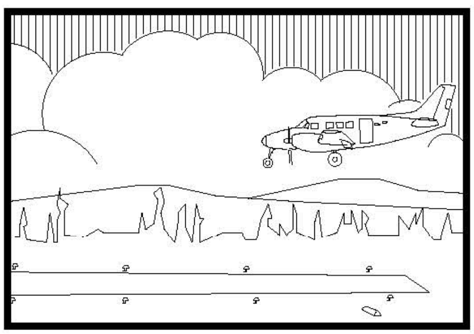
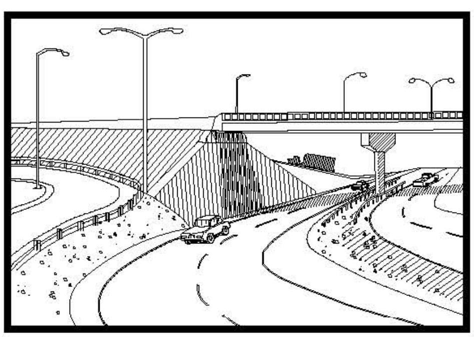
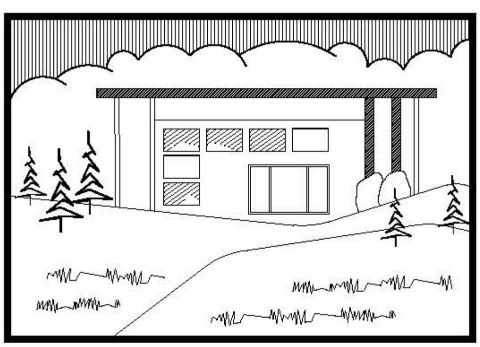
DESIGN STUDY REPORT

Seppala Drive Upgrades

Z620030000/000S828

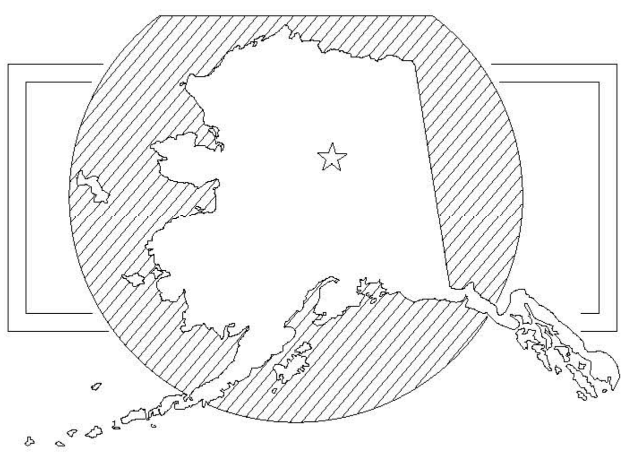






STATE OF ALASKA

Department of Transportation
and Public Facilities



NORTHERN REGION

February 2021

DESIGN APPROVAL

SEPPALA DRIVE UPGRADES

PROJECT NO. Z620030000/000S828

Requested by: 5/7/2021

Joseph Kemp, P.E. Date
Engineering Manager
Northern Region

Design Approval Granted: 5/11/2021

Sarah E. Schacher, P.E. Date
Preconstruction Engineer
Northern Region

Distribution: DSR Distribution Memo Recipients

DESIGN STUDY REPORT
FOR

SEPPALA DRIVE UPGRADES

PROJECT NO. Z620030000/000S828

PREPARED BY: Anne M. Nelson, P.E.

ALASKA DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
NORTHERN REGION DESIGN AND ENGINEERING SERVICES
FEBRUARY 2021

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INTRODUCTION/HISTORY

The Alaska Department of Transportation and Public Facilities (DOT&PF), in cooperation with the Federal Highways Administration (FHWA), proposes to rehabilitate Seppala Drive from the Nome Airport to Bering Street (see Figure 1).

Seppala Drive, a two-lane paved road in Nome, Alaska, serves as the primary connection between the airport to the west and downtown Nome to the east. Jafet Road, which serves the industrial Port of Nome area, intersects Seppala Drive near the middle, as does Center Creek Road, the route that trucks hauling freight and gravel to the port use to bypass the city streets. The eastern third of Seppala Drive provides access to residential and commercial areas and ties into Bering Street, the major north-south corridor in the city center.

The project is needed to address poor pavement conditions, drainage issues, driving safety concerns, and lack of continuous pedestrian facilities. Erosion from high flow or storm surge events is degrading portions of the embankment along Seppala Drive from the bridge towards the airport. This could impact the road and pedestrian facilities in the future. Between Center Creek Road and Jafet Road, the steep grade of Seppala Drive and the close spacing of the intersections are cause for concern. Truck traffic accessing Port Road makes frequent use of the Center Creek and Jafet Road intersections, and slick or icy conditions can make this series of turns difficult to navigate. From Belmont Street to Bering Street, the road shoulders along Seppala Drive are badly deteriorated due to poor surface drainage, unstable soil conditions beneath the road and sidewalks, and settlement near some utility service laterals. Between F Street and Belmont Street, the north side of Seppala Drive has no shoulder. The Dry Creek crossing gets overtopped during high storm surge events, and the culverts are out of round and showing signs of damage to the pipe ends. Pedestrian routes along Seppala Drive do not meet current Americans with Disabilities Act (ADA) standards.

PROJECT DESCRIPTION

This project will rehabilitate Seppala Drive (approximately 1.5 miles) with pavement structure improvements, drainage improvements, intersection improvements, and ADA improvements.

The proposed project layout is shown on the Preliminary Plan and Profile Sheets (Appendix D).

Proposed upgrades include:

- Reconstruct and pave Seppala Drive from Airport Terminal Road to Bering Street, including select improvements to the subgrade.
- Replace and construct pedestrian improvements along Seppala Drive. Improvements include providing a shared use path from the airport to Prospect Place (one or more portions of this path may need to traverse a widened road shoulder due to space limitations); adding sidewalk on the south side of Seppala Drive from Prospect Place to F Street; and replacing sidewalk on both sides of Seppala Drive between F Street and Bering Street.
- Repair sinkhole near F Street.
- Widen the northern road shoulder between the curve west of Belmont Street and F Street.

- Replace existing 6-foot- and 7-foot-diameter Dry Creek culverts with a single 10-foot culvert and raise the height of Seppala Drive approximately 3.7 feet to prevent water flowing over the road surface during storm surges. The new culvert will be bigger and longer than the existing to accommodate the storm surge and the higher embankment, and a portion of Dry Creek will require realignment. Culvert inverts will be depressed to improve flow between the ocean and the tidal zone of Dry Creek.
- Raise profile grade from a few hundred feet west of Center Creek Road to Jafet Road to improve sight distance and turning movement.
- Raise profile grade 4 feet between Station 36+00 and Center Creek Road to prevent overtopping by storm surges. Raising the grade will also improve sight distances and turning movements at the Center Creek Road intersection.
- Replace guardrail along the Snake River. Widen Seppala Drive to the north in order to accommodate the pedestrian improvements and raised profile west of Center Creek Road.
- Add slope protection to the south along the Snake River between the old bridge location and Jafet Road.
- Replace damaged 36-inch-diameter culvert at Center Creek.
- Acquire right of way (ROW) as needed along the project corridor.
- Relocate or repair utilities impacted by the project.

DESIGN STANDARDS

The design of this project is based on:

- DOT&PF *Highway Preconstruction Manual*, 2013 (HPCM)
- DOT&PF *Alaska Flexible Pavement Design Manual*, 2004 (AFPD)
- DOT&PF *Alaska Traffic Manual,* 2016 with latest Interim Revisions
- AASHTO *A Policy on Geometric Design of Highways and Streets*, 2011
- AASHTO *Roadside Design Guide*, 2011
- AASHTO *Guide for the Development of Bicycle Facilities,* 2012
- U.S. Department of Transportation *ADA Standards for Transportation Facilities*, 2006

Refer to Appendix A for the project Design Criteria.

DESIGN EXCEPTIONS AND DESIGN WAIVERS

At this time, no design exceptions or waivers are anticipated for this project.

DESIGN ALTERNATIVES

Center Creek Intersection

The left-hand turn from Center Creek Road eastward onto Seppala Drive has been identified as a challenging maneuver due to the steep grade and the adverse crown on Seppala, which causes vehicles to drift to the outside of their turn and makes it difficult to accelerate up the hill. This movement is commonly used by loaded gravel trucks heading to the port and by local school buses. Two alternatives were considered for this intersection.

- ***Existing Layout:*** Maintain T intersection with Seppala Drive with a 4.3% slope on Seppala between the Center Creek and Jafet intersections.
  - Provides lower profile grade (1%) on Seppala at the intersection, but transitions to 4.3% grade shortly after.
  - Requires less change to the Center Creek Road profile leading into the intersection.

- ***Grade Raise:*** Raise the grade on both Seppala Drive and Center Creek Road at that intersection and flatten the slope climbing up to the Jafet Road intersection.
  - Lowers the Seppala Drive profile grade to 2.5% through the Center Creek intersection and continuing to the Jafet Road intersection.
  - Reduces the effect of adverse grade, because trucks will not be accelerating uphill while turning.
  - Improves sight distance between the two intersections.

PREFERRED DESIGN ALTERNATIVE

The grade raise at the Center Creek intersection was selected as the preferred alternative. This option both reduces the effect of adverse grade experienced by turning traffic and improves the sight distance between the Center Creek and Jafet Road intersections. These improvements are important for safety, as this turning movement is commonly used by trucks hauling freight and gravel and by school buses.

3R ANALYSIS

Not applicable. This is a reconstruction project.

TRAFFIC ANALYSIS

Detailed traffic analysis was not performed as part of this study. Seppala Drive has a functional classification of Minor Arterial. Traffic volumes are projected to increase at a rate of 0.89% per year. Traffic values are:

Seppala Drive	Base (2018)	Predicted (2035)	Predicted (2045)
ADT (2-Way)	2,300	2,670	2,920
DHV (12.5%)	--	330	360
ESALs (Design Lane) T=5.45%	--	271,212	473,115

The existing number of lanes and lack of turn lanes at the Center Creek and Jafet intersections was analyzed by Kittelson and Associates. No additional turn lanes or through lanes are required. See Appendix A for complete Design Designation and Appendix E for Turn Lane Evaluation.

Existing road shoulders vary in width from 6 to 4 feet from project start to Station 44+00 and from Station 58+00 to 67+00. Existing shoulders are 8 feet at all other locations. Shoulders will be increased to 8 feet wide along the entire project corridor.

Official crash data for 2013 through 2017 was analyzed. During that time, one crash was reported: a property damage incident occurred at 704 Seppala Drive when a driver backed into a parked car.

HORIZONTAL/VERTICAL ALIGNMENT

The proposed horizontal alignment generally follows the existing roadway. The horizontal curve between the Snake River and the airport will be shifted slightly north to accommodate the widened shoulder and guardrail along the river while limiting the fill into the Snake River from the slope protection.

The vertical profile of Seppala Drive will generally follow the existing pavement except where it will be raised above the storm surge elevation (see Drainage section). The profile will be raised to elevation 14.5 feet between Station 34+00 and the Center Creek intersection (Sta 45+83) and over the existing Dry Creek culvert. The grade raise should provide 1.5 feet of freeboard over the storm surge elevation to prevent overtopping of the roadway. The profile at the Center Creek intersection will reduce the sag curve and improve the left-hand turn movement from Center Creek Road onto Seppala Drive. This movement is often used by loaded trucks hauling freight to the port.

TYPICAL SECTION(S)

The proposed typical section for the rural area from the airport to Prospect Place on Seppala Drive (Sta 12+00 to 55+50) and for the airport loop (Sta 2+50 to 8+25) is a paved two-lane, two-way roadway with a shoulder/parking lane on both sides and separated shared-use path on one side:

The proposed typical section for the Dry Creek area from Prospect Place to F Street on Seppala Drive (Sta 55+50 to 66+50) is a paved two-lane, two-way roadway with a shoulder/parking lane on both sides and curb and gutter and concrete sidewalk on the right-hand side:

The proposed typical section for the urban area from F Street to Bering Street (Sta 66+50 to 81+60) on Seppala Drive is a paved two-lane, two-way roadway with a shoulder/parking lane, curb and gutter, and concrete sidewalk on both sides:

PAVEMENT DESIGN

Pavement design calculations were performed for a 25-year design life using the AFPD program and manual. The mechanistic method was utilized in the design of the structural pavement section.

The AFPD Manual design methodology is based on two primary traffic load indicators, the average annual daily traffic (AADT) and the equivalent single axle load (ESAL). The AADT and ESAL used were 2,920 and 473,115, respectively. Heavy vehicles consisted of 5.45% of the total traffic load.

The 3-inch-thick asphalt in the roadway will be underlain by 4 inches of base course, 8 inches of subbase, and 10 inches of selected material. The sidewalk will be underlain by 12 inches of subbase material.

PRELIMINARY BRIDGE LAYOUT

Not applicable.

