



City of Whittier

Shotgun Cove Road Extension

Mile 2.0 to 4.5

Draft Design Study Report



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Executive Summary

Introduction

The City of Whittier has contracted with CRW Engineering Group, LLC to provide professional services to prepare a Design Study Report for the Shotgun Cove Road Extension from its current constructed location near Second Salmon Run (Mile 2.0), to the U.S. Department of Agriculture Forest Service (U.S. Forest Service) land at Trinity Point (Mile 4.5). The land along the project corridor, and further east to Shotgun Cove, was transferred from the State of Alaska to the City of Whittier in 1999, under the stipulation that the City would provide access and prepare adjacent lands for public sale. The City applied for funding from the Federal Land Access Program (FLAP) for permitting, design, and construction. The FLAP application identified two main objectives for this project: 1) increase resource access and 2) improve regional transportation systems.

This Design Study Report evaluates two alignment options, a Low Option and a High Option, both beginning at the existing Shotgun Cove Road terminus (Mile 2.0) and extending to Trinity Point (Mile 4.5). The evaluation of alternatives includes a comparison of road profile, length of steep cuts and fills, mass haul, stream crossings, and construction costs. Additionally, conceptual parcel layouts were developed to evaluate how each alignment option could provide public access to the surrounding State and Federal lands, private access to developable properties, and where spur roads would be necessary. This information is summarized in the table below:

Considerations	Low Option	High Option
Length of Roadway	13,500 ft	13,000 ft
Maximum Elevation	160 ft	300 ft
Maximum Grade	9%	10%
Cut	230,800 CY	273,500 CY
Length of Rock Cut (0-20 ft)	3,750 ft	4,950 ft
Length of Rock Cut (> 20 ft)	2,275 ft	3,200 ft
Fill	233,500 CY	249,100 CY
Length of Steep Fill (< 1.5:1)	1,975 ft	2,075 ft
Stream Crossings	25	15
Configured Parcels	83	82
Configured Parcels (Acres)	147 acres	137 acres
Parcels Adjacent to Main Alignment	59	37
Parcels Adjacent to Spur Roads	24	45
Length of Spur Roads	10,550 ft	35,900 ft
Total Project Cost*	\$24,300,000	\$25,400,000
* Does not include cost for constructing spur roads		

Shotgun Cove Road Extension Mile 2.0 to 4.5

The recommended alignment option is the Low Option. Running roughly down the middle of the City-owned land, the Low Option has less change in elevation, fewer steep cuts and fills, but more stream crossings than the High Option. The conceptual parcel configuration for the Low Option has more parcels adjacent to the main road extension and would require less spur roads than the High Option.

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- Appendix A: 2016 Federal Land Access Program Application
- Appendix B: Excerpts from the 2012 Whittier Comprehensive Plan Update
- Appendix C: Preliminary Geotechnical Engineering Report
- Appendix D: Environmental Data Gap Analysis
- Appendix E: Conceptual Engineer's Estimate
- Appendix F (under separate cover): Roadway Plan & Profile and Cross Sections

Abbreviations

AADT	Annual Average Daily Traffic volume (vehicles per day)
AASHTO	American Association of State Highway Transportation Officials
AASHTOGB	AASHTO Policy on Geometric Design of Highways & Streets “Green Book”
ACS	Alaska Communication Systems
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
ADT	Average Daily Traffic volume (vehicles per day)
DOT&PF	Alaska Department of Transportation and Public Facilities
AWWU	Anchorage Water and Wastewater Utility
BLM	Bureau of Land Management
CEA	Chugach Electric Association
cfs	Cubic foot per second
CMP	Corrugated Metal Pipe
DHV	Design Hour Volume
DSR	Design Study Report
EOP	End of Project
EPA	Environmental Protection Agency
FLAP	Federal Land Access Program
GCI	General Communications, Inc.
GDVLVLR	Guidelines for Geometric Design of Very Low-Volume Local Roads
HDPE	High density polyethylene pipe
ITE	Institute of Transportation Engineers
MPH	Miles per hour
MUTCD	Manual of Uniform Traffic Control Devices
NEPA	National Environmental Policy Act
PCM	ADOT&PF Pre-Construction Manual
PUE	Public Use Easement
ROW	Right-of-way
SF	Square feet
SWMM	Storm Water Management Model
SWPPP	Storm Water Pollution Prevention Plan
USACE	US Army Corps of Engineers
vpd	Vehicles per day



I. Introduction

Whittier, the 'Gateway to Western Prince William Sound', is a regional maritime center for commercial, recreational and subsistence fishing, shipping and small boat access, cruise lines, the Alaska Marine Highway System and the Alaska Railroad. Separated from the Municipality of Anchorage and the Kenai Peninsula by the Anton Anderson Memorial Tunnel, the city supports these various uses and its full-time residents on a small area of land at the head of Passage Canal. With the goal of expanding the opportunities for residential and commercial development and alleviating pressure on the regional transportation systems, the City has obtained land east of Whittier to Shotgun Cove, and is currently completing construction of a 2.0-mile segment of Shotgun Cove Road extending toward these tracts.

The City of Whittier has contracted with CRW Engineering Group, LLC to provide professional services to prepare a Design Study Report for the Shotgun Cove Road Extension from its current constructed location near Second Salmon Run (Mile 2.0), to the U.S. Department of Agriculture Forest Service (U.S. Forest Service) land at Trinity Point (Mile 4.5). See Figures 1 and 2 for Project Location and Project Vicinity maps.

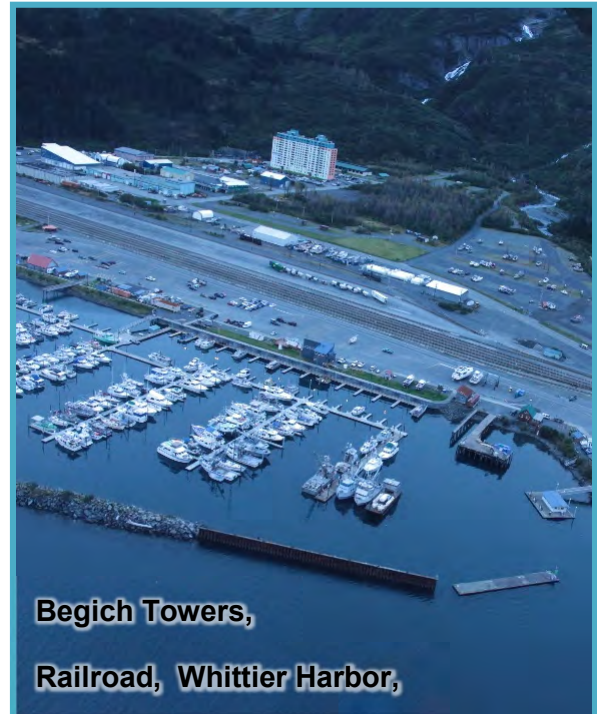
A. Stakeholder Interests and Project Goals

The land along the project corridor, and further east to Shotgun Cove, was transferred from the State of Alaska to the City of Whittier in 1999, under the stipulation that the City would provide access and prepare adjacent lands for public sale. The City applied for funding from the Federal Land Access Program (FLAP) for permitting, design, and construction. The FLAP application identified two main objectives for this project: 1) increase resource access and 2) improve regional transportation systems. See [Appendix A](#) for the complete 2016 FLAP application.

In addition to the City of Whittier and the local population, the FLAP application included three additional stakeholders owning land between the existing town site and Shotgun Cove: the State of Alaska, Chugach Alaska Corporation and the US Forest Service. These two objectives encompass the following interests of the various stakeholder groups:

City of Whittier

The City of Whittier is uniquely situated at the head of Passage Canal and Western Prince William Sound, with close proximity to the Municipality of Anchorage and the Kenai Peninsula. As such, it sees some 20,000 Alaska Marine Highway passengers, 150,000 cruise ship passengers, 75,000 Alaska Railroad passengers, 12,000 small boat launches, and 240,000 vehicles through the Whittier Tunnel annually. It hosts the fishing, tourism, and shipping industries and public transportation and recreational facilities on just 1.8 miles of shoreline. The City's existing geographical limitations restrict opportunities to capitalize on these industries thereby constraining further economic growth. This road extension provides opportunities for commercial development and growth of the City's economic potential.



The City of Whittier owns and operates the Whittier Harbor, boat launch and adjacent parking, the community's center for commercial and public fishing, boating, sightseeing and recreation. The harbor shares marine access to Passage Canal with cruise lines, shipping and the Alaska Ferry, while the boat launch and parking abut the Harbor Business District, the Alaska Marine Highway Terminal, the Alaska Marine Lines truck terminal, the Alaska Railroad freight gate, and the cruise line



bus and rail terminals. The Whittier Harbor is currently at capacity and the single boat launch sees congestion, long wait times during peak operations, as well as conflicts with adjacent transportation modes. Additionally, prevailing wind conditions at the head of Passage Canal can sometimes limit access to Prince William Sound via small craft. This road extension provides opportunities for extending waterfront access, mitigating conflicts between different user groups and transportation modes, decreasing congestion for business districts, and expanding harbor facilities and protected boat launch facilities for small water craft.

Local Population

Whittier's 200 year-round residents generally occupy two large housing structures in the city. Bordered by steep mountainsides and the Alaska Railroad, the existing town site has little available land for commercial and residential development. Based on the repeated inclusion in the City's Capital Projects Priority List and regular discussion at



City Council meetings, this project is viewed favorably by the local population who see this development as an opportunity to enhance quality of life, access to the surrounding environment, and the viability of the local economy.

Chugach Alaska Corporation

Chugach Alaska Corporation represents 2,500 shareholders from the various Alaska Native Tribes of the Chugach Region, the original inhabitants of Western Prince William Sound. Chugach owns land along the recently constructed portion of road as well as in Shotgun Cove. This road extension will provide further opportunities for access to tribal lands, resource development, business opportunities, recreation and subsistence for shareholders and cultural preservation.

State of Alaska

The State of Alaska owns and operates the Anton Anderson Memorial Tunnel, the Whittier Airport, the Alaska Railroad, and the Alaska Marine Highway Terminal, representing four modes of transportation with regional significance. Transfers between these modes all occur in a concentrated area,



occupying much of the existing town site. Increased development will add to the utilization of these transportation modes, and the road extension to Shotgun Cove offers opportunities to alleviate conflicts between user groups.

In addition, the State of Alaska owns lands uphill of City-owned land along the Shotgun Cove Road corridor. This road extension will increase opportunities for the State and its residents to access and utilize public lands.

U.S. Forest Service

The U.S. Forest Service owns land at Trinity Point, bounded by the City-owned land along the corridor. The road extension will enhance access to the land and provide opportunities for its use and the potential development of recreational facilities.



Based on these stakeholder interests, this project has the following consideration:

- Extend the existing Shotgun Cove Road 2.5 miles to Trinity Point.
 - The proposed gravel road will be consistent with previous design criteria to support the traffic associated with the adjacent development potential.
 - Evaluate two alignment options, a Low Option closer to the shore of Passage Canal and a High Option farther uphill of the shore.
 - Consider access to U.S. Forest Service Property.
 - Terminate the road extension at appropriate elevation and alignment for future continuation past Trinity Point to City-owned land in Shotgun Cove.
- Consider land use potential
 - Develop conceptual parcel layout and consider access to parcels.
 - Consider locations for waterfront access, stream setbacks, City-owned lands, and public access to State and Federal land.
- Minimize environmental impacts
 - Match existing topography where possible.
 - Minimize impacts to streams and wetlands.
 - Minimize extensive cuts, fills, and clearing of vegetation.

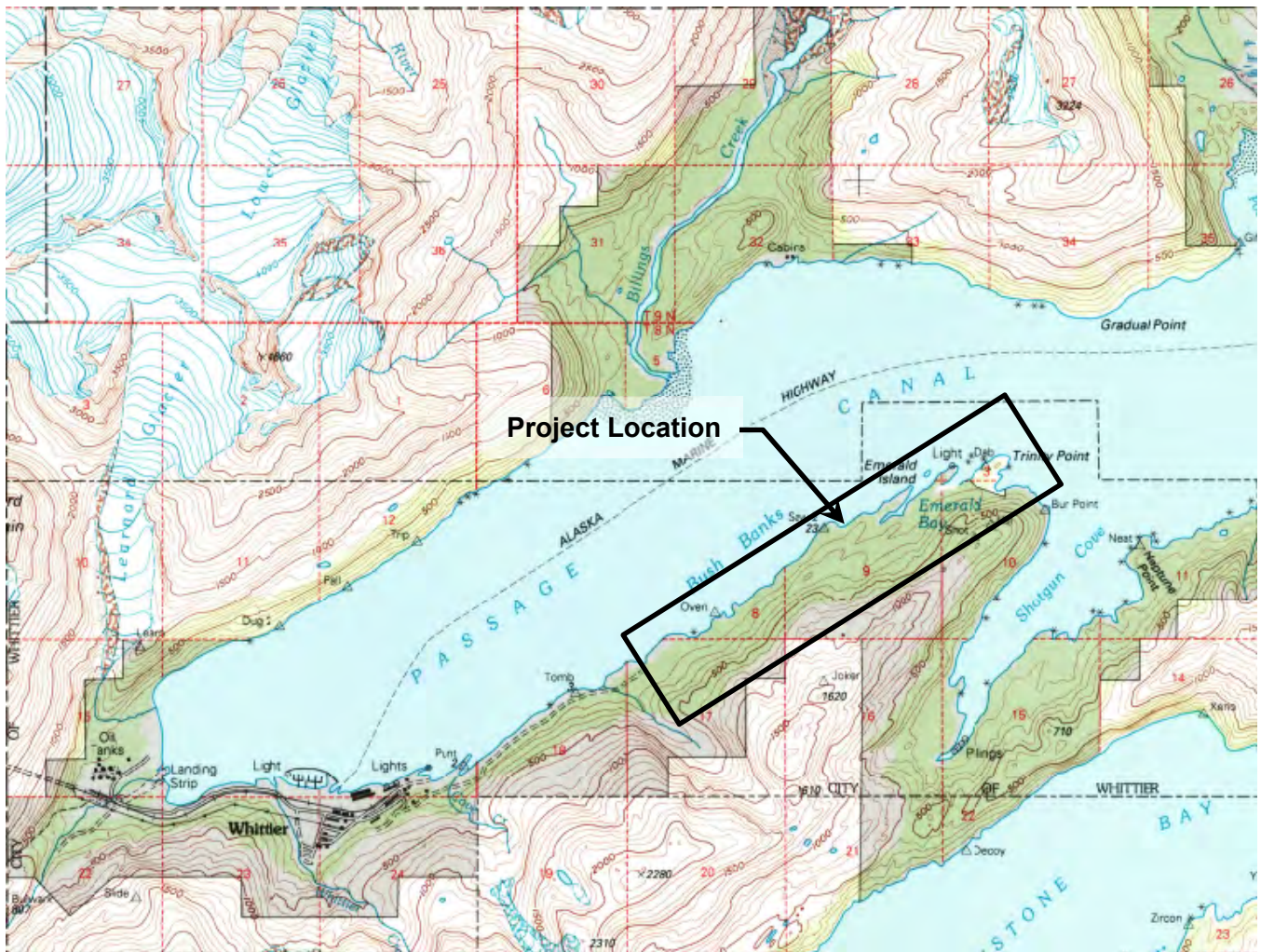
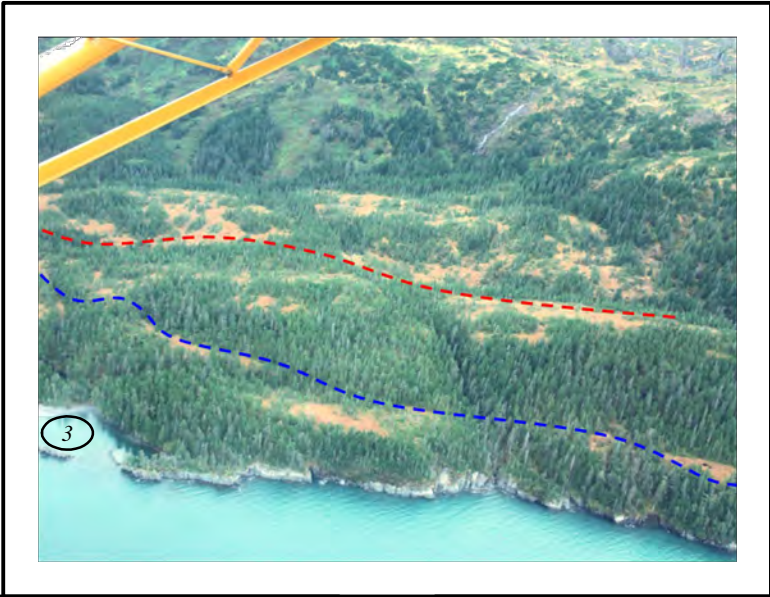
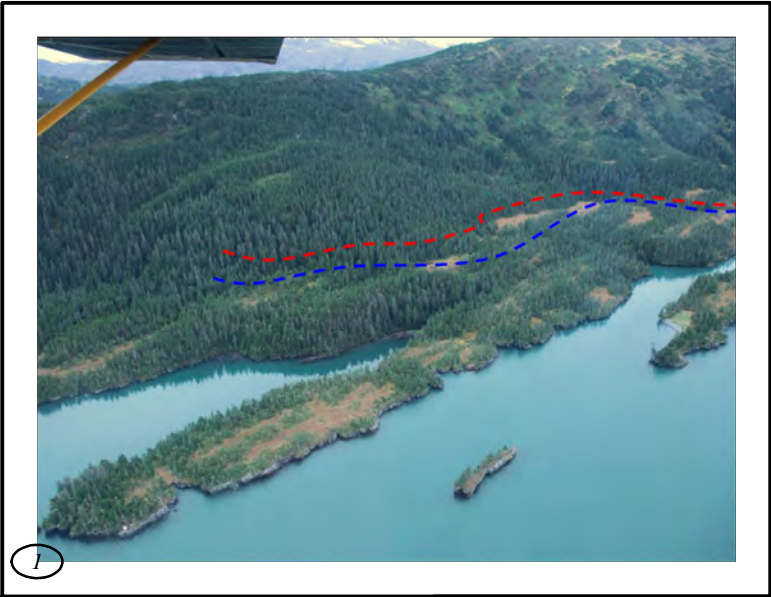
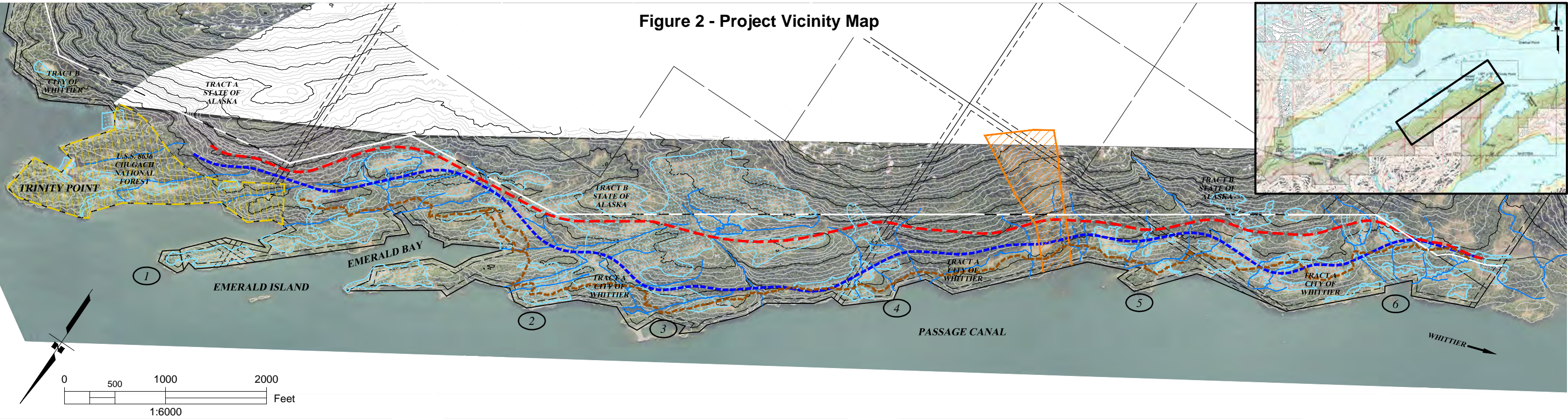
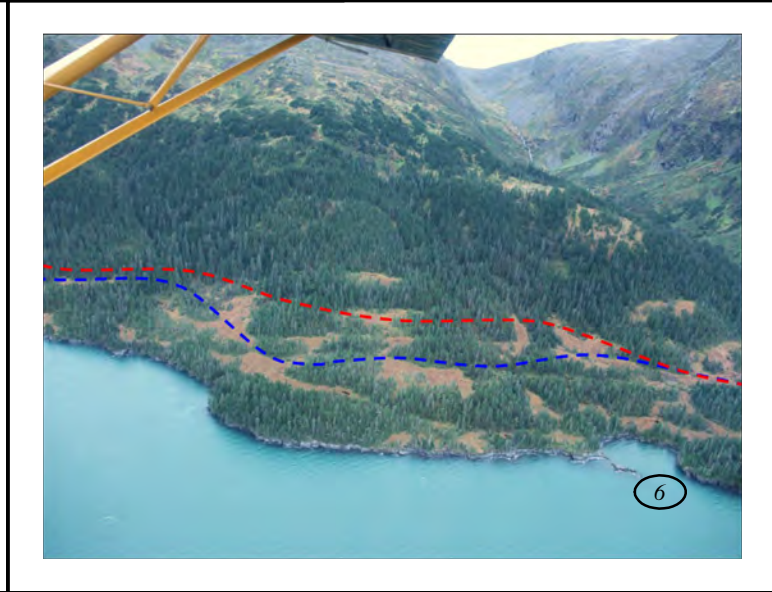
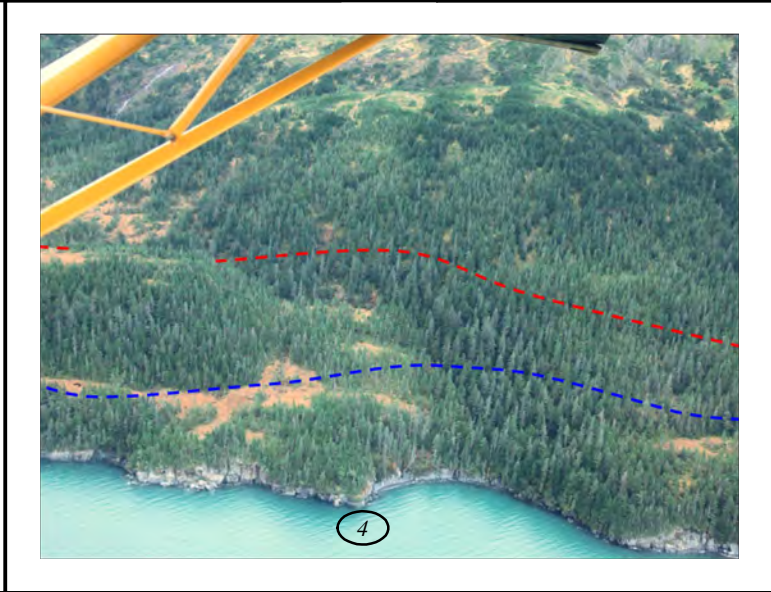
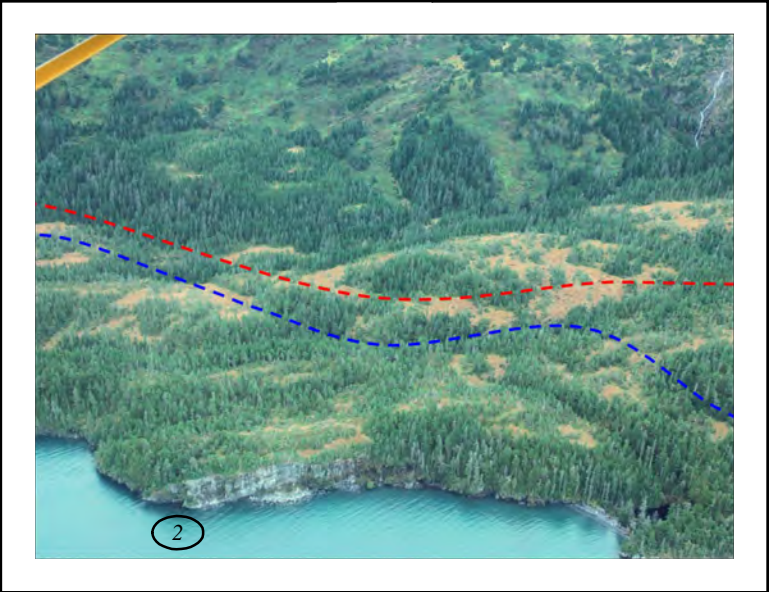


