Gravina Access Project

Construction Cost Estimate Report of the Alternatives to be Considered in the SDEIS Screening Process

A Gateway to the Future
Gravina Access Project

Prepared for:

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Southeast Region

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EXECUTIVE SUMMARY

The cost for the preferred alternative for the Gravina Access Project, as identified in the 2004 *Record of Decision* (ROD) and evaluated in the *Gravina Access Project Environmental Impact Statement* (EIS), exceeds the funding that is currently available for the project, or is expected to become available in the foreseeable future. The Department of Transportation and Public Facilities, Southeast Region (Department), determined that the 2004 cost estimates associated with the alternatives evaluated in the EIS should be updated to 2008 dollars, and should also include the parts of the Gravina Island Highway yet to be constructed. These estimates are then to be used in the identification of reasonable alternatives to be evaluated in a *Supplemental Environmental Impact Statement* (SEIS).

HDR Alaska, Inc reassessed the costs of the six bridge alternatives (C3a, C3b, C4, D1, F1 and F3) and three ferry alternatives (G2, G3 and G4) evaluated in the EIS, as well as the No Action Alternative. Costs of a movable bridge alternative (M1) and a tunnel alternative (T1) were also assessed. In addition, HDR evaluated a design variation of Alternative F3 and a combined C3 and C4, to investigate potential cost savings resulting from changing the design speed, adding an extended approach embankment to or beyond the water's edge (causeway fill to shorten structure length), additional encroachment into the Part 77 airspace, adjusting existing vessel tracklines, or using different component or structure types. These design variants are presented in this Report as Alternatives F3v and C3-4. Subsequently, a phase-constructed approach to the airport ferry alternative (G4), and an alignment modification to the movable bridge alternative (M1) were requested to be considered, and are now identified as Alternatives G4v and M2.

Overall the costs of the alternatives presented in the EIS have increased since the previous evaluation. The F1 alignment was updated, and then the costs for the various elements (in-water substructure work -- deep water piers vs shallow water piers; cofferdams; fenders; long span CIP superstructure vs shorter pre-cast segments; structural quantities – concrete, reinforcing steel, post-tensioning; etc) were then prorated to the other bridge alternatives to update all costs. The biggest cost differential was in superstructure curvature; when the curves were eliminated or reduced on the mainspan, costs were significantly reduced. There is approximately a 20 percent increase in costs due to inflation (17%) and other minor changes for Alternatives F1 and F3, and almost a 55-70 percent increase in the costs for the C and D alignments because of inflation, minor changes and more detailed design information regarding the bridge structure curvature requirements.

The costs for the tunnel and movable bridge alternatives were updated from 2000 and 2005 calculations, while the cost of ferry alternatives were derived from the EIS cost estimates, and increased for inflation.

To ensure a true comparison of the long-term costs of the alternatives, a life-cycle cost analysis was conducted for each alternative. Life-cycle costs incorporate the owner's operation and maintenance costs, and the revenue adjusted life-cycle costs reflect the revenues expected from ferry fares. The following is a summary of the estimated construction and 75-year life-cycle costs for each alternative considered in this Report:

Table 1: Construction and Life-Cycle Costs

Alignment	Construction Cost	Life-Cycle Cost	Life-Cycle Cost (Revenue adjusted)
C3a	$ 463 M	$ 435 M	
C3b	352 M	332 M	
C4	441 M	411 M	
C3-4	240 M	231 M	
D1	291 M	275 M	
F1	375 M	369 M	
F3	304 M	301 M	
F3v	349 M	342 M	
G2	84 M	211 M	$ 168 M
G3	77 M	198 M	155 M
G4	63 M	181 M	138 M
G4v	16 M	148 M	105 M
M1	375 M	388 M	
M2	413 M	445 M	
T1	417 M	442 M	
No-Build	0 M	76 M	30 M

Note: Costs are 2008 dollars

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1.0 INTRODUCTION

1.1 Purpose of this Report

The purpose of this Report is to present cost estimates for the preliminary range of alternatives to be considered in the Gravina Access Project SEIS. This Report updates previous estimates prepared for the alternatives presented in the EIS using 2008 dollars. It also presents cost estimates for other alternatives recently identified as potentially reasonable alternatives by the Department.

1.2 Project Background

The City of Ketchikan is located on Revillagigedo (Revilla) Island, at the extreme southern tip of the Alaska panhandle in the Alexander Archipelago. Revilla Island has steep mountainous terrain, and the majority of the developable flat land is currently occupied by residential, commercial and industrial land uses. However, expansion opportunities exist across the Tongass Narrows on the flatter Gravina and Pennock islands. Travel between Revilla and Gravina islands is possible by a ferry that primarily services the Ketchikan International Airport. Pennock Island is accessed by water taxi or private boat.

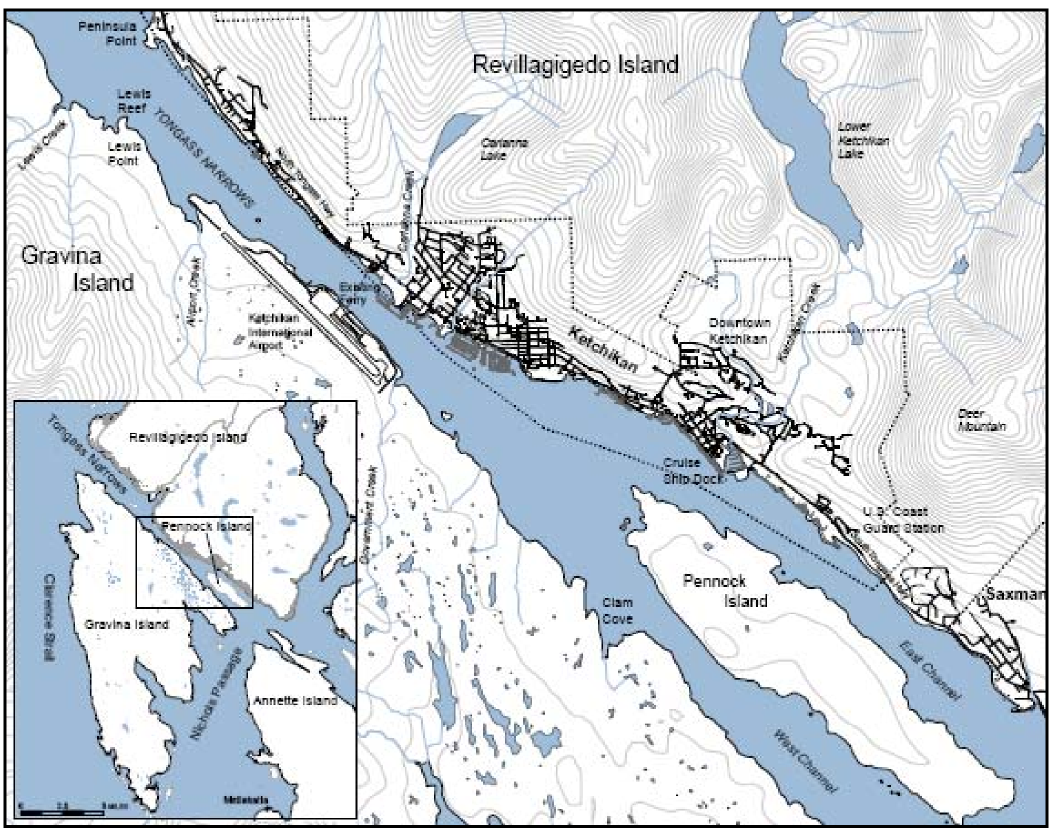


Figure 1: Gravina Island Access Vicinity Map

The purpose of the Gravina Access Project is to improve transportation between Revilla Island and Gravina Island and to provide access to developable and recreational lands. The study area for possible crossing locations is about 8 miles long, from Peninsula Point near Ward Cove to northwest of Saxman (see Figure 1 vicinity map).

In 2004, the Department issued an EIS that considered six bridge alternatives (C3a, C3b, C4, D1, F1 and F3), three ferry alternatives (G2, G3 and G4), and a No Action Alternative to improve access between Revilla and Gravina islands. The ROD identified Alternative F1, which would cross Pennock Island and require bridges over East and West Channels, as the preferred alternative. Well after issuance of the Gravina Access Project ROD, construction cost estimates were updated for the design phase of the project. In 2007, road work commenced on Gravina Island in support of Alternative F1. Subsequently the Governor of Alaska directed the Department to look for the most fiscally responsible alternative for the Gravina Access Project, and in 2008, the Department and FHWA began work on the Gravina Access Project SEIS to identify a lower cost alternative.

1.3 Physical Characteristics of the Project Area

Tongass Narrows is a glacially scoured fjord that is approximately 11 miles long, oriented northwest to southeast. The channel width varies from about 1,200 feet in the vicinity of the airport, to 6,000 feet at the northern end of Pennock Island, to 1,000 and 1,500 feet, respectively, at the West and East Channels around Pennock Island. Bathymetric contours indicate a relatively flat bottom across the channel, with water depths at Mean Lower Low Water (MLLW) varying from approximately 90 to 160 feet. The tidal range is about 24 feet (26.4' maximum range observed). Currents generally trend from the southeast to the northwest during flood tides and reverse during strong ebb tides, but are typically less than 1 knot[1].

Channel bathymetry and geotechnical investigations present a rough estimate of the anticipated depth and possible subsurface conditions that could be encountered at bridge crossing locations. The channel cross-sections show one of three conditions: a thin veneer of sediments over bedrock, a thick layer of glacial drift material overlying bedrock, or loose sands overlying glacial drift and bedrock. Generally, any bridge foundations proposed are envisioned to be drilled piers socketed into the bedrock.

[1] UAA Tidal Current Measurements and Analysis, November 20, 2002, Orson P. Smith, PE, PhD

2.0 DESIGN CONSIDERATIONS SUMMARY

Design criteria for the EIS preferred alternative, Alternative F1, were developed during the EIS and were presented in the draft *Design Study Report* (DSR), which was approved by the Department on August 1, 2005.

During preparation of the EIS, cost estimates made for bridge alternatives near the airport were based on limited design information. Instead, costs of these alternatives were prorated using the cost estimate developed for the EIS preferred alternative.

For this analysis, HDR considered design speed, profile grade, navigational clearance requirements, and facility types to develop detailed construction cost information for potential SEIS alternatives. These design considerations are summarized in the following subsections. All alternatives evaluated in the SEIS incorporate the recently completed Gravina Island Highway, including the No Action Alternative.

