Ro Ferry | 181' L x 50' B x 10' T | Passengers (150) Vehicles |
| *Ivanough* | Nantucket Steamship Authority | Catamaran Ferry | 154' L x 39' B x 5' T | Passengers Only (393) |
| *Grey Lady* | Hy-Line Ferry | Catamaran Ferry | 145' L x 34' B x 6' T | Passengers Only (300) |
| *Taurus* | WETA | Catamaran Ferry | 118' L x 28' B x 6' T | Passengers Only (149) |
| *Isla San Luis* | Grupo TMM | Fast Crewboat | 182' L x 34' B x 13' T | Bulk Cargo Passengers (30) |
| *Harlan S. McCall* | Seacor Marine | Fast Crewboat | 166' L x 30' B x 10' T | Bulk Cargo Passengers (80) |
| *Northern Leader* | Alaska Longline | Monohull Fishing Vessel | 184' L x 42' B x 18' T | Bulk Cargo |
| 180' x 42' Longliner | Jensen Maritime Consultants (designer) | Monohull Fishing Vessel | 180' L x 42' B x 16' T | Bulk Cargo |
| *First and Ten* | Rigdon Marine | Platform Supply Vessel | 190' L x 46' B x 18' T | Bulk Cargo |
| LCU-2000 Class | US Army | Ro/Ro Landing Craft | 174' L x 42' B x 8' T | Bulk Cargo |
| Handy-Size Tug | Jensen Maritime Consultants (designer) | Tug Boat | 74' L x 30' B x 11' T | Tug Boat |

The five vessels which can meet or be best adapted to meet the ISRO mission requirements are described in more detail below.

## *New Ranger IV*

In Alternative 2, *Ranger III* will be replaced with a new *Ranger IV*. Of the ships listed in Table D-1 above, the following vessels could be adapted to perform both the cargo and passenger services currently provided by *Ranger III*.

### MV Stikine

*MV Stikine* (Figure D-1) is a Ro/Ro and passenger ferry operated by Alaska Interisland Ferry. The ferry, built by Dakota Creek Industries in 2006, is larger than *Ranger III*, with a 198-foot length, 51-foot beam, and 11-foot draft, with a capacity for 160 passengers. Designed solely as a Ro/Ro ferry, there is a large enclosed cargo deck for up to 30 standard autos or 10 semi-trailers. Inside the passenger deck, there is a galley, restaurant, two large lounges, and four smaller passenger spaces.

Because *MV Stikine* was designed as a Ro/Ro ferry, there is no room for large bulk cargo on deck. In its current configuration, small boats, trash cans, and large materials would have to be loaded inside the Ro/Ro hold on trailers or pallets. However, it may be possible to modify the aft deck to include a pedestal crane and an area for bulk cargo during construction of a new vessel.

**Figure D-1**
*MV Stikine*
Source: James Crippen, Wikimedia


### LCU-2000 Class

The LCU-2000 Class ships (Figure D-2) are Ro/Ro landing crafts operated by the US Army. These ships, last delivered by VT Halter Marine in 2002, are slightly larger than *Ranger III*, with a 174-foot length, 42-foot beam, and 8-foot draft. These ships are not designed for passengers, and currently only operate with a crew of 13. The aft deckhouse contains a galley, mess space, and crew staterooms. The forward deck is open and can be used for storage of large, bulk cargo. Because the LCU-2000 Class ships have a shallower draft than *Ranger III*, this ship may be able to be used to access smaller docks and inlets around Isle Royale. Furthermore, because they are designed as landing crafts, the ship would not require a dock to offload cargo. Instead, similar to the LCM, the ship could lower its bow ramp on unimproved land to offload cargo and equipment.

The LCU-2000 Class ships have no protected area for baggage and other small cargo. An enclosed area would have to be designed into the new ship. There is not currently a deck crane on board, so a pedestal crane would have to be added during design and construction. The small deck house would also need to be increased in size to comfortably accommodate the crew and passengers on the journey.

**Figure D-2**
**LCU-2000 Class**
Source: US Navy

## *Crew Boat with Passenger Capacity*

In Alternatives 3 and 6, the logistics and staff transport functions of *Ranger III* will be replaced with a new crewboat. *Harlan S. McCall* is a good example of a crewboat which could be used for these missions.

*Harlan S. McCall* (Figure D-3) is a crewboat operated by Seacor Marine. The crewboat, built by Gulf Craft, LLC in 2007, is similar in size to *Ranger III*, with a 166-foot length, 51-foot beam, and 11-foot draft. The crewboat is classified as a USCG Subchapter T vessel with a capacity for 80 passengers. Inside the deckhouse, there is seating for the passengers, as well as berthing and a galley for the crew. The crewboat has a large, open aft deck for bulk cargo. Refrigerated containers could be loaded onto the aft deck to carry perishables (food), while unrefrigerated containers could be loaded onto the aft deck to carry other dry goods. Fuel could be carried in the several tanks below the aft deck. The crewboat can operate at 27 knots, which would allow for a roundtrip in one day.

As currently built, *Harlan S. McCall* does not have a deck crane for loading cargo. A crane could have to be added during construction to allow for unassisted loading and offloading of cargo.

**Figure D-3**
*Harlan S. McCall*
Source: Seacor Marine

## *Park Operated Passenger Ferry*

In Alternatives 5 and 6, the passenger transport function of *Ranger III* will be replaced with a new ferry. *M/V Gemini* is a good example of a ferry which could be used for passenger transport.

*M/V Gemini* (Figure D-4) is a catamaran ferry operated by the Water Emergency Transportation Authority (WETA) located in San Francisco. The ferry, built by Nichols Brothers Boat Builders in 2010, is USCG Subchapter T ferry with a 118-foot length, 28-foot beam, and 6-foot draft. The ferry has a capacity for up to 149 passengers. *M/V Gemini* has a snack bar area for passengers, and has storage space for bicycles which could be repurposed to visitors' baggage. The ferry can operate at 26 knots, which would allow for a roundtrip in one day.

**Figure D-4**
*M/V Gemini*
Source: Jack Snell

### *New Tug Boat*

In all alternatives, a new tugboat will be procured to transport the fuel and work barges from Houghton to Isle Royale. In Alternatives 4 and 5, the tugboat will also be used to transport the new logistics barge. The Handy-Size tug boat a good example of a tug boat which could be used for transportation of the barges.

The Handy-Size tug boat (Figure D-5) is designed by Jensen Maritime Consultants and built by Great Lakes. The tug boat has a 74-foot length, 30-foot beam, and 11-foot draft, and is less than 100 gross tons. The tug boat is designed to be operated with only one licensed operator and one unlicensed crewmember, keeping labor costs low. The small size and high fuel efficiency also reduce maintenance and operating costs. The tug boat can operate at speeds up to 12 knots.

**Figure D-5**
**Handy-Size Tug Boat**
Source: Great Lakes Towing

# Appendix E Transportation Options

Working with ISRO staff, Volpe developed 24 possible options for meeting ISRO's key transportation missions. The options relate to large fleet improvements, intra-island transportation improvements, passenger transport efficiencies, garbage transport efficiencies, and fuel-efficiency related improvements. These options include how the currently-owned fleet could be used to perform the necessary tasks as well as adding new vessels (purchase or lease), contracting out specific missions, or potential ways to eliminate or change the transportation need associated with the mission (i.e., incinerating waste on-island). Each option was analyzed for the ability to improve upon at least one operational activity that is required to fulfill the parks missions. The costs and benefits of each of the options were analyzed, as well as the impacts of visitation changes on each option. These options are described below.

**Table E-1**
**ISRO Transportation Options**
Source: Volpe

| Option ID | Option | Analysis Snapshot |
|---|---|---|
| A | *Ranger III* Service Life Extension and Upgrade Package | This is a safe alternative, but expensive. It may make sense in the low and moderate visitation projections; however not under the high visitation projection. |
| B | Build a New *Ranger IV* | This option makes the most sense in the high visitation projection. |
| C | Use a Crewboat for Cargo Transport | Use of a crewboat for cargo transport could significantly reduce park operating costs and still allow for complimentary transport of park staff and families. |
| D | Tug and Barge for Cargo Transport | This option has a lower initial cost and lower operating cost than the *Ranger III/IV*. This option does not include capacity for passenger transport; however, it could be combined with Option G or H to accommodate passenger transport. |
| E | Use Contract Services for Cargo Transport | This option is high risk and will require a request for information for vessel availability and freight rates before proceeding to implement this option. |
| F | Purchase a High Speed Ferry for Passenger Transport | This option requires some upfront investment, but has much lower operating costs than the *Ranger III*. This option makes the most sense under the high visitation projection, or when combined with Option D or Option E under the low and moderate visitation. |
| G | Use Concessioner Ferry for Passenger Transport | Under this option, the park would still need to operate *Ranger III* for cargo transport. This option is only attractive at the low visitation projection, and only if the number of *Ranger III* trips could be reduced to once per week. |
| H | Staff *Ranger III* with Contract Crew | While the contracted crew may be cost effective, it would be difficult to know the true cost without publishing a request for interest. |
| I | Optimize *Ranger III* Crew Certification Distribution | This option has a low initial investment, and relatively short payback period. |
| J | Increase *Ranger III* Crew Size | This option will be required for *Ranger III* to cover high visitation passenger and cargo requirements. However, the required breakeven ridership is higher than the high visitation projection, and thus does not make economic sense. |

| | | |
|---|---|---|
| K | Make more Roundtrips with *Ranger III* | This option will be required for *Ranger III* to cover high visitation passenger and cargo requirements. However, the required breakeven ridership is higher than the high visitation projection, and thus does not make economic sense. |
| L | Implement More Frequent Schedule of Cruises | The profit from these cruises is small and will not have a big effect on overall revenue. |
| M | Align *Ranger III* Trips with Airline Schedules | Based on the current travel time of the *Ranger III*, adjusting the schedule to accommodate the current flight schedule does not make sense. |
| N | Relocate *Ranger III* Dock to End of Canal | This option is relatively expensive, and carries a lot of uncertainty about the availability and usability of the property for the dock. |
| O | Replace Work Barge with Modular Causeway Platform | This option is expensive, but offers some flexibility and would provide redundancy. This option would not limit the availability of the LCM. |
| P | Outfit LCM as Work Barge | This option would allow access to and use of a work platform without the need for a separate tugboat operator, but would also limit the availability of the LCM to move dumpsters and heavy equipment around ISRO when not in use for construction. |
| Q | Ship Food and Cargo to Windigo on *Voyageur II* | This option is not expected to produce any cost savings. |
| R | Increase Efficiency of Small Fleet | Replacing all workboats with more efficient vessels does not make sense as the fuel savings is heavily outweighed by the capital costs of the new boats. |
| S | Install Automatic Identification System (AIS) on Small Boat Fleet | Unless existing staff could add dispatching vessels to their existing duties, the use of AIS would cost more than it would save. |
| T | Build More On-Island Gasoline Storage | Since there appears to be sufficient gasoline storage on ISRO, this option is unnecessary at the low and moderate visitation, or if *Ranger III* is used to transport gasoline. However, under the high visitation projection, if *Greenstone II* continues to transport gasoline, increasing the gasoline storage capacity at Rock Harbor could eliminate one barge trip per year. |
| U | Increase Diameter of Island Fuel Line | This option constitutes a relatively large investment for a small operational savings. |
| V | Use Alternative Energy in Houghton | Although the payback period could not be justified, this option remains prospective given the NPS' commitment to Green Energy. |
| W | Incinerate On-Island Waste | This option is not feasible because there are no incinerators which meet the requirements of a Class 1 Airshed. |
| X | Burn Waste Kitchen Oil on *Ranger III* | This option offers a small cost savings, and would require a significant level of effort to implement. |

## *A: Complete Ranger III Service Life Extension and Upgrade Package*

*Ranger III* was put into service in 1958. While it's not unusual for the hull of a fresh water ship to last for over 60 years, many of the systems on *Ranger III* are nearing the end of their useful life.

**Discussion:** The *Ranger III* is a 165 foot long steel hull ferry/logistics ship. It is the primary means of transportation from the Isle Royale National Park headquarters (Park HQ) in Houghton, MI to the park at Isle Royale, which is over 60 miles away in Lake Superior. *Ranger III*'s primary mission is to transport food, fuel, building materials and other logistics to the park. It carries trash, fish guts, and recyclables back to the Park HQ for proper disposal. It also carries paying passengers and park employees. The vessel operation is efficient and the ship is suited to the task of providing continuous service every summer.

During the summer season, *Ranger III* makes approximately 44 round trips to the island as well as a few dinner-cruises on the Portage Canal. The rest of the year from October to April, the ship is docked in Houghton, MI with a trip to drydock every five years. While the ship is old, it does not experience high tempo service or much rough weather service, which has benefited the longevity of the *Ranger III*. While the hull is in reasonably good condition, many of the individual systems on the ship are obsolete and difficult to support. Recent problems with the crane, air compressors, and aft capstan have demonstrated the problems associated with supporting old, obsolete systems. The crane and aft capstan both required custom parts to be built at great expense for the machinery to be repaired.

The Volpe Center marine engineers are experienced in working with older ships and extending their service life through a procedure called a Service Life Extension (SLE). The SLE breaks the ship down into its individual systems. Each system is evaluated to determine how much longer the system can be considered safe and reliable. If it is determined that the system cannot last for the desired remaining service life, a course of action to either overhaul or replace the system is made. An SLE will re-capitalize or even upgrade existing systems, but will not give a ship new capability.

In November of 2013, Volpe engineers visited the *Ranger III* in drydock at Sturgeon Bay, WI. Working with the ship's crew, Volpe engineers conducted a review of all of the systems on the *Ranger III*. Volpe also conducted a hull survey to determine if the hull was still in good shape. The hull survey showed that there was no wastage of the hull that exceeded 10% of the original hull thickness. Based on this survey, Volpe engineers were confident that the hull could last for another 30 years of service. Therefore, the systems were evaluated to determine if they could last for an additional 30 years.

Based on this review, Volpe developed a work list of 36 separate action items, which is included in Appendix F The work list calls for the recapitalization of these systems either through an extensive overhaul or replacement with new equipment. Volpe estimated the total cost of the SLE package to be $11.7 million in 2014 dollars. Assuming all components of the SLE are implemented, the annualized capital cost would be $390,000 per year

If the SLE package is not undertaken, the hull may last, but the individual systems will start to break down. Due to the difficulty in obtaining replacement parts, *Ranger III* will eventually be put out of service. It is difficult to predict when that will be, but it is likely that *Ranger III* will not last for more than another 15 years (approximately 2030) without implementing the SLE package.

The 36 items are prioritized so that if the total funding of $11.7 million is not available at once, the NPS can use the work list to rank action items. The risk that the ship will self-decommission prematurely increases with the number of action items that are left incomplete.

In addition to the SLE, Volpe engineers researched eight upgrades that might improve efficiency or enhance the passenger experience. The passenger amenities are mostly of the 1950's period and while most of the systems function properly, some are old and inefficient. Although upgrades are not normally part of an SLE, Volpe marine engineers recognized a benefit to including them in this case.

The following eight upgrade items were developed for *Ranger III*:

1. Replace the Existing Steel Hull life boats
    a. Cost Estimate: $450,000

b. Benefit: Reduced topside weight, improved stability, increased cargo capacity, improved passenger and crew safety, and a possible reduction in crew size.

Replacing the existing steel hull life boats might allow for a reduction in crew size during the peak season from nine crewmembers to eight or perhaps even seven. This would have to be negotiated with the US Coast Guard. If one Ordinary Seaman (OS) was eliminated this would reduce mariner salaries by $32,743 per year and yield a payback period of 15.4. However, if one Able-bodied Seaman (AB) and one OS are eliminated the salary savings is $74,581 per year. This would yield a payback period of 6.7 years.

2. Hydraulic Operated Hatches
    a. Cost Estimate: $650,000
    b. Benefit: Easier to open hatches. Cargo could be regularly loaded with the crane into the lower cargo hold, freeing up more space on deck for additional cargo transport on each trip. This would lower the center of gravity and allow for more cargo storage on the upper decks.

Currently, the *Ranger III* does not carry much cargo in the lower hold because of the difficulty of opening the hatches. Hydraulic operated hatches would eliminate that problem. If we assume that for 30 of the trips each year *Ranger III* could carry an additional five tons of cargo on the way over to ISRO, the additional cargo per year would be 150 tons. At $9/100 pounds, the additional revenue would be $27,000 per year. The payback period would be 24.7 years. While the payback may not make financial sense, the amount of cargo required for the high visitation projection may make additional usable cargo capacity on the *Ranger III* worthwhile.

3. Upgrade Fuel Transport to Carry Gasoline
    a. Estimated Cost: $600,000
    b. Benefit: If *Ranger III* was able to transport gasoline and aviation gas (AVGAS), ISRO would no longer have to hire an expensive tug captain and crew to move the fuel barge between the mainland and the island. It would no longer be an emergency situation when gasoline levels get low on the island. These trips would be limited to 25 passengers.

In 2013, the cost to contract for a crew for the tug and fuel barge was approximately $30,000 for one roundtrip, but this cost is expected to increase in the upcoming years. Over the past several years, ISRO has required an average of 1.5 fuel barge trips per year. In addition to the contract crew, the tugboat and fuel barge have ongoing fuel, maintenance and drydocking costs. The fuel barge, *Greenstone II*, requires drydocking for inspection and maintenance every 10 years. The estimated drydocking and maintenance costs for *Greenstone II* are $150,000 every 10 years. The tugboat, *Shelter Bay*, was built in 1946 and is past its designed service life. Current fuel and maintenance costs for the tugboat are estimated to be approximately $6,000 per year. However, within the next few years, the US Coast Guard will be implementing new design, construction, and operation rules for tugboats. These rules will be implemented under 46 Code of Federal Regulations 136 – 144, USCG Subchapter M. These new regulations likely require several upgrades to *Shelter* Bay to be in compliance with the appropriate standards, and will also require that *Shelter Bay* be drydocked every five years. The estimated drydocking and upgrade costs for *Shelter Bay* are $50,000 every five years. As a worst case scenario, *Shelter Bay* may have to be replaced with a newer vessel to be in compliance with the regulations.

As an alternative to the tugboat and fuel barge operations, *Ranger III* or a new *Ranger IV* could be adapted to carry gasoline and AVGAS. A fixed 5,000 gallon tank could be installed in the aft void, or portable fuel tanks could be carried in the forward cargo areas. Additional provisions required for carrying gasoline include forced ventilation, fire suppression systems, and explosion-proof electrical fittings. A gasoline transfer system would also have to be installed. The estimated cost to install the gasoline tank and associated provisions is $600,000. Additionally, during trips when gasoline would be carried on *Ranger III*, the trip would be limited to 25 persons. Therefore, it is expected that additional fuel-only trips would be added to *Ranger III*'s schedule.

The breakeven point and payback period depend highly upon the amount of fuel transported. At low visitation, the expected gasoline usage is 28,600 gallons per year (approximately six *Ranger III* fuel trips). At moderate visitation, the expected gasoline usage is 31,200 gallons per year (approximately 6.6 *Ranger III* fuel trips). At high visitation, the expected gasoline usage is 69,300 gallons per year (approximately 14.6 *Ranger III* fuel trips).

The estimated costs are approximately $11,200 for labor and fuel for each gasoline-carrying trip. However, adding the ability to carry gasoline to *Ranger III* would also allow the park to eliminate the tugboat and fuel barge. This would allow for a savings for contracted crews; tugboat maintenance, fuel and drydocking; and fuel barge maintenance and drydocking. As shown in Table E-2, for all visitation projections, using *Ranger III* to transport gasoline would not necessarily make economic sense.

**Table E-2**
***Ranger III* Gasoline Trip Costs**
Source: Volpe calculations

| Visitation | Average # *Ranger III* Fuel Trips | Gallons of Gasoline | Annualized Cost of *Ranger III* Trips | Annualized Cost of Equivalent Tug/Barge Operations | Additional Yearly Costs |
|---|---|---|---|---|---|
| Low | 6.0 | 28,600 | $90,100 | $88,000 | $1,800 |
| Moderate | 6.6 | 31,200 | $96,500 | $92,100 | $4,400 |
| High | 14.6 | 69,300 | $188,600 | $147,400 | $41,200 |

Depending on future visitation and gasoline usage, using *Ranger III* to transport gasoline to ISRO may or may not make economic sense. If gasoline use is reduced to less than five *Ranger III* trip per year, cost savings can be expected. However, for all visitation projections (at least 6 *Ranger III* trips), this option would result in additional park spending. Still, there are other benefits to consider. Using *Ranger III* to transport gasoline would allow ISRO to eliminate the need for a fuel barge. In fact, this appears to be the only way to eliminate the fuel barge altogether. If this option is combined with other options, such as purchasing a modular causeway or upgrading the LCM to eliminate the need for the work barge, the tugboat may also be divested. Furthermore, using *Ranger III* to transport gasoline would eliminate the park's reliance on a contract crew to bring gasoline out to the island, saving contract costs and reducing scheduling concerns. This option would also work well in combination with a high speed ferry, as the *Ranger III* gasoline trips would no longer have to deal with limited passenger capacity. In this situation, gasoline could be carried during the existing cargo trips, as opposed to having to add fuel-only trips to the schedule.

4. Install an Alarm Panel and Tank Level Indicating (TLI) System
    a. Estimated Cost: $700,000
    b. Benefit: An engine room automation system could eliminate the need for an engine room watch stander, possibly reducing crew size. An alarm/ TLI system gives the crew quick access to information needed to prevent accidental damage to machinery and to prevent oil spills.

A TLI system will improve safety, but probably will not reduce the amount of labor required to re-fuel the ship. It is possible that through negotiations with the US Coast Guard, an alarm panel could eliminate the need for a full-time engine room watch-stander. If the third engineer could be eliminated, the cost savings per year would be approximately $77,000. If the alarm panel/TLI cost $700,000 to install, the payback period could be as low as nine years.

5. Increase Refrigeration Capacity
    a. Estimated Cost: $500,000
    b. Benefit: The current refrigeration capacity limits the amount of refrigerated goods that may be brought on each trip to ISRO. Increased capacity could allow for more supplies per trip, allowing more flexibility in ship scheduling and destinations.

Currently, *Ranger III* carries about 53 tons of refrigerated cargo per year. Roll-on refrigerators are used during the peak months when the built-in capacity is not adequate. The fee for transporting goods is $9/100 pounds. If refrigerated cargo capacity is increased by 10%, there would be room for an additional 5.3 tons of refrigerated cargo transported to ISRO, which amounts to approximately $1,000 per year in additional revenue. At a cost of $500,000 to install, the payback period would be 500 years, much longer than the expected life-extension of *Ranger III*. While the payback for additional refrigeration may not be attractive, there are other reasons to consider increased refrigeration capacity associated with operations of the boat. While the current fixed and portable capacity will handle refrigerated cargo levels for the low and moderate visitation projections, the current capacity will not be able to support the high visitation scenario. Furthermore, depending on the design, it may be easier to load into built-in cold storage compared to using the portable freezers.

6. Improved Passenger Experience
    a. Modern Seating: $225,000
       Satellite TV: $55,000
       WiFi: $90,000
       Replace Glass Doors: $105,000
       Total: $475,000 for all upgrades
    b. Benefit: The six-hour transit on *Ranger III* is a long trip for passengers. Nicer passenger amenities could improve the experience thereby encouraging increased visitation to ISRO.

Proposed upgrades include modern seating and amenities in the seating areas; adding two TVs and a satellite TV connection to the smoking lounge; providing wireless internet access; and replacing the glass doors between the upper deck lounge and smoking lounge with lighter joiner doors. Together, these improvements cost $475,000.

The total cost for all improvements is $475,000; however, only certain passenger experience upgrades were chosen to carry forward. These improvements include installing satellite internet and upgrading the seating. The total cost to implement these passenger experience upgrades is approximately $315,000.

7. Alternative Energy
    a. Estimated Cost: $1.0M
    b. Benefit: Green energy would reduce the amount of power generation needed onboard, which could reduce fuel consumption by as much as 15%.

Volpe estimated that a $1M investment in alternative energy could save as much as 15% of *Ranger III's* energy consumption, or the equivalent of a savings of about 4,090 gallons. At $4/gallon that would mean an annual savings of $16,360. This yields a payback period of approximately 60 years. Although this does not appear to be economically advantageous, this project may be justified as an effort toward the NPS's dedication to green energy.

8. Baggage Carts
    a. Estimated Cost: $175,000
    b. Benefit: Configuration-controlled baggage carts would make ISRO cargo operations more efficient.

The current baggage carts used on *Ranger III* are unique. They are functional, but when they need repair it is very difficult to get spare parts. By purchasing standard airline baggage carts, repair parts would be readily available when the carts break, reducing the time the park was without them. New carts are estimated to cost $175,000. While the time, cost and effort to maintain the current carts have not been documented, it seems reasonable to assume that the NPS could save as much as $5,000 per year in repairs and lost opportunity, which would result in a 35 year payback period. If the savings were as much as $10,000 per year the payback period would only be 17.5 years. It is expected that these baggage carts would continue to be used for any future transportation to ISRO after *Ranger III's* useful life. This item could be budgeted so that the park could purchase a few each year to replace the current carts as they become obsolete.

The cost to implement all eight upgrades is estimated to be $4,390,000 in 2014$.

**Effect of Visitation:** The SLE does not change the size or carrying capacity of *Ranger III*. *Ranger III* can handle the capacities needed for low and moderate visitation projections. For the high projection, the appropriateness of continued use of *Ranger III*, as compared to use of a larger capacity option, should be considered, since *Ranger III*'s capacity and speed limit its ability to meet the projected demand. More runs will be required at the high visitation projection, which would require a larger crew.

**Conclusion:** Though possible, it is unlikely the ship can last another 15 years without recapitalizing some of the key systems. The recent problems with the crane have further demonstrated that *Ranger III* is vulnerable to self-decommission. Volpe estimated the total cost of the SLE package to be $11.7 million in 2014 dollars. Assuming all components of the SLE are implemented, the annualized capital cost would be $390,000 per year.