Figure 1 – Project Location Map

Figure 2 - Project Vicinity Map



- LEGEND**
- LOW OPTION
 - HIGH OPTION
 - ~ STREAM
 - WETLAND
 - AVALANCHE AREA
 - USFS PROPERTY
 - EMERALD COVE TRAIL



II. Existing Conditions

A. Area Context

The Shotgun Cove Road Extension (Mile 2.0 to 4.5) begins where the previous phases terminated, just northeast of Second Salmon Run. Previous road improvements constructed two fish passage culverts (Photo 1) and a gravel pad for construction staging (Photo 2) in this vicinity, where the Emerald Cove Trail now begins. The Phase 5 Shotgun Cove Road project (under construction in 2018) will construct two parking lots, one at the Emerald Cove trailhead and another further east and closer to the shoreline.

The Emerald Cove Trail extends from the current termination of Shotgun Cove Road (Mile 2.0) towards Trinity Point. The trail consists of portions that are cleared and dug, portions lined with boards (Photo 3), steps or various types of wooden bridges (Photo 4) as well as portions of undefined trail. The developed trail ends approximately a half mile from the U.S. Forest Service land at Trinity Point.



Photo 1



Photo 2

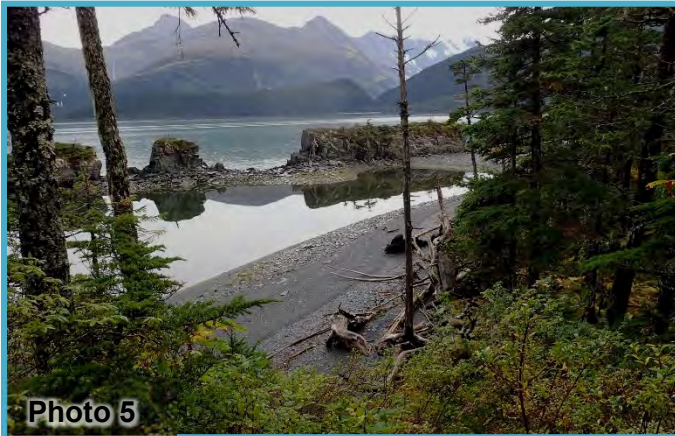


Photo 3



Photo 4

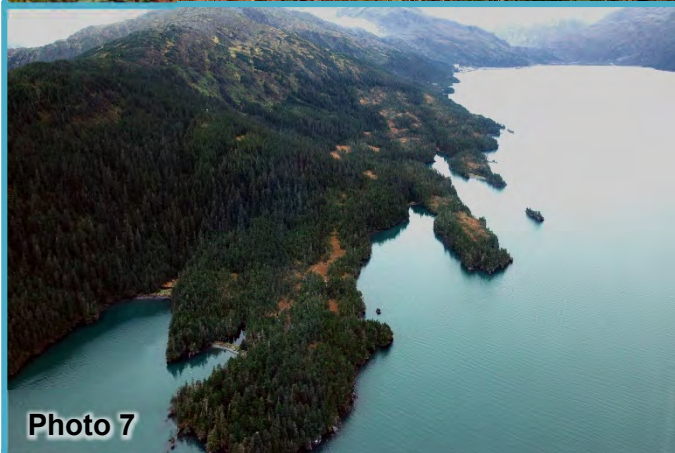
Shotgun Cove Road Extension Mile 2.0 to 4.5

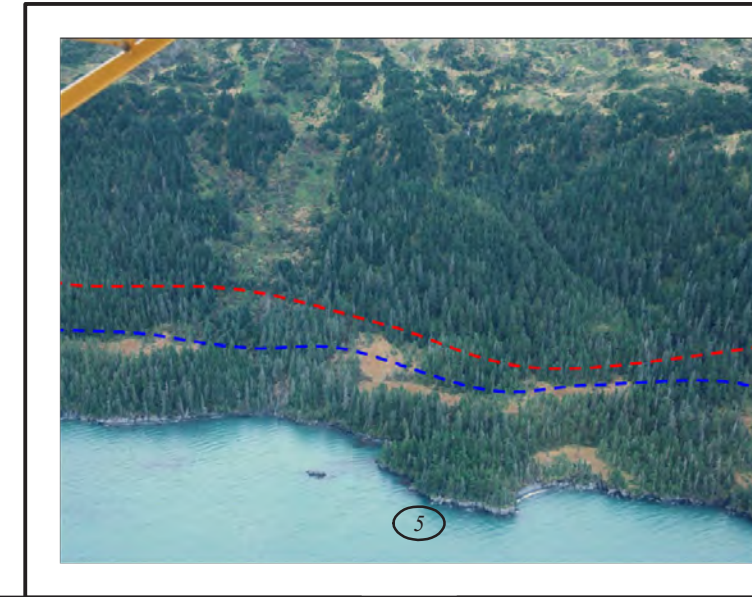
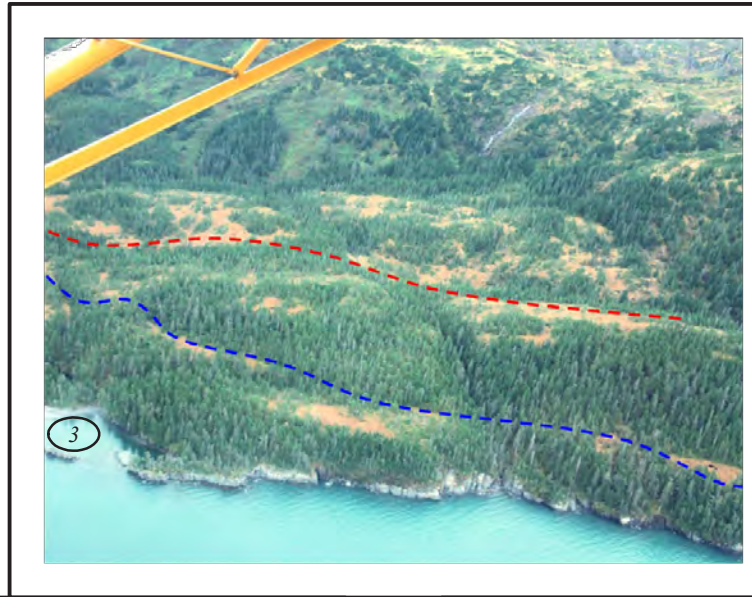
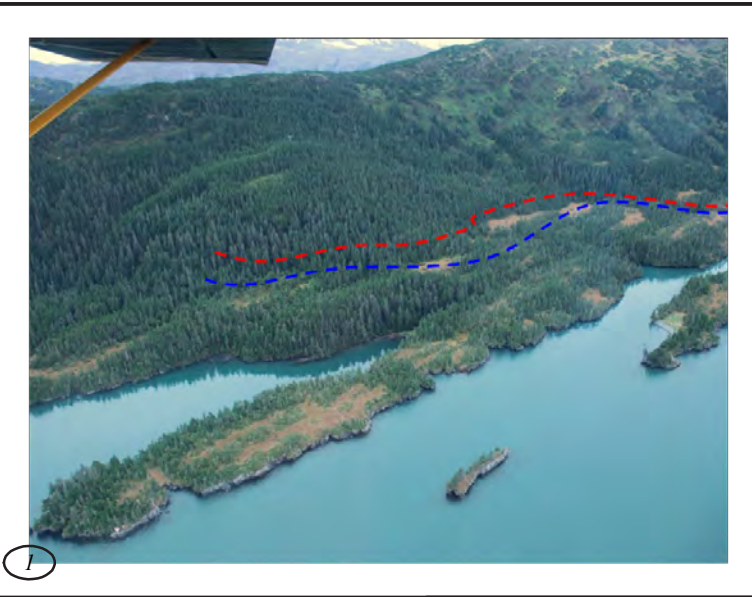
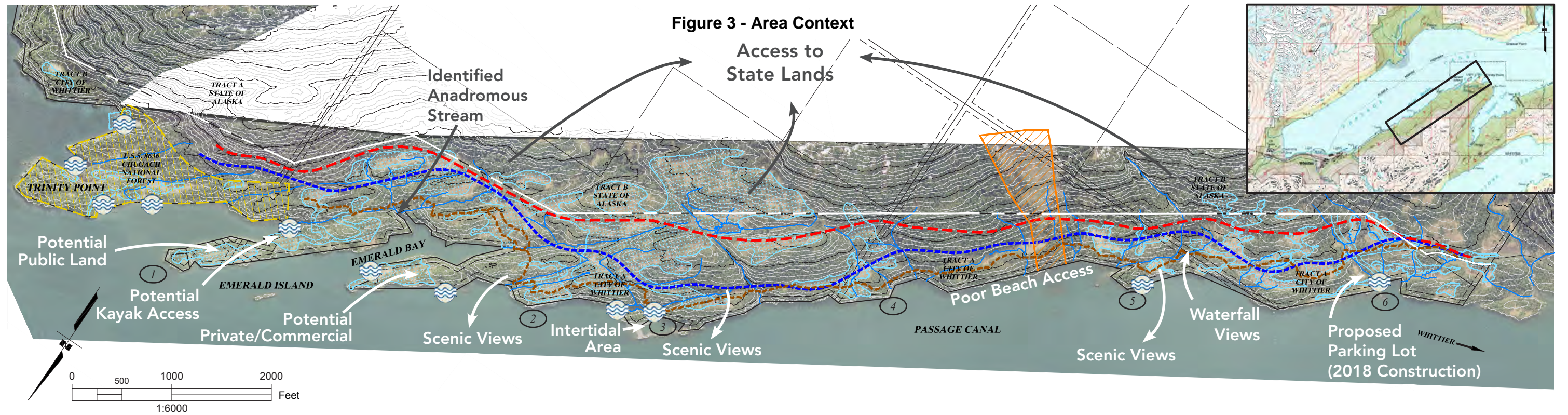


The trail follows the coastline with undulating terrain, a number of stream crossings and a few locations with beach access (Photo 5). The vegetation along the trail varies from open grassy wetlands to tall conifers with thick brush (Photo 6).

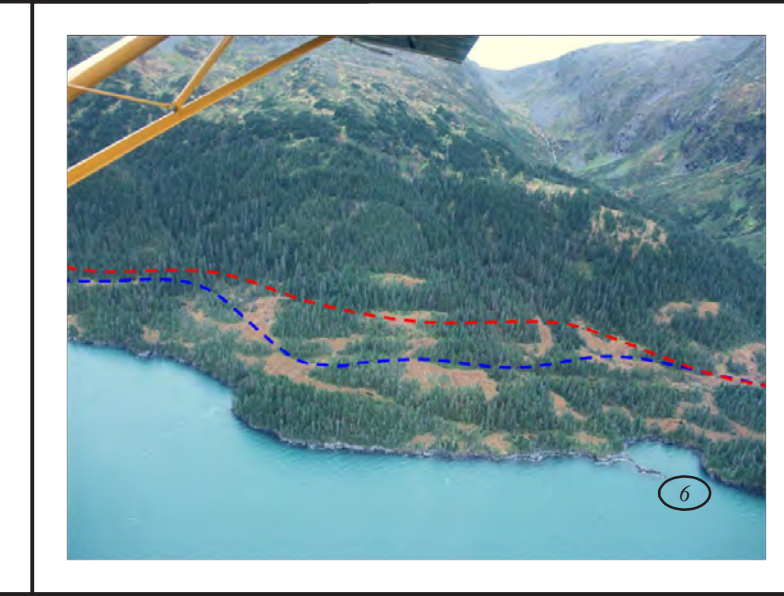
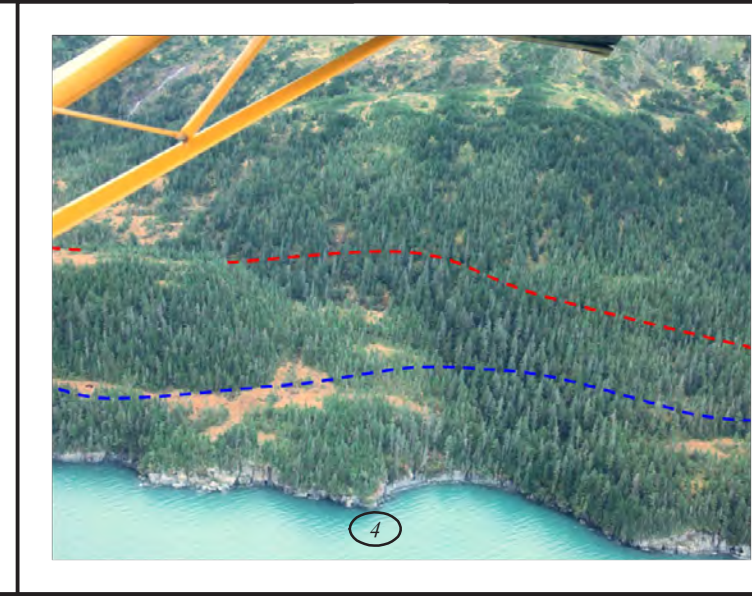
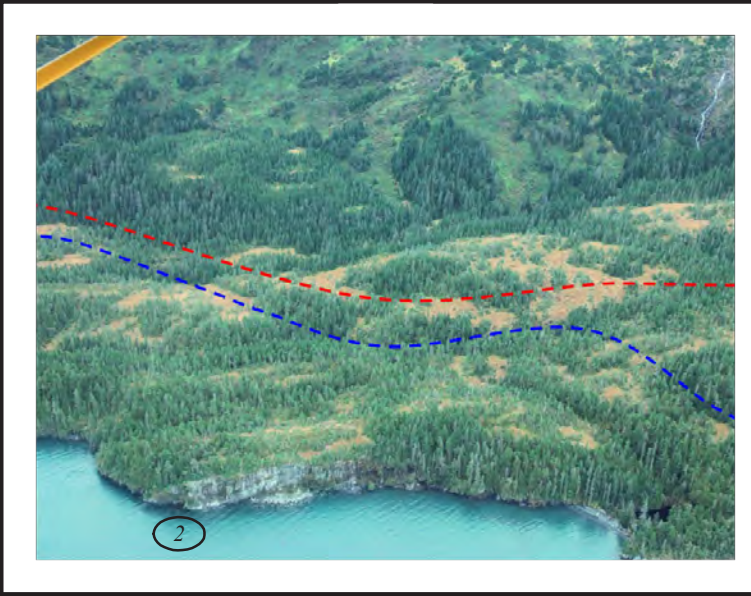


The mountain ridge south of the project corridor runs northeast, parallel to Passage Canal (Photo 7). This ridge separates Passage Canal from Shotgun Cove. While the terrain tends to slope northwest toward the water, there are a number cuts or gullies that run parallel to the coast line resulting in multiple benches separated by significant topographical relief. There are three points or peninsulas, including Trinity Point, on the east end of the project that jut out parallel to Passage Canal, towards the northeast (Photo 7). These peninsulas form two small coves, including Emerald Bay, and contain seven of approximately ten beach access locations along the corridor. The other beach access points are located near Mile 2.6 and an intertidal area near Mile 3.5 (Photo 5). At approximately Mile 2.8, aerial photos depict a cleared swath that extends below normal tree line—characteristics consistent with an avalanche zone (Photo 8).





