



City of Whittier Shotgun Cove Road Extension Mile 2.0 to 4.5 Final Design Study Report



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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
DNR	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.
GDLVR	Guidelines for Geometric Design Low-Volume Roads (2019)
GDVLVLR	Guidelines for Geometric Design of Very Low-Volume Local Roads (2001)
HDPE	High density polyethylene pipe
HPCM	DOT&PF Highway Pre-Construction Manual
ITE	Institute of Transportation Engineers
MPH	Miles per hour
MUTCD	Manual of Uniform Traffic Control Devices
NEPA	National Environmental Policy Act
PUE	Public Use Easement
ROW	Right-of-way
SF	Square feet
SWMM	Storm Water Management Model
ROW	Right-of-way
SF	Square feet
SWMM	Storm Water Management Model
SWPPP	Storm Water Pollution Prevention Plan
USACE	US Army Corps of Engineers
vpa	venicies 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 of Whittier (City) has obtained land east of Whittier to Shotgun Cove, and completed construction of a 2.0-mile segment of Shotgun Cove Road extending toward these tracts in 2019.

The City 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 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 <u>Appendix A</u> for the complete 2016 FLAP application.

In addition to the City 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 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 development and growth of the City's economic potential.

The City 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. On land, 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. The Shotgun Cove Road Extension provides opportunities for expanding waterfront access, mitigating conflicts between different user groups and transportation modes, decreasing congestion for business districts, and expanding 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 considerations:

- 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



LEGEND						
	LOW OPTION					
	HIGH OPTION					
\sim	STREAM					
+++++++++	WETLAND					
	AVALANCHE AREA					
\mathbb{Z}	USFS PROPERTY					
	EMERALD COVE TRA					

II. Existing Conditions

A. Area Context

Shotgun Cove Road begins at Blackstone Road on the east end of Whittier and extends two miles along the south shore of Passage Canal. Previous road improvements (2006-2019) constructed a two-lane gravel road following the alignment of a pioneer road dating back to the 1970's. These improvements constructed two structural plate arch culverts at Second Salmon Run (Photo 1), a construction staging area stockpiling material for future use, and a parking lot at the current road terminus serving as the trailhead for the Emerald Cove Trail (Photo 2). The Shotgun Cove Road Extension (Mile 2.0 to 4.5) begins where the previous road improvements terminated.

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





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 generally slopes northwest toward the water, there are a number cuts or gullies that run parallel to the coast line resulting in multiple benches and areas of steep, undulating terrain. 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 linecharacteristics consistent with an avalanche zone (Photo 8).

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LEGEND						
	LOW OPTION					
	HIGH OPTION					
\sim	STREAM					
++++++++	WETLAND					
	AVALANCHE AREA					
12/21	USFS PROPERTY					
	EMERALD COVE TRAIL					
	BEACH ACCESS					

B. Land Use and Ownership

<u>History</u>

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 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 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 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 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 and the DOT&PF.
- A 50-foot wide public access easement upland of the mean high tide line.
- 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

Subsurface geotechnical explorations for the were limited to borings advanced through the existing stockpiled material and at three discreet locations along the proposed alignment. Anticipated conditions in areas where subsurface explorations were not conducted are based on limited observations of the ground surface and hand probing to measure thickness of overburden (primarily moss, roots, and organic soil). The project corridor consists of areas of grassy wetlands or muskeg and conifer forests, and hand probing found that the type of vegetation was generally related to the thickness of overburden. Organic thicknesses in forested areas ranged from 0.4 to 6.7

feet, with an average of 1.5 feet while organic thicknesses in wetland/muskeg areas ranged from 0.4 to 8.9 feet with an average of 3 feet. Exposed bedrock consisting of meta-shale or slate was observed in some locations, including stream crossings where gravel alluvial was also observed. Two borings along



the proposed alignment generally found 2 feet of organics overlying bedrock while a third found 6 feet of organics overlying 12 feet of medium dense to very dense, silty sand and gravel. See <u>Appendix C</u> for the Geotechnical Engineering Report (Jan 2022).

