Appendix C
Geotechnical Reports

1. **Preliminary Geotechnical Reconnaissance Report. March, 2008 (Text Only, No Figures, Appendices)**

2. **Phase II Reconnaissance Report Memo. August, 2008**

3. **Phase II Reconnaissance Report Memo. Jan 2012 (Text Only, No Figures)**

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PRELIMINARY GEOTECHNICAL RECONNAISSANCE REPORT

KETCHIKAN: SHELTER COVE ROAD

Project No. 68405

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1.0 SUMMARY

The Alaska Department of Transportation and Public Facilities (The Department) proposes to construct a pioneer road to connect the existing logging road systems between Lake Harriet Hunt and Shelter Cove. The project area begins at the end of the Ketchikan road system at Lake Harriet Hunt, located approximately 16 miles north from downtown Ketchikan. The project corridor continues approximately 20 miles northeast to Shelter Cove, along the west side of Carroll Inlet (Figure 1). For much of this corridor, existing logging roads will be utilized, requiring only 5 to 8 miles of new road to be constructed. The objectives of the geotechnical reconnaissance were to ground truth and prioritize the proposed alternatives for this transportation link. Emphasis was placed on portions of the corridor that would require new construction.

The project can be divided into three segments; 1) Lake Harriet Hunt to Leask Cove, 2) Leask Cove to N. Salt Lagoon, and 3) N. Salt Lagoon to Shelter Cove (Figure 2). The first segment, from Lake Harriet Hunt to Leask Cove will be a combination of new construction linked with existing logging roads. Five options have been identified for this segment and will require construction of 2.5 to 3 miles of new road and the use of 3 to 5 miles of existing logging roads. Segment 2, from Leask Cove to North Salt Lagoon, is currently unroaded and will require construction of 5.5 miles of new road. Segment 3 follows 7.8 miles of existing logging roads from North Salt Lagoon to the end of the project at Shelter Cove.

Five possible options were identified for Segment 1, between Lake Harriet Hunt and Leask Cove. The preferred option follows the existing White River Road, owned by the Cape Fox Corporation. The White River Road was not studied during this investigation, pending negotiations with the owners. The remaining options listed in order of preference are Option 1 the South Lake Corridor, Option 2 the North Lake Corridor, Option 3 the Northeast Pass Corridor, and Option 5 the Leask Lake Corridor (Figure 2). For Segment 2, a coastal corridor was proposed from Leask Cove to the northern end of Salt Lagoon. From the north end of Salt Lagoon, two options (Option 6 & 7) have been identified to tie into the existing Shelter Cove Road. The preferred is Option 6, which continues 0.25 miles north along the west bank of North Salt Creek and intersects the existing road at a bridge crossing. Option 7 turns east, crosses North Salt Creek via a proposed bridge crossing and connects into the existing logging road system 1.25 miles away near East Salt Creek.

The only significant geological hazard identified during the investigation is localized slope instability. Within the project area, soils covering steep slopes tend to be unstable. Past research suggests this is especially true in areas that have been logged more than four to five years ago, as root mass strength decays in the remaining stumps. Steep slopes with potentially unstable soils have been historically acknowledged along the White River Road, and were noted during this investigation in Segment 1 east of Lake Harriet Hunt along both the South Lake and North Lake Corridors, along the Northeast Pass Corridor, and along the Leask Lake Corridor. In segment 2 suspect slopes were identified along the west side of Bat Cove between Leask Cove and Salt Lagoon, and in Segment 3 along the western most limits of the existing Shelter Cove road system.

2.0 INTRODUCTION

The existing public road system in Ketchikan is mostly confined to the coastal areas of southeastern Revillagigedo Island. One notable exception is the Ward Lake road, located approximately 4 miles north of downtown Ketchikan. This road penetrates 8.5 miles into the interior of the island, ending at Lake Harriet Hunt. This state maintained road provides access to public recreation areas and privately owned timber harvest areas. Beyond Lake Harriet Hunt, two logging road systems, the Leask Cove road system and the Shelter Cove road system, are separated by a 6 mile gap. The Department proposes to connect these logging road systems and increase public access approximately 20 miles across Revillagigedo Island. For reconnaissance purposes, a design speed of 35 mph and island arterial typical section are assumed. Several alternatives were identified by the Department to complete the proposed connection. These alternatives varied significantly and a geotechnical field reconnaissance investigation was requested to aid reconnaissance engineers in prioritizing the proposed alternatives for the selection of a final corridor.

Between 15 October and 2 November, a seven day geotechnical field reconnaissance investigation was completed. The investigation was conducted from Ketchikan by SE Region Engineering Geologist, Mitch McDonald, with field assistants Chris Crawford (Engineering Technician) and Jim Papoi (Engineering Assistant III). Access to the field area was via the existing public road to Lake Harriet Hunt, and helicopter for areas east of Leask Creek. Traversing the proposed corridors was done on foot, using GPS, compass and an altimeter for navigation. Notes and photographs were taken to characterize the terrain and any significant features.

This geotechnical field reconnaissance investigation is primarily focused on identifying the key issues that will effect project development. The level of work performed in this investigation should be considered preliminary. It is the intention of southeast region geotechnical staff that continuing reconnaissance investigations will be required once a preferred alternative is selected. Additional reconnaissance investigations will help to develop an alignment in the selected corridor. Once the preliminary alignment is developed, design level geotechnical investigations can begin. These investigations would include centerline investigations, foundation investigations, material site studies, slope stability investigations, and rock slope modeling.

3.0 OTHER REPORTS AND INVESTIGATIONS

The Federal Highways, Western Federal Lands Highway Division (WFLHD) conducted a geotechnical site reconnaissance of portions of the Shelter Cove road system. Results were reported as Geotechnical Memorandum No. GM06-03**; Geotechnical Site reconnaissance of Shelter Cove Road System [Addendum to Geotechnical Memorandum GM28-99, "AK PFH 39, Shelter Cove Road: PIR Preliminary Geotechnical Information" (2-18-00)]** and are included in Appendix A. As reported by Dave Lofgren, WFLHD Senior Engineering Geologist, the primary geotechnical features of the road system were stability of the cut slopes, constructing over muskeg, and techniques employed during the original construction of the road (e.g. incorporating overburden and slash into the road embankment). These observations are consistent with my own, and in fact can be said about all the existing logging roads associated with this project.

At the time of this investigation, active logging operations were being conducted on property owned by the Mental Health Trust between Lake Harriet Hunt and Leask Lake. Eric Nichols with Alcan Forest Products, was overseeing the construction of new logging roads associated with this activity and was contacted for information about the area. His letter response is included in Appendix A. The two key items noted in his letter are the potential instability of steep soil slopes, and the recommendation to use the White River Road to access Leask Creek.