RIGHT-OF-WAY REQUIREMENTS

Much of the project will be confined to the existing ROW. The following acquisitions will be necessary (see corresponding numbers on plan and profile sheets):

No.	Acquisition	Current Ownership
1	Acquisition on the inside of the curve at the east end of the airport (Sta 39+00) on the Snake River to capture the slope protection on the inside or the curve.	State of Alaska
2	A strip on the outside of the curve at the west end of the airport (Sta 39+00) to capture the existing roadway embankment and drainage. This is airport property.	State of Alaska
3	Small strips along McClain to fit the roadway and drainage. Existing ROW is 20 feet.	Private
4	Small triangle on the north side of Seppala across from Belmont Street to capture catch slope and drainage.	City of Nome
5	Acquisition to capture the existing Belmont Street embankment.	City of Nome
6	Acquisition to capture catch slope for the grade raise west of Dry Creek.	Bering Straits Native Corporation (BSNC)
7	A small area for the northern catch slope at the grade raise at Dry Creek.	
8	Land for the Dry Creek realignment and catch slope at the grade raise.	BSNC
9	Acquisition where the proposed sidewalk and catch slope fall outside the existing ROW near the SE quadrant of the F Street intersection.	
10	Acquisition where the proposed sidewalk and catch slope fall outside the existing ROW on the north side of Seppala between F Street and E Street.	Private
11	Strip of land to capture catch slope on the north side of Seppala between D Street and C Street.	Private (2 parcels) Kawerak, Inc. (1 parcel)
12	Strip of land to capture catch slope on the north side of Seppala between C Street and B Street.	Private (1 parcel) Nanuaq, Inc. (1 parcel)

Temporary Construction Permits will be obtained for driveway reconstruction.

MAINTENANCE CONSIDERATIONS

The primary maintenance concerns with the existing roadway are patching of deteriorated pavement and repairs necessitated by poor drainage. New curb and gutter, valley gutters across side streets, and swales along side streets will reestablish and improve the drainage system. Installing new pavement and rebuilding the upper portion of the pavement structure will provide a more durable repair of the surface than patching.

This project will reconstruct 4.66 lane miles of road and construct 0.53 lane miles of new shared use path. It will not change the total lane miles of Seppala Drive. Ongoing maintenance will be required to clean debris from the flow lines of gutters and culverts.

MATERIAL SOURCES

All materials will be contractor-furnished. There are enough local commercial or private sources to provide the quantity and quality of aggregate required for the project. The asphalt materials and plant will be imported to Nome if a plant is not located in town when the project is constructed.

UTILITY RELOCATION & COORDINATION

Existing utilities along the Seppala Drive corridor include buried water and sewer and overhead electric and communication lines. Water and sewer extend from the airport to the old Snake River bridge location at Sta 35+00 and from Prospect Place to Bering Street. Depths of water lines are assumed to be 4 to 5 feet, and the sewer line is assumed to be between 5 and 8 feet deep, based on limited as-built and utility permit information in the area. Depths of water and sewer services are unknown.

A force main was installed on top of the existing large diameter culverts at Dry Creek. The force main extends from the lift station located at the south end of Belmont Street to a manhole located at the E Street/ Seppala intersection. On the as-builts, the distance between the existing culvert crown and the bottom of the force main is unclear. Dry Creek crosses a sag in the force main profile between high points at Belmont and E Street, so slightly raising the force main will not change the operational risks. The force main will need to be relocated to accommodate the larger-diameter culvert; a temporary bypass will be utilized during construction. A 2012 project installed a bore water line outside the culverts at the Dry Creek crossing, so water line relocation will not be necessary.

ACCESS CONTROL FEATURES

There are no controlled-access facilities within the project limits. All access control is common access control with driveways onto the roadway. This project will not change the access control.

PEDESTRIAN/BICYCLE (ADA) PROVISIONS

The project will improve the existing sidewalks from F Street (Sta 68+00) to the intersection with Bering Street by widening the sidewalk from 4 feet to 5 feet. The existing pedestrian route from the airport to F Street is via the narrow road shoulder. The proposed pedestrian route will be by sidewalk, 10-foot separated shared-use path, and 8-foot widened shoulder. From the airport to Prospect Place, pedestrians will utilize a separated path along the south side of Seppala Drive. The path will merge into an 8-foot widened shoulder at the curve along the Snake River (Sta 35+50 to 44+60), where not enough ROW is available to accommodate a shared use path. Pedestrians will also use the road shoulder at the Jafet Road intersection, partly because the horizontal geometry involving the river and the bridge does not accommodate a shared use path and partly because it is safer for pedestrians to cross the intersection at the location of the stop bar for vehicles. East of Jafet Road, a shared use path will tie into a 5-foot sidewalk on the south side of the road from Prospect Place to F Street. A 5-foot concrete sidewalk will be available on both the north and south sides of Seppala Drive from F Street to Bering Street.

The pedestrian route design will meet the criteria of the Americans with Disabilities Act, utilizing a maximum cross slope of 1.5% for sidewalks and paths and not exceeding 2% at crosswalks. Profile grades will not exceed 5% except at curb ramps.

SAFETY IMPROVEMENTS

Safety will be improved with the construction of shared use path, sidewalk, and widened shoulders. These will allow pedestrians to move off the narrow shoulders and reduce risk of a pedestrian collision.

The grade raise at Dry Creek and west of Center Creek should prevent future overtopping of the road during storm surges.

The profile changes east of the Center Creek intersection will improve sight distance and reduce the profile grade for turning traffic. This intersection is heavily traveled by trucks loaded with freight or gravel turning left from Center Creek Road to Seppala Drive and then right onto Jafet Road bound for the Port of Nome.

INTELLIGENT TRANSPORTATION SYSTEM FEATURES

Not applicable. There are no intelligent transportation system features within the project limits.

DRAINAGE

Existing drainage along Seppala Drive is via surface flow to culverts that discharge to the Snake River and Norton Sound. From the airport to F Street, water from the road surface flows to drainage swales. Discharge from the north flows into the Snake River through cross culverts along the corridor. The 36-inch cross culvert at Center Creek is aged and out of round and will be replaced with this project.

From F Street to Bering Street, water from the road surface flows into gutters. From the high point at Sta 79+00 (C Street), water flows east to Bering Street and south to Norton Sound or west to Dry Creek and into the Nome harbor. The existing curb and gutter has settled in many places, resulting in drainage issues that include water ponding along the curb line.

The existing 6-foot- and 7-foot-diameter Dry Creek culverts will be replaced with one 10-foot-diameter culvert to accommodate fish passage and storm surge. A 10-foot-diameter culvert can be embedded deep enough to facilitate fish passage while still providing sufficient conveyance of the 100-year storm event. During scoping for this project, the U.S. Fish and Wildlife Service (USFWS) and Alaska Department of Fish and Game (ADF&G) asked to be consulted for input during culvert design in the hope of restoring tidal influence to the Dry Creek and Bourbon

Creek drainages, which discharge through the culverts under Seppala Drive into the small boat harbor and Norton Sound. The existing culverts are perched and too narrow to allow the free exchange of sea water that historicaly influenced the Dry and Burbon Creek wetlands. The restricted exchange of seawater may have changed the lower reaches of the creeks from a brackish ecosystem to a freshwater ecosystem. Preliminary engineering has identified that a single 10-foot culvert will satisfy engineering requirements for conveyance of the design flood and improve tidal influence. Coordination with ADF&G and USFWS will likely result in further design requirements related to the placement of substrate within the embedded culvert as well as refinement of embedment depths and culvert slope/inlet elevations.

A hydrologic and hydraulic (H&H) report was prepared to evaluate the hydrologic characteristics of the Snake River, conduct a hydraulic analysis to determine the flood elevation, and design the erosion protection for the Snake River from Station 34+60 to 46+50. The selected erosion control design is a riprap slope protection section that matches the section used on the Snake River Bridge project. The proposed slope protection will extend from the riprap placed at the old Snake River bridge site (Sta 34+60) down the Snake River to tie into the riprap placed at the new Snake River bridge (Sta 46+50).

The study determined the design flood elevation for a 100-year event to be approximately 13 feet, including effects from storm surge. A design flood elevation of 14.5 feet is used for the roadwalk and riprap design to account for half the height of a 3-foot wave on top of the storm-induced water level. Two sections of the existing road are below this elevation and will be raised to prevent overtopping during storm surges. Grade raises will occur from Station 34+00 to the Center Creek intersection (Sta 45+83) and at the Dry Creek culverts from Station 60+40 to 68+30.

The grade raise at the Dry Creek culverts will expand the embankment's footprint. Part of the Dry Creek channel runs along the north toe of the embankment and will be impacted by this larger footprint. The Dry Creek channel will be realigned to run along the new embankment toe, and slope protection will be placed on the embankment.

SOIL CONDITIONS

The city of Nome is located in a subarctic climate on the coastal lowlands of the Seward Peninsula Physiographic Province, which is generally underlain by relatively warm (ground temperatures near and above 31°F) continuous and discontinuous permafrost. Where construction, mining activity, and development have disturbed the ground surface, permafrost degradation has occurred. Nome experiences 3,900 freezing degree days and 2,300 thawing degree days.

Airport Terminal to Dry Creek (STA 11+00 to 64+00)

- ***Fill:*** 0–2.5 to 15.5 feet bgs – poorly graded Sand, Silty Sand, to Silty Gravel
- ***Subsurface:*** Poorly graded Sand, Silty Sand, Silty Gravel, to Sandy Silt. Schist bedrock was noted in historic boreholes below 27.5 feet bgs.
- ***Permafrost:*** Permafrost was not observed in the upper 21.5 feet; therefore, it is either deeper than 21.5 feet (extent of borehole exploration) or nonexistent.

- ***Groundwater:*** Groundwater was observed at depths between 11 and 14 feet bgs while drilling. Groundwater is expected to be at shallower depths during summer months with peaks during periods of increased precipitation.

Dry Creek to West C Street (STA 64+00 to 77+50)

- ***Fill:*** 0 to 8 feet bgs – Silty Sand and Gravel
- ***Subsurface:*** Poorly graded Sand and Gravel, Silty Sand, and Gravel
- ***Organic Subgrade:*** 6 to 8 feet bgs – Very soft peat and organic silt deposits were observed in boreholes G19-BH-02, G19-BH-03, and G19-BH-06, likely at the base of the original road excavation and embankment. This area also contains silt layers observed in boreholes G19-BH-05 and G19-BH-06 at depths of 27 and 10.5 feet bgs, respectively.
- ***Permafrost:*** Approximately 30 feet bgs in a well graded sand with silt
- ***Groundwater:*** Groundwater was observed between 7 and 21 feet bgs while drilling, but it is expected to be higher during the spring or fall at periods of thaw or increased precipitation.

West C Street to Bering Street (STA 77+50 to 81+35)

- ***Fill:*** 0 to 8.5 feet below ground surface (bgs) – Silty Sand and Gravel
- ***Fine Grained Subgrade:*** 8.5 to 13 feet bgs – Silt, Clayey Silt, Silty Sand, and poorly graded Sand
- ***Subsurface:*** 13 feet bgs to bottom of explorations
- ***Permafrost:*** Permafrost was not observed in the upper 16.5 feet; therefore, it is either deeper than 16.5 feet (extent of borehole exploration) or nonexistent.
- ***Groundwater:*** No groundwater was observed during drilling.

The sinkhole located near F street was formed due to thawing of unstable peat with sand and silt. Based on boreholes performed at the sinkhole location, the permafrost thaw has extended through the peat layer into thaw stable silty sand. Significant additional settlement is that anticipated at this location.

EROSION AND SEDIMENT CONTROL

The project's Erosion and Sentiment Control Plan (ESCP) will include recommended permanent and temporary Best Management Practices (BMPs) that may be used during construction. A Storm Water Pollution Prevention Plan (SWPPP) must be developed by the contractor in order to obtain coverage under the Alaska Pollutant Discharge Elimination System (APDES) Construction General Permit (CGP). This SWPPP will detail the BMPs the contractor will use to prevent sediment-laden stormwater runoff from leaving the project area and entering Norton Sound.

ENVIRONMENTAL COMMITMENTS

ADF&G stipulates that work in Dry Creek may occur only from May through July and work involving the Snake River may only occur between April/May and July. Fish habitat permits must be obtained from ADF&G. DOT&PF will coordinate with ADF&G through the permitting process. ADF&G supports the opportunity to replace the Dry Creek culverts and establish tidal exchange with the Dry Creek and Bourbon Creek wetlands.

USFWS recommends implementing current BMPs to minimize the introduction and proliferation of invasive species.

There are four active contaminated sites along the project corridor. Two sites are located at the airport (Evergreen Helicopters and Mark Air Hangers), one site at the Crowley Tank Farm on F Street and one site at the east side of the Harbor.

WORK ZONE TRAFFIC CONTROL

This project is significant for traffic control as defined in Section 1400.2 of the Highway Preconstruction Manual. The contractor will develop a Traffic Control Plan during construction.

Seppala Drive from the airport to Center Creek Road is a dead end with no detour route. This stretch of road serves the airport terminal, and access must be maintained during construction.

Jafet Road is the only access to the port area, which serves many commercial uses (including the City jetty, water treatment plant, power plant, and post office) and one residence. Access through this intersection and across the Snake River Bridge must be maintained during construction.

Center Creek Road, Little Creek Road, and Bering Street can provide detour access from the airport to downtown Nome during replacement of the Dry Creek culvert and road closures. Downtown Nome itself is laid out on a grid system. From F Street to Bering Street, the contractor may consider closing portions of the road and detouring traffic to the adjacent streets.

VALUE ENGINEERING

Value engineering is not required for this project.

