Appendix C
3 - Phase II Reconnaissance Report
January, 2012. (Text only)

MEMORANDUM

State of Alaska

Department of Transportation & Public Facilities
Design and Engineering Services – Southeast Region Materials

TO: Dan Garner, P.E.
Preliminary Design Engineer

THRU: Bruce Brunette, P.E.
SE Regional Materials Engineer

FROM: Mitch McDonald, Jr.
SE Regional Engineering Geologist

PROJECT NO: 68405
PROJECT NAME: Ketchikan: Shelter Cove Road

DATE: January 3, 2012

SUBJECT: Trip Report- Phase II Reconnaissance of KTN Shelter Cove Rd – Option 5 Corridor

INTRODUCTION

At the request of Dan Garner, P.E., additional reconnaissance work was conducted along the Option 5 corridor identified in the *"Preliminary Geotechnical Reconnaissance Report, Ketchikan: Shelter Cove Road" (March 2008)*. A map of the previously identified options is included as Figure 1. The purpose of this investigation was to record observations further north along the Option 5 corridor not previously investigated. Figure 2 shows the revised Option 5 corridor which has been further developed since the 2008 reconnaissance effort.

Field work was completed by Mitch McDonald, Regional Engineering Geologist and Erik Anderson, Engineering Geologist between September 15 and 19, 2011. This work is supplemental to work completed in October/November 2007 and August 2008. Details of previous work can be found in *"Preliminary Geotechnical Reconnaissance Report, Ketchikan: Shelter Cove Road"* (March 2008) and *"Trip Report- Phase II Reconnaissance of KTN Shelter Cove Road"* (August 27, 2011).

FIELD INVESTIGATION

Five days of field work were completed between September 15 and 19, 2011. The intent of the investigation was to traverse the entire corridor on foot, make generalized observations about the terrain and note any geotechnical issues or hazards. Operations were based in Ketchikan and the field area was reached via helicopter and vehicle access along privately owned logging roads. Proposed routes were preloaded onto a recreational grade GPS and used to navigate in the field. When the GPS signal was lost, map and compass were used to maintain near proximity to the route. Field maps were built from the USGS, 1:63360 scale quad maps; no LIDAR was available at the time of the field work. A sectional peat probe, capable of probing to depths of 12 feet was carried and widely spaced probing was conducted to estimate peat depth and character. Points of interest were marked with the GPS and photographs and notes taken to describe pertinent geotechnical features. Selected photographs are included in this report in Appendix A.

CORRIDOR DESCRIPTION

Option 5 is an inland corridor, approximately 14 miles in length depending on the exact route selected. It will require both reconstruction of existing logging roads and construction of a new road across a variety of terrain types including shallow alpine muskegs, deep muskegs and steep hillsides. As many as five structures may be required, including bridges, large multi-plate culverts and large diameter pipes.

The currently proposed route leaves the existing State road system at mile 1.7 of Lake Harriet Hunt Road and climbs to a high pass immediately north of Lake Harriet Hunt (Appendix A- Photo 1), reaching a maximum elevation of 1050 feet. Once over the pass it descends into a broad flat valley referred to in this report as Wolf Valley (Appendix A- Photo 2). The valley is bound by a moderate ridge to the west, a steep ridge to the east, and Upper Wolf Lake to the north. The current proposal follows the steeper east ridge down to the valley bottom. However, an additional route should be examined that follows the more moderate west ridge down and then crosses the north end of the valley bottom. Both of these options exit Wolf Valley at the northeast corner and connect to the existing Mental Health Trust (MHT) logging road system (Appendix A- Photo 3).

Once on the MHT logging roads, it follows them along the south side of Leask Lake to Leask Creek, diverging briefly to make a new crossing. Once across the creek, it rejoins the existing logging roads and continues to the northeast to the steep hillside on the southeast shore of Lake 360.

