MOUNTAIN AIR DRIVE/HILLSIDE DRIVE EXTENSION
MOA PM&E #08-019

DRAFT DESIGN STUDY REPORT

January 2011

Prepared for:

Municipality of Anchorage
Project Management and Engineering
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SUMMARY

This Design Study Report was completed for the Municipality of Anchorage to determine how best to provide a collector road connection from Rabbit Creek Road to the undeveloped residential parcels between Goldenview Drive and Bear Valley. The extension of Mountain Air Drive or Hillside Drive has been identified in the current Anchorage Bowl 2025 Long Range Transportation Plan, the Official Streets and Highways Plan, and the Hillside Subarea Transportation Study as a necessary route for access and egress to the southeast portion of the Anchorage Hillside.

Three build alternatives were identified and analyzed. Alternative A would extend Mountain Air Drive south past Bear Valley Elementary, jog east, bridge Little Rabbit Creek, and connect with the existing 155th Avenue right of way (ROW). Alternative B would follow the existing Mountain Air Drive ROW around Bear Valley Elementary to the existing Hillside Drive ROW. It would then turn south and end at the existing 155th Avenue ROW. Alternative C would construct 149th Avenue between Mountain Air Drive and Hillside Drive, and then extend Hillside Drive south to the existing 155th Avenue ROW.

Based on the results of our analyses, Alternative A is the recommended alternative. This alternative requires the shortest amount of road construction, avoids impacts to area wetlands, and provides the most direct connection between Rabbit Creek Road and planned subdivisions south of Rabbit Creek.

TABLE OF CONTENTS

TABLES AND FIGURES

Tables

Figures

APPENDICES

ACRONYMS

AASHTO ....American Association of State Highway Transportation Officials
ACS..........................Alaska Communication System
ADT ....Average Daily Traffic
ARDSA ....Anchorage Roads and Drainage Service Area
ATP..........................Areawide Trails Plan
ATV ....All Terrain Vehicle
CEA..........................Chugach Electric Association
DCM ....Design Criteria Manual
DSR ....Design Study Report
HDP ....Hillside District Plan
LRTP ....Long Range Transportation Plan
mph.........................Miles per Hour
MOA........................Municipality of Anchorage
OSHP ....Official Streets and Highways Plan
PLI ....Public Lands and Institutions
PM&E ....Project Management and Engineering
ROW........................Right of Way
USKH ....USKH Inc.

1 INTRODUCTION

This Design Study Report (DSR) was prepared to document and summarize the engineering analyses for the proposed extension of Mountain Air Drive between Rabbit Creek Road and the Shangri-La subdivision, as shown in Figure 1. The proposed project is in the Hillside area of the Municipality of Anchorage (MOA). The project has been funded through a grant from the State of Alaska and is being administered by the MOA Project Management and Engineering (PM&E) department. USKH Inc. (USKH) has been contracted to develop the DSR and prepare construction contract documents for the recommended alternative.

1.1 Background

South of the proposed project exist 550 acres of undeveloped land zoned for rural residential use. Development in this area has been progressing from the west, with vehicular access from Goldenview Drive. When the Shangri-La East Subdivision was annexed into the South Goldenview Limited Roadway Service Area, developers planned to build a road north to Rabbit Creek Road and not use existing service area roads for access between Goldenview Drive and their developments. The connection to Rabbit Creek Road was never built, and subdivision traffic has taken its toll on 162nd Avenue and Sandpiper Road. These local roads lack the width, subgrade strength, drainage, and regular maintenance required to serve the volumes of traffic they are now seeing.

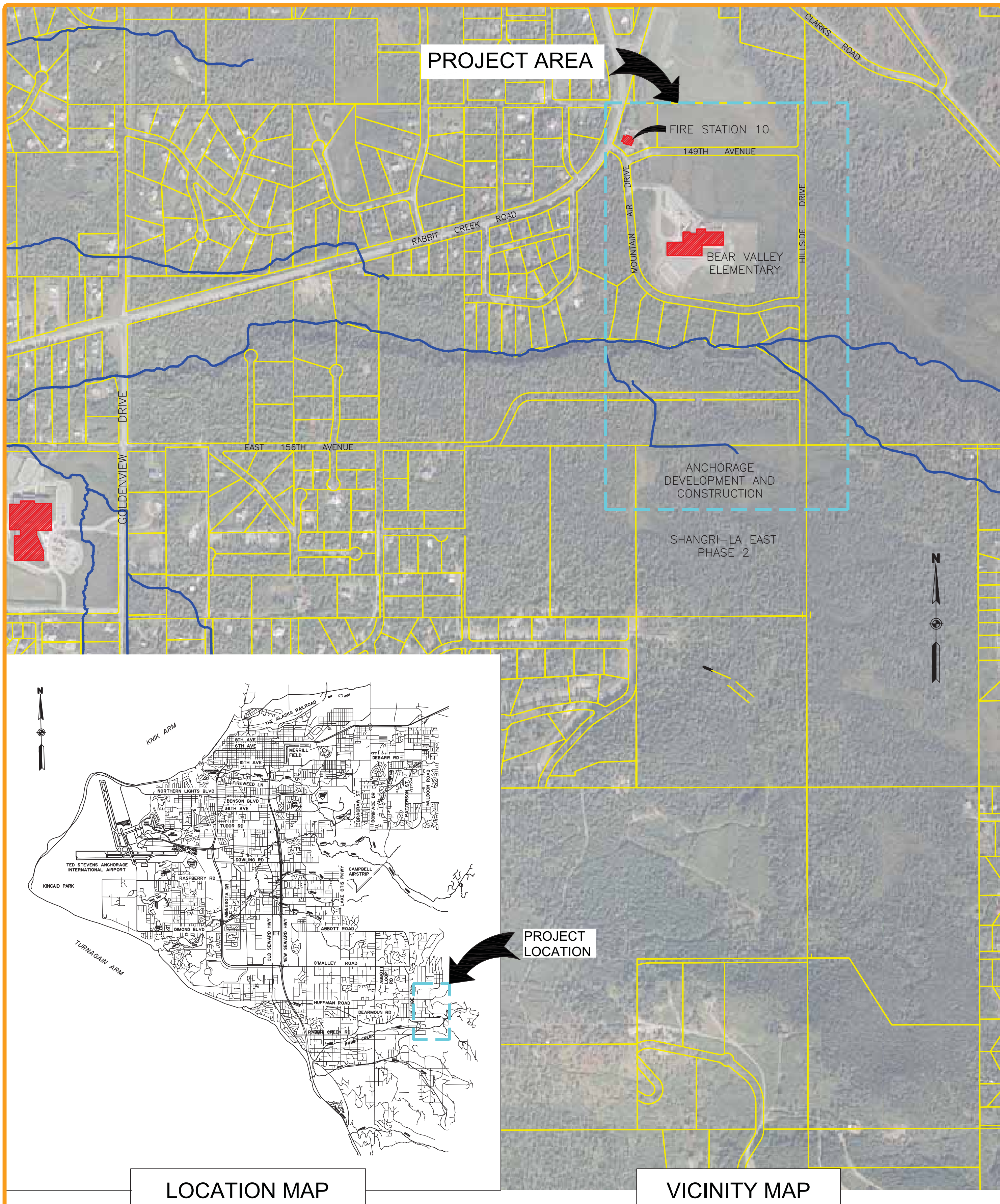
USKH was retained by the MOA Traffic Department in 2005 to conduct a subarea transportation study covering the 550 acres. The plan analyzed internal circulation and external site access. One of the recommendations to come out of the plan was to extend Mountain Air Drive into the Study Area south of 155th Avenue as a collector road. This recommendation coincided with the Anchorage Bowl 2025 Long Range Transportation Plan (LRTP) and the 2005 amendment to the MOA Official Streets and Highways Plan (OSHP), which identifies Mountain Air Drive as a class IB collector.

The MOA Platting Board approved a re-plat of the Shangri-La East Subdivision in 2006 subject to numerous conditions. During the public hearing, the Board heard testimony regarding the cumulative impact of the proposed development on the local roads and drainage systems. As a result, a primary condition of the re-plat required that the funding for the design and construction of Mountain Air Drive and a portion of the Hillside Drive Extension be obligated prior to the recording of the final plat. This extension was deemed necessary before additional lots could be developed in the area. Since that time, significant amounts of grassroots lobbying and legislative support have gone into securing funding for this project. A legislative grant was provided to MOA during the 2008 legislative session.

1.2 Project Objectives

Objectives of this project include:

- Provide access to residential developments between Bear Valley and Goldenview Drive as recommended by the Hillside Subarea Transportation Study and the Hillside District Plan (HDP)
- Provide emergency vehicle access and disaster egress
- Mitigate project impacts to area drainage
- Provide safe non-motorized access to Bear Valley Elementary School
- Minimize construction and maintenance costs



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LOCATION AND VICINITY MAP

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MOUNTAIN AIR DRIVE/HILLSIDE DRIVE EXTENSION
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PROJECT MANAGEMENT AND ENGINEERING #08-019

MOUNTAIN AIR DRIVE extension

FIGURE

1

FILE: I:\1122900\REPORTS\DSR\GRAPHICS\1122900_FIG-1.DWG PLOTTED: Nov 10, 2010 - 11:15:44 AM

2 EXISTING CONDITIONS

2.1 Existing Facilities

Mountain Air Drive currently exists as a paved road between Rabbit Creek Road and the Bear Valley Elementary School driveway, which is a distance of about 400 feet. In this area, the Mountain Air Drive pavement width is about 30 feet wide with no posted speed limit. Mountain Air Drive is stop controlled at Rabbit Creek Road, and the intersection is illuminated. No storm water facilities exist along the corridor. No pedestrian facilities exist along the corridor.

The Mountain Air Drive right of way (ROW) is 60 feet wide, and extends from Rabbit Creek Road around the west and south sides of Bear Valley Elementary School to the section line easement that would be Hillside Drive if it were extended, for a total length of 2,400 feet. A trail has been cleared through the corridor over the years, presumably for installation of Chugach Electric Association (CEA) and Alaska Communication System (ACS) underground cables. The trail appears to be used by locals for hiking and all terrain vehicle (ATV) use.

Rabbit Creek Road is owned and maintained by the State of Alaska DOT&PF and is classified as a residential collector at the intersection with Mountain Air Drive. This two lane road with paved shoulders terminates at the Old Seward Highway to the west and Hillside Drive to the east. Turn lanes have been constructed at major intersections, and the posted speed limit is 45 miles per hour (mph).

Access to the undeveloped residential parcels south of Rabbit Creek Road in the project area is via Goldenview Drive to the west and Clark Road to the east, which are about a mile apart.

2.2 Land Use

Zoning in the area consists of rural residential and Public Lands and Institutions (PLI). The residential zones (R6, R7, R9, R10) are generally referred to as rural residential and allow no more than 2 dwelling units per acre. The residential lands adjacent to the project area are vacant.

PLI is the zoning designation for schools, parks, fire stations, and other civic facilities. Existing PLI facilities in the project area include Bear Valley Fire Station, which is located in the northeast corner of the Rabbit Creek Road/Mountain Air Drive intersection; Bear Valley Elementary School, located east of Mountain Air Drive; and Storck Park, located north of Mountain Air Drive.

2.3 Traffic

Currently, the only traffic on Mountain Air Drive is traffic going to or from Bear Valley Elementary School. Counts conducted by USKH staff in September of 2009 indicate that Mountain Air Drive serves 151 vehicles during the AM peak hour and 189 vehicles during the PM peak hour. Four percent of this traffic was heavy vehicles, in the form of busses. Operations at the Rabbit Creek Road/Mountain Air Drive were within acceptable limits for both the AM and PM peak hour, Level of Service B in both cases. Crash data was collected from the DOT&PF, which indicated that crash rates at the intersection are within normal ranges. The traffic analysis memo developed for this project is included as Appendix D.

2.4 Geotechnical Conditions

A limited geotechnical reconnaissance was conducted in the project area to identify likely road structural section depths. Surface organics were found to be generally 1 to 2 feet thick and up to 7 feet in places. Till-like materials are expected beneath the surface organic layer. Till-like materials can vary greatly and are expected to be moderately to extremely frost susceptible.

The project area is in an area of moderate seismic ground failure susceptibility, but large scale ground failures are not expected in the project area.

The Preliminary Geotechnical Report is attached as Appendix A.

2.5 Environmental Conditions

The proposed project will cross Little Rabbit Creek, which is an anadromous stream (Number 247-60-10320-2020). In particular, this reach supports resident Dolly Varden. Road crossings will need to be designed to accommodate fish passage and minimize impacts on the riparian corridor.

Mapped wetlands exists along the North Fork of Little Rabbit Creek where it crosses the Hillside Drive ROW. Observations made during a site visit conducted by USKH staff in July 2009 indicated that the wetland may have been drained since it was mapped. No unmapped wetland areas were observed during the site visit.

The environmental field trip report is attached as Appendix B.

3 PUBLIC INVOVLEMENT

Public Involvement is an important aspect of project development necessary to ensure successful implementation of the project. Public involvement for the project to date has included an agency scoping meeting and presentations to the Rabbit Creek and Bear Valley Community Councils and the South Goldenview Road Service Area board. In addition, an Open House was held in October and a project newsletter was distributed. Notes taken at those events are included in as Appendix C. Additionally, a project website has been developed (www.mountainairdrive.com) to provide public access to design documents and reports and enable the public to submit comments and feedback on the project.

Individual meetings were also held with the most affected property owner and their engineering representative.

In general, area residents and land owners have been supportive of the project. Some of the more persistent issues brought up in the public meetings include:

- Consistently low support for Alternative C, due to wetlands and school impacts
- Access to and parking for Bear Valley Elementary School is not adequate for the traffic demands
- Emergency access is a main purpose of this project
- The intersection of Rabbit Creek Road and Mountain Air Drive has limited sight distance and as traffic volumes increase safety will become a greater concern
- Concern for students walking the elementary school

Future public involvement opportunities will include a newsletter and public hearings with the Urban Design Commission and the Planning and Zoning Commission. These will occur as the project design is developed.

4 DESIGN CRITERIA

Design criteria for streets constructed within the MOA are listed in the Design Criteria Manual (DCM). The design criteria given in Table 1 apply to Mountain Air Drive, given the rural setting and the Residential Collector classification.

Table 1 - Design Criteria

Design Element	Design Criteria	Reference
Travel Lane Width	11 ft	DCM Table 1-4
Shoulder Width	4 ft	DCM Table 1-4
Design Speed	35 mph	DCM Table 1-4
Posted Speed	30 mph	DCM Table 1-4
Sidewalk/Multi-Use Paths Width	8 ft	DCM Table 1-4
Minimum Grade (new construction without curb & gutter)	1.0%	DCM 1.9 D.2.a
Maximum Grade (desirable) – for hillside area with projected 2000 or greater ADT	8.0%	DCM 1.9 D.2.c.1
Cross Slopes - Tangent Sections	2.0%	DCM 1.9 D.3
Cross Slopes - Superelevated Sections (max)	6.0%	DCM 1.9 D.3
Maximum Grade Break Algebraic Difference with no Vertical Curve	1.0%	DCM 1.9 D.4
Vertical Curve Separation	25 ft	DCM 1.9 D.4
Sag Vertical Curve Separation	25 ft	DCM 1.9 D.4
Cut and Fill Slopes	2:1	DCM 1.9 D.5
Stopping Sight Distance	250 ft	DCM Fig. 1-16/2004 Green Book (Exhibit 3-72)
Rate of Vertical Curvature (crest)	29.0	2004 Green Book (Exhibit 3-71 & 3-72)
Rate of Vertical Curvature (sag)	49.0	2004 Green Book (Exhibit 3-75)
Horizontal Curve Minimum Radius (maximum superelevation of 6.0%)	340 ft	2004 Green Book (Exhibit 3-26)
Horizontal Curve Minimum Radius (no superelevation)	4,100 ft	2004 Green Book (Exhibit 3-26)
Intersection Sight Triangle (distance measured along intersecting roadway)	390 ft	DCM Fig. 1-20/2004 Green Book (Exhibits 9-55 & 9-58)
Clear Zone Requirements Foreslopes 1V:6H 1V:5H – 1V:4H 1V:3H Backslopes (All)	 12 ft – 14 ft 14 ft – 16 ft Avoid 12 ft – 14 ft	AASHTO Roadside Design Guide (Table 3.1)

5 DESIGN ALTERNATIVES

5.1 No Build

The no build alternative consists of making no changes to the area transportation system. This alternative would have no impacts and no construction costs, but would not satisfy the project objectives. Therefore, this alternative was dropped from consideration.

5.2 Alternative A

Alternative A consists of constructing a new road from the existing end of Mountain Air Drive south along the existing, platted ROW to the southwest corner of the Bear Valley Elementary School site. At this point the road would jog to the east and continue south across Little Rabbit Creek and intersect with the platted 155th Avenue. In total, this alternative would require construction of approximately 1,900 feet of road and include a bridge crossing at Little Rabbit Creek.

Benefits of this alternative include no wetland impacts, less road to construct, less out of direction travel for road users, and one creek crossing. The alignment provides the most direct route to the planned extension of the roadway on the south side of the Little Rabbit Creek. The extension of a primary road south of Little Rabbit Creek is identified in the HDP (Map 4.1) and occurs approximately 800 feet west of the Hillside Drive alignment. Alternative A will require acquisition of a portion of two parcels and a 129-foot long bridge structure.

5.3 Alternative B

Alternative B consists of constructing a new road from the existing end of Mountain Air Drive along the existing, platted ROW to the Hillside Drive ROW. From there, Hillside Drive would be constructed south to the platted 155th Avenue. In total, this alternative would require construction of approximately 2710 feet of road and include crossing 2 forks of Little Rabbit Creek.

Benefits of this alternative include access to more adjacent parcels, fewer ROW needs, and makes use of existing platted rights-of-way. In addition, the structures necessary to cross Little Rabbit Creek would be less expensive than a large bridge structure.

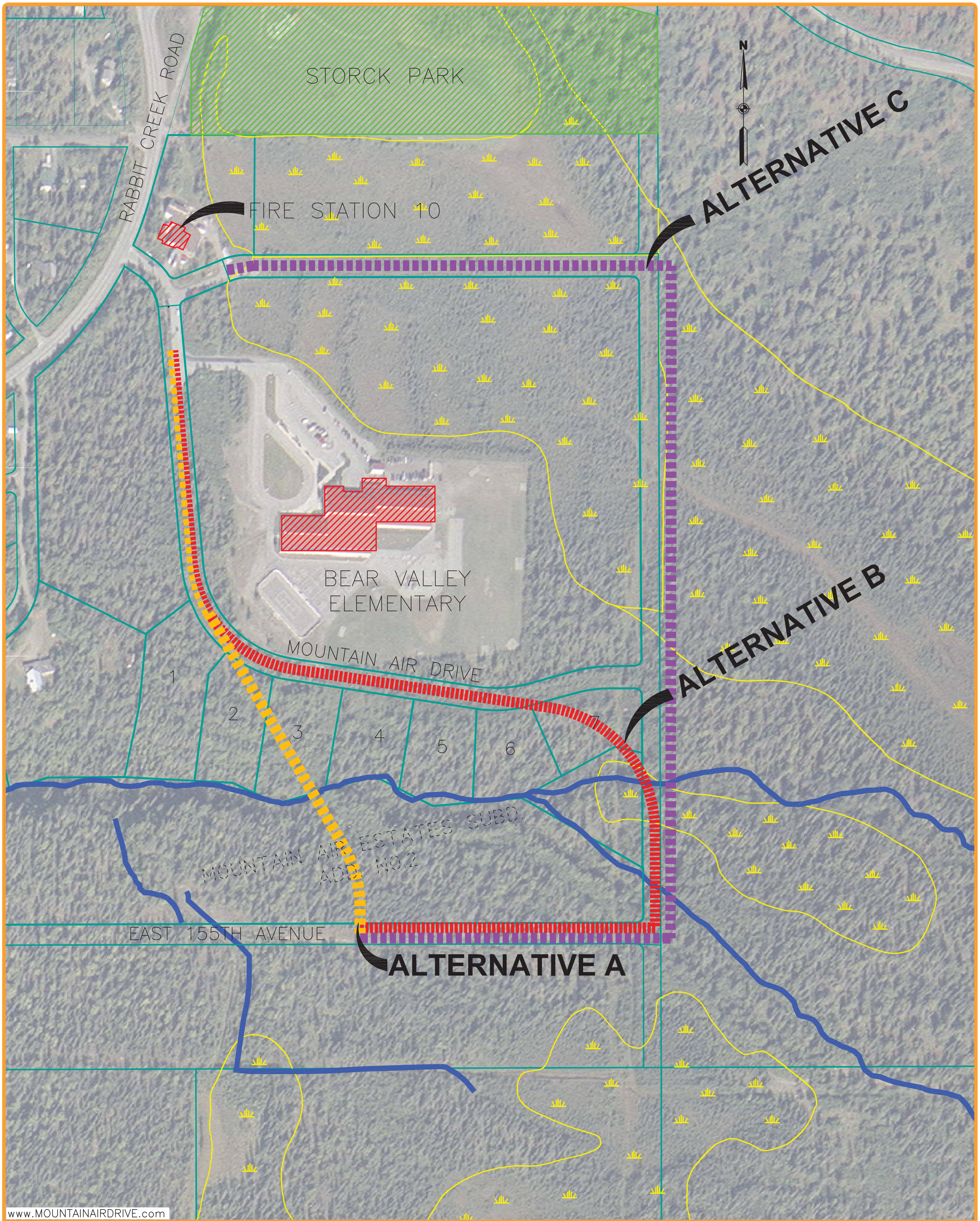
Unfortunately, Alternative B is longer and, in order to build the road to the recommended design speed, Alternative B will impact more parcels of land than other alternatives. The alignment crosses Class A wetlands near the Little Rabbit Creek crossings, which will require mitigation. Alternative B will require constructing approximately 800 feet of East 155th Avenue west from the south end of the Hillside Drive alignment in order to get to the access point for future residential subdivisions to the south.

5.4 Alternative C

Alternative C consists of constructing 149th Avenue between Mountain Air Drive and Hillside Drive. Hillside Drive would then be extended from 149th Avenue south to 155th Avenue. Most of this road would be built on land identified as wetlands. Also, officials at Bear Valley Elementary were concerned that this alignment would hinder the connectivity between the school and the existing park land to the north and east. Since this alignment has similar benefits to Alternative B, which will require constructing approximately 800 feet of East 155th Avenue west from the south end of the Hillside Drive alignment in order to get to the access point for future residential subdivisions to the south. With additional detrimental aspects, it was dropped from further consideration.

5.5 Recommended Alternative

Alternative A is the recommended alternative. This alternative provides the most direct way to meet the access needs of the residential developments between Bear Valley and Goldenview Drive. This alignment alternative will terminate at the northern boundary of the Shangri-La East subdivision where a future primary roadway extension will continue south as depicted in Map 4.1 of the HDP. The location of the roadway access into Shangri-La East subdivision runs between large pockets of mapped wetlands and regulatory agencies have been clear in their objection to impacting these wetlands. Proceeding with Alternative A will avoid unnecessarily constructing road east to the Hillside Drive alignment, only to bring the road back to the west for access to Shangri-La East and subdivisions to the south. With Alternative A, construction of any portion of the East 155th Avenue is not necessary in the short term to meet project objectives. The three alignment alternatives are shown on Figure 3. Preliminary plan and profile sheets for Alternatives A and B are included in Appendix F.



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ALTERNATIVES
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MOUNTAIN AIR DRIVE extension

FIGURE
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6 DESIGN RECOMMENDATIONS

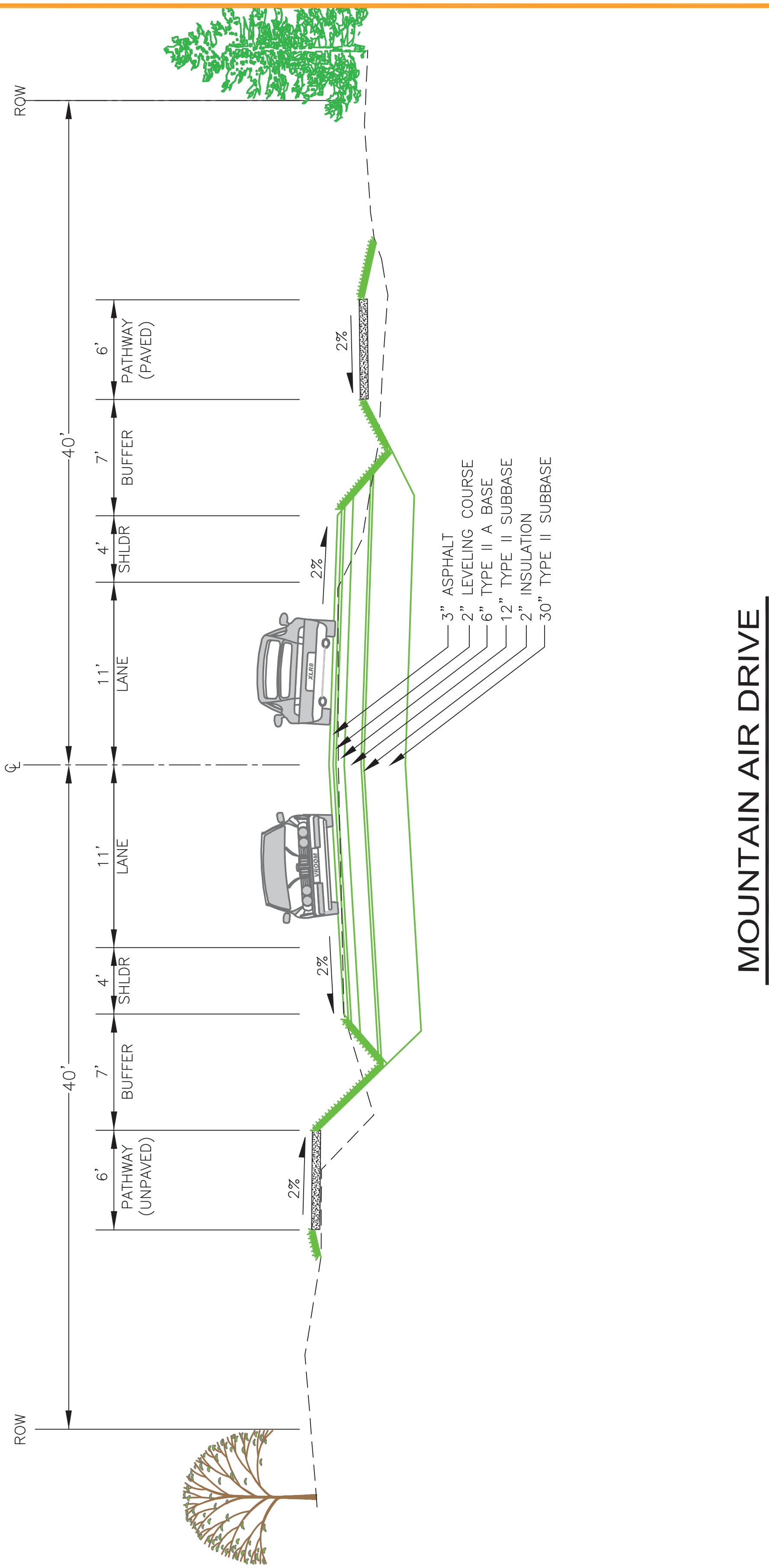
6.1 Non-Motorized Transportation

A non-motorized transportation plan is currently under development for the Anchorage area. In the interim, the HDP has a trails section and recommends a trail along the Mountain Air Drive corridor. This is consistent with the typical section recommendations in the DCM and would provide a connection to the proposed trail network in the Hillside Subarea Transportation Study. MOA Title 21.850 requires that streets with traffic volumes above 1,000 vehicles per day have pedestrian facilities on both sides. This is consistent with comments received from the Anchorage School District and supports the “safe non-motorized access” objective of the project. No surfacing guidance is given in the current documents, but the 1997 Areawide Trails Plan recommended a gravel trail along this corridor, to accommodate equestrians and maintain the rural character of the area. It is recommended that the east side pathway should be paved and the west side pathway should be unpaved. The paved pathway will likely receive more use and putting it on the east side will provide a better connection to BVES.

The 2009 Draft Anchorage Bicycle Plan does not list any proposed commuter bicycle facilities along the project corridor. It does include a general recommendation that “new road construction projects incorporate bicycle infrastructure”. The 4 foot shoulders recommended by the DCM can also function as a paved shoulder bikeway, which fulfills the need for bicycle infrastructure. In areas where guardrail or curb is installed, the shoulder width must be increased to 5 feet (to face of curb or guardrail) to provide continuous bicycle facilities.

6.2 Typical Section

Given the findings of the geotechnical reconnaissance, a structural section was developed using the Limited Subgrade Frost Protection method. The resulting structural section, along with the typical section characteristics, is shown in Figure 3.



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TYPICAL SECTION

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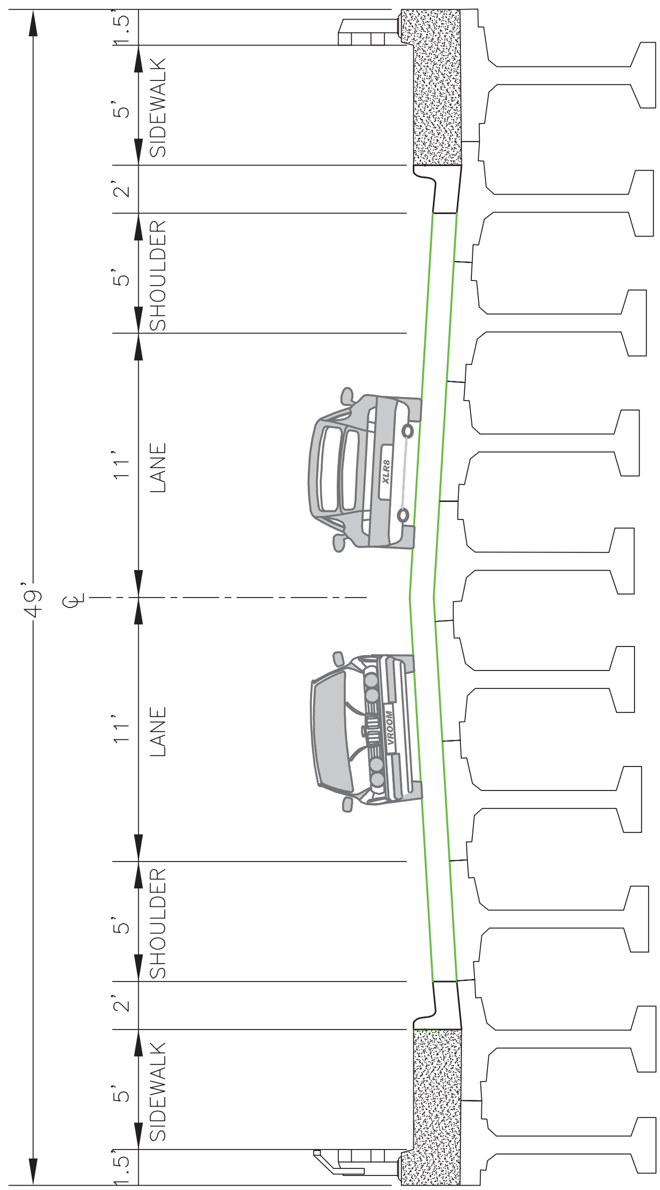
FIGURE

3



TYPICAL SECTION

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BRIDGE TYPICAL SECTION

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FIGURE

4

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6.3 Traffic

The Hillside Subarea Transportation Study estimated that Mountain Air Drive will experience an average daily traffic (ADT) volume of 1,570 when the vacant residential lands south of Mountain Air Drive are fully developed. The proposed two lane road section is adequate to accommodate this volume of traffic. The expected traffic will overwhelm the capacity of the Rabbit Creek Road/Mountain Air Drive intersection by the design year, and probably as soon as 2019. To accommodate all of the design year traffic, a traffic signal or single lane roundabout will be needed. An evaluation of the needs for the intersection and a recommended alternative to handle the future volumes is discussed in Chapter 9.

6.4 Drainage

Research, investigations, and calculations were performed to quantify the hydrology and hydraulics necessary to prepare concept-level plans for crossings of Little Rabbit Creek and the North Fork of Little Rabbit Creek and to provide storm water management for roadway runoff in order to meet local, state and federal water quality standards. Alternative A results in a shorter roadway and will require a single bridge crossing of Little Rabbit Creek. Alternative B requires two creek crossings with either precast concrete 3-sided boxes or multi-plate arches.

For both alternatives, infiltration of runoff is promoted through the use of filter strips, grassed bioinfiltration swales, check dams, infiltration trenches, and level spreaders. These storm water management improvements, along with rock flumes at the crossings, will provide the appropriate level of treatment for storm water discharges. Addressing hillside drainage concerns and soils conditions will necessitate additional cross-culverts through the roadway prism in the final design to prevent glaciation and maintain existing drainage patterns. The estimated storm water management costs for Alternative A are $217,000 and Alternative B are $280,000. These costs do not include the creek crossings, since those have been accounted for in the Structures section.

6.5 Structures

Since both alternatives cross Little Rabbit Creek, some means of conveying the creek under the road will be necessary. An analysis of crossing structures was completed using the current proposed vertical and horizontal alignments, the existing topographical information, and the 100 year flood levels for Little Rabbit Creek.

A single 129-foot long single span concrete bridge was recommended for Alternative A. Retaining wall abutments would need to be constructed to limit the crossing length to 129 feet. Since the original bridge selection report was completed, more detailed design and field measurements have resulted in the use of a shorter, 95 foot long bridge. The total cost for the retaining walls and bridge is estimated to be $1,968,000.

Two 38.5-foot long steel multi-plate arches were recommended for Alternative B, one for each fork of the creek. The total cost for these structures is estimated to be $1,034,000.

The Bridge Selection Report is attached as Appendix G.

6.6 Illumination

The DCM illumination chapter states that “the primary goal of lighting is to enhance traffic and pedestrian safety.” Recommended light levels are given for the different road classifications, but no system of warrants is given to justify whether or not to install a lighting system. We received comments from the public opposing lighting the entire corridor because of a desire to maintain the rural character of the area, to minimize light pollution, and to be more consistent with the other roads in the area. In an effort to achieve the safety goal of lighting systems, respect the desires of the public, and meet the project budget, this project should be designed for lighting only at vehicular conflict points (intersections).

The DCM criteria recommend lighting intersections at collector/local road intersections (the intersections along this project excluding Rabbit Creek Road) to a level of 1.0 foot candles, with an average-to-minimum foot candle ratio of at most 4.0. A continuous lighting system, if constructed, should be designed using the luminance method, with an average luminance of 0.4 candela, an average-to-minimum candela ratio of at most 4.0, a maximum-to-minimum candela ratio of at most 8.0, and a maximum veiling luminance ratio of 0.4.

6.7 Access Control

As a collector street, Mountain Air Drive must serve both accessibility and mobility needs. As such, it is not reasonable to require full access control, nor would it be reasonable to allow continuous driveways. Parcels that front both Mountain Air Drive and a local road should have driveway access to the local road. Driveways onto Mountain Air Drive should conform to the MOA's "Municipal Driveway Standards" Memorandum, dated December 11, 2006.

7 IMPACTS

7.1 Environmental

Alternative A will not impact any wetlands, so no environmental mitigation would be required. This is true for all of the North Improvement options.

Alternative B will impact wetlands between the north fork and main branch of Little Rabbit Creek. Corps of Engineers methodologies assume wetlands extend to 85 feet on either side of each creek crossing. In addition, there are mapped Class A wetlands between the two forks of Little Rabbit Creek that would be impacted by Alternative B. To offset the impacts to these wetland areas, Alternative B will require wetland credits be obtained. This translates to a fee of $640,000. Exact wetland boundaries need to be identified, and it is not yet clear what kind of credits the project may get for using pipe arches rather than full culverts for the creek crossings.

7.2 Right of Way

The existing ROW platted for Mountain Air Drive is 60 feet wide and 50 feet wide for Hillside Drive. The DCM recommends 70 feet of ROW for Class IB collectors. To accommodate the road width, two paths, drainage facilities, and slope limits, the ROW width will need to be 80 feet. ASD has indicated it would be possible to obtain ROW from BVES, provided it does not impact the site use. Additional ROW would need to be purchased from private land owners adjacent to the project. The value of land is assumed to be $0.85 per square foot, based on the MOA's online assessment data.

Table 2 – ROW Needs

Alternative	BVES Land	Private Land	Notes
Alternative A	16,750 SF	118,750 SF	Assumes Lots 2 and 3 can be replatted with the adjacent lots
Alternative B	34,000 SF	62,850 SF	

Alternative A will require acquisition of Lots 2 and 3, Block 8, Mountain Air Estates Subdivision Addition No. 2. The square footages listed in Table 2assume that some portion of those lots can be replatted with adjacent lots and not be fully acquired by the project. Additionally, small portion of Lot 1 and an 80 foot by 400 foot corridor from Tract F-1 and an 80 foot by 350 foot corridor from Tract G-1 will be required. Overall, Alternative A would require approximately 135,500 square feet of additional ROW, with the approximate value of private land required being $101,000.

For Alternative B, the strip takes along the existing Mountain Air Drive ROW would add up to 16,000 square feet. The curve at the Hillside Drive/Mountain Air Drive intersection would need room to be flattened, which would require a complete acquisition of Lot 7, Block 8 of Mountain Air Estates Subdivision Addition No 2, 3,000 square feet from Lot 6, and 1,500 square feet from Tract E-1. Finally, the Hillside Drive ROW would need to be widened from 50 feet to 80 feet between Mountain Air Drive and 155th Avenue. This additional ROW, 30 feet by 450 feet, could be obtained from the Section 36 Park for just the administrative costs.

Overall, Alternative B would require approximately 97,000 square feet of additional ROW, with the approximate value of private land required being $54,000. It may be possible to replat Lots 6 and 7 to minimize the overall land obtained by the project.

7.3 Utilities

Existing utilities in project area are minimal. The underground utilities currently in place along Mountain Air Drive may be exposed where the extension crosses them, and it is possible a transformer may need to be relocated if it is in the way. This applies to both Alternatives A (all options) and B and would cost approximately $25,000. Alternative B would be constructed alongside the existing overhead utility lines in the Hillside Drive ROW. CEA estimates that the utility poles have been installed 33 feet off of the section line, which would provide enough room for the road to be constructed without requiring the poles to be relocated.

8 CONSTRUCTION COSTS

Estimated construction costs for Alternatives A and B are shown in Table 3. Costs listed are estimated for 2010 construction. ROW costs have been multiplied by 2 to account for ROW acquisition administrative costs.

Table 3 - Cost Estimate

	Construction	Contingency	Construction Engineering/ Admin.	Utilities	ROW	Wetland Mitigation	Total Construction Cost
Alternative A /Option 1– No North Improvements	$3,594,000	$719,000	$540,000	$25,000	$210,000	$0	$5,088,000
Alternative B*	$3,258,000	$652,000	$489,000	$25,000	$110,000	$640,000	$5,174,000

* This estimated construction cost does not include construction of 800 linear feet of roadway along 155th Avenue that would be necessary to meet up with the proposed road from Shangri-La East.

9 RABBIT CREEK ROAD CONNECTION

As originally envisioned, any new construction for Mountain Air Drive would simply extend south from the existing Mountain Air Drive. However, the existing portion of road does not meet the design criteria for collector roads. In addition, local residents and agency stakeholders expressed concern with the potential traffic congestion at the intersection of Mountain Air Drive and Rabbit Creek Road. So, following the April 2010 draft submittal of this report, the scope of the project was expanded to include improvements to the Mountain Air Drive/Rabbit Creek Road intersection, including meeting collector road design criteria up to Rabbit Creek Road.

9.1 Improvement Options

Three alternative routes were considered for connecting Mountain Air Drive with Rabbit Creek Road: no-build, increased the northern most curve to meet design criteria, and re-route to Sierra Way. In addition, 3 alternative intersection improvement options were considered: no-build, construct turn lanes, and construct a roundabout. Since any one of the intersection improvement options could be combined with any one of the realignment alternatives, they are presented for separate consideration in this section of the report.

9.1.1 Realignment Options

The realignment options listed below are shown on Figure 5.

Option 1 - No North Improvements

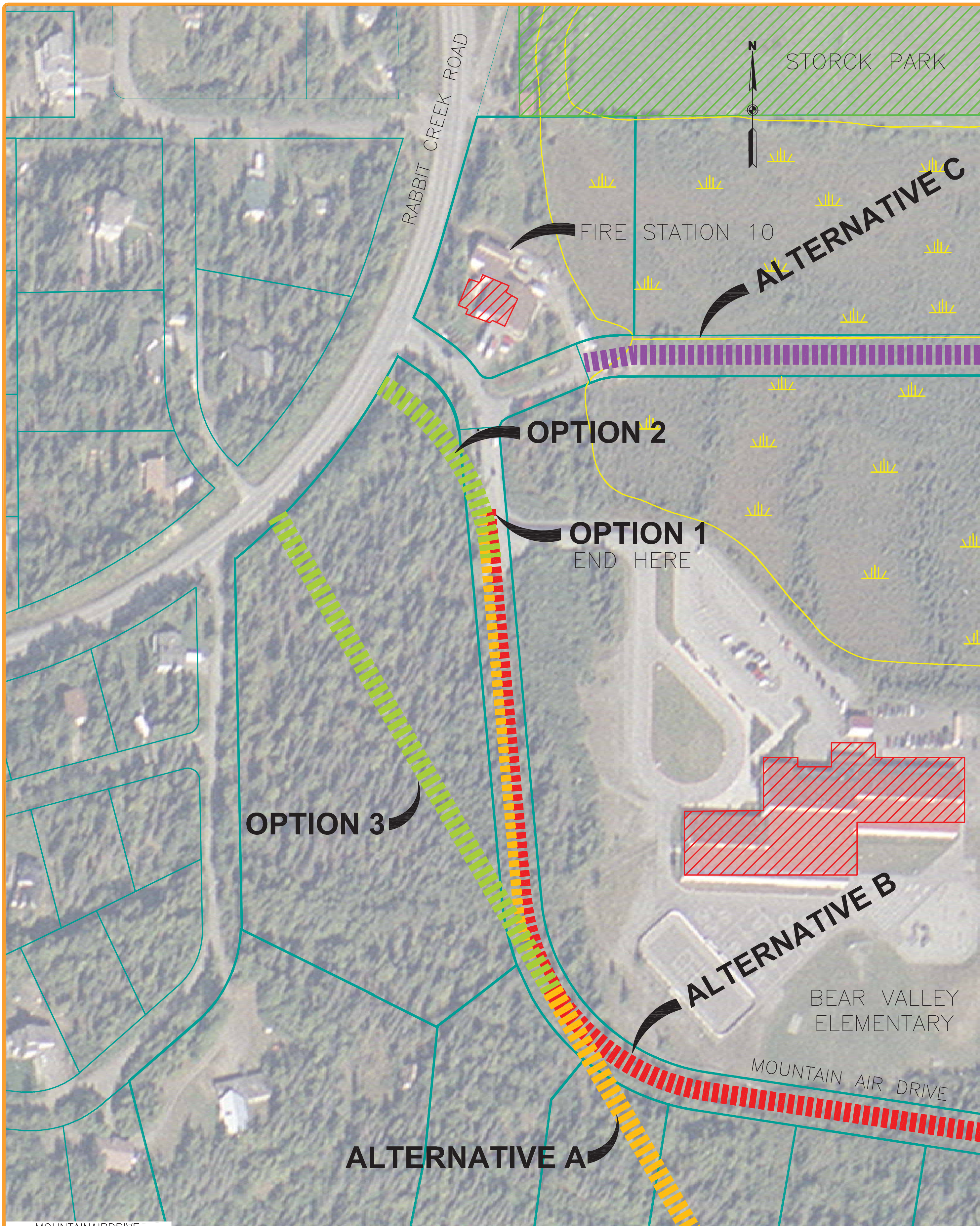
This option would keep the connection to Rabbit Creek Road that currently exists. The Mountain Air Drive improvements would stop just south of the Bear Valley Elementary School driveway. This alternative would have no impacts, but would not support non-motorized access to BVES from Rabbit Creek Road. It would also leave the portion of Mountain Air Drive serving the most traffic not meeting current standards.

Option 2 - Increased Curve Radius

This option would relocate the Mountain Air Drive/Rabbit Creek Road intersection 80 feet west and would increase the radius of the curve near Rabbit Creek Road to 340’, to match the project’s design criteria. This option would require construction of an additional 400 feet of road, and acquisition of 15,000 square feet of ROW. Benefits of this alternative include pedestrian facilities that extend all the way to Rabbit Creek Road, and having Mountain Air Drive meet the design criteria along its entire length.

Option 3 - Reroute Mountain Air Drive to Sierra Way

This option would construct Mountain Air Drive along a straight line between Sierra Way and the proposed south terminus of Alternative A. Cloudcroft Lane would then be extended over to the BVES driveway, and Snow Flake Drive would be terminated at Cloudcroft Lane. The Snow Flake Drive/Rabbit Creek Road intersection would be eliminated. The existing Mountain Air Drive intersection would remain in service, at least for traffic approaching Rabbit Creek Road, to accommodate the fire station. The total length of this option would be 1,900 feet, which is equivalent to the No North Improvements option. It would also require construction of 500 feet of local road. This option would require new ROW along its entire length, but that could be partially offset by vacating some of the existing Mountain Air Drive and Snow Flake Drive ROW.



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REALIGNMENT OPTIONS

DESIGN STUDY REPORT

MOUNTAIN AIR DRIVE/HILLSIDE DRIVE EXTENSION

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING #08-019

MOUNTAIN AIR DRIVE extension

FIGURE 5

Preferred Realignment Option

The preferred realignment option is Option 2, increasing the radius of the final curve. The no-build option was dismissed early on since it would leave the road in a substandard condition. Option 3 would provide some safety benefits in that the alignment is less curvy, and it eliminates an offset intersection along Mountain Air Drive. However, there is a high right of way cost with Option 3 and access to BVES and the Bear Valley Fire Station would not be as good as with the other options. Option 2 best addresses the project objectives at the lowest cost and with the least impact to the adjacent land owners.

9.1.2 Intersection Options

The intersection options described below are shown on Figure 6.

Option 4 – No Intersection Improvements

This option would not build any improvements at the Mountain Air Drive/Rabbit Creek Road; the intersection would remain as a two way stop control intersection with no turn lanes. This is the lowest cost option, but will fail to provide adequate access throughout the life of the project, which is one of the project objectives.

Option 5 – Turn Lanes

This option would construct auxiliary turn lanes on Mountain Air Drive and Rabbit Creek Road. This option would also include constructing underground conduit crossings for a future traffic signal, since it is expected that a traffic signal would be necessary within the 20 year life of this project. Turn lanes would be constructed for northbound right, southbound left, and westbound left turn traffic. Turn lanes on Rabbit Creek Road should be 410 feet long and 12 feet wide, but the length could be reduced to a minimum of 340 feet long, while the turn lane on Mountain Air Drive would extend at least 150 feet and 11 feet wide. This option will continue to give priority to through traffic on Rabbit Creek Road, requires minimal right of way, and should provide adequate level of service for a number of years. The disadvantages of this option is that it fails to provide adequate access throughout the life of the project, at some point an additional $450,000 (2010 costs) will need to be raised to design and construct a traffic signal, and overall vehicular delay is higher than the roundabout option. Additionally, once a signal is installed, $15,000 per year will be required for maintenance and operations.

Option 6 – Roundabout

This option would construct a single lane roundabout at the Mountain Air Drive/Rabbit Creek Road intersection. The roundabout would have a diameter of approximately 130’ and be designed to accommodate WB-67 trucks. People have expressed concern about constructing roundabouts on the Hillside, citing grades and high travel speeds. In this location, the overall intersection has a grade of 1 percent. Mountain Air Drive and Southbound Rabbit Creek Road approaches are also quite flat, and the northbound approach has a 3 percent upgrade. For comparison, this matches the approach grade at the Huffman Road/Old Seward Highway roundabout. Approach speeds require more design consideration, but have not proven to be a problem on many rural roundabouts in other locations around the country.