COST ESTIMATE

The estimated costs for this project are as follows:

Design	$737,754.31
Utilities	$1,000,000
Right of Way	$300,000
Construction (Includes 15% Engineering)	$12,897,356.92
Total Cost of Project	$14,935,111.23

APPENDIX A

DESIGN CRITERIA
AND
DESIGN DESIGNATION

ALASKA DOT&PF PRECONSTRUCTION MANUAL
Chapter 11 - Design
PROJECT DESIGN CRITERIA

Project Name:	SEPPALA DRIVE UPGRADES			
☑ New Construction/Reconstruction	☐ 3R	☐ PM	☐ Other:	
Project Number:	Z620030000/000S828		☐ NHS	☑ Non NHS
Functional Classification:	Current: Minor Arterial			
Design Year:	2045	**Present ADT:**		2300
Design Year ADT:	2920	**Mid Design Period ADT:**		2670
DHV:	360	**Directional Split:**		40-60
Percent Trucks:	5.45%	**Equivalent Axle Loading:**		473,115
Pavement Design Year:	2045	**Design Vehicle:**		WB-67
Terrain:	Level	**Number of Roadways:**		1
Design Speed:	30			
Width of Traveled Way:	(2) 11' lanes - 22'			
Width of Shoulders:	Outside:	8'	Inside: None	N/A
Cross Slope:	2%			
Superelevation Rate:	6%			
Minimum Radius of Curvature:	275			
Min. K-Value for Vert. Curves:	Sag:	37	Crest:	19
Maximum Allowable Grade:	5%			
Minimum Allowable Grade:	0.3%			
Stopping Sight Distance:	200ft			
Lateral Offset to Obstruction:	12'			
Vertical Clearance:	16'-6"			
Bridge Width:	N/A			
Bridge Structural Capacity:	N/A			
Passing Sight Distance:	1470'			
Surface Treatment:	**T/W: Asphalt Concrete**		**Shoulders: Asphalt Concrete**	
Side Slope Ratios:	**Foreslopes: C&G w/ Sidewalks or 4:1**		**Backslopes: N/A**	
Degree of Access Control:	**Driveway Permit Process**			
Median Treatment:	N/A			
Illumination:	Dis-Continuous			
Curb Usage and Type:	Standard C&G			
Bicycle Provisions:	Shared Roadway, Widened Shoulders, Separated Path			
Pedestrian Provisions:	Sidewalk, Widened Shoulders, Separated Path			
Misc. Criteria:				

Proposed - Designer/Consultant:	Anne Nelson, PDC Engineers	**Date:**	
Endorsed - Engineering Manager:	[signature]	**Date:**	5/10/2021
Approved - Preconstruction Engineer:	[signature]	**Date:**	5/11/2021

Shaded criteria are commonly referred to as the *FWHA 13 controlling criteria*. For NHS routes only, these criteria must meet the minimums established in the Green Book (*AASHTO A Policy on Geometric Design of Highways and Streets*). For all other routes, these criteria must meet the minimums established in the *Alaska Highway Preconstruction Manual*. Otherwise a Design Exception must be approved.

Design Criteria marked with a " # " do not meet minimums and must have a Design Exception(s) and/or Design Waiver(s) approved. See the Design Study Report for Design Exception/Design Waiver approval(s) and approved design criteria values.

MEMORANDUM

State of Alaska

Department of Transportation & Public Facilities

TO: Sarah E. Schacher, P.E.,
Preconstruction Engineer
Northern Region

DATE: December 16, 2019

FILE NO: I:\Traffic Data\Design\2019\SeppalaDr_Z62003

TELEPHONE NO: 451-5150

FROM: Scott Vockeroth
Traffic Data Manager
Fairbanks Field Office

SUBJECT: Seppala Drive Upgrades
Z620030000/000S828
Design Designation Request

Please approve the attached design designation by signing the endorsement below which enables your staff to proceed.

The AADT on Seppala Dr changed drastically with the construction of the Snake River Bridge and Jafet Rd that provide a new access point to the port area. Our most recent data collection in 2017 reflects the decrease in the AADT values west of the bridge. There are two traffic links along the project scope, the highest AADT value was used for this Design Designation.

Contact our office if you have any questions.

12/17/2019

Sarah E. Schacher, P.E., Preconstruction Engineer — Date

cc: Joe Kemp, P.E., Engineering Manager, Northern Region

Attachment

DESIGN DESIGNATION
Northern Region Planning
Traffic Data & Forecasting

ROUTE NAME: Seppala Dr
STATE ROUTE NO: 168100
CDS MILEAGE: 0.000-1.3217
FUNCTIONAL CLASS: Minor Arterial
URBAN/RURAL: Rural

	YEAR	AADT	%	
AADT	2018 2035 2045	2300 2670 2920		
DHV	2035 2045		12.50	330 360
D				40-60
T			**5.45** 4.50 0.75 0.20	**Total** Class 5 Class 6 Class 9
ESAL'S (Design Lane)	To Be Provided by Design			

Submitted Data Request Type: Design Designations Request (Northern)

Latest Status Update:	**Data Request Record has been assigned to an email address.**
Assigned to the following e-mail address:	**jill.sullivan@alaska.gov; scott.vockeroth@alaska.gov**
Record Creation:	**December 04, 2019 10:19:10 AM**
Routed to assigned e-mail address:	**December 04, 2019 11:26:15 AM**
Request Resolution:	**Resolution Pending**

Requestor

First Name: *	Joe	Last Name: *	Kemp
Email: *	joseph.kemp@alaska.gov		
Additional Email Contacts:			+
Date Needed: (AKST)	12 / 20 / 2019 12/17/19		

Project Information

Project Name: *	Seppala Road Upgrades
Project Engineer(s): *	Joe Kemp
State Project Number: *	Z620030000
Federal Project Number: *	000S828
Route ID: *	168100
Milepoint (To/From): *	Entire Length
Construction Year: *	2024

Please select the type of project. *

- ● Reconstruction
- Rehabilitation
- New Construction
- Other (please describe) Reconstruction

Project Notes:

Please select the project's region to view the Data Fields that are available to request. *

- Central
- ● Northern
- Southcoast

Data Fields Requested: (please pick at least one) *

- Present AADT
- Design Year AADT (Please specify Year) 2024 2045
- Mid-Design Year AADT (Please specify Year) 2035
- Design Hourly Volume (DHV)
- Directional Split (D)
- Percent Trucks
- Road Functional Classification
- Intersection Turning Movements (Please specify Locations)

Please specify any other requested data fields not listed above:

Traffic Data Request Form

TDR Form-1-10/20/03

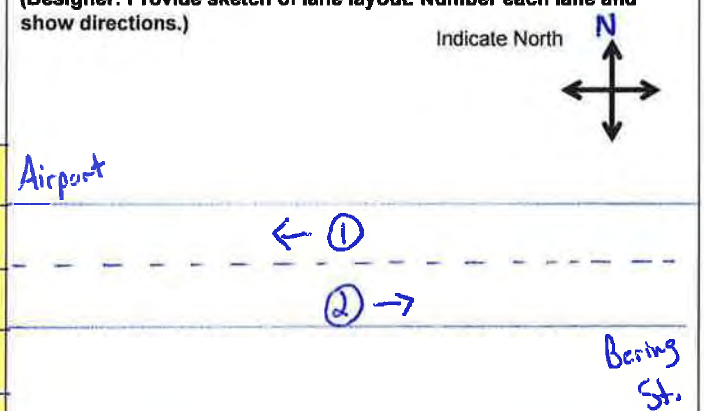
Alaska Department of Transportation & Public Facilities

Requested By: Joe Kemp	**Design Project Number:** Z620030000	**Date Requested:** 12/4/19
Base Year: 2018 **Base Year Total AADT:** 2300 **AADT Growth Rate** **Forward (%/yr):** 0.89 **End Year:** 2045 **Back Cast (%/yr):** **Begin Year:**	**Common Route Name:** Seppala Dr **Functional Class:** Minor Arteri **Urban/Rural** **Historic M.P. Interval:**	**CDS Route Name:** 168100, 9141029X000 **CDS M.P. Interval:** 0-1.3217

Truck Category	Load Factor (ESALs per Truck)	% of Total AADT in Truck Category
2-axle		
3-axle	See	
4-axle	attached	
5-axle		
≥ 6-axle		

Lane Configuration Sketch:
(Designer: Provide sketch of lane layout. Number each lane and show directions.)

Indicate North



Percent of Base Year Total AADT for Each Numbered Lane in Configuration Sketch:

Lane #	%
1	40
2	60

Comments:

Data Provided By:	Provider's Signature:	Date Provided:
Scott Vockeroth	[signature]	12/13/19

Figure 6-1. Traffic Data Request (TDR) Form

Report	Route Log
CDS Route	SEPPALA DRIVE (168100)
From Milepoint	0
To Milepoint	1.3217
Filter	

FacilityType: INTERCHANGE RAMP;NON-INVENTORY;WYE;SECONDARY FERRY ACCESS;ROUNDABOUT;PRIMARY FERRY ACCESS; NON-INTERCHANGE RAMP;MAINLINE;CONNECTOR

Milepoint	Attribute	Side	Feature CDS	Description	Viewer
0	Intersection	B	168500	BERING STREET	
0	Traffic Link	-	-	Start AL001034	
0	Functional Class	-	-	Start MINOR ARTERIAL	
0	FHWA Urban Area	-	-	Start RURAL AREA (RURAL)	
0.0436	Traffic Station	-	-	30956000	
0.2656	Intersection	R	-	WEST F-STREET	
0.6078	Intersection	L	168116	JAFET ROAD	
0.6662	Traffic Link	-	-	AL001034 -> AL001035	
0.6662	Intersection	R	168200	CENTER CREEK ROAD	
0.6981	Traffic Station	-	-	30958000	
1.3217	Traffic Link	-	-	End AL001035	
1.3217	Functional Class	-	-	End MINOR ARTERIAL	
1.3217	FHWA Urban Area	-	-	End RURAL AREA (RURAL)	

Computations and Historical Data
Project: Seppala Rd Upgrades

Historical AADTs

Link	Start CDS	Start Feature	End CDS	End Feature	1980	1981	1982	1983	1984	1985
1	0.000	Bering St	0.666	Center Creek Rd						
2	0.666	Center Creek Rd	1.322	End Feature						

Link	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1														2732	
2														2388	

Link	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1								2650			2599			2606	2614
2								2976			2846			2191	2198

Link	2016	2017	2018
1	2685	2287	2288
2	2258	1214	1214

Growth Rate 0.89% Continuous counter traffic trends

Growth Factors

Year	Factor
2035	1.162
2045	1.269

Future AADT

Year	AADT
2018	2300
2035	2670
2045	2920

D Factor (30) 40-60

K-Factor (30) 12.50% Obtained from Continous Count at Nome-Teller Hwy North of Little Creek Rd

Design Hourly Volume (DHV)

2035	330
2045	360

Class Data

Station ID	Station Description	MP	Year	4	5	6	8	9	10	13	Total Truck %
37032021	Seppala Dr West Of Center Creek	0.696	2017	0.00	4.50	0.75	0.00	0.20	0.00	0.00	5.45
		Load Factor		1.00	0.50	0.85	1.20	1.55	2.24	2.24	
		Number of Axles		2/3	2	3	4	5	6	7+	

(Columns 4–13: Percent by Class)

APPENDIX B

ENVIRONMENTAL DOCUMENT
(only include the signature page of the FONSI or ROD)

VI. Environmental Documentation Approval	N/A	YES	NO
2. The project meets the criteria of one of the following DOT&PF Programmatic Approvals authorized in the Nov. 13, 2017 "Chief Engineer Directive – Programmatic Categorical Exclusions".		☐	☒
• *If yes, select the appropriate Programmatic Approval below, and the CE documentation form may be approved by the Regional Environmental Manager.* • *If no, the CE documentation form must be approved by a NEPA Program Manager.*			
a. Programmatic Approval 1		☐	
b. Programmatic Approval 2		☐	
c. Programmatic Approval 3		☐	

