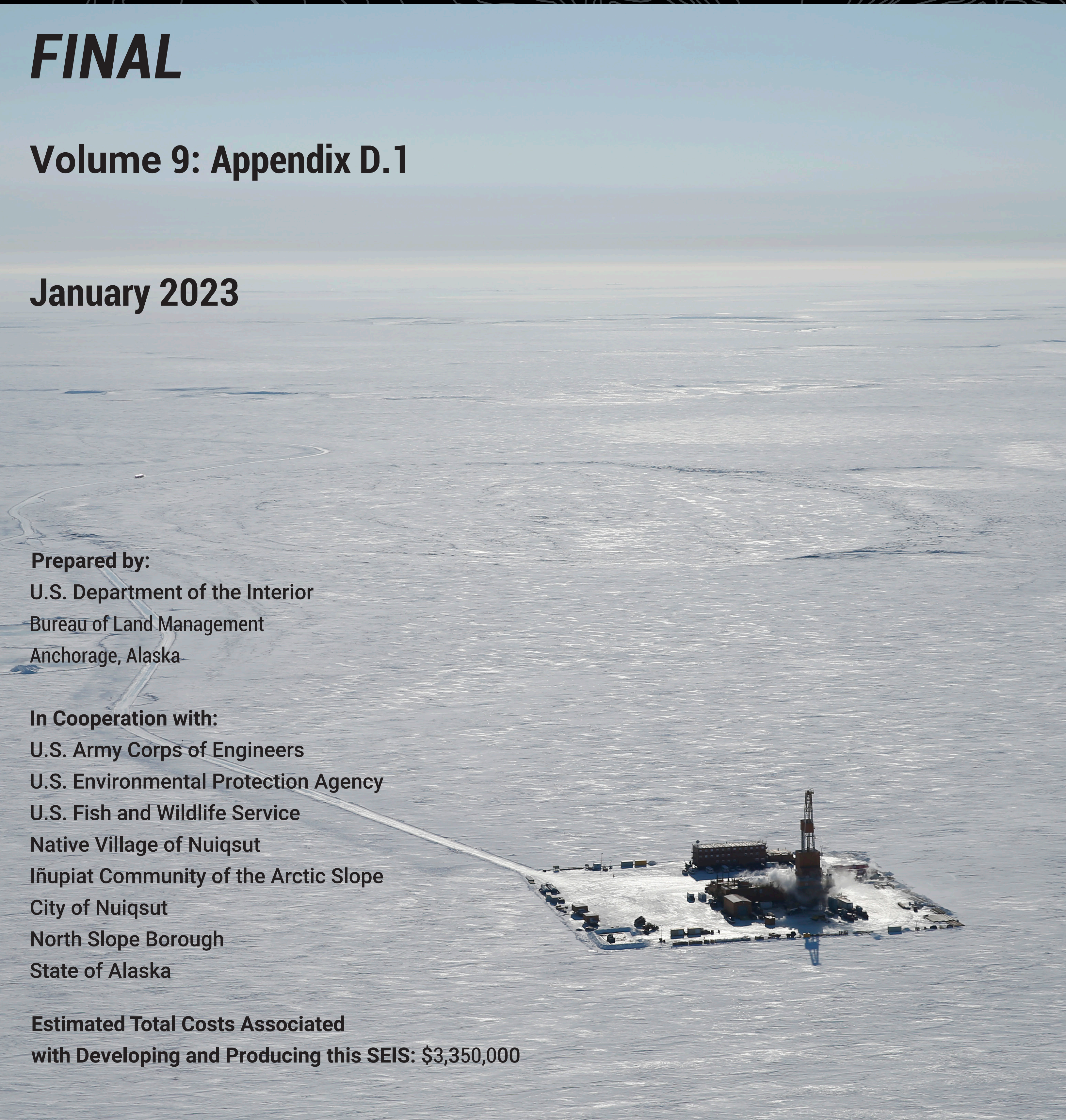
U.S. Department of the Interior
Bureau of Land Management

Willow Master Development Plan

Supplemental Environmental Impact Statement



FINAL

Volume 9: Appendix D.1

January 2023

Prepared by:
U.S. Department of the Interior
Bureau of Land Management
Anchorage, Alaska

In Cooperation with:
U.S. Army Corps of Engineers
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
Native Village of Nuiqsut
Iñupiat Community of the Arctic Slope
City of Nuiqsut
North Slope Borough
State of Alaska

Estimated Total Costs Associated with Developing and Producing this SEIS: $3,350,000

Mission

To sustain the health, diversity, and productivity of the public lands for the future use and enjoyment of present and future generations.

Cover Photo Illustration: North Slope Alaska oil rig during winter drilling.
Photo by: Judy Patrick, courtesy of ConocoPhillips.

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Willow Master Development Plan Final Supplemental EIS

Appendix D
Alternatives Development

January 2023

Appendix D.1
Alternatives Development

Appendix D.2
Willow Mine Site Mining and Reclamation Plan

Appendix D.3
Ice Bridge Plan

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Willow Master Development Plan

Appendix D.1
Alternatives Development

January 2023

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Table of Contents

List of Figures

List of Tables

List of Acronyms

2:1	2 horizontal to 1 vertical ratio
3:1	3 horizontal to 1 vertical ratio
6:1	6 horizontal to 1 vertical ratio
ACF	Alpine central processing facility
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
Alpine	Alpine Development
AOGCC	Alaska Oil and Gas Conservation Commission
APDES	Alaska Pollutant Discharge Elimination System
API	American Petroleum Institute
ASDP	Alpine Satellite Development Plan
BLM	Bureau of Land Management
BTU	Bear Tooth Unit
BT1	Bear Tooth drill site 1
BT2	Bear Tooth drill site 2
BT3	Bear Tooth drill site 3
BT4	Bear Tooth drill site 4
BT5	Bear Tooth drill site 5
CD1	Colville Delta drill site 1
CD4N	Colville Delta drill site 4N
CD5	Colville Delta drill site 5
CEQ	Council on Environmental Quality
CFWR	constructed freshwater reservoir
CPAI	ConocoPhillips Alaska, Inc.
CPF2	Central Processing Facility 2
CRSA	Colville River Special Area
cy	cubic yards
District Court	U.S. District Court for Alaska
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ERD	extended reach drilling
FECP	Facility Erosion Control Plan
GMT	Greater Mooses Tooth
GMT-1	Greater Mooses Tooth 1
GMT-2	Greater Mooses Tooth 2
GW1	Greater Willow 1
GW2	Greater Willow 2
HDD	horizontal directional drilling
HSM	horizontal support member
IAP	Integrated Activity Plan
Kuparuk	Kuparuk River Unit
kV	kilovolt
LS	lease stipulation
MDP	Master Development Plan
MG	million gallons
MLLW	mean lower low water
MTI	module transfer island
NEPA	National Environmental Policy Act
NPR-A	National Petroleum Reserve-Alaska
NPRPA	Naval Petroleum Reserves Production Act
NSB	North Slope Borough

ODPCP	Oil Discharge Prevention and Contingency Plan
OHW	ordinary high water
Project	Willow Master Development Plan Project
Q1	first quarter
Q2	second quarter
Q3	third quarter
Q4	fourth quarter
ROD	Record of Decision
ROP	required operating procedure
SPCC	Spill Prevention Control and Countermeasures
SPMT	self-propelled module transporter
SWPPP	Stormwater Pollution Prevention Plan
TLSA	Teshekpuk Lake Special Area
UIC	underground injection control
USACE	U.S. Army Corps of Engineers
USDOT	U.S. Department of Transportation
VSM	vertical support member
WOC	Willow Operations Center
WOUS	Waters of the U.S.
WPF	Willow Processing Facility

Glossary Terms*

Culvert Battery – A group of two or more culverts.

Extended Reach Drilling – A directional drilling technique used to develop long, horizontal wells allowing a larger area to be reached from one surface location (pad) and providing greater access to a reservoir.

Gas Lift – A method of artificial lift (i.e., process used to increase reservoir pressure and encourage oil to the surface) that uses an external source of high-pressure gas for supplementing formation gas to lift the well fluids.

Hydraulic Fracturing – A well stimulation technique that uses a specially blended fluid that is pumped into a well under extreme pressure causing cracks in the underground reservoir formation. These cracks in the rock allow oil and natural gas to flow, increasing resource production and recovery. Water and sand typically make up 98% to 99.5% of the fluid used in this technique.

Pile Supported – Structures (e.g., buildings, bridges) constructed on columns (i.e., piles) driven into the ground to carry the vertical load.

Screeding – A process which recontours sediment on the marine floor but does not remove sediment from the water. The activity often entails dragging a metal plate such as a screed bar across the sediment, thereby smoothing the high spots and filling the relatively lower areas. The amount of material moved is generally small and localized, and the result is a flat seafloor within the work area. Screeding is necessary to temporarily ground the sealift barges during module offloading; a flat seafloor provides stability and prevents damage to the barge hulls during grounding.

Subsistence – A traditional way of life in which wild, renewable resources are obtained, processed, and distributed for household and community consumption according to prescribed social and cultural systems and values.

Thermosyphon – Passive heat exchanger that uses natural convection without the need for power or a pump. Thermosyphons are designed as a sealed fluid-fill tube, with portions placed above and below ground, and they pull heat from beneath infrastructure, thus preventing substrate (i.e., permafrost) thaw.

Waters of the U.S. – Waterbodies and wetlands under jurisdiction of U.S. Army Corps of Engineers, as defined by 33 CFR 328.3.

1.0 INTRODUCTION*

The Bureau of Land Management (BLM) is the federal manager of the National Petroleum Reserve in Alaska (NPR-A) and is responsible for land use authorizations on federal land within the NPR-A. The BLM is the lead federal agency for National Environmental Policy Act (NEPA) review of the Willow Master Development Plan (MDP) Project (Project), as proposed by ConocoPhillips Alaska, Inc. (CPAI); Figure D.1.1 provides an overview of the Project area with all action alternatives. Additionally, the U.S. Army Corps of Engineers (USACE) is a cooperating agency that has jurisdiction over the Project through its authority to issue or deny permits for the placement of dredge or fill material in Waters of the U.S. (WOUS), including wetlands. Both the NEPA evaluation and USACE's permit review require consideration of project alternatives. This appendix provides a detailed overview of the alternatives development process used by the BLM and cooperating agencies, alternative concepts considered and initially evaluated but eliminated from detailed analysis, alternative concepts carried forward for detailed analysis, and the three action alternatives analyzed in the Environmental Impact Statement (EIS).

This Supplemental EIS was developed by BLM to address the United States District Court for Alaska's (District Court) decision[1] remanding the Willow MDP Final EIS to BLM for the purposes of addressing NEPA deficiencies found by the District Court and to ensure compliance with applicable law. The District Court determined that the EIS was deficient in two respects: 1) it improperly excluded analysis of foreign greenhouse gas emissions, 2) it improperly screened out alternatives from detailed analysis based on BLM's misunderstanding of CPAI's lease rights (i.e., that CPAI's lease rights purportedly afford the right to extract "all possible" oil and gas from each lease tract), and 3) BLM failed to give due consideration to the requirement in the Naval Petroleum Reserves Production Act (NPRPA) to afford "maximum protection" to surface values in the Teshekpuk Lake Special Area (TLSA).

This appendix addresses the second deficiency by documenting BLM's efforts to consider an expanded range of alternatives based on a corrected application of the law, as well as input received from cooperating agencies, tribes, other stakeholders, and the public. This appendix is organized chronologically and documents the alternatives screening and development process for both the 2020 EIS and the 2022 Supplemental EIS. Expanded information about how alternatives were developed during the 2020 EIS has been added to Section 3.2, Alternatives Development for the 2020 Environmental Impact Statement, and is highlighted with a yellow box. To the extent than an alternative concept was considered during both the 2020 and 2022 alternatives development processes, it is described in both Section 3.2 and Section 3.5, *Alternatives Development for the 2022 Supplemental Environmental Impact Statement.*

2.0 REGULATORY SETTING FOR ALTERNATIVES ANALYSIS*

NEPA directs federal agencies to "study, develop, and describe appropriate alternatives to recommend courses of action in any proposal that involves unresolved conflicts concerning alternative uses of available resources" (42 USC 4332). As noted in Chapter 1.0, *Introduction and Purpose and Need*, the NEPA implementing regulations were updated in May 2022 to be consistent with Executive Order 13990 objectives, per President Biden's direction. The Council on Environmental Quality (CEQ) promulgated a final rule on April 20, 2022. As part of the new regulations, CEQ reverted to the original 1978 CEQ definition of reasonable range of alternatives, which defined a reasonable range of alternatives to include "those that are practicable or feasible from the technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant" (CEQ 1981).

The 2020 Willow Final EIS was developed under the 1978 CEQ regulations and the 2022 Supplemental EIS will comply with the 1978 CEQ regulations as they concern a reasonable range of alternatives.

Guidelines developed under Section 404(b)(1) of the Clean Water Act direct the USACE to use the overall project purpose (based on the Project proponent's stated purpose and need) to define alternatives and determine whether the Project proponent's proposed project is the least environmentally damaging practicable alternative prior to making a permit decision. The USACE determines whether an alternative is practicable based on whether it is available and capable of being implemented after taking into consideration cost, existing technology, and

[1] *Sovereign Iñupiat for a Living Arctic et al. v. BLM* (Case No. 3:20-cv-00290-SLG) and *Center for Biological Diversity et al. v. BLM* (3:20-cv-00308-SLG), United States District Court, D. Alaska, August 18, 2021.

logistics, in light of the overall project purpose (40 CFR 230.3(1)). Throughout the process, other cooperating agencies also provide input into alternatives development.

2.1 Lease Stipulations and Required Operating Procedures in the National Petroleum Reserve in Alaska*

Activity in the NPR-A is subject to a variety of existing lease stipulations (LSs) and required operating procedures (ROPs) intended to reduce effects from development activity; these stipulations and ROPs are detailed in the 2022 NPR-A Integrated Activity Plan (IAP) Record of Decision (ROD) (BLM 2022). In 2021, BLM was directed to reevaluate the 2020 NPR-A IAP. The reevaluation of the NPR-A IAP resulted in the issuance of a new NPR-A IAP ROD that selected an alternative nearly identical to the 2013 NPR-A IAP ROD. Many of the previously identified LSs and ROPs are readily incorporable into the Project, although some LSs and ROPs may require exceptions or deviations due to technical constraints and would be evaluated by the BLM on a case-by-case basis. When deviations are granted, they typically are specific to stated Project actions or locations and are not granted for all Project actions. Deviations and exceptions from LSs and ROPs are discussed further in the relevant sections for each action alternative. Table D.2.1 identifies applicable LS and ROPs from the 2022 NPR-A IAP ROD that would apply to the Project.

Table D.2.1. Applicable Lease Stipulations and Required Operating Procedures*

Category	NPR-A IAP Lease Stipulations and Required Operating Procedures
Waste handling and disposal	A-1, A-2, A-7
Fuels and hazardous materials handling and storage; spill prevention and spill response	A-3, A-4, A-5, A-6, E-4
Health and safety	A-8, A-12
Air quality	A-9, A-10
Water use	B-1, B-2
Winter overland moves	C-1, C-2, C-3, C-4
Facility design and construction	E-2, E-3, E-5, E-6, E-7, E-9, E-10, E-11, E-12, E-13, E-14, E-17, E-19, E-20
Aircraft use	F-1
Oilfield abandonment	G-1
Subsistence	A-11, E-1, H-1, H-2, H-3
Worker orientation	I-1
Biologically sensitive areas	K-1, K-2, K-3, K-5, K-6, K-8, K-9, K-10, K-11, K-12
Summer vehicle tundra access	L-1
General wildlife and habitat protection	E-8, E-15, E-18, J, M-1, M-2, M-3, M-4

Source: BLM 2022.
Note: IAP (Integrated Activity Plan); NPR-A (National Petroleum Reserve-Alaska).

Likely deviations to existing LSs and ROPs include E-2, E-7, E-11, K-1, and K-2. Each identified deviation would be reviewed as the Project design engineering advances for opportunities to conform to applicable LSs and ROPs to the extent practicable. (See Section 4.2.12, *Compliance with Bureau of Land Management Lease Stipulations, Required Operating Procedures, and Supplemental Practices*, for additional details on the objective, requirements, and standards for each LS and ROP and the reason for any deviation.) Deviations to ROP C-1 would also be needed for module delivery options 1 and 2, if selected.

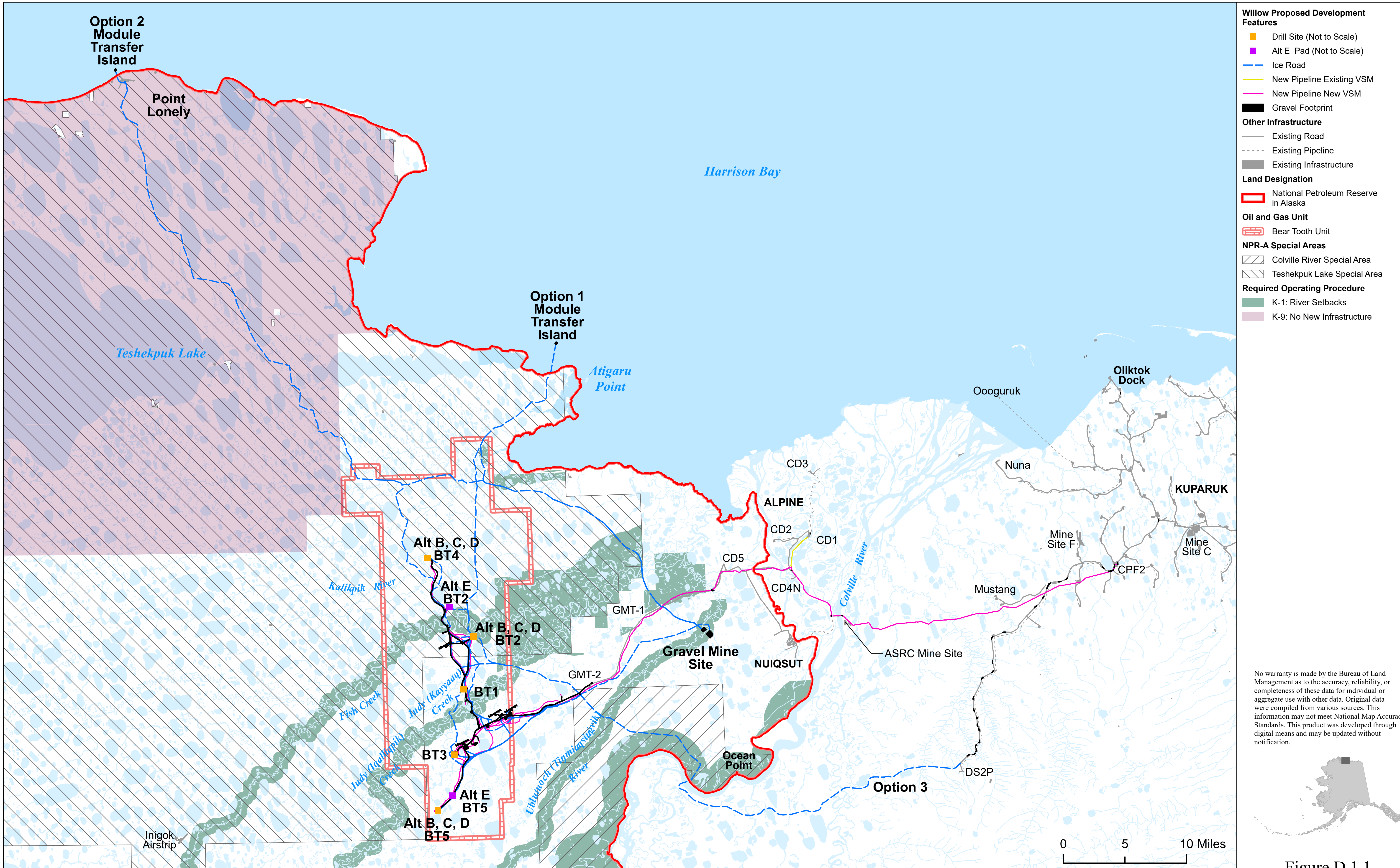
Option 2 Module Transfer Island
Point Lonely
Teshekpuk Lake
Harrison Bay
Option 1 Module Transfer Island
Atigaru Point
Oooguruk
Oliktok Dock
Nuna
KUPARUK
CD3
ALPINE
CD2
CD1
CD5
CD4N
Colville River
Mine Site F
Mine Site C
CPF2
Mustang
Alt B, C, D BT4
Alt E BT2
Alt B, C, D BT2
Kalikpik River
GMT-1
Gravel Mine Site
NUIQSUT
ASRC Mine Site
GMT-2
BT1
Fish Creek
Judy (Kayyaaq) Creek
BT3
Judy (Iqalliqpik) Creek
Alt E BT5
Alt B, C, D BT5
Ublutuoch (Tinmiaqsiugvik) River
Ocean Point
Option 3
DS2P
Inigok Airstrip
0
5
10 Miles
Willow Proposed Development Features
Drill Site (Not to Scale)
Alt E Pad (Not to Scale)
Ice Road
New Pipeline Existing VSM
New Pipeline New VSM
Gravel Footprint
Other Infrastructure
Existing Road
Existing Pipeline
Existing Infrastructure
Land Designation
National Petroleum Reserve in Alaska
Oil and Gas Unit
Bear Tooth Unit
NPR-A Special Areas
Colville River Special Area
Teshekpuk Lake Special Area
Required Operating Procedure
K-1: River Setbacks
K-9: No New Infrastructure
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Figure D.1.1

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3.0 ALTERNATIVES DEVELOPMENT

3.1 Overview of the Alternatives Development Process*

The alternatives section has been described by the Council on Environmental Quality (CEQ) as "the heart of the EIS" in which an agency is to rigorously explore and objectively evaluate all reasonable alternatives, including the proposed action (CEQ 1981).

The CEQ NEPA regulations include the following direction regarding alternatives consideration in NEPA analyses. Agencies shall:

1. Evaluate reasonable alternatives to the proposed action, and, for alternatives that the agency eliminated from detailed study, briefly discuss the reasons for their elimination.
2. Discuss each alternative considered in detail, including the proposed action, so that reviewers may evaluate their comparative merits.
3. Include the no action alternative.
4. Identify the agency's preferred alternative or alternatives, if more than one exists, in the draft statement and identify such alternative in the final statement unless another law prohibits the expression of such a preference.
5. Include appropriate mitigation measures not already included in the proposed action or alternatives.
6. Limit their consideration to a reasonable number of alternatives.

The process used to develop a reasonable range of alternatives for analysis in both the 2020 EIS and the 2022 Supplemental EIS was an iterative process that included the following steps:

1. Meetings with the Project proponent to develop the Proposed Action prior to issuance of the Notice of Intent to prepare an EIS.
2. Developing screening criteria in consultation with cooperating agencies.
3. Developing alternatives to the Proposed Action based on public comments, stakeholder outreach, and consultation with cooperating agencies.
4. Evaluating alternative concepts against the screening criteria.
5. Documenting the rationale for alternatives considered but eliminated from further analysis in the EIS.
6. Carrying the remaining alternatives forward as a reasonable range of alternatives for full analysis in the EIS.

Key components necessary to meet the Project's purpose and need include drill sites, processing facilities, pipelines, Project area access, gravel source(s), and other support infrastructure.

Following Project scoping, the BLM convened a series of alternatives development meetings with EIS cooperating agencies. These meetings identified a range of options for various Project components to address issues identified during scoping. These initial options included various configurations for Project components and access. Options identified during the cooperating agency alternatives development meetings included the elimination of some roads, use of different airstrips, alternatives to the module transfer island (MTI), different pad locations, and use of other central processing facilities.

In developing alternatives for this Supplemental EIS, BLM first reviewed public comments that were submitted on the 2019 Draft EIS and 2019 Draft Supplemental EIS for any alternatives concepts that were previously excluded from consideration but might now be relevant following the District Court's decision. BLM also consulted with key Alaska stakeholders to solicit input on potential alternative concepts that would address the District Court's decision. BLM then met with cooperating agencies to develop an expanded range of alternatives for this Supplemental EIS based on the District Court's decision. BLM and cooperating agencies reexamined alternative concepts that were proposed during the previous EIS process and worked to develop new alternative concepts that would reduce overall Project infrastructure and impacts. New alternatives concepts were developed with a focus on reducing infrastructure within the TLSA and the Colville River Special Area (CRSA) to provide for the "maximum protection" of surface values. Options identified during the cooperating agencies' alternatives development meetings included elimination of a proposed drill site, relocation of proposed drill sites, revised access road alignment, and a new disconnected (i.e., ice road only) drill site option. BLM also held a 30-day public scoping comment period to solicit input from the public on the Willow MDP Supplemental EIS. Commenters suggested alternative concepts such as variations on disconnected 5, 4, and 3 drill site pad alternatives, disconnected drill site pads with seasonal drilling, alternative modes for transporting large modules, use of the Alpine development (Alpine) central processing facility (ACF) to process fluids produced by the Project, a 3-pad alternative concept, and an agency-imposed phased development of the Project.

3.1.1 Alternatives Screening Criteria*

BLM and cooperating agencies developed alternatives screening criteria and used them in evaluating potential alternatives and developing the range of reasonable alternatives for the initial EIS. The following screening criteria were divided into two categories, legality and feasibility, and environmental screening criteria:

Legality and Feasibility Screening Criteria

1. Meets purpose and need: In addition to the applicant's purpose for the project, USACE and BLM each developed their own purpose and need statement for the Willow EIS. Alternatives that did not meet the purpose and need statements were eliminated from further analysis in the EIS.
2. Economically, technologically, and logistically feasible: Alternatives that clearly were not feasible or were impractical from a technological or economic standpoint were eliminated from further analysis in the EIS.
3. Practicable: Alternatives that clearly did not meet USACE's definition of practicable under the Clean Water Act were eliminated from further analysis in the EIS.

Environmental Screening Criteria

1. Substantive issues: Alternatives advanced for analysis in the EIS specifically addressed substantive issues identified during public and agency scoping.
2. Relative environmental effects: Feasible alternatives that would not reduce adverse environmental effects or address resource conflict when compared with the proponent's Project were eliminated from further analysis in the EIS.

Additional considerations for screening alternatives consisted of the following:

- Sufficiently unique: The alternative should be sufficiently unique from other alternatives being evaluated to address resource issues or conflicts that are not already being addressed.
- Future development: The alternative should have the potential to support reasonably foreseeable future development.

3.1.2 Purpose and Need*

The purpose of the Proposed Action is to construct the infrastructure necessary to allow the production and transportation to market of federal oil and gas resources in the Willow reservoir located in the Bear Tooth Unit (BTU) while providing maximum protection to significant surface resources within the NPR-A, consistent with BLM's statutory directives. The need for federal action (i.e., the issuance of authorizations) is established by BLM's responsibilities under various federal statutes, including the NPRPA, as amended, and the Federal Land Policy and Management Act, as well as various federal responsibilities of cooperating agencies under other statutes, including the Clean Water Act. Under the NPRPA, BLM is required to conduct oil and gas leasing and development in the NPR-A (42 USC 6506a).

3.1.3 Feasible and Practicable*

Reasonable alternatives include a "reasonable range that are technically and economically feasible and meet the purpose and need for the proposed action" (40 CFR 1508.1(z)).

The Project's EIS, as supplemented by this Supplemental EIS, will also be used by the USACE for its NEPA evaluation. The USACE will issue a ROD for the Project, and the USACE's requirements to select the least environmentally damaging practicable alternative require consideration of practicability during alternatives development. USACE 404(b)(1) guidelines use the term "practicable" and define it as "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes" (40 CFR 230). Although the "practicable" threshold under the USACE 404(b)(1) guidelines may be considered a more specific and finer filter than the broader "reasonable" threshold from the CEQ guidance, the intent was to not separate or exclude reasonable options under either definition. Therefore, considering the broader CEQ guidance (CEQ 1981), as well as the more specific 404(b)(1) guidance (40 CFR 230), the screening criteria were developed to consider feasibility in terms of cost, logistics, and technology as well as common sense. These are further defined as follows:

- Cost feasibility: Alternatives should not involve components with potential costs that would render the project infeasible. (Clean Water Act regulations cite cost as one of the considerations to be factored into determining whether an alternative is practicable.) This screening criteria does not evaluate the Project's potential profits. Cost feasibility evaluates whether an alternative includes cost prohibitive components, such as elevating the entire road above the tundra on pylons to reduce fill. A proponent's internal evaluation of whether a project is profitable enough to warrant investment does not impact the agency's determination of whether an alternative is feasible from a cost perspective. This screening criteria was not used to rule out any alternative concept in either the 2020 or 2022 EIS processes.
- Logistical feasibility: Alternatives should consider whether there are any constraints to development in terms of location, infrastructure, laws, regulations, ability to be permitted, ordinances, or topography.
- Technological feasibility: Alternatives should not involve components that use uncertain or unavailable technology or introduce an increased risk of operational failure or accidents. Certain aspects of an alternative component may have technical constraints affecting the ability to practicably implement those components.

3.1.4 Substantive Issues

The BLM identified substantive issues to be addressed in the Project EIS through public and agency scoping and consultation with Alaska Native tribes and Alaska Native Claims Settlement Act corporations. Substantive issues identified during scoping included those that would have significant effects; those that are necessary to make a reasoned choice among alternatives; or those that are needed to address points of disagreement, debate, or dispute regarding an anticipated outcome from a Project action. Table 1.5.1 in Chapter 1.0, *Introduction and Purpose and Need*, summarizes the substantive issues within the scope of the EIS that were identified through scoping and are addressed in the EIS.

3.1.5 Relative Environmental Effects

The EIS evaluates alternatives for their impacts on the physical, biological, and social environments. Feasible alternatives resulting in less adverse environmental effects or addressing resource conflicts when compared to the proponent's proposed project were advanced for further analysis in the EIS. Considerations for relative environmental effects were based on substantive issues raised during scoping. These included potential effects on terrestrial wildlife (including caribou [*Rangifer tarandus*]), **subsistence**, public safety, human health, socioeconomics (general and Nuiqsut specific), air quality, the Teshekpuk Lake Special Area (TLSA), and climate change. Therefore, the development of reasonable alternatives considered the potential for each alternative to do the following:

- Reduce the overall Project footprint (i.e., direct impacts from facilities)
- Reduce potential human health impacts (especially those relating to air quality and subsistence)
- Reduce impacts to wildlife, subsistence resources (especially caribou), and subsistence use areas
- Reduce risks related to spills or other accidental releases
- Reduce impacts to water resources and floodplains, including marine habitat

The four screening criteria guided the alternatives development process and provided a basis for eliminating unreasonable or impracticable options through an independent and structured process.

3.2 Alternatives Development for the 2020 Environmental Impact Statement

This section provides an overview of the alternative components considered during alternatives development for the initial 2020 EIS. Alternative components are organized by the Project component being addressed: access, airstrip, module delivery, gravel mine site, gravel pads, processing facility, and the Project schedule. Additional alternative components evaluated and dismissed by CPAI were reviewed by the BLM during the alternatives development process and dismissed due to screening criteria; these are described in CPAI's *Environmental Evaluation Document* (CPAI 2018b) and include use of the ACF, **pile-supported facilities**, ice road-only drill sites, not constructing an airstrip, and more.

3.2.1 Development of the Proposed Action (Alternative B)*

The development of CPAI's proposed action (Alternative B) included extensive coordination with BLM, cooperating agencies, and external stakeholders. Starting in 2017, CPAI personnel and consultants, including petroleum engineers, civil engineers, environmental scientists, biologists, North Slope operations personnel, geoscientists, and construction planners worked together to identify and refine the proposed pad locations and preliminary road alignments to optimize reservoir access while minimizing the impacts of the proposal. CPAI's early Project concept and potential alternatives to CPAI's concepts were shared with BLM in meetings in late 2017 and early 2018 for feedback. BLM provided feedback on how the proposed action could best comply with the LSs and best management practices of the 2013 NPR-A IAP, as well as feedback on how to best protect important surface resources in both the CRSA and TLSA. These concepts and feedback were incorporated and were documented in the ConocoPhillips Road Optimization Memo (Appendix I.2). Pre-application and early project engagement between CPAI and agencies are summarized in Table D.3.1.

In early to mid-2018, CPAI incorporated agency feedback on the early project concept along with updated subsurface information to develop its initial proposed project. This project was documented in CPAI's Environmental Evaluation Document (EED), Revision 0 (CPAI 2018a), submitted to BLM in May 2018. CPAI's initial project and proposed alternative concepts underwent extensive review by BLM and cooperating agencies and Project refinements were made to the proposed action as a result of this review. For example, drill site BT4 was moved out of the Teshekpuk Caribou Habitat Area (LS K-9; formerly best management practice K-5) in response to cooperating agency feedback about minimizing impacts to the Teshekpuk Caribou Herd. These updates were summarized by CPAI in a presentation to BLM and cooperating agencies on October 22, 2021 (CPAI 2021c).

Changes were also made to the proposed action after the 2019 Draft EIS public comment period. For example, in November 2019, following public comment on the Draft EIS, CPAI introduced Option 3 for WCF and drill site module delivery in response to stakeholder feedback on the previously proposed MTI near Atigaru Point. Other changes included shifting the WFC, WOC, and airstrip east, and reducing the airstrip access road in response to concerns regarding caribou impacts. CPAI also reduced some Project roads from a 32-foot surface width to a 24-foot surface width to further reduce the Project's total footprint.

Table D.3.1. Early Engagements Between ConocoPhillips Alaska Inc. and Agencies*

Meeting Date	Agency	Topic(s)
06/22/2017	BLM	Willow Project introduction
12/04/2017	BLM	BLM gave direction on process for NEPA initiation and provided feedback on early CPAI project concepts. CPAI provided update on ongoing environmental studies.
03/27/2018	BLM	BLM SMEs provided direction and feedback on preliminary project concepts including road routing, road connection to GMT-2, airstrip, gravel mine, and module transportation options. BLM SMEs provided environmental data needs (e.g., bird nesting, fish) to support the NEPA process.
04/04/2018	BLM	Environmental studies (hydrology and fish) workshop with the BLM Arctic Field Office SMEs that largely focused on current and upcoming environmental field studies in the Willow area. BLM SMEs provided feedback on interpretation of BLM best management practices to inform project design.
04/05/2018	BLM	Environmental studies (air quality) workshop with the BLM Arctic Field Office and BLM-national SMEs. BLM provided direction on data needs (emissions inventory and project description) used to inform air analysis approach.
04/11/2018	BLM	Environmental studies (caribou and other mammals) workshop with the BLM Arctic Field Office SMEs largely focused on current and upcoming environmental field studies in the Willow area and design measures to mitigate potential project impacts.
04/18/2018	BLM	Environmental studies (birds) workshop with the BLM Arctic Field Office SMEs. BLM SMEs provided feedback on other available avian data and interpretation of BLM's best management practices to inform project design.
04/19/2018	BLM	Environmental studies (cultural resources and archeology) workshop with the BLM Arctic Field Office SMEs. BLM SMEs provided feedback on interpretation of BLM's best management practices to inform project design.
05/16/2018	BLM	Environmental studies (ecological land survey and rare plants) workshop with the BLM Arctic Field Office SMEs. BLM SMEs discussed findings of Willow-area surveys and provided feedback on use of survey data in project design.
06/06/2018	Cooperating agencies	CPAI presented initial Project design to cooperating agencies. BLM introduced the anticipated NEPA process and cooperating agencies asked questions and provided initial feedback on the project design, potential alternatives, and information needs to support review.

Meeting Date	Agency	Topic(s)
06/12/2018	BLM	Environmental studies (subsistence) workshop with the BLM Arctic Field Office SMEs. BLM asked questions regarding previous study findings and provided feedback on how previous findings could inform project design.
10/9/2018	Cooperating agencies	Environmental studies workshop lead by CPAI. SMEs from various agencies provided feedback on regulatory requirements and permitting process.
10/10/2018 – 10/11/2018	Cooperating agencies	BLM-led EIS-development alternatives workshop with the cooperating agencies; CPAI attended portions of the workshop at BLM's request to respond to engineering and technical questions.
11/8/2018	NSB	CPAI SMEs presented findings of past and on-going environmental studies in Willow area (e.g., hydrology, ecological land survey, mammals, fish, subsistence, birds, marine studies) similar to those presented to BLM in early 2018. NSB staff and BLM SMEs asked questions and provided feedback on the use of environmental data to support permitting and review processes.
11/8/2018	USACE	Pre-application discussion of USACE's process and regulatory requirements, including selection process and criteria for determining the Least Environmentally Damaging and Practical Alternative.
02/20/2019	BLM, EPA, USACE	EPA and USACE provided feedback on alternatives from Section 404(b)(1) perspective and suggested additional avoidance and minimization options for the analysis.
03/04/2019	EPA, USACE	EPA and USACE provided feedback on alternative road alignments for consideration.

Note: BLM (Bureau of Land Management); CPAI (ConocoPhillips Alaska, Inc.); EIS (Environmental Impact Statement); EPA (U.S. Environmental Protection Agency); NEPA (National Environmental Policy Act); NSB (North Slope Borough); SME (subject matter expert); USACE (U.S. Army Corps of Engineers).

3.2.2 Access Options

Several options were considered to reduce the Project's impacts related to access road development. Reducing new road infrastructure would lessen the direct and indirect impacts from road construction and gravel mining requirements. A reduced road footprint would reduce direct impacts to WOUS, including wetlands, hydrological resources and connections, and potential impacts to wildlife, especially caribou.

Access options include making certain segments of the Project "roadless" (i.e., no gravel road but connections with ice roads), constructing a bridge across the Colville River, and relocating road segments, including bridges. An alternative infield road alignment that would minimize deviations to LSs and ROPs was also considered.

Each of the access options is described in Table D.3.2.

3.2.3 Airstrip Options

Options were considered to use existing airstrips in the area (three total) and to integrate the airstrip with a Project gravel road. These four options were aimed at reducing impacts from air traffic and construction of a new Project area airstrip (e.g., fill of WOUS, impacts to subsistence and wildlife).

Each of the airstrip options is described in Table D.3.2.

3.2.4 Module Delivery Options

The Project would require a sealift (ocean-going barge) to deliver large, prefabricated modules to the North Slope, and CPAI has proposed the construction of a gravel island in Harrison Bay (near Atigaru Point) to receive the module shipments before transferring them to the Project area via ice road. The alternatives analysis also identified Point Lonely as an alternative location for island construction.

Multiple options to eliminate or modify the proposed MTI were considered during alternatives development to reduce impacts to the marine environment and the infrastructure in subsistence use areas.

Each of the module delivery options is described in Table D.3.2.

3.2.5 Mine Site Options

The Project would require approximately 5.0 to 6.4 million cubic yards (cy) of gravel to complete construction of proposed infrastructure (volume varies by alternative and module delivery option). BLM and cooperating agencies considered all known gravel sources with the capacity to meet the Project's needs during the alternatives development process. One alternative to CPAI's proposed Willow Mine Site was considered during alternatives development (the ASRC mine site), and the BLM later requested that CPAI examine a second alternative related to the methods for gravel mining production that would eliminate or reduce the need to use traditional blasting (i.e., explosive) methods. These alternatives were considered to reduce impacts to habitat (e.g., creation of a new mine site) and the community of Nuiqsut (e.g., noise).

Each of the mine site options is described in Table D.3.2.

3.2.6 Gravel Pads Options

A total of four options for gravel pads was considered during alternatives development. Suggested options for pads ranged from reducing pad size and altering pad locations to reducing the overall number of pads. These options were aimed at reducing direct and indirect impacts to wetlands and vegetation.

Each of the gravel pads options is described in Table D.3.2.

3.2.7 Processing Facility Options

Two options were suggested as an alternative to constructing a Project-specific processing facility to reduce potential impacts to air quality and impacts to wetlands and vegetation from the construction of additional Project infrastructure.

Each of these processing facility options is described in Table D.3.2.

3.2.8 Schedule Options

Two options were suggested as alternatives related to the timing or schedule of how the Project would be executed. These alternatives were aimed at reducing impacts to subsistence users.

Each of these schedule options is described in Table D.3.2.

3.2.9 Alternative Components Summary (2020)*

Table D.3.2 summarizes the alternative components evaluated in the initial 2020 EIS using the alternatives screening criteria for the Draft and Final EISs. Alternative components evaluated in this Supplemental EIS are described in Section 3.5, *Supplemental Environmental Impact Statement Alternatives Development*.

Table D.3.2. Alternative Components Considered during Alternatives Development

Component Category	Component Number	Alternative Component Considered	Description	Why Considered
All	1	No Action Alternative	No action; carried forward as Alternative A in the EIS.	NEPA requirement to serve as a baseline of comparison for impact analysis
All	2	Proponent's proposed project	Project as proposed by CPAI; carried forward as Alternative B in the EIS.	CPAI's proposed action
Access	3	No gravel road connections to drill sites BT2 and BT4	This alternative component would not include a gravel road connection to drill sites BT2 and BT4 (i.e., the gravel road connection would stop at drill site BT1); instead, access to these drill sites would be via aircraft and seasonal ice road.	Reduce footprint and gravelfill Reduce number of stream crossings Reduce impacts to caribou movement
Access	4	Construct a permanent bridge over the Colville River	This alternative component would construct a permanent bridge over the Colville River to provide a year-round gravel road connection between the Project area and the Alaska National Highway System; use smaller sealift modules and deliver them to the Project area from Oliktok Dock via gravel or ice roads.	Eliminate the need for the MTI Reduce annual water consumption required for ice road construction Reduce air traffic to Alpine and the Project area
Access	5	Construct a boat ramp on the Colville River	This alternative component would construct a boat ramp/launch on the Colville River and would provide a connection to year-round road access (e.g., Dalton Highway).	Subsistence access
Access	6	No gravel road connection to drill site BT4	This alternative component would make drill site BT4 disconnected (i.e., no gravel road connection) from the rest of the Project and allow connection by ice road during the winter and by aircraft during the remainder of the year.	Reduce impacts to caribou movement Reduce footprint and gravel fill Reduce number of stream crossings
Access	7	Relocate the Judy (Iqalliqpik) Creek Bridge crossing (as designed by CPAI in its proposed Alternative 2) (CPAI 2018b)	This alternative component would relocate the Judy (Iqalliqpik) Creek Bridge crossing location (proposed by CPAI in Alternative 2) to an area that would allow a shorter crossing of the creek (1,850 feet long as proposed).	Reduce impacts to Judy (Iqalliqpik) Creek (e.g., fish, subsistence, hydrology) Reduce impacts to yellow-billed loons (*Gavia adamsii*)
Access	8	No gravel road connection to the WPF or drill site BT4	This alternative would use only a seasonal road (e.g., ice road) connection for Project access and to access drill site BT4.	Reduce impacts to caribou movement Reduce footprint/fill Reduce number of stream crossings
Access	9	Relocate Judy (Iqalliqpik) Creek Bridge crossing and reroute the road (as designed by CPAI in its proposed Alternative 2) (CPAI 2018b)	This alternative would relocate the Judy (Iqalliqpik) Creek Bridge crossing location and reroute the gravel road; departing from the WPF, the road would cross Judy (Iqalliqpik) Creek to the west before heading to drill sites BT2 and BT4, with a spur road to drill site BT1.	Reduce impacts to Judy (Iqalliqpik) Creek (e.g., fish, subsistence, hydrology) Reduce impacts to yellow-billed loons
Access	10	Different infield road alignment	This alternative would use a different infield road alignment (as presented in CPAI's Environmental Evaluation Document, Alternative 2 [CPAI 2018]) that would maximize conformance to NPR-A LSs and ROPs.	Avoid all but one yellow-billed loon nesting lake shoreline setback (ROP E-11) Avoid the 3-mile Fish Creek setback (LS K-1)

Component Category	Component Number	Alternative Component Considered	Description	Why Considered
Airstrip	11	Use the existing Alpine airstrip	This alternative component would use the existing Alpine airstrip and would not construct a new airstrip in the Project area.	Centralize air traffic in an area with existing air traffic Reduce footprint and gravel fill in the Project area Maximize the use of existing infrastructure
Airstrip	12	Use the existing Nuiqsut airstrip	This alternative component would use the existing Nuiqsut airstrip and would not construct a new airstrip in the Project area. This would require the construction of a new gravel road to the Project area (or GMT-2) or an access agreement to use the privately owned (Kuukpik Corporation) Nuiqsut Spur Road.	Centralize air traffic in an area with existing air traffic outside of the Colville River Delta Reduce footprint and gravel fill in the Project area Offer economic benefit to Nuiqsut Maximize the use of existing infrastructure
Airstrip	13	Use the existing Inigok airstrip	This alternative component would use the existing Inigok airstrip and would not construct a new airstrip in the Project area. This would require the construction of a new gravel road to the Project area extending approximately 20 miles to the northwest.	Move air traffic further away from Nuiqsut Reduce footprint/fill Maximize the use of existing infrastructure
Airstrip	14	Integrate the proposed airstrip and roadway	This alternative component would integrate a portion of the parallel gravel road into the proposed airstrip, resulting in a dual-use facility.	Reduce footprint/fill
MTI	15	Use small-sized sealift modules (550 tons or less) for the WPF	This alternative component would use small-sized sealift modules (550 tons or less; module transporters would be 100 tons) to construct the WPF so modules could be delivered to Oliktok Dock and transported to the Project area over terrestrial ice roads and cross the Colville River seasonal ice bridge (maximum load capacity is 650 tons).	Eliminate the need for the MTI (i.e., reduce impacts to the marine environment and subsistence users) Reduce water consumption
MTI	16	Use medium-sized sealift modules (1,400 tons or less) for the WPF	This alternative component would use medium-sized sealift modules (1,500 tons or less) to construct the WPF so modules could be delivered to Oliktok Dock and transported to the Project area over a combination of sea ice and terrestrial-based ice roads.	Eliminate the need for the MTI (i.e., reduce impacts to the marine environment and subsistence users)
MTI	17	Freeze sealift barges in place in Harrison Bay	This alternative component would ground sealift barges in Harrison Bay (in the same location as the proposed MTI) during the open-water season and allow them to freeze in place during winter.	Eliminate the need for the MTI (i.e., reduce impacts to the marine environment and subsistence users)
MTI	18	Reduce the lifespan of the MTI	The MTI is proposed to be used for two distinct periods (2 consecutive years to support the WPF and drill site module delivery and 1 additional year to support drill site modules); this option would eliminate the second period of module delivery to the MTI (and instead use smaller modules delivered to Oliktok Dock), which would allow for decommissioning of this Project facility sooner.	Reduce the lifespan of the MTI to reduce the length of time for impacts to occur to the marine environment and subsistence users

Component Category	Component Number	Alternative Component Considered	Description	Why Considered
MTI	19	Make the MTI semipermanent	The MTI would be constructed with the intent of being maintained for an extended time beyond the length identified as needed for the Project. This would allow future development (by CPAI or others) in the area to use the facility and not require construction of a similar feature.	Increasing the lifespan of the MTI could potentially reduce the cumulative impacts associated with future development May provide usable infrastructure to local subsistence users
MTI	20	Land sealift barges at the shore near Atigaru Point	This alternative component would ground sealift barges near the shoreline in Harrison Bay during the open-water season and allow them to freeze in place during winter.	Eliminate the need for the MTI (i.e., reduce impacts to the marine environment and subsistence users)
MTI	21	Construct a dock at Atigaru Point	This alternative component would construct a new industrial dock facility at Atigaru Point (located in Harrison Bay) for the delivery of sealift modules during the open-water season.	Eliminate the need for the MTI (i.e., reduce impacts to the marine environment and subsistence users) Reduce potential cumulative impacts from future development May provide usable infrastructure to local subsistence users
MTI	22	Construct a dock at Point Lonely	This alternative component would construct a dock at Point Lonely and use the existing infrastructure from this decommissioned U.S. Department of Defense site for the off-loading and staging of sealift modules.	Eliminate the need for the MTI (i.e., reduce impacts to the marine environment and subsistence users) Maximize the use of existing infrastructure
MTI	23	Construct an MTI at Point Lonely	This alternative component would construct a gravel island at Point Lonely to receive the sealift modules during the open-water season. The existing infrastructure at Point Lonely would be used to stage equipment (e.g., ice-road–making equipment, personnel camp).	Eliminate the MTI at Atigaru Point (i.e., reduce impacts to Nuiqsut subsistence users) Maximize the use of existing infrastructure
MTI	24	Deliver sealift modules to the Project area via a grounded-ice bridge over the Colville River near Umiat	This alternative component would deliver medium-sized or large-sized sealift modules to Oliktok Dock and transfer them to the Project area via ice roads, with a crossing of the Colville River on a grounded-ice bridge, south of the Project area near Umiat.	Eliminate the need for the MTI (i.e., reduce impacts to the marine environment and subsistence users) Maximize the use of existing infrastructure
MTI	25	Construct a dock at the abandoned Kogru River pad	This alternative component would construct a dock at an abandoned pad site along the Kogru River.	Eliminate the need for the MTI (i.e., reduce impacts to the marine environment and subsistence users) Maximize the use of existing infrastructure
Mine site	26	Use the existing Arctic Slope Regional Corporation mine site	This alternative component would use the existing commercial Arctic Slope Regional Corporation mine site near Nuiqsut to supply gravel for the Project instead of constructing a new project-specific gravel mine site.	Consolidate gravel mining operations to a single, existing mine site (i.e., maximize use of existing infrastructure)

Component Category	Component Number	Alternative Component Considered	Description	Why Considered
Mine site	27	Alternatives to traditional blasting to support gravel mining operations	This alternative component would examine alternative methods for gravel mining (e.g., mechanical extraction) that would eliminate or reduce the use of blasting with conventional explosives.	Reduce noise impacts to wildlife, Nuiqsut residents, and subsistence activities
Pads	28	Reduce the number and/or size of drill pads	This alternative component would reduce the overall number of Project drill pads or reduce the size of individual pads.	Reduce footprint and gravel fill
Pads	29	Reduce the size of pads by using pile-supported facilities	It would use pile-supported structures where practicable (e.g., camps, cold storage) instead of placing structures at grade on gravel pads.	Reduce footprint and gravel fill
Pads	30	Relocate drill site BT4 from its proposed location to an area outside of the K-5 Teshekpuk Lake Caribou Habitat Area	This alternative component would relocate drill site BT4 out of its proposed location within the K-5 Teshekpuk Lake Caribou Habitat Area.	Reduce impacts to caribou Reduce the number of stream crossings
Pads	31	Move drill site BT2 westward and away from Fish Creek	This alternative component would relocate drill site BT2 westward and away from Fish Creek.	Avoid Fish Creek setback (LS K-1) Reduce impacts to fish Reduce impacts to subsistence use
Processing facility	32	Use the Alpine central processing facility instead of constructing a Project-specific processing facility	This alternative component would use the existing Alpine central processing facility instead of constructing a project-specific processing facility in the Project area.	Centralize processing activity at an existing facility Maximize the use of existing infrastructure Reduce footprint/fill
Processing facility	33	Relocate the Project processing facility closer to the GMT Unit boundary	This alternative component would relocate the proposed WPF farther to the northeast, closer to the GMT Unit boundary.	Reduce impacts to caribou
Schedule	34	Phase development of the Project so construction does not begin until the GMT-2 development is constructed and is in its drilling/operations phase	This alternative component would institute phasing to begin Project construction after GMT-2 has been constructed and has advanced to the drilling/operations phase so impacts from GMT-2 can be better identified and addressed in the Project.	Provide additional insight into the potential effects to environmental resources that may be addressable in the Project Reduce cumulative impacts in area
Schedule	35	Delay the Project EIS until after GMT-2 is in the drilling/operations phase	This alternative component would delay the development of the Project EIS until after GMT-2 development is in its drilling/operations phase so the impacts from the GMT-2 project would be known and could be further addressed in the design and plans for the Project.	Provide additional insight into the potential effects to environmental resources that may be addressable in the Project Reduce cumulative impacts in area

Note: BT1 (Bear Tooth drill site 1); BT2 (Bear Tooth drill site 2); BT4 (Bear Tooth drill site 4); CPAI (ConocoPhillips Alaska, Inc.); EIS (Environmental Impact Statement); GMT (Greater Mooses Tooth); GMT-2 (Greater Mooses Tooth 2); LSs (lease stipulations); MTI (module transfer island); NEPA (National Environmental Policy Act); NPR-A (National Petroleum Reserve in Alaska); ROP (required operating procedure); WPF (Willow Processing Facility).