TURN LANES

ROUNDABOUT

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INTERSECTION IMPROVEMENT OPTIONS

DESIGN STUDY REPORT

MOUNTAIN AIR DRIVE/HILLSIDE DRIVE EXTENSION
MUNICIPALITY OF ANCHORAGE
PROJECT MANAGEMENT AND ENGINEERING #08-019

MOUNTAIN AIR DRIVE extension

FIGURE 6

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The advantages to the roundabout are that they require no special maintenance over its life, they experience 30 percent fewer collisions than stop controlled intersections (2010 DOT&PF HSIP Handbook), and it would provide for adequate traffic operations beyond the 20 year horizon of this project. Disadvantages include the right of way necessary and the fact that through-traffic must slow down to negotiate the roundabout even when there is no side street traffic.

Preferred Intersection Improvement Option

The preferred intersection improvement will be to construct turn lanes at the Mountain Air Drive/Rabbit Creek Road intersection. The lower upfront construction costs of this option means there is a higher likelihood that it can be constructed with the available construction funds. In addition, the turn lane option does not add delay to the through traffic on Rabbit Creek Road during the first decade or so when the stop control will still function acceptably. Finally, DOT&PF is taking a holistic look at traffic on the Hillside, and the turn lane option will provide the time necessary for DOT&PF to determine the best system of improvements throughout the area without obligating them to a specific action at this location.

9.2 Traffic

Several options were analyzed to determine what improvements would be necessary to maintain LOS D or better by 2029. Turn lanes on Rabbit Creek Road and Mountain Air Drive will be warranted between 2012 and 2022. However, even with turn lanes, the intersection will experience excessive delay by 2024. To accommodate all of the design year traffic, a traffic signal or single lane roundabout will eventually be needed.

A traffic signal would accommodate the design year traffic at acceptable LOS, but the intersection would not meet signal warrants until 2017. The MUTCD states that a “traffic control signal should not be installed unless one or more” of the signal warrants are met. This is to prevent signals from being installed everywhere when some other solution may be more appropriate, and to account for the fact that certain crash types increase when signals are installed.

A roundabout would accommodate the design year traffic at LOS A in the PM and LOS B in the AM. There are no warrants to help determine if a roundabout is justified. Roundabouts are beneficial in that they do not require traffic to stop and are a consistent form of traffic control. However, that consistency can be detrimental in that through traffic is always required to slow down to navigate the roundabout, even when there is no side street traffic.

To help differentiate the roundabout option from the turn lane with signal option, an analysis of projected vehicular delay was conducted. The result was that a roundabout would average 10.4 hours of vehicular delay per day over the 20 year life of the project while constructing turn lanes now and a signal in 2024 would produce 11.7 hours of vehicular delay per day over the life of the project.

9.3 Right of Way

Table 4 summarizes the ROW needs for the north improvement options.

Table 4 – ROW Needs			
Alternative	**BVES Land**	**Private Land**	**Notes**
Alternative A /Option 1– No North Improvements	16,750 SF	118,750 SF	Assumes Lots 2 and 3 can be replatted with the adjacent lots
Alternative A /Option 2– Increased Curve Radius	14,800 SF	134,100 SF	Assumes Lots 2 and 3 can be replatted with the adjacent lots
Alternative A/Option 3 – Reroute	1,000 SF	194,550-313,750 SF	Assumes Lots 2 and 3 can be replatted with the adjacent lots. May be possible to offset with 40,300 SF of ROW
Intersection Option 4 – No Improvements	0 SF	0 SF	
Intersection Option 5 – Turn Lanes	0 SF	6,000 SF	Slope Easements or Fee Acquisitions
Intersection Option 6 - Roundabout	0 SF	7,500 SF	

Option 1 (no north improvements) is discussed under section 7.2

Option 2 requires slightly less land from the school since the road veers west before reaching the north end of the school site. However, 15,350 square feet is necessary from Tract A-1. The approximate value of private land required for this alternative is $114,000.

Option 3 requires the most ROW of the realignment options. Virtually all of this option would be constructed within new right of way. This option would require at least 75,200 square feet from Tract A-1. The impact may be even higher unless Tract A-1 can be rezoned to R-6, from the current R-9 zoning. Under the current zoning, the minimum lot size is 108,900 square feet, and this can include half of the adjacent ROW. Under R-9 zoning, the southwest portion of Tract A-1 could still be developed, but the other remainder parcels would not meet lot size criteria. Thus, the reroute option would need to acquire 195,000 square feet of Tract A-1, worth an estimated $166,000. The R-6 minimum lot size is 54,450, which would allow for the development of all four remainder parcels. The adjacent developments to the north and west both have R-6 zoning, so a rezone would not be out of character with the area. Under R-6 zoning, 75,800 square feet of Tract A-1 would need to be acquired, worth an estimated $64,000. This could be reduced if some of the existing Mountain Air Drive ROW could be swapped for new ROW.

For the intersection options, option 5 would likely require some ROW from Tract A-1 and from the parcels north of Rabbit Creek Road. The ROW would be required to contain the slopes from the proposed 12 foot turn lanes, and would amount to a few feet off the frontage of the parcels.

Option 6, the roundabout option, would require about 2,500 square feet each from Tract A-1, Block 1, Lot 1 Mountain Air Estates Subdivision, and from Fire Station 10.

9.4 Construction Costs

Estimated construction costs for Alternative A with Options 1 through 3 and for Options 4 through 6 are shown in Table 3. Costs are not included for Alternative B with any options because Alternative B was rejected before the options were included in the project. Also, options 4 through 6 are additive to whichever Alternative/Option package is chosen. Costs listed are estimated for 2010 construction. ROW costs have been multiplied by 2 to account for ROW acquisition administrative costs.

Table 5 - Cost Estimate							
	Construction	**Contingency**	**Construction Engineering/ Admin.**	**Utilities**	**ROW**	**Wetland Mitigation**	**Total Construction Cost**
Alternative A /Option 1– No North Improvements	$3,594,000	$719,000	$540,000	$25,000	$210,000	$0	$5,088,000
Alternative A /Option 2– Increased Curve Radius	$3,686,000	$738,000	$553,000	$25,000	$230,000	$0	$5,232,000
Alternative A/Option 3 – Reroute	$3,919,000	$784,000	$588,000	$25,000	$540,000	$0	$5,856,000
Intersection Option 4 – No Improvements	$0	$0	$0	$0	$0	$0	$0
Intersection Option 5 – Turn Lanes	$274,000	$55,000	$42,000	$0	$11,000	$0	$382,000
Intersection Option 6 - Roundabout	$414,000	$83,000	$63,000	$0	$13,000	$0	$573,000

Appendix A
Final Geotechnical Report

Geotechnical Report
Mountain Air Drive Extension
Anchorage, Alaska

June 2010

Submitted To:
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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

GEOTECHNICAL REPORT
MOUNTAIN AIR DRIVE EXTENSION
ANCHORAGE, ALASKA

1.0 INTRODUCTION

This report presents the results of subsurface explorations, laboratory testing and geotechnical engineering studies conducted by Shannon & Wilson, Inc. for the proposed Mountain Air Drive extension in Anchorage, Alaska. The purpose of this geotechnical study was to evaluate subsurface conditions along Mountain Air Drive for road improvements. Presented in this report are descriptions of the site and project, subsurface exploration and laboratory test procedures, an interpretation of subsurface conditions, and our geotechnical engineering recommendations for design of the proposed road improvements.

Authorization to proceed with this work was received in the form of a signed contract from Mr. Steve Kari of USKH on February 17, 2010. Our work was conducted in general accordance with our April 21, 2010 proposal and our revised cost estimate dated February 2010.

2.0 SITE AND PROJECT DESCRIPTION

The project is located in Anchorage, Alaska and includes a portion of the Mountain Air Drive Right-of-Way (ROW) from Rabbit Creek Road south, across Little Rabbit Creek to the East 155th Avenue ROW. A vicinity map indicating the general project location is presented in Figure 1. A site map is included as Figure 2 that provides a more detailed view of the project area including prominent site features, topography, and boring locations.

The developed portion of Mountain Air Drive extends east off Rabbit Creek Road as a two lane, paved road and is approximately 450 feet in length. The undeveloped portion of the project alignment follows the designated Mountain Air Drive ROW for approximately 650 feet and then continues south across Little Rabbit Creek to the undeveloped East 155th Avenue designated ROW as shown in Figure 2. The east side of the project alignment is occupied by the Rabbit Creek Fire Station 10, Bear Valley Elementary School entrance and playground, and undeveloped land. The west side of the project alignment is undeveloped. In general, topography on the northern portion of the proposed alignment slopes south toward Little Rabbit Creek and on the southern portion of the alignment, slopes north toward the creek. We understand the project includes improvements to the existing road and developing the new road with an approximately 130-foot long bridge across Little Rabbit Creek.

3.0 SUBSURFACE EXPLORATIONS

Explorations consisted of advancing and sampling eleven borings, designated Boring B-01 through B-11, from February 24 to March 3, 2010. Approximate boring locations are included as Figure 2. The focus of the field exploration program was to evaluate subsurface conditions along the proposed alignment. Our exploration program included four borings near the approximate proposed bridge abutment locations and seven borings along the proposed alignment. Borings B-01 and B-02 were advanced through the existing pavement section in the developed portion of Mountain Air Drive, the remainder were advanced in the undeveloped area. Drilling services for this project were provided by Discovery Drilling, of Anchorage, Alaska, using a track-mounted CME 75 drill rig.

Borings were advanced with $3^{1}/_{4}$-inch inner diameter (ID), continuous flight, hollow-stem augers to approximately 21.5 feet below ground surface (bgs) for the road alignment explorations and to approximately 51.5 feet bgs for the bridge abutment borings. An experienced geologist from our firm was present continuously during drilling to locate the borings, observe drill action, collect samples, log subsurface conditions, and observe groundwater if encountered.

As the borings were advanced, samples were recovered with a 2-inch outside diameter (OD) split spoon sampler using Standard Penetration Test (SPT) procedures. These samples were recovered by driving the sampler into the bottom of the advancing hole with blows of a 140-lb auto-hammer free falling 30 inches onto the drilling rod. The number of blows required to advance the sampler the final 12 inches of an 18-inch penetration is termed the penetration resistance, which was recorded for each sample. Penetration resistance values that were collected in the field are shown graphically on the boring logs adjacent to the sample depth and give a measure of the relative density (compactness) or consistency (stiffness) of cohesionless or cohesive soils, respectively. In addition to penetration samples, grab samples were taken in the upper 2 feet of each boring and samples of the cuttings were taken from the fill material in Borings B-01, B-02, and B-03 for bulk gradation laboratory testing.

Sampled soils were visually classified in the field using the Unified Soil Classification System (USCS) system presented in Appendix A as Figure A-1. The field classifications were then verified through selective laboratory analysis. USCS group symbols are provided for those soils confirmed by laboratory testing on the grain size classification sheets. Frost classifications were also estimated for select samples based on visual and laboratory evaluations. The frost classification system is presented in Appendix A as Figure A-2. Summary logs of the borings with material descriptions and frost classifications are presented in Appendix A as Figures A-3 through A-13.

Upon completion of drilling in Borings B-03, B-05, B-06, B-08, B-10, and B-11, 1-inch PVC casings were installed. These borings were then backfilled with auger cuttings that were hand tamped. The casings were allowed to stick up above the ground surface, and were installed to provide static water level measurements after drilling. The remaining borings were backfilled with auger cuttings. Asphalt penetrated by the borings on the surface was repaired with asphalt cold patch in Borings B-01 and B-02.

Boring locations shown on Figure 2 were established with a hand held differential global positioning system (GPS) with a horizontal accuracy of approximately 3 feet. The elevations shown on the boring logs were estimated from the topographic data provided by USKH. These locations and the elevations should be considered approximate.

4.0 LABORATORY TESTING

Laboratory tests were performed on selected samples recovered from the borings to confirm our field classifications and to approximate the index properties of the typical materials encountered at the site.

Water content tests were performed on samples collected from the borings. Water content tests were generally conducted according to procedures described in ASTM International (ASTM) D-2216. The results of the water content measurements are presented graphically on the boring logs in Appendix A.

Grain size classification tests were conducted to estimate the particle size distribution of selected samples from the borings. The gradation testing generally followed the procedures described in ASTM C-136 and D-422. Grain size testing results are presented in Appendix A as Figure A-14, and summarized on the boring logs as percent gravel, percent sand, and percent fines. Percent fines on the boring logs are equal to the sum of the silt and clay fractions indicated by the percent passing the Number 200 sieve or as estimated through hydrometer testing. Note that hydrometer testing indicates particle size only and visual classification under USCS designate the entire fraction of soil finer than the Number 200 sieve as silt unless Atterberg limit data shows plasticity properties consistent with clay.

In addition, tests were conducted to estimate the amount of material passing the Number 200 sieve (P-200) in the subgrade material. This test was performed in general accordance with ASTM C-117. The P-200 test provides an estimate of the fines (silt and clay) content. The results of this test are presented on the boring logs, indicated as percent fines.

To aid in classifying and correlating the properties of the cohesive soils, Atterberg limit tests (liquid and plastic limits) were conducted on two fine grained samples. Atterberg limit tests were performed in accordance with ASTM D-438. The results of these tests are presented on the appropriate boring logs and on Figure A-15.

5.0 SUBSURFACE CONDITIONS

Subsurface conditions are presented graphically in the boring logs in Appendix A, Figures A-3 through A-13. In general, our borings encountered medium dense to very dense granular material with occasional zones of fine-grained material. Material encountered was frozen from the ground surface to between 2 and 7 feet bgs.

Borings B-01 and B-02 were advanced through 1 ½ to 2 inches of asphalt and then 4 to 6 feet of fill material. The fill material encountered consisted of slightly silty to silty, sandy gravel. Native material that was found beneath the fill consisted of silty, gravelly sand and sandy silt.

The remaining borings were advanced in undeveloped areas. In Borings B-03, B-04, B-07, and B-08, material encountered in the upper 1 to 2 feet bgs may have been fill; however, it was difficult to discern a difference between this material and the native soil. This possible fill material consisted of slightly silty to silty sand and gravel. Native granular material, found beneath the possible fill typically ranged from slightly silty to silty, gravelly sand to slightly silty to silty, sandy gravel with occasional zones of sandy silt. Soils had penetration resistance values of between 8 and over 50 blows per foot. Boring B-04 encountered soft to stiff, organic silt and silty peat from approximately 1 foot bgs to approximately 13 feet bgs.

Moisture contents in the granular material ranged from 2 to 25 percent with the higher percentages present in the more silty material. The average moisture content for the granular material was approximately 8 percent. Moisture contents in the silt ranged from 13 to 37 percent, averaging approximately 24 percent and moisture contents of the peaty soils ranged from 110 to 149 percent by weight.

Groundwater was encountered during drilling in Boring B-07 at approximately 20 feet bgs, and in Borings B-08, B-09, and B-10 at approximately 35 feet bgs. Water level measurements were made on March 18, 2010 in the PVC casings in Borings B-03, B-05, B-06, B-08, B-10, and B-11. Water was not present in Borings B-03, B-05, B-06, or B-11. Static groundwater levels were measured at 37.7 feet bgs and 39.1 feet bgs in Borings B-08 and B-10, respectively. It is important to note that groundwater levels are subject to seasonal variations and may change by several feet.

6.0 SEISMIC ANALYSIS AND DESIGN

The soils beneath the proposed bridge abutments are largely granular with a moderate to high relative density. Liquefaction and seismically-induced compaction of loose, saturated, cohesionless soils due to seismic loading has been studied over the past 35 years, resulting in methods based on both laboratory and field procedures to evaluate liquefaction potential. The most widely used methods are empirical, and based on correlations between Standard Penetration Test (SPT) resistance (N-value), peak ground acceleration (PGA), and earthquake magnitude. We used three methods to evaluate liquefaction potential at this site:

- Youd et al. (2001)
- Seed et al. (2003)
- Idriss and Boulanger (2004)

An important factor in evaluating liquefaction potential is the fines content (percent of soil by weight smaller than 0.075 millimeter [mm] or a No. 200 sieve) of the soil deposit. We used the results of grain size analyses and fines content tests to characterize the fines content of the subsurface soils at the site. Where no laboratory data were available for individual samples, we estimated the fines content based on the soil classification.

We performed our liquefactions analyses for an earthquake of magnitude 9.2 and a soil PGA of 0.52g. We obtained the magnitude and PGA from regional probabilistic ground motion studies conducted by the U.S. Geological Survey (USGS) and Frankel et al. (2002). These seismic parameters are approximately representative of a 1,000 year return period ground motion and are consistent with the guidelines for seismic design according to American Association of State Highway and Transportation Officials, Load and Resistance Factor Design, Bridge Design Specifications, fifth edition, 2010 (AASHTO). Our analyses did not predict a credible risk of liquefaction during the design earthquake.

Densification of granular soils above and below the water table may occur when subject to earthquake shaking, resulting in potential ground settlement at the site. We used the relationship by Tokimatsu and Seed (1987) and Ishihara and Yosimine (1992), relating earthquake ground motion and penetration resistance with volumetric strain, to estimate the magnitude of ground settlement that may occur at the site. The relationships estimate negligible total ground settlements for the ground motions assumed in our liquefaction analyses. Our analysis was conducted assuming that the bridge abutment site is prepared by excavating and replacing loose and/or organic surface soils to develop a firm, unyielding subgrade that is not subject to compaction during a seismic event. Site preparation is addressed in greater detail in Section 7.1 below.

In our opinion, based on the blow count (N) method and the subsurface conditions described above, and assuming that any surface organic material is removed, the site class according to AASHTO should be D for a profile containing generally stiff soils. Therefore, we recommend that Site Class D be selected as consistent with the concept design and most representative of the overall properties of the site. Based on Section 3.10, Earthquake Effects from the AASHTO design manual, S_s and S_1 were estimated at 1.2 and 0.46, respectively. Consequently, the site specific modifying coefficients for the spectral response accelerations for the Maximum Considered Earthquake are $F_A = 1.1$, and $F_v = 1.5$ for the short and long periods, respectively.

7.0 ENGINEERING CONCLUSIONS AND RECOMMENDATIONS

Geotechnical considerations associated with this project consist of developing appropriate structural support for the pavement section, bridge foundations and utility trench installation. We assume that the pavement design for this project will be consistent with the Municipality of Anchorage (MOA) January 2007 Design Criteria Manual (DCM) and AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications, fifth edition, 2010 will be used for bridge foundations.

7.1 Road Subgrade Preparation

According to our borings along the alignment, surface soils containing occasional to numerous organic material were encountered over the length of the road extension are largely composed of organic silt or silt and sand containing roots and decayed plant matter. Where present, these soils extended to depths of up to 3 feet bgs, with the exception of Boring B-04, in which organic silt and silty peat was encountered to approximately 10.5 feet bgs. This soil is frost susceptible and compressible and will generally not provide adequate support of a roadway structural section. Therefore, we recommend that this material be removed and disposed of from beneath the new embankments.

In sub-cutting to remove organic soils and local areas of loose or compressible soils, the excavation should be extended laterally from the toe of the embankment to allow development of fill slopes at slopes not steeper than 1.5 horizontal (H) to 1 vertical (V). The material should be removed so that firm, native, mineral soils are exposed over the entire excavation bottom. The exposed soils at the bottom of the excavation may be moisture sensitive and flat-nosed excavator buckets should be used. Additionally, equipment should not be operated on the exposed subgrade prior to fill placement if the area is wet and moisture sensitive. After organic soils are removed and firm, mineral soils are exposed, embankment development may proceed as recommended below. Due to the compactness of the native soil, separation fabric will not be needed. If the subgrade is left open to the elements, or heavy equipment is driven on the area so that the surface becomes soft and begins to rut, the softened material should be over excavated and replaced with classified structural fill.

7.2 Embankment Development

Once the area to receive embankment fills have been stripped of organics and other unsuitable soils and a firm, uniform grade is achieved, embankment fill soils can be placed and compacted in controlled lifts as recommended in Section 7.9. For embankment thicknesses greater than the recommended pavement section, the embankment fill material beneath the structural section can be frost-susceptible but must be mineral soils, not containing organics or other unsuitable materials. We recommend limiting the fines content of the embankment fill soils to not more than 20 percent based on the minus 3-inch fraction. These higher silt content materials should only be used if the contractor demonstrates the ability to achieve the density requirements outlined in Section 7.9. Side slopes on embankments should be at least 2H to 1V.

7.3 Asphalt Pavement Section

We assume that the road will primarily be used for relatively light residential traffic with occasional truck traffic for maintenance and other services. The relatively dense native soils (with a frost classification of F-3 to F-4, in general) can provide a suitable subgrade support for roadway pavements if the section is designed to accommodate the frost susceptibility. Pavement design parameters given in the MOA DCM were followed to develop the recommended structural sections below. According to the manual, a structural section over subgrades classified as F2, F3, or F4 must be designed using the "Complete Protection" method which requires excavation of all frost susceptible soils within the active freezing zone and replacement with non-frost susceptible soils. Alternatively, the "Limited Subgrade Frost Penetration" method may be used. In this method, the maximum allowable depth of freeze into the subgrade soil is 10 percent of the structural section thickness. This method may also incorporate insulation into the structural section to reduce the depth of the active freezing zone, and thus the fill thickness.

Because of the relatively deep seasonal frost depth in the Anchorage area (approximately 8 to 10 feet below cleared roadways on average), we have developed recommendations for an insulated section along with an un-insulated section. In comparing the two section options, it is clear that an insulated section will require less excavation and backfill. While the insulated section likely represents the less expensive construction option, buried insulation in the roadway may be problematic during future utility work or road repair.

We evaluated frost penetration using BERG2 to arrive at the following recommended insulated and non-insulated sections. In our analysis, we assumed a generalized soil profile beneath the structural section consisting of silty sand and sandy silt native soils. We assumed a groundwater table approximately 35 feet below the existing ground surface. These sections are provided assuming that the site improvements will be designed to direct surface waters away from the pavement, since the moisture content of soils plays a significant part in determining the frost penetration depth. Based on these considerations and a "Limited Subgrade Frost Penetration" design, the following are recommended for insulated and non-insulated pavement sections. The structural sections for concrete sidewalks and asphalt pathways should also adhere to the recommendations outlined below.

Insulated Section

Thickness (inches)	Material
3	Asphalt
4	Leveling Course
12	Type II/II-A Base
2	Insulation
28	Type II/II-A Subbase

Non-Insulated Section

Thickness (inches)	Material
3	Asphalt
6	Leveling Course
114	Type II/II-A Subbase

The materials should conform to the gradation requirements presented in the Municipality of Anchorage Standard Specifications (MASS). In general, it does not appear that the on-site material meets the gradation requirements for leveling course, Type II-A base, or Type II subbase. The performance of pavement is controlled by the details of construction and by the quality (gradation characteristics) of the materials to develop the needed structural section. MOA Gradation Requirements are presented in Figure 3.

7.4 Insulation Installation

We recommend using 2 inches of extruded polystyrene "blueboard" or equivalent for the project. The MOA DCM provides further guidelines on the application of insulation in pavement structural sections. Insulation should be installed smoothly on the ground surface so that it covers the entire area to be paved. Fill lifts on top of insulation should be placed and compacted as described in Section 7.9. Traffic on top of the initial lift over the insulation should travel in straight lines to prevent damaging the insulation.

Insulation should extend a minimum of 2 feet past the outer edge of the curb and gutter and sidewalks or pathways that are attached to the curb and gutter. Sidewalks or pathways that are detached from the curb/gutter do not require the incorporation of insulation into the structural section as long as some vertical displacement during winter months can be tolerated. A smooth transition should also be provided between the insulated section and approaching roads and driveways. The new structural section should be tapered up at a slope no steeper than 4 H to 1 V.

If utilities are to be repaired or replaced in this project, that work should be done first, before the insulation is installed. Once the insulation has been installed, the remaining structural section for the roadway may be developed by placing (as described in Section 7.9) 12 inches of compacted Type II/II-A Base, 4 inches of leveling course, and 3 inches of asphalt pavement.

7.5 Construction Drainage

Groundwater was encountered in our explorations in March 2010, and could be expected between 20 and 35 feet below the grade of the existing ground surface. We anticipate that excavation for construction of the roadway will not encounter water. The project should be designed such that excavations below groundwater levels in our explorations are limited as much as practicable.

In general, excavation and backfilling work should be closely coordinated such that seepage and surface runoff is not allowed to collect and stand in open trenches for long time periods. The ground surface around excavations should be contoured to drain away from the excavation and the excavation bottoms should be graded to drain to a sump or topographic low. We believe that drainage at the site should work with the existing topography and it will likely be achieved by allowing water to drain downhill to the south.

7.6 Bridge Foundation

We understand that the structural bridge design team is planning to use the American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications methodology for the bridge design. We understand that the structural designer will select size and depths of the footings required to the support the bridge.

7.6.1 Bearing Capacity

We calculated bearing resistance versus effective footing width for the service limit state for total settlements of 1.0 and 2.0 inches, the strength limit, and extreme limit states, assuming a rectangular footing (approximately 48 feet by variable widths) and burial of 5, 8 and 10 feet bgs. The results of our calculations are presented graphically in Figure 4.

7.6.2 Static Settlements

The magnitudes of the static settlements that will develop at the bridge site are dependent upon the applied loads, the density of the support material, and the care with which structural fills are placed and compacted. Compaction recommendations and procedures are described in Section 7.9; these recommendations should be strictly adhered to for best results. We estimated allowable bearing capacities for the service state using the elastic half-space method for calculating settlements and assuming total settlements of 1 inch and 2 inches. These capacity values are presented in Figure 4.

7.6.3 Lateral Earth Pressures

Design of buried shallow footings, stem walls or earth retaining walls should consider the lateral earth pressures that may be imposed or resisted by the soil. We have calculated the following lateral pressures (expressed as equivalent fluid pressures) which, in our opinion, are suitable for design of these structures. The magnitude of the pressure is dependent on the method of backfill placement, the type of backfill material, drainage provisions, and whether the wall is permitted to deflect after or during placement of backfill. For the earth pressures provided herein, we assume that footing trenches will be backfilled with a free-draining structural fill (such as Type II/II-A classified material) and groundwater levels will naturally remain below the footing level.

If the walls are allowed to deflect laterally or rotate an amount equal to about 0.001 times the height of the wall, an active earth pressure condition under static loading would prevail and an equivalent fluid weight of 40 pounds per cubic foot (pcf) is recommended for design of the walls. To simulate seismic loading, at-rest and active earth pressures should be increased with a uniformly distributed, rectangular pressure prism of 10 pounds per square foot per foot of wall length. For rigid walls that are restrained from deflecting at the top, an at-rest earth pressure condition would prevail and an equivalent fluid weight of 61 pcf is recommended.

Lateral forces from wind or seismic loading may be resisted by passive earth pressures against the sides of footings. These resisting pressures can be estimated using an equivalent fluid weight of 250 pcf. This value includes a factor of safety of at least 1.5 on the full passive earth pressure to limit deflections. The ultimate passive earth pressure is reduced during earthquake conditions but will still exceed the 250 pcf allowable pressure so there will be no loss of lateral resistance.

Lateral resistance may also be developed in friction against sliding along the base of foundations. These forces may be computed using a coefficient of 0.4 between concrete and soil.

7.7 <u>Bridge Approach Retaining Wall Design</u>

According to conceptual drawings, both ends of the bridge approach will include retaining wall structures. We understand the planned walls will be modular block MSE retaining walls. We anticipate that the retaining wall structure will likely be a proprietary product and therefore will likely be designed by the product manufacturer. The manufacturer's design should be followed; however, we offer the following additional general recommendations for the new wall.

Additional excavation (compared to that described in Section 7.1) will be needed under MSE supported embankments, at the bridge approaches. We recommend that the less compact, fine grained surface soils (encountered in the upper about 7 feet in our borings in that area) be excavated so that the base of the embankment fill and retaining walls are founded on the dense to very dense granular soil found in our borings in the vicinity of the bridge abutments. The ground surface around the base of the walls should be contoured to discourage surface water from flowing along the base of the wall.

Backfill beneath and behind the retaining walls should consist of clean, well-graded, granular soil (Type II/IIA structural fill) to provide drainage and frost protection and should be placed and compacted as outlined in Section 7.9. We recommend that the base of the retaining wall be established a minimum of 5 feet below the natural ground surface, or as needed to provide lateral resistance at the base of the wall, whichever is greater. As long as the compaction criteria are adhered to, an allowable bearing pressure for the soil below the base of the walls of 4,500 psf is recommended. Lateral earth pressures for the wall may be taken from Section 7.6.3 above. The internal design of the wall should also compensate for seismic loading resulting in horizontal ground acceleration and increased lateral earth pressures.

The existing ground surface slopes on either side of the creek channel are relatively shallow and have a factor of safety against sliding failure of greater than three, based on an idealized stability analyses. In our opinion, the stability of the MSE supported embankments at the bridge approaches will be controlled by the internal design of the walls, since the native soils are very dense and non-liquefiable. Additionally, the orientation of the walls is roughly parallel to the fall line of the natural slopes in the area and therefore, there should not be significant loading of the slope crest that would result in slope destabilization.

7.8 Utility Trench Design

Utility lines below the road surface will likely need to be installed when the road is constructed. We believe open-trench methods are favored for construction; therefore, we recommend that the trenches generally be designed as shown in Figure 6. Based on the generally moderate SPT values and moderate silt content, soils above the water table should have short-term cohesion will likely tend stand steeply initially. However, the typical soil encountered in our borings will likely behave as a cohesionless material over the long term (i.e., as they dry the soils will ravel to their natural angle of repose, which for planning purposes is estimated at about 1.5 horizontal to 1 vertical). Soils excavated below the water table may also slough into the open excavation if dewatering is not conducted. The trench side slopes and bottom conditions should be made the responsibility of the contractor as he or she is present on a day to day basis and can adjust his or her efforts to obtain the needed stability, and meet the applicable Alaska and Federal (OSHA) safety regulations.

Below areas that are receiving pavement sections, trench backfill should be placed in maximum 12-inch loose lifts and compacted to at least 95 percent of the Modified Proctor maximum dry density, as discussed in Section 7.9. The bedding and fill material around the pipe should be compacted to at least 95 percent of the Modified Proctor maximum dry density or per manufacturer recommendations to support and hold the pipe firmly in place. Utility trenches should be backfilled with existing inorganic native soils as much as practical between the top of the pipe bedding and the bottom of the road subgrade, or to original ground surface in areas where no pavement is needed. This procedure limits the contrast between trench backfill and the surrounding soil conditions that can lead to adverse settlement or frost heave behavior. Bulking of backfill into trenches should be discouraged as this can cause variable subgrade support or voids and lead to large future surface settlements with associated pavement distress.

7.9 Structural Fill and Compaction

Structural fill will be needed to support the footing excavation, behind stem walls, to bed and support buried utilities, to replace unsuitable excavated materials, and for support of pavements. Classified structural fill placed in these areas should be clean, granular soil to provide drainage and frost protection. In general, the existing fill and native soils encountered in our borings and tested in our laboratory contain 13 to 76 percent fines and do not meet the requirements for Type II or Type IIA subbase. Therefore, existing soils should not be used as structural fill in pavement sections for this project. However, we believe existing soils that do not contain intermixed organic material are suitable for reuse as unclassified fill above the pipe bedding materials and beneath the new pavement section.

Where imported fill is needed we recommend that it consist of a reasonably well graded, free-draining sand and gravel. Generally, Type II or Type II-A material as specified in MASS works well for this application and as the subbase layer since it can be placed under both wet and dry weather conditions. Its gradation properties are shown in Figure 3. Pipe bedding should also conform to the requirements of the manufacturer for the type of pipe selected in the project design studies. For deep embankments, the material beneath the pavement structural section may include more fines, but should be able to conform to the MASS Type IV classification.

Classified structural fills should be placed in lifts not to exceed 10 to 12 inches loose thickness and compacted to 95 percent of the maximum density as determined by the Modified Proctor compaction procedure (ASTM D-1557). During fill placement, we recommend that cobbles or boulders with dimensions in excess of 2/3 of the layer thickness be removed from structural fills. We recommend that our services be retained to inspect the quality of fill compaction during construction.

When backfilling within 18 inches of the stem walls where the wall is not supported on both sides, material should be placed in layers not to exceed six inches loose thickness and densely compacted with hand operated equipment. Heavy equipment should not be used as it could cause increased lateral pressures and damage walls.

8.0 CLOSURE AND LIMITATIONS

This report was prepared for the exclusive use of our client and their representatives for evaluating the site as it relates to the geotechnical aspects discussed herein. The analyses, conclusions and recommendations contained in this report are based on site conditions as they presently exist. It is assumed that the exploratory borings are representative of the subsurface conditions throughout the site, i.e., the subsurface conditions everywhere are not significantly different from those disclosed by the explorations.

If, during construction, subsurface conditions different from those encountered in these and prior explorations are observed or appear to be present, Shannon & Wilson, Inc. should be advised at once so that these conditions can be reviewed and recommendations can be reconsidered where necessary. If there is a substantial lapse of time between the submittal of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, it is recommended that this report be reviewed to determine the applicability of the conclusions and recommendations considering the changed conditions and time lapse.

We recommend that we be retained to review those portions of the plans and specifications pertaining to earthwork and foundations to determine if they are consistent with our recommendations. In addition, we should be retained to observe construction, particularly the compaction of structural fill, installation of shoring and site excavations, and also to make field measurements of ground displacements and such other field observations as may be necessary.

Unanticipated soil conditions are commonly encountered and cannot fully be determined by merely taking soil samples or advancing borings. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. Therefore, some contingency fund is recommended to accommodate such potential extra costs. Shannon & Wilson has prepared the attachments in Appendix B *Important Information About Your Geotechnical/Environmental Report* to assist you and others in understanding the use and limitations of the reports.

Copies of documents that may be relied upon by our client are limited to the printed copies (also known as hard copies) that are signed or sealed by Shannon & Wilson with a wet, blue ink signature. Files provided in electronic media format are furnished solely for the convenience of the client. Any conclusion or information obtained or derived from such electronic files shall be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, or you question the authenticity of the report please contact the undersigned.

We appreciate this opportunity to be of service. Please contact the undersigned at (907) 561-2120 with questions or comments concerning the contents of this report.

Sincerely,

SHANNON & WILSON, INC.

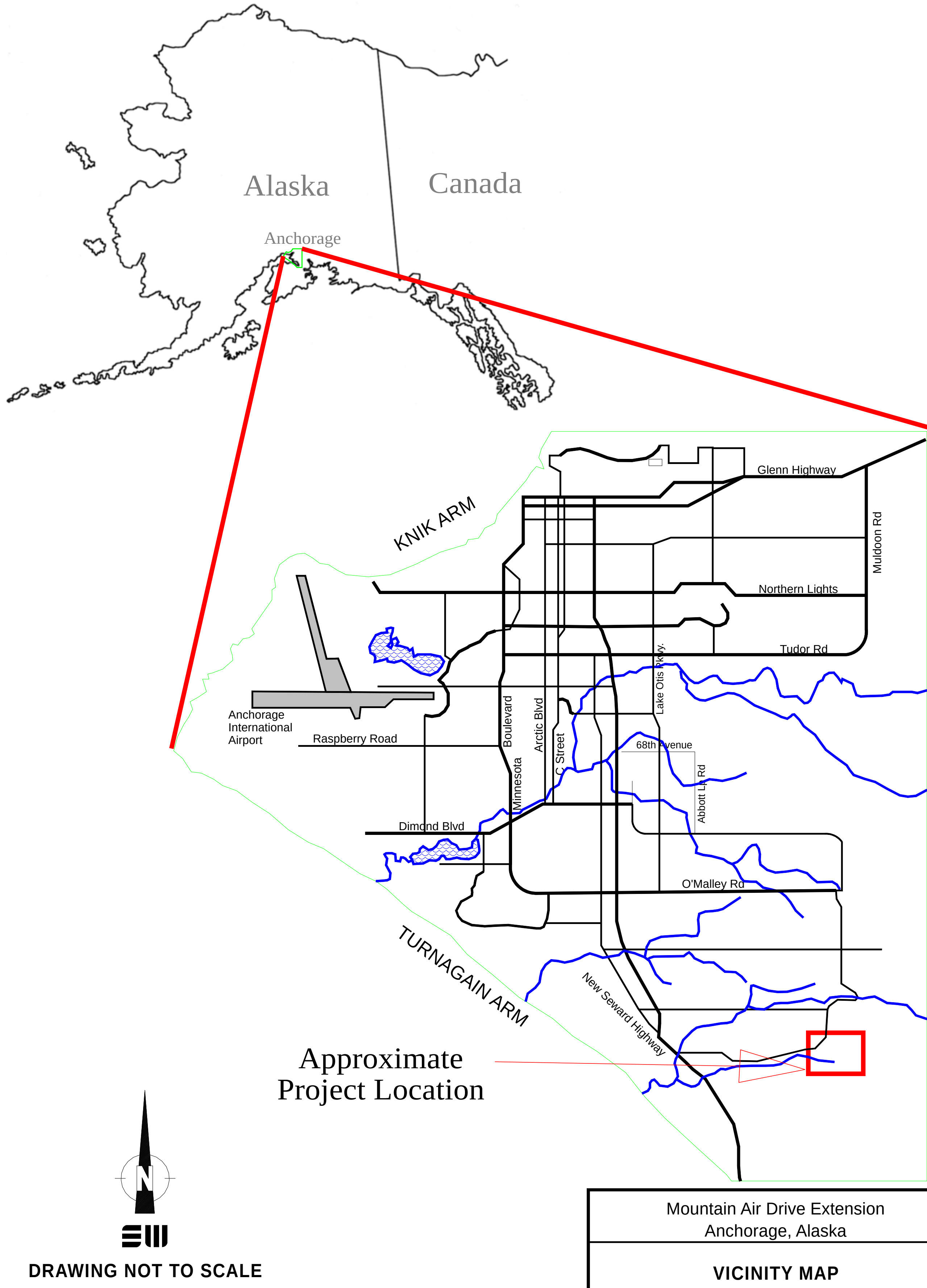
Prepared by:

GW for

Katra Wedeking
Geologist III

Reviewed by:

Grover Johnson, P.E.
Senior Principal Engineer



Mountain Air Drive Extension
Anchorage, Alaska

VICINITY MAP

June 2010 32-1-02055-002

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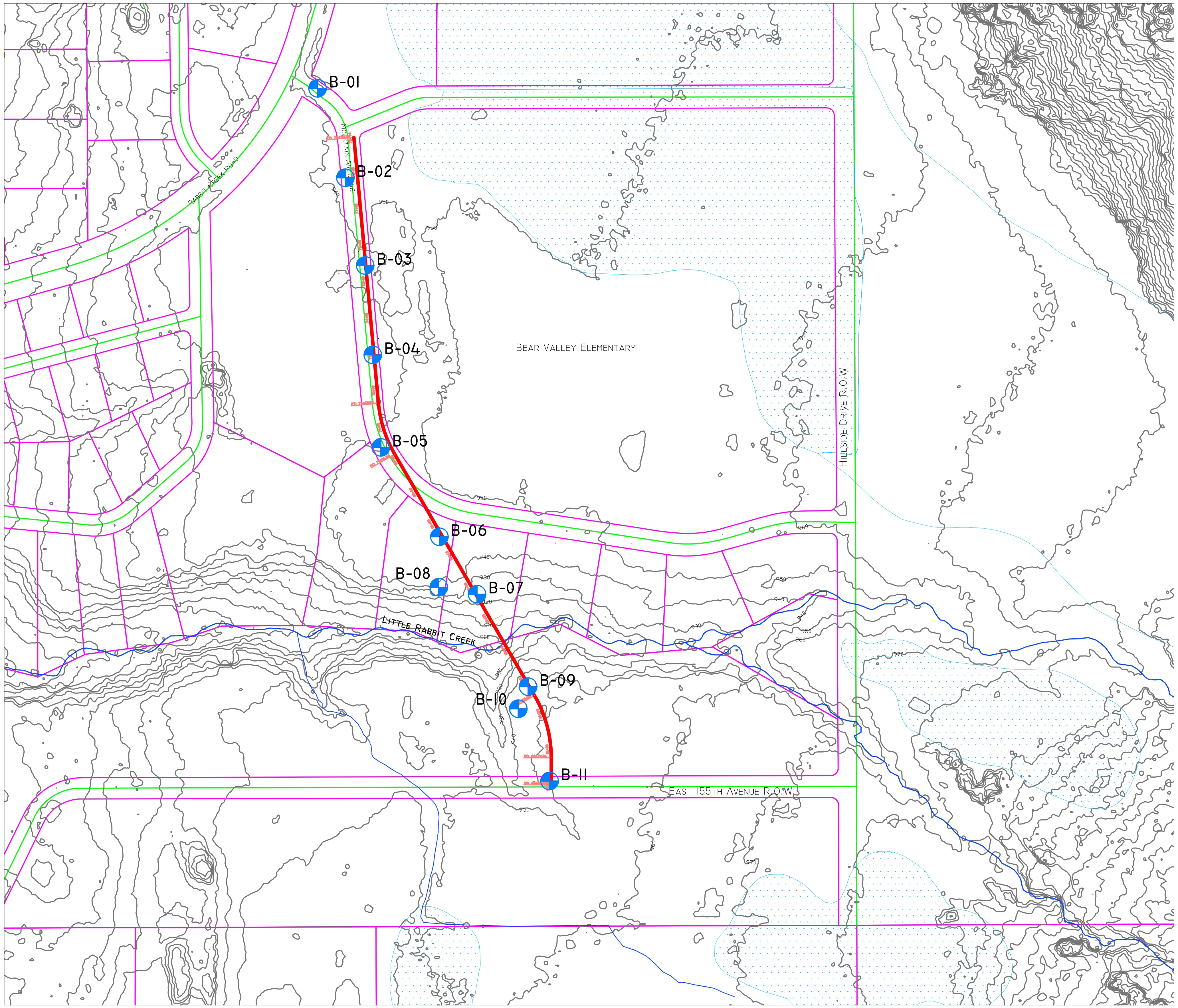
Fig. 1



LEGEND

B-09 Approximate Location of Boring B-09, advanced by Shannon & Wilson, 2010

Approximate Location of wetlands as designated by the municipality of Anchorage GIS Database

Notes:
1) Topographic contours and MOA Rights of Way (ROW) provided by USKH, Inc.
2) Proposed alignment provided by USKH, Inc. and is approximate.
3) Contours represent approximate ground surface elevation in feet.

N

0 150 300 600
APPROXIMATE SCALE IN FEET

Mountain Air Drive Extension
Anchorage, Alaska

Site Plan

March 2010 32-1-02055-002

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Fig. 2

GRADATION REQUIREMENTS

(Adapted from Municipality of Anchorage Standard Specifications, 1994)

LEVELING COURSE

U.S. STANDARD SIEVE SIZE English	Metric	PERCENT PASSING BY WEIGHT
1 in.	25.0 mm	100
3/4 in.	19.0 mm	70 - 100
3/8 in.	9.5 mm	50 - 80
No. 4	4.75 mm	35 - 65
No. 8	2.36 mm	20 - 50
No. 50	0.30 mm	10 - 30
No. 200	0.075 mm	3 - 8*

TYPE II BASE

U.S. STANDARD SIEVE SIZE		PERCENT PASSING BY WEIGHT
8 in.	-	100
3 in.	75 mm	70 - 100
1-1/2 in.	37.5 mm	55 - 100
3/4 in.	19.0 mm	45 - 85
No. 4	4.75 mm	20 - 60
No. 10	2.00 mm	12 - 50
No. 40	0.425 mm	4 - 30
No. 200	0.075 mm	2 - 6**

TYPE II-A BASE

U.S. STANDARD SIEVE SIZE		PERCENT PASSING BY WEIGHT
3 in.	75 mm	100
3/4 in.	19.0 mm	50 - 100
No. 4	4.75 mm	25 - 60
No. 10	2.00 mm	15 - 50
No. 40	0.425 mm	4 - 30
No. 200	0.075 mm	2 - 6**

* The fraction passing the No. 200 sieve shall not exceed 75 percent of the fraction passing the No. 50 sieve.

** The fraction passing the No. 200 sieve shall not exceed 20 percent of the fraction passing the No. 4 sieve.

Mountain Air Drive Extension
Anchorage, Alaska

GRADATION REQUIREMENTS

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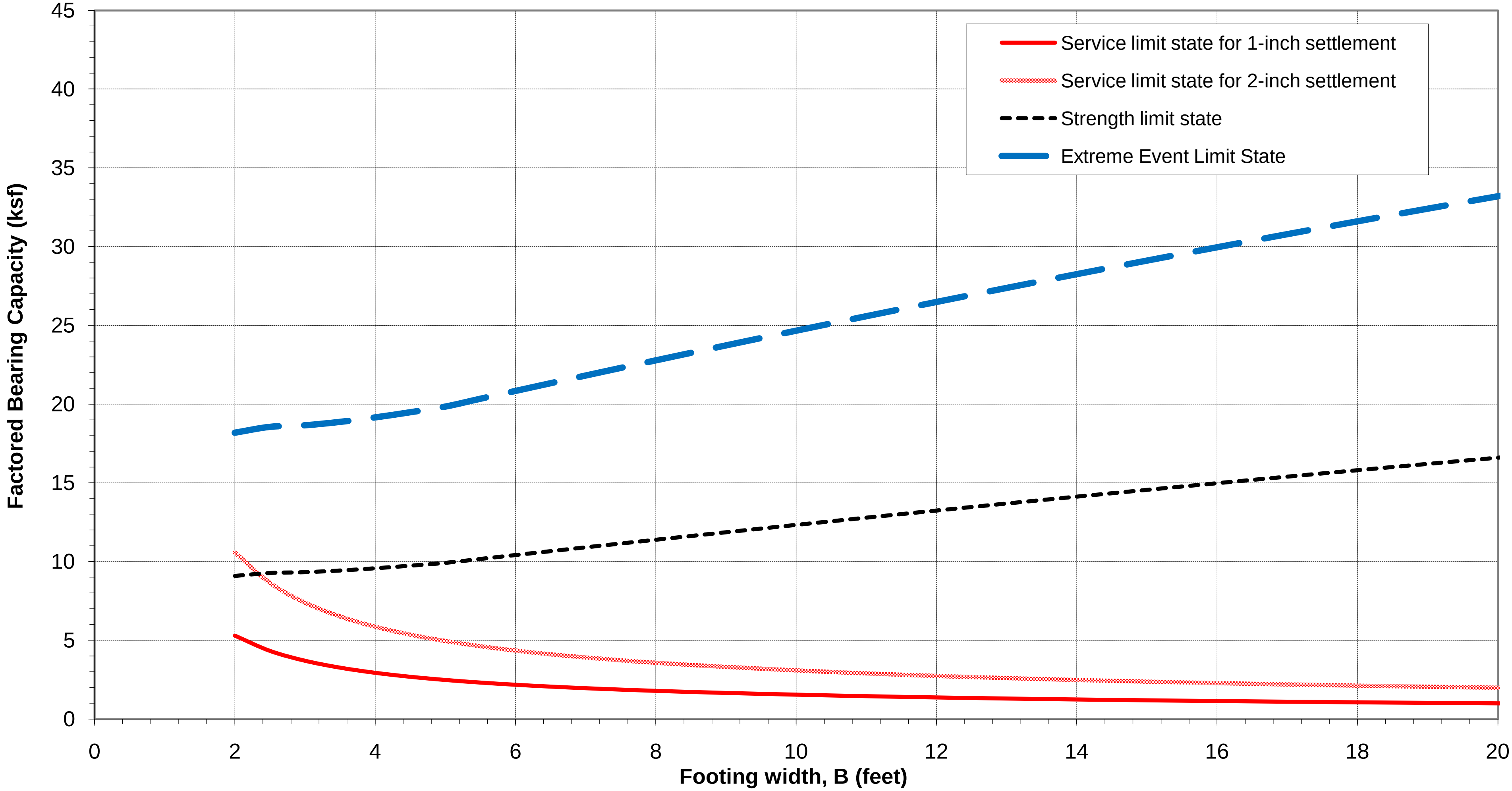
Fig. 3



NOTES

1. We recommend using the following resistance factors for footing LRFD design; the plotted bearing capacities use the bearing capacity resistance factors.

