Ferry Lifecycle Cost Model for Federal Land Management Agencies

User's Guide

I. Introduction

The Ferry Lifecycle Cost Model (model) is a spreadsheet-based sketch planning tool that estimates capital, operating, and total cost for various vessels that could be used to provide ferry service on a particular route given known service parameters. Understanding the cost of ferry service is essential for evaluating potential new routes and for adequately planning for the ongoing cost of new and existing routes. The model is designed to allow users to quickly estimate and compare the total costs of offering service with the different vessel types. The model helps the user:

- Estimate the approximate cost of operating ferry service.
- Determine the most cost-efficient vessel type(s) for a possible service.
- Understand the effect of route time and headway options on cost.
- Compare various ferry investment options based on a consistent analysis technique.

The inputs to the model are route description, estimated passenger demand, and seasonal use. The outputs of the model are estimated annual capital and operating costs for 15 years, as well as service time, speed, and frequency for several vessel options.

The model is tailored to planning ferry service that serves federal land management areas (FLMAs). It should be noted that this model does not estimate revenue projections, nor does it evaluate cost-benefit ratio or financial sustainability. In order to evaluate financial sustainability, funding sources, including fare structure must be known.

The model includes debt repayment, operating and maintenance costs associated with purchasing, financing and operating several common types of ferry vessels. It does not include landside costs associated with docks and terminals, nor does it include costs for on-board passenger services, such as food service or interpretation. The useful life of ferry vessels varies depending on the size of the vessel, the hull-type, the usage, and

maintenance schedule. This model assumes a 25-year useful life for passenger ferries and a 40-year useful life for vehicle ferries.

Estimating the cost of ferry service is a challenge. The base costs of vessels vary significantly depending not only on passenger capacity and speed, but also depending on on-board amenities, hull type, vessel age, marine conditions, and other design features. The operating costs of ferry service varies dramatically depending on an array of factors such as desired speed, fuel price, passenger amenities, marine conditions, and available docking facilities. Cost of service also varies regionally. Costs may be reduced significantly in locations where there is existing ferry service, as docking, maintenance, employment, and other costs may be able to be shared and new services will benefit from the existing supporting infrastructure and skilled labor.

There are several operating models for ferry service that allocate ferry costs and revenues differently:

- Buy-Maintain-Operate: The FLMA owns and operates the ferries completely independently.
- Lease-Maintain-Operate: The FLMA leases ferries from a private owner, but operates the ferry service with FLMA staff. A maintenance agreement is included in the lease terms.
- Contract for service: The FLMA owns or leases the ferries, but negotiates a contract with a private company to operate the ferry service to the FLMA using those vessels.
- Concession: The FLMA contracts with a private company to provide ferry service to the FLMA. Often the FLMA pays a fee to the private operator to subsidize the service. The private company that operates the service may own or lease the ferries. Often private ferry operators have separate holding companies that own the vessels to help manage liability.

Regardless of the operating model, the basic costs are similar. The user can adjust input parameters to reflect the expected operating model.

Data on the costs of ferry service is not readily available. Data were compiled from a variety of sources to develop this model, including two national published data sets describing licensed marine vessels, industry publications, review of other ferry feasibility and evaluation studies, and discussions with experienced ferry operators. Specific information about the data sources and assumptions for each cost category are provided in Section III.

If the model results indicate that ferry service may be feasible, the cost estimate should be refined to reflect specific vessel characteristics, marine conditions, and other particular service characteristics.

Section II describes the twelve vessel categories in the model. Section III describes each of the cost categories in the model and documents that data sources used to estimate costs. Section IV uses an example to illustrate how to use the model.

II. Vessel Categories

The model can estimate costs for twelve vessel categories – eight passenger-only and four vehicle-carrying (RORO) – that represent typical vessels that may be available and appropriate for service to federal lands sites. The categories do not represent every possible ferry vessel. There is a great deal of variation and customization of ferry vessels, making it difficult to generalize the costs. Specialty vessels, such as hydrofoils, and very large ferries are not represented in the model.

The twelve categories were developed using Bureau of Transportation Statistics (BTS) Ferry Census and Army Corps of Engineer Waterborne Transportation Lines of the United States (WTLUS) data. The data were used to identify clusters of vessel types with similar capacity, speed, power, hull material, and crew requirement. Figure 1 below shows the capacity and speed ranges for the eight passenger-only categories and the capacity and speed of vessels built in the last 30 years from these two data sources. A category for mid-size pontoons was

developed, as this type of vessel is different from typical monohull and catamaran ferries that are typical of the other categories. Large vessels were excluded from the model because FLMA ferry systems tend not to use these larger vessels, and also because the high costs associated with these large vessels merit more rigorous analysis than this model can offer.

Figure 1: Passenger Only Vessel Categories

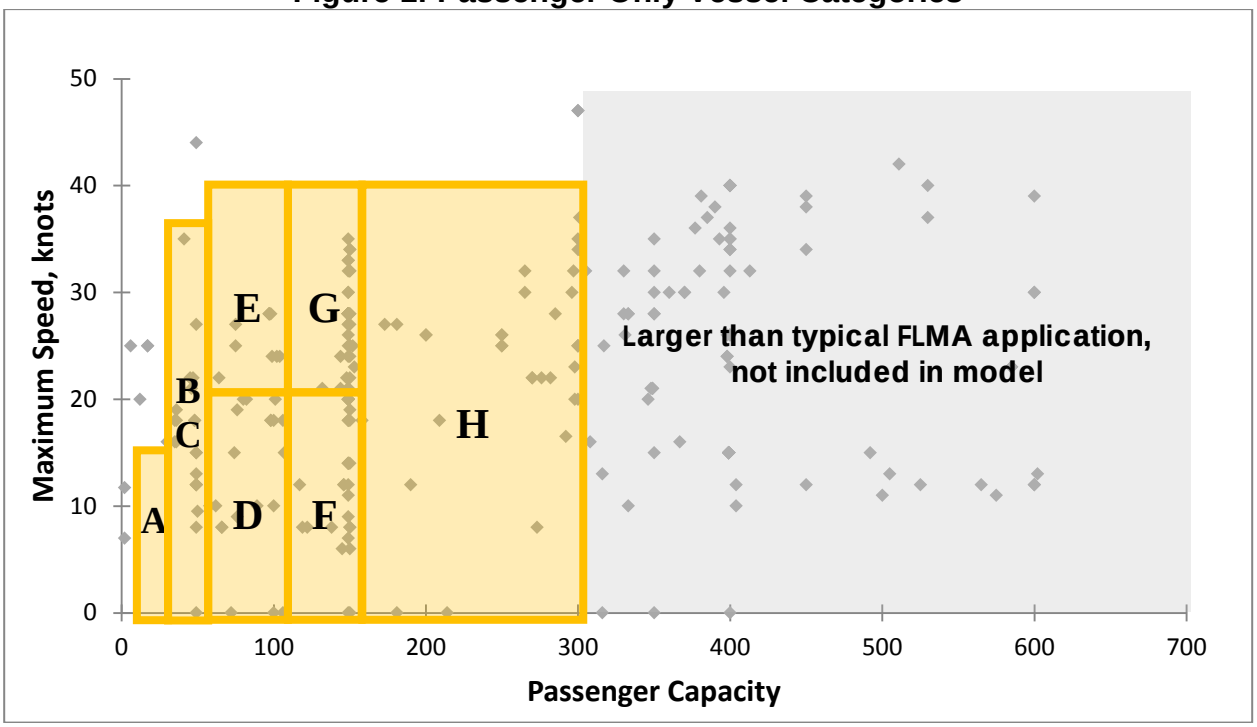


Figure 2 shows the passenger and vehicle capacity ranges for the four vehicle-carrying categories overlaid on the data points from these two data sources.

Figure 2: RORO Vessel Categories

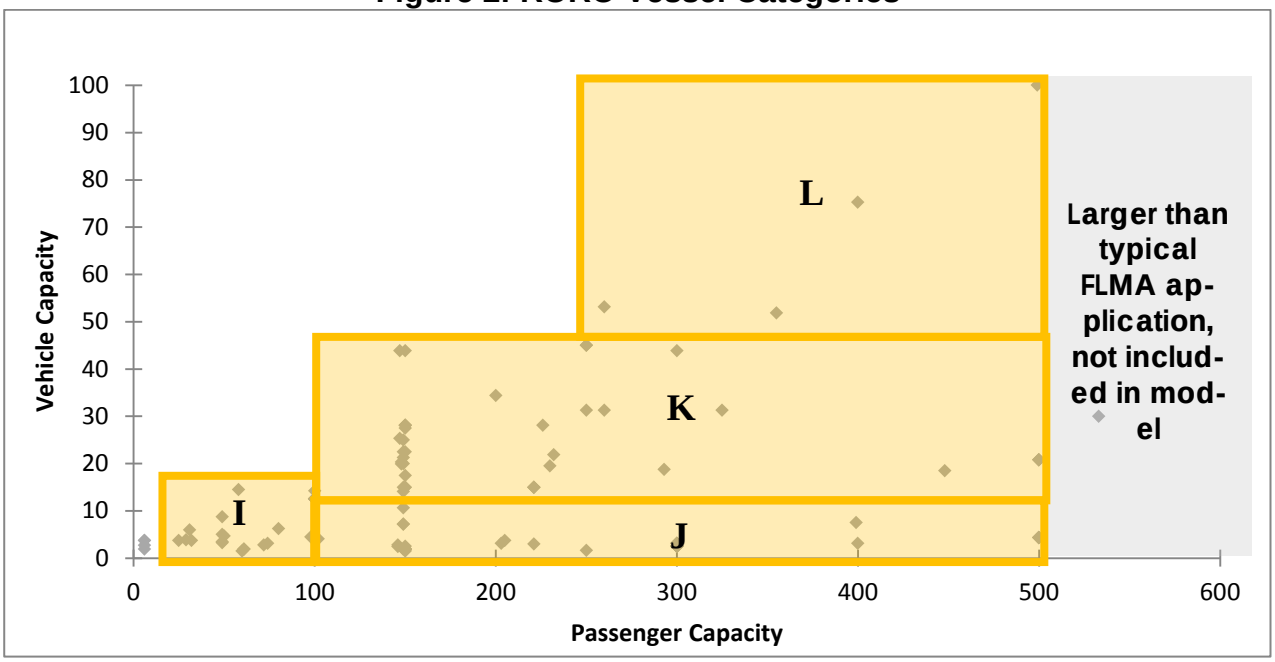


Table 1 summarizes the characteristics of each of the vessel categories.