3.2.10 Additional Alternative Concepts Evaluated in Pre-Notice of Intent Meetings*

CPAI conducted internal examinations of additional concepts to Project elements that were reviewed by BLM and cooperating agencies, which determined that they had been sufficiently described and dismissed.

*3.2.10.1 Use of Alternative Gravel Mine Sites**

Gravel is a scarce resource in the NPR-A and there are very few known gravel deposits. Between 2017 and 2019, CPAI conducted a gravel exploration program to locate potential gravel sources for use in the Project. In 2017, CPAI initiated desktop geologic analysis to identify potential material sources based on public and proprietary information including geologic maps, aerial imagery, elevation data, well logs and reports, geotechnical reports, and conductor logs. Four gravel prospects were identified near the Willow Project area (Clover, Tiŋmiaqsiuġvik, Ridge, and Abandoned Channel). The Tiŋmiaqsiuġvik, Ridge, and Abandoned Channel prospects were explored by drilling boreholes to evaluate their gravel potential. The borehole exploration program identified one source with sufficient gravel near the Ublutuoch (Tiŋmiaqsiuġvik) River, which became the Project's proposed mine site.

The 19-acre Clover Mine Site was previously evaluated by BLM in the Alpine Satellite Development Plan (ASDP) Final EIS (BLM 2004) and the Greater Mooses Tooth 1 (GMT-1) Draft Supplemental EIS (BLM 2014) as a potential source of gravel that could supply approximately 626,000 cy of gravel. Use of the Clover Mine Site was eliminated as a potential gravel source for the following reasons:

- Insufficient material quantity: The Clover Mine Site was insufficient to meet the Project's gravel needs by itself and would require development of another mine site or use of another existing mine site, which would increase the spatial extent of impacts from mining and transportation of gravel. The Clover mine site contained approximately 626,000 cy of gravel and the Project would require approximately 5.0 to 6.4 million cy of gravel depending on the alternative.
- Material quality. The gravel identified at the Clover Mine Site has a higher level of interbedded silt and other fine sediment than the material found in the Tiŋmiaqsiuġvik area. The poorer quality material would result in a larger mine site footprint for the same amount of gravel relative to a mine with better quality material. This lower quality material would also result in increased maintenance of gravel infrastructure and increased potential impacts to adjacent waters or tundra due to the increased likelihood of material sloughing.
- Impacts to hydrology. The previously evaluated mine site contains an ephemeral drainage, and the larger site that would need to be developed to support the Project would impact several streams and drainages.

Existing gravel mine sites were also considered for use in the Willow Project (Figure D.3.1). The ASRC mine site, Mine Site F, Mine Site E, and Mine Site C are the closest existing mine sites to the Project area. All existing gravel mine sites are east of the Colville River and would substantially increase haul distances relative to the proposed action. The use of Mine Sites F, E, and C were eliminated during pre-NOI meetings with CPAI due to the extensive haul distance (between 50 and 60 miles one way) and the need for an ice bridge over the Colville River to reach the Project area. Use of the ASRC mine site was considered and eliminated by BLM and cooperating agencies in the 2020 alternatives screening process (Section 3.3, *Alternative Components Considered but Eliminated in the 2020 Willow MDP*).

3.2.10.2 Ice Road or Tundra Access Only

Development of the Project with access to the Project area other than by gravel road or air was considered as a means of potentially reducing environmental effects from gravel extraction, establishment of gravel roads or airstrips on top of tundra, and disturbance of wildlife through noise and movement. This alternative concept would not include construction of gravel roads, a gravel airstrip, or a gravel helipad; instead, access would be limited to use of low-ground-pressure vehicles and ice roads.

This alternative concept was evaluated in the ASDP Final EIS (BLM 2004). Both the federal and state governments limit tundra travel, other than in emergencies, during large portions of the summer to prevent undue damage to the environment when the ground is soft. Regular routine maintenance and inspection trips to drill sites during summer by low-ground-pressure vehicles would result in sustained and substantial damage to vegetation, soils, and water resources, including important wetland habitat. Vehicle crossings of rivers and streams would result in unacceptable damage to riparian resources and fish habitats and are prohibited in anadromous waterbodies, with few exceptions. Crossing Project area streams with low-ground-pressure vehicles would not be feasible during some periods throughout the year because of breakup, freeze-up, or high-flow conditions. As a result, reliable access would be limited to winter, when ice roads could be constructed and made available for transport to and from the Project area.

Limited access would create unacceptable hazards for safety and emergency response and limit the number of wells that could be drilled per season. Heavy equipment necessary for fire, rescue, and spill response, as well as critical medical equipment such as an ambulance, would not be capable of traveling cross-tundra or across wet environments. Although tundra-travel vehicles (e.g., low-ground-pressure vehicles, tracked vehicles) may be permitted to travel cross-tundra during an emergency, they have serious limitations, including a lack of integrated medical life support equipment, slow travel speeds, and limited weight and volume capacities. The ASDP Final EIS (BLM 2004) found that a project alternative that relies solely on low-ground-pressure vehicles and ice roads for all but emergency access was not a reasonable alternative because it fails to provide adequate continuous access to achieve project purpose and need.

Because development with access other than gravel road or air would not provide continuous access to the Project area, it would not satisfy the Project purpose and need to support production and transportation of petroleum resources from the Project area while protecting important surface resources. Consequently, alternatives other than air or gravel access were not considered feasible and were not considered for further evaluation.

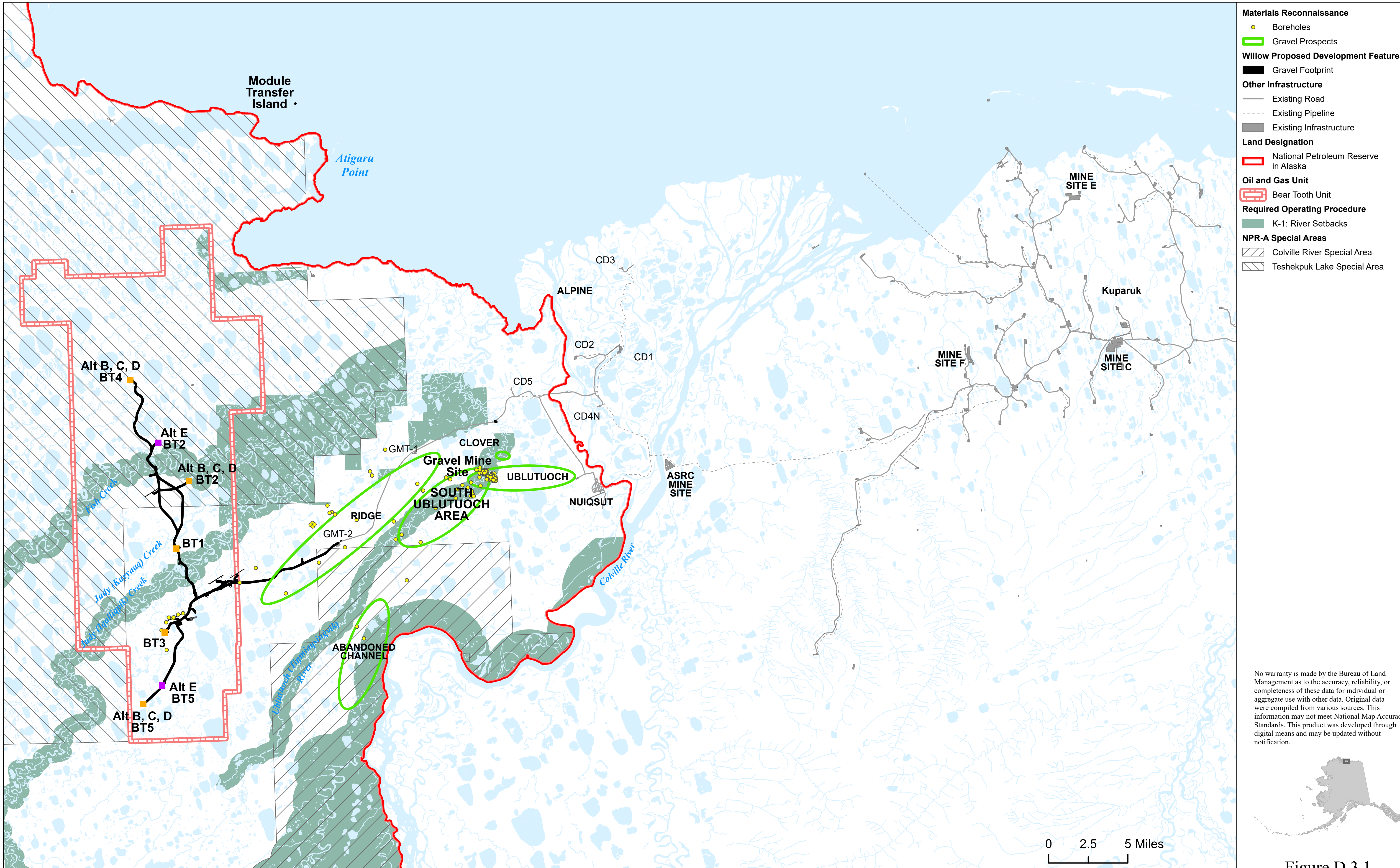

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Figure D.3.1

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3.3 Alternative Components Considered but Eliminated in the 2020 Willow MDP Environmental Impact Statement

As previously described, in the initial 2020 EIS, BLM and the cooperating agencies considered a range of alternative components for various Project components (access, airstrip, MTI, mine site, pads, and processing facility). A total of 33 alternative components (excluding the No Action Alternative and Alternative B [Proponent's Project]) were evaluated to determine whether they were reasonable in light of the Project's purpose. Of these, 26 alternative components were eliminated from further analysis because they did not meet the overall Project purpose; were not considered economically or technically feasible or practicable (as defined by CEQ [1981] guidelines); did not address substantive issues raised during scoping; did not provide benefits over an alternative already being considered; or were determined to be more appropriate as potential mitigation or minimization measures. After the alternative components were evaluated against the screening criteria, they were either 1) eliminated or 2) incorporated into an action alternative to be carried forward for analysis in the EIS. Alternatives components considered but eliminated from further analysis are summarized in Table D.3.3, along with the rationale for elimination.

Table D.3.3. Alternative Components Considered but Eliminated from Further Analysis and the Rationale for Elimination[2]

Component Number	Alternative Component Considered	Rationale for Elimination
3	Access – No gravel road connections to drill sites BT2 and BT4	Would result in 26 to 30 acres of additional surface disturbance (i.e., wetland fill) for additional airstrip, camp, and equipment and supply storage at each drill site. Would result in substantial additional water use over the life of the Project to annually construct resupply ice roads from drill site BT1 to drill sites BT2 and BT4. Would result in additional air traffic during the 9-month period each year when there is no road connection in place (would increase air traffic by approximately 7,000 flights during construction and 1,100 flights during drilling and operations). Would result in an airstrip (at drill site BT4) closer to high-density caribou calving grounds. Due to prevailing winds, most air traffic would land from west to east, which would result in higher levels of air traffic and associated noise west of drill site BT4. The heaviest air traffic would occur in summer (when there would be no ice road), which would spatially and temporally overlap with calving caribou. This potential disturbance could result in caribou displacement that is similar to or greater than having an all-season gravel road connection to drill site BT4. Would increase health and environmental risk in the event of an emergency (i.e., inability to evacuate personnel or respond to oil spill incidents when weather prevents flights in and out of the airstrips, which is common on the North Slope).
4	Access – Construct a permanent bridge over the Colville River	Would not reduce environmental impacts (would likely increase impacts to caribou, subsistence, and wetlands/WOUS). Substantial technical and economic feasibility constraints make this alternative not practicable under the U.S. Army Corps of Engineers Section 404 regulations. Construction of a permanent bridge over the Colville River is not part of the Project's purpose and need.
5	Access – Construct a boat ramp on the Colville River	Would not provide increased access to the Project area for CPAI.
6	Access – No gravel road connection to drill site BT4	Would result in increased surface disturbance (need for additional airstrip, storage, and camps). Would increase health and environmental risk in the event of an emergency (i.e., inability to evacuate personnel or respond to oil spill incidents when weather prevents flights in and out of the airstrips, which is common on the North Slope). Would increase air traffic near the K-5 Teshekpuk Lake Caribou Habitat Area during the 9 months annually when ice roads would not be available (air traffic would increase by approximately 3,500 flights during construction and 550 flights during drilling and operations).

[2] Any impact comparisons provided in Table D.3.3 are made in reference to CPAI's proposed project (Alternative B: Proponent's Project) unless otherwise indicated.

Component Number	Alternative Component Considered	Rationale for Elimination
8	Access – No gravel road connection to the WPF or drill site BT4	Would not appreciably reduce impacts beyond the advanced alternatives: Alternative C (Disconnected Infield Roads) or Alternative D (Disconnected Access). Would increase air traffic at drill site BT4 near the K-5 Teshekpuk Lake Caribou Habitat Area during the 8 months annually when ice roads would not be available (air traffic at this drill site would increase by approximately 3,500 flights annually during construction and 550 flights during drilling and operations).
10	Access – Different infield road alignment	Would not reduce overall impacts: would have 7 additional miles of gravel road, 3 additional stream crossings, and a longer bridge at Judy (Iqalliqpik) Creek
11	Airstrip – Use the existing Alpine airstrip	Would substantially increase air traffic at the Alpine airstrip, which is sited in the Colville River Delta, an area that both resource agencies and Nuiqsut community members have noted is a more environmentally sensitive area (e.g., wildlife, subsistence use) than the Project area. Cooperating agencies emphasized that increased impacts in the Colville River Delta should be avoided. Use of the Alpine airstrip would increase air traffic at Alpine by approximately 700 flights per year during construction and would increase vehicle traffic through the GMT and Alpine developments. Would require upgrades to the Alpine airstrip and construction of an additional bypass road, as the integrated road and airstrip at Alpine would no longer be logistically feasible with the amount of air and vehicle traffic from both the Willow and Alpine developments operating concurrently. This would result in additional impacts to wetlands and other environmental resources in the Colville River Delta. Increased vehicle trips and travel times pose a risk to Project employees through increased personnel exposure to potential accidents during transport between Alpine to Willow (an approximately 2-hour drive each way). The additional travel time also increases the risk to personnel in the event an evacuation is required (e.g., medical emergency). For reference, CPAI documented 510 medical evacuations in the Kuparuk and Alpine oil fields in 2015 and 2016. The Alpine airstrip is located in an area more prone to weather-related flight safety issues (e.g., fog) than the Project area, which poses a number of logistical problems, including safety challenges related to weather limitations. Increasing the number of flights at this airstrip would only exacerbate current weather-related delays. This option would not support reasonably foreseeable future development within the Project area.
12	Airstrip – Use the existing Nuiqsut airstrip	Would require improvements and expansion of the existing Nuiqsut airstrip to accommodate traffic, including fill in adjacent wetlands and streams. Would require a gravel road connection to the Project area from Nuiqsut, which would result in additional fill in wetlands. Use of the existing gravel road connection to Alpine from Nuiqsut (Spur Road) would require approval from the Kuukpik Corporation for CPAI to use and improve the road (to Project standards). BLM discussed this with the Kuukpik Corporation for the GMT-2 development, and the Kuukpik Corporation denied the request. Would require construction of a new all-season gravel road to connect the Project area with Nuiqsut. Would add additional road traffic in Nuiqsut (or require a new gravel road connection between Nuiqsut and the Project area), which would generate increased, traffic, noise, and dust in the community. There is currently no consensus from the community or Native Village of Nuiqsut about whether they would be in favor of Nuiqsut being an operations hub for oil and gas development.
13	Airstrip – Use the existing Inigok airstrip	This option would not reduce environmental impacts: The Inigok airstrip is located more than 20 miles from the Project area (drill site BT5) and would require upgrades and an additional gravel access road to use it, creating additional impacts to wetlands and other environmental resources (e.g., caribou). The new gravel road to Inigok would be in an area used more heavily by caribou than the proposed road connection from GMT-2 to the Project area, and the road to Inigok would be much longer.
14	Airstrip – Integrate the proposed airstrip and roadway	Use of an integrated airstrip for both landing aircraft and vehicle traffic creates safety concerns due to the number of anticipated flights and volume of vehicle traffic. Integrating the proposed airstrip with the road would only reduce impacts to wetlands by 5.5 acres.

Component Number	Alternative Component Considered	Rationale for Elimination
15	MTI – Use small-sized sealift modules (550 tons or less) for the WPF	While the smaller module size would eliminate the need for the MTI because modules could be offloaded at Oliktok Dock and transported across the annual Colville River ice bridge (650-ton maximum weight limit, including module transporters [approximately 100 tons]), this option is not technically feasible due to the some of the individual module components exceeding the maximum load capacity of the Colville River ice bridge. This alternative component would also increase the overall Project footprint because of the need to construct on-site fabrication facilities to complete module installation and because of safety requirements for individual module separation distance minimums. This alternative component would increase the overall amount of vehicle traffic near Nuiqsut during the already busy ice road season when the annual Alpine Resupply Ice Road is in operation. Use of small-sized sealift modules would require significantly increased labor hours on the North Slope (versus the module fabrication facility located outside of Alaska), which would increase the overall safety exposure of Project personnel on the North Slope where weather conditions are extreme and full medical support is limited to distance locations (e.g., Fairbanks, Anchorage).
16	MTI – Use medium-sized sealift modules (1,400 tons or less) for the WPF	While medium-sized modules would eliminate the need for the MTI because modules could be offloaded at Oliktok Dock and use a sea- and tundra-based ice road route to deliver the modules to the WPF pad, additional environmental impacts and Project execution risks would occur. Existing and planned gravel infrastructure size would increase 19 acres and use 73,500 cubic yards of fill material. This would include the curve straightening of existing roads to accommodate the overall length of the module transporters, the construction of the gravel pad near Fish Creek in the Colville River Delta, and an increase in the WPF pad size to address safety requirements (resulting from an increase from four modules to 15). The required length and thickness of the ice road routes to be completed in a single season is at the upper limits of what has been historically constructed in a single winter season on the North Slope. The North Slope does not have enough equipment or personnel capacity to support construction of this route and support other projects by CPAI and other North Slope operators. Due to the design requirements for the sea-ice route and the limited window to transport the 15 sealift modules, the sealift module move would occur over two seasons, effectively doubling impacts (e.g., potential marine mammal disturbance, water consumption) and requiring the construction of the staging pad near Fish Creek in the Colville River Delta. In order to transport the modules (1,800-ton total load with transport vehicles), the sea ice would need to be grounded. In the Colville River Delta, due to year-round flows, the sea ice cannot be grounded and the floating ice would need to be approximately 25 feet thick to support the move. Should a module break through the ice, Project personnel would be in danger, the module could be lost, and the environmental impacts could be significant. (It is estimated that salvage of a module would take between 1 and 3 years.) The increased transport time would delay Project construction by 1.5 years and first oil by 2 years, making the Project economically unfeasible for CPAI. CPAI has notified the BLM that due to the risk to Project personnel, assets (e.g., sealift modules, support equipment), and the environment from the long sea-ice route, this option is unfeasible and could not be implemented if selected as the preferred alternative in the Willow Master Development Plan EIS.

Component Number	Alternative Component Considered	Rationale for Elimination
17	MTI – Freeze sealift barges in place in Harrison Bay	The freeze-in barge concept was evaluated by a team of engineers, including specialists in ice engineering, cold-region engineering, Arctic marine naval architecture, geothermal engineering, and offshore geotechnical engineering to determine risks and potential mitigation measures to reduce risks. The analysis determined that the concept of freezing the sealift modules in place was not practical or feasible from a technological standpoint and presented significant risks to the environment, personnel safety, and modules (CPAI 2019a). Identified ice loading on the barge structure could readily lead to a loss of barge structural integrity. Mitigation measures to counter structural loading included using supplemental refrigeration to freeze ballast water in the barge holds; structural reinforcement of existing barges and custom-built ice class barges; and construction of ice- or gravel-berm protective barriers. Each of these mitigation measures still presented operational risks and uncertainty of varying degrees, including risk to human safety and asset protection. Barge anchoring (i.e., preventing ice loads from moving the barges after they have been grounded to the seafloor) presented additional challenges that engineering design could not mitigate. Mitigation measures included tying/connecting the five barges together as a single unit; installing pipe piles to further anchor the barges to the grounded location; and dredging the grounding site to reach more resistant (to sliding) soils. In the event of a barge structural event, significant ice formation on the modules (i.e., spray accumulation on the module creating uneven loading) or ice pileups against the loaded barges could result in a module or barge (or both) sinking in Harrison Bay. Such an event would create a significant risk to Project personnel and would result in a significant salvage operation with a potential for serious environmental impacts.
18	MTI – Reduce the lifespan of the MTI	The MTIs (module delivery options 1 and 2) have been designed to accommodate two distinct sealifts: the first would deliver the WPF modules and three drill site modules (BT1, BT2, and BT3); the second sealift would deliver two drill site modules (BT4 and BT5). Drill site module design and detailed engineering is not anticipated to be completed until at least 2020. If the drill site module design can produce sealift modules weighing less than 650 tons (with module transporters), CPAI could deliver the sealift modules to Oliktok Point and transport them to the Project area via a combination of ice and gravel roads. (This route would require crossing the Colville River ice bridge, which has a maximum weight rating of 650 tons.) At the current time, this alternative component has been eliminated from consideration in the EIS, as its implementation is speculative; however, should CPAI determine that this is technically and logistically feasible, Project plans could be updated with the BLM and the MTI could be decommissioned earlier than proposed.
19	MTI – Make the MTI semipermanent	CPAI has not identified any reasonably foreseeable future projects that would require sealift module delivery in the NPR-A and has no need for an MTI following Project construction. The MTI would be located in State of Alaska waters (under module delivery options 1 and 2), and the State of Alaska has expressed no interest in taking ownership of the MTI following Project construction. Since the MTI will require annual inspection and maintenance as needed (e.g., gravel bag armor replacement) and there is no other identified entity to take possession and responsibility for the MTI, this alternative option has been eliminated as not being logistically feasible.
20	MTI – Land sealift barges at shore near Atigaru Point	Landing sealift module barges at the shore would require dredging approximately 2.5 miles of seafloor (approximately 100 acres) to a depth of approximately 11.5 feet to 14.5 feet, creating greater impacts to the marine environment than the construction of the MTI at Atigaru Point. Significant dredging activity has been identified by local stakeholders (e.g., Nuiqsut subsistence users) as being overly disruptive to subsistence activity.

Component Number	Alternative Component Considered	Rationale for Elimination
21	MTI – Construct a dock at Atigaru Point	Construction of a dock at Atigaru Point would have greater impacts to the marine environment and wetlands and WOUS: For marine vessels to reach shore, dredging would be required for approximately 2.5 miles of seafloor (approximately 100 acres) to a depth of approximately 11.5 feet to 14.5 feet, creating greater impacts to the marine environment than the construction of the MTI at Atigaru Point. Significant dredging activity has been identified by local stakeholders (e.g., Nuiqsut subsistence users) as being overly disruptive to subsistence activity. Dock facilities would require additional fill to construct gravel pads and the dock in wetlands and WOUS.
22	MTI – Construct a dock at Point Lonely	Construction of a dock at Point Lonely is not technically feasible due to accelerated rates of shoreline erosion occurring at the site. Annual shoreline erosion at Point Lonely in recent years has accelerated in excess of 80 feet per year. Such shoreline erosion rates, where the causeway would connect to the shoreline, cannot be adequately addressed through Project planning and engineering design.
24	MTI – Deliver modules to the Project area via grounded-ice bridge over the Colville River near Umiat	Umiat is the only location upstream of Nuiqsut with Colville River flow data for a substantial period of record. U.S. Geological Survey data shows that the Colville River at Umiat frequently has flowing water year-round. The lowest flow periods are only one month long (April). As such, the Colville River at Umiat or downstream would not have the required grounded ice conditions.[3] There are multiple feeder rivers and streams that would need to be crossed on the approach to Umiat, and they may also not have fully grounded ice. The ice road route would be approximately 115 miles to south Umiat and an additional 50 miles north to reach the Project area. Ice road transit would require a minimum of one multi-season ice pad or gravel pad due to the length of the route (i.e., module delivery would likely take 2 years to complete). Crossing the Colville River at Umiat would have greater environmental impacts than crossing the river near Ocean Point due to the increased distance from the Project area (e.g., additional ice roads, additional transport year) and is not sufficiently unique from Option 3 (Colville River Crossing) analyzed in the Final EIS.
25	MTI – Construct a dock at the abandoned Kogru River pad	Construction of a dock at the abandoned Kogru River pad would have greater impacts to the marine environment and wetlands/WOUS: For marine vessels to reach shore, dredging would be required for approximately 9 miles of seafloor (approximately 370 acres) to a depth ranging from 11.5 feet to 14.5 feet, creating greater impacts to the marine environment than the Proposed Action. Significant dredging activity has been identified by local stakeholders (e.g., Nuiqsut subsistence users) as being overly disruptive to subsistence activity. Dock facilities would require the placement of additional fill to construct gravel pads in wetlands and WOUS
26	Mine site – Use the existing ASRC mine site	Use of this mine site would have greater impacts in Nuiqsut than the proposed mine site, as the ASRC mine site is approximately half the distance to Nuiqsut: Blasting activity would have greater impacts. Gravel hauling would also occur through or near the community, creating additional noise and air quality impacts in Nuiqsut. The ASRC mine site is farther from the Project area and would increase the round-trip gravel hauling operation by approximately 20 miles per load.

[3] BLM and cooperating agencies dismissal of the Colville River crossing location at Umiat was based on the year-round river flow in the area and the understanding that grounding an ice bridge at this location or downstream would not be feasible. Based on stakeholder feedback, CPAI continued to look for a feasible crossing location and with additional data collection and was able to identify a crossing location where an ice bridge could be partially grounded near Ocean Point. This crossing location would allow for a partially grounded ice bridge (where some water flow would still occur in small channels) and was included as Option 3 (Colville River Crossing) in the Supplement to the Draft EIS and in the Final EIS.

Component Number	Alternative Component Considered	Rationale for Elimination
27	Mine site – Alternatives to blasting to support gravel mining operations	CPAI reviewed multiple gravel mining methods as alternatives to blasting at the request of the BLM, including mechanical methods (e.g., crushers, mining saws, terrain levelers, road headers, continuous miners), steam or thermal thawing, and alternative blasting products (e.g., Autostem products). Of the equipment types requested by the BLM for CPAI to investigate, the majority were not capable of producing mining rates required for the short gravel mining season in the Project area. Previous North Slope operations working on smaller scale projects (e.g., pad work, road work) have employed some of the mechanical methods noted by the BLM with success. However, the equipment has had a history of hydraulic failures at temperatures approach -15 degrees Fahrenheit; winter temperatures on the North Slope are regularly colder than this limit. Additionally, due to the slower rate of mining production, the mine site would need to be operated year-round, which is not feasible for the Project because the mine site would not be connected by gravel road (mining operations would only occur during winter with ice road access).
28	Pads – Reduce the number and/or size of drill site pads	Would not allow CPAI to exercise their rights under their leases to develop the oil and gas within the leased areas. Leases provide the lessee the right to develop the oil and gas resources within the lease, subject to regulation. Drill pads have already been optimized to the minimum size needed for the proposed activity (e.g., 20-foot wellhead spacing). Drill pad locations have already been optimized to provide maximum accessibility to the resources based on existing extended-reach drilling technology and reservoir location and characteristics.
29	Pads – Reduce the size of pads by using pile-supported facilities	Would create safety risks related to emergency egress and access for emergency responders (e.g., firefighters), who would only have access to one or two sides of the structure for a portion of the year. Would limit maintenance access and opportunities outside of the winter season. Pile-supported modules overhanging tundra that require resupply by truck (e.g., chemical tanks, fuel tanks) would pose an increased risk to the environment in the event of an overfill or spill. Most support facilities (e.g., central processing facility modules, fleet and equipment repair shop, fabrication shop) are designed to have access to all sides of the structures for functionality and to provide space to move material and equipment around safely and efficiently. Would not appreciably reduce impacts to wetlands in comparison with the Proposed Action due to shading effects beneath buildings.
31	Pads – Move drill site BT2 west, away from Fish Creek	Relocating these drill sites to the west would move them into setback buffers that are intended to protect other resources. BT2 would be within the setback buffer for Fish Creek and moving them into setback buffers for other resources would not provide an environmental benefit to waterfowl or caribou within the Fish Creek corridor.
32	Processing – Use the Alpine central processing facility instead of constructing a Project-specific processing facility	The Alpine central processing facility does not have capacity to process Project production (peak estimate of 200,000 barrels of oil per day, 175,000 barrels of water per day, and 300 million standard cubic feet of gas per day). The Alpine central processing facility is currently at gas handling capacity and the expected production from GMT-1 and GMT-2 will keep the facility at or near capacity for gas and water handling into the 2030s. The Project reservoir pressures are substantially less than those found at the Alpine development, presenting additional challenges to co-processing fluids at the existing facility. Upgrades to increase capacity of the Alpine central processing facility would increase overall Project impacts in the Project area and the Colville River Delta, an environmentally sensitive area: Partial processing facilities in the Project area would be required (i.e., although a full central processing facility would not be required, a partial processing facility would still be required). Transport of multiphase fluids to the Alpine central processing facility would require additional pumping and heating equipment in the Project area, expanding the gravel footprint within the Project area.

Component Number	Alternative Component Considered	Rationale for Elimination
34	Schedule – Phase development of the Project so construction does not begin until GMT-2 development is constructed and is in the drilling/operations phase	This is already accomplished under the action alternatives, including the proponent's Proposed Action through planned sequential construction of drill sites (versus simultaneous development) over 8 to 10 years (varies by alternative). Additionally, future potential development of the Greater Willow 1 and Greater Willow 2 areas are considered in the EIS as reasonably foreseeable future development for cumulative effects analysis; development of these sites requires additional subsurface data, and these sites would be subject to future National Environmental Policy Act reviews.
35	Schedule – Delay the Project EIS until after GMT-2 is in the drilling/operations phase	The BLM is unable to postpone Project permitting based on regulatory requirements applicable to the NPR-A found in 42 USC 6506(a). Deferral of a project authorization would be inconsistent with the directives of the Naval Petroleum Reserves Production Act to expeditiously carry out an oil and gas leasing program. Delayed permitting would be inconsistent with the rights of CPAI acquired with the subject leases to reasonably develop the oil and gas within those lease tracts (generally limited to a 10-year lease term) and with CPAI's obligations in the Bear Tooth Unit Agreement to promptly pursue development.

Note: ASRC (Arctic Slope Regional Corporation); BLM (Bureau of Land Management); BT1 (Bear Tooth drill site 1); BT2 (Bear Tooth drill site 2); BT3 (Bear Tooth drill site 3); BT4 (Bear Tooth drill site 4); BT5 (Bear Tooth drill site 5); CPAI (ConocoPhillips Alaska, Inc.); EIS (Environmental Impact Statement); GMT (Greater Mooses Tooth); GMT-2 (Greater Mooses Tooth 2); MTI (module transfer island); NEPA (National Environmental Policy Act); NPR-A (National Petroleum Reserve in Alaska); WOUS (Waters of the U.S.).

3.4 Alternative Components Carried Forward in the 2020 Willow MDP Environmental Impact Statement

In developing the alternatives to be considered in the initial 2020 Project EIS, several alternative components suggested were incorporated into Alternatives C and D analyzed in the EIS. Additionally, some alternative components were able to be incorporated into all action alternatives (e.g., as a ROP) or were being analyzed in the EIS until a determination on their feasibility is determined.

Table D.3.4 summarizes those alternative components carried forward as either alternatives or standalone components for analysis in the EIS.

Table D.3.4. Alternative Components Considered and How They Are Carried Forward in the Environmental Impact Statement

Component Number	Alternative Component Considered	Description of How an Alternative Component is Carried Forward in the Environmental Impact Statement
1	No action alternative	No action; carried forward as Alternative A in the EIS.
2	Proponent's proposed project	Project as proposed by CPAI; carried forward as Alternative B (Proponent's Project) in the EIS.
7	Access – Relocate the Judy (Iqalliqpik) Creek Bridge crossing (as designed by CPAI in its proposed Alternative 2) (CPAI 2018b)	All action alternatives with a crossing of Judy (Iqalliqpik) Creek use the same road and bridge alignment. The proposed bridge length has been reduced from 1,850 feet to 420 (Draft EIS) to 380 feet (Final EIS).
9	Access – Relocate the Judy (Iqalliqpik) Creek Bridge crossing and reroute the road (as designed by CPAI in its proposed Alternative 2) (CPAI 2018b)	All action alternatives with a crossing of Judy (Iqalliqpik) Creek use the same road and bridge alignment; the road alignment has been further refined between the Draft and Final EIS. The proposed bridge length has been reduced from 1,850 feet to 420 (Draft EIS) to 380 feet (Final EIS).
23	MTI – Construct an MTI at Point Lonely	This alternative concept has been carried forward in the EIS as Option 2: Point Lonely Module Transfer Island.
30	Pads – Move drill site BT4 out of the K-5 Teshekpuk Lake Caribou Habitat Area	Drill site BT4 has been relocated outside of the K-5 Teshekpuk Lake Caribou Habitat a\Area and east of the Kalikpik River for all action alternatives. CPAI has agreed to apply all K-5 BMPs (BLM 2013) to the drill site due to its proximity to the K-5 area.
33	Processing facility – Relocate the Project processing facility closer to the GMT Unit boundary	This alternative component has been incorporated into Alternative C (Disconnected Infield Roads) in the Draft EIS. The Willow Processing Facility was relocated approximately 4 miles to the west (i.e., closer to the GMT Unit boundary) for Alternative B (Proponent's Project) in the Final EIS.

Note: BMP (best management practice); BT2 (Bear Tooth drill site 2); BT4 (Bear Tooth drill site 4); CPAI (ConocoPhillips Alaska, Inc.); EIS (Environmental Impact Statement); GMT (Greater Mooses Tooth); MTI (module transfer island).

3.5 Alternatives Development for the 2022 Supplemental Environmental Impact Statement*

Developing new alternative concepts was an iterative process led by BLM that used technological and logistical input from CPAI and feedback from cooperating agencies, tribal entities, and other stakeholders to consider additional alternative concepts and finalize the new action alternative (Alternative E) included in this Supplemental EIS. The alternative concepts developed during this process were vetted by BLM, CPAI, and cooperating agencies. BLM and cooperating agencies met to develop and evaluate potential new alternatives and Project component alternatives for this Supplemental EIS that would be responsive to the District Court's decision in a series of alternatives development workshops. BLM considered comments submitted during scoping for this Supplemental EIS that addressed potential new alternatives and Project components, and reviewed comments previously submitted during initial Project scoping and on the Draft EIS for potential alternative concepts or components that warranted renewed or further evaluation. Potential new alternative concepts were evaluated against revised Project screening criteria and were discussed with CPAI for how the changes to proposed infrastructure would affect engineering, safety, logistics, and access to subsurface resources. At the conclusion of alternatives development workshops with cooperating agencies, alternatives or alternative components that met the screening criteria were advanced as a new alternative and those that did not meet the screening criteria were dismissed from further evaluation.

3.5.1 Revised Screening Criteria for the Supplemental Environmental Impact Statement*

Project screening criteria were reevaluated and augmented as a result of the District Court's decision while developing this Supplemental EIS to ensure any new alternatives adequately addressed the decision and were compliant with applicable law. In its decision, the District Court remanded the Willow MDP EIS to BLM for the following reasons:

- BLM acted contrary to law insofar as it developed its alternatives analysis based on the view that CPAI had the right to extract "all possible" oil and gas from its leases.
- BLM acted contrary to law in its alternatives analysis for the TLSA insofar as it failed to consider the statutory directive that BLM give "maximum protection" to surface values in that area.

All screening criteria from the previous Willow MDP EIS were retained (Section 3.1.1, *Alternatives Screening Criteria*) and a new screening criteria was adopted to directly address the District Court's reasons for remanding the Willow MDP EIS to BLM. The new screening criteria is:

- Addresses the District Court's decision: This screening criteria was developed in recognition of the District Court's finding that CPAI did not have the unfettered right to extract "all possible" oil and gas from its leases and to evaluate whether an alternative concept directly addresses the District Court's directive to BLM to consider alternatives that would reduce infrastructure and environmental impacts relative to CPAI's proposal (i.e., Alternative B), and specifically to consider alternative concepts that would reduce infrastructure and impacts within the TLSA.

3.5.2 Consideration of Special Areas and Protections for Surface Resources*

BLM began the alternatives development process for the 2022 Supplemental EIS with a hard look at the NPR-A Special Areas, particularly the TLSA and CRSA, and the protections outlined in both the 2020 NPR-A IAP and the 2022 NPR-A IAP. BLM reviewed comments submitted during the 2020 EIS process for suggestions of alternatives concepts that could provide additional protection to important surface resources in the NPR-A Special Areas. A map showing the geographic setbacks for important surface resources was developed and overlain on the outline of the Willow reservoir to provide a baseline for how important surface resources overlay the sub-surface resources (Figure D.3.2). Subsurface information was provided by CPAI and verified by BLM oil and gas staff, and setback distances were established using the 2022 NPR-A IAP LS and ROP setbacks (then in draft form). This showed BLM and cooperating agencies where infrastructure could be placed to access the subsurface resource and how surface restrictions interacted with the location of the subsurface resource. BLM also requested drilling reach polygons from CPAI to illustrate how much of the subsurface resource could be accessed from a given drill site pad location. This information was used to evaluate whether, in BLM's expert opinion, an alternative concept met the Project's purpose and need and addressed the Court's instruction to provide maximum protection to important surface resources, particularly in NPR-A Special Areas.

In many areas of the NPR-A, and especially in the TLSA, surface protections overlapped each other and severely limited where infrastructure could be placed without requiring an exception to a setback (Figure D.3.2). Surface topography also presented engineering challenges in some areas where infrastructure was permissible. BLM experts carefully considered the important surface resources that setbacks were designed to protect and prioritized some setbacks over others when determining the best location for surface infrastructure (BLM 2021c) (. To the extent that an alternative concept required BLM to place infrastructure in a setback, the setback with the lowest relative environmental importance was chosen for surface infrastructure.

3.5.3 Alternative Components Considered during the Alternatives Screening Process*

*3.5.3.1 Gravel Pads Options**

This Supplemental EIS considered additional alternative concepts that would reduce the number of gravel pads and relocate them from previously proposed locations. All gravel pads were evaluated for potential relocation and drill site BT4 was considered for elimination. These alternative concepts were aimed at reducing impacts to fish, caribou, yellow-billed loons, and subsistence, as well as the providing for “maximum protection” of surface values within the TLSA. To determine the viability of potential drill site pad locations, a map was produced to reflect the estimated drilling reach of reconfigured drill site locations over the Willow reservoir to confirm the estimated amount of recoverable resource (Figure D.3.3).

Each of these gravel pad options is described in Table D.3.5.

*3.5.3.2 Access Options**

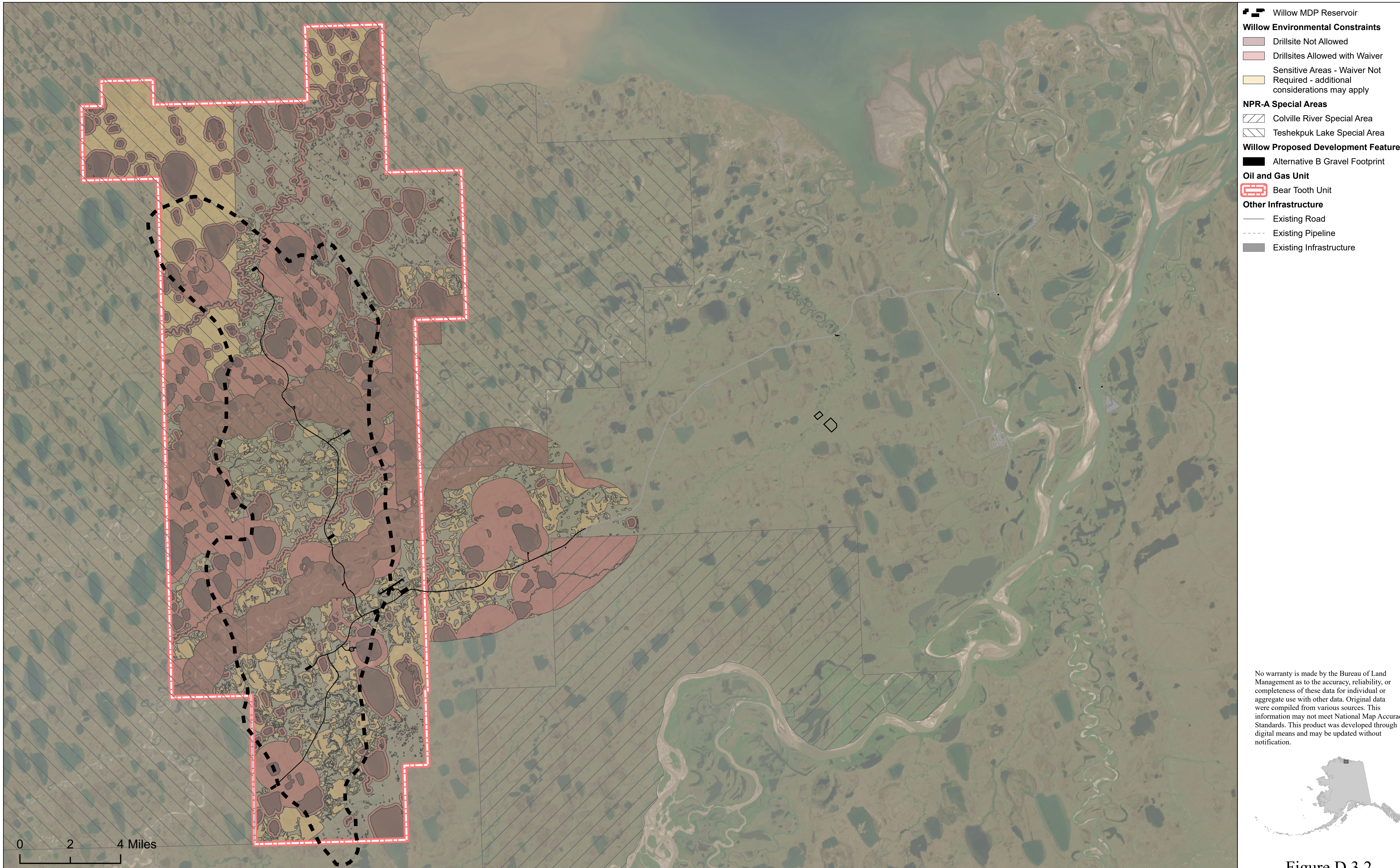
This Supplemental EIS considered multiple new disconnected access (i.e., no all-season gravel road but connections with gravel airstrips and annual winter ice roads) configurations for the Project, including for drill sites BT2 North (newly generated for this Supplemental EIS), BT2, and BT5. Additionally, the access road connection at GMT-2 was reevaluated for a potential new alignment to avoid crossing the CRSA. An alternative to barging modules was also considered.

Each of the access options is described in Table D.3.5.

*3.5.3.3 Infrastructure Options**

This Supplemental EIS considered multiple alternatives for the placement of different Project components. It considered extending the proposed diesel pipeline from the ACF at Alpine CD1 to the Project area, instead of trucking the material as proposed under Alternative B. It also considered different locations for the Willow mud plant (at the existing K-Pad or at the WOC), as well as using the ACF instead of constructing a new Willow CPF. The Supplemental EIS also considered eliminating barging the modules and transporting them by truck or aircraft. These alternative concepts were generated by comments from the Kuukpik Corporation and other stakeholders and would evaluate how the placement of different Project components could impact traffic volumes between the existing Alpine and the proposed Willow developments.

These options are further described in Table D.3.5.



No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Figure D.3.2

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*3.5.3.4 Phasing Options**

This Supplemental EIS considered developing the Project in a phased approach, as suggested by Kuukpik Corporation and other stakeholders. Different phasing options were proposed for consideration, from a delay in permitting the entire Project to approving only certain segments of the Project and pausing for a defined period of time before considering authorization of the reminder.

The phasing options are further described in Table D.3.5.

*3.5.3.5 Alternative Components Summary (2022)**

Table D.3.5 summarizes the alternative components developed for the 2022 Supplemental EIS using the revised Supplemental EIS screening criteria (Section 3.5.1, *Revised Screening Criteria for the Supplemental Environmental Impact Statement*).

Table D.3.5. Alternative Components Considered during Alternatives Development*

Component Category	Component Number	Alternative Component Considered	Description	Why Considered[a]
Access	36	Reroute the access road from GMT-2 outside of the Colville River Special Area	This alternative concept would reroute the proposed access road from GMT-2 to avoid crossing the Colville River Special Area	Reduce infrastructure within a designated special area
Access	37	No gravel road connection to drill site BT2 North (four-pad alternative; newly generated for the Supplemental EIS)	This alternative concept would eliminate BT4 and relocate BT2 north of Fish Creek. This concept would also eliminate the gravel road connection between BT1 and BT2 North, and would require constructing duplicate Project facilities, including a second airstrip, operations center, camp, drilling support/laydown area, chemical storage, and emergency response center to serve drill site BT2 North. This concept would require an annual ice road be constructed each winter to provide resupply of equipment materials that cannot be flown to the drill site.	Reduce impacts to caribou movement Reduce impacts to subsistence Reduce footprint and gravel fill Reduce infrastructure within the TLSA
Access	38	Eliminate gravel road connections to drill sites BT4 and/or BT5	This alternative concept would eliminate the gravel road connection to BT4 and/or BT5 and would require constructing duplicate Project facilities, including a second airstrip, operations center, camp, drilling support/laydown area, chemical storage, and emergency response center to serve the drill site(s). This concept would require an annual ice road be constructed each winter to provide resupply of equipment and materials that cannot be flown to the drill site(s).	Reduce impacts to caribou movement Reduce impacts to subsistence Reduce footprint and gravel fill
Access	39	Seasonal drilling at drill sites with no gravel road connection	All drill sites without a gravel road connection (i.e., disconnected) would be analyzed with an option for seasonal (i.e., ice road only) drilling.	Reduce safety risks to employees Reduce impacts to migratory birds
Access	40	No barging of modules	This alternative concept would eliminate the sealift barging of modules to the North Slope and would instead transport the modules or module components by truck or aircraft to the North Slope for transport to the Project area.	Reduce impacts to endangered seal species
Pads	41	Relocate drill site BT4 to the south	This alternative concept would retain all five drill site pads but would relocate drill site BT4 to a location south of its proposed location under Alternative B.	Reduce impacts to caribou calving habitat
Pads	42	Relocate drill sites BT2 and BT2 North to the west	This alternative would shift drill site BT2 (Alternatives B, C, and D) and BT2 North (Alternative E) to the west of its proposed locations to put more distance between the drill site and Fish Creek.	Reduce impacts to caribou movement and waterfowl by reducing noise in the vicinity of Fish Creek
Pads	43	Eliminate drill sites BT4 and BT5	This alternative would be a three-pad alternative using the locations of BT1, BT2, and BT3 from Alternative B; drill sites BT4 and BT5 would be eliminated.	Reduce impacts in the TLSA Reduce the Project footprint
Pads	44	No infrastructure within the TLSA	This alternative concept would remove all infrastructure (e.g., gravel pads, gravel roads, pipelines) from within the TLSA. This alternative would construct three drill site pads (BT1, BT2, and BT5).	Reduce impacts to caribou movement Reduce impacts to subsistence Reduce footprint and gravel fill Eliminate infrastructure within the TLSA

Component Category	Component Number	Alternative Component Considered	Description	Why Considered[a]
Pads	45	BT2 north of Fish Creek (four-pad alternative)	This alternative concept would remove BT4 and shift BT2 north of Fish Creek, eliminating one of two drill sites proposed within the TLSA.	Reduce impacts to caribou movement Reduce impacts to subsistence Reduce footprint and gravel fill Reduce infrastructure within the TLSA
Pads	46	BT2 south of Fish Creek (four-pad alternative)	This alternative concept would remove BT4 and BT2 would remain in its previously proposed location, eliminating one of two drill sites proposed within the TLSA.	Reduce impacts to caribou movement Reduce impacts to subsistence Reduce footprint and gravel fill Reduce infrastructure within the TLSA
Pads	47	Four pad northern shift (four-pad alternative)	This alternative concept would remove BT4 and would shift the remaining four drill sites to the north. Under this concept, BT1 would be located just outside of the TLSA and BT2 would be the only drill site located within the TLSA.	Reduce impacts to caribou movement Reduce impacts to subsistence Reduce footprint and gravel fill Reduce infrastructure within the TLSA
Pads	48	Relocate drill site BT5 out of the yellow-billed loon setback buffer	This alternative concept would relocate BT5 to a new location to the northeast, just outside of a yellow-billed loon nest setback buffer.	Reduce impacts to yellow-billed loons Reduce the overall extent of Project infrastructure
Infrastructure	49	Extend the diesel pipeline from Alpine to the Project area	This alternative concept would extend a diesel supply pipeline from the Alpine central processing facility to the Project area.	Reduce potential spill risk by eliminating the need to truck fuel from Alpine to the Project area
Infrastructure	50	Expand the Alpine Processing Facility to accommodate processing Willow produced oil and gas	This alternative concept would not construct the Willow Processing Facility to support the Project but would instead expand the existing Alpine Processing Facility to accommodate processing Willow produced oil and gas. The products would be transported between Willow and Alpine by pipeline.	Reduce new infrastructure through the use existing infrastructure
Infrastructure	51	Locate the Project mud plant at the Willow Operations Center instead of on K-Pad	This alternative concept would locate the proposed mud plant at the Willow Operations Center rather than at the K-Pad.	Reduce the amount of traffic on the road system between the Alpine and Willow developments Reduce impacts to subsistence
Phasing	52	Construct the Project in two phases with a pause between development	This alternative concept would construct the Project over two distinct construction phases, with 3 drill sites and associated supporting facilities (e.g., roads, pipelines, operations center) constructed in phase I, followed by an agency-defined period of time to evaluate Project impacts, and then finish Project construction.	Reduce impacts to wildlife Reduce impacts to subsistence
Phasing	53	Delay permitting the Project indefinitely	This alternative concept would delay consideration of the Project and pause the National Environmental Policy Act analysis.	Reduce impacts to wildlife Reduce impacts to subsistence
Phasing	54	Restrict future development near the Project	This alternative concept would restrict the amount of development allowed in the Bear Tooth Unit and future development that uses the planned Project infrastructure. Under this alternative concept, Greater Willow and other discoveries west of the Project, as well as the amount of infrastructure allowed to develop the Willow reservoir would be restricted in the Willow Record of Decision.	Reduce cumulative impacts to all resources

Note: BT1 (Bear Tooth drill site 1); BT2 (Bear Tooth drill site 2); BT4 (Bear Tooth drill site 4); BT5 (Bear Tooth drill site 5); EIS (Environmental Impact Statement); GMT-2 (Greater Mooses Tooth 2); IAP (Integrated Activity Plan); NPR-A (National Petroleum Reserve in Alaska); ROD (Record of Decision); TLSA (Teshekpuk Lake Special Area).

[a] Column reflects goals of BLM and cooperating agencies in developing the initial alternative concept; additional analysis was required to determine if the alternative concept would provide the desired relative environmental benefit.

3.5.4 Alternatives Concepts Suggested During the 2022 Draft EIS Public Comment Period*

Several alternatives concepts were suggested by commenters during the 2022 Draft Supplemental EIS public comment period and they are described in Table D.3.6. Some of these alternative concepts were considered previously and were reevaluated as part of the response to comments.

