DOWN BAY FERRY
PRELIMINARY DESIGN REPORT

BHGI DOC #: 23494-010_ R1

12NOV25

BRISTOL HARBOR GROUP INC.

Casco Bay Lines
Portland, Maine

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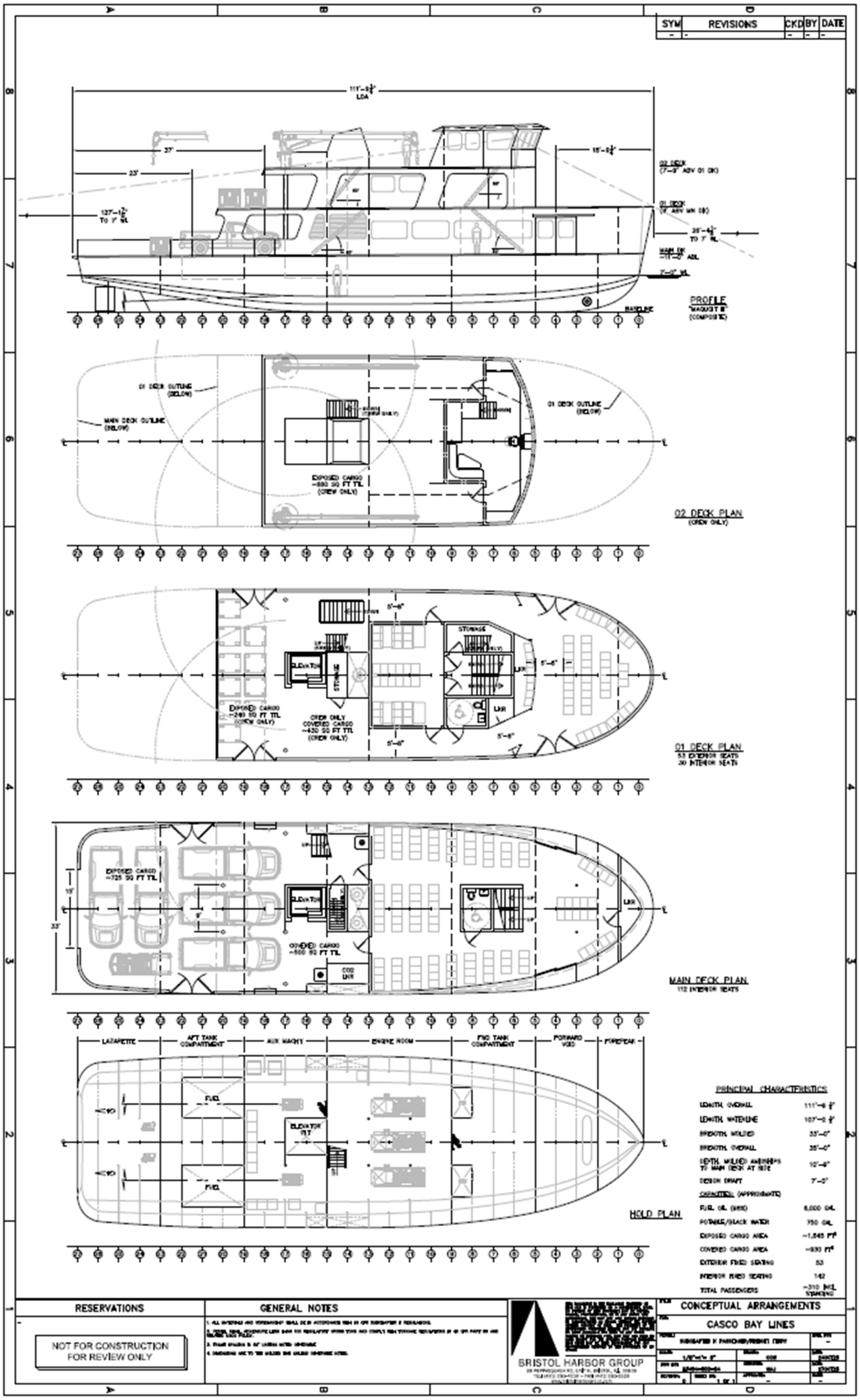
Executive Summary

Bristol Harbor Group, Inc. (BHGI) conducted a preliminary design study for Casco Bay Lines (CBL) to evaluate replacement vessel options for the existing ferry MV MAQUOIT II, currently providing service between Portland, ME and the islands of Casco Bay. The objective of this study was to develop and assess concept level designs that meet CBL's operational requirements, align with existing shoreside infrastructure, and improve upon the current service capabilities.