Table 1: Vessel Categories

Category	Pax Capacity	Vehicle Capacity	Max Speed	Horsepower	Hull Type
A	12-30	-	16-25	115-375	Mono
B	31-50	-	8-24	180-700	Pontoon
C	31-50	-	12-30	180-850	Mono or Cat
D	51-100	-	8-20	230-900	Mono or Cat
E	51-100	-	21-38	525-2,100	Mono or Cat
F	101-150	-	10-20	225-1800	Mono
G	101-150	-	21-35	900-4,000	Cat
H	151-300	-	8-37	400-7,200	Mono
I	25-100	2-15	5-15	100-1,000	Mono
J	100-500	2-10	9-15	500-3,000	Mono
K	100-500	10-50	9-15	285-4,500	Mono
L	250-500	50-100	39-42	19,300-22,600	Mono

As noted in Table 1, ferries used for FLMA service generally have one of three hull types – monohull, catamaran, or pontoon. Monohulls are a traditional hull design that are often used for slower speed services. Monohulls can be designed for high speeds, but generally more engine power is required to reach the same top speed with a monohull than with a catamaran hull. RORO ferries are almost always monohulls. Catamarans are often used for higher speed services. They require less power, and thus less fuel to travel at the same speed as

a monohull, and provide a more stable ride for passenger comfort. Pontoons are more affordable than other hull types, but generally only carry 30-50 passengers and cannot travel at high speeds.

III. Cost Elements

The cost of providing ferry service can be subdivided into capital, operating and maintenance costs. Table 2 lists the costs in each category that are and are not included in the model estimates. Note that costs associated with docking, terminals, and on-board sales and services are not included in the model. Docking and terminal costs are highly variable and must be evaluated on a case-by-case basis. On-board sales and services are a relatively small cost element, and are generally only offered if they can be self-sustaining. For this reason, on-board sales costs and revenues should be considered together.

Table 2: Cost Elements

Cost Element	Included in the Model	Not Included in the Model
Capital	Vessel purchase (Cash and debt repayment) Start-up costs	Dock facilities Terminal facilities
Operations & Maintenance	Wages and benefits for onboard deck and engine crew Fuel and lubricants Vessel maintenance Hull insurance Protection & indemnity insurance Administration Marketing Sales	On-board sales (food, beverage) On-board passenger service crew (sales, interpretation) Outside professional services (accounting, legal, etc.) Dockage fees

Certain cost elements, such as labor expense, usually represent a disproportionately large share of total expenses, whereas certain indirect cost elements are quite modest and in some cases relatively insignificant relative to overall expenses. Priority was placed upon obtaining reasonable and accurate estimates for those cost elements that represent the largest share of overall operating costs, since it is here where any variation would result in the greatest relative change in financial performance. Wherever possible, estimates based on actual operating experience were utilized.

For the purposes of evaluating the relative economic performance of the various vessel options for a specified route, the financial performance of the different vessel types is measured by calculating the total cost over the useful life of the vessels, including one year of start-up (26 years for passenger ferries and 41 years for RORO ferries) and the cost per passenger in the first year of service. The financial analysis approach outlined below is applicable to a broad spectrum of ferry operations. These measures do not give a complete picture of the financial performance of ferry service – revenue is not included, nor are taxes – but it is useful for indicating the approximate financial investment required and allowing consistent, comparable analysis of various service options. All costs are in 2010 dollars.

A series of annual expenditure statements are estimated for each year, under the various operating scenarios, using different vessel types. Total expenditures are then summed and discounted at the expected rate of inflation.

In keeping with generally accepted principals and methods for the financial analysis of transportation business entities, total expenses (cash outflows) are classified into three mutually exclusive categories of capital costs, direct operating costs and indirect operating costs. Vessel debt repayment includes principal and interest payments on the portion of the vessel purchase price not funded by the equity investment of the owners. Direct operating costs are defined here as vessel direct operating costs, which include crew costs (in this case deck

and engine crew only, excluding passenger service crew), fuel and lubricant costs, and vessel maintenance. Indirect operating costs are defined here as including insurance, marketing, advertising, and general administration. Items that are not included in the model, such as passenger service crew costs, terminal related costs such as passenger facility charges and docking fees are additional indirect operating costs that can be included in refined financial analysis.

FLMAs use a variety of owner-operator arrangements to offer ferry service. In some cases the federal agency owns and operates the service. More commonly, the FLMA issues a concession contract for the service. The financial analysis provided by the model is applicable, regardless of the service arrangement. User inputs may be adjusted to more closely reflect the anticipated operating model, as described in Section IV.

A. Capital Cost

Sometimes a newly built vessel may be purchased by the operator to provide service on the route being studied, sometimes a used vessel may be purchased, and sometimes an existing vessel already owned and operated by the operator may be used to provide service on the route. In an attempt to arrive at reasonable purchase price estimates for vessels, the observed purchase prices for recently acquired vessels of varying types and capacities were used for guidance.

Quoted purchase prices for approximately 80 new vessels were compiled to form the basis for the vessel purchase prices for the twelve vessel categories in the model. These price data were compiled from a variety of sources including newspaper archives, marine industry magazines, other ferry cost studies, and discussions with ferry operators. Vessel purchase prices vary greatly, and many vessels are built to meet particular specifications, which are not always made clear when prices are reported. Table 3 shows the range of purchase prices found for new vessels in each vessel category.

Table 3: Vessel Costs

Category	Pax Capacity	Vehicle Capacity	Max Speed	Horsepower	Hull Type	New Vessel Cost		
						Low	High	Average
A	12-30	-	16-25	115-375	Mono	$ 90,000	$300,000	$195,000
B	31-50	-	8-24	180-700	Pontoon	$200,000	$600,000	$400,000
C	31-50	-	12-30	180-850	Mono or Cat	$180,000	$990,000	$585,000
D	51-100	-	8-20	230-900	Mono or Cat	$225,000	$1,000,000	$613,000
E	51-100	-	21-38	525-2,100	Mono or Cat	$450,000	$3,000,000	$1,725,000
F	101-150	-	10-20	225-1800	Mono	$400,000	$1,800,000	$1,100,000
G	101-150	-	21-35	900-4,000	Cat	$700,000	$8,000,000	$4,350,000
H	151-300	-	8-37	400-7,200	Mono	$820,000	$11,400,000	$6,110,000
I	25-100	2-15	5-15	100-1,000	Mono	$1,000,000	$5,000,000	$3,000,000
J	100-500	2-10	9-15	500-3,000	Mono	$3,300,000	$7,500,000	$5,400,000
K	100-500	10-50	9-15	285-4,500	Mono	$7,000,000	$18,000,000	$12,500,000
L	250-500	50-100	39-42	19,300-22,600	Mono	$25,000,000	$43,000,000	$34,000,000

To estimate the price of a *used vessel*, its value as a new vessel is estimated, and is then depreciated based on the approximate age of vessels that the user indicates. The new vessel price is assumed to be reduced by an

amount equivalent to 2.3% of the new vessel purchase price for each year of age, for vessels that are 30 years old or younger. Because many users of this model may not know the exact age of the vessels that will service the route being studied, the model simplifies this formula by grouping vessels by age range and estimating the depreciated value as the average value for the age range. The estimated value of a used vessel as a percentage of its value as a new vessel is shown in Table 4. Therefore, for example, a 15 year old, 49-passenger, passenger-only vessel with a maximum speed of 25 knots is estimated to have a current average value of approximately $386,000.

Table 4: Used Vessel Value

Age of Vessel (user input tab choices)	Used Vessel Price as a Percentage of New Vessel Purchase Price
New	100%
1-5 Years	93%
6-10 Years	82%
11-20 Years	64%
21-30 Years	41%
More than 30 Years Old	20%

The useful life of ferry vessels varies depending on the size of the vessel, the hull-type, the usage, and maintenance schedule. This model assumes a 25-year useful life for passenger ferries and a 40-year useful life for vehicle ferries. These expected useful lives were determined based on a review of Washington State, Alaska, and Newfoundland ferry financial policies, as well as a review of the average age of vessels reported in the WTLUS survey data.[1]

Often ferry vessels operate on different routes on different days of the week or at different times of year. Care must be taken to properly allocate vessel expense among the different routes on which the vessel is being operated. The model allocates vessel expenses to each route according to the number of days it will be operated on each route.