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.



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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, 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 was held 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 <u>Appendix D</u>.

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 DNR, 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, the design standards used and the road ownership. The owner of the facility and the funding source often dictate design standards that are used. The City 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 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 more flexible design guidance for low-volume local and collector roads compared to those described for paved, higher-volume roads in the AASHTOGB. An updated version entitled "Geometric Designs of Low-Volume Roads" (GDLVR) was published in 2019, expanding the scope to include local and collector roads with volumes up to 2,000 vpd.

3. State of Alaska

The DOT&PF Highway Preconstruction Manual (HPCM) provides detailed design criteria for federally-funded roadway projects within the State of Alaska. The HPCM is intended to interpret and amend the goals and objectives of the AASHTOGB. While the HPCM references other documents like the AASHTOGB and the GDVLVLR for many design parameters, including lane and shoulder width, design speed, sight distance, horizontal curves, grades, and intersection design it also identifies its own friction factors and maximum superelevation for gravel roads

which controls most horizontal geometry. The most recent version of the HPCM does not reference the 2019 GDLVR which proposes alternative criteria for local and collector roads with volumes up to 2,000 vpd.

B. Traffic Projections

Previous phases of Shotgun Cove Road projected design traffic volumes of 700 vpd (2024). The 2012 City 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. 2021 ADT traffic volumes for West Camp Road between the Anton Anderson Memorial Tunnel and the city were 720 vpd.

Traffic projections will vary significantly based on the types of potential development that may occur along the project corridor: 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. <u>Tables 1 - 4</u> provide ranges of trip generation based on the number of projected dwelling units, hotel rooms, public land acreage, and harbor berths. The range of values demonstrates the variability of the studied areas, and their limited application forecast trip generation for Whittier's unique context.

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	reational Home 20		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 1 – Trip Generation Values for Residential Use

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

Table 2 – Trip Generation Values for Tourism Accommodation

Table 3 – 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

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

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 are also factors 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.

The Shotgun Cove Road Extension (Mile 2.0 to 4.5) envisions phased construction of the mainline, access roads, and recreation facilities over 10-30 years and does not anticipate winter maintenance of the road or extension of utilities in that timeframe given limited demand and high capital and maintenance costs. As such, the type of development would likely consist primarily of seasonally used recreational homes for the medium term following construction. While the proposed action includes one launch site for non-motorized craft and road infrastructure for other water access points on Trinity Point, the Shotgun Cove Road Extension does not include planning or design of small craft boat launches or harbors, Alaska Marine Highway ferry terminals, or airstrips of any kind. While the proposed road terminus (Mile 4.5) is planned with further extension in mind, the project also acknowledges the steep terrain past Trinity Point that makes full-width road access to Shotgun Cove unlikely.

Based on this information the project estimates the following traffic projections:

Table 5 – Traffic Projections, Shotgun Cove Road Extension – Mile 2.0 to 4.5

Design Year	Shotgun Cove Road Mainline	Access Roads
A.D.T. 2022	<100	-
A.D.T. 2042	700	<250

C. Functional Classification

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

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

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

The 2012 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 (HPCM 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 (GDLVR 2.3.1). This category describes the functional classification of Shotgun Cove Road, since the proposed mainline will provide access to adjacent properties and serve through traffic to destinations at Trinity Point and potentially in Shotgun Cove in the future.

Access roads or spurs connecting to Shotgun Cove Road would serve primarily for access to abutting properties and therefore would be classified as local roads or "rural minor access roads."

While the City 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 GDLVR discusses the different performance characteristics of unpaved roads with the following research findings (pg. 4-37) 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 GDLVR 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 reductions in crash frequency or severity," (pg. 1-2). 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 needed for the low-speed environment of an unpaved road," (pg. 4-37).

Previous phases of Shotgun Cove Road anticipated a design ADT (2024) of 700 vehicles per day, exceeding the volumes specifically addressed in the GDVLVLR, the edition of the publication referenced by the HPCM. 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.