Furthermore, while all of the upgrades would improve operations or the passenger experience just three have a payback period of less than 30 years, which is the projected service life extension. The three upgrades are:

1. Replace Steel Hull Life Boats: Payback Period 6.0 years
4. Install Alarm Panel and TLI: Payback Period 9.0 years
8. Baggage Carts: Payback Period 17.5-35.0 years.

Additional passenger experience upgrades were also chosen to carry forward. These improvements include installing satellite internet and upgrading the seating. The total cost to implement these five specific upgrades is approximately $1.64 million. The total estimated cost of the SLEU is $13.3 million in 2014 dollars, for an approximate annualized cost of $444,000 per year.

If the SLE or SLEU is to be undertaken, the ideal time would be during the next drydocking in the fall 2018. To accommodate this schedule, the specifications would need to be submitted to the contracting officer by January 2018. Since it will take approximately two years to develop the specifications, drawings, and order long lead time material, the work on the specifications and drawings would need to begin in early FY2016.

### B: Build a New Vessel, Ranger IV

*Ranger III* was put into service in 1958 and at the time of this report is 56 years old. While it's not unusual for the hull of a fresh water ship to last for over 60 years, many of the systems on *Ranger III* are nearing the end of their useful life. Either these systems must be replaced or a new *Ranger IV* built if the ISRO is to continue Isle Royale ferry operations.

**Discussion:** *Ranger III* is a 165 foot long steel hull ferry/logistics ship. It is the primary means of transportation from the Isle Royale National Park headquarters (Park HQ) in Houghton, MI to the park at Isle Royale, which is over 60 miles away in Lake Superior. *Ranger III*'s primary mission is to transport food, fuel, building materials and other logistics to the park. It carries trash, fish guts, and recyclables back to the Park HQ for proper disposal. It also carries paying passengers and park employees. The vessel operation is efficient and the ship is suited to the task of providing continuous service every summer. *Ranger III* makes approximately 44 round trips to the island every year plus a few dinner-cruises on the Portage Canal. The rest of the year from October to April, the ship is docked in Houghton, MI with a required trip to drydock every five years. While the ship is old, it does not experience high tempo service or much rough weather service, which has benefited the longevity of the *Ranger III*. The problem is that many of the individual systems on the ship are obsolete and difficult to support. Recent problems with the crane, air compressors, and aft capstan have demonstrated the problems associated with supporting old, obsolete systems.

As described in Option A, it is estimated that extending the life of the *Ranger III* for an additional 30 years will cost $11.7 million dollars ($11.7M) in 2014 dollars (2014$). A set of additional upgrades to *Ranger III*, costing $1.6M were proposed to improve operations and customer comfort. It is expected that these types of improvements would be incorporated into a future vessel designed specifically for the park, here named, *Ranger IV*. The annualized costs of the SLE and SLEU are $390,000 and $444,000 respectively.

Volpe has worked with ISRO to develop a concept for *Ranger IV*, which is estimated to cost $22M, based on the cost of recent similar ships built in US shipyards. This value is considered a rough order of magnitude (ROM) and the actual cost may vary up to 20% when more detailed specifications are developed. Volpe estimates the cost for developing the specifications and a more accurate estimate to be $200,000. *Ranger IV* would be designed to carry up to 149 passengers and be approximately the same size as *Ranger III* which would allow it to continue to be considered under Coast Guard Subchapter H.

Even without the detailed specifications, it is believed that a *Ranger IV* would compare favorably to the SLEU to *Ranger III* based on the extended useful life of the *Ranger IV*, which is estimated to be 55 years.

With an estimated cost of $22M to build and outfit, the annualized cost spread over 55 years would be $400,000. The operating cost is assumed to be the same as *Ranger III*. The moderate visitation projection estimates 1,538 paying customers per season. Current average revenue per rider is $80 and is expected to stay steady without changes in ticket price. This amounts to approximately $90,000 in passenger revenues. The current annual estimated operating costs for the *Ranger IV* that is the same size and capability as *Ranger III* and would meet the needs of the moderate visitation projection are shown in Table E-3 below.

**Table E-3**
**Estimated Annualized Costs for Moderate Visitation**
Source: Volpe calculations

| Item | Ranger IV | *Ranger III* SLE | *Ranger III* SLEU |
|---|---|---|---|
| Annualized Capital Cost | $400,000 | $390,000 | $444,000 |

| | | | |
|---|---|---|---|
| Annual Operating Costs | $1,092,000 | $1,092,000 | $1,092,000 |
| Salaries | $713,000 | $713,000 | $713,000 |
| OT | $15,000 | $15,000 | $15,000 |
| Per diem | $17,000 | $17,000 | $17,000 |
| USCG/ABS | $44,000 | $44,000 | $44,000 |
| Maintenance | $20,000 | $20,000 | $20,000 |
| Training | $33,000 | $33,000 | $33,000 |
| Drydocking/5 | $150,000 | $150,000 | $150,000 |
| Fuel | $100,000 | $100,000 | $100,000 |
| Total Annualized Costs | $1,492,000 | $1,482,000 | $1,536,000 |
| Estimated Revenue | $123,000 | $123,000 | $123,000 |
| Annual Park Subsidy | $1,369,000 | $1,359,000 | $1,413,000 |

Under the Low Visitation Projection, a smaller *Ranger IV* would be possible. The smaller *Ranger IV* would carry 1,028 passengers during the season. The total average ticket revenue would be $82,000. There would also be a reduction in cargo commensurate with the lower park visitation numbers and the closing of the concessions lodging. The cost of building and outfitting the smaller *Ranger IV* is assumed to be 20% less, or approximately $17.6M. The annualized cost of this smaller *Ranger IV* would be $320K based on a service life of 55 years. Although the new vessel would be smaller, the same size crew would be needed. Operating cost savings would come from fuel savings and a less expensive drydocking cost. Table E-4 compares the annualized costs for *Ranger IV* and the *Ranger III* SLE and SLEU. While revenue for *Ranger III* would go down, its operating costs would not, making Ranger IV cost effective for the low visitation scenario.

**Table E-4**
**Estimated Annualized Costs for Low Visitation**
Source: Volpe calculations

| Item | Ranger IV | *Ranger III* SLE | *Ranger III* SLEU |
|---|---|---|---|
| Annualized Capital Costs | $320,000 | $390,000 | $444,000 |
| Annual Operating Costs | $1,048,000 | $1,092,000 | $1,092,000 |
| Salaries | $713,000 | $713,000 | $713,000 |
| OT | $15,000 | $15,000 | $15,000 |
| Per diem | $17,000 | $17,000 | $17,000 |
| USCG/ABS | $44,000 | $44,000 | $44,000 |
| Maintenance | $16,000 | $20,000 | $20,000 |
| Training | $33,000 | $33,000 | $33,000 |
| Drydocking/5 | $120,000 | $150,000 | $150,000 |
| Fuel | $90,000 | $100,000 | $100,000 |
| Total Annualized Costs | $1,368,000 | $1,482,000 | $1,536,000 |
| Estimated Revenue | $82,000 | $82,000 | $82,000 |
| Annual Park Subsidy | $1,286,000 | $1,400,000 | $1,454,000 |

Under the High Visitation Projection, the new *Ranger IV* would carry 4,885 passengers during the season, with the peak of approximately 167 passengers per trip during the high season. *Ranger III* cannot accommodate this level of demand and would need to be paired with another mode of visitor transportation. The larger *Ranger IV* would be longer, wider and draw more water. The annualized procurement cost and the other operating costs would be approximately 20% higher than the current *Ranger III*. A larger *Ranger IV* would create some other problems. The channel into Rock Harbor/Mott

Island would have to be dredged and possibly even widened. The approaches to the piers in Mott Island, Rock Harbor, Houghton and Windigo may also require some dredging. The estimated cost of all this dredging is $5M. This does not include the administrative and legal costs necessary to get the required permits.

Increasing the passenger capacity over 149 would not be favorable, as it would require more lifeboat capacity and safety equipment on board. In turn, this would require additional crewmembers for lifeboat operations, more training for the additional crewmembers, and more inspections on the safety equipment. This is estimated to increase the USCG/ABS and training costs by 20%.

In the high visitation projection the *Ranger IV* would carry an average of 4,885 passengers annually. The estimated average annual total revenue would be $391,000. This amount will be subtracted from the Annualized Total Operating Costs for the larger *Ranger IV*. The estimated annualized costs of operating the larger *Ranger IV* are shown in Table E-5 below:

**Table E-5**
**Estimated Annualized Costs for High Visitation *Ranger IV***
Source: Volpe calculations

| Item | Ranger IV |
|---|---|
| Annualized Capital Costs | $480,000 |
| Annual Operating Costs | $1,351,000 |
| Dredging | $91,000 |
| Salaries | $856,000 |
| OT | $18,000 |
| Per diem | $20,000 |
| USCG/ABS | $53,000 |
| Maintenance | $19,000 |
| Training | $40,000 |
| Drydocking/5 | $144,000 |
| Fuel | $110,000 |
| Total Annualized Costs | $1,831,000 |
| Estimated Revenue | $391,000 |
| Annual Park Subsidy | $1,439,000 |

**Effect of Visitation:** A new *Ranger IV* could be designed to a specific visitation level to ensure it is optimized for passenger and cargo capacity requirements.

**Conclusion:** A *Ranger IV* would have all of the features evaluated in the SLEU. It compares favorably in the low visitation scenario and when compared to the SLEU in the moderate visitation scenario. *Ranger IV* may even compare favorably to the basic SLE of the *Ranger III* since the cost estimates for *Ranger IV* have a 20% margin of error. Significant consideration needs to be made in whether a *Ranger IV* by itself could accommodate the high visitation projections.

Because the expected life of the SLEU *Ranger III* is less than that of the Status Quo *Ranger IV*, it would really be necessary to include the discounted cost of a new *Ranger IV* at the end of *Ranger III*'s life. This makes the Status Quo *Ranger IV* even more attractive.

Further design development is recommended to better understand the costs of a new vessel. If the purchase/build specifications and drawings for a new *Ranger IV* were developed, then they would be available in the event that funding becomes available.

## *C: Use Crewboat for Cargo Transport*

*Ranger III* was put into service in 1958. While it's not unusual for the hull of a fresh water ship to last for over 60 years, many of the systems on *Ranger III* are nearing the end of their useful life. Either these systems must be replaced or a new vessel built if ISRO is to continue Isle Royale ferry operations.

**Discussion:** *Ranger III* is a 165 foot long steel hull ferry/logistics ship. It is the primary means of transportation from the Isle Royale National Park headquarters (Park HQ) in Houghton, MI to the park at Isle Royale, which is over 60 miles away in Lake Superior. *Ranger III*'s primary mission is to transport food, fuel, building materials and other logistics to the park. It carries trash, fish guts, and recyclables back to the Park HQ for proper disposal. It also carries paying passengers and park employees. The vessel operation is efficient and the ship is suited to the task of providing continuous service every summer. *Ranger III* makes approximately 44 round trips to the island every year plus a few dinner-cruises on the Portage Canal. The rest of the year from October to April, the ship is docked in Houghton, MI with a required trip to drydock every five years. While the ship is old, it does not experience high tempo service or much rough weather service, which has benefited the longevity of the *Ranger III*. The problem is that many of the individual systems on the ship are obsolete and difficult to support. Recent problems with the crane, air compressors, and aft capstan have demonstrated the problems associated with supporting old, obsolete systems.

As described in Option A, it is estimated that extending the life of the *Ranger III* for an additional 30 years will cost $11.7 million dollars ($11.7M) in 2014 dollars (2014$). A set of additional upgrades to *Ranger III*, costing $1.6M were proposed to improve operations and customer comfort. It is expected that these types of improvements would be incorporated into a future vessel designed specifically for the park, here named, *Ranger IV*. The annualized costs of the service life extension and extension and upgrade are $390,000 and $444,000 respectively.

Instead of building a new *Ranger IV* in kind as described in Option B, a new fast crewboat could be acquired for logistics operations. The new crewboat would be designed and built to fulfill all of ISRO's logistics missions, such as transport of dry cargo, refrigerated cargo, trash, small boats, and diesel fuel. The crewboat would be between 150 and 175 feet in length, have a draft between 5 and 7 feet, have a cruising speed of 25 to 30 knots, and be under 100 gross tons. The lower draft requirements of the crewboat versus *Ranger III* would allow the crewboat to access smaller ports, such as Amygdaloid and Malone Bay, and the faster speed of the crewboat would allow a roundtrip to be performed on one day as opposed to two days for *Ranger III*. The open deck space would allow the new crewboat to carry the same amount or more deck cargo than *Ranger III,* while the below deck cargo would allow for between 9,000 and 17,000 gallons of diesel fuel, depending on the overall size of the vessel. The new crewboat would also have a capacity between 60 and 80 passengers. This passenger capacity would allow park staff and families to travel to ISRO aboard the crewboat, as opposed to having to ride a concessioner ferry. The passenger capacity could also be used to allow visitors to access ISRO during the shoulder season, when concessioner ferries operate fewer trips.

While *Ranger III* requires a crew of seven to nine personnel to operate between Houghton and ISRO, a new crewboat would only require a crew of two or three staff. Furthermore, compared to *Ranger III*, the less complex crewboat would require less maintenance, which would significantly reduce operating costs. The crewboat also operates at a higher speed than *Ranger III*. While this would increase fuel use, it would also allow the crewboat to depart and return on the same day, reducing overnights and saving labor costs.

With an estimated cost of $9M to build and outfit, the annualized cost spread over 30 years would be $300K. The operating cost is estimated to be $564,000.

**Effect of Visitation:** There is no expected effect from the low or moderate projections, as the crewboat would still make two roundtrips per week. At high visitation, the higher speed of the crewboat would allow for more weekly roundtrips. This would increase service to the island but also increase the annual fuel and labor costs.

**Conclusion:** If paying passengers are transported to ISRO on other vessels, such as a high speed ferry or concessioner vessel, the use of a crewboat for cargo transport could significantly reduce park operating costs. The crewboat would still be able to transport between 60 and 80 passengers, mainly available for park staff and families. The passenger capacity can also be used to allow visitors to access ISRO during the shoulder season, when concessioner ferries operate fewer trips.

## D: Use Tug and Barge for Cargo Transport

Due to its remote location, operations at ISRO are very expensive on a per visitor basis. ISRO currently operates all transportation logistics on the island except for some visitor travel. ISRO owns and operates a 165-foot ferry/logistics ship (*Ranger III*), a small tug boat (*Shelter Bay*) and two barges (*Beaver* and *Greenstone II*). These boats and barges play an important role in the ISRO operation, but they are also a very large expense. Could the park continue to operate at a reduced cost if ISRO decommissioned *Ranger III* and acquired a new tug boat and logistics barge?

**Discussion:** A new tug would be needed, because the current tug is old and small. If a tug is going to be making more frequent trips, a new tug is in order. The new tugboat would be approximately 75 feet in length, have a ten foot draft, and have twin engines and propellers with around 1,200 total horsepower. The new tug would also be able to transport *Greenstone II* and the work barge *Beaver*. The new logistics barge would be approximately 100 feet long and have a 30 foot beam, with a diesel capacity of at least 10,000 gallons. The tug/barge combination would have a much smaller crew than *Ranger III*. ISRO would still be able to deliver all logistics to Isle Royale; however, visitors and staff that previously used *Ranger III* for transport to ISRO would have to find a different mode of transport.

According to records obtained from ISRO, the average annual amount of freight going to and coming from ISRO on *Ranger III* and *Greenstone II* is approximately 1,000 long tons. This includes baggage, food, supplies, refrigerated cargo, diesel fuel, gasoline, AVGAS, trash, and boats. At the moderate visitation project, *Ranger III* also transports 1,538 paying passengers, plus an additional 750 complimentary passenger roundtrips per year. All of these passengers would have to be transported on commercial vessels.

On average, *Ranger III* would take in approximately $123,000 in passenger fees annually from its 1,538 paying visitors per trip. *Ranger III* also carries around 1,000 tons of cargo per year, approximately 75% of which is for park operations. The rest, approximately 266 tons, is for the concessioner. *Ranger III* collects fees for concessioner dry cargo, refrigerated cargo, trash, gasoline, and diesel fuel. This brings in approximately $30,000 per year. NPS will continue to receive this revenue from the concessioner. *Ranger III* also charges for passenger boats and canoes. This takes in approximately $15,000 per season. Because the concessioner ferry would not be able to transport powerboats, they would have to be transported separately on the ISRO-operated tug and barge. The ferry and tug and barge schedules would need to be coordinated to allow for close arrival and departure times for the visitors and their small boats.

If *Ranger III* is decommissioned and does not transport passenger cargo, NPS would lose approximately $140,000 in annual revenue.

Table E-6 shows the break-down of estimated annual operating cost for *Ranger III* in 2014.

**Table E-6**
***Ranger III* SLE Annualized Costs**
Source: Volpe calculations

| Component | Annual Cost |
|---|---|
| SLE Costs | $390,000 |
| Fuel | $100,000 |
| Crew Wages + Training | $778,000 |
| Maintenance & Consumables | $64,000 |
| 1/5 of Drydocking | $150,000 |
| **Total** | **$1,482,000** |

With revenues of $170,000, the park subsidy to operate *Ranger III* is $1,312,000 annually.

The tug and barges are expected to make 44 roundtrips per year. A new tug and logistics barge with dry and refrigerated containers will cost approximately $5,500,000. Assuming that there will be no change in operating costs compared to operating the current tug and barges, the new logistics barge will require an estimated annual operating budget of $50,000. A 1/5 share of the five-year drydockings will cost approximately $50,000 per year. The annual fuel costs will remain approximately the same. The trip will take longer, but a slower speed on more efficient engines will probably be a wash. The winter fuel needed to keep the tug from freezing up is estimated to be approximately $5,000.

The new arrangement will have only three crewmembers instead of the seven to nine that are currently employed. The smaller and less complex tug and barges will require less maintenance and will not require any year-round crew. The tug is slower and will require 10 hours to make a trip across the lake instead of the six hours it currently takes. Therefore, although the crew will be smaller, they will log more over-time. The estimated annual crew wages will be about $250,000.

Table E-7 summarizes the annualized costs for the tug and barge operation in 2014.

**Table E-7**
**Tug and Barge Annualized Costs**
Source: Volpe calculations

| Component | Annual Cost |
|---|---|
| New Tug + Logistics Barge Capital Costs | $183,000 |
| Fuel | $85,000 |
| Crew Wages | $250,000 |
| Maintenance & Consumables | $50,000 |
| 1/5 of Drydocking | $50,000 |
| **Total** | **$618,000** |

In addition to the lost revenue, ISRO would need to pay for the 1,500 one-way trips currently provided by *Ranger III* complementarily. Assuming they had to pay full commercial fare on the concessioner vessel, the cost translates to about $90,000. The operating cost of the tug and barge plus the fees for transporting the currently complementary trips would be about $708,000.

**Effect of Visitation:** In the low visitation scenario, the net operating costs of *Ranger III* would increase; however, the cost to operate the tug and barge would decrease. The result would be a net gain for NPS to choose the tug and barge system.

In the high visitation, the *Ranger III* net operating costs would be moderately lower. The operating costs for the tug and barge could go up significantly if more trips are required to meet the logistical needs. This would make the option less attractive.

**Conclusion:** Use of a tug and barge for cargo transport could significantly reduce park operating costs. While this option is cost effective, another method for passenger transport would be needed. Some passengers could be picked up by existing concessions, and an additional high speed ferry service could be provided out of Houghton, either provided by ISRO or a concession, to transport the remaining visitors and complimentary passengers. A solution, such as the high speed passenger ferry discussed in Option F and G may be a good pairing with this as it seems like it could be financially self-sustaining and could revenue from fees could potentially subsidize operation of the tug and barge.

## *E: Use Contract Services for Cargo Transport*

Due to its remote location, operations at ISRO are very expensive on a per visitor basis. ISRO currently operates all transportation logistics on the island except for some visitor travel. In order to do this, ISRO owns a ferry/logistics ship, two barges (one for construction and one for fuel transport) and a tug boat. Could the operating costs at ISRO be reduced if the NPS owned fleet was discontinued and all logistics, passenger, and employee transport was contracted out?

**Discussion:** ISRO owns and operates a 165-foot ferry/logistics ship (*Ranger III*), a small tug boat (*Shelter Bay*) and two barges (*Beaver* and *Greenstone II*). These boats and barges play an important role in the ISRO operation, but they are also a very large expense. The average annual amount of freight being transported to and from ISRO on *Ranger III* and *Greenstone II* is around 1,000 long tons (LT), of which approximately 75% is for park operations. This includes baggage, food, supplies, refrigerated cargo, diesel fuel, gasoline, AVGAS, trash, and boats. *Ranger III* also transports an average of 1,538 passengers per year. Approximately 1,500 additional complimentary trips are provided each year for park employees and other passengers.

If ISRO continues to operate without the large fleet vessels, cargo and passengers will need to be transported in an alternative way. In order to continue operating, NPS would have to contract with local vendors to get logistics (including fuel) out to the island from Houghton. Visitors and employees would have to be transported on commercial vessels.

**Income:** *Ranger III* takes in approximately $125,000 in passenger fees annually and collects approximately $30,000 in fees from the concessioner for carrying cargo. Revenues from *Ranger III's* transport of passenger baggage including boats and canoes are approximately $15,000 per year. The total annual revenue is approximately $170,000. If ISRO stops providing visitor and cargo transport, it loses that revenue.

**Costs:** There are three major categories of cost associated with the NPS marine transportation system. They are:

1. Operation and Maintenance of *Ranger III*
2. Operation and Maintenance of *Shelter Bay*, *Greenstone II*, *Beaver*
3. Travel for Park Employees and other "Comped" passengers.

### 1. Operation and Maintenance of *Ranger III*

Table E-8 provides the annualized costs of owning and operating *Ranger III*.

**Table E-8**
***Ranger III* Annualized Costs**
Source: Volpe calculations

| Component | Annual Cost |
|---|---|

| | |
|---|---|
| Fuel | $100,000 |
| Crew Wages + Training | $778,000 |
| Maintenance & Consumables | $64,000 |
| 1/5 of Drydocking | $150,000 |
| **Total** | **$1,092,000** |

### 2. Operation and Maintenance of Tug and Barges

The *Greenstone II*/*Shelter Bay* makes an average of 1.5 gasoline runs per year with a contracted crew. The cost for this operation is approximately $45,000 per year. The barges and the tug have to be maintained. The *Beaver* work barge does not have a regular schedule and has been used very little in the past three years since there is no on-staff crew. They are all drydocked periodically and are subject to some Coast Guard inspections. The cost for annualized operations and maintenance is estimated to be $120,000 per year. Table E-9 summarizes the average annual costs for barge use and maintenance.

**Table E-9**
**Tug and Barge Annualized Costs**
Source: Volpe calculations

| Component | Annual Cost* |
|---|---|
| *Greenstone II* fuel runs | $45,000 |
| Upkeep *Beaver*, *Shelter Bay* and *Greenstone II* | $120,000 |
| **Total** | **$165,000** |

* Annual costs include labor, fuel, maintenance, and annualized drydocking costs.

Costs could be reduced and more service could be received out of these vessels if an on-staff crew existed (see Option I).

### 3. Employee and other Complimentary Travel

While not currently an explicit cost, if ISRO were to contract out all transportation, some accommodation would need to be made to transport staff and others who currently don't pay to travel to ISRO on *Ranger III*. Based on current per trip ticket costs on the concessioner services of $60, the current 1,500 employee and other complimentary passenger trips would cost ISRO $90,000 per year.

Total cost to NPS for marine transportation is $1,245,000 per year.

If the revenue of $170,000 is subtracted from the total NPS marine transportation operating cost of $1,245,000, the net operating cost is $1,075,000.

### Cost of Contracting Out:

The real problem is getting the supplies out to ISRO. Most cargo ships on the Great Lakes cannot fit into the channel at ISRO. The smallest cargo ships on the lakes are 400 feet long. Tugs and barges are available; although, their ability to transport diesel, gasoline, AVGAS, and refrigerated cargo is unknown.

***Ranger III***: The NPS is currently charging the concessioner the rates as shown in Table E-10.

**Table E-10**
***Ranger III* Estimated Cargo Transportation Costs**
Source: Volpe calculations

| Dry Cargo | Cost | Park Costs | Lodging Costs |
|---|---|---|---|
| Freight & Trash | $200/Ton | $175,000 | $20,540 |
| Diesel | $1.70/Gallon | $59,500 | $4,452 |
| Gasoline | $0.35/Gallon | $4,200 | $5,200 |
| AVGAS | $0.35/Gallon | $350 | |
| Total | | $239,050 | $29,992 |

If the contractor charged the same as *Ranger III* to haul logistics to ISRO the annual charge would be approximately $250,000 per season. Coupled with $90,000 in employee transportation per year, it would cost NPS $340,000 per year to have a contractor take over the current jobs of cargo and passenger transport assigned to *Ranger III* and *Greenstone II*.

The difference between the cost to hire a contractor to perform the duties of the NPS large fleet and the cost of operating the NPS large fleet is shown in Table E-11.

**Table E-11**
**Comparison of Costs**
Source: Volpe calculations

| | Cost |
|---|---|
| Cost to Operate and Maintain NPS Large Fleet | $ 1,257,000 |
| Cost to contract out (Local) | $ 340,000 |
| Difference | $ 735,000 |

Assuming the contractor charged NPS the same rates that NPS charges the concessioner, NPS would realize a savings of approximately $735,000 per year through this option. This does not include any fees that could be extracted from a potential passenger ferry using the NPS piers and buildings at Houghton.

Volpe investigated a number of other comparisons in order to determine whether using *Ranger III*'s costs were appropriate for estimating the rate at which a concessioner would charge.

**MARAD Great Lakes Freight Rates:** In 2008 MARAD compiled data on freight rates on the great lakes. This data is shown in Table E-12. Even accounting for inflation over the past six years it's easy to see these rates are much less than *Ranger III* charges the concessioner; however, these are bulk cargoes and cost less to load and unload.