Limit State	Sliding Shear	Passive Press.	Bearing Capacity
Service	N/A	N/A	1.0
Strength	0.8	0.5	0.45
Extreme Event	1.0	1.0	0.9

2. The factored bearing capacities are based on a soil friction angle of 32 degrees, a soil cohesion of 0 psf, a total unit weight of 130 pcf, a Poisson's ratio of 0.3, and a soil elastic modulus of 300 ksf. We assumed that the bottom of the footing was 5 feet below the ground surface.

3. **psf** - pounds per square foot; **pcf** - pounds per cubic foot; **ksf** - kips per square foot (1 kip = 1000 pounds)

Mountain Air Drive Extension
Anchorage, Alaska

FACTORED BEARING CAPACITY VERSUS FOOTING WIDTH, DEPTH = 5 FT RECTANGULAR FOOTING, LENGTH = 48

June 2010 32-1-02055-002

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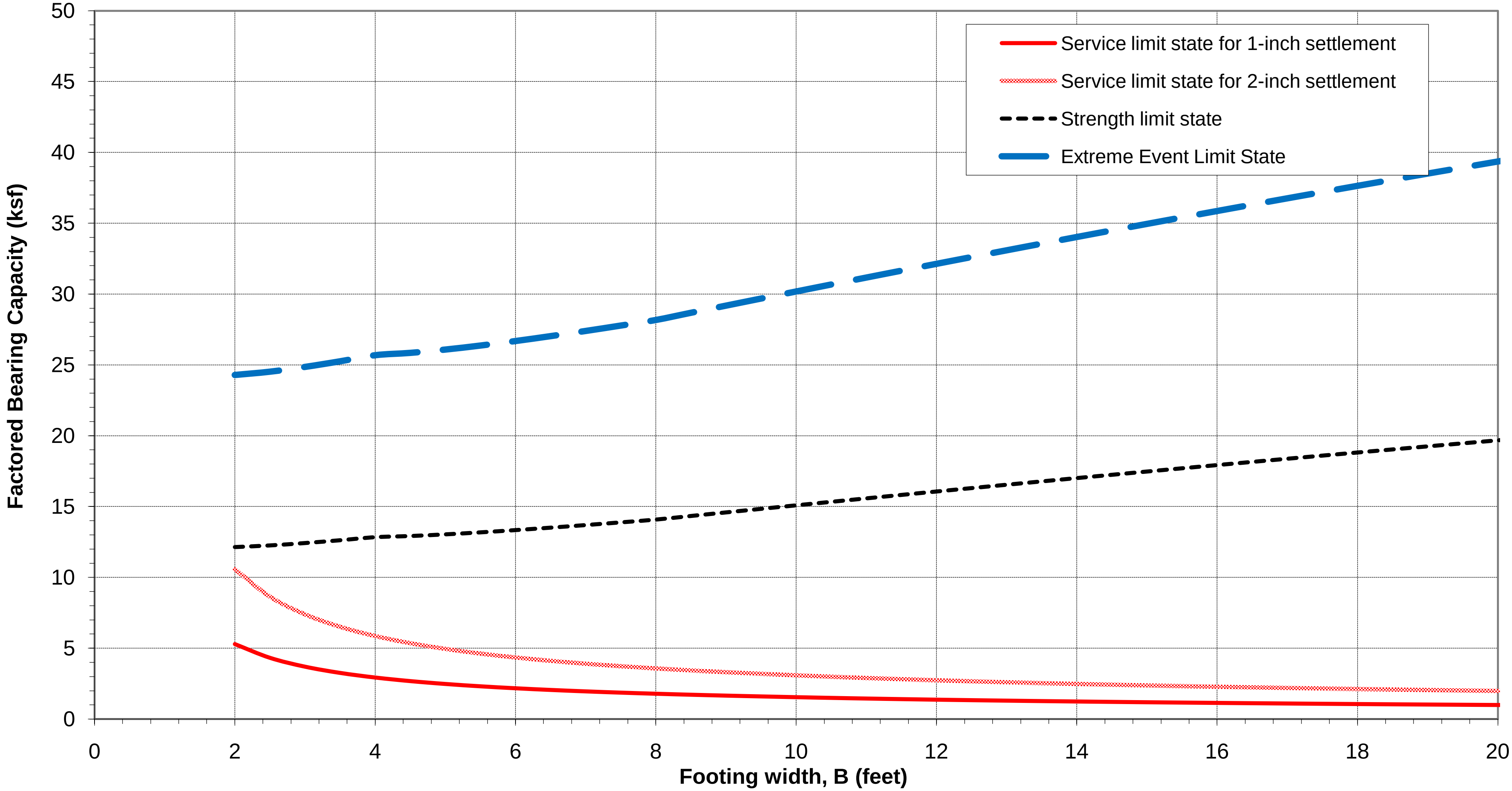
FIG. 4
Sheet 1 of 3

FIG. 4



NOTES

1. We recommend using the following resistance factors for footing LRFD design; the plotted bearing capacities use the bearing capacity resistance factors.

Limit State	Sliding Shear	Passive Press.	Bearing Capacity
Service	N/A	N/A	1.0
Strength	0.8	0.5	0.45
Extreme Event	1.0	1.0	0.9

2. The factored bearing capacities are based on a soil friction angle of 32 degrees, a soil cohesion of 0 psf, a total unit weight of 130 pcf, a Poisson's ratio of 0.3, and a soil elastic modulus of 300 ksf. We assumed that the bottom of the footing was 8 feet below the ground surface.

3. **psf** - pounds per square foot; **pcf** - pounds per cubic foot; **ksf** - kips per square foot (1 kip = 1000 pounds)

Mountain Air Drive Extension
Anchorage, Alaska

FACTORED BEARING CAPACITY VERSUS FOOTING WIDTH, DEPTH = 8 FT RECTANGULAR FOOTING, LENGTH = 48

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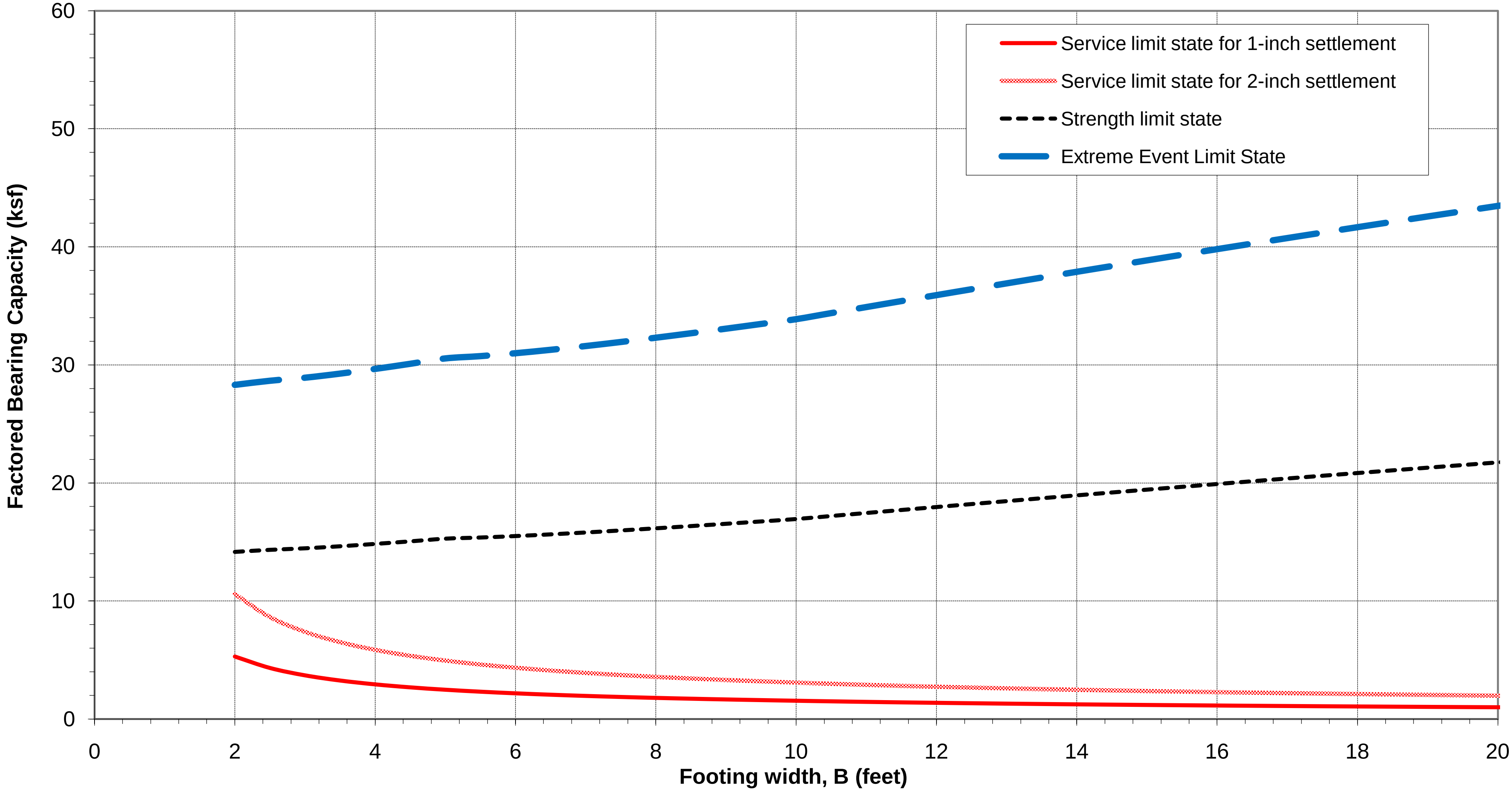
FIG. 4
Sheet 2 of 3

FIG. 4



NOTES

1. We recommend using the following resistance factors for footing LRFD design; the plotted bearing capacities use the bearing capacity resistance factors.

Limit State	Sliding Shear	Passive Press.	Bearing Capacity
Service	N/A	N/A	1.0
Strength	0.8	0.5	0.45
Extreme Event	1.0	1.0	0.9

2. The factored bearing capacities are based on a soil friction angle of 32 degrees, a soil cohesion of 0 psf, a total unit weight of 130 pcf, a Poisson's ratio of 0.3, and a soil elastic modulus of 300 ksf. We assumed that the bottom of the footing was 10 feet below the ground surface.

3. **psf** - pounds per square foot; **pcf** - pounds per cubic foot; **ksf** - kips per square foot (1 kip = 1000 pounds)

Mountain Air Drive Extension
Anchorage, Alaska

FACTORED BEARING CAPACITY VERSUS FOOTING WIDTH, DEPTH = 10 FT RECTANGULAR FOOTING, LENGTH = 48

June 2010 | 32-1-02055-002

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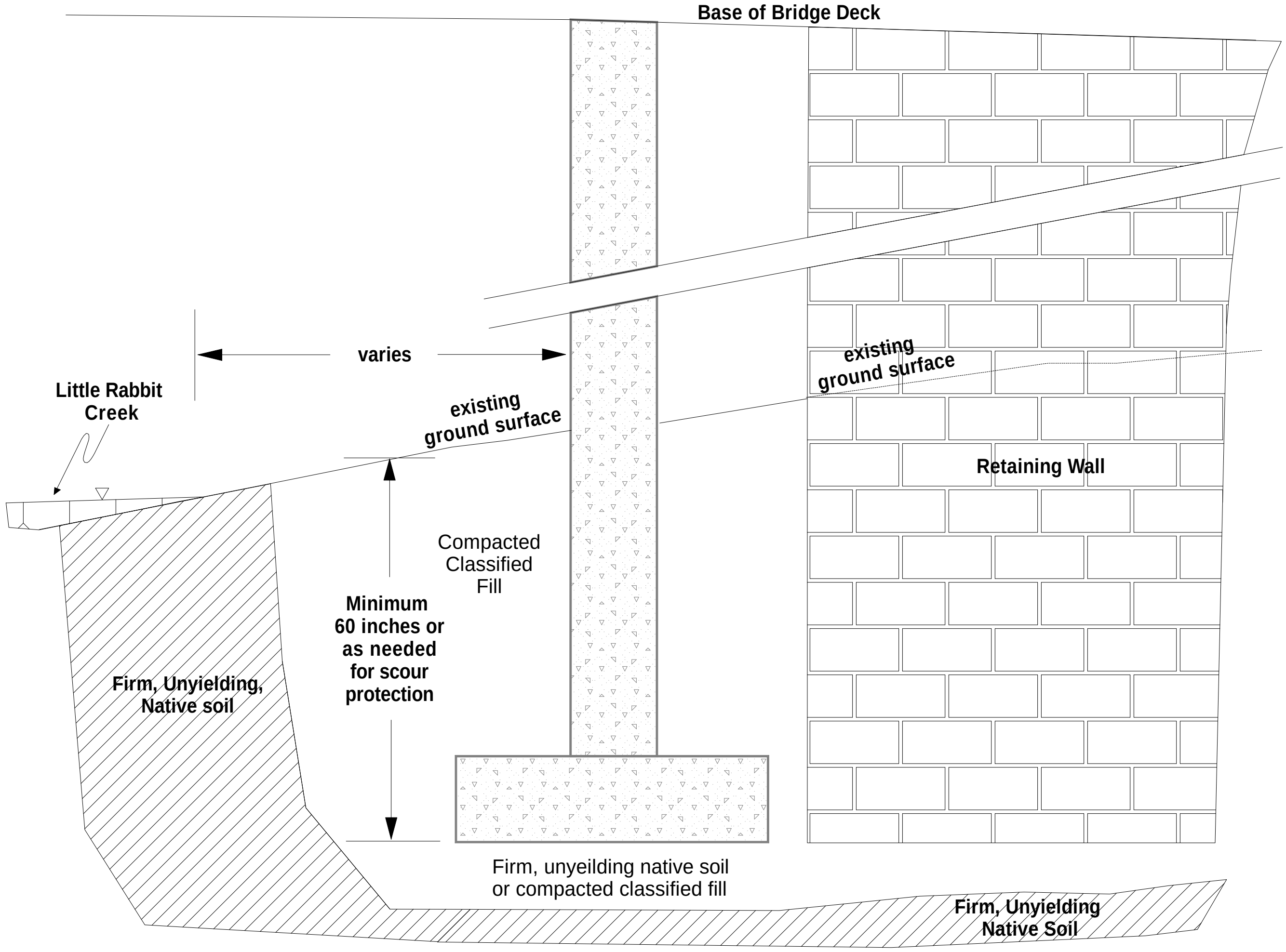
FIG. 4
Sheet 3 of 3

FIG. 4



NOTES:

1. If conditions render on-site soil unsuitable for compaction and drainage, backfill the zone shown above with free-draining granular soil with not more than 6% (by weight based on minus 3/4" portion) passing No. 200 sieve (by wet sieving) with no plastic fines.
2. All backfill should be placed in layers not exceeding 10 to 12 inches loose thickness and densely compacted. Structural fill should be compacted to 95% minimum, non-structural fill compacted to 90%, of ASTM D-1557.
3. Backfill within 18 inches of vertical foundation components should be placed in layers not exceeding 6 inches and densely compacted with hand-operated equipment. Heavy equipment should not be used for backfill, as such equipment operated near the wall could increase lateral earth pressures and possibly damage the wall.
4. If material beneath footing is soft and/or unsuitable, it should be overexcavated a minimum of 2 feet below footing grade and replaced with classified structural fill.

DRAWING NOT TO SCALE

Mountain Air Drive Extension
Anchorage, Alaska

TYPICAL FOOTING DETAIL

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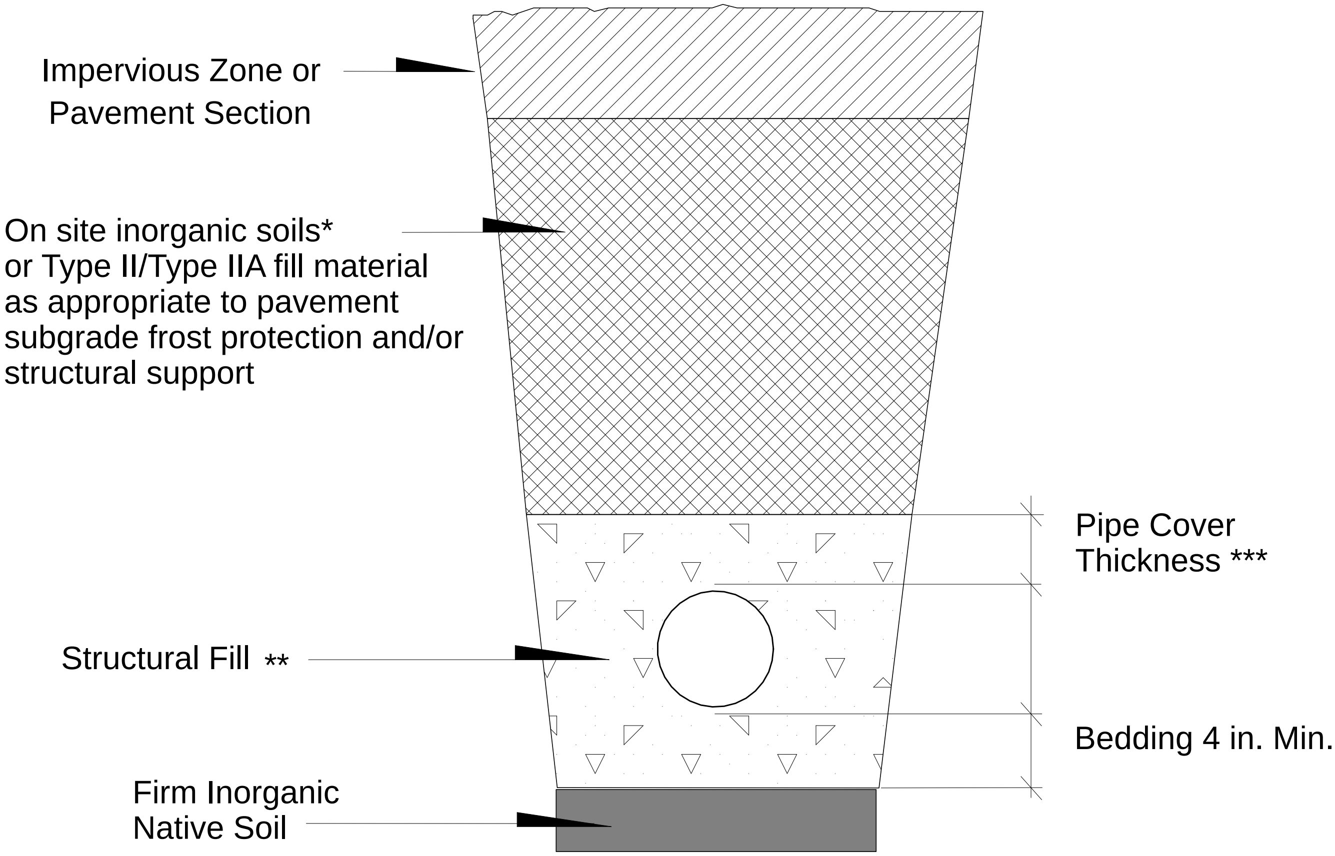
Fig. 5



* Inorganic soils, 95% compaction below structural fill supporting footings, streets, etc., 90% compaction in non structural support areas.

** Inorganic clean sand or well-graded sand and gravel (max. particle size 2-inch diameter) with less than 6 percent fines. Fill to be compacted to 95% Modified Proctor maximum dry density (ASTM D 1557) or as recommended by pipe manufacturer for specific application.

*** Pipe cover thickness as specified by pipe manufacturer for specific application. Absent manufacturer specifications, pipe cover thickness depends on corrosion and structural support properties. In non-structural support and non-corrosive environment, minimum bedding fill thickness should be at or above springline of pipe. In non-structural support area with corrosive environment, pipe cover should extend at least 6-inches above top of pipe. In structural support area, minimum pipe cover should be 6-inches or one pipe diameter above top of pipe, whichever is greater.

NOTE:

OSHA requires slope protection and support for all trenches greater than 4 feet deep. Side slope requirements are variable depending upon soil type and the duration of time in which the trench remains open. The contractor should be made responsible for compliance to these regulations as he/she is at the project on a day to day basis and is aware of changing conditions.

DRAWING NOT TO SCALE

Mountain Air Drive Extension
Anchorage, Alaska

UTILITY TRENCH DETAIL

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Fig. 6

APPENDIX A

BORING LOGS AND LABORATORY RESULTS

Figures

Unified Soil Classification System

GROUP NAME Criteria for Assigning Group Names and Group Symbols			Soil Classification Group Symbol	with Generalized Group Descriptions
COARSE-GRAINED SOILS more than 50% retained on No. 200 sieve	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	Clean GRAVELS Less than 5% fines	GW	Well-graded Gravels
			GP	Poorly-graded Gravels
		GRAVELS with fines More than 12% fines	GM	Gravel & Silt Mixtures
			GC	Gravel & Clay Mixtures
	SANDS More than 50% of coarse fraction passes No. 4 sieve	Clean SANDS Less than 5% fines	SW	Well-graded Sands
			SP	Poorly-graded Sands
		SANDS with fines More than 12% fines	SM	Sand & Silt Mixtures
			SC	Sand & Clay Mixtures
FINE-GRAINED SOILS 50% or more passes the No. 200 sieve	SILTS AND CLAYS Liquid limit 50% or less	INORGANIC	ML	Non-plastic & Low-plasticity Silts
			CL	Low-plasticity Clays
		ORGANIC	OL	Non-plastic and Low-plasticity Organic Clays Non-plastic and Low-plasticity Organic Silts
	SILTS AND CLAYS Liquid limit greater than 50%	INORGANIC	CH	High-plasticity Clays
			MH	High-plasticity Silts
		ORGANIC	OH	High-plasticity Organic Clays High-plasticity Organic Silts
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat

Organic Content

Adjective	Percent by Volume
Occasional	0-1
Scattered	1-10
Numerous	10-30
Organic	30-50, minor constituent
Peat	50-100, MAJOR constituent

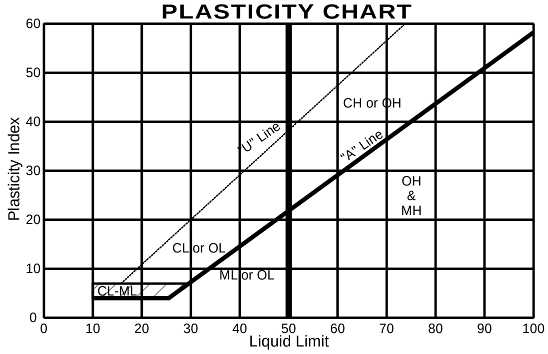
Descriptive Terminology Denoting Component Proportions

Description	Range of Proportion
Add the adjective "slightly"	5 - 12%
Add soil adjective[(a)]	12 - 50%
Major proportion in upper case, (e.g., SAND)	>50%

(a) Use gravelly, sandy, or silty as appropriate

NOTE: The soil descriptions used in the boring logs lists constituents from smallest percentage to largest percentage.

PLASTICITY CHART



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SOIL CLASSIFICATION LEGEND

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Fig. A-1

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FROST CLASSIFICATION

(after Municipality of Anchorage)

GROUP		0.02 Mil.	P-200	USC SYSTEM (based on P-200 results)
NFS	Sandy Soils		0 to 3	SW, SP
	Gravelly Soils	0 to 3	0 to 6	GW, GP, GW-GM, GP-GM
F1	Sandy Soils	0 to 3	3 to 6	SW, SP, SW-SM, SP-SM
	Gravelly Soils	3 to 10	6 to 13	GM, GW-GM, GP-GM
F2	Sandy Soils	3 to 15	6 to 19	SP-SM, SW-SM, SM
	Gravelly Soils	10 to 20	13 to 25	GM
F3	Sands, except very fine silty sands**	Over 15	Over 19	SM, SC
	Gravelly Soils	Over 20	Over 25	GM, GC
	Clays, PI>12			CL, CH
F4	All Silts			ML, MH
	Very fine silty sands**	Over 15	Over 19	SM, SC
	Clays, PI<12			CL, CL-ML
	Varved clays and other fined grained, banded sediments			CL and ML CL, ML, and SM; SL, SH, and ML; CL, CH, ML, and SM

P-200 = Percent passing the number 200 sieve
0.02 Mil. = Percent material below 0.02 millimeter grain size

*Approximate P-200 value equivalent for frost classification.
Value range based on typical, well-graded soil curves.
P-200 criteria in absence of hydrometer data.

** Very fine sand : greater than 50% of sand fraction passing the number 100 sieve

Mountain Air Drive Extension
Anchorage, Alaska

FROST CLASSIFICATION LEGEND

June 2010 32-1-02055-002

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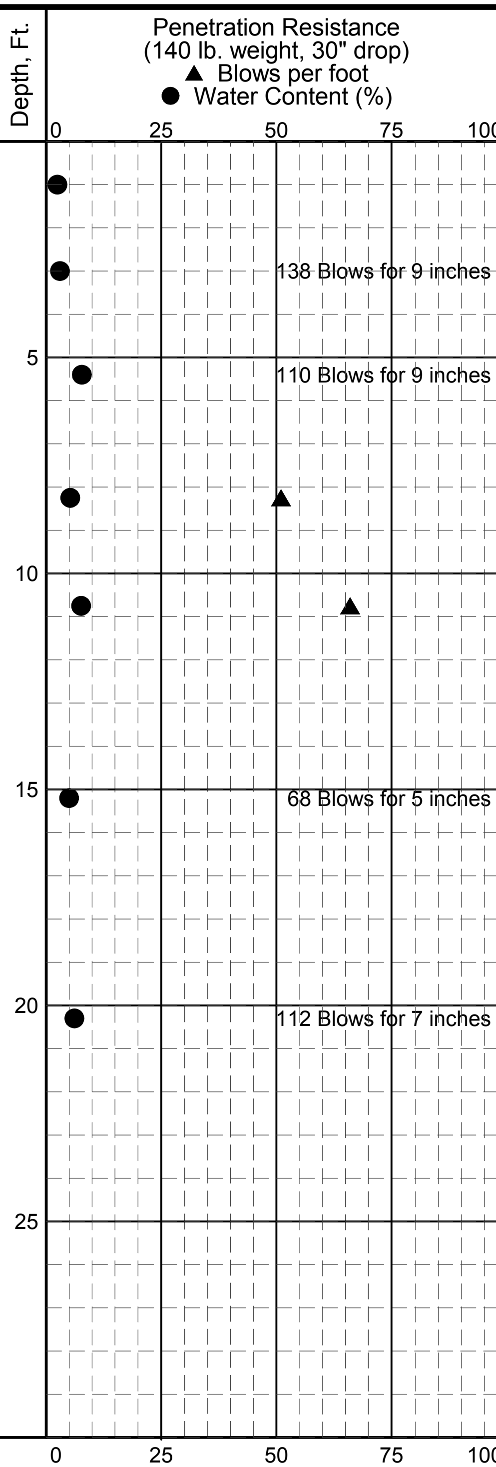
Fig. A-2

MATERIAL DESCRIPTION Approx. Elevation: 940 Ft.	Depth, Ft.	Samples	Ground Water
1 1/2 inches of asphalt on surface Frozen, brown, slightly silty to silty, sandy GRAVEL; moist [FILL] SBulk 0-5 ft bgs: 46% Gravel, 42% Sand, 12% Fines (F1 (P200))	0.1	S1 S2 SBulk 0-5 ft bgs S3	
Very dense, brown, gravelly, silty SAND; moist S4: 23% Gravel, 51% Sand, 26% Fines (F3 (P200))	6.0	S4 S5 S6 S7	Groundwater not encountered during drilling on 3/1/10
Bottom of Boring Boring Completed 3/1/10	20.6		



LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- Bulk Sample
- Frozen

● Water Content (%)

Plastic Limit |—●—| Liquid Limit

Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

Mountain Air Drive Extension
Anchorage, Alaska

LOG OF BORING B-01

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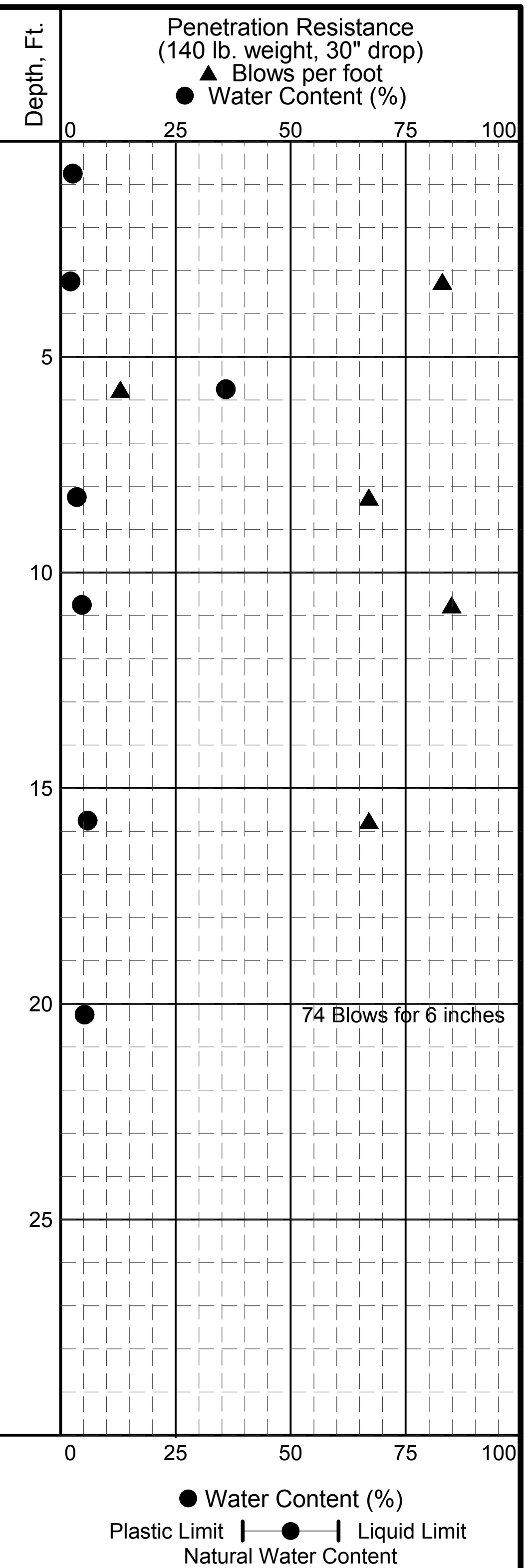
Fig. A-3

MATERIAL DESCRIPTION Approx. Elevation: 944 Ft.	Depth, Ft.	Samples	Ground Water
2 inches asphalt on surface Frozen, brown, slightly silty to silty, sandy GRAVEL; moist [FILL] SBulk 0-4 ft bgs: 45% Gravel, 40% Sand, 15% Fines (F1 (0.02mm))	0.2	S1, SBulk 0-4 ft bgs, S2	Groundwater not encountered during drilling on 3/1/10
Frozen, brown, gravelly, sandy SILT; moist S3: 51% Fines (F4 (P200))	4.0	S3	
Very dense, brown, silty, gravelly SAND; moist S5: 28% Gravel, 52% Sand, 20% Fines (F3 (P200))	7.0	S4, S5, S6, S7	
Bottom of Boring Boring Completed 3/1/10	20.5		



LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- Bulk Sample
- Frozen

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

Mountain Air Drive Extension
Anchorage, Alaska

LOG OF BORING B-02

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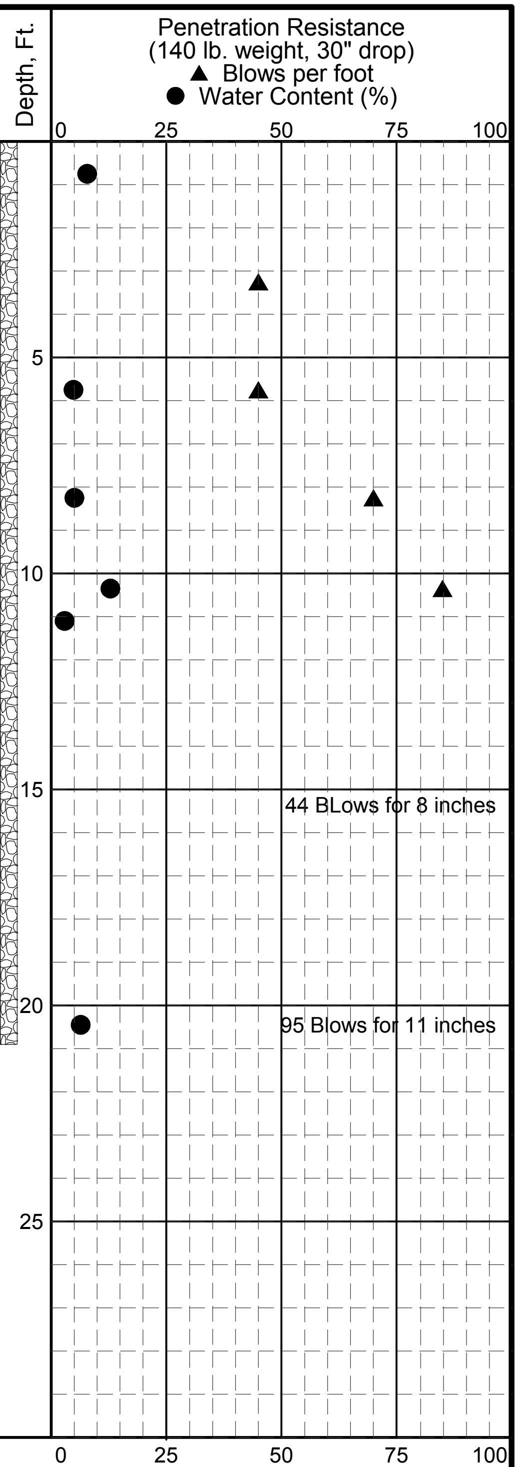
Fig. A-4

MATERIAL DESCRIPTION	Depth, Ft.	Samples
Approx. Elevation: 942 Ft.		
Frozen, tan, slightly silty, gravelly SAND; moist [FILL?]		S1
Frozen to very dense, tan, silty, gravelly SAND; moist	2.0	S2 *
SBulk 0-7 ft bgs: 31% Gravel, 47% Sand, 22% Fines (F3 (P200))		SBulk 0-7 ft bgs
		S3
S4: 33% Gravel, 43% Sand, 25% Fines (F3 (P200))		S4
Hard, tan SILT; moist	9.5	S5a
Very dense, tan, slightly silty, gravelly SAND; moist	10.7	S5b
Very dense, tan, silty, sandy GRAVEL; moist	13.0	S6 *, S7
Bottom of Boring Boring Completed 2/26/10	20.9	

Ground Water: Groundwater not encountered during drilling on 2/26/10



LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- Bulk Sample
- Frozen
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill
- Well Casing and Filter Sand
- Bentonite Seal

● Water Content (%)

Plastic Limit |—●—| Liquid Limit

Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
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Mountain Air Drive Extension
Anchorage, Alaska

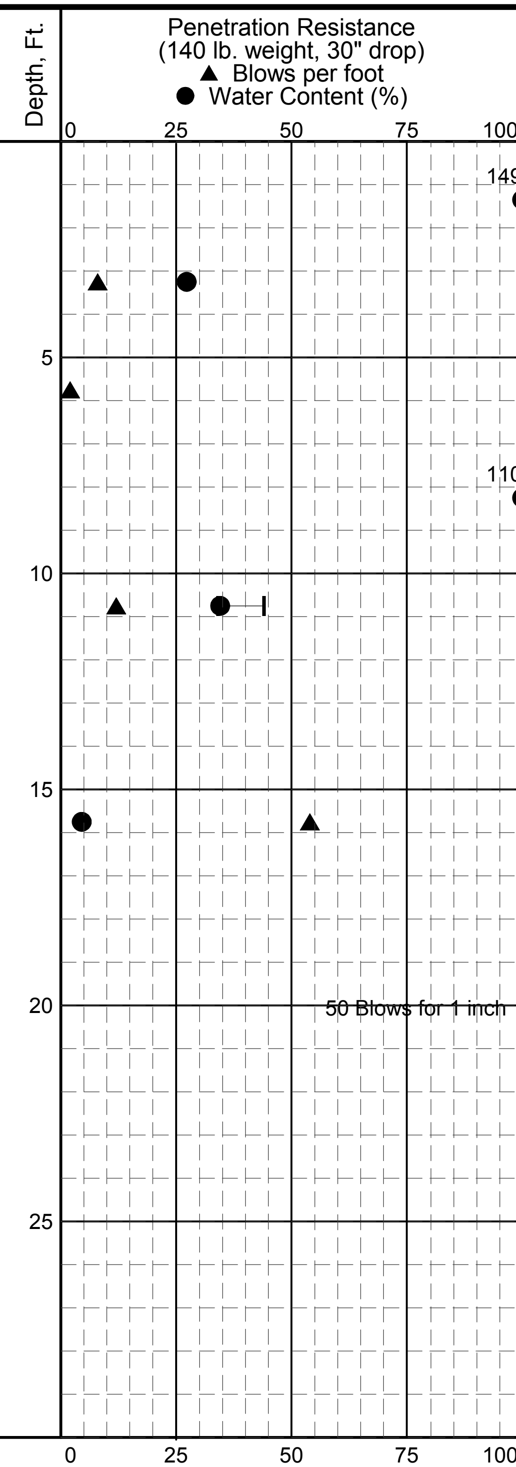
LOG OF BORING B-03

June 2010 32-1-02055-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Fig. A-5

MATERIAL DESCRIPTION Approx. Elevation: 938 Ft.	Depth, Ft.	Samples	Ground Water
Frozen, tan, silty, sandy GRAVEL; moist [FILL]	0.7		
Frozen, dark brown, organic SILT; moist	2.5	S1	
Frozen to stiff, mottled light gray/red-orange SILT; moist to wet	3.8	S2	
Loose, red-orange SAND; wet	4.5		
Soft, tan, silty PEAT; moist Sample S4: Sampler penetrates 1.5 feet with weight of hammer	10.5	S3 * S4	
Very stiff, gray, sandy SILT; moist to wet	13.0	S5	
Very dense, tan, silty, gravelly SAND; moist S6: 42% Gravel, 46% Sand, 13% Fines (F2 (P200))	20.1	S6 S7 *	Groundwater not encountered during drilling on 2/26/10
Bottom of Boring Boring Completed 2/26/10			



LEGEND

* Sample Not Recovered
2" O.D. Split Spoon Sample
Bulk Sample
Frozen

● Water Content (%)
Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
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Mountain Air Drive Extension
Anchorage, Alaska

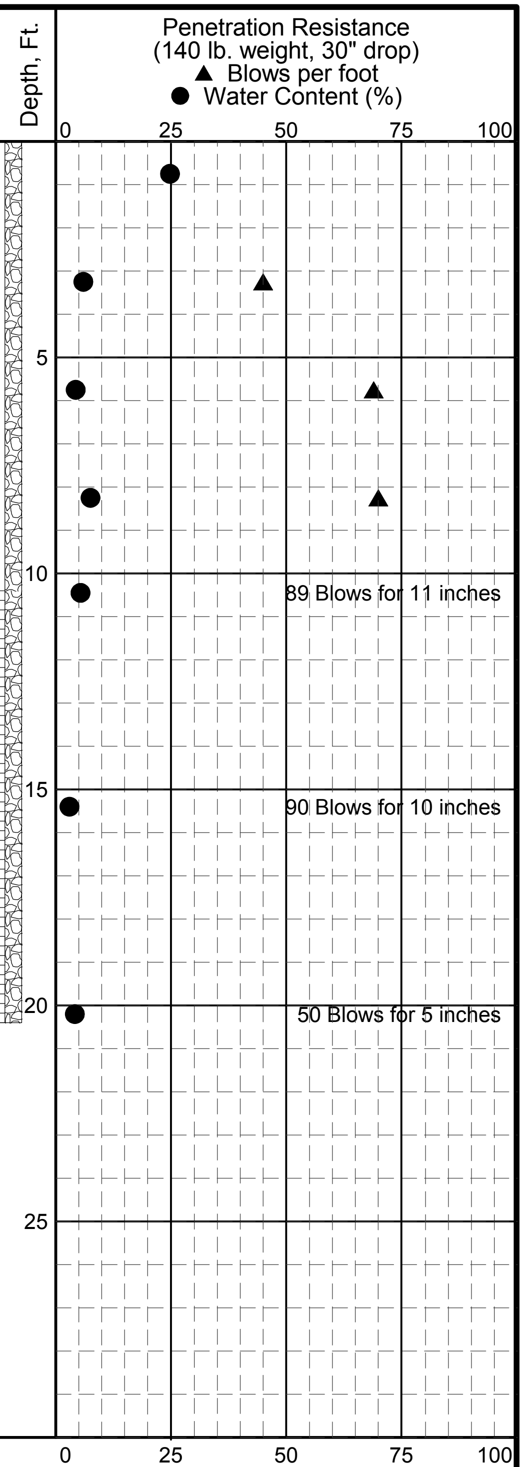
LOG OF BORING B-04

June 2010 32-1-02055-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Fig. A-6

MATERIAL DESCRIPTION Approx. Elevation: 940 Ft.	Depth, Ft.	Symbol	Samples	Ground Water
Frozen, brown, slightly gravelly, silty SAND; moist S1: 7% Gravel, 52% Sand, 40% Fines (F3 (P200))			S1	
Very dense, tan, silty, gravelly SAND; moist S3: 32% Gravel, 48% Sand, 20% Fines (F2 (0.02mm))	2.5		S2 S3	
Very dense, tan, slightly gravelly, silty SAND to silty, gravelly SAND; moist	7.0		S4 S5	Groundwater not encountered during drilling on 2/26/10
Very dense, tan, silty, sandy GRAVEL; moist	15.5		S6	
Bottom of Boring Boring Completed 2/26/10	20.4		S7	



LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- Bulk Sample
- Frozen
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill
- Well Casing and Filter Sand
- Bentonite Seal

● Water Content (%)

Plastic Limit ├──●──┤ Liquid Limit

Natural Water Content

NOTES

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2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
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Mountain Air Drive Extension
Anchorage, Alaska

LOG OF BORING B-05

June 2010 32-1-02055-002

SHANNON & WILSON, INC.
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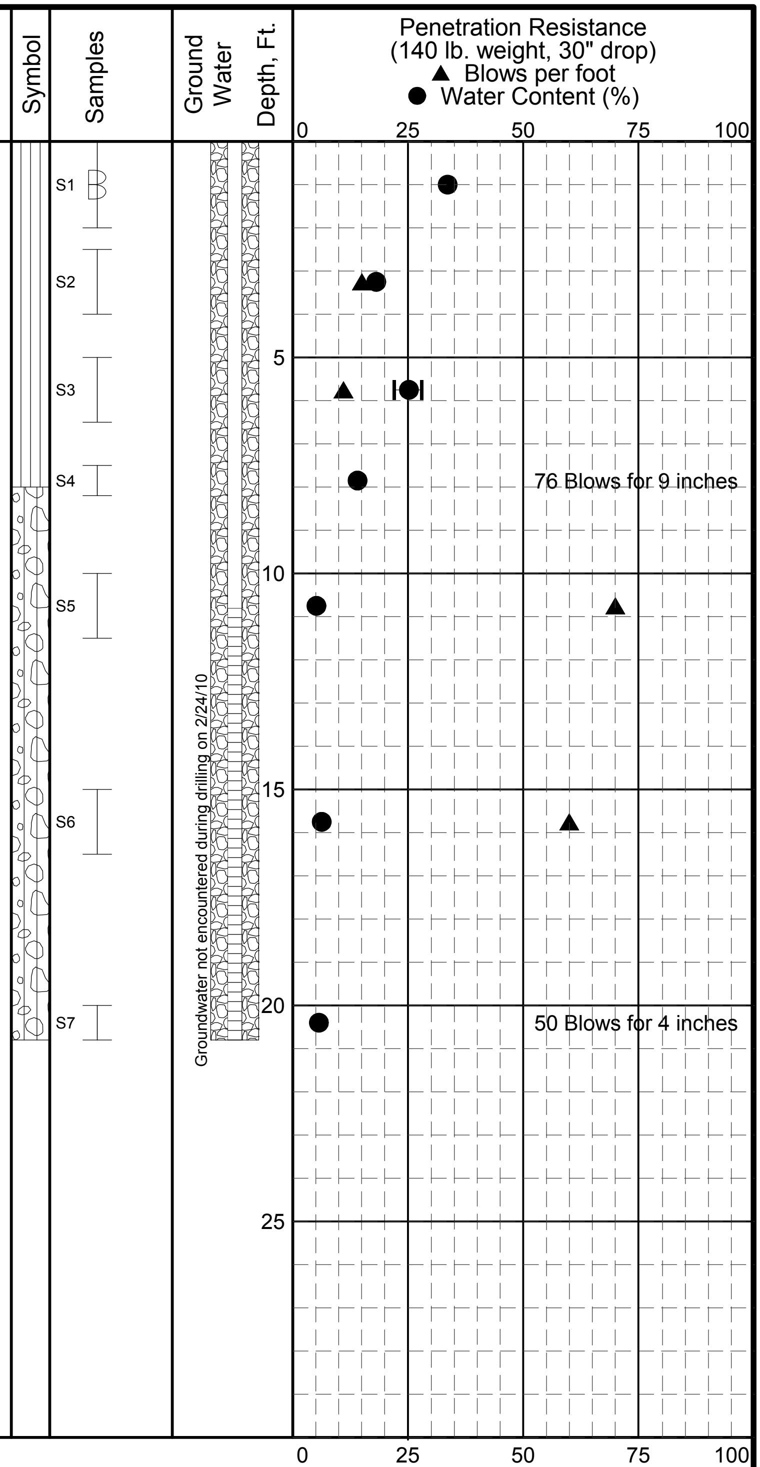
Fig. A-7

GEOTECHNICAL LOG 02055-002 GINT.GPJ S&W GEO1.GDT 6/21/10

MATERIAL DESCRIPTION Approx. Elevation: 946 Ft.	Depth, Ft.
Frozen to stiff, tan/brown mottled, sandy, clayey SILT; moist	
Very dense, brown, slightly silty to silty, sandy GRAVEL; moist	8.0
Bottom of Boring Boring Completed 2/24/10	20.8



LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- Bulk Sample
- Frozen
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill
- Well Casing and Filter Sand
- Bentonite Seal

● Water Content (%)

Plastic Limit |—●—| Liquid Limit

Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
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Mountain Air Drive Extension
Anchorage, Alaska

LOG OF BORING B-06

June 2010 32-1-02055-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Fig. A-8

MATERIAL DESCRIPTION Approx. Elevation: 924 Ft.	Depth, Ft.	Symbol	Samples	Ground Water
Medium dense, brown, silty, gravelly SAND; moist [FILL?] S1: 39% Gravel, 41% Sand, 20% Fines (F3 (P200))			S1	
Frozen to stiff, brown, sandy SILT; moist S2: 58% Fines (F4 (P200))	2.0		S2 S3	
Dense to very dense, brown and gray, silty, gravelly SAND; moist S4: 42% Gravel, 42% Sand, 16% Fines (F3 (P200))	7.0		S4 S5 S6 S7 S8	2/25/10