2.1 Design Speed

Traffic Volumes. With the consideration of ferry service alternatives, it can be expected that their ticket prices would discourage some drivers, and the anticipated volumes to Gravina Island would be lower. The original traffic projections for access to Gravina Island assumed three growth scenarios[2], of which the medium development scenario was selected. It predicted the traffic counts for bridge crossings at the airport, bridge crossings via Pennock Island, and ferry access, to reach both the airport and Borough-owned lands on Gravina Island. The numbers were developed for a 2025 design year; but with the unavoidable delays, a 2030 design year is now envisioned, and the old counts have been adjusted based on a 2 percent growth rate (the 1990-2000 Ketchikan growth rate was approximately 2%, however, the Alaska Department of Labor projection for 2010-2030 is a decrease of about 1%; even if the higher growth rate does not occur, the counts should not change significantly). The following table is a summary of the anticipated ADTs.

ALTERNATIVE	1999 ADT	2010 ADT	2025 ADT	2030 ADT
Bridge Crossing at Airport			6,600	7,300
Bridge Crossing via Pennock Island		275	8,400	9,300
Improved Ferry Service			1,200	1,300
No-Build	252		1,000	1,100

Table 2: Gravina Island Access Anticipated ADTs

Typical Section. The bridge structures are designed to be consistent with the typical roadway section of the Gravina Island Highway, which was designed to be a part of the National Highway System (NHS). For that facility, the 2005 draft DSR recommended a two-lane, paved, 40-foot wide roadway, generally within a 300-foot wide controlled-access corridor that would allow for frontage road access, utilities, and pathways at a future date. The bridge structures would have the same roadway typical section with the addition of an 8-foot wide walkway adjacent to the full shoulder. It is assumed that the demand for access would not vary, so the traffic volumes for

[2] Northern Economic Traffic Projects Technical Memorandum, 2002

the bridge crossings would remain the same, and therefore, the originally recommended two-lane typical section would remain unchanged for those alternatives. The typical section is shown in Figure 2 below.

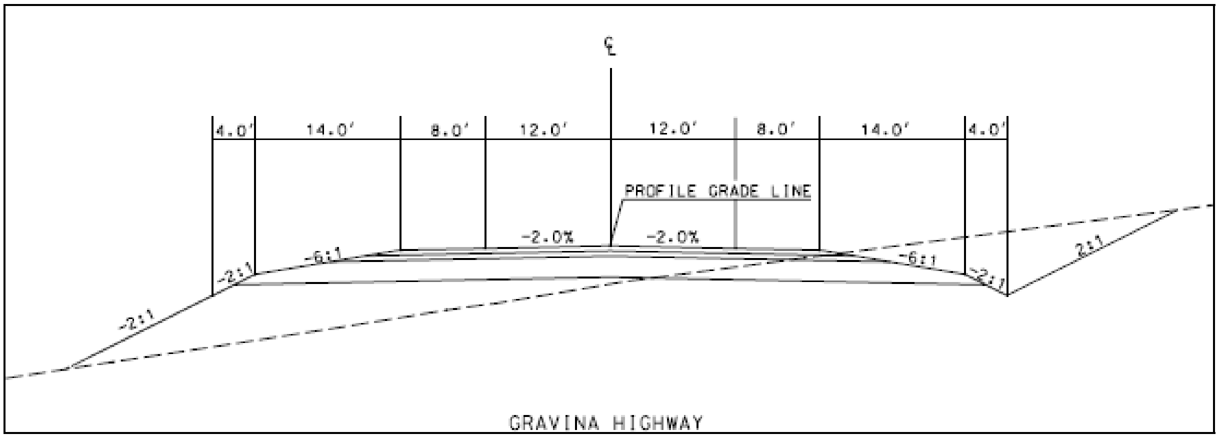


Figure 2: Typical Section

Design Speed. The recommended design speed for the preferred facility was 50 MPH, recognizing that most of the 7 miles of roadway traverses rural undeveloped lands (the 2005 draft DSR, which was specific to Alternative F1, recommended a lower design speed between the end of the East Channel bridge and the intersection with South Tongass Highway to account for the steep grade and abrupt stop condition at the bottom of the hill).

A rural freeway would be expected to have a higher speed than a shorter urban roadway. An alternative that is contained within the urban street network could reasonably be expected to have a lower posted speed, and therefore lower operating speeds. For an NHS urban arterial, a revised design speed of 30 MPH would be consistent with the expected use. It is therefore recommended that the roadways and structures crossing Tongass Narrows near the airport (C3a, C3b, C4, C3-4, D1, M1 and M2) be designed as urban arterials with a design speed of 30 MPH; and the crossings and Gravina Island roadways (F1, F3, F3v, G2, G3 and T1) be designed as rural highways with a design speed of 50 MPH[3].

Appendix A presents the revised urban and rural roadway Design Criteria.

2.2 Navigational Clearances

The 2004 EIS established the minimum vertical clearance to the lowest bridge member for alternatives designed to allow cruise ship passage at 200 feet above Mean Higher High Water (MHHW) (200' above MHHW equals 200.9' above Mean High Water (MHW), 207.4' above Mean Sea Level (MSL), and 215.4' above MLLW). This height was derived using the vertical clearance of Lions Gate Bridge in Vancouver, BC. The vertical clearance at Seymour Narrows aerial cable crossing is 185 feet, but the cable could feasibly be raised to 200 feet, matching the vertical clearance of the Lions Gate Bridge. The largest vessels currently operating in Alaska have an air draft of approximately 175 feet, and an average gross tonnage of approximately 75,000 tons with a number of ships exceeding 110,000 tons. The Alaska Marine Highway

[3] AASHTO Policy on Geometric Design of Highways and Streets, 2001, pages 67-72

System (AMHS) ferries require a minimum vertical clearance of 120 feet above MHHW based upon the current Columbia-class ferries[4].

The EIS also established horizontal navigational clearances, using 550 feet for one-way passage of cruise ships and 500 feet for two-way passage for AMHS ferries.

For the high clearance Alternatives C3a, C4 and C3-4, the AMHS ferries would be required to shift slightly to the cruise industry trackline; for Alternatives M1 and M2, the cruise ships and AMHS ferries would have to adjust to a single new trackline between their current alignments; for Alternative T1, the cruise ships would have to adjust their trackline slightly to the east; for Alternatives F3 and F3v, the cruise ships would have to adopt the AMHS West Channel trackline to achieve structure clearance; and for the low clearance Alternatives C3b and D1, the cruise ships would have to sail around Gravina Island.

The West Channel high bridge alternatives for the cruise industry would require dredging of the West Channel to accommodate the deeper drafts.

The East Channel low bridge associated with Alternatives F3 and F3v would be designed to allow barge traffic with a horizontal clearance of 350 feet and a vertical clearance of 60 feet above MHHW (for comparison, the clearance under the Sitka Japonski Bridge is 50 feet at MHW, and the Gastineau Channel Bridge in Juneau is 51 feet at MHW, about 50 feet at MHHW).

Preliminary engineering work conducted for the EIS confirmed the need for pier protection for all bridge alternatives to protect both the structure and vessel in the event of a collision.

2.3 Profile Grade

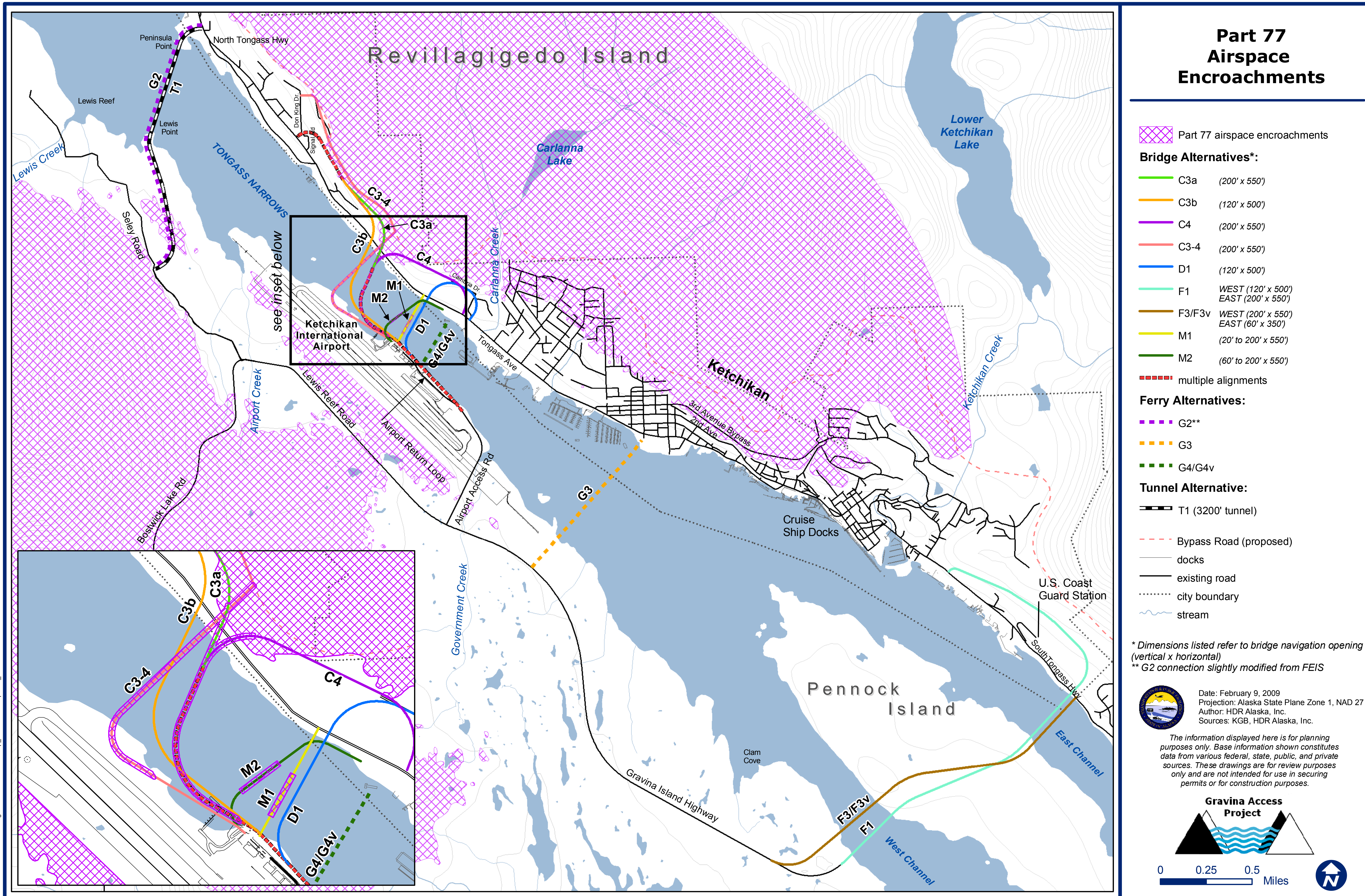
Roadway grades considered in the design of the alternatives are consistent with AASHTO standards; ie, 7 to 11 percent, depending on the local terrain (mountainous), and location (rural or urban). For the most part, the grades associated with the alternatives are less than 6 percent, except for the Cambria Drive approach to the Alternative C4 bridge (8%); both the existing short hill on Misty Marie Lane at WalMart (9%) and the approach to Ketchikan International Airport (8%) on Alternative C3-4; and the large cut to South Tongass Highway on Revilla Island for Alternative F1 (8%).