The GDLVR was published after the completion of the Draft DSR and it is not yet clear if future versions of the HPCM will adopt the GDLVR for application to rural collector roads with less than 2,000 vpd. As such the Shotgun Cove Road Extension advances to detailed design based on the current standards of the HPCM, more closely reflecting the precedent of the previous sections of road. Meanwhile, proposed access roads follow the guidance of the GDLVR which is consistent with the previous version of the GDVLVLR for very low-volume local roads.

E. Design Speed and Sight Distance

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 Shotgun Cove Road used a 30 MPH design speed and a 10% maximum longitudinal grade. These values are consistent with the HPCM recommended criteria for collector roads with 400 – 2,000 vpd in mountainous terrain. The same criteria calls for a 20 MPH design speed for rural local roads with less than

400 vpd. The City identifies maximum grades of 10% for all roadway classifications, while the HPCM recommends maximum grades of 16% for local roads in mountainous terrain. The HPCM also allows for grades up to 12% on collector roads and 18% on local roads for lengths 500 feet or less. Though previous phases used stopping sight distance values consistent with HPCM, passing sight distance values of 1,090 feet exceed recommendations. The HPCM identifies stopping and passing sight distances for both roadway classifications, which are shown with other design criteria in <u>Table 7</u>.

Dosign Critoria	Shotgun Cove Road	Shotgun Cove I	Road Extension
Design Citteria	Mile 0.0 to 2.0	Mainline	Access Roads
Design Speed	30 MPH	30 MPH	20 MPH
Maximum Grade	10%	10%	16%
Stopping Sight Distance	200 ft	200 ft	115 ft
Passing Sight Distance	1,090 ft	500 ft	400 ft

Table 7 – Design Speed and Sight Distance, Comparison Previous vs. Proposed

F. Typical Section

Previous phases of Shotgun Cove Road used 12-foot lanes, 4-foot shoulders, a typical cross-slope of 2%, and showed a paved surface that was not included for construction. The HPCM design standards for rural collector roads with 30 MPH design speed and 400 - 2,000 vpd in mountainous terrain are shown in <u>Table 8</u>.

Rural Collector Roadway – 30 MPH, Mountainous Terrain						
Design Year Traffic Volumes (ADT)	401-60	401-600 vpd 601-1,500 vpd		1,501-2,000 vpd		
% Trucks	≤ 10%	> 10%	≤ 10%	> 10%	≤ 10%	> 10%
Lane Width (ft)	9	10	10	10	10	10
Shoulder Width (ft)	2	5	5	5	6	6

Table 8 – Lane and Shoulder Width, HPCM

HPCM refers to guidance from GDVLVLR for rural local roads and collectors with less than 400 vpd, recommending a total road with of 18 feet. It's noteworthy that <u>Table 8</u> reflects a similar approach, recommending narrow lanes and shoulders for rural collectors with 401-600 vpd and low percentage of trucks. The recently-published GDLVR expands this approach to rural local roads and collectors with 400-2,000 vpd,

recommending a total road width of 23 feet for major access roads with 30 MPH design speed. All other values in <u>Table 8</u> are fairly consistent with slightly wider travel lanes and wider shoulders. Proposed typical section values consistent with HPCM recommendations are shown in <u>Table 9</u>.

Previous phases of Shotgun Cove Road differ from HPCM recommendations, with wider travel lanes and narrower shoulders. While the total road width on previous phases matches the recommended road width for rural collectors with 1,500-2,000 vpd, and the lane width and shoulder width are not distinguishable on unpaved roads, the shoulder width is a determining factor for clear zone width.