After the field investigation, an interview was conducted with Golder Associates about their involvement with construction of the nearby Swan Lake transmission line. Although no direct information was obtained, names and contacts were provided to obtain geotechnical data collected at tower locations along the transmission line that parallels much of project corridor in Segment 1 and 2. Attempts to obtain this data are ongoing.

4.0 PHYSICAL SETTING

4.1 Climate

The Ketchikan climate is typical for Southeast Alaska's coastal communities. It has relatively mild rainy winters and cool wet summers. The record maximum temperature is 89°F and the record minimum is -4°F. Tabulated below are the average annual and monthly temperature, precipitation and snowfall for Ketchikan.

Ave Temp	Yearly 45	Jan 31	Feb 134	Mar 37	Apr 6	May 48	Jun 54	Jul 54	Aug 57	Sep 54	Oct 45	Nov 37	Dec 33
Ave High	52	36	39	43	48	55	63	64	64	61	52	43	37
Ave Low	39	27	30	32	36	41	46	52	52	48	41	34	30
Ave Pcn	150	14	13	12	10	8	5	5	10	15	23	18	17
Ave Snow	70	21	18	8	2	1	---	---	---	---	2	6	16

Temperatures are in degrees Fahrenheit and precipitation in inches.

4.2 Topography, Drainage and Vegetation

The project corridor lies within the coastal regime of SE Alaska in the southwest quarter of Revillagigedo Island. The island is bound on the west, north and east by the horseshoe shaped Behm Canal, and bound on the south by Revillagigedo Channel. Mountains and ridges in the area are typically less than 2000 feet elevation. The proposed corridor runs between elevations 200 and 800 feet. Two prominent fiords, George Inlet and Carroll Inlet, cut deeply into the island along a north-south trend. Glaciation was the major factor in the formation of the landforms in this area. Ice sheets as thick as 3200 feet probably disappeared at the end of the last major ice age 12,000 years ago. Deglaciation left behind steep mountains, U-shaped valleys, elongated lakes, rounded bedrock knobs, and scoured fiords. As the weight of the ice was removed, the Earth's crust began to rebound slowly and has raised the shorelines of Revillagigedo Island between 100 and 300 feet. Although rebound is still occurring in other parts of southeast Alaska, the uplift in the Ketchikan area has effectively stopped *(Lemke, 1975, Reconnaissance Engineering Geology of the Ketchikan Area, Alaska, with emphasis on Evaluation of Earthquake and Other Geologic Hazards).*

Numerous drainages cross the proposed corridor, and are often steep and deeply incised into bedrock. Bridges will be required to cross the two largest drainages, Leask Creek and an unnamed creek (called N. Salt Creek for this report) flowing into Salt Lagoon. Both are currently spanned by temporary logging road bridges, and are otherwise very difficult to cross on foot. Three large lakes are found along the corridor, Lake Harriet Hunt (elevation 640 feet) in the east and Lake 473 and North Saddle Lake (elevation 473 feet) in the west.

Slopes are covered by dense forests of spruce, hemlock and cedar. Valleys and level terrain are typically covered by muskeg and wooded-muskeg terrain. Logging activity has been ongoing for several decades. In the more recent harvest areas, slash and thick brush cover the ground. In older areas, dense second growth of spruce and alder dominate. Both make foot travel very difficult.

4.3 Regional Geology

Two major fault systems occur in southeast Alaska, the Denali Fault and the Fairweather-Queen Charlotte Fault. The Denali Fault is considered to be too far from the project area to be of concern, however, the Fairweather-Queen Charlotte Fault has produced seismic events impacting the project area. In the August 22, 1949 earthquake (magnitude 8.1) occurring on the Queen Charlotte Islands, 140 miles southwest of Ketchikan, dramatic results were witnessed at Ward Lake. Records described a two-foot high seiche wave in the lake and boiling, possibly produced by gas or air escaping from the lake bed. Closer to the project area are two major lineaments that may be interpreted as faults. To the east, Behm Canal defines the eastern shores of the island and is interpreted to be a possible fault following the Coast Range lineament. To the west Clarence Straight is also interpreted to be a fault mapped as the Clarence Straight lineament. None of these lineaments has produced any historical seismic activity *(Lemke, 1975, Reconnaissance Engineering Geology of the Ketchikan Area, Alaska, with emphasis on Evaluation of Earthquake and Other Geologic Hazards).*

Revillagigedo Island is composed of rocks associated with the Taku Terrane. Within the project corridor, these rocks are mostly Paleozoic to Mesozoic, metamorphosed and deformed strata described as locally pyritic dark-gray slate, phyllite and metagraywacke with subordinate occurrences of green andesitic or basaltic metatuff and rusty-weathering felsic or intermediate metatuff. Near the mouth of Leask Creek are fault bounded units of Permian marble and Cretaceous ultramafic rocks. Between Salt Lagoon and North Saddle Lake is a large pluton of Cretaceous, plagioclase-porphyritic granodiorite and quartz diorite *(Berg and others, 1988, Geologic Map, Ketchikan and Prince Rupert Quads, Alaska: U.S. Geological Survey Map I-1807, scale 1:250000.)*

As deglaciation began, ocean waters flooded into low lying areas and began depositing marine sediments. Subsequent rebound elevated these low areas and in many, muskegs began to develop. Glacially derived sediments are also commonly encountered as moraines and in some cases have been reworked by wave action along the shorelines or by mass wasting along steep mountain slopes. Receding ice reduced confining stresses on the near surface bedrock. Over time, the newly exposed bedrock began to relax and weather, forming talus and colluvial fans at the base of mountains and ridges.

4.4 Existing Road Systems

This project will incorporate approximately 14 miles of existing logging roads. These roads are part of two disconnected logging road systems. The Leask Cove road system is concentrated just to the northeast of Lake Harriet Hunt. Access to this system is via the

White River Road, which departs the Ward Lake road approximately 2.5 miles from Lake Harriet Hunt and roughly follows the White River through Cape Fox Corporation property. Although a thorough evaluation of existing roads was not within the scope of this investigation, a few observations were noted to give an overview of the road conditions. Roads in this system are 16-20 feet wide, single lane with turn outs. Grades are commonly between 10-15%, with short radius curves following the terrain. Cut slopes appear to be relatively stable, but most fills are oversteepened. Rock used to construct the road surface seems to be of marginal quality and as a consequence the driving surface has high fines content with a tendency to rut and pump. Rock exposed in the cuts varied widely in both composition and quality. As a consequence, future material sites will need to be carefully selected. Heavy truck traffic and logging activity was noted at the time of this investigation.