2.4 FAA Part 77

Within the study area is the Ketchikan International Airport (KTN), a paved 7,500-foot long runway capable of landing jet aircraft in most weather conditions. The Federal Aviation Administration (FAA) Title 14 Part 77 airspace standard regulates adjacent height restrictions for airport environs. The surfaces imposed around Ketchikan's runway are described as:

- From the centerline of Runway 11/29, the *primary surface* extends out horizontally 500 feet on each side (KTN Airport Elevation is 88 feet MSL, 80.6 feet above MHHW).
- At 500 feet, the *transition surface* slopes up at a 7:1 (h:v) to a height of 150 feet above the highest runway elevation (230.6 feet above MHHW).

[4] Glosten Reconnaissance of Vessel Navigation Requirements, May 2003



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- At 150 feet above the Airport Elevation, the flat *horizontal surface* extends out to a distance of 10,000 feet from the runway centerline.
- At the end of the horizontal surface, the *conical surface* rises on a slope of 20:1 (430.6 feet above MHHW) for a horizontal distance of 4,000 feet.
- The end of the Part 77 airspace is at 14,000 feet from the runway centerline at elevation 430.6 feet above MHHW.

Of the seven single bridge alternatives across Tongass Narrows at the airport, all but two penetrate the FAA Part 77 airspace: C3a, C4, C3-4, M1, and M2 were designed with high bridges that allow for cruise ship passage.

The *approach surfaces* at each end of the KTN runways are different. Runway 11 is an instrument approach, but runway 29 is a visual approach from the south at 34:1 that ends at the outside edge of the horizontal surface (at elevation 430.6 feet, 14,000 feet from the runway threshold). The alignments for Alternatives F1, F3, and F3v are just outside these limits, and with a concrete box girder type structure they would have no impact on the approach. However if a cable-stayed bridge were constructed, FAA would probably require special lighting since the towers are about 600 feet tall. Penetrations into this Part 77 airspace must be approved by the FAA prior to construction.

2.5 Ferries

The Ketchikan Gateway Borough currently operates ferry service (*Bob Ellis* and *Oral Freeman*, however the *Bob Ellis* is scheduled to be replaced by the end of 2010 with one similar to the *Oral Freeman*) from Revilla Island to the airport on Gravina Island. The EIS analyzed three ferry alternatives that would add ferry service at different locations: one at Peninsula Point (Alternative G2), one near downtown at Bar Point (Alternative G3), and one adjacent to the existing service at Charcoal Point directly across from the airport (Alternative G4). Under each ferry alternative, the existing ferry service would continue to operate, resulting in a total of four terminals (three under G4), four docks, and four ferries. The terminals would have limited parking (with the exception of the Charcoal Point terminal which has a large short-term and long-term parking lot), a ticket booth and passenger shelter, and electrical power.

Alternatives G2 and G3 are intended to be closer to populations north or south of the existing ferry crossing, and to also provide service to Borough-owned lands. The *purpose and need* statement includes providing cost-effective access to the Borough's land for long-term development and recreation that would be enhanced by this project. Ferry alternatives were therefore included for initial construction at Peninsula Point (G2) or Bar Point (G3) specifically to promote economic development.

It is assumed the ferry alternatives would operate at current levels: 15 minute cycles during the summer, and 30 minute cycles throughout the rest of the year. In order to provide improved service, all ferry alternatives are planned to operate 16 hours per day (two shifts), with four ferries during the summer peak demand, and two for the rest of the year.

All the ferry alternatives include two features not considered in the EIS. An enclosed 1500 SF 60 passenger waiting area with restrooms and enhanced baggage handling (luggage and passenger shuttle vans) would be provided at Charcoal Point on Revilla Island for walk-ons to the passenger terminal at the airport. This location has the largest parking lot to accommodate people who want to leave their car (or are dropped off) and then walk to the airport; not many walkers are expected at either Peninsula Point or Bar Point, and therefore only minimal passenger waiting facilities are being provided at those locations. The cost of the walk-on shuttle service would be included in the price of the ferry ticket.

The ferry alternatives also include a new dock and ¾-acre freight terminal (see Figure 3) near the airport just south of the existing ferry berth, to provide heavy freight access to Gravina Island not currently provided by the existing ferry. This facility would be capable of landing vessels and barges carrying large heavy loads, such as construction equipment and materials, transit mixers, fuel tankers, and fire trucks. The terminal would also be able to accommodate the larger AMHS MV Malaspina and Matanuska vessels. Dock facilities that can accommodate the large loads are currently available only on Revilla Island (AMHS terminal facilities, Saxman Seaport, Alaska Marine Lines, and Northland Services).

Figure 3: Gravina Island Heavy Freight Dock and Staging Area

The baggage handling and heavy freight dock costs were provided by the Department, and are included in the updated ferry alternative cost estimates.

2.6 Tunnel

Tunnel alternatives were considered in the initial range of alternatives developed for the EIS. Through a screening process, the tunnel alternatives were eliminated from detailed evaluation in the EIS based on high construction and maintenance and operational costs. At the Administration's request in 2006, cost estimates were developed for a submersed tunnel alternative between Peninsula Point and Lewis Point that would have an enclosed length of approximately 3,200 feet, and provide for either a 26 foot or 40 foot wide roadway with an enclosed 8 foot walkway and a separate ventilation chamber. In addition to having a high maintenance component, a tunnel alternative would require dedicated operators to monitor the operations, which is assumed to be available at all hours, every day. A tunnel of this length also necessitates compliance with the *National Fire Protection Agency* (NFPA) ventilation requirements.

2.7 Movable Structures

A moveable bridge alternative was also considered in the initial range of alternatives developed for the EIS, but was eliminated from detailed analysis because the anticipated frequency of bridge openings would not provide convenient and reliable access to Gravina Island. Based on comments received during scoping and at the US Coast Guard's request, the estimate for a movable bridge was updated. A low flat crossing was developed to provide the lowest cost movable span to meet the agency request, and then a second option was looked at to provide a movable span that was more reasonable in terms of both traffic and navigation operation.

The cost estimate is based on a vertical-lift structure, which is a simple span with lifting towers at the support ends. This type of moveable bridge is the only type that could accommodate the required cruise ship navigational clearances in the raised position; ie, 200 foot vertical and 550 foot horizontal clearances (a similar bridge is shown in Figure 4 below). Each corner of the lift span would be elevated with cables that run from the span up and over sheaves (large rollers) at the top of the towers, and their ends would then be connected to counterweights that are almost equal to the weight of the structure. The weight of the steel truss lift span would be about 6 million pounds. The potential for cable stretch that may cause the lift to jam requires constant monitoring; but stretch can be avoided with cables that are properly manufactured and installed. A lift bridge requires large members that catch more wind force than a standard profile structure. The towers and span for a vertical-lift structure in the open position cause significant over-turning moments from wind loads, and the foundations cannot allow for any settlement resulting in more substantial stresses. A fendering system to deflect any ship collision has to be provided on all tower corners. The lifting towers would be designed and constructed to address these concerns, which also adds to their cost.

Figure 4: Arthur Kill Vertical-Lift Bridge

In addition to having a high maintenance component, a moveable bridge alternative would require a dedicated operator during operation, which is assumed to be available 24 hours per day, every day. The bridge's minimum vertical clearance in the lowered position would be either 20 feet or 60 feet above MHHW depending on alternative (M1 or M2, respectively). Therefore, almost all commercial vessels would require the bridge to be lifted in order to pass. Because of liability concerns, the lift span would be raised to the full extent for each passage request.

The time to raise the span, allow a vessel to pass, and then lower the span can be considerable – up to 30 minutes for each passage. The following are the anticipated cycle times:

- Change traffic signals, clear vehicles, and lower oncoming traffic gates 1 minute
- Raise lift span (minimum) 2 minutes
- Passage of navigational traffic 20 minutes
- Lower left span and seat (minimum) 2.5 minutes
- Change traffic signals and raise gates 1 minute

2.8 Pedestrians

While not anticipated to be a high number, there are expected to be pedestrians and cyclists interested in crossing over to Gravina Island. The majority of this volume will probably be tourists walking to mid-span of a bridge crossing for the view. All of the bridge structures will include an 8-foot wide pedestrian walkway. The tunnel includes a separate, enclosed 8-foot walkway below the ventilation chamber. The ferries also accommodate walk-ons. At the current time, there are no provisions for additional sidewalks or separated trails off the structures, and the users will need to use the shoulder of the roadway. The proposed right-of-way widths do accommodate a future pathway system.

2.9 Utilities

The bridge and tunnel alternatives will not initially have utilities on them, but the utility companies will be informed that if they want space on these structures, they need to contact the Department with their desires and design criteria.

3.0 ALTERNATIVES EVALUATED

The following alternatives were evaluated in the EIS and are included in this *Construction Cost Estimate Report* (see map on next page):