**Table E-12**
**MARAD Costs**
Source: MARAD Status of the U.S.-Flag Great Lakes Water Transportation Industry, February 2013

| Commodity Group | US to US per Ton |
|---|---|

| | |
|---|---|
| Grain | $32.67 |
| Aggregates | $22.39 |
| Non-metallic Minerals | $12.37 |
| Metallic Minerals | $10.82 |
| Coal | $20.00 |
| Diesel oil | $20.75 |
| Iron and Steel | $44.27 |

**Mackinac Island Freight Rates:** There are two ferry systems servicing Mackinac Island from the mainland across the straits of Mackinac. They charge by the item for some things and by weight for others. The by-weight category works out to be approximately $120 per ton.

**Beaver Island Freight Rates:** Beaver Island is 32 miles from the mainland (lower peninsula or "The Mitt") in Lake Michigan. The nearest city is Charlevoix. The freight rates to *Beaver* Island from Charlevoix are more in line with *Ranger III*'s rates and they average about $200 per ton.

Interestingly, neither island gets diesel oil delivered. Both get electrical power via an underwater cable from the mainland.

**Leasing an Off-Shore Workboat:** Two styles of off-shore workboats which could be used to transport cargo to ISRO include supply boats and fast crew boats. However, most off-shore workboats are too large to transit the channels at ISRO. The few that are small enough charter for approximately $6,500 per day. Assuming they would accept a six month charter (most require a minimum one year charter), the charter cost would be approximately $1,200,000 per year. This estimate includes the crew and maintenance, but not fuel.

A supply boat cruises at about ten-to-twelve knots and burns approximately 80 gallons of gasoline per hour or 1,000 gallons of gasoline per round trip between Houghton and ISRO. Assuming 44 round trips per season with fuel at $3.48/gallon, the fuel cost would be approximately $153,000. The total for the charter and fuel would therefore be $1,353,000. The supply boat can carry 16 passengers, which would likely be park staff or other complimentary passengers.

A fast crew boat cruises at about 25 knots and burns approximately 300 gallons of fuel per hour or 2,400 gallons per round trip between Houghton and ISRO. Assume 44 round trips per season with fuel at $3.48/gallon yields a fuel cost of approximately $367,000. Total of charter and fuel is $1,567,000. The fast crew boat can carry 80 passengers, most of which would be reserved for complimentary passengers.

Table E-13 compares the cost of leasing an off-shore workboat to the cost of operating *Ranger III*.

**Table E-13**
**Leasing an Offshore Work Boat**
Source: Volpe calculations

| Ship | Gross Operating Costs | Passenger Revenue | Cargo Revenue | Net Operating Costs |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| *Ranger III* | $1,092,000 | $125,000 | $30,000 | $937,000 |
| Supply Boat | $1,353,000 | - | $30,000 | $1,323,600 |
| Fast Crew Boat | $1,567,000 | - | $30,000 | $1,537,000 |

Table E-13 indicates that leasing a supply boat would increase operating costs by $386,000 per year and leasing a Fast Crew Boat would increase operating costs by $600,000 per year.

Note that none of these calculations include the operation of the *Beaver/Shelter Bay* combination for ISRO maintenance and construction.

**Effect of Visitation:** There is no expected effect from low, moderate, or high visitation projections. Because the contracted vessels would not be carrying paid passengers, only two trips per week would be required for all visitation projections (same service level as currently being performed by *Ranger III*).

**Conclusion:** In the medium scenario, contracting out for services to replace the ISRO large fleet could reduce operating costs by approximately $735,000. This assumes that the potential contractor would charge NPS the same rates that NPS is currently charging the concessioner. That could be a risky assumption that bears further investigation before proceeding to implement this option.

In the high visitation scenario the Fast Crew Boat looks like the best option, because it can meet the cargo and complimentary passenger requirements. This only works if the boat can be chartered for six months every year instead of chartering for an entire year as required by some workboat owners

## *F: Purchase High Speed Ferry for Passenger Transport*

The trip from Houghton, MI to Rock Harbor currently takes six hours aboard *Ranger III*, with the departure from Houghton on one day and the return trip on the next. Using a high-speed ferry, the one-way trip could be completed in four hours, which would allow a round-trip in one day. This would potentially make the trip attractive to more visitors, would allow for additional trips per week, and provide the crew with more flexibility. The high-speed ferry would be used to transport passengers, baggage, and boxed supplies, but could not be used to transport fuel, trash, refrigerated cargo, heavy cargo, and boats, which would be left to *Ranger III* or other means of cargo transport.

**Discussion:** Volpe has previously developed a Ferry Lifecycle Cost Model[*] as a planning tool to estimate capital, operating, and total cost for vessels that could be used to provide ferry service on a particular route, given known service parameters. The model allows users to estimate and compare total costs of offering service with different vessel types.

To evaluate initial viability for a high speed passenger ferry service, Volpe input the existing *Ranger III* service parameters from Houghton to Rock Harbor into the cost model[†]. Volpe specifically looked at the two high speed ferry classes within the model: 51-100 passengers and 101-150 passengers. The estimated purchase prices for the smaller and larger high-speed ferries are $1.9 million and $4.7 million, respectively.

An analysis of operating costs and capacity was conducted for two service levels with service twice per week and three times per week represented by Table E-14 and Table E-15, respectively.

[*] http://www.volpe.dot.gov/transportation-planning/public-lands/department-interior-bus-and-ferry-lifecycle-cost-modeling

[†] This includes: the distance between Houghton, and Mott/Rock Harbor and the wages of the crew.

**Table E-14**
**Operating Characteristics for 2 Trips Per Week**
Source: Volpe calculations

| | 50-100 Passenger Ferry | | | 101-150 Passenger Ferry | | |
|---|---|---|---|---|---|---|
| Visitation | Low | Medium | High | Low | Medium | High |
| | 1,028 | 1,538 | 4,885 | 1,028 | 1,538 | 4,885 |
| Passenger capacity needed* | 24 | 35 | 111 | 24 | 35 | 111 |
| Annual Operating Cost | $204,000 | | | $278,000 | | |
| Annualized Drydocking Cost | $100,000 | | | $100,000 | | |
| Break-even Operating + Maintenance Cost Per Passenger (One-Way) | $148 | $99 | Not Plausible Visitation Too High | $184 | $123 | $39 |
| Total Capital Costs | $1.9M | | | $4.7M | | |
| Annualized Capital Costs+ | $63,000 | | | $157,000 | | |
| Annualized Capital Cost Per Passenger (One-Way) | $31 | $21 | | $76 | $51 | $16 |
| Total One-Way Break-even Cost | $179 | $120 | | $260 | $174 | $55 |

* It is assumed that visitors will take the ferry both directions. Capacity is for each one way trip and assumes an even distribution of visitors on every trip throughout the season. Capacity has not been adjusted for seasonal projections; capacity needed during peak season will be higher. Passenger capacity needed does not include park staff or other complimentary passengers, which currently make up approximately 33% of ridership, including during the peak months. These passengers may be accommodated on *Ranger III* or the high-speed ferry depending on park operating procedures.
+Assuming a 30-year lifespan.

**Table E-15**
**Operating Characteristics for 3 Trips Per Week**
Source: Volpe calculations

| | 50-100 Passenger Ferry | | | 101-150 Passenger Ferry | | |
|---|---|---|---|---|---|---|
| Visitation* | Low | Medium | High | Low | Medium | High |
| | 1,028 | 1,538 | 4,885 | 1,028 | 1,538 | 4,885 |
| Passenger capacity needed | 16 | 24 | 74# | 16 | 24 | 74 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Annual Operating Cost | $245,000 | | | $355,000 | | |
| Annualized Drydocking Cost | $100,000 | | | $100,000 | | |
| Break-even Operating + Maintenance Cost Per Passenger (One-Way) | $168 | $112 | $35 | $221 | $148 | $47 |
| Total Capital Costs | $1.9M | | | $4.7M | | |
| Annualized Capital Costs+ | $63,000 | | | $157,000 | | |
| Annualized Capital Cost Per Passenger (One-Way) | $31 | $21 | $7 | $76 | $51 | $16 |
| Total One-Way Break-even Cost | $199 | $133 | $42 | $297 | $199 | $63 |

* It is assumed that visitors will take the ferry both directions. Capacity is for each one way trip and assumes an even distribution of visitors on every trip throughout the season. Capacity has not been adjusted for seasonal projections; capacity needed during peak season will be higher. Passenger capacity needed does not include park staff or other complimentary passengers, which currently make up approximately 33% of ridership, including during the peak months. These passengers may be accommodated on *Ranger III* or the high-speed ferry depending on park operating procedures.

+Assuming a 30-year lifespan.

# While a 100 passenger vessel may accommodate the demand for most of the season, it is expected that not all of the passengers will be able to travel on their desired trip.

Current *Ranger III* fees for adults are $63 and $53 one-way for the high and low season, respectively, and only cover a small fraction of the cost of operating *Ranger III*. Between 2008 and 2013, an average of 2,175 one-way equivalent tickets was sold and revenues averaged $127,000 per year for an average one-way fare of $58[*]. Concessioner ferries charge similar one-way fares, typically between $60 and $70 for a full fare ticket. At high visitation levels, using a high speed ferry would break even at fares around the previous average cost, meaning the service could be financially viable.

Use of the high-speed ferry would not eliminate the need to operate and maintain a logistics vessel. *Ranger III* or an equivalent vessel for cargo transport would still be needed to carry fuel, trash, refrigerated cargo, and heavy cargo. While the *Ranger III* would require a smaller crew, the cost savings (approximately $46,000) would be minimal relative to the revenue lost from passenger ticket sales in supporting operation of *Ranger III*. Other transportation options, such as replacing *Ranger III* with a tug and barge may be considered to reduce the costs for logistics transport.

**Effect of Visitation:** Visitation level impacts the appropriate size of the ferry and the required break-even cost per passenger. By sizing the boat as close to capacity as possible, the cost per passenger can be minimized. However, in doing this the ability to capture peak demand is also minimized, since the assumption is that there is the same number of people on the early June trip as the peak July week. At high visitation, a logistics vessel with passenger capacity, such as *Ranger III* or a new crewboat, could be used to supplement a high speed ferry.

**Conclusion:** If *Ranger III* continues to operate in order to transport cargo, the crew savings from eliminating passengers does not offset the lost passenger revenue. Use of a high speed passenger ferry could make sense if there is a way to significantly reduce costs of transporting cargo out to Isle Royale via an alternative transportation method. A crewboat as described in Option C or a tug and barge as described in Option D may be such alternatives.

## G: Use Concessioner Ferry for Passenger Transport

This option considers contracting out passenger service to the island that is currently provided by the *Ranger III*.

[*] This includes high and low seasons, adults, children, groups and reduced fare passengers.

**Discussion:** For this option, the park would put a contract out to bid for passenger transport services from Houghton, MI. While the *Ranger III* would no longer be shuttling passengers, it would continue to carry visitor boats and canoes as well as food and supplies for the park and the island concessioner. For this analysis, it is assumed that the schedule of passenger and freight transport to the island would remain unchanged.

*Ranger III* can run with a smaller crew size than the current crew of nine, and maintain limited passenger capacity. According to the Certificate of Inspection, *Ranger III* is allowed to operate with a crew size of six; although, the captain's preference has been to operate with a minimum of seven crew. With a reduced crew, a small number of passengers may be carried. Table E-16 shows *Ranger III*'s passenger capacity and crew costs for each crew size.

**Table E-16**
***Ranger III* Crew Size and Passenger Capacity**
Source: Volpe calculations

| Crew Size | Passenger Capacity | Crew Cost | Savings |
|---|---|---|---|
| 9 (Current) | 128 | $713,000 | $0 |
| 7 | 43 | $667,000 | $46,000 |
| 6 | 21 | $620,000 | $93,000 |

By reducing the crew size, the park would save on crew labor costs. However, eliminating passenger service would mean that the park would no longer receive direct revenue from passenger tickets sales. The average annual ticket sale revenue from 2008 through 2012 was $126,980. This revenue is approximately what would be expected under the moderate visitation projection level. Current transportation concessioners pay the park annual franchise fees ranging from 4-6% of gross ticket sales. If a 4% franchise fee—the rate paid under the two most recent contracts—were collected for this route, it would yield an estimated $5,080 annually.

Park staff, immediate family members, contractors, and researchers currently travel to the island aboard *Ranger III* for free. Even if *Ranger III*'s crew size is reduced, most of these complimentary passengers should still be able to ride *Ranger III* to ISRO. Between 2006 and 2012, there were approximately 20 trips per year which had over 21 complimentary passengers, and only approximately one trip per year which had over 43 complimentary passengers. If the *Ranger III* crew was reduced to six, an average of 147 complimentary passengers would have to ride a concessioner ferry; if the crew was reduced to seven, an average of only eight complimentary passengers would have to ride a concessioner ferry.

If *Ranger III* no longer carried passengers, it may also be possible to reduce the number of trips per year at certain time of the season, which would reduce fuel costs and employee overtime hours. If the *Ranger III* used only half as much fuel during the season, there would be a savings of about $43,000. Furthermore, if the number of trips was reduced, the reduction in employee hours would also yield a savings of approximately $163,000. However, it may not be possible for *Ranger III* to reduce its service to one trip per week throughout the season, since *Ranger III* currently ships a full load of dumpsters on many trips. Unless the *Ranger III*'s capacity for dumpsters can be increased, it will not have the sufficient capacity to make just one round trip per week. If the *Ranger III* only made trips once per week, this would also interfere with its shipment of passenger boats, which might impact visitation and freight fees. Reducing the number of trips will also impact transport of complimentary passengers, and require that some of the complimentary passengers ride a concessioner ferry instead. Reducing the number of trips is most plausible during the low visitation projection when Rock Harbor Lodge is closed.

**Effect of Visitation:** At the low visitation projection level, if the number of *Ranger III* trips could be reduced, the park could save up to $163,000 in crew costs and $43,000 in fuel savings. The expected ticket sales revenue is approximately $120,000 at the low visitation projection. From the franchise fee for the paid passengers, the park could expect to make about $4,800 in concession payments. This yields a total of approximately $211,000 in savings/revenue. Because the park would be losing $120,000 in ticket sales, this would result in a net savings of approximately $91,000 per year. However, if additional trips would have to be made to carry equipment or dumpsters, the additional labor and fuel costs would reduce the savings.

At moderate and high visitation projections, *Ranger III* would still have to make at least two trips per week. While the park could save $46,000 to $93,000 per year in salaries, the park would lose more than $140,000 in ticket sales revenue. Therefore, at the moderate and higher visitation levels, the cost savings would be less than the lost revenue from tickets.

**Conclusion:** The park would still need to operate *Ranger III* even if it contracts out for passenger service in order to move cargo. This option is only attractive at the low visitation projection, and only if the number of *Ranger III* trips could be reduced to once per week. At the moderate and high visitation projections, this option does not make economic sense.

## *H: Staff Ranger III with Contract Crew*

Like most operations that require human intervention, labor costs are one of the single largest line item in the operating costs. Government employees are generally thought to be more expensive than private sector workers. Could the annual salaries for *Ranger III* be reduced if the crew was contracted out?

**Discussion:** The crew of *Ranger III* consists of three full-time crew members and six part-time crew members. All of them are government employees of the U.S. National Park Service. Some of them perform other duties in the park when they are not working on *Ranger III*. Their salaries only count against the *Ranger III* operating costs when they are actually assigned to the ship. Currently all of the crew members receive varying amounts of overtime pay for the 33-week season. The three-person full-time crew also gets some overtime during the off-season. The crew received a substantial pay raise for the 2014 season, for a total expected salary of $713,000. The government crew also receives per diem (M&IE) four days per week during the season, which equates to $47,840 per annum bringing the crew total compensation to $761,000 per year, or approximately 4% less than the total cost for the contracted crew.

In this option, the NPS would advertise for a contractor to provide a qualified crew to supply the same amount of labor hours, straight and over time, as currently supplied by the crew of NPS employees. The total cost of the contract would not be known until the bids were received making the final cost tradeoff unknown.

Crew costs are estimated from the average cost for mariners on the Great Lakes. This cost was taken from the 2012 Department of Labor's Bureau of labor Statistics (BLS). The 2014 average wages are shown below in Table E-17.

**Table E-17**
**BLS 2014 Average Wages**
Source: BLS

| Position | Hourly Wage |
|---|---|
| Seaman or Oiler | $19.73 |
| Master/Mate | $34.49 |
| Engineer | $32.84 |

Based on these values, the total salary for replacing the hours the NPS government crew works on *Ranger III* with contract staff would be $543,000.

In addition to covering the standard workload of the *Ranger III*, provisions should be made to allow for the contractor to supply labor beyond the amount requested in the government contract in case of issues such as an equipment breakdown or accident. As such, estimated salaries should be increased by approximately 10% to allow for unavoidable incidents, or $597,300.

The labor force on the Keweenaw Peninsula is the smallest in the State of Michigan. The potential contractors may encounter some problems hiring mariners from the local area. If the contractor has to draw from a larger geographic area, additional cost may be incurred to account for their higher living and travel expenses. An additional $92,700 has been estimated for needing to hire outside of the local area based on an equivalent of $1,000 travel stipend and the equivalent for meals and incidental expenses for each employee, bringing the total cost to $690,000. Adding a profit of 10% or 15% would increase the cost of the contract to $759,000 or $794,000 respectively. These values are comparable to current crew costs.

**Effect of Visitation:** Of the various visitation projections, only the high visitation projection is expected to have any impact on the use of a contracted crew although it would have similar implications for the NPS government crew. Greater use of staff from outside of the Houghton area could increase the relative cost of using a contracted crew. Conversely, a larger contract for more staff may bring down the cost of the contract since a lower profit margin may be acceptable.

**Conclusion:** Since the costs are relatively equivalent, the flexibility of the two options may be a major factor in determining the attractiveness of each. This flexibility would primarily depend on the contract language; although as more flexibility is included, the overall cost may rise. Ensuring that unanticipated circumstances can be managed within the contract will also be important. While the contracted crew may be cost effective, it would be difficult to know without publishing a request for interest, since the current salaries seem to be cost competitive. In addition, the process of looking for a contract crew may have a negative impact on the morale of the existing crew if the contracted crew does not end up as the preferred option.

## I: Optimize Ranger III Crew Certification Distribution

ISRO has a gasoline barge and construction barge that are propelled by a park-owned tug. The construction barge is used to carry construction material to ISRO from Houghton, MI; it can also be used to transport material and workers around ISRO and as a work platform. There is a built-on crane to facilitate work. The gas barge is used to transport fuel to the island an average of 1.5 times per season. ISRO's current staff does not have the required certification to operate the tug. Due to a lack of permanent crew, the construction barge is not being used and an expensive contract crew has to be hired to make the gasoline barge runs.

**Discussion:** As a result of personnel turnover, the full-time crew for the tug and barges were lost three years ago. The tug and barge crew were seasonal employees and together their wages amounted to approximately $75,000 per year. If they were still on the payroll their wages would now be approximately $90,000 per year. Replacing the crew at a reasonable price is problematic. Houghton is an isolated location and there are not many licensed mariners available in the area for part-time work. Gasoline and

AVGAS are critical to the operation of ISRO and a contract crew has to be hired to operate the tug and gasoline barge. The gasoline barge run is performed, on average, 1.5 times per year. Currently, it costs about $30,000 per run (averaging $45,000 per year) to operate the gas barge with the contracted crew. The construction barge is not being used due to the cost of hiring a contracted crew. *Ranger III* and the LCM can transport some of the construction materials, but some of the larger and heavier items cannot be easily transported. Therefore, some larger construction projects may not be possible relying solely on the *Ranger III* and LCM. These projects may require a contracted crew to transport materials out and site the construction barge, or some park operations will have to be curtailed.

Currently, two of the *Ranger III* crew members do not work on *Ranger III* during the shoulder season, which includes the months of May and September. If they had the right licenses and qualifications, they could operate the tug and barge before or after the peak season when not serving on the crew of the *Ranger III*. This could best be accomplished by replacing or upgrading one of the Able Bodied Seaman (AB) positions to a Third Mate with pilot credentials and changing one of the Ordinary Seaman (OS) to an Oiler with a tankerman's credentials.

One consideration is that due to the current *Ranger III* schedule, it would be challenging to move the work barge during the peak season since most layover time is currently spent in Houghton. The crew may need to be flown to or from the island to accommodate mid-season tug work without missing out on their work on *Ranger III*, which doesn't allow for much flexibility in construction. That said, the park is not currently doing any of this work due to the inability to move the work barge.

There would be one-time costs to attend training to obtain the correct credentials. The AB can attend training at the Maritime Institute of Technology and Graduate Studies (MITAGS) in Baltimore, MD for a ten week course. The cost of the ten week course is $29,000. The tankerman can attend a ten week training course at the Tankerman's Career Academy for $13,000. It includes one week of classroom training and nine weeks of trainee work on a tanker ship for nine weeks during the winter season.

There would also be a cost associated with the promotion of the two staff throughout the season as well as the additional weeks of service. It is assumed that two additional pay periods (one month) would be adequate time to make two gasoline runs per season and move the construction barge a few times[*]. The breakdown of costs in 2014 dollars, based on current (2014) data is shown in Table E-18 and Table E-19.

**Table E-18**
**One-Time Costs for Training**
Source: Volpe calculations

| | Cost |
|---|---|
| AB to Third Mate 10 week course @ MITAGS Baltimore, MD | $ 29,000 |

[*] Whether all movement of the construction barge could be accommodated before/after the peak season is unknown. Fitting in time to move the barge during the peak season may be a challenge since most layover time is currently spent in Houghton. The crew may need to be flow to or from the island to accommodate mid-season tug work without missing out on their work on *Ranger III*.

| | |
|---|---|
| Tankerman's ten week course @ Tankerman Career Academy TX, LA | $ 13,000 |
| Per Diem ten weeks in Baltimore @ $216/day | $ 15,000 |
| Eleven weeks AB & Oiler salaries @ $1,682 per week | $ 18,500 |
| Travel | $ 5,000 |
| Coast Guard Exams for both positions | $ 500 |
| **Total One-Time Training Costs** | **$ 81,000** |

**Table E-19**
**Continuing Annual Costs for Salary Difference**
Source: Volpe calculations

| | **Cost** |
|---|---|
| AB to 3rd Mate for 14 pay periods difference is $625/pay period | $ 8,800 |
| 3rd Mate for 2 additional pay periods @ $4,000 per pay period | $ 8,000 |
| Oiler/Tankerman for 8 pay periods difference is $138/pay period | $ 1,100 |
| Oiler/Tankerman for 2 additional pay periods @ $3,500/pay period | $ 7,000 |
| **Total Additional Annual Salary Costs** | **$ 25,000** |

The annual costs for the certified crew member and the additional time to operate the tug and barge is $25,000. Since the park is spending approximately $45,000 for the contracted crew, the staff would need to stay at ISRO for four seasons to make the one-time training cost effective.

**Effect of Visitation:** This option should not be affected much by the difference between the high and low visitation. However, one possible consideration is if the high visitation resulted in increased gasoline usage and a mid-season gasoline run was required. The tug and barge crew might be able to squeeze in a gasoline run between regular trips on *Ranger III*; however, if not it might be necessary to cancel one of *Ranger III*'s scheduled trips during the high season in order to make another gasoline run.

**Conclusion:** If the gasoline barge and tug are the only considerations, the training and use of the "shoulder crew" for two extra pay periods per year will pay for itself in less than four years.

## J: Increase Ranger III Crew Size

This option considers expanding the crew of *Ranger III* to allow for three watch periods. The current crew works 52 to 56 hours per week. Expanding the crew would allow *Ranger III* to depart and return on the same day, eliminating overnight stays and reducing over-time, while allowing for between three and seven weekly trips while allowing crew labor hours to remain at acceptable levels.

**Discussion:** For this option, the crew size of *Ranger III* would be expanded to accommodate three watches. In a three-watch system, watchstanders stand four hours of watch at a time in three sections. This system allows the ship's crew to effectively operate the ship 24 hours per day, which would allow *Ranger III* to depart and return on the same day. This would eliminate overnight stays at Rock Harbor for the crew. With the larger crew and shorter round-trip duration, *Ranger III* could also make additional weekly trips to carry more passengers. With two trips per week, *Ranger III's* current capacity per season is 5,632 passengers. Increasing the number of weekly trips to three would increase the capacity to 8,448 passengers per season. If *Ranger III* began making daily trips, the capacity would increase to 19,712 passengers per season.

Currently, there are nine crewmembers on *Ranger III*. If the crew was expanded to accommodate three watches, *Ranger III's* crew would have to be expanded to 15 crewmembers. The current and expanded crew distributions are shown in Table E-20.

**Table E-20**
***Ranger III* Crewmembers**
Source: Volpe calculations

| Position | Current Crew | Expanded Crew |
|---|---|---|
| Master | 1 | 1 |
| Mate | 1 | 2 |
| Chief Engineer | 1 | 1 |
| Engineer | 1 | 2 |
| Able-Bodied Seaman (AB) | 3 | 6 |
| Ordinary Seaman (OS) | 2 | 3 |
| **Total** | **9** | **15** |

With the current crew size doing two trips per week, the expected labor cost for 2014 will total approximately $713,000, or approximately $16,200 per trip. If the crew size was expanded to 15 crew members, but *Ranger III* continued to only make two trips per week (44 roundtrips), the labor costs are expected to rise to $808,000 ($18,400 per trip), an increase of $95,000 annually. If the crew size was expanded and *Ranger III* began to make three roundtrips per week (66 roundtrips total), the labor costs are expected to rise to $1,282,000 annually ($19,400 per trip), an increase of $569,000 annually. Furthermore, the additional roundtrips would increase the annual fuel costs by $43,000 for the extra 22 trips.

The full-fare high season ticket cost for *Ranger III* is $63 for a one-way trip, or $126 for a round trip. To cover the costs of the larger crew, *Ranger III's* ridership would have to increase by a minimum of 4,516 full-fare high-season roundtrip adults[*]. This additional ridership is almost three times the current ridership of *Ranger III*.