VII. Environmental Documentation Approval Signatures

Prepared by: [signature] Date: 3.11.19

[Signature] Environmental Impact Analyst

Melissa Jensen

[Print Name] Environmental Impact Analyst

Reviewed by: [signature] Date: 3/11/2019

[Signature] Engineering Manager

Christopher Johnston

[Print Name] Engineering Manager

Programmatic CE

Approved by: ____________________ Date: ____________

[Signature] Regional Environmental Manager

____

[Print Name] Regional Environmental Manager

Non-Programmatic CE

Approval Recommended by: Brett D Nelson Date: 3-11-19

[Signature] Regional Environmental Manager

Brett Nelson

VII. Environmental Documentation Approval Signatures

[Print Name] Regional Environmental Manager

Approved by: [signature] Date: 03/11/19

[Signature] NEPA Program Manager

Melissa Goldstein

[Print Name] NEPA Program Manager

APPENDIX C

PAVEMENT DESIGN

Project: Seppala Drive Proj No.: GAI# 1780790											New Construction by:Andrew Daggett 3/6/2020 11:35:31 AM
AADT = 2,900	Past Loadings	Future Loadings						X/Y Load Locations (in): Load = 4500 (lbs) Tire Pressure = 110 (psi)		0 0	13.5 0
10% Spring 40% Summer 10% Fall 40% Winter --------------- Total:	----------	47312 189,246 47312 189,246 ---------- 473,115							X/Y Evaluation Points (in):	6.75 0	0 0
Layer	Critical Z Coordinate	Asphalt Properties	Season	Modulus (ksi)	Poisson's Ratio	Tensile Critical Micro Strain	Critical Compressive Stress (psi)	Million Cycles to Failure		Future Damage %	Total Damage %
3(in) Asphalt_Concrete	2.99	4% Air 5.5% Asph 148 pcf	Spring	755	0.3	243		1.35		3.49	3.49%
			Summer	510	0.3	259		1.54		12.32	12.32%
			Fall	510	0.3	259		1.54		3.08	3.08%
			Winter	1,500	0.3	105		11.93		1.59	1.59%
								Total Damage:		**20.48**	**20.48**
4(in) Agg_Base_P200<6%	3.01		Spring	45	0.35		33.00	1.08		4.36	4.36%
			Summer	50	0.35		41.60	0.72		26.33	26.33%
			Fall	50	0.35		41.60	0.72		6.58	6.58%
			Winter	100	0.35		36.40	10.64		1.78	1.78%
								Total Damage:		**39.05**	**39.05**
18(in) Select_A_P200<6%	7.01		Spring	25	0.4		16.50	1.53		3.09	3.09%
			Summer	35	0.4		19.30	2.75		6.89	6.89%
			Fall	35	0.4		19.30	2.75		1.72	1.72%
			Winter	90	0.4		18.50	68.55		0.28	0.28%
								Total Damage:		**11.98**	**11.98**
S-Infinite Subgrade_P200>30%	25.01		Spring	45	0.45		5.25	434.44		0.01	0.01%
			Summer	10	0.45		2.78	16.52		1.15	1.15%
			Fall	10	0.45		2.78	16.52		0.29	0.29%
			Winter	10	0.45		1.64	92.29		0.21	0.21%
								Total Damage:		**1.65**	**1.65**

Based on BH-05, BH-08 – Asphalt, sand, gravel, sand, gravel, sand

LOCATION	THAW N	FREZ N	MAAT	THAW °F DAY	FREZ °F DAY	THAW DAYS	FREZ DAYS
NOME	1.70	1.00	28	2870	4980	165	200

		1	2	3	4	5	6
THAW CYCLE	FROZEN % MOIS.	0.0	6.0	2.5	5.0	8.0	6.0
	FROZEN DENS.	138.0	110.0	130.0	130.0	130.0	110.0
	LATENT HEAT	0	950	468	936	1498	950
	FROZEN HEAT CAP	28.00	22.00	23.73	25.35	27.30	22.00
	FROZEN COND.	0.86	0.82	0.84	1.36	2.00	0.82
	THAWED % MOIS.	0.0	6.0	2.5	5.0	8.0	6.0
	THAWED DENS.	138.0	110.0	130.0	130.0	130.0	110.0
	THAWED HEAT CAP	28.00	25.30	25.35	28.60	32.50	25.30
	THAWED COND.	0.86	0.99	1.13	1.48	1.72	0.99
	INITIAL THICK	0.58	0.75	0.83	4.00	6.00	12.00
	AMOUNT THAWED	0.58	0.75	0.83	4.00	6.00	2.09
	CONSOLIDATION	----	----	----	----	----	----
	FINAL THICK	0.58	0.75	0.83	4.00	6.00	12.00
FREEZE CYCLE	LATENT HEAT	0	950	468	936	1498	950
	FROZEN DENS.	138.0	110.0	130.0	130.0	130.0	110.0
	FROZEN HEAT CAP	28.00	22.00	23.73	25.35	27.30	22.00
	FROZEN COND.	0.86	0.82	0.84	1.36	2.00	0.82
	INITIAL THICK	0.58	0.75	0.83	4.00	6.00	12.00
	AMOUNT FROZEN	0.58	0.75	0.83	4.00	6.00	1.73

ESTIMATED THAW=14.25 FREEZE=13.89 PRINT LOCATION SOIL QUIT

Based on BH-07, BH-10, BH-09 – Asphalt, sand, gravel, gravel, sand

LOCATION	THAW N	FREZ N	MAAT	THAW °F DAY	FREZ °F DAY	THAW DAYS	FREZ DAYS
NOME	1.70	1.00	28	2870	4980	165	200

		1	2	3	4	5
THAW CYCLE	FROZEN % MOIS.	0.0	6.0	2.5	2.5	6.0
	FROZEN DENS.	138.0	110.0	130.0	130.0	110.0
	LATENT HEAT	0	950	468	468	950
	FROZEN HEAT CAP	28.00	22.00	23.73	23.73	22.00
	FROZEN COND.	0.86	0.82	0.84	0.84	0.82
	THAWED % MOIS.	0.0	6.0	2.5	2.5	6.0
	THAWED DENS.	138.0	110.0	130.0	130.0	110.0
	THAWED HEAT CAP	28.00	25.30	25.35	25.35	25.30
	THAWED COND.	0.86	0.99	1.13	1.13	0.99
	INITIAL THICK	0.58	0.75	0.83	4.50	10.00
	AMOUNT THAWED	0.58	0.75	0.83	4.50	8.03
	CONSOLIDATION	----	----	----	----	----
	FINAL THICK	0.58	0.75	0.83	4.50	10.00
FREEZE CYCLE	LATENT HEAT	0	950	468	468	950
	FROZEN DENS.	138.0	110.0	130.0	130.0	110.0
	FROZEN HEAT CAP	28.00	22.00	23.73	23.73	22.00
	FROZEN COND.	0.86	0.82	0.84	0.84	0.82
	INITIAL THICK	0.58	0.75	0.83	4.50	10.00
	AMOUNT FROZEN	0.58	0.75	0.83	4.50	6.70

ESTIMATED THAW=14.69 FREEZE=13.36 PRINT LOCATION SOIL QUIT

Based on Boreholes BH-03, BH-02 – asphalt, sand, gravel, gravel, silt, sand, silt

LOCATION	THAW N	FREZ N	MAAT	THAW °F DAY	FREZ °F DAY	THAW DAYS	FREZ DAYS
NOME	1.70	1.00	28	2870	4980	165	200

THAW CYCLE	1	2	3	4	5	6	7
FROZEN % MOIS.	0.0	6.0	2.5	2.5	10.0	6.0	10.0
FROZEN DENS.	138.0	110.0	130.0	130.0	90.0	110.0	90.0
LATENT HEAT	0	950	468	468	1296	950	1296
FROZEN HEAT CAP	28.00	22.00	23.73	23.73	19.80	22.00	19.80
FROZEN COND.	0.86	0.82	0.84	0.84	0.45	0.82	0.45
THAWED % MOIS.	0.0	6.0	2.5	2.5	10.0	6.0	10.0
THAWED DENS.	138.0	110.0	130.0	130.0	90.0	110.0	90.0
THAWED HEAT CAP	28.00	25.30	25.35	25.35	24.30	25.30	24.30
THAWED COND.	0.86	0.99	1.13	1.13	0.46	0.99	0.46
INITIAL THICK	0.58	0.75	0.83	4.00	4.00	12.00	5.00
AMOUNT THAWED	0.58	0.75	0.83	4.00	4.00	2.02	0.00
CONSOLIDATION	----	----	----	----	----	----	----
FINAL THICK	0.58	0.75	0.83	4.00	4.00	12.00	5.00

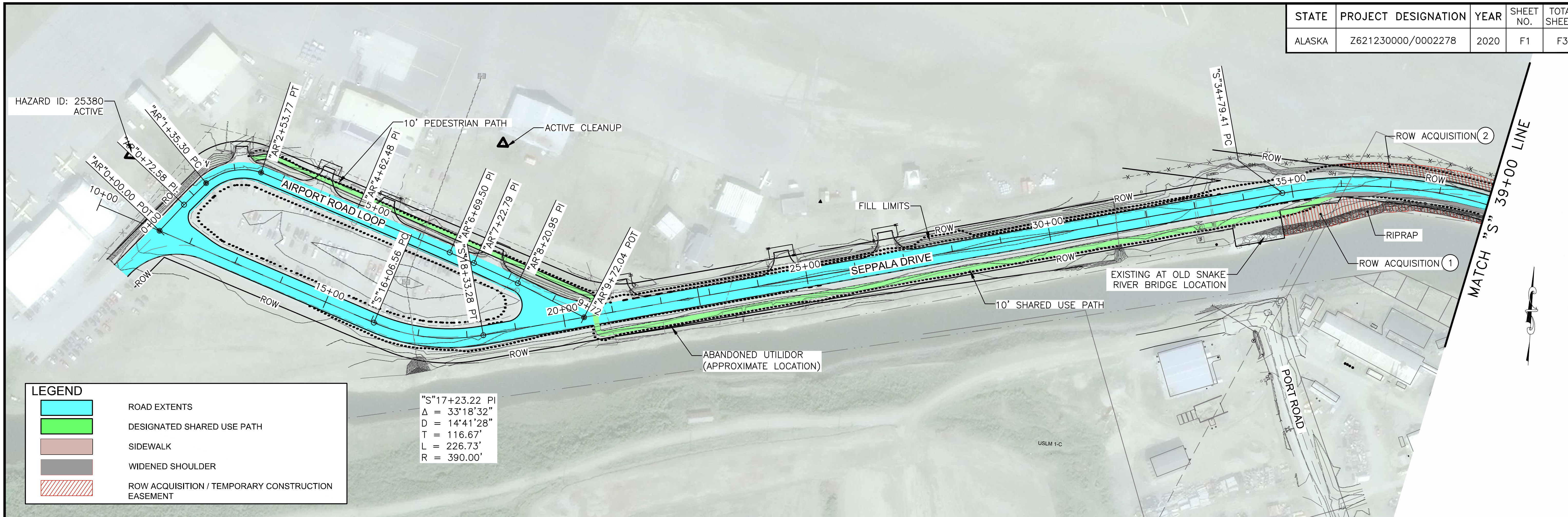
FREEZE CYCLE	1	2	3	4	5	6	7
LATENT HEAT	0	950	468	468	1296	950	1296
FROZEN DENS.	138.0	110.0	130.0	130.0	90.0	110.0	90.0
FROZEN HEAT CAP	28.00	22.00	23.73	23.73	19.80	22.00	19.80
FROZEN COND.	0.86	0.82	0.84	0.84	0.45	0.82	0.45
INITIAL THICK	0.58	0.75	0.83	4.00	4.00	12.00	5.00
AMOUNT FROZEN	0.58	0.75	0.83	4.00	4.00	1.25	0.00

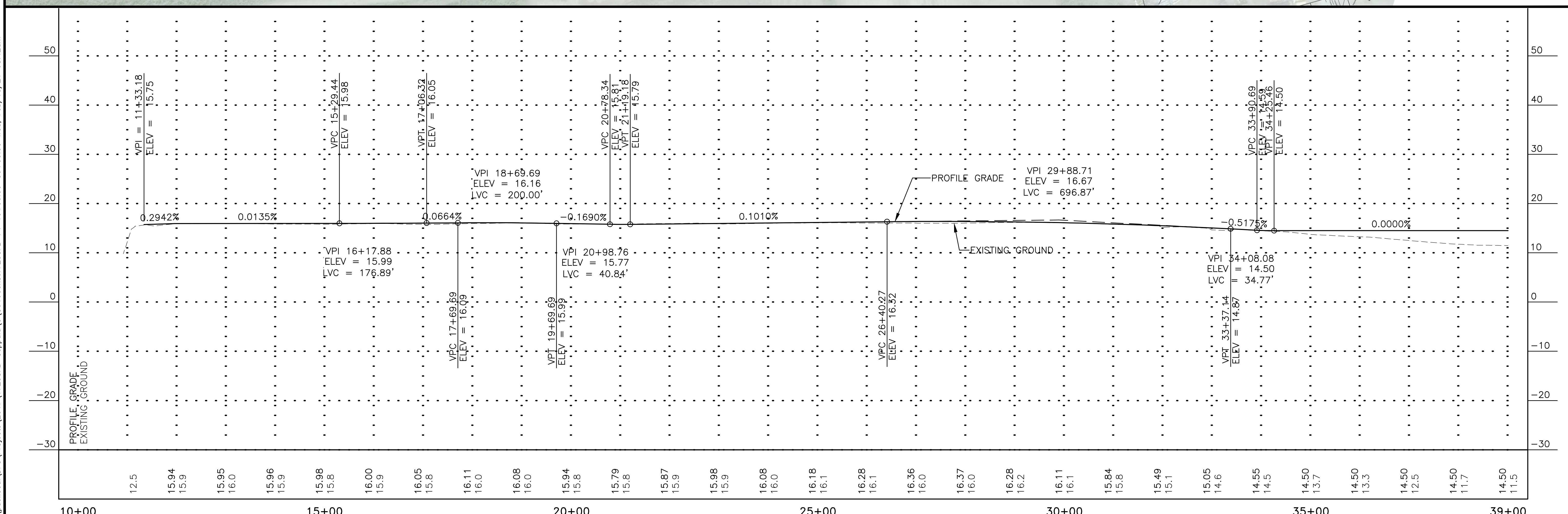
ESTIMATED THAW=12.18 FREEZE=11.41 PRINT LOCATION SOIL QUIT

APPENDIX D

PRELIMINARY PLAN AND PROFILE SHEETS

STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z621230000/0002278	2020	F1	F3