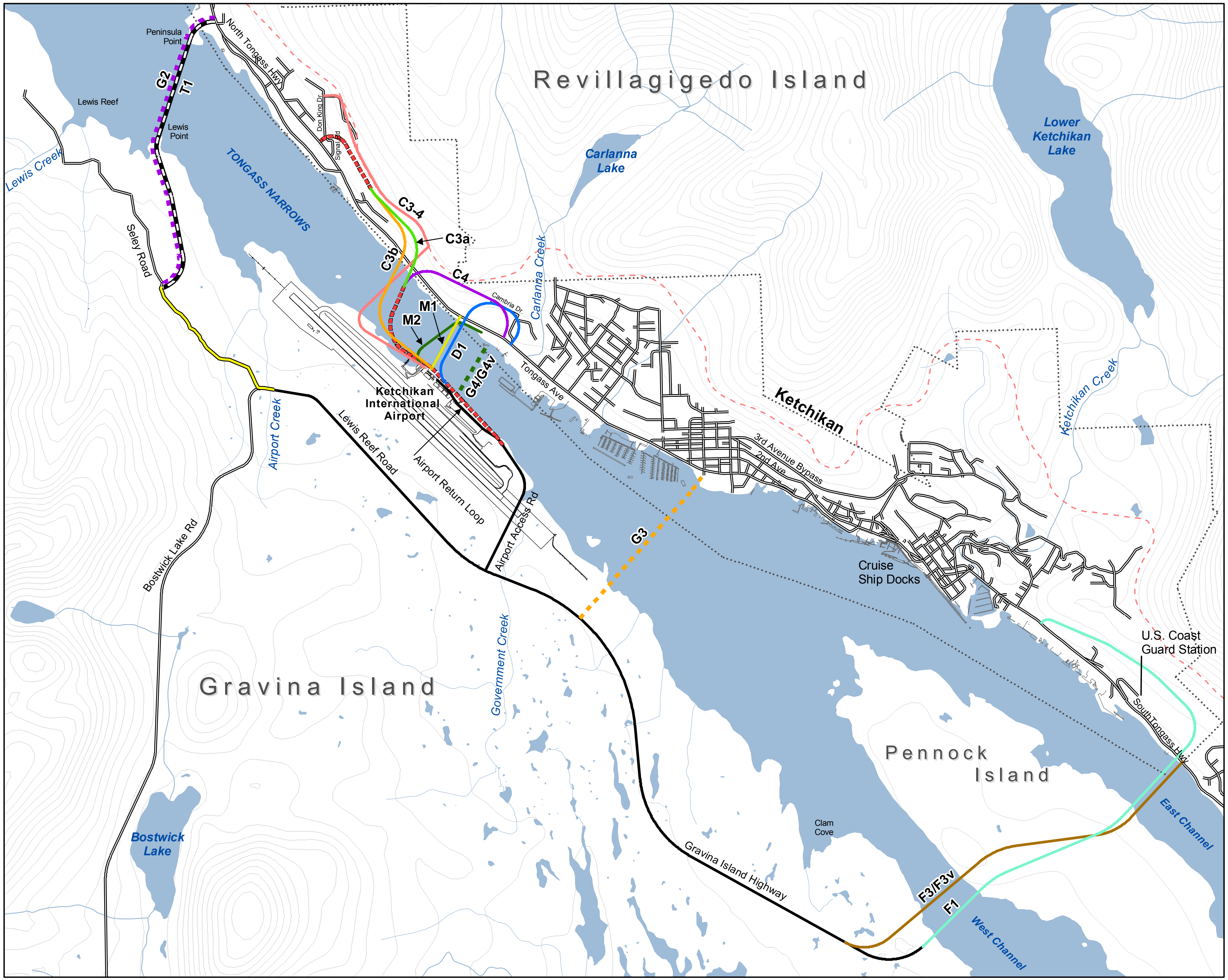
- **Alternative C3a** -- bridge between North Tongass Highway at Signal Road and north of the airport terminal (200-foot vertical clearance)
- **Alternative C3b** -- bridge between North Tongass Highway at Signal Road and north of the airport terminal (120-foot vertical clearance)
- **Alternative C4** -- bridge between Tongass Avenue north of Cambria Drive and north of the airport terminal (200-foot vertical clearance)
- **Alternative D1** -- bridge between Tongass Avenue at Cambria Drive and north of the airport terminal (120-foot vertical clearance)
- **Alternative F1** -- bridges across East and West Channels via Pennock Island (200-foot and 120-foot clearances, respectively) connecting South Tongass Highway to the airport terminal via the Gravina Island Highway
- **Alternative F3** -- bridges across East and West Channels via Pennock Island (60-foot and 200-foot clearances, respectively) connecting South Tongass Highway to the airport terminal via the Gravina Island Highway
- **Alternative G2** -- ferry between Peninsula Point and Lewis Point, connecting North Tongass Highway with the airport terminal via Lewis Reef/Seley Roads
- **Alternative G3** -- ferry between downtown at Bar Point and Clump Cove, connecting downtown with the airport terminal via the Gravina Island Highway
- **Alternative G4** -- ferry between new terminals adjacent to existing ferry terminals, connecting Charcoal Point with the airport terminal
- **No Action Alternative** -- continued ferry service to the airport terminal

Additional alternatives examined in this Report include:

- **Alternative F3v** -- a variation on Alternative F3 that increases fill and minimizes the length of the bridge structures
- **Alternative C3-4** -- bridge between Bench Road near Signal Road and north of the airport terminal (200-foot vertical clearance)
- **Alternative G4v** – a phase-constructed variant of Alternative G4
- **Alternative M1** -- moveable bridge on a straight flat alignment directly in front of the airport passenger terminal (20x200-foot vertical clearance in the raised position)
- **Alternative M2** – movable bridge on a curvilinear alignment at existing ferry location (60x200-foot vertical clearance in the raised position)
- **Alternative T1** -- tunnel between Peninsula Point and Lewis Point, connecting North Tongass Highway with the airport terminal via Lewis Reef/Seley Roads

Descriptions of the alternatives are provided in the following paragraphs.

Alternatives to be Considered in the SDEIS Screening Process



recently constructed roads common to multiple alternatives

road constructed independent of FEIS

Bridge Alternatives*:

- C3a *(200' x 550')*
- C3b *(120' x 500')*
- C4 *(200' x 550')*
- C3-4 *(200' x 550')*
- D1 *(120' x 500')*
- F1 *WEST (120' x 500') EAST (200' x 550')*
- F3/F3v *WEST (200' x 550') EAST (60' x 350')*
- M1 *(20' to 200' x 550')*
- M2 *(60' to 200' x 550')*
- multiple alignments

Ferry Alternatives:

- G2**
- G3
- G4/G4v

Tunnel Alternative:

- T1 (3200' tunnel)

Bypass Road (proposed)

docks

existing road

city boundary

stream

** Dimensions listed refer to bridge navigation opening (vertical x horizontal)*
*** G2 connection slightly modified from FEIS*

Date: February 12, 2009
Projection: Alaska State Plane Zone 1, NAD 27
Author: HDR Alaska, Inc.
Sources: KGB, HDR Alaska, Inc.

The information displayed here is for planning purposes only. Base information shown constitutes data from various federal, state, public, and private sources. These drawings are for review purposes only and are not intended for use in securing permits or for construction purposes.

Gravina Access Project

0 0.25 0.5 Miles

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3.1 Alternative C3a

Figure 5: Alternative C3a bridge from north of Wolff Point on North Tongass Highway, looking south

Alternative C3a provides a bridge across Tongass Narrows approximately 2,500 feet north of the Ketchikan International Airport passenger terminal. The length of the alternative alignment would be 1.95 miles, including the 6,800-foot long bridge. The bridge would have a maximum height, excluding lighting, of approximately 265 feet above MHHW. The main span of the bridge would have a vertical navigational clearance of 200 feet above MHHW and a horizontal navigational clearance of at least 550 feet. The main span of the bridge would be located over water with depths in excess of 40 feet at MLLW to accommodate deep draft vessels. These clearances would accommodate one-way passage of cruise ships and two-way passage of most other ships including the largest AMHS ferries. The main span eastern pier would be in water about 115 feet below MLLW, and the western pier would be about 70 feet deep.

On Revilla Island, the paved road alignment would begin at the North Tongass Highway near Signal Road. The connection at North Tongass Highway would be the only access to this route on Revilla Island; no neighborhood streets would be used for cut-through access. From this terminus, the alignment would traverse the hillside southward, gain elevation, and turn southwestward. The bridge would cross over North Tongass Highway and Tongass Narrows, and then turn southward paralleling the Narrows and descend to the ground surface on Gravina Island south of the terminal. A 0.34 mile long airport return loop road would connect the bridge approach to the airport terminal. The total road distance between Signal Road and the airport passenger terminal is 2.22 miles.

Due to the close proximity to the airport runway, the bridge is expected to penetrate the FAA Part 77 airspace (about 265’ vs 230.6’). Since the surrounding topography already penetrates significant portions of the Part 77 airspace, the infringement of the bridge is not expected to be a large issue.

The alignment of Alternative C3a is shown in Appendix E.

3.2 Alternative C3b

Alternative C3b provides a bridge across Tongass Narrows approximately 3,000 feet north of the airport passenger terminal. The alignment would be about 1.72 miles long, with a bridge that would be approximately 4,250 feet long, and have a maximum height of approximately 175 feet. The main span of this bridge would have a vertical navigational clearance of 120 feet above MHHW and a horizontal navigational clearance of more than 500 feet. The main span would be located over water with depths in excess of 40 feet at MLLW. These clearances would accommodate passage of shipping as large as the AMHS ferries, but not the largest cruise ships. The main span eastern pier would be in water just over 100 feet deep, and the western pier would be about 90 feet deep.

On Revilla Island, the paved alignment would connect to North Tongass Highway near Signal Road. Similar to Alternative C3a, this intersection would be the only access point. Alternative C3b would have the same general alignment on Revilla and Gravina Islands as Alternative C3a, but with a lower bridge profile. The alignment's touchdown on Gravina Island would be closer to the airport passenger terminal, necessitating only a 0.03 mile airport return loop road. The total road distance from Signal Road to the airport passenger terminal is 1.58 miles.

Figure 6: Alternative C3b bridge from north of Wolff Point on North Tongass Highway, looking south

This alternative does not penetrate the FAA Part 77 airspace.

The alignment of Alternative C3b is shown in Appendix F.

3.3 Alternative C4

Alternative C4 includes a bridge across Tongass Narrows approximately 2,500 feet north of the airport passenger terminal, generally on the same structure alignment as Alternative C3a. This alignment would be 1.88 miles long, and the bridge would be approximately 5,000 feet long and have a maximum height of approximately 260 feet. The main span of this bridge would have a vertical navigational clearance of 200 feet above MHHW and a horizontal navigational clearance of over 550 feet. The main span would be located over water with depths in excess of 40 feet at MLLW to accommodate deep draft vessels. These clearances would accommodate one-way passage of cruise ships and two-way passage of most other ships, including AMHS ferries. The main span eastern pier would be in water about 115 feet deep, and the western pier would be about 50 feet deep.

Figure 7: Alternative C4 bridge from north of Wolff Point on North Tongass Highway, looking south

On Revilla Island, the paved alignment would connect to Tongass Avenue north of Cambria Drive, across from the access to the existing ferry terminal. The connection at Tongass Avenue would be the only access to this alternative alignment on Revilla Island; no neighborhood streets would be used for cut-through access. From this terminus, the alignment would extend northward and traverse the hillside around the quarry; the bridge would cross over North Tongass Highway and Tongass Narrows, turn southward to parallel the airport runway, and then touch down on Gravina Island south of the airport passenger terminal. A 0.35 mile long airport return loop road would connect the bridge approach to the terminal. The total road distance between Cambria Drive and the airport passenger terminal is 1.96 miles.

Due to the close proximity to the airport runway, the bridge is expected to penetrate the FAA Part 77 airspace (about 260' vs 230.6'). Since the surrounding topography already penetrates significant portions of the Part 77 airspace, the infringement of the bridge is not expected to be a large issue.

The alignment of Alternative C4 is shown in Appendix G.