At moderate visitation, *Ranger III* is expected to carry 1,538 paying visitors per year. With the additional capacity, the number of paying passengers would need to increase to at least 6,310 per year to break even[†]. However, the high visitation project is only 4,885 paying visitors, less than is needed to cover the larger crew costs.

**Effect of Visitation:** This option does not make economic sense in looking at the low or moderate visitation options.

If *Ranger III* continued to make only two trips per week, *Ranger III*'s maximum carrying capacity would only be 5,632 passengers, including complimentary and reduced fares. At high visitation, *Ranger III* is expected to carry 4,885 paid passengers plus approximately 1,500 complimentary passengers, for a total of 6,400 passengers per year. This required capacity is greater than *Ranger III*'s maximum carrying capacity at current service levels. In order to transport passengers at high visitation levels, *Ranger III* would be required to make at least three trips per week, which would require an expanded crew.

[*] The breakeven ridership minimum will increase because of low-season and reduced fares.

[†] This assumes the current per-passenger subsidy will continue.

**Conclusion:** If *Ranger III's* crew was expanded and the number of trips was increased, *Ranger III's* ridership would have to increase by at least 4,516 paying visitors, for a total of 6,310 paid visitors per year, to cover the additional labor and fuel costs. Even at the high visitation projection, *Ranger III* is only expected to carry 4,885 paying visitors per year. Since the required ridership to cover the costs of the larger crew is significantly higher than expected ridership, this option does not make economic sense.

## *K: Make More Roundtrips with Ranger III*

This option considers increasing the current *Ranger III* frequency from two days per week to three days per week.

**Discussion:** Increasing the frequency of service to Isle Royale would create more travel options for visitors allowing them to vary their arrival dates and the length of their stay. This may attract more visitors to the island or draw some visitation from the concession out of Copper Harbor who operates six to seven days per week during the peak season. In the case of increased visitation as estimated in the high visitation scenario, such service may be necessary to accommodate the proposed demand.

Using the available trip breakdown data for 2006 through 2012, the number of days that the *Ranger III* ridership approached its maximum capacity of 128 can be tabulated. Table E-21 shows the number of days when ridership on the *Ranger III* was greater than 100 passengers, averaging eight trips per season over that time period.

**Table E-21**
**Days per Year When *Ranger III* Ridership Was Greater Than 1000 Passengers**
Source: Volpe calculations

| Year | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|
| # Days When *Ranger III* Ridership Was Greater Than 100 Passengers | 8 | 6 | 11 | 9 | 10 | 4 | 5 |

Increasing trips to the island might increase visitation if the *Ranger III* is at capacity on multiple days during the season. Since there have not been more than 11 days per year during this seven-year period when there have been more than 100 passengers aboard the *Ranger III*, there does not appear to be a problem with lack of capacity aboard the *Ranger III* for current visitation levels. For the projected high visitation scenario, additional trips by *Ranger III* would be needed to accommodate the additional demand for service.

Another possibility is that the *Ranger III's* current schedule prohibits visitation, because its current two trips per week are inconvenient for prospective visitors. *Ranger III* currently makes Tuesday-Wednesday roundtrips and Friday-Saturday roundtrips, so it is likely that any change in the schedule would be for accommodating shorter weekend trips for people who live close to the park. While it's possible that having a weekend option may appeal to additional visitors, it is likely that this represents a small subset of total prospective visitors. Additional trips would also benefit both ISRO and concessions staff as it would provide additional opportunities and capacity to bring fresh and refrigerated items to the island, as well as transport trash back to Houghton.

If *Ranger III* were to make three trips per week, the crew size would have to be expanded to three watches to ensure that the crew does not exceed the work hour limits imposed by the International Maritime Organization (IMO). As discussed in Option J, if *Ranger III's* crew was expanded and the number of trips was increased, *Ranger III's* ridership would have to increase by at least 4,516 paid visitors, for a total of

6,310 paid visitors per year, to breakeven on the additional labor costs. Even at the high visitation projection, *Ranger III* is only expected to carry 5,697 paid visitors per year. Since the required ridership to break even is significantly higher than the expected ridership, this option does not make economic sense. More frequent trips could be completed without an increase in crew size if a high speed ferry was purchased as described in Option F.

**Conclusion:** Even at the high visitation projection, the required ridership to break even is significantly higher than expected ridership. Therefore, this option does not make economic sense.

## L: Implement More Frequent Schedule of Cruises

Cruises operated by the park are a potential source of revenue. If additional cruises are added, ISRO may be able to gain additional revenue to offset the operations costs of the park.

**Discussion:** On occasion, *Ranger III* is used to provide cruises up and down the Keweenaw Canal. When the cruises are operated in the afternoon, there are no additional costs other than fuel. For example, there are no additional labor costs as the *Ranger III* crew is already being paid for those working hours. The *Ranger III* uses about 110 gallons of diesel fuel on cruises that travel south of Houghton in the Keweenaw Canal and about 90 gallons for cruises that travel north of Houghton. The cost per gallon of diesel fuel is estimated to be $3.48, which results in a total cost per trip of $383 for southbound cruises and $313 for northbound cruises. As shown in Table E-22, assuming an adult ticket cost of $20, it would take 20 adult riders to cover fuel costs on a southbound cruise and 16 adult riders to cover fuel costs on a northbound cruise.

**Table E-22**
**Cruise Breakeven Ridership Estimates**
Source: Volpe calculations

| | Gallons Used | Cost/Gallon | Total Cost | Adult Ticket | Breakeven Ridership |
|---|---|---|---|---|---|
| Southbound Cruise | 110 | $3.48 | $383 | $20 | 20 |
| Northbound Cruise | 90 | $3.48 | $313 | $20 | 16 |

**Effect of Visitation:** There is no effect from low or moderate visitation to the island. If *Ranger III* makes additional roundtrips to ISRO to add passenger capacity for high visitation, there may not be enough downtime to add additional Keweenaw Canal cruises.

**Conclusion:** Ridership in excess of the breakeven point would generate revenue for the park. For example, if a southerly cruise carried 50 passengers, the profit for the park would be $600. However, this additional revenue is very small compared to the overall operations of *Ranger III*. Setting a base price for charter of *Ranger III* is one way to minimize risk of losing revenue from a cruise.

## M: Align Ranger III Trips with Airline Schedules

For visitors traveling to the Keweenaw Peninsula by plane, the Houghton County Memorial Airport is the primary option. As of January 2015, each day there are two arriving flights and two departing flights at the airport. Arrivals occur at about 1:15 p.m. and 11:00 p.m. Departures occur at 6:00 a.m. and 2:15 p.m. The *Ranger III* currently leaves Houghton for Rock Harbor at 9:00 a.m. and returns from Rock Harbor to

Houghton at about 3:00 p.m., essentially requiring travelers to spend two extra days in Houghton, at the beginning and at the end of their trips.

**Discussion:** Changing the schedule of the *Ranger III* to align with airline flights would produce two potential benefits. Visitors by plane would no longer be forced to add two days in Houghton to their trip. This would improve the visitor experience, because they could spend more time on the island or have a shorter trip that would more easily fit their schedule. This change would also benefit the park because visitors would be more likely to spend the first and last day of their trip on the island.

There are potential drawbacks to this change as well. If the *Ranger III* departed from Houghton at 2:30 p.m., this would allow visitors that arrive on the 1:15 p.m. flight with adequate time to travel to the park headquarters from the airport. Departing from Houghton at 2:30 p.m., the *Ranger III* would arrive at Rock Harbor at 9:00 p.m. This would mean that any passenger or freight off-loading would occur after dark. Similarly, in order to return to Houghton in time to catch the 2:15 p.m. departure, the *Ranger III* would need to leave Rock Harbor at 6:30 a.m., with loading and boarding occurring even earlier. While the schedule would not be convenient for park staff, as long as *Ranger III* crew was simply shifted and not extended, no additional crew expenses would be expected as a result of this change. Use of a higher speed boat may provide additional scheduling flexibility to better coordinate with airline schedules while still maintaining a reasonable schedule for staff and other visitors not flying to ISRO.

An alternative option would be to work with the airlines to see if the schedules of the flights to and from the Houghton Airport could be adjusted. The number of visitors who fly to/from Houghton for their trip to ISRO is unknown, since data are not tracked in this way. However, given the proportion of travelers to ISRO compared to the total number of airline passengers, it is assumed that ISRO visitors make up a small proportion of all flyers. While it is believed that changes to the flight schedule to and from Houghton may benefit many travelers, including non-park visitors, it is assumed that the complexities of airline scheduling and the relative small demand for service to Houghton may limit the airlines' willingness to adjust their schedules.

**Effect of Visitation:** Under the high visitation scenario, it is assumed that a significantly larger number of visitors would be flying through Houghton Airport. Whether this volume of air traffic would warrant an additional daily flight or increase the airline's willingness to adjust their schedules is unknown.

**Conclusion:** Based on the current travel time for the *Ranger III*, adjusting the schedule to accommodate the current flight schedule does not make sense. Higher demand may make the airlines more willing to adjust their schedules and a faster vessel would allow more flexibility to coordinate with the airlines schedule without impacting staff and other visitors.

## N: Relocate Ranger III Dock to End of Canal

The *Ranger III* dock is located about six miles from the entrance to the Hancock Canal. It is a "No Wake Zone" nearly all of the way from Houghton to the canal entrance, requiring an hour to transit at a reduced speed on each trip to and from ISRO. While traveling through this No Wake Zone, *Ranger III* is not operating at economy speed for best fuel consumption. It also adds an hour of crew wages to each transit, and makes it difficult to justify replacing *Ranger III* with a high speed ferry if it is not possible to go any faster than five to six knots for an hour each way.

**Discussion:** If the *Ranger III* dock was moved to a new location near the north canal entrance it would cut an hour off of the transit time each way, which would reduce fuel consumption and crew wages. There is an old abandoned Coast Guard small boat station on the east side of the canal entrance. The Coast Guard relocated the station to Houghton in about 1990 and decommissioned the pre-existing station shortly after that. All of the buildings and the boat basin are still there, but are likely in some disrepair. Currently the ownership of the property is not clear, but it appears to have been absorbed by the McLains State

Park. Note that the park headquarters and main visitor center in Houghton should still remain open under this option.

By studying aerial maps of the property and historic Coast Guard records, Volpe determined a series of improvements that would need to be addressed before the property could be used as a dock for *Ranger III*. These improvements include:

1. Demolishing an existing boat house
2. Removing an existing finger pier
3. Widening the boat basin by about 25 feet
4. Extending the length of the boat basin by nearly 100 feet
5. Building new quay walls on three sides of the boat basin
6. Building a new dock
7. Running utilities to the new dock
8. Demolishing an existing garage
9. Demolishing an existing tool shed
10. Renovating the existing crew quarters for NPS office space
11. Renovating the existing station house for NPS office space and passenger services
12. Building a new logistics support building
13. Replacing existing fuel tanks
14. Building a visitor parking lot
15. Repairing an access road

The combined cost of these 15 tasks is estimated to be $4.1M in 2014 dollars. Some assumptions were made to develop the estimates, including:

1. The property can be transferred to NPS at no cost.
2. Permits can be obtained to widen and extend the current boat basin.
3. The Michigan State Historic Preservation Office (SHPO) will approve the work.
4. The site is not contaminated.

If this option appears feasible, a closer examination of the property should be made before making any final decisions in order to confirm site condition and required work. There is also anecdotal evidence that in certain weather conditions, large waves and storm surges can make their way from Lake Superior into the canal. In these conditions, docking maneuvers could be more difficult. Furthermore, any unprotected vessels docked near the end of the canal would be subject to potentially higher wave action, which could cause damage to the vessels and dock in extreme situations. Because the new location is more exposed, it may be advisable to move *Ranger III* back to the dock at Houghton during the off-season. Another implication to consider would be on visitors and the impact of a more remote loading area. Will people be attracted by the shorter ride? Or, will they be turned off by the more remote location?

Based on the estimated wage scale for 2014, NPS will pay the *Ranger III* crew a total salary of $713,000. Assuming the crew makes 44 round trips per year, and the trips are shortened by an hour each way, the reduction in wages could be about $82,000.

Based on the fuel consumption data, the *Ranger III* burns about 55 gallons of fuel per hour when underway. If each round trip is shortened by two hours, then each round trip will see a reduction in fuel consumption of 110 gallons. If the *Ranger III* makes 44 round trips per season, the resulting savings will be a total of 4,840 gallons of fuel per season. Assuming the fuel price is about $3.48 per gallon, the reduction in fuel costs would be $17,000 per season.

The total resulting reduction in operating costs from wages and fuel is about $99,000 per year. Therefore, the payback period on the $4.1M estimated investment to move the *Ranger III* is approximately 40 years. However, the additional annual operating and maintenance costs for the new facility are estimated to cost approximately $100,000 per year. This negates any savings from operating costs from *Ranger III*.

**Effect of Visitation:** There is no expected effect from low or moderate visitation projections. However, if the number of weekly roundtrips is increased to cover high visitation levels, there will be additional fuel and time savings on each trip, which may make this option more attractive.

**Conclusion:** The reduction in *Ranger III* crew wages and fuel costs are offset from the additional annual operating and maintenance costs of the new facility. However, there are some other benefits to consider:

- The shorter trip could attract more visitors.
- A high speed ferry could be better utilized if it was not under speed limitations for a significant portion of the journey.

## O: Replace Work Barge with Modular Causeway Platform

Island construction projects have been delayed several years, because ISRO does not have a tugboat operator to move the work barge. A contract tugboat crew could be hired to move the work barge, but this has not been done in the past because the crew costs are prohibitive.

**Discussion:** A modular causeway system is a combination of portable, interlocking sections used to create a larger floating platform. The individual sections can be transported on a ship and then constructed into a platform on site using a large, shipboard crane. After being constructed, the platform can be moved around using a small tugboat. When the platform is no longer necessary, the platform can be disassembled into individual sections, which can be transported back to their homeport on a ship.

For ISRO, a modular causeway can be used to replace the work barge. Initially, the sections will have to be transported to the island on a cargo vessel or barge. Once at ISRO, the platform can be constructed and used as the work barge to support construction projects. If the platform needs to be relocated, the LCM can be used to move the assembly; the crew requirements for the LCM are less stringent than the tugboat and current full-time staff members are able to operate it. At the end of the season, the platform can be disassembled and the sections stored on Mott Island for the winter.

Because the modular causeway does not have a fixed crane, a separate boom crane will also be required. This truck-based crane could be transferred from land to the platform using the LCM.

The estimated cost for a 100 foot by 30 foot platform is about $350,000 (smaller sized platforms are available, but the cost will be comparable). The estimated cost for a boom crane is approximately $150,000. The cost to initially bring the sections from Houghton, MI to ISRO is expected to be approximately $30,000, and could be accomplished either by loading the sections onto the work barge and using a contract crew or by contracting out for another transportation service.

If the tugboat is used to move the platform, then the NPS would either have to hire a tugboat captain and deckhand to operate the tugboat, or contract a crew for each round-trip. In 2012, the combined salary of a tugboat captain and deckhand was $77,650 per year. Due to recent pay increases for crew, it is estimated that the new combined salary for a tugboat captain and deckhand will be approximately $90,000 per year. This crew would be available for moving the work and gasoline barge at any point during the season, unlike some of other options where movement of the work barge would be limited by crew availability.

Since ISRO doesn't currently have a crew for the tugboat, they have been contracting a tugboat crew for approximately $30,000 per tugboat roundtrip. If the work barge was brought to ISRO at the beginning of the season and then back to Houghton at the end of the season, the cost would be $60,000. Each additional trip to move the work barge around ISRO would cost an additional $30,000.

The initial cost for the platform and crane is $530,000. To compare the cost of the causeway to a tugboat crew to move the work barge, it can be assumed that the tug and work barge will be used with a permanent crew ($90,000 per year salary). In this case, the causeway will pay for itself in six years. Alternatively, if it is assumed that a contracted crew is used for two trips per season, then the payback period would be nine years; however, it could be faster if additional trips were added.

**Effect of Visitation:** There is no expected effect from the low, moderate, or high visitation projections or construction requirements.

**Conclusion:** This option would cost ISRO approximately $530,000 to replace the tugboat and work barge with a modular causeway system and crane. However, there are other benefits to consider. This option will allow access to, and use of, a work barge without the need for a separate tugboat operator or contract crew. Depending on whether an alternative is identified for transporting fuel, the transition to use of a modular causeway platform instead of the work barge could also eliminate the need for ISRO to own and maintain the tugboat at all.

### *P: Outfit LCM as Work Barge*

Because ISRO does not have a tugboat operator to move the work barge, island construction projects have been delayed for several years. A contract tugboat crew could be hired to move the work barge; however, this has been cost-prohibitive in the past. Contracting for a tugboat crew costs approximately $30,000 per roundtrip.

**Discussion:** For this option, a crane would be installed on the LCM to allow for use as a work platform. While the tugboat, *Shelter Bay*, will soon need to comply with USCG Subchapter M regulations, which includes having a licensed tugboat crew, the LCM can be operated with lesser licensure currently held by ISRO staff.

The cargo deck on the LCM is approximately 42 feet by 14 feet. While this space is significantly smaller than the deck of the work barge, it can still be used as a work platform.

The estimated cost to install a fixed crane on the LCM is $500,000.

In 2012, the combined salary of a tugboat captain and deckhand was $77,650 per year. Due to recent pay increases for crew, it is estimated that the new combined salary for a tugboat captain and deckhand will be approximately $90,000 per year.

Contracting for a tugboat crew costs approximately $30,000 per tugboat roundtrip. Thus, if the work barge was brought to ISRO at the beginning of the season and then back to Houghton at the end of the season, the cost would be about $60,000. Each additional trip to move the work barge around ISRO would cost an additional $30,000.

If we assume that the tug boat and work barge will be used with a permanent crew ($90,000 per year salary), the LCM upgrades will pay for themselves in six years. If the contracted crew is the alternative, the LCM would pay for itself in 9 years.

**Effect of Visitation:** There is no expected effect from the low, moderate, or high visitation projections on construction requirements.

**Conclusion:** This option would cost ISRO approximately $500,000 to outfit the LCM as a work platform. While adding a crane to the LCM will allow access to and use of a work platform without the need for a separate tugboat operator, it will also limit the availability of the LCM to move dumpsters and heavy equipment around ISRO when it is in use for construction.

## *Q: Ship Food and Cargo to Windigo on Voyageur II*

*Beaver*, the boat used to transport groceries from Mott Island to Windigo, makes an estimated 16 trips per year and uses approximately 60 gallons of diesel fuel per round trip. An existing concessioner vessel, *Voyageur II,* makes the same trip between Rock Harbor and Windigo three times per week. *Voyageur II* could be used to transport food and small cargo between Rock Harbor and Windigo, which would save the park diesel fuel.

**Discussion:** At a cost of $3.48 per gallon of diesel fuel[*], the estimated fuel savings from using *Voyageur II* instead of *Beaver* to bring food and supplies to Windigo would be about $3,100 per year. However, *Voyageur II* is not currently set up to transport the portable freezers and carts used to transport food and supplies. At this time, cargo has to be manually lifted onto the roof of the passenger compartment. To lift freezers and carts, portable cranes will be needed at both Rock Harbor and Windigo. The procurement of two portable cranes is estimated to cost $25,000. Furthermore, the park will likely have to pay the concessioner to ship cargo on *Voyageur II*. In the end, this would likely not result in significant savings or expenditures.

It is expected that the high visitation scenario would exacerbate the costs as *Beaver* could transport the larger cargo requirements at the same costs while payment to the concessioner would only increase. Since most of this cost would be borne by the concessioner, it may not directly impact the park's budget, but instead impact the overall visitor experience.

**Effect of Visitation:** This option would likely not result in significant savings or expenditures at low, moderate, or high visitation levels.

**Conclusion:** This option is not expected to produce any cost savings.

## *R: Increase Efficiency of Small Fleet*

In 2012, the small fleet boats used approximately 18,000 total gallons of gasoline and diesel fuel.

**Discussion:** Fuel and its transport are major cost drivers for ISRO. *Ranger III* transports diesel fuel to the park, and fueling operations require extra labor hours from the crew. Use of the fuel barge to transport gasoline requires a contracted crew for tugboat and barge operations, which costs the park around $30,000 per trip. If the park boats were replaced with newer, more efficient vessels, less gasoline and diesel fuel would be required, which would reduce *Ranger III* crew costs and fuel barge contract crew costs. If all park boat engines were switched to diesel engines, gasoline consumption would be limited to visitor boats and would be reduced even further, which would dramatically reduce the number of fuel barge trips required.

Within the past few years, all outboard engines were replaced with new, efficient Honda engines. To further improve the efficiency of the vessels, the purchase of a new fleet would be required. If all workboats were replaced with new vessels with more efficient hull forms, a fuel savings of 10% would be an extreme best-case scenario. This would save approximately 1,800 gallons of fuel per year, or approximately $6,300 per year. Over an estimated 20 year lifespan of the new vessels, a fuel savings of $126,000 can be expected. However, assuming an average cost of $15,000 per new boat for 34 vessels being replaced, the capital costs would be $510,000. This would result in a net spending of $384,000 over 20 years.

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[*] Energy Information Administration's Annual Energy Outlook 2014

At the time of this report, there are no new diesel outboard engines currently for sale in the United States.

**Effect of Visitation:** There is no effect from low, moderate, or high visitation.

**Conclusion:** Replacing all workboats with more efficient vessels does not make sense as the fuel savings is heavily outweighed by the capital costs of the new boats. Replacing all gasoline outboard engines with diesel outboard engines is not feasible because there are no diesel outboard engines currently for sale in the United States.

## *S: Install Automatic Identification System on Small Boat Fleet*

ISRO has a fleet of 36 small boats ranging in size from 17 feet to 31 feet that collectively use approximately 12,000 gallons of fuel per year performing their functions in the park. Could fuel consumption be reduced by installing a centralized monitor and dispatch system?

**Discussion:** The ISRO small boat fleet is stationed at seven different locations on ISRO:

- Windigo
- Mott Island
- Edison Fishery
- Amygdaloid Island
- Rock Harbor
- Malone Bay
- Tobin Harbor

The various boats have several different missions including:

- Maintenance
- Transport
- Search and Rescue, Law Enforcement, Emergency Medical Services
- Interpretation
- Patrol
- Food Deliveries

The boats are required to have authorization for a mission, but that authorization could come from one of several different mission managers. There appears to be little coordination among the managers. Assuming there was a single command center that cleared all sailings and kept track of the boats, it seems logical that the number of trips and miles traveled could be reduced. This would have the effect of reducing fuel consumption and therefore reducing operating costs.

The U.S. Coast Guard has developed a National Automatic Identification System (NAIS) that can track any ship or boat that has an NAIS transponder on it. The NPS would only need to install a transponder on each boat and get permission from the Coast Guard to tap into the NAIS system to display the boat locations on a large flat panel TV screen.

**Analysis:** In 2012 the ISRO small boat fleet consumed approximately 12,000 gallons of fuel. At $3.48 per gallon for diesel fuel, that yields an annual fuel bill of approximately $42,000. If we assume that fuel consumption can be cut by as much as 20% the annual savings in the fuel bill would be $8,400. A transponder for a boat costs $4,000 each. ISRO would need 36 transponders at a total cost of $144,000 plus $15,000 for the display unit and a radio. Providing the Coast Guard agrees, there should be no annual fee for the service, for a total of $159,000.

However, ISRO would need to staff the new command center. It is assumed that two people would be needed for an eight-hour shift every day and that the "graveyard," or overnight, shift would not be covered. It is also assumed that only emergency or law enforcement missions would be running on the graveyard shift and these could proceed without clearance from the command center. Wages for the two employees would be $80,000.

The total one-time cost for installing the system would be approximately $159,000. At this rate the initial investment would pay for itself in a little over 14 years. However, there is an annual operating expense of $80,000 that is over nine times the annual fuel savings of $8,400. Consequently, the payback period will never go positive.

**Effect of Visitation:** There is no effect from low, moderate, or high visitation.

**Conclusion:** Unless existing staff could add dispatching vessels to their duties, the use of AIS would cost more than it would save.

## *T: Build More On-Island Gasoline Storage*

When *Greenstone II* is anchored in the cove off of Mott Island, it is usually used to store additional gasoline. More on-island gasoline storage could be built and installed to eliminate the need for *Greenstone II* to be used as a storage facility. *Greenstone II* has a capacity to carry and store 29,260 gallons of fuel. This concept could be combined with reconfiguring *Ranger III* to transport gasoline and AVGAS, part of the proposed upgrade package, so that the need for the fuel barge and tugboat crew could be eliminated.

**Discussion:** Between 2008 and 2013, an average of 16,802 gallons of gasoline was sold on ISRO. A total of 73% of the gasoline was sold at Rock Harbor (12,264 gallons), and 27% of the gasoline was sold at Windigo (4,538 gallons). These usage ratios were applied to the low, moderate, and high visitation level fuel rates to determine the overall gasoline usage for each projection. Table E-23 shows the expected annual gasoline usage for low, moderate, and high visitation.

**Table E-23**
**ISRO Gasoline Usage**
Source: Volpe calculations

| | Visitation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Location** | **Low** | | | **Moderate** | | | **High** | | |
| | **(gal)** | **%** | **(gal)** | **(gal)** | **%** | **(gal)** | **(gal)** | **%** | **(gal)** |
| Rock Harbor | 16,700 | 73% | 12,200 | 19,300 | 73% | 14,100 | 57,400 | 73% | 41,900 |
| Windigo | 16,700 | 27% | 4,500 | 19,300 | 27% | 5,200 | 57,400 | 27% | 15,500 |
| Mott Island | 11,900 | | | 11,900 | | | 11,900 | | |
| Total | 28,600 | | | 31,200 | | | 69,300 | | |
| # Barge Trips | 1 | | | 2 | | | 3 | | |

The current on-island gasoline storage capacities are:

- Rock Harbor: 20,000 gallons gasoline
- Windigo: 26,000 gallons gasoline + 6,000 gallons AVGAS
- Mott Island: 25,000 gallons gasoline

At the low and moderate visitation levels, the expected annual gasoline usage is less than the current storage capacities at all three locations. In these visitation projections, because the total existing storage on ISRO is greater than the maximum expected usage, it appears that additional gasoline storage is not necessary. At the highest visitation level, the expected gasoline usage at Rock Harbor (41,900 gallons) is over two times greater than the current storage capacity (20,000 gallons).