Table D.3.6. Alternative Components Suggested During Draft Public Comment Period*

Component Category	Component Number	Alternative Component Considered	Description	Why Considered[a]
Access	55	Eliminate the Willow airstrip	This alternative concept would eliminate the airstrip(s) at the Willow Project location and use the existing airstrip at Alpine for all air traffic to support the Willow Project. This alternative concept was previously considered in the 2020 EIS.	Reduce footprint and gravel fill
Access	56	Use extended reach drilling to develop Willow reservoir	This alternative concept would require the use of extended reach drilling to the maximum extent demonstrated on the North Slope (approximately 7 miles) to develop the Willow reservoir. Pad locations would be based on a projected 7-mile drilling reach.	Reduce footprint and gravel fill
Infrastructure	57	Integrate the Willow airstrip with the road	This alternative concept would integrate the airstrip with a Willow road instead of having a standalone airstrip. This alternative concept was previously considered in the 2020 EIS.	Reduce footprint and gravel fill
Infrastructure	58	Eliminate prefabricated modules	This alternative concept would not use prefabricated modules at all and would ship all the components for the drill site modules and central processing facility to the North Slope separately and the Willow Project would be "stick built" on the North Slope. This alternative concept was previously considered in the 2020 EIS.	Provide jobs locally for construction of the modules Eliminate the impacts of barging
Infrastructure	59	Eliminate the use of hydraulic fracturing in the Willow Development	This alternative concept would completely eliminate the use of hydraulic fracturing in the Willow development, including for initial well stimulation.	Reduce impacts to water resources
Infrastructure	60	Eliminate development of a new gravel mine site	This alternative concept would eliminate development of a new gravel mine site and would source gravel from existing mine sites on the North Slope. This alternative concept was previously considered in the 2020 EIS.	Reduce surface impacts from development of a new gravel mine site
Phasing	61	Include development of West Willow in the Willow MDP	This alternative concept would add development of the so-called "West Willow" prospect (Greater Willow 1 and 2) to the Willow MDP.	Analyze impacts of developments that could be facilitated by the Willow infrastructure
Phasing	62	Delay permitting the Willow Project pending a global climate agreement	This alternative concept would delay permitting the Willow Project until the US develops a framework to limit its GHG emissions consistent with a global plan to limit climate change to 1.5 degrees Celsius	Prevent irreversible greenhouse gas emissions that are not consistent with a 1.5-degrees Celsius pathway

Component Category	Component Number	Alternative Component Considered	Description	Why Considered[a]
Phasing	63	Delay development of drill site pads in the Teshekpuk Lake Special Area	This alternative concept would delay development of drill site pads in the Teshekpuk Lake Special Area to provide more time for consultation with Nuiqsut on ways to reduce impacts to migrating caribou and subsistence hunters.	Reduce impacts to subsistence users
Water source	64	Use an underground low salinity freshwater formation to supply Project water	This alternative concept would replace in whole or in part the use of freshwater from Project area lakes or a constructed freshwater reservoir. Under this alternative concept, freshwater would instead be produced using an underground low-salinity freshwater formation(s).	Reduce impacts to surface water resources and fish

Note: EIS (environmental impact statement); MDP (Master Development Plan).
[a] Column reflects goals of BLM and cooperating agencies in developing the initial alternative concept; additional analysis was required to determine if the alternative concept would provide the desired relative environmental benefit.

3.5.5 Alternative Components Considered but Eliminated from Further Analysis*

BLM and cooperating agencies developed this Supplemental EIS range of alternative components and concepts to respond to the District Court's decision. In all, 28 new alternative components (Tables D.3.5 and D.3.6) were considered and evaluated against the screening criteria (Section 3.5.1, *Revised Screening Criteria for the Supplemental Environmental Impact Statement*). Of these, 24 alternative components and concepts were eliminated from further analysis because they did not pass the screening criteria; three alternative concepts (components numbers 45, 48, and 52) were carried forward and incorporated into a new action alternative to be analyzed in detail, Alternative E (Three-Pad Alternative [Fourth Pad Deferred]); and one alternative component (number 51) was carried forward for detailed analysis as an option that could be applied to any action alternative. Table D.3.7 summarizes the rationale for eliminating alternative components and concepts from further analysis. Sections 3.5.5.1 through 3.5.5.24 provide additional detail on the alternative concepts and why they were eliminated from further analysis.

Table D.3.7. Alternative Components Considered but Eliminated from Further Analysis and the Rationale for Elimination[4]*

Component Number	Alternative Component Considered	Rationale for Elimination
36	Access – Reroute the access road from GMT-2 outside of the Colville River Special Area	Would result in more impacts to yellow-billed loons relative to the proposed action; this road alignment would pass directly over or in very close proximity to an observed yellow-billed loon nest. Would be less compliant with NPR-A IAP requirements. The NPR-A IAP allows infrastructure in the Colville River Special Area, but it would require an exception to encroach on yellow-billed loon nesting setback buffer (ROP E-11).
37	Access – No gravel road connection to drill site BT2 North (four-pad alternative, newly generated for the Supplemental EIS)	Worker safety would be reduced. Unlike the Alpine CD3 drill site pad, there would be no river access to drill site BT2, and if an injury, illness, or emergency occurred in the summer months during poor flying conditions, CPAI would be unable to evacuate the worker(s). This alternative also would not provide an environmental benefit relative to the proposed action (Alternative B). An alternative with a drill site that would not have a gravel road connection would require: • A 50% increase in fixed-wing aircraft traffic and a 20% increase in helicopter traffic relative to Alternative B (Proponent's Project) over the life of the Project. Aircraft traffic is the most commonly cited impact to subsistence hunters and would be heaviest at the most sensitive times (calving and nesting) in the TLSA. • A 20% increase in road traffic compared to Alternative B (due to annual ice road construction) over the life of the Project. Impacts on caribou winter migration would be similar to a road connected to drill site BT2 alternative due to traffic on the annual ice road. • Wholly duplicates multiple pieces of proposed infrastructure and the associated impacts. • Would require a diesel pipeline crossing of Judy (Iqalliqpik) Creek, Fish Creek, and Judy (Kayyaaq) Creek. • Would increase freshwater requirements (approximately 59 million gallons more than Alternative B over the life of the Project). • Increased spill risk and overall operational safety risks relative to the year-round gravel-road connected alternatives due to seasonal access constraints, which would limit response capabilities. • A 5 acre increase in gravel footprint within the TLSA (relative to Alternative B). Would not provide an environmental benefit relative to another alternative concept that was carried forward for detailed analysis in this Supplemental EIS (component number 45, BT2 north of Fish Creek [four-pad alternative]; now Supplemental EIS Alternative E: Three-Pad Alternative [Fourth Pad Deferred]), due to the substantial increase in ground and air traffic relative to Alternative E.

[4] Any impact comparisons provided in Table D.3.6 are made in reference to CPAI's proposed project (Alternative B [Proponent's Project]) unless otherwise indicated.

Component Number	Alternative Component Considered	Rationale for Elimination
38	Access – Eliminate gravel road connections to drill sites BT4 and/or BT5	Worker safety would be reduced. Unlike the Alpine CD3 drill site pad, there would be no river access to Project drill site(s), and if an injury, illness, or emergency occurred in the summer months during poor flying conditions, CPAI would be unable to evacuate the worker(s). This alternative would not provide an environmental benefit relative to the proposed action (Alternative B). An alternative with drill sites that would not have a gravel road connection would require: • A substantial increase in fixed-wing aircraft and helicopter traffic relative to Alternative B (Proponent's Project) over the life of the Project. Aircraft traffic is the most commonly cited impact to subsistence hunters. Levels of aircraft traffic for this alternative concept would be similar to Component 37 (No gravel road connection to drill site BT2 North). • A substantial increase in road traffic compared to Alternative B (due to ice road construction) over the life of the Project. Impacts on caribou winter migration would be similar to a road connected to drill sites BT4 or BT5 due to traffic on the annual ice road. • Wholly duplicates multiple pieces of proposed infrastructure and associated impacts. • Increased spill risk and overall operational safety risks relative to the year-round gravel-road connected alternatives due to seasonal access constraints, which would limit response capabilities.
39	Access – Seasonal drilling at drill sites with no gravel road connection	This alternative concept is associated with all alternative concepts that would eliminate segments of gravel road. Under these alternative concepts, worker safety is significantly reduced. Unlike the Alpine CD3 drill site pad, there would be no river access to the Project pads and if any injury, illness, or emergency occurred during the summer months and poor flying conditions were present, CPAI would be unable to evacuate the worker(s). Although drilling under this alternative would only occur seasonally during times when the ice road would be in place, work would still be conducted on a year-round basis during construction and routine operations. The additional infrastructure necessary to support operations at a disconnected drill site pad would be the same as the other disconnected alternative concepts, including increased aircraft traffic and an increased gravel footprint.
40	Access – No barging of modules	The maximum weight that can be shipped by over-the-road truck is 170,000 pounds, and the largest piece of the module assembly that would need to be shipped would be approximately 220,000 pounds. Breaking modules down small enough (weight and dimensions) to ship by truck would greatly increase the construction activity (e.g., ground traffic, air traffic) and would require expanding the gravel footprint of each pad to reassemble the modules. Processing facility modules would be purchased preassembled and breaking them down and reassembling them during winter would create a safety risk to workers working outside in severe winter weather conditions.
41	Pads – Relocate drill site BT4 to the south	This alternative concept is substantially similar to alternative concept 45, BT2 North of Fish Creek. The purpose of this alternative concept is to reduce the infrastructure that would be constructed in the TLSA; rather than having two drill sites with overlapping drilling reach in the TLSA, it is more beneficial to surface resources to eliminate drill site BT4.
42	Pads – Relocate drill sites BT2 and BT2 North to the west	Relocating these drill sites to the west would move them into setback buffers that are intended to protect other resources. Neither BT2 or BT2 North are within the setback buffer for Fish Creek and moving them into setback buffers for other resources would not provide an environmental benefit to waterfowl or caribou within the Fish Creek corridor.
43	Pads – Eliminate drill sites BT4 and BT5	This alternative concept does not meet the Project's purpose and need and would strand economically viable quantities of recoverable oil accessed by BT4 and BT5. BLM determined that there are economically viable quantities of recoverable oil in these areas based on its review of the available geologic data and because there is enough resource accessible from BT4 and BT5 that CPAI has proposed constructing gravel roads and drill site pads to access it.
44	Pads – No infrastructure within the TLSA	This alternative concept would not meet the Project's purpose and need and would strand an economically viable quantity of recoverable oil. This alternative concept would strand all of the oil that would be accessed by drill site BT4 and some of the oil that would be accessed from drill site BT2. BLM determined that there is an economically viable quantity of recoverable oil in this area based on its review of the available geologic data and because there is enough resource accessible from BT4 that CPAI has proposed constructing a gravel road and drill pad to access it.

Component Number	Alternative Component Considered	Rationale for Elimination
46	Pads – BT2 south of Fish Creek (four-pad alternative)	This alternative concept would not meet the Project's purpose and need and would strand an economically viable quantity of recoverable oil. This alternative concept would strand all of the oil that would be accessed by drill site BT4. BLM determined that there is an economically viable quantity of recoverable oil in this area based on its review of available geologic data and because there is enough resource accessible from BT4 that CPAI has proposed constructing a gravel road and drill pad to access it.
47	Pads – Four pad northern shift (four-pad alternative)	This alternative concept is substantially similar to another alternative concept that was carried forward for full analysis in this Supplemental EIS (component number 45, BT2 north of Fish Creek [four-pad alternative]; now Supplemental EIS Alternative E: Three-Pad Alternative [Fourth Pad Deferred]). Alternative E better addresses the District Court's decision by reducing infrastructure in the TLSA. This alternative would require additional exceptions to NPR-A IAP requirements, construct more miles of gravel road in the TLSA than component number 45 (Alternative E), be more difficult from and engineering standpoint, and would provide less access to the subsurface resource than the newly generated BT2 North drill site location.
49	Infrastructure – Extend the diesel pipeline from Alpine to the Project area	A diesel pipeline extension to the Project area (WPF) would reduce the amount of diesel trucked by road and therefore incrementally reduce spill risk along the road. A diesel pipeline would also marginally reduce traffic along the road over the life of the Project. However, the overall benefits would not outweigh the impacts associated with extending the pipeline: • The diesel pipeline would not be operational until the end of construction; however, it is during the construction phase when the Project would have the greatest fuel requirements. • Fuel would only be pumped along the pipeline a few days each month to refill storage tanks and would remain idle the remainder of the time. The idle diesel fuel would increase the potential for sedimentation and corrosion within the pipeline, which would increase the risk of a diesel pipeline spill. • Extending the pipeline would add an additional year to the construction phase, which would also require extending water withdrawals to support ice road construction. • Pipeline construction would increase traffic during a time when the Project has its highest traffic levels (construction phase), further increasing potential impacts from construction traffic. • Other pipelines planned to be constructed as part of the Project (e.g., sales oil) cannot be used to temporarily transport diesel. This alternative concept was evaluated and dismissed in the 2020 Willow MDP Final EIS and ROD.
50	Infrastructure – Expand the Alpine Processing Facility to accommodate processing Willow produced oil and gas	The processing capacity necessary to support the Project production is estimated at a maximum of 200,000 barrels of oil per day, 175,000 barrels of water per day, and 300 million standard cubic feet of gas per day. With the expected production from GMT-1 and GMT-2, the Alpine Processing Facility is expected to operate at or near gas and water handling capacity into the 2030s. Accommodating Project production at the Alpine Processing Facility would require a substantial facility expansion within the Colville River Delta as well as additional infrastructure in the Project area to pressurize fluids for transport to Alpine.
53	Delay permitting the Project indefinitely	This alternative concept is substantially similar to the No Action Alternative which is analyzed in detail in the Supplemental EIS. Should the No Action alternative be selected, the Project would be delayed indefinitely.
54	Restrict future development near the Project	Although BLM may require some modifications of the project layout and may include stipulations or mitigation measures to reduce impacts, BLM does not categorically prohibit development of other leases as a condition for developing the Willow reservoir.
55	Eliminate the Willow airstrip	This alternative concept was eliminated due to potential impacts in a sensitive area. The Alpine airstrip, located in the Colville River Delta (designated as an aquatic resource of national importance), was developed specifically for access only to the Alpine development. The U.S. Fish and Wildlife Service (a cooperating agency) strongly recommends against any increase in air traffic at this airstrip due to potential impacts to trust resources. Use of the airstrip for projects beyond Alpine would require expansion of the airstrip footprint and activity in this sensitive area, thereby impacting the unique wetlands and avian species within the Colville River Delta, with particular impacts to nesting and brood rearing birds.
56	Use extended reach drilling to develop Willow reservoir	The Willow development will use extended reach drilling to the maximum extent practicable. Although certain drill rigs such as Doyon Drilling, Inc. Rig 26 (i.e., "The Beast") are able to reach subsurface resources up to seven miles from a drill pad in certain conditions, those conditions (e.g., localized geology, depth to resource) do not exist in the relatively shallow Willow reservoir.

Component Number	Alternative Component Considered	Rationale for Elimination
57	Integrate the Willow airstrip with the road	Integrating the airstrip with a road presents a serious safety concern and the Federal Aviation Administration recommended against this alternative concept for that reason.
58	Eliminate prefabricated modules and barging	Certain Project components, such as turbines, separators, and vessels, are too large to transport via the existing Alaska highway system. Breaking down these components would require cutting them in pieces and re-welding them on the North Slope or building a fabrication facility on the North Slope to build them on site. This presents a safety hazard (e.g., a weld creates a failure point that could cause a separator to explode under pressure) or is impractical in the case of building a single use manufacturing plant on the North Slope.
59	Eliminate the use of hydraulic fracturing in the Willow Development	Hydraulic fracturing to stimulate well flow is a necessary and routine component of oil and gas development on the North Slope, where the practice was originally pioneered decades ago. Oil cannot be readily pumped to the surface without stimulating the well. The Willow development will not regularly hydraulically fracture the reservoir rock as is done in unconventional oil developments in the Lower 48.
60	Eliminate development of a new gravel mine site	Alternatives to the Willow Mine Site were evaluated in the 2020 EIS process (see section 3.2.10.1, *Use of Alternative Gravel Mine Sites*). Gravel is an extremely scarce resource on the North Slope and no viable alternative to the proposed action exists.
61	Include development of West Willow in the Willow MDP	The so called "West Willow" prospect is extremely speculative and it is unclear at this time whether the prospect will ever be developed. Only two exploratory wells have been drilled at this location (Greater Willow 1 and 2) and there is not enough information available to determine what infrastructure would be needed to develop the subsurface resource.
62	Delay permitting the Willow Project pending a global climate agreement	This alternative concept is substantially similar to Alternative A, No Action Alternative, which is analyzed in detail in the Supplemental EIS. Should the No Action alternative be selected, the Project would be delayed indefinitely, but it would not preclude CPAI from applying to develop the Willow Project again at the conclusion of ongoing climate negotiations.
63	Delay development of drill site pads in the Teshekpuk Lake Special Area	This alternative concept is substantially similar to the phasing concept (alternative concept number 52) being carried forward for full analysis in the Supplemental EIS.
64	Use an underground low salinity freshwater formation to supply Project water	Salinity analysis from all vertical appraisal wells in the Project area indicate that there are no freshwater intervals in the formations to support use for Project activities.

Note: BLM (Bureau of Land Management); BT2 (Bear Tooth drill site 2); BT4 (Bear Tooth drill site 4); BT5 (Bear Tooth drill site 5); CPAI (ConocoPhillips Alaska Inc.); EIS (environmental impact statement); GMT-1 (Greater Mooses Tooth 1); GMT-2 (Greater Mooses Tooth 2); IAP (Integrated Activity Plan); MDP (Master Development Plan); NPR-A (National Petroleum Reserve in Alaska); ROD (Record of Decision); ROP (required operating procedure); TLSA (Teshekpuk Lake Special Area); WPF (Willow processing facility).

*3.5.5.1 Access Concept – Reroute Access Road**

This alternative concept would reroute the proposed access road connection near its starting point at GMT-2 to avoid crossing the CRSA. This concept was driven by a cooperating agency comment seeking to avoid impacting the CRSA (BLM 2021a).

BLM examined three potential alignment options (Figure D.3.3):

- North Route – This alignment would route the road north and west to avoid yellow-billed loon nesting lakes. This alignment was found to be approximately 3 miles longer than the proposed alignment and it would include a crossing of Bill's Creek (near the headwaters) not required by the proposed alignment.
- Middle route – This alignment would route the access road between two lakes which are known to contain yellow-billed loon nests. This alignment would require exceptions to cross through the yellow-billed loon setback buffers (ROP E-11).
- South Route – This alignment would travel immediately outside of the CRSA, but it would cross yellow-billed loon setback buffers. This alignment would be approximately 0.5 mile longer than the proposed route and require exceptions to cross through the yellow-billed loon setback buffer (ROP E-11).

Multiple road alignments were previously reviewed and evaluated by cooperating agencies (e.g., EPA, USACE) (Appendix I.2, *ConocoPhillips Road Optimization Memorandum*) and the crossing of the northwest corner of the CRSA was determined to be preferable due to lower relative environmental impacts. While the proposed road alignment would encroach on the CRSA, alternative alignments would either increase the road's length and/or require significant encroachment on yellow-billed loon setback buffers. Further, the portion of the CRSA the proposed alignment would cross allows for new infrastructure construction and does not have special significance for CRSA raptor populations. This alternative concept was eliminated from further consideration in this Supplemental EIS.

*3.5.5.2 Access Concept – Disconnected BT2**

This alternative concept would eliminate one drill site (BT4) and develop a single drill site (BT2) within the TLSA that would not be connected to the other Project drill sites with a gravel road. Although disconnected (i.e., ice road only) drill sites were previously considered in the EIS, cooperating agencies were initially interested in examining a new disconnected configuration with only four drill site pads as an alternative concept.

An alternative without a gravel road connection would require additional, largely duplicative infrastructure, including a second airstrip, operations center, laydown yard, camp, drilling support/laydown area, chemical storage, and emergency response center to serve drill site BT2. For this alternative concept, three different airstrip locations (V1, V2, and V3) were examined to potentially support a disconnected drill site (newly generated for this Supplemental EIS as BT2 North) (Figure D.3.4). The BT2 North drill site location is the same location as the four-pad road connected alternative (Alternative E), and it would provide the greatest reservoir access for a single drill site within the TLSA. All location concepts (V1, V2, and V3) would require a diesel pipeline connection to the WOC. An annual ice road would be constructed between BT3 and BT2 North to provide for material and equipment resupply.

Site layout V1 would construct an airstrip and second WOC west of drill site BT2 North with a gravel road connection between the three facilities (Figure D.3.5).

Site layout V2 would construct an airstrip and second WOC south of drill site BT2, south of Fish Creek (Figure D.3.6). A gravel road would connect the three facilities and a bridge would be required across Fish Creek.

Site layout V3 would construct an airstrip and second WOC east of drill site BT2 with a gravel road connection between the three facilities (Figure D.3.7).

Disconnected drill site (i.e., no gravel road connection) development would remove the gravel road connection to drill site BT2 North, reducing the overall gravel footprint and this linear infrastructure, relative to CPAI's proposal (Alternative B). However, pipelines would still connect the drill site to other Project infrastructure, additional gravel infrastructure would be required to support year-round operations at drill site BT2 North, and an annual ice road would be required for the life of the Project. This alternative concept would also include the following additional, duplicative infrastructure in the TLSA:

- Airstrip

- Operations center
- Camp
- Chemical storage
- Laydown yard and storage
- Diesel pipeline
- Emergency response equipment

In addition to the extra gravel infrastructure, a drill site without a gravel road connection would require an annual ice road to provide for the resupply of materials and equipment, and the annual ice road construction would increase the overall vehicle activity within the TLSA over the life of the Project. Finally, disconnected drill sites increase spill risk as pipelines cannot be regularly monitored from roadways and any spills or releases are more challenging to respond to without all-season road access to the area.

BLM and CPAI identified three potential locations to locate an airstrip and supporting facilities for a disconnected BT2 North drill site. Of the three locations examined for siting an airstrip, only the V2 location would be logistically feasible from an engineering standpoint. The airstrip locations are described below.

Developing the V1 Siting location would require a larger gravel footprint than constructing a gravel-road connected drill site. The increased footprint would result from the additional infrastructure (e.g., airstrip, WOC) required to support an ice-road only drill site. The location of the airstrip would present significant topographic challenges as there is an approximately 20-foot elevation difference from end-to-end for the runway, which would require substantial gravel fill (up to approximately 30 feet deep in some locations). This also presents a safety concern for landing aircraft; if an aircraft overshot the runway, it could fall approximately 20 feet to the surrounding tundra at the end of the runway. Additionally, construction of the airstrip and support facilities would result in encroachments ROP E-11 (BLM 2022) yellow-billed loon nest setback buffers.

Developing the V2 Siting location would require a larger gravel footprint than constructing a gravel-road connected drill site. The V2 location would not encroach on yellow-billed loon setback buffers, but the access road from the airstrip would require crossing Fish Creek with a bridge to reach drill site BT2 North.

Developing the V3 Siting location would require overcoming substantial engineering challenges due to the undulating terrain and localized topography. Portions of the airstrip would be located along the side of a long hill and cross a swale, requiring greater gravel volumes and presenting similar feasibility and safety concerns as the V1 Siting location. Quantitative data (e.g., gravel fill volume, traffic numbers) for the V3 location was not calculated as the site was determined to have greater environmental impacts than the V2 location.

When reviewing the alternative concepts, ADF&G and NSB Wildlife representatives both stated a belief that a development without gravel road connections would have more impacts to subsistence hunters and caribou (from air traffic) than a gravel-road connected drill site (Person 2021). NVN and City of Nuiqsut representatives indicated that the increased air traffic volume would be too high and cause greater impacts to caribou and subsistence users (BLM 2021d).

This alternative concept would be logistically challenging because of the increased spill risk associated with pipelines without parallel roads and the increased safety risks associated with drilling on a pad that does not have year-round road access. The disconnected four-pad alternative would also not provide a clear environmental benefit relative to the originally proposed action (Alternative B). Of the three locations examined for siting an airstrip (V1, V2, and V3), only the airstrip location south of Fish Creek (V2) is logistically feasible from an engineering standpoint. This airstrip and road configuration would have the following impacts:

- A 50% increase in fixed-wing aircraft traffic and a 20% increase in helicopter traffic relative to Alternative B over the life of the Project. Aircraft traffic would be heaviest at the most sensitive times (calving and nesting) for the surface resources in the TLSA. Aircraft traffic is also the most cited impact to local subsistence hunters; the City of Nuiqsut is opposed to any alternative that increases aircraft traffic for this reason.
- A 20% increase in road traffic compared to Alternative B (due to ice road construction) over the life of the Project. Impacts on winter migration of caribou would be similar to a road connected BT2 alternative due to traffic associated with the construction and use of the annual ice road.
- An 8% increase in freshwater use relative to Alternative B.

- An overall decrease in gravel footprint (11-23 acres depending on BT5 location) but a 5 acre increase in gravel footprint in the TLSA relative to Alternative B.

The different impacts associated with a four-pad ice road-only BT2 alternative concept would not provide a clear net benefit to the important surface resources in the TLSA (Teshekpuk Caribou Herd and nesting migratory birds). In general, static obstacles such as roads cause less disturbance to caribou than sudden loud noises and movement (e.g., aircraft landing or taking off). During ice road season (winter to spring), impacts to caribou migrating through the Fish Creek corridor would be similar to a road connected alternative; however, traffic volumes would be much higher during this time period compared to a road-connected alternative due to the activity associated with ice road construction and the need to move a year's worth of resupply materials over approximately 3 to 4 months. Impacts to nesting migratory birds would be greatest between mid-May to mid-July and would be greatest within 0.5 mile of the airstrip under a disconnected BT2 alternative. Table D.3.8 provides a summary of preliminary impacts for the disconnected BT2 alternative concept (Site V2).

Table D.3.8. Summary of Preliminary Impacts for the Disconnected BT2 (Site V2) Alternative Concept*

Metric	Alternative B (Proponent's Project)	Alternative E (Three-Pad Alternative [Fourth Pad Deferred])	BT2 North Disconnected Alternative Concept (Site V2)
TLSA Gravel Footprint (acres)	106	61	111
Total Gravel Footprint (acres)	450	399	427
Total Gravel Volume (million cubic yards)	4.9	4.5	5.2
Total Ground Traffic (number of trips)	3,188,910	3,145,870	3,885,083
Total Fixed-Wing Traffic (number of trips)	12,101	11,983	18,030
Total Helicopter Traffic (number of trips)	2,421	2,421	2,965
Ice road (total miles)	495.2	431.2	590.7
Total Freshwater Use (million gallons)	1,662.4	1,478.7	1,721.6

Source: CPAI 2021.

Because of the increased ground and air traffic relative to CPAI's proposed project (Alternative B) and Supplemental EIS Alternative E, and the increased Project footprint within the TLSA, this alternative concept would not provide a relative environmental benefit compared to other Supplemental EIS alternatives and this alternative concept was eliminated from further analysis.

*3.5.5.3 Access Concept – Disconnected Drill Sites**

Several disconnected drill site concepts were suggested by different stakeholders during scoping, consultation, and cooperating agency meetings. Disconnected concepts included a five-pad alternative with disconnected drill sites BT4 and/or BT5, and a four-pad alternative with a disconnected BT5 (Figure D.3.8).

These disconnected alternative concepts would remove the gravel road connection to drill sites BT4 and/or BT5, reducing the overall gravel road footprint and linear infrastructure, relative to CPAI's proposal (Alternative B). However, pipelines would still connect the drill sites to other Project infrastructure and additional gravel infrastructure would be required to support year-round operations at drill sites BT4 and/or BT5. Like the Disconnected BT2 concept discussed above, a disconnected BT5 would require additional infrastructure to support BT5 activity:

- Airstrip
- Operations center
- Camp
- Chemical storage
- Laydown yard and storage
- Diesel pipeline
- Emergency response equipment
- Annual ice road connection to BT4 and/or BT5

In addition to the extra gravel infrastructure, a drill site without a gravel road connection would require an annual ice road to provide for the resupply of materials and equipment, and the annual ice road construction would increase the overall vehicle activity over the life of the Project. Finally, disconnected drill sites increase spill risk as pipelines cannot be regularly monitored from roadways and any spills or releases are more challenging to respond to without all-season road access to the area.

Impacts from a four-pad disconnected BT4 or BT5 drill site would be similar to those of a disconnected BT2 North drill site, with an increase in aircraft and vehicle traffic, increased freshwater requirements, and increased gravel needs. For these reasons and based on the evaluation of the Disconnected BT2 alternative concept, including comments received from cooperating agencies (BLM 2021d; Person 2021), this alternative concept was eliminated from further analysis in this Supplemental EIS.

A five-pad alternative that disconnects BT4 and a five-pad alternative that disconnects BT5 are substantially similar to Alternative C, and these alternative concepts were eliminated from further analysis for that reason. The five-pad disconnected concept would also have significant increases in aircraft traffic during the summer caribou calving season near the Teshekpuk Caribou Herd calving grounds and would not provide an environmental benefit relative to Alternative B.

A five-pad alternative that disconnects BT4 and BT5 would require three airstrips and three operations center pads, and this alternative concept would not provide an environmental benefit relative to Alternative B.

*3.5.5.4 Access Concept – Seasonal Drilling**

This concept is tied to alternative concepts that propose the use of disconnected drill sites. Under this alternative concept, drilling on disconnected pads would only occur during the winter ice-road season to prevent drilling-related emergencies occurring when there is not ice-road access to the drill site; there are no instances on the North Slope where a drilling rig has been required to respond to an uncontrolled well incident on a pad where active drilling was not occurring. Under this alternative concept, construction and routine operations would still occur year-round; only drilling would be limited to the ice road season.

This alternative concept was used in the development of Alpine CD3; however, there are key differences between the Willow and Alpine projects. Although this alternative concept would reduce potential impacts from an uncontrolled well incident, it does not address the greatly elevated health, safety, and environmental risks at a disconnected drill site. Construction and routine work operations would occur year-round and personnel safety would be compromised if an injury or illness required evacuation during a severe weather event outside the ice road season. Unlike at Alpine's CD3 drill site, none of the proposed Project drill sites are located near a river to provide summer water access in the event a worker must be evacuated due to a medical emergency when flights are precluded due to inclement weather. Mobilization of emergency response equipment by aircraft or tundra travel vehicle is subject to adverse weather conditions such as extreme low temperatures, low level fog, high winds, and blowing snow, all of which are routine on the North Slope, even outside of the traditional ice road season. Limited road access reduces or eliminates options for mobilizing necessary response and medical equipment and personnel. Mobilization of critical emergency response equipment could prove impossible. In BLM's expert opinion, disconnected drill sites would create unacceptable hazards for safety and emergency response, as well as protection of the environment.

This alternative concept would also have the additional infrastructure requirements (and additional surface impacts) as other disconnected drill site alternatives (Sections 3.5.3.3 and 3.5.3.4).

*3.5.5.5 Access Concept – No Barging of Modules**

Under this alternative concept, drill site and processing modules would be fabricated into sizes capable of being transported by truck or aircraft to the Project area, and no barging of modules or bulk construction materials would be permitted. This alternative concept is logistically infeasible and would not provide an environmental benefit relative to the proposed action (Alternative B). The maximum weight that can be shipped by truck is approximately 170,000 pounds due to weight limitations and restrictions of bridges along the Dalton Highway. The Project modules can only be made so small and the largest module component that would need to be shipped is approximately 220,000 pounds. A single sealift module would equate to 35 to 45 truck trips and certain module components are too large or too heavy to be shipped by truck (e.g., tanks with greater than 750 barrels in volume capacity, primary and secondary separators). Shipping module components by aircraft is also logistically infeasible; the weight limitation for a C-130 aircraft is approximately 48,000 pounds. Furthermore, breaking modules down far enough to truck them to the Project area would greatly increase the construction activity (e.g., aircraft trips, vehicle traffic) and would require an expansion of the gravel footprint at each pad for module assembly. Processing facility modules are purchased preassembled and breaking them down and reassembling them during winter would create additional safety risks to workers exposed to severe winter weather conditions.

*3.5.5.6 Pad Concept – Relocate BT4 to the South**

This five-pad alternative concept would move drill site BT4 south to avoid or reduce impacts calving caribou. This alternative concept is substantially similar to Alternative E, which was carried forward for full analysis in this Supplemental EIS. The purpose of both of these alternative concepts is to reduce infrastructure within the TLSA. Alternative E is the better alternative concept because it has a greater infrastructure reduction within the TLSA; rather than having two drill sites with overlapping drilling reach in the TLSA, Alternative E eliminates drill site BT4 in its entirety.

*3.5.5.7 Pad Concept – Relocate BT2 to the West**

This alternative concept applied to both four- and five-pad alternatives and it would relocate drill site BT2 (or drill site BT2 North) westward to increase the buffer between the drill site and Fish Creek. Relocating the drill site to the west would move it into setbacks intended to protect other resources. Neither BT2 or BT2 North are within the Fish Creek setback and moving the drill sites into other resource setbacks would not provide an environmental benefit to water quality, waterfowl, or caribou movement within the Fish Creek corridor.

*3.5.5.8 Pad Concept – Eliminate BT4 and BT5**

This alternative concept would include drill sites BT1, BT2, and BT3 and would eliminate drill sites BT4 and BT5 from the Alternative B Project B configuration.

This alternative concept would address the District Court's decision, but would not meet the Project's purpose and need and would strand an economically viable amount of oil based on BLM's review of available geologic data and the fact that CPAI has proposed constructing a gravel road and pad to extract it in its proposed action (Alternative B).

*3.5.5.9 Pad Concept – No Infrastructure within the Teshekpuk Lake Special Area**

Under this alternative concept, no new Project infrastructure would be constructed within the TLSA. This alternative concept was driven by comments received from Trustee's for Alaska on the 2019 Willow MDP Draft EIS and the 2021 District Court ruling vacating the Willow ROD. Under this concept, drill site BT4 would be eliminated and drill site BT2 would shift south to be just outside of the TLSA (Figure D.3.9).

Approximately 67% CPAI's BTU leases by surface area are located in the TLSA. This concept would completely eliminate access to oil and gas resources in several BTU leases located in the TLSA, substantially reduce access to such resources in additional BTU leases located in the TLSA, and create significant overlap in drilling reach between drill sites BT1 and BT2, which would have the net effect of having all of the surface impacts of a road and two pads but with far less resource recovery.

While this alternative concept would theoretically address the District Court's directive to provide maximum protection to important surface resources in the TLSA, it would not meet the Project's purpose and need and would strand an economically viable quantity of recoverable oil. This alternative concept would strand all of the oil that would be accessed by drill site BT4 and some of the oil that would be accessed from drill site BT2. BLM determined that there is an economically viable quantity of recoverable oil in this area based on its review of the available geologic data and because there is enough resource accessible from BT4 that CPAI has proposed constructing a gravel road and drill site pad to access it.

*3.5.5.10 Pad Concept – BT2 South of Fish Creek**

Under this alternative concept, the Project would eliminate one drill site (BT4) and construct four drill sites (Figure D.3.10), with one drill site (BT2) remaining in the TLSA, south of Fish Creek. This alternative concept was suggested by BLM and cooperating agencies during alternatives development. Due to existing ROPs (e.g., Fish Creek setback), CPAI did not identify a more favorable location (i.e., a site where additional oil resources could be targeted) and this alternative concept would use the same BT2 location as action alternatives B, C, and D.

This alternative concept would address the District Court's decision, but it would not meet the Project's purpose and need and would strand an economically viable amount of oil based on BLM's review of available geologic data and the fact that CPAI has proposed building a road and pad to extract it in its proposed action (Alternative B).

*3.5.5.11 Pad Concept – Four Pad Shift**

This alternative concept was developed by BLM in an attempt to move all drill site pads outside of resource setbacks while reducing the overall surface infrastructure within the TLSA and maximizing extraction of the targeted oil deposits. This concept would eliminate drill site BT4 and shift the four remaining drill site pads north (Figure D.3.11) to access as much of the oil-producing reservoir as feasible, while having four drill site pads overall and only allowing one drill site within the TLSA. All drill site pad locations would avoid BLM setback buffers. This alternative concept was eliminated from full analysis because it is substantially similar to the BT2 North of Fish Creek alternative concept (Section 3.5.4.1), which was advanced for full analysis as a new alternative (Alternative E: Three-Pad Alternative [Fourth Pad Deferred]) in this Supplemental EIS. Of the two alternative concepts, BT2 north of Fish Creek would provide better reservoir access, is more consistent with the requirement of BLM regulations, and was most responsive to the District Court's decision because it would provide the greatest reduction of infrastructure and activity within the TLSA.

*3.5.5.12 Infrastructure Concept – Diesel Pipeline Extension**

This alternative concept was suggested by Kuukpik Corporation in comments on the Draft EIS. A diesel pipeline connection between Kuparuk CPF2 and the WPF is included under Alternatives C and D (a requirement to supply fuel for the life of the Project under these alternatives due to Project components not being connected to existing development at Alpine with an all-season gravel road). The intent of including a diesel pipeline under all action alternatives would be to reduce the amount of fuel trucked over Project roadways to try and reduce the risk of a fuel spill along Project roads and to reduce the impacts of vehicle traffic on subsistence users in the Project area. Inclusion of a diesel pipeline could potentially be accomplished in two ways: first, by constructing a standalone diesel pipeline designed and constructed for this express purpose, or second, by using one of the pipelines intended for seawater or sales oil.

Overall, the benefits of a diesel pipeline extension to the WPF would not outweigh the impacts associated with extending the pipeline:

- A diesel pipeline extension would not be in operation until the end of Project construction; however, during the construction phase is when the Project would require the greatest amount of diesel fuel. Installation of a diesel pipeline would not eliminate a significant portion of the truck traffic required to haul diesel fuel between Alpine and the Project area.
- Following construction, fuel would only be pumped through the pipeline for a few days each month to refill storage tanks and the pipeline would remain idle the remainder of the time. The idle diesel fuel pipeline would increase the potential for sedimentation and corrosion within the pipeline, which would increase the risk of a diesel pipeline spill.
- Extending the pipeline to the WPF would add an additional year to the construction phase, which would also require extending water withdrawals to support ice road construction.
- Pipeline construction would further increase traffic during a time when the Project would have its highest traffic levels (construction phase), further increasing potential impacts from construction traffic.
- Pipelines built for other purposes (i.e., seawater pipeline, sales oil pipeline) would not be suitable for transporting diesel fuel. The optimal pipeline diameter for the amount of diesel need for the Project is 4 to 6 inches; using the 14-inch sales oil pipeline or the 20-inch seawater pipeline would result in a pipeline flow rate less than 5 feet per second, the minimum velocity needed to prevent water and solids from falling out of the fuel).

For these reasons, BLM has eliminated the alternative concept of extending a diesel pipeline to the WPF for action alternatives with a year-round gravel road connection to the Project area and each drill site; the diesel pipeline is still included as part of Alternatives C and D due to their disconnected access to Project facilities (varies by alternative).

*3.5.5.13 Infrastructure Concept – Use the Alpine Central Processing Facility**

Use of the existing ACF at CD1 would not be technically or economically feasible. The ACF does not have sufficient capacity to accommodate the anticipated Project production. The ACF receives and processes produced fluids from drill sites within the Colville River Unit (CRU) and Greater Moose's Tooth Unit (GMTU). The ACF's gas handling capacity of 190 to 220 million standard cubic feet per day is a primary driver of total liquid throughput, and with the production from GMT-1, the ACF is expected to operate at or near gas and water handling capacity into the 2030s. The estimated processing capacity necessary to support Project production is estimated at a maximum of 200,000 barrels of oil per day, 175,000 barrels of water per day, and 300 million standard cubic feet of gas per day, which exceeds the maximum capacity at ACF.

Accommodation of the Project's production at the ACF would require a substantial expansion of the existing facility in the Colville River Delta, a sensitive area with trust resources of concern for the U.S. Fish and Wildlife Service. Furthermore, the ACF is located approximately 40-pipeline miles from the closest proposed drill site (BT3) and 54-pipeline miles from the farthest drill site (BT4). These distances are beyond the outer limits over which the transport of produced fluids and power is economically feasible. Moreover, pressures in the Project's targeted reservoirs are substantially less (approximately 50%) than pressures observed in other Western North Slope developments, presenting additional technical challenges to fluid transport and coprocessing with the higher-pressure Alpine development.

Movement of produced fluids from the Project area to the ACF would likely result in the need for additional facilities and additional gravel footprint within the Project area as well as at Alpine. Processing Project production at the ACF would also require substantial facility expansion and debottlenecking, as well as facility in the Project area to boost production fluid pressure sufficiently to overcome pipeline backpressure from the ACF. Boosting the fluid pressure could be accomplished by multiphase pumps or partial processing, similar to Kuparuk Central Processing Facility 3. However, either method would still require substantial infrastructure in the Project area and expansion of the ACF, likely by means of a parallel processing train on a new gravel pad with the Colville River Delta. Additionally, power expansion at Alpine would require upgrades to the entire existing power grid from 13.8 to 34.5 kilovolt (kV), requiring not only additional generation capacity at the ACF, but also upgrades to the bus and power grid at the ACF and existing Alpine drill sites (including GMT-1 and GMT-2) and a new 34.5 kV grid in the Project area.

*3.5.5.14 Phase Concept – Delay Permitting of the Willow Project Indefinitely**

This alternative concept would delay issuing a decision on the Project indefinitely. This is substantially similar to the No Action Alternative (Alternative A) that was fully analyzed in the Supplemental EIS. The No Action Alternative would deny CPAI's application to develop the Willow Project, although it would not preclude CPAI from applying again in the future.

*3.5.5.15 Phase Concept – Restrict Future Development's Use of Willow Project Infrastructure**

This alternative concept would issue a ROD for the Project with a rider that restricts future development in the BTU and prevents development outside the BTU from using the Project's proposed infrastructure. Although BLM may require modifications to the project layout and may include stipulations or mitigation measures to reduce impacts, BLM does not categorically prohibit development of other leases as a condition of the developing the Willow reservoir.

*3.5.5.16 Access Concept – Eliminate the Willow Airstrip**

This alternative concept would eliminate the Willow airstrip and route all aircraft traffic through the Alpine airstrip. This alternative concept was eliminated due to potential impacts in the Colville River Delta, a sensitive area designated as an aquatic resource of national importance. The Alpine airstrip was developed specifically to access only to the Alpine development. The U.S. Fish and Wildlife Service (a cooperating agency) strongly recommends against any increase in air traffic at this airstrip due to potential impacts to trust resources. Use of the airstrip for projects beyond Alpine would require expansion of the airstrip footprint and activity in this sensitive area, thereby impacting the unique wetlands and avian species within the Colville River Delta, with particular impacts to nesting and brood rearing birds (Personal communication between Stephanie Rice and Louise Smith, U.S. Fish and Wildlife Service).

*3.5.5.17 Infrastructure Concept – Use Extended Reach Drilling to Develop the Willow Reservoir**

This alternative concept would require the use of extended reach drilling (ERD) to the maximum extent demonstrated on the North Slope (7 miles) to develop the Willow reservoir. ERD, which is defined as directional drilling of very long wells, generally with a horizontal to vertical ratio equal to or greater than 2:1. For the Project, this would equate to an ERD reach of approximately 2.5 miles. However, requiring the Project to be designed around an assumed 7-mile ERD reach from drill site pads is technologically infeasible due to the Willow reservoir's shallow depth. Although there is a drill rig on the North Slope that has demonstrated the potential to hit drill targets 7 miles from a drill pad (e.g., Doyon Drilling, Inc. Rig 26), the conditions necessary to achieve this do not exist at the Willow reservoir. ERD limitations are based on factors such as mechanical limitations of the drill string, limitations of rock formations, dynamic and static downhole fluid pressures, and the ability to run casing and completion strings to final depth of the well. In simple terms, the deeper the target reservoir, the further ERD can reach from a surface drill pad. The relatively shallow Willow reservoir would not allow for a 7-mile drilling reach with current technology. The Willow reservoir is at a true vertical depth less than approximately 4,000 feet, which is approximately 3,000 feet shallower than the reservoir targeted by ERD in the Colville River Unit by the Doyon Drilling, Inc. Rig 26 drill rig.

*3.5.5.18 Infrastructure Concept – Integrate the Willow Airstrip with the Road**

This alternative concept would integrate the Willow airstrip with the road to reduce the Project's overall gravel footprint. Although this has been done at Alpine, there are serious safety concerns with integrating a road and airstrip. The poor visibility and lack of a control tower at the Willow airstrip would create an unacceptable risk of a vehicle and aircraft collision and the Federal Aviation Administration strongly recommended against such an alternative concept based on safety concerns (Personal communication between Stephanie Rice and Moss, Federal Aviation Administration).

*3.5.5.19 Infrastructure Concept – Eliminate Prefabricated Modules and Barging**

This alternative would eliminate all modules and break down Project equipment to a size that could be transported via road or aircraft to the North Slope. The modules would be "stick built" at the Project location. This alternative concept presents serious worker and operations safety issues. Breaking down separators and other equipment to a size that could be transported via the existing road system would require cutting them in half and welding them back together on the North Slope. This would create a failure point that could cause the separator to explode when under pressure. Building an on-site fabrication facility to produce this equipment would also be infeasible and would require a significant expansion of the Project footprint.

Assembling the Project facilities on site would also create a safety hazard for workers. North Slope operations are typically conducted indoors to prevent cold weather injuries to workers in the winter; assembling drill site and central processing facility modules would require outdoor work in temperatures as low -60 degrees Fahrenheit to assemble the modules. Limiting construction to the summer season would require a significant expansion of the gravel footprint to provide enough laydown space for the component pieces of the modules prior to assembly.

*3.5.5.20 Access Concept – Eliminate the Use of Hydraulic Fracturing**

This alternative concept would eliminate the use of hydraulic fracturing for initial well stimulation. This alternative concept is not technologically feasible; nearly all oil developments on the North Slope require the use of hydraulic fracturing to initially stimulate the flow of oil and gas from wells. See Section 4.2.10.2.1, *Hydraulic Fracturing*, for a description of how hydraulic fracturing would be used in the Project.

*3.5.5.21 Access Concept – Eliminate Development of the Willow Mine Site**

This alternative concept would eliminate development of the new Willow Mine Site. This alternative was investigated extensively during the 2020 EIS process and no feasible alternative exists to the proposed mine site. See Section 3.2.10.1, *Use of Alternative Gravel Mine Sites*, for more details.

*3.5.5.22 Phase Concept – Include Development of West Willow in the Willow Master Development Plan**

This alternative concept would expand the scope of the Willow MDP to include development of the so called "West Willow" prospect. The West Willow prospect is different than the Willow reservoir and the reservoirs are at different points in the exploration and development process. The Willow reservoir has had several exploratory and appraisal wells drilled and is part of an established oil and gas unit; the Willow MDP is the development plan for the BTU. Although West Willow is a reasonably foreseeable future action and is analyzed in cumulative effects (Willow MDP EIS, Section 3.20), it is far too speculative to create a detailed development proposal. Only two exploratory wells have been drilled at West Willow (Greater Willow 1 and 2) and these wells do not provide enough detail about this prospect for it to be unitized or included in an existing unit. Until more information is known about the West Willow prospect, it is speculative to assume what form a development would take and whether it would be developed.

*3.5.5.23 Phase Concept – Delay Permitting the Willow Project Pending a Global Climate Agreement**

This alternative concept would delay permitting the Willow Project until a global agreement exists to limit greenhouse gas emissions. This alternative is substantially similar to the Alternative A, the No Action Alternative, which was analyzed in detail in the Supplemental EIS.

*3.5.5.24 Phase Concept – Delay Development of Drill Site Pads in the Teshekpuk Lake Special Area**

This alternative concept would delay development of drill site pads in the TLSA to provide more time for consultation with Nuiqsut on ways to reduce impacts to migrating caribou and subsistence hunters. Under Alternatives B, C, and D, this concept would delay the development of drill sites BT2 and BT4, and under Alternative E, this concept would delay development of drill site BT2. This alternative concept is substantially similar to the phasing concept carried forward for full analysis in the Supplemental EIS, which would delay permitting of drill site BT5 under Alternative E, and would delay permitting of drill sites BT4 and BT5 under Alternatives B, C, and D.

Reducing the overall linear length of the Project was suggested by Kuukpik (an Alaska Native Claims Settlement Act corporation representing the environmental justice community of Nuiqsut) in their scoping comments as the best way to reduce impacts to migrating caribou and subsistence hunters (Kuukpik Corporation 2022). Their comments suggested that the Project should be reduced in length on both the northern and southern end. In the case of Alternative E, the northern extent of the Project was reduced by eliminating drill site BT4, and the southern extent was reduced by deferring development of drill site BT5 and relocating it 1.8 miles to the northeast. Under the other action alternatives, impacts to subsistence hunters and migrating caribou are addressed by deferring development of the northern most and southern most drill sites (BT4 and BT5, respectively).

*3.5.5.25 Water Source Concept – Use Underground Low-Salinity Freshwater Formations to Support Project Activities**

This alternative concept would replace in whole or in part the use of Project area surface waters or the CFWR. Freshwater would instead be produced using underground, low-salinity freshwater formations. Such formations have been successfully used near Milne Point and Prudhoe Bay to support oil and gas development activities. However, salinity analysis of all vertical appraisal wells in the Project area indicates that there are no freshwater intervals in area formations to use for Project activities.