3.4 Alternative C3-4

Since issuance of the EIS, the Borough finalized its preferred routing for the Bench (ByPass) Road on the small topographic bench above the touchdown points on Revilla Island of the bridge alternatives near the airport. A small refinement of alignment C3a or C4 using the proposed Bench Road to Rex Allen Drive/Misty Marie Lane/Signal Road near the WalMart parking lot rather than a large cut to North Tongass Highway would minimize costs of excavation and the curved structure on the eastern approach. If the trackline is allowed to be moved to the east, the mainspan and backspans of the crossing could then be segmental concrete box girders on tangent. With the 30 MPH design speed, the curvature is moved off the backspan. The curve at the transition pier and approach tangent on the west could then be constructed of the Department's preferred precast concrete deck bulb-T girders. The tangent spans could be constructed of 100- to 140-foot precast girders or even 200-foot spliced precast girders. Alternative C3-4 is 1.86 miles long with a structure length of 4,190 feet. The navigational opening would be 200 feet high and at least 550 feet wide. The main span would be located over water with depths in excess of 40 feet at MLLW. These clearances would accommodate one-way passage of cruise ships and two-way passage of most other ships, including AMHS ferries. The main span eastern pier would be in water about 115 feet deep, and the western pier would be about 100 feet deep.

Figure 8: Alternative C3-4 bridge from north of Wolff Point on North Tongass Highway, looking south

Alternative C3-4 provides a bridge across Tongass Narrows approximately 3,000 feet north of the airport passenger terminal, for a total road distance from Misty Marie Lane at the WalMart to the airport passenger terminal of 1.95 miles. The costs of constructing Misty Marie Lane and the Bench Road are included in the engineer's estimate.

Due to the close proximity to the airport runway, the bridge is expected to penetrate the FAA Part 77 airspace (about 290' vs 230.6'). Since the surrounding topography already penetrates significant portions of the Part 77 airspace, the infringement of the bridge is not expected to be a large issue.

The alignment of Alternative C3-4 is shown in Appendix H.

3.5 Alternative D1

Alternative D1 includes a bridge that would cross Tongass Narrows directly east of the airport passenger terminal. The alignment would be about 1.35 miles long, and the bridge would be approximately 3,600 feet long and have a maximum height of approximately 165 feet. The main span of this bridge would have a vertical clearance of 120 feet above MHHW and a horizontal clearance of approximately 500 feet. The main span would be located over water with depths in excess of 40 feet at MLLW. These clearances would accommodate passage of shipping as large as the AMHS ferries, but not the largest cruise ships. The main span eastern pier would be in water just over 100 feet deep, and the western pier would be about 55 feet deep.

Figure 9: Alternative D1 bridge from near Wolff Point on North Tongass Highway, looking south

On Revilla Island, the paved road would connect to Tongass Avenue at Cambria Drive near the existing airport ferry terminal. The connection at Tongass Avenue would be the only access to this alternative alignment on Revilla Island; no neighborhood streets would be used for cut-through access. From here, the alignment would rise along the hillside and turn westward; the bridge would cross over North Tongass Highway and Tongass Narrows, and then turn southward to parallel the shoreline on Gravina Island eventually landing south of the airport terminal. A 0.35 mile long airport return loop road would connect the bridge approach to the terminal. The total road distance between Cambria Drive and the airport passenger terminal is 1.43 miles.

This alternative does not penetrate the FAA Part 77 airspace.

The alignment of Alternative D1 is shown in Appendix I.

3.6 Alternative F1

Alternative F1 is approximately 5.88 miles long, and would cross *Tongass Narrows* via Pennock Island with two bridges. One bridge would cross the East Channel and the other would cross the West Channel. The East Channel bridge would be approximately 3,400 feet long, and have a maximum height of approximately 285 feet as it rises up to meet the Pennock Island bluff. The bridge would have a vertical navigational clearance of 200 feet above MHHW and a horizontal navigational clearance of approximately 550 feet. The main span of the bridge would be centered on the cruise ship trackline and would be over water with depths in excess of 40 feet at MLLW to accommodate deep draft vessels. These clearances would accommodate one-way passage of cruise ships and two-way passage of most other ships, including AMHS ferries.

The West Channel bridge would be approximately 2,465 feet long and have a maximum height of approximately 160 feet. The bridge would have a vertical navigational clearance of 120 feet above MHHW and a horizontal navigational clearance of approximately 500 feet. The main span would be located over water with depths in excess of 40 feet at MLLW. These clearances would accommodate passage of ships as large as the AMHS ferries, but not the largest cruise ships.

Figure 10: Alternative F1 bridges and Pennock Island from mid-Tongass Narrows near the airport, looking south

The bridge crossings of East and West Channels are perpendicular to the main navigational tracklines. Both the East Channel main span piers would be in water about 110 feet deep. The West Channel main span western pier would be in water just under 90 feet deep, and the eastern pier would be on dry land.

On Revilla Island, the Alternative F1 alignment would connect to South Tongass Highway just south of Deermont Street and near the southern end of the quarry. The connection at South Tongass Highway would be the only access to the alignment on Revilla Island. From this terminus, the alignment would rise to the southeast in a deep rock cut along the hillside (and east of the tank farm, the cemetery, and the US Coast Guard Station), turn westward skirting the southern end of the USCG property and north side of the Forest Park subdivision, and cross over South Tongass Highway and the East Channel to Pennock Island. The alignment would cross the main plateau of Pennock Island before crossing the West Channel. The West Channel bridge would cross to Gravina Island and connect with the Gravina Island Highway, which continues northward approximately 3.15 miles to its intersection with the Airport Access Road and Lewis Reef Road. At the intersection, the 1.15-mile long paved Airport Access Road would then connect to the airport passenger terminal. The total road distance from Revilla Island to the airport passenger terminal is 7.03 miles.

The alignment of Alternative F1 is shown in Appendix J.

3.7 Alternative F3

Similar to Alternative F1, the 4.71 mile long Alternative F3 would have bridges that cross the two channels of Tongass Narrows via Pennock Island. The East Channel bridge would be approximately 1,985 feet long and have a maximum height of approximately 115 feet. The bridge would have a vertical navigational clearance of 60 feet above MHHW, lower than any of the other bridge options, and a horizontal clearance of approximately 350 feet. These clearances would not accommodate cruise ships or ferries that currently use the East Channel as their primary navigational route. The primary users are anticipated to be tug and barge transportation for both dry and liquid cargoes throughout southeast Alaska.

Figure 11: Alternative F3 bridges and Pennock Island from mid-Tongass Narrows near the airport, looking south

The West Channel bridge would be approximately 2,470 feet long and have a maximum height of approximately 270 feet. The bridge would have a vertical navigational clearance of 200 feet above MHHW and a horizontal navigational clearance of approximately 550 feet. These clearances would accommodate one-way passage of cruise ships and two-way passage of most other ships, including AMHS ferries.

In order to improve its navigational characteristics for cruise ships transiting the West Channel, the narrowest portion of the channel under this alternative would be widened. Currently, the width of the navigable portion of West Channel (ie, with respect to large cruise ships) is approximately 400 feet at its narrowest point with a minimum depth of 40 feet below MLLW. With the modifications, this portion of the channel would have a new channel width of 750 feet -- the center 550 feet would have a minimum depth of 40 feet below MLLW and both remaining sides would have a minimum depth of 30 feet below MLLW. The deepest part of the new channel would be centered on the navigational opening of the West Channel bridge. The dredged quantity is approximately 184,000 CYs over 16 acres. The bridge would be located at the southern end of the widened channel, which would extend approximately 2,000 feet north of the bridge. South of the bridge crossing, and north of the channel improvement area, the existing channel is wider and deeper than the improvement.

Both crossings would be located over water with depths in excess of 40 feet at MLLW. The bridge crossing of the West Channel would be perpendicular to the main navigational channel.

The eastern East Channel main span pier could be in water as deep as 120 feet, and the western pier in only 40 feet of water. Both the West Channel main span piers would be in water just over 40 feet deep.

On Revilla Island, the East Channel bridge would connect directly to South Tongass Highway between the US Coast Guard Station and the Forest Park subdivision. From here, the bridge would rise across the East Channel and then traverse Pennock Island. From Pennock Island, the West Channel bridge would cross to Gravina Island and connect with the Gravina Island Highway. The paved Gravina Island Highway would continue northward approximately 2.99 miles to its intersection with the Airport Access Road and Lewis Reef Road. The 1.15 mile paved Airport Access Road would then go down the hill, under the runway and north along the Channel to the terminal. The total road distance between Revilla Island and the airport passenger terminal is 5.87 miles.

The alignment of Alternative F3 is shown in Appendix K.

3.8 Alternative F3v

Alternative F3v would be located on the same alignment as Alternative F3, and have a total road distance of 5.87 miles. The main difference between the Alternatives F3 and F3v is the use of fill to minimize the length of the bridge structures crossing both channels.

The use of embankment for bridge approaches allows the length of structure to be reduced with the intent of achieving an overall cost saving. The implementation of approach embankments makes use of readily available and accessible rock material in the area. For the configuration where the embankment construction extended beyond water’s edge, it is assumed that it is feasible to place embankment to a depth of -40 feet. The engineering parameters are that embankment material above water’s edge can be placed and maintained at a 2:1 slope. Material below MHHW water is assumed to be placed at 3:1, and on a bottom slope at the toe of embankment no greater than 10 percent. It is believed that the fills that extend beyond water’s edge can be constructed from landside out using the advancing embankment as egress, except where the bottom exceeds 10 percent, requiring embankment placement from barges and constructed back towards land to buttress the work. The limits of the embankment are not permitted to encroach into the ship’s water draft navigational opening above -40 feet below MLLW.

Also, two different bridge configurations were considered to reduce costs; one lends itself to a segmental concrete box girder with a main span length of approximately 700 feet, and the other lends itself to a cable-stayed alternative with a single deep water pylon and symmetric spans of 880 feet on each side (see Appendix C, *Bridge Memorandum*, for additional information).

The East Channel low profile box girder and cable-stayed bridges would each be approximately 1,700 feet long and have a vertical navigational clearance of 60 feet above MHHW and a horizontal clearance of approximately 350 feet. The West Channel high profile box girder bridge would be approximately 1,720 feet long and the cable-stayed bridge would be about 1,760 feet long. Both would have a vertical navigational clearance of 200 feet above MHHW and a horizontal navigational clearance of approximately 550 feet.

In the final analysis, topography dropped off such that the fills proved to be either too much to realistically place in the channel (the East Channel opening was reduced about 30% in width and 35% in flow area, and the West Channel opening was reduced approximately 40% in width and 30% in area), or were so large (2.5 million cubic yards on the west side of the West Channel) that the cost and actual time to construct the in-water embankment far out-weighed the potential cost savings of a shorter bridge, or caused a pier to move into deeper water – which would be more expensive than the original alternative by almost 15 percent. Other variations of using fill in lieu of bridge structure were investigated to reduce the overall cost of this alternative, including filling all the land from the edge of Tongass Narrows to the abutments on Pennock Island. None of these variations resulted in a substantial cost reduction over Alternative F3 (see Appendix C, *Bridge Memorandum*).