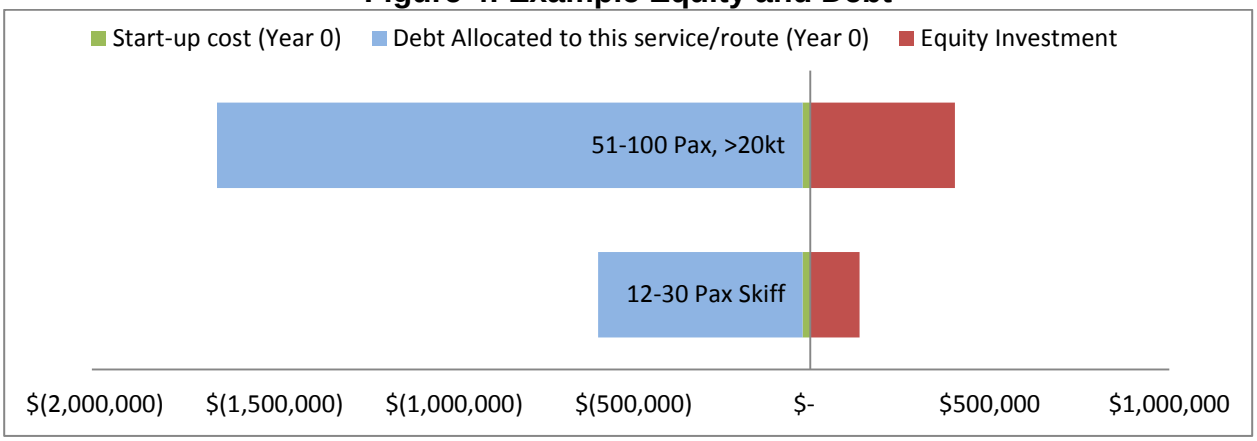
Vessel debt repayment represents principal and interest payments on the portion of the vessel purchase price not funded by the equity investment of the owners. For the acquisition of a newly built vessel, in industry practice, various vessel financing terms are possible, including various amortization schedules, loan terms, and interest rate amounts and types (fixed, variable, etc.). To calculate the debt repayment expense a 20-year, equal payment amortization schedule is assumed, with the owner equity (down payment) and fixed interest rate specified by the user.

The debt repayment calculations include only the portion of vessel costs allocated to the route being modeled based on the portion of service days the vessels will operate on the proposed route, as described in Section IV.

Equity investment is assumed to be a fixed percentage of the vessel purchase price. This means that for the same proposed service, options that use more expensive vessels are assumed to require more equity investment. The down payment is equal to the specified equity investment less start-up expenses needed to provide working capital for new routes. Figure 4 shows an example, comparing the equity and debt assumptions for a proposed service using three 51-100 passenger vessels and using twelve skiffs. The assumed equity investment is about $250,000 more if service is offered using 51-100 passenger vessels rather than 12-30 passenger skiffs. In each case, the equity investment is 20 percent of the total vessel costs.

[1] Washington State Office of Financial Management: http://www.ofm.wa.gov/policy/30.50.htm
Alaska DOT ferry study:
http://dot.alaska.gov/stwdplng/projectinfo/ser/Gravina/assetts/Previous_docs/Screening_Alternatives/AppdxAforScreening.pdf
Newfoundland, Canada ferry replacement: http://www.bellisland.net/ferry_users/reports/replace_HS.pdf

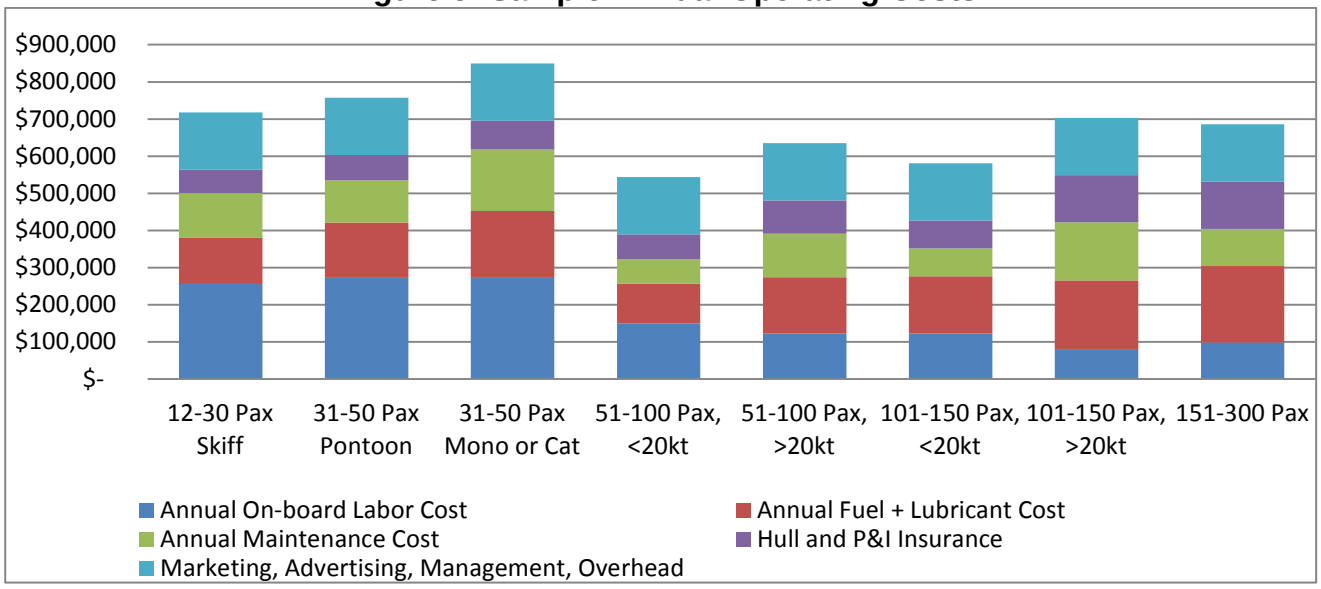
Figure 4: Example Equity and Debt



B. Operating Costs

Operating costs in the model include on-board labor; fuel and lubricant; maintenance; insurance; and marketing, overhead and management. Figure 5 shows a sample breakdown of operating expenses for various vessel options. Labor costs represent a larger portion of the operating costs for smaller vessels because larger vessels have similar crew requirements, but can carry more passengers. Fuel and insurance costs represent a larger share of operating costs for larger vessels.

Figure 5: Sample Annual Operating Costs



Salaries, Wages and Benefits (Deck and Engine Crew)

For the vessel sizes, route lengths and the location of the routes generally serving FLMAs, a relatively simple set of crew labor categories that consist of *captains* and *deck hands* can be used. Captains are in overall command of the operation of vessel, supervise the work of all other crew, and oversee the landing and discharging of passengers. Deck hands operate the vessel under the captain's direction, handle lines when

docking and departing, and perform routine maintenance chores. The total crew complement for each vessel type analyzed was determined on the basis of the observed manning requirements of existing vessels and reported crew complements in the WTLUS database.

National Industry-Specific Occupational Employment and Wage estimates from the 2010 Bureau of Labor Statistics Standard Occupational Classification for Class 53 – Transportation and Material Moving Occupations, are provided as the default values for hourly wage rates for captains and deckhands, and are summarized in Table 5 below.

Table 5: Default Wage Rates

Occupational Title	SOC Code	Mean Hourly Wage
Sailors and Marine Oilers	53-5011	$12.89
Captains, mates, and pilots of water vessels	53-5021	$21.23

Total expense for this category includes the cost of wages and benefits for the crew. The default value for the labor benefits and overhead is estimated to be 15% of base wages. Labor hours include vessel operating hours and some additional time added to account for labor time required for vessel preparation and vessel turnaround activities. The default value for the amount of additional time is estimated as 25% of vessel operating hours.

Vessel Fuel and Lubricants

Vessel fuel and lubricant expenses represent the costs associated with the provision of fuel and refueling services, including fuel taxes. For a specific vessel type, total annual fuel and lubricant expense is a function of:

1. Vessel time by operating mode (e.g., service speed, intermediate speed, slow speed, idle, etc.),
2. Fuel consumption rate by operating mode, and
3. Current and future unit fuel and lubricant cost.

Vessel time is broken down into idle time, slow speed time, and service speed time. Idle time is a function of the stop time and the number of stops per round-trip. Slow speed time is based on an assumption that an average speed of 5 knots will be maintained within ½ nautical mile of all stops. Service speed time is all remaining time. The default assumption is that service speed is 80 percent of maximum speed.

Route profiles detailing the distance traveled and operating speed over each segment of a route for each vessel type developed using electronic charting software and digital nautical charts are an important step in planning ferry service and accurately estimating costs and vessel requirements. However, for this model it is assumed that these detailed profiles are not available and some simplifying assumptions are made to estimate vessels hours by operating mode.