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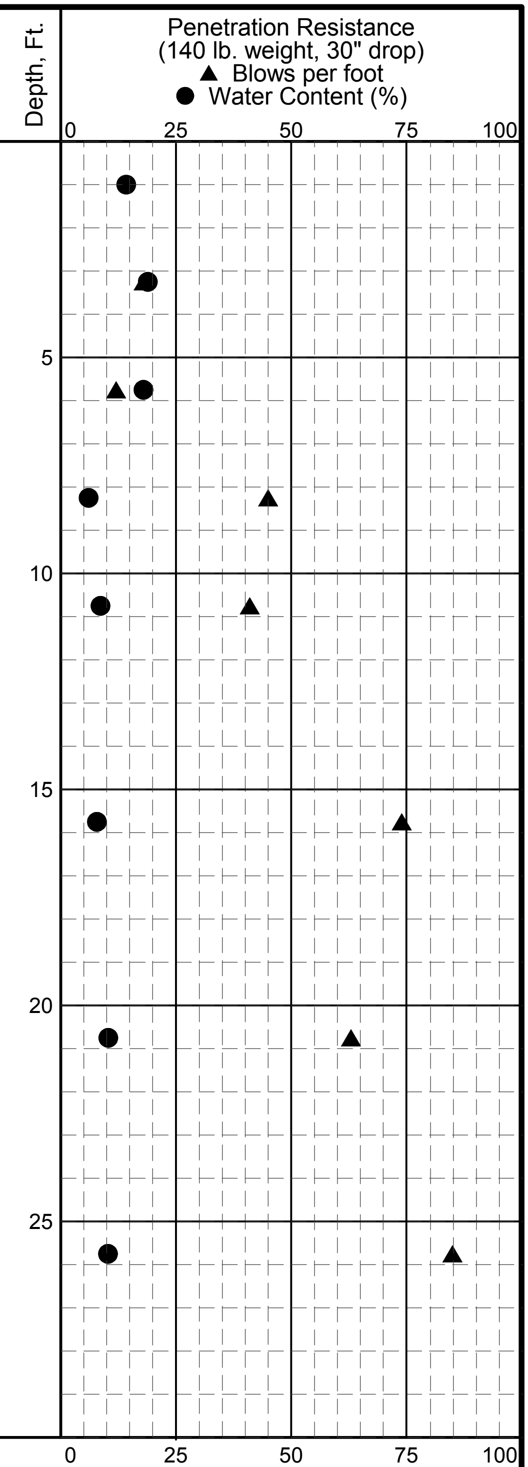

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- Bulk Sample
- Frozen
- Ground Water Level At Time Of Drilling

● Water Content (%)
Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

NOTES

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Mountain Air Drive Extension
Anchorage, Alaska

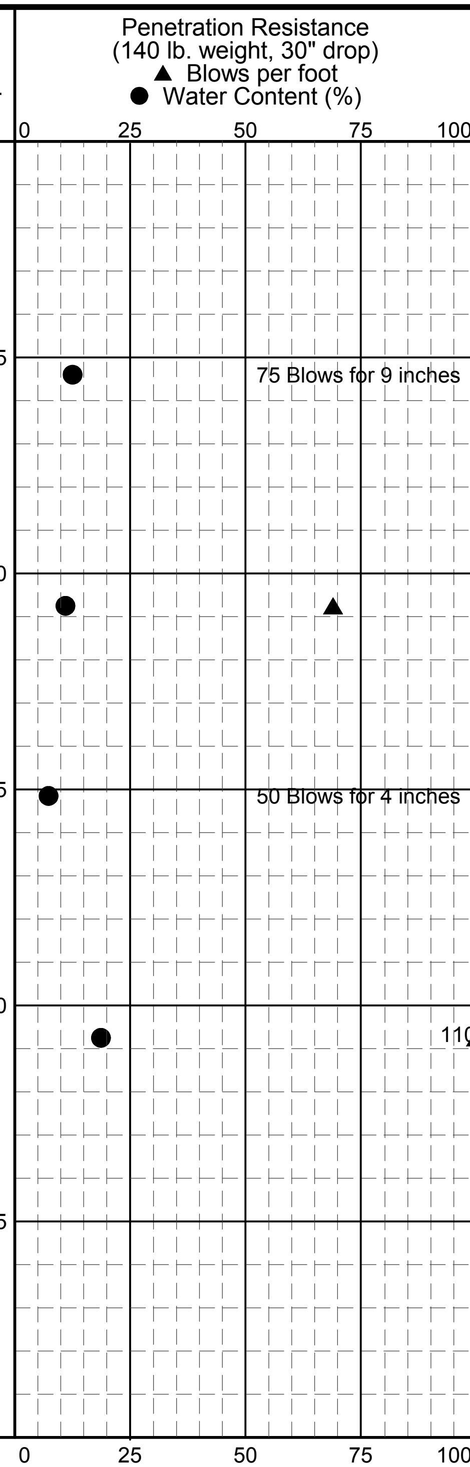
LOG OF BORING B-07

June 2010 | 32-1-02055-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Fig. A-9
Sheet 1 of 2

MATERIAL DESCRIPTION	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.
Approx. Elevation: 924 Ft.					
Dense to very dense, brown and gray, silty, gravelly SAND; moist					
Very dense, gray, sandy, silty GRAVEL to hard, gray, gravelly, sandy SILT; moist to wet	32.0		S9		35
			S10		40
			S11		45
			S12		50
Bottom of Boring Boring Completed 2/25/10	51.5				55



LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- Bulk Sample
- Frozen
- Ground Water Level At Time Of Drilling

● Water Content (%)

Plastic Limit ├──●──┤ Liquid Limit

Natural Water Content

NOTES

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2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
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Mountain Air Drive Extension
Anchorage, Alaska

LOG OF BORING B-07

June 2010 32-1-02055-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Fig. A-9
Sheet 2 of 2

GEOTECHNICAL LOG 02055-002 GINT.GPJ S&W GEO1.GDT 6/21/10

MATERIAL DESCRIPTION Approx. Elevation: 937 Ft.	Depth, Ft.	Samples
Frozen, brown, silty, gravelly SAND; moist [FILL?] S1: 31% Gravel, 45% Sand, 25% Fines (F3 (P200))		S1
Frozen to very dense, brown, slightly silty, sandy GRAVEL; moist	2.0	S2, S3, S4
Hard, brown SILT; moist	10.0	S5
Very dense, brown, slightly silty, sandy GRAVEL; moist	11.0	S6, S7, S8
Hard, brown and gray, sandy SILT; moist	28.0	

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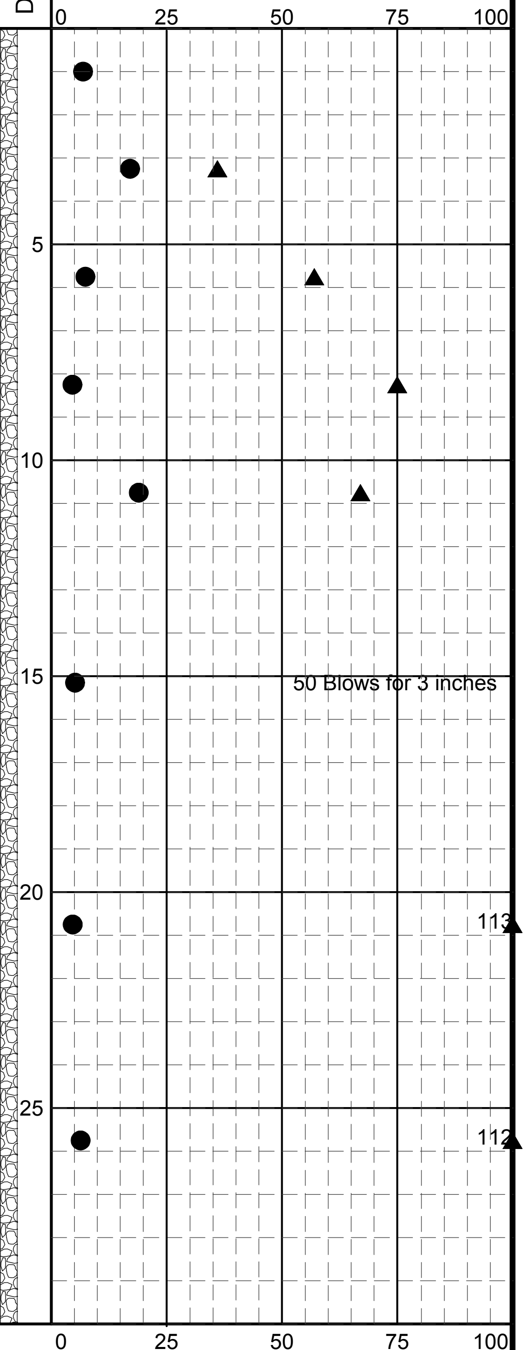
Ground Water

Penetration Resistance (140 lb. weight, 30" drop)
▲ Blows per foot
● Water Content (%)



LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- Bulk Sample
- Frozen
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill
- Well Casing and Filter Sand
- Bentonite Seal
- Ground Water Level At Time Of Drilling
- Static Water Level

● Water Content (%)
Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

Mountain Air Drive Extension
Anchorage, Alaska

LOG OF BORING B-08

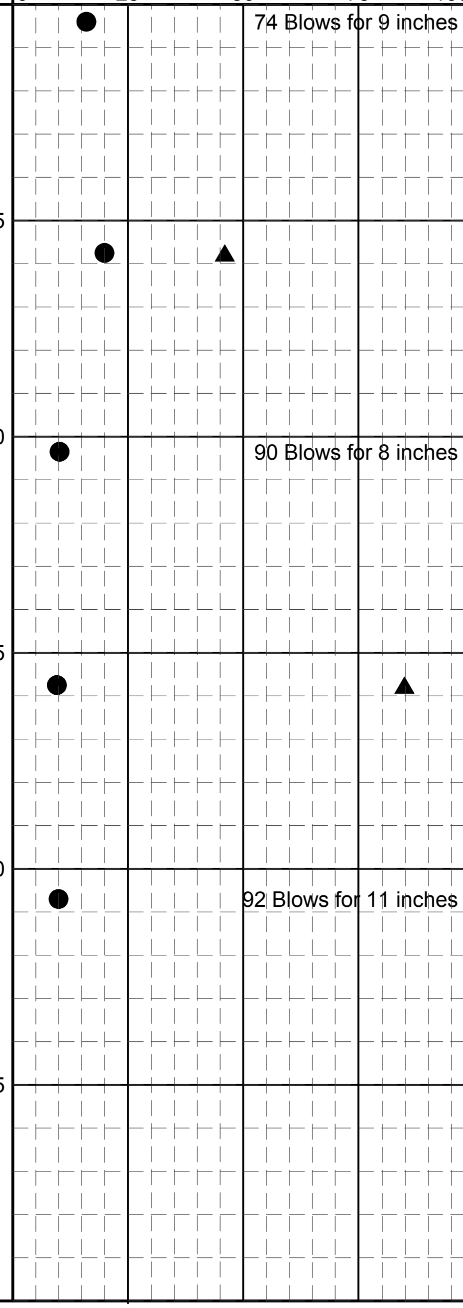
June 2010 32-1-02055-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Fig. A-10
Sheet 1 of 2

MATERIAL DESCRIPTION Approx. Elevation: 937 Ft.	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.
Hard, brown and gray, sandy SILT; moist			S9		
					35
6 inches of slightly silty SAND from approximately 35.5 to 36 feet bgs.			S10	2/26/10 ▽	
Very dense, dark brown, slightly silty, sandy GRAVEL; wet	38.0			3/18/10 ▼	
			S11		40
Very dense, dark gray, slightly silty to silty, gravelly SAND; wet	43.0				
			S12		45
			S13		50
Bottom of Boring Boring Completed 2/25-26/10	51.4				
					55

Penetration Resistance (140 lb. weight, 30" drop)
▲ Blows per foot
● Water Content (%)



LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- Bulk Sample
- Frozen
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill
- Well Casing and Filter Sand
- Bentonite Seal
- ▽ Ground Water Level At Time Of Drilling
- ▼ Static Water Level

● Water Content (%)

Plastic Limit |—●—| Liquid Limit

Natural Water Content

NOTES

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Mountain Air Drive Extension
Anchorage, Alaska

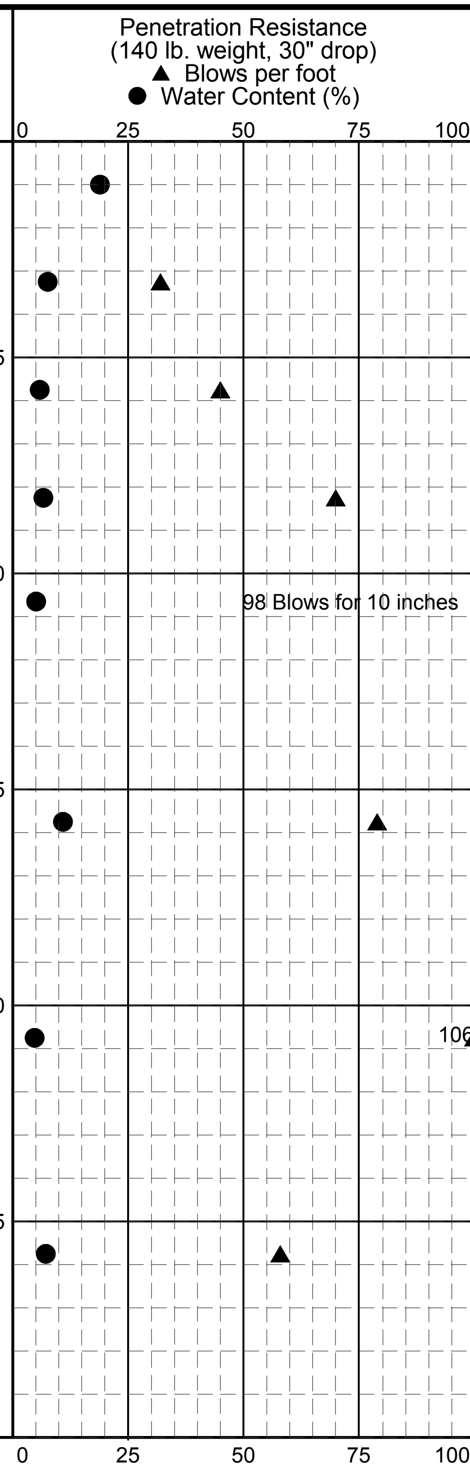
LOG OF BORING B-08

June 2010 32-1-02055-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Fig. A-10
Sheet 2 of 2

MATERIAL DESCRIPTION	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.
Approx. Elevation: 946 Ft.					
Frozen, light brown, slightly sandy to sandy SILT with occasional organics; moist			S1		
Medium dense to dense, brown, gravelly, silty SAND; moist S2: 19% Gravel, 42% Sand, 40% Fines (F3 (P200))	2.0		S2 S3		5
S4: 26% Gravel, 48% Sand, 26% Fines (F3 (P200)) Very dense, brown, slightly silty to silty, gravelly SAND and slightly silty, sandy GRAVEL; moist to wet	7.0		S4 S5 S6 S7 S8		10 15 20 25



CONTINUED NEXT PAGE

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- Bulk Sample
- Frozen
- Ground Water Level At Time Of Drilling

● Water Content (%)
Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

NOTES

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Mountain Air Drive Extension
Anchorage, Alaska

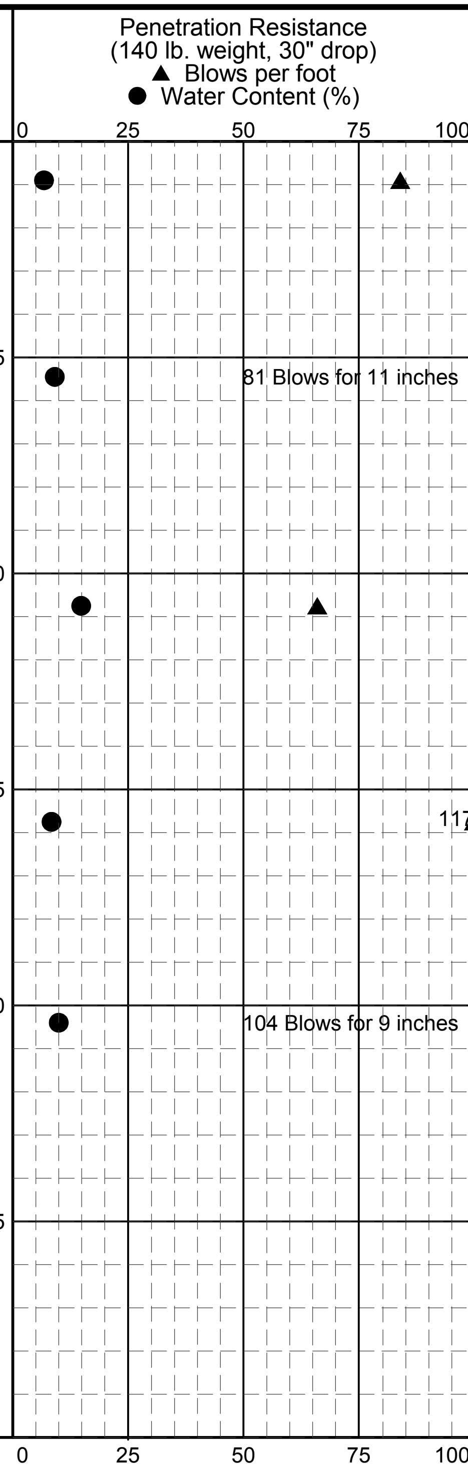
LOG OF BORING B-09

June 2010 32-1-02055-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Fig. A-11
Sheet 1 of 2

MATERIAL DESCRIPTION Approx. Elevation: 946 Ft.	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.
Very dense, brown, slightly silty to silty, gravelly SAND and slightly silty, sandy GRAVEL; moist to wet			S9, S10, S11	3/3/10 ▽	35, 40
Very dense, gray, slightly silty, gravelly SAND; wet	42.0		S12, S13		45, 50
Bottom of Boring Boring Completed 3/2-3/10	50.8				55



LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- Bulk Sample
- Frozen
- ▽ Ground Water Level At Time Of Drilling

● Water Content (%)
Plastic Limit |—●—| Liquid Limit
Natural Water Content

NOTES

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Mountain Air Drive Extension
Anchorage, Alaska

LOG OF BORING B-09

June 2010 32-1-02055-002

SHANNON & WILSON, INC.
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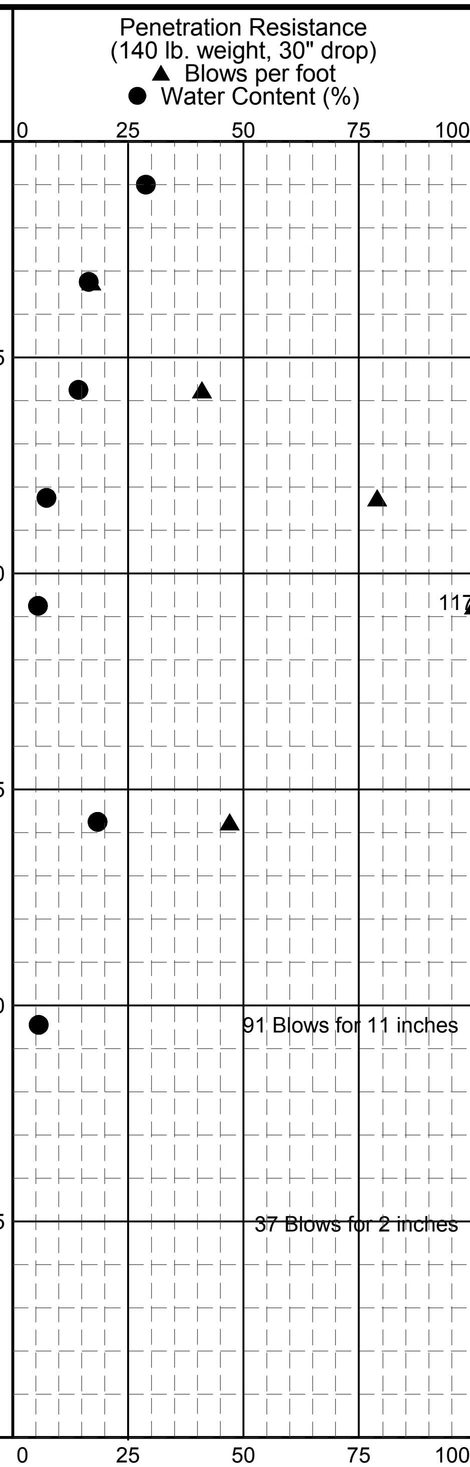
Fig. A-11
Sheet 2 of 2

GEOTECHNICAL LOG 02055-002 GINT.GPJ S&W GEO1.GDT 6/21/10

MATERIAL DESCRIPTION Approx. Elevation: 947 Ft.	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.
Frozen to very stiff, brown, sandy SILT; moist S1: 89% Fines (F4 (P200))			S1		
S2: 2% Gravel, 22% Sand, 76% Fines (F4 (0.02mm))			S2		
Dense to very dense, brown, silty, gravelly SAND; moist	4.5		S3		5
			S4		
S5: 33% Gravel, 51% Sand, 16% Fines (F3 (P200))			S5		10
Hard, brown, slightly sandy to sandy SILT; moist	13.0				
			S6		15
Very dense, brown, slightly silty, sandy GRAVEL; moist	17.0				
			S7		20
			S8 *		25



CONTINUED NEXT PAGE

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- Bulk Sample
- Frozen
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill
- Well Casing and Filter Sand
- Bentonite Seal
- Ground Water Level At Time Of Drilling
- Static Water Level

● Water Content (%)

Plastic Limit ├─●─┤ Liquid Limit

Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
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Mountain Air Drive Extension
Anchorage, Alaska

LOG OF BORING B-10

June 2010 32-1-02055-002

SHANNON & WILSON, INC.
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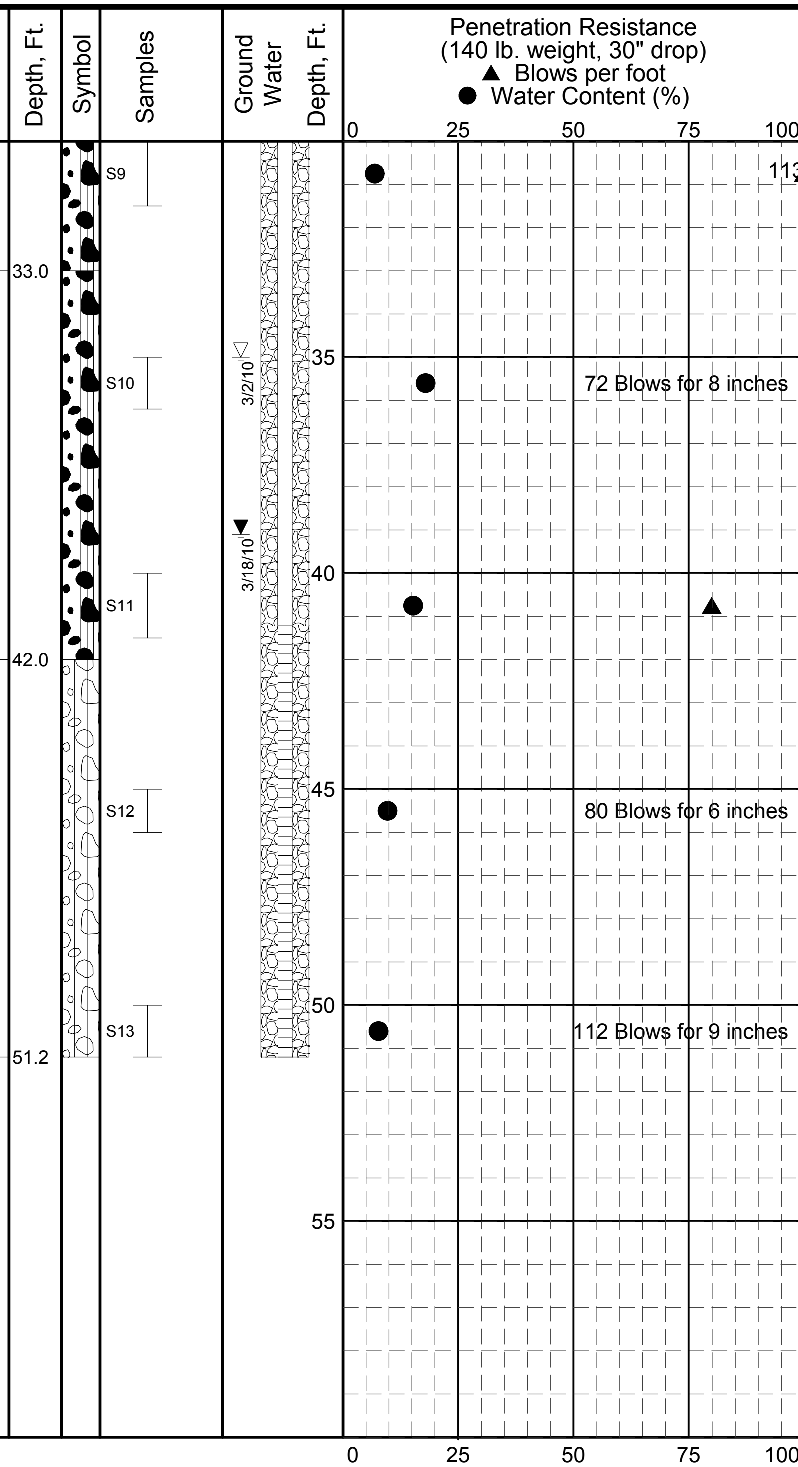
Fig. A-12
Sheet 1 of 2

MATERIAL DESCRIPTION Approx. Elevation: 947 Ft.	Depth, Ft.
Very dense, brown, slightly silty, sandy GRAVEL; moist	33.0
Very dense, brown, slightly silty, sandy GRAVEL interbedded with very dense, brown, silty SAND; wet	42.0
Very dense, brown and gray, slightly silty to silty, sandy GRAVEL; wet	51.2

Bottom of Boring
Boring Completed 3/2/10



LEGEND

*	Sample Not Recovered
	2" O.D. Split Spoon Sample
	Bulk Sample
▮	Frozen
	Blank Section, Cuttings Backfill
	Slotted Section, Cuttings Backfill
	Well Casing and Filter Sand
	Bentonite Seal
▽	Ground Water Level At Time Of Drilling
▼	Static Water Level

0 25 50 75 100

● Water Content (%)

Plastic Limit |—●—| Liquid Limit

Natural Water Content

NOTES

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Mountain Air Drive Extension
Anchorage, Alaska

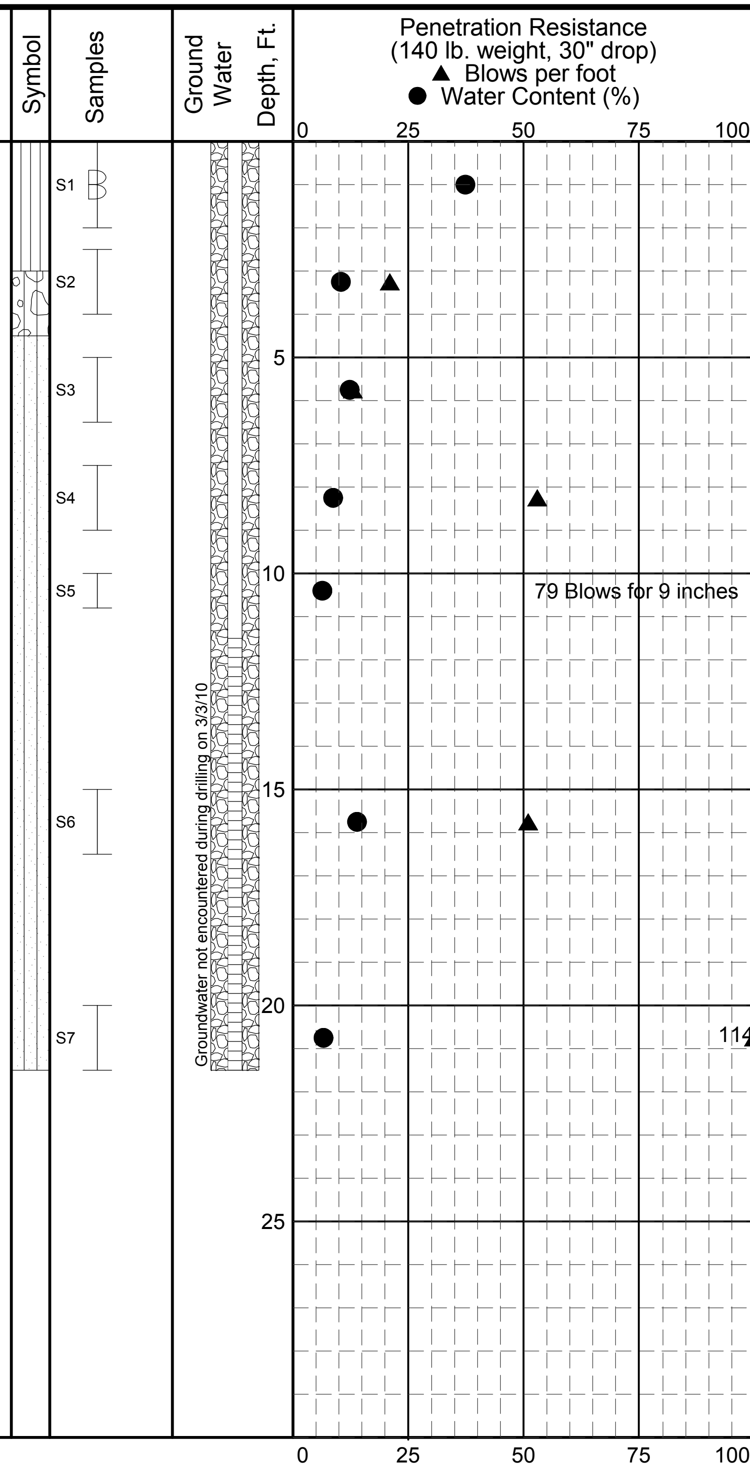
LOG OF BORING B-10

June 2010 32-1-02055-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Fig. A-12
Sheet 2 of 2

MATERIAL DESCRIPTION	Depth, Ft.
Approx. Elevation: 950 Ft.	
Frozen, brown, slightly sandy SILT with numerous organics; moist	
Medium dense, brown, silty, sandy GRAVEL; moist	3.0
Medium dense to very dense, brown, gravelly, silty SAND; moist S3: 17% Gravel, 46% Sand, 37% Fines (F3 (0.02mm)) S4: 25% Gravel, 46% Sand, 29% Fines (F3 (P200)) 5 inch layer of laminated sandy SILT at approximately 15.5 feet bgs.	4.5
Bottom of Boring Boring Completed 3/3/10	21.5



LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- Bulk Sample
- Frozen
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill
- Well Casing and Filter Sand
- Bentonite Seal

● Water Content (%)

Plastic Limit |—●—| Liquid Limit

Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
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Mountain Air Drive Extension
Anchorage, Alaska

LOG OF BORING B-11

June 2010 32-1-02055-002

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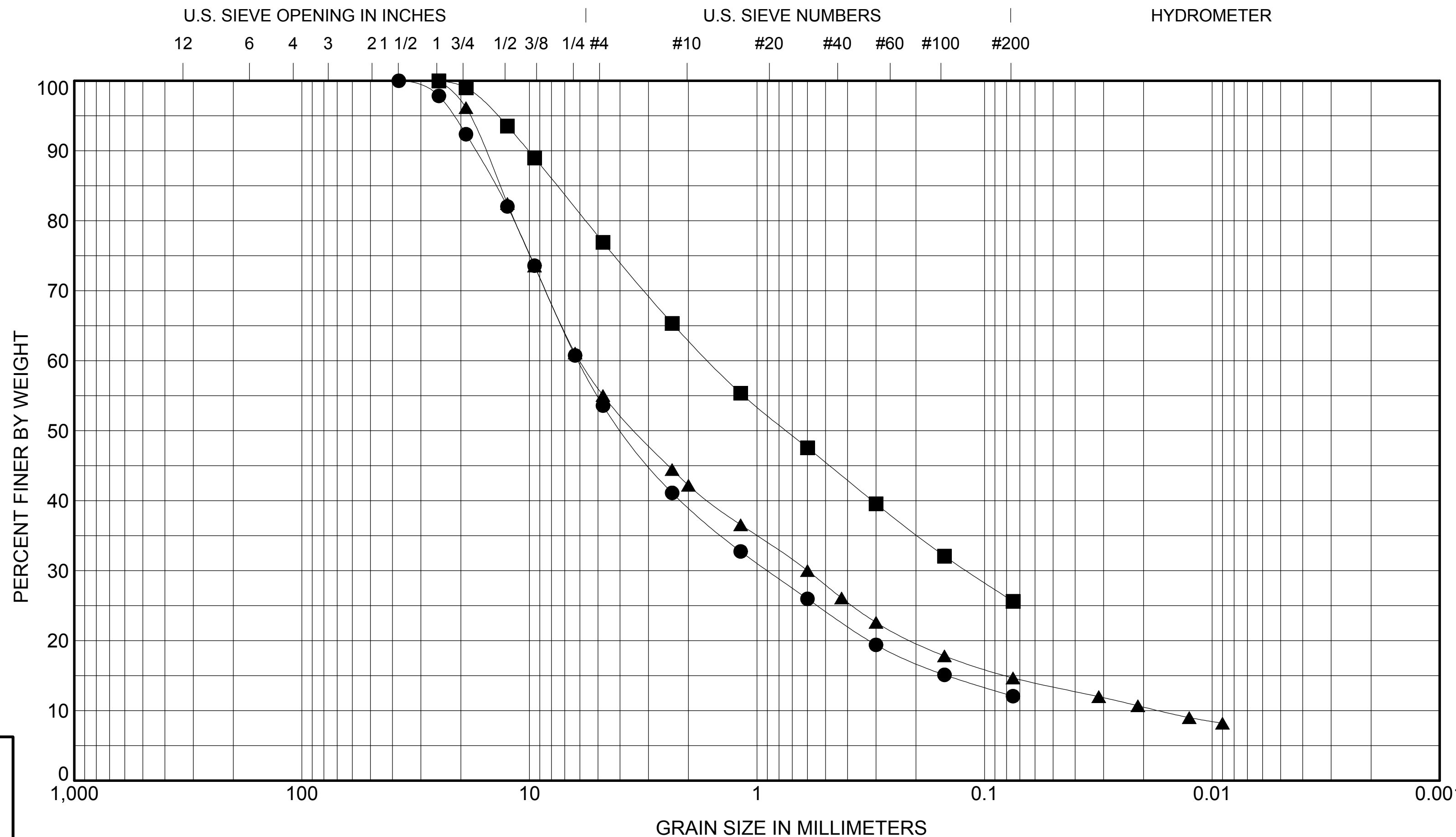
Fig. A-13



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**B-01 SBulk**	**0.0 - 5.0**	**Slightly silty, sandy GRAVEL (GW-GM)**				**2.8**	**130.6**
■	**B-01 S4**	**7.5 - 9.0**	**Gravelly, silty SAND (SM)**					
▲	**B-02 SBulk**	**0.0 - 5.0**	**Silty, sandy GRAVEL (GM)**				**3.5**	**349.9**

	Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt / %Clay
●	**B-01 SBulk**	**0.0 - 5.0**	**37.5**	**6.12**	**0.9**		**46**	**42**	**12**
■	**B-01 S4**	**7.5 - 9.0**	**25**	**1.63**	**0.12**		**23**	**51**	**26**
▲	**B-02 SBulk**	**0.0 - 5.0**	**25**	**5.99**	**0.6**	**0.02**	**45**	**40**	**15**

Mountain Air Drive Extension
Anchorage, Alaska

GRAIN SIZE CLASSIFICATION

June 2010

32-1-02055-002

SHANNON & WILSON, INC.
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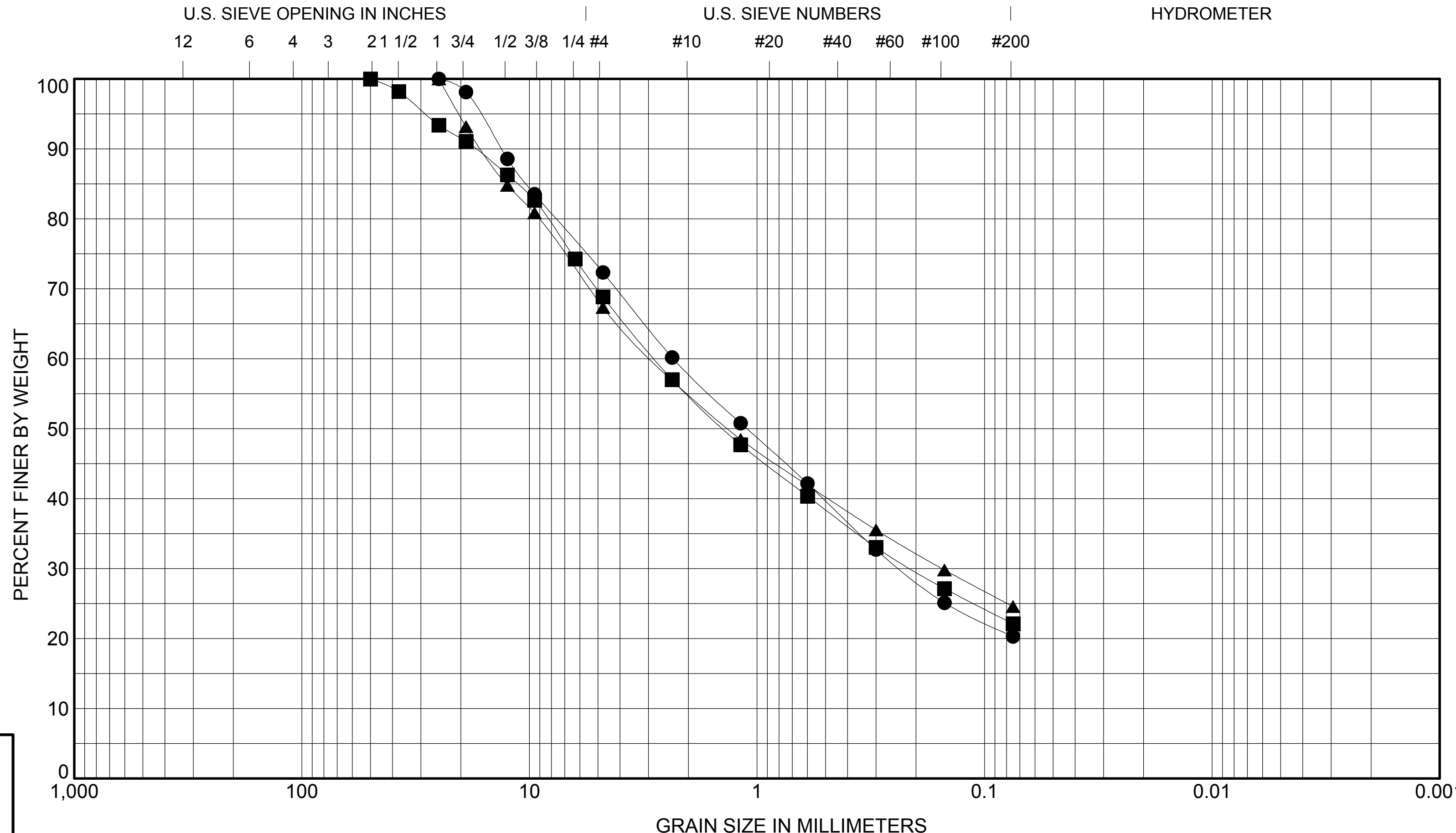
Fig. A-14
Sheet 1 of 6



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**B-02 S5**	**10.0 - 11.5**	**Silty, gravelly SAND (SM)**					
■	**B-03 SBulk**	**0.0 - 7.5**	**Silty, gravelly SAND (SM)**					
▲	**B-03 S4**	**7.5 - 9.0**	**Silty, gravelly SAND (SM)**					

	Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-02 S5**	**10.0 - 11.5**	**25**	**2.33**	**0.23**		**28**	**52**	**20**	
■	**B-03 SBulk**	**0.0 - 7.5**	**50**	**2.82**	**0.21**		**31**	**47**	**22**	
▲	**B-03 S4**	**7.5 - 9.0**	**25**	**2.91**	**0.15**		**33**	**43**	**25**	

Mountain Air Drive Extension
Anchorage, Alaska

GRAIN SIZE CLASSIFICATION

June 2010

32-1-02055-002

SHANNON & WILSON, INC.
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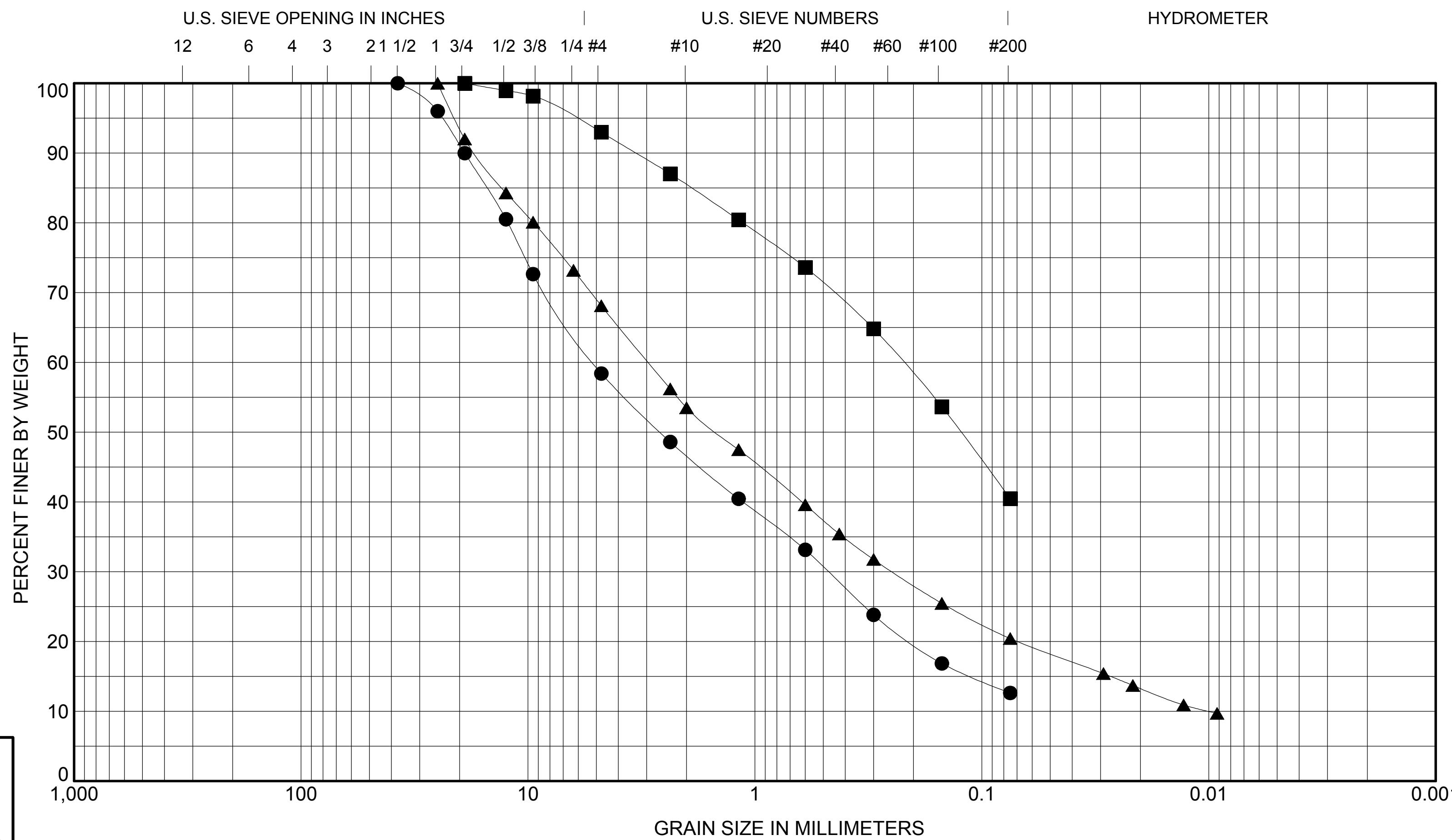
Fig. A-14
Sheet 2 of 6



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**B-04 S6**	**15.0 - 16.5**	**Silty, gravelly SAND (SM)**					
■	**B-05 S1**	**0.0 - 1.5**	**Slightly gravelly, silty SAND (SM)**					
▲	**B-05 S3**	**5.0 - 6.5**	**Silty, gravelly SAND (SM)**				**2.1**	**294.7**

	Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt / %Clay
●	**B-04 S6**	**15.0 - 16.5**	**37.5**	**5.13**	**0.48**		**42**	**46**	**13**
■	**B-05 S1**	**0.0 - 1.5**	**19**	**0.22**			**7**	**52**	**40**
▲	**B-05 S3**	**5.0 - 6.5**	**25**	**2.95**	**0.25**	**0.01**	**32**	**48**	**20**

Mountain Air Drive Extension
Anchorage, Alaska

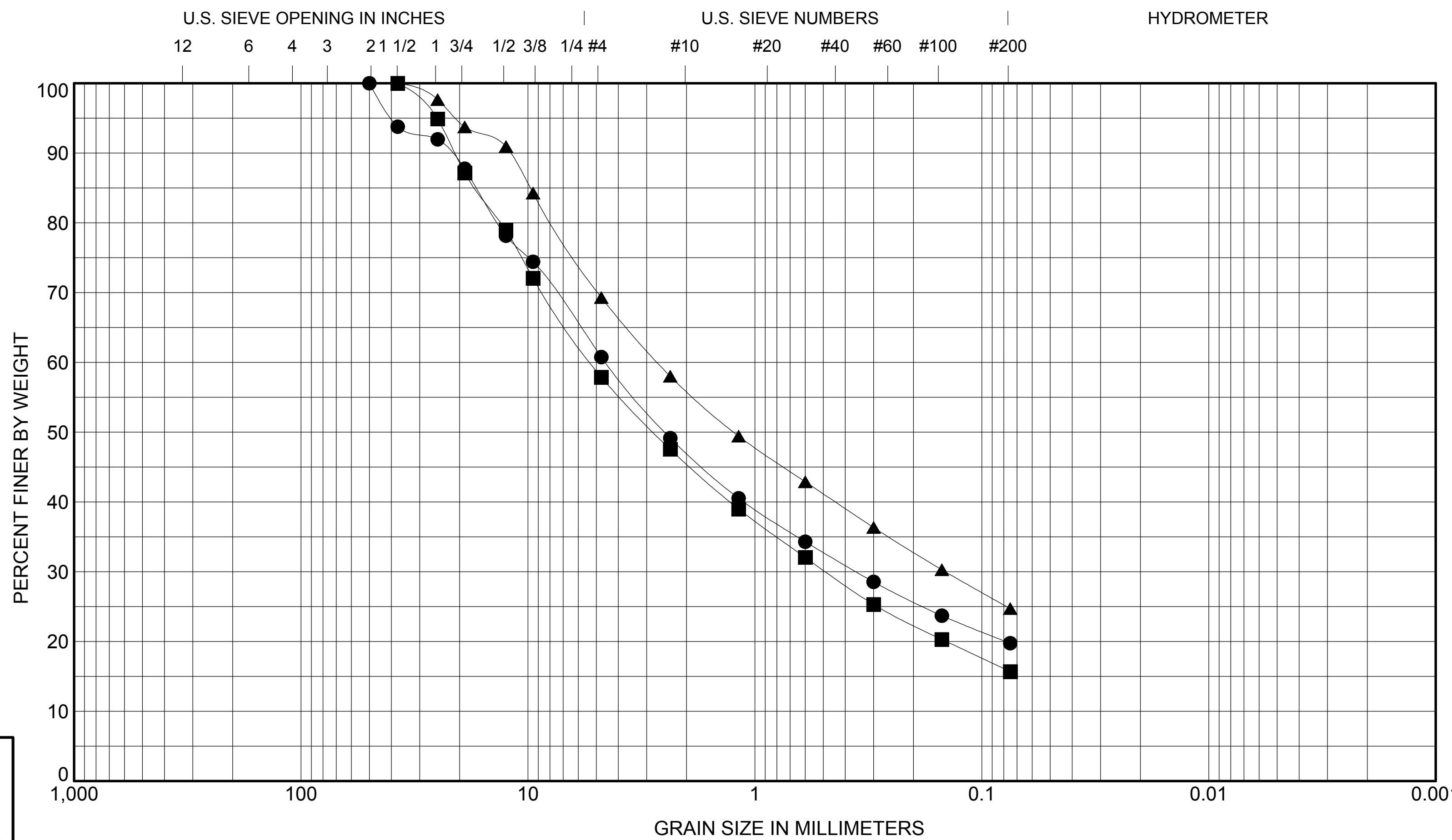
GRAIN SIZE CLASSIFICATION

June 2010

32-1-02055-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Fig. A-14
Sheet 3 of 6