Design Critoria	Shotgun Cove Road	Shotgun Cove Road Extensio		
Design Chiena	Mile 0.0 to 2.0	Mainline	Access Roads	
Lane Width	12 ft	10 ft	9 ft	
Shoulder Width	4 ft	5 ft	-	
Cross Slope	2%	3%	3%	
Clear Zone (Fill)	11 ft @ 5:1	10 ft @ 5:1	4 ft @ 5:1	
Clear Zone (Cut)	12 ft @ 4:1	14 ft @ 4:1	4 ft @ 4:1	

Table 9 – Typical Section, Comparison Previous vs. Proposed

G. Clear Zone

The HPCM identifies clear zone requirements in Section 1130, consistent with AASHTO's Roadside Design Guide. The HPCM 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 HPCM are presented in <u>Table 10</u>:

Clear Zone Distance ≤ 40 mph In feet from edge of traveled way						
Design Year	Fill S	lopes		Cut Slopes		
Volumes (ADT)	≤ 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	

Table 10 – Clear Zone, HPCM

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 HPCM 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. By using HPCM-recommended shoulder widths and clear zone criteria corresponding to traffic projections, the proposed road decreased the fill condition width by 3 feet on each side. Meanwhile, proposed recoverable slope width for cut sections is controlled by rock cut design, resulting in a more conservative clear zone. Following guidance for low-speed, low-volume, unpaved roads, reduced recoverable slope widths were selected for proposed access roads.

H. Rock Cuts

Design standards identified in the HPCM section 1130, present a direct relationship between clear zone and rock catchment ditch width for cuts less than 20 feet. When higher than 20 feet the HPCM has specified values for both "V" and flat bottom ditches. These recommendations don't consider the effect of rock slope, don't discuss assumptions about rockfall retainage, and show minimum ditch width of 15 feet. DOT&PF Central Region Materials Section clarified that section 1130 is a starting point that may be more consistent with larger clear zones and recommended further analysis based on ODOT Rockfall Catchment Design Guide (2001) and geotechnical recommendations. Preliminary geotechnical analysis recommended a more-conservative vertical slope of 0.4H:1V. Modelling of rockfall catchment using Rocfall Software and 95% retention resulted in the recommendations shown in Table 11.

	Shotgun Cove Road Mile 0.0 to 2.0			Shotgu Mainl	n Cove Road ine and Acces	Extension s Roads
Height of Rock Cut	Vertical Slope	Back Slope @ 4:1	Flat Ditch Width	Vertical Slope	Back Slope @ 4:1	Flat Ditch Width
0-20		8 ft	-			
20-30	0.3H:1V			0.4H:1V	9 ft	
30-40		Q ff	10 ft			-
40-50	0.3H:1V	οn	12 11	0.4H:1V	10 ft	
50-60	Bench			Bench	15 ft	