The Shelter Cove road system is accessible via the Shelter Cove Log Transfer Facility (LTF), located near the north end of Carroll Inlet. An evaluation of this road was conducted as a part of this investigation. The main road in this system is in excellent condition. Recent maintenance includes grading and the addition of six inches or more of good quality, crushed rock. The width varies from 18-20 feet. From the LTF to North Saddle Lake the grades can reach as high as 10-12%. The profile generally flattens in the vicinity of the lake with a few short segments with grades near 10%. During the evaluation, very high rainfall had created a minor flood condition in both North Saddle Lake and Lake 473. High water was at or near the toe of embankment fills in some areas. Any future widening of this road may require retaining walls to limit impact to the lake. West of the lakes, the road becomes undulating with grades commonly at 10%. Additionally, steep soil cuts exhibited a tendency to ravel throughout this segment.

5.0 FIELD INVESTIGATION

Between 15 October and 2 November, a seven day geotechnical field reconnaissance investigation was completed. The investigation was conducted from Ketchikan by SE Region Engineering Geologist, Mitch McDonald, with field assistants Chris Crawford (Engineering Technician) for five days and Jim Papoi (Engineering Assistant III) for two days. Access to the field area was from the existing public road to Lake Harriet Hunt, and with helicopter for areas east of Leask Creek. Future work should include the use of a small boat to access areas to the east of Lake Harriet Hunt. All traverses were done on foot with the exception of a ride across some of the active logging areas between Leask Creek and the northeast pass above Lake Harriet Hunt. Ground conditions were difficult and the work was accordingly strenuous. Three major obstacles were encountered, Leask Creek, Salt Lagoon and The Gorge at the head of George inlet on the west shore before the Salt Lagoon outlet. Navigating along the proposed corridors was accomplished with GPS, Brunton compass and an altimeter. The GPS signal was often blocked by thick vegetation and steep terrain. Notes and photographs were taken to characterize the terrain and any significant features. Whenever possible, GPS points were collected at each point of interest and labeled as sequentially numbered "Stops". At each "Stop" a brief description was recorded. Due to the reconnaissance nature of this project, no centerline stationing was available, and so all notes were related to a numbered "Stop". These "Stops" are depicted as red circles on the maps in Figures 3-5. East of Leask Creek, the field area was accessed by helicopter. GPS points were taken at all landing zones (LZ) used or identified to aid in future work.

The majority of the field work was focused on proposed routes that would require new construction. Areas that will require new construction include the connection between the Lake Harriet Hunt road and the end of the White River road (Segment 1, Figure 2), and the connection between the Leask Cove road system and the Shelter Cove road system (Segment 2, Figure 2). Four options were investigated for Segment 1, and approximately one day was spent on each of these options. A coastal corridor was proposed for Segment 2 and three days were spent investigating it. An additional day of field work was spent walking the Shelter Cove road from the existing bridge crossing at N. Salt Creek to the Log Transfer Facility (LTF) located in Shelter Cove (Segment 3, Figure 2). Table 1 below lists the traverses completed each day.

Table 1- Traverse Summary

TRAVERSE	STOPS	AREA	DESCRIPTION
Traverse 1 Oct 15	1-15	Segment 3- Shelter Cove Road	7.8 miles, from Shelter Cove LTF to Salt Lagoon Creek bridge, following existing roads
Traverse 2 Oct 16	16-28	Segment 2-North Salt Lagoon	3.5 miles, from north Salt Lagoon LZ 1 east to Shelter Cove Road, northwest along the road to Salt Lagoon Creek, then down the west bank of the creek to LZ 3
Traverse 3 Oct 17	29-44	Segment 2- Bat Cove to Salt Lagoon	2.3 miles, Bat Cove to midway along the west shore of Salt Lagoon at LZ Salt

Traverse 4 Oct 18	45-52	Segment 2- Bat Cove to Northeast Pass	4.2 miles with 1.3 miles travelled in a vehicle, Bat Cove to Leask Ck, then along logging roads up the valley toward the northeast pass above Lake Harriet Hunt
Traverse 5 Oct 19	53-64	Segment 1- Lake Harriet Hunt	3 miles, from the end of the Harriet Hunt Road around the lake back to the road
Traverse 6 Oct 30	65-68	Segment 1- East of Lake Harriet Hunt	4.8 miles, from Harriet Hunt Road along the south shore across to the logging roads to the east, then back to the Harriet Hunt Road along the north shore of the lake
Traverse 7 Oct 31	69-74	Segment1 - Northwest Pass of Lake Harriet Hunt	3.5 miles, from the end of Harriet Hunt Road up and over the northwest pass, then east along the 500 foot contour, then back up to the pass via the 1636 peak, and back to the road

6.0 CORRIDOR DESCRIPTION

The project corridor can be divided into three Segments; Segment 1) Lake Harriet Hunt to Leask Cove, Segment 2) Leask Cove to North Salt Lagoon, and Segment 3) North Salt Lagoon to Shelter Cove (Figure 2). Each of these segments and options within the segments are discussed sequentially below. Each section includes a summary, route description, and traverse description. The summary is a brief statement of any significant features and a ranking if more than one option has been proposed. Rankings are based on the field engineering geologist's opinion on how the terrain would influence design and construction. No cost analysis or design optimization studies were conducted. The route description is a verbal description of the proposed corridor, giving distances, elevations, directions and named landmarks. The traverse description is written to provide more detailed information to aid design engineers with the location of the preliminary alignment. This includes the description of all the pertinent field "Stops" (depicted on Figures 3-5), terrain descriptions, geotechnical issues, limited recommendations, and more detailed discussions of the photos found in Appendix B.

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6.1 Segment 1- Option 1, South Lake

Summary
Major features include bedrock ridges alternating with muskeg terrain, a possible bridge crossing at the outlet creek on the east side of Lake Harriet Hunt, and steep slopes with the potential for instability east of the lake where this option would tie into the existing White River Road Extension. Based on the modest terrain and short length of new construction, this option is ranked 2nd among the five options proposed for Segment 1.

Route Description
The alignment for this option starts at mile 2.1 of the Lake Harriet Hunt Road (Figure 3). It departs the road and continues east along the undeveloped south shore of the lake for 1.1 miles until it crosses the outlet creek. Beyond the creek, it continues northeast to the Harriet Hunt Lineaments, then turns to the southeast and contours between 500-600 feet elevation around a low mountain approximately 1400 feet high. As the alignment contours around the mountain to the east, it begins to drop from 500 feet elevation and merges with the existing White River Road at 300 feet elevation. Total distance of this option is 2.81 miles.