BHGI recommends proceeding with the design and development of a 111.75'x 35'x 10.75' freight/passenger ferry as shown in Figure 1 (henceforth referred to as Down Bay Ferry). The total allowable passenger count for the proposed design is 310. BHGI recommends that CBL pursue a diesel-electric (DE) propulsion configuration utilizing (3) diesel generators powering (2) electric motors which are connected to (2) fixed pitch propellers. This system offers reduced capital expenditure compared to a hybrid or all electric installation while providing a modular foundation for future upgrades, including potential battery integration as technology matures. The proposed DE arrangement offers operational flexibility, fleet compatibility simplifying maintainability, and opportunities for emissions reduction.

This report summarizes BHGI's efforts to define the recommended vessel configuration, evaluate propulsion alternatives, and establish a baseline technical and cost framework for subsequent design phases. The design process considered several key attributes, including vessel size and layout, hull form efficiency, propulsion system selection, integration with existing freight handling and passenger service operations, and estimated vessel cost.



PROFILE
02 DECK PLAN
01 DECK PLAN
MAIN DECK PLAN
HOLD PLAN
PRINCIPAL CHARACTERISTICS
RESERVATIONS
NOT FOR CONSTRUCTION FOR REVIEW ONLY
GENERAL NOTES
BRISTOL HARBOR GROUP
CONCEPTUAL ARRANGEMENTS
CASCO BAY LINES

Figure 1

BACKGROUND

CBL currently operates the MAQUOIT II, which has provided reliable freight and passenger service since 1995. The MAQUOIT II is a 98'x 32'x 10.75', twin screw, diesel mechanically powered passenger vessel certificated under Subchapter K of 46CFR. CBL has contracted BHGI to develop the design of a replacement vessel. The replacement vessel is also to be certificated under Subchapter K of 46CFR.

Before beginning the design process, BHGI conducted on-site observations aboard the MAQUOIT II to gain firsthand understanding of current vessel operations. BHGI personnel observed docking procedures, freight handling, and passenger operations at Portland and at each island terminal. Interviews with the vessel's captain and crew provided insight into operational strengths, areas for improvement, and features desired in a replacement vessel.

The preliminary design process was guided by input from the Vessel Advisory Committee (VAC**)**, which comprises representatives from each island, CBL management, the CBL board of directors, vessel captains, deckhands, and maintenance personnel. VAC members contributed diverse perspectives regarding operational requirements and priorities for the new vessel. From the outset, the VAC emphasized the following design guidelines:

- The new ferry should function primarily as a freight vessel that carries passengers, rather than as a passenger ferry with secondary freight capability.
- Design tradeoffs that would compromise freight operations were to be avoided.
- The new ferry would be the lifeline to the islanders, and as such, reliability and simplicity should guide the design as much as possible.
- Improving the freight handling if possible and increasing capacity in comparison to MAQUOIT II were desirable.

BHGI conducted multiple design coordination meetings with the VAC, beginning in September of 2024 and continuing through November 2025. VAC member input played a critical role in shaping the recommended design. The process incorporated VAC feedback across numerous working sessions, focusing on vessel size, layout, and regulatory compliance. Passenger and freight flow, freight handling efficiency, and increased capacity relative to the MAQUOIT II were focal points of VAC discussions. The design effort was also guided by the need to work seamlessly with existing shoreside infrastructure, including berthing facilities, loading ramps, and vehicle staging areas. Acquisition and operational costs were also identified as critical by VAC members.