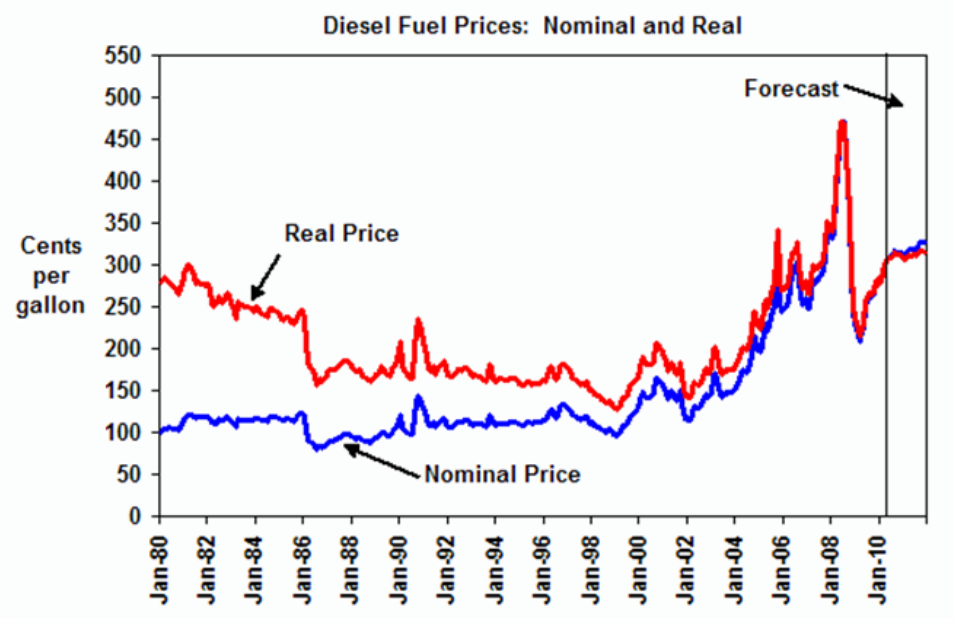
Fuel consumption rates by operating mode are estimated based on vessel powering data and the specific fuel consumption of various marine diesel engine types.

There is a wide variety of commercially available diesel fuel oil. Diesel No. 2 (low sulfur) is utilized for most ferry vessels. The retail price per gallon for Diesel No. 2, including all taxes, was about $3.10 in spring 2010, assuming a five percent discount for bulk purchases; $2.95 per gallon is the default cost. Retail prices for low sulfur diesel are reported weekly for the country and several states and regions on the U.S. Energy Information Administration website: http://www.eia.doe.gov/dnav/pet/pet_pri_gnd_dcus_nus_w.htm. Diesel price can be quite volatile, and also varies geographically throughout the country. Figure 3 shows diesel fuel prices over the last 30 years in the United States.

Projecting future price of fuel is an essential component of projecting lifecycle cost for ferry service, but is notoriously difficult. The default value for annual change in the cost of diesel fuel is 10%, which reflects the

average trend from 2000 to 2010, but users may vary this value in the model. Note that this is the annual change in cost before adjusting for inflation.

Figure 3: Diesel Fuel Price Trend, US Energy Information Administration



Based on discussion with shipyards and vessel operators, the quantity of lubricant consumed is assumed to be 0.4% of the quantity of fuel consumption, with the unit cost of lubricant assumed to be $8.00 per gallon.

Vessel Maintenance Costs

Vessel maintenance expenses represent the cost of vessel hull and engine repairs and preventative maintenance, including periodic replacement of engines and related systems. Maintenance is assumed to be carried out either in-house, or contracted to an outside service provider, with the maintenance expense representing all components of total maintenance cost, including labor, materials and parts, and burden (overhead).

In general, it is thought that maintenance for high speed vessels such as catamarans is more preventative, more proactive, and done more frequently than for conventional vessels. Despite this, maintenance expense for older conventional monohull vessels may not necessarily be less than for a high speed vessel, due in large part to the age of these older vessels and the possibility of more frequent upgrades and overhauls being required.

Limited maintenance cost information provided by shipyards was used to estimate this cost category. In order to refine these maintenance costs estimates, and provide estimates for vessels for which limited data was available, the existing data were reconciled and combined into the following maintenance cost estimation methodology, based in part upon maintenance cost methodologies used in other ferry service feasibility studies.

Total annual maintenance expense per vessel is hypothesized to be partially dependent upon total vessel hours per year, especially for engine maintenance. Based on the observed data, total annual vessel maintenance expense for a new vessel is estimated to be equal to 3.5% of the purchase price of the vessel, for a vessel operating a nominal 1,000 hours annually. To account for variation in total annual maintenance expense resulting from different levels of annual vessel operating hours and different vessel ages, the following formula is then used to estimate total annual maintenance expenses for a vessel:

$$[M * F * P] + [(M * V * P) * (H_a / H_n)]$$

M = estimated total annual maintenance cost for new vessel, expressed as a percentage of the new vessel purchase price
F = percent of maintenance cost that is fixed (does not vary with vessel hours)
P = new vessel purchase price
V = percent of maintenance cost that varies with vessel hours
H_a = actual annual vessel hours operated
H_n = nominal annual vessel hours (1,000 hours)

In this formula, 60% of total maintenance expenses is essentially fixed, with the remainder varying as a function of total vessel hours, with nominal annual vessel hours assumed to be 1,000. For a vessel operated less than 1,000 hours annually, total maintenance expense is reduced somewhat, and above 1,000 hours, it is increased. Note that the resulting value for vessel maintenance, expressed as a per hour rate, may actually be less for higher operating hours, since although total maintenance expense increases, it increases at a slower rate than do total annual operating hours, resulting in somewhat lower hourly figures for maintenance.

Finally, to account for variations in maintenance expense resulting from the age of a vessel, the result of the above formula is then increased for each year of vessel age by a value equal to 2% of the new vessel annual maintenance expense, for each year of vessel age. Therefore, a ten year old vessel would have an annual maintenance expense that is 20% more than that for a similar new vessel.

Insurance

The insurance cost category includes Marine Hull Insurance and Protection and Indemnity Insurance.

Hull insurance primarily represents property insurance coverage for the vessel and equipment, and often includes collision liability coverage for damage to other vessels and their cargo as well. In determining insurance premiums, a variety of factors are usually taken into consideration. These include: (1) size of vessel, (2) age of vessel, (3) hull value, (4) area of navigation, (5) years of operating experience, (6) completion of USCG safety courses, and (7) extent of fire protection equipment on the vessel. Based on discussion with ferry operators, policies are treated as "actual cash value" policies, which pay the depreciated value of the vessel, rather than the full replacement value of a new vessel, in the event of a loss. Estimates obtained from shipyards, existing ferry operators, and other ferry service feasibility studies suggest that annual insurance expense typically equals between 1% to 3% of the value of the vessel being insured.

Protection and Indemnity (P&I) Insurance includes insurance against passenger liability, crew liability, and other liabilities (which often include liquor liability, pollution liability, premises liability and medical payments). P&I covers a wide range of liability exposures and miscellaneous expenses that a vessel owner might incur. Injuries to crew members and other persons on board the insured vessel are generally the most common claims. Coverage is typically provided for injury to persons aboard other vessels struck by the insured vessel, and for damage to property (other than vessels) struck by the insured vessel. Accidental pollution from the discharge of fuel oil or other similar substances is also often covered, unless due to negligence by the operator. Based on previous ferry feasibility studies and information from ferry operators, this expense category is assumed to vary as a function of the number of passengers carried, and to be equal to $0.35 per passenger boarding.

In the model, total annual insurance expense is calculated as 2% of the current estimated value of the vessels plus $0.35 per rider.

C. Indirect Operating Costs

Indirect Operating costs include ongoing marketing, reservations, management and general administration. The model combines these into one cost element.

Marketing costs include the production and distribution of marketing materials and costs associated with the purchase of print, radio, television or other media advertising.

Reservation and sales costs include labor costs of reservations and sales personnel, and commission costs, or direct charges arising from sales of passenger tickets.

Management and general administration costs represent costs of a general corporate nature that are incurred in performing activities which contribute to more than a single operating function. Specific examples include leasing of office space, telephone & communications costs, office supplies, travel, and management and administrative personnel compensation and benefits.

Based on previous ferry feasibility studies and information from ferry operators, indirect operating costs can vary significantly between service, but generally are assumed to vary as a function of total passenger revenues, and thus indirectly as a function of total ridership. Because revenue is not included either as an input or output in this cost model, indirect operating costs are estimated as a function of expected passenger demand. The default cost per passenger is $0.60. Indirect operating costs are likely to be higher for a completely new operator and route, than for an existing operator adding a new route that would contribute only marginally to the overall general administration expenses of that operator.

D. Start-Up Costs

Start-up expenses and provision of working capital represent one-time costs associated with the start-up of a completely new service (e.g., marketing and advertising, accounting, legal, permitting, licensing, etc.). Start-up expenses and provision of working capital for *new* routes are estimated to be equal to three months of year 1 indirect operating costs (including marketing, sales, management, and general administration).

In addition, $70,000 in marketing and administrative costs is added for the first year of service on a new route. This category is of particular importance to new startup services in creating awareness and building ridership.

IV. Using the Model

The model consists of 20 worksheets, or tabs. The first tab lists all of the user input values that are required to run the model. Additional inputs may be entered on the Manual or Manual RORO tabs if the user is interested in manually selecting a fleet of vessels. The results of the model are summarized on the Pax Summary and RORO Summary tabs. Table 6 summarizes the contents of each of the worksheets.