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**B-07 S1**	**0.0 - 2.0**	**Silty, gravelly SAND (SM)**					
■	**B-07 S4**	**7.5 - 9.0**	**Silty, gravelly SAND (SM)**					
▲	**B-08 S1**	**0.0 - 2.0**	**SIlty, gravelly SAND (SM)**					

	Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-07 S1**	**0.0 - 2.0**	**50**	**4.54**	**0.36**		**39**	**41**	**20**	
■	**B-07 S4**	**7.5 - 9.0**	**37.5**	**5.27**	**0.49**		**42**	**42**	**16**	
▲	**B-08 S1**	**0.0 - 2.0**	**37.5**	**2.67**	**0.14**		**31**	**45**	**25**	

Mountain Air Drive Extension
Anchorage, Alaska

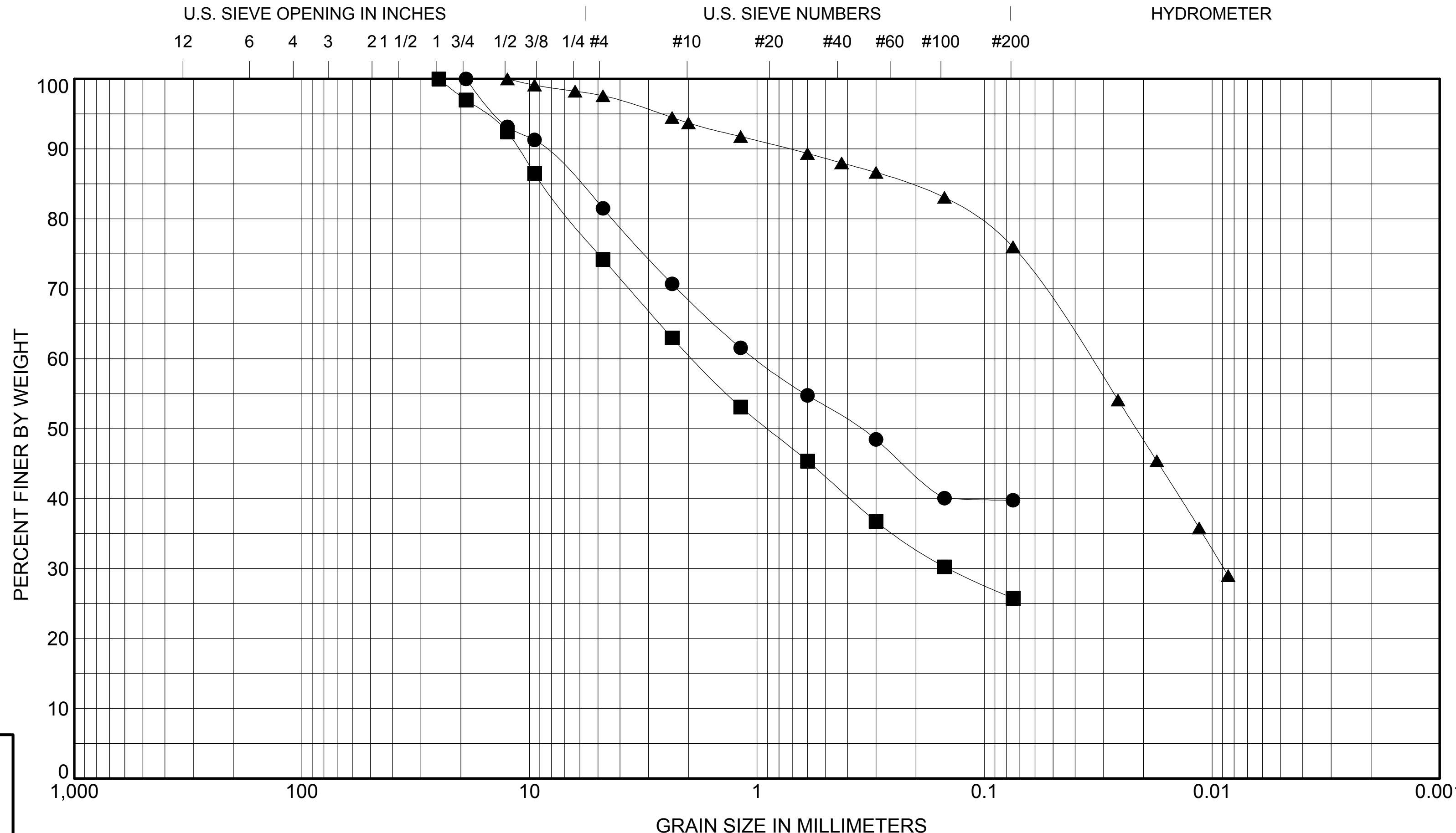
GRAIN SIZE CLASSIFICATION

June 2010

32-1-02055-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Fig. A-14
Sheet 4 of 6



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**B-09 S2**	**2.5 - 4.0**	**Gravelly, silty SAND (SM)**					
■	**B-09 S4**	**7.5 - 9.0**	**Silty, gravelly SAND (SM)**					
▲	**B-10 S2**	**2.5 - 4.0**	**Sandy SILT (ML)**					

	Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt / %Clay
●	**B-09 S2**	**2.5 - 4.0**	**19**	**1.01**			**19**	**42**	**40**
■	**B-09 S4**	**7.5 - 9.0**	**25**	**1.91**	**0.14**		**26**	**48**	**26**
▲	**B-10 S2**	**2.5 - 4.0**	**12.5**	**0.03**	**0.01**		**2**	**22**	**76**

Mountain Air Drive Extension
Anchorage, Alaska

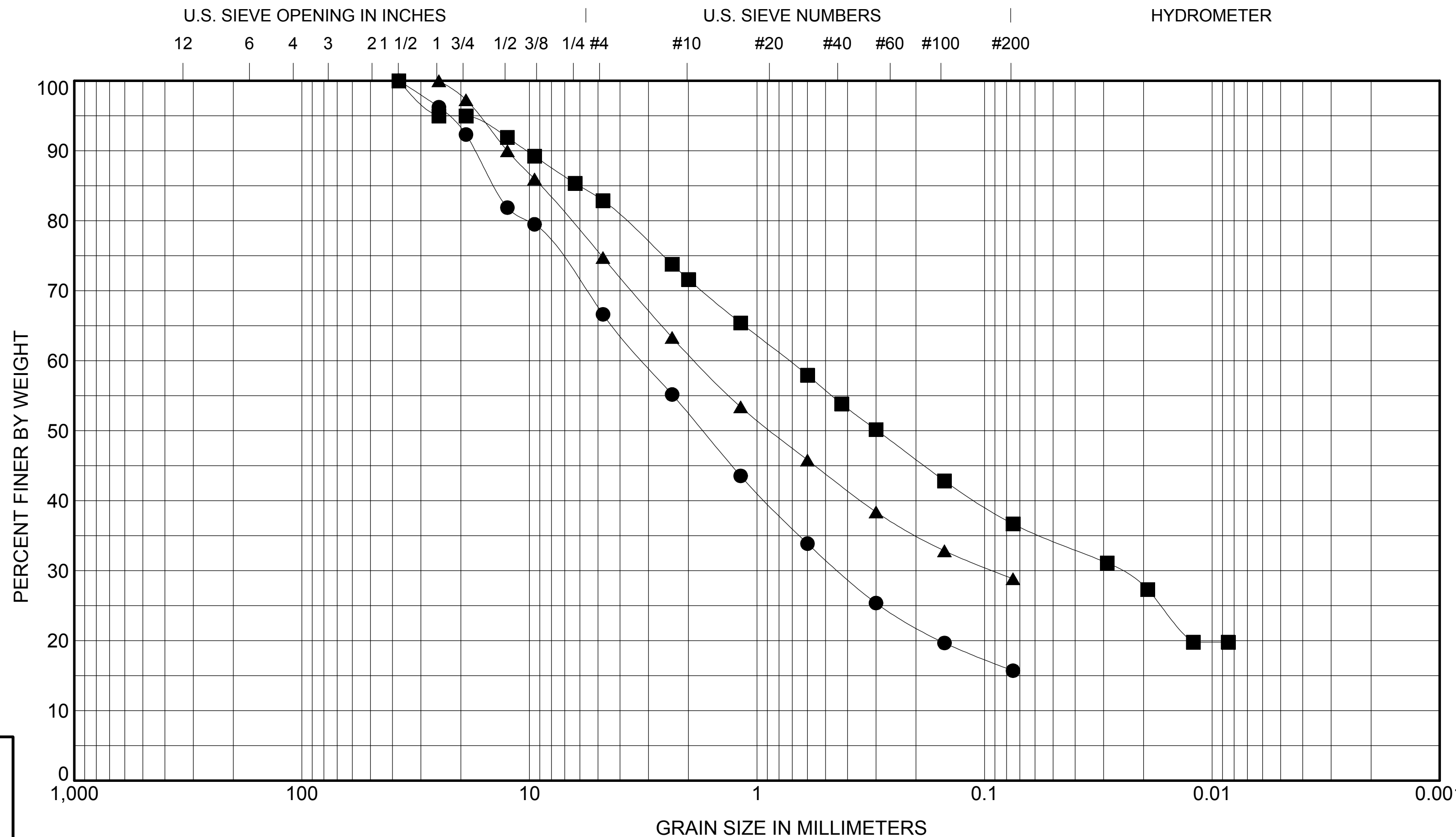
GRAIN SIZE CLASSIFICATION

June 2010

32-1-02055-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Fig. A-14
Sheet 5 of 6



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample		Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**B-10 S5**	**10.0 - 11.5**	**Silty, gravelly SAND (SM)**					
■	**B-11 S3**	**5.0 - 6.5**	**Gravelly, silty SAND (SM)**					
▲	**B-11 S4**	**7.5 - 9.0**	**Gravelly, silty SAND (SM)**					

Sample		Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-10 S5**	**10.0 - 11.5**	**37.5**	**3.17**	**0.44**		**33**	**51**	**16**	
■	**B-11 S3**	**5.0 - 6.5**	**37.5**	**0.72**	**0.03**		**17**	**46**	**37**	
▲	**B-11 S4**	**7.5 - 9.0**	**25**	**1.87**	**0.09**		**25**	**46**	**29**	

Mountain Air Drive Extension
Anchorage, Alaska

GRAIN SIZE CLASSIFICATION

June 2010

32-1-02055-002

SHANNON & WILSON, INC.
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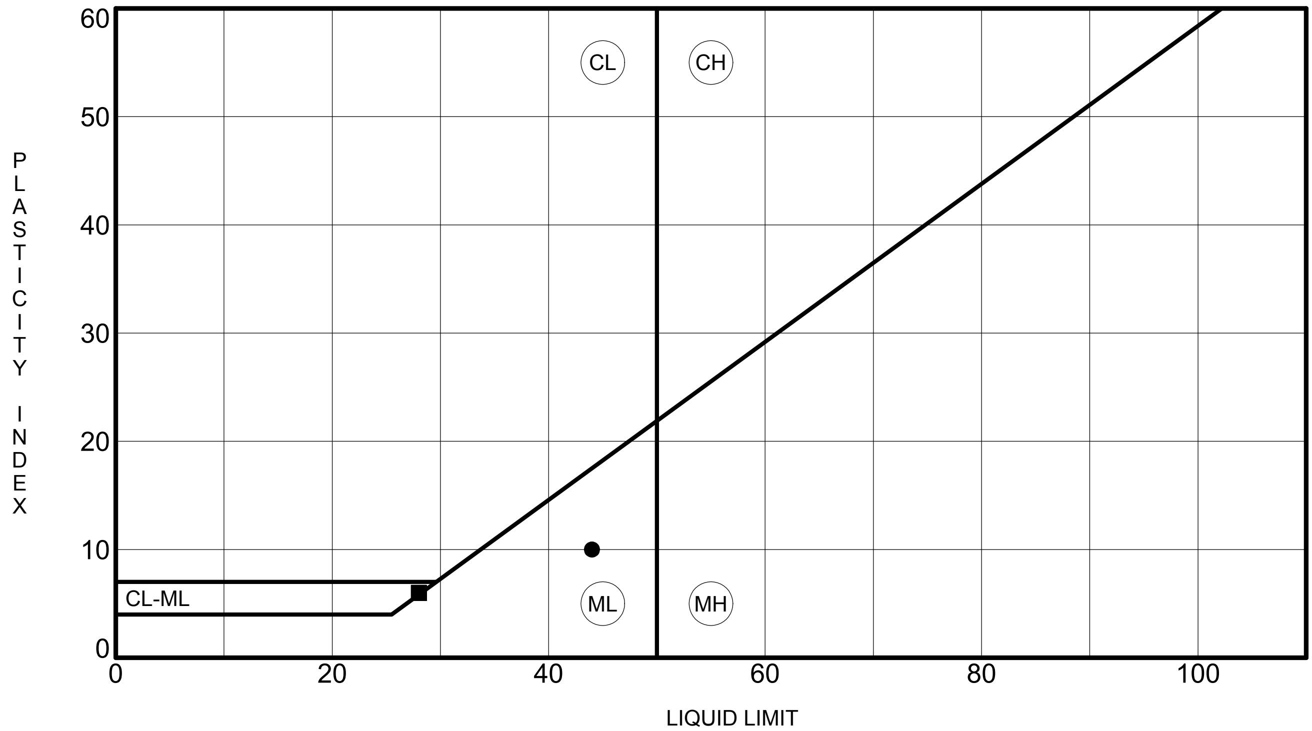
Fig. A-14
Sheet 6 of 6



	Boring	Depth, Ft	LL	PL	PI	Fines	Classification
●	**B-04**	**10.0 - 11.5**	**44**	**34**	**10**		**ML**
■	**B-06**	**5.0 - 6.5**	**28**	**22**	**6**		**CL-ML**

Mountain Air Drive Extension
Anchorage, Alaska

ATTERBERG LIMITS RESULTS

June 2010 32-1-02055-002

SHANNON & WILSON, INC.
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Fig. A-15

APPENDIX B

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL/ENVIRONMENTAL REPORT

Date: June 2010
To: USKH
Re: Mountain Air Drive Extension, Anchorage, Alaska

Important Information About Your Geotechnical/Environmental Report

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include: the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used: (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors, which were considered in the development of the report, have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the
ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland

Appendix B
Environmental Field Trip Report

USKH
SHARED VISION. UNIFIED APPROACH.

Technical Memorandum

Date:	July 22, 2009	**W.O.#:**	1122900
To:	Steve Kari, P.E., Project Manager	**cc:**	File
From:	Cindy Anderson, Environmental Analyst		
Project:	Mountain Air Drive/Hillside Drive Extension		
Subject:	Site Investigation – July 22, 2009 - 1:00 p.m. to 3:30 p.m.		

On July 22, 2009, Linda Smith and Cindy Anderson of USKH Inc. (USKH) drove to the proposed start of the Mountain Air Drive northern alignment located near Bear Valley Elementary School. The purpose of the site visit was to identify potential wetlands and/or Waters of the U.S. along the proposed extension of Mountain Air Drive routes A and B (see attached map). The Municipality of Anchorage (MOA) Wetlands Atlas, Volume 1: Anchorage Bowl 2004 Edition, map number 102 provided preliminary information for our field investigation.

We surveyed the alignment from the north end of Mountain Air Drive along the existing trail to the south towards Little Rabbit Creek. The overall site is an upland mixed forest consisting of cow parsnip, grasses, alders, and dandelions as well as birch trees and white spruce. No indicators of any unmapped wetland hydrology or vegetation were observed.

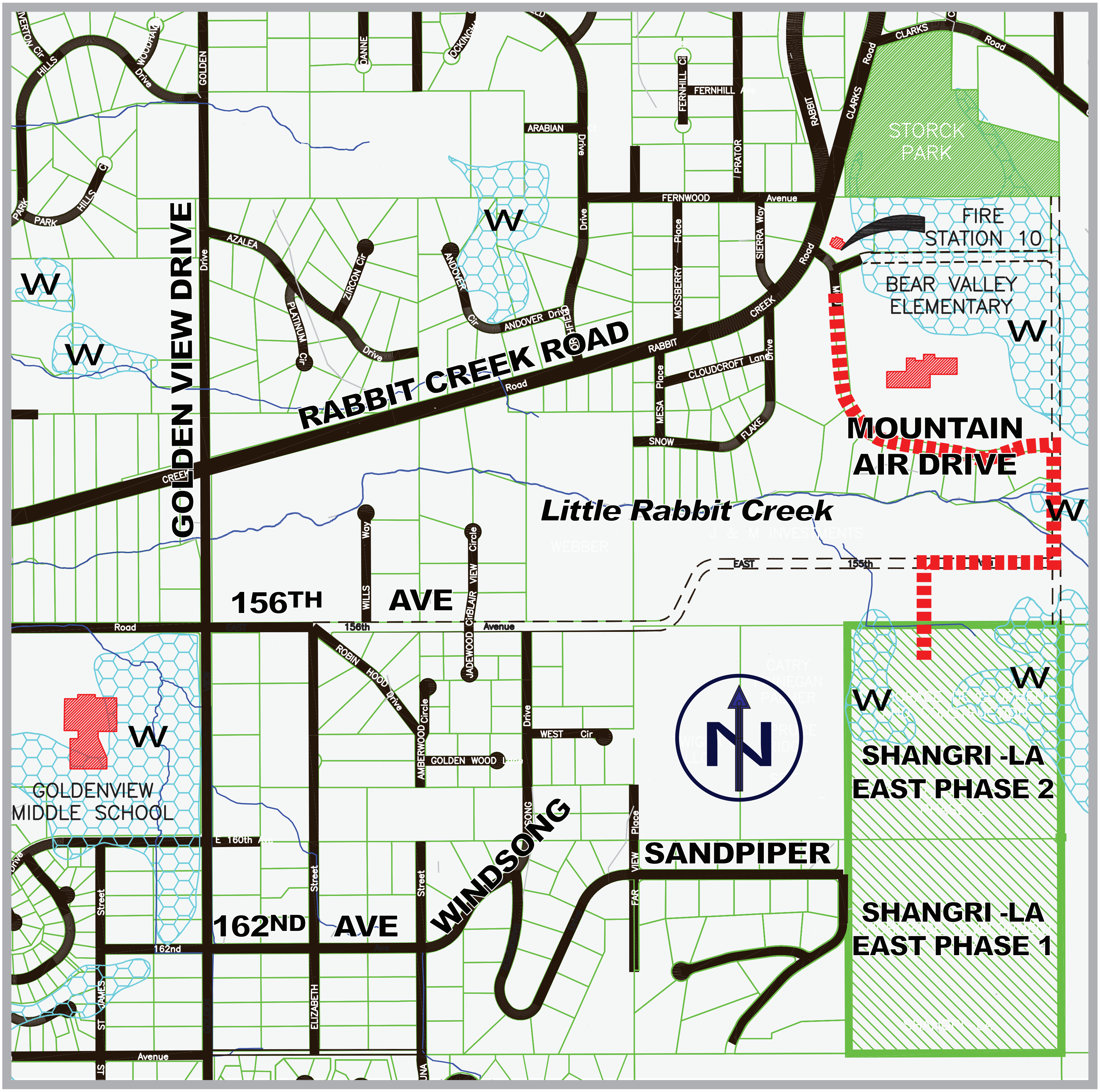
As we proceeded along the corridor, we climbed up the hill towards the south where we located the Chugach Electric Association (CEA) box number 12942 and buried cable CEA SC 61. We continued up the grade until the trail took a turn and followed the side of the hill to Rabbit Creek (photo 1). The vegetation was thick and consisted of alders, birch trees, grasses, watermelon berry, cow parsnip, and monkshood (photo 2). Upland vegetation grew to the edge of Little Rabbit Creek. A wetland fringe along the riparian edge the Creek was not observed (photo 3). The north slope down to the creek appeared to have less vegetation.

We continued on the trail through the intersection with the CEA power line and followed the trail south towards a known wetland area to identify the wetland margins. A man-made ditch is located running east to west along the wetland edge, apparently draining the wetland towards the west (see photos 5-6 where the wetlands drainage runs west). The most conservative edge of the wetlands was marked with a survey stake labeled USKH#1W. It is found approximately 1-1/2 power pole lengths north of the intersection with 156th Street (photo 7).

Our investigation continued north along the right-of-way (ROW) for the power line. We did not observe wetland vegetation, as evidenced by vegetation boundaries, as the corridor crossed the South Fork of Little Rabbit Creek. The project map that we used for comparison identified a wetland area encompassing the stream corridor of the North Fork. We observed that the floodplain area is wider in that area, but did not observe “obligates” or obviously wet vegetation. We did observe *Equisetum* and wild Iris growing. Further investigation would be needed to determine the status at this juncture.

As we continued up the corridor to the north, we did not find further wetlands until we reached the disturbed area at the top of the hill southeast of the Bear Valley Elementary School. This area transitions to a wetland but has been drained and disturbed (photo 11 and 12). The MOA wetlands map (number 102) for this area, details this area as wet, but it has apparently been impacted by a man-made ditch and cleared of some natural vegetation. A clear vegetation transition from wetland to upland was not apparent across the two habitats. Vegetation within the drained wetland area is a mixture of cow parsnips and *Calamagrostis* grass (See photos 11- 13).

Proposed route for Mountain Air Drive



Project Area

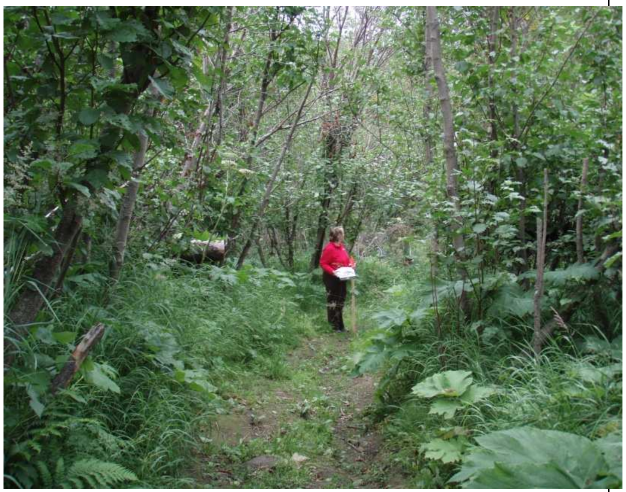


Photo 1: **Upland vegetation heading south on alignment for Mountain Air Drive**

Photo 2: **Upland vegetation on Alignment A before descent to creek**

Photo 3: **Little Rabbit Creek lower crossing on Alignment A**

Photo 4: **Upland vegetation at top of grade of Alignment A**

Photo 5: **Wetland draining south of 155th**

Photo 6: **Wetland ditch south of 155th**

Photo 7: **Edge of wetlands in ROW**

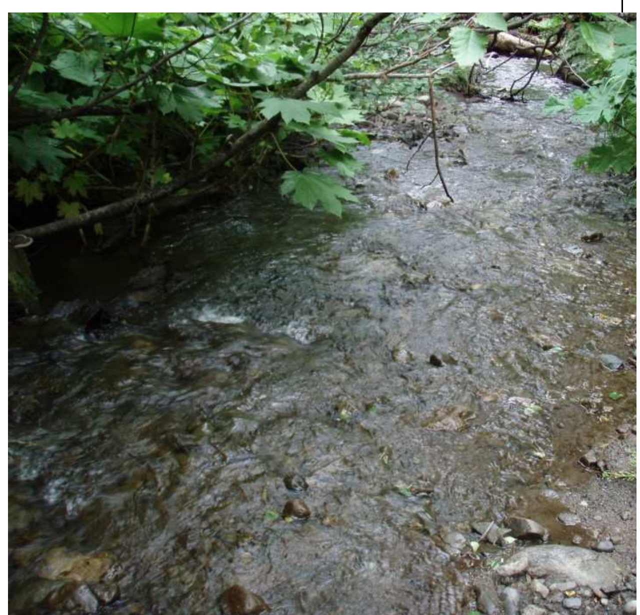


Photo 8: **South Branch Little Rabbit Creek**

Photo 9: **South fork Little Rabbit Creek**

Photo 10: **North Fork Little Rabbit Creek**

Photo 11: **Drained wetland area at power line ROW and Mountain Air Drive alignment B**

Photo 12: **Intersection of power line ROW and Mountain Air Drive on Alignment B**

	
Photo 13: **End of power line ROW facing south on Alignment B**	Photo 14: **End of power line facing west on Alignment B**

Appendix C
Public Involvement

MOUNTAIN AIR DRIVE EXTENSION
PME #08-019
SCOPING MEETING SUMMARY
AUGUST 5, 2009

ATTENDEES:

Cleo Hill	AFD
Wade Straham	AFD
Margaret O'Brien	MOA Planning
Steve Kalmes	ASD Student Transportation
Thede Tobish	MOA Planning
Heather Dean	EPA
Mary Cary	ASD Facilities
Ben Barclay	Enstar
Will Frost	ADF&G
Bob Kneifel	MOA Traffic
JoAnn Contreras	MOA Planning
Lori Schanche	MOA PM&E
Don Keefer	MOA PM&E
Lori Davey	South Goldenview Rural Road Service Area (SGRRSA)
Tom Knox	MOA Municipal Surveyor
Holly Spoth-Torres	MOA Parks & Rec
Sharon Ferguson	MOA Planning
Scott Stringer	MOA Parks & Rec
Dan Southard	MOA
Michael Tullius	Chugach Electric
Lance Wilber	MOA Traffic
Chuck Brazil	ADF&G
Francis McLaughlin	MOA Planning
Todd Jacobson	The Boutet Company
Steve Kari	USKH
Joann Mitchell	USKH
Linda Smith	USKH
Karthik Murugesan	USKH

Todd Jacobson from The Boutet Company is managing the project on behalf of the MOA. Todd opened the meeting with a brief project introduction. The goal of the project is to extend Mountain Air Drive south from Rabbit Creek to the Shangri La subdivision. The project is funded through a state grant of $4.5 million. The $4.5 million is the total amount available for construction, right of way, design, etc. From past experiences, of the $4.5 million, about $2.8 million will be available for construction. The ideal schedule is to begin construction next year as delays typically increase costs. That is a very aggressive schedule, but it can be done with everyone's cooperation.

Steve Kari, the project manager for USKH, briefly reviewed the project area and described the three alignments that will be considered (see attachment). Steve reiterated that the project is just getting started. Field crews are visiting the site to make initial recommendations regarding the three routes under consideration. As the alternatives get further defined, some may not advance for further evaluation, but at this point, everything is “on the table” for consideration.

Attendees were then asked to voice any issues or concerns they had that the design team should be aware of as the design begins.

The question was asked why not just connect to Goldenview Drive via 156th Avenue? The answer is that such a connection would not relieve the ever-increasing traffic on Goldenview. It was then asked if the extension of Mountain View Drive would truly be used. The traffic models suggest that it would be.

Mike Tullius (CEA) mentioned that CEA has underground and overhead facilities in the project area, along the section line. He thinks the poles are 33 feet off the section line, and therefore he does not believe they would be in the eventual roadway right of way.

Lori Schanche (MOA Non-motorized Transportation Coordinator) feels that a pathway on one side of the road is the minimum; pathways on both sides of the road would be preferable. She also mentioned that the school would really benefit from the path.

Margaret O’Brien (MOA Planning) commented that fire access to Prominence Pointe is one of the goals of the area. The developers of Shangri-La were told that no further development could take place until an additional access to Rabbit Creek was developed (other than Goldenview Drive). The main reason is because of emergency access or evacuation.

Lori Davey (SGVRRSA) stated that the extension of Mountain Air Drive will provide an important connection. The intersection of Goldenview Drive and Rabbit Creek Road is a problem and there are very few options to increase the capacity of the intersection because of the topography. Eventually, Mountain Air Drive will connect all the way through to Potter Valley Road. This provides an alternative to Goldenview and also provides access from the fire station without evacuation route conflicts. Lori lobbied hard for the $4.5 million state grant and the amount of that grant is based on estimates prepared by MOA.

Tom Knox said to verify, and verify again, if the section easement does actually exist.

Holly Spoth-Torres (MOA Parks and Rec) said that they are currently working on a master plan for the Section 36 area. The Section 36 land (640 acres) is currently in the Heritage Land Bank inventory. The park could definitely tie into the pedestrian path planned for Mountain Air Drive and will have a connection to Bear Valley Elementary School. Holly has some concept plans of what is being considered for the design team’s information. The southwest corner of Section 36 is identified for low development.

Mary Cary (ASD) said that a connection between the school and Section 36 would be a real benefit to the school. She felt that Alternative C would divide that connection and she had concerns about the amount of traffic that will use Mountain Air Drive.

Lance Wilber (MOA Traffic) stated that the extension of Mountain Air Drive is recognized as a key connection in the Long Range Transportation Plan (LRTP). He feels that Alternative A offers some benefits, but in the long run, it needs to connect to Jamie Street, which Alignment B does better. Alignment A would require a significant structure across the creek. The topography is basically flat, except at the creek. A lot of work has been done in the past to determine the best route for the extension, as is reflected in Alternatives A and B. Alternative C had been considered, but eliminated from further consideration because it divides the school, park, and fire station. Lance also commented that Bear Valley residents are concerned about the Jamie Street connection.

Heather Dean (EPA) questioned if a wetland delineation was being done. Linda Smith (USKH) responded that a preliminary walk thru had been done, but a more complete delineation would be done. Heather felt that some areas noted as wetlands on the map (particularly between the creeks) may not actually be wetlands. She also asked if the creeks would be mapped because there is an unmapped creek right near the planned connection of the road to the Shangri La subdivision.

Will Frost (ADF&G) stated that Dolly Varden could be expected to be found in Rabbit Creek and perhaps juvenile coho as well. So any planned culverts would need to be designed for fish passage. He plans to go out in the field next week and set traps to see what is there.

Heather Dean (EPA) commented that compensatory mitigation may not be needed. There may be an opportunty to do restoration along the creek along the top edge of the Shangri-La subdivision.

Wade Strahan (AFD) said that AFD is concerned about the grades coming out of the fire station—basically everything is downhill from the station.

Thede Tobish (MOA Planning) stated the ADF&G wildlife is concerned about wildlife movement and design efforts will need to be coordinated with them. At full build-out, the creek corridor will be very important so coordination with ADF&G (Rick Sinnott) is critical.

Todd Jacobson told the attendees that the adjacent property owners are all very supportive of the project.

Steve Kari closed the meeting by stating that we will be visiting the community councils in September with a public Open House in October, right after the draft Design Study Report is submitted. The hope is to go to bid next spring. He thanked everyone for their time and participation at the meeting and looks forward to continuing to work with everyone as the project develops.

USKH
SHARED VISION. UNIFIED APPROACH.

Memorandum

Date:	8-14-09	**W.O.#:**	1122900
To:	file	**cc:**	W. Webb, J. Mitchell
From:	Steve Kari		
Subject:	Rabbit Creek Community Council (RCCC) Rabbit Creek Community Church, 7 PM, approx. 20 attendees		

Visited the RCCC to introduce the Mountain Air Drive project. Indicated that we just received a contract and described the approach that we were taking to preserve construction money with a streamlined and efficient design process – survey, geotech, bridge study, H&H, public involvement, and schedule. Indicated that we would be back in October with design/alignment recommendations in a draft DSR. Distributed graphic with three alternatives that were used in the previous agency scoping meeting.

The group as a whole was supportive of the project. The following are some of the issues raised by the council:

1) Come up with an innovative solution to the intersection with Rabbit Creek that works better than Goldenview intersection.

2) Consider pathway(s) that may be narrower, unpaved, and not necessarily connected to the roadway cross-section (IE variable distance). Get enough right-of-way for the pathway(s).

3) Traffic at the Bear Valley Elementary is a nightmare with drop off and pickup during peak hours. School circulation changes provide relief?

4) No one supported the Conceptual alignment "C" that goes through the wetlands.

5) Concern that the draft study schedule may be too rapid and key issues/design flaws may result in the future.

6) Question as to what would happen if the available funding only sufficient for construction for a portion of the road?

USKH
SHARED VISION. UNIFIED APPROACH.

Memorandum

Date:	September 9, 2009	**W.O.#:**	1122900
To:	File	**cc:**	
From:	Will Webb, P.E.		
Subject:	Bear Valley Community Council Meeting		

Visited Bear Valley Community Council with Steve Kari of USKH to introduce the Mountain Air Drive project. Steve presented the project to the group and described the approach we were taking to design the process – survey, geotech, bridge study, hydrology, public involvement, and schedule. Steve mentioned the website and that there would be an open house October 21st. Steve then described the three alignments with an aerial photo.

Comments from the group included

- A desire to see left turns out of Mountain Air Drive onto Rabbit Creek Road prohibited to keep the new traffic out of the Goldenview/Rabbit Creek intersection
- Some community members did not want to see additional connectivity to Bear Valley
- Alternative C looked favorable to some community members
- A request to look at connections using the Hillside Drive Alignment (Alt B and C), since that may provide better access to the south
- Look at the Section 36 Master plan for information on the park to the east.

Overall, there was not wide spread sentiment for or against the project.

MOUNTAIN AIR DRIVE EXTENSION
PME #08-019
OPEN HOUSE MEETING SUMMARY
OCTOBER 22, 2009
Bear Valley Elementary School
6:30 pm to 8:30 pm

A Public Open House meeting was held to present the three alternatives that were considered for the extension of Mountain Air Drive. Attendees were asked to sign in and advised to leave written comment at the meeting, on the website, or mail in their comments for consideration by the design team during the Draft Design Study Report phase.

Steve Kari, USKH Project Manager, and Todd Jacobson, Project Manager for MOA, presented the project and fielded questions from the attendees. Following is a summary of comments made to either to a member of the design team, or to the group as a whole during the presentation.

- Steve Kalmes (ASD Student Transportation) noted that his only concern is the schedule and impacts of construction on the school operations.
- The developers of the Shangri-La Subdivision were told by the Corps of Engineers that their subdivision road had to meet the Mountain Air Drive extension at what is shown as the terminus of Alternative A. Aligning their road with Alternative B would require going through wetlands and they were told the Corps would not allow it.
- When it was reported that field data indicated the extent of the wetlands to be less than what the maps showed, one person asked if the dry summer would be a reason for that.
- Bear Valley Community Council (BVCC) is concerned about rising crime rates as the number of roads in the area increase.
- Construction of 155th Avenue is not currently programmed. *(Todd Jacobson)*
- A state grant for $5.5 million was received and another $1 million was requested. Of that, approximately 55% is available for construction ($3.0 million of the original grant). *(Todd Jacobson)*
- The intersection of Rabbit Creek Road and Mountain Air Drive was a significant concern raised by several people in attendance. The horizontal geometry makes it difficult now to safely turn onto Rabbit Creek Road. What kind of controls are there going to be? How does it compare to the volumes at Rabbit Creek and Goldenview?

Todd Jacobson from The Boutet Company is managing the project on behalf of the MOA. Todd opened the meeting with a brief project introduction. The goal of the project is to extend Mountain Air Drive south from Rabbit Creek to the Shangri La subdivision. The project is funded through a state grant of $4.5 million. The $4.5 million is the total amount available for construction, right of way, design, etc. From past experiences, of the $4.5 million, about $2.8 million will be available for construction. The ideal schedule is to begin construction next year as delays typically increase costs. That is a very aggressive schedule, but it can be done with everyone's cooperation.

Steve Kari, the project manager for USKH, briefly reviewed the project area and described the three alignments that will be considered (see attachment). Steve reiterated that the project is just getting started. Field crews are visiting the site to make initial recommendations regarding the three routes under consideration. As the alternatives get further defined, some may not advance for further evaluation, but at this point, everything is "on the table" for consideration.

Attendees were then asked to voice any issues or concerns they had that the design team should be aware of as the design begins.

The question was asked why not just connect to Goldenview Drive via 156th Avenue? The answer is that such a connection would not relieve the ever-increasing traffic on Goldenview. It was then asked if the extension of Mountain View Drive would truly be used. The traffic models suggest that it would be.

Mike Tullius (CEA) mentioned that CEA has underground and overhead facilities in the project area, along the section line. He thinks the poles are 33 feet off the section line, and therefore he does not believe they would be in the eventual roadway right of way.

Lori Schanche (MOA Non-motorized Transportation Coordinator) feels that a pathway on one side of the road is the minimum; pathways on both sides of the road would be preferable. She also mentioned that the school would really benefit from the path.

Margaret O'Brien (MOA Planning) commented that fire access to Prominence Pointe is one of the goals of the area. The developers of Shangri-La were told that no further development could take place until an additional access to Rabbit Creek was developed (other than Goldenview Drive). The main reason is because of emergency access or evacuation.

Lori Davey (SGVRRSA) stated that the extension of Mountain Air Drive will provide an important connection. The intersection of Goldenview Drive and Rabbit Creek Road is a problem and there are very few options to increase the capacity of the intersection because of the topography. Eventually, Mountain Air Drive will connect all the way through to Potter Valley Road. This provides an alternative to Goldenview and also provides access from the fire station without evacuation route conflicts. Lori lobbied hard for the $4.5 million state grant and the amount of that grant is based on estimates prepared by MOA.

Tom Knox said to verify, and verify again, if the section easement does actually exist.

Holly Spoth-Torres (MOA Parks and Rec) said that they are currently working on a master plan for the Section 36 area. The Section 36 land (640 acres) is currently in the Heritage Land Bank inventory. The park could definitely tie into the pedestrian path planned for Mountain Air Drive and will have a connection to Bear Valley Elementary School. Holly has some concept plans of what is being considered for the design team's information. The southwest corner of Section 36 is identified for low development.

Mary Cary (ASD) said that a connection between the school and Section 36 would be a real benefit to the school. She felt that Alternative C would divide that connection and she had concerns about the amount of traffic that will use Mountain Air Drive.

Lance Wilber (MOA Traffic) stated that the extension of Mountain Air Drive is recognized as a key connection in the Long Range Transportation Plan (LRTP). He feels that Alternative A offers some benefits, but in the long run, it needs to connect to Jamie Street, which Alignment B does better. Alignment A would require a significant structure across the creek. The topography is basically flat, except at the creek. A lot of work has been done in the past to determine the best route for the extension, as is reflected in Alternatives A and B. Alternative C had been considered, but eliminated from further consideration because it divides the school, park, and fire station. Lance also commented that Bear Valley residents are concerned about the Jamie Street connection.

Heather Dean (EPA) questioned if a wetland delineation was being done. Linda Smith (USKH) responded that a preliminary walk thru had been done, but a more complete delineation would be done. Heather felt that some areas noted as wetlands on the map (particularly between the creeks) may not actually be wetlands. She also asked if the creeks would be mapped because there is an unmapped creek right near the planned connection of the road to the Shangri La subdivision.

Will Frost (ADF&G) stated that Dolly Varden could be expected to be found in Rabbit Creek and perhaps juvenile coho as well. So any planned culverts would need to be designed for fish passage. He plans to go out in the field next week and set traps to see what is there.

Heather Dean (EPA) commented that compensatory mitigation may not be needed. There may be an opportunty to do restoration along the creek along the top edge of the Shangri-La subdivision.

Wade Strahan (AFD) said that AFD is concerned about the grades coming out of the fire station—basically everything is downhill from the station.

Thede Tobish (MOA Planning) stated the ADF&G wildlife is concerned about wildlife movement and design efforts will need to be coordinated with them. At full build-out, the creek corridor will be very important so coordination with ADF&G (Rick Sinnott) is critical.

Todd Jacobson told the attendees that the adjacent property owners are all very supportive of the project.

Steve Kari closed the meeting by stating that we will be visiting the community councils in September with a public Open House in October, right after the draft Design Study Report is submitted. The hope is to go to bid next spring. He thanked everyone for their time and participation at the meeting and looks forward to continuing to work with everyone as the project develops.

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Memorandum

Date:	February 2, 2010	**W.O.#:**	1122900
To:	File	**cc:**	
From:	Joann Mitchell, P.E.		
Subject:	Bear Valley Community Council February Meeting		

Joann Mitchell and Steve Kari attended the February 2010 Bear Valley Community Council meeting to update the community on the status of the project. Steve presented the recommended alternative (Alt A) and mentioned that the project website has been updated. Steve also noted that the USKH contract was amended to include an evaluation of the intersection of Rabbit Creek Road and Mountain Air Drive. We understand that legislative funds are being sought for construction of the intersection improvements. Once the project reaches the 70% complete stage, the plans will be posted on the website. Construction will begin in 2011. Steve then entertained questions.

Q. What are the ROW costs and bridge costs?
A. The estimated total cost of construction is $4.5 million. There was very little different in costs between Alternatives A and B. We are assuming $280,000 for ROW acquisition.

Q. What if the additional funds do not get approved?
A. Construction will be phased to use the funds available. The additional money is for the intersection improvements so the road construction can begin without the added monies.

Q. Will the bridge design need to consider wildlife crossings?
A. The bridge is actually elevated approximately 50 feet so wildlife crossings won't be an issue.

Q. What about street lights? The Community Council passed a resolution that they wanted the lighting to be minimal and with full cut-off.
A. We understand the community's concern with lighting but we also heard support for lighting the pathway for students walking to school—along with requests for a pathway on both sides of the road. We will do what we can to limit the lighting impacts but the design does need to meet MOA design criteria for illumination because it is a safety issue. The cost of lighting is not that great relative to the overall cost of the project.

Q. What will you be looking at for improvements at the intersection with Rabbit Creek Road?
A. We will evaluate the sight distances, speeds, and turning movements and volumes. Turn lanes will probably be recommended along with a potential signal. The firefighters from Bear Valley Station in attendance at the meeting added that they currently do not have a problem at the intersection with the exception of the times when traffic volumes are heavy from school traffic.

Q. Do the affected landowners support the project?
A. The affected landowners are in support of extending Mountain Air Drive though they are not all in support of Alternative A. USKH, along with MOA representatives have been meeting with, and will continue to meet with, those most impacted to see what can be done to minimize the impacts.
Q. What permits will be required for construction?
A. Because Alternative A does not impact wetlands, a fill permit will not be required from the Corps of Engineers. A flood hazard review by the Muni will be done as part of the bridge plan review process.

As with all road projects, we will need to acquire a ROW permit and the Alaska Department of Environmental Conservation will review the stormwater plans. It's possible other permits may be needed for construction activities.

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Memorandum

Date: February 11, 2010 **W.O.#:** 1122900

To: File **cc:**

From: Joann Mitchell, P.E.

Subject: Rabbit Creek Community Council February Meeting

Joann Mitchell attended the February 2010 Rabbit Creek Community Council meeting to update the community on the status of the project. Joann presented the recommended alternative (Alt A) and mentioned that the project website has been updated. Joann also noted that the USKH contract was amended to include an evaluation of the intersection of Rabbit Creek Road and Mountain Air Drive. We understand that legislative funds are being sought for construction of the intersection improvements. Once the project reaches the 70% complete stage, the plans will be posted on the website. Construction will begin in 2011.

The estimated construction cost, including the cost of the bridge and ROW is $4.5 million. This does not include design nor project administration. When that is added in, it does not appear that there are enough funds to construct the entire length of the project. However, the project will be phased so that the road can be built to at least the far side of the bridge (the bridge will be included).

The property owners affected the most by Alternative A were in attendance. They expressed their dissatisfaction with the fact that Alt A was being recommended, particularly since Alt B was the preferred route at the time of the fall Open House. Joann explained to them that during the review process it was discovered that the Municipality is responsible for constructing the road to the terminus of Alt A. Therefore, Alt B would need to be revised to include construction along the 155th Avenue ROW, making that alternative less desirable. In addition, there was more public and agency support for Alt A.

Appendix D
Traffic Analysis

Technical Memorandum

Date:	12 January 2011	**W.O.#:**	1122900
To:	Steve Kari, P.E., Project Manager	**cc:**	
From:	Will Webb, P.E.		
Project:	Mountain Air Drive /Hillside Drive Extension		
Subject:	Mountain Air Drive Traffic Analysis		

Introduction

To support our efforts in the preliminary engineering for the Mountain Air Drive Extension, we must analyze the existing and expected future traffic so we can provide facility design recommendations. The scope of this analysis is to update the traffic projections developed in the 2006 Hillside Subarea Transportation Study, produced by USKH Inc. (USKH) for the Municipality of Anchorage (MOA) Traffic Department.

The design year for traffic purposes is 2029.

Project Description

The proposed road improvements include extending Mountain Air Drive between Rabbit Creek Road and the platted alignment of 155th Avenue. Mountain Air Drive currently exists as an access road that extends between Rabbit Creek Road and Bear Valley Elementary School, a distance of about 400 feet. Mountain Air Drive is classified as a Class IB Collector in the current Official Streets and Highways Plan (OSHP). As such, the design speed will be 35 miles per hour (mph), and the cross section is expected to have one lane in each direction with paved shoulders.

Rabbit Creek Road is classified as a Class I Collector in the OSHP. It is owned and maintained by the State of Alaska Department of Transportation and Public Facilities (DOT&PF). The two-lane road has a posted speed limit of 45 mph in the project area.

The Rabbit Creek Road/Mountain Air Drive intersection is a three-legged intersection with stop sign control on Mountain Air Drive. An overhead flashing beacon has been installed, with yellow signals on the Rabbit Creek Road approaches and a red signal for the Mountain Air Drive approach. There are currently no auxiliary turn lanes at this intersection.

Analysis Methodology

Traffic conditions were evaluated for this analysis using the Level of Service (LOS) methodologies of the *Highway Capacity Manual* (Transportation Research Board, 2000). The *Highway Capacity Manual* (HCM) provides a nationally recognized and locally accepted method of measuring traffic flow and congestion at intersections. Criteria range from LOS A, indicating free-flow conditions with minimal vehicle delays; to LOS F, indicating congestion with significant vehicle delays.

LOS for a two-way or four-way stop controlled intersection is the function of the average vehicle delay experienced by a particular approach or approach movement during a peak hour. Typically, the approach or movement experiencing the worst LOS is reported for the entire intersection. Table 1 outlines the LOS criteria for unsignalized and signalized intersections.

Table 1 – Intersection LOS Criteria			
LOS	**Unsignalized Average Delay (sec/veh)**	**Signalized Average Delay (sec/veh)**	**General Description**
A	≤10	≤10	Free Flow
B	>10 - 15	>10 - 20	Stable Flow (slight delays)
C	>15 - 25	>20 - 35	Stable flow (acceptable delays)
D	>25 - 35	>35 - 55	Approaching unstable flow (tolerable delay, occasionally wait through more than one signal cycle before proceeding)
E	>35 - 50	>55 - 80	Unstable flow (intolerable delay)
F	>50	>80	Forced flow (jammed)
Source: Highway Capacity Manual (TRB, 2000)			

MOA recognizes LOS D as the minimum acceptable condition for intersections. Transportation improvements will be recommended for areas projected to operate below this LOS threshold.

Existing Traffic Conditions

Traffic counts were collected by USKH staff on September 1, 2009, for both AM and PM peak hours. School was in session during these counts, so the maximum traffic demands should be reflected in these counts. Peak hour counts are shown in Figure 1. The AM peak hour coincided with the beginning of the school day, while the PM peak hour was from 3:15 PM to 4:15 PM, also corresponding to the end of the school day. Existing LOS values are listed in Table 2.

Table 2 - Existing LOS				
	AM		**PM**	
Intersection	**LOS**	**Delay (seconds/vehicle)**	**LOS**	**Delay (seconds/vehicle)**
Rabbit Creek Rd/ Mountain Air Dr	B	14.6	B	11.1

The observed peak hour factor was 0.45 for the AM and 0.7 for the PM. Usually the PHF is around 0.9. These exceptionally low observations indicate a very sharp peak in traffic, which is not surprising since much of the current traffic is comprised of school drop offs and pick ups. For analysis of future conditions, a PHF of 0.7 was used.