Additional storage at Rock Harbor would allow the *Greenstone II* to unload adequate fuel at Rock Harbor in two of the trips instead of servicing Rock Harbor on all three. If an additional 10,000 gallon gasoline tank was added at Rock Harbor (estimated purchase and installation cost of $90,000) to match the capacity of the fuel barge, the number of fills could be reduced to two, and *Greenstone II* would not need to be used for storage. Assuming the tug and barge are operated by a contract crew, increasing the storage capacity would save $30,000 per year for the one barge roundtrip.

**Effect of Visitation:** There is no effect from low or moderate visitation. Existing gasoline storage on the island appears to be sufficient in all visitation cases.

At high visitation levels, if *Ranger III* is used to transport gasoline, there still appears to be sufficient storage capacity.

At high visitation levels, if *Greenstone II* is used to transport gasoline, increasing the gasoline storage capacity at Rock Harbor could reduce the number of annual refueling trips by one, saving crew costs.

**Conclusion:** At low and moderate visitation, or if *Ranger III* is used to transport gasoline, this option is not necessary as there appears to be sufficient gasoline storage on ISRO. If *Greenstone II* will still be used to transport gasoline, at high visitation, increasing the gasoline storage capacity at Rock Harbor could eliminate one barge trip per year, yielding savings on crew costs.

## *U: Increase Diameter of Island Fuel Line*

At some time in the recent past, the diesel fuel fill line at Mott Island was replaced with a double hull line, which decreased the effective inside diameter of the lines from two inches down to 1 1/8 inches. This small decrease in diameter led to a corresponding decrease in flow rate in the pipe. It effectively reduced the flow rate by 60%. It currently takes about four hours to re-fuel the storage tanks at Mott Island. If the pipe diameter was restored to two inches it would cut the fueling time from four hours down to about one and one-half hours. This would reduce the crew wages and ship's fuel consumed by the time saved. Since the three mariners on the fueling detail are currently receiving overtime wages, the savings would be even more significant.

**Discussion:** The fueling station at Mott Island is fueled on average about seven times per year. Volpe assumes the mariners on the fueling detail are paid at the overtime rate during the fueling operation. All other crew members are considered off-duty.

The fueling detail consists of the Master, Chief and 3rd Engineer. One hour of their wages at the overtime rate is $191. If the fueling evolution is decreased by 2 ½ hours the savings in crew wages would be $478 per fueling process. Volpe estimates that $50 in ship's fuel could also be saved if the fueling process was reduced because the ship would have 2 ½ less hours supplying its own electrical power. This yields a total savings of $528 per refuel. If the station at Mott Island is refueled seven times during the season, then the total savings for one season would be $3,693

Volpe estimated the cost of replacing the fuel lines two different ways:

1. Total contracted job: For this option, ISRO would contract out for the pipe replacement task. The contractor would receive no assistance from NPS other than to be able to use the NPS pier at

Mott Island to tie up their construction barge and tug boat. This would represent the high cost alternative. Volpe estimated this option would cost $419,000 in 2014$.

2. In-house labor: For this option, NPS maintenance personnel perform all of the work using their own equipment except for some minimum equipment rental. This would represent the low cost option. Volpe estimated this option would cost $191,000 in 2014$.

The low cost option using the in-house labor scenario is estimated to cost $191,000 and will only save $3,700 per season. Therefore, it would require 51 years to pay back the investment in the new pipe. The high cost alternative of contracted labor is estimated to cost $419,000. This pay-back period would be 113 years.

**Effect of Visitation:** Since there are no expected staffing changes with the various visitation projections, there is no expected change in fuel use at Mott Island.

**Conclusion:** Replacing the pipe solely for the purpose of speeding fueling is not cost effective.

## V: Use Alternative Energy in Houghton

Dockside power use represents a substantial expense for the *Ranger III*. The winter layup in Houghton is particularly costly, because the boat is heated continuously. Heating and power generation required for the winter layup between 2011 and 2012 required approximately $24,000 worth of diesel fuel and $11,000 worth of electricity. This option considered the possibility of using renewable energy to offset some of the energy costs from *Ranger III* while it is docked during the winter.

**Discussion:** Volpe considered three renewable energy scenarios to determine whether on-site renewable energy could be used to reduce the electric energy costs associated with powering *Ranger III* during its annual winter layup in Houghton.

*Energy Consumption by Ranger III*

*Ranger III* currently consumes 40.3 gallons of diesel fuel per day during the 170 day winter layup in Houghton, MI; the majority of this fuel is used in the ship's boilers to produce heat, some residual is used for electricity production. At approximately $3.48 per gallon and 40.3 gallons per winter day, this is a cost of $140 per day for fuel oil alone. Use of diesel oil for heat is relatively efficient, compared to the use of electricity. To use electricity to heat the ship would likely require retrofits allowing the ship's components to be heated with radiators and/or space heaters. These heaters are inefficient; from a cost perspective, replacing the boiler's function during the winter would likely be cost prohibitive. *Ranger III* may have the opportunity to obtain alternative fuels, such as biodiesel from commercial waste (i.e. restaurants) or purpose-created biogenic fuels (i.e. corn or soy-based biodiesel); although these options are not specifically explored in this option.

During the winter layup, the vessel also consumes about 360 kWh of electricity per day from land-based power supplies. Provided by Upper Peninsula Power Company (UPPCO) at approximately $0.18/kWh[*], the cost for this power is $64.80/day. Over the 170 day period, *Ranger III* consumes 61,200 kWh of energy at a cost of nearly $11,000[†]. This report analyzes the following options to replace this energy use with renewable energy:

- Offsite renewable energy purchase

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[*] The Upper Peninsula Power Company currently charges an average of $0.18 per kWh. See General Service Tariff, issued December 30, 2013. Available at http://www.uppco.com/company/tariffs/UD2D12.pdf

[†] $10,947

- "Large" on-site solar photovoltaic energy
- "Small" on-site solar photovoltaic energy
- Wind

The land-based power electricity consumption can be offset through renewable energy, either through the purchase of renewable energy certificates (RECs), UPPCO-offered renewable energy retail programs, or on-site renewable energy, sold back to the utility at retail rates.

Offsite

RECs are offered in Michigan on a state-specific market, and are usually obtained through aggregators; prices are often negotiated. While RECs offer the opportunity to ensure that renewable energy is funded, they are a financial mechanism and not directly visible to the public. UPPCO offers a renewable purchase program called "UPPCO Green" in which UPPCO obtains RECs on behalf of retail customers in 100 kWh blocks[*]. At the most rigorous level ("Champion"), ISRO could obtain 3,000 kWh per month, or 36,000 kWh per year (60% of *Ranger III*'s winter electricity consumption) at an additional cost of $864 per year. This is a premium on top of the standard electricity rate, and thus the bill would be approximately $11,864. ISRO would not have a physical renewable energy plant on-site with this program.

Onsite

Alternatively, ISRO could choose to build a moderately sized renewable energy facility to serve some or all of its on-site needs, and use a program available in Michigan to "net meter" its electricity use. Net metering allows customers to sell back renewable energy to the grid at retail (or near retail) rates. Effectively, this is similar to if the energy were used "behind the meter" at ISRO, but the retail customer receives the benefit of a reliable grid and continuous power. The net metering provisions in Michigan allow customers with renewable energy facilities less than 20 kW in size to sell all of the generated energy at full retail rates (i.e. $0.18/kWh); larger facilities sell at the cost of UPPCO's generation – or $0.12/kWh.

To evaluate on-site options, Volpe assessed a large solar facility (generating enough to provide the boat's requirements), a small solar facility at 20 kW, and a small commercial wind turbine at 60 kW.

Large Solar

A 60 kW solar photovoltaic (PV) system would offset *Ranger III*'s winter consumption, generating 60,700 kWh. Solar potential in Michigan is relatively small, with only about an 11.5% capacity factor (i.e. solar generates at the equivalent of full capacity only 11.5% of the time)[†]. Such a system could be estimated to cost about $210,000 (at an estimated cost of $3.5/watt, installed)[‡] with a 25 year lifetime, or $8,400 annualized. Net metering on a large facility yields a payment of $7,025 from the utility (at $0.12/kWh). ISRO would end up paying for its standard electricity bill, less the payment from UPPCO, plus the annualized cost of the solar array. In total, this option would cost $12,322 per year – a little over the current bill.

Small Solar

A small solar system is designed to capture the full retail rate for net metering, but leaves ISRO paying for the remainder of its energy. A 20 kW solar PV system would generate 20,233 kWh per year and cost about

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[*] See http://www.uppco.com/environment/green_business.aspx

[†] Capacity factor is calculated as (total annual energy kWh) / (8760 hrs * system capacity kW). 11.5% from NREL's PV-Watts system.

[‡] See http://www.nrel.gov/analysis/tech_cost_dg.html

$70,000, or $2,800 annualized. Since it would be a small system, ISRO would be paid the full retail rate for the energy it produces and expect a payment of $3,620 from the utility for "savings" of $820 for the 1/3 of the total electricity *Ranger III* uses. The remainder of *Ranger III*'s energy use would cost $7,400. In total, this option would cost $10,128 per year – a modest net savings relative to the current bill.

Wind

Standard utility-scale turbines are 1.5 MW or larger –generating more than 40 times the consumption of *Ranger III* in a year. However, smaller-scale turbines, on the order of 60-100 kW are made available for commercial customers[*]. At the smaller size, 60 kW, the turbine would still generate far more in a year than could be consumed by *Ranger III* during the winter, and thus ISRO would lose the opportunity to net-meter the remainder of this energy[†]. Assuming that ISRO could only net-meter the boat, this is a fairly expensive option.

A 60 kW turbine would cost roughly $390,000, or $15,600 annualized over its 25-year projected lifespan. Assuming it could generate at a 20% capacity factor (likely high for this region and a physically short turbine), the turbine would generate 105,120 kWh, or nearly twice what *Ranger III* requires today during the winter. ISRO would receive net metering payments of $7,080 (net metering to the amount of energy consumed by *Ranger III* at $0.12/kWh[‡]), leaving the park with annual energy bills approximately $8,500 higher than they are today.

If ISRO had additional facilities that could be put under the same net metering umbrella, the economics of the wind option could be significantly improved. If other buildings and facilities at ISRO also draw about as much as *Ranger III*, the whole of a 60 kW turbine could be net metered (at energy rates) for a payment of $12,200 from UPPCO – thus only raising annual bills by $3,400 per year.

**Effect of Visitation:** There is no expected effect from low, moderate, or high visitation projections.

**Conclusion:** ISRO has the opportunity to obtain renewable energy to meet some or all of the *Ranger III* winter layup's electrical requirements and possibly additional park energy needs. These could either be obtained in part or in whole from utility programs, or via on-site renewable energy. From a financial perspective, building a small 20 kW solar PV array on-site (requiring only 160 square meters, or a 40x40 square foot space) allows the NPS to save money on a small portion of its electrical bill. Other options would be more costly but could offset a larger portion of the NPS's electrical needs. Table E-24 summarizes the costs for each of the alternative energy options.

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[*] See, for example http://www.northernpower.com/products/nps60/

[†] ISRO might be able to net meter against other on-site facilities, depending on the arrangement of meters and agreements or negotiations with UPPCO about the boundaries of the ISRO customer.

[‡] In most net-metering programs, facilities cannot sell more energy back to the utility then they consume, and thus the park would not be able to recover payments for all of the energy produced.

**Table E-24**
**Alternative Energy Options**
Source: Volpe calculations

| Option | Annualized Capital Cost | Renewable Energy Cost (Payment) | *Ranger III* Electricity Cost | Total *Ranger III* Electricity Cost |
|---|---|---|---|---|
| Status Quo | $0 | $0 | $11,000 | $11,000 |
| Offsite | $0 | $900 | $4,500 | $5,400 |
| "Large" Solar | $8,400 | ($7,000) | $11,000 | $12,400 |
| "Small" Solar | $2,800 | ($3,600) | $11,000 | $10,200 |
| Wind | $15,600 | ($7,100) | $11,000 | $19,500 |

## *W: Incinerate On-Island Waste*

All trash produced on ISRO is shipped back to Houghton, MI aboard *Ranger III* for disposal. The trash is stored and transported in dumpsters, which are loaded onboard the forward deck of *Ranger III* using the shipboard crane. Because of the limited foredeck space, dumpsters are often competing for transport space with construction cargo and private boats. If the trash were incinerated on-island, the amount of trash brought back to Houghton could be significantly reduced, which would open up additional deck space for other cargo and private boat transport.

**Analysis:** Since the Clean Air Act Amendments of 1977, ISRO has been designated as part of a Class I Airshed*. A Class 1 Airshed is the highest designation under federal standards, and essentially equates to pure air. The Clean Air Act tolerates no degradation of visibility in Class 1 Airsheds, including any visible smoke from incinerators.

Currently, there are no incinerators which meet the standards for a Class 1 Airshed.

**Effect of Visitation:** There is no effect from low, moderate, or high visitation.

**Conclusion:** This option is not feasible because there are no incinerators which meet the requirements of a Class 1 Airshed.

## *X: Burn Waste Kitchen Oil Onboard Ranger III*

Waste kitchen oil from Isle Royale must be carried back to Houghton on board *Ranger III* for proper disposal. It has to be collected, carried to *Ranger III,* loaded, unloaded and transported to a disposal site. There is also a disposal fee. This procedure could be simpler and less expensive if the oil could be burned onboard *Ranger III* in the engines or boilers.

**Discussion:** Waste kitchen oil can be burned successfully in some internal combustion engines. The sulfur and carbon content are much lower so it generally burns much cleaner than Marine Diesel Oil (MDO) or gasoline. (Though it is somewhat more odiferous.) Since it is commonly provided at no-cost, its use has the potential to reduce the total fuel cost; however, there are a few drawbacks:

* http://www.nature.nps.gov/rm77/air/define.cfm

1. The power derived from cooking oil in BTUs is much lower than gasoline or MDO. Therefore the miles per gallon (MPG) is much lower; this is not a concern from a cost perspective since waste kitchen oil is often provided at no-cost.
2. Waste kitchen oil is frequently in a solid or jellied state so it may need heating before it can be used.
3. Kitchen oil can be burned in boilers or converted gasoline engines. Normally it cannot be burned in a diesel engine because it will clog the injectors.
4. According to Park Records only 750 pounds (~15 gallons) of waste cooking oil are produced on the island per year.

In addition to the drawbacks listed above, *Ranger III* has medium speed diesel engines for main propulsion and ship's service electrical power. These engines are not good candidates for conversion to burning waste kitchen oil. However, the boiler could be modified to burn waste kitchen oil. It would require the addition of a small tank to hold the oil. Hot water could be tapped off of the boiler to heat the oil into a liquid state. The oil could then be mixed with the marine diesel oil and injected into the boiler. This addition to the system could be added for an estimated cost of $10,000

Item #33 in the *Ranger III* SLEU package includes the installation of an Oily Water Separator (OWS). Another method of disposing of the oil would be to run it through the OWS and then pump it to a disposal truck with the rest of the ship's oily waste. Volpe estimated the cost of this system at $40,000. For an estimated additional $5,000, a heating tank and piping could be added and the piping modified to handle the waste kitchen oil. While this is another option for disposal of kitchen waste oil, the oily water separator did not score high enough to be included in the proposed upgrades.

For this analysis the cost of disposing of the waste kitchen oil in Houghton is $1 per pound, making the annual bill under $1,000.

There are four options for disposing of the waste kitchen oil:

1. Continue current practice of disposing in Houghton
2. Burning in the engines
3. Burning in the boiler
4. Processing through an OWS

Option 1 continues the current practice and is estimated to cost $1,000 per year.

Option 2 is a non-starter as the waste kitchen oil would just plug up the diesel engine injectors and require frequent injector replacement and repair.

Option 3 is feasible, but would require a capital investment of an estimated $10,000. It could save approximately $1,000 a year in disposal costs. Assuming the waste kitchen oil reduces the amount of MDO burned in the boiler by 15 gallons per year the savings in fuel at $3.48 per gallon would be $52 per year. The total savings would be $1,050 per year, which yields a payback period of 10 years in 2014 $.

Option 4 requires an initial investment of $45,000, or $5,000 if the OWS is going to be installed anyway. It would probably cost half as much to dispose of the waste kitchen oil in this manner so instead of a $1,000 annual disposal fee, it would be a $500 annual disposal fee. If the entire $45,000 is attributed to the waste kitchen oil disposal then the payback period is 90 years in 2014 $. If we only attribute the cost of the heating tank and the piping ($5,000) then the payback period is only 10 years.

**Effect of Visitation:** The amount of waste oil is expected to remain constant in the low and moderate visitation projects, and increase to approximately 50 gallons in the high visitation scenario. As the volume of waste oil increases, the amount of MDO used in the boiler is reduced, increasing the cost effectiveness of burning waste oil in the boiler.

**Conclusion:** If the waste kitchen oil is proposed to be disposed of in a manner other than what is currently done, burning it in the boiler makes the most sense. If capital investment is the driving factor, then the status quo wins out.

**Appendix F SLEU Report**

# Isle Royale National Park
## *M/V RANGER III Service Life Extension and Upgrade Report*

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## Contents

## Definitions

The following terms are used in this report:

| | |
|---|---|
| ADA | Americans with Disabilities Act |
| ASW | Auxiliary Seawater System |
| BWTS | Ballast Water Treatment System |
| ECS | Engine Control System |
| EDG | Emergency Diesel Generator |
| EPA | US Environmental Protection Agency |
| FY | Fiscal Year |
| HAZMAT | Hazardous Material |
| HVAC | Heating, Ventilation and Air Conditioning |
| IBA | Inflatable Buoyant Apparatus |
| ISRO | Isle Royale National Park |
| MDE | Main Diesel Engine |
| NPS | National Park Service |
| OEM | Original Equipment Manufacturer |
| PA | Public Address System |
| SCCS | Ship Command and Control System |
| SLE | Service Life Extension |
| SLEU | Service Life Extension and Upgrade |
| SME | Subject Matter Expert |
| SSDG | Ship's Service Diesel Generator |
| CPP | Controllable Pitch Propeller |
| TLI | Tank Level Indicating |
| USCG | US Coast Guard |

## Introduction

This is the Service Life Extension and Upgrade (SLEU) Report for the M/V RANGER III.

A SLEU consists of work items that address the re-capitalization of specific systems to extend the Service Life of the vessel by 30 years or more and to provide options for increasing a ship's capability. The service life extension extends the service life of a vessel by replacing obsolete, unsupportable, or maintenance-intensive equipment, and by seeking standardization of configuration issues. Ultimately, a SLEU is aimed at saving the National Park Service (NPS) maintenance money and improving the availability of an asset beyond its designed service life.

A SLEU will include a complete structural evaluation and overhaul for the vessel. Whenever possible, upgrades will incorporate new, proven technologies to reduce lifecycle costs (includes acquisition, personnel, training, and maintenance) and mitigate any environmental liabilities present. A SLEU should:

- Reduce lifecycle costs,
- Seek energy efficiency,
- Comply with all current government environmental and safety standards to the greatest extent possible,
- Include all documentation and support required.

Many of the systems and equipment on the M/V RANGER III are not unique to the NPS and consequently there is substantial data stored at Volpe that can be used to develop a reliable SLEU program in terms of life expectancy or repair cost estimates. However, some systems are somewhat unique and may require some additional research.

The ability of the NPS to complete the M/V RANGER III SLEU requires a robust cost estimate. This cost estimate includes $2.9M for Engineering, including business case analyses/engineering assessments, and $7.7M worth of work on the vessel, plus an optional $1.2M for engineering and $4.9M worth of work for upgrades to the vessel. This cost estimate does not include unforeseen project growth and miscellaneous administrative costs. These preliminary figures are given in Fiscal Year 2016 dollars.

In addition to completing a proposed work list, each item will be ranked according to four separate but equal weighted categories:

1. Safety
2. Readiness
3. Economic Payback
4. Probability (of Future Problems)

These categories encompass the majority of engineering and operational concerns and provide a means for prioritization of work items.

## Basic Vessel Information

The M/V RANGER III was built by the Christy Corporation of Sturgeon Bay, Wisconsin, and delivered to Isle Royale National Park in September 1958. It is 165 feet long and is the largest piece of moving equipment in National Park Service. The vessel's primary mission is logistical support for the park's island operations. The M/V RANGER III also provides regularly scheduled passenger, freight, and diesel fuel deliveries from Houghton, Michigan to the park. All park staff are transported to and from the island on this vessel, as well as the majority of freight used to support projects and construction contracts on the island. All diesel fuel required to run the electric generators on the island is also transported by this boat.

The M/V RANGER III has been in continuous service for 55 years. The ship was repowered in 1999 and has had continuous maintenance and electronic upgrades. The vessel recently added a ballast water treatment system and two new life rafts to replace some of the antiquated 1958 lifeboats and davit-launching systems. The ship has four integral, single-skin oil tanks - two for bunkers and two for cargo diesel oil, and recently received a congressional (OPA-90) waiver on mandated double-hulling of the "cargo" oil tanks.

While the vessel has had some upgrades over 55 years, the hull, plumbing, heating, electrical, propulsion shaft and interior cabin components are original equipment. Joiner work, ceiling tile, flooring tile and underlayment have some asbestos content with 55 years of layered paint. There is localized damage to flooring tiles and underlayment which requires repair or total replacement to meet EPA standards. Portions of the insulation in machinery spaces have asbestos content which has been maintained to EPA standards. Interior structural framing components below the main deck are coated with lead-based preservative paint.

Auxiliary systems such as the anchor windlass, mooring winches, fire pumps, ballast pumps, controllable pitch propeller system, electrical distribution panels, emergency generator and emergency steering gear are 55 years old. The current steering gear is only a single ram system and is grandfathered from meeting current industry standards. The deck crane, which handles 40% of all cargo, was just refurbished, but the crane engine is 28 years old. Most of the original equipment manufacturers are no longer in business. This frequently requires that parts be custom made or the component replaced in whole, to maintain USCG-inspected safety standards.

## Replacement and Disposal Costs

Volpe estimates the cost of a replacement RANGER is $25M-$30M.

Volpe estimates that disposal costs for M/V RANGER III will be $1.5M.

## General Recommendations

In addition to the Service Life Extension (SLE) projects and optional upgrades, Volpe offers the following general comments concerning the proposed overhaul:

1. Assume a $350K drydocking and fire watch cost. These costs are included in Work Item 3, Drydocking and Temp Services.
2. Assume an $800K per month "burn rate."
3. Conduct an inclining experiment before and after RANGER goes through the SLEU, per Work Item 1.
4. Conduct an electrical load analysis, per Work Item 2.

## Methodology

The Volpe Center prepared work item descriptions that contain most of the known available information on 36 Service Life Extension (SLE)projects and 8 potential upgrades for the M/V RANGER III. Subject Matter Experts (SMEs) at Volpe and from NPS reviewed the issues described in the briefing book plus additional concerns identified as critical to meeting current and future operational requirements. The goals for each system were to develop a common understanding of the issues, agree on a potential solution, estimate the Rough Order of Magnitude (ROM) costs of implementing the solution, describe the risks of not addressing the issue, and rank the issues to determine priorities. Unanimous decisions were not achieved on all work items. The recommendations are based on a consensus of the Volpe and NPS SMEs.

Volpe ranked each issue based on four criteria – safety, readiness, payback and probability. These criteria are defined as follows:

1. **Safety:** Defined as the probability of the issue impacting personnel and passenger safety if it were not addressed.
2. **Readiness:** The probability of impacting the vessel's ability to maintain current readiness levels, assuming operations at the current level.
3. **Economic Payback:** The return in operational effectiveness and economy for the labor hours and dollars spent on addressing the issue.
4. **Probability:** The likelihood of this issue becoming a problem if the item was not addressed. (Probability was not used when ranking upgrade options.)

A scale of 1 to 10 was used for each criterion (with 10 being the most likely to have a negative impact) to rank the issues. Ratings of the four criteria were added together to produce a total score. A prioritized list of projects was assembled starting with the highest total score.

## Recommended Projects

Table F-1 provides a list of the 36 projects and 8 upgrades recommended for the M/V RANGER III SLEU in order by the priority assigned to them by the SME consensus.