Table 6: Model Worksheets Overview

Worksheet Name	Description	Passenger-only/RORO/ Both
User Inputs	All fields that the user must complete to run the automatic portion of the model. Some fields have default values. Values describing the route, passenger demand, and schedule do not have default values.	Both
Vessel Data	Summarizes characteristics for each category of vessel. Many include a low value and a high value that represent boundaries for the expected value for the category's vessels.	Both
Pax Service Overview	For each of the eight passenger-only vessel categories, this worksheet calculates the number of vessels and crew members needed to provide service for the expected level of demand and route described on the USER INPUTS tab. The preliminary service plan calculated on this page includes different plans for peak and off-peak hours and for peak and shoulder seasons. This is a rough approximation for realistic service plans that often include longer headways and fewer service vehicles during off-peak times.	Passenger-Only
Pax Capital	Based on the number of vessels calculated on the PAX SERVICE OVERVIEW tab, this worksheet calculates the total fleet cost, equity investment, and debt repayment schedule. All of the capital costs are pro-rated to reflect only the portion of the total capital costs that are allocated to this route. This worksheet calculates low, average, and high values for the capital costs based on the ranges on the VESSEL DATA tab. The average values are furthest to the left, followed by the low values, and finally high values at the far right. This format is repeated on many other tabs in the model.	Passenger-Only
Pax Oper Maint	For each of the eight passenger-only vessel categories and service plans described on the PAX SERVICE OVERVIEW tab, this worksheet estimates labor, fuel, lubricant, maintenance, insurance, marketing and overhead costs for the first 15 years of service.	Passenger-Only
Pax Total Cost	This worksheet sums the capital, operating and maintenance costs from the previous tabs. The net present value of the estimated total cost is calculated, as is the cost per passenger in the first year.	Passenger-Only
Pax Summary	Summarizes the service characteristics and cost of providing ferry service to meet the parameters input on the USER INPUTS tab using a fleet made up of each of the eight passenger-only vessel types.	Passenger-Only
Manual	User enters the number of each vessel type that will be used during each of the four schedule periods (peak and off-peak hours, peak and shoulder season) in pink shaded boxes. Yellow shaded boxes indicate whether the entered vessels will accommodate the demand entered on the USER INPUTS tab. Worksheet calculates total vessel hours and crew requirement. Whereas the model automatically estimates costs for fleets made up entirely of one vessel type, the manual option allows the user to develop cost estimates for fleet made up of multiple vessel types.	Passenger-Only
Manual Capital	Calculates total capital cost and debt repayment schedule for the portion allocated to this route for the manual fleet entered on the MANUAL tab.	Passenger-Only
Manual Oper Maint	Estimates labor, fuel, lubricant, maintenance, insurance, marketing and overhead costs for the fleet and service plan entered on the MANUAL tab for the first 15 years of service.	Passenger-Only
Manual Total	This worksheet sums the capital, operating and maintenance costs for the Manual fleet and service plan. The net present value of the estimated total	Passenger-Only

	cost is calculated, as is the cost per passenger in the first year.	
RORO Service Overview	Similar to PAX SERVICE OVERVIEW, but for four RORO vessel categories.	RORO
RORO Capital	Similar to PAX CAPITAL, but for four RORO vessel categories.	RORO
RORO Oper Maint	Similar to PAX OPER MAINT, but for four RORO vessel categories.	RORO
RORO Total Cost	Similar to PAX TOTAL COST, but for four RORO vessel categories.	RORO
RORO Summary	Similar to PAX SUMMARY, but for four RORO vessel categories.	RORO
Manual RORO	User enters the number of each vessel type that will be used during each of the four schedule periods (peak and off-peak hours, peak and shoulder season) in pink shaded boxes. Yellow shaded boxes indicate whether the entered vessels will accommodate the demand entered on the USER INPUTS tab. Worksheet calculates total vessel hours and crew requirement. Whereas the model automatically estimates costs for fleets made up entirely of one vessel type, the manual option allows the user to develop cost estimates for fleet made up of multiple vessel types.	RORO
Manual Capital RORO	Calculates total capital cost and debt repayment schedule for the portion allocated to this route for the manual fleet entered on the MANUAL tab.	RORO
Manual Oper Maint RORO	Estimates labor, fuel, lubricant, maintenance, insurance, marketing and overhead costs for the fleet and service plan entered on the MANUAL tab for the first 15 years of service.	RORO
Manual Total RORO	This worksheet sums the capital, operating and maintenance costs for the Manual fleet and service plan. The net present value of the estimated total cost is calculated, as is the cost per passenger in the first year.	RORO

In this section an example is used to illustrate a four step process for using the model:

1. Enter input values about the route and estimated passenger demand.
2. The model will automatically generate service parameters and cost estimates for each vessel type (eight for passenger-only, four for vehicle-carrying (RORO) ferry service). Review these service parameters and cost estimates.
3. Create a vessel fleet that combines multiple vessel types in a way that may be more desirable or practical than the automatically generated options (referred to as a “manual fleet”) and compare the Manual Fleet cost and service parameters to the automatically generated fleets.
4. Iterate steps 4 and 5 to develop a fleet with desirable and practical service parameters and cost efficiency.

Note: To use the model to analyze changing an existing ferry route (for example, by adding one or more stops) the model should first be run for the existing route and then for the proposed route so that the costs and service parameters can be compared.

Step 1. Enter Input Values

On the USER INPUTS tab, fill in the pink boxes. The inputs include a description of the route, estimates of the passenger demand in the peak and shoulder seasons, and indication of whether the ferry vessels will be used on other routes or services during the off-season. Table 8 describes each input value.

Default values or a range of reasonable values are provided for the factors, assumptions and unit costs in the right column. These are used to calculate costs in the model. These factors may vary over time, geographically, and due to many other factors. The user should review these factors to ensure that they are appropriate for the particular application. The user may also wish to vary these factors to conduct some sensitivity analysis for various factors.

Table 7: User Inputs

User Input	Default Value/ Range	Description/ Comments
Is this a new service, or will it be a new route added to an existing system?	None	When a new route or destination is added to an existing ferry service, existing staff, vessels, facilities, and infrastructure can often be shared, resulting in considerable cost savings. In the model, start-up, marketing, advertising and management costs associated with new services are higher for new services than for added routes included in the model.
What is the estimated round-trip route distance in nautical miles?	None	The exact route for a proposed service will depend on marine conditions that may not be known at this stage of planning; however, the route distance can generally be readily estimated with reasonable accuracy. Note: one nautical mile = 1.15 miles
How many stops will there be?	None	How many times will the vessel dock during each round-trip?
Will the ferry transport vehicles?	None	Different vessel types are available for carrying vehicles and passengers than for passengers only.
If yes, how many during the peak hour?	None	Estimate the maximum number of vehicles that will be carried in an hour.
Peak Season	None	The model allows for up to two seasonal schedules and an off-season. Demand will vary on a daily basis, but service is generally planned seasonally. The peak season is the busiest season.
Shoulder Season	None	The shoulder season is a transitional period on one or both sides of the peak season during which service will be offered, but not as frequently as during the peak season.
How many days in the peak (shoulder) season?	None	How many days per year will the peak service plan operate? And how many will the shoulder season operate?
What is the estimated peak hour passenger demand on the peak segment?	None	This input determines the maximum passenger load that the service must support. At the busiest time, how many passengers will travel along a particular link in an hour. For example, if a proposed three-stop route will pick up passengers at a parking area and transport them to two island destinations, the peak load will be on the link between. The model assumes that during each season half of the operating hours will run a schedule that accommodates the seasonal peak demand, and the other half of the operating hours will operate a reduced service plan that can accommodate half of the seasonal peak demand. This could reflect a service on which more service is provided on weekends than on weekdays, or on which more service is provided a few hours each day and less frequent service is provided during off-hours.
What is the estimated daily passenger demand?	None	The estimated daily passenger demand during the peak season and shoulder season are used only to calculate the average cost per passenger trip. Estimating demand for transit service is challenging, but often use of existing services, park visitation, visitor surveys and/or ridership on comparable services can help develop a reasonable estimate.
How many hours per	None	It is assumed that at least one vessel circulates continuously on the route

day will the service operate?		during these hours (more than one vessel if needed to accommodate demand).
Can spare vessels be used elsewhere during the shoulder season?	None	Because demand is lower in the shoulder season than in the peak season, there may be spare vessels that are not needed during the shoulder season. If these vessels will be used on other routes during the shoulder season, a portion of the capital costs are offset by this use.
Will the service operate year-round?	None	No service is offered on the route during the off-season. If service will be offered year-round, there is no off-season.
How many days will vessels operate on other routes/services?	None	This can range from zero to the full number of days in the off-season. If the vessels will not be used during the off-season, this input should equal zero. If the vessel will be used locally throughout the off-season, the input should equal the length of the off-season. If the vessel will be used in a remote location during the off-season, it may be appropriate to subtract a few days for transport.
Service Speed/ Max Speed	0.7 - 0.8	The ratio of the average service speed to the maximum speed. Vessels typically do not cruise at their top speed.
Stop Time (min)	2 – 10	The duration of each stop depends on a variety of factors, including the number of passenger boardings.
Labor Overhead Rate	15% - 40%	The ratio of labor benefits and overhead (not including management and administration) to the base wages.
Crew Hours/Vessel Hours	1.2 – 1.3	The ratio of vessel crew hours to the hours that service is offered. Crew members work before and after the hours that service is offered to prepare and clean vessels and perform other routine duties. For example, crew may work 8am to 8 pm when service is offered from 9am to 7pm.
Captain Hourly Wage Rate	$ 21.23	National Industry-Specific Occupational Employment and Wage estimates from the Bureau of Labor Statistics for May 2009, http://www.bls.gov/oes/current/naics3_483000.htm. Captains, mates and pilots of water vessels (53-5021) Sailors and Marine Oilers (53-5011)
Deckhand Hourly Wage Rate	$ 12.89	
Diesel Fuel Cost/Gallon	$ 2.95	Retail prices for low sulfur diesel are reported weekly for the country and several states and regions on the U.S. Energy Information Administration website: http://www.eia.doe.gov/dnav/pet/pet_pri_gnd_dcus_nus_w.htm.
Annual Change in diesel cost/gallon	0% - 16%	Diesel prices have been very volatile, and the cost of fuel has a significant impact on the lifecycle cost of ferry service. Between 2000 and 2010, diesel fuel price increased 10% per year.
Lubricant Cost/Gallon	$ 8.00	Based on discussion with shipyards and vessel operators, the unit cost of lubricant assumed to be $8.00 per gallon.
Annual Vessel Depreciation (as % of vessel purchase price)	2.3%	Based on a review of used vessel prices, annual depreciation is estimated to be 2.3%.
Annual inflation	1.5% - 3.5%	
Interest rate	6% - 10%	
Marketing, Admin cost per passenger	$ 0.40 - $1.00	
Is a spare vessel	Yes	Often a spare vessel is needed so that service can be maintained during