Traverse Description
The field traverse began by crossing small, undulating ridge crests and lowlands (Appendix B, Photo 1). The ridges are northeast/southwest trending bedrock features separated by lowlands occupied by muskegs and grasslands. Existence and depths of soft soils in these low areas could be determined efficiently with subsequent peat probing. The ridges rise steeply, 20-50 feet above the lowlands and are covered with thin soils, dense tress, and brush. Rock types appeared to be the prevalent gray phyllites mapped in the area. With optimized grades, the bedrock ridges present the opportunity for a balanced section for the first 1.2 miles. Soft soils encountered in the lowlands should be removed to the extent practical. Overlay of any soft soils should include a minimum of four feet of embankment and a separation geotextile fabric. Differential settlement between sections of the road cut through bedrock and sections overlying soft soils should be expected.

The outlet creek of Lake Harriet Hunt (Appendix B, Photo 2) will have to be crossed 1.2 miles from the start of this road (Figure 3, Stop 63). The creek flows over bedrock at the outlet and then descends rapidly along a series of low waterfalls, also exposing bedrock, within a well confined and deeply incised channel. The exact crossing should be located in the field to utilize the terrain as best as possible. The creek is approximately 10 feet wide and 1-3 feet deep. It is possible that a structure other than a bridge might be sufficient to cross the creek depending on the road elevation at the crossing. Abundant debris was observed in the channel, and needs to be considered in structure selection.

Once across the outlet creek, the road begins to traverse a steep hillside that drops into the first of the two Harriet Hunt Lineaments (Figure 3, Stop 66 & 67). Cuts are expected to be in bedrock but some soils may be present. Fills will tend to run great distances without catching and may require walls at the toe to stay within typical R.O.W. distances and avoid sliver fills. The Harriet Hunt Lineaments are the likely remnants of faults. The West Lineament contains a modest creek that would easily be passed with a culvert (Appendix B, Photo 3). The

alignment crosses the West Lineament in a location where soil thicknesses of 10 feet were noted on the west side, and only a few feet above exposed bedrock on the east side. Once across the West Lineament, the road begins to contour between 500 and 600 feet elevation around a hill that rises to approximately 1400 feet elevation. Approximately 1200 feet from the West Lineament, the road crosses the East Lineament (Appendix B, Photo 4). This lineament also contains a small creek. The existing logging road crosses this lineament without placement of a culvert, but simply passes the water through a boulder layer in bottom of the embankment. Our visit corresponded to a period of heavy rainfall, and there was no sign of flooding or other impact to the road. At Stop 67 (Figure 3) rock cuts around the East Lineament expose an unknown rock unit that is highly weathered and of poor quality. At least one rock failure was noted to have impacted the existing logging road in this area with approximately 10-50 cubic yards of rock (Appendix B, Photo 5). Cuts in this rock unit may require slopes flatter than the standard 0.25H:1V slopes typically used and/or other mitigation measures. Beyond the East Lineament, slopes steepen and the likelihood of slope stability in overlying colluvial soils increases. From review of aerial photos, four small landslides were interpreted just above the proposed alignment, and are delineated in Figure 3. At least one of these slides has crossed the proposed alignment and may represent a continued problem. Detailed examination of these slides should be incorporated into the next phase of geotechnical work to determine any continued risk to the alignment and any mitigation measures needed. The traverse was terminated at Stop 68 (Figure 3).

6.2 Segment 1- Option 2, North Lake

Summary

Major features of this proposed alignment (Appendix B, Photo 6) include wet, steep slopes, numerous small creeks deeply incised into bedrock above the lake, potentially deep muskeg deposits at the east end of the lake, and the same slope instability potential discussed for Option 1 where it contours around the 1400 foot elevation mountain. This option is ranked 3rd among the five options proposed for crossing Segment 1. While the second half of this route is similar to Option 1, the traverse along the north side of Lake Harriet Hunt will require more rock cuts in steep terrain and drainage control than the south side of the lake.

Route Description

This option begins at the end of the Lake Harriet Hunt Road (Figure 3). It follows the undeveloped north shore of Lake Harriet Hunt between 700 and 800 feet elevation for 1.3 miles, then crosses the West Harriet Hunt Lineament and turns to the south. It then drops to approximately 600 feet elevation where it crosses the East Harriet Hunt Lineament and contours the 1400 foot elevation mountain, eventually merging with the Option 1, South Lake alignment before it intersects the existing White River Road. Total distance of this option is 2.75 miles.

Traverse Description

The field traverse started by crossing the hillside approximately 100 feet above the north shore of the lake. The first half of the traverse, between Stops 54 and 60, (Figure 3) crosses gentle to moderate slopes covered with brush, small timber and small, discontinuous muskegs (Appendix B, Photo 7). The ground was very wet, nearly completely saturated at

the time of this investigation and extra cross culverts should be considered in the design. These slopes are cut by several small creeks flowing in steep-sided, deep bedrock channels. Some of the channels are 30-50 feet deep, with sides cut down into the bedrock at 40-50° slopes (Appendix B, Photo 8, 9). Though bedrock is presumed to be fairly shallow across this area, soil depths up to 10 feet were noted in some locations near the west end of Lake Harriet Hunt. In the vicinity of Stop 61 (Figure 3), the slopes begin to steepen for approximately 2000 feet along the alignment. Saturated surficial soils were still prevalent, and vegetation was dense brush with small to large timber. Cuts in this area are anticipated to be in bedrock.

As the slopes begin to flatten out, the alignment emerges from the east end of Lake Harriet Hunt and crosses the top of four moderate sized muskegs (Appendix B, Photo 10). Minor realignment to the north could avoid these areas of potentially soft soils. Beyond the muskegs, the alignment climbs slightly and crosses near the head of the West Harriet Hunt Lineament. From here to where the alignment intersects the White River Road, approximately 1.4 miles away, the slopes are moderate to steep with the potential for slope instability in colluvial soils. The field traverse ended at Stop 68 (Figure 3), however, aerial photos indicate the presence of a landslide or debris flow 580 feet east of this point, just before the Option 1 and Option 2 alignments merge. The slide appears to have originated on a steep slope at 1000 feet elevation, and continued down to 470 feet elevation where it crosses the proposed Option 2 alignment. This interpreted slide should be verified in future investigations, and if substantiated could be used as a model to help predict future events.

6.3 Segment 1- Option 3, Northeast Pass

Summary
Steep slopes, steep grades, and the high elevation of the pass make this a fairly undesirable option, and it is ranked 4th out of five options for crossing Segment 1.

Route Description
The Northeast Pass Option is a variation of Option 2, North Lake. It follows that route across the north shore of Lake Harriet Hunt for approximately 1.0 mile but begins to diverge at the east end of the lake. Here it starts to climb 0.76 miles up to the pass between Peak 1636 and a 1400 foot mountain to a maximum elevation of 1100 feet. From the pass the alignment descends northward and merges with existing logging roads at an elevation of approximately 600 feet. The road continues to descend steeply for 1.5 miles and intersects the White River Road Extension at 200 feet elevation. Total length of new road required is 2.5-3.12 miles, depending on the exact merge location with the existing logging roads. An additional variation on this option is discussed in Section 9 of this report.