**Table F-1**
**M/V RANGER III Recommended Project List**
Source: Volpe

| Item | Project Name | Safety | Readiness | Economic Payback | Probability | Total Score |
|---|---|---|---|---|---|---|
| 1 | Inclining Experiment and Weight Management | 10 | 10 | 10 | 10 | 40 |
| 2 | Electrical Load Analysis | 10 | 10 | 10 | 10 | 40 |
| 3 | Drydocking and Temp Services | 10 | 10 | 10 | 10 | 40 |
| 4 | Outfitting and Provisioning | 10 | 10 | 10 | 10 | 40 |
| 5 | Fire Alarm Control System | 9 | 6 | 7 | 7 | 29 |
| 6 | Emergency Diesel Generator | 7 | 8 | 4 | 8 | 27 |
| 7 | Structural Repairs | 9 | 9 | 3 | 5 | 26 |
| 8 | Firemain & Bilge System | 8 | 8 | 4 | 6 | 26 |
| 9 | Deck Crane | 6 | 7 | 6 | 7 | 26 |
| 10 | Hazmat Removal | 9 | 3 | 6 | 7 | 25 |
| 11 | Engine Room Fire Suppression System | 8 | 6 | 7 | 4 | 25 |
| 12 | SCCS | 6 | 7 | 4 | 8 | 25 |
| 13 | Main Diesel Engine and Reduction Gear | 4 | 9 | 4 | 8 | 25 |
| 14 | Ship Service Diesel Generator | 4 | 9 | 4 | 8 | 25 |
| 15 | Main Diesel Engine Control System | 7 | 7 | 4 | 6 | 24 |
| 16 | Electrical Power Distribution System | 6 | 9 | 2 | 7 | 24 |
| 17 | Propulsion Shaft, Seals & Bearings | 4 | 9 | 3 | 7 | 23 |
| 18 | Anchor Windlass | 5 | 5 | 5 | 7 | 22 |
| 19 | Stern Winch | 5 | 5 | 5 | 7 | 22 |
| 20 | Rudder | 7 | 7 | 3 | 4 | 21 |
| 21 | Ballast Water System | 6 | 6 | 4 | 5 | 21 |
| 22 | Compressed Air | 6 | 8 | 3 | 4 | 21 |
| 23 | Potable & Sanitary Water Systems | 5 | 7 | 4 | 5 | 21 |
| 24 | Refrigeration System | 3 | 6 | 8 | 4 | 21 |
| 25 | Fuel Oil System | 6 | 7 | 2 | 4 | 19 |
| 26 | Auxiliary Seawater System | 6 | 6 | 2 | 5 | 19 |
| 27 | Bow Thruster | 5 | 3 | 4 | 7 | 19 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 28 | Sewage System | 4 | 8 | 3 | 4 | 19 |
| 29 | Lighting System | 4 | 5 | 7 | 3 | 19 |
| 30 | Heating and Ventilation System | 6 | 4 | 2 | 6 | 18 |
| 31 | Ventilation System, Engine Room | 6 | 4 | 2 | 6 | 18 |
| 32 | Propulsion Shaft and Propeler | 3 | 6 | 5 | 4 | 18 |
| 33 | Waste Oil System | 3 | 6 | 4 | 5 | 18 |
| 34 | Interior Communications | 7 | 4 | 2 | 4 | 17 |
| 35 | Commissary Equipment | 3 | 3 | 4 | 5 | 15 |
| 36 | Habitability Overhaul | 2 | 2 | 4 | 4 | 12 |
| | | | | | | |
| U-1 | Life Boats | 7 | 3 | 5 | | 15 |
| U-2 | Hydraulically Operated Hatches | 4 | 3 | 8 | | 15 |
| U-3 | Fuel Transport | 3 | 3 | 9 | | 15 |
| U-4 | Automation, Alarm Panel & TLI | 6 | 3 | 5 | | 14 |
| U-5 | Refrigeration Capacity | 3 | 3 | 8 | | 14 |
| U-6 | Passenger Experience | 2 | 2 | 5 | | 9 |
| U-7 | Alternative Energy | 2 | 2 | 5 | | 9 |
| U-8 | Baggage Carts | 2 | 2 | 3 | | 7 |

## Estimated Project Costs

Table F-2 provides the M/V RANGER III SLEU estimated cost data for the 36 SLE projects and 8 upgrades. Costs include:

- One-time engineering costs
- Cost for procurement of parts and materials
- Cost for installation
- Total work item costs

Engineering costs are given in FY 2016 dollars. Individual work items, Yard and Administration costs are the average of FY18 dollar estimates.

**Table F-2**
**M/V RANGER III Estimated Project Costs**
Source: Volpe

| Work Item # | Work Item Description | One time Eng. Costs | Procurement | Installation | Total Cost |
|---|---|---|---|---|---|
| 1 | Inclining Experiment and Weight Management | $30,000 | | | $30,000 |
| 2 | Electrical Load Analysis | $20,000 | | | $20,000 |
| 3 | Drydocking and Temp Services | $350,000 | | | $350,000 |
| 4 | Outfitting and Provisioning | $200,000 | | | $200,000 |
| 5 | Fire Alarm Control System | $50,000 | $50,000 | $60,000 | $160,000 |
| 6 | Emergency Diesel Generator | $50,000 | $200,000 | $100,000 | $350,000 |
| 7 | Structural Repairs | $400,000 | $100,000 | $100,000 | $600,000 |
| 8 | Firemain & Bilge System | $25,000 | $25,000 | $75,000 | $125,000 |
| 9 | Deck Crane | $50,000 | $350,000 | $100,000 | $500,000 |
| 10 | Hazmat Removal | $100,000 | | $300,000 | $400,000 |
| 11 | Engine Room Fire Suppression System | $50,000 | $150,000 | $150,000 | $350,000 |
| 12 | SCCS | $150,000 | $100,000 | $100,000 | $350,000 |
| 13 | Main Diesel Engine and Reduction Gear | $100,000 | $1,500,000 | $150,000 | $1,750,000 |
| 14 | Ship Service Diesel Generator | $50,000 | $300,000 | $150,000 | $500,000 |
| 15 | Main Diesel Engine Control System | $50,000 | $50,000 | $50,000 | $150,000 |
| 16 | Electrical Power Distribution System | $100,000 | $150,000 | $250,000 | $500,000 |
| 17 | Propulsion Shaft, Seals & Bearings | $50,000 | $50,000 | $100,000 | $200,000 |
| 18 | Anchor Windlass | $50,000 | $175,000 | $75,000 | $300,000 |
| 19 | Stern Winch | $30,000 | $180,000 | $50,000 | $260,000 |

| | | | | | |
|---|---|---|---|---|---|
| 20 | Rudder | $25,000 | $10,000 | $25,000 | $60,000 |
| 21 | Ballast Water System | $25,000 | $25,000 | $25,000 | $75,000 |
| 22 | Compressed Air | $10,000 | $10,000 | $10,000 | $30,000 |
| 23 | Potable & Sanitary Water Systems | $50,000 | $35,000 | $50,000 | $135,000 |
| 24 | Refrigeration System | $50,000 | $100,000 | $150,000 | $300,000 |
| 25 | Fuel Oil System | $25,000 | $25,000 | $25,000 | $75,000 |
| 26 | Auxiliary Seawater System | $25,000 | $25,000 | $25,000 | $75,000 |
| 27 | Bow Thruster | $25,000 | $200,000 | $75,000 | $300,000 |
| 28 | Sewage System | $30,000 | $30,000 | $30,000 | $90,000 |
| 29 | Lighting System | $50,000 | $200,000 | $150,000 | $400,000 |
| 30 | Heating and Ventilation System | $50,000 | $50,000 | $75,000 | $175,000 |
| 31 | Ventilation System, Engine Room | $25,000 | $55,000 | $50,000 | $130,000 |
| 32 | Controllable Pitch Propeller System | $200,000 | $600,000 | $200,000 | $1,000,000 |
| 33 | Waste Oil System | $40,000 | $40,000 | $40,000 | $120,000 |
| 34 | Interior Communications | $25,000 | $55,000 | $45,000 | $125,000 |
| 35 | Commissary Equipment | $25,000 | $25,000 | $25,000 | $75,000 |
| 36 | Habitability Overhaul | $200,000 | $500,000 | $700,000 | $1,400,000 |
| | **M/V RANGER III SLE Item Totals** | **$2,785,000** | **$5,315,000** | **$3,510,000** | **$11,660,000** |
| U-1 | Life Boats | $100,000 | $250,000 | $100,000 | $450,000 |
| U-2 | Hydraulically Operated Hatches | $150,000 | $300,000 | $200,000 | $650,000 |
| U-3 | Fuel Transport | $75,000 | $300,000 | $225,000 | $600,000 |
| U-4 | Automation, Alarm Panel & TLI | $200,000 | $200,000 | $300,000 | $700,000 |
| U-5 | Refrigeration Capacity | $100,000 | $200,000 | $200,000 | $500,000 |
| U-6 | Passenger Experience | $75,000 | $200,000 | $200,000 | $475,000 |
| U-7 | Alternative Energy | $100,000 | $500,000 | $400,000 | $1,000,000 |
| U-8 | Baggage Carts | | $175,000 | | $175,000 |
| | **M/V RANGER III Upgrade Item Totals** | **$800,000** | **$2,125,000** | **$1,625,000** | **$4,390,000** |
| | **M/V RANGER III SLEU TOTAL** | **$3,585,000** | **$7,440,000** | **$5,135,000** | **$16,050,000** |

## Work Items

The following 36 SLE items address the recapitalization of specific systems to extend the service life of RANGER by 30 years.

### 1. Inclining Experiment and Weight Management *097*

An inclining experiment and the resulting stability calculations determine the center of gravity and buoyancy of the vessel and predict how a ship will behave in a seaway.

**Shipcheck:**

- No issues were reported with stability.

**Volpe Recommendation:**

- Perform inclining experiment before and after the SLEU.

**Service Life Assessment:** Stability calculations should be performed any time a major modification to a ship is completed to confirm the modified weights and centers of the vessel and to ensure stability of the ship is not degraded.

**Estimated Costs:** Volpe estimates the one-time engineering costs to be $30,000.

**Risk of not Funding:** High. If the actual weights and centers of a vessel are not known, the stability of the vessel could be compromised and could potentially lead to capsizing.

**Impact on NPS Operations:** Unknown stability information may incorrectly limit the amount of cargo able to be carried onboard the vessel.

**Scoring:**

Safety: 10
Readiness: 10
Economic Payback: 10
Probability: 10
**Total Score: 40**

## 2. Electrical Load Analysis 086

An electrical load analysis calculates the expected loads on each circuit to determine required electrical capacity of the generators, switchboards and circuit breakers.

**Shipcheck:**

- The generator capacity is sufficient for the current load on the vessel. However, if a new HVAC system, water heater, lighting and entertainment system are added, the electrical load will increase significantly. This may require a larger generator capacity.
- Currently a second generator needs to be brought online to run the Ballast Water Treatment System (BWTS).

**Volpe Recommendation:**

- Perform electrical load analysis on the vessel.
- Maintain an electrical load database.

**Service Life Assessment:** An electrical load analysis should be completed any time major electrical equipment or electrical loads are modified.

**Estimated Costs:** Volpe estimates the one-time engineering costs to be $20,000.

**Risk of not Funding:** High. If an electrical load analysis is not completed, the new main switchboard and power distribution system may not be correctly sized or the electrical phases may not be balanced properly.

**Impact on NPS Operations:** The ship may eventually lack the capabilities to properly carry out assigned missions.

**Scoring:**

Safety: 10
Readiness: 10
Economic Payback: 10
Probability: 10
**Total Score: 40**

### 3. Drydocking and Temp Services 070

Some of the SLEU work will take place when RANGER is in drydock. Volpe estimates that the SLEU drydocking will take 3 months. The entire SLEU overhaul will require 4-5 months based on the estimated cost and "Burn Rate." RANGER may have to stay at the shipyard all winter until the ice on Lake Superior recedes.

**Shipcheck:**

- The M/V RANGER III gets drydocked on a 5-year basis.

**Volpe Recommendation:**

- Ensure drydocking and temp services costs are included in SLEU work package.

**Service Life Assessment:** N/A

**Estimated Costs:** Volpe estimates the drydocking and temp services costs to be $350,000. This is based on the 2013-2014 drydocking.

**Risk of not Funding:** High. If the drydocking and temp services costs are not included in the work package, funding may have to be taken away from other work items to cover the costs.

**Impact on NPS Operations:** The Coast Guard would cancel Ranger's credentials and the ship would not be permitted to sail.

**Scoring:**

Safety: 10
Readiness: 10
Economic Payback: 10
Probability: 10
**Total Score: 40**

### 4. *Outfitting and Provisioning 066*

Vessels need to have spares and equipment onboard to be used for underway repairs.

**Shipcheck:**

- No issues were noted with outfitting or provisioning during the ship check. However, if many systems are replaced there will be problems with shortages of spares and consumables on the new systems.

**Volpe Recommendation:**

- Provide RANGER with a revised outfitting package. This will consist mostly of spare parts and consumables for systems that were re-capitalized during the SLEU.

**Service Life Assessment:** A shortage of spares and consumables can shorten the life of operating systems.

**Estimated Costs:** Volpe estimates the outfitting and provisioning costs to be $200,000.

**Risk of not Funding:** High. If the vessel does not have onboard spares, trips may have to be cut short to return to port for fixes.

**Impact on NPS Operations:** The ships may eventually lack the capabilities to properly carry out assigned missions.

**Scoring:**

Safety: 10
Readiness: 10
Economic Payback: 10
Probability: 10
**Total Score: 40**

## 5. Fire Alarm Control System 436

The Fire Alarm Control System uses smoke and heat detectors located throughout the vessel to detect and alert the crew in the event of a fire. RANGER has a Fenwal Fire Detection System controlled from the Fire Alarm Control Panel located in the Pilothouse. The system is original to the vessel.

**Shipcheck:**

- The Fire Alarm Control System is obsolete. It meets the minimum regulatory requirements but spare parts are difficult to obtain. No issues were reported with the current system.

**Volpe Recommendation:**

- Replace the Fire Alarm Control System with a new supportable state-of-the-art-system.
- Perform in conjunction with Work Item #15, Main Engine Control System, and Upgrade Item #U-6, Automation, Alarm Panel and Tank Level Indicating System.

**Service Life Assessment:** The Fire Alarm Control System is original to the vessel and is obsolete. Spare parts are no longer available for the system.

**Estimated Costs:** Volpe estimates the one-time engineering costs to be $50,000, procurement costs to be $50,000, and the installation costs to be $60,000.

**Risk of not Funding:** High. A serious casualty could result without a functioning alarm system and could result in RANGER being badly damaged and possibly resulting in personnel casualties. If a fire occurs undetected, RANGER could be damaged and sailings could be canceled.

**Impact on NPS Operations:** A non-functioning system could prevent RANGER from sailing. If a fire occurs, RANGER could be damaged and sailings could be cancelled.

**Scoring:**

Safety: 9
Readiness: 6
Economic Payback: 7
Probability: 7
**Total Score: 29**

## 6. *Emergency Diesel Generator 312*

The Emergency Diesel Generator (EDG) is used to provide emergency power to vital systems in the event of a loss of power from the Ship's Service Diesel Generators. RANGER's EDG is a Waukesha diesel engine coupled to a Kohler generator. It is rated for at 10 kW, 450 VAC, 3 phase, 60 Hz at 1800 RPM.

**Shipcheck:**

- The Waukesha diesel engine is original to the ship. The generator and switchboard were replaced in 1993.
- The EDG capacity of 10 kW is not sufficient. It can only support the lights onboard the vessel.

**Volpe Recommendation:**

- Replace the EDG with an EPA-compliant unit. Recommend using same manufacturer as SSDG (Work Item #14) for commonality of parts and configuration control. Increase EDG capacity to at least 25 kW.
- Replace EDG switchboard.

**Service Life Assessment:** The EDG engine is obsolete. The manufacturer of the engine is no longer in business.

**Estimated Costs:** Volpe estimates the one-time engineering cost to be $50,000, the procurement costs to be $200,000, and the installation costs to be $100,000.

**Risk of not Funding:** High. If the emergency generator engine fails it could lead to a total loss of electrical power to the vessel and even missed operational days.

**Impact on NPS Operations:** The vessel could lack the right capabilities (emergency electrical power generation) to carry out assigned missions.

**Scoring:**

Safety: 7
Readiness: 8
Economic Payback: 4
Probability: 8
**Total Score: 27**

## 7. Structural Repairs 100

RANGER is a monohull displacement vessel constructed of steel. RANGER is 55 years old and most of the hull steel is original.

**Shipcheck:**

- A side scan of the hull will be performed during the 2013 drydocking.
- Volpe took a representative sample of hull thickness measurements in November 2013 in drydock. Hull wastage averaged around 10%.
- The tanks and voids looked to be in good shape but could use a good cleaning.

**Volpe Recommendation:**

- Do a complete scan of the hull, longitudinals, superstructure and all piping systems.
- Repair any plate and supporting structure that is either damaged or worn by more than 25% from the original thickness.
- Repair any damaged or corroded areas on the superstructure.
- Clean and re-preserve all tanks.
- In coordination with Work Item #10, HAZMAT Removal, blast and preserve all exposed steel, including hull and superstructure.

**Service Life Assessment:** The RANGER has been in continuous service for 55 years and is past its designed service life.

**Estimated Costs:** To perform all structural repairs, Volpe estimates the one-time engineering costs to be $400,000, procurement costs to be $100,000, and remediation and installation costs to be $100,000. This is based on Volpe experience with other vessels of similar size and construction.

**Risk of not Funding:** High. Failure to properly maintain watertight integrity greatly impedes survivability of the ship. The ship's structural integrity might not be maintained

**Impact on NPS Operations:** The ship's structural integrity might not be maintained.

**Scoring:**

Safety: 9
Readiness: 9
Economic Payback: 3
Probability: 5
**Total Score: 26**

## 8. Firemain and Bilge System 521

The firemain onboard RANGER provides water to the fire stations located throughout the vessel, which can be used to fight a fire onboard the vessel. The bilge system is used to pump out water from the bilges of the vessel in the event of flooding.

RANGER is equipped with two Goulds in-line centrifugal fire/bilge pumps. They are original to the vessel.

**Shipcheck:**

- No issues reported with the fire and bilge systems.
- The fire pumps are 55 years old and spare parts are not available.

**Volpe Recommendation:**

- Replace fire/bilge pumps aboard the vessel.
- Replace deteriorated piping per scan findings.

**Service Life Assessment:** Volpe has found that large pumps need to be replaced after approximately 20 years of service. This is frequently the point at which spare parts are no longer available.

If accomplished during the SLEU overhaul, it is safe to assume that this system will need to be replaced again before the Ranger III reaches the end of its extended service life.

**Estimated Costs:** Volpe estimates one-time engineering costs to be $25,000, procurement costs to be $25,000, and the installation costs to be $75,000 for a total cost of $125,000.

**Risk of not Funding:** High. If the piping deteriorates, the firemain and bilge systems could leak water into the bilges of the vessels. If the fire pumps fail during an emergency, the ships could be severely damaged.

**Impact on NPS Operations:** The ship's existing firemain and bilge systems are difficult to maintain due to the lack of available spare parts.

**Scoring:**

Safety: 8
Readiness: 8
Economic Payback: 4
Probability: 6
**Total Score: 26**

## 9. Deck Crane 573

RANGER has a 3-ton crane on the bow for lifting cargo onto the forward deck. The crane handles 40% of all of RANGER's cargo. The crane has its own diesel engine for power.

**Shipcheck:**

- The crane is nearly 30 years old.
- The crane was pulled off the ship for inspection and overhaul during the 2013 drydocking period. The traversing gear was making noise and is going to be fixed during the overhaul.

**Volpe Recommendation:**

- Replace the crane and crane engine.

**Service Life Assessment:** The crane is almost 30 years old and is past its design service life.

**Estimated Costs:** Volpe estimates the one-time engineering cost to be $50,000, the procurement costs to be $350,000, and the installation costs to be $100,000. Total cost is $500,000.

**Risk of not Funding:** Medium. If the crane fails, RANGER will not be able to load/unload all cargo for ISRO.

**Impact on NPS Operations:** The vessel could lack the right capabilities (cargo transportation) to carry out all assigned missions

**Scoring:**

Safety: 6
Readiness: 7
Economic Payback: 6
Probability: 7
**Total Score: 26**

## 10. HAZMAT Removal 600

Lead paint and asbestos were widely used in shipbuilding prior to the 1970s. RANGER was built in the 1950s and has lead paint and asbestos onboard. Although some HAZMAT abatement has been performed, there is still some lead paint and asbestos on RANGER.

**Shipcheck:**

- Interior structural framing components below the main deck are coated with lead-based preservative paint.
- Portions of the insulation in machinery spaces have asbestos content which has been maintained to EPA standards.
- Wallboard, ceiling tile, flooring tile and underlayment have asbestos content with 55 years of layered paint. There is localized damage to flooring tiles and underlayment which requires repair or total replacement to meet EPA asbestos standards.

**Volpe Recommendation:**

- Perform a HAZMAT survey on the RANGER.
- Remove all interior hull insulation, deck coverings, joiner work and ceiling tiles using appropriate health, safety, and environmental precautions for lead paint and asbestos.

**Service Life Assessment:** The RANGER has been in continuous service for 55 years and is past its designed service life.

**Estimated Costs:** To perform all HAZMAT removal, Volpe estimates the one-time engineering costs to be $100,000 and remediation costs to be $300,000.

**Risk of not Funding:** High. Failure to properly maintain asbestos wallboard, insulation, and tiles may lead to hazardous conditions and sickness for crew and passengers. It will also not meet OSHA and Coast Guard requirements.

**Impact on NPS Operations:** Crew and passenger health will be affected if lead paint and asbestos particles becomes airborne.

**Scoring:**

Safety: 9
Readiness: 3
Economic Payback: 6
Probability: 7
**Total Score: 25**

## 11. Engine Room Fire Suppression System 555

Vessels typically have a fixed fire suppression system installed in the machinery areas that can be used to combat a major fire. They are typically used as a last resort.

RANGER's engine room is protected with a fixed Carbon Dioxide ($CO_2$) fire extinguishing system. Because $CO_2$ depletes the oxygen in the space, an accidental release may cause the death of personnel in the engine room.

**Shipcheck:**

- RANGER has a fixed $CO_2$ system installed in the engine room.

**Volpe Recommendation:**

- Replace the engine room $CO_2$ system with an inert gas system that will not harm people in the space in the event of an accidental release. Volpe recommends a Kidde product called FM-200. This is a fixed Fire Suppression system that uses an inert gas that is not an ozone depleter and does not harm people in the event of an accidental release. Volpe has installed over 300 of these systems on Army and Coast Guard vessels. Install additional FM-200 systems in the Auxiliary Machinery Room and EDG Room.

**Service Life Assessment:** Based on Volpe Center fire protection engineering experience and expertise on watercraft, $CO_2$ Systems with proper routine maintenance and OEM Factory Certified Inspections, should last the life of the vessel.

**Estimated Costs:** Volpe estimates the one-time engineering costs to be $50,000, procurement costs to be $150,000, and the installation costs to be $150,000.

**Risk of not Funding:** High. An accidental release of $CO_2$ can kill anyone in the space. The cost from one accidental death or major shipboard fire could far exceed the cost of installing the FM-200 system.

**Impact on NPS Operations:** A major shipboard fire will cause loss of operational days for RANGER and could seriously impact operations on ISRO.

**Scoring:**

Safety: 8
Readiness: 6
Economic Payback: 7
Probability: 4
**Total Score: 25**

## 12. SCCS 420

The Ship Command and Control System (SCCS) is used for the safe navigation of RANGER between Houghton and ISRO. RANGER's SCCS consists of:

- Surface Search Radar
- Communications Suite
- Depth Sounder
- Speed Log
- NAV Package
- Weather Pack

**Shipcheck:**

- The fathometer transducer is being replaced during the 2013 drydocking.

**Volpe Recommendation:**

- Renew the SCCS equipment.

**Service Life Assessment:** SCCS equipment is typically unsupportable after 15-20 years of service. If accomplished during the SLEU overhaul, it is safe to assume that this system will need to be replaced again before the Ranger III reaches the end of it's extended service life.

**Estimated Costs:** Volpe estimates the one-time engineering cost to be $150,000, the procurement costs to be $100,000, and the installation costs to be $100,000.

**Risk of not Funding:** Medium. If the SCCS fails, RANGER will not have the proper navigation equipment to travel from Houghton to ISRO.

**Impact on NPS Operations:** RANGER will not be able to deliver visitors and supplies to ISRO.

**Scoring:**

Safety: 6
Readiness: 7
Economic Payback: 4
Probability: 8
**Total Score: 25**

## 13. Main Diesel Engine and Reduction Gear 233

The main diesel engines (MDE) provide the propulsion power to move ships across water. The reduction gears step down the rotation speed between the MDEs and the propellers.

**Main Diesel Engines** RANGER is fitted with two diesel engines (CAT 3508B), each driving a propeller via a flange mounted gearbox. The engines are 8-cylinder, 4-stroke, turbo-charged and capable of delivering 850 Brake Horsepower (BHP) each. These engines are EPA Tier 2 Compliant.

**Reduction Gear** Each propulsion engine is fitted with a Reintjes LAF 643 Reduction Gear. The reduction ratio is 3.548:1.

**Shipcheck:**

- The engines were replaced in 1999. At the time of the shipcheck, the starboard engine had 9,184 hours and the port engine had 9,173 hours of operation time.
- The reduction gears were replaced with the engines in 1999.

**Volpe Recommendation:**

- Replace the main engines with new EPA-compliant engines.
- Replace the reduction gears in conjunction with the new engines.

**Service Life Assessment:** In 2048, the end of the SLE, the current engines would be 50 years old. If the assessed value of the vessel after major modifications is more than double the assessed value of the vessel before major modifications, the vessel will need EPA-compliant engines. At the time of the SLEU, Tier 4 requirements will be in effect.

**Estimated Costs:** Volpe estimates the one-time engineering costs to be $100,000, the procurement costs to be $1,500,000 and the installation costs to be $150,000. Total cost is $1,750,000.

**Risk of not Funding:** Low. If the engines are not EPA compliant, the vessel will not be allowed to sail.

**Impact on NPS Operations:** The ship's availability for operations might suffer. The ship will not be able to comply with future environmental requirements for diesel engines.

**Scoring:**

Safety: 4
Readiness: 9
Economic Payback: 4
Probability: 8
**Total Score: 25**

## *14. Ship's Service Diesel Generator 311*

The Ship's Service Diesel Generators provide power to run all of the electrical equipment onboard RANGER, including the SCCS, lighting, ventilation fans, refrigeration compressors, and computers.

RANGER is fitted with two Caterpillar SR-4 diesel gensets, each capable of generating 55KW, 450 Volt, 3-phase 60 HZ electrical power.

**Shipcheck:**

- The SSDGs were replaced in 1993. At the time of the shipcheck, the starboard genset had 14,603 hours and the port genset had 14,525 hours of operation time.

**Volpe Recommendation:**

- Replace the SSDGs with new, EPA-compliant units. The generators should be sized to meet the requirements of the Electrical Load. This should be coordinated with Work Item #2, Electrical Load Analysis.

**Service Life Assessment:** If the assessed value of the vessel after major modifications is more than double the assessed value of the vessel before major modifications, the vessel will need EPA-compliant gensets. At the time of the SLEU, Tier 4 requirements will be in effect.

**Estimated Costs:** Volpe estimates the one-time engineering costs to be $50,000, procurement costs to be $300,000, and the installation costs to be $150,000.