Table 11 – Lane and Shoulder Width, HPCM

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I. Design Criteria Summary

	Design Criteria	Shotgun Cove Road Mile 0.0 to 2.0	Shotgun Cove Road Extension Mainline	Reference
	Functional Classification		Collector Street	HPCM 100.2
	Current ADT	<100 vpd (2001)	< 100 vpd	
Traffic	Design ADT	700 vpd (2024)	< 750 vpd	
Data	Terrain		Mountainous	AASHTO 3.4.1
	Design Speed	30 mph	30 mph	AASHTO Table 6-1
	Posted Speed	25 mph	25 mph	
	Surface	Pavement (Not Constructed)	Gravel	
	Number of Lanes	2	2	
	Lane Width	12 ft	10 ft	HPCM Table 1130-3
	Shoulder Width	4 ft	5 ft	HPCM Table 1130-3
	Clear Zone		7-10 ft	HPCM Table 1130-2 * See AASHTO RDG
	Side Slopes, Maximum	1.5H to 1V	1.5H to 1V	Geotech Recommendation**
Cross	Side Slopes, Rock Cut	1H to 3V	1H to 2.5V	Geotech Recommendation
Section	Rockfall Catchment Width H=0-20ft (Foreslope Width @ Slope, Flat Bottom Width)	8 ft @ 4:1, No Flat Ditch	9 ft @ 4:1, No Flat Ditch	Rocfall Analysis
	Rockfall Catchment Width H=20-40ft (Foreslope Width @ Slope, Flat Bottom Width)	8 ft @ 4:1, 12 ft Flat Ditch	9 ft @ 4:1, No Flat Ditch	Rocfall Analysis
	Rockfall Catchment Width H=40-80ft (Foreslope Width @ Slope, Flat Bottom Width)	8 ft @ 4:1, 12 ft Flat Ditch	15 ft @ 4:1, No Flat Ditch	Rocfall Analysis
	Cross Slope	-2.0%	-3.0%	HPCM Figure 1130-1
	Superelevation, Maximum	6.0%	6.0%	HPCM Figure 1120-1
	Horizontal Curve Radius, Minimum	275 ft		
Horizontal	Horizontal Curve Radius, Minimum, Maximum Superelevation (e = 6%)		375 ft	HPCM Figure 1120-3
Alignment	Horizontal Curve Radius, Minimum, Normal Crown (e = -3%)		857 ft	HPCM Figure 1120-3
	Vertical Grade, Maximum	10.0%	10.0%	AASHTO Table 6-2
	Stopping Sight Distance, Minimum, Level Roadway	200 ft	200 ft	AASHTO Table 3-1
Vertical	Stopping Sight Distance, Minimum, Maximum Grade (-10.0%)		231 ft	AASHTO Eq 3-3
Alignment	Passing Sight Distance	1090 ft	500 ft	AASHTO Table 3-4
	Vertical Curve K-Value, Min Crest Curve		19	AASHTO Table 3-34
	Vertical Curve K-Value, Min Sag Curve		37	AASHTO Table 3-36

Table 12a – Design Criteria– Shotgun Cove Road Extension Mainline

** In areas with stable subgrade conditions

	Design Criteria	Shotgun Cove Road Extension Access Roads	Reference
	Functional Classification	Rural Minor Access Road	GDLVR 2.3.1
	Current ADT	< 100 vpd	
Traffic	Design ADT	< 250 vpd	
Data	Terrain	Mountainous	AASHTO 3.4.1
	Design Speed	20 mph	AASHTO Table 5-1
	Posted Speed	20 mph	
	Surface	Gravel	
	Number of Lanes	2	
	Lane Width	9 ft	GDLVR 4.2.1.1
	Shoulder Width	0 ft	GDLVR 4.2.1.1
	Clear Zone	7-10 ft	HPCM Table 1130-2 * See AASHTO RDG
	Side Slopes, Maximum	1.5H to 1V	Geotech Recommendation**
Cross Section	Side Slopes, Rock Cut	1H to 2.5V	Geotech Recommendation
	Rockfall Catchment Width H=0-20ft (Foreslope Width @ Slope, Flat Bottom Width)	9 ft @ 4:1, No Flat Ditch	Rocfall Analysis
	Rockfall Catchment Width H=20-40ft (Foreslope Width @ Slope, Flat Bottom Width)	9 ft @ 4:1, No Flat Ditch	Rocfall Analysis
	Rockfall Catchment Width H=40-80ft (Foreslope Width @ Slope, Flat Bottom Width)	15 ft @ 4:1, No Flat Ditch	Rocfall Analysis
	Cross Slope	-3.0%	HPCM Figure 1130-1
	Superelevation, Maximum	6.0%	HPCM Figure 1120-1
Horizontal	Horizontal Curve Radius, Minimum, Maximum Superelevation (e = 6%)	157ft	HPCM Figure 1120-3
Alignment	Horizontal Curve Radius, Minimum, Normal Crown (e = -3%)	333 ft	HPCM Figure 1120-3
	Vertical Grade, Maximum	16.0%	AASHTO Table 6-2
	Stopping Sight Distance, Minimum, Level Roadway	115 ft	AASHTO Table 3-1
Vertical Alignment	Stopping Sight Distance, Minimum, Maximum Grade (-10.0%)	127 ft	AASHTO Eq 3-3
	Passing Sight Distance	400 ft	AASHTO Table 3-4
	Vertical Curve K-Value, Min Crest Curve	7	AASHTO Table 3-34
	Vertical Curve K-Value, Min Sag Curve	17	AASHTO Table 3-36