Traverse Description
Field traverses only covered portions of this alignment, the north side of Lake Harriet Hunt (already discussed in Option 2, North Lake), and the last 0.5 miles where it connects to the existing road system. The last 0.5 mile of the alignment, in the vicinity of Stops 52, LZ6, and LZ5 (Figure 3), will traverse a steep slope with potential for slope instability if significant thicknesses of colluvium are encountered. A creek crosses the alignment just beyond the

limits of the field traverse at Stop 52, and it is not known if a bridge or other structure will be required to cross it.

6.4 Segment 1- Option 4, White River Road

Summary
This is the 1st ranked option for crossing Segment 1. This option eliminates construction of any new road in Segment 1, avoids some of the steep grades of the Lake Harriet Hunt Road, and maintains a lower elevation than all other options which will allow the road to stay open later into the winter and earlier in the spring. Total length of this option is 5.28 miles, all along existing logging roads. The road appears to be in good condition, and active grading operations were noted during this investigation. Slope failures in colluvial soils are known to have occurred along this road in the past.

Route Description
Detailed review of this existing road was not part of this investigation and it will only be discussed generally here. The White River Road is owned by the Cape Fox Corporation and begins at a gated access, just beyond the turn off to the Lake Harriet Hunt Road (Figure 2). From the intersection with the Lake Harriet Hunt Road it goes 1.4 miles southeast at elevations around 450 feet (Appendix B, Photo 11, 12). It then turns sharply to the northeast and runs along the base of a long ridge for 2.3 miles and drops to 50 feet in elevation where it crosses a tributary to the White River. From there it slowly climbs the remaining 2.3 miles to an elevation of 200 feet at the Cape Fox property boundary. Beyond the property boundary the road continues as the White River Road Extension, currently being used to access the Leask Cove road system for logging operations.

6.5 Segment 1- Option 5, Northwest Pass

Summary
The most significant features of this alignment are muskeg deposits, steep road grades, steep terrain, localized slope instability, and several canyons. This proposed alignment is ranked 5th among the five options for Segment 1. This low ranking is attributed to its 6 mile length, the steep grades required to climb into a high elevation pass, and the severe terrain found on the north side of the pass.

Route Description
This option begins at mile 1.7 of the Lake Harriet Hunt Road, at elevation 750 feet (Figure 3). It begins to climb as it contours onto the hillside west of the lake, and eventually tops out at 1050 feet in elevation, in the pass between a small 1600 foot elevation knob to the west and Peak 1636 to the east. In the pass, the proposed route crosses 0.4 miles of flat muskeg believed to be over fairly shallow bedrock (Appendix B, Photo 13). As the route drops down the north side of the pass, the terrain steepens dramatically. At an elevation of 750 feet the proposed alignment makes a sharp switchback at mile 2.47 and continues to the east, side-hilling this steep slope. At mile 3.5, the proposed alignment turns north continuing to side-hill at 400 to 500 feet elevation along the bottom of a steep ridgeline. Once beyond the

ridgeline, this route would then turn east and tie into the existing logging roads along an undefined corridor.

Traverse Description
The traverse began at Stop 53 (Figure 3), at the end of the Lake Harriet Hunt Road, and was planned to continue to Leask Lake. Due to the length of the proposed traverse, it was decided not to follow the proposed alignment exactly, and so the first 1.5 miles of this proposed alignment were omitted. Due to its close proximity to the existing road system, the omitted 1.5 mile segment could easily be investigated at a latter time.

From the end of Lake Harriet Hunt Road, a well used foot trail was utilized to climb up to the pass very close to the proposed alignment. The trail is marked on Figure 3 by Stop points 53, 54, 55, 57, 56 and terminates at 69. The proposed alignment was intersected at Stop 69 where it crests onto the pass. The terrain on the pass is gentle to flat and is covered by an expansive muskeg with isolated pockets of trees (Appendix B, Photo 14). The muskeg is interpreted to be shallow, likely less than 5 feet, and overly bedrock. The isolated pockets of trees are interpreted to be areas of very shallow muskeg over bedrock. If required, peat probing would be effective for determination of muskeg thickness. At Stop 71 (Figure 3) the alignment begins to drop elevation off the north side of the pass. Here the traverse left the proposed alignment and continued in a northeast direction to intersect the alignment at 650 feet elevation beyond the switchback. The switchback is at mile 2.47 of the alignment and marks the beginning of the most difficult terrain along the route. At this point the alignment begins to contour between 500 and 700 feet elevation around a steep cirque. The slope is commonly between 30° and 40°, thickly vegetated with trees and brush, covered with a thin mantle of soil over the bedrock, and cut by deep canyons. Along the traverse two rock slides were noted (Appendix B, Photo 15, 16). Each appeared to be breaking back to a foliation plane between 45° and 60°. This angle is a very rough estimate because the slopes were too steep to access for measurement. Failures at this angle do indicate that bench cuts will either have to be less than the typical 0.25:1, or require extensive rock slope mitigation measures. At least four canyons cut the slope (Appendix B, Photo 17, 18). These canyons range from 50 to 100 feet wide (estimated distance from top of bank to top of bank), and 20 to 50 feet deep. The banks slope 35° to 45° and can be quite difficult to negotiate. The streams are 3-6 feet wide, shallow, easy to cross and descend in both steep, cleaned out bedrock channels and stepped channels with platy gravel bed loads. The requirements for crossing these canyons will be grade dependent and could range from culverts with high fills to bridges. Navigating this terrain was quite difficult, and poor GPS reception prevented the field crew from following the alignment with much certainty. At Stop 74 the traverse was terminated since the alignment did not appear to be viable.

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6.6 Segment 2- Leask Cove to North Salt Lagoon

Summary

Segment 2 includes the area of all new construction that would connect the Leask Cove Road system to the Shelter Cove road system at the north end of Salt Lagoon (Figure 2). The only proposed corridor was along the coast of northern George Inlet, then turning inland along the west side of Salt Lagoon (Figure 4). At the north end of Salt Lagoon, two options (Option 6 and Option 7) were proposed for connecting into the existing Shelter Cove Road. Option 6 is the preferred option, due to its short length, ease of construction and not requiring construction of a new bridge across North Salt Creek.

The significant features of this corridor include steep slopes along the west side of Bat Cove, potential instability along steep slopes with deposits of colluvial soils, wide flood plains along the upper reaches of North Salt Creek and the possible need for bridge crossings at Leask Creek, The Gorge and one or two small unnamed creeks on the west side of Salt Lagoon.