At Lake 360 the route leaves the MHT road system and continues northeast to the Heckman Lake valley. Several routes across Heckman Valley may be viable but all should avoid the very steep hillside running parallel to the east side of the Heckman Lake tributary creek. The route followed during this reconnaissance follows the west side of the valley, finally crossing the Heckman Lake tributary and climbs via a broad switchback into a narrow, steep-sided valley referred to in this report as Newt Valley. It follows this valley to the southeast and connects to the existing Shelter Cove Road System. For a detailed discussion of the Shelter Cove Road system see the previous report, “*Preliminary Geotechnical Reconnaissance Report, Ketchikan: Shelter Cove Road*” *(March 2008)*.

Table 1: Corridor Outline

Corridor Segment	***Approximate Distance (miles)**	**Description**
Harriet Hunt Road to MHT Road System	4.9	New construction across shallow alpine muskeg, steep hillsides, deep muskegs
MHT Road System to Lake 360	3.6	Reconstruction of existing logging roads
Lake 360 to Shelter Cove Road System	4.6	New construction across steep hillsides and deep muskegs

* All distances will change with the exact route selected across each segment

GEOTECHNICAL FEATURES

The Option 5 corridor passes through a variety of terrain types, each requiring different construction methods. General terrain types include 1) shallow alpine muskeg, 2) deep muskeg, 3) steep hillsides and 4) existing logging roads over mixed terrain. These features are roughly shown in Figure 2.

Shallow Alpine Muskeg

Shallow alpine muskegs are typically less than 5 feet thick and often directly overlie bedrock or thin mineral soils over bedrock (Appendix A- Photo 4-5). Construction across these areas will require removal and wasting of the organic rich overburden to expose mineral soil or bedrock. In some cases rock cuts or subgrade blasting will be required depending on the final grades. Any side hill fills placed should not toe out on these muskeg deposits, creating potential of failure or long term subsidence along the shoulder of the road.

Deep Muskeg

Deep muskeg deposits range widely in thickness from 5 feet to greater than 12 feet and overlie different types of mineral soils and bedrock (Appendix A- Photo 6-7). No information as to the suitability of the underlying soils has been collected, but regional experience suggests they will be very high in silt content, including glacial deposits and silty sands with gravel deposited in lake or stream settings. Construction across these deep muskegs could require deep over-excavation of the organic soils down to firm mineral soil, which will generate large quantities of waste. Inventive methods for wasting the organics could help reduce costs and negate the requirement for excavation waste storage areas. These might include creating landscaped mounds in suitable areas outside the limits of any proposed future widening of the roadway.

If complete removal of the organic deposits is not practical, a gravel surfaced road could be considered. The gravel option could be constructed on top of the existing muskeg deposits, but will settle significantly immediately after construction and experience long term differential settlement throughout the service life of the roadway requiring continual maintenance. As a general rule of thumb, the embankment will initially settle half the thickness of the embankment. To construct this type of roadway, the organic mat should be left intact as much as practical and corduroy or other logging road construction methods employed. The embankment should then be constructed over the organic mat or corduroy with 4 feet of Select Material, and 12 inches of combined subbase, base and surface course. If this construction method is selected and paving is planned for a later date, significant effort will be required to improve the strength of the embankment and make it suitable for pavement.

Steep Hillsides

Steep hillsides along the Option 5 corridor are commonly 30-40° (55-85% grades) and sometimes as steep as 45° (100% grades). They are a mixture of poor quality bedrock and occasionally thick mantels of silty rocky soils (Appendix A- Photo 8).

The soils are of two main types; 1) colluvium formed by the loose accumulation of talus and cliff debris and 2) residual soils formed in place by the complete decomposition of bedrock. Both types are typically silt rich and not suitable for road construction without some amount of processing (Appendix A- Photo 9-11). Colluvium deposits have the additional component of organic debris generated from small soil slides and tree fall. All soils should be cut at 2H:1V. In some instances soils may be cut steeper when properly treated with robust mitigation measures. These may include the use of anchored reinforcing mesh applied directly to the slope, armoring the slope with Class I rip rap, or retaining walls. Retaining walls are generally the least favorable option due to high cost and construction complexity. Retaining walls constructed on uphill cuts should be limited to types that minimize excavation along the toe of the slope.