**Risk of not Funding:** Low. If the engines are not EPA compliant, the vessel may not be allowed to sail. The electrical load may exceed the generating capacity after the SLEU if the generators are not properly sized.

**Impact on NPS Operations:** The vessel could lack the right capabilities (electrical power generation) to carry out assigned missions.

**Scoring:**

Safety: 4
Readiness: 9
Economic Payback: 4
Probability: 8
**Total Score: 25**

## 15. Main Diesel Engine Control System 202

The main propulsion machinery plant is controlled by the engine control system (ECS). RANGER has control units located in the pilot house and on the main control stand in the engine room. The system controls both the main engine speeds and CPP system.

**Shipcheck:**

- The control system was replaced when the vessel was repowered in 1999. The unit allows remote engine operation from the pilot house or local operation from the engine room.

**Volpe Recommendation:**

- In conjunction with the Work Item 13, Main Diesel Engine, Volpe recommends installing a whole ship integrated system. These systems not only control the engines and CPP system but allow the users to check engine diagnostics, tank levels, and alarms from a single screen.

**Service Life Assessment:** Volpe experience with Coast Guard vessels has shown that the estimated the life expectancy of an ECS system is 7-10 years before the equipment is obsolete.

**Estimated Costs:** Volpe estimates the one-time engineering costs to be $50,000, procurement costs to be $50,000, and the installation costs to be $50,000.

If accomplished during the SLEU overhaul, it is safe to assume that this system will need to be replaced again before the Ranger III reaches the end of it's extended service life.

**Risk of not Funding:** Medium. Vessels not receiving a replacement main propulsion control system will continue to rely on the OEM to supply a limited number of highly expensive repair parts. System reliability will continue to decline. Eventually the system will become so antiquated that parts and service will become unobtainable. Failure of the main propulsion control system in a maneuvering situation could result in damage to the vessel.

**Impact on NPS Operations:** The ship's availability for operations might not be maintained.

**Scoring:**

Safety: 7
Readiness: 7
Economic Payback: 4
Probability: 6
**Total Score: 24**

## 16. Electric Power Distribution System 324

The Electric Power Distribution System consists of the main switchboard, breakers, and cabling which provides power to electric equipment throughout the ship.

RANGER's switchboard is designed for the control, metering and distribution of the two SSDGs. The switchboard is original to the vessel but was upgraded when the SSDGs were replaced in 1993. The physical size of the switchboard is very large and takes up a lot of the engine room.

Most of the shipboard wiring is original to the vessel.

**Shipcheck:**

- No issues reported with the switchboard or wiring.

**Volpe Recommendation:**

- Replace the main switchboard with a more compact solid state/digital unit in conjunction with Work Item #2, Electrical Load Analysis, Work Item #14, Ship's Service Diesel Generator, and Work Item #6, Emergency Diesel Generator.
- Replace all electrical cabling throughout the vessel.
- Replace subpanels throughout the vessel.

**Service Life Assessment:** Provided that routine maintenance is regularly and properly performed, the switchboard should last the life of the vessel. Electrical cabling can deteriorate over time and is already past its designed service life.

**Estimated Costs:** Volpe estimates the one-time engineering costs to be $100,000, procurement costs to be $150,000, and the installation costs to be $250,000.

**Risk of not Funding:** Medium. Some systems will not be powered up if a failure occurs during while underway. This could lead to a loss of some or all, operational capability. If vital equipment is lost during a maneuvering situation, damage to the vessel could occur.

**Impact on NPS Operations:** The ship's electrical systems would not be properly maintained

**Scoring:**

Safety: 6
Readiness: 9
Economic Payback: 2
Probability: 7
**Total Score: 24**

### 17. Propulsion Shaft, Seals, and Bearings 243

The propulsion shafts transfer power from the main engine reduction gears to the propellers. Bearings along the length of the shaft provide support for the weight of the shaft as well as for both axial and radial motion. The shaft seals prevent water from entering the vessel where the shaft penetrates the hull.

RANGER uses the Bird-Johnson CCP System to control the two controllable-pitch propellers (CPP). The propeller pitch is 78”, and the propeller diameter is 6.33’.

**Shipcheck:**

- The shaft is original to the vessel.

**Volpe Recommendation:**

- Pull and inspect shafts, bearings and flex coupling for damage, and repair as necessary.
- Replace shaft seals.
- Inspect stern tube and repair corroded areas.
- Perform alignment of propulsion shafting.

**Service Life Assessment:** The propellers are original to the vessel. A more efficient design should be available. While spare parts are currently still available, they may not be in 30+ years.

**Estimated Costs:** Volpe estimates the one-time engineering costs to be $50,000, procurement costs to be $50,000 and the installation costs to be $100,000. Total cost is $200,000.

**Risk of not Funding:** Low. Shaft damage due to bad bearings could result in loss of operational days. Leaky shaft seals or stern tube could lead to flooding of the engine room or auxiliary spaces. The ships’ availability for operations might suffer.

**Impact on NPS Operations:** The ships’ availability for operations might suffer.

**Scoring:**

Safety: 4
Readiness: 9
Economic Payback: 3
Probability: 7
**Total Score: 23**

## 18. Anchor Windlass 581

The anchor windlass is used to lower and raise the ship's anchors. It is also used to let out and take in mooring lines and cable. RANGER's anchor windlass is a Markey Type WEWD-12, wildcat 1-1/16, SN#8183.

**Shipcheck:**

- No issues reported with anchor windlass. However, it is reportedly original equipment and now approximately 55 years old.
- The capstan is slow and frequently doesn't pay out lines fast enough to meet the needs of mooring operations.

**Volpe Recommendation:**

- In conjunction with Work Item #19, Stern Winch, replace the windlass with a new, supportable unit.

**Service Life Assessment:** The windlass is original to RANGER and is obsolete. Spare parts are hard to get.

**Estimated Costs:** Volpe estimates the one-time engineering cost to be $50,000, procurement costs to be $175,000, and installation costs to be $75,000. Total cost is $300,000.

**Risk of not Funding:** Medium. The windlass may be out of service if major repairs are required. The windlass is mission critical equipment and the RANGER may not be able to deploy until repairs are made.

**Impact on NPS Operations:** The ship will be without an anchor windlass in the event of an emergency or routine anchoring operation.

**Scoring:**

Safety: 5
Readiness: 5
Economic Payback: 5
Probability: 7
**Total Score: 22**

## *19. Stern Winch 581*

The stern winch is used to let out and take in mooring lines and cable. RANGER's stern winch is Markey DEWD-12, SN# 8184, dated May 1958.

**Shipcheck:**

- The stern winch was recently damaged. The winch was rebuilt during the 2013 drydocking.

**Volpe Recommendation:**

- In conjunction with Work Item #18, Anchor Windlass, replace the stern winch with a new, supportable unit.

**Service Life Assessment:** The stern winch is original to RANGER and is obsolete. Spare parts are hard to get.

**Estimated Costs:** Volpe estimates the one-time engineering cost to be $30,000, procurement costs to be $180,000, and installation costs to be $50,000.

**Risk of not Funding:** Medium. The winch may be out of service while receiving major repairs. The winch is mission critical equipment and the RANGER may not be able to deploy until repairs are made.

**Impact on NPS Operations:** RANGER uses the stern for mooring operations. These operations will be more difficult if the stern winch is unavailable.

**Scoring:**

Safety: 5
Readiness: 5
Economic Payback: 5
Probability: 7
**Total Score: 22**

## 20. Rudder 562

The rudder is used to steer the vessel underway. RANGER has one rudder located on centerline. It is the original rudder.

**Shipcheck:**

- No issues reported with the rudder.

**Volpe Recommendation:**

- Renew the rudder bearings.
- Preserve the rudder.

**Service Life Assessment:** The rudder is original to the vessel. Volpe has found that rudder bearings need to be replaced every 10-15 years.

**Estimated Costs:** Volpe estimates the one-time engineering cost to be $25,000, procurement costs to be $10,000, and installation costs to be $25,000.

If accomplished during the SLEU overhaul, it is safe to assume that this bearing will need to be replaced again before the Ranger III reaches the end of it's extended service life.

**Risk of not Funding:** Medium. If the rudder bearings seize, the rudder could become stuck and the vessel would lose the ability to steer.

**Impact on NPS Operations:** The ship will not be able to operate if the rudder is inoperative.

**Scoring:**

Safety: 7
Readiness: 7
Economic Payback: 3
Probability: 4
**Total Score:** 21

## *21. Ballast Water System 529*

The ballast water system is used to fill ballast tanks with water to adjust the stability characteristics of a vessel. By filling low-down water tanks with water, the center of gravity of the vessel is lowered. This then allows a vessel to carry more cargo up higher on deck.

RANGER is also equipped with a fairly new Ballast Water Treatment System (BWTS). This treatment system eliminates aquatic invasive species in ballast water to prevent introducing these invasive species into new environments during ballast transfer.

**Shipcheck:**

- No issues reported with the BWTS.
- It was noted that the BWTS was installed using a 2" recirculation line. The ideal installation would have used a 3" ballast line, but the appropriate pipe had deteriorated past its useful life. The 3" line was not accessible and could not be replaced during the installation of the BWTS.

**Volpe Recommendation:**

- Replace deteriorated piping per scan findings.
- Replace the ballast water pumps.
- Re-pipe the BWTS to use the 3" ballast water line.

**Service Life Assessment:** Volpe has found that small pumps need to be replaced every 10-12 years.

**Estimated Costs:** Volpe estimates one-time engineering costs to be $25,000, procurement costs to be $25,000, and the installation costs to be $25,000.

If accomplished during the SLEU overhaul, it is safe to assume that this system will need to be replaced twice before the Ranger III reaches the end of it's extended service life.

**Risk of not Funding:** Medium. If the piping deteriorates, ballast water could leak water into the bilges of the vessels. Slow ballasting operations require the crew to work more labor hours, increasing the operational costs of the vessel.

**Impact on NPS Operations:** The ship's ballast system would be difficult to maintain.

**Scoring:**

Safety: 6
Readiness: 6
Economic Payback: 4
Probability: 5
**Total Score: 21**

## 22. Compressed Air 551

Compressed air is used onboard RANGER to provide starting air for the main diesel engines and to provide ship's service air for pneumatic tools. RANGER has two start air compressors and compressed air tanks. Ship service air is tapped off of the start air system.

**Shipcheck:**

- The ship's service air compressors were being replaced in the 2013 drydocking period.

**Volpe Recommendation:**

- Replace deteriorated compressed air piping.
- Perform inspection and pressure test of compressed air tanks.

**Service Life Assessment:** Volpe has found that air systems can be expected to last 20-25 years before requiring replacement.

**Estimated Costs:** Volpe estimates the one time engineering costs to be $10,000, procurement costs to be $10,000, and the installation costs to be $10,000.

**Risk of not Funding:** Medium. A lack of start air could prevent the crew from restarting the engines onboard the RANGER.

**Impact on NPS Operations:** The vessel's infrastructure (compressed air system) will be difficult to maintain.

**Scoring:**

Safety: 6
Readiness: 8
Economic Payback: 3
Probability: 4
**Total Score: 21**

## 23. Potable and Sanitary Water Systems 533

The potable and sanitary water systems provide water to the galley, water fountains, sinks and toilets. RANGER has a 5,000 gallon potable water tank. The vessel has a hot water heater that is tied into the heating boiler system. The new hot water heater is 130 gallons.

**Shipcheck:**

- The 5,000 gallon potable water tank is very large for the ship. The Captain rarely fills the tank with more than 2,500 gallons. Potable water is filled with municipal water in Houghton. RANGER uses approximately 600 gallons of potable water per round trip.
- The Captain would like to separate the hot water heater from the heating boiler. This would allow the crew to run glycol in the heating boiler without affecting the potable water.
- The Captain would like isolation valves added into the potable and sanitary water systems to allow toilets to be shut off during the winter storage months.
- The hot water heater is being replaced in the 2013 drydocking period.

**Volpe Recommendation:**

- Replace deteriorated piping per scan findings.
- Replace all pipe insulation.
- Replace current water heater with an electric water heater, in conjunction with Work Item #16, Electric Power Distribution System.
- Add isolation valves to potable and sanitary water systems to allow toilets to be shut off during winter storage months.
- Replace potable and sanitary water pumps.

**Service Life Assessment:** Volpe has found that small pumps need to be replaced every 10-12 years.

**Estimated Costs:** Volpe estimates the one-time engineering costs to be $50,000, procurement costs to be $35,000, and the installation costs to be $50,000.

If accomplished during the SLEU overhaul, it is safe to assume that this system will need to be recapitalized twice more before the Ranger III reaches the end of its extended service life.

**Risk of not Funding:** Medium. Crew morale and health will be degraded if the system fails. Trips may have to be cut short or cancelled.

**Impact on NPS Operations:** The ships' potable water systems would be difficult to maintain.

**Scoring:**

Safety: 5
Readiness: 7
Economic Payback: 4
Probability: 5
**Total Score: 21**

## 24. Refrigeration System 516

The reefer boxes are used to transport fresh and frozen foods from Houghton to the ISRO administration on Mott Island and to the concessioner at Rock Harbor. RANGER currently has approximately 500 cubic feet of combined reefer and freezer storage capacity.

The reefer and reefer compressors are original to the ship. The compressors are manufactured by York Division, Borg-Warner Corp. The nameplate indicates they use Freon-12 or Freon-22 as a refrigerant.

Upgrade Item U-7 involves increasing the size of the reefers.

**Shipcheck:**

- The reefer compressors are original to the ship and obsolete.
- The reefer boxes are original to the ship.

**Volpe Recommendation:**

- Replace reefer boxes.
- Replace reefer compressors.

**Service Life Assessment:** The reefer boxes and compressors onboard RANGER are already past their design service life.

**Estimated Costs:** Volpe estimates the one-time engineering cost to be $50,000, procurement costs to be $100,000, and installation costs to be $150,000.

**Risk of not Funding:** Low. If the reefers fail, the ship risks a loss of all perishable food for the NPS employees and for the concessioner.

**Impact on NPS Operations:** Loss of reefers would seriously degrade the living conditions of employees stationed on ISRO.

**Scoring:**

Safety: 3
Readiness: 6
Economic Payback: 8
Probability: 4
**Total Score: 21**

## 25. Fuel Oil System 260

RANGER has two fuel oil transfer pumps. The pumps allow for transfer of fuel between the integral storage tanks and are also used to offload fuel at ISRO. Fuel oil piping runs between the main engines, SSDGs, manifold, and storage tanks. In addition to storing and delivering fuel to the ship's engines, the system also stores and transfers diesel oil to the concessions and park headquarters on Isle Royale.

**Shipcheck:**

- No issues reported with the fuel system.
- The fuel oil pumps are older.
- There is no Fuel Oil Purifier installed onboard.
- RANGER uses portable plastic tubs for secondary containment under the fuel transfer stations.

**Volpe Recommendation:**

- Replace deteriorated piping per scan findings.
- Replace fuel pumps and fuel filters.
- Install fixed secondary containment boxes under both fuel transfer stations. This should include drains to an oily slop tank.

**Service Life Assessment:** Volpe has found that small pumps need to be replaced every 10-12 years.

**Estimated Costs:** Volpe estimates one-time engineering costs to be $25,000, procurement costs to be $25,000, and the installation costs to be $25,000.

If accomplished during the SLEU overhaul, it is safe to assume that this system will need to be replaced twice more before the Ranger III reaches the end of its extended service life.

**Risk of not Funding:** Medium. Failure of the fuel pumps could prevent offloading fuel oil at ISRO. Fuel leaks due to corroded piping can lead to fuel spills and or fires. ISRO may not have the necessary fuel supply to continue operation

**Impact on NPS Operations:** The ship's fuel system would not be properly maintained and ISRO may not have the necessary fuel supply to continue operation.

**Scoring:**

Safety: 6
Readiness: 7
Economic Payback: 2
Probability: 4
**Total Score: 19**

## 26. *Auxiliary Seawater Piping 524*

Auxiliary Sea Water (ASW) piping brings cooling water to the main engine and SSDG heat exchangers.

**Shipcheck:**

- No issues reported with ASW piping.

**Volpe Recommendation:**

- Repair any piping found to be deteriorated during the piping scan conducted during the drydocking.

**Service Life Assessment:** The estimated lifespan of ASW pipes using *saltwater* is approximately 15 years. Fresh water piping can last much longer depending on the "hardness" (mineral content) of the water.

**Estimated Costs:** Volpe estimates the one-time engineering costs to be $25,000, procurement costs to be $25,000, and the installation costs to be $25,000.

**Risk of not Funding:** Medium. Corroded piping could cause ASW leaks into the ship. If the ASW system has to be shut off because of leaks, the main engines and SSDGs will have to be shut down and the vessel will not be operational.

**Impact on NPS Operations:** If the ASW system has to be shut off because of leaks, the main engines and SSDGs will have to be shut down and the vessel will not be operational.

**Scoring:**

Safety: 6
Readiness: 6
Economic Payback: 2
Probability: 5
**Total Score: 19**

## 27. Bow Thruster 568

Bow thrusters increase the maneuverability of a ship during docking by allowing athwartship thrust. RANGER has a hydraulic-powered Thrust Master bow thruster. The unit is 250 HP, 3' diameter. Hydraulic power units are coupled to the front of both main engines. They are both 250 HP and operate at 4,000 PSI.

**Shipcheck:**

- There is pitting in the bow thruster tunnel and on the hub that appear to be from cavitation. The area in the tunnel is a waster piece that can be replaced. The manufacturer recommended using fiberglass resin to patch the hub.

**Volpe Recommendation:**

- Replace the bow thruster.

**Service Life Assessment:** The bow thruster was added about 15 years ago and is still in good working order. However, it will not last another 30 years without an overhaul.

**Estimated Costs:** Volpe estimates the one-time engineering cost to be $25,000, the procurement costs to be $200,000, and the installation costs to be $75,000. Total cost is $300,000.

**Risk of not Funding:** Low. If the bow thruster fails, RANGER will lose some maneuvering capabilities.

**Impact on NPS Operations:** A reduction in maneuvering capability would make it more difficult to moor at the different ports.

**Scoring:**

Safety: 5
Readiness: 3
Economic Payback: 4
Probability: 7
**Total Score: 19**

## 28. Sewage System 593

Ships on the Great Lakes are not allowed to discharge black water and sewage overboard.

RANGER has a 1,500 gallon sewage holding tank in the auxiliary machinery room and a 300 gallon holding tank in the engine room (collects sewage from the crew's quarters). When RANGER is in port, an educator off the fire pump is used to discharge the tank contents though the shore connections located on the main deck. Within the last 10 years, low water use toilets were installed to lessen black water quantities. The system does not interface with the sewage systems on Isle Royale. The tanks have to be pumped down at the headquarters in Houghton.

RANGER has a separate sewage transfer pump to transfer sewage from the 300 gallon tank in the engine room to the holding tank in the auxiliary machinery room.

**Shipcheck:**

- With the newer low water use toilets, the sewage capacity is sufficient.
- RANGER tends to have approximately 900 gallons of sewage at the end of each round trip. This sewage gets pumped off every time the ship is in Houghton.

**Volpe Recommendation:**

- Replace deteriorated piping per scan findings.
- Replace the sewage transfer pump.
- Pipe and install a new sewage discharge pump, separate from the fire pump.

**Service Life Assessment:** Volpe has found that small pumps need to be replaced every 10-12 years.

**Estimated Costs:** Volpe estimates the one-time engineering costs to be $30,000, procurement costs to be $30,000, and the installation costs to be $30,000.

**Risk of not Funding:** Low. If this system is not properly maintained, the vessel could be in violation of state and local environmental laws. The ships could be ordered to curtail or even cease operations until such time as they can comply with regulations.

**Impact on NPS Operations:** The vessel will not have the right mix of capabilities (sewage system) to perform assigned missions.

**Scoring:**

Safety: 4
Readiness: 8
Economic Payback: 3
Probability: 4
**Total Score: 19**

## 29. *Lighting System 330*

RANGER uses a variety of light fixtures, using both fluorescent and incandescent bulbs.

**Shipcheck:**

- The lights onboard RANGER all appear to be original.

**Volpe Recommendation:**

- Replace all lighting and control systems onboard RANGER. Use energy efficient lighting (e.g. LED) where possible. Perform in conjunction with Work Item #2, Electrical Load Analysis, and Work Item #16, Electrical Power Distribution System.

**Service Life Assessment:** The lighting systems should be expected to last for up to 30 years.

**Estimated Costs:** Volpe estimates the one-time engineering cost to be $50,000, procurement costs to be $150,000, and installation costs to be $150,000. Total cost is $400,000.

**Risk of not Funding:** Low. Extra fuel will have to be burned to power inefficient lighting onboard.

**Impact on NPS Operations:** Continuing to use inefficient lighting will waste fuel and cost more to operate.

**Scoring:**

Safety: 4
Readiness: 5
Economic Payback: 7
Probability: 3
**Total Score: 19**

## *30. Heating and Ventilation System 510*

RANGER uses a hot water boiler and hot water radiators for heating throughout the ship. Fresh air ventilation is also provided throughout the ship to provide the required amount of air changes. There is no air conditioning on the vessel.

**Shipcheck:**

- No issues were reported with the Heating and Ventilation system.
- The Captain would like to be able to isolate the potable hot water heater from the boiler. This would allow glycol to be used in the radiators during the winter.
- Although it has been serviced and upgraded, the boiler is original to the ship and parts support is difficult.

**Volpe Recommendation:**

- Perform heat load analysis for current crew size and new equipment to be installed as part of SLEU.
- Replace any deteriorated piping found during the scan.
- Clean all ductwork.
- Replace hot water boiler and burner with new, supportable unit.
- Replace HV system with new units. Renew all pipe insulation.

**Service Life Assessment:** Volpe experience with US Coast Guard cutters is that HVAC systems of a vessel are highly susceptible to rust and dirt accumulation. The ventilation motors are almost continuously in use, and have a finite life. During a 30 year period these systems will need to be renewed at least once.

**Estimated Costs:** Volpe estimates the one-time engineering costs to be $50,000, procurement costs to be $50,000, and the installation costs to be $75,000.

**Risk of not Funding:** Medium. Some ventilation system breakdowns could impact mission performance. Dirty duct work is a fire hazard and can impact crew and passenger health. The HV system affects the health and safety of the crew and passengers.

**Impact on NPS Operations:** The Heating and Ventilation system affects the health and safety of the crew, which impacts their readiness for operation.

**Scoring:**

Safety: 6
Readiness: 4
Economic Payback: 2
Probability: 6
**Total Score: 18**

### *31. Ventilation System, Engine Room 513*

RANGER has engine room ventilation fans designed and built for the marine environment. The fans provide fresh air for the crew and for MDE and SSDG combustion.

**Shipcheck:**

- No issues were reported with the engine room ventilation system.

**Volpe Recommendation:**

- Clean engine room ductwork.
- Replace the engine room blower fan.

**Service Life Assessment:** The engine room ventilation fans are original to the vessel and obsolete.

**Estimated Costs:** Volpe estimates the one-time engineering costs to be $25,000, procurement costs to be $55,000, and the installation costs to be $50,000.

**Risk of not Funding:** Medium. Some ventilation system breakdowns could impact mission performance. The vessel may have to scale back operations if the engine room ventilation is not available for service. Dirty plenums are a fire hazard and can impact crew health. The ventilation system affects the health and safety of the crew which impacts their readiness for operation.

**Impact on NPS Operations:** The ventilation system affects the health and safety of the crew, which impacts their readiness for operations.

**Scoring:**

Safety: 6
Readiness: 4
Economic Payback: 2
Probability: 6
**Total Score: 18**

## *32. Controllable Pitch Propeller System 243*

The propulsion shafts transfer power from the main engine reduction gears to the propellers, which provide the thrust for the ship. The RANGER uses the Bird-Johnson CPP System to control the two three-bladed controllable-pitch propellers (CPP). The propeller pitch is 78°, and the propeller diameter is 6.33'.

**Shipcheck:**

- The propellers and CPP system are original to the vessel, even though the vessel was repowered in 1999.
  There was some damage to the starboard propeller. At least one blade will need to be replaced.

**Volpe Recommendation:**

- Replace propellers and control systems in conjunction with Work Item #13, Main Engine and Reduction Gear replacement. Ensure propellers are matched to the new engines. This item would also be performed in conjunction with Work Item #17, Propulsion Shaft, Seals and Propeller.

**Estimated Costs:** Volpe estimates the one-time engineering costs to be $200,000, procurement costs to be $600,000 and the installation costs to be $200,000. Total cost is $1,000,000.

**Risk of not Funding:** Low. If the propellers are not properly matched to the engines, they will not operate efficiently and will waste fuel.

**Impact on NPS Operations:** Propellers matched to the new engines will allow RANGER to operate more efficiently.

**Scoring:**

Safety: 3
Readiness: 6
Economic Payback: 5
Probability: 4
**Total Score: 18**

## 33. Waste Oil System 529

Regulations do not allow ships to dump oily water overboard in any body of water. RANGER has an oily water tank for storage of oily water and a waste oil discharge pump for offloading in port.

**Shipcheck:**

- No issues reported with the waste oil system.

**Volpe Recommendation:**

- Install an oily water separator and waste oil tank.
- Replace the waste oil pump on the vessel.
- Replace deteriorated piping per scan findings.

**Service Life Assessment:** Volpe has found that small pumps need to be replaced every 10-12 years. RANGER does not currently have an oily water separator onboard, but MARPOL requires all vessels greater than 400 gross tons to have an oily water separator (RANGER is registered at 648 gross tons).

**Estimated Costs:** Volpe estimates one-time engineering costs to be $40,000, procurement costs to be $40,000, and the installation costs to be $40,000.

**Risk of not Funding:** Low. If the piping deteriorates, the waste oil systems could leak oily water into the bilges of the vessel causing environmental issues.

**Impact on NPS Operations:** The ship's waste oil system would be difficult to maintain.

**Scoring:**

Safety: 3
Readiness: 6
Economic Payback: 4
Probability: 5
**Total Score: 18**

## 34. Interior Communications 430

The RANGER has hard-wire phone, PA, and sound powered phone systems onboard. These systems are used for general announcing and station-to-station communications.