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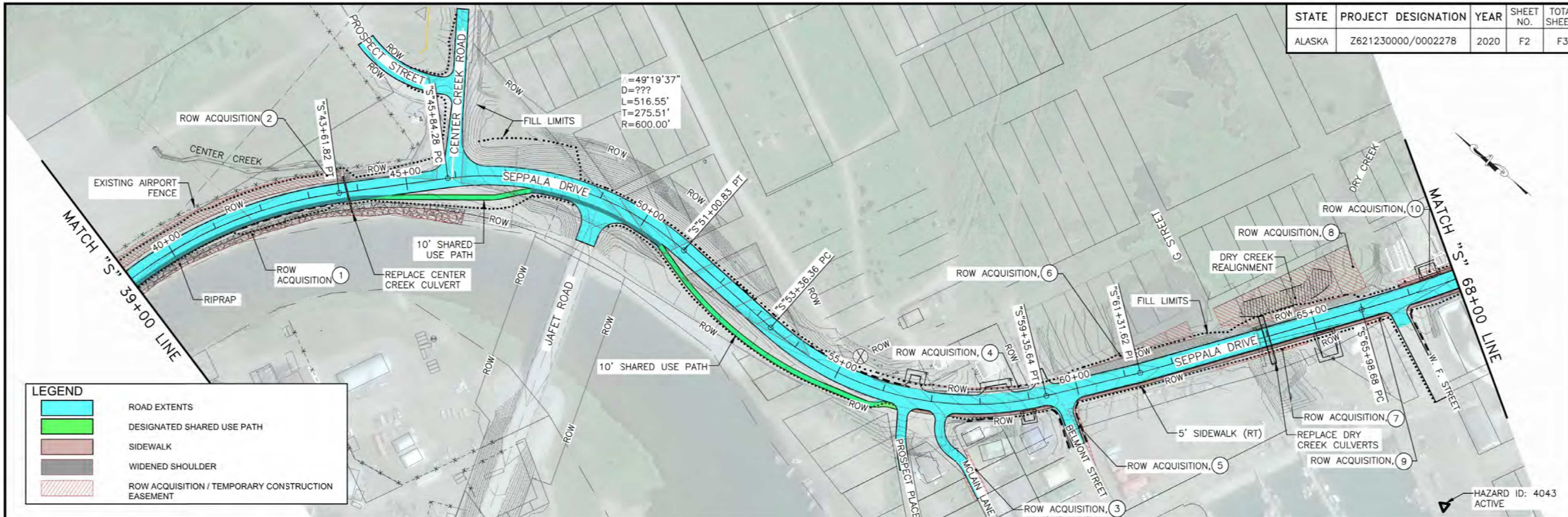
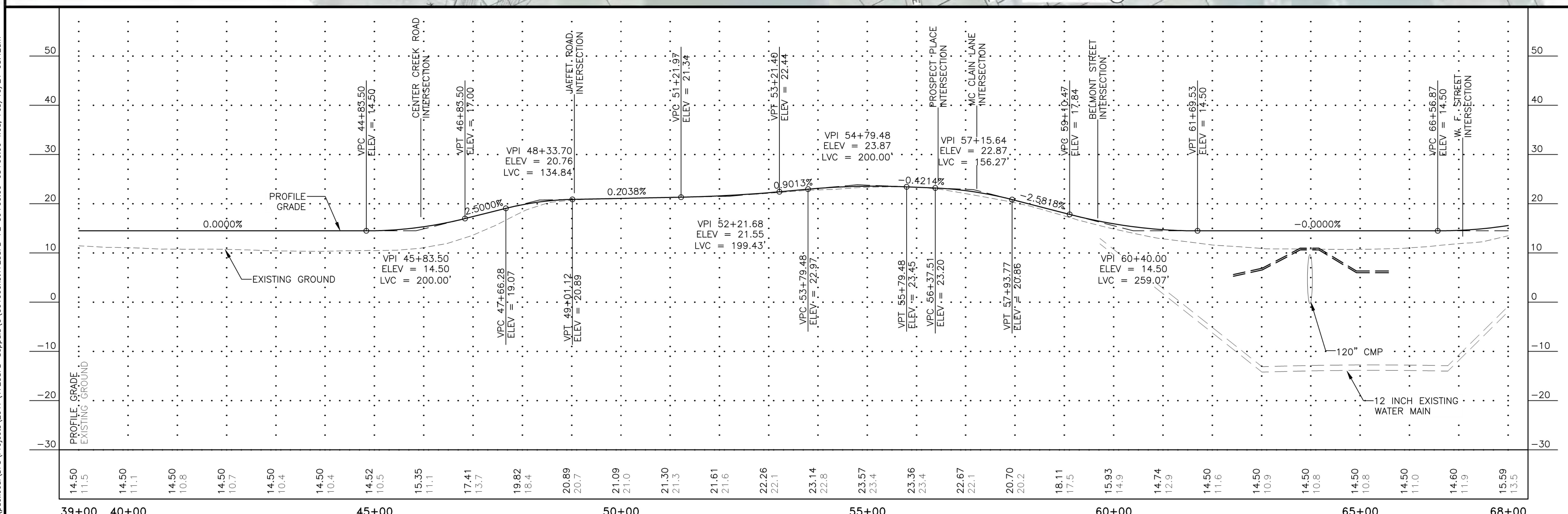
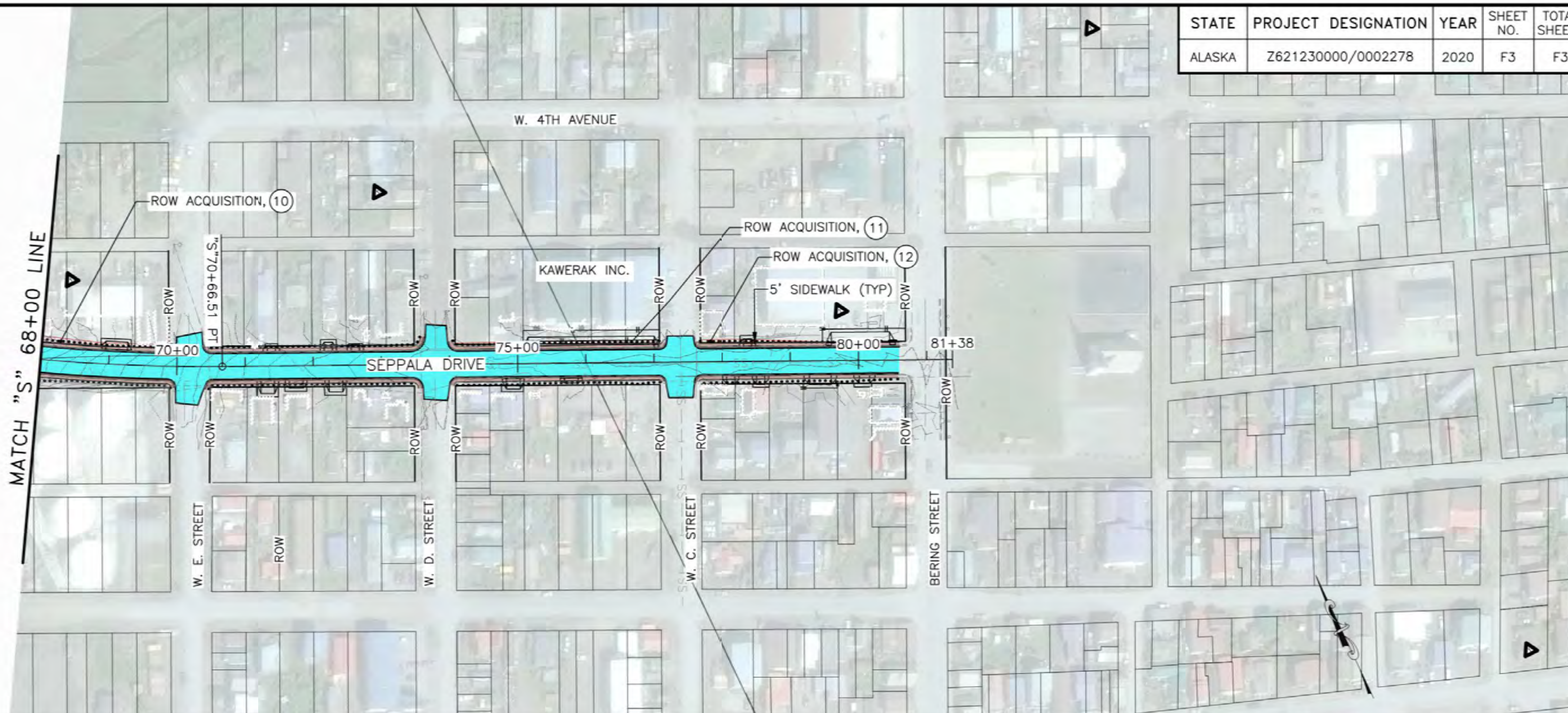
STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z621230000/0002278	2020	F2	F3





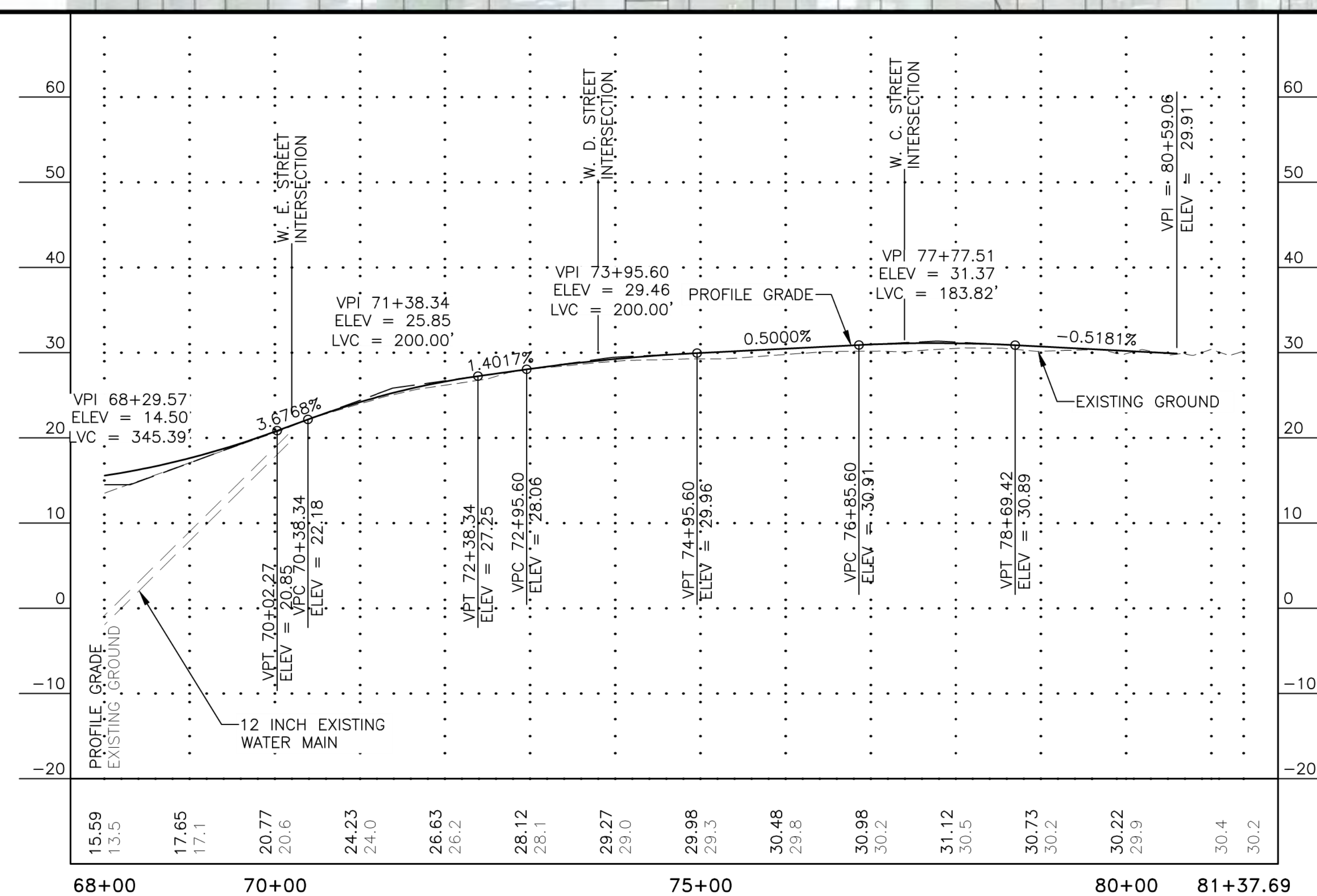
\\pdc.local\DFS\Projects\2017\17258FB-Seppala\C\C0100cnst17258FB-F2 39+00.00-68+00.00 Wed, Feb/10/21 08:42am

STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z621230000/0002278	2020	F3	F3



LEGEND

- ROAD EXTENTS
- DESIGNATED SHARED USE PATH
- SIDEWALK
- WIDENED SHOULDER
- ROW ACQUISITION / TEMPORARY CONSTRUCTION EASEMENT



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APPENDIX E

TURN LANE EVALUATION

KITTELSON & ASSOCIATES
1600 A STREET, SUITE 105
ANCHORAGE, AK 99501
P 907.646.7995

MEMORANDUM

Date:	March 19, 2020	Project #: 21556
To:	Keith Hanneman, PE PDC Engineers	
From:	Andrew Ooms, PE, PTOE, RSP	
Project:	Seppala Drive Upgrades	
Subject:	Jaffet Road/Center Creek Road Turn Lanes	

The Seppala Drive Upgrades project is providing separated path, ADA, drainage, and pavement preservation improvements for Seppala Drive between Bering Street and the airport. The project team has investigated safety improvements along the corridor, specifically turn lanes at the offset intersections of Seppala Drive with Jaffet Road and Center Creek Road as shown in Exhibit 1. This memorandum documents traffic data collected by DOT&PF along Seppala Drive and evaluates the need for turn lanes at this location.