Future Traffic Conditions

The Mountain Air Drive Extension, coupled with expected residential development in the areas south of the project, will change traffic patterns at the Mountain Air Drive/Rabbit Creek Road intersection. The Hillside SubArea Transportation Study projected that up to 1,570 trips per day will use Mountain Air Drive when fully developed. Data from the Institute of Transportation Engineers (ITE) Trip Generation Manual were used to convert this daily value into peak hour trips. In addition, a growth rate of 3.5 percent per year was used to project background traffic volumes to future levels. This growth factor accounts for the traffic generated by developments not specifically considered in the Hillside Sub-Area Transportation Plan and is the same value as used in that plan. Figures 2 and 3 show the expected 2029 traffic volumes with and without the Mountain Air Drive Extension.

Note that the school traffic was increased at 3.5 percent per year along with the rest of the existing traffic. This may not be a reasonable growth rate for school attendance over the 20-year life of the project, but school traffic in the Anchorage area has been increasing at a higher rate than school attendance as fewer children ride busses, so the traffic growth assumption is still reasonable. Additionally, the peak hour for project-generated traffic has been assumed to correspond to the existing peak hour of the study area. This is probably not the case, particularly in the afternoon, but assures a conservative analysis.

Table 3 – 2029 LOS With Mountain Air Dr Extension

	AM		PM	
Intersection	**LOS**	**Delay (seconds/vehicle)**	**LOS**	**Delay (seconds/vehicle)**
Rabbit Creek Rd/ Mountain Air Dr	F	559.9	F	81.1
Mountain Air Dr/ Bear Valley Elementary	B	12.5	B	10.2

As shown in Table 3, LOS during both AM and PM peak hours will be unacceptable in the design year.

Improvement Options

In general, when capacity is exceeded at a stop control intersection, the first step is to consider adding auxiliary lanes or otherwise changing the channelization. If those steps are not adequate to improve the LOS, the next step is to look at changes in the traffic control. When analyzing the improvement options, we assumed the traffic from residential development south of Mountain Air Drive would grow linearly between now and 2029.

<u>Turn Lanes.</u> The National Cooperative Highway Research Program (NCHRP) has developed a series of thresholds to use when analyzing channelization improvements at intersections. These thresholds are listed in NCHRP Report 457. Specifically, based on the anticipated traffic demands, a northbound right-turn lane on Rabbit Creek Road, a southbound left-turn lane on Rabbit Creek Road, and a second westbound lane on Mountain Air Drive are warranted.

With the additional lanes, the 2029 PM traffic would improve to an acceptable LOS D, but AM traffic would still experience LOS F. The turn lanes would operate at LOS D or better until 2021. The turn lanes on Rabbit Creek Road should be 410 feet long (340 feet minimum) to accommodate vehicle deceleration. The right turn lane on Mountain Air Drive should be at least 150 feet long to meet MOA criteria. Deceleration is not a concern since it is a stop controlled approach, and right turn queues are expected to be small. The right turn lane will be blocked by left turning traffic during peak periods with queues anticipated to extend 500 feet or more. It is not practical to construct a right turn lane that long.

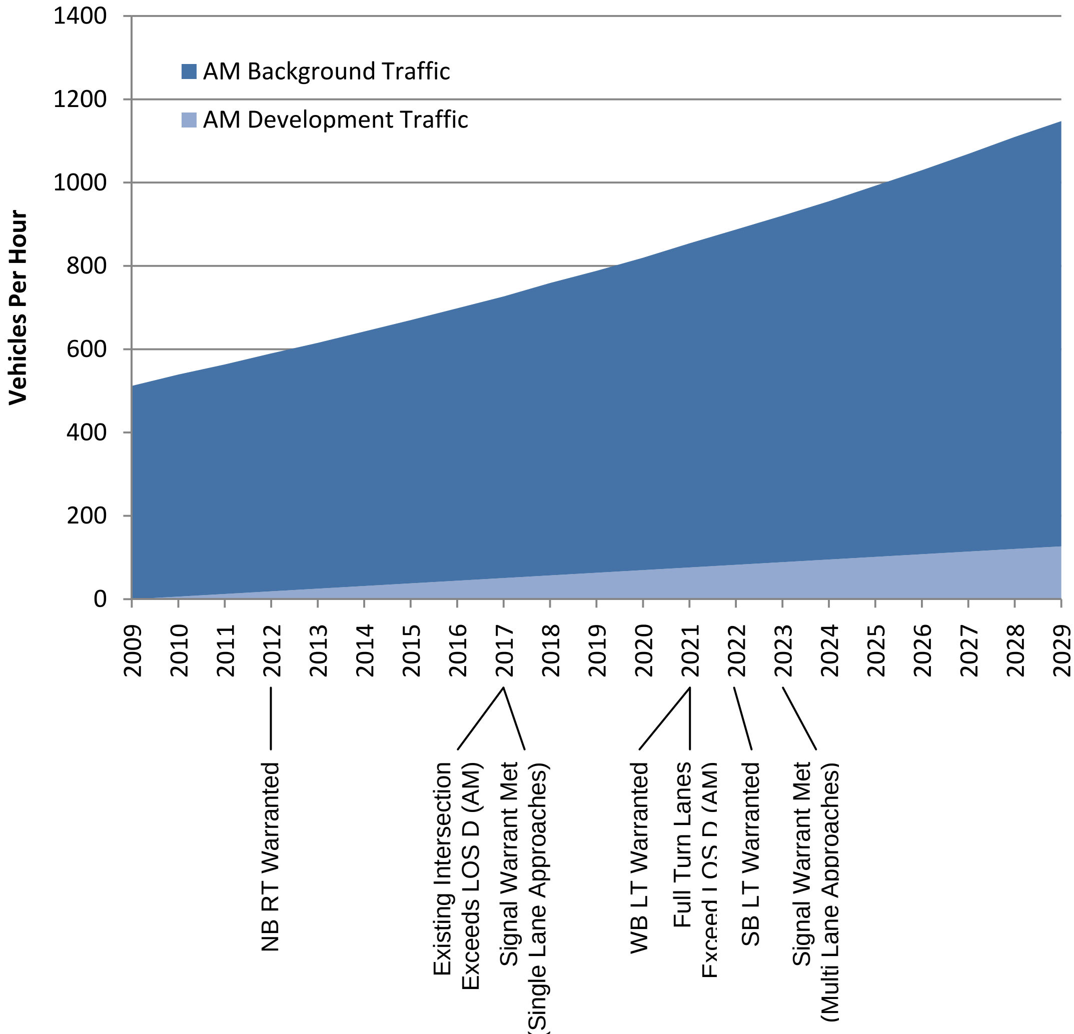
<u>Roundabout.</u> Since the additional lanes would not satisfy the traffic demands, control alternatives must be considered. All-way stop control would not be appropriate since the dominant traffic pattern is through traffic on Rabbit Creek Road. Roundabout control would be an acceptable alternative, based on the criteria given in NCHRP Report 457. NCHRP Report 572 provides methodologies for estimating capacity and delay at roundabouts. Based on those methodologies, a single-lane roundabout would result in LOS B for the AM peak hour and LOS A for the PM peak hour. A single lane roundabout would need to be approximately 130 feet in diameter.

<u>Traffic Signal</u>. Signal warrants were also analyzed for this intersection. Signal warrants use traffic volumes and intersection characteristics as an indicator as to whether the expense and delay involved

with signal installation can be justified. Warrant 3, the peak hour warrant, is expected to be met by 2017 if no turn lanes are constructed and by 2023 if all of the turn lanes mentioned above are constructed. This warrant is recommended for use only at *"facilities that attract or discharge large numbers of vehicles over a short time."* Bear Valley Elementary School fits this description. Given the 2029 AM traffic volumes, a signal at this intersection with no auxiliary lanes would produce an average delay of 33.3 seconds, resulting in LOS C. Projected 2029 PM volumes result in an average delay of 10.8 seconds and LOS B for single-lane signal control. If a signal is installed with all of the turn lanes, the AM delay would be 8.6 seconds for LOS A, and the PM delay would be 6.7 seconds for LOS A.

Figure 1 shows the projected AM peak hour traffic volumes, as well as a time line of when various improvements would be warranted. AM Traffic is shown since it is the higher of the peak periods. Roundabout information is not included because there is no system of roundabout warrants.

Figure 1 – Traffic Timeline



Recommendations

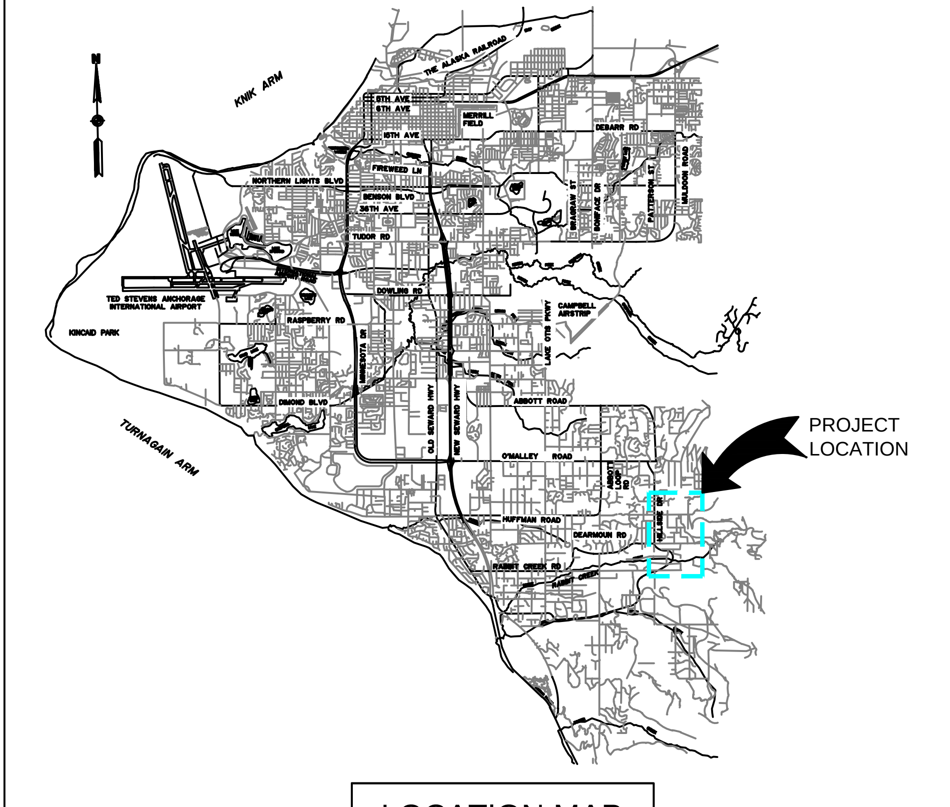
There are essentially three options for improving the intersection capacity to accommodate the anticipated traffic once the existing capacity is exhausted: construct auxiliary lanes with future plans to install a signal, construct a roundabout, or construct a signal. Of these options, constructing auxiliary lanes or constructing a roundabout should be considered further. Simply constructing a signal with no auxiliary lanes will likely create safety problems as turning traffic stops in the through lanes along Rabbit Creek Road. This would also not conform to the Design Criteria Manual. Additionally, auxiliary lanes may serve the traffic demand for years before the expense, both annual and capital, of a signal is necessary.

Building auxiliary lanes or a roundabout will be expensive. Given the limited budget of the Mountain Air Drive project, it may be necessary to postpone intersection improvements to a separate project. Since Mountain Air Drive will not connect to any immediate traffic generators, building the extension without improving the intersection will not cause immediate traffic problems. With no changes to the intersection, LOS will reach the D/E threshold in the AM peak around 2017 (depending on development schedules). Thus, if improvements are not built with the Mountain Air Drive Extension they should be programmed into local transportation plans so they will be in place before traffic operations break down.

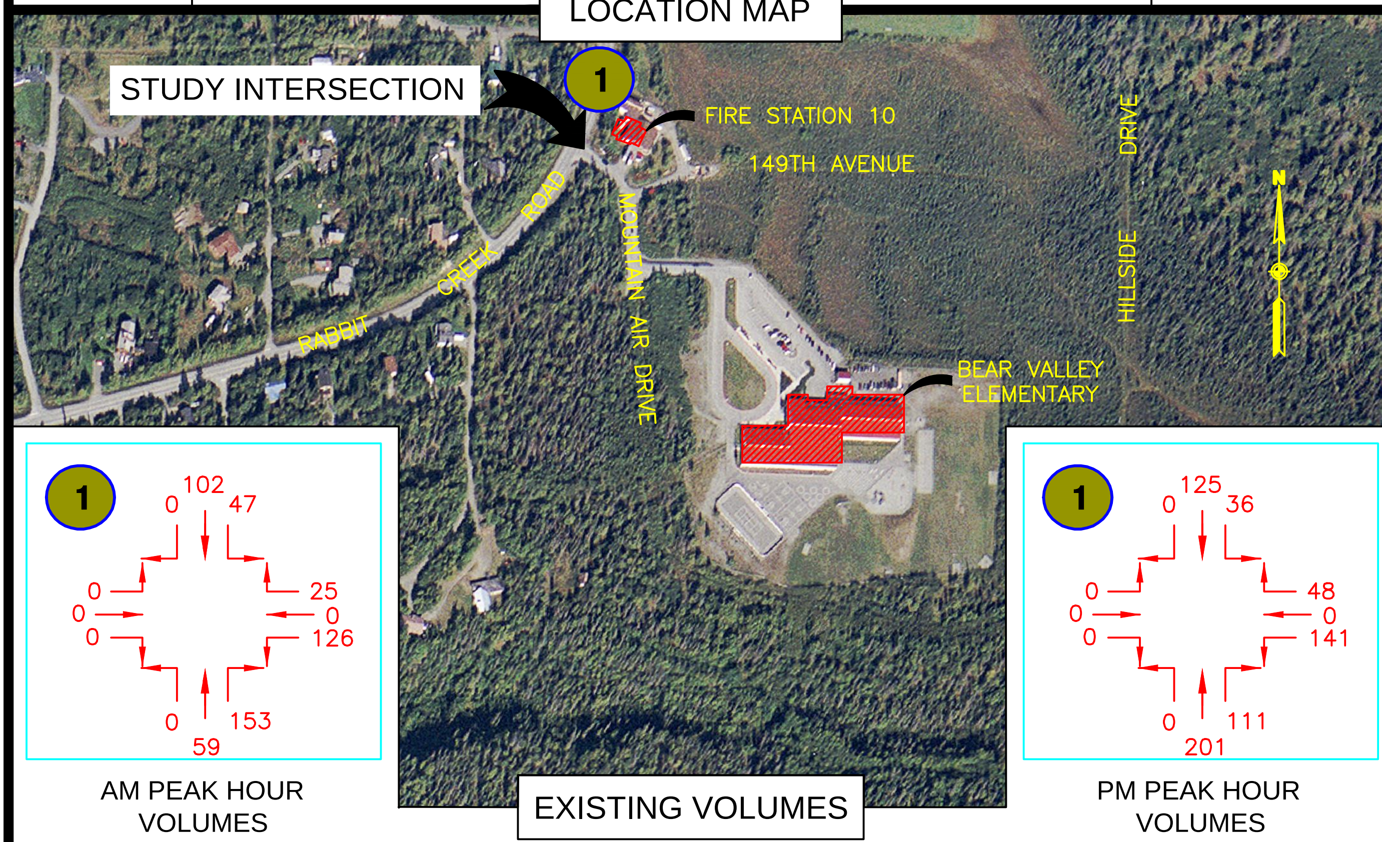
Delay Estimates

When considering intersection improvements, it is important to recognize that there are more costs than those incurred during construction. One of the most significant is the change in motorist delay caused by the choice of improvement. That is one consideration in the LOS requirement - once delay gets beyond a certain point, the improvement is said to fail. When attempting to compare multiple improvements that do not exceed LOS requirements, it is important to consider delay imposed on the traveling public as a cost of the improvement.

To compare delay between the auxiliary lane and roundabout options, we have analyzed traffic operations throughout a typical day. We assumed the AM and PM peak traffic volumes last 2 hours each, and we have developed an off-peak traffic volume to use for the rest of the day. The off-peak traffic volume was calculated by determining, from PTR data, the percentage of traffic that occurs during the peak periods and averaging the remaining traffic over the remaining time in the day. In this case, the off peak traffic volume was 44.2 percent of the PM peak hour volume. This process was repeated for 5 year increments to develop average delay values for the two improvement options. The end result is that, on the average day for the 2009 to 2029 period, a roundabout would cause 10.4 hours of delay and the auxiliary turn lanes/signal would cause 11.7 hours of delay.



LOCATION MAP



EXISTING VOLUMES

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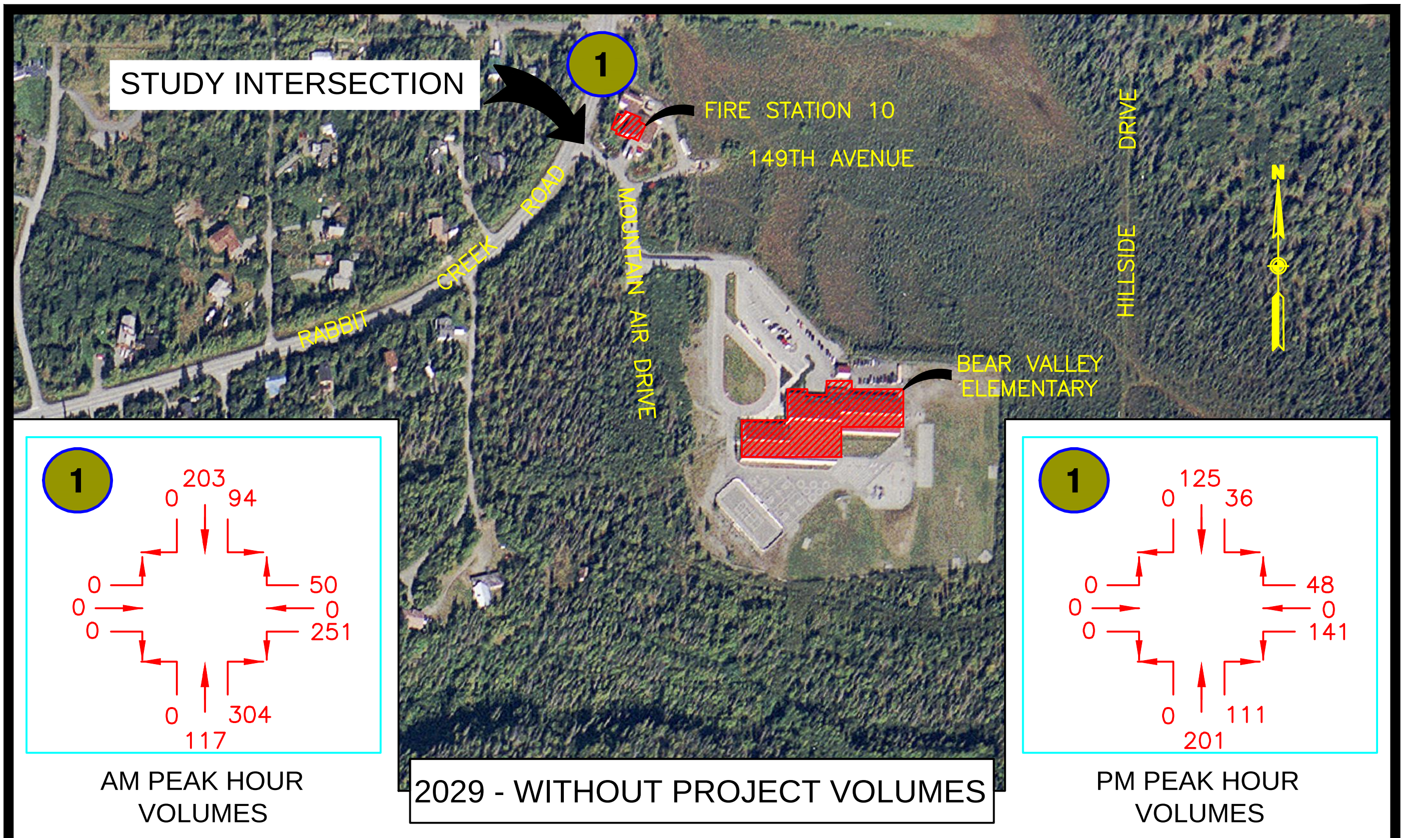
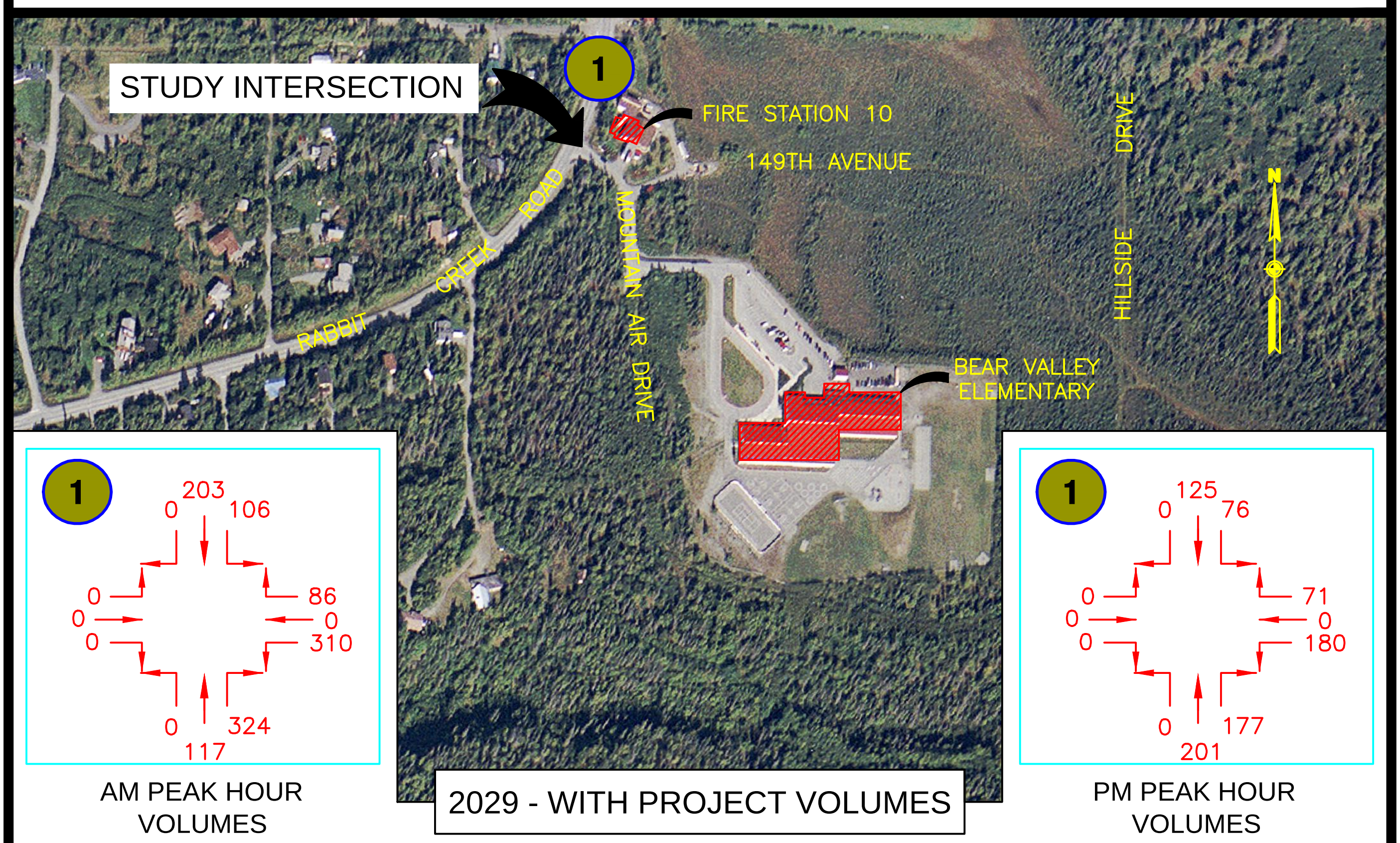
MOUNTAIN AIR DRIVE
HILLSIDE DRIVE EXTENSION
MOA PM&E PROJECT NO. 08-019

TRAFFIC ANALYSIS - FIGURE 1

MOUNTAIN AIR DRIVE extension





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MOUNTAIN AIR DRIVE
HILLSIDE DRIVE EXTENSION
MOA PM&E PROJECT NO. 08-019

TRAFFIC ANALYSIS - FIGURE 2

MOUNTAIN AIR DRIVE extension

Appendix E
Hydrology Analysis

Technical Memorandum

Date:	September 29, 2010	**W.O.#:**	1122900
To:	Steve Kari	**cc:**	Will Webb Ray Plummer
From:	Hans Arnett and Kim Elliott		
Project:	Mountain Air Drive/Hillside Drive Extension		
Subject:	August 31, 2010 Hydrology Site Visit—Proposed Alternative A Bridge Crossing Site - Final		

Site Visit Overview

A site visit was performed at the location of the proposed Mountain Air Drive bridge crossing of Little Rabbit Creek in the late morning and early afternoon of August 31, 2010. The site visit was performed by USKH Inc. (USKH) hydrologist Hans Arnett and Water Resources Engineer Kim Elliott. The weather during the site visit was overcast and calm, with temperatures in the high 50s.

The purpose of the site visit was to examine the new proposed Alternative A stream crossing location, which had changed since the completion of hydraulic analyses presented in the Draft Design Study Report (DDSR) for the project. Those analyses, which included estimates of the water surface elevation and top width of the 100-year flood at the old crossing site, were completed in the autumn of 2009. The old crossing site is located approximately 140 feet upstream (as measured along the stream channel) from the current site. The new alignment and crossing location were selected in the winter of 2009/2010, and were surveyed in late January 2010. The bridge design presented in the DDSR is for the new alignment and crossing site. In a September 1, 2010 conversation with USKH design team member, Will Webb, it was learned that the current crossing location was selected due to the narrowness of the Little Rabbit Creek valley at that site.

During the site visit, observations were made of the stream channel and valley at the crossing site, and for a distance of approximately 200 feet upstream and downstream of the crossing. Measurements of the ordinary high water (OHW) width of the stream and the estimated 100-year floodplain width were made at five locations, including at the proposed crossing site. A water surface slope measurement was made approximately 50 feet downstream of the new crossing site.

General Observations of the Little Rabbit Creek Channel and Floodplain

The channel of Little Rabbit Creek is relatively steep and narrow in the reach where the Alternative A crossing site is located. At the time of the site visit, water in the channel was approximately at bankfull stage. Therefore, at the time of the site visit, measured OHW widths approximately equaled the wetted and bankfull widths of the stream. Measured OHW widths ranged from 8 to 11 feet, except for at the crossing site, where it was 36 feet (the crossing site is discussed in more detail below). Measured OHW widths are presented in Table 1. Measurement locations are shown in Figure 1.

Table 1 – Ordinary High Water and Floodplain Widths for Little Rabbit Creek Near the Proposed Alternative A Bridge Crossing Site

Measurement Sites	Distance from crossing* [ft]	Ordinary High Water Width [ft]	100-Year Floodplain Width [ft]
A	100 US[1]	8	38
B	70 US	11	30
Bridge Crossing	-	36	72
C	50 DS[2]	11	42
D	75 DS	11	58

*Distance is approximate and measured along the stream
[1] US = upstream
[2] DS = downstream

Flow in the channel was shallow, swift, and relatively consistent in depth. Water depths were typically 0.5 feet or less, except in scour pools near obstructions or along the base of cutbanks on the outside of channel bends. Stream banks are low, typically vertical or close to vertical, and occasionally undercut.

Stream bed substrate consists of coarse, rounded gravel with sand and abundant cobbles. Boulder sized material was present, but rare.

The sinuosity of the channel is low, with tight meander bends being uncommon. Woody debris is common in the system, and partially buried deadfalls forming drops within the streambed were noted at a number of locations. These drops were typically a foot or less in height, and usually had associated scour pools at the base.

A moderately well formed floodplain is present along the stream. The floodplain is usually only present along one side of the stream or the other (see Photograph 1). Thick vegetation exists on floodplain surfaces, and little evidence was noted of significant recent sediment deposition or erosion on floodplain surfaces. Measurements of estimated 100-year floodplain widths are presented in Table 1. The location of measurement sites are shown in Figure 1.

Observations of the Proposed Alternative A Bridge Crossing Site

The channel of Little Rabbit Creek makes a sharp, 90-degree bend to the right (with respect to a viewer facing downstream) immediately upstream of the proposed bridge crossing site. At the site, approximately six large, fallen, beetle-killed spruce trees are present. The trees have fallen in a crisscrossed pattern and at least two of the trees have become partially buried in the stream bed, forming a log jam. Sediment and woody debris are accumulating on the upstream side of the log jam, which is acting as a sediment trap. Vegetation has begun to grow on top of the accumulated sediment and woody debris. The accumulation of sediment and woody debris has caused the stream channel to split into three braids at the crossing site, which coalesce to form a single channel a short distance downstream of the log jam. The net result is that the OHW width of the channel has become more than triple the measured average OHW width for that reach of the stream. The estimated 100-year floodplain of the stream is also significantly wider at the proposed crossing site than the average measured along this reach of the stream (see Table 1 and Photographs 2-6).

The floodplain is present along the right hand side of the valley at the proposed crossing site. A number of springs are present along the base of the hillside and on the floodplain. The springs have resulted in pools and soft, mucky, saturated, iron-stained ground at the base of the hillside at the proposed crossing site.

This is a less than ideal stream crossing location from a hydrologic and hydraulic perspective because of the 90-degree bend immediately upstream of the crossing, large OHW and estimated 100-year floodplain widths, springs and saturated ground on the floodplain, and the presence of a log jam that cannot be removed without causing a major disturbance to the stream bed and release of sediments accumulated on the upstream side of the log jam. Furthermore, if the bridge length is to be shortened to reduce costs, this crossing location presents the least flexibility with regard to bridge length within this reach of the stream.

Crossing Site Recommendations

The log jam and braided channel at the crossing site preclude making even a simplified single cross-section analysis of the water surface elevation and top width of the 100-year flood at the crossing site. To address this and to allow making the bridge as short as possible, an exercise was performed to map a conservative estimate of the 100-year floodplain boundary in the reach of the stream in which the proposed crossing is located. The boundary was developed by combining the estimates of the 100-year floodplain width measured in the field (and presented in Table 1), with the results of a single cross-section analysis of the channel approximately 50 feet downstream of the proposed crossing site. That analysis used the water surface slope measured in the field (2.15%) along with observations of channel dimensions to develop overbank depths (approximately 2 feet) that were applied within the reach. The results were further modified using analyses of contour data, topographic field survey data, and engineering judgment to develop conservative mapping of the estimated 100-year floodplain boundary on either side of the valley in the vicinity of the proposed bridge crossing. The mapped boundary is shown in Figure 2.

Using the mapped estimate of the 100-year floodplain boundary, the bridge length can be reduced to the minimum that allows spanning the full width of the floodplain at either the existing proposed location or at a nearby location where the floodplain is narrower. At the existing crossing location the minimum bridge length, based on floodplain width, is approximately 90 feet.

A good alternate crossing location is approximately 50 feet downstream of the existing proposed crossing location. The OHW and estimated 100-year floodplain widths are much narrower at the alternative crossing location, and the stream flows within a relatively straight, single channel. However, roadway fill quantities would be higher for an alignment that crossed at the alternative location, particularly on the south side of the crossing. The minimum bridge length at this location would be approximately 70 feet, depending on the skew of the alignment to the floodplain.

The narrowest floodplain is located a short distance upstream of the existing proposed location. The minimum bridge length at this location would be approximately 70 feet, depending on the skew of the alignment to the floodplain.

Photograph 1 – Little Rabbit Creek and floodplain approximately 100 feet upstream from proposed Alternative A bridge crossing site. Floodplain width is approximately 40 feet at this location. View facing upstream.

Photograph 2 – Log jam and large woody debris in the stream at the proposed Alternative A bridge crossing site on Little Rabbit Creek. The stream channel goes through a 90-degree bend immediately upstream of the log jam and crossing site. View facing downstream.

Photograph 3 – Another view of the log jam in the stream at the proposed Alternative A bridge crossing site. The stream channel splits into three braids as it passes through the log jam. Flagging in the center of the photograph marks the approximate centerline of the crossing. View facing downstream.

Photograph 4 – Vegetation growing on stream sediments and woody debris trapped on the upstream side of the log jam at the proposed Alternative A bridge crossing site. Flagging in the center of the photograph marks the approximate centerline of the crossing. Flow is from left to right.

Photograph 5 – View of the proposed Alternative A bridge crossing site from the top of the south side of the Little Rabbit Creek valley. Note the 90-degree bend of the stream as it approaches the crossing site.

Photograph 6 – View facing upstream toward the downstream side of the log jam at the proposed Alternative A bridge crossing. The photograph is taken at the point where the three braids of the channel coalesce to form a single channel after passing through the log jam.

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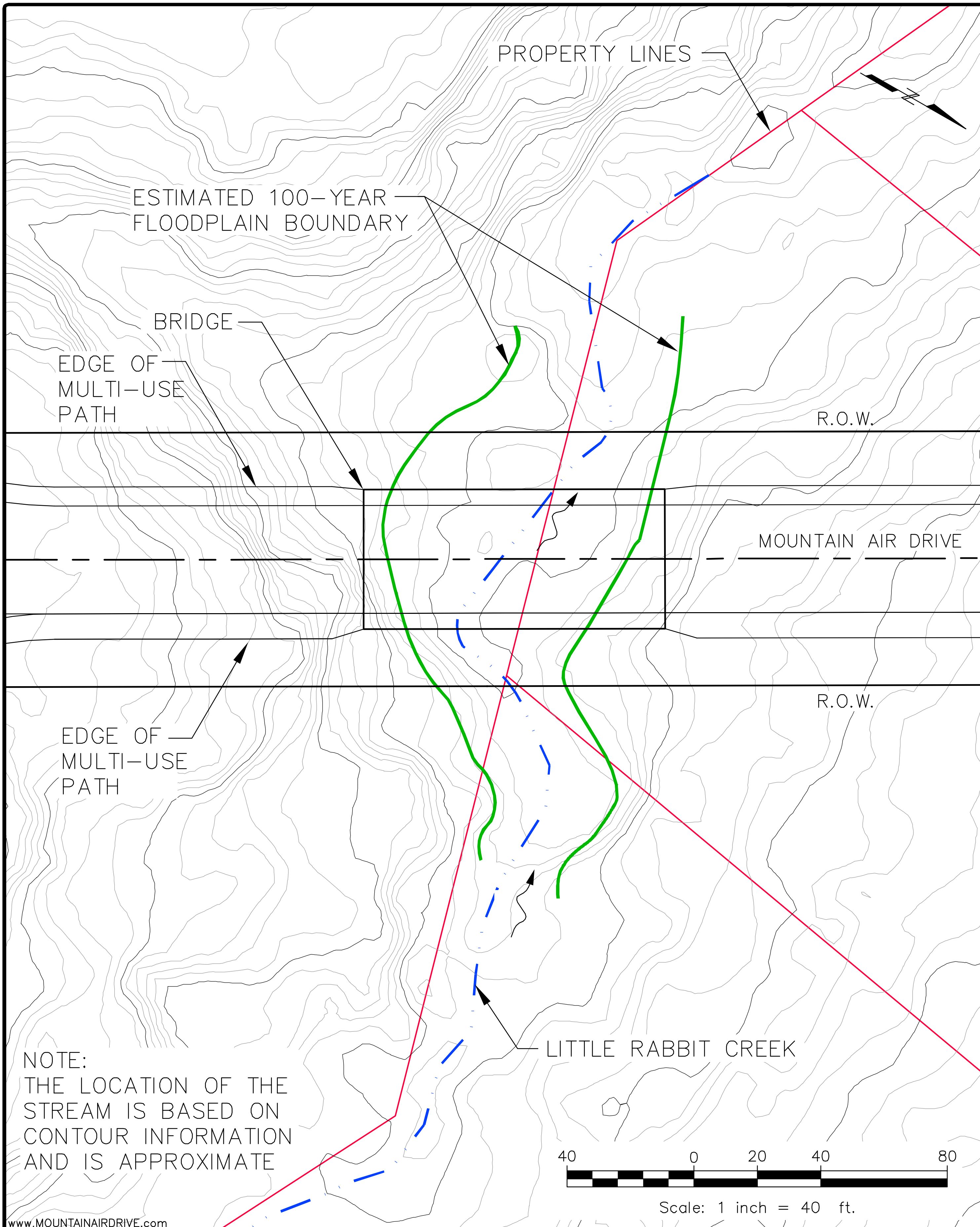
AUGUST 2010 HYDROLOGY SITE VISIT - FIELD MAP

MOUNTAIN AIR DRIVE/HILLSIDE DRIVE EXTENSION
MUNICIPALITY OF ANCHORAGE
PROJECT MANAGEMENT AND ENGINEERING #08-019

MOUNTAIN AIR DRIVE extension

FIGURE 1

SEPT 2010



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AUGUST 2010 HYDROLOGY SITE VISIT
ESTIMATED 100-YEAR FLOODPLAIN
MOUNTAIN AIR DRIVE/HILLSIDE DRIVE EXTENSION
MUNICIPALITY OF ANCHORAGE
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MOUNTAIN AIR DRIVE extension

FIGURE 2
SEPT 2010

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Technical Memorandum

Date:	June 24, 2011	**W.O.#:**	1122900
To:	Steve Kari, P.E., Project Manager	**cc:**	File
From:	Raymond Plummer, P.E. and Hans Arnett		
Project:	Mountain Air/Hillside Drive Extension		
Subject:	Hydrologic and Hydraulic Analyses		

This memorandum summarizes hydrologic and hydraulic analyses conducted for the Mountain Air Drive/Hillside Drive Extension project. Recommendations are included for crossings of Little Rabbit Creek along two proposed alignments, and for storm water treatment facilities. The current stream crossing concept for Alignment A consists of a 90-foot, single span bridge. Alignment B crosses two forks of Little Rabbit Creek – the North Fork and the Main Branch. The current Alignment B crossing plan is for single span structural plate arch culverts at both crossings. The arches would be similar in size, with spans of 39 feet, heights of 18.5 feet, and lengths of 48 feet.

This document provides an update to an October 5, 2009 hydrology and hydraulics memorandum. The update addresses changes to the concept design for Little Rabbit Creek crossing structures along the Alternative B alignment, which were developed after the completion of the original memorandum. Storm water treatment information has not been updated.

Hydrology

Basin Overview

<u>Anchorage Climate</u>: Snowfall averages about 70 inches annually in Anchorage, with a record seasonal snowfall of 133 inches and a record daily snowfall of approximately 26 inches. Summer temperatures average around 60 degrees (deg) Fahrenheit (F). Extreme temperatures range from a maximum of 86 deg F to a minimum of -38 deg F. Precipitation averages 15.8 inches annually. The maximum recorded annual precipitation was over 27 inches, and the highest recorded daily precipitation was 2.76 inches. The rainy season in Anchorage is August through October, with four of the five highest rainfall events on record occurring within the month of August.

<u>Basin Geography</u>: As shown in Figure 1, most of the Little Rabbit Creek basin above the project site is located in alpine and subalpine regions with mountain slopes contributing to both Little Rabbit Creek and the North Fork of Little Rabbit Creek. Although the majority of the basin is relatively steep, the Bear Valley Elementary School site is relatively flat and wetlands are located to the east of the school.

According to Scott Wheaton, Watershed Scientist with the Municipality of Anchorage Watershed Management Services (MOA-WMS), the existing wetlands east of Bear Valley Elementary School convey the flows to the creek as interflow and ground water. The MOA-WMS is concerned that construction of roadway and ditch features across these wetlands may impound this interflow on the upstream side of the new roadway and concentrate flows on the downstream side. Possible impacts of impoundment and flow concentration include icings, loss of natural flow attenuation, and excessive erosion of natural conveyances.

Analyses

In order to estimate stream flow magnitudes for each stream crossing, a regression analysis was performed using methods presented in the U.S. Geological Survey (USGS) publication *Estimating the Magnitude and Frequency of Peak Streamflows for Ungaged Sites on Streams in Alaska and Conterminous Basins in Canada*, WRI 03-4188 (Curran, Meyer, and Tasker, 2003). Drainage basin delineations were performed using 1:63,360-scale USGS topographic mapping. The results of these analyses are summarized in Table 1.

Table 1 Little Rabbit Creek Regression Analysis Results

Crossing Site	Basin Area (mi^2)	Q_2 (cfs)	Q_5 (cfs)	Q_{10} (cfs)	Q_{25} (cfs)	Q_{50} (cfs)	Q_{100} (cfs)	Q_{200} (cfs)	Q_{500} (cfs)
Alternative A	4.7	40	70	90	120	150	180	210	250
Alternative B – North Fork	1.4	10	20	30	40	50	60	80	90
Alternative B – Main Branch	3.3	30	50	70	90	110	130	150	190

The regression equations in WRI 03-4188 are specific to rural Alaska. However, the sparse amount of development within the contributing basins makes it appropriate to use this regression technique for the development of flood frequency estimates. Research conducted by Jeffery D. Urbanus, MOA-WMS (*Flood Hydrology of Little Campbell Creek*, University of Alaska, 2008), indicates that USGS regression results compare favorably to results obtained through *United States Army Corps of Engineers Hydrologic Engineering Center – Hydrologic Modeling System* modeling of 100-year stream flows.

Hydraulics

This hydraulics section is broken into three main sections. The first section discusses 100-year flood analyses to develop estimates of the width of the 100-year floodplain at the three crossing sites. The second section describes fish passage at the crossing sites. The last section discusses the impact the development of the proposed roads will have on flow to the creek and the cross-drainage calculations used to determine the design of a conveyance and treatment system to handle these flows.

100-year Flood Analyses

Single cross-section hydraulic calculations for the 100-year flood were performed for the three proposed crossing sites. Cross-section data were developed from a combination of 2-foot contour interval photogrammetric mapping, field measurements made on August 10, 2009, and data provided in the MOA's streams geodatabase. Cross-sections were cut perpendicular to stream flow lines for each proposed crossing location. Channel widths were determined using ordinary high water measurements taken during the August 10 hydrology site visit. Channel depths were estimated from field observations and data provided in the MOA streams geodatabase. Water surface slope measurements were made during the site visit, and were compared to slopes measured using the contour data at each crossing and reach slopes given in the MOA streams geodatabase. The most conservative values were used for the calculations. The calculation efforts were performed without the benefit of field-surveyed topographic data.

Table 2 presents the 100-year flood analysis results for the three crossing sites.

Table 2 100-Year Flood Analysis Results for Little Rabbit Creek

	Alignment A	Alignment B – North Fork	Alignment B – Main Branch
Discharge (cfs)	180	60	130
Water Depth (ft)	2.3	1.7	1.6
Water Surface Elevation (ft)	909	945	955
100-Year Floodplain Width (ft)	35	20	27

The current stream crossing concept for Alignment A consists of a 90-foot, single span bridge, which is significantly wider than the calculated 100-year floodplain width of 35 feet presented in Table 2. The current plan for the two Alternative B stream crossings is for single span structural plate arch culverts with spans of 39 feet at both crossings. This is wider than the calculated 100-year floodplain widths of 20 feet for the North Fork of Little Rabbit Creek and 27 feet for the Main Branch of Little Rabbit Creek presented in Table 2. Therefore, no hydraulic concerns are anticipated at any of the three crossing sites.

Fish Passage

The *Memorandum of Agreement Between the Alaska Department of Fish and Game and the Alaska Department of Public Facilities for the Design, Permitting, and Construction of Culverts for Fish Passage* (Memorandum of Agreement) states that for a Tier I design, the design slope must be within 1 percent of the existing conditions slope and the culvert width must be nine-tenths of the ordinary high water width of the creek. Since the proposed crossing structures at all three crossing sites completely span the 100-year floodplain, the crossing designs can all be considered Tier 1 under the Memorandum of Agreement, and no fish passage analyses are required.

Roadway Cross-Drainage Features

<u>Hydrology</u>

The cross-drainage culverts and associated ditches and swales will be designed to convey peak flows for the 10-year, 24-hour event.

In order to estimate design flows at the cross-drainage culverts, a HEC-HMS model was developed. The rainfall quantities input into this model were calculated according to Intensity-Duration-Frequency data presented in the MOA *Drainage Design Guidelines* and scaled up for orographic effects according to data in the MOA *Design Criteria Manual*. Curve Numbers were calculated based on full development according to existing zoning designations and regulations, as well as local soil types. The basin areas contributing flows to the cross drainage features were delineated using MOA Geographic Information System (GIS) data layers, including those for 2-foot interval contours, MOA basin delineations, and MOA mapped drainageways. Lag time values for each basin and subbasin were estimated according to guidelines in the *MOA Drainage Design Guidelines*.

Hydraulics

The design criteria for the roadway cross-drainage features have been obtained from Chapter 2 of the MOA *Design Criteria Manual*.

All cross-drainage culverts will:

- Be designed for the 10-year, 24-hour event
- Be at least 18 inches in diameter
- Have at least 1 foot of cover
- Have a slope of at least 0.5 percent
- Be designed to have un-submerged inlets during the design event

The cross-drainage culverts will be designed and placed to:

- Convey peak flow rates considering full development according to local zoning
- Maintain existing MOA mapped drainageway connections
- Maintain dispersed flow in downstream wetlands
- Address snowmelt peaks
- Address potential glaciation, using concepts presented in the MOA *Hillside District Plan Pilot Watershed Drainage Plan Little Rabbit Creek and Little Survival Creek Watersheds*, Draft April 2008

Upon selection of the preferred alternative, submittals meeting the requirements of the MOA *Drainage Design Guidelines* – Complex Large Project, will be prepared during the plans production phase of the project.

Water Quality

A facet of the municipal storm water management program emerging in the new Municipal Separate Storm Sewer System (MS4) permit requirements will be the use of Low Impact Development (LID) management strategies. The *Proposed Permit – July 2009* (AKS-052558) states, *“Within four years of the effective date of this permit the permittees must evaluate five pilot projects that use LID concepts for on-site control of water quality.”* LID is a storm water management approach that focuses on maintaining or restoring the natural hydraulic functions of a site for the purpose of water resources protection. As opposed to collecting runoff in a piped or channelized network and managing the storm water in a large-scale “end of pipe” location, LID uses a decentralized approach that disperses flows and manages runoff closer to where it originates. According to the traditional engineering approach, standing water is a deficiency in the design, and storm water is a waste product and must be disposed of. According to LID practices, however, storm water is a valuable resource that must be conserved and used to keep natural systems healthy. Implementation of LID elements on the Mountain Air Drive project could allow for some MS4 permit-required public education and involvement opportunities and may count as one of the municipal pilot projects under the *Green Infrastructure/Low Impact Development Strategy and Pilot Projects* in the draft permit. Furthermore, LID implementation will help serve to address both the impoundment of interflow and concentration of flow concerns voiced by MOA-WMS.

Initial observations and a preliminary data review performed by Shannon & Wilson indicates favorable conditions for LID implementation, with a layer of peat and organics ranging from 2 to 7.5 feet thick overlying mineral soils adjacent to the areas slated for LID elements. The LID elements for Alternatives A and B include filter strips, grassed bioinflitration swales, check dams, infiltration trenches, and level spreaders. In addition, the amount of curbed roadways and piped storm drainage infrastructure has been minimized to prevent loss of baseflow recharge and to minimize the occurrence of concentrated discharges. These sustainable LID elements are incorporated to meet the requirements for a letter of non-objection from the Alaska Department of Environmental Conservation to remove *“total suspended solids particles greater than 20 microns in size from stormwater runoff during storms less than the 2-year six-hour rain event.”* Design standards used to develop the infiltration trenches and filter strips will be in accordance with the MOA *Low Impact Development Design Guidance Manual*.