Route Description

This segment begins on the east side of Leask Creek, from the end of the logging roads currently being constructed on Mental Health Trust lands at the eastern edge of Segment 1 (Figure 4 and Appendix B, Photo 19). From this point the proposed road corridor would cross a prominent, steep sided canyon. After making this crossing, the road would turn south in a large curve, crossing the Swan Lake transmission line easement and dropping from 250 feet elevation to approximately 150 feet elevation. It then continues east along the coastline for approximately 0.9 miles, then turns north, once again crossing the transmission line easement (Appendix B, Photo 20, 21). It then traverses along the steep western slopes of Bat Cove, around the head of Bat Cove, and turns south, crossing the transmission line easement once again before crossing the base of Bat Point, at mile 2 of this segment (Appendix B, Photo 22). From Bat Point the corridor follows the coastline to the northeast until it intercepts a deep canyon at mile 2.8, referred to as The Gorge in this report. The Gorge is a major surface feature requiring the corridor to turn inland and climb to an elevation between 250 and 300 feet in order to find a single span crossing. Once across The Gorge, the corridor begins to descend towards the west side of Salt Lagoon, reaching a low point of 80 feet, at mile 3.8 midway up Salt Lagoon. The corridor then continues along the west side of Salt Lagoon between 100 and 200 feet elevation. At mile 4.4 the corridor begins to follow up the west side of North Salt Creek, still between 100 and 200 feet elevation (Appendix B, Photo 23). At mile 5, the corridor splits into Option 6 and Option 7.

Option 6 continues north 0.5 miles along North Salt Creek where it intersects the existing Shelter Cove Road. Option 7 turns east and crosses North Salt Creek at a new proposed bridge location. Once across the creek, the corridor turns south and climbs up a cliff line that continues for 0.8 miles along the east side of the creek. After the corridor traverses up the cliff face it makes a turn back to the east and connects to the existing Shelter Cove Road. The total length of Option 7 is 1.5 miles.

Traverse Description
The traverse of Segment 2 took three days to complete. It included Traverse 2, 3, and 4 as shown in Table 1. The data from each traverse is combined below to yield a description of the corridor from west to east. For this reason, the "Stop" numbers are not sequential.

The corridor begins at the point labeled "End Leask Rd" (Figure 4), on the east side of Leask Creek. At the time of the field investigation, this was not shown as the start point, and this portion of the logging road was still under construction. For these reasons, this location was not visited. From a close examination of the LIDAR contours, a prominent canyon is located at the proposed start of this corridor. The exact nature of the proposed crossing is unknown, and it is possible that a bridge may be required. However, the canyon feature appears to end abruptly just below the proposed corridor, and a minor realignment may help to avoid this crossing if necessary. The field traverse along this part of the corridor was done along the beach and a short way up along the banks of Leask Creek. The lower portion of the creek is a single 30 foot wide channel, with broad flat terrain along both banks (Appendix B, Photo 24, 25). The water is approximately 2 feet deep and very swift, making the crossing quite difficult. At the point labeled "Fork" (Figure 4), the creek channel narrows, but splits into as many as three channels (Appendix B, Photo 26). If the currently proposed starting location changes, there are several suitable bridge crossings between the Fork and the beach. The proposed corridor was intercepted at Stop 49 (Figure 4), 0.4 mile along the alignment. Just before this Stop, three chutes were noted in the field. These were observed as 50-200 foot wide, linear changes in the vegetation running up the hill and down to the beach (Appendix B, Photo 20). It is likely that they are artifacts from previous logging activity, but they were noted just in case additional evidence suggests they may have another source. From Stop 49 to Stop 48 (Figure 4), the corridor is following a nice bench across moderate slopes at approximately 100-150 feet elevation. Between these stops, two short debris flows were interpreted from the channel morphology, located on Figure 4 as "Debris Flow 1" and "Debris Flow 2" (Appendix B, Photo 27). From the vegetation present, they do not appear to have been active for at least 5-10 years. These channels do not appear to pose any hazard to a road alignment, but may indicate the potential for some small localized stability issues along this section of the slope. This portion of the slope may also contain thicker deposits of colluvial soils. At Stop 48 (Figure 4), the corridor begins to traverse along a saddle between two small knobs and the south slope of Peak 1466. The surface organics on the saddle are fairly saturated, with at least one small creek flowing on bedrock exposed just beneath the forest organic layer (Appendix B, Photo 28). At mile 0.8 of the corridor, moderate slopes give way to the steep bedrock and colluvial slopes along the west side of Bat Cove (Appendix B, Photo 29, 30).

As the corridor heads into Bat Cove, it passes beneath the transmission line, where it makes an unsupported span more than 1000 feet long across Bat Cove. Care should be taken not to locate the alignment too close to the foundation elements of the transmission towers to avoid possibly inducing a failure. The slopes along the west side of Bat Cove are notably steep, from 30-45°. They continue up 400 feet above the corridor and could be problematic. Several small, discontinuous, exposures of blocky, jointed bedrock were observed. These outcrops were mantled with minor thicknesses of boulder rich colluvial soils that will require slope stabilization when encountered at the crest of any road cuts. These soils also produce

abundant hazard rocks, typically angular boulders loosely seated in a fine soil matrix. These hazard rocks will need to be removed or secured during construction. The steepness of the slope will produce fairly high rock cuts. To avoid this, the road corridor could follow an abandoned logging road grade that starts at Stop 46 (Appendix B, Photo 31) near the mouth of the cove and ends at Stop 45 (Figure 4) near the head of the cove. This will require a significant drop in elevation between Stop 48 and Stop 47, to hit the road grade at Stop 46 (Figure 4). The abandoned road grade is at approximately 20-25 feet in elevation, and would require extensive reconstruction, including cuts into the hillside, raising the grade and rip rap protection. The surface of the road is flat, overgrown, covered with 3 to 12 inches of totally saturated, very soft, organic silt. Beneath the organic layer, the road grade is hard and rocky feeling, and is presumed to be shot rock. As the corridor rounds the head of Bat Cove, it follows the east shoreline of the cove towards Bat Point. During the field investigation, the traverse was incorrectly made at a higher elevation, approximately 100-150 feet, revealing some information above the corridor. From Stop 29 to Stop 30 (Figure 4) a fairly wide, stable, and overgrown talus field was encountered, with boulders commonly 12 inches across. Keeping the proposed corridor away from the toe of this talus field is ideal. Additionally, further inspection of the talus field may reveal that it could be used as a rip rap source for the west side of the cove. At mile 1.7, the corridor turns inland and begins to climb beneath the transmission line easement and between two low hills at the base of Bat point. The corridor climbs from an elevation of 30 feet to a high of approximately 170 feet along an apparent creek, not verified during the field traverse. Based on the rapid change in elevation, it is presumed that this will be a fairly significant thru cut, and therefore a potential material source. The corridor transitions out of the presumed thru cut at Stop 33 (Figure 4), and crosses a long narrow muskeg and creek at Stop 34, mile 2.1 of the corridor (Appendix B, Photo 32). Once across the muskeg the corridor turns northeast and parallels the coastline from Stop 34 (Figure 4) at 2.1 mile, to Stop 37 at 2.7 mile (Figure 4). The location of the corridor is constrained to the southeast by private property along the beach, and to the northwest by the transmission line at the base of the mountain. The terrain consists of a moderate slope rising from the coast, to a narrow spine that broadens into a bench, running parallel to the coast at approximately 100-150 feet in elevation (Appendix B, Photo 33). This bench is the most ideal location for the road. Moving inland, above the bench, the ridgeline falls away to the linear muskeg at the base of a steep, 40° slope also paralleling the coast. This steep slope rises to 190 feet where the transmission line has been constructed along the naturally occurring bench. Above this bench, the slope climbs steeply up to the top of the ridgeline at approximately 1000 feet in elevation. This entire stretch has been logged some time ago and is now densely vegetated over abundant quantities of manmade debris, including cable and scrap iron. Clearing and grubbing in this area may be problematic. At Stop 37 a small creek was encountered, exposing bedrock just below the forest organic layer.