BHGI developed multiple concept arrangements including variations in hull length, beam, and deck layout for review and discussion with the VAC. The final recommended design reflects the collective feedback, operational insights, and priorities expressed throughout this collaborative process, ensuring a vessel well suited to the unique needs of CBL and the communities it serves.

VESSEL DESCRIPTION

GENERAL ARRANGEMENT AND PROFILE

BHGI developed several conceptual arrangements for the proposed replacement ferry. Length overall ranged from 103.83’ to 115.33’. The final recommended length overall is 111.75’. Beam overall ranged from 33’ to 35’. The final recommended beam overall is 35’. All of the concepts were longer and beamier than the MAQUOIT II due to the requirement to increase freight capacity and operational flexibility. Beam was maximized per the allowable space constraints at the Portland terminal. The wider beam also allows for more efficient passenger and freight movements on the 01 deck.

The recommended layout (Down Bay Ferry) is as shown in Reference 7. The layout is intentionally similar to the MAQUOIT II. Input from the vessel operators on the VAC provided insight into the strengths and limitations of freight handling and passenger transit on the MAQUOIT II. Space allocation was revised on the proposed arrangement to eliminate bottlenecks and restrictions while increasing cargo capacity.

Highlights of the proposed design include:

- Significant increase in dedicated deck cargo area compared to the MAQUOIT II
- Covered external deck cargo areas have been incorporated
- External passenger seating on the 01 Deck forward
- The interior layouts have been designed to be in compliance with the Americans with Disabilities (ADA) Act. ADA compliant heads are located on both the Main Deck and the 01 Deck. A passenger elevator was incorporated in the design, accessible from either the Main or 01 Decks.
- The 01 Deck side passageway has been widened to facilitate improved passenger flow
- Maximum passenger count of 310
- (2) deck cranes have been incorporated on the 02 Deck to allow operation from either the port or starboard side of the vessel
- The selected deck cranes have a longer boom than the crane in use on the MAQUOIT II (25’ vs 20’)
- Full beam pilothouse has been incorporated to improve visibility during docking and cargo handling

Figure 2 provides a comparison of the deck area allocated to freight on the MAQUOIT II vs the proposed design.

Deck Cargo Areas (sq ft)			
	MAQUOIT II	Down Bay Ferry	% increase
Main Deck	810	1225	51%
01 Deck	345	670	94%
02 Deck	600	880	47%

Figure 2

Figure 3 provides a breakdown of the fixed seating on the proposed design.

Down Bay Ferry Fixed Passenger Seating		
	Interior	Exterior
Main Deck	112	0
01 Deck	30	53
02 Deck	0	0

Figure 3

The vessel layout maintains a balance between freight capacity and passenger comfort, incorporating similar passenger amenities to those found aboard the MAQUOIT II.

HULL FORM AND LINES

Preliminary hull lines (see Figure 4 and Reference 2) were developed using BHGI's in-house design tools (Rhino and Orca3D Marine Design). Multiple hull forms were evaluated before selecting a final geometry. The selected hull utilizes a double chine and will exhibit greater hydrodynamic efficiency than the existing MAQUOIT II (due to the stern extension that was added to the MAQUOIT II). The improved efficiency will result in reduced resistance and improved fuel economy at service speed. Hull resistance was analyzed using computational fluid dynamics, and refinements were made to achieve an optimal balance between seakeeping, constructability, and operational draft constraints.