Table 12b – I	Design Criteria–	Shotgun	Cove Road	Extension	Access Roads
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** In areas with stable subgrade conditions

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.
- Attaining adequate cover at steep stream crossings: avoiding fills over steep wetlands, or cuts that would drain uphill wetlands
- 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 for the mainline alignment is an unpaved, two lane roadway, consisting of 10-foot wide travel lanes, 5-foot wide gravel shoulders, and 5-foot wide recoverable slopes in fill conditions or 9-foot wide drainage swales or rock catchment ditch where rock cuts are present (see <u>FIGURE 4A</u>). The total mainline road surface width is 30 feet (measured from edge of shoulder to edge of shoulder).

The recommended typical cross-section for the access roads is an unpaved, two lane roadway, consisting of 9-foot wide travel lanes, no shoulders, and 4-foot wide recoverable slopes in fill conditions or 9-foot wide drainage swales or rock catchment ditch where rock cuts are present (see <u>FIGURE 4B</u>). The total access road surface width is 18 feet (measured from edge of shoulder to edge of shoulder).

C. Structural Section

Prior to placing embankment fills, the tree and brush vegetation should be removed. Organic material may be left in place in areas where it is deeper than 4 feet below the finish grade of the road surface and in areas where the ground surface is not steeply sloping. In areas where the finish grade is less than 4 feet above existing ground or where new embankments will be constructed on natural slopes steeper than about 2.5H to 1V, surface organics and soft, fine-grained soils should be grubbed from beneath the embankment footprint and replaced with shot rock.



Figure 4a – Proposed Mainline Typical Cross Section



Figure 4b – Proposed Access Roads Typical Cross Section

Where organics are left in place, consolidation of organic soils under embankment loads will result in settlement on the order of 30 to 40 percent of the original organic layer thickness. Over most of the alignment, this will result in approximately 1 foot of settlement on average, most of which will occur as the fill is placed.

Shot rock fill will be placed to build embankments up to the subgrade elevation of the recommended roadway structural section. Nonwoven geofabric will be placed beneath the structural section to reduce the risk of fines migration into the shot rock fill of the embankment. In bedrock cuts, subgrade blasting will extend 12 inches below the subgrade elevation of the recommended roadway structural section to break up the rock material and allow for better drainage. Based on the geotechnical engineering report, the structural road section will consist of: 6 inches of E-1 surface course over 24 inches of Selected Material Type A structural fill as defined by the DOT&PF standard specifications. In areas where the roadway is constructed through bedrock cuts, subgrade blasting thickness of Selected Material can be reduced to 12 inches which can be placed directly on the bedrock.

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 uplands.
- An alignment along the southern boundary of City-owned property will have the most change in elevation and limited access to shoreline.
- 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 access 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. Due to the limited availability and expensive haul of borrow sourced 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 Draft DSR 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 City of Whittier land uphill of U.S. Forest Service Land at Trinity Point (Mile 4.5). See <u>Figure 5</u> for an overview of each option.

This Final DSR presents the changes that have been made through the EA and 95% Design phases, showing the evolution of the preferred option, and providing a clearer view of the proposed action. This report does not rewrite the analysis of the Draft DSR, or apply the additional information, changes in scope, and refined design criteria to the Low and High Options. The analysis of the two alternatives based on the assumptions at the time were adequate and are still representative of route selection criteria.

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.







STREAM WETLAND AVALANCHE AREA USFS PROPERTY EMERALD COVE TRAIL

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 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 converging valleys with a sag vertical curve and begins an ascent up forested terrain adjacent to 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.

See <u>APPENDIX F</u> for Draft DSR roadway plan and profile sheets.