Also at Stop 37, the corridor turns sharply inland to a suitable crossing at The Gorge. The Gorge is a major terrain obstacle consisting of a steep, deep canyon that becomes more severe as it approaches tide water. During the field investigation, The Gorge was crossed very close to the transmission line easement. At this location a bridge would be required to cross. Although there is a creek in the bottom of this canyon, it is very small and insignificant compared to the topographic relief (Appendix B, Photo 34). The brush and steepness of the terrain made movement very difficult, and there was not enough time to reach the proposed

corridor crossing. Therefore, nothing is known about the proposed crossing location, and it should be assumed that a bridge or very high fill will be required to cross until further work is done. Once across The Gorge, the terrain changes to small, open, discontinuous muskegs and forested wetlands all draining down into a basin midway along the west side of Salt lagoon. Because the area is fairly wet, and the corridor roughly follows the prevailing drainage pattern, surface drainage along the section will be an important design element. Bedrock was noted at very shallow depths in a few of the creeks, and it is expected to be near the surface for most of this section. The traverse ended at "LZ Salt" (Figure 4) midway up Salt Lagoon.

The proposed corridor between "LZ Salt" and the intersection with the Shelter Cove Road was not covered. The traverse through this area was made along the banks of North Salt Creek, in an attempt to locate an adequate bridge crossing farther south than the existing North Salt Creek Bridge. As a result, not much is known about the corridor in this area. A detailed examination of aerial photography and LIDAR topography does reveal at least 5 major drainage features. Most appear to be quite narrow, but a broad drainage trending west to east at the mouth of North Salt Creek may be a fairly major terrain feature. The corridor along this section might be optimized slightly by taking a straighter course along the banks of the creek holding to an elevation of 100 to 200 feet. From the LIDAR contours, it appears as though moderate cuts will be required at this elevation. At mile 5.0, the corridor splits into Option 6 and Option 7 (Figure 4).

Option 6 is the shortest at 0.5 miles. It continues north along the west side of North Salt Creek and then intersects the logging roads very near the existing bridge crossing the creek. The creek along this section splits into several moderate sized channels, approximately 5-15 feet wide and less than 2-feet deep. During the field investigation, heavy rains had caused the creek to flood the entire basin in a wide flood plain. Additional work should be done to delineate the limits of this flood plain and ensure the road alignment is placed an appropriate distance away. The existing bridge is in good condition and is described at the end of Section 8.7 of this report (Appendix B, Photo 35, 36).

Option 7 is longer and more complicated than Option 6. The total length of this option is 1.5 miles. From the split this option turns east and crosses North Salt Creek, requiring a new bridge. The crossing shown on the preliminary corridor appears to be slightly offset, and it is assumed that the crossing is to be made at a perpendicular to the creek and not the long skew depicted. The crossing proposed is across the wide flood plain described above in Option 6 and is not recommended. A field traverse was made from the existing bridge crossing, downstream to North Salt Lagoon. The traverse is shown on Figure 4 as Stop 15, 23-28, and LZ3. The broad Flood plain was noted approximately between Stop 15 at the bridge, to Stop 23. At Stop 23 the creek narrows significantly but is still wide enough to possibly require a multi-span bridge. At Stop 24, the creek narrows to a confined channel approximately 20-30 feet wide, with steep banks rising on both sides (Appendix B, Photo 37). At Stop 25 the creek widens to approximately 30 feet. Just downstream of this stop, bedrock was noted along the banks of the creek (Appendix B, Photo 38). While it is likely that bedrock is fairly shallow from Stop 24, this is the first observed outcrop. At Stop 26 the creek narrows back down to approximately 20 feet with bedrock exposed on both banks (Appendix B, Photo 39).

Between Stop 24 and 27, the creek is 20-30 feet wide, well confined in a channel with steeply rising banks on both sides, 1-3 feet deep, and a boulder rich bed load. Optimal crossing locations are between Stop 24 and 25, or Stop 26 and 27. At Stop 27 the channel narrows down to 10 feet and drops over a bedrock waterfall that appears to be a fish barrier. The west bank at this location becomes a very steep, 45-60°, bedrock cliff. Also at this location is what appears to be a stream gauge. The bedrock cliff continues downstream along the west bank to Stop 28, where it begins to widen gradually to the mouth at North Salt Lagoon. Once a crossing is selected, the Option 7 corridor will climb along a bench cut to the mouth of the creek. At this point it will turn east again to tie into the existing Shelter Cove Road. The east bank of the creek was not traversed in the field, but from observations at the creek and the LIDAR contours, it is guessed that this will be a bedrock cut with unknown mantles of colluvial and organic soils. This bench cut and the following curve look to be in fairly difficult terrain and may produce large cut heights and steep grades. As an alternative, the bench cut could be extended slightly farther to the south to intercept a broad, flat bench between 100 and 200 feet elevation. This bench was traversed in the field from Stop 17 to Stop 19 (Figure 4 and Appendix B, Photo 40), and is mostly muskeg and forested wetlands, passing at the foot of The Knob (Stop 13, Figure 4), a prominent bedrock feature overlooking this area (Appendix B, Photo 41). The transition at Stop 19, to connect with the Shelter Cove Road will also be challenging, as the corridor passes between the existing road and the steep banks dropping into East Salt Creek. Slope stability of this transition will be an important element in any future work along Option 7.