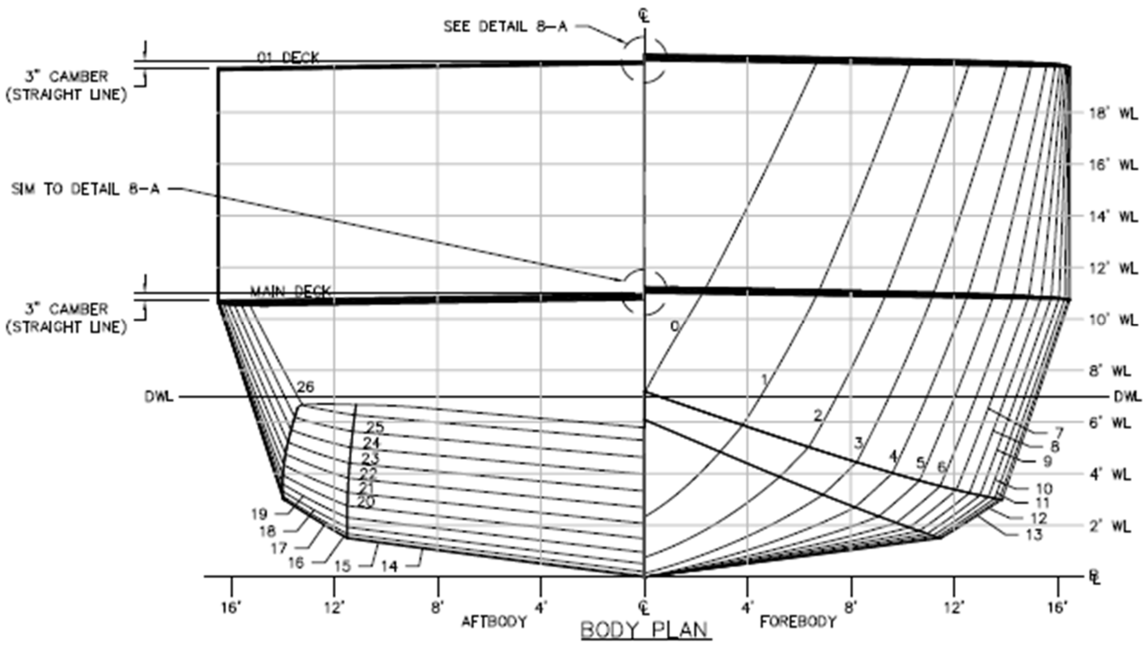


Figure 4

HULL STRUCTURE

The vessels' preliminary structural design was developed in compliance with applicable regulatory standards and best practices for ferries of similar size. The proposed structure ensures optimal strength, stiffness, and weight distribution, while minimizing long term maintenance requirements. The structural design was also developed with an eye towards minimizing construction costs through the use of developable surfaces, flat bar stiffeners, flanged plate girders, and straight-line camber.

The structural design (see Reference 6 for midship scantlings) adheres to the American Bureau of Shipping (ABS) Rules for Building and Classing Marine Vessels (2025). The structure is of all steel construction, chosen for its durability and suitability for the operational environment of Casco Bay. The hull is longitudinally stiffened with transverse bulkheads and tonnage frames, enhancing the vessel's overall strength and rigidity.

Cargo decks are reinforced to accommodate a maximum deck loading of 2,000 PSF, ensuring the vessel can safely transport freight and passengers under varying operational conditions. Additionally, the main structural elements were utilized to enclose the elevator, optimizing space and maintaining structural integrity throughout the vessel.

WEIGHT BUDGET AND STABILITY

A preliminary weight budget (Reference 3) and stability assessment (Reference 4) were developed to verify that the proposed vessel complies with applicable intact and damage stability requirements under Subchapter K of 46 CFR.

The weight budget was organized in accordance with the Ship Work Breakdown Structure (SWBS) format. Structural weight estimates were derived from a complete Rhino surface model of the hull and superstructure. The resulting structural weight served as the basis for estimating the remaining SWBS group weights, including outfitting, machinery, electric, and special features. This approach provides a consistent framework for refining the weight distribution as the design progresses.

A corresponding stability model was developed using GHS software to evaluate intact, damage, and lifting stability across a range of operational loading conditions. The analysis included lightship, departure, and arrival conditions, accounting for both maximum passenger capacity and maximum cargo load scenarios. Vessel route was assumed to be protected waters similar to the MAQUOIT II.

The vessel's intact stability was evaluated in accordance with 46 CFR 170.170 (weather criteria), 170.173 (vessels of unusual proportion and form), and 171.050 (passenger heel). Lifting stability was assessed per 46 CFR 173 Subpart B, and one-compartment damage stability was analyzed in accordance with 46 CFR 171.080(f). Stability criteria were applied to seven representative load cases to ensure compliance under all relevant operating conditions.