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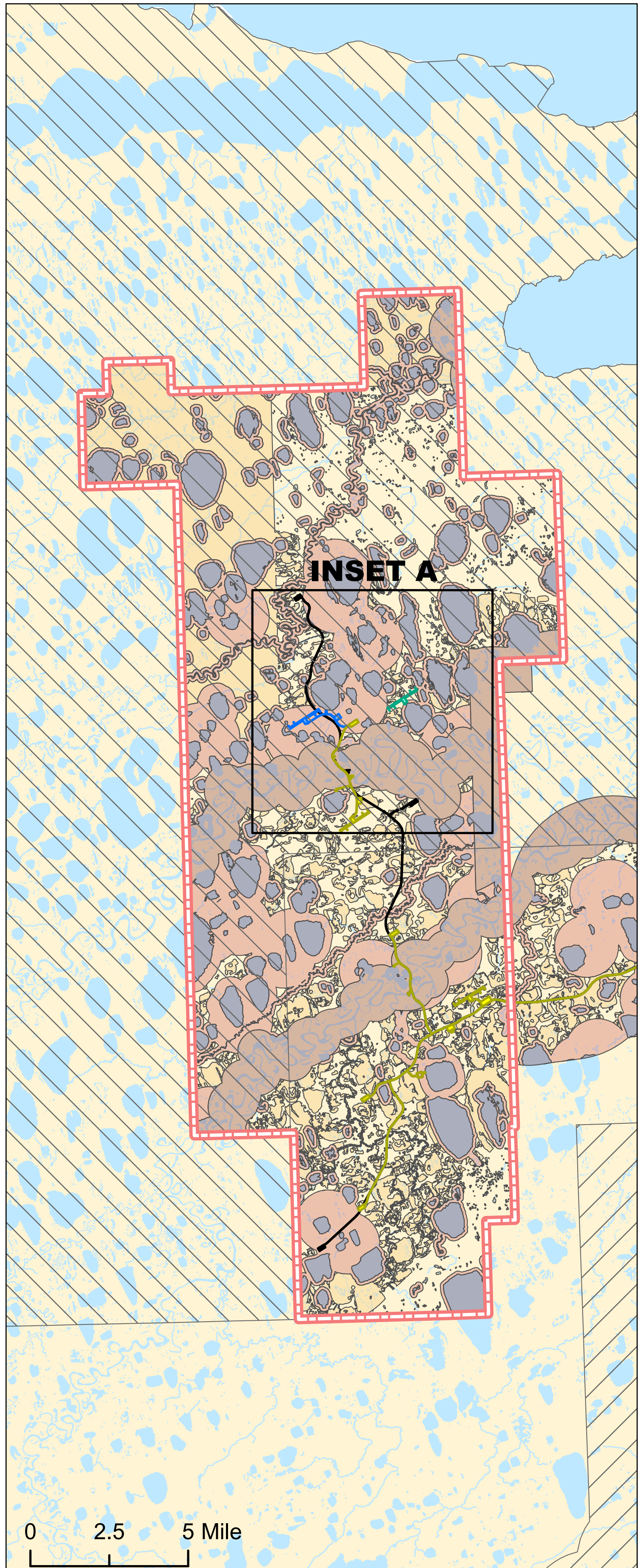
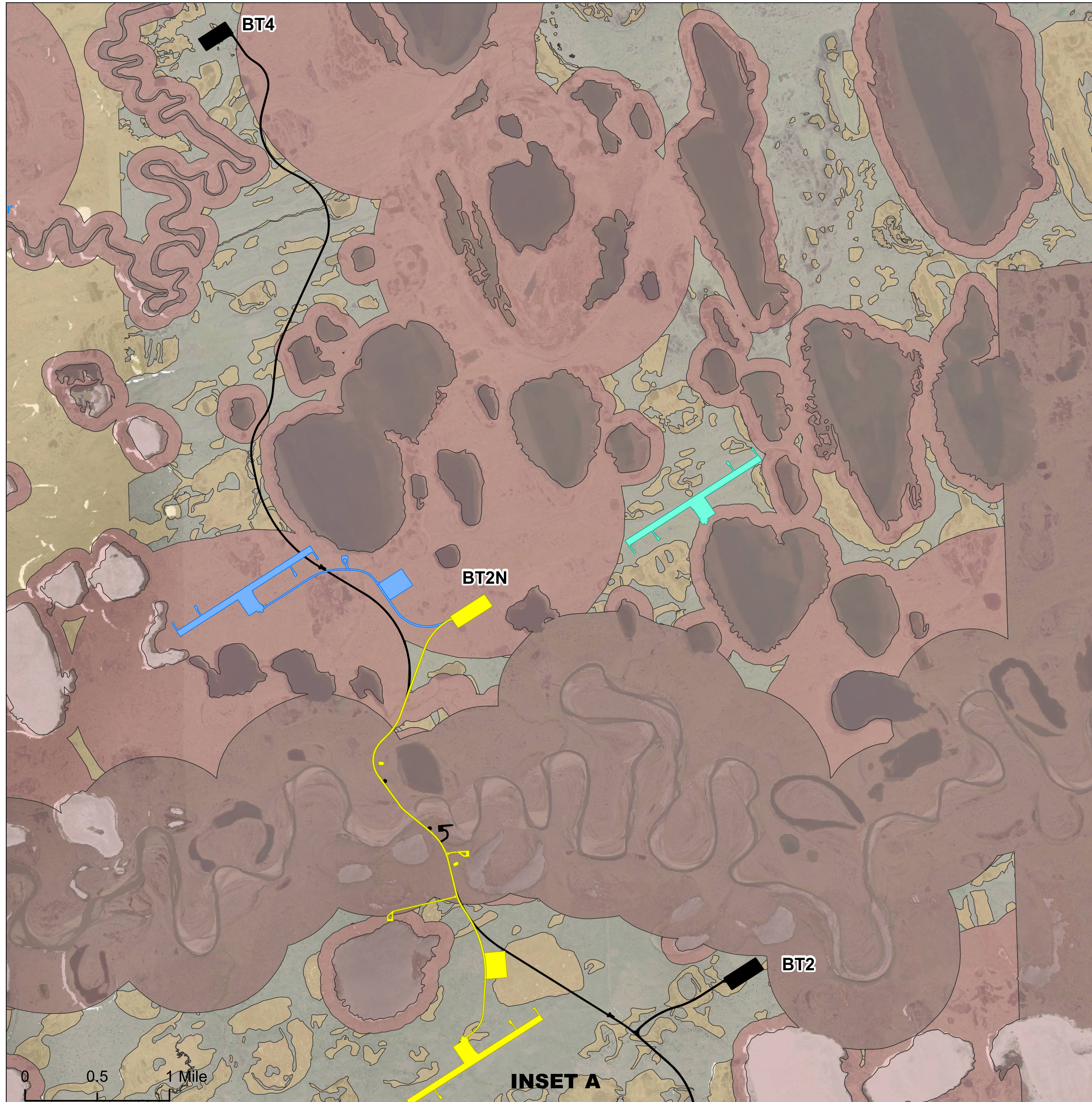
Figure D.3.3





Alternative Access Concepts
- Proposed Roadless BT2N V1
- Proposed Roadless BT2N V2
- Proposed Roadless BT2N V3

Willow Proposed Development Features
- Alternative B Project Footprint

Oil and Gas Unit
- Bear Tooth Unit

NPR-A Special Areas
- Colville River Special Area
- Teshekpuk Lake Special Area

Land Designation
- National Petroleum Reserve in Alaska

Willow Environmental Constraints
- Drillsite Not Allowed
- Drillsites Allowed with Waiver
- Sensitive Areas - Waiver Not Required - additional considerations may apply

Note: Entire area of figure is within Teshekpuk Lake Special Area and National Petroleum Reserve in Alaska

Figure D.3.4

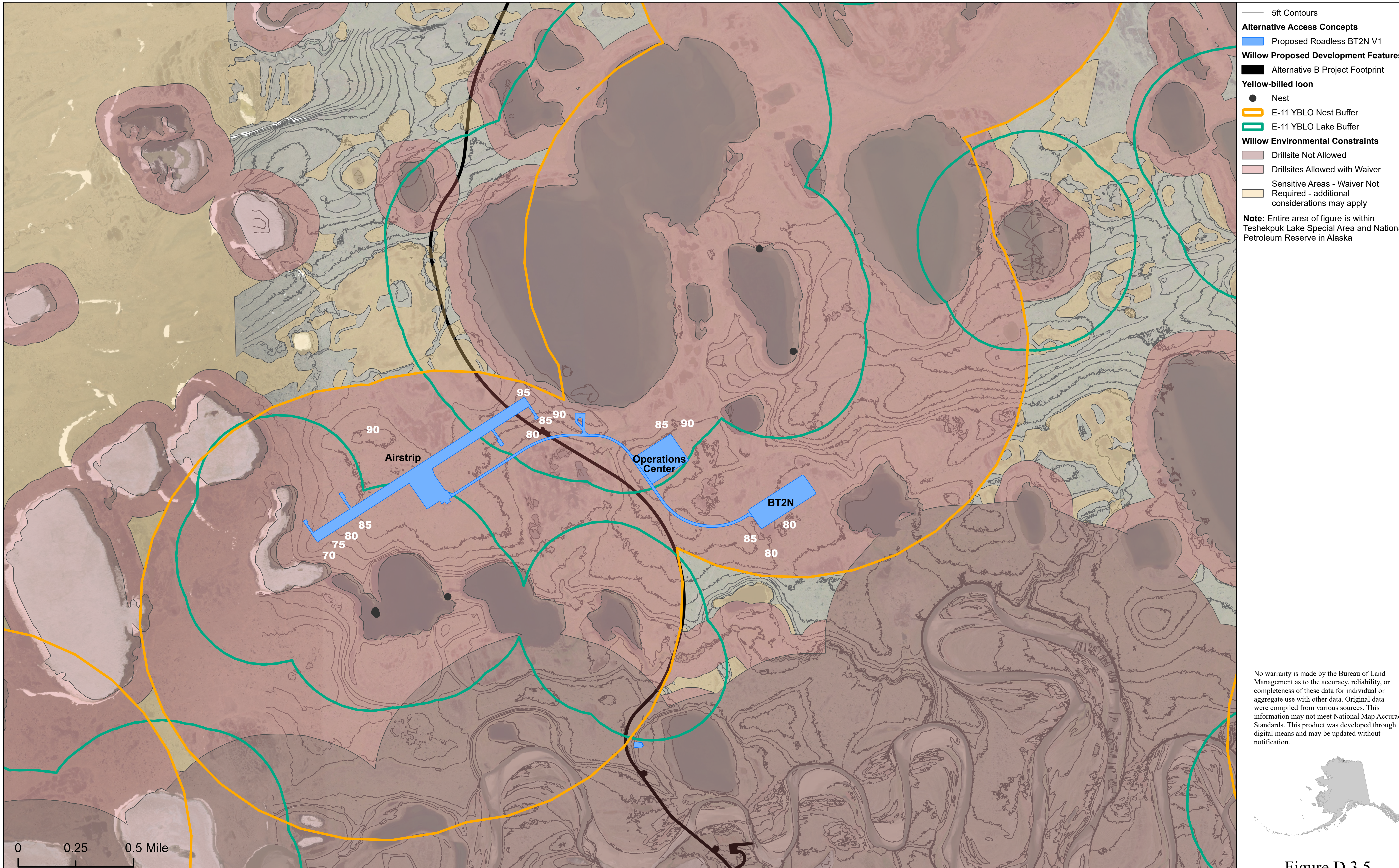


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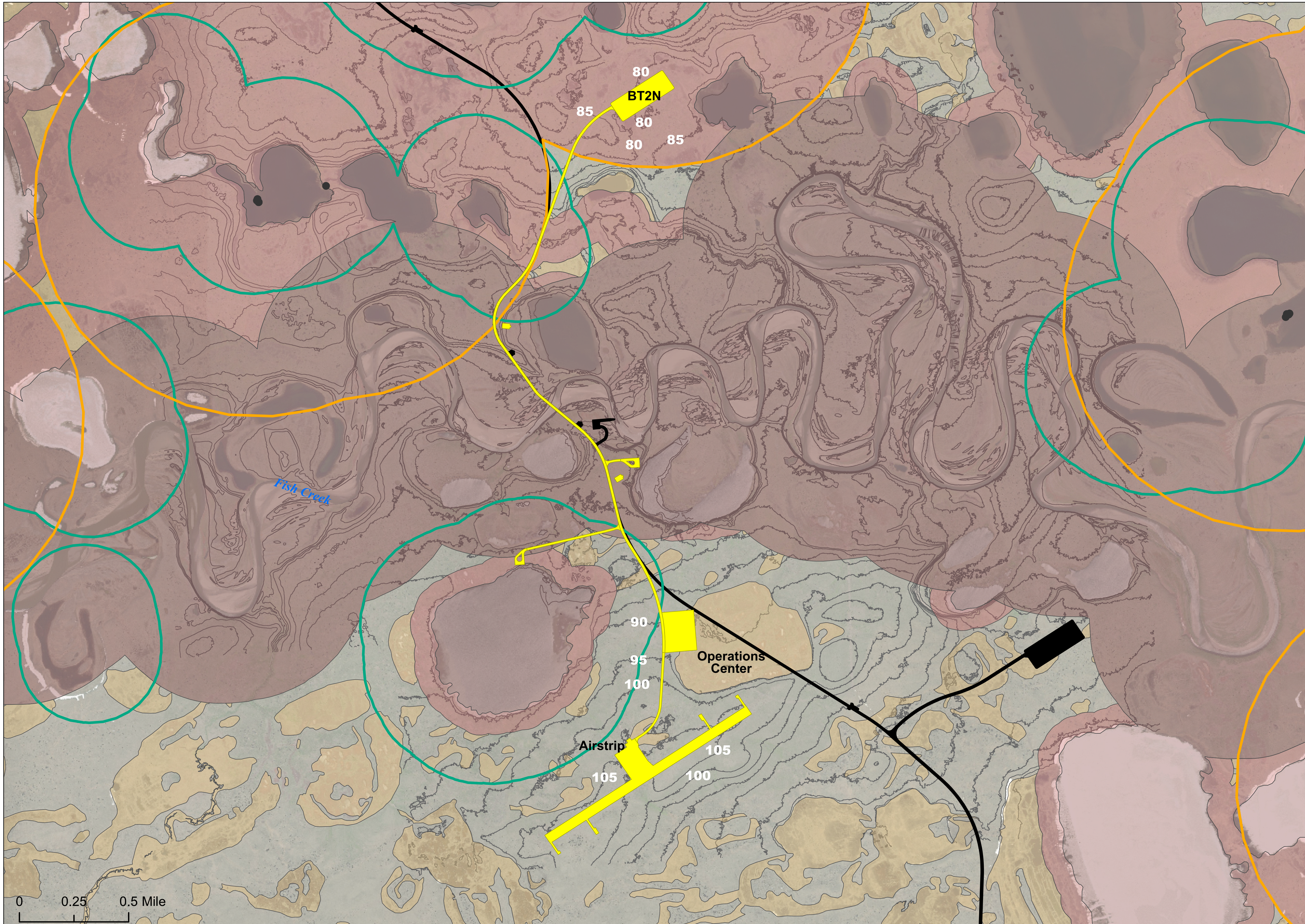
Figure D.3.5



5ft Contours
Alternative Access Concepts
Proposed Roadless BT2N V2
Willow Proposed Development Features
Alternative B Project Footprint
Yellow-billed loon
Nest
E-11 YBLO Nest Buffer
E-11 YBLO Lake Buffer
Willow Environmental Constraints
Drillsite Not Allowed
Drillsites Allowed with Waiver
Sensitive Areas - Waiver Not Required - additional considerations may apply

Note: Entire area of figure is within Teshekpuk Lake Special Area and National Petroleum Reserve in Alaska

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Figure D.3.6

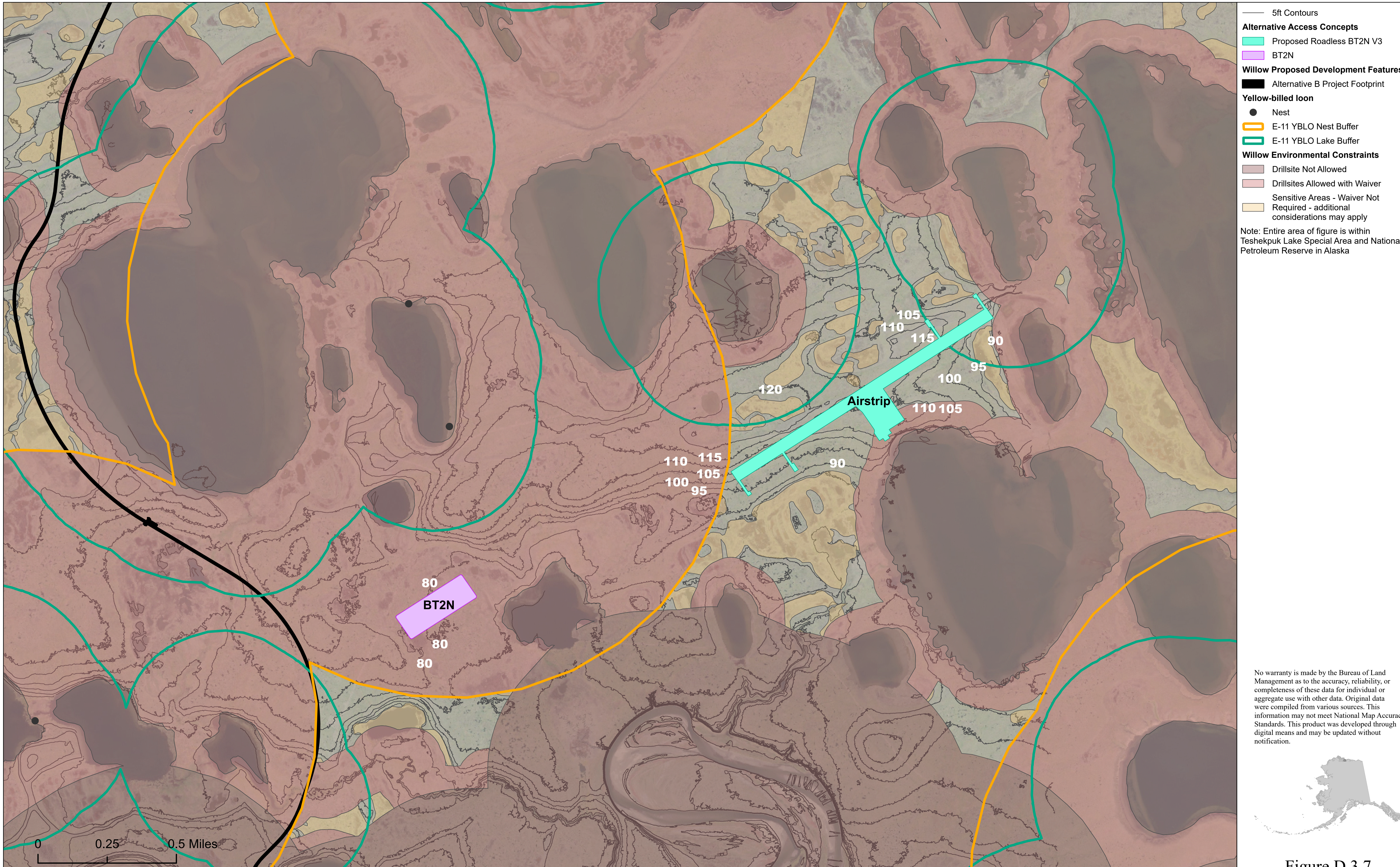
5ft Contours
Alternative Access Concepts
Proposed Roadless BT2N V3
BT2N
Willow Proposed Development Features
Alternative B Project Footprint
Yellow-billed loon
Nest
E-11 YBLO Nest Buffer
E-11 YBLO Lake Buffer
Willow Environmental Constraints
Drillsite Not Allowed
Drillsites Allowed with Waiver
Sensitive Areas - Waiver Not Required - additional considerations may apply
Note: Entire area of figure is within Teshekpuk Lake Special Area and National Petroleum Reserve in Alaska
Airstrip
BT2N
0
0.25
0.5 Miles

Figure D.3.7


BT3
Airstrip
Operations Center
BT5
Lake R0064
0
0.25
0.5 Mile
Alternative Access Concepts
Disconnected BT5 Gravel Footprint
Willow Proposed Development Features
Alternative B Project Footprint
Oil and Gas Unit
Bear Tooth Unit
Yellow-billed loon
Nest
E-11 YBLO Nest Buffer
E-11 YBLO Lake Buffer
NPR-A Special Areas
Teshekpuk Lake Special Area
Willow Environmental Constraints
Drillsite Not Allowed
Drillsites Allowed with Waiver
Sensitive Areas - Waiver Not Required - additional considerations may apply
Note: Entire area of figure is within National Petroleum Reserve in Alaska

Figure D.3.8

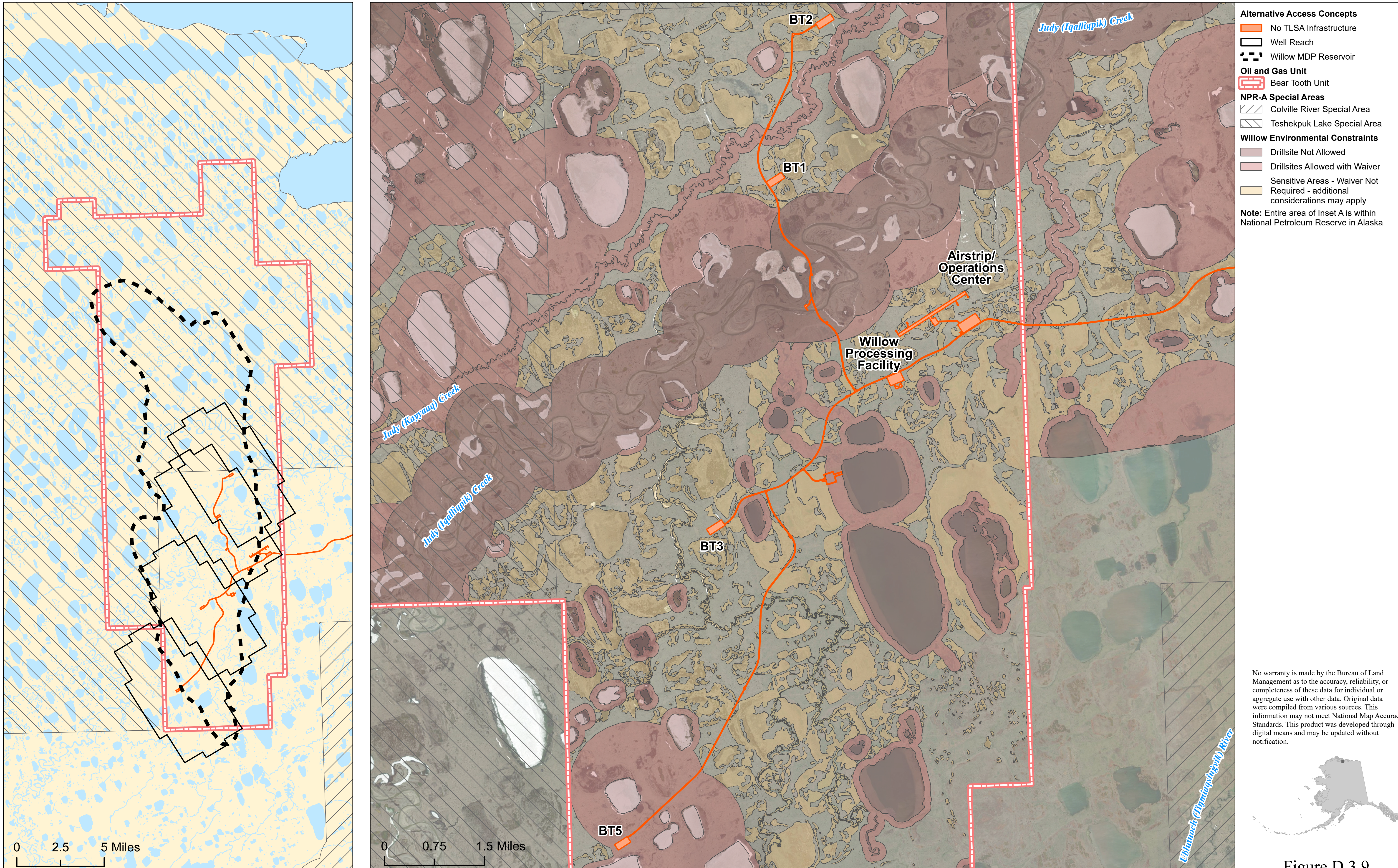

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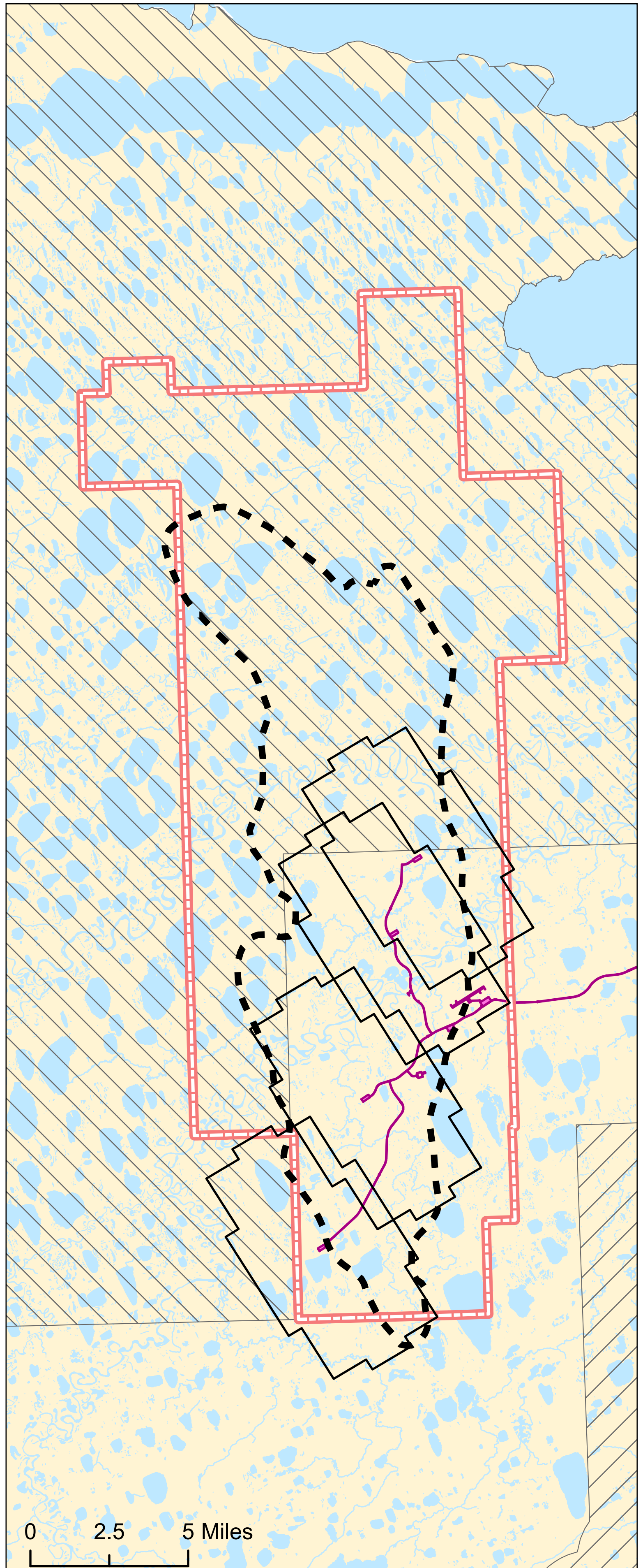
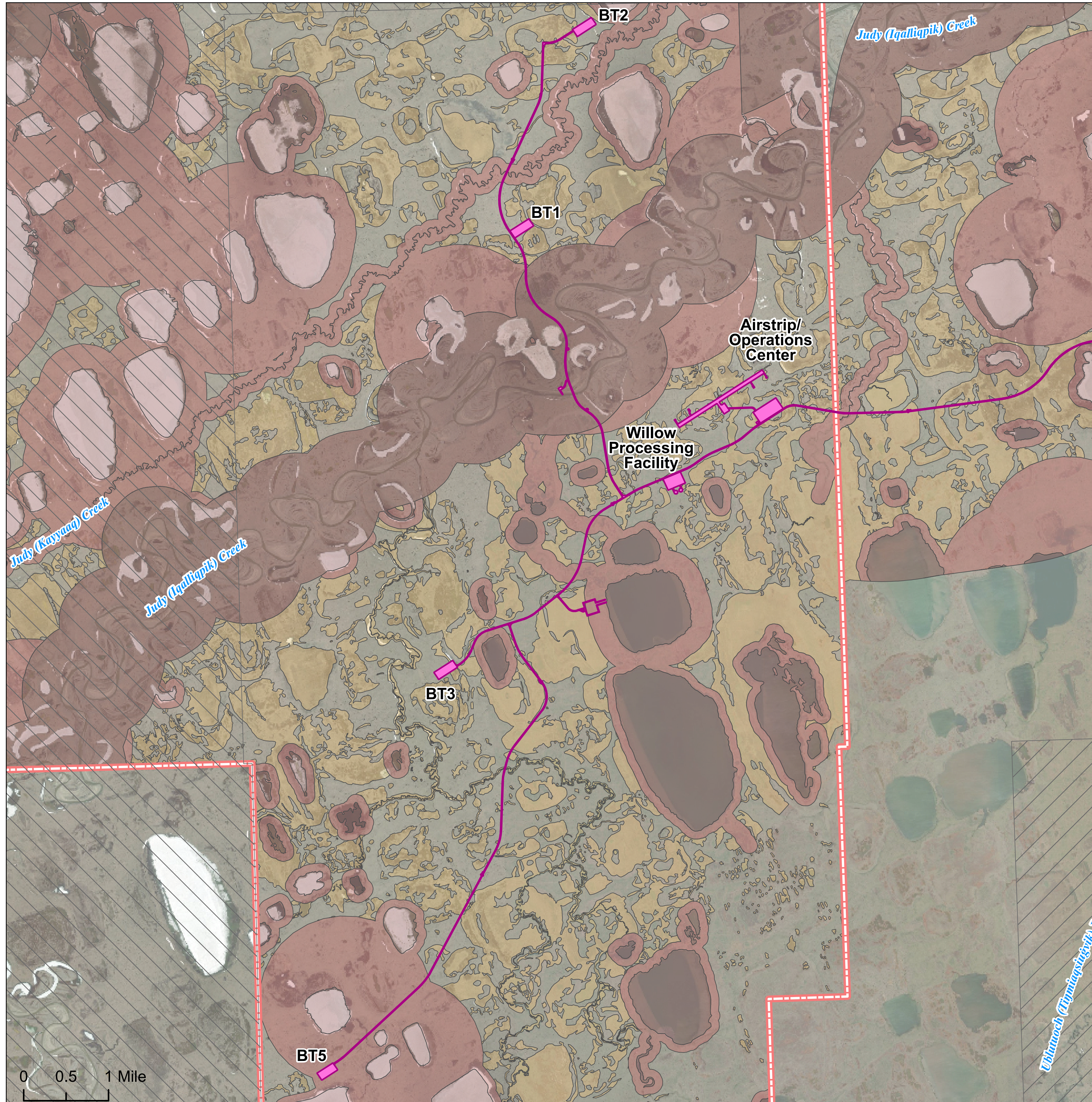
Figure D.3.9





Alternative Access Concepts
- BT2 South of Fish Creek
- Well Reach
- Willow MDP Reservoir

Oil and Gas Unit
- Bear Tooth Unit

NPR-A Special Areas
- Colville River Special Area
- Teshekpuk Lake Special Area

Willow Environmental Constraints
- Drillsite Not Allowed
- Drillsites Allowed with Waiver
- Sensitive Areas - Waiver Not Required - additional considerations may apply

Note: Entire area of Inset A is within National Petroleum Reserve in Alaska

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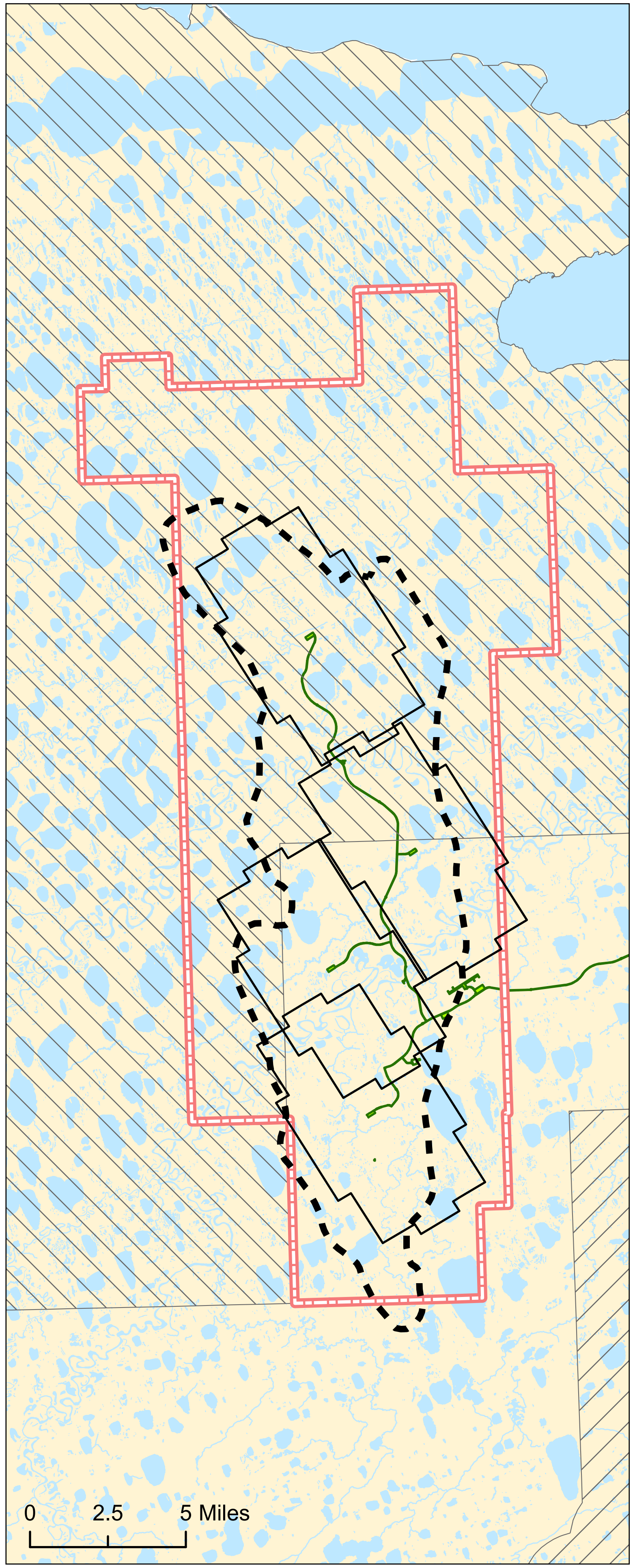
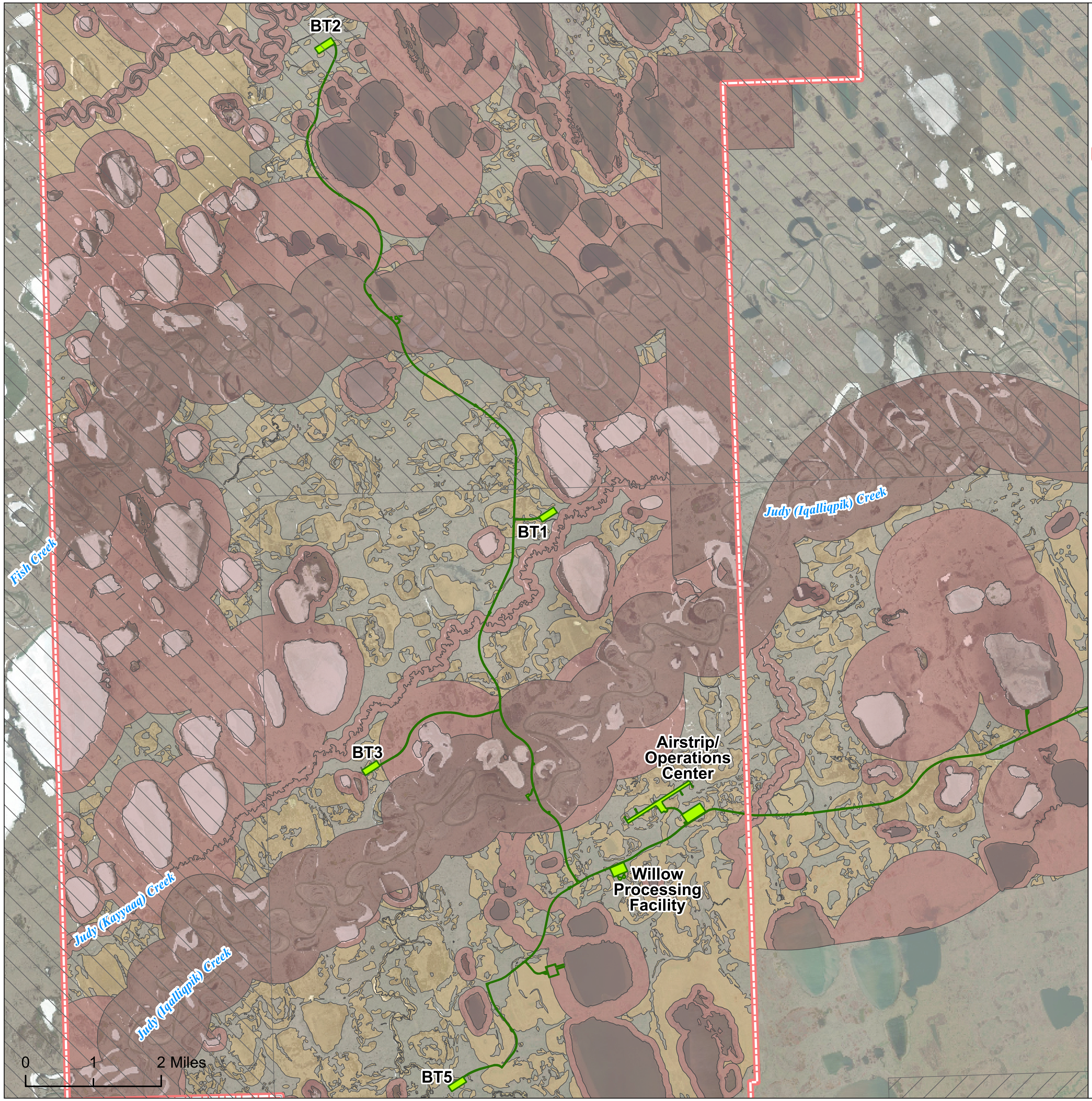
Figure D.3.10





Alternative Access Concepts
- Four Pad Shift Gravel Footprint
- Well Reach
- Willow MDP Reservoir

NPR-A Special Areas
- Colville River Special Area
- Teshekpuk Lake Special Area

Oil and Gas Unit
- Bear Tooth Unit

Willow Environmental Constraints
- Drillsite Not Allowed
- Drillsites Allowed with Waiver
- Sensitive Areas - Waiver Not Required - additional considerations may apply

Note: Entire area of Inset A is within National Petroleum Reserve in Alaska

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Figure D.3.11

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3.5.6 Alternative Components Carried Forward*

In developing the new alternative(s) to be considered in this Supplemental EIS, additional alternative concepts were incorporated into the new action alternative. Table D.3.9 summarizes those alternative components carried forward as either alternatives or alternative components for analysis in this Supplemental EIS. Sections 3.5.4.1 through 3.5.4.3 provide additional detail on the alternative concepts and how they were incorporated into this Supplemental EIS for further analysis.

Table D.3.9. Alternative Components Considered and How They Are Carried Forward in the Supplemental Environmental Impact Statement*

Component Number	Alternative Component Considered	Description of How an Alternative Component is Carried Forward in the Environmental Impact Statement
45	BT2 north of Fish Creek (four-pad alternative)	Carried forward in this Supplemental EIS (Site V0) as Alternative E: Three-Pad Alternative (Fourth Pad Deferred).
48	Relocate drill site BT5 out of the yellow-billed loon setback buffer	Incorporated into this Supplemental EIS (Site V1) as part of Alternative E: Three-Pad Alternative (Fourth Pad Deferred).
51	Locate the Project mud plant at the Willow Operations Center instead of on K-Pad	Carried forward in this Supplemental EIS. Alternative B evaluates the mud plant located at the Willow Operations Center and Alternative E evaluates the mud plant at K-Pad. Either location may be selected in the Project's Record of Decision.
52	Construct the Project in two phases with a pause between developments	Incorporated into this Supplemental EIS as part of Alternative E: Three-Pad Alternative (Fourth Pad Deferred). Only three drill site pads would be authorized for construction should Alternative E be selected in BLM's Record of Decision; a fourth pad would not be authorized for construction prior to Project Year 7. BLM may also consider additional deferrals under this Alternative. Under Alternatives B, C, and D, BLM's Record of Decision could authorize only three drill site pads in Phase 1 and two additional drill site pads in Phase 2.

Note: BLM (Bureau of Land Management); BT2 (drill site BT2); BT5 (drill site BT5); EIS (Environmental Impact Statement).

*3.5.6.1 Pad Concept – BT2 North of Fish Creek**

Under this alternative concept, the project would eliminate one drill site (BT4) and construct four drill sites (Figure D.3.12), with one drill site (BT2) remaining in the TLSA, north of Fish Creek. BLM requested CPAI identify possible siting locations for drill site BT2 and CPAI identified 9 total potential locations (V0 through V8) for preliminary analysis (Figure D.3.13).

Site V0 was the location initially proposed by CPAI to maximize reservoir access, consistent with other engineering and environmental constraints. This location would avoid steep terrain and high-valued wetlands such as flooded tundra. This site would overlap yellow-billed loon nest setback buffers as defined in ROP E-11 (BLM 2022).

Site V1 would be approximately 0.4 mile south of the V0 location. The V1 location would intersect yellow-billed loon nest setback buffer ROP E-11 and ROP E-2 fish-bearing waterbody setback (BLM 2022) around an unnamed lake. The V1 location would place gravel fill in an area with high-value flooded tundra wetlands. Gravel pad construction in very wet or flooded tundra presents additional engineering and long-term operational and maintenance challenges, and often requires a greater gravel volume to construct. Saturated or flooded areas can cause additional challenges for summer activities by increasing the potential for subsidence, erosion, and settling, likely requiring a large portion of the pad to be covered in rig mats during the drilling phase. This would increase overall pad traffic, activity, and noise. The V1 site is also located in an area with steep topography and near an unnamed lake. Compared to the V0 location, the V1 site would have increased engineering and operations and maintenance challenges, while reducing reservoir access. The V1 location would likely result in greater environmental impacts.

The V2 location would be approximately 0.5 mile south of the V0 location. The V2 location would intersect a ROP E-2 fish-bearing waterbody setback buffer associated with an unnamed lake and ROP E-2 fish-bearing waterbody setback buffer from Willow Creek 8. The V2 location would also occupy steep topography which would require an increased gravel volume for fill in wetlands near an unnamed lake and Willow Creek 8. Compared to the V0 location, the V2 location would have increased engineering challenges and reduced reservoir access. The V2 location would likely result in greater environmental impacts.

The V3 location would be approximately 0.3 mile south of the V0 location. The V3 location would intersect yellow-billed loon nest setback buffer ROP E-11 and an ROP E-2 fish-bearing waterbody setback around an unnamed lake. The V3 location would place gravel fill in an area of high-value flooded tundra wetlands. Compared to the V0 location, the V3 site would have increased engineering and operations and maintenance challenges, while reducing reservoir access. The V3 location would likely result in greater environmental impacts.

The V4 location would be approximately 0.2 mile south of the V0 location. The V4 location would intersect yellow-billed loon nest setback buffer ROP E-11 and an ROP E-2 fish-bearing waterbody setback around an unnamed lake. Compared to the V0 location, the V4 location would likely result in greater environmental impacts and slightly reduced reservoir access.

The V5 location would be approximately 0.5 mile south of the V0 location. The V5 location would cross steep terrain at its southwest corner and would intersect high-value flooded tundra wetlands at its northwest corner. The northeast corner of the drill site pad would intersect the LS K-1 setback buffer for Fish) Creek, which is a high-priority subsistence use area. The V5 location would also place the gravel pad in closer proximity to an area of active natural erosional subsidence connected to Fish Creek. Placement of the gravel pad near the flooded and eroded area could exacerbate the natural environmental changes already occurring at this location. Compared to the V0 location, the V5 location would result in increased engineering and operational and maintenance challenges, reduce reservoir access, and likely have greater environmental impacts.

The V6 location would be approximately 0.4 mile southwest of the V0 location. This location was proposed by the U.S. Fish and Wildlife Service for feasibility analysis. The V6 pad location would intersect yellow-billed loon nest setback buffer ROP E-11. However, the V6 location is located on sloping terrain and would require approximately 20% more gravel fill than the V0 location (as well as the associated gravel-hauling traffic). The V6 location would also result in a large reduction to the reservoir access compared to the V0 location. Compared to the V0 location, the V6 location would result in increased engineering and operational and maintenance challenges and would likely have greater environmental impacts.

The V7 location would be approximately 2.3 miles northwest of the V0 location. The V7 pad location would not intersect with any setback buffers. However, the V7 pad location would require more than a mile of additional gravel road and pipeline rack through two ROP E-11 yellow-billed loon nest setback buffers and at least two LS E-2 fish-bearing water waterbody setback buffers. This location would require more than 60,000 cubic yards of gravel to fill a minimum of 7 additional acres of wetlands compared to the V0 location. Due to the topography of the surrounding area, the access road and gravel pad constructed at the V7 location would be significantly thicker than the V0 location, further increasing the footprint and gravel fill requirements. An access road to the V7 pad location would also intersect two yellow-billed loon setback buffers (ROP E-11). Additionally, compared to the V0 location, the V7 location would reduce the reservoir access and have greater environmental impacts, including miles of gravel road within the TLSA.

The V8 location would be approximately 2.2 miles northwest of the V0 location. Like the V7 location, the V8 location would require more than a mile of additional gravel road and pipeline rack through two ROP E-11 yellow-billed loon setback buffers and at least two LS E-2 fish-bearing water waterbody setback buffers. The V8 location would also result in a larger footprint within the TLSA and occupy an area of wetter tundra where ponding and thermokarsting currently exist. The access road to the V8 gravel pad location would have to ascend a steep hill directly southeast of the pad, which would require an extensive amount of gravel fill to provide a road grade that would accommodate drill rig movements, increasing the V8 location's footprint. Compared to the V0 location, the V8 location would result in increased engineering and operations and maintenance challenges, reduce reservoir access, and have greater environmental impacts.

Figure D.3.13 shows the alternative pad siting locations and Table D.3.10 provides a summary comparison of the 9 siting location options considered for the drill site BT2 relocation.

Table D.3.10. Summary of Relative Impacts for Different Drill Site BT2 North Siting Options*

ID	Reservoir Access[a]	Road Length[a]	Pad Gravel Volume[a]	Loon Nest (ROP E-11)	Willow 8 Fish Bearing Waters (LS E-2)	Other Fish Bearing Waters (LS E-2)	Fish Creek (LS K-1)
V0	NA	NA	NA	Yes/No	No	No	No
V1	Less	Longer	More	Yes/No	No	Yes	No
V2	Less	Longer	Much more	No	Yes	Yes	No
V3	Less	Longer	More	Yes/No	No	Yes	No
V4	Less	Shorter	More	Yes/No	No	Yes	No
V5	Less	Longer	More	No	No	No	Yes
V6	Less	Shorter	More	Yes/No	No	No	No
V7	Much less	Much longer	Much more	No	No	No	No
V8	Much less	Much longer	Much more	No	No	No	No

Note: LS (lease stipulation); NA (not applicable); ROP (required operating procedure).
[a] Effects are relative to the proposed BT2 North drill site location V0.

This alternative concept best addresses the District Court's decision while being consistent with CPAI's lease development plans. This alternative concept would have the least amount of infrastructure within the TLSA relative to other four-pad alternative concepts and it would have less vehicle traffic and aircraft relative to the Disconnected BT2 alternative concept.

BLM has identified site V0 as the preferred location for drill site BT2 North and this location has been incorporated into Alternative E. The V0 pad location minimizes the gravel road length and overall gravel fill requirements, provides the best reservoir access, and would be the most compliant with ROPs outlined in the NPR-A IAP. Where an exception would be required, it would be required for the least important setback (i.e., a yellow-billed loon buffer under ROP E-11) (BLM 2021b). This location for BT2 North was also applied to the Disconnected BT2 alternative concept (Section 3.5.3.3, *Access Concept – Disconnected BT2*).

Preliminary impacts for BT2 North (site V0), are summarized in Table D.3.11.

Table D.3.11. Summary of Preliminary Impacts for Alternative Concept BT2 North (Site V0)*

Metric	Alternative B (Proponent's Project)	Alternative E (BT2 North)
TLSA gravel footprint (acres)	106.3	61.2
Total gravel footprint (acres)	484.0	428.4
Total gravel volume (million cubic yards)	4.9	4.5
Total ground traffic (number of trips)	3,188,910	3,145,870
Total fixed-wing traffic (number of trips)	12,101	11,983
Total helicopter traffic (number of trips)	2,421	2,421
Ice road (total miles)	495.2	431.2
Total freshwater use (million gallons)	1,662.4	1,478.7

Note: BT2 North (drill site BT2 North); TLSA (Teshekpuk Lake Special Area).

*3.5.6.2 Pad Concept – Relocate BT5**

Since the Project was initially proposed by CPAI and evaluated in BLM's Willow MDP Final EIS, two new yellow-billed loon nests have been observed at lakes adjacent to the proposed drill site BT5 pad location (CPAI 2021a). Based on this new data, BLM requested CPAI identify two new potential locations for drill site BT5 and its access road that would not encroach on yellow-billed loon nest setback buffers (ROP E-11).

This alternative concept would relocate drill site BT5 outside of yellow-billed loon setback buffers to the proposed Site V1 or site V2 locations (Figure D.3.14). In addition to the two proposed drill site locations, site V2 includes two options for the drill site access road: BT5 V2 Route A and BT5 V2 Route B. V2 Route A would cross the yellow-billed loon setback buffers along an alignment similar to what was previously proposed, and V2 Route B would travel to the north around the setback buffers, cross just into the TLSA and head south to drill site location BT5 V2.

The V1 Site location would be approximately 1.8 miles northeast of the previously proposed BT5 drill site location. The V1 Site would avoid overlapping two ROP E-11 yellow-billed loon nest setback buffers around two unnamed lakes. This location would also avoid a road crossing of those same nest buffers and lake shoreline buffers. The V1 location would reduce environmental impacts by reducing the road length and avoiding all buffers described in the 2022 NPR-A IAP ROD.

The V2 Site location would be approximately 0.6 mile west of the previously proposed BT5 drill site location. The V2 Site would not overlap the two ROP E-11 yellow-billed loon nest setback buffers. However, the two ROP E-11 setback buffers could still be affected depending on the route used to access the V2 Site location. Route A would extend the previously proposed access road from the previous BT5 location to the new V2 Site, providing the most direct access, but crossing the ROP E-11 setback buffers. Route B would avoid crossing the ROP E-11 setback buffers by routing the road to the north, around the unnamed lakes, but this would add approximately 3 miles of additional gravel road. Route B would also locate a portion of the BT5 access road within the TLSA and within ROP E-11yellow-billed loon setback buffers.

Table D.3.12 summarizes the alternative concept variations.

Table D.3.12. Summary of the Relocate BT5 Variations Evaluated as part of the Relocate BT5 Alternative Concept*

Concept	Reservoir Access[a]	Road Length[a]	Pad Gravel Volume[a]	Loon Nest (ROP E-11)	Fish Bearing (LS E-2)	TLSA Footprint
BT5 (FEIS)	NA	NA	NA	Yes	No	No
V1	Less	Shorter	Similar	No	No	No
V2, Route A	Similar	Slightly longer	Similar	Yes	No	No
V2, Route B	Similar	Much longer	Similar	No	No	Yes

Note: BT5 (drill site BT5); FEIS (Final Environmental Impact Statement); LS (lease stipulation); NA (not applicable); ROP (required operating procedure); TLSA (Teshekpuk Lake Special Area).
[a] Effects are relative to the proposed BT5 drill site location included under Alternatives B, C, and D.

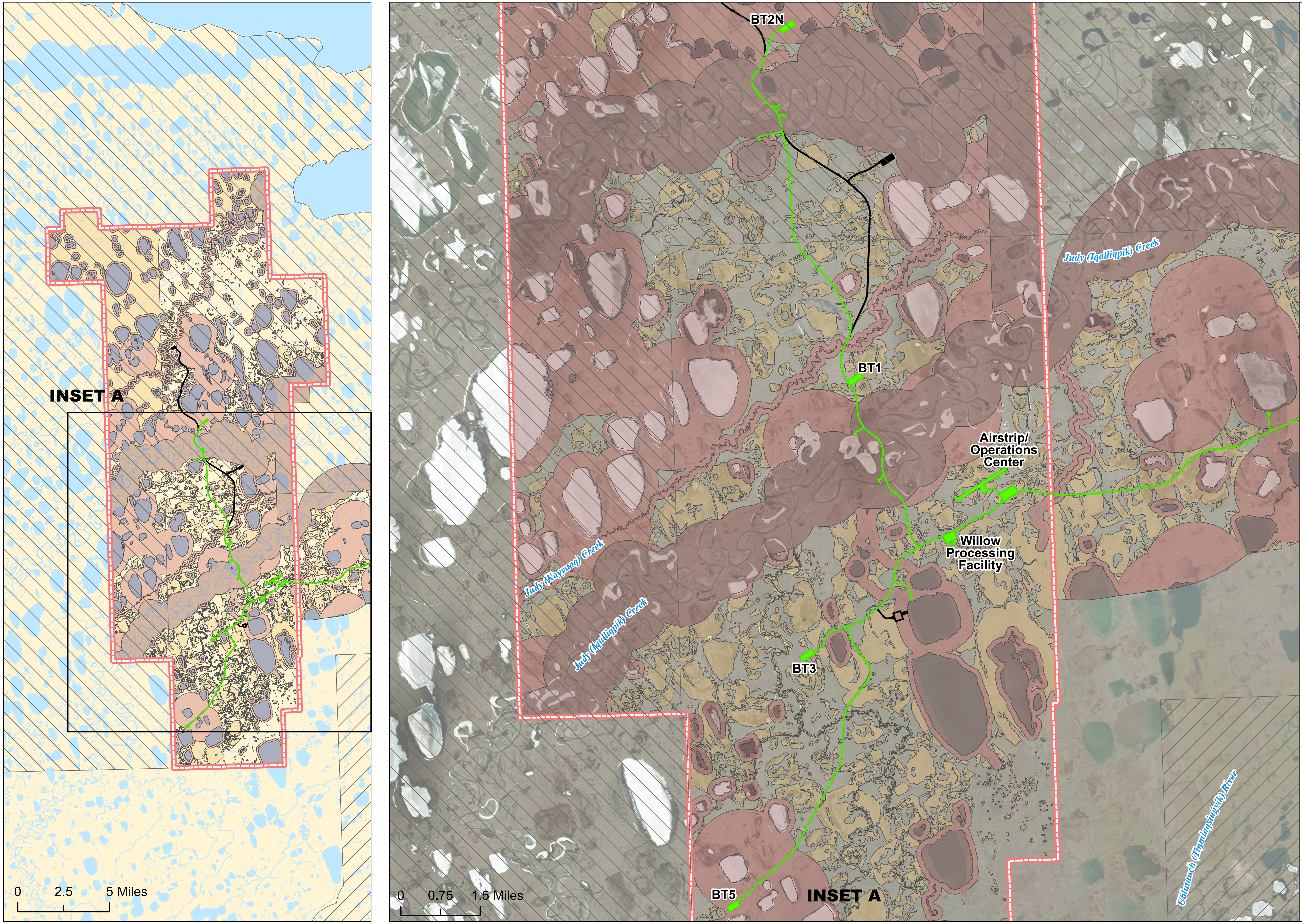
Although the Final EIS BT5 location and the V2 location would have better reservoir access than the V1 location, it would not result in the stranding of an economically viable quantity of oil and the relative environmental impacts would be reduced using the V1 location. BLM has identified V1 as the preferred alternate location for drill site BT5 and this location has been included in Alternative E (Three-Pad Alternative [Fourth Pad Deferred]).