needed?		vessel maintenance and inspection.
Vessel owner equity / down payment (as % of vessel costs)	20%	
On average, how old will the purchased vessels be?	New - >30 years	

Figure 6 shows the input and default values on the USER INPUTS tab for an example ferry route. This example route, described below, is used throughout this section to demonstrate how to use the ferry model.

In this example, the proposed route would be a new service with three stops and a total route length of approximately six nautical miles. The service will not carry vehicles. The peak season is between Memorial Day and Labor Day – approximately 90 days. Service will also be offered on weekends in April, May, and September. This shoulder season is 24 additional service days. During the shoulder season the vessels will be used on other routes when they are not needed on this route. October through March, no service will be offered on this route, and it is anticipated that the vessels would be transported south and used on another route for most of this season – approximately 180 days.

Based on a visitor survey, experience at other parks, and a model of visitor use and demand for ferry service, it is estimated that about 1,400 people will ride the ferry on a typical summer day, and about 600 on a typical shoulder season day. If these trips were distributed evenly throughout the 10 hour day there would be 140 inbound and 140 outbound passengers each hour. However, staff noted that there are some higher demand and some lower demand times during the days, so it is estimated that at the busiest time of day in the summer there will be about 300 passengers on a particular route segment.

Figure 6: Example User Inputs

ENTER VALUE			SELECT APPROPRIATE VALUE (OR DEFAULT)		
Is this a new service, or will it be a new route added to an existing system?	New Service		Service Speed/ Max Speed=	0.8	
What is the estimated round-trip route distance in nautical miles?	6		Stop Time (min)	5	
How many stops will there be?	3		Labor Overhead Rate	15%	
Will the ferry transport vehicles?	No		Crew Hours/Vessel Operating Hours	1.25	
If yes, how many during the peak hour?			Captain Hourly Wage Rate	$	21.23
Peak Season			Deckhand Hourly Wage Rate	$	12.89
How many days in the peak season?	90		Diesel Fuel Cost/Gallon	$	2.95
What is the estimated peak hour passenger demand on the peak segment?	300		Annual Change in diesel cost/gallon	10%	
What is the estimated daily passenger demand?	1,400		Lubricant Cost/Gallon	$	8.00
How many hours per day will the service operate during peak season?	10		Annual Vessel Depreciation (as % of vessel purchase price)	2.3%	
Shoulder Season			Annual inflation	2.0%	
How many days in the shoulder season?	24		Loan period (years)		20
What is the estimated peak hour passenger demand on the peak segment?	100		Loan Interest rate	6%	
What is the estimated daily passenger demand?	600		Annual Marketing, Admin cost per passenger	$	0.60
How many hours per day will the service operate during shoulder season?	10		Is a spare vessel needed?		Yes
Can spare vessels be used elsewhere during the shoulder season?	Yes		Vessel owner equity / down payment (as % of vessel costs)		20%
Off-Season			On average, how old will the vessels used for the service be?	6-10 Years	
Will the service operate year-round?	No				
If not: How many days will the vessels operate on other routes/services?	180				
What is the estimated annual passenger demand	140,400		Average age of purchased vessels		7.5
Total operating hours on this route/service	1,140		Price of vessels as % of new price		83%

In the example shown in Figure 6, no default values are changed.

Step 2 Review Calculated Service Alternatives

As described in Section III, the model is organized around twelve vessel categories (eight passenger-only and four RORO). These categories represent typical vessels that may be appropriate for services to federal lands. The categories do not represent every possible ferry vessel, but they attempt to capture the range of vessels typically used for FLMA applications.

Several tabs in the workbook provide detailed descriptions of the service characteristics and cost estimates for ferry service provided using vessels from each category. The SUMMARY tab outlines key service parameters and estimated costs for each of the vessel categories. This is the best place to review and compare options. Table 8 describes each of the outputs on the SUMMARY tab.

Table 8: SUMMARY Tab Output Values

Model Output	Description
Fleet Overview	
Fleet Size	The number of vessels needed to accommodate the forecast demand on the route. If a spare vessel was selected on the USER INPUTS tab, it is included in the fleet size.
Estimated cost per vessel	Average cost per vessel for each vessel category. This cost factors in the average age of vessels indicated on the USER INPUTS tab.
Service Summary	
Service Speed	The average cruising speed for each vessel in knots (nautical miles/hour).
Round Trip Time	The calculated time for one round-trip. Assumes slow speed (average 5 knots) within ½ nautical mile of each stop and includes stop time listed on USER INPUTS tab.
Minimum Headway	The time between departures during the peak season when all the service vessels are operating.
Maximum Headway	The time between departures during non-peak hours in the shoulder season.
Average Cost Summary	
Cost per passenger trip (Year 1)	The total cost in the first year of operation divided by the number of passenger trips indicated on the USER INPUTS tab. Note that in most cases, cost per passenger is twice this value.
Cost per Vessel-Hour (Year 1)	The total cost in the first year of operation divided by the total number of vessel-hours in that year.
NPV of Total Cost (Year 0-15)	The Net Present Value (NPV) is sum of the total costs incurred in the first fifteen years, discounted based on the annual rate of inflation indicated on the USER INPUTS tab.
Total Cost (Year 0-15)	The sum of all costs expected to be incurred in the first fifteen years, not discounted for inflation.
Equity Investment	The upfront cash investment, calculated based on the percent equity indicated on the USER INPUTS tab.
Finance Payments	The total debt service payments made in the first 15 years, assuming an equal payment loan with the interest rate indicated on the USER INPUTS tab.
Direct Operating Costs	Sum of on-board labor, fuel and lubricant costs in the first year.
Indirect Operating Costs	Maintenance, Marketing, Management and Overhead costs in the first 15 years.
Fixed Operating Costs	Insurance costs in the first 15 years, including hull, protection, and indemnity insurance.
Total Operating Cost	Sum of direct, indirect and fixed operating costs. This value is the light green bar in the bar chart.
Total Capital Costs	Sum of finance payments in first 15 years and equity investment. This value is the dark green bar in the bar chart.
Operating cost per Operating hour (Year 1)	Total operating cost in the first year of service divided by the number of operating hours in that year. This value is the light orange bar in the bar chart.
Capital cost per operating hour (Year 1)	Total capital cost in the first year of service (not including equity investment) divided by the number of operating hours in that year. This value is the dark orange bar in the bar chart.

The bar chart at the top of the SUMMARY tab shows total costs for each vessel type over a 25-year horizon in green, and cost per operating hour in the first service year in orange. The costs are broken down into capital

and operating costs – capital costs are shown in the darker color. The bars represent the estimated average cost for each vessel category. The narrower vertical bars show the estimated range of costs, reflecting variation between vessels in each category. Typically, the green bars representing Total Costs and the orange bars representing Cost per Operating Hour follow similar patterns.

The first page of the SUMMARY tab shows three summary charts describing the cost for each vessel category that could be used. The page contents are described in more detail below. Initially, the manual fleet should be ignored. It will be addressed in Steps 3 and 4. The least cost option is highlighted in yellow on this page. Moving to the right in the worksheet, the second page lists the estimated average values for each category. Because costs vary dramatically, a range of estimated costs may be a more practical planning tool than the average estimated value. Estimated high and low values are also shown on the pages further to the right in the SUMMARY worksheet, as shown in Figure 7. The third page indicates the low end of the estimated range, and the fourth page indicates the high end of the range.