Based on the results of these analyses, the proposed vessel meets the applicable Subchapter K stability requirements for all load cases in protected waters up to a maximum LCF draft of 6.98 feet. These results confirm that the baseline configuration provides a sound foundation for continued refinement and detailed design development. Figure 5 illustrates a comparison of the deadweight carrying capacity of the MAQUOIT II vs the proposed design.

MAQUOIT II			
	Cargo (lb)	Passengers (lb)	Total (lb)
300 Passengers	60000	55500	115500
399 Passengers	40000	73815	113815

Down Bay Ferry			
	Cargo (lb)	Passengers (lb)	Total (lb)
310 Passengers	74000	57350	131350
(Full Load)	123%	103%	114%
178 Passengers	106000	32930	138930
(Increased Cargo)	177%	59%	120%

Figure 5

SHORESIDE INTERFACES

The vessel design was developed with careful consideration of compatibility with the existing shoreside infrastructure, including berthing facilities, loading ramps, and vehicle staging areas. Ensuring seamless integration with current operations was a primary objective of the design effort.

Each terminal within the Casco Bay network features distinct docking arrangements, requiring a vessel capable of accommodating a range of interface conditions. Accordingly, flexibility in docking, loading, and unloading operations was identified as a key design requirement.

To maintain operational continuity and minimize shoreside modifications, BHGI established early in the design process that the new vessel should closely match the freeboard and vehicle deck elevations of the existing MAQUOIT II. This approach ensures continued compatibility with current island docks and loading infrastructure. Comparisons of the vessel profiles are shown in Figure 6.

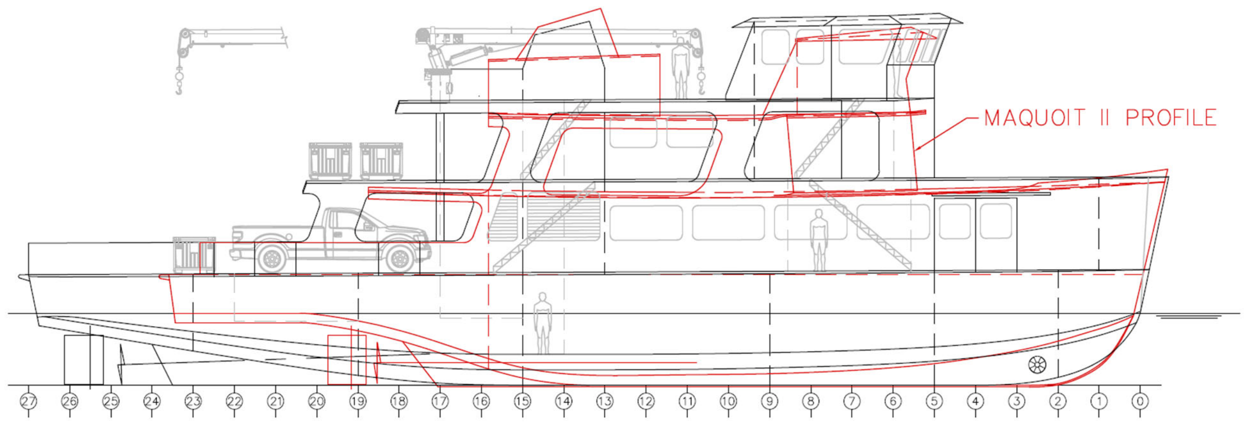


Figure 6

Docking plans were developed (Reference 5) to illustrate and confirm the fit of the proposed hull geometry at each island facility. These plans were presented to the VAC for review and feedback, supporting verification of the vessel's integration with existing berthing configurations.

Considerations were also given to ramp geometry, mooring arrangements, and provisions for shore power connectivity. These assessments confirm that the proposed design maintains operational flexibility while aligning with CBL's established terminal interfaces and service requirements.