*3.5.6.3 Infrastructure Concept – Locate the Willow Mud Plant at the Willow Operations Center**

This alternative concept would locate the mud plant at the WOC rather than at K-Pad (as under Alternative E). Although Alternative E is described in this Supplemental EIS with the mud plant located at K-Pad, the mud plant is evaluated at the WOC under Alternative B and this mud plant location may be adopted in the ROD for any alternative.

*3.5.6.4 Phasing Concept – Construct the Project in Two Phases with a Pause between Development**

This alternative concept would restrict the amount of development allowed in the BTU and future development that would use planned Project infrastructure. Alternative E has been developed to account for two distinct Project phases, the first of which would allow construction of up to three drill sites (BT1, BT2, and BT3). Construction of a fourth drill site (BT5) would be deferred until at least Year 7 under Phase 2, and BLM may consider additional deferrals. This alternative concept could be applied to any of the action alternatives; under Alternatives B, C, and D, Phase 1 would include construction of three drill sites (BT1, BT2, and BT3) and Phase 2 would include construction of two drill sites (BT4 and BT5).



Willow Proposed Development Features
- BT2N Project Footprint

Willow Proposed Development Features
- Alternative B Project Footprint

Oil and Gas Unit
- Bear Tooth Unit

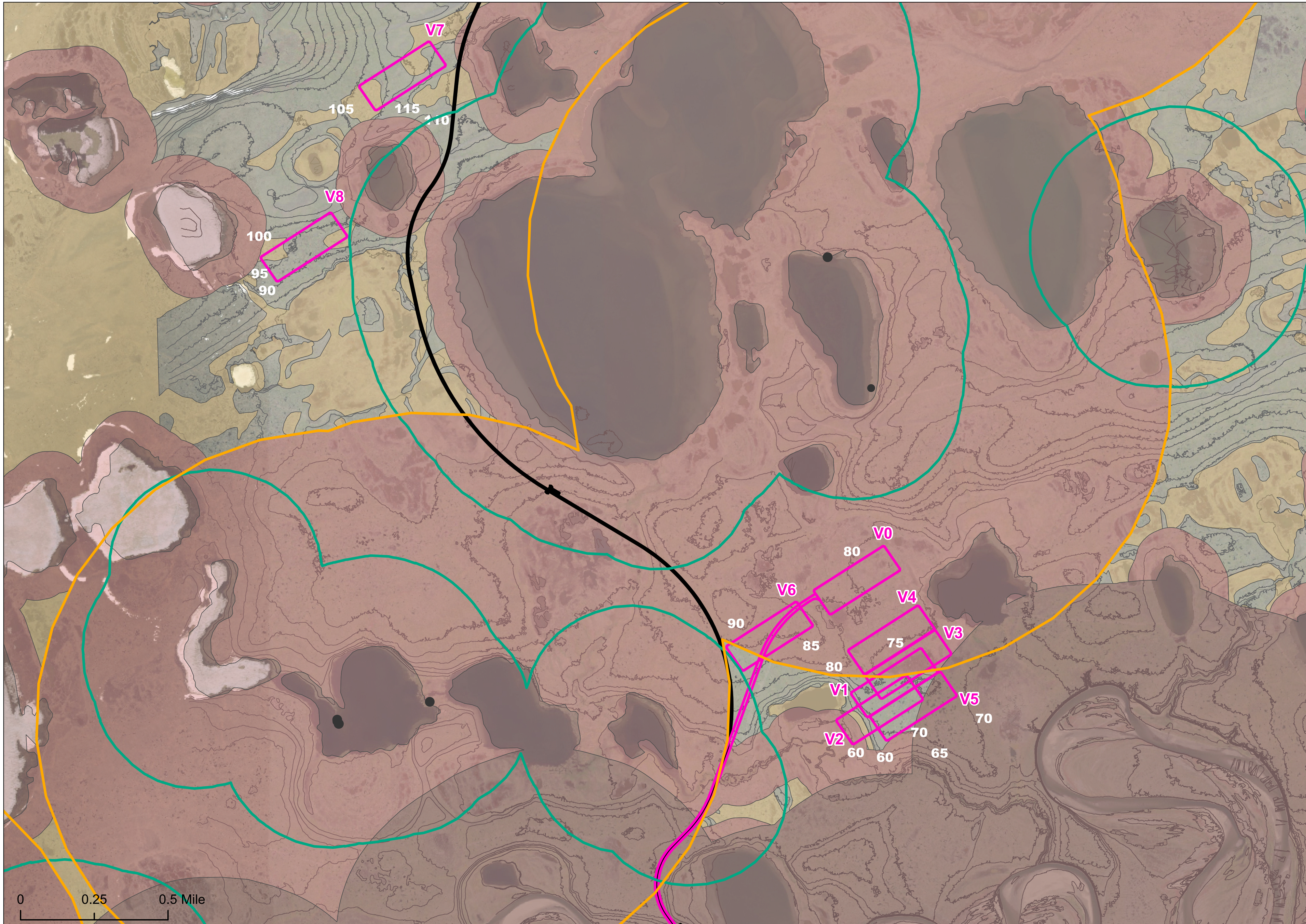
NPR-A Special Areas
- Colville River Special Area
- Teshekpuk Lake Special Area

Willow Environmental Constraints
- Drillsite Not Allowed
- Drillsites Allowed with Waiver
- Sensitive Areas - Waiver Not Required - additional considerations may apply

Note: Entire area of Inset A is within National Petroleum Reserve in Alaska

No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Figure D.3.12



5ft Contours

Yellow-Billed Loon

Nest

E-11 YBLO Nest Buffer

E-11 YBLO Lake Buffer

Alternative Access Concepts

BT2 North Footprint Variations

Willow Proposed Development Features

Alternative B Project Footprint

Willow Environmental Constraints

Drillsite Not Allowed

Drillsites Allowed with Waiver

Sensitive Areas - Waiver Not Required - additional considerations may apply

Note: Entire area of figure is within Teshekpuk Lake Special Area and National Petroleum Reserve in Alaska

No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Figure D.3.13


Alternative Access Concepts
Proposed Gravel Footprint
BT5 Variations Footprint
Yellow-billed loon
Nest
E-11 YBLO Nest Buffer
E-11 YBLO Lake Buffer
NPR-A Special Areas
Teshekpuk Lake Special Area
Willow Environmental Constraints
Drillsite Not Allowed
Drillsites Allowed with Waiver
Sensitive Areas - Waiver Not Required - additional considerations may apply
Note: Entire area of figure is within National Petroleum Reserve in Alaska
0
0.25
0.5 Mile

Figure D 3.14

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3.6 Updates to Alternatives since the Draft Environmental Impact Statement

CPAI provided BLM with Project updates and refinements based on continued engineering and Project evaluation. Project updates were applied to all action alternatives and include one new module delivery option (Option 3: Colville River Crossing). This section summarizes the Project updates; detailed descriptions are included in Section 4.2, *Project Components Common to All Action Alternatives*, through Section 4.8.3, *Option 3: Colville River Crossing*.

3.6.1 Greater Mooses Tooth 2 Processing at Willow

The Greater Mooses Tooth 2 (GMT-2) drill site, located within the NPR-A and northeast of the Project (Figure D.1.1), was recently constructed and is now operational with well drilling underway. This CPAI project was evaluated previously by BLM with a Final Supplemental EIS (2018) to the ASDP. This drill site became operational in 2021 with infield pipelines connecting the drill site to the ACF. The ACF will process produced fluids and provide other operational support to the GMT-2 project.

CPAI is evaluating a possible connection from GMT-2 to the Willow Processing Facility (WPF) beginning in 2026 to optimize future production efficiency. Connecting GMT-2 to the WPF would route production and injection fluids to Willow instead of Alpine. CPAI has not yet made a final determination on whether this configuration will be implemented; this decision will not affect the drilling schedule at GMT-2. The final decision to execute this GMT-2 project optimization would be influenced by long-term operational performance at the ACF and the drilling results for GMT-2. Incorporation of this GMT-2 configuration has been included in all Willow action alternatives.

If this development concept is implemented, new infield pipelines would be constructed between GMT-2 and the WPF during Project construction. Additionally, a 34.5 kV power and fiber-optic communications cable would be suspended beneath the pipelines from the WPF to GMT-2. These new pipelines, power line, and communications cable would be installed with the Project pipelines on pipeline racks between the WPF and GMT-2, which have sufficient extra space to support the additional GMT-2 pipelines. The WPF footprint and emissions inventory did not require design changes to accommodate this additional input as the facility was originally designed with additional capacity.

Drilling and operational activity in support of the GMT-2 project was previously analyzed (BLM 2018), and no additional wells, freshwater use, or ground or air traffic is considered in the Willow MDP EIS analysis.

3.6.2 Freshwater Source Updates

Ongoing Project engineering and planning have indicated that additional freshwater sources to support drilling and operations would be required. To meet these freshwater needs, CPAI proposes to include a constructed freshwater reservoir (CFWR) in the Lake M0015 and Lake R0064 drainage basin for all action alternatives. The CFWR would include a connection channel with a weir and fish exclusion screen to Lake M0015.

CPAI also proposes to construct gravel access to one or two additional lakes, depending on the alternative. Alternative B would provide a gravel access road connection to Lake L9911 (also called Lake R0061) near GMT-2. Alternative C would include the gravel access road to Lake L9911 and an additional access road to Lake M0235 near the north Willow Operations Center (WOC). Alternative D would include gravel access to Lake M0235.

Section 4.2.5, *Water Sources and Use*, provides additional details on the CFWR and supplemental water sources.

3.6.3 Module Delivery Option 3: Colville River Crossing

Based on discussions with stakeholders, CPAI developed a third module delivery option that would use the existing Oliktok Dock to offload sealift modules and then use existing gravel roads and Project-specific ice roads to deliver the large sealift modules to the Project area. This option would include an ice road crossing of the Colville River near Ocean Point, where a partially grounded ice crossing is feasible. The specific crossing location was selected based on favorable hydrology, topography, and bathymetry, and it is far enough upstream from the Colville River Delta to minimize fish passage impacts.

Use of Oliktok Dock for sealift module delivery was previously considered during alternatives development (Section 3.3, *Alternative Components Considered but Eliminated from Further Analysis in the 2020 Willow MDP EIS*), but the variants used either a sea-ice road, the annual Alpine Resupply Ice Road, or a crossing of the

Colville River near Umiat to deliver the modules to the Project area. These concepts were eliminated from further analysis based on technical or logistical constraints.

3.6.4 Other Refinements to the Action Alternatives

All action alternatives were further refined following additional engineering. Project-wide refinements address facility locations, adjustments to gravel pad sizes, gravel road alignments, the mine site footprint, ice road design, projected water use volumes, estimated traffic values, and Project facilities on existing gravel pads.

3.6.4.1 Alternative B Support Facility Locations Updates

The locations of the WOC, WPF, and airstrip have been shifted approximately 3 to 4 miles to the northeast to address concerns related to caribou movement. The WPF would be located on its own gravel pad (it was previously colocated with Bear Tooth drill site 3 [BT3]); the location of BT3 has not changed.

3.6.4.2 Gravel Footprint Updates

CPAI has updated the footprints to the gravel pads, airstrips, and aircraft aprons. The changes in gravel footprints vary by alternative (Section 4.3, *Alternative B* [*Proponent's Project*]; Section 4.4, *Alternative C* [*Disconnected Infield Roads*]; Section 4.5, *Alternative D* [*Disconnected Access*]; and Section 4.6, *Alternative E* [*Three-Pad Alternative, Fourth Pad Deferred*]). Generally, drill site pads have increased by several acres to accommodate **hydraulic fracturing** equipment and material storage. The largest increases are at Bear Tooth drill sites 1, 2, and 4 (BT1, BT2, and BT4) for Alternative C. The WOC (North WOC and South WOC for Alternative C) pad size was increased to accommodate additional laydown space and storage, and the WPF gravel pad size has also increased slightly. The airstrip was lengthened to 6,200 feet to accommodate Bombardier Q400 aircraft, and the apron footprint was increased to provide additional fuel and materials storage. The two roads included in the Draft EIS to access airstrip approach lighting were removed from all action alternatives to reduce the overall Project gravel footprint.

To avoid potential interference with the airstrip, a separate communications tower pad has been added to all action alternatives. Under Alternative D, a gravel staging pad was added east of GMT-2 to store ice road equipment needed for the annual ice road that would be required to support Project resupply for this alternative.

For all action alternatives, the widths of several infield gravel roads (connecting Project drill sites and support facilities) were narrowed from 32 feet wide to 24 feet wide. This includes the road between BT2 and BT4 and the infield roads to BT3 (except under Alternative D, where BT3 and the WPF would be colocated, and Alternative E which does not include BT4) and Bear Tooth drill site 5 (BT5). The airstrip access road was similarly narrowed from 32 feet wide to 24 feet wide for all action alternatives. CPAI would limit vehicle speeds to 25 miles per hour (versus 35 miles per hour) as a voluntary mitigation measure along these 24-foot-wide road segments. This mitigation measure is intended to address health, safety, and environmental purposes, including potential impacts from dust and to wildlife.

3.6.4.3 Tiŋmiaqsiuġvik Gravel Mine Site Updates

Since publication of the Draft EIS, CPAI has completed further evaluations of the Tiŋmiaqsiuġvik Gravel Mine Site, and the mine site footprint was reduced. The mine site footprint still includes two individual mine cells, but the individual cell footprints have been reduced from 115.0 acres each to 109.3 acres and 40.4 acres (149.7 total acres).

3.6.4.4 Traffic and Freshwater Use Estimate Updates

Estimated traffic and freshwater use volumes were updated. These changes are a result of refinements in engineering design, the inclusion of an additional year of construction, and other Project updates described in this section (3.7, *Updates to Alternatives since the Draft Environmental Impact Statement*).

3.6.4.5 Ice Road Widths and Water Use Updates

CPAI refined ice design assumptions for ice road widths and water use for all action alternatives and module delivery options; ice road water use estimates are now consistent with the values used for the evaluation of the GMT-1 and GMT-2 projects. Table D.3.13 summarizes ice road widths and water volumes required for construction by ice road type.

Table D.3.13. Ice Road Design Widths and Freshwater Requirements Update Summary

Ice Road Type/Use	Draft EIS Width (feet)	Draft EIS Water Volume Requirement (MG per mile)	Final EIS Width (feet)	Final EIS Water Volume Requirement (MG per mile)
Gravel haul	70	3.0	50	1.4
Pipeline construction	35	1.5	70	2.0
Sealift module haul (over tundra)	105	4.5	60	2.5[a]
General access[b]	35	1.5	35	1.0

Note: EIS (Environmental Impact Statement); MG (million gallons).
[a] Module haul ice roads would require additional strengthening to support module weight.
[b] General access ice roads include the annual resupply ice roads and would apply to Alternatives C and D.

3.6.4.6 New Facilities on Existing Gravel Pads

The Project would include the installation of support modules and equipment on the existing Kuparuk River Unit (Kuparuk) CPF2 and the ACF gravel pads. The Kuparuk CPF2 pad would be expanded to accommodate additional facilities under all action alternatives; the ACF pad would only require expansion under Alternative D.

3.6.4.7 Boat Ramps

CPAI would construct up to three boat ramps (number varies by alternative) to serve as voluntary mitigation for Project impacts on subsistence activities. Under all action alternatives, a boat ramp would be constructed along the Ublutuoch (Tiŋmiaqsiuġvik) River, with access from the existing gravel road between Alpine Colville Delta drill site 5 (CD5) and GMT-1. Under Alternative B, up to two additional boat ramps could be constructed at Judy (Iqalliqpik) and Fish creeks.

3.6.4.8 Schedule Update

An additional year has been added to the construction phase for all action alternatives, which would delay first oil and the start of the operations phase by 1 year. Gravel mining and gravel infrastructure construction would still begin in 2021; however, construction of gravel pads and related facility installation (e.g., WPF, drill sites) and drilling activity would begin 1 year later. The drilling schedule has been revised to reflect two drilling rigs operating simultaneously over a short period of time (now 6 years).

3.7 Updates to Alternatives (B, C, and D) since the Final Environmental Impact Statement*

Since publication of the Final EIS, CPAI has continued with Project permitting and detailed engineering, and some Project components have undergone further refinement or modification. This Supplemental EIS incorporates the following Project components updates:

- Shortening of the airstrip for all action alternatives to 5,700 feet (from 6.200 feet long) as a result of the NSB rezoning process. The airstrip apron and access road alignments were updated to accommodate logistics changes from shortening the runway (Section 4.2.3.3, *Airstrip and Associated Facilities*)
- Updated mine site footprint for Alternatives C and D (Section 4.2.6, *Gravel Mine Site*)
- Updated production schedule based on additional characterization of the target reservoir and further engineering refinement (Section 4.2.10.3, *Operations Phase*)

For the purposes of the EIS, Project schedule information has been updated to remove specific years (e.g., 2022, 2023) and instead use "Year 1" (Year 1), "Year 2" (Year 2), and so forth to allow flexibility for the Project start date to account for potential delays. If the MDP is approved, construction is currently assumed to start in either the winter of 2022/2023 or winter 2023/2024.

4.0 REASONABLE RANGE OF ALTERNATIVES*

The following four alternatives are analyzed in detail in the EIS:

- Alternative A: No Action
- Alternative B: Proponent's Project (Figure D.4.1)
- Alternative C: Disconnected Infield Roads (Figure D.4.2)
- Alternative D: Disconnected Access (Figure D.4.3)
- Alternative E: Three-Pad Alternative (Fourth Pad Deferred) (Figure D.4.4)

Action alternatives (B, C, D, and E) presented in the EIS include variations on specific Project components (e.g., Project access). The range of alternatives was developed to address the resource impact issues and conflicts identified during internal scoping with the BLM Interdisciplinary Team and external scoping with the public and cooperating agencies. Additionally, the following three options are presented for how sealift modules (required for all action alternatives) would be delivered to the Project; any option could be paired with any action alternative:

- Option 1: Atigaru Point Module Transfer Island (Figure D.4.5)
- Option 2: Point Lonely Module Transfer Island (Figure D.4.6)
- Option 3: Colville River Crossing (Figure D.4.7)

Sealift module delivery options are discussed in Section 4.8, *Sealift Module Delivery Options*.

4.1 Alternative A: No Action

Under the No Action Alternative, the Project would not be constructed; however, oil and gas exploration in the area would continue. Under the NPRPA, the BLM is required to conduct oil and gas leasing and development in the NPR-A (42 USC 6506a). On previously leased lands, the U.S. Court of Appeals has determined BLM has made an irrevocable commitment to allow some surface disturbances to support drilling and operations (BLM 2018).

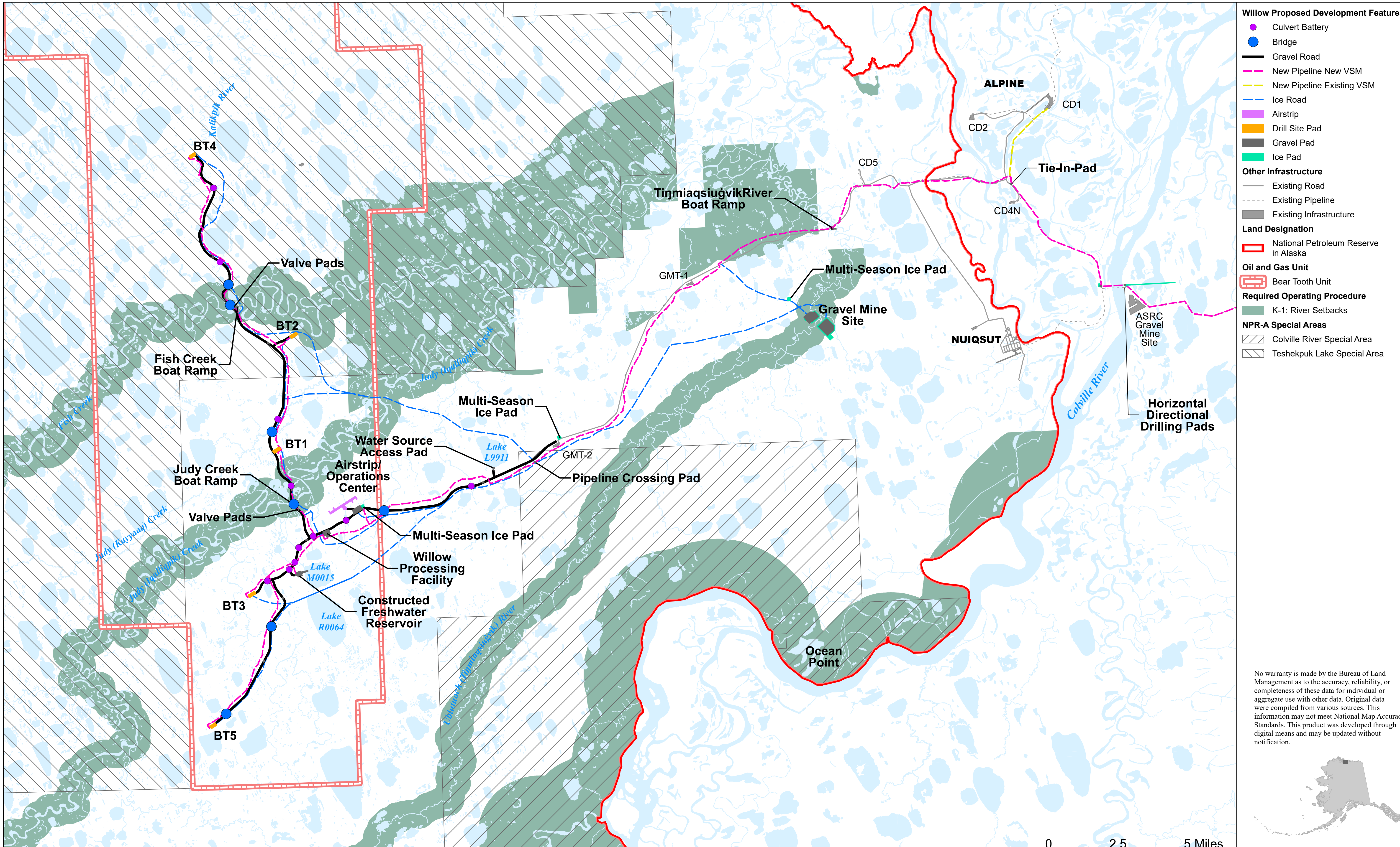
Willow Proposed Development Features
Culvert Battery
Bridge
Gravel Road
New Pipeline New VSM
New Pipeline Existing VSM
Ice Road
Airstrip
Drill Site Pad
Gravel Pad
Ice Pad
Other Infrastructure
Existing Road
Existing Pipeline
Existing Infrastructure
Land Designation
National Petroleum Reserve in Alaska
Oil and Gas Unit
Bear Tooth Unit
Required Operating Procedure
K-1: River Setbacks
NPR-A Special Areas
Colville River Special Area
Teshekpuk Lake Special Area
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.
ALPINE
CD1
CD2
CD5
CD4N
Tie-In-Pad
TiŋmiaqsiuġvikRiver Boat Ramp
GMT-1
GMT-2
Multi-Season Ice Pad
Gravel Mine Site
NUIQSUT
ASRC Gravel Mine Site
Horizontal Directional Drilling Pads
Colville River
BT4
BT2
BT1
BT3
BT5
Kalikpik River
Valve Pads
Fish Creek Boat Ramp
Fish Creek
Judy (Iqalliqpik) Creek
Judy Creek Boat Ramp
Judy (Kayyaaq) Creek
Multi-Season Ice Pad
Water Source Access Pad
Lake L9911
Airstrip/ Operations Center
Pipeline Crossing Pad
Willow Processing Facility
Lake M0015
Lake R0064
Constructed Freshwater Reservoir
Ublutuoch (Tiŋmiaqsiuġvik) River
Ocean Point
0
2.5
5 Miles

Figure D.4.1

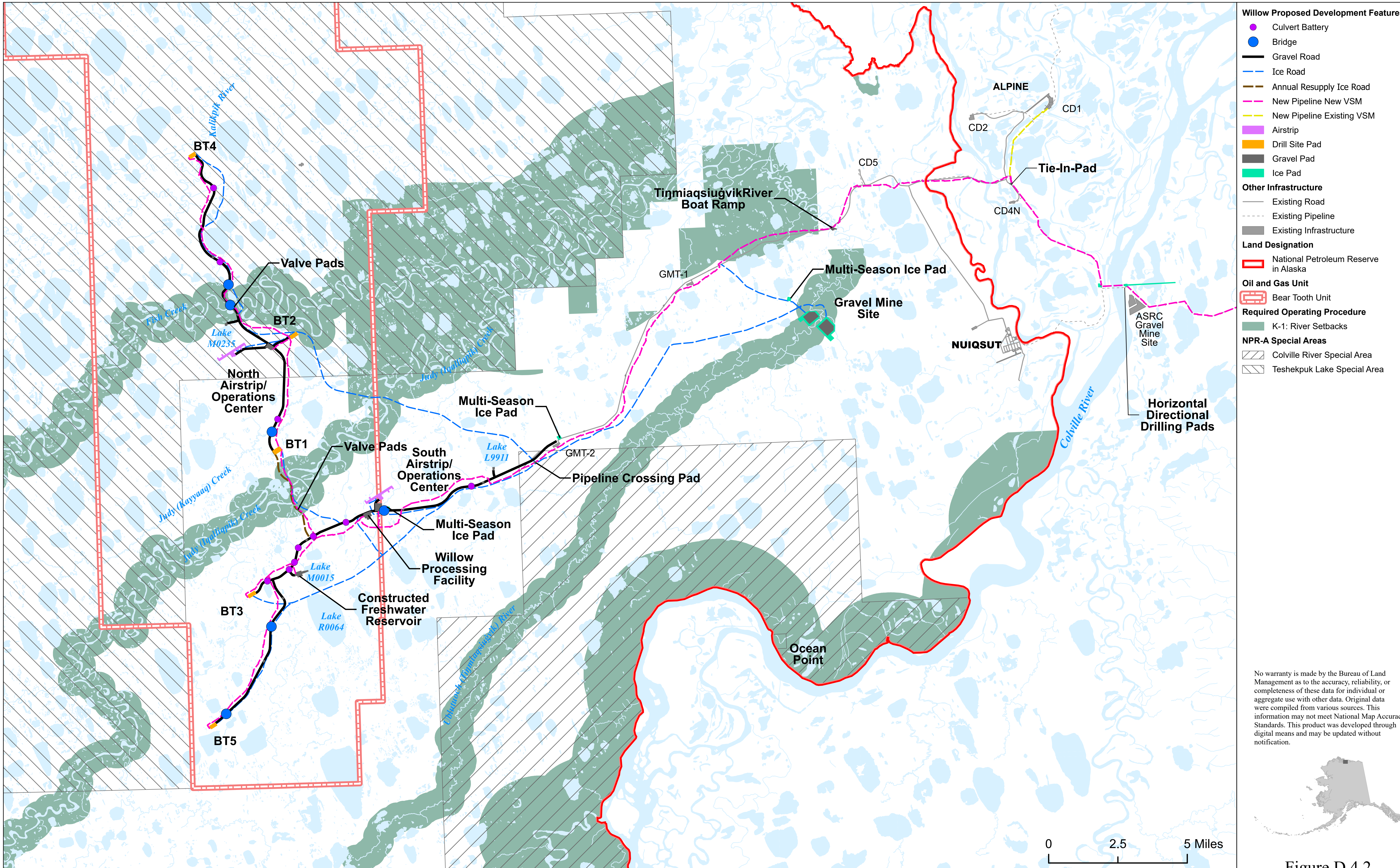
Willow Proposed Development Features
Culvert Battery
Bridge
Gravel Road
Ice Road
Annual Resupply Ice Road
New Pipeline New VSM
New Pipeline Existing VSM
Airstrip
Drill Site Pad
Gravel Pad
Ice Pad
Other Infrastructure
Existing Road
Existing Pipeline
Existing Infrastructure
Land Designation
National Petroleum Reserve in Alaska
Oil and Gas Unit
Bear Tooth Unit
Required Operating Procedure
K-1: River Setbacks
NPR-A Special Areas
Colville River Special Area
Teshekpuk Lake Special Area
BT4
BT2
BT1
BT3
BT5
Valve Pads
North Airstrip/ Operations Center
South Airstrip/ Operations Center
Multi-Season Ice Pad
Willow Processing Facility
Constructed Freshwater Reservoir
Pipeline Crossing Pad
GMT-1
GMT-2
Tiŋmiaqsiuġvik River Boat Ramp
Gravel Mine Site
ALPINE
CD1
CD2
CD5
CD4N
Tie-In-Pad
NUIQSUT
ASRC Gravel Mine Site
Horizontal Directional Drilling Pads
Ocean Point
Colville River
Fish Creek
Judy (Kayyaaq) Creek
Judy (Iqalliqpik) Creek
Kalikpik River
Ublutuoch (Tiŋmiaqsiuġvik) River
Lake M0235
Lake L9911
Lake M0015
Lake R0064
0
2.5
5 Miles
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Figure D.4.2

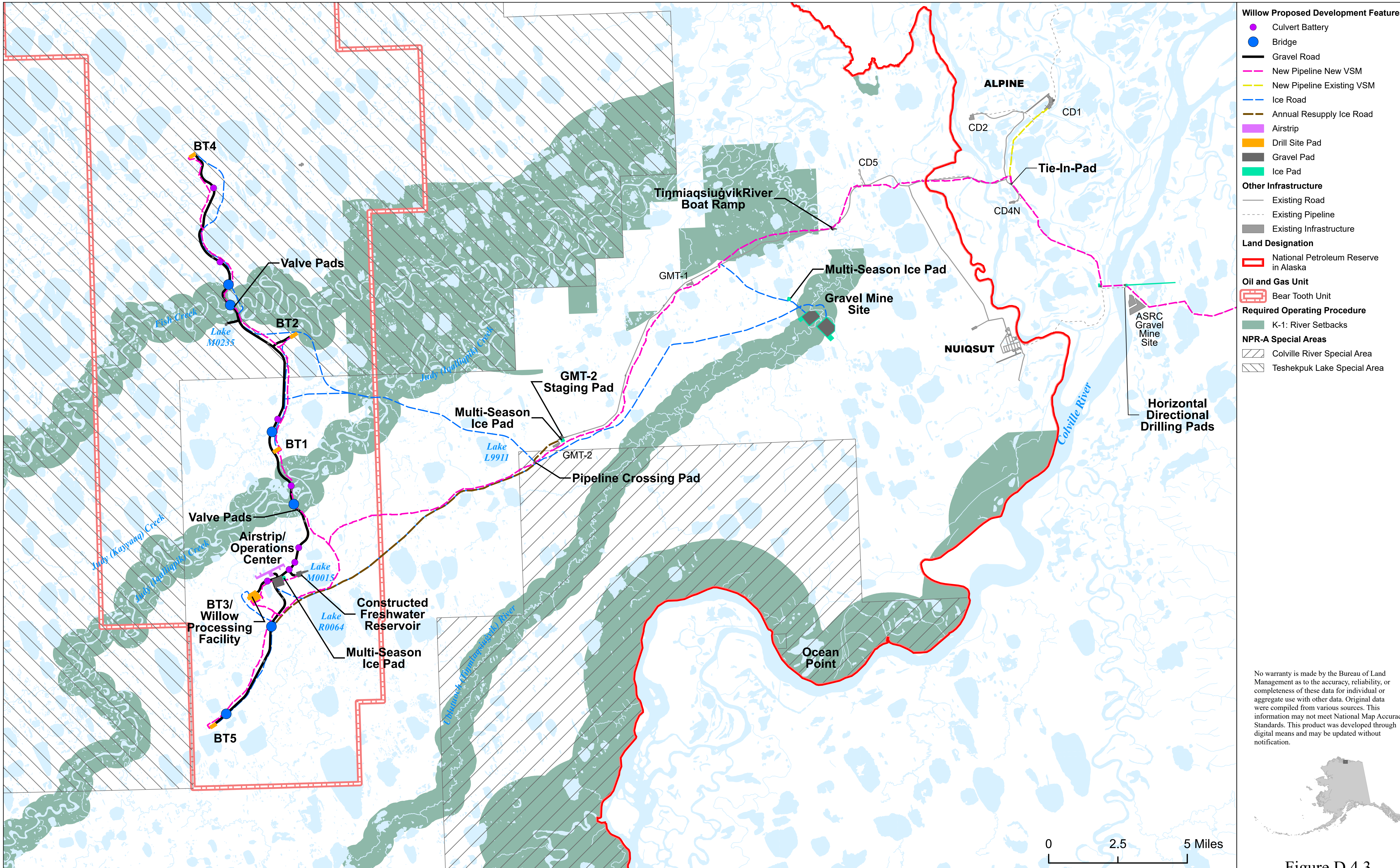
Willow Proposed Development Features
Culvert Battery
Bridge
Gravel Road
New Pipeline New VSM
New Pipeline Existing VSM
Ice Road
Annual Resupply Ice Road
Airstrip
Drill Site Pad
Gravel Pad
Ice Pad
Other Infrastructure
Existing Road
Existing Pipeline
Existing Infrastructure
Land Designation
National Petroleum Reserve in Alaska
Oil and Gas Unit
Bear Tooth Unit
Required Operating Procedure
K-1: River Setbacks
NPR-A Special Areas
Colville River Special Area
Teshekpuk Lake Special Area
BT4
Valve Pads
BT2
BT1
Valve Pads
Airstrip/ Operations Center
BT3/ Willow Processing Facility
Constructed Freshwater Reservoir
Multi-Season Ice Pad
BT5
Fish Creek
Lake M0235
Judy (Iqalliqpik) Creek
Judy (Kayyaaq) Creek
Lake M0015
Lake R0064
Lake L9911
GMT-2 Staging Pad
Multi-Season Ice Pad
GMT-2
Pipeline Crossing Pad
GMT-1
TiŋmiaqsiuġvikRiver Boat Ramp
Multi-Season Ice Pad
Gravel Mine Site
CD5
ALPINE
CD1
CD2
Tie-In-Pad
CD4N
NUIQSUT
ASRC Gravel Mine Site
Horizontal Directional Drilling Pads
Colville River
Ocean Point
0
2.5
5 Miles
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Figure D.4.3

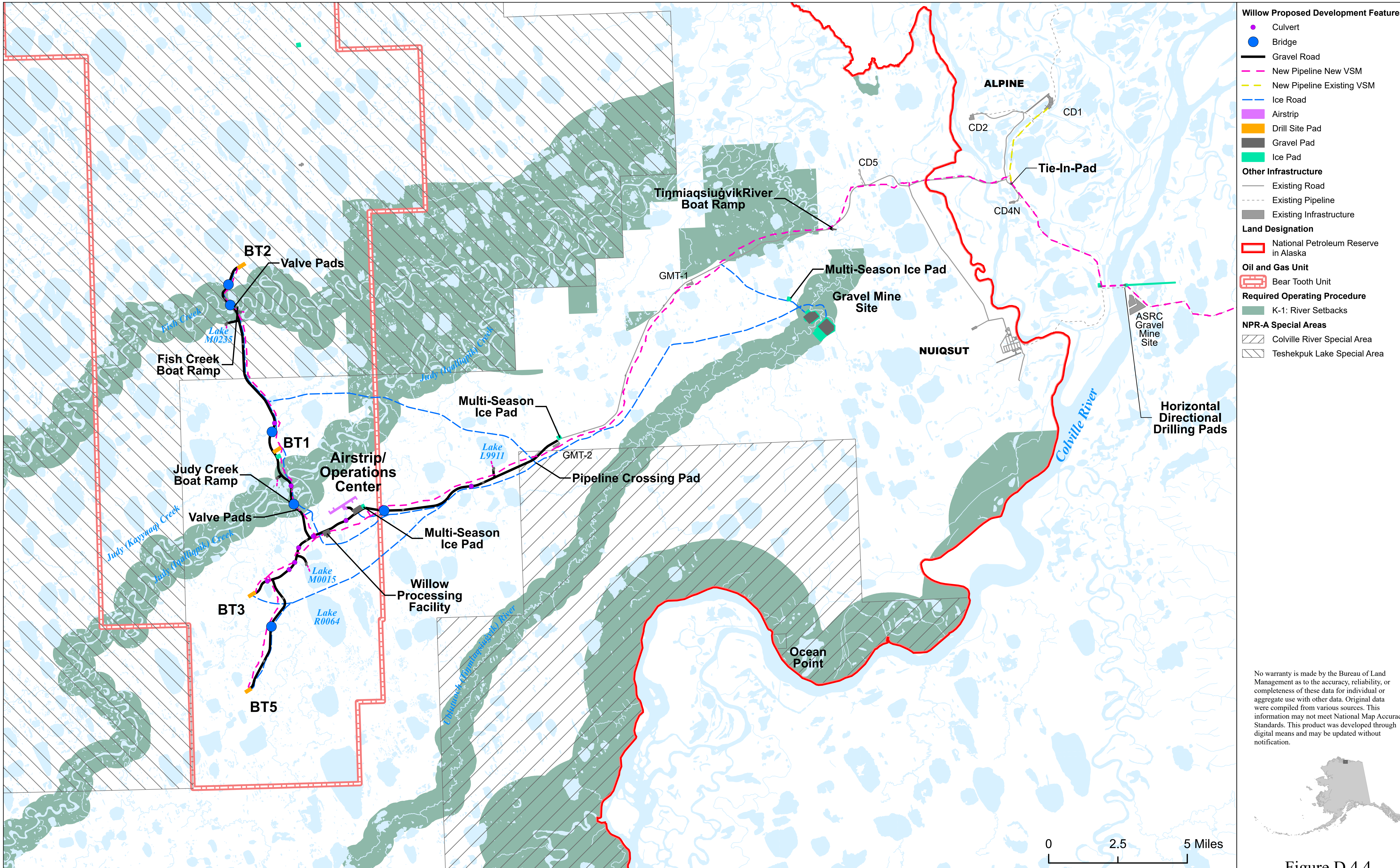
Willow Proposed Development Features
Culvert
Bridge
Gravel Road
New Pipeline New VSM
New Pipeline Existing VSM
Ice Road
Airstrip
Drill Site Pad
Gravel Pad
Ice Pad
Other Infrastructure
Existing Road
Existing Pipeline
Existing Infrastructure
Land Designation
National Petroleum Reserve in Alaska
Oil and Gas Unit
Bear Tooth Unit
Required Operating Procedure
K-1: River Setbacks
NPR-A Special Areas
Colville River Special Area
Teshekpuk Lake Special Area
ALPINE
CD1
CD2
CD5
CD4N
Tie-In-Pad
TiṉmiaqsiuġvikRiver Boat Ramp
GMT-1
GMT-2
Multi-Season Ice Pad
Gravel Mine Site
NUIQSUT
ASRC Gravel Mine Site
Horizontal Directional Drilling Pads
Colville River
BT2
Valve Pads
Fish Creek
Lake M0235
Fish Creek Boat Ramp
Judy (Iqalliqpik) Creek
BT1
Airstrip/ Operations Center
Judy Creek Boat Ramp
Valve Pads
Multi-Season Ice Pad
Lake L9911
Pipeline Crossing Pad
Multi-Season Ice Pad
Willow Processing Facility
Judy (Kayyaaq) Creek
Judy (Iqalliqpik) Creek
Lake M0015
Lake R0064
BT3
BT5
Ublutuoch (Tiṉmiaqsiuġvik) River
Ocean Point
0
2.5
5 Miles
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Figure D.4.4

Option 1: Atigaru Point Module Transfer Island

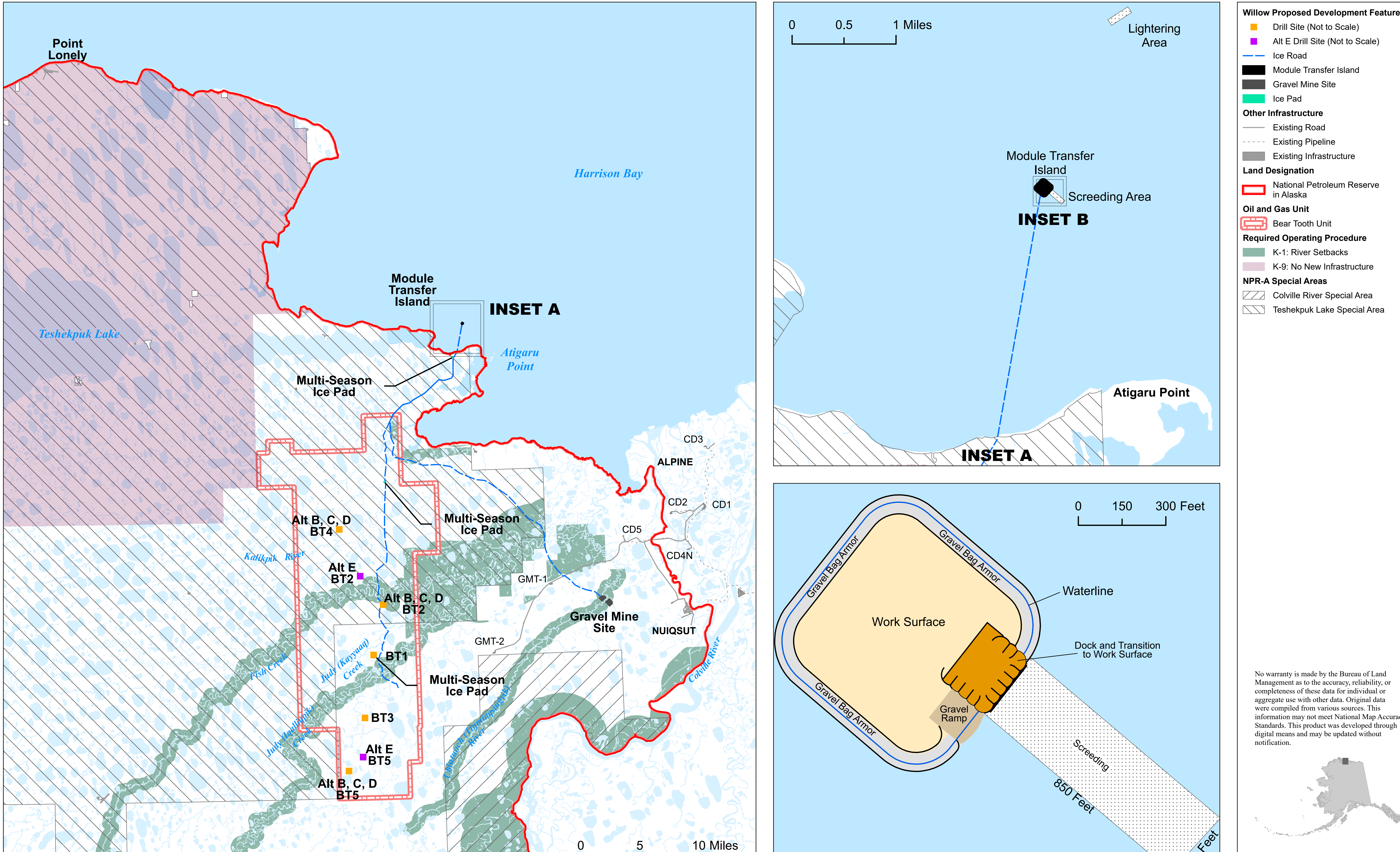


Figure D.4.5

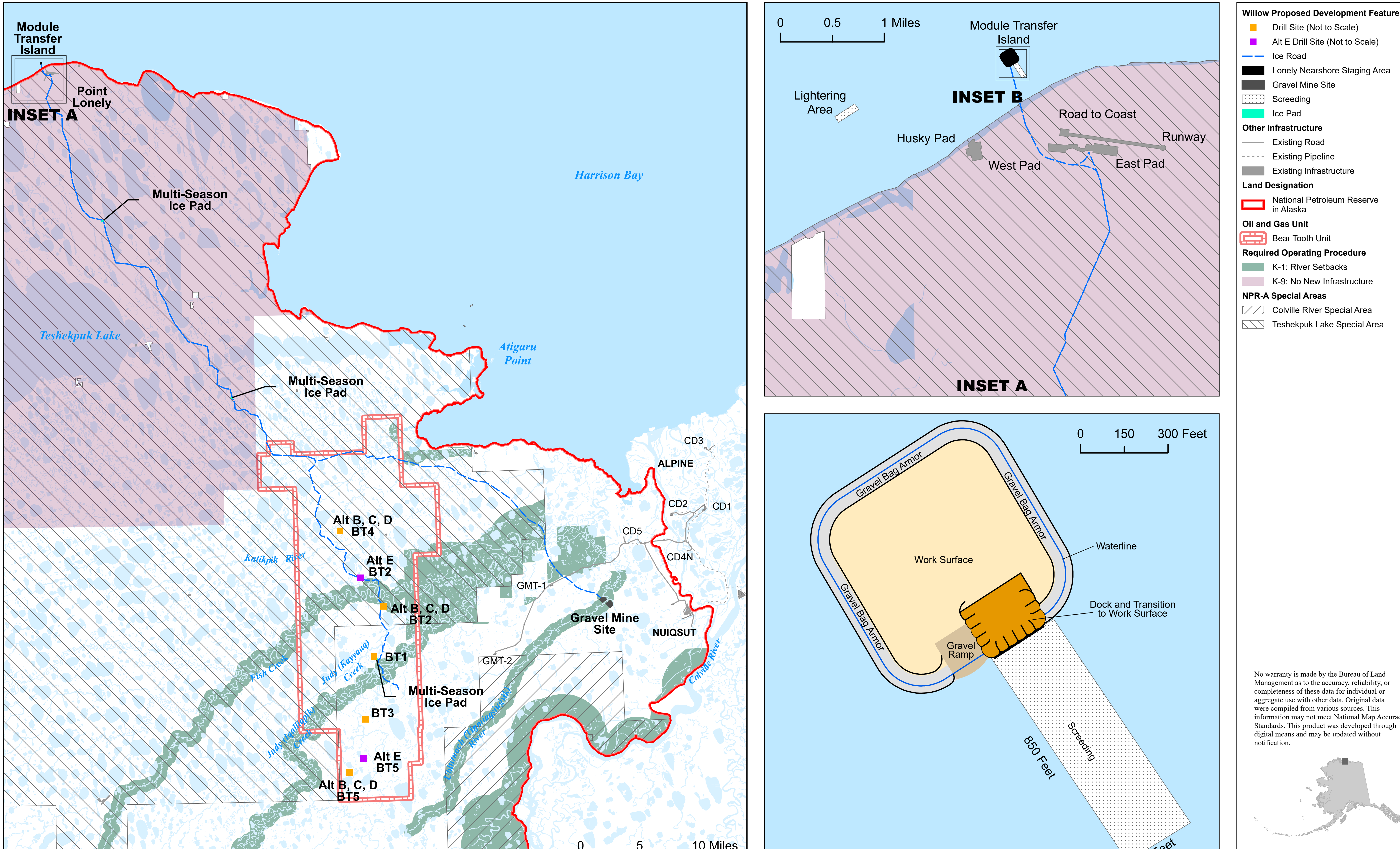
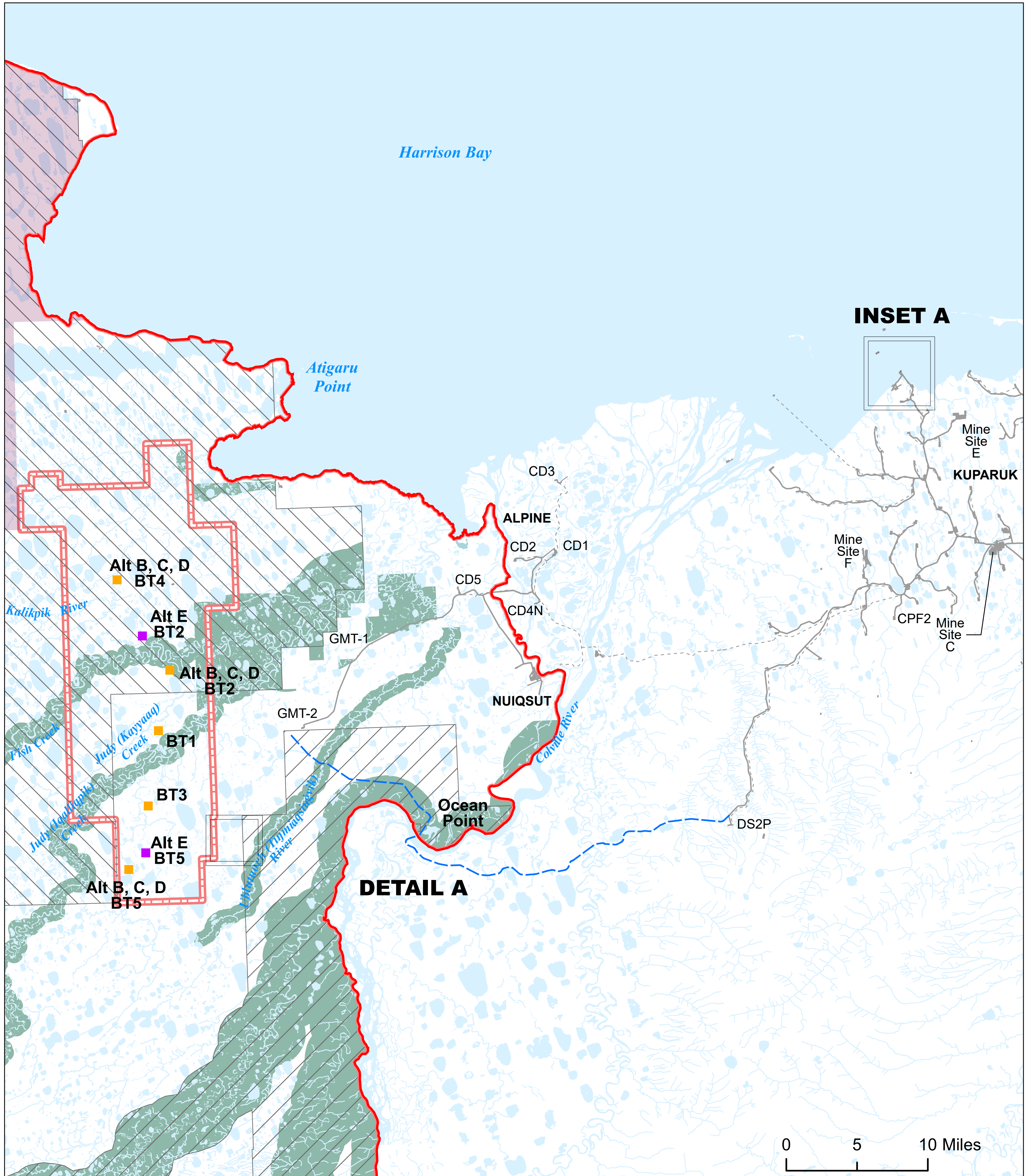
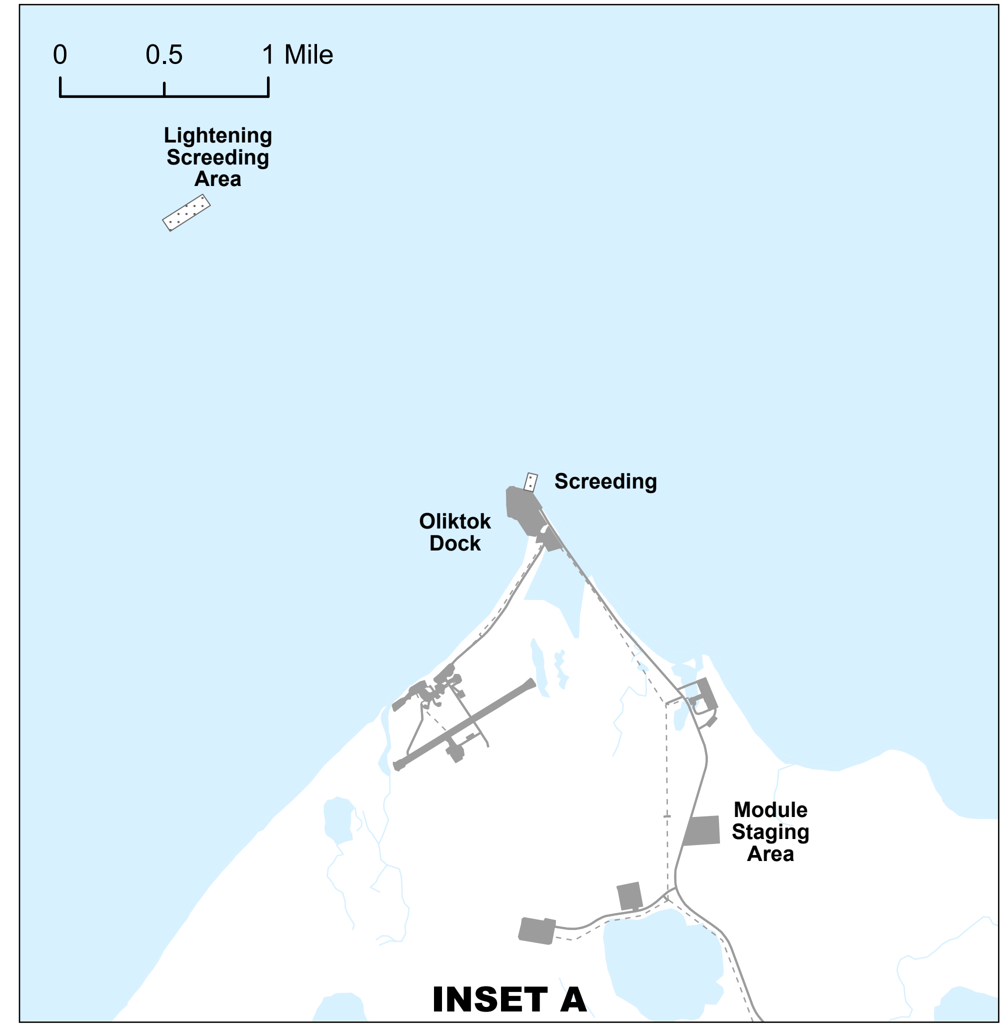
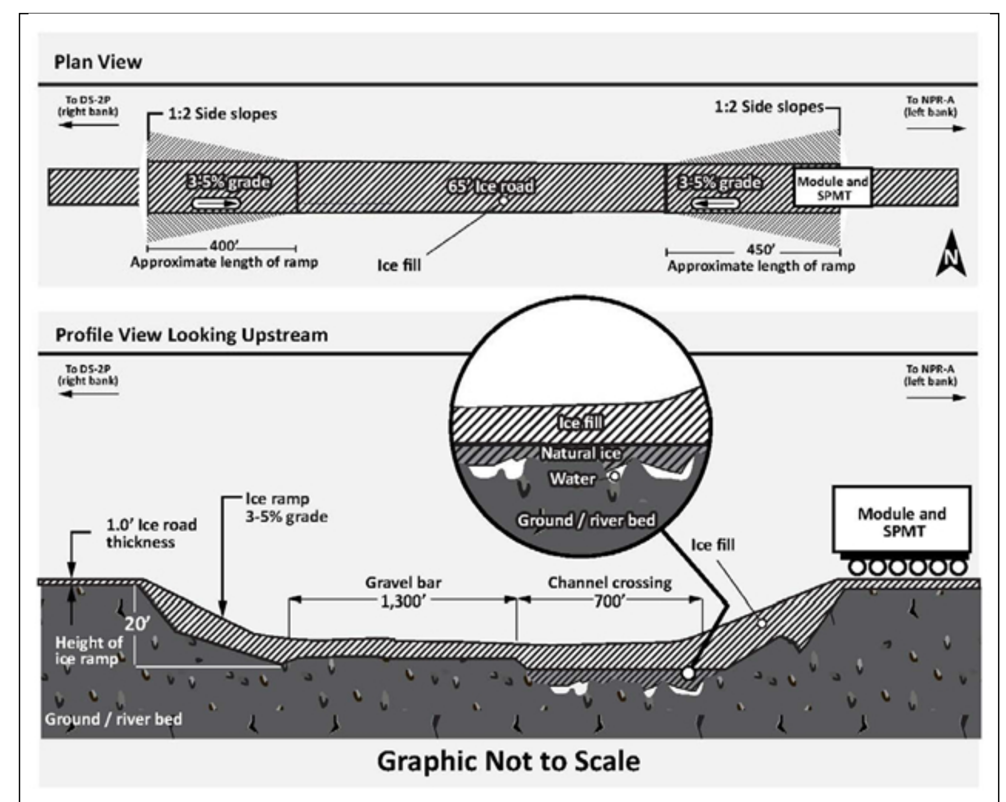