Figure 7: SUMMARY tab pages

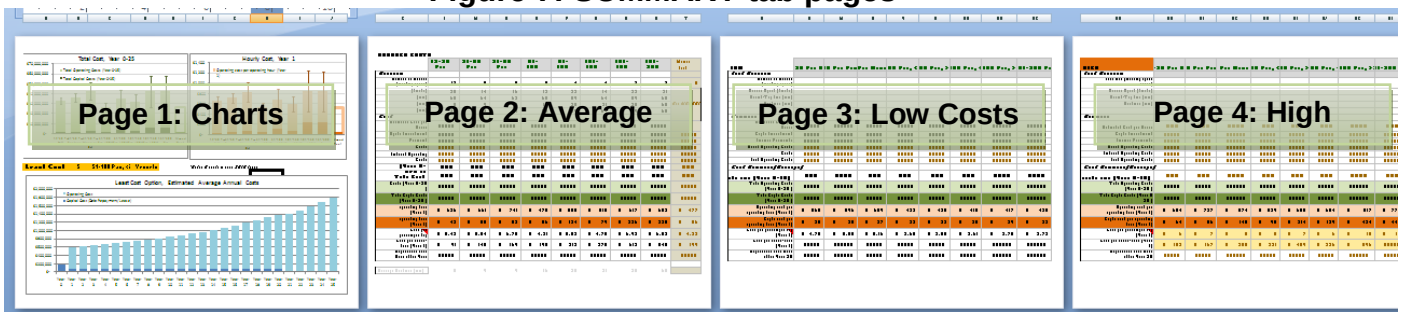
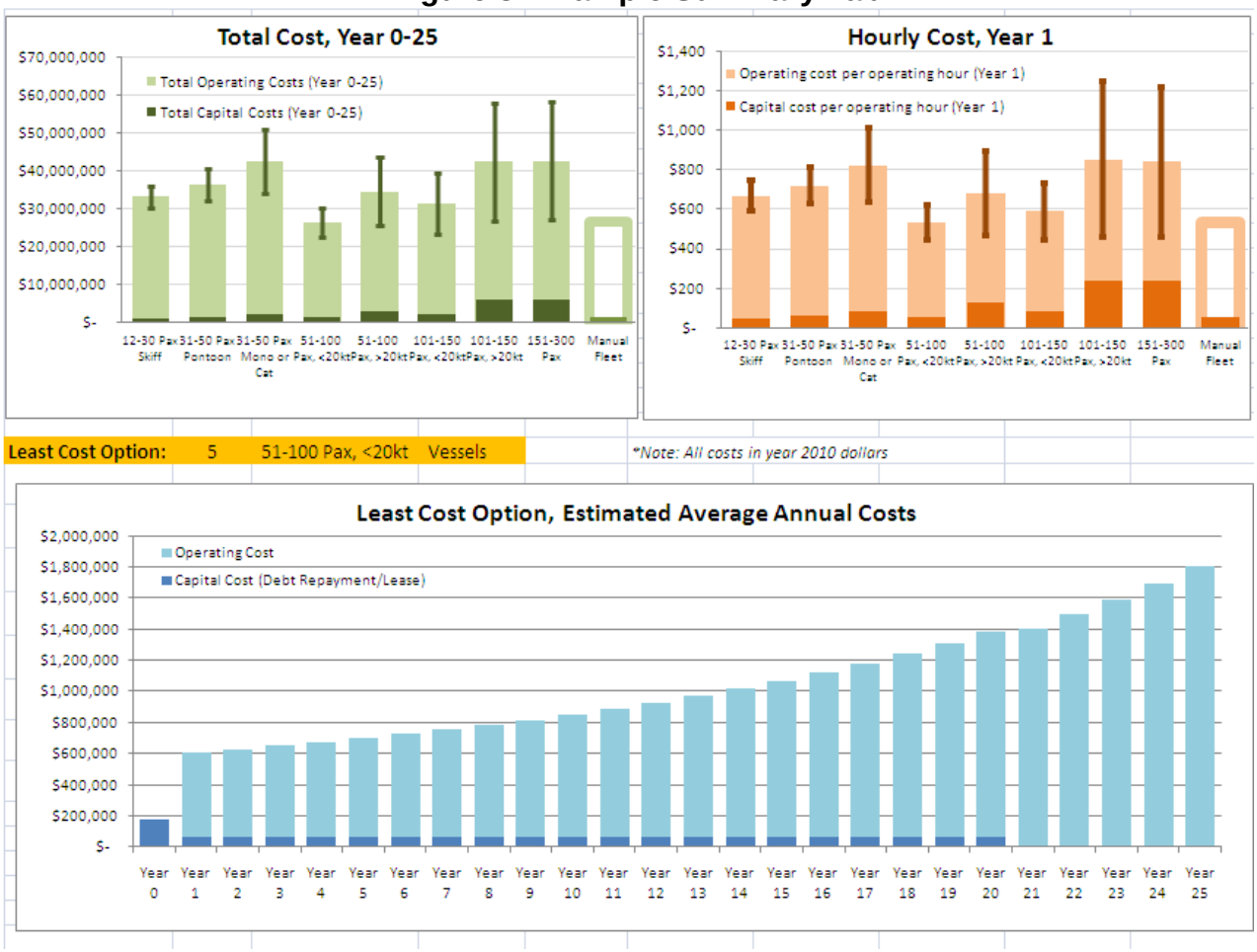


Figure 8 below shows the SUMMARY tab for the example route. The calculated range of estimated costs are shown with error bars in the chart. The bar chart shows that the 51-100 Pax, <20kt vessel category is the most cost efficient. Note that the capital costs (shown in the darker shades) are a small portion of total costs for all of the options. Operating costs represent the majority of ferry expenditures.

The table below the bar chart shows additional information about each option. Five 51-100 passenger vessels are needed to accommodate the forecast passenger demand (entered on the USER INPUT tab), including a spare vessel that can be used when another vessel needs maintenance or inspection. It will take one of these vessels just over an hour to complete a round-trip (65 minutes) so that when all four service vessels are operating at peak times the headway is 16 minutes, and when just one vessel is operating at off-peak times the headway is 65 minutes. In this example, the total cost is estimated to be between $22 million and $30 million.

Figure 8: Example Summary Tab



The user can then review more specific costs for the least cost option (and the other options) in column O of this worksheet. Each of these vessels will cost about $510,000. The assumed equity investment is $180,000; the balance of the capital cost is assumed to be financed with a 20-year loan yielding annual payments of about $63,700. The total cost to operate the ferry service with these vessels for 25 years is estimated to be about $26.4 million dollars. $25 million of this represents operating costs, and $1.5 million represents capital costs including debt financing costs. Taking the portion of these total costs expended in the first year of service and dividing by the number of hours service will be provided yields the operating and capital costs per operating hour shown in orange in both the table and the chart ($475 and $56 respectively for this example). These cost estimates are raw dollar amounts – no discount rate has been applied. See Section II for an explanation of the financial calculations including Net Present Value calculations.

Note that the next most cost effective option is to provide service using four 101-150 passenger <20 knot vessels. This option costs an estimated $5.2 million more than using five 51-100 passenger vessels and has slightly longer peak headway. For $33.2 million, service could be provided with much shorter headways using twelve small skiffs.

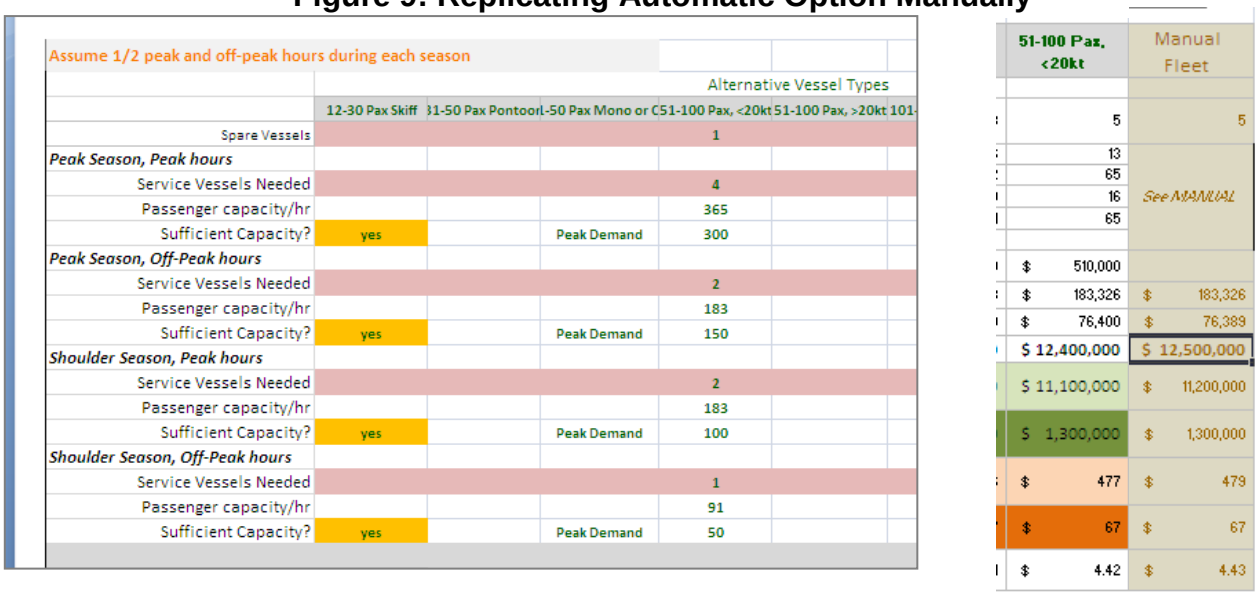
Step 3. Create a Manual Fleet

After reviewing the costs of the options that are automatically generated by the model, the next step is to develop a refined fleet manually. The manual fleet option allows the user to combine different types of vessels to fit desired service characteristics, to include vessels that are known to be available, and/or to further reduce estimated costs.