The alignment of Alternative F3v is shown in Appendix L.

3.9 Alternative G2

Alternative G2 would be a new ferry service that would complement the existing airport ferry for vehicles and passengers between Peninsula Point on Revilla Island and Lewis Point on Gravina Island, crossing Tongass Narrows approximately 2 miles north of the airport passenger terminal. The crossing distance would be approximately three-quarters of a mile.

Figure 12: Alternative G2 ferry from Gravina Island shoreline near the northern end of the airport runway, looking north

This alternative would require two new ferry vessels, as well as construction of a new ferry terminal and dock on each side of Tongass Narrows. The dredged quantity would be approximately 1,400 CYs over 0.2 acres. The terminals include minimal parking and a combination ticket booth and passenger waiting area.

Additionally, this alternative includes a passenger waiting area and enhanced baggage handling facilities at Charcoal Point on Revilla Island for walk-ons to the passenger terminal at the airport. It would also include the heavy freight terminal and staging area south of the current ferry dock on Gravina Island.

A 0.8 mile long road would be constructed on Gravina Island to connect the ferry terminal at Lewis Point with Seley Road, which would be upgraded to meet the Lewis Reef Road. The total road distance between Lewis Point and the airport passenger terminal is 4.1 miles.

The layout of Alternative G2 is shown in Appendix M.

3.10 Alternative G3

Alternative G3 would be new ferry service that would complement the existing airport ferry for vehicles and passengers between Bar Point at Jefferson Street (near the Plaza Mall and downtown Ketchikan) on Revilla Island and a location approximately 1.3 miles south of the airport passenger terminal on Gravina Island near Clump Cove. The sailing distance would be approximately one-half mile.

This alternative would require two new ferry vessels and the construction of a new ferry terminal and dock on each side of Tongass Narrows. The existing breakwater could also be widened and extended for use as the ferry terminal pier. It is not anticipated that the new terminal would interfere with the new development in the area. Dredging may be required to provide adequate navigational depths for the ferry docks on Revilla and Gravina Islands; the quantity would be approximately 18,600 CYs over 2.14 acres.

Figure 13: Alternative G3 ferry from the north parking area adjacent to Plaza Port West, looking northwest toward Gravina Island

Additionally, this alternative includes a passenger waiting area and enhanced baggage handling facilities at Charcoal Point on Revilla Island for walk-ons to the passenger terminal at the airport. It would also include the heavy freight terminal and staging area south of the current ferry dock on Gravina Island.

A paved road would be constructed on Gravina Island from the ferry terminal uphill past the new runway 11/29 extension approximately 0.25 miles to the Gravina Island Highway, which would connect to the airport. The total road distance from Clump Cove to the airport passenger terminal is 1.9 miles.

The layout of Alternative G3 is shown in Appendix N.

3.11 Alternative G4

Alternative G4 would be new ferry service for vehicles and passengers, and walk-ons, adjacent to the existing airport ferry route on a quarter-mile crossing of Tongass Narrows, 2.6 miles north of downtown. This alternative would require construction of a new ferry terminal on the Gravina Island side of Tongass Narrows, two new docks, and two new ferry vessels. The dock on Revilla Island would be parallel to the existing airport ferry dock, but the new dock on Gravina Island would be angled opposite of the existing dock so that development-bound traffic can enter and exit the ferry more conveniently. The total dredged quantity would be approximately 15,200 CYs over 1.22 acres. This alternative includes a passenger waiting area and enhanced baggage handling facilities at Charcoal Point on Revilla Island for walk-ons to the passenger terminal at the airport. It would also include the heavy freight terminal and staging area south of the current ferry dock on Gravina Island.

Figure 14: Alternative G4 ferry at existing location, looking west towards Gravina Island

The layout of Alternative G4 is shown in Appendix O.

3.12 Alternative G4v

Alternative G4v is the phased-construction of G4, where initially only the addition of the passenger waiting facility and shuttle vans to carry both pedestrians and their luggage to the airport terminal would be provided. It would also include the heavy freight terminal and staging area south of the current ferry dock on Gravina Island. However, unlike G4, the new terminal, docks, and ferries would not be constructed at this time. When ferry demand increases enough to necessitate it, a new ferry, and two new docks at the same location as proposed in G4, could be constructed. Although a fourth ferry is not anticipated in the 75 year design life of the project, another ferry could be built in the future if demand warrants its addition.

The layout of Alternative G4v is shown in Appendix P.

3.13 Alternative M1

Alternative M1 is a moveable bridge that would be straight across Tongass Narrows, between the quarry on Tongass Avenue and the existing ferry terminal on Gravina Island. The alignment would be about 0.31 miles long, and the bridge would be approximately 1,400 feet long with a minimum height of about 25 feet to the deck, but the lift towers would be about 300 feet high. The bridge would be a vertical-lift of a steel through-truss span, providing navigational clearances of 200 feet vertical and 550 feet horizontal in the raised position. In the lowered position, the vertical clearance would be about 20 feet above MHHW. The alignment would connect to Tongass Avenue using a T-intersection and access Gravina Island in the vicinity of the airport terminal, resulting in a relatively flat profile grade. The lift span would accommodate one-way passage of cruise ships and two-way passage of most other ships, including AMHS ferries. The eastern lift tower would be in water about 80 feet deep, and the western tower would be in water about 20 feet deep.

Due to the close proximity to the airport runway, the towers and the raised span are expected to penetrate the Part 77 airspace (about 300’ vs 230.6’). Much of the surrounding landscape already penetrates substantial portions of the Part 77 airspace.

One concern with a moveable bridge option is the interruption of vehicle access during bridge openings; the time to raise the span, allow a vessel to pass, and then lower the span can be up to 30 minutes for each passage. With a minimum vertical clearance of only 20 feet, the bridge would be raised for cruise ships (up to 8 cruise ships per day enter and leave Tongass Narrows during the summer), AMHS ferries (up to 6 passages per day during the summer), the Inter-Island Ferry, barges, tankers, commercial fishing boats, and most recreational craft. During bridge closures to allow vessel passage, left- and right-turn lanes are proposed on Tongass Avenue to accommodate vehicles queuing up to cross from the Revilla Island side.

The alignment of Alternative M1 is shown in Appendix Q.

3.14 Alternative M2

Alternative M2 is the same moveable bridge segment that would cross Tongass Narrows as Alternative M1, except it begins in the existing ferry terminal parking lot on Revilla Island and rises up, crosses, and then descends to the airport terminal on Gravina Island. The alignment would be about 0.53 miles long, and the bridge would be about 1,700 feet long with a maximum height of approximately 65 feet to the deck, and with lift towers about 300 feet high. The bridge would also be a vertical-lift of a steel through-truss span, providing navigational clearances of

200 feet vertical and 550 feet horizontal in the raised position. In the lowered position, the vertical clearance would be 60 feet above MHHW, the same as the East Channel bridge on the F3 alignments. The lift span would accommodate one-way passage of cruise ships and two-way passage of most other ships, including AMHS ferries. The eastern lift tower would be in water about 80 feet deep, and the western tower would be in water about 20 feet deep.

Due to the close proximity to the airport runway, the towers are expected to penetrate the Part 77 airspace (about 300’ vs 230.6’). Much of the surrounding landscape already penetrates substantial portions of the Part 77 airspace.

The alignment of Alternative M2 is shown in Appendix R. The *Movable Bridge Report* is shown in Appendix S.

3.15 Alternative T1

Alternative T1 is a new alignment of the tunnel alternatives presented in the EIS. The alternative would be a 3,200 foot long tunnel crossing between Peninsula Point on Revilla Island and Lewis Point on Gravina Island, at the location of Alternative G2. The Tongass Narrows crossing distance would be approximately three-quarters of a mile. A short 450 foot section of road will connect the eastern tunnel portal with the North Tongass Highway on the Revilla Island side. A 0.8 mile long new road would be constructed on Gravina Island to connect the tunnel with Seley Road, which would be upgraded to meet the Lewis Reef Road. The total road distance between North Tongass Highway and the airport passenger terminal would be 4.8 miles.

The alignment of Alternative T1 and the *Peninsula Point Tunnel Report* are shown in Appendix T.

3.16 No Action Alternative

The No Action Alternative consists of continued operation of the existing ferry on the present schedule. Although there are no construction costs, a 75 year life-cycle cost estimate was developed for the No Action Alternative based on operation and maintenance costs. Ferry replacement every 35 years and maintenance of the Gravina Island Highway and the Lewis Reef and Seley Roads are included in those costs.

3.17 Features Common to All the Alternatives

Each alternative includes maintenance of:

- The gravel Gravina Island Highway to the southern airport reserve boundary, for a total length of approximately 3.2 miles (except for Alternative G3 at 2.6 miles);
- The gravel Lewis Reef and Seley Roads to the northern airport reserve boundary, for a total length of approximately 2.2 miles; and
- The paved Airport Access Road, which extends from the airport terminal, passes beneath the runway safety area in a tunnel, and then climbs the hill to its intersection with the Gravina Island Highway and Lewis Reef Road, a distance of approximately 1.15 miles.

All build alternatives include the construction of a replacement to the existing unpaved single-lane bridge over *Airport Creek* at the end of Lewis Reef Road. The upgraded bridge would be

36 feet wide to provide gravel access to the northern developable lands, except under Alternatives G2 and T1 where the roadway and bridge would be paved 40 feet wide.

Also, when warranted and funding is available, a 300-car parking structure could be built at the airport terminal to accommodate additional airport traffic from improved access. The funding source is anticipated to be FAA rather than FHWA; this is a change from the EIS.

4.0 MAINTENANCE and OPERATIONS COSTS

Ongoing maintenance costs are a major consideration by the Department since all revenues to operate the public's facilities are funded in total from the State general fund, with no assistance at the federal level. The Department seeks measures to minimize costs with efficient infrastructure whenever possible. The Borough is currently responsible for the maintenance and operations (M&O) of the shuttle ferries for the airport under an operational agreement with the Department, and the Department funds the capital improvements. The recurring costs are the annual maintenance costs for the structure(s), roadways, and ferry system. Periodic costs are repairs, improvements and replacements that can be expected over the life of the facility.

4.1 Bridges

Bridge structures not only have annual routine maintenance that includes drainage system cleaning and repairs, bridge deck patching, restriping, and snow removal, but also require the cleaning of expansion joints, repairs of railing, and painting of metal parts. Periodic bridge maintenance expenses include pavement overlays of the wearing course, replacement of signs and illumination, changing of damaged bridge railing, expansion joint gland renewal, and occasionally replacing the whole modular expansion joint assembly.