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6.7 Segment 3- Shelter Cove Road

Summary

Segment 3 of the project covers the area between Salt Lagoon and the end of the project at Shelter Cove, located midway up the west side of Carroll Inlet (Figure 2). Initially two general corridors were proposed, one crossing the north end of Salt lagoon and one that crossed the inlet at the south end of Salt Lagoon. Both corridors then merged with the existing road system leading into Shelter Cove. During the initial over-flight of the project area, all proposed alternatives for Segment 3 were quickly discarded in favor of using the existing Shelter Cove Road where it crossed at the north end of Salt lagoon. Other routes proposed for Segment 3 would have required the construction of some new roads, as well as reconstruction of some existing, but abandoned, roads.

The Shelter Cove road system is isolated from the Ketchikan road system and is accessed via helicopter or vehicles based at the Shelter Cove Log Transfer Facility (LTF). Shelter Cove Road is the main collector for the logging roads constructed in Segment 3 (Figure 2). It has been well maintained and is in excellent condition. The width varies from 18-20 feet.

The only significant features along this segment include some grades between 10% and 15%, and small, localized slope failures in colluvial soils. Otherwise, the road is in good condition and has been recently graded and resurfaced with 6-inches or more of silty crushed rock.

Route Description

Segment 3 begins where the Shelter Cove Road crosses North Salt Creek (Figure 5). From here it climbs along a stepped 10% grade for 1.6 miles, rising from 150 feet to approximately 400 feet elevation, to an area referred to in this report as The Knob. From The Knob, the road climbs 1.2 miles, around the nose of a ridge, to the western end of Lake 473 at an elevation of 560 feet. It follows an undulating grade as steep as 10% in places, with several short radius curves. From the west end of Lake 473, the road continues 3.4 miles along the shorelines of Lake 473 and North Saddle Lake. It gently drops elevation from 560 feet to approximately 400 feet at the east side of North Saddle Lake. Once beyond North Saddle Lake, the road begins to descend the final 1.6 miles to the Shelter Cove LTF. Grades along this portion of the road were as steep as 10% to 15%, but typically only for short pitches. Total length of Segment 3, following the existing Shelter Cove Road, is 7.8 miles.

Traverse Description

The field traverse began at the Shelter Cove LTF and ended at the North Salt Creek Bridge (Figure 5). Note that the descriptions of this traverse are in the reverse order of the road direction. A helicopter was used to access the LTF, and then the traverse was completed on foot to the bridge crossing. The LTF is in very good condition, with a barge landing, boat ramp, small single-finger dock, two USFS vehicles, and two private vehicles (Appendix B, Photo 42). From the LTF the road climbs 0.6 miles at 10-15% to an intersection with a spur road at Stop 2 (Appendix A, East Site Map). Just beyond Stop 2 a major creek crosses the road in a 10-12 foot diameter pipe. The creek is unnamed and will be called Shelter Creek in this report. The pipe appeared to be in satisfactory condition. The road continues to climb at gentle grades from Stop 2 (Appendix B, Photo 43) until it crosses the Swan Lake

transmission line at Stop 4, 1.3 miles from the LTF. Here grades steepen to 15% as the road climbs up to North Saddle Lake (Appendix B, Photo 44). At Stop 5 (Figure 5), above the outlet creek for North Saddle Lake, very high rainfall had created a minor flood condition in the lake and high water was at or near the toe of embankment fills. Any future widening of the fill may require retaining walls to limit impact to the lake. Continuing around the lake, the road generally flattens out but with some minor undulations. At Stop 6 (Figure 5), 1.8 miles from the LTF, a low rock cut in a jointed intrusive rock, displayed a tendency for slope instability in the shallow colluvial soils mantling the natural slope above the cut (Appendix B, Photo 45). Although this slope does not appear to be a hazard, or threaten closure of the road, it does imply that slope treatments may be required at the crests of any new cuts. Additionally, it also indicates a possible ongoing maintenance issue. The road continues around North Saddle Lake and connects to Lake 473 (Appendix B, Photo 46) at Stop 9 (Figure 5), 3.3 miles from the LTF. The creek connecting these lakes has a very odd geometry, and the pipe currently conveying it through the embankment forces it to make a 90-120° turn. Minor flooding at the time of this investigation did not appear to be inundating the pipe, despite this odd geometry. As the road passes the west end of Lake 473 it reaches a high point of 560 feet in elevation (Appendix B, Photo 47). It then begins to drop elevation as it rounds the nose of a ridge and continues along an undulating grade with short segments as steep as 10-15%, and numerous short radius curves. It hits a low point of 310 in feet elevation at the East Salt Creek crossing 6 miles from the LTF. During the field investigation, a large diameter pipe was located with the GPS at Stop 12 (Figure 5), 5.8 miles from the LTF. However, from an evaluation of the LIDAR contours, it appears as though the GPS location was inaccurate. A point taken a few days later, approximately 1000 feet farther down the road, and labeled “creek crossing” on Figure 5 is likely the correct location of this pipe. This is the crossing for East Salt Creek. On the downhill side of the road, East Salt Creek makes a 90° bend to the west and runs parallel to the road for approximately 1000 feet. Between the creek and the road is a very steep slope, approximately 40°. Any modifications to the existing road made on the downhill side would require careful study for slope stability, and caution should be exercised. From East Salt Creek the road climbs to a prominent overlook discussed as The Knob in this report (Appendix B, Photo 48). It continues climbing past The Knob, reaching a crest at Stop 20 (Figure 5), 6.6 miles from the LTF at a little over 600 feet elevation. The climb up to this point, as well as the descent towards the bridge, is along winding, steep roads with grades reaching 10% to 12%. The road flattens out at Stop 21, and continues to Stop 22 (Figure 5). At Stop 22 the road once again begins to descend along a series of steps, with grades between 6% and 10%, and finally reaches a low point at the North Salt Creek Bridge, 7.8 miles from the LTF where the traverse ended. Between Stop 11 and the bridge at Stop 15, some cut slopes expose significant thicknesses of colluvial soils on steep slopes rising several hundred feet above the road. These slopes may represent an ongoing maintenance issue and may warrant further investigation for overall stability. The North Salt Creek Bridge is a narrow, single span, steel bridge with wood decking, founded on log stringer abutments. It appears to be in good condition, and placed at an adequate height above the creek to pass typical debris observed in the channel (Appendix B, Photo 35, 36).

7.0 ADDITIONAL CORRIDOR PROPOSALS

An additional option proposed by the U.S. Forest Service is a variation of Segment 1, Option 3, Northeast Pass (discussed above in section 8.3). By continuing the Option 3 alignment to the southeast and connecting to the end of an existing logging road, the length of new road needed could be reduced from 2.5-3.1 miles to 1.9 miles. Although the existing logging road that would be used with this option was not traversed during the field investigation, it was observed during helicopter over-flights. It appeared to be fairly narrow with oversteepened, high fills on the northwest side of the road. Additional work is recommended along the existing road if this option is considered further.