Module Transfer Island
Point Lonely
INSET A
Multi-Season Ice Pad
Harrison Bay
Teshekpuk Lake
Atigaru Point
Multi-Season Ice Pad
CD3
ALPINE
CD2
CD1
CD5
CD4N
Alt B, C, D BT4
Kalikpik River
Alt E BT2
GMT-1
Alt B, C, D BT2
Gravel Mine Site
NUIQSUT
BT1
Judy (Kayyaaq) Creek
Fish Creek
GMT-2
Colville River
Multi-Season Ice Pad
BT3
Judy (Iqalliqpik) Creek
Alt E BT5
Alt B, C, D BT5
0 5 10 Miles
0 0.5 1 Miles
Module Transfer Island
Lightering Area
INSET B
Road to Coast
Husky Pad
Runway
West Pad
East Pad
INSET A
0 150 300 Feet
Gravel Bag Armor
Gravel Bag Armor
Waterline
Work Surface
Gravel Bag Armor
Dock and Transition to Work Surface
Gravel Ramp
Screeding
850 Feet
250 Feet
INSET B
Willow Proposed Development Features
Drill Site (Not to Scale)
Alt E Drill Site (Not to Scale)
Ice Road
Lonely Nearshore Staging Area
Gravel Mine Site
Screeding
Ice Pad
Other Infrastructure
Existing Road
Existing Pipeline
Existing Infrastructure
Land Designation
National Petroleum Reserve in Alaska
Oil and Gas Unit
Bear Tooth Unit
Required Operating Procedure
K-1: River Setbacks
K-9: No New Infrastructure
NPR-A Special Areas
Colville River Special Area
Teshekpuk Lake Special Area
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Figure D.4.6







DETAIL A - Colville River Ice Bridge

Willow Proposed Development Features

- Drill Site (Not to Scale)
- Alt E Drill Site (Not to Scale)
- Ice Road
- Screeding

Other Infrastructure

- Existing Road
- Existing Pipeline
- Existing Infrastructure

Land Designation

- National Petroleum Reserve in Alaska

Oil and Gas Unit

- Bear Tooth Unit

Required Operating Procedure

- K-1: River Setbacks
- K-9: No New Infrastructure

NPR-A Special Areas

- Colville River Special Area
- Teshekpuk Lake Special Area

Figure D.4.7

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4.2 Project Components Common to All Action Alternatives

The Project would include construction of up to five drill sites, a processing facility (i.e., WPF), an operations center (i.e., WOC), pipelines, gravel roads, an airstrip, water source access, and one to three subsistence boat ramps, and development of a gravel mine site. Components common to more than one action alternative are described below. Individual action alternatives are detailed in Sections 4.3 through 4.6; module delivery options are described in Section 4.8, *Sealift Module Delivery Options*.

4.2.1 Project Facilities and Gravel Pads*

The Project would include multiple gravel pads to support Project infrastructure, as described in the following sections. Pads would be a minimum of 5 feet thick (with an average thickness greater than 7 feet) to maintain a stable thermal regime and protect underlying permafrost. Pad thickness and the gravel fill volume needed for each pad would vary due site-specific topography and design criteria (e.g., flat gravel surface). CPAI would use an extruded polystyrene foam insulation board where practicable to reduce the average height, volume, and acreage of gravel fill while maintaining thermal properties to protect permafrost. Gravel pads require approximately 14,000 cubic yards of gravel per acre of pad. Embankment side slopes would be 2 horizontal to 1 vertical ratio (2:1). Erosion potential would be evaluated on a pad-specific basis and embankment erosion protection measures would be designed and employed as necessary.

In response to NSB rezoning requirements, CPAI would use closed-cell foam insulation where practicable to reduce the required gravel fill volumes for gravel pads, while still protecting underlying permafrost. Use of insulation would likely result in reduced pad heights (versus only gravel fill), though the existing tundra topography would control overall pad heights. It is anticipated the Willow operations center and WPF pads will use insulation where there would not be a conflict with on-pad infrastructure.

CPAI would use **thermosyphons** to protect Project infrastructure and underlying permafrost for facilities located on gravel pads. Thermosyphons operate via passive heat exchange using natural convection without the need for power or a pump, and they pull heat from beneath a structure, thus preventing thawing of the substrate. Thermosyphon design includes a sealed fluid-filled tube, with portions above and below ground. Thermosyphons are a routinely used design feature in arctic environments.

4.2.1.1 Willow Processing Facility

The WPF would include the main plant facilities needed to separate and process multiphase production fluids and deliver sales-quality crude oil. Produced water would be processed at the WPF and reinjected to the subsurface as part of reservoir pressure maintenance/water flood for secondary recovery. Produced natural gas would be used to fuel plant and facility equipment, be reinjected into a producing reservoir formation to maintain reservoir pressure and increase recovery, and used for **gas lift**.

Under plant startups, shutdowns, and upset conditions, natural gas may be flared to maintain safe operations. Project flaring activity can be categorized as follows:

- Initial cleanout – Initial cleanup/flowback from production and injection wells in order to remove fluids from the wellbore. The associated gas would be flared prior to WPF startup; following WPF commissioning, gas would be returned to the production system and would not be flared except under upset conditions. Flaring would only be associated with wells drilled prior to WPF startup (BT1 and some BT2 wells). The anticipated duration would be 1 to 2 days.
- Stimulation cleanout – Cleanup/flowback after well stimulation activities are complete to remove proppant and stimulation fluids from the wellbore. The associated gas would be flared prior to WPF startup; following WPF commissioning, gas would be returned to the production system and would not be flared except under upset conditions. Flaring would only be associated with wells drilled prior to WPF startup (BT1 and some BT2 wells). The anticipated duration would be 4 to 7 days.
- Well testing – Flowback of wells to tanks prior to facility startup in order to determine fluid rates and water cut. Associated gas would be flared prior to WPF startup; following WPF commissioning, gas would be returned to the production system and would not be flared except under upset conditions. Flaring would only be associated with wells drilled prior to WPF startup (BT1 and some BT2 wells). The anticipated duration would be 4 to 7 days.
- Facility upset – Flaring of excess gas, in accordance with regulated flaring limits, to stabilize WPF conditions during startup or facility upset. The goal would be to flare small volumes of gas in order to

avoid a facility shutdown. Flaring at the WPF would be regulated, and the WPF would have a limited number of permitted flaring events allowed in the permit. The anticipated duration would be hours.
- Facility emergency blowdown – Flaring all gas within the boundaries of the WPF in order to shut down and depressurize the facility in the event of an emergency. The anticipated duration would be minutes to hours.

The WPF would house processing equipment and support facilities and would include the following:
- Emergency shutdown equipment
- Natural-gas-fired turbine generators
- Gas-turbine compressors
- Gas strippers
- Gas treatment facilities
- Heat exchangers
- Separators
- Stabilizer unit
- Flare system
- Utility systems (e.g., heating glycol, nitrogen)
- Oil-producing vessels
- Pumps
- Pigging facilities
- Metering facilities
- Electrical equipment
- Fuel supply storage tank(s) and associated fueling station
- A tank farm, which could include methanol, sales oil or off-specification crude oil, crude oil flowback fluids, scale inhibitor, emulsion breaker, biocide,[5] corrosion inhibitor, and minor volumes of other chemicals as required to support Project operations
- Warm storage facilities for equipment

Additional facilities would be required to accommodate production from the GMT-2 drill site (Section 3.7.1, *Greater Mooses Tooth 2 Processing at Willow*); any equipment necessary to accommodate GMT-2 production would be housed within the GMT-2 footprint and the WPF pad. The additional equipment would include the following:
- Electrically driven booster compressor to increase gas pressures for injection into the deeper GMT-2 reservoir
- Electrically driven booster pump to increase water pressure for injection into the deeper GMT-2 reservoir
- Separation and metering equipment required for the independent measurement of fluids crossing the Bear Tooth-Greater Mooses Tooth Unit boundary
- Chemical storage tanks at GMT-2 to support chemical treatment of pipelines between GMT-2 and the WPF

The previously proposed electrical generation equipment would provide sufficient power to support the additional equipment needed to process the GMT-2 resources; there would be no additional emission sources or changes to fueled equipment sizes associated with processing GMT-2 production at the WPF.

In addition to the equipment and facilities listed above, each action alternative may require additional equipment or facilities to meet logistical needs specific to each action alternative. At various times throughout the Project's producing lifetime, temporary modules, maintenance buildings, pipelines, and other structures may be used at the WPF to address short-term needs. Processing facility buildings would be designed to industry standards and building codes appropriate for each purpose. The designs would consider factors such as temperature, wind, precipitation, seismicity, building contents, purpose, personnel health and safety, and other environmental factors.

*4.2.1.2 Drill Sites**

The Project would construct up to four or five drill sites (varies by alternative). Each drill pad has been designed to accommodate all drilling and operations facilities, wellhead shelters, drill rig movement, material storage, and well work equipment. Each drill site would be sized to accommodate up to 70 wells (Alternatives B, C, and D) or up to 80 wells (Alternative E) with typical 20-foot wellhead spacing; subject to potential changes based on conditions discovered when development drilling commences, the Project would have a total of 251 wells under

[5] Biocide would be used in the seawater system to kill micro-organisms which cause internal pipeline corrosion.

Alternatives B, C, and D, and 219 wells under Alternative E. Additional facilities typical for drill sites would include the following:

- Emergency shutdown equipment
- Fuel gas treatment equipment
- Well test and associated measurement facilities
- Electrical and instrumentation control equipment
- Pig launchers and receivers
- Chemical injection facilities (including tanks, containment, small pumps, and exterior tank fill connections)
- Production heater and associated equipment
- Spill response equipment containers
- Communications infrastructure (including tower(s) up to 200 feet tall)
- High-mast lights
- Temporary tanks to support drilling and well work operations
- Production operations storage tanks
- Production operations stand-by tank (normally empty)
- Transformer platforms (oil-insulated)
- Pipe racks or manifold piping/valves (or both)

The Project would use hydraulic fracturing and **extended reach drilling** (ERD) to access the targeted hydrocarbon deposits and develop wells (Section 4.2.10.2.1, *Hydraulic Fracturing*). Hydraulic fracturing is a well stimulation technique used to increase the flow of oil and natural gas. ERD is a directional drilling technique used to develop long, horizontal wells and allow a larger area to be reached from a single surface location (i.e., drill pad), providing greater access to a reservoir (Section 4.2.10.2.2, *Extended Reach Drilling*).

Wells would be categorized as either production or injection. The production wells would generate the Project's oil and gas production while the injection wells would be used to inject water (e.g., treated seawater and/or WPF-processed produced water) and/or gas into the producing formation(s) to maintain reservoir pressure. Wells would be equipped with appropriate safety valve systems in accordance with 20 AAC 25.265. Manifold or pipe rack piping (or both) would combine individual wellhead piping into a common gathering line through which all produced fluids would be transported to the WPF.

Table D.4.1 summarizes the different drill site locations and the associated alternatives.

Table D.4.1. Drill Site Location and Associated Alternative Summary*

Drill Site	Alternative(s)	Latitude	Longitude	Township	Range	Section(s)
BT1	B, C, D, E	70.1749° N	152.1150° W	10 N	1 W	34
BT2	B, C, D	70.2357° N	152.0838° W	10 N	1 W	11
BT2 North	E	70.2733° N	152.1598° W	11 N	1 W	28
BT3	B, C, D, E	70.0998° N	152.1577° W	9 N	1 W	28, 33
BT4	B, C, D	70.3325° N	152.2296° W	11 N	1 W	6
BT5	B, C, D	70.0300° N	152.2213° W	8 N	1 W	19
BT5 North	E	70.0482° N	152.1673° W	8N	1W	16

Note: BT (Bear Tooth); N (north); W (west). All public land survey system data in Umiat Meridian.

4.2.1.3 Willow Operations Center

The base of operations for the Project would be the WOC (South WOC under Alternative C), which would be located near the WPF (but separated by approximately 1 mile for safety reasons). The WOC location would minimize the risk to Project personnel by placing permanently occupied buildings (e.g., living quarters) away from potential blast hazards associated with the WPF, which is consistent with current best safety practices and standards, including the American Petroleum Institute (API) Recommended Practice 752. The WOC would be adjacent to the Project airstrip.

The WOC would contain accommodations and utility buildings and maintenance and storage facilities to support Project operations, including the following:

- Permanent Willow Operations Camp facilities, including living quarters, offices, meeting rooms, dining facilities, a central control building, a lab, a medical clinic, and wellness facilities
- Wastewater and water treatment plants, water tanks, and chemical storage
- Freshwater storage tanks

- At least two Class I underground injection control (UIC) disposal wells
- Emergency response center, including spill response shop, fire department, and ambulance bay
- Essential and emergency generators
- Gas turbine generator
- Craft maintenance shop and tool room
- Hazardous waste accumulation and storage
- Fleet maintenance shop
- Fabrication and weld shop
- Warehouse
- Storage tents
- Diesel and jet fuel tanks and pump skids
- Drilling shop
- Solid waste incinerator
- Staging areas
- Drilling and cuttings storage
- Operations and maintenance storage
- Laydown space
- Rolling stock parking

Under Alternatives B, C, and D, the WOC (or South WOC) would include a mud plant. Under Alternative E, the mud plant would be located at the K-Pad, near Alpine Colville Delta drill site 5 (CD5) (Section 4.2.1.8, *New Project Facilities on Existing Gravel Pads*).

In addition to the facilities listed above, each alternative may require additional equipment or facilities to meet logistical needs specific to each alternative. Temporary surface structures such as camps, offices, shops, envirovacs (bathroom), connexes, fuel and chemical storage areas, and warehouses may be used at the WOC to support Project activities.

Alternative C would include a second WOC (North WOC) which is further described in Section 4.4, *Alternative C: Disconnected Infield Roads*.

4.2.1.4 Valve Pads

Remotely-operated isolation valves would be installed on each side of pipeline crossings at Fish Creek and Judy (Iqalliqpik) Creek, allowing the isolation of produced fluids pipelines on either side of the bridges to minimize potential spill impacts in the event of a leak or break. To support valve infrastructure, gravel pads would be constructed on each side of the identified crossings (two valve pads per crossing; four valve pads total). Valve pads would be located adjacent to gravel roads and approximately 400 to 2,000 feet from the bridge crossings. Under Alternative C, the valve pads at Judy (Iqalliqpik) Creek would not be located adjacent to a gravel road and would only be accessible via helicopter; therefore, these valve pads would be larger to allow helicopter access.

4.2.1.5 Pipeline Pads

Four pipeline pads would be constructed to support pipeline construction and operations:

- One pipeline crossing pad would be located along the import/export pipelines near GMT-2 to allow north to south ice road crossings. Pipelines would be placed in casings through the gravel pad embankment.
- Two new horizontal directional drilling (HDD) pipeline pads would be constructed near the existing Alpine Sales Pipeline HDD Colville River crossing. These pads would be where the proposed diesel and seawater pipelines (Section 4.2.2.3, *Other Pipelines*) transition from aboveground to belowground on each side of the Colville River. These gravel pads would include a rectifier (west bank only) to support the cathodic protection system (i.e., corrosion prevention equipment) and passive thermosyphons (east and west banks). The west bank may also include a module housing remote electrical and instrumentation module unit to support the cathodic protection and pipeline monitoring systems.
- The Willow Pipeline (Section 4.2.2.2, *Willow Pipeline*) would tie into existing pipeline infrastructure at a new tie-in pad located along the Alpine Pipeline near Alpine Colville Delta drill site 4 North (CD4N). One or more truckable modules would be installed on this pad to support pigging, provide overpressure protection, and meter fluids as well as infrastructure to facilitate warm-up or de-inventory of the Willow

Pipeline and seawater pipeline. This includes drag reducing agent tanks and equipment for injection into the sales oil pipeline system.

*4.2.1.6 Water Source Access Pads**

Year-round freshwater access would vary by action alternative, as described in Section 4.2.5, *Water Sources and Use*. Year-round water sources would be accessed by gravel water source access pads, which would be connected to other proposed infrastructure via short spur roads. Water source access pads would vary by action alternative, and Table D.4.2 summarizes the water source access pads for each action alternative. All pads would be sized to minimize the gravel footprint while maintaining adequate space for vehicles to access the water sources and safely maneuver. All water source access pads would include space for a pump house.

Table D.4.2. Water Source Access Pads and Associated Action Alternatives Summary*

Water Source	Applicable Alternative(s)
Constructed freshwater reservoir	B, C, D
Lake L9911	B, C, E
Lake M0015	E
Lake M0112	E
Lake M0235	C, D, E
Lake M1523A	E

Note: The water source access pads located on the north side of Lake R0064 evaluated in the Willow MDP Draft EIS (BLM 2019) are no longer included as part of any action alternative.

4.2.1.7 Communications Tower Pad

To avoid potential interference with the airstrip and comply with Federal Aviation Administration (FAA) requirements, the communications tower associated with the WOC (South WOC under Alternative C) would be constructed on a separate pad for all action alternatives. For Alternatives B, C, and E, the gravel pad would be located adjacent to the WOC or South WOC (Alternative C), respectively. For Alternative D, the gravel pad would be located approximately 1,250 feet south of the WOC along the gravel road to BT5. The communications tower pad would house communications infrastructure, including a communications tower up to 200 feet tall.

*4.2.1.8 New Project Facilities on Existing Gravel Pads**

The Project would include installation of additional modules and equipment on existing gravel pads at Kuparuk CPF2 and the ACF (located at Alpine Colville Delta drill site 1 [CD1]). The Kuparuk CPF2 pad would be expanded 1.0 acre to accommodate these new facilities. The ACF pad would only require expansion (1.3 acres) under Alternative D.

Modules and equipment would be installed on the existing Kuparuk CPF2 pad for the following purposes:

- Diesel transfer tanks, pumps, and pigging facilities
- Seawater transfer pumps and pigging facilities
- Infrastructure to facilitate warm-up or de-inventory of the Willow pipeline and seawater pipeline

Modules, equipment, and storage tanks would be installed on the existing ACF gravel pad for the following purposes:

- Crude oil surge drum and associated equipment to assist with pressure management of the sales-oil pipeline system
- Diesel tanks and pigging facilities to receive product from Kuparuk CPF2
- Diesel transfer tanks/pumps and pigging facilities for delivery to the WPF (Alternatives C and D)
- Infrastructure to facilitate warm-up or de-inventory of the Willow Pipeline and seawater pipeline

In addition to the above facilities, space for a new heavy-duty fleet shop, additional warehouse, and maintenance shop would be needed at the ACF under Alternative D.

Modules, equipment, and storage tanks would be installed on the existing GMT-2 pad to support potential production from GMT-2. This option, if implemented, would include the following:

- Separation and metering equipment to measure fluids crossing the GMT-BT unit boundary
- Chemical storage to support chemical injection into pipelines connecting GMT-2 and the BT unit

Under Alternative E, the existing mud plant located at the K-Pad (Figure D.4.4) would be expanded on existing gravel to accommodate Project requirements (Section 4.6, *Alternative E: Three-Pad Alternative [Fourth Pad Deferred]*).

4.2.2 Pipelines

The Project would include infield and import/export pipelines. Infield pipelines would carry a variety of products, including produced fluids, produced water, seawater, miscible injectant, and gas, between the WPF and each drill site.

Import/export pipelines would include the Willow Pipeline, a seawater pipeline, and a diesel pipeline. The Willow Pipeline, a U.S. Department of Transportation (USDOT) regulated sales-oil transport pipeline, would carry sales-quality crude oil processed at the WPF to a tie-in with the existing Alpine Sales Pipeline near Alpine CD4N. Other pipelines would carry seawater (using the existing seawater treatment plant in Kuparuk), diesel fuel (a USDOT-regulated pipeline), freshwater, treated water, and fuel gas pipelines.

Pipeline design would conform to the American Society of Mechanical Engineers codes B31.4 and B31.8, as appropriate, applicable federal and state standards, and CPAI's internal specifications and criteria. All pipelines would be hydrostatically tested prior to startup, as required by the appropriate design code (e.g., B31.4 and B31.8). Typical pipeline construction would consist of carbon steel pipe, as dictated by service, pipeline size, and code; pipelines would be externally coated with fusion-bonded epoxy to prevent external corrosion and then covered with rigid polyurethane insulation and metal jacketing that would be nonreflective or buffed in the field. Pipelines would rest on common horizontal support members (HSMs) atop vertical support members (VSMs) placed approximately 55 feet apart, with an estimated 80% of VSMs being singular and 20% being installed as pairs. VSMs would have a typical diameter of 12 to 24 inches (approximately 75% and 25% of VSMs, respectively) and a disturbance footprint of 18 to 32 inches (up to 5.6 square feet). VSMs would be driven to a minimum of 17 feet below the active permafrost layer to prevent subsidence or frost jacking. CPAI would maintain VSMs through its asset integrity inspection and maintenance program for monitoring and repairs.

At Fish Creek and Judy (Iqalliqpik) Creek (except under Alternative C), pipelines would be placed on structural steel supports attached to the bridge girders, below the bridge deck. At smaller stream crossings, pipelines would be installed approximately perpendicular to the channel with VSMs on each side of the crossing to avoid VSM placement in streams to the extent practicable. VSMs placed below ordinary high water (OHW) would typically be 48 inches in diameter.

Fiber-optic and power cables would be suspended via messenger cable attached to the HSMs, except at pipeline-road crossings, where fiber optic and power cables would be installed in a trench beneath the road. Trenches would be excavated in winter, and soils would be temporarily sidecast onto plywood, plastic sheeting, or an adjacent ice pad. Excavated materials would be backfilled into the trench. Trenching may also be used to bury power and communications cables at the HDD pads.

Pipelines (including suspended cables) on new VSMs would be a minimum of 7 feet above the surrounding ground surface, including in areas where new VSMs would be placed adjacent to existing Alpine or Kuparuk pipelines, which may be less than 7 feet above the ground surface. New pipelines that share existing VSMs and HSMs would match the existing HSM heights. Where Project pipelines would parallel existing pipelines, the new VSMs would be aligned with the existing VSMs (to the extent practicable) to avoid a picket fence effect. Except for locations where there is no gravel road connecting Project facilities, all pipelines would parallel new and existing gravel roads, typically between 500 and 1,000 feet from roadways. This separation distance provides daily opportunities to observe pipelines for leaks or other damage while maintaining enough distance to prevent collisions between pipelines and vehicles and reduces impacts (e.g., disturbance) for caribou crossing roads and pipelines. Pipelines would be routed an appropriate distance from the WOC to maintain the recommended pipeline blast radii and gas dispersion safety zones. This would require the pipelines between the WOC and airstrip be greater than 1,000 feet from the road. Similarly, pipelines under Alternative D would be over 1,000 feet from gravel roads to adhere to the FAA clearance envelope surrounding the adjacent airstrip.

4.2.2.1 Infield Pipelines

Infield pipelines would include the following pipelines connecting the WPF to each Project drill site and to GMT-2:

- Produced fluids pipeline – Produced crude oil, gas, and water transported from each drill site to the WPF for processing.
- Injection water pipeline – Seawater or produced water transported from the WPF for injection to support enhanced oil recovery.
- Gas pipeline – Lean gas transported from the WPF for artificial lift, pressure support, and fuel gas.
- Miscible-injectant pipeline – Miscible injectant transported from the WPF for injection to support enhanced oil recovery.

The infield pipeline supports would include space to accommodate future pipelines to support potential future development in the Project area (e.g., Greater Willow 1 [GW1] and Greater Willow 2 [GW2]; Figure D.1.1). Infield pipelines between GMT-2 and the WPF would be carried on Project import/export pipeline supports (i.e., Project pipeline VSMs and HSMs).

All infield pipelines would be designed to allow pipeline inspection and maintenance (e.g., pigging) between each drill site or GMT-2 and the WPF. Permanent pigging facilities would be installed for the produced fluid and injection water pipelines. Pipeline valves that can be closed in the event of an emergency would be installed on produced fluids pipelines at each side of the Judy (Iqalliqpik) Creek and Fish Creek crossings, isolating the section of pipeline between the valves to minimize potential spill impacts in the event of a pipeline leak or break.

Pipelines would be designed to minimize redundant parallel pipelines to the extent practicable. For example, BT2 pipelines would tie in to BT1 pipelines at BT1 to reach the WPF under each action alternative. An additional set of infield pipelines would connect BT5 to the WPF, GMT-2 to the WPF, and except for Alternative D, an additional set of infield pipelines would connect BT3 to the WPF (note: under Alternative D, the WPF is colocated with BT3). Infield pipelines would use single VSMs, except where anchor supports are used in expansion loops (i.e., “Z” bends), where two VSMs per pipeline support would be used.

4.2.2.2 Willow Pipeline

The Willow Pipeline, a USDOT-regulated sales-oil transport pipeline, would carry sales-quality crude oil processed at the WPF to a tie-in with the existing Alpine Sales Pipeline at the tie-in pad near Alpine CD4N. From Alpine CD4N, sales-quality crude oil would be transported via the existing Alpine Sales Pipeline to the Kuparuk Pipeline and onward to the Trans-Alaska Pipeline System near Deadhorse, Alaska, for shipment to market.
The Willow Pipeline would be placed on new VSMs between the WPF and the tie-in pad near Alpine CD4N. Between the WPF and the tie-in pad near CD4N, vertical lops or isolation valves would be installed on each side of the Ublutuoch (Tiŋmiaqsiuġvik) River and on each side of the segments crossing the Niġliagvik Channel, Niġliq Channel, and Lakes L9341 and L9323.

The Willow Pipeline would comply with USDOT spill response plan requirements for onshore pipelines.

4.2.2.3 Other Pipelines

Other Project pipelines would include a seawater import pipeline, a diesel import pipeline, a freshwater pipeline, a treated water pipeline, and a fuel gas pipeline. The new seawater pipeline would import seawater from Kuparuk CPF2 to the WPF for injection in the target reservoirs. The USDOT-regulated diesel pipeline would transport diesel fuel and other refined hydrocarbon products to power drilling support equipment, well work operations, and vehicles and equipment, as well as provide freeze protection of wells.

Under Alternatives B and E, the diesel pipeline would extend from Kuparuk CPF2 to the ACF at Alpine CD1; from the ACF, diesel fuel would be trucked to the WPF and other locations in the Project area, as needed. Under Alternatives C and D, the diesel pipeline would transport fuel from Kuparuk CPF2 to CD1 and then to the WOC and WPF. Alternative C would also include a diesel pipeline connecting the WPF to the North WOC.
The seawater pipeline would be placed on new VSMs from Kuparuk CPF2 to the WPF. The diesel pipeline would share new VSMs with the seawater pipeline, except for the pipeline segment between Alpine CD4N and the ACF at CD1, where it would be placed on existing VSMs. New VSMs would also be shared with the Willow Pipeline, where available. Between Kuparuk CPF2 and Alpine CD4N, vertical loops would be installed on the diesel pipeline on each side of the Miluveach River, the Kachemach River, and the Colville River.

The seawater and diesel pipelines would cross beneath the Colville River and would be installed using HDD. The Colville River crossing would be near the existing Alpine Pipeline HDD crossing, approximately 400 feet downstream (north). The pipeline crossing would be similar in design and size to the existing Alpine pipeline crossing. Each pipeline would be installed approximately 60 feet apart in its own casing. Pipelines would be insulated and placed within the outer pipeline casing, which would serve to inhibit heat transfer to permafrost, contain fluids in the event of a leak or spill, and provide structural integrity. A pipe anode would be installed between the seawater and diesel pipelines to convey an anode as part of the pipelines' cathodic protection system.

The HDD process would involve drilling a borehole under the Colville River that is large enough to accommodate the pipeline casing. The HDD entry and exit locations would be set back more than 300 feet from the riverbanks and the total length of the borehole would be approximately 4,500 feet. The depth below the river channel bottom at the center of the HDD crossing would be approximately 70 feet. Throughout the process of drilling and enlarging the borehole, a slurry made of naturally occurring nontoxic materials (typically bentonite clay and water) would be circulated through the drilling tools to lubricate the drill bit, remove drill cuttings, and hold the borehole open. Pipeline sections would be staged and welded together to form segments long enough to span the entire crossing. Once the borehole is ready, the completed pipeline segments would be pulled through the drilled borehole.

Two new gravel pads would be constructed for the HDD crossing where the pipelines transition from aboveground to belowground, with one on each side of the river near the existing Alpine Pipeline HDD gravel pads. The HDD crossing would be constructed during winter. Two HDD ice pads and an HDD laydown pad (approximately 42 total acres) would be constructed with one HDD ice pad on each side of the Colville River to support the HDD crossing construction.

Under alternatives B, C, and D, a raw water pipeline would transport freshwater from the intake infrastructure at the CFWR to the WPF and the WOC. The raw water pipeline would be placed on VSMs parallel to the water source access road before connecting to VSMs shared with other infield pipelines to the WPF and the WOC (South WOC under Alternative C). Under Alternative E, at each water source lake (L9911, M0235, M0112, M1523A, and M0015), two pipelines would extend from the pumphouse out into a deep portion of the lake on VSMs for water intake and water would be hauled by truck from the water source access pads to where it is needed in the Project area.

All alternatives include treated water pipelines between the WOC and the WPF. Alternative C would also construct a second treated water pipeline between the WPF and the North WOC (Section 4.2.4.5, *Potable Water*). A fuel gas pipeline would also connect the WPF and WOC (South WOC for Alternative C) under all action alternatives. Alternative E would also include a seawater pipeline spur that would connect to an existing seawater pipeline to the existing mud plan on the K-Pad.

4.2.3 Access to the Project Area

Access to the Project area from Alpine, Kuparuk, or Deadhorse would occur via ground transportation over existing gravel roads, ice roads, fixed-wing aircraft, and helicopters. Construction material (e.g., pipeline, VSMs) may be delivered to the North Slope and Project area by ground transportation and barge. Small modules and bulk materials would be delivered by barge to Oliktok Dock and transported to the Project area via the annual Alpine Resupply Ice Road (Section 4.2.3.4, *Sealift Barge Delivery to Oliktok Dock*). The larger sealift modules comprising the processing facilities at the WPF and the drill sites would also be delivered to the North Slope by sealift barge; however, these modules would be too large to cross the Colville River ice bridge used by the Alpine Resupply Ice Road. As a result, three different options for the WPF and drill site sealift module deliveries are described in Section 4.8, *Sealift Module Delivery Options*.

Anticipated ground, air, and marine traffic is detailed by alternative (Sections 4.3 through 4.6).

4.2.3.1 Ice Roads

Ice roads would be used primarily during construction to support gravel infrastructure and pipeline construction, for lake access, and to access the gravel mine site. Due to heavy equipment size and the frequency of construction traffic, safety considerations dictate the use of separate ice roads for pipeline construction, gravel placement, and general traffic.

Ice road construction is dependent upon ground temperature and precipitation (i.e., sufficient snow for prepacking routes) and typically begins in November or December. Vehicle access via ice road depends on the ice road season opening and closing dates and the distance from existing infrastructure. The usable ice road season for travel to the Project area is anticipated to be shorter than that of Kuparuk and Alpine operations due to the logistical challenges of constructing and completing a remote ice road. Based on CPAI's experience at GMT-1 and other projects conducted in the NPR-A, the annual ice road use season for the Project is expected to be 90 days, from approximately January 25 through April 25. A typical ice road would be at least 6 inches thick with a 35- or 70-foot-wide surface, depending on its use. A typical ice road used for gravel hauling would have a 50-foot-wide surface. All ice road routes in the EIS are estimated, and final alignments would be determined through design optimization and impact minimization analysis prior to Project construction.

Ice road design begins with a desktop analysis to identify preliminary routes that have been field verified the prior summer and adjusted to address design constraints and field conditions. Routes would be field staked in October and November, and ice road construction would begin when suitable conditions allow. Ice road construction would begin by prepacking the route with tundra-approved vehicles, after which general construction would commence. Typical equipment used in ice road construction includes Tucker Sno-Cats (tracked crew vehicles), Rolligons, water buffalos (portable water tanks), Terra Gators (water spreaders), front-end loaders, Maxi Hauls (tractor and dump trailer), water trucks, trimmers (for creating ice chips), and graders. Following the construction of ice roads, water trucks, graders, and snow blowers are used for ice road maintenance. Ice and snow ramps, thicker ice sections at select water crossings, and use of supplemental materials such as rig mats, may be used to increase ice road strength.

Following the end of the ice road season, all ice road stream crossings would be breached or slotted, and the ice built up artificially at crossings (e.g., ice or snow ramps) would be removed to match the static water elevation. Following spring breakup, work crews would conduct "stick picking" to remove any anthropogenic materials.

Best management practices typically used in conjunction with ice roads include:

- Placement of delineators to mark ice road edges
- Frequent maintenance of routes
- Use of portable spill containment (i.e., duck ponds) under vehicles and equipment
- Coordination with the Kuukpik Subsistence Oversight Panel and the ice road monitors to patrol routes for spill cleanup needs
- Summer cleanup activities (i.e., stick picking)

Large modules comprising the processing facilities would be delivered to the North Slope by sealift barge (Section 4.8, *Sealift Module Delivery Options*) during the open-water season. During the following winter construction season, the sealift modules would be transported via ice road (combination of sea ice and over tundra) to the Project area. A typical tundra-based ice road used for sealift module mobilization would be 60 feet wide.

During drilling and operations, seasonal ground access from Deadhorse and Kuparuk to the Project area would be provided by the annually constructed Alpine Resupply Ice Road and then via existing Alpine and GMT gravel roads; under Alternative D, an annual ice road would be constructed from GMT-2 to the Project area. Alternative C would require the construction of an annual ice road between the WPF and BT1 to provide annual resupply for drill sites BT1, BT2, and BT4. For annual (i.e., resupply) ice roads, the same general area would be used year after year, with the previous year's location being mapped so subsequent years can follow the same route, as is reasonably practicable and appropriate. This method of ice road layout has the fewest impacts from an overall footprint perspective. CPAI would remove any anthropogenic debris (i.e., stick pick) from the route annually and perform annual inspections, as required by respective landowners and land managers.

Estimated ice road mileage by alternative is summarized in Table D.4.3. Additional ice roads to support sealift module delivery are described in Section 4.8, *Sealift Module Delivery Options*.

Table D.4.3. Estimated Total Ice Road Mileage by Alternative and Year*

Year	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)*
Year 1	32.7	32.2	41.0	32.6
Year 2	43.9	44.6	92.0	42.0
Year 3	99.3	155.2	151.6	98.1
Year 4	137.6	109.0	150.9	146.9
Year 5	44.0	77.7	62.1	47.5
Year 6	56.2	14.7	27.9	12.6
Year 7	50.2	59.6	17.4	43.6
Year 8	21.0	65.8	68.6	7.9
Year 9	10.3	15.7	69.1	0.0
Year 10	0.0	3.6	19.3	0.0
Year 11+ (Annual)[a]	0.0	3.6	12.5	0.0
Year 11 – Life of Project[b]	0.0	72.0[c]	262.5[d]	0.0
Total	**495.2**	**650.1**	**962.4**	**431.2**

Note: "*" Indicate a new row since the Final EIS was published.

[a] This row indicates the miles of ice roads that would be constructed annually from Year 11 through the life of the Project.

[b] Life of the Project would be 30 years for Alternatives B, C, and E and 31 years for Alternative D.

[b] Assumes 3.6-mile-long annual ice road to connect Bear Tooth drill site 1 (BT1) to Bear Tooth drill site 3 (BT3) for the life of the Project.

[c] Assumes 12.5-mile-long annual ice road between Greater Mooses Tooth Unit and the Project area for the life of the Project.

*4.2.3.2 Gravel Roads**

All-season gravel roads would connect the Project drill sites to the WPF and to the existing GMTU (with some exceptions under Alternatives C and D) and Alpine gravel infrastructure. Gravel roads would be designed to maintain the existing thermal regime and would be a minimum of 5 feet thick (average of 7 feet thick due to topography) and have 2:1 side slopes. CPAI would use insulation where practicable to reduce the average height, volume, and acreage of gravel fill while maintaining thermal properties to protect permafrost. Gravel roads require approximately 60,000 cubic yards of gravel per mile of gravel road. The roads to BT3 (except under Alternative D), BT4 (except under Alternative E), BT5, the airstrip(s), and the water source access road(s) would be 24 feet wide at the surface (i.e., crown width) with an average toe-to-toe width of approximately 53 feet. All other Project roads would be 32 feet wide (crown width) with an average 61-foot toe-to-toe width. CPAI would limit 24-foot-wide Project roads to 25 miles per hour (32-foot-wide roads would have 35 mile per hour speed limits). Roads would include subsistence tundra access ramps at road pullouts; locations and designs would be based on lessons learned from GMT-1 and GMT-2, on community input, and in consultation with Nuiqsut but would generally be every 2.5 to 3.0 miles. These pullouts and tundra access ramps would allow local residents to cross gravel roads or gain access to subsistence use areas.

In response to NSB rezoning requirements, CPAI would use closed-cell foam insulation where practicable to reduce the required gravel fill volumes for gravel roads, while still protecting underlying permafrost. Use of insulation would result in reduced road heights and reduced gravel fill volumes. Areas where insulation would not be practicable include bridge approaches, stream crossings, areas with significant topography changes, pipeline crossings, and areas with other environmental limitations. Using insulation for gravel roads would reduce the height and visual barriers of gravel roads (approximately 1.5 feet), potentially reducing impacts to caribou movement and subsistence activities. Based on current design parameters, it is estimated that approximately 75 to 80% of gravel roads would use insulation (varies by alternative).

Thermosyphons may be installed long Project roads as needed to address permafrost thaw and prevent thermokarsting.

Where possible, roads would be constructed at least 500 feet from pipelines to minimize caribou disturbance, prevent excessive snow accumulation from snowdrifts, and allow for snow removal. However, pipelines would typically be constructed within 1,000 feet of roads to allow visual inspection from the road. Where practicable, roads would be designed to conform to BLM requirements and ROPs. Anticipated deviations from these ROPs are detailed by alternative (Sections 4.3 through 4.6).

4.2.3.2.1 Bridges

All action alternatives would include bridges. All bridges would be designed to maintain bottom chord clearance of at least 4 feet above the 100-year design flood elevation or at least 3 feet above the highest documented flood elevation, whichever is higher. Bridges crossing Judy (Iqalliqpik) Creek (Alternatives B, D, and E) and Fish Creek (all action alternatives) would be designed to maintain a bottom chord clearance of at least 13 feet above the 2-year design flood elevation (open water) to provide vessel clearance. Water surface elevations would be analyzed considering snow and ice impacts as well as open water conditions. Design analysis would be based on observations and measurements and modeled conditions (e.g., ice and snow effects), and would vary from crossing to crossing based on site-specific conditions.

Shorter, single-span bridges would be designed, where practical, to avoid the placement of piers in main channels. Each bridge deck would have a removable guardrail and would be designed to support drill rig movement. At the Fish Creek and Judy (Iqalliqpik) Creek (excluding Alternative C) crossings, pipelines would be placed on structural steel supports attached to the bridge girders below the bridge deck. At smaller streams, pipelines would span the streams on VSMs.

The multi-span Judy (Iqalliqpik) Creek, Judy (Kayyaaq) Creek, Fish Creek, Willow Creek 2, and Willow Creek 4 bridges would be constructed on steel-pile pier groups, made up of sets of four pilings positioned approximately 40 to 70 feet apart with sheet-pile abutments located above OHW at each end of the bridge. Crossings over Willow Creek 4A and Willow Creek 8 would be constructed using single-span bridges (sets of four pilings positioned approximately 50 to 60 feet apart with sheet-pile abutments at each end of the bridge). Bridged crossings would range from 40 to 420 feet in length. Specific bridge crossings are detailed in Sections 4.3 through 4.6.

4.2.3.2.2 Culverts

Culverts would be designed, constructed, and maintained to ensure fish passage and stream flow. Culverts would be placed in the road to maintain natural surface drainage patterns; culverts at swale crossings would be placed perpendicular to the road, where feasible. The size, layout, and quantity of culverts crossing swales would be based on site-specific conditions to pass the 50-year flood event with a headwater elevation not exceeding the top of the culvert (headwater/diameter ratio of 1 or less). Typical culverts would be steel pipe pile, would extend approximately 2 feet past the toe of the slope, and would have a minimum of 3 feet of gravel cover (dependent on pipe material, wall size, and design loads), or slightly less in insulated roadway sections. Neighboring culverts would be spaced a minimum of 3 feet between the outer walls of each culvert to provide for proper gravel compaction and load distribution.

Where fish passage is required (as designated by the Alaska Department of Fish and Game [ADF&G]), culverts would be designed with at least one of the culverts in the **culvert battery** having the invert embedded 20% below grade, situated in the deepest part of the stream channel. Fish passage culverts would be backfilled to match existing grade (20% of the culvert diameter) to provide conditions similar to a streambed within the culvert. Fish passage culverts would be corrugated steel plate or steel pipe pile. Baffles may be added on a site-specific basis and in consultation with permitting agencies.

Preliminary cross-drainage culvert locations would be selected based on aerial photography. CPAI (or its representative) would walk the road alignment prior to construction to optimize final culvert locations, noting low areas where culverts are needed, and review the data with regulatory agencies for concurrence. Thus, the final design for the size, number, and location of the cross-drainage culverts would be determined following the field survey. The estimated spacing of the cross-drainage culverts is one every 1,000 feet; however, some culverts may be spaced closer or farther than the 1,000-foot estimate, as is common for roads associated with North Slope oil and gas development. The culverts would be installed per the final design prior to breakup of the first construction season, but additional culverts may be placed after breakup as site-specific conditions are further assessed with regulatory agencies. Culverts would be regularly inspected as part of CPAI's roads and pads maintenance program.

*4.2.3.3 Airstrip and Associated Facilities**

Year-round access to the Project area from Alpine, Kuparuk, Deadhorse, or other locations would be provided by aircraft. Air access would be supported by a 5,700-foot-long gravel airstrip with aprons located near the WOC under Alternatives B, D, and E and near the South WOC under Alternative C; Alternative C would include a second, same size airstrip near the North WOC (Section 4.2.3, *Access to the Project Area*). The airstrip(s) would be capable of supporting and could include regular use by Hercules C-130, DC-6, Otter, CASA, and Bombardier Q400 aircraft, or similar. Additional airstrip facilities would include a traffic advisory center and approach lighting with airstrip module lighting pads. Trenching may be required to bury power and communications cables between the WOC and airstrip, and along the airstrip between modules and lighting components. Trenching would be conducted in the same manner as described for power and communications cables at pipeline road crossings (Section 4.2.2, *Pipelines*).

Helicopters would be used to support Project construction, ongoing environmental studies, ice road permit compliance, and to a lesser extent, drilling and operations. Helicopter support for future exploration, including exploration wellhead inspections and debris cleanup (i.e., stick picking) from winter exploration activities, is not part of the Project.

Airstrip location(s) is constrained by a number of factors to ensure the safety of aircraft taking off and landing at the airstrip(s). These factors include the height of the drill rig(s) at BT3 (Alternative D), the WPF and WOC structure heights, and the setback distances required by the FAA for aircraft approaches and takeoffs. The airstrip(s) would be oriented in a southwest-northeast direction due to the prevailing winds. Airstrip locations and access roads vary by alternative.

Aircraft would support the transportation of work crews, materials, equipment, and waste to and from the Project area and Fairbanks, Anchorage, Kuparuk, and Deadhorse. Air transportation to the Project area would occur year-round. During the useable winter ice road season (approximately February through April), material resupply and waste transportation to Kuparuk and the North Slope gravel road system would also occur via the annual Alpine Resupply Ice Road. Aircraft would maintain altitudes consistent with ROP F-1 , except during takeoffs and landings and unless doing so would endanger human life or violate safe flying practices. Aircraft flight paths would be routed to avoid the airspace above Nuiqsut to the extent practicable.

Fueling and chemical deicing of aircraft would occur on the airstrip apron(s); chemical deicing of the runway(s) is not anticipated.

In response to NSB rezoning requirements, CPAI would use closed-cell foam insulation to reduce the required gravel fill volumes for the airstrip (not under the aircraft landing surface) and apron. Use of insulation for the airstrip (not including the runway) would effectively allow for a reduction of the entire airstrip embankment height. Much of the airstrip apron/taxiway would use an insulated embankment and the overall height may be reduced by up to 2 feet.

4.2.3.4 Sealift Barge Delivery to Oliktok Dock

Sealift barges would be used to deliver the processing and drill site modules, as well as other bulk materials, to the North Slope. Barge transit routes would follow existing, regularly used marine transportation routes. Under all action alternatives, bulk materials and smaller, prefabricated modules that can be transported on the annual Alpine Resupply Ice Road would be delivered to Oliktok Dock; large processing and drill site modules that are too heavy to be transported on the Alpine Resupply Ice Road are addressed in Section 4.8, *Sealift Module Delivery Options*.

Sealift barges would make deliveries to Oliktok Dock during four open-water (summer) seasons. Sealift barges to Oliktok Dock may used to transport bulk materials such as VSMs, HSMs, and pipeline pipe and modularized equipment to the North Slope.

After delivery to Oliktok Dock, bulk materials and smaller modules would be stored at an existing 12-acre pad located approximately 2 miles south of Oliktok Dock (Figure D.4.7). The following winter, the materials would be transported to the Project area via existing gravel roads and the annual Alpine Resupply Ice Road. No improvements to the existing gravel roads or additional ice road construction would be necessary to complete this material delivery. Additionally, no improvements would be required at the 12-acre staging pad. (Vehicle trips associated with this material movement from Oliktok Dock to the Project area are included in the construction traffic numbers for the action alternatives.)

Oliktok Dock was originally constructed in the early 1980s, and to accommodate the 25-foot-high side-shell sealift barges expected to be used for the Project, CPAI would raise the existing dock surface approximately 6 feet by adding structural components (two new 50-ton bollards installed at the dock face) and constructing a gravel ramp, which would require 5,200 cy of gravel sourced from an existing Kuparuk mine site (e.g., Mine Site C, Mine Site E, or Mine Site F). All modifications to the dock would be within the dock’s existing development footprint and no in-water work would be required.