TRAFFIC DATA

Per data collected by DOT&PF for the design designation, Seppala Drive has a 2018 average annual daily traffic (AADT) volume of 2,300 vehicles per day. Long-term growth is forecast at 0.89 percent annually, though traffic volumes are down 10 to 15 percent since the 2008 peak east of Center Creek Road. Traffic volumes west of Center Creek Road decreased approximately 50 percent with the construction of the Jaffet Road bridge. Truck percentages are 5.45 percent.

Hourly counts collected by DOT&PF in August 2017 at the offset intersections of Seppala Drive with Jaffet Road and Center Creek Road indicate that the weekday peak hour is 12:00 to 1:00 p.m. with a total entering volume of 372 vehicles. During the 12-hour count, 39 pedestrians were observed traversing the intersection, primarily to or from the east.

Seppala Drive is posted at 25 mph, though speed data collected by DOT&PF in August 2017 indicated that 77 percent of observed vehicles were exceeding that limit. The 85th percentile speed was approximately 35 mph.

Crash data supplied by DOT&PF included no reported crashes in the area of the offset intersections between 2010 and 2014.

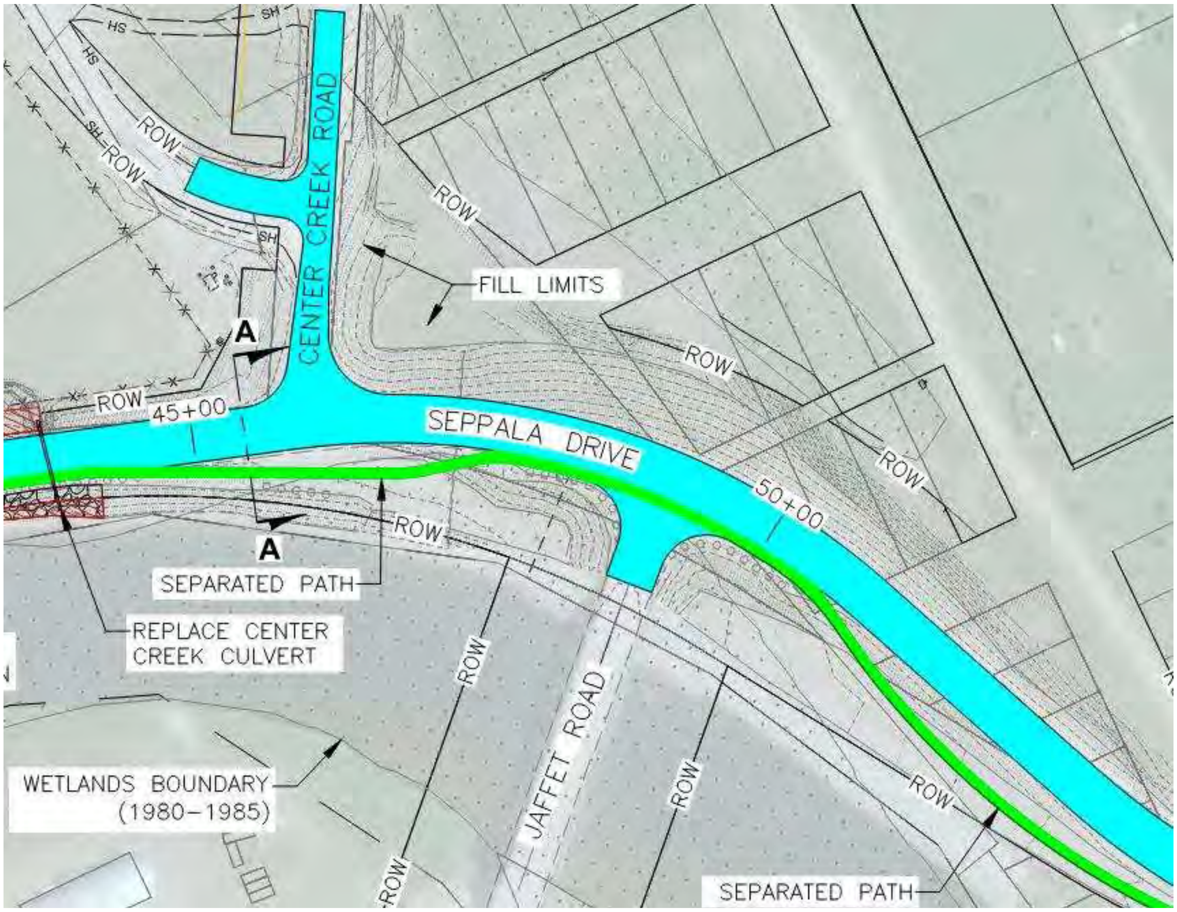

Exhibit 1 Seppala Drive Path and Pavement Limits

Looking East From Center Creek Road towards Jaffett Road

TURN LANE EVALUATION

Intersection turn lanes provide deceleration and queueing space for vehicles waiting for a gap in traffic and/or pedestrians to make a turning maneuver. Key evaluation factors for turn lanes at the offset intersections of Seppala Drive with Jaffet Road and Center Creek Road are turning volumes, conflicting vehicle volumes (for left turn lanes), travel speeds, and crash history.

Unique to the offset intersections in the travel maneuver to connect Jaffet Road with Center Creek Road as this movement is common for trucks, which require larger gaps in traffic. The offset position of the roadways leads to this movement being a left turn off the stop-controlled side street and a right turn off Seppala Drive.

Peak hour intersection volumes in 2017 show 66 vehicles on the Center Creek Road approach and 75 on the Jaffet Road approach. Given the low conflicting volumes on Seppala Drive (115 vehicles) these approaches will experience minimal delay (less than 12 seconds/vehicle), therefore side street turn lanes will be of minimal value.

Peak hour left turns are 21 southbound lefts and 45 northbound lefts with fewer than 100 opposing through and right turns. This indicates a conflicting vehicle every 36 seconds, resulting in few turning vehicles experiencing a conflicting vehicle and nominal delay when that occurs.

Given the minimal vehicle conflicts and delay, the absence of a crash history at this location, and the relatively low travel speeds, turn lanes are not recommended at the offset intersections. The benefits would be small compared to the increased construction and maintenance costs, particularly as an alignment of Center Creek Road and Jaffet Road is planned, making any improvement at the intersection temporary.

APPENDIX F

HYDROLOGIC AND HYDRAULIC REPORT

DRAFT

Hydrologic and Hydraulic Report

Snake River Riprap Design

At Seppala Drive Nome

Prepared for:

PDC Engineers
1028 Aurora Drive
Fairbanks, AK 99709

And the

Alaska Department of Transportation
and Public Facilities
Northern Region
Fairbanks, AK 99709

Prepared by:

Hydraulic Mapping and Modeling
1091 West Chena Hills Drive
Fairbanks, AK 99709

December 2020

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Figure 3. Surveyed cross-sections in the bend upstream of the Snake River Bridge. 6

Project Location and Description

The Alaska Department of Transportation and Public Facilities (ADOT&PF) wishes to make improvements to Seppala Drive in Nome (Figure 1). Planned improvements include street resurfacing and sidewalk, curb, and gutter replacement.

Erosion is occurring at a bank on a curved section of the Snake River adjacent to Seppala Drive, upstream from the new Snake River Bridge. This ongoing erosion may affect the long-term stability of Seppala Drive, and should be addressed.

This report includes an analysis of the hydrologic characteristics of the Snake River, and a hydraulic analysis of the preferred design for embankment erosion protection.

Hydrology

A comprehensive overview of the Snake River watershed and hydrology at Nome is described in USKH (2009). That overview is summarized here. The Snake River is located on the coastal plain adjacent to Norton Sound. Surface water is abundant throughout the area, and shallow groundwater is available in limited quantities. Numerous small streams and rivers traverse the coastal plain. Near Nome, the two largest rivers are Snake River and Nome River. The Snake River flows from northeast to southwest, and passes close to the southern boundary of both Nome Airport runways. It enters Norton Sound through the Nome Harbor, just to the west of the central section of Nome. The Nome River flows from north to southwest and enters Norton Sound about 3 miles southeast of the city.

The Snake River channel is tidally influenced. On the rising (flood) tide, flow comes up the Snake River and flows up the channel adjacent to the runway. Following high tide, the ebb tide flows out the tidal channel to Norton Sound.

The U.S. Geological Survey (USGS) operates a stream gage on the Snake River (USGS 15621000 Snake River near Nome, Alaska). The gage operated from September 1, 1965 through September 30, 1991, and was recently restarted in August 2020. The gage is located upriver of the Snake River Bridge, and has a smaller drainage area than the project site.

A review of the Snake River hydrograph for the streamgage operational period indicates that the annual peak flow generally occurs during the spring breakup. However, late summer precipitation events can occasionally result in peak flows higher than the spring breakup flows.

The flood frequency analysis described in the USKH report utilized USGS regression equations to estimate flood recurrence interval magnitudes (Curran et al, 2003). The 1% Annual Exceedance Probability (AEP) flow (100-year peak flow) was estimated at 5,400 cfs; the 0.2% AEP (500-year) peak flow was estimated at 6,600 cfs.

A flood frequency analysis was conducted by FEMA for the 1983 City of Nome Flood Insurance Study (FIS). The analysis utilized 10 years of data from the USGS 15621000 gage, adjusted for

Figure 1. Project site map, with new Snake River cross-sections and location of proposed bank riprap design.

the difference in drainage areas between the gage and the study reach. The 1% AEP peak flow was estimated at 6,000 cfs; the 0.2% AEP peak flow was estimated at 8,400 cfs.

Hydraulic Analysis-Riverine

As part of the previous analysis for the design of the new Snake River Bridge, hydraulic modeling was conducted using the HECRAS computer program (USKH, 2009). Three conditions were modeled; the existing pre-construction conditions at the replacement bridge site, and bridge replacement Options 1 and 2 as shown on preliminary bridge plans provided by DOT&PF. River geometry and cross-section data were obtained from the October 2008 PDC survey provided by DOT&PF. No hydraulic calibration data were available for the modeling effort.

For this study, a new HEC-RAS analysis of the project site was conducted using updated cross-sections. PDC surveyors surveyed 13 river cross-sections in October 2020, upstream and downstream of the new bridge. Surveyed cross sections were aligned perpendicular to overbank flow and to channel flow. The cross-sections were developed in Civil3D and formatted for use to create the HEC-RAS Snake River geometric model. Each cross-section was assigned a river station, using units of feet, with River Station RS 00 assigned to the most downstream cross-section. The most upstream cross-section, located 1767 feet upstream of the new Snake River Bridge, is assigned RS 2472.5.

Other geometric and hydraulic data, such as the bridge geometry and hydraulic roughness factors, were taken from the 2009 USKH model.

Results from the new HEC-RAS analysis for the 100-year and 500-year peak flows are found in Appendix 1. Because the 100-year flood water surface elevation at the site is governed by coastal flooding rather than flood flows, channel hydraulic analysis efforts were concentrated on developing estimates of hydraulic parameters necessary for scour computations and riprap sizing.

Bank Erosion Analysis

A large tension crack has developed between the Seppala Drive pavement and the left (north) bank of the Snake River. See Figure 2. The crack is located along the section of road near the Center Creek drainage culvert, upstream of the new Snake River Bridge. The presence of tension cracks often indicate potential bank stability issues.

Several possible causes of bank failure were assessed to determine if corrective measures were needed to address the tension crack. Three possible causes of bank failure were considered: hydraulic failures, geotechnical failures, and a combination of hydraulic and geotechnical failures.

Figure 2. Tension crack at top of Snake River bank, upstream of new bridge. PDC Engineers photo.

Hydraulic Failure - Particle Erosion

Local scouring and bank erosion at the outer bank in bendways occurs when flowing water exerts a tractive force that exceeds the critical shear stress for the streambank material. Scour of the bed and bank toe increases the bank's height and slope angle, decreasing its stability with respect to mass failure under gravity. Subsequent bank retreat and the development of tension cracks behind the bank then takes place primarily by mass failures of over-heightened and over-steepened banks. Hydraulic failure is generally characterized by a lack of vegetation, high boundary velocities, and no mass soil wasting at the toe of the slope.