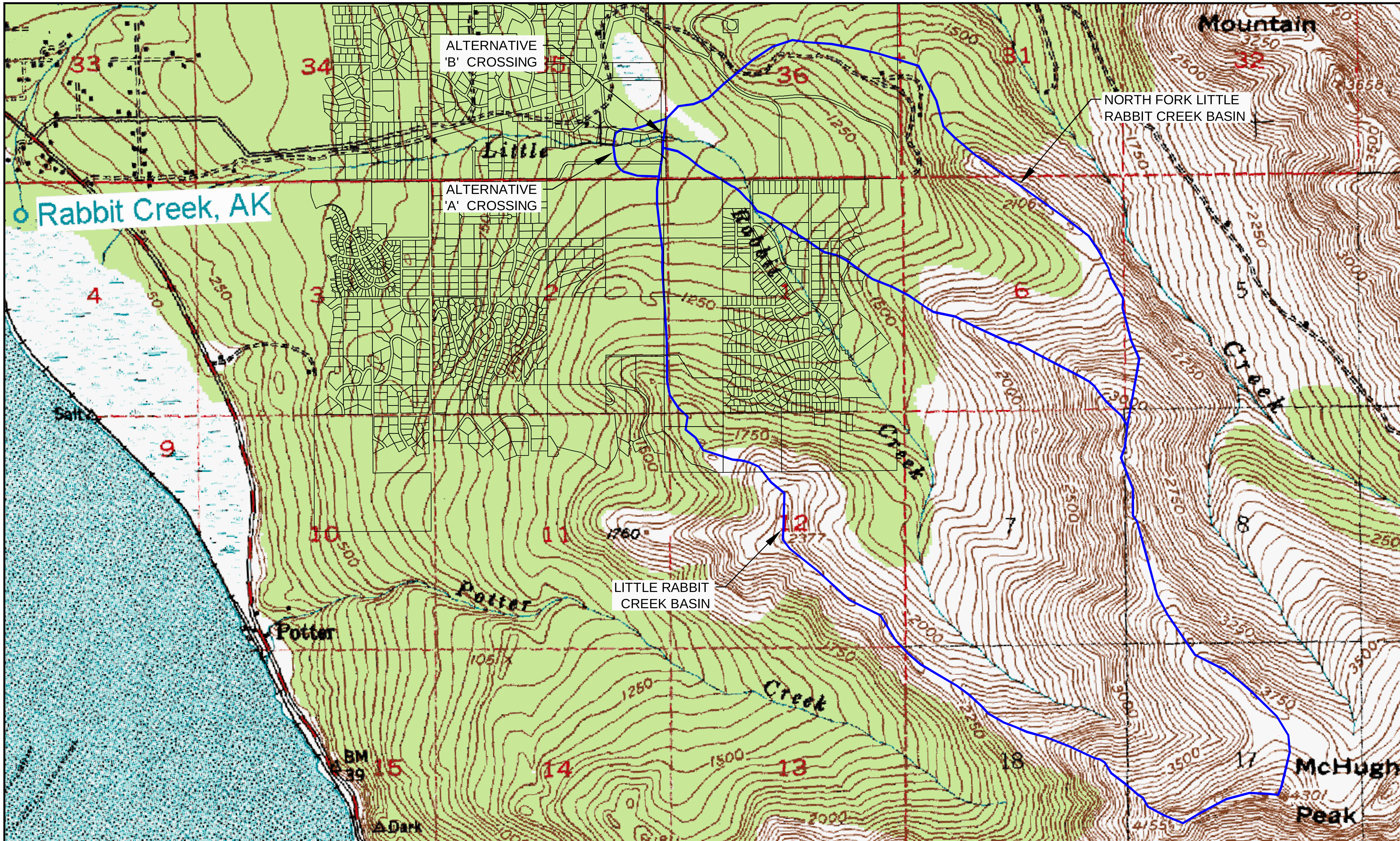
Adequate erosion and sediment controls are expected to be a critical aspect of design and construction due to the proximity to waters of the United States. Temporary erosion and sediment control measures may include retention of existing vegetation, temporary seeding or covering, stabilized construction exits, haul route cleaning, straw wattles, silt fence, floating silt curtains, rock check dams, rock flumes, temporary diversions, sediment basins, and dewatering filter bags as conditions warrant.

The overall project construction is anticipated to result in a land disturbance of one acre or more, including offsite borrow and disposal areas. The MOA and the General Contractor will need to seek coverage under Alaska’s version of the Environmental Protection Agency’s General Construction Permit through preparation of a Storm Water Pollution Prevention Plan (SWPPP) and issuance of a Notice of Intent (NOI). Activities required during construction to remain in compliance include, but are not limited to: implementation of the SWPPP, installation and maintenance of Best Management Practices (BMPs), inspections, recordkeeping, and meeting final stabilization requirements.

Recommended drainage features for both project alternatives are shown in Figure 2.

Summary

Research, investigations, and calculations were performed to develop hydrologic and hydraulic estimates necessary to assist in the preparation of concept-level plans for crossings of Little Rabbit Creek, and to provide storm water management for roadway runoff in order to meet local, state, and federal water quality standards. Alternative A results in a shorter roadway with a single bridge crossing. Alternative B requires two crossings with multi-plate arch pipes. The bridge and the multi-plate arch pipes completely span the 100-year floodplain at the crossing sites and therefore do not affect fish passage. For both alternatives, infiltration of runoff is promoted through the use of filter strips, grassed bioinfiltration swales, check dams, infiltration trenches, and level spreaders. These storm water management improvements, along with rock flumes at the crossings, will provide the appropriate level of treatment for storm water discharges. Addressing hillside drainage concerns and soils conditions will necessitate additional cross-culverts through the roadway prism in the final design to prevent glaciation and maintain existing drainage patterns.



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INSPECTOR:			
CONSTRUCTION RECORD	VERTICAL DATUM		

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TOPOGRAPHY	NE	SK	ELECTRIC	NE	SK
PROFILE	KP	SK	CABLE TV	NE	SK
SANITARY SEWER	NE	SK	TRAFFIC SIGNAL	WW	SK
STORM SEWER	NE	SK	DESIGN	KP	SK
WATER	NE	SK	QUANTITIES	KM	SK
GAS	NE	SK	MUN. FINAL CHECK		

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DRAINAGE BASINS

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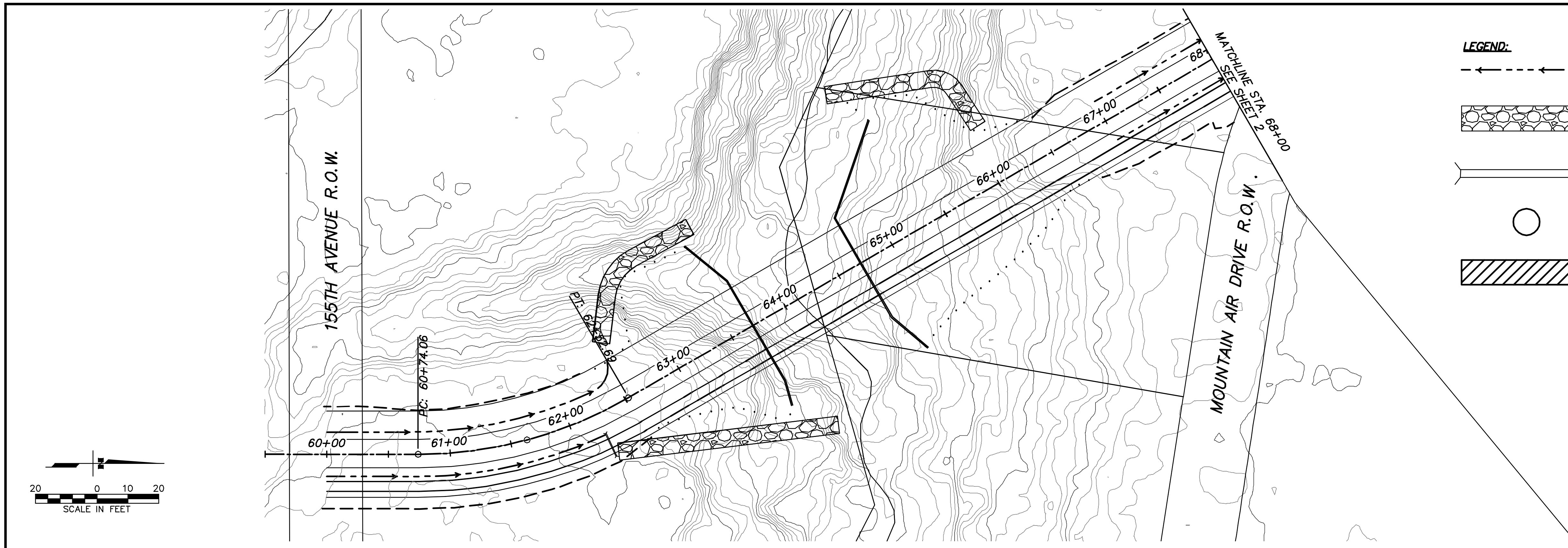


LEGEND:

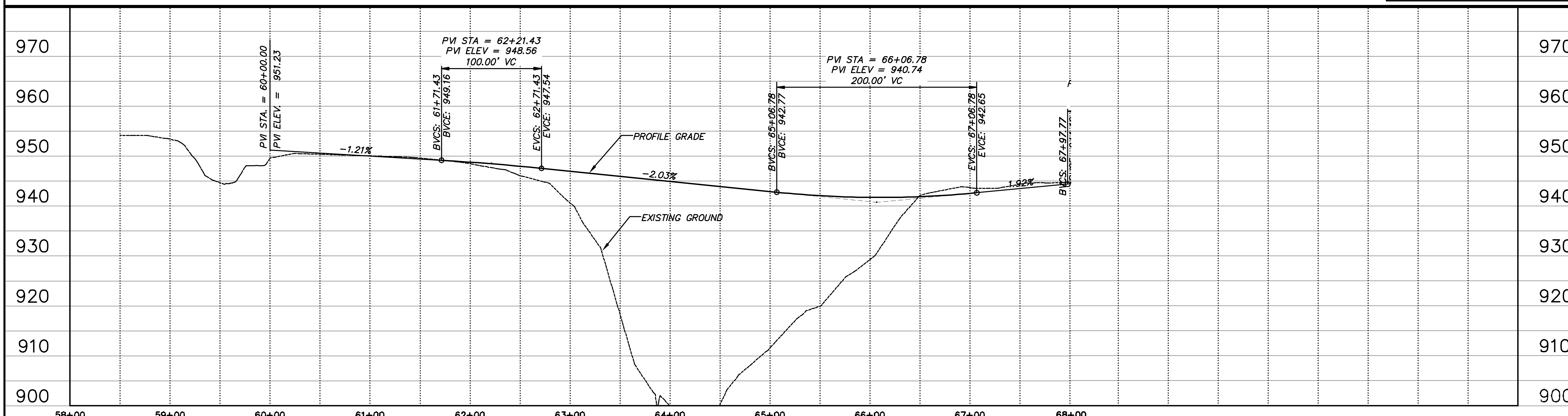
- BIOINFILTRATION SWALE WITH CHECK DAMS
- ROCK FLUME
- CROSSING CULVERT
- INLET
- INFILTRATION TRENCH AND LEVEL SPREADER

CALL BEFORE YOU DIG

The Contractor shall notify all area utility companies prior to commencement of excavation. The following is a partial list:

LOCATE CALL CENTER of ALASKA	278–3121
STATE STORM/STREET LIGHTS	333–2411
MILITARY PETROLEUM LINES	862–4112

(Includes ATU, AWWU, CEA, ENG, Butler Aviation/Tesoro, Prime Cable, MLP, Traffic Signals, MOA Storm/Streets)



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PROFILE	KP	SK	CABLE TV	NE	SK
SANITARY SEWER	NE	SK	TRAFFIC SIGNAL	WW	SK
STORM SEWER	NE	SK	DESIGN	KP	SK
WATER	NE	SK	QUANTITIES	KM	SK
GAS	NE	SK	MUN. FINAL CHECK		

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ALTERNATIVE A–PLAN & PROFILE B.O.P. TO STA. 68+00

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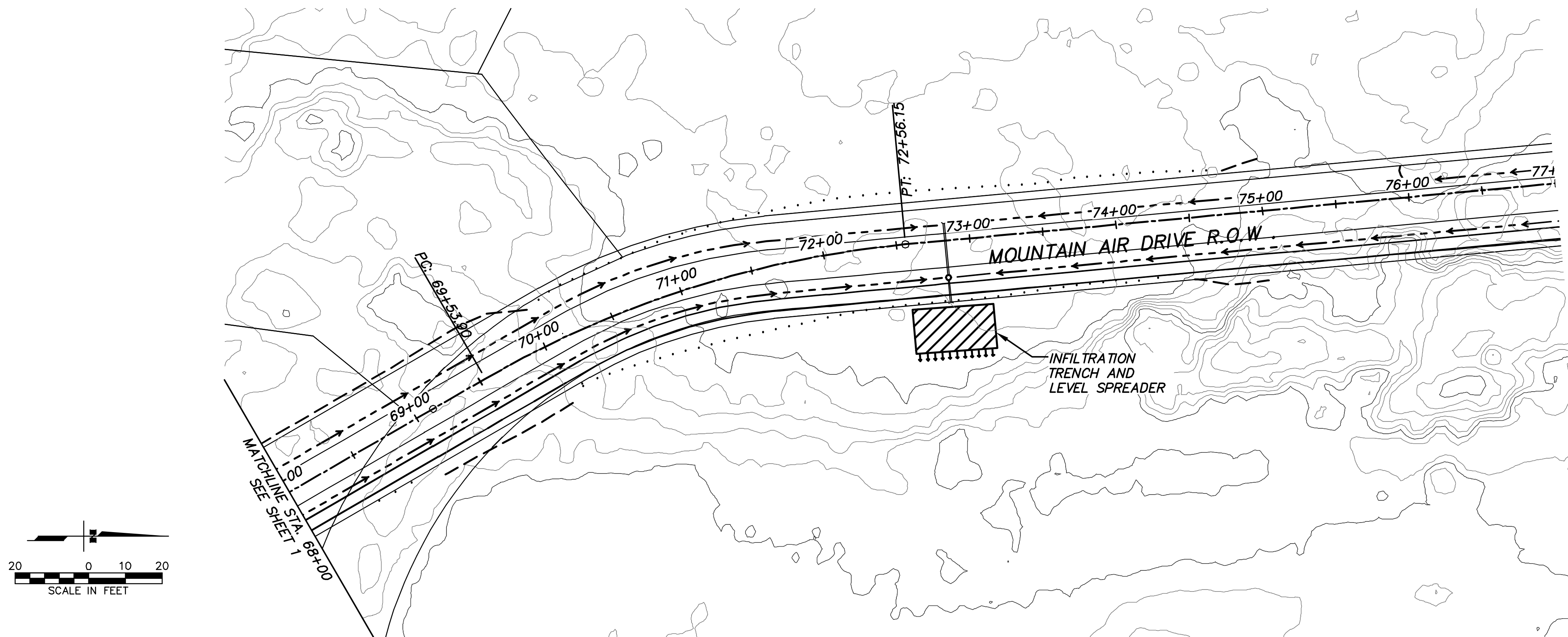

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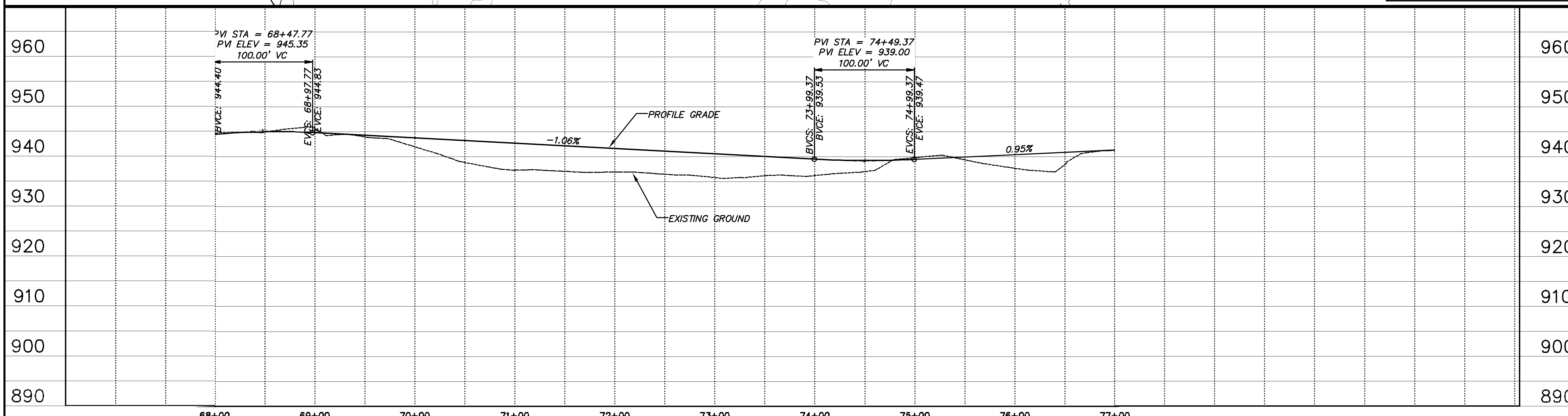

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ASBUILT:					STORM SEWER	NE	SK	DESIGN	KP	SK
					WATER	NE	SK	QUANTITIES	KM	SK
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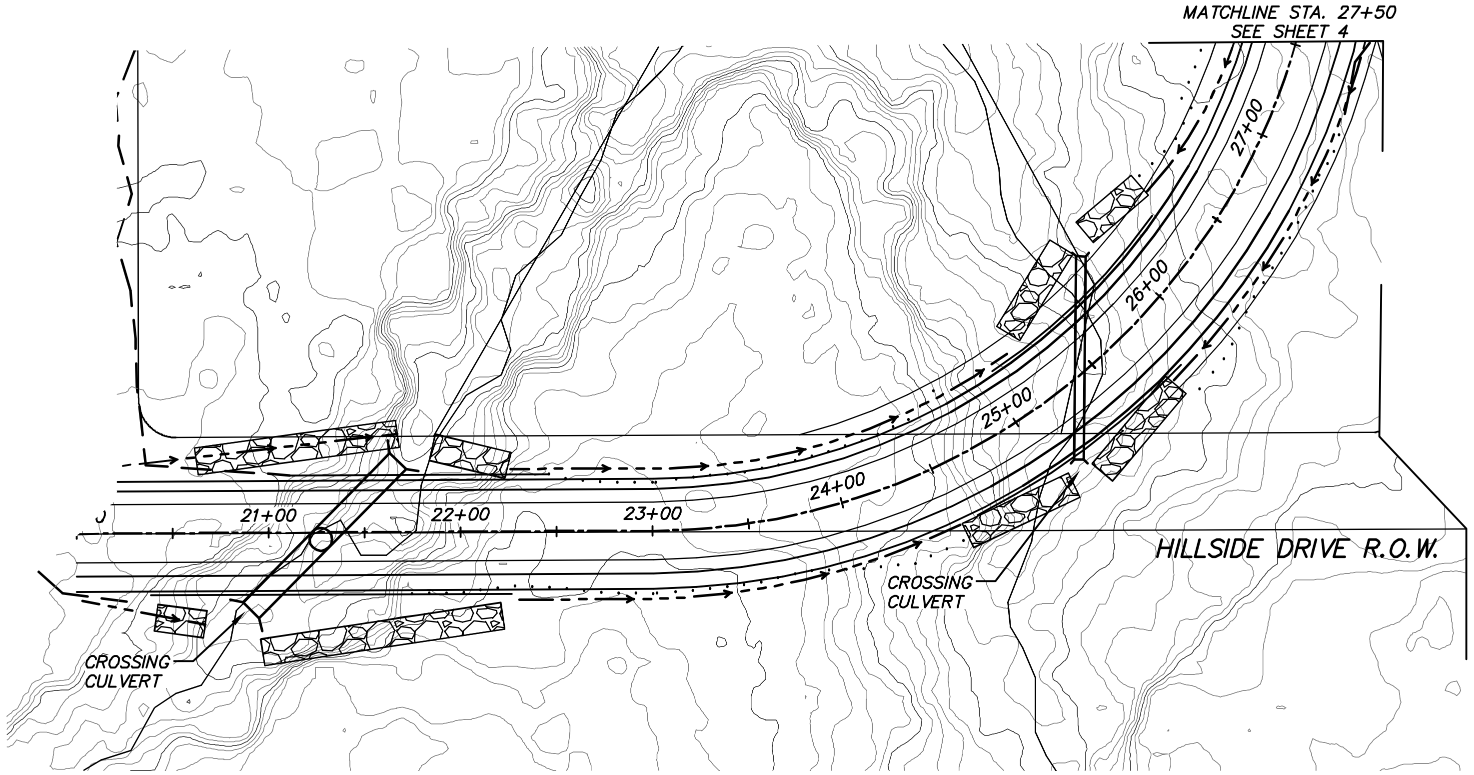

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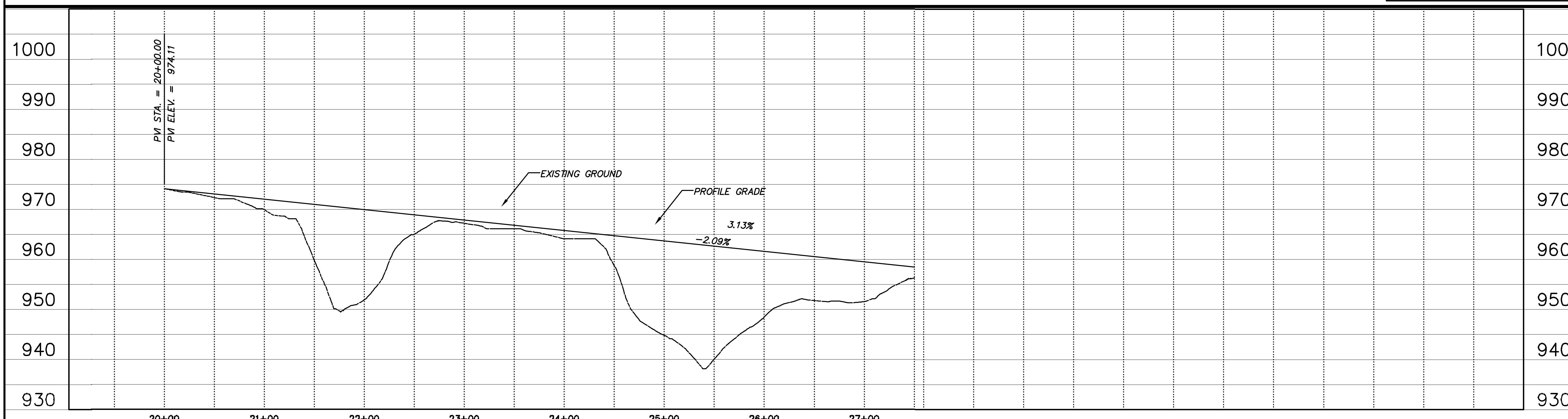

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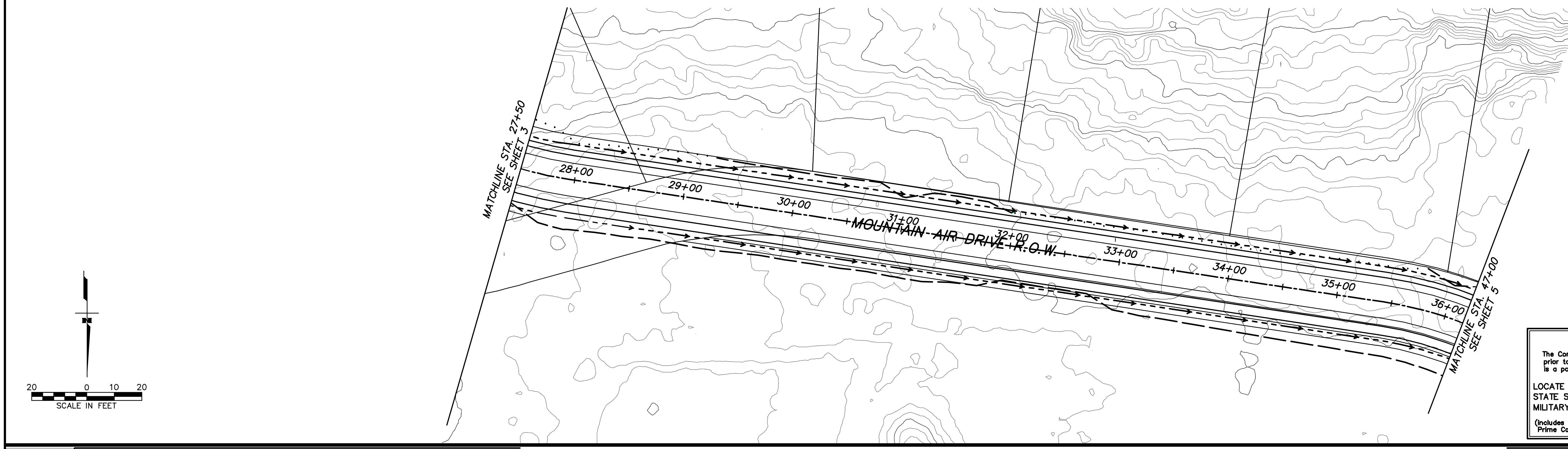

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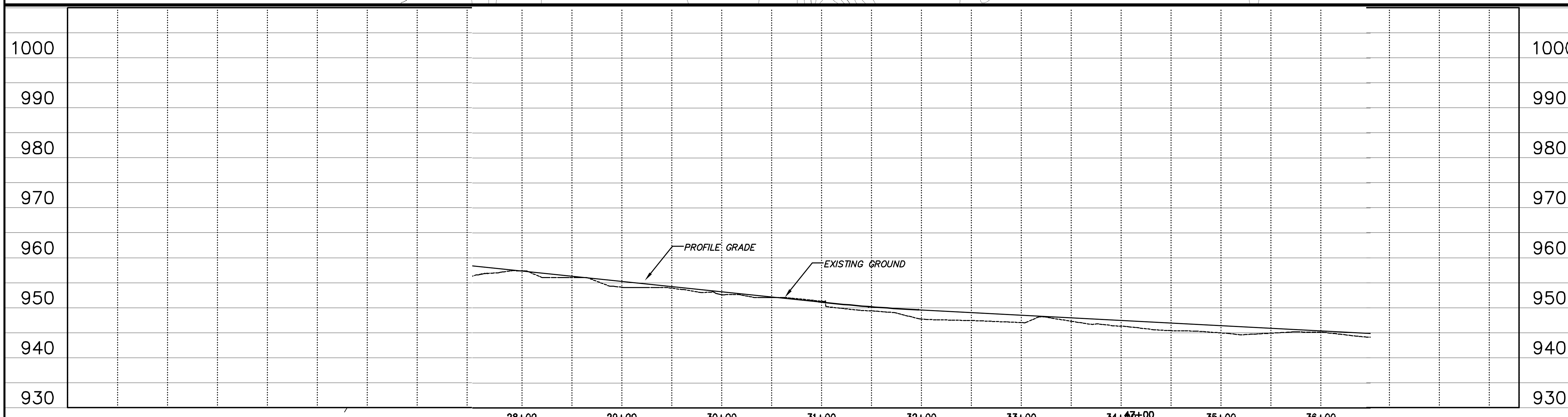

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TOPOGRAPHY	NE	SK	ELECTRIC	NE	SK
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SANITARY SEWER	NE	SK	TRAFFIC SIGNAL	WW	SK
STORM SEWER	NE	SK	DESIGN	KP	SK
WATER	NE	SK	QUANTITIES	KM	SK
GAS	NE	SK	MUN. FINAL CHECK		

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08-019 MOUNTAIN AIR DRIVE/HILLSIDE DRIVE EXTENSION
HYDROLOGY DESIGN CONCEPTS

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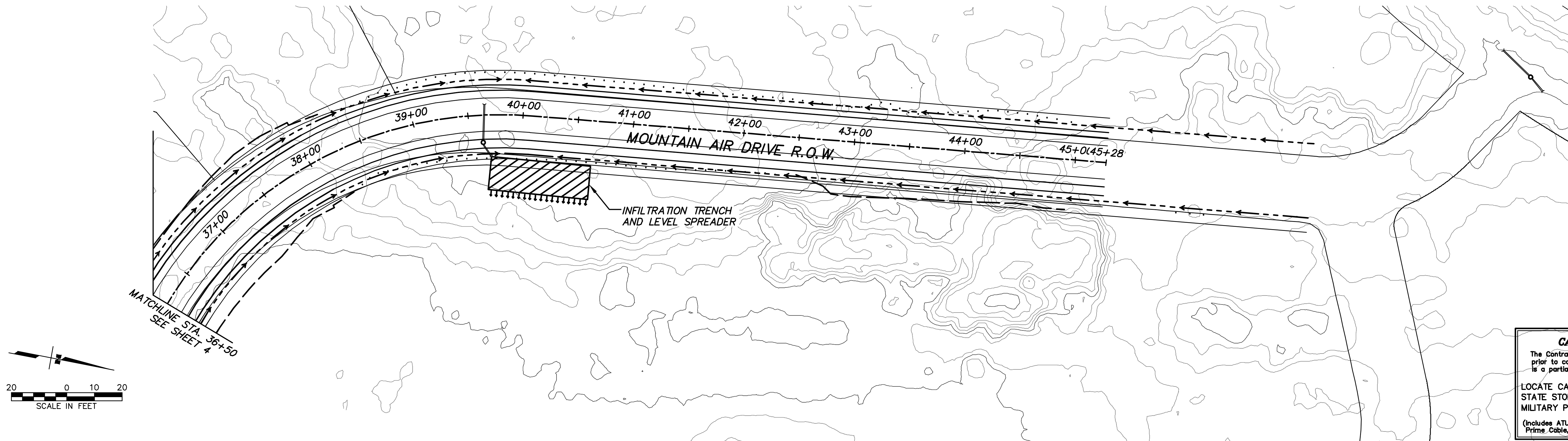

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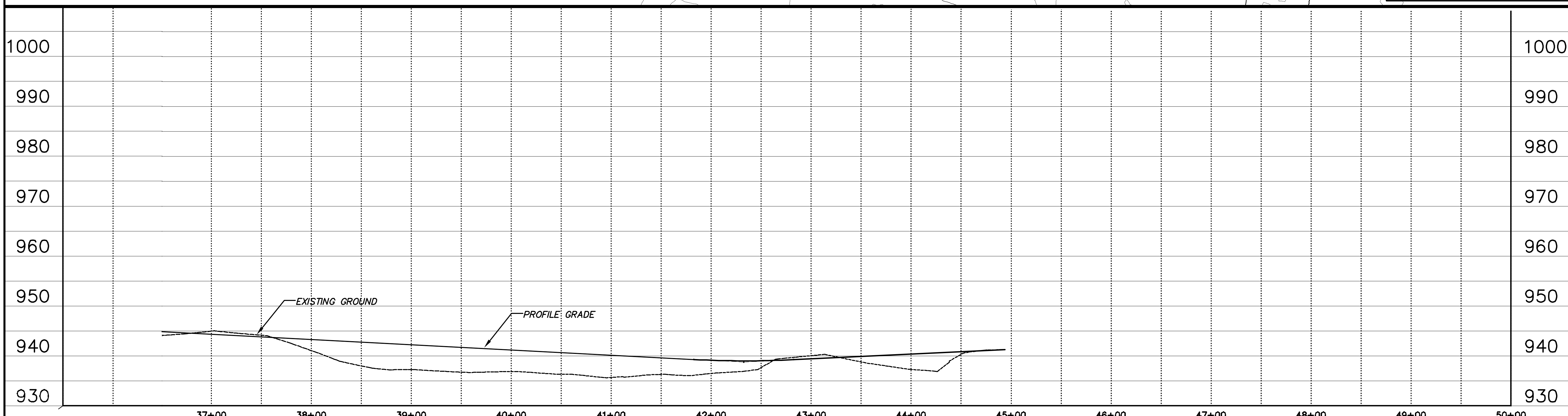
MILITARY PETROLEUM LINES	862-4112

(Includes ATU, AWWU, CEA, ENG, Butler Aviation/Tesoro, Prime Cable, MLP, Traffic Signals, MOA Storm/Streets)



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INSPECTOR:									
CONSTRUCTION RECORD	VERTICAL DATUM			PLAN CHECK					

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY

REVISIONS

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LAND SURVEYING • PLANNING
CONSULTANT

STATE OF ALASKA
49TH
STEVEN M. KARI
No. CE 9203
REGISTERED PROFESSIONAL ENGINEER
SEAL

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

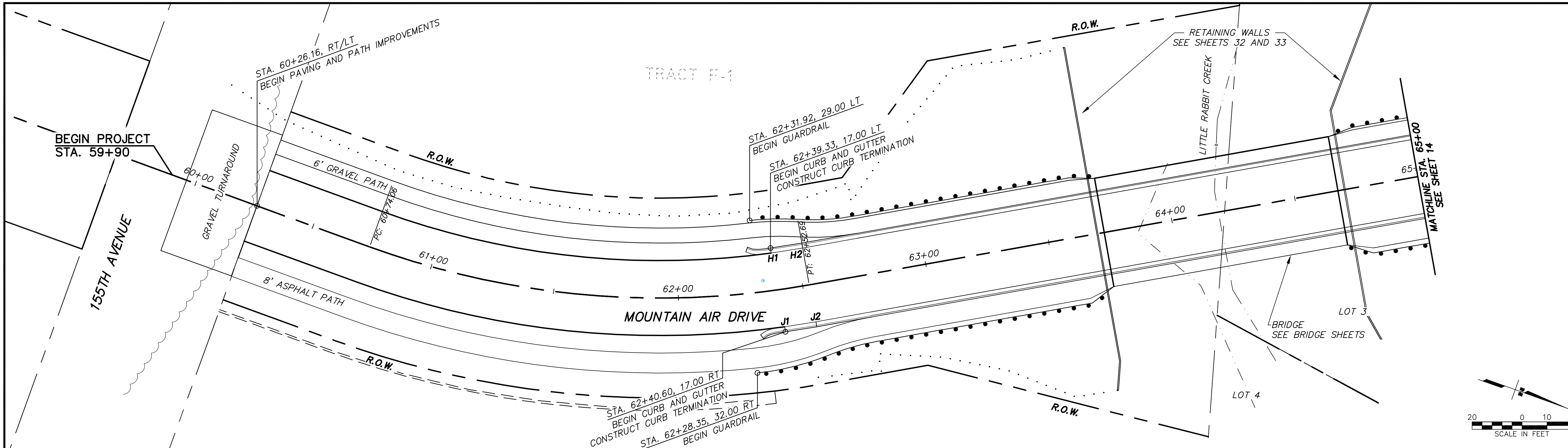
08-019 MOUNTAIN AIR DRIVE/HILLSIDE DRIVE EXTENSION
HYDROLOGY DESIGN CONCEPTS

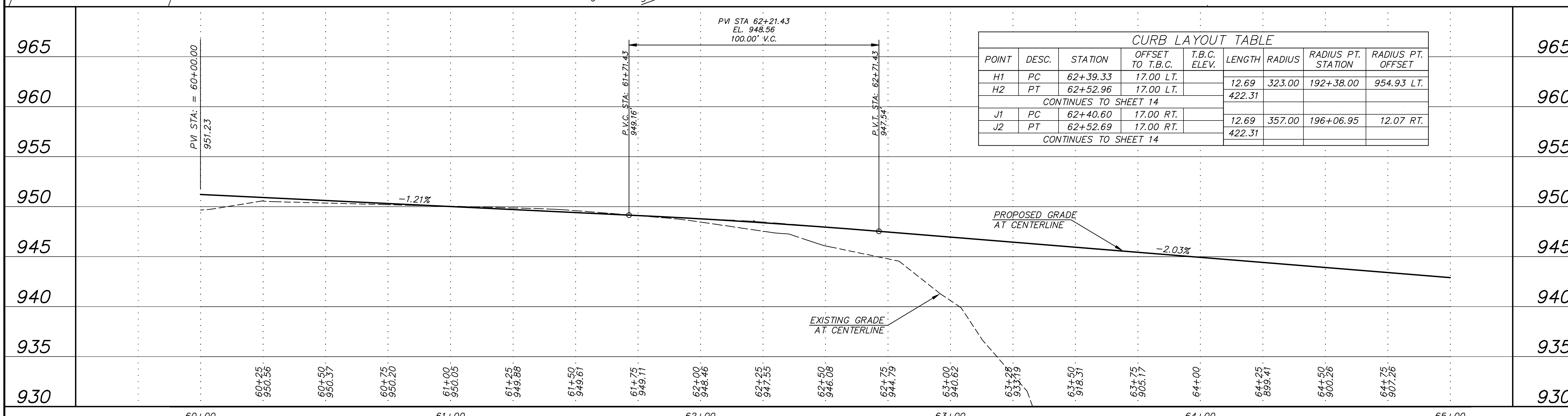
ALTERNATIVE B-PLAN & PROFILE
STA. 36+50 TO E.O.P.

SCALE: 1"=50'	DATE: 10/2009	GRIDS: XXX XXX XXX XXX	SHEET 5 of 5
	ACCT. NO.		

FILE NO.–

Appendix F
Plan and Profile





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H2	PT	62+52.96	17.00 LT.		422.31			
CONTINUES TO SHEET 14								
J1	PC	62+40.60	17.00 RT.		12.69	357.00	196+06.95	12.07 RT.
J2	PT	62+52.69	17.00 RT.		422.31			
CONTINUES TO SHEET 14								

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STORM SEWER	N/A	SK	DESIGN	WW	SK
WATER	N/A	SK	QUANTITIES	KM	SK
GAS	N/A	SK	MUN. FINAL CHECK		

PLAN CHECK

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY
						PLOTTED: 8-Oct-10 4:13 PM	

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PRELIM. DESIGN SUBMITTAL 10/8/2010
SEAL

MUNICIPALITY OF ANCHORAGE

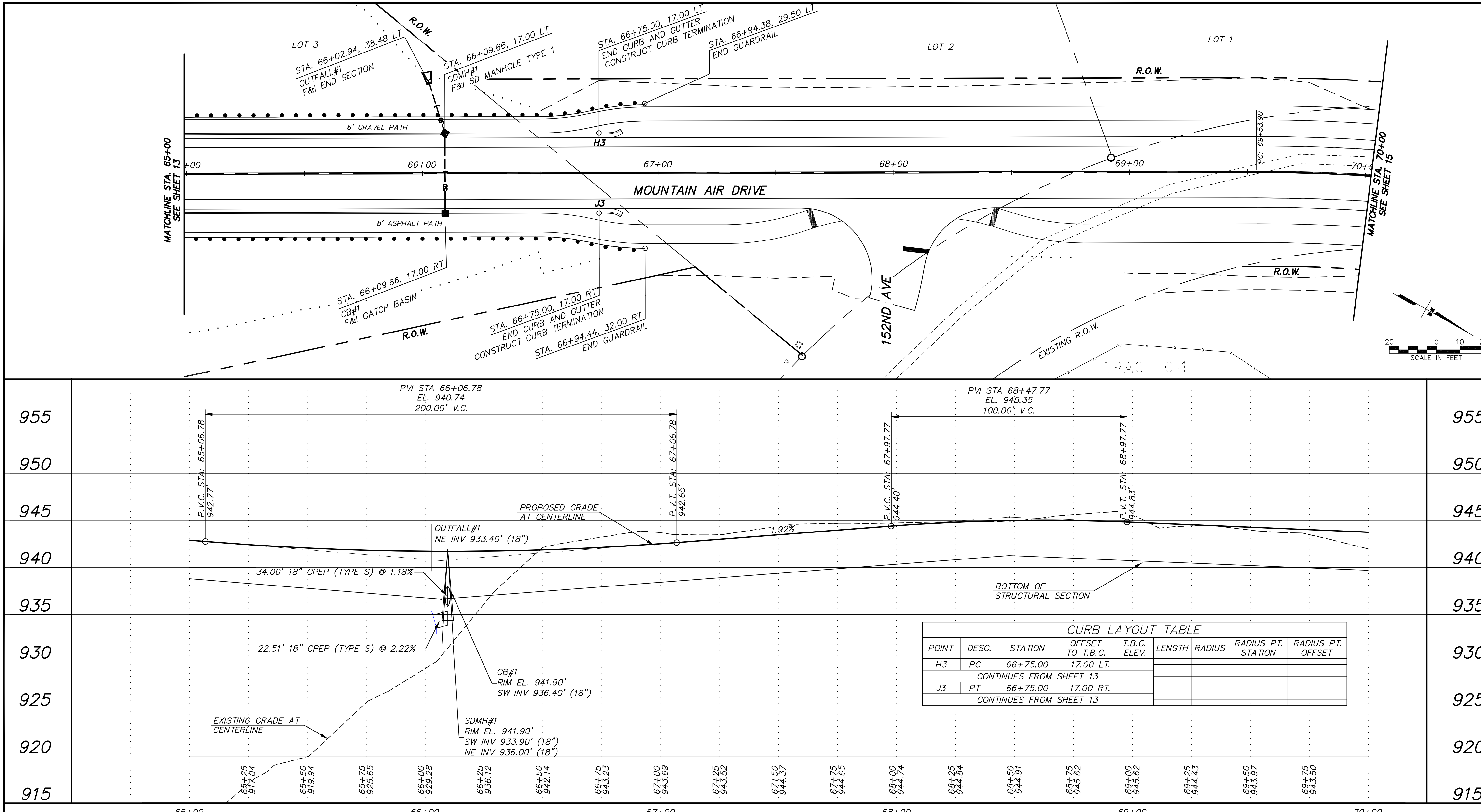
PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

08-019 MOUNTAIN AIR DRIVE/HILLSIDE DRIVE EXTENSION SCHEDULE A,B,C

PLAN AND PROFILE
B.O.P TO STA. 65+00

SCALE: N.T.S. DATE: XX/2010 GRIDS: XXX XXX XXX XXX ACCT. NO. SHEET 13 of X

FILE NO.-



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J3	PT	66+75.00	17.00' RT.					
CONTINUES FROM SHEET 13								

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INSPECTOR:	

CONSTRUCTION RECORD

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GAS	N/A	SK	MUN. FINAL CHECK		

PLAN CHECK

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PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

08-019 MOUNTAIN AIR DRIVE/HILLSIDE DRIVE EXTENSION SCHEDULE A,B

PLAN AND PROFILE
STA. 65+00 TO STA. 70+00

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ACCT. NO.