To facilitate module delivery, CPAI would use a 9.6-acre offshore barge lightering area approximately 1.8 nautical miles (2.0 miles) from Oliktok Dock, where the water is approximately 9 to 10 feet deep. Lightering is the process of transferring cargo between vessels to reduce a vessel's draft, which allows it to enter a dock or port with shallower waters. The water depth at Oliktok Dock is too shallow (approximately 8 feet deep) to accommodate the draft depth of a fully loaded sealift barge. As a result, a portion of the load on each barge would be lightered onto an empty barge to allow transport to the dock. Lightering would be used to facilitate the delivery of modules, equipment, and bulk materials to Oliktok Dock.

During the lightering process, barges would be grounded on the seabed, which would require **screeding**, which is the redistribution or recontouring of the existing seafloor to provide a level surface for the barges to be grounded on during load transfers.[6] The relatively flat seafloor prevents pressure point damage to the barge hulls and allows the barges to be safely grounded. Grounding barges would require intaking seawater as ballast and then discharging the seawater to refloat the barges. Ballast water intake and discharge would occur at the lightering area and at the dock face; ballast water to ground barges would not be transported. Barge ballast tanks would be stripped of water and dried before departing the fabrication site for the North Slope.

Following sealift barge grounding and cargo transfer, each barge with a lightened load would be grounded in front of Oliktok Dock and offloaded. To prevent pressure points on the barge hull during the grounded offload at the dock, approximately 2.5 acres of marine area in front of the dock would also be screeded immediately before the first barge delivery each year. Screeding would occur in summer shortly before barges arrive and would take approximately 1 week to complete, with bathymetry measured afterward to confirm the seafloor surface is acceptable to the barge operator. Screeding would occur once during each open-water season with barge deliveries at the barge lightering area and in front of Oliktok Dock.

Grounding barges at the lightering area and the dock would require the barges to take in seawater as ballast and then discharging the seawater to refloat the barges; this would require an exception to LS K-5 (BLM 2022) which prohibits the ballast water transfers and discharges within 3 miles of the coast except when necessary for safe vessel operation.

4.2.3.4.1 Protected Species Observers

Each sealift barge delivery would consist of a combination of barges and tugboats; barges would be unpowered and un-crewed. Tugboats would pull and maneuver the barges along the transit route to the barge lightering area and to Oliktok Dock. Each sealift would include at least one Protected Species Observer (PSO) from Dutch Harbor to Oliktok Dock. The PSO would be located on the lead vessel and would be the central point of contact for any observations of sensitive species. All tugboat captains would be required to complete a wildlife awareness training program prior to the sealift and report any sensitive wildlife sightings to the PSO. In order to maintain 24-hour observation coverage, two to three PSO personnel would be aboard the lead vessel to allow for shift rotations.

4.2.4 Other Infrastructure and Utilities

4.2.4.1 Ice Pads

Single-season and multi-season ice pads would be used to support construction. Single-season ice pads are built and used for a single winter construction season, and they would be used during all years of construction to house construction camps, stage construction equipment, and support construction activities. Single-season ice pads would be used during construction at the gravel mine site during gravel mining activities (Section 4.2.6, *Gravel Mine Site*), on either side of bridge crossings during gravel road and pipeline construction, at the Colville River HDD pipeline crossing, and at other locations as needed near proposed infrastructure within the Project area. Single-season ice pad acreage estimates include 10.0 acres of ice pad for every 15.0 miles of ice road that would be constructed; this estimate is based on CPAI's North Slope operating experience.

In addition to single-season ice pads, multi-season ice pads would be used on a limited basis to stage construction materials between winter construction seasons, which would avoid the placement of gravel fill to support

[6] Screeding operations are typically accomplished by dragging a metal plate attached to a screeding barge across the bottom of the seafloor to move sediments in a leveling operation. The amount of material moved is typically small and localized; no sediments would be removed from the water and no new fill material would be added. A backhoe or excavator may be used to assist where required; however, the bucket would not be raised above the water surface during operation.

temporary activities. Multi-season ice pads would be constructed similarly to single-season ice pads with compacted snow over a base layer of ice. However, multi-season ice pads would also include a vapor barrier over the ice to prevent melting from rain and evaporation as well as structural insulated panels to insulate the pads and white tarps to reflect sunlight and heat. The multi-season ice pads would then be covered by rig mats made of wood, steel, or composite materials (USACE 2012, Appendix G). Once a multi-season ice pad is no longer needed, the rig mats, tarp, insulation, and vapor barrier would be removed; the ice surface would be cleaned of any potential spill or release remnants; and thickened ice greater than 1 foot above the tundra would be excavated and removed to assure the ice base melts in the early spring and the tundra recovers over the course of the summer.

Multi-season ice pads would be built during one winter, remain over the subsequent summer, and be used the following winter before being disassembled and allowed to melt; each multi-season ice pad would last no longer than approximately 18 months. In areas where the multi-season ice pads are required for a longer time, each consecutive ice pad would be constructed in a slightly different location so the footprints do not overlap. (Note: figures showing the locations of multi-season ice pads should be viewed as portraying approximate locations rather than exact locations.)

Ten-acre multi-season ice pads would be used at three locations during Project construction under all action alternatives. These include multi-season ice pads near GMT-2, near the WOC (South WOC under Alternative C), and at the Tiŋmiaqsiuġvik Gravel Mine Site. Construction and use of these three pads would allow ice road, gravel mining, and other construction equipment to be stored in the field over the summer to support earlier construction starting during the following winter construction season while minimizing the need for additional gravel infrastructure.

4.2.4.2 Camps

Camps required to support Project construction include temporary construction camps within the Project area at the WOC (for Alternatives B, D, and E; at the North and South WOCs under Alternative C) as well as other existing camp space at Alpine (Alpine Operations Camp), the K-Pad (near the intersection of the Nuiqsut Spur Road and Alpine CD5), and the Sharktooth Camp in Kuparuk. The housing of construction workers at the Kuukpik Hotel in Nuiqsut would also be possible. Camps to support drilling would be located at each drill site. The Willow Camp would support operations and would be housed on the WOC pad (for Alternatives B, D, and E; at the North and South WOCs under Alternative C). Details of camp sizes and locations by alternative are provided in Sections 4.3 through 4.6 and Section 4.8.

*4.2.4.3 Power Generation and Distribution**

Electrical power for the Project would be generated by a 98-megawatt power plant at the WPF, equipped with natural-gas-fired turbines. Power would be delivered to each drill site and the WOC(s) via power cables suspended from pipeline VSMs using messenger cables attached to the HSMs.

Prior to WPF startup, drill rigs and hydraulic fracturing equipment would be powered with Tier 4 Final engines or similar emissions reduction technology. Following facility startup, the natural-gas fired powerplant at the WPF would also be used to power drill rigs. Engines housed within the drill rigs would also be necessary to provide immediate power for drilling operations. Situations where CPAI would operate drill rigs on their own power include, but are not limited to, when WPF highline power is taken down for maintenance and when the WPF may be otherwise unavailable.

4.2.4.4 Communications

Communications infrastructure throughout the Project area would include fiber-optic cables suspended from pipeline VSMs via messenger cables attached to HSMs. Permanent communications towers would be located on the communications tower pad near the WOC and at each drill site. The communications towers would be up to 200 feet tall; the required tower height is primarily determined by the distance, topography, and supported telecommunications technologies that would be used. Permanent towers would be triangular, self-supporting lattice towers and would not use guy wires. Temporary towers would be pile supported and may require guywire supports. Guywires would include devices to mitigate bird strikes (e.g., bird diverters). All towers would have warning lights, as required by the FAA for aircraft safety. Bird nesting diversion equipment may be installed on towers consistent with BLM NPR-A ROP E-8 (BLM 2022)(BLM 2022), as is practicable given the equipment layout and potential for snow and ice loading and associated concerns.

4.2.4.5 Potable Water*

The primary source of freshwater used during Project construction would vary by alternative. The CFWR adjacent to Lake M0015 (also called R0056) would be the primary source of freshwater for domestic use under Alternatives B, C, and D (Table D.4.2). Water would be withdrawn directly from Lake M0015 for Alternative E. Additional freshwater sources include Lake L911 (Alternatives B, C, and E), Lake M0235 (Alternatives C, D, and E) and Lakes M0112 and M1523A (Alternative E). The freshwater intake infrastructure at the CFWR and Lakes L9911, M0235, M0112, and M1523A would be accessed by water source access roads and pads (Section 4.2.1.6, *Water Source Access Pads*).

The water from the CFWR and Lakes L9911, M0235, M0112, and M1523A would be treated in accordance with State of Alaska Drinking Water Regulations (18 AAC 80), as required for any potable drinking water system. Prior to operation of the freshwater intake system, potable water for construction and drilling camp use would be withdrawn using temporary equipment and trucked to the water plant at the temporary construction camp. Additional freshwater withdrawals from other local permitted lakes would be needed during the construction phase (e.g., ice road and pad construction, hydrostatic pipeline testing, HDD), the drilling phase (e.g., drilling support), and the operations phase (e.g., dust control); these are described in Section 4.2.5, *Water Sources and Use*.

4.2.4.6 Domestic Wastewater

Domestic wastewater treatment infrastructure would be located at the WOC (North and South WOCs under Alternative C). Sanitary waste generated from camps would be hauled to the wastewater treatment facility. The treated wastewater would be disposed of in the Class I UIC disposal wells located at the WOC(s), hauled to and disposed of at another approved disposal site (e.g., Alpine), or in an emergency, discharged under the Alaska Pollutant Discharge Elimination System (APDES) General Permit (AKG-572000).

Prior to the establishment of the UIC well at the WOC, domestic wastewater would be treated and either hauled to Alpine or Kuparuk (winter only) for injection in an existing UIC disposal well or, in instances where weather or conditions at Alpine prevent disposal, discharged to tundra per APDES permit conditions.

4.2.4.7 Solid Waste

Domestic waste (e.g., food, paper, wood, plastics) would either be incinerated (to prevent attracting animals) on-site or at Alpine or, if non-burnable, would be recycled or transported to a landfill facility in Deadhorse (North Slope Borough [NSB] landfill), Fairbanks, or Anchorage. Incinerator ash would be stored on-site until it could be transported to a landfill for disposal. Other hazardous and solid waste from the Project would be managed in accordance with Alaska Department of Environmental Conservation (ADEC) and U.S. Environmental Protection Agency (EPA) regulations, as well as BLM ROPs.

4.2.4.8 Drilling Waste

Drilling waste (e.g., drilling mud, cuttings) would be disposed of on-site through annular disposal (i.e., pumped down the well through the space between the two well casing strings) and/or transported to an approved disposal well (e.g., Class I UIC disposal wells at the WOC). Reserve pits would not be required or used by the Project. A temporary storage cell (typically a lined, wooden structure) may be constructed for staging drilling muds and cuttings prior to disposal. Produced water would be processed at the WPF and reinjected to the subsurface through injection wells as part of reservoir pressure maintenance and waterflood for secondary recovery. Well work waste materials would be managed according to the *Alaska Waste Disposal and Reuse Guide* (CPAI and BP n.d.). In addition to regulations governing waste handling and disposal, the Project would also be managed under BLM ROPs.

4.2.4.9 Fuel and Chemical Storage

Liquid hydrocarbon fuels and other chemicals would primarily be stored at the WPF, with additional storage at drill sites. Fuel would be stored in temporary tanks on-site during construction under all action alternatives. During the drilling and operations phases, the WPF would include bulk fuel storage tank(s) with an associated fueling station as well as a tank farm to store methanol, crude oil flowback, corrosion inhibitor, biocide, scale inhibitor, emulsion breaker, and other chemicals, as required. Jet fuel would be stored on the airstrip apron(s) for refueling helicopters. Fuel trucks supplied by storage tanks located at the WOC would be used to refuel larger aircraft.

Drill sites would have temporary tanks to support drilling operations, including brine tanks, cuttings and mud tank, and a drill rig diesel fuel tank (built into the drill rig structure). Production operations storage tanks at drill sites would include chemical storage tanks that may contain any of the following (depending on operational needs): corrosion inhibitor, methanol, scale inhibitor, emulsion breaker, anti-foaming agent, weathered crude, or diesel fuel. Portable oil storage tanks to support well and pad operational activities and maintenance (i.e., well work, well testing) may be present on an as-needed basis.

Fuel and oil storage would comply with local, state, and federal oil pollution prevention requirements, according to the Oil Discharge Prevention and Contingency Plan (ODPCP) and Spill Prevention Control and Countermeasures (SPCC) Plan. Secondary containment for fuel and oil storage tanks would be sized as appropriate to the container type and according to governing regulatory requirements (18 AAC 75 and 40 CFR 112). Fuel and chemical storage for the Project would be managed under BLM ROPs (BLM 2022).

4.2.5 Water Sources and Use*

Year-round freshwater access would vary by alternative and is summarized in Table D.4.4.

Table D.4.4. Year-Round Water Source Access Summary by Water Source*

Water Source	Alternative	Total Source Volume (MG)[a]	Maximum Winter Water Withdrawal (MG)	Maximum Ice Aggregate Withdrawal (MG)	Lake Depth at VSMs (feet)
CFWR[b]	B, C, D	NA[c]	NA	NA	NA
Lake M0015	E[b]	614.7	To be determined	41.7	5
Lake L9911	B, C, D, E[b]	1,585.8	59.1	14.2	6
Lake M1523A	E[b]	164.4	12.6	10.3	11
Lake M0235	C, D, E[b]	327.0	65.4	5.5	7
Lake M0112	E[b]	164.2	22.7	3.4	13

Note: CFWR (constructed freshwater reservoir); MG (million gallons); NA (not applicable); VSM (vertical support member).
[a] Annual allowed water withdrawal volumes vary based on lake depth and presence or absence of sensitive fish species.
[b] Water source access pad would include a pumphouse.
[c] Estimated water withdrawal volume is 55 million gallons.

4.2.5.1 Constructed Freshwater Reservoir

Under Alternatives B, C, and D, CPAI would construct a CFWR (Figure D.4.8) to ensure a reliable source of freshwater for the Project. The CFWR would be sized for an estimated winter withdrawal volume of 55 million gallons (MG), with an overall volume of 80 MG. This value assumes the presence of ice approximately 6 feet thick and would maintain 5 feet of water at the CFWR bottom for settling.

The CFWR has been designed similar to the existing freshwater reservoir adjacent to Kuparuk CPF2. The CFWR would consist of an 800-foot-long by 700-foot-wide by 50-foot-deep pit with 6 horizontal to 1 vertical ratio (6:1) side slopes. An approximately 1,325-foot-long, 6- to 10-foot-deep connection channel would connect the CFWR to Lake M0015 to support initial reservoir flooding and facilitate annual recharge. The connection channel dimensions are approximate and include a 15-foot-wide flat bottom and 6:1 side slopes to ensure slope stability; the final design is pending following the completion of additional geotechnical studies. The excavation footprint for the CFWR would be 16.4 acres. The channel connection would include a sheet-pile weir with a fish-exclusion screen designed to limit fish access to the CFWR and prevent potential fish entrainment. A flow control gate and valve would allow CPAI to restrict and reduce the velocity of flow into the CFWR based on the monitoring of Lake M0015 water levels and the lake's outlet to Willow Creek 3. At times of low flow in Willow Creek 3, the flow control gate could be closed so that water is not diverted into the CFWR.

The initial filling of the CFWR from Lake M0015 would occur during the first year's breakup (i.e., during high flow) following reservoir construction. The volume of water required to fill the CFWR (55 MG) would be less than 4% of the water volume storage within the Willow Creek 3 basin (which contains both Lake M0015 and Lake R0064, which are hydraulically connected). The estimated recharge volume of the basin exceeds that of the volume of the CFWR. CPAI does not anticipate water levels in Lake M0015 or summer flows in Willow Creek 3 would be affected by construction of the CFWR. The CFWR would be refilled annually during spring breakup; refill would not occur during low-flow periods.

The CFWR would be bordered by a 7-foot-high permanent berm (3.9-acre footprint), which would provide foot access around the CFWR and help maintain the thermal stability of the permafrost adjacent to the CFWR.

The berm would be comprised of approximately 25,000 cy of native material excavated from the CFWR pit and capped with approximately 6,000 cy of gravel to accommodate equipment access for maintenance of the CFWR, including the connection channel. Excess material excavated from within the CFWR footprint would be hauled to the Project mine site for disposal (Section 4.2.6, *Gravel Mine Site*).

The CFWR would be accessed by a 0.3-mile-long gravel access road from the gravel road connection to BT3. Water would be withdrawn using a submerged pump (screened per ADF&G design standards) and would likely be accessed via a catwalk extending into the CFWR. From the CFWR, raw water would be transported via pipeline to the WPF for firewater use and to the WOC (South WOC under Alternative C) for treatment and transport elsewhere in the Project area as needed.

Alternative E would not require construction of the CFWR because:

1. The relocated BT2 drill site would provide year-round access to water source lakes M0235 and M0112 in time to meet peak summer freshwater demands.
2. Use of the K-Pad mud plant would include access to existing seawater supply which would reduce peak summer freshwater demands in the Project area.

*4.2.5.2 Other Water Sources**

CPAI would also construct gravel access roads to connect to Lake L9911 (Alternatives B, C, and E), Lake M0235 (Alternatives C, D, and E), and lakes M0112, M0015, and M1523A under Alternative E, to supply water for the Project's drilling and operations phases (Table D.4.4). Under Alternatives B, C, and D, intake infrastructure at Lakes L9911 and M0235 would consist of a triplex pump (housed within secondary containment) sitting on the water source access pad. The pump would have a hose connection for filling water trucks. No permanent infrastructure would be constructed on these water source access pads. Under Alternatives B, C, and D, year-round water withdrawals at Lake L9911 would only occur during construction, and during operations, withdrawal from Lake L9911 would be limited to winter months.

Under Alternative E, intake infrastructure at lakes L9911, M0235, M0112, and M1523A would consist of a pumphouse on each water source access pad connected to intake piping which would extend out into the deep portion of the lakes on VSMs. Under Alternative E, water withdrawal at Lake L9911 would occur year-round during both the construction and operations phases.

Freshwater for construction and the maintenance of ice roads and ice pads would be withdrawn from lakes near the ice construction activities as allowed by State of Alaska temporary water use authorizations and fish habitat permits (where necessary).

Seawater for hydraulic fracturing and well injection would be sourced from the existing Kuparuk Seawater Treatment Plant at Oliktok Point. Seawater would be transported to the Project area from Kuparuk CPF2 via a new seawater pipeline (Section 4.2.2.3, *Other Pipelines*). Alternative E would include a seawater pipeline spur that would connect an existing seawater pipeline to the existing mud plant located on the K-Pad (Figure D.4.4).

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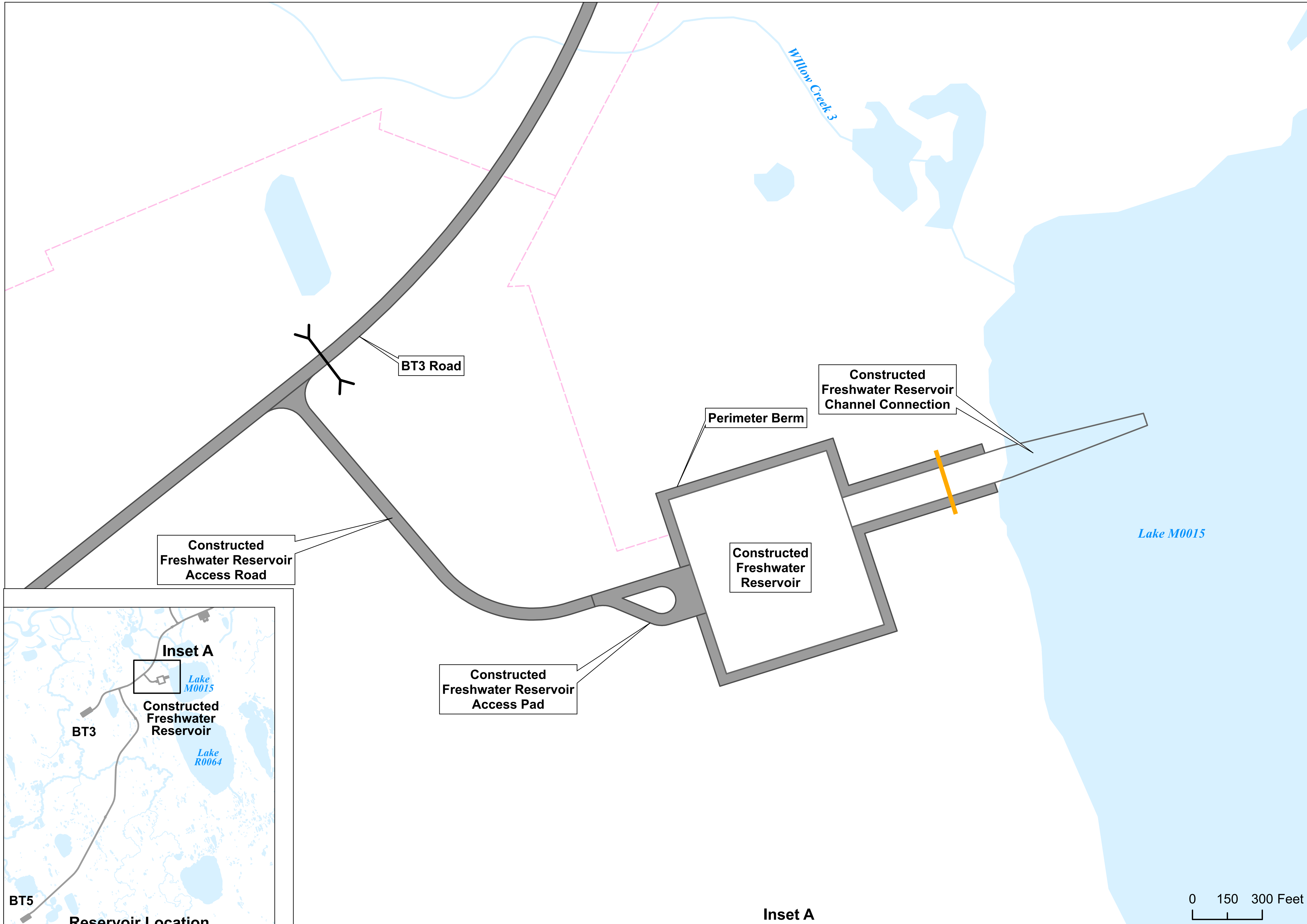

Willow Proposed Development Features

- Culvert Battery
- Weir
- New Pipeline New VSM
- Gravel Footprint

Notes:
Alternative B is shown as a reference. The freshwater reservoir would be the same for alternatives C and D.

The constructed freshwater reservoir would apply to Alternatives B, C, and D.

No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Figure D.4.8

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4.2.5.3 Water Use

Freshwater would be required for domestic use at remote construction camps and for construction and maintenance of ice roads and ice pads. Potable water requirements are based on a demand of 100 gallons per day per person. Freshwater would also be used for hydrostatic testing; the specific water volume required would be based on pipeline diameter and length.

Depending on the use, ice road widths would be 35 feet, 50 feet, or 70 feet; the volume of freshwater required to construct these ice roads would be approximately 1.0 MG, 1.4 MG, and 2.0 MG, respectively. Multi-season ice pads require approximately 0.25 MG of water per acre, per foot of thickness; Project multi-season ice pads would typically be between 5 to 7 feet thick (including insulation and rig mats), depending on site-specific topography. Multi-season ice pads are individually engineered based on geographic and seasonal variables, and 0.25 MG of water per acre, per foot of thickness of multi-season ice pad is used as high-level estimate for multi-season ice pad construction. Water use for module delivery is described in Section 4.8, *Sealift Module Delivery Options*.

Freshwater would be required for domestic use at the drilling camp and during drilling activities (100 gallons per day per person for potable water). Prior to WPF startup, freshwater would be used for drilling water and hydraulic fracturing. Drilling water requirements are estimated to be 1.4 MG per rig per month and hydraulic fracturing would require approximately 1.0 MG of water per well. Following WPF startup, freshwater needs for drilling water would drop to approximately 0.4 MG per well; the remaining drilling water and all of the hydraulic fracturing water would then be seawater.

Freshwater for drilling may be withdrawn from lakes near the Project using temporary triplex pump and truck connections, as allowed by temporary water use authorizations and fish habitat permits. Anticipated freshwater use is detailed by Project phase and action alternative in Table D.4.5; detailed freshwater use by alternative can be found in Section 4.3.5, *Water Sources and Use*; Section 4.4.5, *Water Sources and Use*; Section 4.5.5, *Water Sources and Use*; and Section 4.6.5, *Water Sources and Use*.

Table D.4.5. Estimated Total Freshwater Use (million gallons) by Alternative and Project Phase*

Project Phase	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)*
Construction[a]	1,207.5	1,368.6	1,523.6	1,072.2
Drilling[b]	228.0	228.0	228.0	179.6
Operations[c]	226.9	317.7	534.7	226.9
Total	**1,662.4**	**1,914.3**	**2,286.3**	**1,478.7**

[a] The construction phase would include ice road construction (1.0 million gallons [MG] per mile for a 35-foot-wide road, 1.4 MG per mile for a 50-foot-wide road, and 2.0 MG per mile for a 70-foot-wide road), ice pad construction (0.25 MG per acre), dust suppression, hydrostatic testing, and camp supply (100 gallons per person per day).
[b] The drilling phase would include drilling water (1.4 MG per month per drilling rig prior to processing facility startup and 0.4 MG per rig per month after facility startup), hydraulic fracturing (1.0 MG per well prior to processing facility startup), and camp supply (100 gallons per person per day).
[c] The operations phase would include dust suppression, camp supply (100 gallons per person per day), and the annual resupply ice road (1.0 MG per mile for a 35-foot-wide road; Alternatives C and D).

During construction, seawater would be used for ballast water by sealift barges making deliveries to Oliktok Dock. Following WPF startup, seawater would be used for the hydraulic fracturing of production and injection wells, drilling, and for reservoir injection to support enhanced oil recovery. Hydraulic fracturing is expected to require approximately 1.0 MG of seawater per well. Drilling is expected to require approximately 1.0 MG of seawater per drilling rig per month. Enhanced oil recovery would require approximately 2.1 to 3.8 MG of seawater per day beginning in Year 5 (Alternatives B, C, and E) or Year 6 (Alternative D).

4.2.6 Gravel Mine Site

The amount of gravel required for the Project varies by alternative and module delivery option (approximately 4.6 to 6.3 million cy depending on the alternative and module delivery option). Gravel to support Project construction would be obtained from a new gravel source in the Tiŋmiaqsiuġvik area, approximately 4 to 5 miles southeast of GMT-1 (Figures D.4.1, D.4.2, D.4.3, and D.4.4). The mine site footprint would overlap the Ublutuoch (Tiŋmiaqsiuġvik) River 0.5-mile setback (Figures D.4.9A, D.4.9B, and D.4.9C); however, mine development is allowed in the setback area (LS K-1 in BLM 2022).

Gravel required for construction activity in the Kuparuk area (e.g., Oliktok Dock) would be sourced from an existing Kuparuk area mine site (e.g., Mine Site C, Mine Site E).

*4.2.6.1 Mine Site Description**

CPAI proposes to develop a new gravel mine with two mine site cells (Area 1 and Area 2) located on BLM-managed lands in the Tiŋmiaqsiuġvik area (approximately 20 miles from the WOC; Figures D.4.9A and D.4.9B) to construct the Project. Under Alternative B Mine Site Area 1 would have an excavation footprint up to 90.5 acres and Mine Site Area 2 would have an excavation footprint of 28.9 acres (119.4 total excavation acres), and 30.3 acres surrounding the mine site cells would have perimeter berms constructed for safety purposes. Under Alternatives C and D, additional gravel would be required, and Mine Site Area 1 would have an excavation footprint up to 109.3 acres and Mine Site Area 2 would have an excavation footprint of 80.5 acres (189.8 total excavation acres), and 38.4 acres of mine site perimeter berms. Under Alternative E, Mine Site Area 1 would have an excavation footprint up to 86.1 acres and Mine Site Area 2 would have an excavation footprint of 28.9 acres (115.0 total excavation acres), and 29.7 acres of mine site perimeter berms.

The gravel mine site would be accessed seasonally via ice road; no permanent gravel road to the mine site is proposed as part of the Project. There would be no activity at the mine site outside of the winter construction season. Gravel mining operations would occur over five to seven winter construction seasons (varies by action alternative) to support construction of Project drill sites, WPF and WOC pads, airstrip(s), and all-season roads.

The mine site area layouts would be designed to maximize access to the most suitable construction materials while minimizing overall surface disturbance at the site. Overburden removal and gravel mining would proceed as material is needed. Mine site excavation would begin with the removal of overburden followed by removal of suitable gravel material over five to seven winter construction seasons over an eight- or ten-year construction phase (varies by alternative).

Mining disturbance would generally occur incrementally over the construction phase; for example, only those areas necessary to extract gravel for the first and second winter construction seasons would be disturbed during initial mining activities. Overburden would be stockpiled on ice pads after which it would be removed from the ice pad and placed in the excavated area to begin initial mine site rehabilitation. In subsequent construction seasons, CPAI would conduct initial rehabilitation on previously mined areas using the overburden removed from newly mined areas to minimize the overall disturbance footprint. In the mine site cells, the excavation area side slopes would be graded to a 3 horizontal to 1 vertical ration (3:1). Pumping would be necessary to minimize ponding in the mine site cell(s) during mining operations. Pumped water would be discharged through a diffuser onto tundra close to the Ublutuoch (Tiŋmiaqsiuġvik) River, just upstream from the confluence with Bill’s Creek, and/or tundra close to Bill’s Creek, just upstream from its confluence with the Ublutuoch (Tiŋmiaqsiuġvik) River.

Overburden material would be used to create a berm (approximately 5 feet tall and 15 feet wide at the top) around the entire perimeter of Mine Site Areas 1 and 2. These berms would be placed directly on the surrounding tundra to prevent surface water flow into the mine site (minimizing the amount of required dewatering), help maintain thermal stability of permafrost adjacent to the mine footprint, safeguard the stability of the mine walls during mine operation, and provide a protective physical barrier around the mine site for local residents. Mine Site Area 1 and Area 2 would have its own perimeter berms. The perimeter berms would be constructed during the first season of mining at each mine site area and would remain in place through the reclamation process.

4.2.6.2 Mine Site Reclamation

Incremental mine site reclamation would begin once excavation has progressed enough to provide room within the excavated area to safely perform both mining and reclamation activities concurrently. Reclamation materials would include overburden removed during mining and soils generated during Project construction (e.g., CFWR excavation, if applicable). The material stockpiled on the adjacent ice pads would be placed back into the excavated area. It is anticipated the overburden generated in Mine Area 2 would remain stockpiled through one summer before being used for mine site reclamation. Following the removal of the overburden stockpiles, monitoring and treatment of the underlying tundra would be completed as needed. All subsequent overburden removed during mining operations would then remain in the excavated mine site. Performing reclamation during the same season as mining would minimize the overall disturbance footprint by eliminating the ongoing need to stockpile overburden outside of the mine site excavation.

When the mine site is no longer needed as a gravel source, the perimeter berms would be incrementally expanded into thermal berms as part of mine site reclamation. The thermal berms would fill the mine excavation side slopes and tie into the perimeter berms, providing an additional thermal barrier to promote stability of the mine walls. Once mine site reclamation efforts are complete, the mine site walls would have 3:1 slopes. The mine site area cells would be allowed to naturally fill with water (e.g., precipitation, meltwater) to provide potential waterfowl and shorebird habitats similar to existing habitats in the surrounding area. The reclaimed mine sites would include deepwater habitat areas, with a maximum depth of approximately 70 feet in Mine Area 1 and 50 feet in Mine Area 2. It is anticipated it will take a decade or longer to fill the excavation sites with water.

The Willow Mine Site Mining and Reclamation Plan is included as Appendix D.2, *Willow Mine Site Mining and Reclamation Plan*.

4.2.7 Erosion and Dust Control

The Project would follow a Facility Erosion Control Plan (FECP), which would outline procedures for the operation, monitoring, and maintenance of various erosion control methods. A Stormwater Pollution Prevention Plan (SWPPP) would describe management of surface water drainage for Project gravel pads. Both plans would be based on the existing Alpine FECP and Alpine SWPPP.

The FECP would describe snow removal and dust control measures. Snow removal plans would include the use of snow-blowing equipment to minimize significant snow build-up along the shoulders of roads and gravel dispersion to the tundra as well as the placement of cleared snow in designated areas. Rotary snow blowers and road graders would be used to clear snow from roads; use of this equipment would spread snow across a wide surface area and prevent thick berms from forming along the road shoulder, which would decrease the incidence of snowdrift accumulations during high-wind events. The FECP would discuss snow removal and gravel deposition removal for CPAI operations staff. CPAI would select snow push (i.e., storage) areas annually based on avoiding areas of thermokarst and proximity to waterbodies, and evaluating how the area looks based on previous years' activities.

CPAI would implement a Project Dust Control Plan to minimize the incidence of fugitive dust. The Dust Control Plan would identify Project sources for fugitive dust, dust control methods and measures to be used for each source, and monitoring and record keeping parameters. Dust control would include watering gravel roads to minimize dust impacts to the tundra and to maintain gravel road integrity. The Willow Dust Control Plan can be found in Appendix I.3, *Dust Control Plan*.

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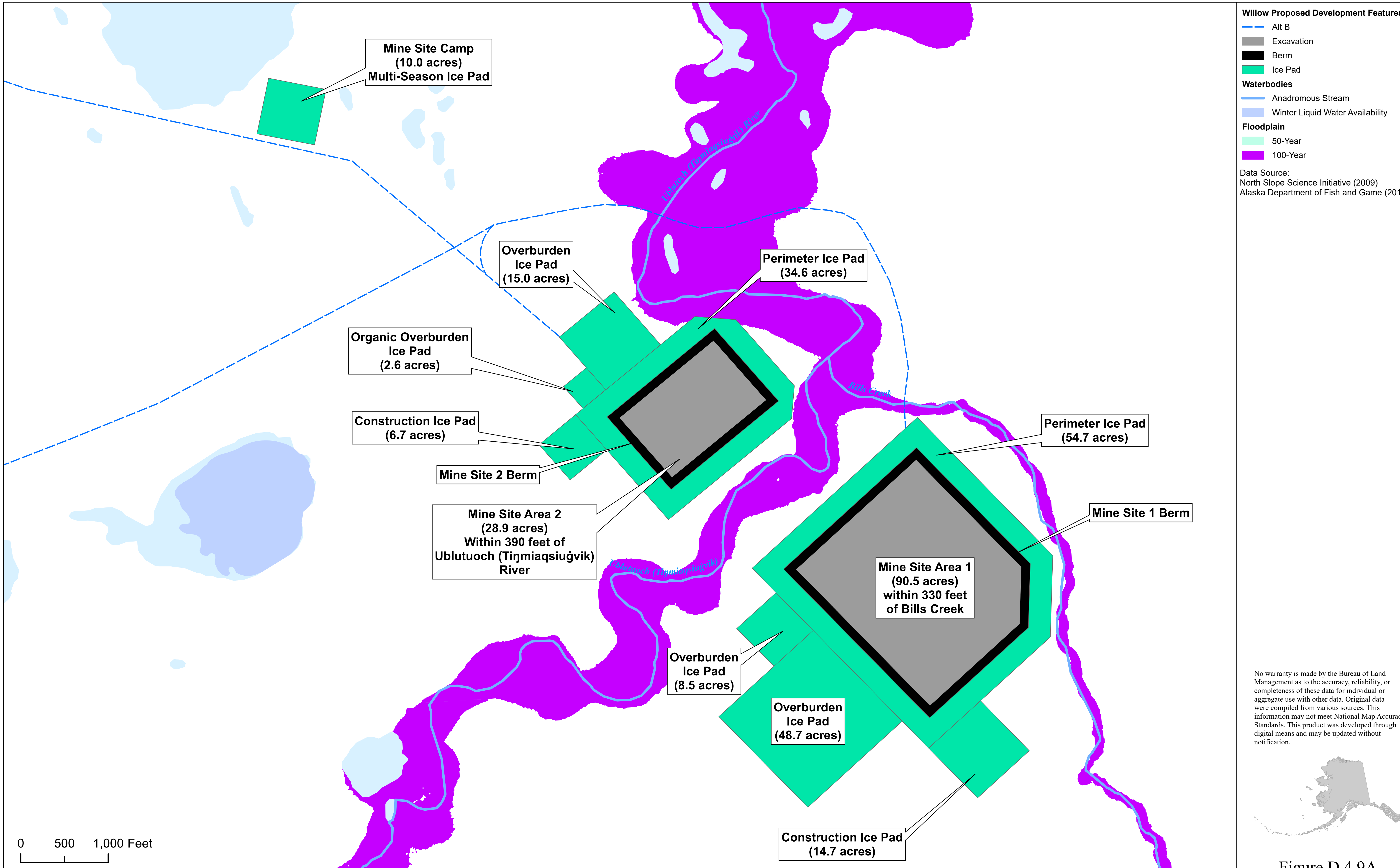
Mine Site Camp
(10.0 acres)
Multi-Season Ice Pad
Overburden Ice Pad (15.0 acres)
Perimeter Ice Pad (34.6 acres)
Organic Overburden Ice Pad (2.6 acres)
Construction Ice Pad (6.7 acres)
Mine Site 2 Berm
Mine Site Area 2 (28.9 acres) Within 390 feet of Ublutuoch (Tiŋmiaqsiuġvik) River
Perimeter Ice Pad (54.7 acres)
Mine Site 1 Berm
Mine Site Area 1 (90.5 acres) within 330 feet of Bills Creek
Overburden Ice Pad (8.5 acres)
Overburden Ice Pad (48.7 acres)
Construction Ice Pad (14.7 acres)
Ublutuoch (Tiŋmiaqsiuġvik) River
Bills Creek
0
500
1,000 Feet
Willow Proposed Development Features
Alt B
Excavation
Berm
Ice Pad
Waterbodies
Anadromous Stream
Winter Liquid Water Availability
Floodplain
50-Year
100-Year
Data Source:
North Slope Science Initiative (2009)
Alaska Department of Fish and Game (2018)
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Figure D.4.9A

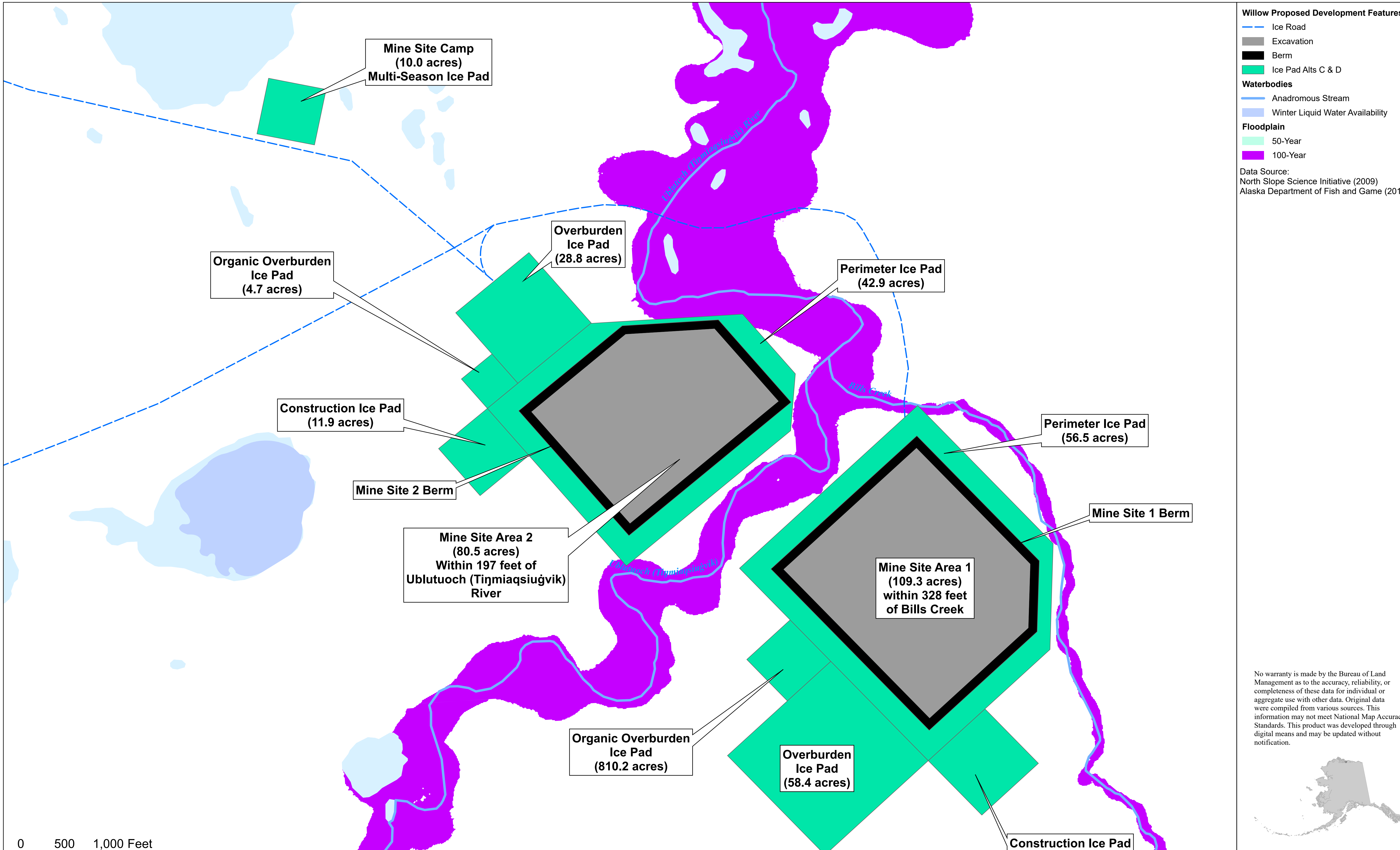
Mine Site Camp
(10.0 acres)
Multi-Season Ice Pad
Overburden
Ice Pad
(28.8 acres)
Organic Overburden
Ice Pad
(4.7 acres)
Perimeter Ice Pad
(42.9 acres)
Construction Ice Pad
(11.9 acres)
Mine Site 2 Berm
Mine Site Area 2
(80.5 acres)
Within 197 feet of
Ublutuoch (Tiŋmiaqsiuġvik)
River
Ublutuoch (Tiŋmiaqsiuġvik) River
Bills Creek
Ublutuoch (Tiŋmiaqsiuġvik)
Perimeter Ice Pad
(56.5 acres)
Mine Site 1 Berm
Mine Site Area 1
(109.3 acres)
within 328 feet
of Bills Creek
Organic Overburden
Ice Pad
(810.2 acres)
Overburden
Ice Pad
(58.4 acres)
Construction Ice Pad
(17.6 acres)
0 500 1,000 Feet
Willow Proposed Development Features
Ice Road
Excavation
Berm
Ice Pad Alts C & D
Waterbodies
Anadromous Stream
Winter Liquid Water Availability
Floodplain
50-Year
100-Year
Data Source:
North Slope Science Initiative (2009)
Alaska Department of Fish and Game (2018)
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Figure D.4.9B

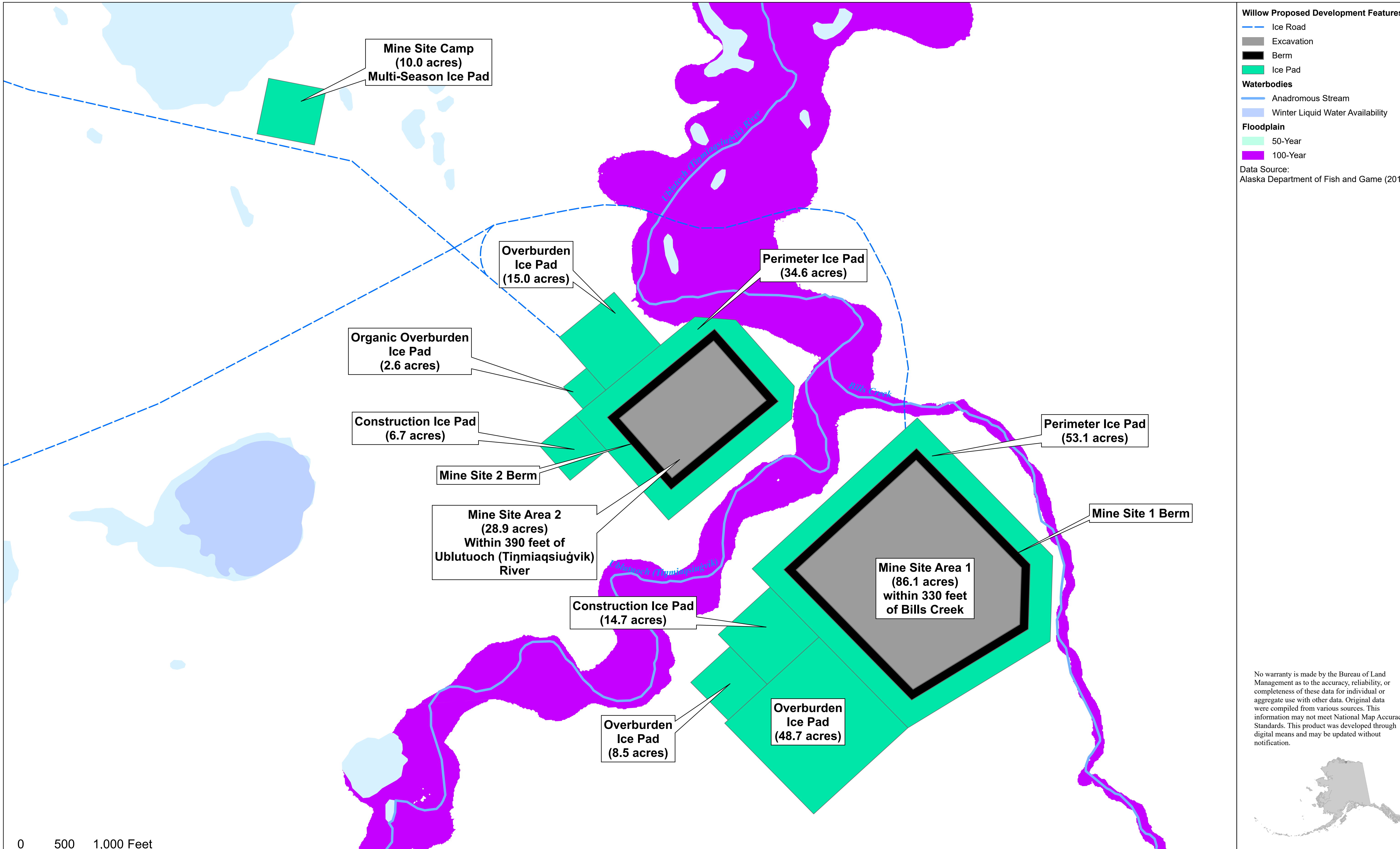
Mine Site Camp (10.0 acres) Multi-Season Ice Pad
Overburden Ice Pad (15.0 acres)
Perimeter Ice Pad (34.6 acres)
Organic Overburden Ice Pad (2.6 acres)
Construction Ice Pad (6.7 acres)
Mine Site 2 Berm
Mine Site Area 2 (28.9 acres) Within 390 feet of Ublutuoch (Tiŋmiaqsiuġvik) River
Ublutuoch (Tiŋmiaqsiuġvik) River
Bills Creek
Perimeter Ice Pad (53.1 acres)
Mine Site 1 Berm
Mine Site Area 1 (86.1 acres) within 330 feet of Bills Creek
Ublutuoch (Tiŋmiaqsiuġvik)
Construction Ice Pad (14.7 acres)
Overburden Ice Pad (8.5 acres)
Overburden Ice Pad (48.7 acres)
0 500 1,000 Feet
Willow Proposed Development Features
Ice Road
Excavation
Berm
Ice Pad
Waterbodies
Anadromous Stream
Winter Liquid Water Availability
Floodplain
50-Year
100-Year
Data Source:
Alaska Department of Fish and Game (2018)
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Figure D.4.9 C

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4.2.8 Spill Prevention and Response

Facilities would be designed to mitigate spills with spill prevention measures and spill response capabilities. CPAI would implement a pipeline maintenance and inspection program and an employee spill prevention training program to further reduce the likelihood of spills occurring. CPAI's design of production facilities would include provisions for secondary containment of hydrocarbon-based and hazardous materials, as required by state and federal regulations. If a spill occurs on a pad, the fluid would typically remain on the pad unless the spill is near a pad edge or exceeds the pad's general retention capacity. Fuel transfers near pad edges would be limited to the extent practicable to mitigate this risk. In addition to regulations governing spill prevention and response, the Project would be managed under the BLM ROPs described for solid waste and fuel and chemical storage (BLM 2022). Additional details on spill prevention and response are in Appendix H, *Spill Summary, Prevention, and Response Planning*.

*4.2.8.1 Spill Prevention**

Spill prevention and response measures that would be used during construction, drilling, and oil production operations would be outlined in the Project's SPCC Plan. CPAI would also prepare an ODPCP specific to the Project which would address spill prevention and response measures for drilling, oil production, and Willow Pipeline operations. The intent of the ODPCP and SPCC Plan are to demonstrate CPAI's capability to prevent oil spills from entering the water and land and to ensure rapid response if a spill event occurs. The ODPCP would comply with applicable State of Alaska requirements in AS 46.04.030 and 18 AAC 75 for spill prevention and response, and federal EPA regulation sin 40 CFR 112.20, Subpart D (Facility Response Plans) and USDOT regulations in 49 CFR 194 for onshore oil pipeline oil response plans. The SPCC Plan would comply with the federal EPA regulation in 40 CFR 112.

Pipelines would be constructed of high-strength steel and pipeline welds would be validated using nondestructive examination during pipeline construction to ensure their integrity and pipelines would be hydrostatically tested prior to operation. The production fluids, water injection, seawater, and export pipelines would be fully capable of accommodating pigs for cleaning and corrosion inspection.

4.2.8.2 Spill Response

CPAI would implement the Project's ODPCP and SPCC Plan to minimize accidental oil spills and associated impacts from oil drilling, production, and pipeline operations. Through the ODCP, CPAI would demonstrate that readily accessible inventories of fit-for-purpose oil spill response equipment and personnel would be available for use at Project facilities. In addition, a state-registered primary response action contractor would serve as CPAI's primary response action contractor and would provide trained personnel to manage all stages of a spill response, including containment, recovery, and cleanup.

Spill response equipment would be pre-staged at strategic locations across the Project area as outlined in the ODPCP for an initial response.

*4.2.8.3 Spill Training and Inspections**

CPAI provides regular training for its employees and contractors on the importance of preventing oil or hazardous material spills, including new employee orientation, annual environmental training seminars, and appropriate certification classes for specific issues covering spill prevention. The CPAI Incident Management Team participates in regularly scheduled training programs and conducts spill response exercises in coordination with federal, state, and local agencies. Employees are encouraged to participate in the North Slope Spill Response Team where members receive regularly scheduled spill response training to ensure immediate availability of skilled spill responders located on the North Slope.

CPAI would follow federal and state regulations regarding pipeline inspection and aerial overflights. Current regulations include 49 CFR 195.412(a) and Subpart G for USDOT-regulated pipelines, and 18 AAC 75.05(a)(3) and 18 AAC 75.425 for remote crude oil sales pipelines not otherwise accessible by road. Consistent with these regulations, CPAI would plan to conduct aerial overflights every 7 days, weather and safety permitting. Aerial overflights provide visual inspection and can be aided by infrared technology, when required. Infrared technology, employed either aerially using aircraft or from the ground using handheld systems, is a spill detection method using the temperature "signature" resulting when warm fluids leak. CPAI would also conduct regular visual inspections of facilities and pipelines from gravel roads, where available, and from ice roads and aircraft for sections of pipelines not paralleled by gravel roads (Alternatives C and D).