On the MANUAL tab allows the user to input combinations of different vessel types that meet the capacity requirements for four operating schedules: peak hours during the peak season, off-peak hours during the peak season, peak hours during the shoulder season, and off-peak hours during the shoulder season. The capacity requirements for each of these seasons is calculated automatically based on data on the USER INPUTS tab. On the MANUAL tab, the user enters the number of each vessel type that will be used in each season in the pink shaded boxes. The orange shaded cells indicate "yes" if the capacity requirements are met, and "no" if they are not met. Note that the model will report an error if a vessel that is not in service during the peak hour, peak season is listed in one of the other service seasons. It is assumed that all available vessels will operated during the peak hours in the peak season.

It may be helpful to start by replicating the most cost effective option from the SUMMARY tab, and then altering it to examine different options. In Figure 9, the most cost effective fleet for the example (five 51-100 passenger <20 knot vessels, including one spare) has been replicated. During the peak season all four service vessels operate at peak times. The service vessels for the other seasons can be found on the SERVICE PARAMETERS tab. The four service vessels have a passenger capacity of 365 per hour, which is sufficient to meet the estimated peak demand of 300. During the off-peak hours, only two service vessels are needed to meet the expected demand. During the shoulder season peak hours, the expected demand is 100 passengers per hour. Turning back to the SUMMARY tab, the Manual Fleet values will now be the same as the 51-100 Pax, <20kt values (there may be small differences related to rounding error).

Figure 9: Replicating Automatic Option Manually



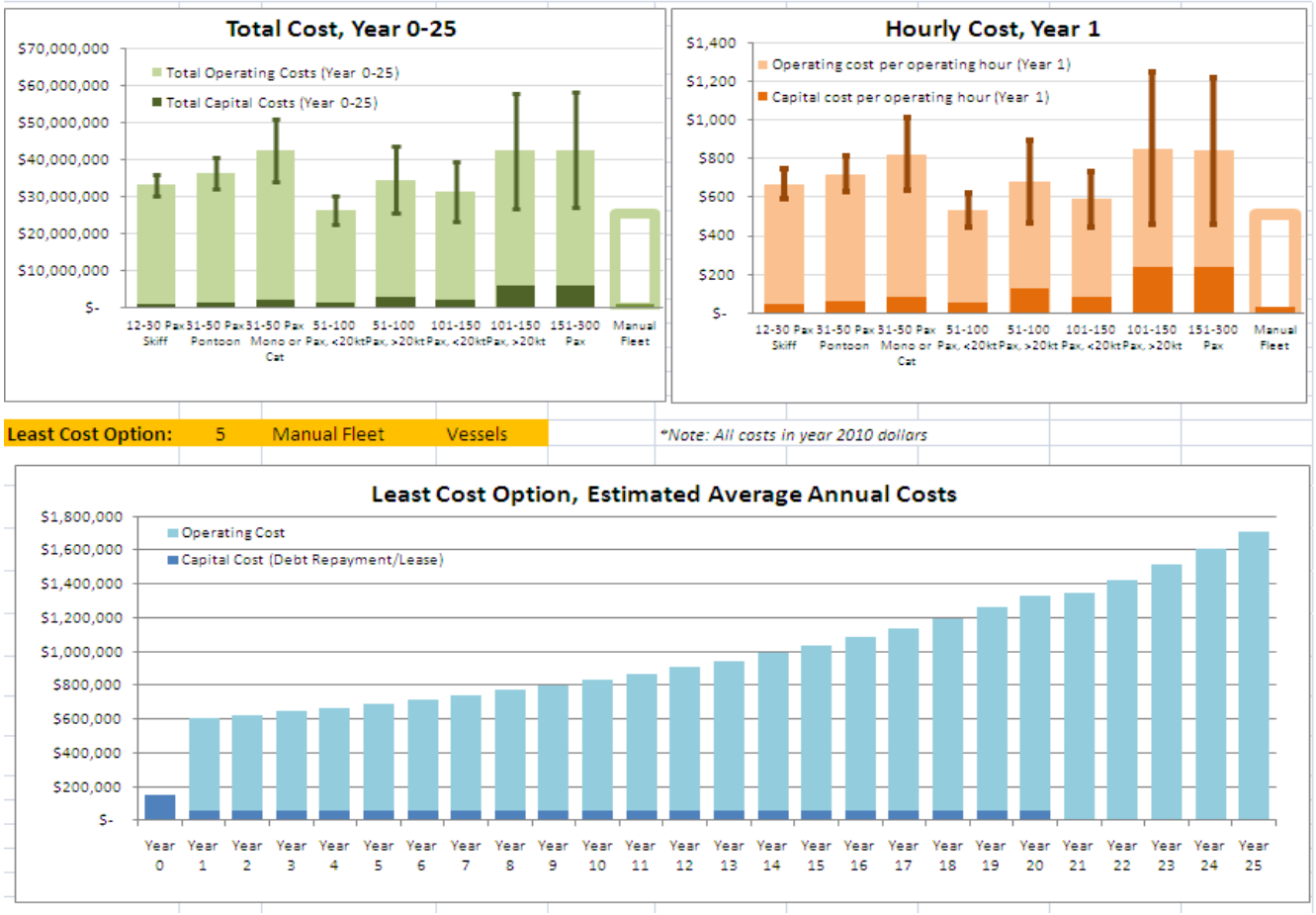
Assume 1/2 peak and off-peak hours during each season							51-100 Pax, <20kt	Manual Fleet
	Alternative Vessel Types							
	12-30 Pax Skiff	31-50 Pax Pontoon	31-50 Pax Mono or C	51-100 Pax, <20kt	51-100 Pax, >20kt	101-		
Spare Vessels				1			5	5
Peak Season, Peak hours								
Service Vessels Needed				4			13	
Passenger capacity/hr				365			65	
Sufficient Capacity?	yes		Peak Demand	300			16	*See MANUAL*
Peak Season, Off-Peak hours							65	
Service Vessels Needed				2				
Passenger capacity/hr				183			$ 510,000	
Sufficient Capacity?	yes		Peak Demand	150			$ 183,326	$ 183,326
Shoulder Season, Peak hours							$ 76,400	$ 76,389
Service Vessels Needed				2			$ 12,400,000	$ 12,500,000
Passenger capacity/hr				183			$ 11,100,000	$ 11,200,000
Sufficient Capacity?	yes		Peak Demand	100			$ 1,300,000	$ 1,300,000
Shoulder Season, Off-Peak hours							$ 477	$ 479
Service Vessels Needed				1			$ 67	$ 67
Passenger capacity/hr				91			$ 4.42	$ 4.43
Sufficient Capacity?	yes		Peak Demand	50				

Reviewing the MANUAL tab information, the user can observe that during the shoulder season peak hours, the expected demand is 100 passengers per hour, while the passenger capacity of the proposed two vessel service is 183 passengers per hour. There may be an opportunity for cost savings if this spare capacity could be reduced. Changing the fleet as shown in Figure 10 reduces some of this spare capacity and results in an estimated cost savings of about $300,000 as shown in Figure 11. The revised manual fleet includes four of the 51-100 Pax vessels and one Skiff. The Skiff helps to meet the expected demand without as much excess capacity.

Figure 10: Example Revised Manual Inputs

Assume 1/2 peak and off-peak hours during each season									
	Alternative Vessel Types								
	12-30 Pax Skiff	31-50 Pax Pontoon	31-50 Pax Mono or C	51-100 Pax, <20kt	51-100 Pax, >20kt	101-150 Pax, <20kt	101-150 Pax, >20kt	151-300 Pax	
Spare Vessels				1					
Peak Season, Peak hours									
Service Vessels Needed	1			3					
Passenger capacity/hr	29			274					
Sufficient Capacity?	yes		Peak Demand	300					
Peak Season, Off-Peak hours									
Service Vessels Needed				2					
Passenger capacity/hr				183					
Sufficient Capacity?	yes		Peak Demand	150					
Shoulder Season, Peak hours									
Service Vessels Needed	1			1					
Passenger capacity/hr	29			91					
Sufficient Capacity?	yes		Peak Demand	100					
Shoulder Season, Off-Peak hours									
Service Vessels Needed				1					
Passenger capacity/hr				91					
Sufficient Capacity?	yes		Peak Demand	50					

Figure 11: Example Revised Manual Fleet on SUMMARY Tab



Step 4. Iterate to Identify Desirable Option

The manual fleet can be iteratively refined to reduce costs and/or meet other constraints. For example, if one or more of the vessels for the service are already known, they can be listed in the manual fleet.

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14. ABSTRACT

The Ferry Lifecycle Cost Model (model) is a spreadsheet-based sketch planning tool that estimates capital, operating, and total cost for various vessels that could be used to provide ferry service on a particular route given known service parameters. Understanding the cost of ferry service is essential for evaluating potential new routes and for adequately planning for the ongoing cost of new and existing routes. The model is designed to allow users to quickly estimate and compare the total costs of offering service with the different vessel types. The model is tailored to planning ferry service that serves federal land management areas (FLMAs). The model includes debt repayment, operating and maintenance costs associated with purchasing, financing and operating several common types of ferry vessels. It does not include landside costs associated with docks and terminals, nor does it include costs for on-board passenger services, such as food service or interpretation. The useful life of ferry vessels varies depending on the size of the vessel, the hull-type, the usage, and maintenance schedule. This model assumes a 25-year useful life for passenger ferries and a 40-year useful life for vehicle ferries.

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