- LEGEND**
- LOW OPTION
 - HIGH OPTION
 - STREAM
 - WETLAND
 - AVALANCHE AREA
 - USFS PROPERTY
 - EMERALD COVE TRAIL
 - BEACH ACCESS



B. Land Use and Ownership

History

In 1984, due to the lack of available private land, the Alaska State Legislature authorized a grant of approximately 600 acres along Passage Canal and in Shotgun Cove to the City of Whittier through the Municipal Land Trustee Program. This land extends east of the existing terminus of Shotgun Cove Road at Mile 2.0 and is located within Sections 8, 9, 10, 11, 14, 15, 16 and 17, Township 8 North, Range 5 East of the Seward Meridian.

On May 17, 1994, the State of Alaska received title to 2,455 acres of land around the City of Whittier by U.S. Patent No. 50-94-0170. The tracts of land subject to transfer from the State of Alaska were surveyed in 1997, and the Alaska State Cadastral Survey No. 93-169 Plat creating the land tracts was recorded on January 26, 1999 by Plat No. 99-3, filed in the Anchorage Recording District Office. The City of Whittier then received ownership of 486.01 acres by State Patent, No. 17251, and 114 acres by State Patent, No. 17252, both dated July 26, 1999.

The underlying City of Whittier owned land tracts along the Shotgun Cove Road Extension (mile 2.0 to 4.5) include Tract A of Section 17; Tract A of Section 8; Tract A of Section 9 and Tract B of Section 10. In addition, there is a 40 acre parcel of State of Alaska owned property within Section 17 at the west end of the Shotgun Cove Road Extension project near Mile 2.0.

Land Use Conditions

A condition within State Patent No. 17251 states: Land conveyed under this patent and not sold by August 30, 2004, reverts to the State of Alaska unless the Commissioner of the Department of Natural Resources finds that the City has diligently prepared for the sale of the land. If the commissioner finds that the City has diligently prepared for the sale of the land, the commissioner may extend the deadline for a period determined proper by the commissioner. Sale of this land shall occur after public notice and by competitive method.

On December 17, 2003 the State of Alaska extended the sale of land deadline to August 30, 2014 by a Modification of Patent Restriction.

On January 16, 2014 the State of Alaska extended the sale of land deadline again to August 30, 2024 by a second Modification of Patent Restriction. All other terms and conditions of the original Patent No. 17251 remained as written.

Easements

Existing easements along the proposed road corridor include:

- A 100-foot wide right-of-way for the proposed Shotgun Cove Road, referenced by Note No. 8 on Plat 99-3. The plat note states that platting of this right-of-way will require coordination between the City of Whittier and the Alaska Department of Transportation and Public Facilities.
- A 50-foot wide public access easement upland of the mean high tide line of Passage Canal.
- A 50-foot wide easement each side of the surveyed section lines, which are reserved to the State of Alaska for Public Highways under Alaska Statute 19.10.010. Given that in most cases the road alignment will not follow along existing section lines, but creates an alternate legal access to the land, there is potential for the section lines to be vacated to optimize future parcel layouts. The State of Alaska has a process in place for vacating section line easements, requiring a lengthy Department of Natural Resources (DNR) application process, public notice and comments, and review by the local platting authority.

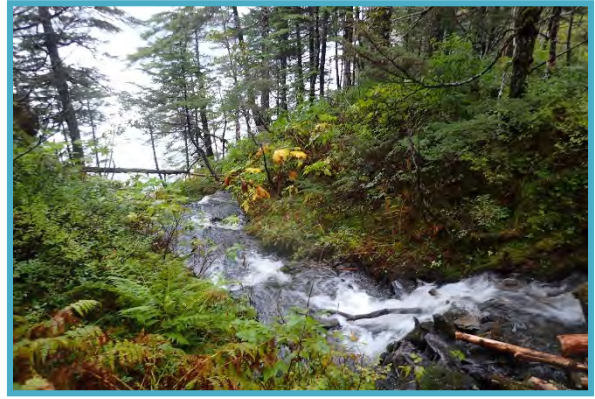
C. Geotechnical Summary

The project corridor consists of undisturbed areas of grassy wetlands or muskeg and conifer forests. Geotechnical characteristics of the corridor generally vary by the type of vegetation. Conifer forests typically contain mature trees, underbrush, and have an estimated average of 2 feet of overburden (consisting primarily of moss and roots) over bedrock. Based on initial probing, typical depth of surficial organics in wetland or muskeg areas ranges from 2 to 7.5 feet, with an average of 4 feet along the corridor. Exposed bedrock was observed in some locations, including stream crossings where gravel alluvial was also observed. Exposed bedrock consists of meta-shale or slate. Given the observed depth to bedrock, there does not appear to be a substantial amount of soil along the corridor. See [Appendix C](#) for the Preliminary Geotechnical Engineering Report (May 2018).



D. Drainage

There are a number of streams along the corridor, both following the natural slope northwest towards Passage Canal and following gullies that run parallel to the coastline. Due to the shallow depth of bedrock along the corridor, groundwater is near the surface, with numerous smaller



drainages and extensive wetlands even on steep slopes. According to the Alaska Climate Research Center, the average annual precipitation in Whitter is 215 inches. Shallow bedrock, limited amounts of soil, and steep gullies can result in high runoffs during storm events.

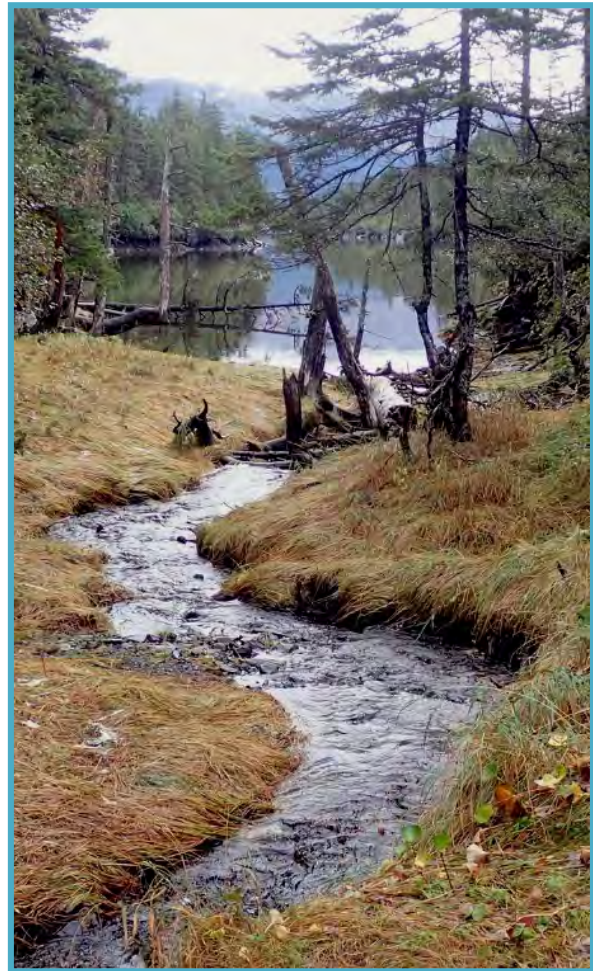
E. Vegetation

The project area is made up of primarily needleleaf forest with white and Sitka spruce, mountain hemlock, and western hemlock. Shrubland areas characterize avalanche chutes and beach fringe areas and are dominated by Sitka alder and salmonberry. Wetland areas are dominated by sweetgale, crowberry, bunchberry; grasses such as Sitka sedge and cotton grass; and peat (Sphagnum) moss.



F. Environmental

In order to identify environmental and social resources relevant to the proposed project before a National Environmental Policy Act (NEPA) review and approval from the Federal Highway Administration (FHWA), Western Federal Lands (WFL), the project gathered existing data, reports, and information and prepared a Preliminary Environmental Research document. The document was distributed to agencies on March 15, 2018. A public open house was held on April 11, 2018 to gather input on the environment, the project, and its potential impacts. On April 24, 2018 a pre-NEPA agency scoping meeting was held in Anchorage, and a second meeting with the Alaska Department of Fish and Game (ADF&G) on April 26, 2018. Comments and information gathered through preliminary environmental research and the aforementioned pre-NEPA scoping meetings have been incorporated into the Shotgun Cove Road Extension Data Gap Analysis (June 2018) and can be found in [Appendix D](#).



Historic Properties, Archeological and Cultural Resources

Section 106 of the National Historic Preservation Act (NHPA) requires federal agencies to consider the effects of their activities on historic properties. There are no known Alaska Heritage Resources Survey (AHRs) sites in the project area. There have been no previous cultural resource surveys in the project corridor. However, it is understood that Prince William Sound has been important historically for indigenous peoples and Whittier saw development during World War II.

Wetlands and Waters of the U.S.

According to a January 24, 2018 review of the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI), there are approximately 150 acres of freshwater forested/shrub wetland (PF04/EM1B) and approximately six acres of freshwater emergent wetlands (PEM1B) within the study area. A 2011 field-based effort of the

area also identifies freshwater forested/shrub and freshwater emergent wetlands in the project area.

During the April 24, 2018 Shotgun Cove Road Extension pre-NEPA agency scoping meeting, a USACE representative stated that USACE could provide a Preliminary Jurisdictional Determination (PJD) based on existing NWI and supplemental information including the abovementioned field survey. A PJD is not appealable, and to obtain a formally appealable Approved Jurisdictional Determination (AJD), it was stated that USACE generally requires fieldwork. A wetlands permit would be needed for the road. Understanding that FHWA would be the lead agency on the environmental document, USACE would likely adopt FHWA's decision during USACE's permitting process. The USACE permitted the existing Shotgun Cove Road under permit #POA-2003-764-4. The USACE stated that the proposed project will likely be authorized by modifying this permit.

Floodplain and Regulatory Floodway

An October 3, 2017 review of the Federal Emergency Management Agency Flood Map Service Center revealed that a flood hazard study has not been completed for the City of Whittier or the project area, and there are no Flood Insurance Rate Maps or critical facilities maps available for the area.

Whittier is prone to storm surge, rainfall, snowmelt, and glacier melt flooding; however, the proposed low and high road options both have components of the roadway at a minimum of approximately 80 feet from Marine waters, which is likely outside the floodplain.

Water Quality

The project area is located approximately 2.3 miles northeast of the City of Whittier's drinking water source that originates from the three groundwater wells located near 100 West Whittier Road, and the proposed project would not impact this area. According to a January 25, 2018 review of the ADEC Alaska Water Quality Map, there are no impaired waterbodies in or near the project area. There are approximately fifteen existing streams and drainages that have potential to intersect the proposed low and/or high road options.

Essential Fish Habitat and Fish Streams

The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) governs U.S. marine fisheries management and requires federal agencies to consult with National Oceanic and Atmospheric Administration (NOAA) National Marine

Fisheries Service (NMFS) on action or proposed actions that may adversely affect Essential Fish Habitat (EFH).

A January 2018 review of the NMFS EFH mapping tool indicated that marine waters in the project vicinity are EFH. Seine dives were completed by NMFS in Passage Canal, which is a minimum of approximately 250 to 350 feet northwest of the proposed road options, and eelgrass beds were identified during these dives, primarily in the Shotgun Cove area. Passage Canal supports a variety of fish, but the proposed project would avoid impacts to marine waters.

An October 3, 2017 review of the Fish Resource Monitor, ADF&G's mapping tool for the Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes, identified five anadromous fish streams, which are EFH, in close proximity to the project area and one anadromous stream, Trinity Creek, that will likely intersect the project. However, ADF&G stated that Trinity Creek may have been mapped in an incorrect location and there may be additional unmapped streams containing anadromous fish species within the project area.

Wildlife and Migratory Birds

The proposed project would develop a road in an area that supports birds, fish, and wildlife and could increase human and wildlife interactions. Black bears, coyotes, and mount goats are predominant large land animals near Whittier, and moose and wolves are occasionally seen. Common small mammals that are present include snowshoe hares, porcupines, beavers, river otters, mink, marmots, squirrels, and weasels. The proposed project would avoid impacts to the adjacent Passage Canal marine environment. Birds frequent the Whittier area including geese, ducks, cranes, Bald Eagles, ptarmigan, and hummingbirds, and suitable nesting habitat, such as mature trees, exists in and adjacent to the project corridor.

The USFWS IPaC report for this project identifies 42 migratory bird species that may be present within the project area. According to a May 21, 2018 review of the Wetland Ecosystems Services Protocol for Southeast Alaska mapper, there are no Bald Eagle nests within the project area. There is one nest located approximately 2,087 feet west of the project area at latitude 60.7764, longitude -145.6935, and other nests are more than 20,000 feet away from the project area.

Through a March 20, 2018 email correspondence, USFWS concurred that the proposed project's preliminary environmental research was reviewed and included IPaC information and vegetation clearing timing windows; USFWS indicated that the

agency had no additional comments at that time. A May 23, 2018 email from USFWS reiterated that the agency had no further comments after reviewing the pre-NEPA agency scoping meeting summary.

Invasive Species

A January 24, 2018 search of the Alaska Exotic Plants Information Clearinghouse showed that there is one invasive plant species present with the project area's vicinity. The alsike clover (*Trifolium hybridum* L.) was identified at latitude 60.777, longitude -148.662 and infests an area of 0.0117 acres. During the April 24, 2018 Shotgun Cove Road Extension pre-NEPA agency scoping meeting it was noted by the Chugach National Forest and City of Whittier representatives that European black slugs (*Arion ater*) have been observed in the project area's vicinity, and an adjacent area was treated for noxious weeds.

4(f)/6(f) Resources

A potential 4(f) property (Shotgun Cove/Emerald Cove Trail) is located within the project area, and the trailhead is located at the southwest end of the proposed roadway. Shotgun Cove/Emerald Cove Trail is located on land owned by the City of Whittier and runs parallel to the coastline to Trinity Point. The trail was built and is maintained by the Alaska Department of Natural Resources (ADNR), Division of Parks & Outdoor Recreation. The road options would parallel Shotgun Cove/Emerald Cove Trail, and depending on the road option that is chosen, the road would intersect between one and six times.

Social and Economic Issues

Minority populations make up about 35% of Whittier's demographics, and approximately 12% of the population lives below the poverty level. There are no federally-recognized tribes in Whittier. The geographically-closest tribes to the project area are the Native Village of Tatitlek, the Native Village of Chenega, and the Native Village of Eyak.

III. Road Design Criteria

A. Design Standards

Project design criteria are a function of the roadway characteristics and the design standards used. The owner of the facility and the funding source often dictate design standards that are used. The City of Whittier has its own design standards which previous projects have supplemented with design criteria from the Federal Government and the State of Alaska.

1. City of Whittier

Title 16 of the City of Whittier Municipal Code, Chapter 16.20 identifies general design standards for streets and subdivisions, including functional classification, ROW and pavement widths, maximum grade and lot configurations.

2. Federal

AASHTO's "Policy on Geometric Design of Highways and Streets," the "Green Book," (AASHTOGB) is a comprehensive reference manual for planning and design of highways and streets in the United States. The most current publication year for the AASHTOGB is 2011. The manual provides roadway design standards based on functional classification.

AASHTO's "Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT≤400)" (GDVLVLR) provides additional design guidance for low-volume local and collector roads, presenting less-restrictive design criteria than those described for paved, higher-volume local and collector roads in the AASHTOGB.

3. State of Alaska

The DOT&PF Highway Preconstruction Manual (PCM) provides detailed design criteria for federally-funded roadway projects within the State of Alaska. The PCM is intended to interpret and amend the goals and objectives of the AASHTOGB. The PCM references other documents, including AASHTOGB and the GDVLVLR, for many design parameters including lane width and shoulder width, design speed, sight distance, horizontal curves, grades, and intersection design.

B. Traffic Projections

Previous phases of the Shotgun Cove Road used the following traffic projections:

Table 1 – Design Designations, Previous Phases

Shotgun Cove Road	
A.D.T. 2001	<100
A.D.T. 2024	700

The 2012 City of Whittier Comprehensive Plan Update presents 2001 ADT traffic volumes for Cove Creek Road, located on the west end of Shotgun Cove Road, but did not discuss traffic projections for Shotgun Cove Road.