PROPULSION STUDY

The power generation plant is the heart of a vessel. This is where energy is created to spin propellers and power the electrical system. Traditional vessel arrangements typically utilize dedicated diesel engines to turn propeller shafts, and separate diesel-powered generators to provide electricity for house loads. This is the system in use on the MAQUOIT II. BHGI, with our sister company The Shearer Group, Inc. (TSGI), analyzed the operational profile of the MAQUOIT II and selected several potential power generation options for evaluation. All of the options considered utilized Caterpillar diesel engines and generators. The power generation systems that were considered and the abbreviations used in this report are:

1. MECH: Diesel mechanical with (2) x C18 engines (500 bkW each) and (2) x house generators (72 ekW each)
2. DE 2xC18s: Diesel electric with (2) x C18 generators (430 ekW each) and (1) x house generator (45 ekW)
3. DE 3xC18s: Diesel electric with (3) x C18 generators (430 ekW each) and (1) x house generator (45 ekW)
4. DEWB NMC: Diesel electric with NMC batteries: (2) x C18 generators (430 ekW each) and 1,000 kWh of NMC batteries
5. DEWB LFP: Diesel electric with LFP batteries: (2) x C18 generators (430 ekW each) and 1,000 kWh of LFP batteries

A Diesel Mechanical (MECH) system is similar to what is in current operation on the MAQUOIT II. This system consists of two prime movers connected to the propulsors via reduction gears. Ship's electrical power is provided by two smaller generators, with one running always while operating. While failures of the above systems may not be common, they were considered in the overall evaluation of redundancy.

In a Diesel Electric (DE) arrangement, the vessel's propellors are turned by large electric motors instead of being coupled directly to a diesel engine. The motors are powered from the ship's electronic switchboard, and that electricity is supplied by diesel powered electric generators. Generators are selected based on their power generation capacity such that at any given time, only two generators are required to be running to support all the loads on the vessel. A third generator is a backup in the event there is loss of one of the other generators due to failure or maintenance requirements. An automatic system brings on the backup generator in the event there is an unexpected shutdown.

A Diesel Electric with Batteries (DEWB) system combines all of the same safety and reliability benefits from a Diesel Electric system but also adds the ability to store electricity as a spinning reserve that can be used to power the vessel on batteries alone, or to supplement the diesel generators to increase the overall efficiency of the vessel. Furthermore, the ability to store and save generated electricity for future use adds additional levels of safety and extra levels of redundancy.

A feasibility study (Reference 8) was conducted on the possible propulsion systems. Criteria to evaluate the propulsion systems include operating expenses (OPEX), capital expenses (CAPEX), sustainability, serviceability, and reliability. OPEX was evaluated by the costs incurred due to frequent engine/generator maintenance, fuel consumption, and electricity usage. CAPEX was evaluated by vessel construction cost estimates and infrequent equipment maintenance costs including overhauls and replacements. Sustainability was evaluated by daily CO_2 emissions. Serviceability was evaluated using five subjective metrics. Reliability was evaluated by the relative availability of the propulsion systems to meet operational requirements. Each propulsion system received a raw score for each criterion. These criteria were assigned weightings to capture the level of importance to the VAC. The final weightings were provided by the VAC and are as shown in Table 7.

Evaluation Criteria	Weighting of Overall Score
OPEX	39%
CAPEX	19%
Sustainability	12%
Serviceability	10%
Reliability	20%

Table 7

The raw score for each criterion was multiplied by the criteria weightings to provide a weighted criteria score. These scores were summed together to calculate the total propulsion system score. The cumulative final scores from the propulsion study are as shown in Table 8.

Evaluation Criteria	MECH	DE 2xC18s	DE 3xC18s	DEWB NMC	DEWB LFP
OPEX	3.08	3.28	3.28	3.90	3.90
CAPEX	1.90	1.77	1.75	1.56	1.65
Sustainability	1.05	1.02	1.02	1.20	1.20
Serviceability	1.00	0.83	0.83	0.66	0.66
Reliability	1.44	0.88	1.69	2.00	2.00
Sum:	**8.47**	**7.78**	**8.57**	**9.31**	**9.40**

Table #8 – Weighted criteria scores and cumulative scores of propulsion systems.