Final Preferred Alignment

The Low Option, selected as the preferred alignment in the Draft DSR, was advanced to detailed design for further refinement. The following changes were made to the preferred alignment (based on Draft DSR stationing):

Station 50+00 to 75+00 – Instead of sweeping close to shoreline, the alignment stays uphill of the existing wetlands, cutting into the forested slope as it approaches the largest stream crossing.

Station 75+00 to 100+00 – The three horizontal curves are shifted down station, crossing first to the north side of the valley in order to cross perpendicular to two fish streams, and avoid significant cut when approaching large wetland area.

Station 100+00 to 135+00 – The significant cut is replaced with a gradual climb and fill condition across the large wetland area. Brokeback horizontal curves are replaced with a single curve crossing two fish streams near the State property line. The alignment is shifted towards Passage Canal where it follows a ridge and crosses a single stream and valley with a sag vertical curve. The alignment follows another gully closer to Emerald Bay and begins a horizontal curve ascending to another flat area. The alignment crosses a corner of Forest Service land, crests, parallels Forest Service property line, then descends along a ridge to a sweeping turnaround within 200 ft of a pocket beach on Trinity Point.

These changes allow for direct vehicular access to Forest Service land at Trinity Point, and were coordinated with the Forest Service to complement future development which is still in a separate planning phase. Other changes to the Shotgun Cove Road Extension proposed action since the Draft DSR are discussed in <u>Chapter V</u>. See <u>APPENDIX G</u> for 95% Design 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. <u>Table 13</u> presents the usable cut and fill volumes for two phases of each option, though phases could be constructed in shorter $\frac{1}{2}$ mile to $\frac{3}{4}$ mile increments. Quantities presented for both options are based on design criteria and survey information from the Draft DSR. Refined quantities for the preferred alignment are presented in <u>Chapter V</u>.

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)		

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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 mainline 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. These areas were further refined during the Environmental Assessment phase and are presented along with proposed recreational impacts and improvements in <u>Chapter V</u>.

Both alignment options 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. See <u>Table 14</u> for a comparison of parcel size distribution.

	Low C	Option	High (Option
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

Table 14 – Parcel Size Distribution

Table 15 – Parcel Grade Distribution

	Low C	Option	High (Option
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

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 <u>Table 15</u> for a comparison of parcel grade distribution.

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

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

Table 16 – Parcel Location













LOW OPTION







HIGH OPTION





E. Project Area Shallow Utilities

1. Utility Extension Down Shotgun Cove Road

Extension of utility service down Shotgun Cove Road would require entering into a line extension agreement with each of the respective utility companies. Each utility company would 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.



Figure 10 - Utility Typical Section

A typical layout of utilities is shown on <u>Figure 10</u>. 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 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 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-ofway. 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 would 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 Cover 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 <u>Table 17</u>. It is assumed that cable television, electric, and telephone would 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.

Description	Shotgun Cove Road	Shotgun Cove Road Extension Mile 2.0 to 4.5		
		Low Option	High Option	
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	

Table 17 –	Shallow	Bury Ut	ility Extension	Cost Comparison
	••			

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 potential 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. While seasonally used recreational homes are anticipated for the near term, residences could one day range from year-round homes for locals 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 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 Draft 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 below. 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 Rainwater 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.

Water Utility Alternatives	City Capital Cost	Property Owner Capital Cost
New Distribution Line and Tank from Existing Water Source	\$ 6.5M	-
Rainwater Cisterns	-	\$ 3,000
Sewer Utility Alternative		Property Owner Capital Cost
Advanced On-Site Treatment	-	\$ 17,500

Table 18 – Water and Sewer Alternative Estimates

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 \$3,000 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 advanced on-site 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. Alignment Option Cost Estimates

A conceptual project cost estimate for the both options is presented in summary format in <u>Table 19</u>. 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 cost breakdown of the Draft DSR Conceptual Engineer's Estimate is found in <u>Appendix E</u>.