Traffic projections will vary significantly based on the type of development that occurs along the project corridor, whether residential, commercial, city lands, U.S. Forest Service recreation facilities, small craft boat launch or harbor, relocated Alaska Marine Highway Ferry Terminal, or relocated Whittier Airport. Daily traffic can be estimated for each of these types of development using the Institute of Transportation Engineers (ITE) Trip Generation Manual, which provides factors for various land uses based on national studies. Tables 2 - 5 provide ranges of trip generation based on the number of projected dwelling units, hotel rooms, harbor berths and public land acreage. The range of values demonstrates the variability of the studied areas, and their limited application forecast trip generation for Whittier's unique context.

Table 2 – Trip Generation Values for Residential Use

Trip Generation - Residential				
Single Family Detached Housing Dwelling Units	40	60	80	100
Daily Trips	345 - 452	517 - 656	690 - 855	862 - 1,050
Recreational Home Dwelling Units	20	40	60	80
Daily Trips	56 - 65	113 - 130	169 - 194	226 - 259
Timeshare Dwelling Units	20	40	60	80
Daily Trips	115 - 341	230 - 682	346 - 1024	461 - 1,365

Table 3 – Trip Generation Values for Tourism Accommodation

Trip Generation - Hotel				
Hotel Rooms	25	50	100	200
Daily Trips	0 - 212	74 - 424	401 - 848	802 - 1696

Table 4 – Trip Generation Values for Small Craft Boat Harbor

Trip Generation - Marina				
Marina Berths	25	50	100	200
Daily Trips	74 - 640	148 - 1,000	296 - 2,000	592 - 4,000

Table 5 – Trip Generation Values for City Lands and U.S. Forest Service Facilities

Trip Generation - Park			
County Park Acres	25	50	75
Daily Trips	57 - 103	114 - 207	171 - 310
State Park Acres	25	50	75
Daily Trips	16 - 28	33 - 55	49 - 83

While these factors can help estimate trip generation by land use, they do little to describe actual traffic projections along the corridor without knowing the proximity of these land uses to one another and to the major employment, transportation, and commercial centers of the city.

- If the land along the project corridor is developed primarily for residential use, tourism accommodations, recreation, and regional transportation facilities with the places of employment, commerce, and public services remaining at the existing town site, then the majority of trips will occur back and forth between Shotgun Cove Road and the city center.
- If some of these services and places of employment are included in the development along Shotgun Cove Road, then a higher percentage of daily trips originating from residential dwellings and tourism accommodations will remain in the area with less through traffic to and from the city center.

The unknown timeframe for further extension of the road past Trinity Point and the type of development that would occur in Shotgun Cove is also a factor for determining

future volumes. While it is not necessary to predict actual traffic volumes, traffic projections are an important part of determining appropriate design criteria.

C. Functional Classification

The City of Whittier Design Standards define the following road classifications and minimum right-of-way and pavement widths:

Table 6 – City of Whittier Right-of-Way and Pavement Widths §16.20.040(c)

Right-of-Way	Surface (ft)	Width (ft)
Major Streets	60	40
Collectors	50	30
Local Streets	40	25
Alleys	20	20

The 2012 City of Whittier Comprehensive Plan Update identifies Shotgun Cove Road as a local road.

City, State and Federal design standards define local roads as a road primarily for access to homes, businesses, or other abutting property and collector roads as a road collecting traffic from local roads and channeling it to the arterial system (PCM Section 100.2). State and Federal design guides also describe “rural major access roads” or “collector streets” as roads that serve a dual function of providing access to abutting properties as well as providing through or connecting service between other local roads or higher type facilities (GDVLVLR Ch. 2). This category describes the functional classification of Shotgun Cove Road, since the proposed road will provide access to adjacent properties and serve through traffic to destinations at Trinity Point and potentially in Shotgun Cove in the future.

While the City of Whittier Design Standards use functional classification to determine ROW and pavement width for road improvements, State and Federal design criteria depend more heavily on operational characteristics, traffic volumes and topography.

D. Operational Characteristics

The GDVLVLR discuss the different performance characteristics of unpaved roads with the following research findings (pg. 50) from the National Cooperative Highway Research Program (NCHRP):

- “Crash rates are generally higher for unpaved roads than for paved roads for traffic volumes of 250 vehicles per day or more.”
- “Crash rates for unpaved roads [are] lower for narrower roadway widths. Therefore, existing unpaved roads should not generally be widened as a safety measure unless there is evidence of a site-specific safety problem that may be corrected by widening.”

Based on these safety considerations and the potential to reduce environmental impacts and construction costs by minimizing the road footprint, the GDVLVLR discourages “widening of lanes and shoulders, changes in horizontal and vertical alignment, and roadside improvements except in situations where such improvements are likely to provide substantial safety benefits.” It goes on to state that the “provision of roadside clear zones, flatter slopes, or traffic barriers is generally inconsistent with the economic decision to build and maintain an unpaved surface and is not generally necessary for the low-speed environment of an unpaved road.”

Previous phases anticipated a design ADT (2024) of 700 vehicles per day, exceeding the volumes specifically addressed in the GDVLVLR. However, given that the project may be constructed in phases with an unknown timeframe for adjacent land development, it is uncertain how long traffic volumes would fall under the classification of a very-low-volume local road. As acknowledged in the guide, any new construction should anticipate an eventual increase in traffic volumes and obtain the ROW necessary for subsequent widening. Given the topographic relief along the project corridor and the necessary rock cuts required for construction, it would be disadvantageous to design for minimum road width in areas of significant cut or fill and risk necessary re-widening of rock cuts at a future date.

E. Design Speed

The design speed affects the length of sight distance available along the roadway’s horizontal alignment and vertical profile, particularly at intersecting roadways and pedestrian facilities. As design speeds increase, longer sight distances are required to provide more reaction time and braking distance to respond to roadway obstacles. Additionally, higher design speeds require a more gradual change in horizontal and vertical alignment, which typically increases the extent of cut and/or fill near hills. It is important that the design speed is slightly higher than the posted speed (typically 5 to

10 MPH higher) to provide a margin of safety for drivers driving at the speed limit in unfavorable conditions such as poor weather.

Previous phases of the Shotgun Cove Road used the following design criteria for design speed and maximum grade:

Table 7 – Design Speed and Maximum Grade, Previous Phases

Shotgun Cove Road	
Design Speed	30 MPH
Maximum Grade	10%

These values are consistent with the PCM recommended criteria for collector roads with 400 – 2,000 vpd in mountainous terrain. The City of Whittier identifies maximum roadway of 10% for all roadway classifications, while the PCM recommends higher maximum grades for local roads and allows for grades up to 12% on collector roads for lengths 500 feet or less. The design criteria in Table 7 are appropriate and will be used for the Shotgun Cove Road Extension. The PCM identifies minimum stopping sight distance and passing sight distance of 200 feet and 1,090 feet respectively.

F. Typical Section

Previous phases of the Shotgun Cove Road used the following typical section:

Table 8 – Typical Section, Previous Phases

Shotgun Cove Road	Width	Cross Slope
Lane	12 ft	2%
Shoulder	4 ft	2%
Clear Zone (Fill Condition)	11 ft	5:1
Clear Zone (Cut Condition)	12 ft	4:1

The PCM provides the following design standards that meet the criteria identified in Table 7 for collector roads with 400 – 2,000 vpd in mountainous terrain:

Table 9 – Lane and Shoulder Width, PCM

Rural Collector Roadway – 30 MPH, Mountainous Terrain						
Design Year Traffic Volumes (ADT)	401-600 vpd		601-1,500 vpd		1,501-2,000 vpd	
% Trucks	≤ 10%	> 10%	≤ 10%	> 10%	≤ 10%	> 10%
Lane Width	9	10	10	10	10	10
Shoulder Width	2	5	5	5	6	6

It's noteworthy that Table 9 reflects an approach similar to the GDVLVLR for lower volume rural collectors and low percentage of trucks, with narrow lanes and shoulders. All other values in Table 9 are fairly consistent with slightly wider travel lanes and wider shoulders. These widths differ from previous phases of Shotgun Cove Road which had wider travel lanes and narrower shoulders. While the total road width on previous phases matches the road width for higher volume rural collectors, and the lane width and shoulder width are not distinguishable on unpaved roads, the shoulder width is a determining factor for clear zone width.

G. Clear Zone

The PCM identifies clear zone requirements in Section 1130, consistent with AASHTO's Roadside Design Guide. The PCM defines the clear zone as the unobstructed, traversable area provided beyond the edge of the through traveled way for the recovery of errant vehicles. The clear zone includes shoulders. Clear zone values from the PCM are presented in Table 10:

Table 10 – Clear Zone, PCM

Clear Zone Distance ≤ 40 mph In feet from edge of traveled way					
Design Year Traffic Volumes (ADT)	Fill Slopes		Cut Slopes		
	≤ 6:1	5:1 to 4:1	3:1	4:1 to 5:1	≤ 6:1
<750	7-10	7-10	7-10	7-10	7-10
750-1,500	10-12	12-14	10-12	10-12	10-12
1,501-6,000	12-14	14-16	12-14	12-14	12-14

Due to the 12-foot lane, 4-foot shoulder configuration of previous phases, the width of recoverable slopes on either side of the road must be 2-feet wider than the PCM configuration to attain the same clear zone. With 4-foot shoulders and 7 to 8-foot recoverable slopes (4:1 to 5:1), previous phases of Shotgun Cove Road had clear zones of 11 feet on fill sections and 12 feet on cut sections consistent with 750 to 1,500 vpd.

H. Rock Cuts

Per design standards identified in the PCM section 1130, clear zone has a direct impact on rock cut design for cuts less than 20 feet. When higher than 20 feet the PCM has specified values for both vee and flat bottom ditches. Vertical slope is based on geotechnical recommendations. A comparison of rock cuts for various shoulder widths and traffic volumes is presented in Table 11.

Table 11 – Lane and Shoulder Width, PCM

Rock Catchment Ditch Width In feet from edge of shoulder						
Design Year Traffic Volumes (ADT)	Clear Zone	Height of Rock Cut	Lane Width/ Shoulder Width (Phase 5)	Ve Ditch Width	Lane Width/ Shoulder Width (DOT&PF PCM)	Ve Ditch Width
<750	7-10	0-20	12 / 4	3-6	10 / 5	2-5
		20-30		16		16
		30-60		19		19
750-1,500	10-12	0-20	12 / 4	6-8	10 / 6	4-6
		20-30		16		16
		30-60		19		19
1,501- 6,000	12-14	0-20	12 / 4	8-10	10 / 6	6-8
		20-30		16		16
		30-60		19		19

I. Design Criteria Summary

Table 12 – Design Criteria– Shotgun Cove Road Extension Mile 2.0 to 4.5

	Criteria	Design Std. Value	Reference
Traffic Data	Functional Classification	Rural Local/Collector Roadway	PCM 100.2
	AADT – 2001	< 100 vpd	Previous Plans
	AADT – 2024	700 vpd	Previous Plans
	Design Speed	30 MPH	Previous Plans
	Design Speed (Mountainous Terrain)	30 MPH	PCM Tables 1130-3 through 1130-6
	Posted Speed	25 MPH	Previous Plans
Horizontal Alignment	Horizontal Curve Radius, Minimum	275 ft	Previous Plans
	Horizontal Curve Radius, Minimum, Normal Crown (e = 2%)	275 ft	AASHTO Table 3-13b
	Horizontal Curve Radius, Minimum, Normal Crown (e = -2%)	330 ft	AASHTO Table 3-13b
	Horizontal Curve Radius, Minimum, Maximum Superelevation (e = 6%)	231 ft	AASHTO Table 3-7
	Stopping Sight Distance, Minimum, Level Roadway	200 ft	Previous Plans AASHTO Table 3-1
	Stopping Sight Distance, Minimum, Maximum Grade (-10.0%)	231 ft	AASHTO Eq 3-3
Vertical Alignment	Passing Sight Distance	1,090 ft	Previous Plans
	Vertical Grade, Maximum	10.0%	Previous Plans
	Vertical Curve K-Value, Min Crest Curve	19	AASHTO Table 3-34
Cross Section	Vertical Curve K-Value, Min Sag Curve	37	AASHTO Table 3-36
	Number of Lanes	2	Previous Plans
	Lane Width	12 ft	Previous Plans
	Shoulder Width	4 ft	Previous Plans
	Lane Width	10 ft	PCM Tables 1130-3 through 1130-6
	Shoulder Width (No Parking Lane)	5-6 ft	PCM Tables 1130-3 through 1130-6
	Superelevation, Maximum	6.0%	Previous Plans
	Clear Zone	11-12 ft	PCM Table 1130-2 * See AASHTO RDG
	Side Slopes, Maximum	2.0H to 1V	Geotech Recommendation
	Side Slopes, Rock Cut	1/3H to 1V	Geotech Recommendation
	Rockfall Catchment Width H=0-20ft (Foreslope and Ditch)	8 ft	PCM Figure 1130-3
	Rockfall Catchment Width H=20-60ft (Foreslope and Ditch)	20 ft	PCM Figure 1130-3

IV. Road Design Alternatives

A. Design Challenges

Some of the significant design challenges associated with the Shotgun Cove Road Extension include:

- Steep cross-slopes and significant topographical relief along the project corridor resulting in larger cuts and fills.
- Stream crossings forcing significant fill conditions due to shallow channel depths, proximity to ridgelines and proposed vertical curves, and steep gullies.
- Limited availability and expensive haul of borrow material, requiring balanced mass haul for constructability and phasing of the proposed roadway.

B. Roadway Cross Section

The recommended typical cross-section is an unpaved, two lane roadway, consisting of 12-foot travel lanes with 4-foot gravel shoulders and 7 to 8-foot recoverable slopes, and drainage swales or rock cut along the uphill sides (see [FIGURE 4](#)). The total road surface width is 32 feet. If paved at a later date, the road could be striped with 10-foot travel lanes and 6' foot paved shoulders.

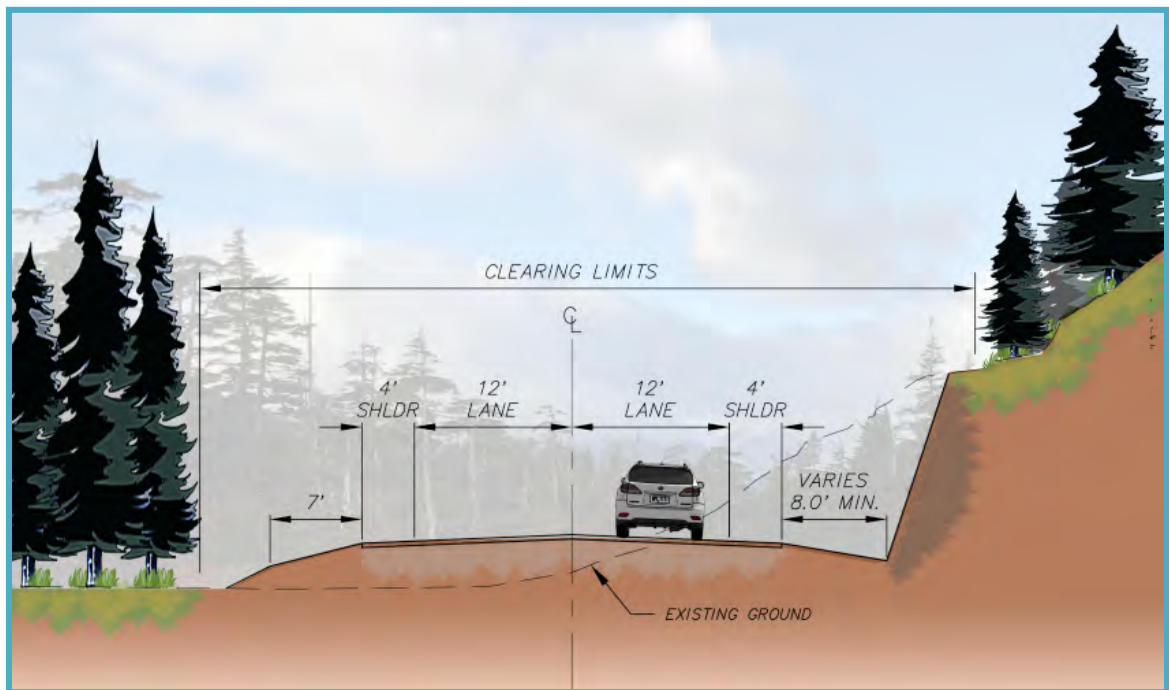


Figure 4 – Proposed Typical Cross Section

C. Structural Section

Geotechnical reconnaissance found that across areas of grassy wetland or muskeg and areas of mature conifer forest the project corridor generally consists of an organic layer of varying thickness (approximate average depth of 3 feet) overlying bedrock, with little to no soil. During construction the roadway should be cleared and grubbed, removed of any upper layer organics (organic silt, peat, etc.) and unsuitable soils (loose or soft sand and silt, soils with high water content, or soils susceptible to long term settlements) and replaced with compacted Selected Material Type B or blast rock.

Based on the geotechnical reconnaissance effort, and to be confirmed by the Design Phase geotechnical investigation for the roadway, the structural road section may consist of: a minimum of 6 inches E-1 surface course over 20 inches of Selected Material Type A structural fill as defined by the DOT&PF standard specifications. The structural section may be developed over native granular materials or bedrock as discussed in Appendix C. This section may experience some vertical displacement during freezing and thawing cycles and minor subgrade strength loss during the spring thawing cycle, which is considered acceptable.

D. Roadway Alignment & Profile

1. Methodology

A proposed roadway alignment that follows existing contours will limit steep grades and significant changes in grade. An alignment that cuts across steep slopes will result in significant cuts and fills. An alignment too close to the existing shoreline will limit development of waterfront properties and have limited access to steeper lots further from the shore, while an alignment along the southern boundary of City-owned property will have the most topographical relief and limited access to waterfront properties. An optimal alignment will balance access to all parts of City-owned land and surrounding Federal and State lands.. The proposed alignment will require additional spur roads or easements to provide access to other parts of the corridor.

Proper design and coordination of the alignment and profile, with consistent horizontal and vertical curves and appropriate sight distance for the selected design speed, is crucial for the operational safety of the roadway. Selection of a road profile depends on the existing terrain, location of streams and wetlands, roadway drainage, impacts on

adjacent slopes, and grades of future adjacent roads and driveways. The vertical roadway profile is generally slightly above the existing grade to allow drainage from the roadway to the northwest without the need for a ditch while still minimizing impacts on adjacent slopes. Due to the limited availability and expensive haul of borrow material from offsite, a profile that balances the mass haul along the corridor is key for the constructability and phasing of the project.