The diesel electric system utilizing (3) C18's (Option #3) was selected as the recommended option. While BHGI recognizes that the recommended configuration did not score the highest in the cumulative summary, it is our opinion that this configuration offers CBL the best combination of benefits while minimizing CAPEX costs.

Based on the assigned criteria weightings, the diesel electric systems with batteries outperformed the other candidate propulsion systems. Incorporating energy storage would reduce operational costs, lower emissions, and improve redundancy with additional and reliable power sources. These improvements are at significant initial (and periodic) expense. Additionally, BHGI notes that adding appropriately matched shoreside charging capabilities would add additional costs that were not included in the CAPEX assessment.

The next highest scoring system was the diesel electric system with (3) C18s. This system had an average score for most criterion considered. This system has improved reliability due to the additional power source but will not require the battery related costs that the diesel electric systems with batteries do. This system retains benefits of a diesel electric system while avoiding the added complexity of energy storage systems. Proceeding with a diesel electric system also offers the potential for incorporating future energy storage capabilities as the technology matures.

BHGI incorporated VAC input related to operator experience, capital cost, lifecycle cost, operational flexibility, and the ability to incorporate future battery augmentation in our determination of which system to recommend. The selected arrangement provides redundancy and simplified mechanical integration, reducing maintenance complexity and accommodating future emission-reduction initiatives.

CONCEPT LEVEL NOISE AND VIBRATION ANALYSIS

BHGI subcontracted with J&A Enterprises, Inc. (J&A) to develop a noise and vibration review of the new ferry design (Reference 10). J&A specializes in noise and vibration analysis and control. J&A has experience with the CBL fleet, having been aboard several of the vessels collecting noise and vibration measurements. As the design was in the conceptual phase during their review, J&A provided a review of the conceptual layout, identified noise and vibration drivers, and provided expected noise levels for multiple powering options.

J&A also developed proposed noise levels that should be included in the contract specifications. J&A's experience with CBL vessels allowed them to provide a comparison of the proposed noise targets of the new ferry design against known CBL vessels. The proposed noise targets are as shown in Figure 9.

Levels _ dB(A) and Class, ABS COMF, limits

Space	Aft Mn Dk, exterior	Passg'r Mn dk Aft	Passg'r Mn Dk,Fwd	Passg'r -01 dk exterior	Pilot Hs
Machigonne	81	79	66 -64	74	
Island Ferry	90		80		64
ABS HAB	85 (workboat HAB)	55	55	65	65
Proposed target Maquoit III	85	65	65	65-70	65

Figure 9

The proposed DE configuration offers advantages in isolating machinery noise and vibration from occupied spaces, particularly when combined with resilient mounting and flexible coupling arrangements.

Concept Level Cost Estimate

BHGI subcontracted with NWE, LLC (NWE) to develop a concept level construction cost estimate. NWE specializes in providing cost estimation services. NWE provides support to both shipyards preparing responses to RFP's as well as vessel designers. Their long experience in the marine industry allows NWE to reliably predict construction costs.

BHGI tasked NWE with developing a baseline concept level cost estimate for a diesel mechanically driven vessel utilizing (2) Caterpillar C18 diesels. NWE developed their cost estimate based on recent shipyard pricing data and similar projects that they have been involved with. Specific major equipment pricing (deck cranes and the elevator) was also included. The baseline cost estimate is shown in Figure 10[1].