	Low Option	High Option
Basic Bid Estimate at Draft DSR	\$ 17,200,000	\$ 18,100,000
Construction Engineering	\$ 2,600,000	\$ 2,800,000
Total Construction Cost (2018)	\$ 19,800,000*	\$ 20,900,000*
Estimated Planning, Compliance, Permitting, and Design from FLAP	\$ 4,500,000	\$ 4,500,000
Total Estimated Project Cost (2018)	\$ 24,300,000	\$ 25,400,000
*Draft DSR Estimate Does not include constru-	ction cost of Trinity	Point terminus,
access roads, parking lots, or recreational facilities.		

Table 19 – Summary of Draft DSR Conceptual Engineer's Estimate

B. Recommended Alignment Option

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 mainline and less access 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 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:

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 Mainline	59	37
Parcels Adjacent to Access Roads	24	45
Length of Access Roads	10,550 ft	35,900 ft
Total Estimated Project Cost (2018)*	\$24,300,000	\$25,400,000
*Draft DSR Estimate Does not include construction cost of Trinity Point terminus, access roads, parking lots, or recreational facilities.		

 Table 20 – Alternative Matrix

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.

C. Refined Recommended Alignment

Following the completion of the Draft DSR, the alternative analysis was presented to the public for comment and the Low Option was advanced to the draft environmental assessment (EA) and detailed design. Identification of a preferred alignment allowed the project to gather more detailed information about the corridor: cultural resources, fish habitat, higher resolution topographic data, aerial imagery, and surface and subsurface geotechnical investigations. Presentation of a preferred alignment in conceptual form led to more concrete discussions with the City, funding agency, U.S.

Forest Service, and public about the scope of improvements, identifying three changes: termination of the road on U.S. Forest Service land at Trinity Point with the possibility of water access; inclusion of access roads as part of the proposed action for improved coastal and land access; inclusion of viewpoints, trailheads, and improvement to remaining sections of trail to offset impacts to the Emerald Cove Trail. As the Low Option was advanced to detailed design, a number of design criteria were also refined: lane and shoulder widths, minimum radii and superelevation, rock cut design, culvert and ditch design, fish passage structures, MSE walls, and muck disposal.

	Shotgun Cove	Road Extension
	Mainline	Access Roads
Basic Bid Estimate at 95% Design	\$ 22,570,406	\$ 10,000,037
Construction Engineering at 10%	\$ 2,201,541	\$ 974,504
Bid Contingency* at 20%	\$ 4,954,389	\$ 2,194,908
Total 2023 Construction Cost	\$ 29,730,000	\$ 13,170,000
Total Projected Construction Cost**	\$ 36,030,000	\$ 17,380,000

Table 21 – Summary of 95% Design Engineer's Estimate

* Accounts for higher bids and change orders

** Accounts for inflation of phased construction

Considerations	Shotgun Cove Road Extension		
Considerations	Mainline	Access Roads	
Length of Roadway	19,094 ft	8,132 ft	
Cut	175,400 CY	71,900 CY	
Length of Rock Cut, Both Sides	8,400 ft	3,200 ft	
Fill	188,100 CY	75,200 CY	
Length of Steep Fill (< 1.5:1), Both Sides	5,800 ft	2,500 ft	
Stream Crossings	45	14	
Parking Lots	6	3	
Length of New/Improved Trail	1,966	130	
Total Estimated Construction Cost (2023)	\$29,730,000	\$13,170,000	

Table 22 – Proposed Action Summary

Legend

	Streams
	Wetlands
	US Forest Service
>	Existing Shotgun Cove Road
	Proposed Shotgun Cove Road Extension Mile 2.0 to 4.5
	Proposed Access Roads
	Reserved Public Lands
	Existing Trail - Abandon
	Existing Trail - Minor Improvements
P	Proposed Recreational Parking
	Public Toilet
	Viewpoint
≫	Beach Access
*	Tidal Areas
	Kavak Launch

Backcountry Access

Figure 11 - Shotgun Cove Road Extension - Proposed Action at 95% Design

Passage Canal

State of Alaska

Chugach National Forest

<mark>S</mark>ource: Esrl, Maxar, GeolEye, Earlhstar Geo