2. Alignment Options

Based on these considerations the project developed two alignment options, a Low Option and a High Option, both beginning at the existing Shotgun Cove Road terminus (Mile 2.0) and extending to Trinity Point (Mile 4.5). See [Figure 5](#) for an overview of each option.

Low Option

The Low Option is generally located 250 to 350 feet from the shoreline of Passage Canal, roughly running down the middle of the City-owned land. Due to its proximity to the shore, the Low Option has less change in elevation, but crosses more streams with higher flow and deeper gullies. The Low Option is slightly longer than the High Option since a portion of it follows the natural bench near the shoreline.

Station 0+00 to 25+00 – The Low Option has a slight downhill grade from the existing Shotgun Cove Road terminus, skirting to the south of proposed parking lot improvements, crossing a small gully, continuing through an area of wetlands and cutting through a hill.

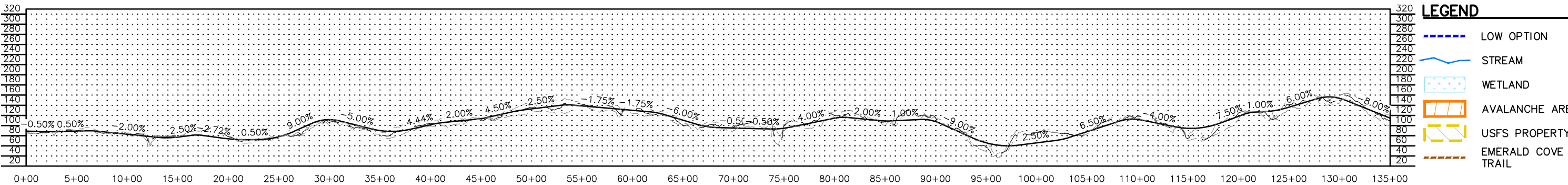
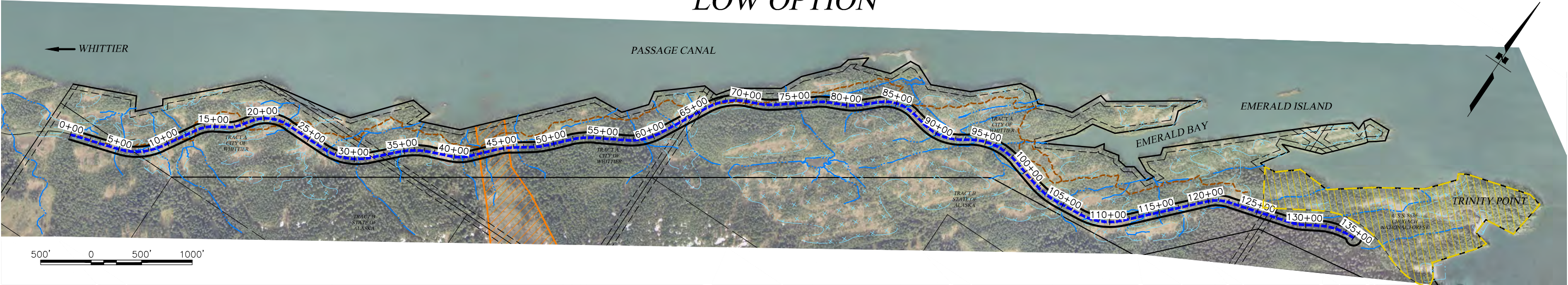
Station 25+00 to 50+00 – The road curves upland and begins a 9% climb providing adequate cover for a stream crossing at the crest vertical curve (upstream of the observed waterfall). The profile then follows existing terrain with a descent, sag vertical curve, and gradual upgrade cutting across the avalanche area.

Station 50+00 to 75+00 – The Low Option crests and begins a gradual descent on the natural bench, below steep forested terrain, crosses a number of streams and sweeps closely to the shoreline. The road begins a cut section in advance of the largest stream crossing along the corridor.

Station 75+00 to 100+00 – Following the stream crossing, the road climbs up the other side and skirts around a ridgeline with the first of three successive horizontal

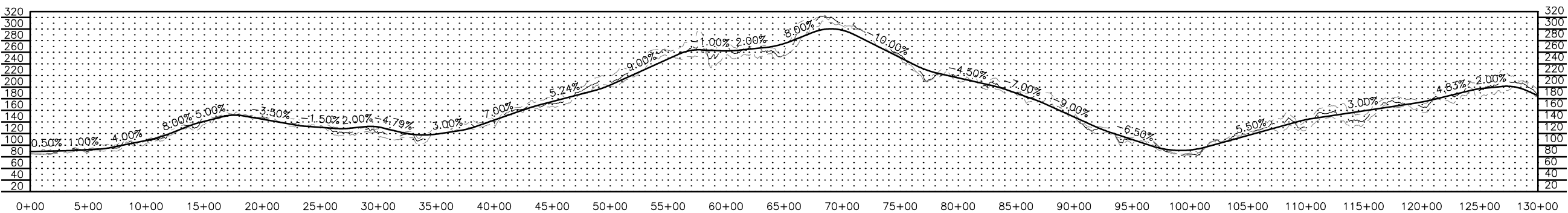
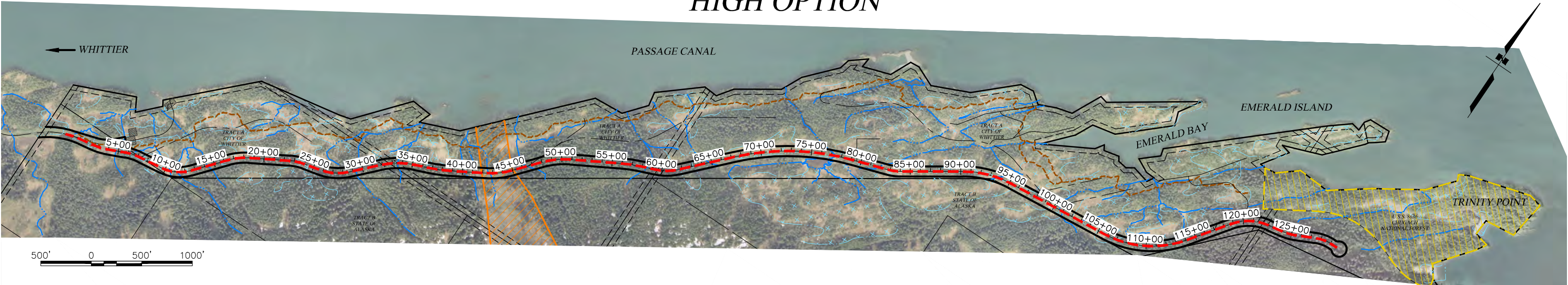
Figure 5 - Alignment and Profile Overview

LOW OPTION



- LEGEND**
- LOW OPTION
 - STREAM
 - WETLAND
 - AVAILANCE AREA
 - USFS PROPERTY
 - EMERALD COVE TRAIL

HIGH OPTION



- LEGEND**
- HIGH OPTION
 - STREAM
 - WETLAND
 - AVAILANCE AREA
 - USFS PROPERTY
 - EMERALD COVE TRAIL

curves coordinated with a 9% downgrade and sag vertical curve at the base of two converging valleys.

Station 100+00 to 135+00 – The road then climbs with the most significant cut along this alignment, approaches the back property line, and crests before following a gully parallel to Emerald Bay. The road crosses two more converging valleys with a sag vertical curve and begins an ascent up the forested terrain adjacent to the U.S. Forest Service land.

High Option

The High Option is generally located adjacent to the southern boundary of City-owned property. Due to its proximity away from the shore, the High Option has more elevation gain but crosses fewer streams and drainages with smaller flows and less topographic relief. The High Option is a slightly more direct route to the U.S. Forest Service land, and is approximately 500 feet shorter than the Low Option.

Station 0+00 to 25+00 – The High Option has an uphill grade from the existing Shotgun Cove Road terminus, skirting to the south of the proposed parking lot improvements, following existing contours and avoiding area wetlands.

Station 25+00 to 50+00 – The road follows existing contours and maintains its elevation to provide adequate cover for a stream crossing at a slight crest vertical curve (further upstream of the observed waterfall) and begins a steady upgrade cutting across the avalanche area.

Station 50+00 to 75+00 – The High Option continues the steady 2,500 foot climb across steep forested terrain, crests with a cut through a narrow ridge, and levels out with a winding section along steep slopes. The road crosses a stream and follows on the backside of a ridge northwest of the adjacent stream and pond, cutting into the hill towards this alignment's highest point before beginning a 10% descent.

Station 75+00 to 100+00 – The road crosses the stream uphill from the steep gully and adjacent to the pond before continuing a steady descent along the back property line (including one 9% grade) near a large area of wetlands.

Station 100+00 to 135+00 – The road then continues with a steady climb along the southern boundary of City-owned property. across steep forested terrain, avoiding adjacent drainages.

Further refinement of the alignment and profile are expected during the design process once the preferred alignment has been selected. While the two alignment options were designed using Lidar Imagery, the design will be updated with survey data to confirm adequate sight distance, improve drainage, and further reduce impacts to adjacent slopes. See APPENDIX F for preliminary roadway plan and profile sheets.

3. Mass Haul

As discussed previously, balancing the mass haul along the roadway corridor is key for the constructability and phasing of the project. A mass haul diagram also helps determine locations along the corridor where cuts and fills balance and where a project might be broken into phases. Table 13 presents the usable cut and fill volumes for two phases of each option, though phases could be constructed in shorter ½ mile to ¾ mile increments.

Table 13 – Usable Cut and Fill Summary

Shotgun Cove Road Extension Quantities				
	Area (SF)	Cut (CY)	Fill (CY)	Net (CY)
Low Option	1,004,300	230,800	(233,500)	(2,600)
Phase 1 0+00 to 80+00	583,200	113,500	(129,600)	(16,100)
Phase 2 80+00 to 135+00	421,100	117,300	(103,900)	13,500
High Option	1,031,900	273,500	(249,100)	24,300
Phase 1 0+00 to 80+00	568,600	161,300	(126,800)	34,500
Phase 2 80+00 to 130+00	463,300	112,200	(122,300)	(10,200)

4. Conceptual Parcel Layouts

Access to adjacent Federal, State and City-owned lands is one of the primary objectives of the project and a primary function of a “rural major access road.” Therefore, potential parcel configurations are a key factor in the conceptual roadway design and in selecting a preferred alignment. While the type of future development along the corridor is uncertain, a conceptual parcel layout for each option analyzed potential development of City-owned land for single family homes. The conceptual lot configuration was not based on standard lot dimensions, but instead based on

topography, streams, and standing water. Important considerations for each individual parcel include: proximity to road alignment, acceptable driveway grades, constraints due to wetlands and streams, proximity to the shoreline, topography of the parcel, parcel size, aesthetic quality of land and views. Conceptual parcel configurations for each option are shown in [Figures 6 and 7](#) with additional analysis in [Figures 8 and 9](#). Both configurations identify a number of areas as “Potential City of Whittier Land.” These areas consist of potential stream easements, avalanche zones, undevelopable environmental features, and other low buildable value/high recreational value areas. These locations were considered to provide opportunities for trails and parking to access Passage Canal and State lands along the southern boundary of the project area.

Both configurations provided a minimum parcel size of one acre with enough diversity of parcel sizes to allow for a range of developments from dry cabins, seasonal tourism accommodations, year-round single-family residences, rental properties, and high-value residences and vacation properties. Additionally, a number of properties could support larger tourism accommodations or other commercial development that may eventually grow to support year-round residences. See [Table 14](#) for a comparison of parcel size distribution.

Table 14 – Parcel Size Distribution

	Low Alignment		High Alignment	
Parcel Size	Number of Parcels	Total Area (Acres)	Number of Parcels	Total Area (Acres)
1 - 1.5 Acres	35	43	43	55
1.5 - 2 Acres	22	37	21	36
2 - 2.5 Acres	18	40	14	31
2.5+ Acres	8	27	4	15
Total	83	147	82	137

Grade is another important consideration for parcel configurations, limiting driveway access to properties as well as building design. Grades were analyzed for both conceptual parcel layouts, with parcels classified by the minimum grade across the property. See [Table 15](#) for a comparison of parcel grade distribution.

Table 15 – Parcel Grade Distribution

	Low Alignment		High Alignment	
Parcel Grade	Number of Parcels	Total Area (Acres)	Number of Parcels	Total Area (Acres)
0 - 10 %	10	21	14	27
10 - 20 %	44	79	40	68
20 - 30 %	18	26	20	30
30 - 40 %	8	16	8	12
40 - 50 %	3	5	0	0
Total	83	147	82	137

Proximity of parcels to the main alignment and adjacent steep cut and fill sections are important considerations for analyzing alignment options and conceptual parcel layouts. If the main alignment provides direct access to most properties, it decreases the need for construction and maintenance of additional local access roads, or spurs. Spurs can be useful to provide more economic access to areas of challenging topography or recreational opportunities off the main alignment as well as decrease through traffic through residential areas. The Low Option conceptual parcel configuration included 10,550 feet of spur roads, while the High Option configuration included 35,900 feet of spur roads. In some conditions, parcels that are adjacent to the main alignment may not always be accessible due to steep cuts and fills. [Table 16](#) compares the parcel location and steep cuts and fills for both options as shown in [Figures 8 and 9](#).

Table 16 – Parcel Location

	Low Alignment			High Alignment		
Parcel Location	Number of Parcels	Total Area (Acres)	Main Alignment Access Limited by Steep Cut/Fill	Number of Parcels	Total Area (Acres)	Main Alignment Access Limited by Steep Cut/Fill
Adjacent to Main Alignment and Spurs	22	40	8	24	39	8
Adjacent to Main Alignment	37	67	5	13	24	1
Adjacent to Spurs	24	41		45	75	
Total	83	147	13	82	137	9

LOW OPTION

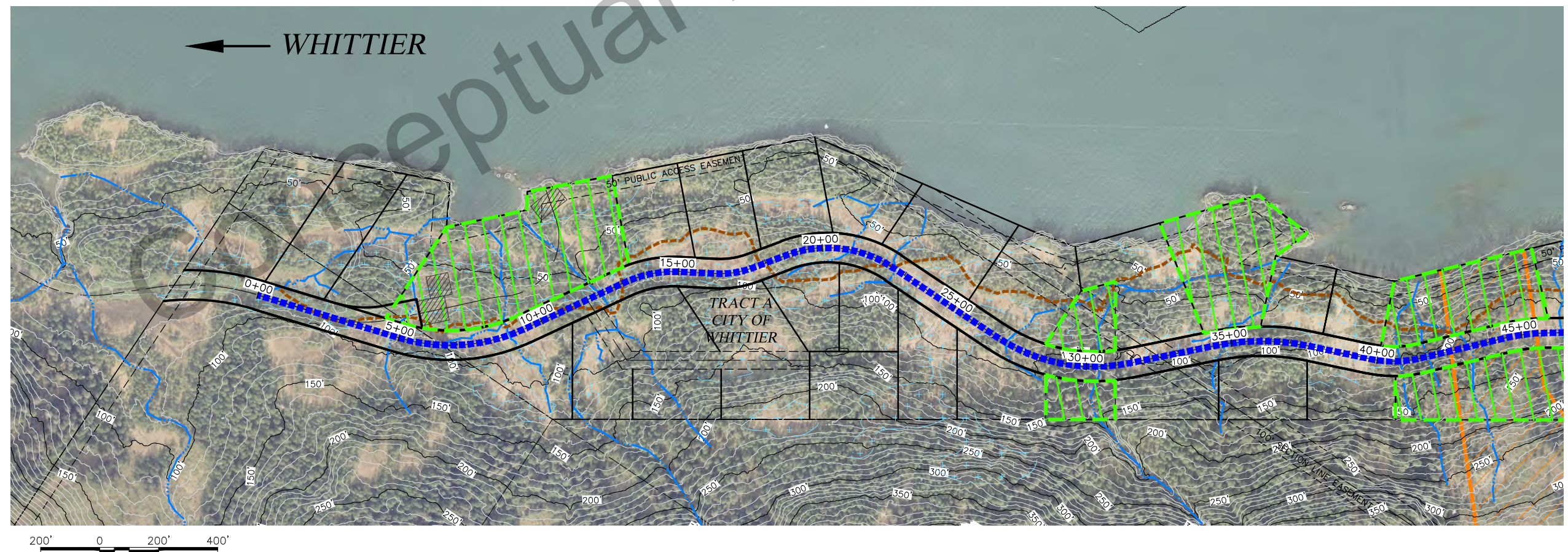
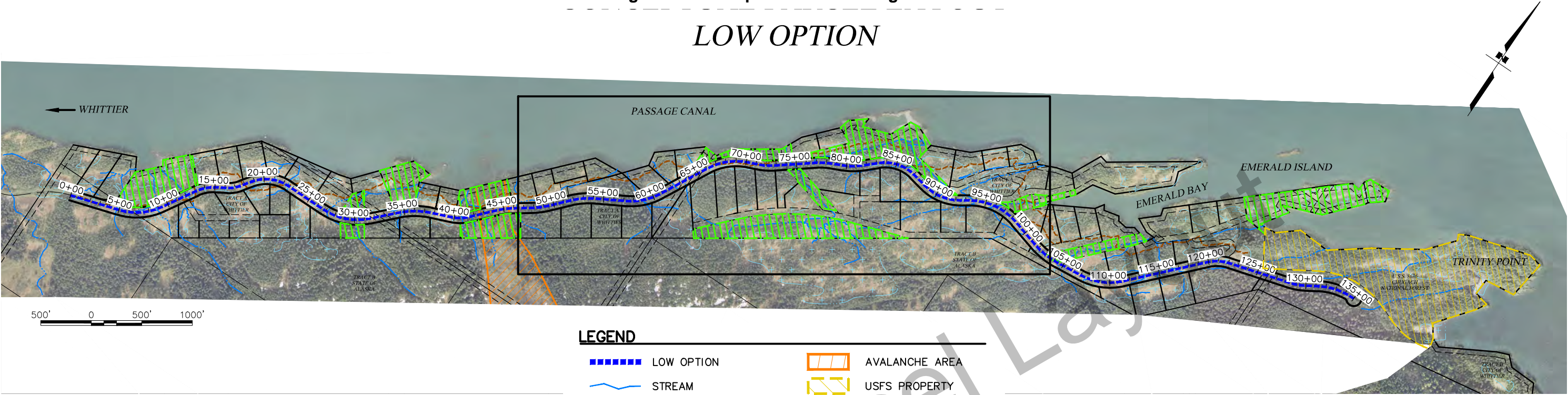


Figure 6 - Conceptual Parcel Configuration

LOW OPTION



LEGEND

- | | |
|------------------------------|--------------------------|
| ■■■■■ LOW OPTION | ▨ AVALANCHE AREA |
| — STREAM | ▨ USFS PROPERTY |
| ▨ WETLAND | - - - EMERALD COVE TRAIL |
| ▨ POTENTIAL CITY OF WHITTIER | |