HULL ONE - 2025							
VESSEL CONSTRUCTION ESTIMATE							
GROUP	DESCRIPTION	LABOR (HOURS)	MATERIALS ($)	SUBTOTAL ($)	MATERIAL MARKUP ($)	TOTAL ITEM ($)	PERCENT
0	ENGINEERING & YARD SERVICES	0	$ -	$ -	$ -	$ -	0.0%
1	HULL STRUCTURE	18,760	$ 432,287	$ 2,046,000	$ 65,000	$ 2,111,000	13.9%
2	PROPULSION	4,184	$ 1,224,232	$ 1,584,000	$ 184,000	$ 1,768,000	11.6%
3	ELECTRIC PLANT	5,698	$ 733,395	$ 1,223,000	$ 110,000	$ 1,333,000	8.8%
4	COMMAND AND SURVEILLANCE	513	$ 523,118	$ 567,000	$ 78,000	$ 645,000	4.2%
5	MACHINERY, GENERAL	9,443	$ 2,028,690	$ 2,841,000	$ 304,000	$ 3,145,000	20.6%
6	OUTFIT & FURNISHINGS	9,042	$ 1,470,059	$ 2,248,000	$ 221,000	$ 2,469,000	16.2%
8	INTEGRATION	16,504	$ 832,500	$ 2,252,000	$ 125,000	$ 2,377,000	15.6%
9	POST CONSTRUCTION SUPPORT	5,140	$ 820,181	$ 1,262,000	$ 123,000	$ 1,385,000	9.1%
	SUBTOTAL	69,285	$8,064,461	14,023,000	$1,210,000	$15,233,000	
	LABOR RATE - 2025	$86.00	PER HOUR				
	MATERIAL MARKUP	15%		1,210,000			
	PRICE - 2025 DOLLARS			15,233,000			
	CONTINGENCY - CONCEPT DESIGN	15%		2,284,950			
	PRICE WITH CONTINGENCY			17,517,950			

Figure 10

The baseline cost estimate was then adjusted based on the recommended propulsion option to derive a total estimated construction cost (Reference 1). The summary of the concept level cost estimate of the recommended vessel is shown in Figure 11.

[1] All cost estimates are in 2025 USD. No inflation adjustments are included.

Down Bay Ferry Conceptual Cost Estimate (2025 USD)	
Baseline Cost Estimate (Ref 1)	$17,517,950
Adjustment for Propulsion Option 3	$1,596,000
Total Estimated Cost	$19,113,950

Figure 11

Recent shipyard responses to RFP's (both commercial and government issued) have shown consistent upwards deviations from what would have been expected based on historical trends. The deviations can reasonably be ascribed to a combination of spot market conditions and limited shipyard competition. It is likely that both of these conditions will be encountered at the time of issuing an RFP for the Down Bay Ferry construction. It is impossible to estimate the impact of these conditions on the final cost of the project, as the shipyard response to the RFP will likely be market driven, not cost driven. It is BHGI's recommendation that a significant margin be included in the allocated budget to account for this uncertainty.

CONCLUSIONS AND RECOMMENDATIONS

BHGI recommends proceeding with the design and development of a 111.75’x 35’x 10.75’ freight/passenger ferry as outlined in this report. BHGI recommends that CBL pursue a diesel-electric (DE) propulsion configuration utilizing (3) diesel generators powering (2) electric motors which are connected to (2) fixed pitch propellers. This system offers reduced capital expenditure compared to a hybrid or all electric installation while providing a modular foundation for future upgrades, including potential battery integration as technology matures. The proposed DE arrangement offers operational flexibility, fleet compatibility simplifying maintainability, and opportunities for emissions reduction. This configuration provides a sound balance between performance, cost, and future adaptability. The design concept leverages existing infrastructure, maintains freight-handling efficiency, and offers operational flexibility over the existing fleet.

The next steps will include refinement of the arrangements, development of structural, system, outfitting, and electrical drawings, updating the weight and stability models, and development of a contract-level specification suitable for shipyard solicitation. BHGI looks forward to continuing its collaboration with CBL as the project advances into the contract design phase.

RENDERINGS

Figure 12- Rendering based on BHGI dwg 23494-900-02

REFERENCES

#	Dwg / Doc #	Rev	Description
1	23494-045-01	0	Concept Level Cost Estimate
2	23494-105-01	0	Hull Lines
3	23494-115-01	0	Weight Budget
4	23494-150-01	0	Conceptual Stability Report
5	23494-298-01	0	Dock Layouts
6	23494-301-01	0	Midship Section
7	23494-900-04	0	Conceptual Arrangements
8	23494-099-1	0	CBL Ferry Propulsion System Feasibility Study
9	23494-199-6	0	All Electric Ferry Battery Sizing Study
10	J&A Memo	-	Down Bay Ferry Noise & Vibration Review