The majority of the bedrock is very poor quality, pyrite rich, thinly foliated slate and phyllite. Exposed rock masses display steeply dipping, unfavorable structural discontinuities for rock cuts. Well developed clay seams up to 2 inches thick were observed in some outcrops (Appendix A- Photo 12-16). All rock cuts should be initially designed at 0.5H:1V. In some cases the cut heights may be sufficiently high or rock qualities may be poor enough to require the use of pattern rock dowels or tensioned rock bolts. A unit of better quality rock was observed in an existing quarry along the MHT road system just before Lake 360. This unit appears to be an altered volcanic or greenstone and should be better delineated in future geotechnical work to determine its possible use for base course or surface course materials (Appendix A- Photo 17). The quarry exposure showed a high degree of fracture along structural discontinuities that will dictate the cut slope angles for high cuts.

Existing Logging Roads

The midway section of the Option 5 corridor follows approximately 3.6 miles of existing MHT logging roads. They are single lane roads with turnouts, numerous short radius curves and grades typically up to 10% with some short stretches in excess of 15% (Appendix A- Photo 18). The embankment is constructed with locally quarried shot rock and excavated mineral soils. Break down of the shot rock from traffic loads has developed a silt rich driving surface. The thickness of the shot rock embankment section has been optimized to make efficient use of building materials. Main trunk roads have a slightly thicker section while those near the edges of the timber harvest areas have minimal sections. Where the ground is firm the embankment has been constructed directly over it. Otherwise a corduroy foundation built of low value timber and root wads has been placed beneath the embankment (Appendix A- Photo 19-20). In some areas where roads are no longer in use, the embankment materials are being removed and used to construct new roads in active harvest areas. The use of culverts has been minimized and the road embankment constructed allows surface water to pass directly through it. Rock cuts appear to be mostly 0.25H:1V with rough, unscaled faces. In some areas soil cuts are 1H:1V so they will daylight in the steep terrain. Where widening or realignment of the existing logging road is proposed, refer to mitigation measures discussed above in the "Steep Hillsides" section.

If the proposed road is to be paved, construction of new roads over the existing logging roads will require the removal of any existing embankment materials not meeting AKDOT specifications, and any corduroy materials down to firm mineral soil. The amount of subexcavation required is expected to vary considerably and should be further defined with subsequent geotechnical work as the design progresses. Large quantities of organic waste, logs and stumps will have to be wasted during the clearing and grubbing phase of construction.

An alternative to complete removal of unsuitable materials beneath the existing road section is to construct an improved embankment directly over it. This type of construction would present the potential for longer term settlement and ongoing maintenance issues. Paving immediately after construction is not compatible for this option. Design grades will have to be carefully balanced to eliminate complete removal of the existing embankment that would expose the weak soils below. Newly constructed embankments should be a minimum of 4 feet of select material and 12 inches of combined subbase, base and surface course over the existing embankment. Site specific recommendations for embankments can be developed with additional design level geotechnical investigation.

In special cases where the existing road crosses a steep hillside, and the existing embankment is not removed, it is recommended that a “buttress section” be constructed on the downhill side and benched into the slope in accordance with AKDOT specifications to prevent possible settlement or shoulder failure from occurring.

Structures

There are four creeks that may require major drainage structures to cross. These are located at an unnamed fish creek draining north into Leask Lake, at Leask Creek, the tributary draining north into Heckman Lake, and across an unnamed creek flowing southeast into Newt Valley. All locations are identified in Figure 2. An additional major structure may be required to cross the Wolf Lake Tributary if a route is selected that crosses the north side of Wolf Valley. Structures might include bridges, large structural multi-plate culverts, and large diameter metal pipes. Size, type and location of structure can be determined once finalized grades and alignments are selected.

SIGNIFICANT TERRAIN FEATURES

North Face of Harriet Hunt Ridge

The north face of the Harriet Hunt Ridge is characterized by steep, 30-45° slopes formed by slate and phyllite bedrock with a thin deposit of topsoil and some areas of colluvium. Several 20-50 feet deep, 30-80 feet wide, near vertically sided chasms cut the slope and drain into Wolf Valley (Appendix A- Photo 21). The chasms appear to have been developed by small drainages that cut into highly erodible soils or weak zones within the bedrock. These features do not show up well on the existing 1:63,360 USGS quadrangle maps. Crossing them will require very high fills, long culverts and possibly even short bridges if not crossed at optimum locations. Along the Option 5 corridor they appear to start abruptly at approximately 800 feet in elevation. Above 800 feet they appear to be insignificant and easily avoided. Obtaining additional LIDAR coverage in this area will help to delineate these features and allow design engineers to better avoid or optimize these crossings as much as possible. A variation of the current Option 5 alignment should be considered that follows the ridge on the west side of Wolf Valley and crosses the north end of Wolf Valley. This would reduce the length of the alignment that traverses the steep north face of the Harriet Hunt Ridge and reduce the number of chasms that have to be crossed.