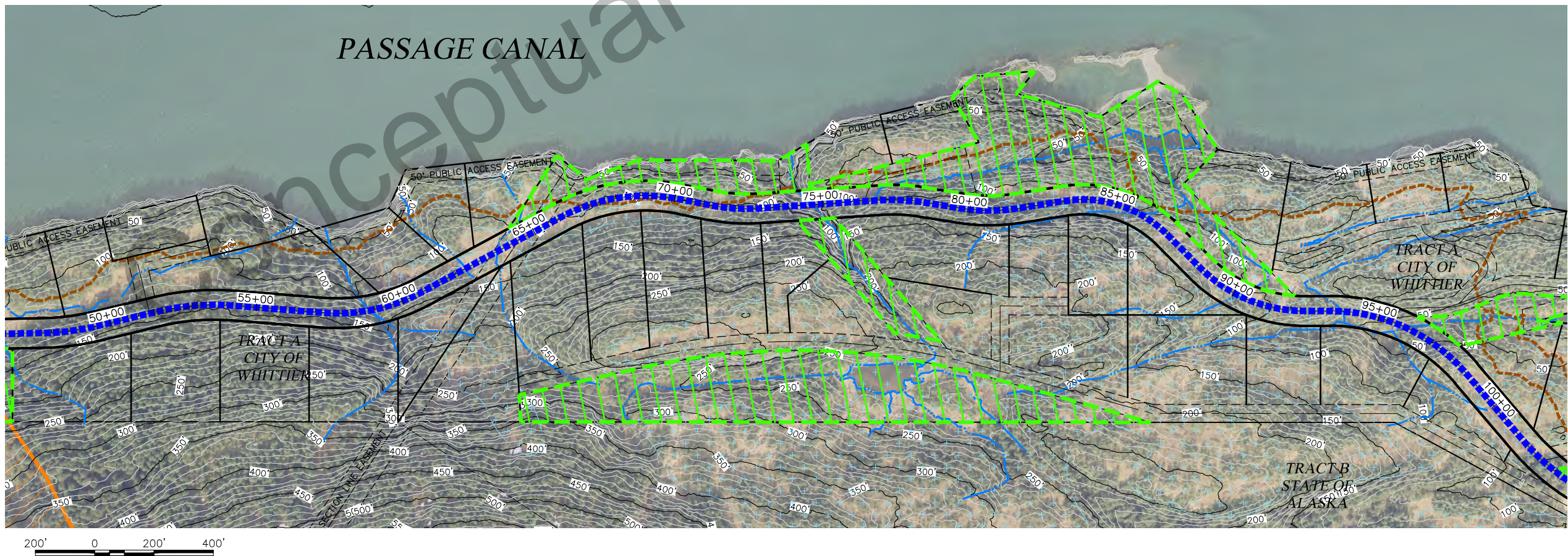


Figure 6 - Conceptual Parcel Configuration

LOW OPTION

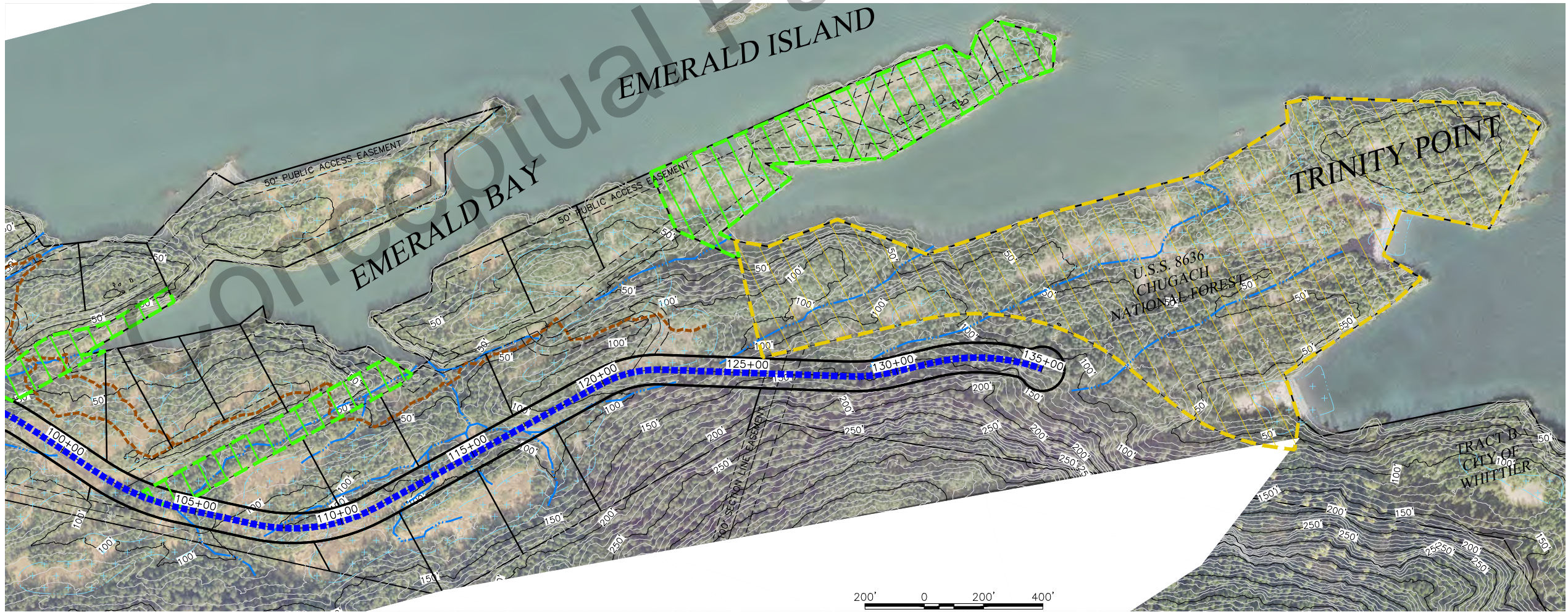
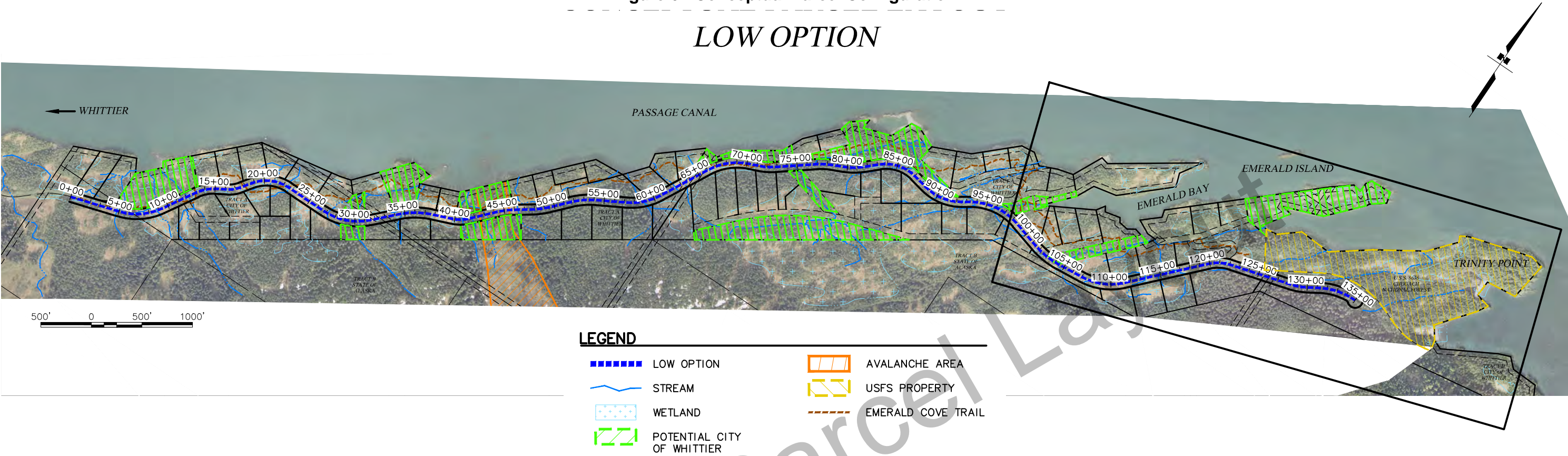


Figure 7 - Conceptual Parcel Configuration

HIGH OPTION

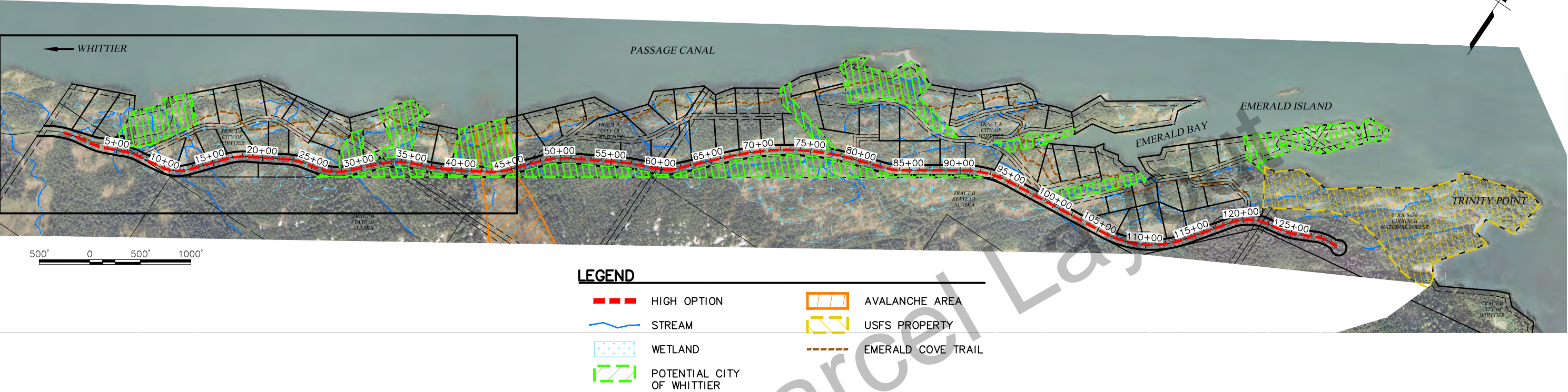


Figure 7 - Conceptual Parcel Configuration

HIGH OPTION

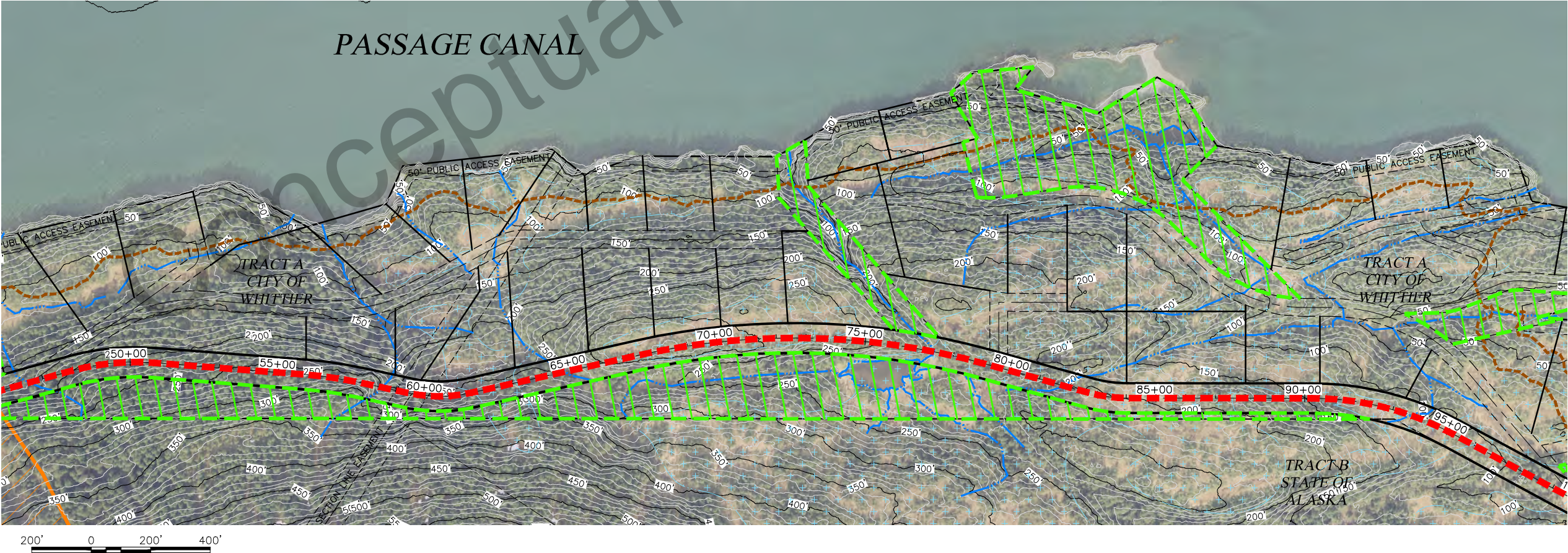
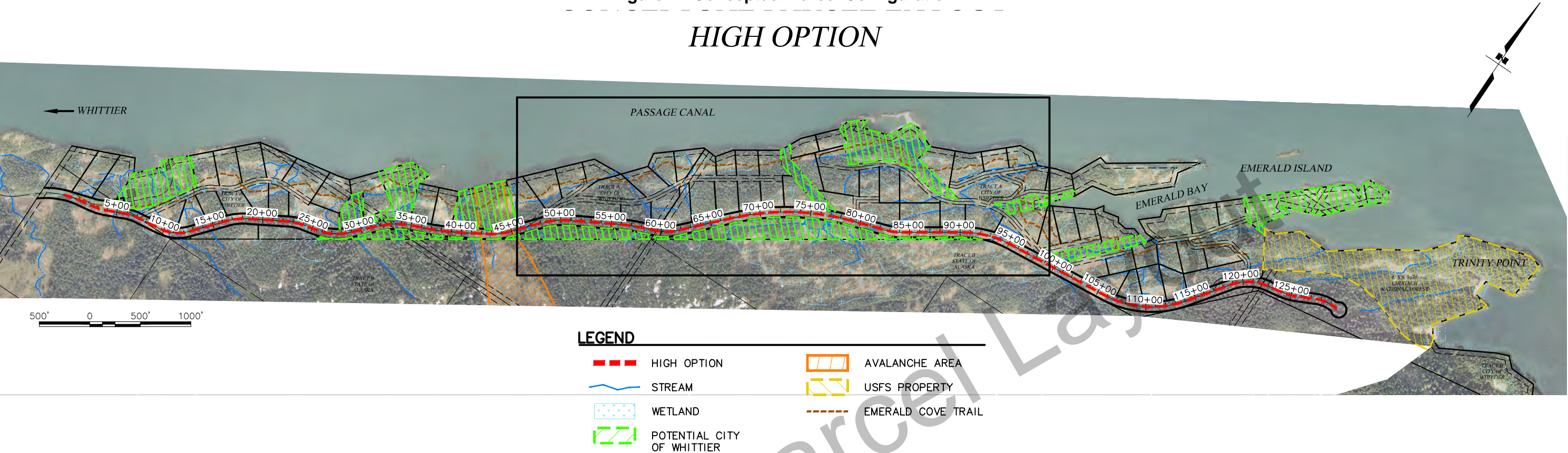
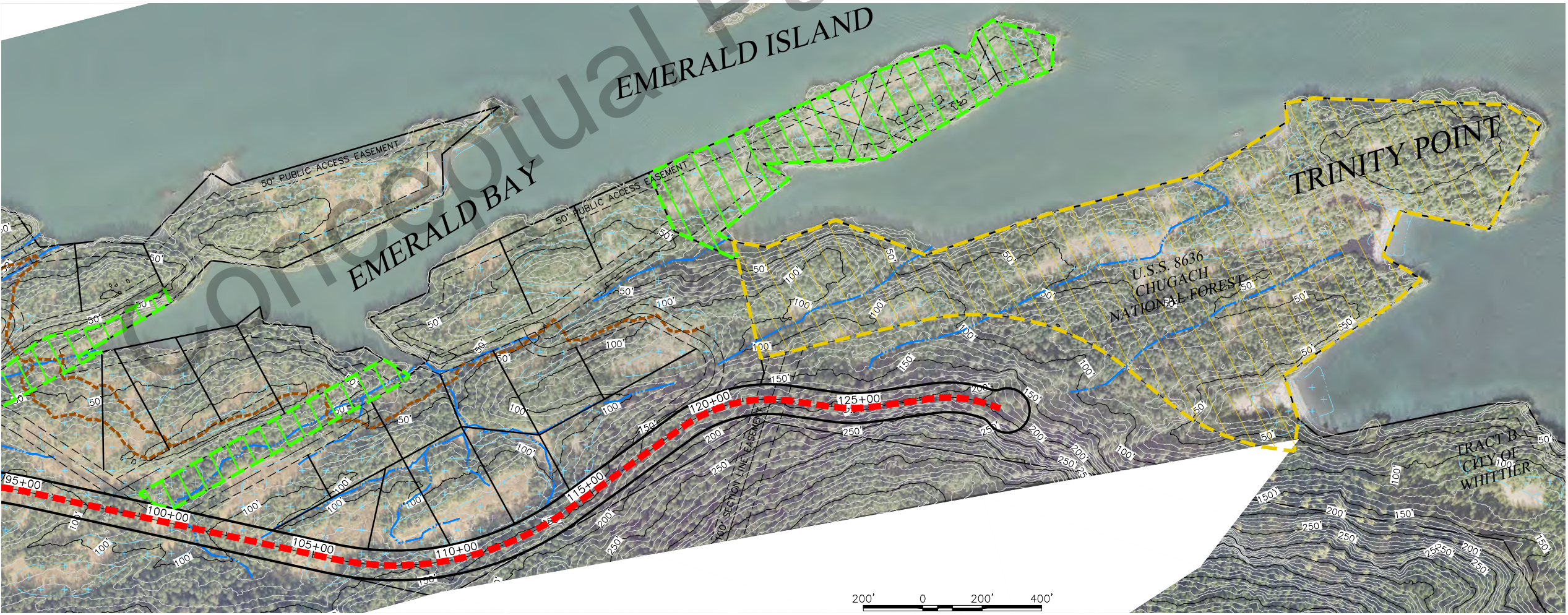
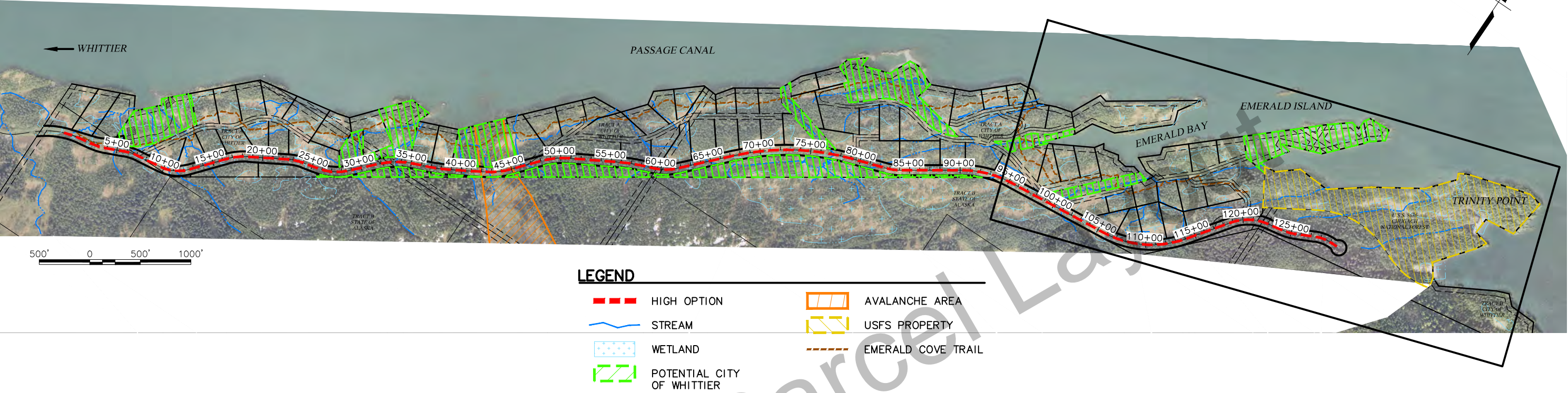