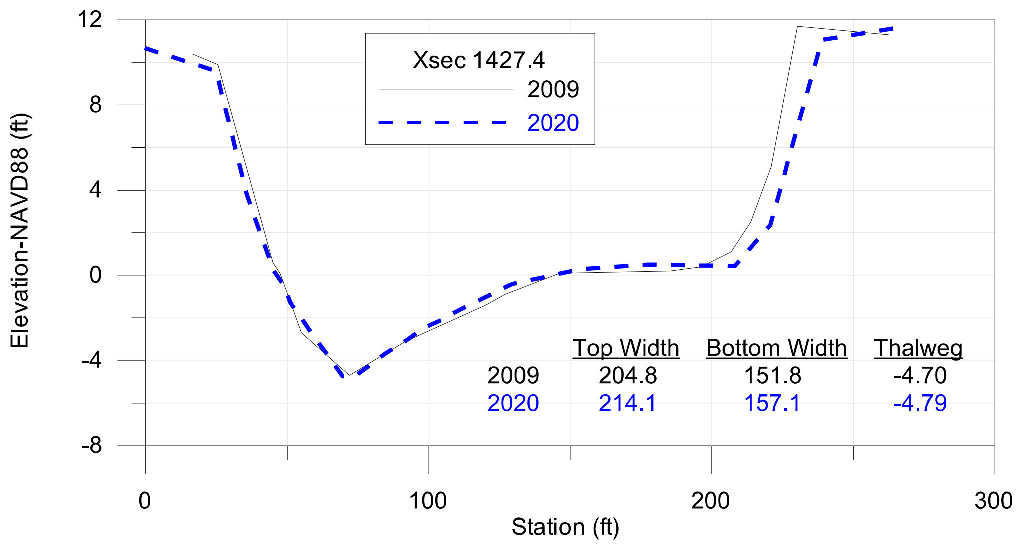
Quantitative slope stability analysis can be applied to streambanks to determine their stability and define the most critical mechanism of failure. However, such analysis requires detailed site investigations and laboratory tests on intact samples of soil. These data were not available.

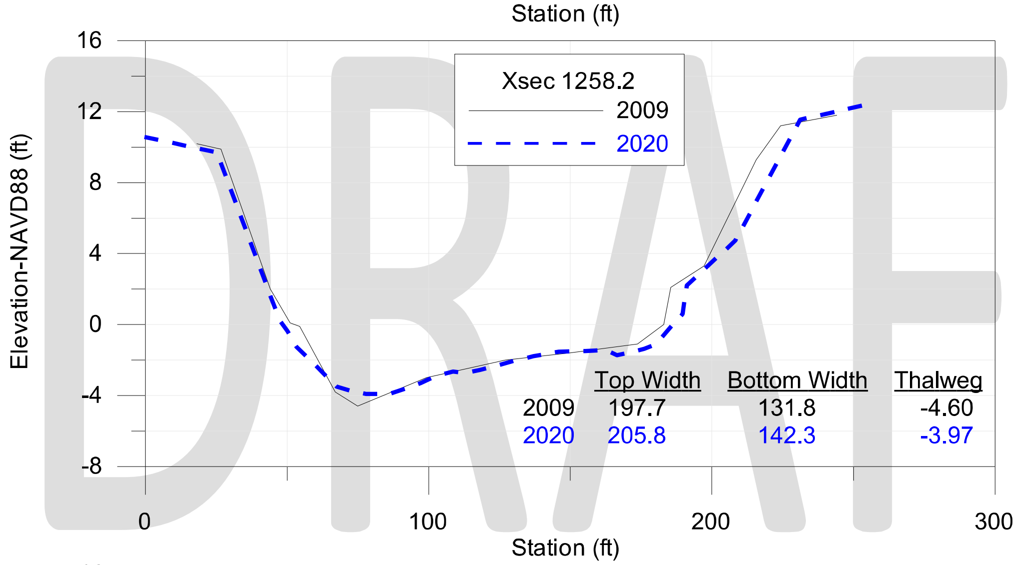
To assess the potential for hydraulic failures at the project site, surveyed cross-sections and hydraulic analysis were used. Upstream of the new bridge in the reach where the tension crack is located, three cross-sections from the 2020 survey; Xsec 1427.4, 1258.2, and 1075.1, are co-located with 3 cross-sections from the 2009 USKH survey: Xsec 1525, 1335, and 1105. The co-located sections are actually between 6 and 40 feet apart, but considered close enough to compare approximate bank and thalweg locations for estimations of lateral channel movement. We compared these cross-sections to estimate changes in top width, toe width, and thalweg elevation. See Figure 1 for cross-section locations, and Figure 3 below.

Cross-sections 1427.4 and 1258.2 indicate that channel widening has occurred between 2009 and 2020. Top widths have increased by 8-9 feet, and bottom widths have increased by 5-10 feet. Cross-section positions indicate that the right bank is showing the most change; typical channel behavior would suggest that banks on the outside bend (left banks here) would be subject to the most erosion. Note that the lowest elevation of the channel changed only slightly, or actually increased, between 2009 and 2020.

At Cross-section 1075.1, top and bottom widths actually decreased over time. This is likely due to some type of bank work that added riprap or other material to the inside (right) bank.

A review of all the surveyed cross-sections for both 2020 and 2009 shows that starting about the channel thalweg is located on the left side of the channel, This is normal behavior along a channel bend, where faster flowing water on the outside bend erodes bank sediments and deposits this and other sediments downstream. Some erosion on this non-cohesive bank is to be expected over time.





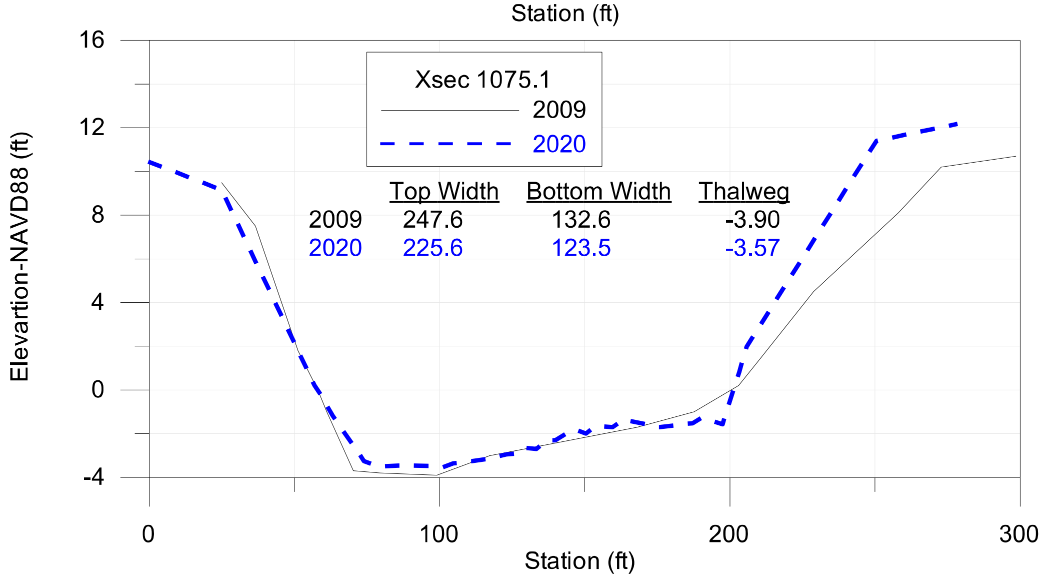


Figure 3. Surveyed cross-sections in the bend upstream of the Snake River Bridge.

Hydraulic Failure - Wave Erosion

Waves have the ability to generate tremendous forces and cause considerable damage when they are riding on top of storm surge. The energy contained in waves can erode banks and damage roads and bridges. Storm surge contributes greatly to this erosion damage by allowing the waves to attack the banks at higher elevations than normal. The combination of storm surge and waves can cause overtopping and overwash on some low elevation roads.

The Snake River mouth was relocated in 2005, creating a longer fetch for wind-generated waves traveling upriver. Storm waves caused erosion of the bank of the Snake River along Seppala Drive in the vicinity of the new bridge site, in 2005, 2006, and 2007. Class II riprap revetment installed to repair the bank erosion and prevent future wave damage was completed in August 2008, prior to the new bridge construction.

The potential for wave erosion in the vicinity of the new Snake River Bridge was analyzed in the 2009 H&H report (USKH, 2009). Wave analysis utilized a model (SWAN) to predict wave growth and transformation from the seaward side of the two Nome Port breakwaters up to the proposed bridge site. The upstream and downstream limits of the required wave erosion protection armor were determined by the geometry of the breakwaters, width of the harbor opening, channel bathymetry, and straight-line travel of waves up the narrow channel. Based on a maximum wave height of 12 feet at the breakwater entrance and a design surge level of 13 feet, the wave height at the bridge was estimated to be 1.4 feet. A conservative wave height of 3.0 feet was selected for erosion design purposes.

Based on the results of the modeling and analysis, a Wave Protection gradation for armor riprap was developed, and Wave Protection riprap was designed to protect the west and east bridge abutments. For the east bank, the design also included Wave Protection riprap for a distance of 150 feet upstream and downstream from the bridge centerline, installed between elevations 6 ft and 16 ft.

Upstream of the straight-line fetch that terminates at the bridge location, overall wave energy is likely significantly reduced as the upriver channel bends to the west. However, some waves may reflect off the banks and persist upstream of the wave protection armor, with wave heights that are expected to be less than 1.4 feet. Wave erosion may be responsible for some bank erosion and tension cracks upstream of the new bridge, but other factors likely play a larger role.

Geo-technical Failure - Pore-Water Pressure

Positive pore-water pressure can develop in a streambank when river stage drops much more quickly than the water table following a high-water condition. Positive pore-water pressure can lead directly to streambank erosion and instability. In addition to increasing the weight of the bank, pore-water pressure reduces the effective friction (normal stress) between soil particles, thereby weakening the soil and allowing particles to be dislodged. With the reduction of matric suction and the sudden loss of the confining pressure of the river during the flow recession, positive pore-water pressure can trigger mass failure in banks.

Bank erosion from positive pore water pressure is commonly attributed to areas with shallow water tables and non-cohesive bank materials such as gravels and sand. As mentioned, typical conditions for the development of pore-water pressure are a rapid decline in high river stage. Steep flood recession limbs, and banks that experience large daily tidal ranges are prone to positive pore-water pressure development.

The mean difference between high and low tidal levels at Nome is typically not large. For example, the Nome tide station 9468756 reports the Mean Higher-High Water (MHHW) elevation is 1.53 ft, and the Mean Lower-Low Water (MLLW) elevation is 0.00 ft. The variation in tide levels occurs approximately every 6 hours. Such a small change in stage is unlikely to trigger significant erosion due to positive pore-water pressure conditions.

However, storm surge can cause significant changes in the water level at Nome in addition to the tides. Storm surge is an increase in water level along the coast in response to the storm winds and pressures. The Norton Sound region is especially susceptible to large variations in water level, due to its west-facing opening and shallow average depth.

Large storm surges in Nome occur regularly. The largest storm surges occur in autumn and are associated with high tides and strong southwest winds. Extremely high tides will push up the Snake River channel and saturate the banks. Once the low-pressure system leaves the region and winds die down, the water level retreats quickly. Large storms push water levels over the Snake River bank, and even smaller storms will result in extremely high water.

The large increase and subsequent rapid decrease in water elevations as a very large low-pressure storm system moves through the Nome area result in very high positive pore-water pressures in the channel banks, and are likely responsible for the tension cracks and failed cohesive bank material. Once the bank soil strength is reduced by positive pore-water pressure, material fails and falls away from the bank face. Hydraulic forces exerted by flowing water on in situ bank-toe material and failed cohesive material at the bank toe are often sufficient to entrain materials at relatively frequent flows and to maintain steep lower-bank profiles.

Geo-technical Failure - Thermal Degradation

Melting permafrost and bank erosion have been attributed to changing thermal conditions in various locations around Alaska. Reports documenting the effects of coastal shore erosion from warming or melting permafrost, and thermokarsting (thawing process associated with disturbance of the surface thermal regime in areas of ice-rich permafrost) are readily available. Researchers have noted thermally induced erosion of areas with high ground ice content, including hillslopes and river channels (Rowland et al., 2010). Permafrost degradation has been repeatedly documented in developed areas where the original tundra landscape was modified by mining and construction activity which induced thawing and disturbed the original permafrost balance. This includes possible dredge tailings near the mouth of the Snake River that were derived from the Snake River alluvium (Golder Associates, Inc, 2020).

Comparisons of geotechnical explorations conducted in 1980, 2004, and 2019 indicate that permafrost has continued to degrade in the Nome area. Along Seppala Drive, the thaw front has progressed deeper into relatively thaw-stable beach sand and gravel in the past 15 years. The recent geotechnical analysis indicates that though previous settlement along Seppala Drive may have been due, in part, to the thawing of previously frozen ice-rich soils, future thaw-related differential settlements are unlikely due to the now deeper permafrost. However, seasonal frost related movements reflected at the roadway surface should be expected to continue due primarily to the fines content and elevated frost susceptibility of the roadway prism fill material (Golder Associates, Inc., 2020).

Bank Erosion Analysis Summary

The tension crack that has formed along Seppala Drive and associated bank erosion is likely due to one or more of the following causes: positive pore-water pressure following storm events, hydraulic shear stress, and (less likely) wave erosion and thermal degradation. The depth of the crack is unknown. Cross-section surveys taken nine years apart do not indicate excessive bank erosion to date. However, the tension crack is indicative of a slip-plane failure, potentially leading to additional bank erosion. Corrective measures to address the tension crack and reduce or eliminate future bank erosion are recommended.

Riprap Design

Bank erosion and channel scour countermeasures were designed for this project. Values for the average depth of flow and average velocity at the 100-year flood were developed from the HEC-RAS analysis. Methods in HEC-23 (FHWA, 2009) were used to size the rock riprap for the bank erosion and scour protection. See Appendix 2.