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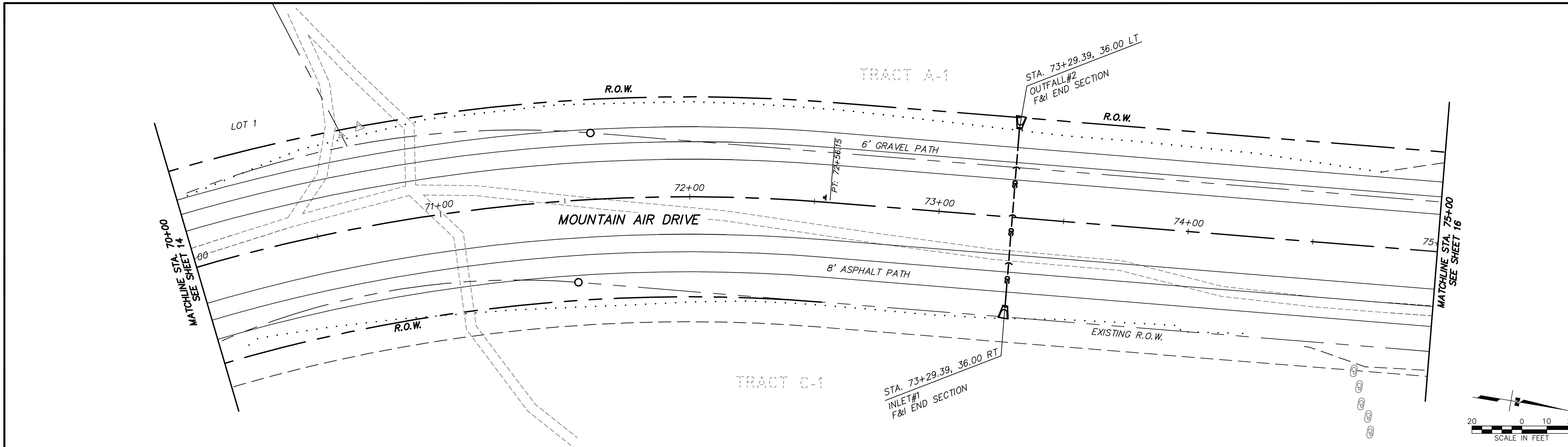

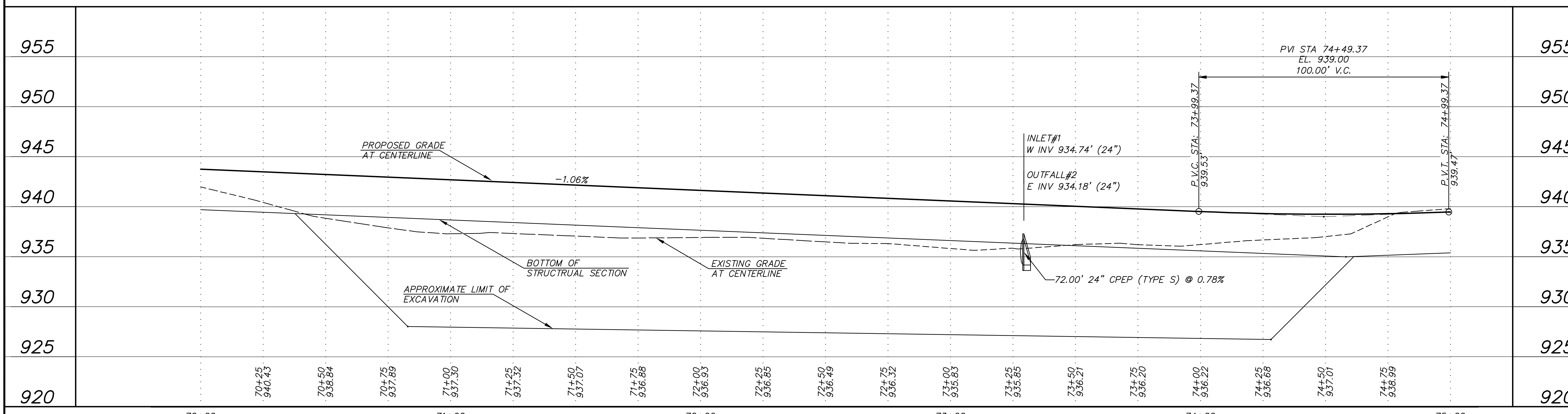

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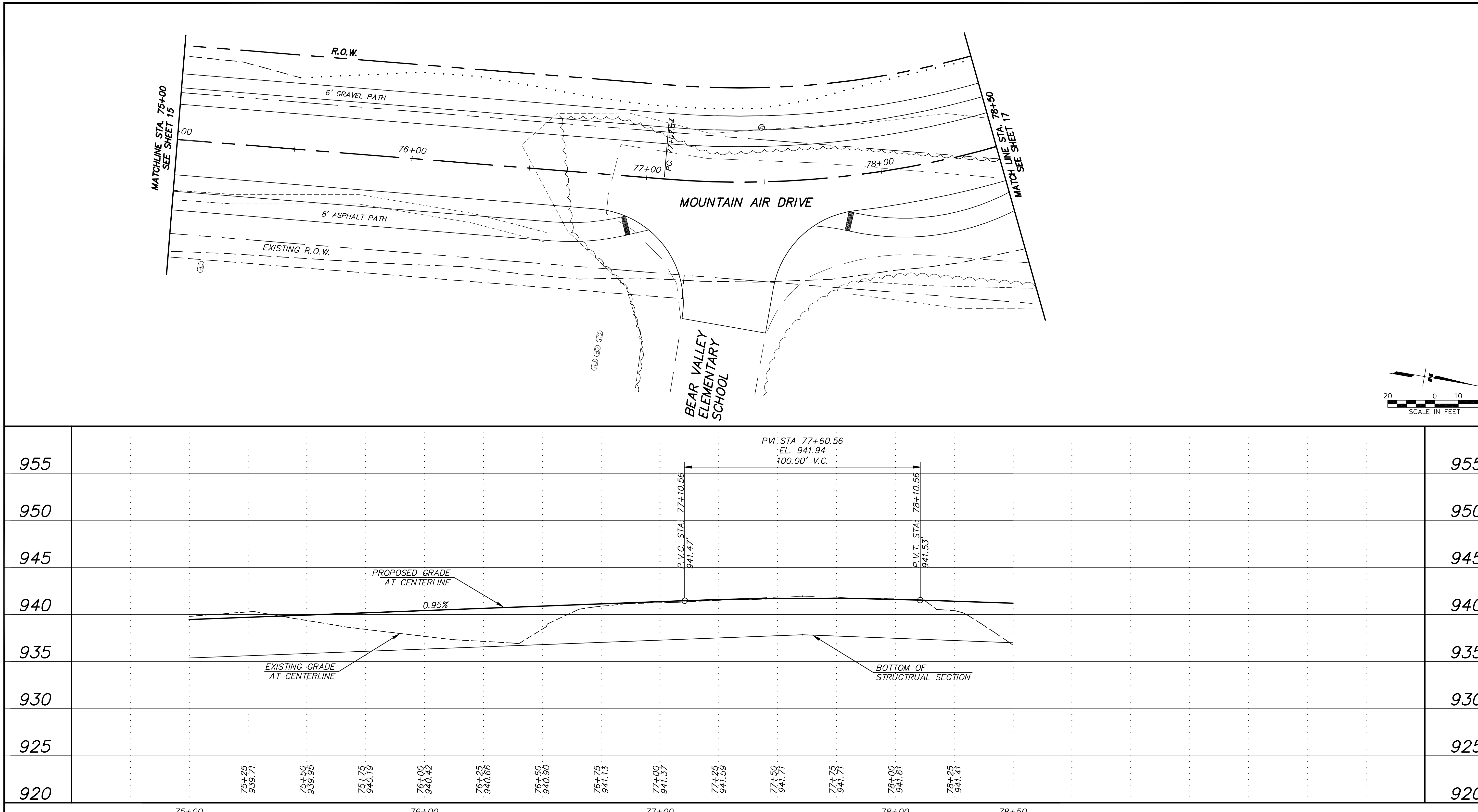
PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

08-019 | MOUNTAIN AIR DRIVE/HILLSIDE DRIVE EXTENSION | SCHEDULE A,B

PLAN AND PROFILE
STA. 70+00 TO STA. 75+00

SCALE: N.T.S. | DATE: XX/2010 | GRIDS: XXX XXX XXX XXX | ACCT. NO. | SHEET 15 of X

FILE NO.–



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PLAN CHECK

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PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

08-019 | MOUNTAIN AIR DRIVE/HILLSIDE DRIVE EXTENSION | SCHEDULE A,B

PLAN AND PROFILE STA. 75+00 TO STA. 78+50

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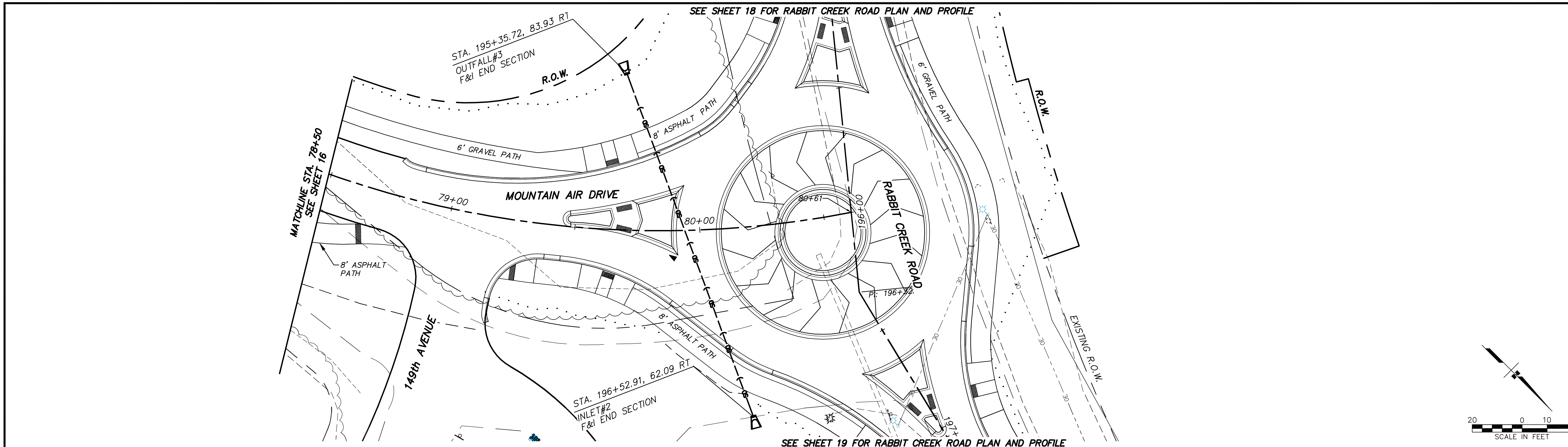

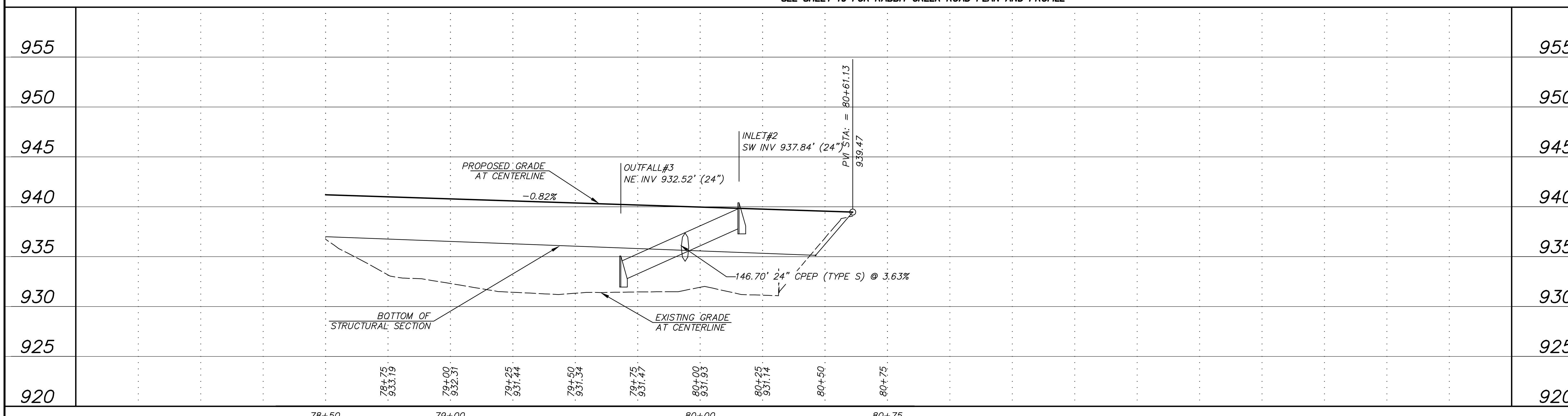

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GAS	N/A	SK	MUN. FINAL CHECK		

PLAN CHECK

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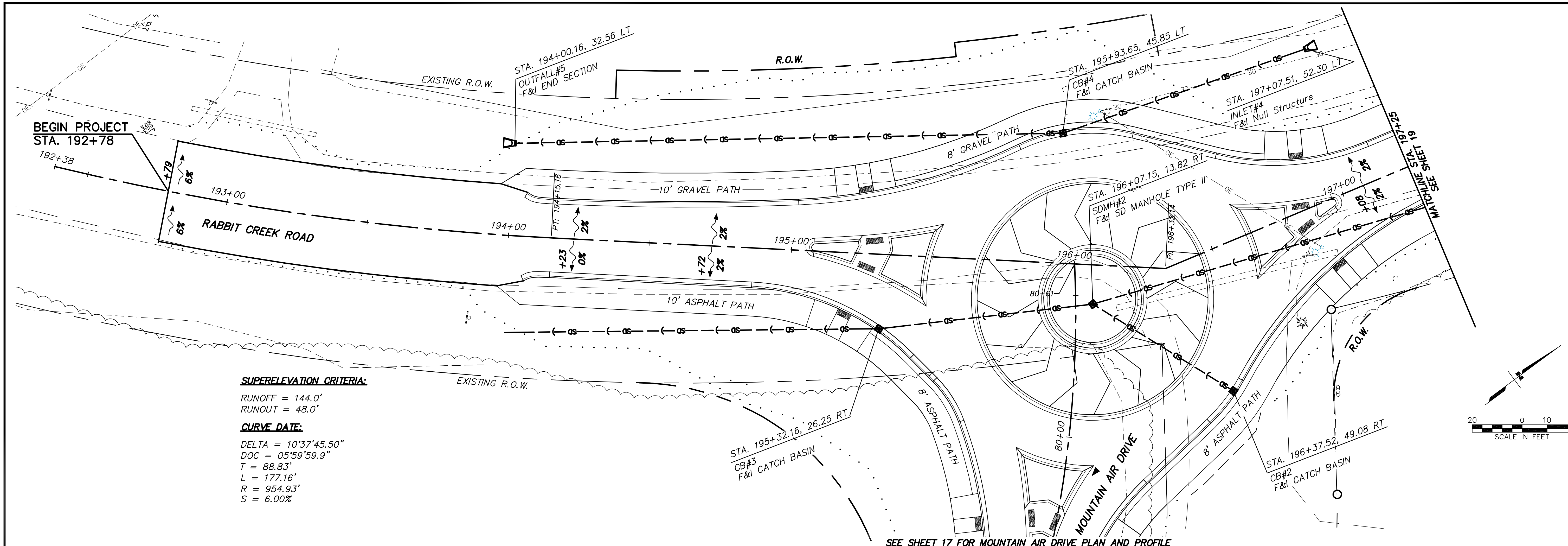
PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

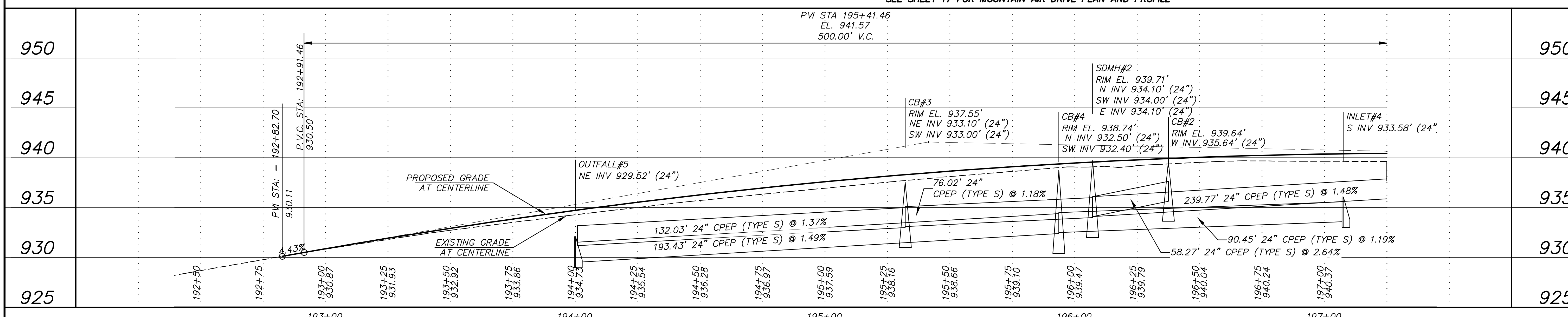
08-019 MOUNTAIN AIR DRIVE/HILLSIDE DRIVE EXTENSION SCHEDULE A,B

PLAN AND PROFILE
STA. 78+50 TO E.O.P.

SCALE: 1"=xx' DATE: XX/2010 GRIDS: XXX XXX XXX XXX SHEET 17 of X
ACCT. NO.

FILE NO.-





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MUNICIPALITY OF ANCHORAGE

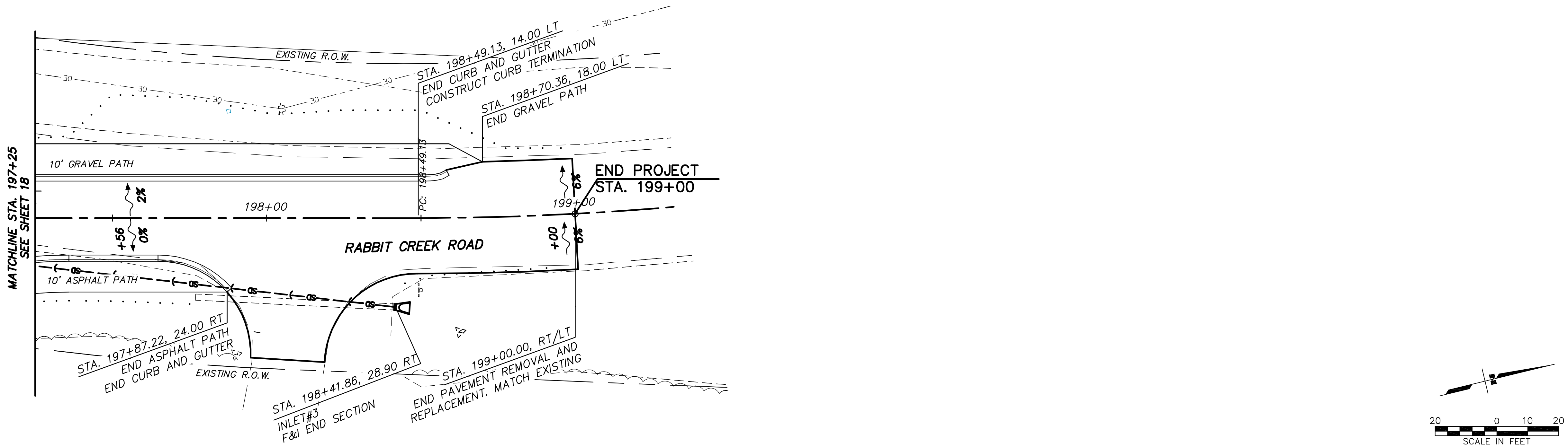
PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

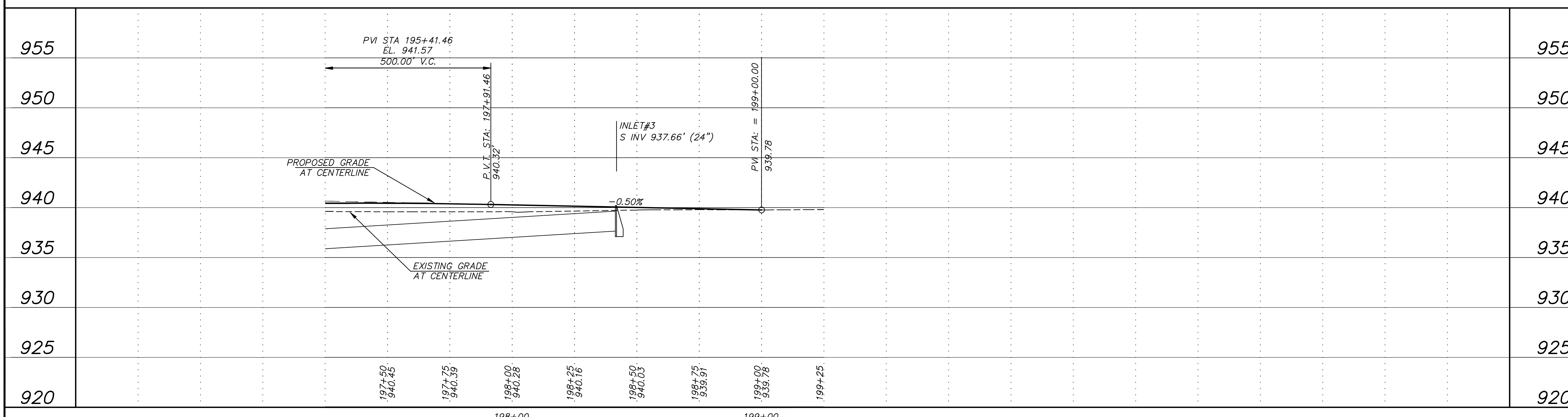
08-019 MOUNTAIN AIR DRIVE/HILLSIDE DRIVE EXTENSION SCHEDULE A,B

PLAN AND PROFILE
B.O.P. TO STA. 197+25

SCALE: 1"=xx' | DATE: XX/2010 | GRIDS: XXX XXX XXX XXX | ACCT. NO. | SHEET 18 of X

FILE NO.–





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PLAN CHECK

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MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

08-019 MOUNTAIN AIR DRIVE/HILLSIDE DRIVE EXTENSION SCHEDULE A,B

PLAN AND PROFILE
STA. 197+25 TO E.O.P.

SCALE: 1"=xx' DATE: XX/2010 GRIDS: XXX XXX XXX XXX ACCT. NO. SHEET 19 of X

FILE NO.-

Appendix G
Bridge Selection Report

Municipality of Anchorage

Mountain Air Drive / Hillside Drive Extension

Project Management and Engineering, No. 08-019

Bridge Selection Report

DRAFT October 2009

SHEARER DESIGN LLC.

Bridge Design, Construction Engineering and Infrastructure Aesthetics

100 N. 35th Street

Seattle, WA 98103

(206) 781-7830

Mountain Air Drive / Hillside Drive Extension

Bridge Selection Report

Municipality of Anchorage

Bridge Selection Report

<u>Executive Summary</u>

The Municipality of Anchorage is proposing to construct a new collector road to serve the Bear Valley area by extending Mountain Air Drive / Hillside Drive south from Bear Valley Elementary School to the Shangri-La East Phase 2 development south of the East 155th Avenue right-of-way. This new road will increase vehicular access while decreasing traffic congestion to the rapidly growing Anchorage Hillside Bear Valley Area. The Mountain Air / Hillside Drive Extension will provide access to the area south of Rabbit Creek Road and east of Goldenview Drive for future development, while helping to alleviate some of the current congestion along Goldenview Drive.

As part of the project, any proposed road will need to pass over Little Rabbit Creek and the purpose of this study is to evaluate various feasible structure types to cross over Little Rabbit Creek.

A 129-foot bridge using concrete decked bulb tee girders is recommended for Alignment A. The estimated structure construction cost for the bridge and walls option is $1.97 million.

For Alignment B, two 38.5-foot steel multi-plate arches are recommended. The estimated structure construction cost for both arches and walls is $1.03 million.

Location

The project is located in the Municipality of Anchorage, Alaska.

Figure 1: Site Location

General Project Overview

The Municipality of Anchorage is proposing to construct a new collector road to serve the Bear Valley area by extending Mountain Air Drive / Hillside Drive south from the Bear Valley Elementary School to the Shangri-La East Phase 2 development south of the East 155th Avenue right-of-way. This road will increase emergency vehicle access while decreasing existing traffic congestion to the rapidly growing Anchorage Hillside Bear Valley Area. Currently, Goldenview Drive is the only collector street in the area, and at this time has a poor level of service due to traffic accidents and congestion at the intersection with Rabbit Creek Road. As this area continues to be developed, greater access will be needed. The Mountain Air Drive / Hillside Drive Extension will provide access to the area south of Rabbit Creek Road and east of Goldenview Drive for future development, while helping to alleviate some of the current congestion along Goldenview Drive.

As part of the project, traffic will need to pass over Little Rabbit Creek. Two alignments and three structure types were evaluated in this study.

Geotechnical Review

The geotechnical information for this study is based on a preliminary geotechnical report (Shannon & Wilson 2009) which uses borings taken in 1982 at the neighboring Bear Valley Elementary School as well as a site inspection along the two proposed alignments options. The subgrade can be briefly described as follows:

The area generally consists of a 1-foot to 5-foot surface layer of organics and peat overlying a till-like glacial derived material which includes silt and silty-granular soils with periodic zones of silty-clay and clayey-silt. No bedrock outcroppings were observed at the site nor indicated on previous borings.

Foundation Type: Either deep or shallow foundations are appropriate for use at this site. For deep foundations, 16-inch to 24-inch pipe piles or H-piles should be driven to approximately 40 to 50 feet below the ground surface. Boulders and cobbles are fairly common in this base material and could make pile driving difficult. Shallow foundations should be buried at least 10 feet below the ground surface to protect them from seasonal frost.

Wetlands

According to the MOA Wetlands Atlas, Class A, wetlands have been mapped in and around the project, most notably near Alignment B. A jurisdictional determination will need to be completed along the proposed alignments to clarify the existence of wetlands within the project limits.

Design Criteria

The specific project criteria that have been used for this report is:

- HL-93 Live Loading
- The typical road section across the stream is as follows: 4 foot shoulders, 11 foot traffic lanes and an 8-foot pathway. Curb to curb width is 38 feet minimum.
- AASHTO Standard Specifications for Highway Bridges 17th Edition

Design Alignments

The following two alignments were evaluated for the creek crossing at this site. Both of these alignments are considered feasible. See Figure 1.

Alignment A

This alignment travels in a southerly direction from the current end of Mountain Air Drive to East 155th Avenue. The proposed road will cross the Little Rabbit Creek near the southwest corner of Bear Valley Elementary School. At this location, Little Rabbit Creek is in a valley that is approximately 330 feet across along the proposed alignment and about 45 feet deep at the lowest point. This alignment is approximately 2,200 feet long and would require a single stream crossing structure with approach embankments.

Pro's
- This alignment provides a more direct route across the creek.
- A single structure is required.

Con's
- The creek is deeply incised at this location, requiring a fairly long structure.
- Extensive approach embankments are required to minimize the bridge cost.
- The structure construction schedule is longer.

Alignment B
As seen in Figure 1, this alignment extends the existing road approximately 4,000 feet from the present terminus of Mountain Air Drive and continues along the current right-of-way, then east along the perimeter of Bear Valley Elementary School until it reaches the Hillside Drive right-of-way. There, the alignment turns south and follows the Hillside Drive right-of-way until it reaches the East 155th Avenue right-of-way. Next, the alignment turns and continues west for approximately 1,000 feet along the East 155th Avenue right-of-way. As the alignment travels along the Hillside Drive right-of-way, the route crosses two forks of the Little Rabbit Creek. This alignment would require two crossing structures; the crossings are approximately 150 and 280 feet long and about 20 feet deep at their lowest points.

Pro's
- Smaller structures are required
- Short construction schedule

Con's
- Two structures are required
- Fairly extensive retaining walls and approach embankments are required
- Wetlands may be impacted along this alignment

Bridge Type Alternates

The following three structure types were evaluated and costs estimated for new crossings at this site. Alternate 1 follows Alignment A, while Alternates 2 & 3 follow Alignment B.

Alternate 1: Decked Bulb Tee Bridge on Alignment A

This option is a 129-foot single-span structure that uses standard 66-inch deep prestressed concrete decked bulb tee girders covered with an asphalt wearing surface. The substructure is comprised of a 3-foot deep cap beam supported on 24-inch diameter steel piles. The approach embankments will run from the edge of the ravine to the backface of the bridge supports and are held in place by mechanically stabilized earth (MSE) style retaining walls. Riprap will be used to protect the piling. Projected cost $1.97 million.

Alternate Rationale: This option was developed to examine a conventional concrete bridge using precast standard concrete girders, with the span minimized by using MSE approach embankments.

Pro's
- Conventional construction
- Low maintenance structure

- The supporting columns are located outside the main flow of the creek
- The girders can be locally produced

Con's

- Transport and placement of the long girders can be difficult.
- Extensive approach embankments are required.

Alternate 2: Multi-Plate Steel Arches on Alignment B

This option utilizes two single-span steel structural plate arches, each spanning 38.7 feet and are 18.5 feet tall by 48 feet long. This option requires concrete spread footings with short stem walls, buried 10 feet below the ground to minimize the effects of frost. Each arch is topped with a five-foot layer of soil and an asphalt pavement roadway surface with guardrails utilized for traffic protection. The road will cross one structure at a right angle while the other will be skewed to account for the angled path of the creek. MSE style retaining walls will be used for containing the embankments and supporting the steel arch openings. Riprap will protect the base of the walls and arches. Projected cost $1.03 million.

Alternate Rationale: This option was developed to examine installing two conventional steel multi-plate arches along Alignment B.

Pro's

- Conventional construction
- Short construction schedule
- Low maintenance structure

Con's

- A fair amount of earth fill is required to backfill the structure
- In stream work required
- Abrasion can be a concern
- The structure must be shipped in from outside Alaska

Alternate 3: Precast Concrete 3-Sided Boxes on Alignment B

This option utilizes two single-span precast concrete 3-sided boxes, each spanning 42 feet and is 14 feet tall by 42 feet long. The boxes are supported by concrete spread footings with tall stem walls, and buried 10 feet below the ground to minimize the effects of frost. The concrete box is topped with a two foot layer of soil and an asphalt pavement roadway surface with guardrails utilized for traffic protection. The road will cross one structure at a right angle while the other will be skewed to account for the angled path of the creek. A concrete headwall will support the soil above the arch, while MSE style retaining walls will be used to contain the embankments and riprap will protect the base of the walls and boxes. Projected cost $1.32 million.

Alternate Rationale: This option was developed to examine precast concrete three sided box installed on Alignment B.

Pro's

- Conventional construction
- Short construction schedule
- Low maintenance structure

Con's

- A fair amount of earth fill and retaining walls are required to backfill the structure.
- In stream work required
- Abrasion is not a concern

- Heavier structures with higher shipping costs that must be shipped in from outside Alaska.

Other Alternates Reviewed
Multispan Bridge on Alignment A: This option would have continuous spans of 50'-135'-135' and be constructed using prestressed girders with a cast-in-place concrete deck. This option would span the whole valley without approach embankments. However, this structure would be significantly larger, have a longer construction schedule and be more expensive than the other options.

Decked Bulb Tee Girder Bridge on Alignment A with Sloping Approach Banks: This option utilizes the same bridge as in Alternate A, but the retaining wall quantity would be reduced by allowing the approach banks to slope away from the bridge. Due to the creek turning on the west side of the bridge and a small ravine in the southwest corner of the bridge, the quantity of retaining walls are not significantly reduced, while the quantity of the borrow is much greater.

Spilling Approach Embankments for Both Options on Alignment B: These versions of the concrete 3-sided box and the steel arch options would minimize the quantity of retaining wall by allowing the approach banks to slope out from the road at a rate of 2h : 1v until the slope meets the existing ground. These approach banks would cover a greater area of land than the approaches with retaining walls, and may impact wetlands that may exist near Alignment B.

Short Span Bridges on Alignment B with and without Retaining Walls: This option would use prestressed components supported on cast-in-place abutments and piling. This alternate was evaluated using full approach embankment retaining walls or allowing the approach banks to slope out from the road at a rate of 2h : 1v until the slope meets the existing ground. Both versions would be significantly more expensive than Alternates 2 & 3 on Alignment B.

Assumptions & Potential Higher Cost Items
Foundation No structure specific foundation / geotechnical exploration was performed for this report. The developed bridge quantities were based on borings from a neighboring site, and may differ at the final structure location.

Recommendations

For Alignment A, we recommend that Alternate 1, the concrete decked bulb tee girder bridge with retaining walls, be considered for further design and construction. The estimated construction cost is $1.97 million.

For Alignment B, we recommend that Alternate 2, the two multi-plate steel arches with retaining walls, be considered for further design and development. The estimated construction cost is $1.03 million.

Cost Estimates

The cost estimates prepared for this study are compiled from a number of sources. The probable estimated construction cost is the most reasonable estimate that can be compiled given the level of design development at this time. These estimates are subject to economic conditions, bidding climate, the procurement method and normal bid fluctuations at the time of project tendering. All estimates are given in year 2009 dollars.

The estimates provided are for the structure items only such as walls, concrete footings and girders or the culvert sections. Any roadway items such as subgrade, paving surface, sidewalk, and guardrail are assumed to be included with the roadway cost.

Contingency & Construction Administration

A 15% contingency has been added to the construction cost to allow for changes in layout, detail modifications and other uncertainties.

The unit price & lump sum estimate reference sources used for this study include:

- Big R Super-Cor Arch Estimate 2009
- Contech Con/Span Estimate 2009
- Alaska DOT&PF Bid Prices 2009

Reference Documents

- ❑ Preliminary Geotechnical Report – Mountain Air Drive Extension – Anchorage, Alaska – Shannon & Wilson, Inc. - September 2009
- ❑ Anchorage-Mountain Air Drive / Hillside Drive Extension TPS Report 47167 2009
- ❑ Municipality of Anchorage Memorandum - Shangri-La East Subdivision - Case S-11352-3 - May 2, 2007

Appendix

- ❑ **Cost Estimates**
- ❑ **Bridge Type Drawings**

Mountain Air Drive / Hillside Drive Extension
Alternate 1: Decked Bulb Tee Bridge
Alignment A

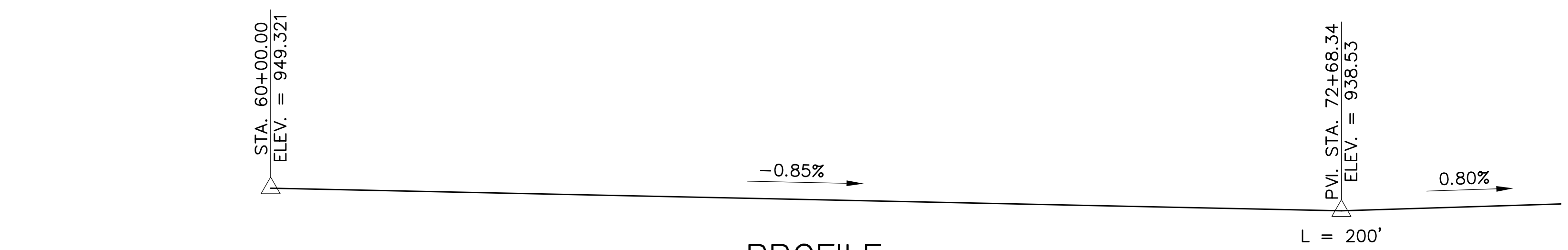
ITEM No	Unit Measure	ITEM DESCRIPTION	APPROX. QUANTITY	UNIT PRICE	Extended Price	Notes
1	Ton	BORROW	13,100	$9.00	**$117,900**	
2	L.S.	BRIDGE STRUCTURE MOUNTAIN AIR DRIVE	1	L.S.	**$1,343,000**	
3	S.F.	RETAINING WALLS	12,500	$20.00	**$250,000**	
				CONSTRUCTION	**$1,710,900**	
				CONTINGENCY 15%	**$256,635**	
				CONSTRUCTION COST ESTIMATE (Rounded)	**$1,968,000**	

Mountain Air Drive / Hillside Drive Extension
Aternate 2: Multi-Plate Steel Arches
Alignment B

ITEM No	Unit Measure	ITEM DESCRIPTION	APPROX. QUANTITY	UNIT PRICE	Extended Price	Notes
1	C.Y.	EXCAVATION FOR STRUCTURE	940	$30.00	**$28,200**	
2	Ton	BORROW	12,000	$9.00	**$108,000**	
3	C.Y.	CLASS A CONCRETE	183	$850.00	**$155,550**	
4	Lbs	REINFORCING BAR	32,900	$1.75	**$57,575**	
5	L.S.	SUPER-COR STEEL ARCH	1	L.S.	**$211,000**	
6	L.S.	INSTALL SUPER-COR STEEL ARCH	1	L.S.	**$84,400**	
7	S.F.	RETAINING WALLS	7,970	$20.00	**$159,400**	
8	L.S.	RIPRAP & MISC	1	L.S.	**$80,413**	
9	L.S.	DEWATERING	1	L.S.	**$15,000**	
				CONSTRUCTION	**$899,538**	
				CONTINGENCY 15%	**$134,931**	
				CONSTRUCTION COST ESTIMATE (Rounded)	**$1,034,000**	

Mountain Air Drive / Hillside Drive Extension
Alternate 3: Precast Concrete 3-Sided Boxes
Alignment B

ITEM No	Unit Measure	ITEM DESCRIPTION	APPROX. QUANTITY	UNIT PRICE	Extended Price	Notes
1	C.Y.	EXCAVATION FOR STRUCTURE	440	$30.00	**$13,200**	
2	Ton	BORROW	8,700	$9.00	**$78,300**	
3	C.Y.	CLASS A CONCRETE	338	$850.00	**$287,300**	
4	Lbs	REINFORCING BAR	60,800	$1.75	**$106,400**	
5	L.S.	CON/SPAN 3-SIDED BOXES	1	L.S.	**$353,000**	
6	L.S.	INSTALL CON/SPAN 3-SIDED BOXES	1	L.S.	**$105,900**	
7	S.F.	RETAINING WALLS	4,590	$20.00	**$91,800**	
8	L.S.	RIPRAP & MISC	1	L.S.	**$103,590**	
9	L.S.	DEWATERING	1	L.S.	**$15,000**	
				CONSTRUCTION	**$1,154,490**	
				CONTINGENCY 15%	**$173,174**	
				CONSTRUCTION COST ESTIMATE (Rounded)	**$1,328,000**	



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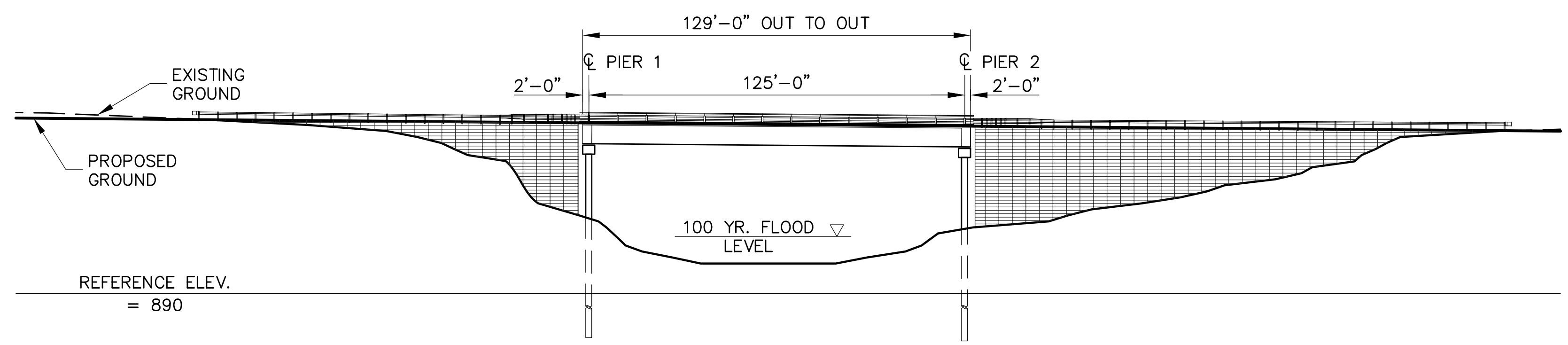
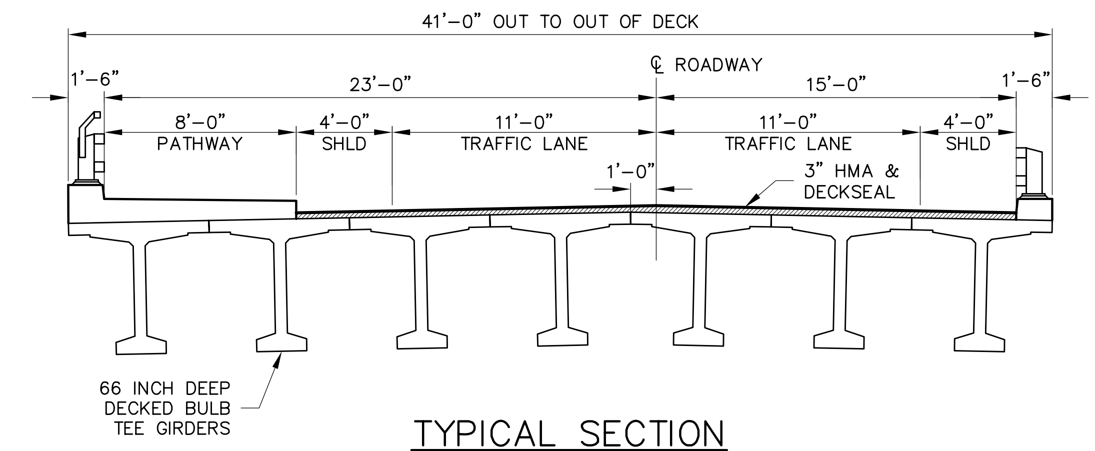


BRIDGE ELEVATION

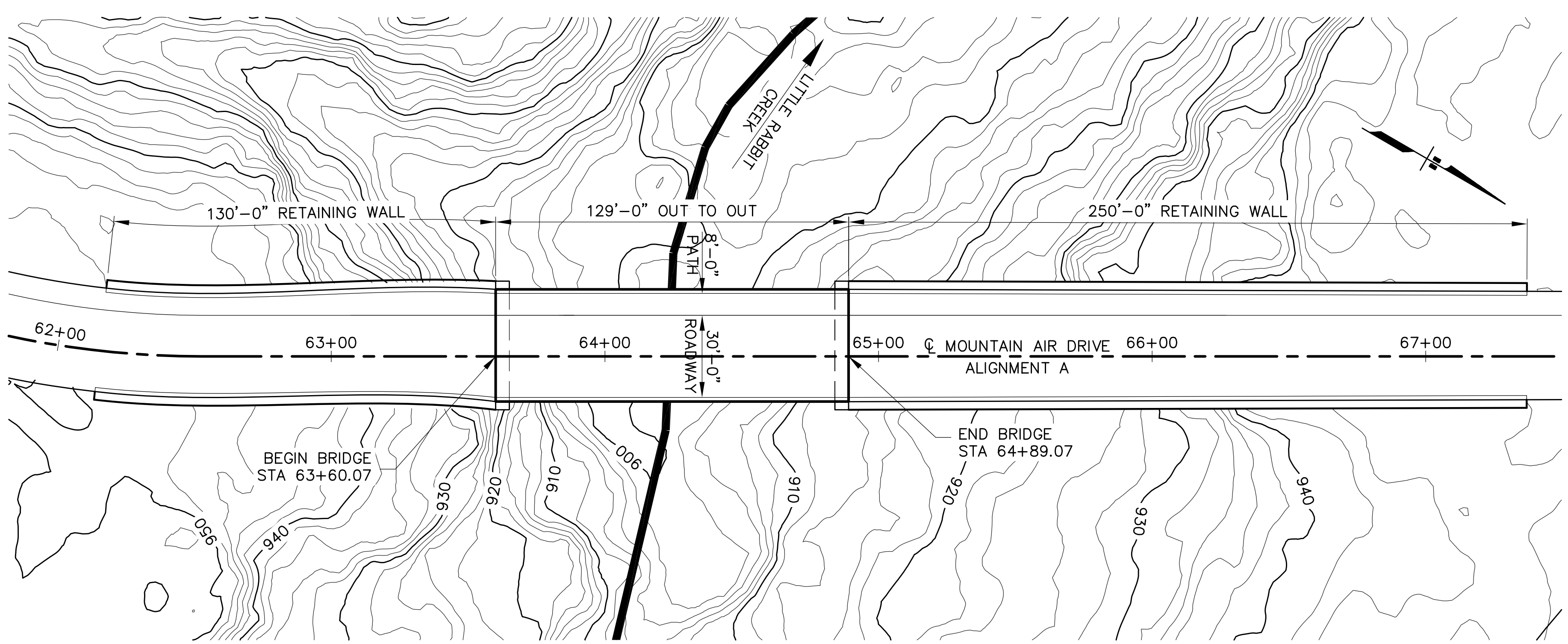
GROUNDLINE ALONG ℄ OF ROAD

30 15 0 30 60
FEET



TYPICAL SECTION

4 0 4 8
FEET



BRIDGE PLAN

30 15 0 30 60
FEET

ALIGNMENT A

NO.	REVISION	BY	DATE

DESIGNED: DRS CHECKED: DRS PROJECT NO. .
DRAWN: DRS PROJECT ENGR: DRS
APPROVED: ____ CITY ENGINEER

SCALE: AS NOTED
DATE

BAR IS ONE INCH ON ORIGINAL DRAWING ADJUST SCALES ACCORDINGLY
0" 1"

SHEARER DESIGN L.L.C.
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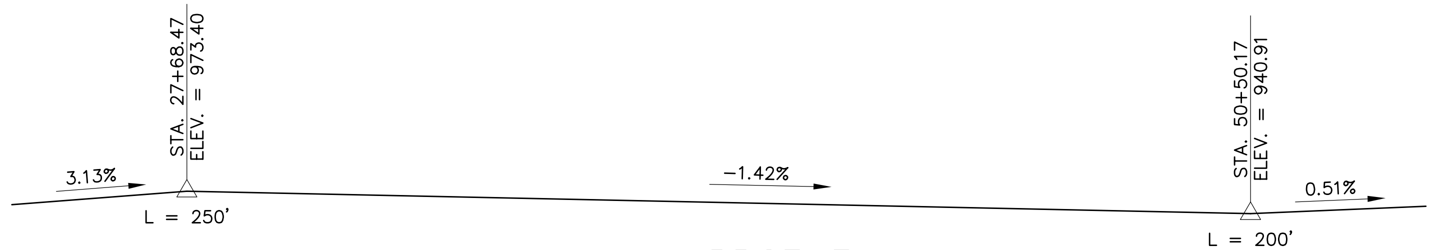
MOUNTAIN AIR DRIVE / HILLSIDE DRIVE EXTENSION
ANCHORAGE, AK
ALTERNATE 1: DECKED BULB TEE BRIDGE

SHEET 1 OF 2
FILE NO.

Oct 05, 2009 - 10:58am joshua \\Sdserver\Jobs\0166 Mt Air - Hillside Drive\DWG\0166 PLAN & ELEVATION BSR.dwg Layout Name: ALIGNMENT B



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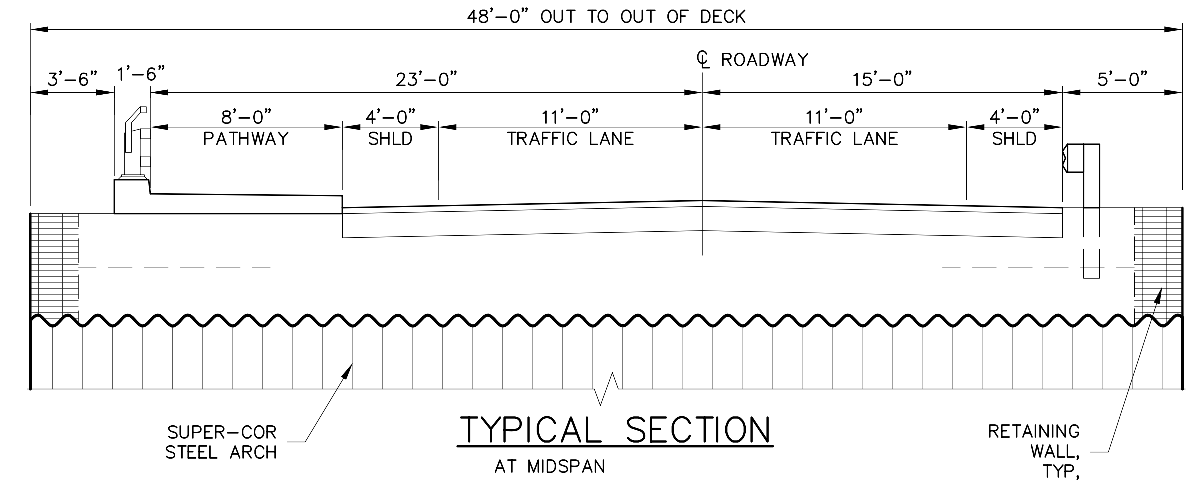
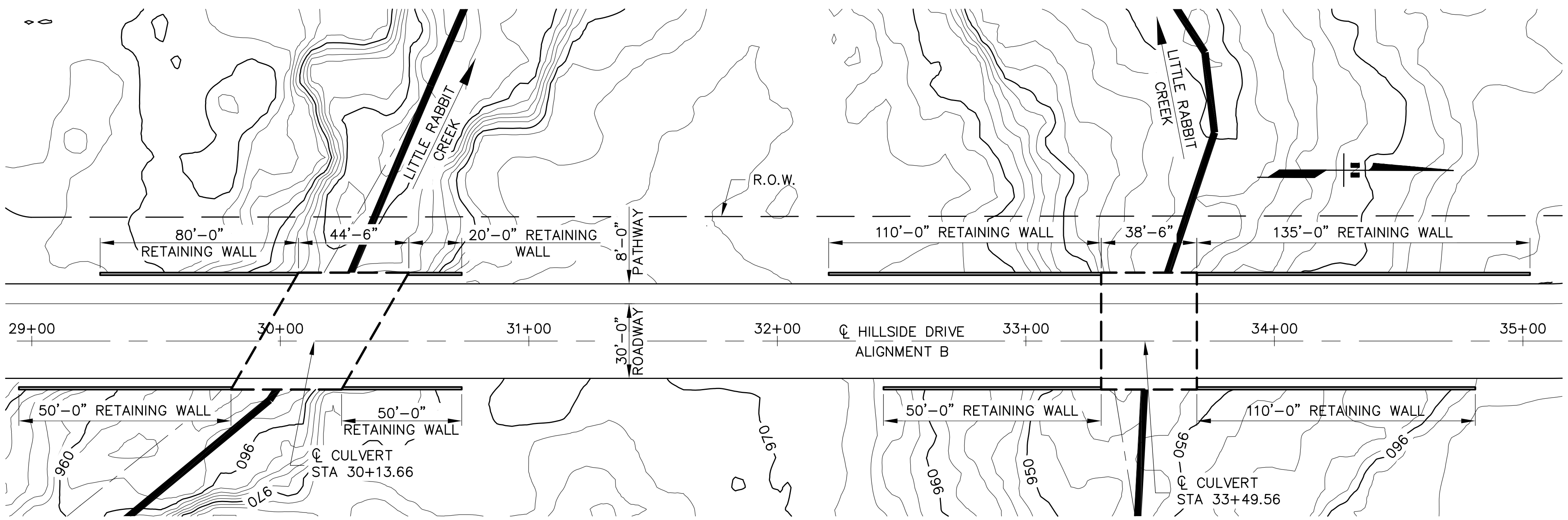


TYPICAL SECTION

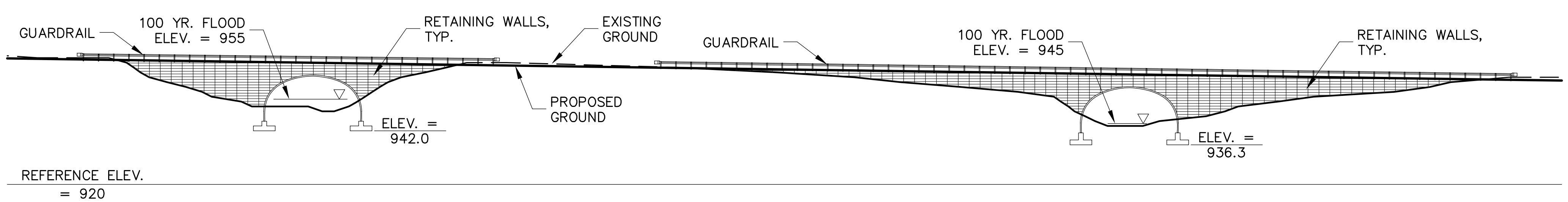
AT MIDSPAN

4 0 4 8
FEET



BRIDGE PLAN

30 15 0 30 60
FEET



BRIDGE ELEVATION

GROUNDLINE ALONG ℄ OF ROAD

30 15 0 30 60
FEET

ALIGNMENT B

NO.	REVISION	BY	DATE

DESIGNED: DRS | CHECKED: DRS | PROJECT NO.
DRAWN: DRS | PROJECT ENGR: DRS
APPROVED: ____ CITY ENGINEER
SCALE: AS NOTED
DATE

BAR IS ONE INCH ON ORIGINAL DRAWING ADJUST SCALES ACCORDINGLY
0" 1"

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MOUTAIN AIR DRIVE / HILLSIDE DRIVE EXTENSION
ANCHORAGE, AK

ALTERNATE 2: MULTI-PLATE STEEL ARCHES

SHEET 2 OF 2

FILE NO.