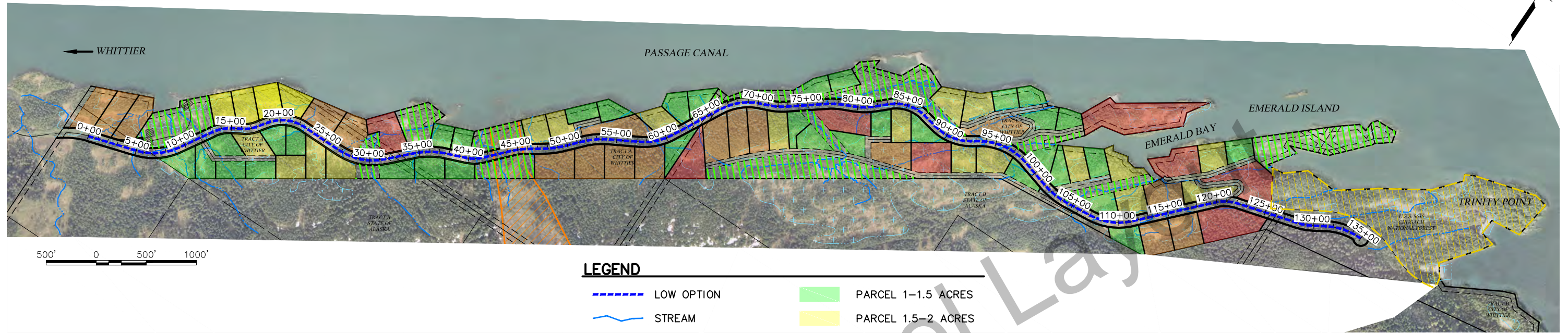
Figure 7 - Conceptual Parcel Configuration

HIGH OPTION

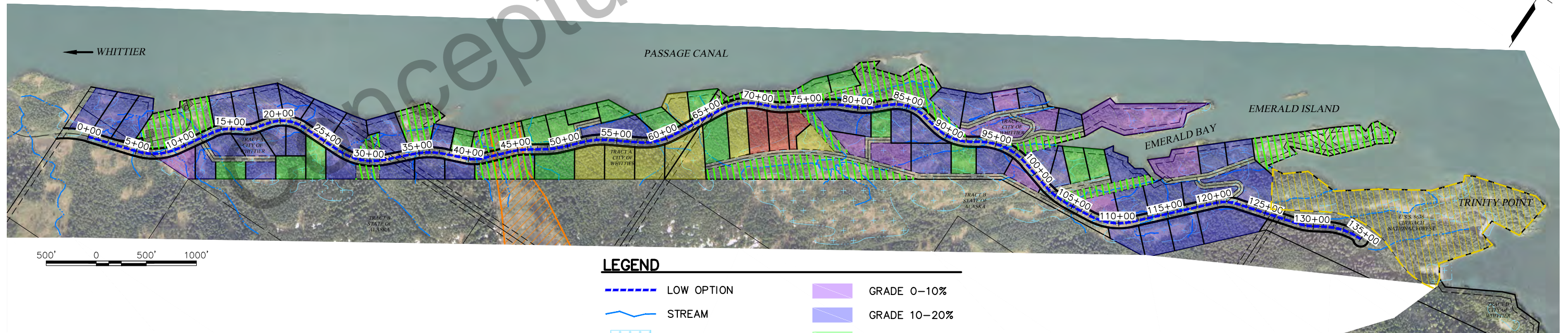


CONCEPTUAL PARCEL AREAS LOW OPTION

Figure 8 - Conceptual Parcel Configuration Analysis

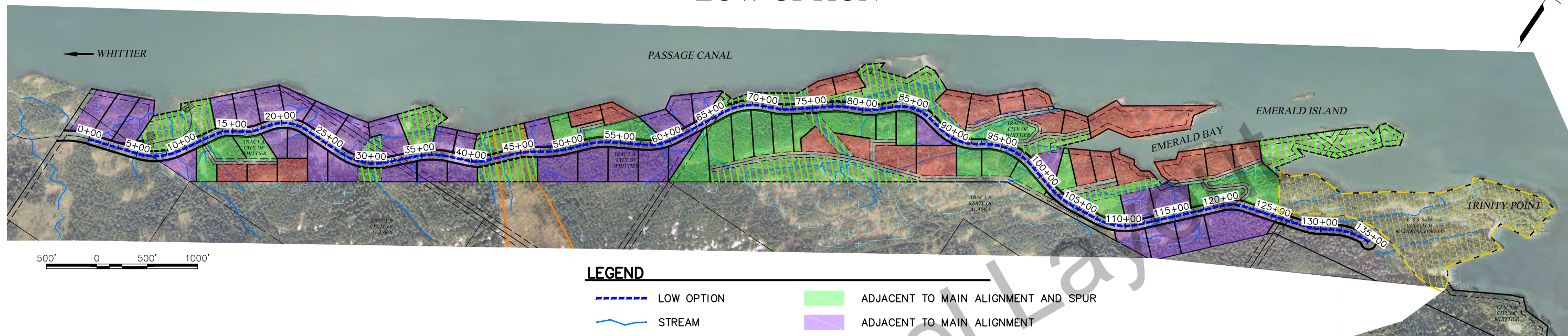


CONCEPTUAL PARCEL EFFECTIVE GRADES LOW OPTION



CONCEPTUAL PARCEL ACCESS LOCATIONS LOW OPTION

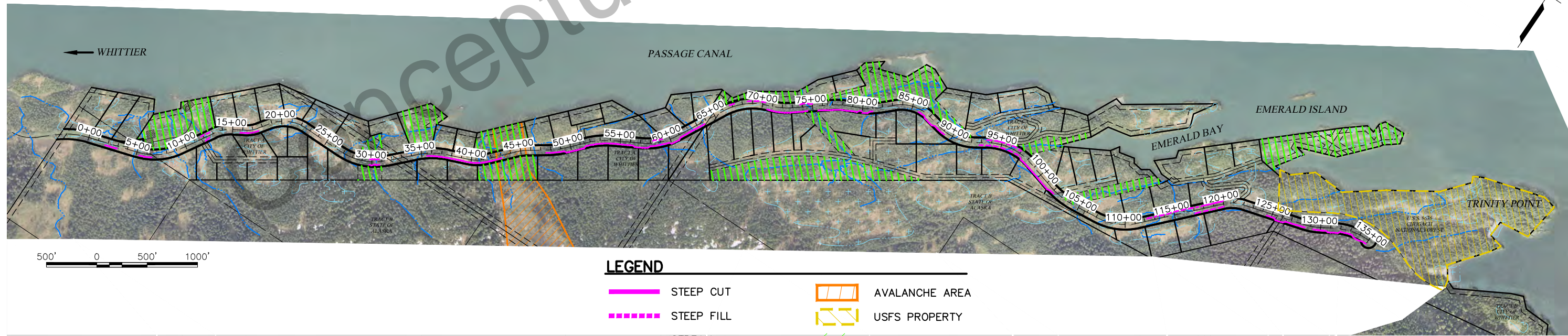
Figure 8 - Conceptual Parcel Configuration Analysis



LEGEND

- LOW OPTION
- STREAM
- WETLAND
- AVALANCHE AREA
- USFS PROPERTY
- POTENTIAL CITY OF WHITTIER
- ADJACENT TO MAIN ALIGNMENT AND SPUR
- ADJACENT TO MAIN ALIGNMENT
- ADJACENT TO SPUR

MAIN ALIGNMENT STEEP CUT/FILL LOW OPTION

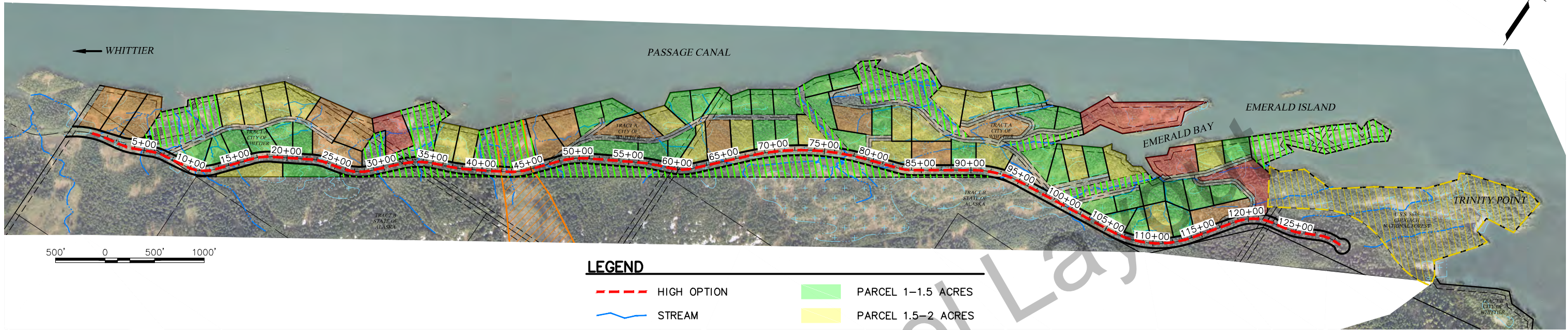


LEGEND

- STEEP CUT
- STEEP FILL
- STREAM
- WETLAND
- AVALANCHE AREA
- USFS PROPERTY
- POTENTIAL CITY OF WHITTIER

CONCEPTUAL PARCEL AREAS HIGH OPTION

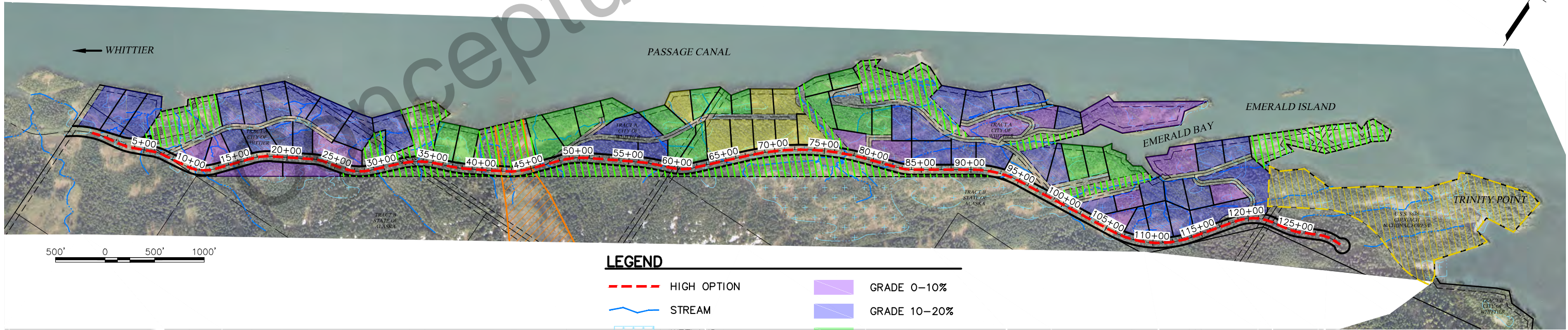
Figure 9 - Conceptual Parcel Configuration Analysis



LEGEND

- HIGH OPTION
- STREAM
- WETLAND
- AVALANCHE AREA
- USFS PROPERTY
- POTENTIAL CITY OF WHITTIER
- PARCEL 1-1.5 ACRES
- PARCEL 1.5-2 ACRES
- PARCEL 2-2.5 ACRES
- PARCEL 2.5+ ACRES

CONCEPTUAL PARCEL EFFECTIVE GRADES HIGH OPTION

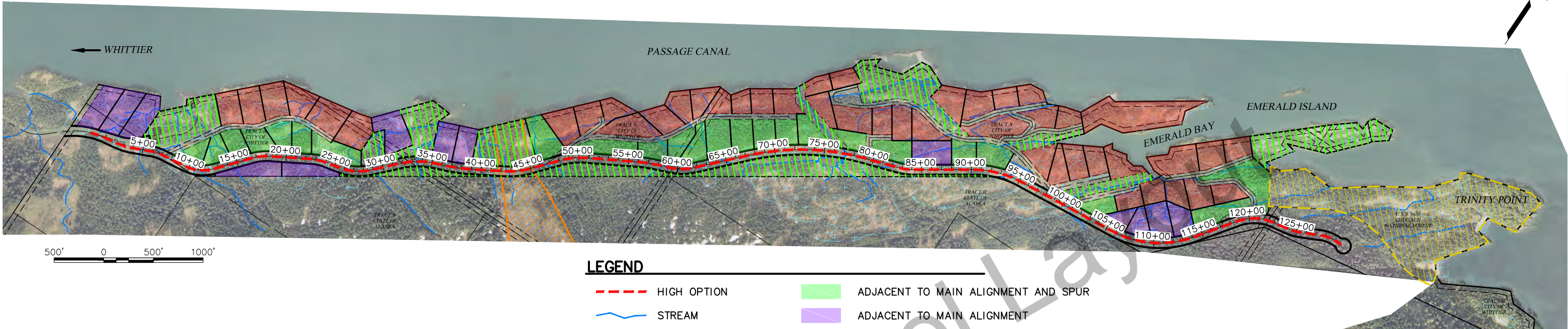


LEGEND

- HIGH OPTION
- STREAM
- WETLAND
- AVALANCHE AREA
- USFS PROPERTY
- POTENTIAL CITY OF WHITTIER
- GRADE 0-10%
- GRADE 10-20%
- GRADE 20-30%
- GRADE 30-40%
- GRADE 40-50%

CONCEPTUAL PARCEL ACCESS LOCATIONS HIGH OPTION

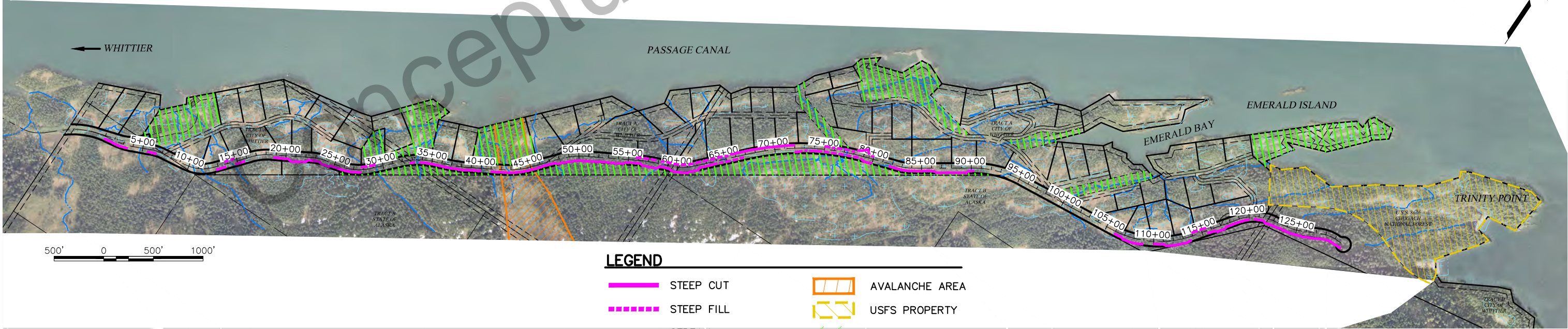
Figure 9 - Conceptual Parcel Configuration Analysis



LEGEND

- HIGH OPTION
- STREAM
- WETLAND
- AVALANCHE AREA
- USFS PROPERTY
- POTENTIAL CITY OF WHITTIER
- ADJACENT TO MAIN ALIGNMENT AND SPUR
- ADJACENT TO MAIN ALIGNMENT
- ADJACENT TO SPUR

MAIN ALIGNMENT STEEP CUT/FILL HIGH OPTION



LEGEND

- STEEP CUT
- STEEP FILL
- STREAM
- WETLAND
- AVALANCHE AREA
- USFS PROPERTY
- POTENTIAL CITY OF WHITTIER

E. Project Area Shallow Utilities

1. Utility Extension Down Shotgun Cove Road

Extension of utility service down Shotgun Cove Road will require entering into a line extension agreement with each of the respective utility companies. Each utility company will evaluate their service and provide a preliminary estimate and design for review. Natural gas lines and electric lines should be separated by at least 3.0 feet. A

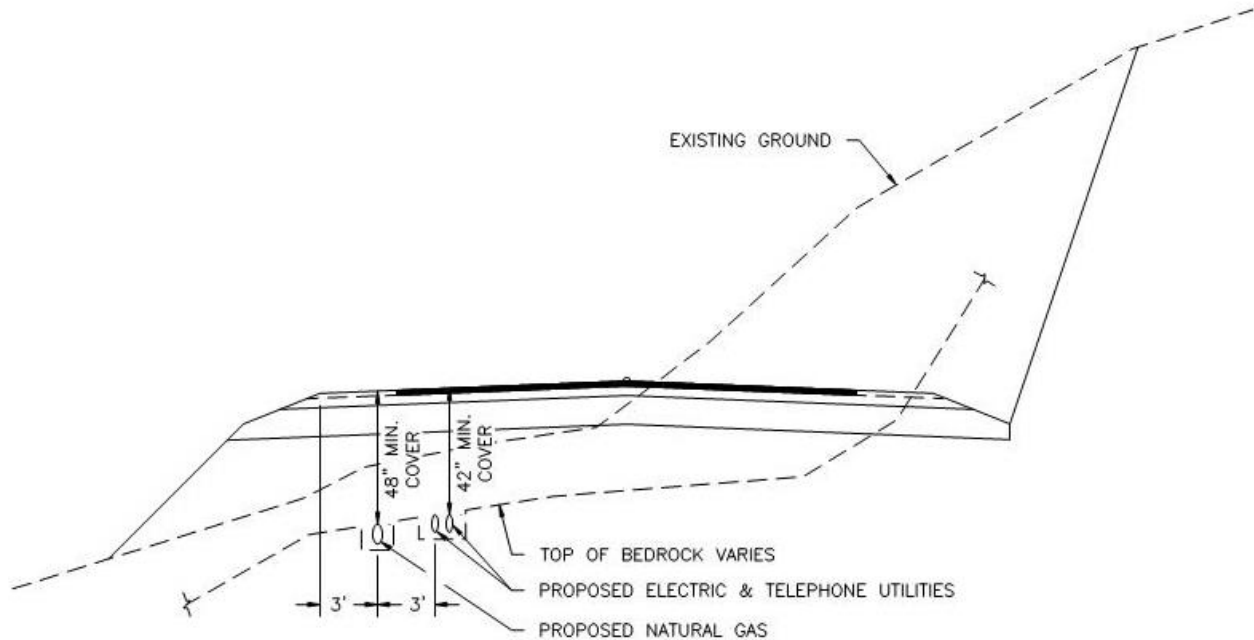


Figure 10 - Utility Typical Section

typical layout of utilities is shown on Figure 10. Electric and telecommunication facilities should be installed in a joint trench to reduce costs for each utility. While planned during earlier phases of Shotgun Cove Road development, conduits for future utility use were not installed as part of road construction. However, the constructed roadway section included rock blasting to a depth of 4.0 feet below grade. This depth is assumed adequate for shallow utility construction, and utilities should not encounter bed rock during construction. Depending on scheduling, the future phases of the Shotgun Cove Road Extension project could include installation of conduit reducing the trench and backfill costs.