The HEC-23 analysis indicates that Class I riprap will protect against bank erosion from a 1% annual exceedance probability flood. However, Class II riprap is recommended, based on the following factors:

- Class II riprap has been used in the past to repair damage done to the Snake River bank by waves.
- River ice on the lower Snake River channel may pluck or push smaller rock off the revetment downstream (or upstream).
- The Snake River channel is tidal at this location, and subject to flows in 2 directions.
- For the 2009 bridge design project, wave heights were modeled only up to the bridge location. Upstream of the bridge, wave heights are likely smaller than those predicted at the bridge, due to the limited fetch, narrow channel, and sharp bend. However, some waves may persist upstream of the bridge with enough energy to cause bank erosion.

- Seppala Drive is the primary access route to the main terminal of the Nome Airport. Life safety considerations indicate that a conservative (heavier) riprap gradation is used to protect the airport access road.

Based on these analyses, it is recommended that the Snake River bank be protected using Class II riprap. Class II riprap has a W_{50} of 200 lbs. Using Hudson's Equation, the upper design wave height for an embankment protected with a 200 lb W_{50} riprap gradation is 2.8 feet (FHWA, 2008).

The recommended blanket thickness is the diameter of the D_{100} (recommended) or two times the D_{50}. A 50% increase in riprap thickness is required to account for uncertainties with underwater placement. The riprap slope should not exceed 2.0H:1V.

A filter should be placed between the riprap and the underlying soil. A properly designed filter will provide rapid transfer of water through the material while holding soil particles and is strong enough to survive the construction process without puncturing by the overlying rocks. To match the filter designed for the 2009 Snake River Bridge erosion protection project, we recommend that a composite filter, consisting of a 1.5-foot-thick granular layer on top of a geotextile be utilized. The granular layer should have a median weight no smaller than one-tenth that of the armor layer stones. An Erosion Control Class I geotextile should be used.

Though the riprap and filter should extend below the anticipated scour depth, a launch apron can be incorporated on the left (north) side of the channel to eliminate the need to excavate a scour trench in the active channel. The launch apron must have sufficient riprap available to be launched into the scour hole as it develops. See Scour Estimation below and Appendix 4.

Scour Estimation

At the toe of banks on the outside of bends, scour depths generally increase after construction of riprap bank revetments. This type of scour is attributed to intensified stresses acting at the bank toe, and is in reaction to the increased resistance to bank erosion from the riprap. The Maynord Bend Scour Equation uses an empirical relationship for estimating toe scour at the outside of bends protected by armored revetments (USDA, 2008).

The estimated scour depth for the Snake River bend is 4.5 feet. See Appendix 3.

Design Flood Elevation

Erosion protection design requires a design flood elevation. The design flood has a recurrence interval of 100 years, also referred to as having a 1-percent annual exceedance probability (AEP). Two types of flooding may occur in the Nome area; runoff from precipitation events and coastal storm surges. Analyses of both types of floods were conducted to determine the type and water surface elevation of the governing 100-year flood.

The USKH report notes that there is no documentation of rainfall runoff-induced flooding of the relocated portion of the lower Snake River between the western end of the airport and the river mouth (USKH, 2009). This is attributed to the hydraulic capacity of the relocated channel reach, which is well in excess of flow rates associated with extremely low frequency peak flow events. HEC-RAS modeling confirms that large magnitude flows (0.5% AEP) do not result in bank overtopping, even at typical daily high tide levels. Therefore, the design flood elevation will be controlled by coastal storm surge.

Some work on analysis and modeling of storm surges in Alaska has occurred. A statistical model was developed from the Alaska storm surge climatology developed by Wise et al. (1981). Regression analysis was used to correlate surge height with various parameters. For the Nome area (Coastal Sector 8), the 50-year surge height is 11.4 feet above mean high water (MHW); the 100-year surge height is 13 feet above mean high water (MHW).

The U.S. Army Corps of Engineers conducted a storm-induced water level prediction study for the western coast of Alaska (Chapman et al, 2009). The study developed frequency-of-occurrence relationships of storm-generated water levels for 17 selected communities along Kotzebue and Norton Sounds, the Bering Sea, and Bristol Bay. The stage-frequency modeling analysis for Nome is found in Table 4. Stage units are feet mean lower-low water (ft MLLW).

Frequency of Occurrence

Return Period (years)	5	10	15	20	25	50	100
Surge Level (ft MLLW)	5.79	7.07	7.82	8.35	8.68	9.66	10.51
Std. Deviation (ft)	0.46	0.46	0.59	0.75	0.75	0.98	1.25

The USKH H&H report (2009), after reviewing a number of sources (USACE, 1983 FEMA study; 1981 Wise et al.,) estimated the 100-year storm surge at 13 feet (datum MLLW). The report also noted that a wave height should be superimposed on the storm surge to produce the final design water level. Following wave analysis and modeling, the report recommended that the 100-year design high water level for the project to be 14.5 feet (storm surge plus half the height of a 3-foot wave). For riprap design at the bridged, the report added 1.5 feet for wave runup and freeboard, setting the riprap design height at 16.0 feet.

Wave height and wave runup are expected to be smaller in magnitude upstream of the Snake River Bridge than the predicted downstream values. For bank riprap design upstream of the Snake River Bridge, it is recommended that a design height of 14.5 feet is used.

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Appendix 1-2020 HEC-RAS Results for Snake River at Seppala Drive

River Sta	Q Total	Min Ch El	W.S. Elev	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
	(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
0	5400	-6.44	0	0.44	0.004715	5.33	1013.74	457.17	0.63
	6600	-6.44	0.26	0.79	0.004973	5.82	1133.72	465.74	0.66
193.4	5400	-5.16	0.75	1.24	0.003543	5.62	960.34	322.37	0.57
	6600	-5.16	1.07	1.67	0.003995	6.19	1066.14	339.05	0.62
389.6	5400	-4.56	1.36	1.96	0.003457	6.19	874.09	251.86	0.58
	6600	-4.56	1.74	2.47	0.003769	6.82	971.21	264.62	0.62
641.7	5400	-5.08	2.92	2.86	0.001695	5.93	973.28	238.78	0.44
	6600	-5.08	3.46	3.45	0.001803	6.5	1086.7	240.71	0.46
705	Bridge								
782.5	5400	-6.85	3.29	3.72	0.001243	5.41	1070.36	246.57	0.38
	6600	-6.85	3.85	4.36	0.001345	5.96	1188.96	247.83	0.4
1075.1	5400	-3.57	3.58	4.15	0.001765	6.08	895.85	168.88	0.45
	6600	-3.57	4.13	4.84	0.001925	6.75	990.24	173.47	0.48
1258.2	5400	-3.97	3.9	4.46	0.001602	6.02	908	164.37	0.43
	6600	-3.97	4.48	5.17	0.001746	6.68	1005.54	169.69	0.46
1427.4	5400	-4.79	4.24	4.75	0.001761	5.73	948.55	189.88	0.44
	6600	-4.79	4.88	5.48	0.001778	6.23	1070.87	192.42	0.45
1650.2	5400	-4.51	4.56	5.11	0.001419	6.03	928.39	160.1	0.41
	6600	-4.51	5.2	5.87	0.001536	6.67	1031.46	164.19	0.44
1768.2	5400	-3.65	4.71	5.28	0.00132	6.06	902.06	138.73	0.4
	6600	-3.65	5.35	6.05	0.001467	6.77	991.21	141.03	0.43
2006.1	5400	-3.97	4.92	5.71	0.001762	7.13	768.03	113.98	0.46
	6600	-3.97	5.56	6.54	0.001979	7.99	841.55	116.52	0.5
2256.5	5400	-4.1	5.51	6.08	0.001151	6.1	900.9	124.21	0.38
	6600	-4.1	6.25	6.96	0.001262	6.78	994.55	126.44	0.41
2472.5	5400	-4.83	5.7	6.39	0.001463	6.69	808.28	107.58	0.43
	6600	-4.83	6.45	7.31	0.001598	7.44	889.88	109.48	0.45

Appendix 2 - Riprap Calculation For Left Bank of Snake River At Seppala Drive Upstream of New Bridge

From Federal Highway Administration, 2009. Bridge scour and stream instability countermeasures: experience, selection, and design guidance-third edition. Hydraulic Engineering Circular No. 23. September 2009, Publication No. FHWA-NHI-09-111.

$$d_{30} = y(S_f C_S C_V C_T)\left[\frac{(V_{des})}{\sqrt{K_1(S_g-1)gy}}\right]^{2.5}.$$

Local depth of flow, y =	7.9 ft	from HEC-RAS
Safety factor S_f =	1.2	HEC-23 Guidance DG4.5
Stability coefficient C_S =	0.30	angular rock –HEC-23
Velocity distribution coefficient, C_V =	1.163	HEC-23 Guidance DG4.4
Blanket thickness coefficient, C_T =	1.0	HEC-23 Guidance DG4.4
Characteristic velocity for design, V_{des} =	8.6 ft/sec	HEC-23 Guidance DG4.4 & HEC-RAS
Average Channel Velocity, V_{avg} =	6.02 ft/sec	from HEC-RAS
Side slope correction factor, K_1 =	0.87	HEC-23 Guidance DG4.4
Bank Angle, θ	26.6 degrees	design
Centerline radius of curvature of channel bend, R_c =	650 ft	from plan view drawing
Water surface width upstream channel bend, W =	114 ft	from HEC-RAS
Specific gravity of riprap, S_g =	2.65	typical
Acceleration due to gravity, g =	32.2 ft/sec^2	
Particle size for which 30% is finer by weight, d_{30} =	0.45 ft	
Particle size for which 50% is finer by weight, d_{50} =	0.54 ft	HEC-23, $d_{50} = 1.2\ d_{30}$
Particle weight for which 50% is finer, W_{50} =	22 lb	HEC-23, density = 165 lb/ft^3

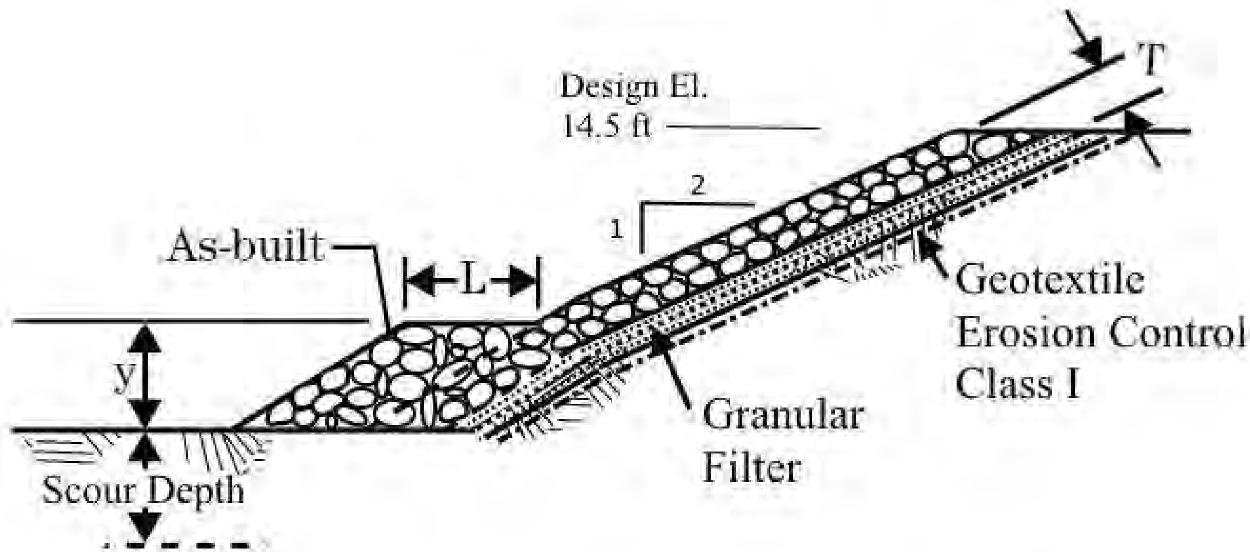
Appendix 3 - Scour Calculation For Left Bank Riprap Installation, Snake River At Seppala Drive Upstream of New Bridge

From U.S. Department of Agriculture (USDA), 2008. National Engineering Handbook, Scour Calculations. August 2007, Technical Supplement 14-B.

$$\frac{y_{max}}{y_e} = FS\left[1.8 - 0.051\left(\frac{Rc}{W_i}\right) + 0.0084\left(\frac{W_i}{y_e}\right)\right]$$

Mean water depth in upstream crossing, y_c =	6.5 ft	from HEC-RAS
Safety factor FS =	1.05	Supplement 14-B guidance
Centerline radius of curvature of channel bend, R_c =	650 ft	from plan view drawing
Water surface width upstream channel bend, W_i =	164 ft	from HEC-RAS
Maximum water depth in bend, y_{max} =	12.35 ft	
Existing Depth at riprap bend, $y_{existing}$ =	7.87 ft	from HEC-RAS
Scour at riprap bend, below thalweg, $scour_{bt}$ =	4.5 ft	$y_{max} - y_{existing}$

Appendix 4 – Self-Launch Riprap Toe



For slope = 1V:2H and estimated scour depth = 4.5 ft,
volume for self-launch toe is:
$V_{stone} = 15.1\ T$

$T = 2 \times d_{50}$ or $1 \times d_{100}$