Also, bridge and underwater foundation inspections are accounted for in these expenses. For the biennial above-water structure inspection, it is assumed a crew of three bridge inspectors would be needed for the interior of the concrete segmental box girder inspection, the under bridge inspection bucket, approach girders, deck, abutments, and pier bases. An underwater inspection every 5 years would include a 3-person dive team. For piers in water depths of 80 feet or greater, OSHA requires a recompression chamber, which increases expenses. Road and navigation traffic control is also needed for all structure inspections, both above and below water.

A movable bridge has an electrical consumption component plus typical maintenance. Staffing needs would include one employee on duty at all times monitoring the waterway, stopping traffic, and opening the bridge; checking equipment; watching for breakdowns; etc. Year-round coverage would require a staff of four. These costs are incurred in addition to the bridge and roadway maintenance costs.

4.2 Roadways

It is assumed that normal and routine roadway maintenance costs are typically drainage control, brush clearing, and snow removal, expressed as a lane-mile[5] expense. For paved roads, this also includes restriping and possibly pothole patching; and for gravel roads there would be constant grading of the driving surface – due to the rolling nature of Gravina Island, washboarding of the gravel surface is to be expected. For Southeast Alaska, this cost to the Department is $6,800/L-M. Additionally, it is assumed the paved road would need an overlay about every 10 years, and gravel roads may need to be resurfaced with more crushed base material every few years.

Due to their exposure to the environment, signing and luminaire poles have a limited life span, and it is assumed this whole system would be replaced about every 15 years on average.

[5] A lane-mile is defined as the width of a mile of roadway divided by 12; therefore there are 3.33 lane-miles on one mile of 40-foot wide roadway.

Guardrail is another element that endures high wear and tear, especially during the winter season. To account for this, the estimates include replacing 50 percent of the roadway railing every 5 years. These costs have been developed on a per foot basis to be used on the various lengths for each alternative.

4.3 Ferries and Docks

Ferry and dock annual maintenance costs used the estimates prepared for the EIS, and then inflated them to 2008 dollars. Above and underwater inspections similar to bridge inspections are required. Periodic maintenance costs for the docks (for anode replacement, fendering repairs, recoating, etc) and ferry replacement costs ($8 million every 35 years) were provided by the Department.

4.4 Tunnels

Maintenance of tunnels is more expensive than bridges and roadway maintenance because of the myriad of items that need care. Annual maintenance expenditures includes the obvious drainage pumping system cleaning and repairs, but also the cleaning or repair of joints/seals, wall tile repairs, painting of metal parts, and occasional portal/bulkhead repairs.

M&O costs primarily involving electrical consumption plus typical maintenance. The electrical loads are estimated at about $500,000 to $600,000 annually. Staffing needs would be at least two employees on duty at all times monitoring security cameras, fire detection, breakdowns, etc, and then calling for backup and responding to incidents. Year-round coverage would be about four teams of two. These costs are incurred in addition to the roadway maintenance costs.

To ensure the proper care of a major capital investment, inspections must be a part of any preventative maintenance program. Costs for the annual tunnel inspection and underwater inspections every 5 years have been included.

Usually the main non-annual cost to anticipate is the expense of pavement overlays of the facility about every 10 years with a new wearing surface. Other considerations are periodic expenditures for the tunnel consisting of joint seal renewal, cathodic protection of sheetpiles, pump replacement, ventilation repairs, etc. The estimate as shown on Table 3 also includes estimated annual replacements costs.

In summary, the major categories of maintenance costs include:

Table 3: Maintenance and Repairs

EXPENSE	CYCLE (yrs)	ESTIMATED COST
Normal and Routine Maintenance		
Annual bridge maintenance costs (w/o road cost)	1	$ 1,500/L-M ($1.15/LF)
Annual paved road maintenance costs	1	6,800/L-M ($4.30/LF)
Annual gravel road maintenance costs	1	6,800/L-M ($4.30/LF)
Annual ferry and dock maintenance costs (G2 and G3)	1	5.71 M
Annual ferry and dock maintenance costs (G4)	1	5.70 M
Annual ferry and dock maintenance costs (no-build G4v)	1	3.42 M
Periodic Repairs		
Above ground structure (bridge/dock/tunnel) inspections	2	$ 40,000
Underwater foundations (bridge/tunnel) inspections	5	40,000
Underwater foundations (dock) inspections	5	25,000
Fendering system repairs	5	50,000
Guardrail replacement	5	117/LF
Pavement planing and overlay	10	102/LF
Heavy freight dock resurfacing	10	400,000
Anode replacement (bridge)	10	100,000
Anode replacement (ferry dock)	10	20,000
Anode replacement (heavy freight dock)	10	100,000
Neoprene gland expansion joint replacement	10	500,000
Signing and illumination replacement	15	5/LF
Recoat transfer span	15	150,000
Bridge support-float recoat	15	75,000
Expansion joint assembly replacement	25	1,400,000
Ferry replacement costs	35	8,000,000
Ferry terminal mooring structure replacement	35	1,500,000
Transfer bridge replacement costs	75	2,000,000

5.0 LIFE-CYCLE COSTS

A life-cycle cost is defined as the overall estimated cost of a single alternative over a defined period. The *Intermodal Surface Transportation Efficiency Act of 1991* (ISTEA) required the consideration of life-cycle cost analysis in the design of pavements and bridges[6]. The idea behind life cycle cost analysis is that transportation investment decisions should consider all of the costs incurred during the period over which the alternatives are being compared (http://isddc.dot.gov/OLPFiles/FHWA/010621.pdf).

Bridges last longer than pavements and typically represent a major initial capital cost (a significant portion of the overall project and Regional budget) and a long-term maintenance investment. On August 10, 2005, the President signed into law the *Safe, Accountable, Flexible, Efficient Transportation Equity Act -- A Legacy for Users* (SAFETEA-LU), and Section 1904 of this law requires the application of value engineering methods, including the analysis of life-cycle costs, to bridge projects with an estimated total cost of $20 million or more.

All of the expenses associated with an alternative that occur during its life are used to calculate the life-cycle cost. Comparing life-cycle costs is a common way to evaluate different alternatives. Life-cycle costs can be compared using present worth, future value, or annual costs. For the Gravina Access Project, present worth is used to compare the life-cycle costs of different crossing concepts. The life-cycle costs were prepared using the costing software for bridges, *BridgeLCC*, by the National Institute of Standards and Technology (NIST)[7], as recommended by the FHWA (http://www.fhwa.dot.gov/infrastructure/asstmgmt/lcca.cfm). The software uses a life-cycle costing methodology based on both ASTM standard E 917 and a cost classification developed at NIST. The inflation rate, nominal discount rate, and real discount rate can all be used in the analysis of life-cycle costs. The inflation rate can be used to compute the costs of future expenditures and then the nominal discount rate can be applied to bring these costs back to a present value or worth. Alternatively, the real discount rate, already adjusted for the effects of inflation, can be used to compute the present value of these future costs. The rates were obtained from the NIST and Office of Management and Budget *OMB Circular A-94* (http://www.bfrl.nist.gov/bridgelcc/analyses.html and http://www.whitehouse.gov/omb/circulars/a094/a94_appx-c.html). The inflation rate used is 2.05 percent, the nominal discount rate used is 4.91 percent, and the real discount rate used is 2.80 percent.

The life-cycle costs for all of the alternatives were computed in 2008 dollars. The initial cost of construction and project development was distributed over the construction period and occurs at the beginning of the year. Construction is expected to be complete and the facility open at the end of 2012, but minor cleanup would probably continue into 2013. Annual maintenance and operating costs would be incurred starting at the end of 2013. The term of the analysis is 75 years to correspond with the design life of the bridges, as required by the FHWA, and therefore the final cost occurs at the end of 2088. In comparison, the EIS used a 20-year life-cycle cost analysis to match the proposed facility design life.

Each of the maintenance items occurs at its respective frequency after the beginning of 2013. The analysis assumes the proposed bridges have an expected life of 75 years, 35 years for the

[6] NCHRP Report 483, Bridge Life-Cycle Cost Analysis, 2003, page I-5
[7] NIST AEB&FRL BridgeLCC Life-Cycle Costing Software for the Preliminary Design of Bridges

ferries, and up to 150 years for the tunnel. At the end of their life span, the bridge, ferry or tunnel may be rehabilitated or salvaged and replaced by a new facility.

As is commonly done in life-cycle cost studies, the salvage value at the end of the project life span for structures such as bridges is established using a straight-line method of depreciation, based on the life of the structure. Salvage value is hard to determine since structures and roadways are typically rehabilitated to extend their useful lives decades beyond their planned retirement. For this analysis, the salvage value was assumed to be the cost of demolition and disposal, and therefore established as zero dollars at the end of 75 years for all alternatives.

The *Life-Cycle Cost Reports* are shown in Appendix D.

6.0 CONSTRUCTION ESTIMATE

Although several new alignments were developed for consideration, no other new engineering design was conducted for this Report. The costs presented in the 2004 EIS for the bridge alternatives were derived from a preliminary cost estimate for Alternative F1, and per-square-foot unit costs applied to the other bridge alternatives (F3, C3a, C3b, C4 and D1). The EIS cost estimates were updated in 2006 for Alternative F1, and the other alternatives were updated similarly. For this Report, costs for Alternative F1, including features such as piers, deck, and other elements were updated to 2008 dollars, and then the individual feature costs (ie, cost of foundation in deep water, foundation in shallow water, long span box girder, etc) were applied to the other alternatives to develop cost estimates for all bridge alternatives.

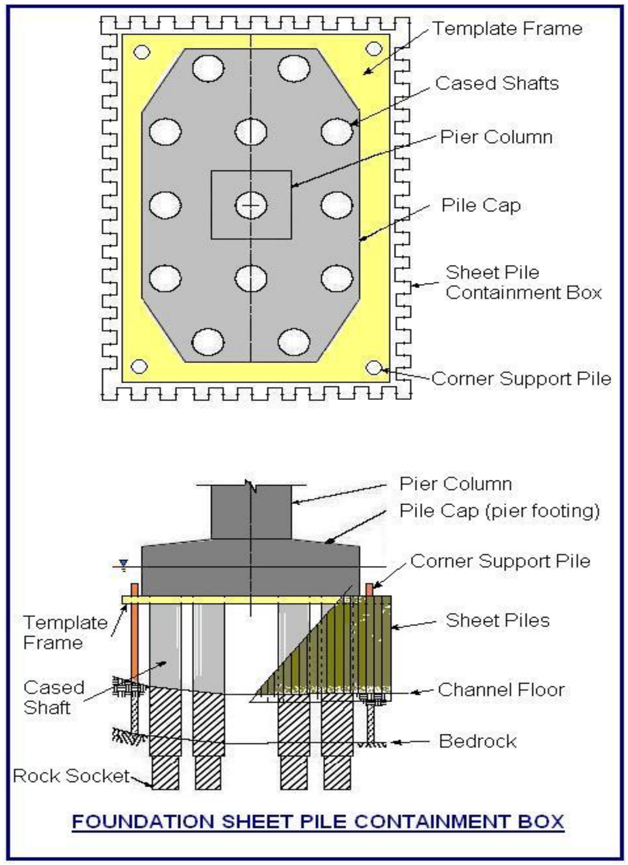

Figure 15: Foundation Sheet Pile Containment Box

6.1 Structures

The Department instructed HDR to reexamine the EIS bridge costs, recognizing that costs for Alternative F1 were more refined than the other alternatives, including verifying the reasonableness of quantities based on the proposed structure and available data for similar/comparable structures that had been constructed in the past. In this process, a reasonable per unit cost (ie, pier in 80' of water = $21.6 M) was developed for the other alternatives. The quantities for reinforcing steel and post-tensioning were reduced somewhat from the EIS quantities as a result of this review.