2. Natural Gas

ENSTAR Natural Gas Company (ENSTAR) owns and operates natural gas facilities in Whittier including underground steel and plastic lines that serve commercial and residential properties throughout Whittier. There is no existing natural gas service on Shotgun Cove Road. To provide service to the City property along Shotgun Cove Road Extension, natural gas lines would need to be extended down Shotgun Cove Road via a 4 to 6-inch underground gas main. Typical trench depth for natural gas lines is 48 inches; however, 30 inches is the minimum depth required by code. The closest ENSTAR facility to Shotgun Cove Road is a 12-inch steel gas main that runs along the west side of the Depot Road. This line would need to be extended up Blackstone Road to Shotgun Cove Road.

3. Electric

Chugach Electric Association (CEA) provides electrical power to the City of Whittier via overhead power lines extending from the Portage Substation. CEA's facilities in Whittier include underground and overhead three phase and single phase lines that provide service to commercial and residential properties.

There are currently no electric facilities on Shotgun Cove Road and power would need to be extended from the overhead power lines on the north side of Blackstone Road. Typical depth of bury for underground electric lines is 42 inches in the public right-of-way. As an alternative to underground lines, overhead power facilities could be installed along Shotgun Cove Road. While less expensive than installing underground lines, the overhead facilities might impact the views of Passage Canal and be more susceptible to outages from environmental factors. A Planning and Zoning Commission variance will be necessary for overhead power facilities.

4. Telecommunication

Alaska Communications (ACS) and General Communications Incorporated (GCI) own and operate overhead and underground telecommunication facilities in Whittier. These facilities include coaxial television cables, fiber optic lines, and copper telephone wires. There is currently no telecommunication service to Shotgun Cove Road.

To provide cable television service to Shotgun Cove Road, GCI would need to extend their existing .500 coaxial cable on Blackstone Road. The closest GCI fiber optic facility is located at the intersection of Blackstone Road and Eastern Avenue.

5. Cost Comparison

A rough order of magnitude cost estimate for extending service down Shotgun Cove Road is provided in Table 17. It is assumed that cable television, electric, and telephone will be installed by joint trenching lowering the costs for the telephone and cable television. Due to the high cost of installing underground utilities, a separate estimate was prepared for installing electric, telephone and television overhead.

Table 17 – Shallow Bury Utility Extension Cost Comparison

Description	Shotgun Cove Road Mile 0.0 to 2.0	Shotgun Cove Road Extension Mile 2.0 to 4.5	
		Low Alignment	High Alignment
Natural Gas	\$625,000	\$ 425,000	\$ 405,000
Underground			
Electric	\$900,000	\$ 850,000	\$ 815,000
Telephone	\$250,000	\$ 310,000	\$ 300,000
Cable Television	\$285,000	\$ 355,000	\$ 340,000
Overhead			
Electric	\$460,000	\$ 567,000	\$ 540,000
Telephone	\$235,000	\$ 285,000	\$ 270,000
Cable Television	\$255,000	\$ 310,000	\$ 300,000

F. Project Area Water and Sewer Utilities

The constructed phases of Shotgun Cove Road, Mile 0.0 to 2.0, include a trench for future utilities. The Shotgun Cove Road Extension, Mile 2.0 to 4.5, will extend the road through city-owned land to Trinity Point, with the intention of one day continuing another 4.25 miles to Neptune Point in Shotgun Cove.

The conceptual parcel configuration presented in this Report indicates residential use with the potential for commercial development on select sites. Residences could range from year-round homes for locals to seasonal dry cabins to rental properties for tourists. Approximately 300 residential lots and one to three commercial lots are

planned for full buildout of the Shotgun Cove Tract out to Neptune Point. This report addresses buildout up to Trinity Point, for a total of approximately 80 lots.

The Draft Shotgun Cove Master Plan was written in 2009 by USKH and addresses water and sewer utility options. The Draft was never finalized. This report expands on alternatives identified in the Master Plan which could be implemented in Shotgun Cove.

1. Existing Utilities

Municipal piped water and sewer utilities supply the core area of Whittier. Three water wells, ranging from 220 to 530 gallons per minute, supply a one million gallon tank located on the east side of the City. A 0.5-mile road connects the existing water storage tank to the west end of Shotgun Cove Road. Wastewater undergoes primary treatment through a set of septic tanks before the effluent is discharged into Prince William Sound. Discharge of effluent without secondary treatment is allowed under a Section 301(h) permit issued by EPA, which allows for discharge of up to 80,000 gallons per day with 25% removal of the biochemical oxygen demand and 35% removal of total suspended solids.

2. Water Alternatives

Four of five alternatives addressed in the 2009 Draft Shotgun Cove Master Plan are expanded on in this report: individual wells, rainwater cisterns, self-haul/community watering point, and municipal piped water and tank; each are discussed in the following sections. Community haul was not determined to be feasible and will not be considered further.

Individual wells, rainwater cisterns, and municipal piped water have the capability to provide adequate water supply for fully plumbed homes. A water haul system would be better suited for seasonal or dry cabins.

Individual Wells

Existing groundwater conditions are unknown in the Shotgun Cove area. The 2005 Water Master Plan recommended test wells in the area. This alternative would require drilling test wells and additional geotechnical investigation.

If individual wells are installed, any wastewater system must be at least 100 feet away from the well to meet Alaska Department of Environmental Conservation (ADEC) requirements.

Insulated Rain Cisterns with Self Water Haul

Individual water collection via rain cisterns could be utilized as a water source for future residential development along the Shotgun Cove Road Extension. Average annual precipitation in Whittier is 215 inches, with every month receiving over 9 inches of precipitation. Runoff from the roof would be collected by gutters and routed to an insulated or partially buried water storage tank, called a cistern. A filter would be installed for removal of particles but requires regular owner maintenance to keep functioning correctly. Rain cistern systems require roofing and other components to be made of or coated with specific materials that will not contaminate the water supply, and organic matter must be kept off of the collection surface. If collected water is not suitable for drinking, it could be used for non-potable uses and a water haul system for potable uses could be combined with this alternative. Water hauling does have the potential to introduce contaminants into the water supply during transportation and storage in secondary tanks. In addition, severe weather could delay or prevent water deliveries.

Typical privately operated water haul charges in similar communities within southcentral Alaska are around \$0.15 per gallon. Assuming a potable water use of 210 gallons per week for a four-person household, this would be a monthly cost of \$140. Households could also transport potable water individually, but depending on fill location and quantity, may have to pay a fee.

Individual cisterns and potable water storage tanks could be located on each property adjacent to the structure. Assuming a household non-potable water usage of 50 gallons per day, the minimum cistern size would be approximately 800 gallons and the roof area used for rain catchment would need to be at least 900 square feet. A potable water storage tank would need to hold enough water for household use between deliveries. If monthly delivery occurs, a 1,000 – 1,200-gallon tank would be adequate.

Several residences could utilize one larger potable water storage tank, which would require groupings of homes in a clustered arrangement for ease of water distribution from the tank. These tanks would be privately owned and maintained by the property owners.

Municipal Piped Water and Storage Tank

A municipal piped water supply to the future development along the Shotgun Cove Road Extension would provide the most convenience and least maintenance to future property owners, both residential and commercial. The capital cost and maintenance requirements of piped infrastructure for the City would be significantly higher than privately-owned individual water collection or haul systems. In addition, a piped water supply would require a more robust wastewater collection and treatment system, as the water usage capacity will be higher than that for a cistern or water haul system. A 12-inch distribution line would run approximately 4 miles from the existing one million gallon water storage tank to a localized high point near Emerald Bay, where a new 180,000-gallon water storage tank would be located. This size of tank would hold adequate storage for full build-out of Shotgun Cove up to Trinity Point and include water capacity for fire protection. From the new water storage tank, distribution lines would provide water supply for Shotgun Cove properties via gravity feed. A booster station would be required near the east end of the City's existing water system, and would fill the new water storage tank from the existing water storage tank as needed.

3. Sewer Alternatives

Three of the six alternatives addressed in the 2009 Draft Shotgun Cove Master Plan are expanded on in this report: holding tanks and hauling to Anchorage, septic tanks and drain fields, and advanced on-site treatment. Each alternative allows homes to be fully plumbed, and requires wastewater to either be treated on-site or transported to Anchorage. The Anchorage Water and Wastewater Utility (AWWU) will accept wastewater from surrounding areas including Whittier. Other alternatives from the 2009 Draft Shotgun Cove Master Plan that were not considered feasible for Whittier are honeybucket systems, a piped system connecting to Whittier's existing wastewater treatment system, and non-liquid treatment systems. A municipal wastewater collection system owned and operated by the City was not considered due to prohibitively high capital costs for both wastewater collection and treatment systems.

Depending on the water alternative selected, wastewater volumes will vary from approximately 20 to 80 gallons per person per day for a water haul system or piped water distribution system, respectively, assuming all scenarios include a fully-plumbed house with low-flow fixtures. Where wastewater flows are lower, typical waste concentration will be stronger.

Insulated Holding Tanks – Individual or Cluster

Insulated holding tanks could be used to hold raw wastewater before being emptied into a privately-owned pumper truck and transported to Anchorage for disposal at the AWWU King Street Septage Facility. This system would work best with the cistern and water haul system, which would produce lower wastewater flows. Pumping services would be required at least weekly, with some variation depending on holding tank sizes. Larger shared tanks could be utilized with a cluster of residences. Assuming each 4-person residence produces a conservative volume of 560 gallons of wastewater per week, a significant amount of trucking would be required to support a build-out size of approximately 80 residences. It is assumed this service would be provided by a private septic hauler hired by the property owner.

Septic Tanks with Drain Fields

Septic tanks with infiltrator drain fields may be an option for wastewater treatment and disposal, but will require further geotechnical investigation to determine their feasibility. Individual or shared private septic tanks would receive wastewater and settle out solids before distributing the flow to a series of underground infiltrators for distribution into the soil. Due to limited depth of infiltrative soils in the area, replacement of bedrock with a sand liner, or construction of a mound-type leach field over the existing ground would be required for adequate infiltration. Because the infiltrative area will be surrounded by bedrock, the design life will be shorter than an infiltrative area constructed in soils with faster percolation rates. In addition, construction costs will be higher due to removal of bedrock and import of the sand liner. Septic systems would be owned and maintained by the property owners.

Individual septic systems would require a minimum septic tank size of 1,000 gallons. The drain field area would vary depending on the type and specific existing conditions, but with an ADEC-approved 7.5-foot deep sand liner would most likely require a 600 square foot area.

A typical septic system to serve a cluster of 8 four-bedroom homes would require a minimum septic tank size of 5,000 gallons. A drain field with a 7.5-foot deep sand liner would most likely require a 4,800 square-foot area.

Advanced On-Site Treatment

Alternative wastewater systems would allow property owners to manage wastewater on-site. Alternatively, some of these systems could be arranged as a shared private system serving a cluster of homes. The City could require property owners to utilize a certain product or type of treatment to ensure adequate treatment occurs.

The Advantex treatment system is a package system from Orenco that consists of a packed bed filter, which wastewater passes through. Filter effluent is recirculated through the system and is treated to secondary treatment standards. These systems are installed across Alaska and have been successfully permitted through ADEC for discharge to an infiltration gallery, and are used with UV disinfection in Juneau and permitted for surface/ marine discharge. Individual systems would require each property to have a 9'x5'x6' system downstream of an individual septic tank. A shared private system would allow properties to only have a septic tank which would feed into a larger shared treatment system. A shared private system would require additional piping costs, but this would be offset by the lower per-property cost of a shared treatment system.

Aerobic Treatment Systems consist of settling, aeration, and clarification of wastewater. These systems are similar to an Advantex system except that the filtration is replaced with aeration, which requires additional power and mechanical parts. These systems have also been installed across Alaska in individual and community configurations. Typical discharge is to an infiltration gallery.

Table 18 – Water and Sewer Alternative Estimates

Water Utility Alternatives	City Capital Cost	Property Owner Capital Cost
New Distribution Line and Tank Existing Water Source	\$ 6.5M	
Rainwater Cisterns		\$ 2,755
Sewer Utility Alternative		Property Owner Capital Cost
Advanced On-Site Treatment		\$ 17,500

4. Recommendations

All systems will require approval by ADEC.

The recommended alternative for water supply to future development along the Shotgun Cove Road Extension are rainwater cisterns with privately-operated potable water hauling. Whittier has adequate yearly precipitation to supply water for non-potable uses, and property owners can haul potable water for use as needed, or pay for a private water delivery service. This option requires minimal capital costs for property owners but allows the City to develop Shotgun Cove without construction of a piped distribution system, which is a significant expense. The estimated cost per property for a rainwater cistern and potable water storage tank is approximately \$2,000. This does not include water delivery fees, which are estimated at approximately \$140 per month per property.

A piped water distribution system would provide Shotgun Cove with the most robust water supply, but estimated capital cost for a new system is approximately \$6.5 million. For that reason, a new piped distribution system is not the recommended alternative. However, if funding is secured for a water distribution project, this alternative would be the recommended option and would support greater commercial development in the project area.

The recommended alternative for wastewater treatment in Shotgun Cove is an alternative treatment system. The Advantex system with UV disinfection could be used for surface/marine discharge, and if installed as a shared private system would require only a septic tank on each property. Each individual system costs approximately \$17,500 with UV disinfection and monitoring. A shared private system would cost each property approximately 70% of an individual system, but would require additional piping costs. In addition, the shared private system requires a dedicated telephone line for monitoring.

V. Design Recommendations

A. Design Cost Estimate

A cost estimate for the both options is presented in summary format in Table 19. Costs are based on a preliminary construction estimates developed for each alignment option and planning, compliance, permitting, and design costs listed in the FLAP application. A more detailed construction cost breakdown is found in Appendix E. Please note that the construction estimates shown include 50% for design contingency, construction contingency, and construction management.

Table 19 – Summary of Conceptual Engineer’s Estimate

Considerations	Low Option	High Option
Construction subtotal:	\$ 13,200,000	\$ 13,900,000
Design contingency, Construction Contingency, Construction Management (40%)	\$ 6,600,000	\$ 7,000,000
Construction total:	\$ 19,800,000	\$ 20,900,000
Planning:	\$ 1,250,000	\$ 1,250,000
Compliance:	\$ 750,000	\$ 750,000
Permitting:	\$ 625,000	\$ 625,000
Design and preliminary work:	\$ 1,875,000	\$ 1,875,000
Total estimated project cost:	\$ 24,300,000	\$ 25,400,000

B. Recommended Roadway Alignment

While it is difficult to evaluate a roadway option’s ability to accommodate unknown types of development and unknown traffic volumes, these two alignments are a balanced comparison of two unique ways forward. The Low Option generally provides property access with 59 of the 83 configured lots directly adjacent to the main road extension and less spur roads required, whether or not grades allow for optimum driveways. The Low Option has less elevation gain and has better access to the shoreline, although it takes up some flatter properties with road ROW. The Low Option has more stream crossings and less significant rock cuts and steep fills. Meanwhile the High Option stays on the uphill side of most properties taking a more direct route along

the southern boundary of City-owned property, with only 37 of the 82 configured lots directly adjacent to the main road extension. To provide access to the remaining properties, the High Option has three times the spur road length of the Low Option, adding additional future cost for development. The High Option has more elevation gain, but long steady climbs and descents with less change in grade as well as better access to State land. A comparison of both options is provided in the matrix below:

Table 20 – Alternative Matrix

Considerations	Low Option	High Option
Length of Roadway	13,500 ft	13,000 ft
Maximum Elevation	160 ft	300 ft
Maximum Grade	9%	10%
Cut	230,800 CY	273,500 CY
Length of Rock Cut (0-20 ft)	3,750 ft	4,950 ft
Length of Rock Cut (> 20 ft)	2,275 ft	3,200 ft
Fill	233,500 CY	249,100 CY
Length of Steep Fill (< 1.5:1)	1,975 ft	2,075 ft
Stream Crossings	25	15
Configured Parcels	83	82
Configured Parcels (Acres)	147 acres	137 acres
Parcels Adjacent to Main Alignment	59	37
Parcels Adjacent to Spur Roads	24	45
Length of Spur Roads	10,550 ft	35,900 ft
Total Project Cost*	\$24,300,000	\$25,400,000
* Does not include cost for constructing spur roads		

Both options appear equal with regard to second stated goal of the FLAP application to improve regional transportation systems. Based on the first stated goal of increasing resource access, and secondary considerations to minimize cost and environmental impacts, the Low Option is the recommended alternative.