Wolf Valley and Heckman Lake Valley

These valleys contain very deep peat, in some places greater than 12 feet. Extensive peat probing should be conducted along proposed corridors across these valleys in an effort to identify areas of shallow peat. When possible the selected alignment should be located across areas of shallow peat to minimize subexcavation quantities and waste disposal required during construction.

Leask Creek Crossing

Leask Creek divides the two MHT logging road systems that will be used as part of the Option 5 corridor (Appendix A- Photo 22). The crossing was not investigated during this field effort, but an interview with a local expert indicates that the best crossing option is near the currently proposed crossing shown in Figure 2. Obtaining LIDAR or ground survey information will help to optimize the crossing.

Lake 360

Lake 360 is the elongated lake approximately 1 mile northeast from the smaller of the Leask Lakes. It is at elevation 360 feet and lies at the base of a very steep hillside (Appendix A- Photo 23). This is a narrow choke point to gain access to the Heckman Lake valley. The proposed Option 5 corridor will fall somewhere between the lake shore and the existing logging roads. Depending on the exact location, high cuts may be required. The existing road is a bench cut in the slate bedrock with a sidecast fill supporting the shoulder (Appendix A- Photo 24-25). This sidecast fill will need to be stabilized if the Option 5 road cut daylights below it.

Heckman Lake Tributary Crossing

Once the Option 5 corridor enters the Heckman Lake valley it must eventually cross the tributary that flows northwesterly down its center. The creek is generally 10-20 feet wide, 1-3 feet deep and low to moderate flow rate. However, the crossing is complicated by the complex network of overflow channels, beaver ponds and deep muskeg flanking both sides of the creek (Appendix A- Photo 26). An attempt to traverse the banks of the creek was abandoned due to the difficulty of navigating the beaver ponds. Careful survey or detailed LIDAR will be needed to locate the optimum crossing for this creek.

Newt Valley

Newt Valley is a narrow, steep-sided valley notable for the lakes, beaver ponds, creeks and marshy ground filling the valley floor (Appendix A- Photo 27). To the extent reasonable, construction through this valley should be limited to the steep side slopes. Numerous benches along the slope should allow uphill cuts to daylight within reasonable limits. Care should be taken to eliminate any fills from toeing out in the mostly soft organics in the valley floor. Where it is impractical to avoid such fills, field confirmation of ground conditions at these locations will be required to ensure adequate bearing capacity. No traverse was completed along the north side of the valley. If further refinement of the corridor along the south slope proves difficult, exploring the north side of the valley may be helpful.

SUMMARY OF PLANNING LEVEL DESIGN GUIDELINES

- Construct cuts in mineral soil at 2H:1V
- Where soil cuts must be made steeper than 2H:1V or are in organic soils consider
  - anchored reinforcing mesh
  - raising the grade to reduce slope height
  - armoring the slope with Class I rip rap
  - gravity, concrete cantilever or pile and lagging retaining walls
- Construct rock cuts at 0.5H:1V
- Where rock cuts are steeper than 0.5H:1V and/or higher than 50 feet, consult with geotechnical staff for rock cut recommendations
- Excavate all soft and/or organic soils down to firm mineral soil and replace with Select materials as allowed by AKDOT specifications. This includes corduroy materials in existing logging roads
- Where over excavation of existing corduroy materials, soft and/or organic soils is not practical, construct a minimum embankment of 4 feet of Select material and 12 inches of subbase, base and surface coarse over the existing subgrade. Paving is not recommended for roads constructed in this manner
- Construct all side hill fills at 2H:1V and in accordance with AKDOT specifications