**Shipcheck:**

- No issues with the communication systems.

**Volpe Recommendation:**

- Groom the sound powered phone systems.
- Replace the hard wire phone and the PA system with new state of the art, supportable systems.

**Service Life Assessment:** The interior communication systems should be expected to last for up to 25 years. The systems are well past their designed service life.

**Estimated Costs:** Volpe estimates the one-time engineering costs to be $25,000, procurement costs to be $55,000, and the installation costs to be $45,000.

**Risk of not Funding:** Medium. Communications during emergencies could be seriously impacted if the interior communications are not available for use.

**Impact on NPS Operations:** The vessels operations will be more complicated if communications are not available for use.

**Scoring:**

Safety: 7
Readiness: 4
Economic Payback: 2
Probability: 4
**Total Score: 17**

## 35. *Commissary Equipment 651*

The Galley and Mess Deck Area is located on the main deck of RANGER. The galley equipment is used by both the concessioner and crew for preparation of meals.

General Galley Equipment:

- Range
- Ice Maker
- Refrigerator/Freezer

**Shipcheck:**

- The galley equipment looked to be in good shape. However, it will not last another 35 years.

**Volpe Recommendation:**

- Renew/replace galley equipment.
- Install a dishwasher.
- Install a counter refrigerated tray for cold cuts and salad.

**Service Life Assessment:** Volpe recommends a galley overhaul/rehab after 10 years of service.

**Estimated Costs:** Volpe the one-time engineering costs to be $25,000, procurement costs to be $25,000, and the installation costs to be $25,000.

**Risk of not Funding:** Low. Vessels not receiving replacement galley may experience downtime affecting the health, safety, and morale of the crew and prevent the concessioner onboard RANGER from providing food to guests. Maintenance of galley equipment will increase taking time away from other duties. Failure to properly maintain the wet spaces could lead to serious structural damage to the vessel.

**Impact on NPS Operations:** A crew that is not properly fed may not be ready or willing when needed. The concessioner onboard RANGER may not be able to provide food to guests.

**Scoring:**

Safety: 3
Readiness: 3
Economic Payback: 4
Probability: 5
**Total Score: 15**

## 36. Habitability Overhaul 655

While RANGER's interior is in good condition, most of it is original to the ship. Wallboard, ceiling tile, flooring tile and underlayment have asbestos content with 55 years of layered paint. There is localized damage to flooring tiles and underlayment which requires repair or total replacement to meet EPA asbestos standards. Portions of the insulation in machinery spaces have asbestos content which has been maintained to EPA standards.

**Boat Deck** The Boat Deck contains a Sea Cabin for crew.

**Upper Deck** The upper deck contains the Observation Lounge, Smoking Lounge, and Passenger Lounge. There is also a Men's Toilet and a Women's Toilet.

**Main Deck** The forward half of main deck is mostly crew area, while the aft half of main deck is mostly passenger area. The Captain's office and head, crew mess, ship's office, day cabins, passenger lunch lounge and snack bar are all located on main deck. There is also a Men's Toilet and a Unisex ADA-accessible toilet.

**Lower Deck** The lower deck contains crew's quarters and the laundry room. There is also a toilet space and shower space.

**Shipcheck:**

- The passenger and crew spaces looked to be in pretty good shape, but the joiner work, floors, and most furniture is original to the ship. Some of the materials contain asbestos.

**Volpe Recommendation:**

- Replace paneling, flooring, furniture, insulation, lighting, shower stalls, and lockers throughout the vessel. Preserve murals in Smoking Lounge.

**Service Life Assessment:** Experience with other vessels indicates that crew living spaces require a major renovation every 15-20 years. The RANGER has been in continuous service for 55 years and the equipment is past its designed service life.

**Estimated Costs:** Volpe estimates the one-time engineering costs to be $200,000, procurement costs to be $500,000, and the installation costs to be $700,000.

**Risk of not Funding:** Low. As the habitability items continue to age, the ship will look older and be less comfortable for passengers. Failure to properly maintain asbestos wallboard, insulation, and tiles may lead to hazardous conditions and sickness for crew and passengers.

**Impact on NPS Operations:** An old, uncomfortable ship may dissuade visitors from taking RANGER to ISRO and will not provide comfortable quarters for the crew.

**Scoring:**

Safety: 2
Readiness: 2
Economic Payback: 4
Probability: 4
**Total Score:** 12

## Upgrade Items

The following 10 upgrade items provide options for increasing RANGER's capability to perform its current missions.

### *U-1 Life Boats 583*

Life boats and life rafts would be used to abandon ship during an emergency. RANGER had four davits and hard chine life boats on the Boat Deck, which are original to the vessel. RANGER recently had two Inflatable Buoyant Apparati (IBAs) and four inflatable life rafts installed with a total capacity of 150 people.

**Shipcheck:**

- The life boats and davits are original to the vessel.
- Two life boats and davits may be removed during the upcoming 2013 shipyard period, if funding is available.
- The Coast Guard is currently requiring that the other life boats remain on the ship in the event of a man overboard.
- Ranger has procured a boom for the crane which should aid in picking up a man overboard.

**Volpe Recommendation:**

- Remove all lifeboats and davits from the Boat Deck.
- Install new davit and Rigid Hull Inflatable Boat (RHIB) to be used during man-overboard emergencies.

**Estimated Costs:** Volpe estimates the one-time engineering cost to be $100,000, the procurement costs to be $250,000, and the installation costs to be $100,000. Total cost is $450,000.

**Risk of not Funding:** Medium. There is no change to current operation. The current boats and davits would remain.

**Impact on NPS Operations:** If the heavy davits and life boats are removed from the Boat Deck, the stability characteristics of RANGER will improve, allowing more cargo to be carried.

**Scoring:**

Safety: 7
Readiness: 3
Economic Payback: 5
**Total Score: 15**

## *U-2 Hydraulically Operated Hatches 584*

RANGER has removable deck plates in the forward upper deck and forward main deck. These deck plates have to be removed using the deck crane. When removed, the crane can then lower cargo into the holds of the vessel.

**Shipcheck:**

- The cargo hatches have to be unbolted by hand and then removed by the crane. This makes crane access to the cargo holds difficult and cumbersome.
- The lower cargo hold is rarely used because of difficult access, and is currently used approximately 2 times per year for very heavy cargo.

**Volpe Recommendation:**

- Install hydraulically-operated cargo hatches in the upper deck and main deck. These may be able to run off of the bow thruster HPU units located on the main engines.

**Estimated Costs:** Volpe estimates the one-time engineering cost to be $150,000, the procurement costs to be $300,000, and the installation costs to be $200,000.

**Risk of not Funding:** Low. There is no change to current operation. The current cargo hold access limitations would still be in effect.

**Impact on NPS Operations:** If the cargo hatches are hydraulically operated, they will be easier to use on a regular basis. Cargo could be regularly loaded with the crane into the lower cargo hold, freeing up more space on deck for additional cargo transport on each trip. This would lower the center of gravity and allow for more cargo storage on the upper decks.

**Scoring:**

Safety: 4
Readiness: 3
Economic Payback: 8
**Total Score: 15**

## *U-3 Fuel Transport 549*

ISRO owns a tugboat and fuel barge used to transport gasoline and AVGAS from the mainland to the island. Gasoline is used for the park's small boats and for marina sales, and AVGAS is used during winter studies on the island. Finding a captain and seaman for the tug and fuel barge has been difficult and expensive in recent years.

With the proper upgrades, RANGER would be allowed to transport gasoline and AVGAS in certified, portable tanks, both on deck and below deck. These requirements are specified in:

| | |
|---|---|
| Propane: | 49 CFR 176 Subpart H – Detailed Requirements for Class 2 (Compressed Gas) Materials |
| Gasoline: | 49 CFR 176 Subpart I – Detailed Requirements for Class 3 (Flammable) and Combustible Liquid Materials |

When transporting propane and gasoline, RANGER would be limited to 25 passengers.

**Shipcheck:**

- RANGER is not currently equipped to transport gasoline or AVGAS.
- RANGER does have sprinkler systems installed in the main deck and lower deck cargo holds.

**Volpe Recommendation:**

- Upgrade the Main Deck and Lower Deck cargo holds and adjacent spaces in accordance with 49 CFR 176.200, General Stowage Requirements (Class 2 Materials), 49 CFR 176.205, Under Deck Stowage Requirements (Class 2 Materials) and 49 CFR 176.305, General Stowage Requirements (Class 3 Materials).
    - Install forced ventilation in cargo holds
    - Install metal coverings on all electrical power lines in the cargo holds to prevent crushing by cargo
    - Replace all electrical fixtures in the cargo holds with explosion-proof fixtures
    - Replace all openings to adjacent areas with gas-tight openings
    - Install fire screens on all ventilation ducts from the leading hold
    - Install electric disconnects so that all electrical equipment in the holds can be shut off from its power source by a positive means located outside of the hold
    - Install at least 3" of insulation on entire bulkhead between cargo holds and accommodation areas.
    - Provide one B-V semiportable foam (40 gallon capacity), dry chemical (100 lb minimum capacity), or equivalent fire extinguisher, to be placed in vicinity of cargo holds
    - Provide two dry chemical (15 lbs.) or foam-type (10 L) fire extinguishers, to be installed in proximity to cargo holds
    - Install combination solid stream and water spray nozzle for all fire stations in vicinity of cargo holds
- Purchase ten (10) approved portable fuel tanks to transport gasoline and AVGAS, in a small enough size that RANGER's crane can be used to lift the full tanks onto the vessel.

  **- OR -**

- Upgrade the aft void and adjacent spaces in accordance with 49 CFR 176.200, General Stowage Requirements (Class 2 Materials), 49 CFR 176.205, Under Deck Stowage Requirements (Class 2 Materials) and 49 CFR 176.305, General Stowage Requirements (Class 3 Materials), and described above.

- Install a fixed gasoline storage tank in aft void main deck.
- Install an inert gas system to prevent combustion in  the gasoline storage tank after use.
- Install a gasoline transfer system in the aft void and piping connections on the main deck.

**Estimated Costs:** Volpe estimates the one-time engineering cost to be $75,000, the procurement costs to be $175,000, and the installation costs to be $225,000.

Volpe estimates the procurement costs for ten (10) portable fuel tanks to be $125,000.

**Risk of not Funding:** Low. There is no change to current operation. The tug and fuel barge would still have to be used to transport gasoline and AVGAS.

**Impact on NPS Operations:** If RANGER were able to transport gasoline and AVGAS, ISRO would no longer have to to hire an expensive tug captain and crew to move the fuel barge between the mainland and the island. It would no longer be an emergency situation when gasoline levels get low on the island. It would take 7-8 trips per season to transport the required amount of gasoline; these trips would be limited to 25 passengers.

**Scoring:**

Safety: 3
Readiness: 3
Economic Payback: 9
**Total Score: 15**

## U-4 Automation, Alarm Panel and Tank Level Indicating System 430

Alarm Panel and Tank Level Indication Systems (TLI) monitor the status and condition of the Steering Gear, Port Generator, Starboard Generator, Fire Pumps, Bilge Levels, Tank Levels, and other miscellaneous systems onboard a vessel.

**Shipcheck:**

- RANGER does not currently have an Alarm Panel or TLI system. The engine room is not automated.

**Volpe Recommendation:**

- Install a new Engine Room Automation System. This would include an integrated Alarm Panel, Tank Level Indicating System, and Bilge Alarms. Perform in conjunction with Work Item #15, Main Engine Control System, and Work Item #5, Fire Alarm Control System.

**Estimated Costs:** Volpe estimates the one-time engineering costs to be $200,000, procurement costs to be $200,000, and the installation costs to be $300,000.

**Risk of not Funding:** Medium. Installing an engine room automation system with integrated alarm system gives the crew quicker access to issues on the vessel. Furthermore, while manual sounding of tanks will continue to work, a TLI system would make ballasting and fueling operations quicker and easier. TLIs also provide real-time tank levels and could prevent accidental oil spills that could result during fill and transfer operations.

**Impact on NPS Operations:** An engine room automation system could eliminate the need for an engine room watch stander, possibly reducing crew size. An alarm/TLI system gives the crew quick access to information needed to prevent accidental damage to machinery and to prevent spills.

Note: Under the current Certificate of Inspection (COI), reducing the crew size might also require reducing the number of passengers carried. These details would have to be discussed with the Coast Guard.

**Scoring:**

Safety: 6
Readiness: 3
Economic Payback: 5
**Total Score: 14**

## *U-5 Refrigeration Capacity 516*

The reefer boxes are used to transport fresh and frozen foods from Houghton to the ISRO administration on Mott Island and to the concessioner at Rock Harbor. RANGER currently has approximately 500 cubic feet of combined reefer and freezer storage capacity.

**Shipcheck:**

- Reefer capacity is not sufficient during the summer months when transporting supplies to Mott Island and to the concessions on Rock Island. Separate portable freezers are often carried in the cargo hold to add reefer capacity.

**Volpe Recommendation:**

- Increase reefer and freezer storage capacity. This may involve reconfiguring habitability spaces on Main Deck. This item would replace Work Item #24.

**Estimated Costs:** Volpe estimates the one-time engineering cost to be $100,000, procurement costs to be $200,000, and installation costs to be $200,000.

**Risk of not Funding:** Low. There is no change to current operation. NPS will continue to have to use portable freezers to take up the slack when extra food supplies need to be transported.

**Impact on NPS Operations:** The current reefer capacity limits how much food supplies are brought on each trip to ISRO. Increase capacity could allow for more supplies per trip, allowing more flexibility in ship scheduling and destinations.

**Scoring:**

Safety: 3
Readiness: 3
Economic Payback: 8
**Total Score: 14**

## U-6 Passenger Experience 645

The mess, lounge, and snack bar areas are original to the ship. The heads were upgraded approximately 10 years ago. There is no entertainment system or Wi-Fi.

**Shipcheck:**

- The mess, lounge, and snack bar areas, although in good condition, all look dated.
- Some seating on the upper deck was replaced with airline-style seating, but even those seats are old.
- The passenger heads are in good condition, but have limited facilities for the number of passenger.
- There is a TV which can be used to play videos, but does not get used often.
- The Captain said they used to be able to get an analog TV signal through the antenna, but since TV technology was upgraded, they cannot get digital TV. The Captain said passengers used to watch the news on the TV during major world events.
- If Wi-Fi was added, a new demographic of visitors may be reached.
- There is no air conditioning onboard RANGER.

**Volpe Recommendation:**

- Upgrade the passenger areas with modern seating and amenities.
- Add two TVs and a satellite TV connection to the smoking lounge.
- Add Wi-Fi internet access.
- Replace with glass doors between the upper deck lounge and smoking lounge with lighter joiner doors.
-

**Estimated Costs:** Volpe estimates the one-time engineering cost to be $75,000, procurement costs to be $200,000, and installation costs to be $200,000.

**Risk of not Funding:** Low. There is no change to current operation.

**Impact on NPS Operations:** The six-hour transit on RANGER is a long trip to passengers. Nicer passenger amenities could improve the experience and even lead to more people willing to spend 12 hours to ride the ship roundtrip (increased visitation for ISRO).

**Scoring:**

Safety: 2
Readiness: 2
Economic Payback: 5
**Total Score: 9**

### U-7 Alternative Energy 390

Wind turbines and solar panels have been installed on newer vessels to generate green power.

**Shipcheck:**

- RANGER does not currently have any green power systems onboard.

**Volpe Recommendation:**

- Install wind turbines and solar panels on the boat deck and pilot house top. These can be used to charge the battery packs. This will also require upgrades to the switchboards and possibly the installation of additional batteries.

**Estimated Costs:** Volpe estimates the one-time engineering costs to be $100,000, procurement costs to be $500,000 and the installation costs to be $400,000.

**Risk of not Funding:** Low. Operations will continue on RANGER as they are.

**Impact on NPS Operations:** Green energy would reduce the amount of power generation needed onboard, which could reduce fuel consumption by as much as 15%.

**Scoring:**

Safety: 2
Readiness: 2
Economic Payback: 5
**Total Score: 9**

## *U-8 Baggage Carts 573*

The park owns 35 baggage carts, 26 of which can fit onboard RANGER at one time.

**Shipcheck:**

- RANGER's baggage carts are custom built, and some have modifications. Pieces from one cart may not fit on another.

**Volpe Recommendation:**

- Replace all 35 baggage carts with new units.

**Estimated Costs:** Volpe estimates the procurement costs to be $175,000.

**Risk of not Funding:** Low. Operations will continue on RANGER as they are.

**Impact on NPS Operations:** Configuration-controlled baggage carts would make ISRO cargo operations easier.

**Scoring:**

Safety: 2
Readiness: 2
Economic Payback: 3
**Total Score: 7**

# Appendix G Preliminary Specifications for *Ranger IV*

I. Dimensions

| | | |
|---|---|---|
| a. | Length (LOA) | 175’ |
| b. | Beam (B) | 36’ |
| c. | Draft (D) | no greater than 11’ mean, Max 12’ |
| d. | Gross Tonnage | under 500 gross tons |

II. Preliminary engineering costs $200K

III. Estimated Construction Costs $20-22Million (2014$)

IV. Construction Period of 18 months

V. Capacities

| | | |
|---|---|---|
| a. | Passenger Capacity | 149 (subchapter H) |
| b. | Fuel Capacity | 15,000 gallons of diesel II (10,000 gallons, double hulled, for cargo and 5,000 gallons for ship’s fuel) |
| c. | Cargo | 100 LT bulk cargo |
| d. | Reefer | 600 cubic feet |
| e. | Freezer | 250 cubic feet |
| f. | Propane | 200 cubic feet (in bottles) |
| g. | Potable Water | 2,500 gallons |
| h. | Hot Potable Water | 250 gallons |
| i. | Gray Water | 2,000 gallons |
| j. | Black Water | 1,500 gallons |
| k. | Lube oil | 500 gallons |
| l. | Hydraulic oil | 250 gallons |

VI. Accommodations

a. Crew: Ten private staterooms. Two staterooms will have private heads for Captain and Park Superintendent. The other eight with two staterooms sharing a head, for a total of four heads. Galley, mess room, lounge and scullery for the crew.

b. Passengers: Six small staterooms with private baths for VIP/premium passengers. Open air and inside seating for up to 150 passengers.

c. Big flat screen TV with Satellite connection. Have a separate TV lounge with two or three 40”-42” screens. Have one (as below) large screen in main passenger lounge for passenger programs and pre-sail safety briefings, training, demonstrations.

d. Amphitheater for Ranger presentations.

e. Men’s, women’s, and handicapped heads with, spring- loaded-off low water use fixtures. Heads need fast-pressure flush – no tank-type toilets

f. Bar and Grill, separate galley and scullery. Eating area.

g. Souvenir sales.

VII. Hull

a. All steel construction
   i. Hull
   ii. Decks
   iii. Watertight bulkheads
   iv. Superstructure
   v. Mast

b. Non-watertight bulkheads and non-tight doors are joiner work

c. ABS Ice Class – Ice Capable

VIII. Main Propulsion

a. Two medium speed diesel engines capable of driving the ship at speeds up to 20 knots in sea state 3. EPA Tier III/IV compliant. Air start.
b. Two Reduction gears
c. Two air operated clutches
d. Two propulsion shafts with bearings and shaft seal.
e. Two controllable pitch propellers
f. Local control in Engine Room
g. Remote control on bridge and bridge wings
h. Un manned engine room

IX. Auxiliary Systems

a. Two ships service diesel generators capable of generating 150 KW 110/440 each
b. Electric distribution system with switchboard in engine room with automatic bus transfers
c. Heating and ventilation system for crew and passenger spaces
d. Hot water heater and pumps
e. Potable water system with two pumps and pressure tank
f. Lube oil purifier
g. Fuel oil purifier
h. Oily water separator
i. Electro-Hydraulic twin rudder steering system with two rams, two pumps and two motors.
j. Ventilation and heating system for cargo, and auxiliary engineering spaces
k. Separate heating and ventilation system for the engine room
l. Two ships service/starting air compressors with accumulators.
m. Lighting system
n. Firemain system with two fire pumps, one forward and one aft.
o. Bilge pumping system
p. Ballast pumping system
q. Ballast water treatment system
r. Fuel Cargo pumping system
s. Active roll stabilization system
t. Oil fired heating boiler
u. Incinerator
v. Sewage collection, storage and discharge
w. Deck Crane (6 ton Capacity/35'-40' telescoping reach)
x. Hydraulically operated cargo hatches
y. Central hydraulic system (?)

X. Ship control

a. Electro-Hydraulic-Follow-Up Steering system
b. Two Anchors
c. Two anchor windlasses and capstans
d. One aft capstan
e. Bridge wing control stations
f. S and X band surface search radar

g. Depth finder
h. Wind Bird
i. Gyro Compass
j. Magnetic Compass
k. GPS navigation system with a backup set
l. VHF-FM Radio Communications system with back-up system
m. Interior Communications
n. PA System
o. Bow Prop Unit ~ 300 BHP
p. Navigation lights
q. Ship's whistle
r. AIS

XI. Emergency Systems
a. Fire suppression systems in engineering spaces
b. Water sprinkling system in passenger spaces (?)
c. Life boats
d. Rigid Hull Inflatable Boat (RHIB) with articulating crane launching system
e. Storage for firefighting and damage control gear
f. Alarm system (fire, smoke, intruder, flooding)
g. Signal search light

XII. Miscellaneous
a. Small arms storage
b. Cargo deck tie downs for International Organization for Standardization (ISO) containers
c. Roll-on, Roll-off airline baggage carts
d. Roll-on, Roll-off freezers and reefers
e. Side loading for cargo and passengers (both sides)
f. Green energy (i.e. solar panels, vertical wind turbines, Liquefied Natural Gas (LNG) fuel) where practical
g. Separate ventilated garbage storage for ship's and Island waste
h. Murals from Ranger III transferred to Ranger IV
i. Capability to drain fluids from all systems while ship is "Laid-up" during the winter
j. On-board spare parts storage, minimal
k. Automated preventive maintenance system
l. Shore-power connections for potable water, electricity, telephone, data

XIII. Regulatory Considerations
a. Navigation 33 CFR § 83-90 (Navigation and Navigable Waters, USCG Subchapter E, Inland Navigation Rules). Additionally, all vessels carrying any oil operated under the authority of the United States and is certified for coastwise service beyond three nautical miles from land are required to comply with the International Convention for the Prevention of Pollution from Ships (MARPOL), which is implemented in 33 CFR § 151 (Navigation and Navigable Waters, USCG Subchapter O, Pollution, Vessels Carrying Oil, Noxious Liquid Substances, Garbage, Municipal or Commercial Waste, and Ballast Water).
b. Passenger Ferry Regulations Comply with the regulations in 46 CFR § 70-89 (Shipping, USCG Subchapter H, Passenger Vessels).

c. Cargo Vessel Regulations Comply with the regulations in 46 CFR § 90-105 (Shipping, USCG Subchapter I, Cargo and Miscellaneous Vessels).
d. Tank Vessel Regulations Comply with the regulations in 46 CFR § 30-39 (Shipping, USCG Subchapter D, Tank Vessels). Furthermore, tank vessels are also required to comply with the regulations in 33 CFR § 155 (Navigation and Navigable Waters, USCG Subchapter O, Pollution, Oil or Hazardous Materials Pollution Prevention Regulations for Vessels) and 33 CFR § 157 (Navigation and Navigable Waters, USCG Subchapter O, Pollution, Rules for the Protection of the Marine Environment Relating to Tank Vessels Carrying Oil in Bulk).
e. Transportation of Hazardous Materials Comply with the regulations in 49 CFR § 171-177 (Transportation, Federal Motor Carrier Safety Administration, Subchapter C, Hazardous Materials Regulations) as follows:
    - 49 CFR § 171 – General Information, Regulations, and Definitions
    - 49 CFR § 172 – Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans
    - 49 CFR § 176 – Carriage By Vessel
f. Personnel and Passenger Safety Comply with the International Convention for the Safety of Life at Sea (SOLAS), which ensures that the ship complies with minimum safety standards in construction, equipment, and operation. These regulations are implemented in 46 CFR § 199 (Shipping, USCG Subchapter W, Lifesaving Appliances and Arrangements).
g. Fuel Transfer must follow regulations set forth in 33 CFR § 156 (Navigation and Navigable Waters, USCG Subchapter O, Pollution, Oil and Hazardous Material Transfer Operations).
h. Ranger IV Construction designed and built in accordance with the American Bureau of Shipping (ABS) ship construction rules. The expected rules applicable to *Ranger IV* include:
    - ABS Rules for Building and Classing Steel Vessels Under 90 Meters (295 Feet) in Length;
    - ABS Rules for Building and Classing Steel Vessels, Part 5C, Chapter 2 – Vessels Intended to Carry Oil in Bulk (Under 150 meters (492 feet) in Length);
    - ABS Rules for Building and Classing Steel Vessels, Part 5C, Chapter 7 – Vessels Intended to Carry Passengers; and
    - ABS Rules for Building and Classing Steel Vessels, Part 6, Chapter 1 – Strengthening for Navigation in Ice.

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**14. ABSTRACT**

Isle Royale National Park is a remote archipelago located in western Lake Superior, fourteen miles from the closest mainland and 60 miles from the park's headquarters in Houghton, MI. While visitors treasure the parks pristine environment and solitude, transporting visitors to and operating a park in such a remote location is costly. Isle Royale has the highest cost per visitor ($170) of any unit in the National Park System.

In this transportation study, Volpe defines what transportation activities are necessary to maintain operation of the park and determine what alternatives may feasibly replace the current manner of doing business. At the time of writing, the 55-year old Ranger III provides the primary means of transporting visitors, cargo and some fuel to the island. Other vessels with the Park's fleet are used on a limited basis. Upgrading and replacing Ranger III is considered as well as outsourcing specific actives and changing the operations of some activities such as waste disposal. The park has already begun to add solar energy systems to reduce the need to transport fuel for electricity

**15. SUBJECT TERMS**

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