The bridge prices represent an average cost of the approach spans, overall mid-span lengths, pile depths, and column heights for a high span cast-in-place balanced cantilever concrete box girder bridge. All structure estimates include the costs for stiffening the piers or providing fenders for vessel impacts. In-water work windows were addressed by adding between $4 and $8.5 million for foundation containment cofferdams (see Figure 15) with bubble curtains to allow year-round foundation construction. Alignment curvature quantities and added back-span piers also figured significantly into the estimate increases for crossing Alternatives C3a, C3b, C4 and D1.

For the cost comparison of the structures alone (see Appendix C), the following table is provided:

Table 4: Structure Costs

ALT	STRUCTURES ESTIMATE		
	EIS Cost (2004)	Post-ROD Cost (2006)	Updated Cost (2008)
C3a	$ 93 M	$ 200 M	$ 335.0 M
C3b	76 M	-- *	239.8 M
C4	83 M	193 M	311.6 M
C3-4	--	--	164.2 M
D1	51 M	128 M	195.6 M
F1	100 M	200 M	239.2 M
F3	99 M	120 M	183.8 M
F3v	--	--	184.5 M
M1	--	--	290.0 M
M2	--	--	304.9 M
T1	--	320 M	337.2 M

* No updated cost was prepared for Alignment C3b

6.2 Roadways

The estimated roadway costs for each alternative were developed with roadway quantities prepared from 2002 aerial photography. Updated unit prices were extrapolated from the Southeast Region's *Bid Tabs* from 1997 through 2008 for the larger projects of similar type work in the Panhandle.

The 2008 cost estimates are between 15 and 20 percent higher than those presented in the EIS due to inflation and because some construction items have seen major cost increases (steel and oil). Due to the minimal geotechnical information available, no subsidence across the wetlands was assumed, but a muck excavation cost place holder was identified. To cover the numerous minor and incidental pay items that could elevate costs, contingency factors (20% for major structures and 15% for roads) have been incorporated into these estimates.

The airport access is a paved roadway from its start on Revilla Island to the airport passenger terminal on Gravina Island, the specific route depends on the alternative. Access to Ketchikan Gateway Borough (KGB) property off the airport reserve is by the existing gravel access roads; the only cost is for upgrading the Seley Road to the same standards as the existing Gravina Island Highway and Lewis Reef Road.

6.3 Ferries

The costs of the ferry alternatives presented in the EIS assumed new ferries would be similar to the existing vessels, and new shelter/ticket booths and terminals would be constructed at each shoreline terminus. For this effort, the original costs were only adjusted for inflation to 2008 dollars using the *CPI Inflation Calculator*. As discussed earlier, all the ferry alternatives now include costs for passenger waiting and enhanced baggage handling facilities for the existing Charcoal Point ferry terminal on Revilla Island, and a single heavy freight dock and staging area near the airport. Costs for these facilities were provided by the Department. Ferry facility costs are summarized in the table below:

Table 5: Ferry Facility Costs

ITEM	EIS Cost (2004)	Updated Cost (2008)
Ferry and Docks (G2)	$ 34.2 M	$ 41.7 M
Ferry and Docks (G3)	34.4 M	42.0 M
Ferry and Docks (G4)	32.8 M	40.0 M
Baggage Handling		1.5 M
Heavy Freight Terminal		5.8 M

6.4 Right-of-Way

The controlled-access right-of-way costs were determined by overlaying the slope limits on the Borough's property tax maps and assuming total takes for the majority of the parcels (some of the larger parcels not requiring a total take were assigned a percentage for the takes), and then adding their 2008 appraised values. Government parcels were assumed to be obtained at no cost. The ferry alternatives assume a lump sum acquisition cost. The following table summarizes right-of-way costs for each alternative:

Table 6: Right-of-Way Costs

ALT	RIGHT-of-WAY
C3a	$ 5.7 M
C3b	5.0 M
C4	4.5 M
C3-4	3.8 M
D1	8.1 M
F1	1.7 M
F3	0.3 M
F3v	0.3 M
G2	1.0 M
G3	1.0 M
G4	0.5 M
G4v	0.5 M
M1	0.2 M
M2	0.2 M
T1	7.5 M

6.5 Design and Construction Costs

Construction estimates are used for initial build costs, and include contingencies (15% for roadway and 20% for bridges) and 5 percent for construction administration. Developmental costs are assumed to be 7 percent of the construction amount (2 percent for environmental studies and 5 percent for design phases). A lump sum cost was assessed for utility relocation, and right-of-way acquisition cost was determined using the Ketchikan Gateway Borough's tax appraised values. Additionally, an annualized average ICAP of 5 percent was computed on the total costs.

6.6 Total Costs

The construction, maintenance and operation, and life-cycle costs for the studied alternatives are summarized in the following table:

Table 7: Engineer's Construction Cost Estimate

ALT	ENGINEER'S ESTIMATE								
	EIS 2004[8]			Post-ROD 2006[9]*			SEIS 2008		
	Total Const Costs	Annual M&O Costs	Life Cycle Costs	Total Const Costs	Annual M&O Costs	Life Cycle Costs	Total Const Costs	Annual M&O Costs	Life Cycle Costs
C3a	$ 200 M	$ 150 K	$ 160 M	$ 274 M**	--	--	$ 463 M	$ 209 K	$ 435 M
C3b	170 M	160 K	135 M	--	--	--	352 M	193 K	332 M
C4	195 M	150 K	160 M	271 M**	--	--	441 M	200 K	411 M
C3-4	--	--	--	--	--	--	240 M	244 K	231 M
D1	135 M	130 K	105 M	185 M**	--	--	291 M	188 K	275 M
F1	230 M	110 K	190 M	328 M	--	--	375 M	216 K	369 M
F3	205 M	110 K	170 M	227 M	--	--	304 M	188 K	301 M
F3v	--	--	--	--	--	--	349 M	187 K	342 M
G2	60 M	5 M	90 M	--	--	--	84 M	5.87 M	211 M
G3	70 M	5 M	100 M	--	--	--	77 M	5.85 M	198 M
G4	60 M	5 M	90 M	--	--	--	63 M	5.85 M	181 M
G4v	--	--	--	--	--	--	16 M	3.57 M	148 M
M1	--	--	--	--	--	--	375 M	1.0 M	388 M
M2	--	--	--	--	--	--	413 M	1.0 M	445 M
T1	--	--	--	396 M	2.0 M	412 M	417 M	2.2 M	442 M
No-Build	--	2 M	13 M	--	--	--	0 M	3.55 M	76 M

* Did not include pavement
** Did not include Airport Access, Lewis Reef and Seley roads, or Gravina Island Highway

The parking structure to accommodate increased traffic to the Ketchikan International Airport is estimated to cost an additional $13.1 million. This cost was not included in the above estimates. Depending on the availability of appropriate FAA program funding, the Department may elect to construct the proposed airport parking structure at a later time when parking demand warrants.

The costs presented are for the alternatives described earlier in this Report (see cost matrix in Appendix B). The intent is to allow for a relative comparison between the alternatives. These cost estimates are not to be viewed as actual construction costs. As more design information is developed or the alternatives are modified, the estimates would be adjusted accordingly.

[8] Gravina Access Project Final Environmental Impact Statement, July 30, 2004, page 2-2, 2-3
[9] Draft Design Study Report, Estimates, October 2006

7.0 CONCLUSION

The estimated costs of the bridge alternatives evaluated in this Report range from approximately $240 million to $460 million in first-quarter 2008 dollars. The construction effort would probably take multiple seasons, so it would not be unreasonable to expect a financial plan to prorate these costs over several fiscal years.

Compared with the costs presented in the EIS, there is approximately a 20 percent increase in costs due to inflation (17%) and other minor changes for Alternatives F1 and F3, and almost a 55-70 percent increase in the costs of the C and D alternatives because of inflation, minor changes, and more detailed design information regarding the bridge structure curvature requirements.

The bridge alternatives have high initial construction costs, ranging from $240 million to over $460 million, and they also have high life-cycle costs due to their high initial costs.

The ferry alternatives have lower initial costs, varying up to about $85 million, but their high annual operating costs and periodic repairs/replacements elevate their life-cycle costs substantially.

The movable bridges and the tunnel have high initial costs, approximately $375 million to over $410 million, and have a high annual operational cost (including substantial labor costs) resulting in high life-cycle costs.

No user costs were incorporated into these estimates; life-cycle costs represent only the owner's costs. However, for a movable bridge where delay should figure prominently, user costs could be considered. In a recent study, the Department used $15/hour for the user's cost of delay – so if the crossing were closed just for ship transit for an hour during a given summer day, the total user costs could be as high as $11,000 for that hour of delay (730 vehicle demand per hour in 2030). Assuming 8 cruise ships and 3 ferries passages per day during the summer, each requiring a half-hour closure, this could result in over $60,000 per day in user cost by the design year.

For operations where revenue would be received (ferries), the annualized incomes were subsequently estimated based on averaged income received to date ($1.5 million), and the life-cycle costs were then adjusted. Table 8 summarizes those results:

Table 8: Life-Cycle Costs for Ferry Alternatives (with and without Revenue)

ALT	CONSTRUCTION COST	LIFE-CYCLE COST	LIFE-CYCLE COST (Revenue adjusted)
G2	$ 84 M	$ 211 M	$ 168 M
G3	77 M	198 M	155 M
G4	63 M	181 M	138 M
G4v	16 M	148 M	105 M
No Build	0	76 M	30 M

Based upon recent aerial photography, it is evident that there have been expansions of the quarry off Tongass Avenue and new structures are being built in the Cambria Drive and Jefferson Street areas. These recent developments could increase costs of alignments C4, D1, or G3. New development is on-going in Ketchikan, and the resulting alignments will be adjusted in final design to avoid or minimize impacts to the extent practicable.

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