4.2.9 Abandonment and Reclamation

The abandonment and reclamation of Project facilities would be determined at or before the time of abandonment. The plan for abandonment and reclamation is subject to input from federal, state, and local authorities and private landowners. Other stakeholders would also provide comments on the Abandonment and Reclamation Plan. Controlling factors for the Abandonment and Reclamation Plan may include the following:

- BLM leases, applications for permits to drill, and rights-of-way
- USACE Section 404 permit conditions
- State of Alaska easement(s)
- Alaska Oil and Gas Conservation Commission requirements for plugging and abandoning wells
- NSB Title 19 requirements
- Private agreements addressing private lands

The abandonment and reclamation of Project facilities may involve removing gravel pads and roads, or alternatively leaving them in place for alternative purposes. Revegetation of abandoned gravel facilities may be accomplished by seeding with native vegetation or by allowing natural colonization. Depending on the types of abandonment and reclamation activities that are undertaken, road and air traffic levels may occur at potentially lower intensity levels and shorter durations than the levels observed during construction activities.

If the gravel infrastructure is removed as part of the reclamation process, it could be used for other development projects. To assist with abandonment and reclamation, BLM holds bonds from any company conducting development activities within the NPR-A to cover the cost of reclamation. Reclamation standards are determined by the BLM authorized officer at the time of reclamation.

4.2.10 Schedule and Logistics

Project timing is based on several factors, including permitting and other regulatory approvals, project sanctioning, and purchase and fabrication of long lead time components. The schedule presented in the EIS is an estimated schedule that would be dependent on subsequent detailed Project planning and a variety of contingencies. Subject to those qualifications, Project construction would occur over approximately 8 to 10 years (depending on the alternative) beginning in the first quarter (Q1) of Year 1. Under Alternatives B, C, and E, first oil would occur in Year 6, and under Alternative D, first oil would occur in Year 7. Operations would run to the end of the Project's field life, which is estimated to be 30 years (Alternatives B, C, and D) or 31 years (Alternative D). Table D.4.6 provides a Project milestone schedule overview. Detailed schedules for each action alternative are provided for Alternative B in Section 4.3.8, *Schedule and Logistics*; Alternative C in Section 4.4.8, *Schedule and Logistics*; Alternative D in Section 4.5.8, *Schedule and Logistics*; and Alternative E in Section 4.6.8, *Schedule and Logistics*.

Table D.4.6. Project Schedule Overview by Alternative and Project Milestone*

Project Milestone	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)*
Life of Project	30 years (Year 1 through Year 30)	30 years (Year 1 through Year 30)	31 years (Year 1 through Year 31)	30 years (Year 1 through Year 30)
Construction	9 years (Year 1 through Year 9)	9 years (Year 1 through Year 9)	10 years (Year 1 through Year 10)	8 years (Year 1 through Year 8)
Drilling[a]	6 years (Year 4 through Year 9)	6 years (Year 4 through Year 9)	6 years (Year 5 through Year 10)	7 years (Year 4 through Year 10)
Operations	25 years (Year 6 through Year 30)	25 years (Year 6 through Year 30)	25 years (Year 7 through Year 31)	25 years (Year 6 through Year 30)
First oil	Year 6	Year 6	Year 7	Year 6

[a] Drilling would consist of Bear Tooth drill site 1 (BT1) pre-drilling activity (2 years) before the Willow Processing Facility (WPF) is operational; development drilling (4 years) would commence after the WPF is operational. During pre-drilling, drilling rigs would operate on diesel generators and during development drilling, drill rigs would operate on electrical power provided by the WPF.

*4.2.10.1 Construction Phase**

Gravel mining and placement would be conducted almost exclusively during winter. A typical construction season begins with prepacking of snow in November, or as soon as conditions allow, with ice road construction occurring primarily in December and January to allow for use by February 1. The schedule anticipates typical weather conditions and is subject to change based on annual field conditions.

Gravel for the gravel infrastructure associated with initial construction (access road [Alternatives B and C], BT1, BT2, BT3, connecting roads, WPF, WOC, and airstrips) would be mined and placed during winter (January through April) of the first 4 to 5 years of construction (varies by alternative). Two additional winter seasons of gravel mining and placement would occur to construct BT4 (except Alternative E), BT5, and associated roads, except for Alternative E (Three-Pad Alternative [Fourth Pad Deferred]), which would have one winter season of gravel mining and placement for the BT5 pad and associated infield road.

Gravel roads and pads would be built by constructing an ice road followed by gravel placement. Gravel conditioning and compaction would occur during the summer (typically July to October) to expose, thaw, and dewater the deeper layers and re-compact the gravel. Culvert locations would be identified (as described in Section 4.2.3.2.2, *Culverts*) and culverts would be installed per the final design during the first construction season prior to spring breakup. Additional culverts may be placed after spring breakup as site-specific needs are further assessed. Bridges would be constructed during winter from ice roads and ice pads.

Once gravel pads are constructed, on-pad facility construction and installation would commence. Modules for the WPF, BT1, BT2, and BT3 would be delivered by sealift barge during the summer open-water season in Year 4 (or Year 5 under Alternative D) (Section 4.8, *Sealift Module Delivery Options*). Modules would be staged until the following winter construction season, when they would be transported to their installation location via a combination of gravel roads and ice roads (ice road routes would vary by module delivery option). Modules for BT4 and BT5 (only BT5 under Alternative E) would be delivered via a second sealift 2 years after the first delivery and moved to the Project area in the same manner as modules for BT1, BT2, and BT3.

Under Alternatives B, C, and D, the CFWR would be constructed during Q1 and the second quarter (Q2) of Year 3. Excavated material within the reservoir and channel connection would be removed and used to construct the perimeter berm or hauled to the mine site for disposal within the mine site excavation pit. The freshwater pipelines would also be constructed in Year 3. CPAI anticipates that the reservoir would flood during the breakup seasons of Year 3 and Year 4 (at the end of Q2). The degree to which the CFWR would fill in Year 3 would be dependent on the water volume available from Lake M0015 during breakup and the adaptive management efforts by CPAI to avoid impacts to Lake M0015 and Willow Creek 3. CPAI assumes the CFWR would be available for use in the third quarter (Q3) of Year 4.

Pipelines would be installed during winter from ice roads. First, VSM locations would be surveyed and drilled. In most locations, a VSM and an HSM would be assembled and installed using a sand slurry for backfill around the VSM. Alternatively, VSMs may be driven into an undersized borehole using a vibratory hammer. Engineering design would determine which method would be used for any given set of VSMs. The pipelines would be strung, welded, tested, and installed on pipe saddles atop the HSMs. The HDD Colville River pipeline crossing would be completed during the winter construction season of Year 4 (Section 4.2.2.3, *Other Pipelines*). Pipeline installation would take from 1 to 4 years per pipeline, depending on pipeline length and location.

The subsistence boat ramp along the Tiŋmiaqsiuġvik River would be constructed in one of the first Project construction seasons. Subsistence boat ramps at Judy (Iqalliqpik) Creek and Fish Creek (Alternatives B and E) would be constructed after site visits and input from local stakeholders and within 2 years of constructing the BT1 and BT2/BT4 access roads, respectively. Boat ramp construction methods would be similar to the construction methods described for other gravel placement. Construction would occur primarily in winter, with gravel seasoning and compaction occurring over the following summer season.

Gravel haul and placement to modify Oliktok Dock would occur during the Year 2 summer season (Alternatives B, C, and E) or Year 3 (Alternative D). During the summer open-water season before sealift barge arrival, screeding of the area in front of Oliktok Dock would occur around mid-July, once the risk of ice encroachment has passed. Under Alternatives B, C, and E, sealift barges would deliver modules and/or bulk construction materials in the summers of Year 2 through Year 4 and in Year 6. Under Alternative D, sealift barges would deliver modules and/or bulk material in the summers of Year 3 through Year 5 and Year 7. CPAI has committed to using Protected Species Observers to monitor for marine mammals for each sealift during the transit between Dutch Harbor and Oliktok Dock.

*4.2.10.2 Drilling Phase**

Drilling is planned to begin in Year 4 (Alternatives B, C, and E) or Year 5 (Alternative D) at BT1. Two drilling rigs would be mobilized to the Project area and drilling would begin prior to completion of the WPF and drill site facilities. This pre-drilling period would last approximately 24 months and would allow the WPF to be commissioned immediately following construction by timing the completion of a sufficient number of wells to provide the minimum fluid rates to commission the pipelines and the WPF. Pre-drilling would eliminate a 1- to 2-year delay between construction and production of first oil. It is assumed the wells would be drilled consecutively, from BT1 to BT5 (excluding BT4 under Alternative E); however, CPAI would determine the final timing and order of drilling based on economics and drill rig availability.

Drilling is anticipated to take 6 years, except under Alternative E which would take 7 years, and would be conducted year-round with an anticipated progress rate of approximately 15 to 30 days per well. It is anticipated Alternative E would require an additional year of drilling to account for more wells at BT1 and BT2, and one fewer pad on which to place rigs and supporting equipment.

4.2.10.2.1 Hydraulic Fracturing

Project drilling would include the use of hydraulic fracturing techniques, which is a process used to increase the flow of fluids from a reservoir into the wellbore and to establish a connection between oil-bearing formation layers. Each production well would receive a multistage hydraulic fracturing operation similar to those employed at other North Slope developments. The process would involve isolating a portion of the reservoir to be fractured and then pumping gelled seawater or brine mixed with a proppant (small beads of sand or human-made ceramic material) at high pressure into the formation. The high-pressure fluid would create fractures in the formation, and the proppants would prevent the fracture from closing, allowing oil and gas within the formation to flow into the wellbore and, ultimately, the surface.

It is anticipated that each well would be hydraulically fractured one time with approximately 12 to 20 individual fracturing locations within the well. Hydraulic fracturing operations would last approximately 6 days per well with six wells per pad per year being fracture stimulated. Two hydraulic fracturing operations could occur concurrently, although not on the same pad; however, fracturing operations may occur simultaneously, with well drilling on the same pad. Total water use for hydraulic fracturing would be approximately 14,000 to 24,000 barrels (0.6 to 1.0 MG) of seawater (following WPF startup). Hydraulic fracturing would only be used during the initial stage of drilling to stimulate flows at the production and injection wells.

The Alaska Oil and Gas Conservation Commission (AOGCC) maintains jurisdiction over the subsurface fracturing process (20 AAC 25.283), and all hydraulic fracturing activities would comply with AOGCC regulations. AOGCC regulations specifically require the disclosure of chemicals used in the hydraulic fracturing process, including the anticipated volume of fluids to be used in the operation. Other agencies (e.g., EPA, ADEC, Alaska Department of Natural Resources) maintain some regulatory oversight, although this is primarily limited to surface activities associated with the equipment and materials used in the hydraulic fracturing process.

4.2.10.2.2 Extended Reach Drilling*

ERD is directional drilling with very long horizontal wells, generally with a horizontal to vertical ration equal to or greater than 2:1. ERD is employed to reach a larger area from one surface location and to keep a production well in the target reservoir for a longer distance in order to maximize productivity and resource recovery. All Project wells would be ERD based on the horizontal departure to vertical depth ratio. ERD limitations are based on factors such as mechanical limitations of the drill string, limitations of rock formations, dynamic and static downhole fluid pressure, and the ability to run casing and completion strings to their final planned depth.

Figures D.4.10 and D.4.11 provide comparisons of the action alternatives ability to reach the Willow reservoir.

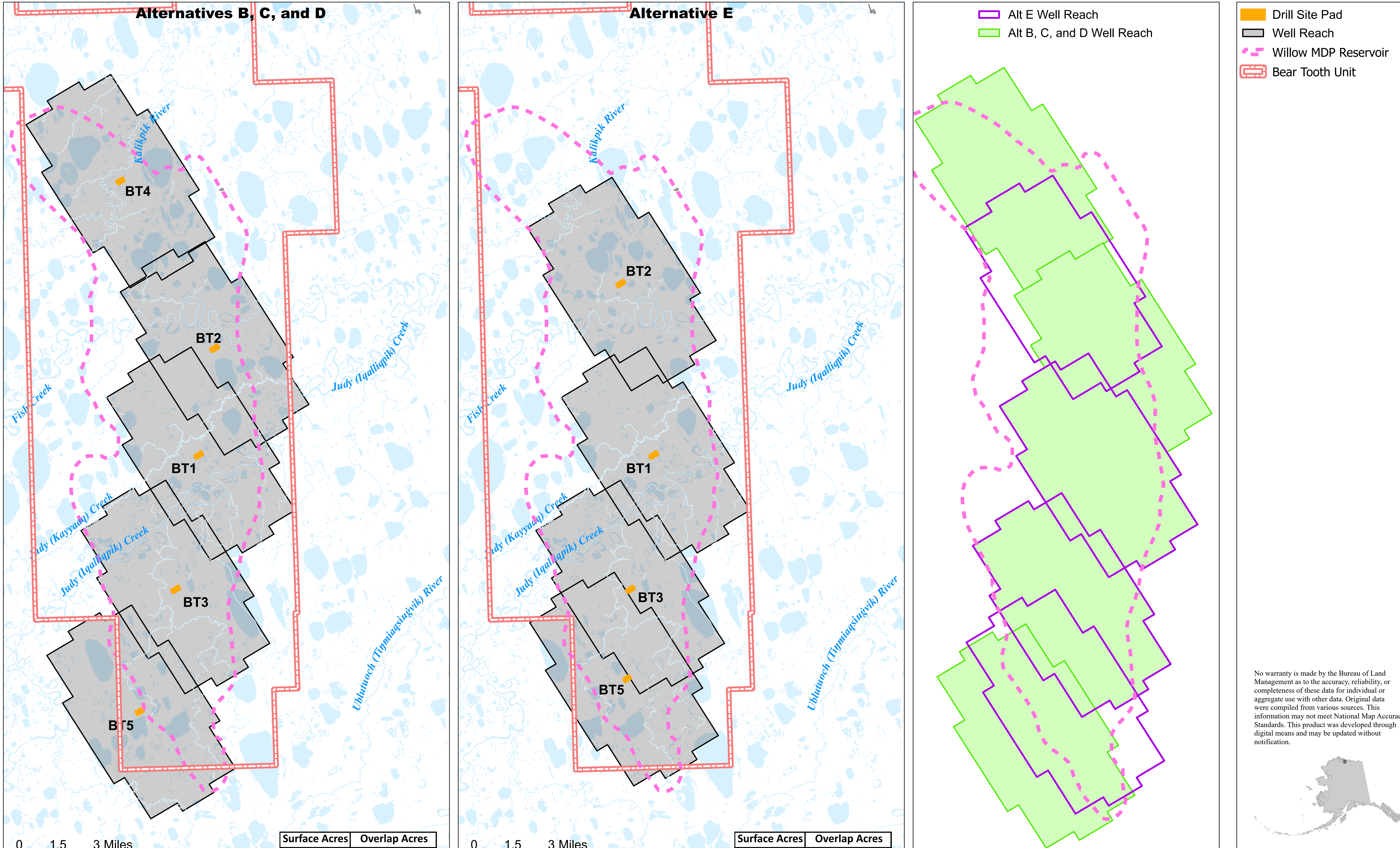
Alternatives B, C, and D
BT4
BT2
BT1
BT3
BT5
Kalikpik River
Fish Creek
Judy (Kayyaaq) Creek
Judy (Iqalliqpik) Creek
Ublutuoch (Tinmiaqsiuġvik) River
0 1.5 3 Miles
Surface Acres
97,898.0
Overlap Acres
8,741.2
Alternative E
BT2
BT1
BT3
BT5
Surface Acres
75,621.7
Overlap Acres
9,689.6
Alt E Well Reach
Alt B, C, and D Well Reach
Drill Site Pad
Well Reach
Willow MDP Reservoir
Bear Tooth Unit
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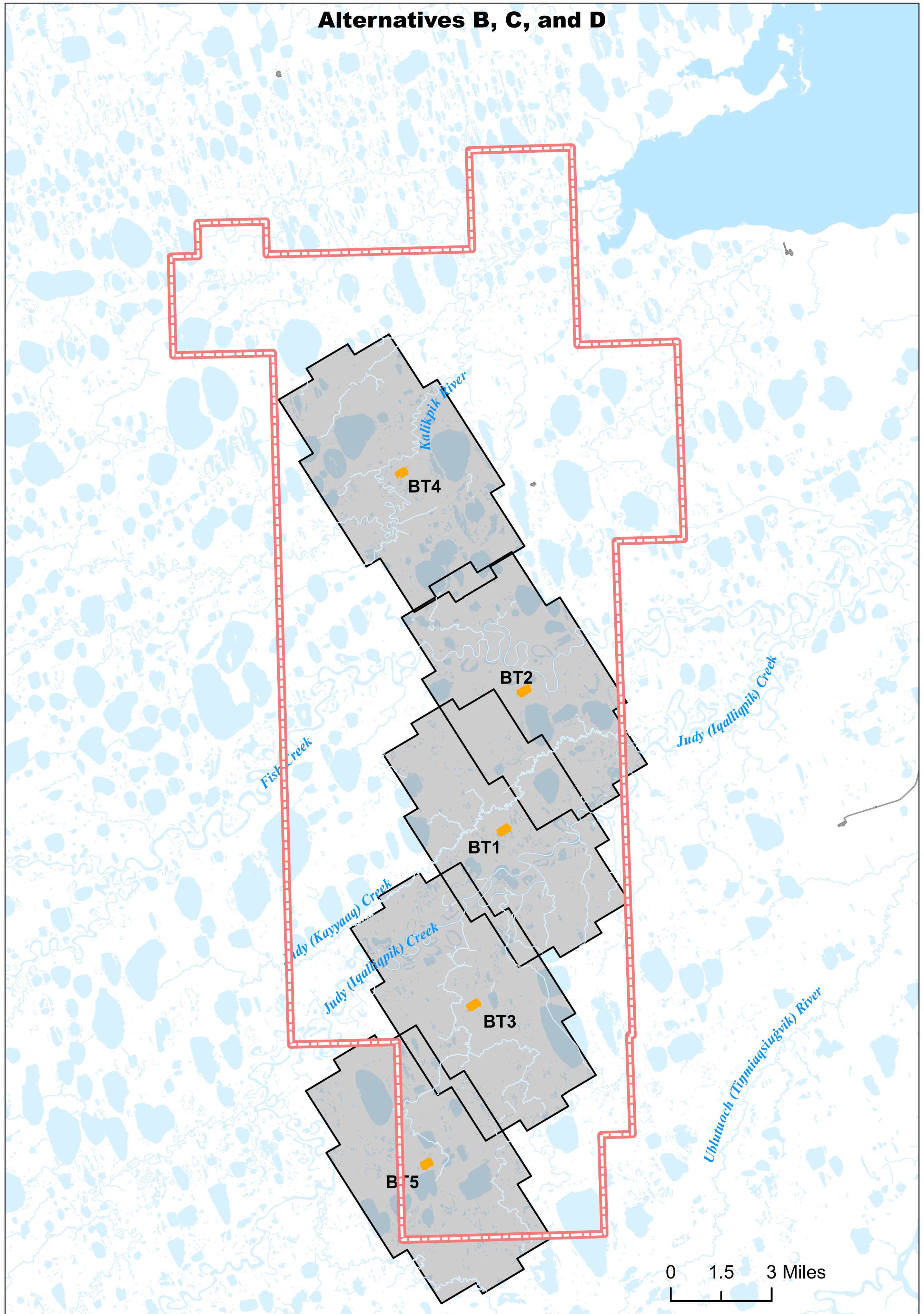
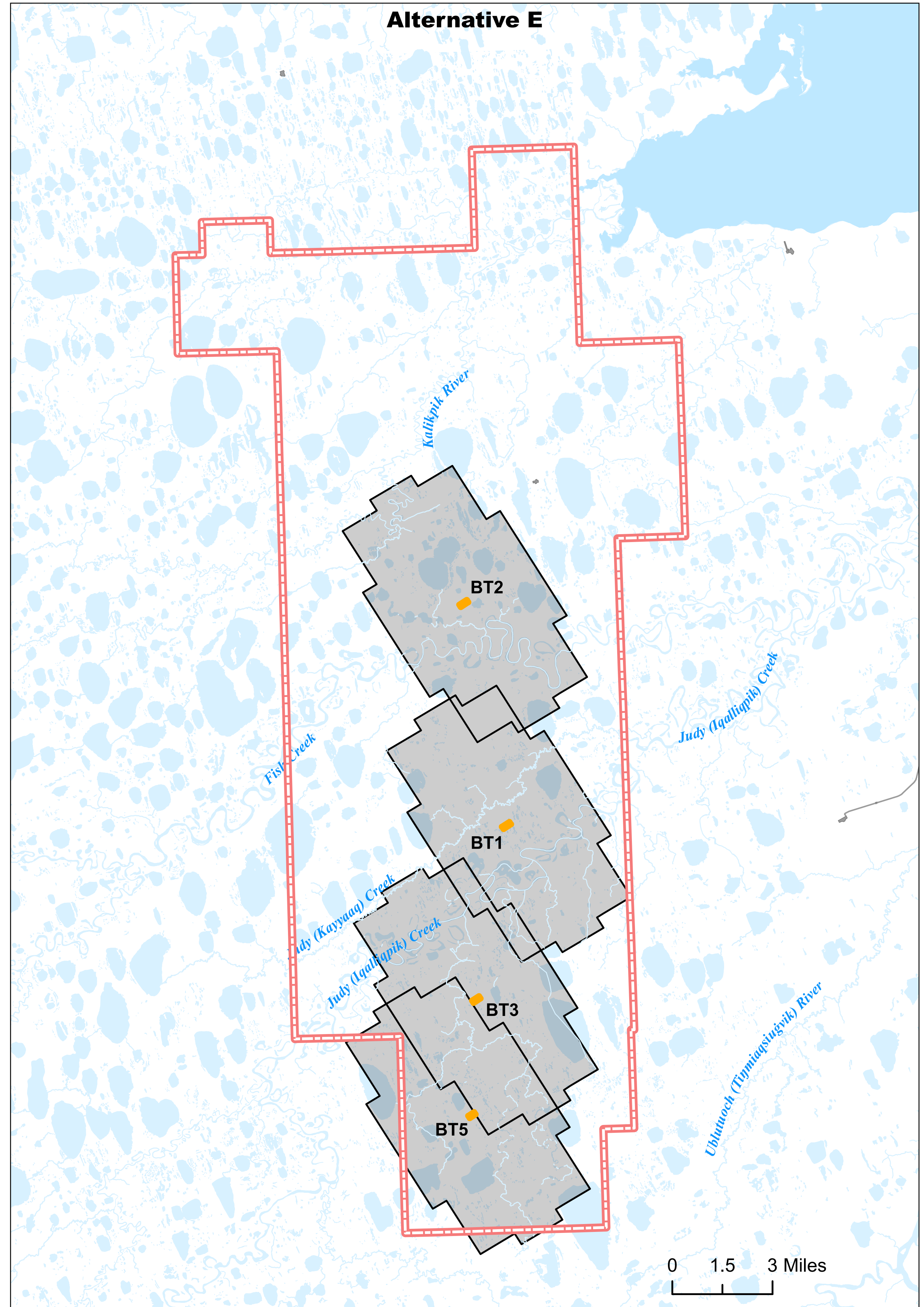
Figure D.4.10





Well Reach
Willow Proposed Development Features
Drill Site Pad
Oil and Gas Unit
Bear Tooth Unit
Other Infrastructure
Existing Road
Existing Pipeline
Existing Infrastructure

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Figure D.4.11

*4.2.10.3 Operations Phase**

Following initial well drilling and WPF start-up, typical operations would consist of well operations and production and transportation of produced hydrocarbons. Well maintenance operations and routine drilling activities would occur intermittently throughout the life of the Project. CPAI's standard operations and maintenance practices would be implemented for this Project phase.

Table D.4.7 summarizes the anticipated daily production profile for each action alternative and Table D.4.8 summarizes the cumulative Project production over the life of the Project. Tables D.4.9 and D.4.10 further breakdown the estimated production profiles (daily production and cumulative production) under Alternative E by individual drill site. The production values provided in Tables D.4.7 through D.4.10 do not include fluids produced at GMT-2 that may be processed at the WPF. Production from GMT-2 would not change or affect the production equipment sizing proposed for the Project.

Note: Tables D.4.7 through D.4.10 are based on the most recent CPAI appraisal data.

Table D.4.7. Estimated Daily Oil and Non-Gas Liquids Production Profiles by Alternative (thousands of barrels of oil per day)*

Year	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)
Year 6	165.5	165.5	0.0	165.2
Year 7	182.1	182.1	165.5	183.2
Year 8	162.5	162.5	182.1	164.9
Year 9	144.1	144.1	162.5	141.7
Year 10	127.1	127.1	144.1	125.1
Year 11	112.6	112.6	127.1	108.0
Year 12	101.2	101.2	112.6	96.9
Year 13	91.2	91.2	101.2	85.5
Year 14	81.8	81.8	91.2	76.3
Year 15	73.3	73.3	81.8	69.2
Year 16	66.3	66.3	73.3	63.2
Year 17	58.9	58.9	66.3	57.3
Year 18	52.3	52.3	58.9	51.0
Year 19	44.5	44.5	52.3	43.7
Year 20	38.9	38.9	44.5	38.2
Year 21	33.8	33.8	38.9	32.8
Year 22	30.0	30.0	33.8	28.7
Year 23	26.5	26.5	30.0	25.4
Year 24	24.0	24.0	26.5	22.8
Year 25	22.1	22.1	24.0	20.7
Year 26	20.4	20.4	22.1	19.0
Year 27	17.3	17.3	20.4	16.1
Year 28	17.0	17.0	17.3	15.9
Year 29	15.5	15.5	17.0	14.3
Year 30	14.3	14.3	15.5	13.3
Year 31	0.0	0.0	14.3	0.0

Table D.4.8. Estimated Cumulative Oil and Non-Gas Liquids Production Profiles by Alternative (million barrels of oil)*

Year	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)
Year 6	60.4	60.4	0.0	60.4
Year 7	126.9	126.9	60.4	127.4
Year 8	186.2	186.2	126.9	187.6
Year 9	238.8	238.8	186.2	239.4
Year 10	285.2	285.2	238.8	285.2
Year 11	326.3	326.3	285.2	324.7

Year	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)
Year 12	363.2	363.2	326.3	360.1
Year 13	396.5	396.5	363.2	391.3
Year 14	426.3	426.3	396.5	419.2
Year 15	453.0	453.0	426.3	444.5
Year 16	477.3	477.3	453.0	467.6
Year 17	498.8	498.8	477.3	488.5
Year 18	517.8	517.8	498.8	507.2
Year 19	534.1	534.1	517.8	523.1
Year 20	548.3	548.3	534.1	537.1
Year 21	560.6	560.6	548.3	549.1
Year 22	571.5	571.5	560.6	559.6
Year 23	581.2	581.2	571.5	568.8
Year 24	590.0	590.0	581.2	577.2
Year 25	598.0	598.0	590.0	584.7
Year 26	605.5	605.5	598.0	591.7
Year 27	611.8	611.8	605.5	597.6
Year 28	618.0	618.0	611.8	603.4
Year 29	623.7	623.7	618.0	608.6
Year 30	628.9	628.9	623.7	613.5
Year 31	628.9	628.9	628.9	613.5
Total	**628.9**	**628.9**	**628.9**	**613.5**

Table D.4.9. Estimated Daily Oil and Non-Gas Liquids Production Profiles for Alternative E by Drill Site (thousands of barrels of oil per day)*

Year	Drill Site BT1	Drill Site BT2	Drill Site BT3	Drill Site BT5	Total
Year 6	124.8	40.5	0.0	0.0	**165.2**
Year 7	128.0	43.1	12.1	0.0	**183.2**
Year 8	84.9	31.2	48.8	0.0	**164.9**
Year 9	55.2	28.1	53.6	4.9	**141.7**
Year 10	48.3	28.2	39.0	9.6	**125.1**
Year 11	46.8	24.2	28.3	8.8	**108.0**
Year 12	42.0	22.1	24.6	8.2	**96.9**
Year 13	37.1	19.6	21.1	7.7	**85.5**
Year 14	33.7	17.4	18.2	7.1	**76.3**
Year 15	31.0	15.6	16.2	6.3	**69.2**
Year 16	28.5	14.2	14.8	5.7	**63.2**
Year 17	25.6	13.1	13.6	5.1	**57.3**
Year 18	21.7	12.1	12.6	4.6	**51.0**
Year 19	17.8	10.5	11.3	4.2	**43.7**
Year 20	14.8	9.7	9.8	3.8	**38.2**
Year 21	12.2	8.8	8.4	3.5	**32.8**
Year 22	10.3	8.0	7.2	3.2	**28.7**
Year 23	8.7	7.4	6.3	3.0	**25.4**
Year 24	7.7	6.8	5.5	2.8	**22.8**
Year 25	6.8	6.3	5.0	2.7	**20.7**
Year 26	5.9	6.0	4.6	2.5	**19.0**
Year 27	4.7	5.2	3.8	2.4	**16.1**
Year 28	4.6	5.4	3.7	2.3	**15.9**
Year 29	4.1	4.9	3.1	2.2	**14.3**
Year 30	3.6	4.6	2.9	2.1	**13.3**

Note: BT1/2/3/5 (Bear Tooth drill sites 1/2/3/5).

Table D.4.10. Estimated Cumulative Oil and Non-Gas Liquids Production Profiles for Alternative E by Drill Site (million barrels of oil)*

Year	Drill Site BT1	Drill Site BT2	Drill Site BT3	Drill Site BT5	Total
Year 6	45.6	14.8	0.0	0.0	**60.4**

Year	Drill Site BT1	Drill Site BT2	Drill Site BT3	Drill Site BT5	Total
Year 7	92.4	30.5	4.4	0.0	**127.4**
Year 8	123.4	41.9	22.3	0.0	**187.6**
Year 9	143.6	52.2	41.8	1.8	**239.4**
Year 10	161.3	62.5	56.1	5.3	**285.2**
Year 11	178.4	71.4	66.4	8.5	**324.7**
Year 12	193.7	79.4	75.4	11.5	**360.1**
Year 13	207.3	86.6	83.1	14.3	**391.3**
Year 14	219.6	92.9	89.8	16.9	**419.2**
Year 15	230.9	98.6	95.7	19.2	**444.5**
Year 16	241.4	103.8	101.1	21.3	**467.6**
Year 17	250.7	108.6	106.0	23.1	**488.5**
Year 18	258.7	113.1	110.7	24.8	**507.2**
Year 19	265.1	116.9	114.8	26.3	**523.1**
Year 20	270.6	120.5	118.4	27.7	**537.1**
Year 21	275.0	123.7	121.4	29.0	**549.1**
Year 22	278.8	126.6	124.1	30.2	**559.6**
Year 23	281.9	129.3	126.4	31.3	**568.8**
Year 24	284.7	131.8	128.4	32.3	**577.2**
Year 25	287.2	134.1	130.2	33.3	**584.7**
Year 26	289.4	136.3	131.8	34.2	**591.7**
Year 27	291.1	138.2	133.2	35.1	**597.6**
Year 28	292.8	140.2	134.5	35.9	**603.4**
Year 29	294.3	142.0	135.7	36.7	**608.6**
Year 30	295.6	143.6	136.8	37.5	**613.5**
Total	**295.6**	**143.6**	**136.8**	**37.5**	**613.5**
Total as percentage of overall production	**48%**	**23%**	**23%**	**6%**	**100%**

Note: BT1/2/3/5 (Bear Tooth drill sites 1/2/3/5).

4.2.11 Project Infrastructure in Special Areas*

All action alternatives would include Project infrastructure located in BLM-identified Special Areas.

Alternatives B, C, and E would construct approximately 1 mile of gravel road and pipeline and Alternative D would construct approximately 1 mile of pipeline in the CRSA (BLM 2008a), an approximately 2.4 million acre area that includes lands around the Colville River. In making this designation, the Secretary of the Interior stated that

> *the central Colville River and some of its tributaries provide critical nesting habitat for the arctic peregrine falcon, an endangered species. The bluffs and cliffs along the Colville River provide nesting sites with the adjacent areas being utilized as food hunting areas* (42 FR 28515, June 3, 1977).

The Project infrastructure would avoid setbacks established along the Colville River to protect Arctic peregrine falcon (*Falco peregrinus tundrisus*) nesting habitat in the CRSA (Protection 1 in BLM [2008] and LS K-12 in BLM [2022]). Consistent with BLM LS K-12 (BLM 2022), in designing the Project, CPAI made reasonable and practicable efforts to locate permanent facilities as far from raptor nests as feasible and to minimize loss of potential raptor foraging habitat, with consideration for other environmental values, such as avoidance of yellow-billed loon nest and lake setback buffers, stream crossings, and overall gravel footprint.

Under all action alternatives, drill site BT2 (including the BT2 North location for Alternative E) and its associated roads and pipelines, would be located within the TLSA. For all action alternatives, except Alternative E, drill site BT4 and its associated roads and pipelines would be located within the TLSA. Other supporting infrastructure that would be sited within the TLSA is described for each alternative in Sections 4.3 through 4.6. The TLSA was established in 1977 (BLM 2013) with the purpose of protecting caribou calving and insect-relief areas and waterbird and shorebird breeding, molting, staging, and migration habitats. As described in BLM (2013),

> *designation of lands as a Special Area carries with it no specific restrictions on activities. It does require, however, that activities be conducted in a manner which will assure the maximum protection of surface values [as identified by the Secretary for the Special Area] to the extent consistent with the requirements of the [Naval Petroleum Reserves Production Act] NPRPA for exploration and production activities.*

According to the District Court's August 18, 2021, summary judgment order in the Willow MDP EIS litigation, oil and gas activity in the TLSA is to "be conducted in a manner which will assure the maximum protection of surface values." In developing the action alternatives, specific attention was paid to the minimization of impacts on caribou, waterbird, and shorebird habitats, consistent with the purpose of the TLSA.

4.2.12 Compliance with Bureau of Land Management Lease Stipulations, Required Operating Procedures, and Supplemental Practices*

Each action alternative is designed to comply with applicable lease stipulations and with ROPs from the 2022 NPR-A IAP ROD, though due to technical constraints, some Project facilities would require exceptions from NPR-A LSs and ROPs (Section 2.1., *Lease Stipulations and Required Operating Procedures in the National Petroleum Reserve in Alaska*). The likely exceptions are described in Table D.4.11. Each identified exception would be reviewed as the Project design engineering advances for opportunities to conform to LSs and ROPs to the extent practicable. When exceptions are granted, they typically are specific to stated Project actions or locations and are not granted for all Project actions. BLM may not approve an exception that does not meet the objective of the LS or ROP. The specific number and locations of these exceptions for each action alternative are described in Sections 4.3 through 4.6.

Table D.4.11. Anticipated Exceptions from National Petroleum Reserve in Alaska Lease Stipulations and Required Operating Procedures*

LS or ROP[a]	LS and ROP Description and Reason for Exception	Applicable Alternative or Option[a]
ROP A-5	*Objective:* Minimize the impact of contaminants from refueling operations on fish, wildlife, and the environment. *Requirement/Standard:* Refueling of equipment within 500 feet of the active floodplain of any waterbody is prohibited. Fuel storage stations shall be located at least 500 feet from any waterbody with the exception of small caches (up to 210 gallons) for motorboats, float planes, ski planes, and small equipment (e.g., portable generators and water pumps) are permitted. The authorized officer may allow storage and operations at areas closer than the stated distances if properly designed to account for local hydrological conditions. *Reason for exception:* Exceptions may be required to support refueling and fuel storage for marine vessels for emergency response and refueling of specialized equipment for which regular movement is not feasible (e.g., drilling rigs, cranes) during construction activities within floodplains. (Specific waterbodies where exceptions may be required have not yet been identified.)	All
ROP B-1	*Objective*: Maintain populations of, and adequate habitat for, fish and invertebrates. *Requirement/Standard*: Withdrawal of unfrozen water from rivers and streams during winter is prohibited. The removal of ice aggregate from grounded areas ≤ 4-feet deep may be authorized from rivers on a site-specific basis. *Reason for exception*: Option 3 may require management of flowing water under the partially grounded ice bridge over the Colville River at Ocean Point. This may result in the need to pump water around the ice bridge over 2 winters of ice bridge use.	Option 3

LS or ROP[a]	LS and ROP Description and Reason for Exception	Applicable Alternative or Option[a]
ROP B-2	*Objective:* Maintain natural hydrologic regimes in soils surrounding lakes and ponds, and maintain populations of, and adequate habitat for fish, invertebrates, and waterfowl. *Requirement/Standard*: Withdrawal of unfrozen water from lakes and the removal of ice aggregate from grounded areas ≤ 4-feet deep may be authorized on a site-specific basis depending on water volume and depth and the waterbody's fish community. Current water use requirements are: a. Lakes with sensitive fish (i.e., any fish except ninespine stickleback or Alaska blackfish): unfrozen water available for withdrawal is limited to 15% of calculated volume deeper than 7 feet; only ice aggregate may be removed from lakes that are ≤ 7-feet deep. b. Lakes with only non-sensitive fish (i.e., ninespine stickleback, Alaska blackfish): unfrozen water available for withdrawal is limited to 30% of calculated volume deeper than 5 feet; only ice aggregate may be removed from lakes that are ≤ 5-feet deep. c. Lakes with no fish present, regardless of depth: water available for use is limited to 35% of total lake volume. d. In lakes where unfrozen water and ice aggregate are both removed, the total use shall not exceed the respective 15%, 30%, or 35% volume calculations. *Reason for exception*: Exceptions may be requested to allow for ice aggregate collection from bed-fast waterbodies that exceeds regulatory withdrawal limits for liquid water and ice aggregate. Many of the lakes in the Project area are shallower than the 7-foot and 5-foot maximum depth criteria and have documented sensitive or resistant fish species, resulting in little or no liquid water availability during winter. Removal of water as ice from areas with grounded ice would not reduce the quantity of potential resistant overwintering fish habitat. Exception request would not exceed the Alaska Department of Natural Resources water withdrawal criteria which ensure that recharge will occur each spring. (Specific waterbodies where exceptions may be required have not yet been identified.)	All
ROP C-1	*Objective*: Protect grizzly bear, polar bear, and marine mammal sea ice breathing holes, lairs, and birthing locations. *Requirement/Standard*: Sea ice trails must not be greater than 12 feet wide. No driving will be allowed beyond the shoulder of the ice trail or off planned routes unless necessary to avoid ungrounded ice or for other human or marine mammal safety reasons. *Reason for exception*: Ice roads connecting the module transfer islands to shore would be wider than the prescribed maximum to support module delivery.	Options 1, 2
ROP E-2	*Objective*: Protect fish-bearing waterbodies, water quality, and aquatic habitats. *Requirements/Standard*: Permanent oil and gas facilities, including roads, airstrips, and pipelines, are prohibited within 500 feet from the ordinary high-water mark of fish-bearing waterbodies. Essential pipeline and road crossings will be permitted on a case-by-case basis. *Reason for exception*: ROP E-2 requires a 500-foot setback from fish-bearing waterbodies, although essential pipeline and road crossings are permitted on a case-by-case basis. Deviations from this ROP are warranted because compliance is technically infeasible due to the hydrology and number of waterbodies in the Project area. As a result, it is not possible in all instances to avoid encroachment within 500 feet of every waterbody. All action alternatives include essential road and pipeline crossings of fish-bearing waterbodies and freshwater access infrastructure.	Alternatives B, C, D, E
ROP E-7	*Objective*: Minimize disruption of caribou movement and subsistence use. *Requirement/Standard*: Pipelines and roads shall be designed to allow the free movement of caribou and safe, unimpeded subsistence access. Design standards include: Pipelines shall be elevated a minimum of 7 feet above the surrounding ground surface and have a minimum distance of 500 feet between pipelines and roads. *Reason for exception*: While ROP E-7 requires a minimum distance of 500 feet between pipelines and roads, it is acknowledged this may not be feasible in all areas. In these cases, alternative designs would be considered by the BLM authorized officer. Initial pipeline engineering has identified that the minimum distances would not be feasible in all areas for all action alternatives based on road and pipeline design constraints. Deviations would occur where roads and pipelines converge on a drill pad or at narrow land corridors between lakes where it is not possible to maintain 500 feet of separation between pipelines and roads without increasing potential impacts to waterbodies.	Alternatives B, C, D, E

LS or ROP[a]	LS and ROP Description and Reason for Exception	Applicable Alternative or Option[a]
ROP E-11	*Objective*: Minimize impacts on bird species, particularly those listed under the Endangered Species Act and BLM Special Status Species, from direct or indirect interaction with infrastructure. *Requirement/Standard*: Specific requirements for surveys, facility siting, and facility design vary based on species (which includes spectacled and Steller's eiders [*Somateria fischeri* and *Polysticta stelleri*] and yellow-billed loons [*Gavia adamsii*]). *Reason for exception*: All action alternatives would cross the default standard mitigation disturbance setback of 0.5 mile around recorded nest sites for yellow-billed loons and a 500-meter (1,625-foot) setback of the shoreline of lakes with yellow-billed loon occupancy.	Alternatives B, C, D, E
LS K-1	*Objective*: Minimize the disruption of natural flow patterns and changes to water quality and the disruption of natural functions resulting from the loss or change to vegetative and physical characteristics of floodplain and riparian areas; the loss of spawning, rearing, or overwintering habitat for fish; the loss of cultural and paleontological resources; the loss of raptor habitat; impacts on subsistence cabins and campsites; the disruption of subsistence activities; and impacts on scenic and other resource values. *Requirement/Standard*: Permanent oil and gas facilities (e.g., gravel pads, roads, airstrips, pipelines) are prohibited in streambeds and adjacent to rivers listed. Rivers in the Project area that are listed include the Colville River (2-mile setback), Fish (Creek (3-mile and 0.5-mile setback), Judy (Kayyaaq) Creek (0.5-mile setback), and the Ublutuoch (Tiŋmiaqsiuġvik) River (0.5-mile setback). *Reason for exception*: Alternatives B, D, and E would include essential road and pipeline crossings of Judy (Iqalliqpik) and Fish creeks; Alternative C would include an essential road and pipeline crossing of Fish Creek and an essential pipeline crossing of Judy (Iqalliqpik) Creek. Pipeline valve pads would also be located within the prescribed setbacks under all action alternatives. All action alternatives would locate the Tiŋmiaqsiuġvik Gravel Mine Site within the prescribed setback.	Alternatives B, C, D, E
LS K-2	*Deep Water Lakes* *Objective*: Minimize the disruption of natural flow patterns and changes to water quality; the disruption of natural functions resulting from the loss or change to vegetative and physical characteristics of deepwater lakes; the loss of spawning, rearing or overwintering habitat for fish; the loss of cultural and paleontological resources; impacts on subsistence cabins and campsites; and the disruption of subsistence activities. *Requirement/Standard*: Permanent oil and gas facilities (e.g., gravel pads, roads, airstrips, pipelines) are prohibited on the lake or lakebed within 0.25 mile of the ordinary high-water mark of any deep lake (i.e., depth greater than 13 feet). *Reason for exception*: All action alternatives include a constructed freshwater reservoir or a water access pad near Lake M0015, a previously identified deep water lake.	Alternatives B, C, D, E
LS K-5	*Coastal Area Setback* *Objective*: Protect coastal waters and their values as fish and wildlife habitat (including, but not limited to, that for waterfowl, shorebirds, and marine mammals); minimize hindrance or alteration of caribou movement within caribou coastal insect-relief areas; protect the summer and winter shoreline habitat for polar bears and the summer shoreline habitat for walruses and seals; prevent loss of important bird habitat and alteration or disturbance of shoreline marshes; and prevent impacts on subsistence resources and activities. *Requirement/Standard*: Marine vessels shall not conduct ballast transfers or discharge any matter into the marine environment within 3 miles of the coast, except when necessary for the safe operation of the vessel. *Reason for exception*: All action alternatives include sealift barge delivery of bulk construction materials, which would require grounding of barges to facilitate offloading. Barge grounding would require ballast water transfers.	All

Note: ≤ (less than or equal to); BLM (Bureau of Land Management); LS (lease stipulation); ROP (required operating procedure).
[a] Excludes essential road and pipeline crossings.

4.2.13 Boat Ramps for Subsistence Users

CPAI voluntarily proposes to construct up to three boat ramps (number varies by action alternatives) to improve river access for subsistence use as part of its effort to mitigate Project effects on the community of Nuiqsut (Figure D.4.12) based on Nuiqsut stakeholder feedback. CPAI proposes to construct one boat ramp (all action alternatives) to access the Ublutuoch (Tiŋmiaqsiuġvik) River along the existing gravel road between Alpine CD5 and GMT-1. Two additional boat ramps could be constructed along Judy (Iqalliqpik) Creek and/or Fish Creek under Alternatives B and E, pending further community input; these boat ramps would be accessed via short gravel roads connected to Project roads near Project bridges. Due to ice road-only sections contained in Alternatives C and D, these two additional boat ramps would not apply to these alternatives as there would be no gravel road connection to these locations from Nuiqsut.

Preliminary locations and boat ramp design have been determined, but CPAI is seeking community feedback on the preferred location(s) that would best serve the needs of the community. Each boat ramp would be approximately 375 feet long and would include a gravel pad with space for vehicles to turn around and provide parking space for approximately 10 vehicles with trailers. Each boat ramp would be accessed via a short, 24-foot-wide (crown width) access road from an existing or proposed gravel Project road. The total acreage below OHW for all three boat ramps would be approximately 0.2 acres. The gravel access road would likely have a surface width of 24 feet. Boat ramp footprints are summarized in Table D.4.12. CPAI estimates approximately 20,000 cy of gravel fill would be required to construct each of the three boat ramps. Gravel for the boat ramps would come from the Tiŋmiaqsiuġvik Gravel Mine Site (Section 4.2.6).

Table D.4.12. Boat Ramp Footprint Summary

Boat Ramp Location[a]	Applicable Alternative	Total Footprint (acres)[a]	Gravel Fill Volume (cubic yards)[a]
Ublutuoch (Tiŋmiaqsiuġvik) River	B, C, D	1.8	20,000
Judy (Iqalliqpik) Creek	B	2.0	20,000
Fish Creek	B	2.1	21,000
Total	**NA**	**5.9**	**61,000**

Note: NA (not applicable).
[a] Includes gravel boat ramp access road, gravel (parking) pad, and boat ramp above and below ordinary high water.

The Ublutuoch (Tiŋmiaqsiuġvik) River boat ramp would be constructed during the first year of Project construction, and under Alternatives B and E, the boat ramps at Judy (Iqalliqpik) Creek and Fish Creek would be constructed within 2 years of constructing the BT1 and BT4/BT2 access roads, respectively, after site visits and input from local stakeholders. Gravel placement would occur during winter months with gravel seasoning and compaction occurring the following summer. Boat ramp construction would not require pile driving. The need for erosion control would be evaluated during the final design phase, after locations have been finalized based on community input.

The boat ramp would be designed and constructed to avoid impacts on fish and fish habitat and would be coordinated with BLM and ADF&G. Boat ramps would be maintained by CPAI.

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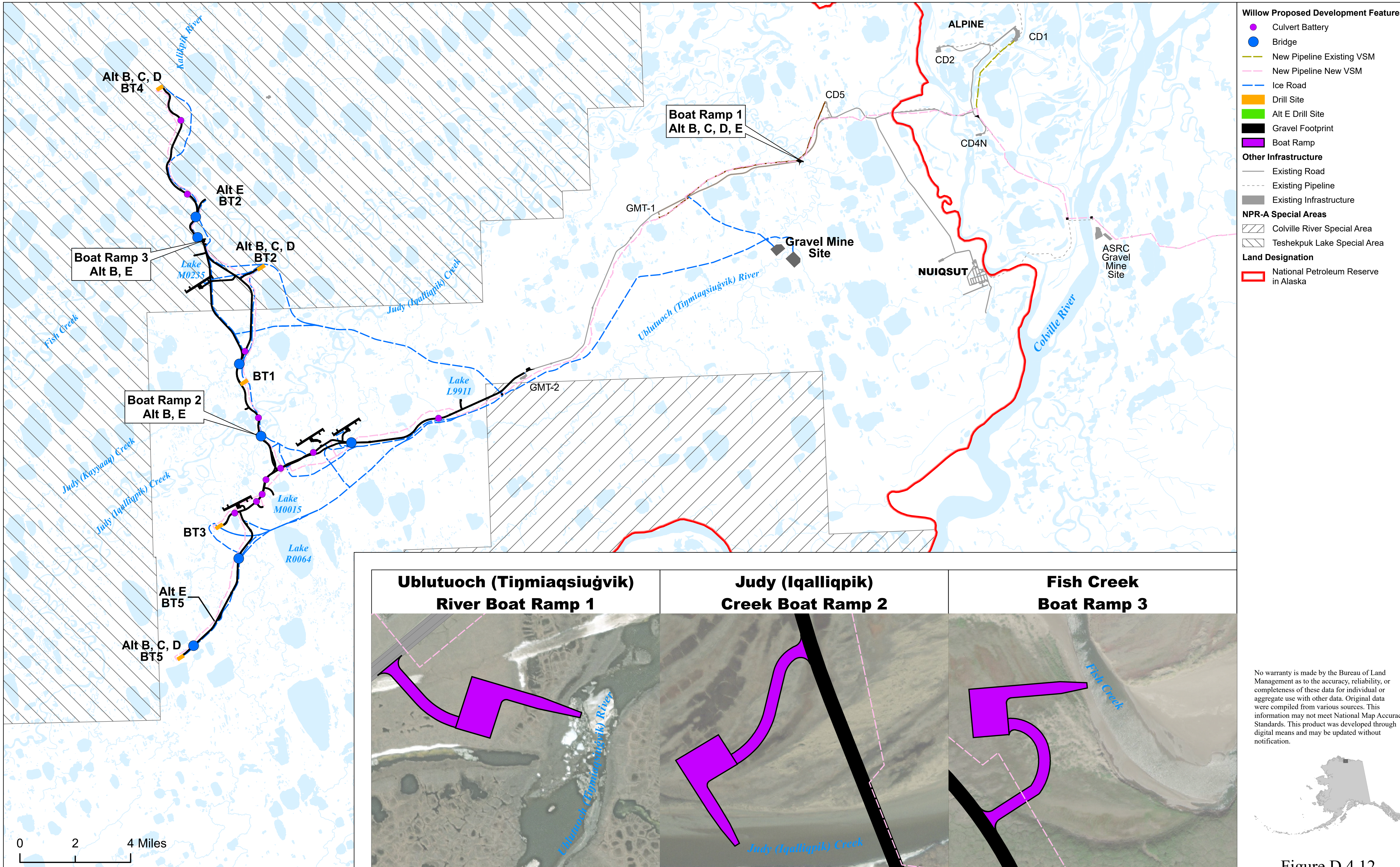

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Figure D.4.12

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4.3 Alternative B: Proponent's Project

Alternative B would extend an all-season gravel road from the GMT-2 development southwest, toward the Project area (Figure D.4.1). Gravel roads would connect to all Project facilities, including the WPF, WOC, airstrip, and all five drill sites. Additional Project support facilities would include the CFWR, four valve pads, four pipeline pads, two water source access pads (at the CFWR and Lake L9911), eight road turnouts (with subsistence access ramps), HDD pipeline pads at the Colville River, and three subsistence-use boat ramps.

Alternative B would construct seven bridges (one on the road extending from GMT-2 and six on the roads to Project pads). Infield (multiphase) pipelines would connect individual drill sites to the WPF and export/import pipelines would connect the WPF to existing infrastructure on the North Slope. Diesel fuel would be piped from Kuparuk CPF2 to the ACF and then trucked 37.5 miles to the Project area. Alternative B would also include pipeline tie-in pad near Alpine CD4N and an expansion of the existing pad at Kuparuk CPF2.

Sealift module delivery to the Project area would be required (Section 4.8, *Sealift Module Delivery Options*).

The Alternative B road alignment would provide direct gravel road access from the existing gravel road network in the GMT and Alpine developments to the Project facilities. The full, all-season gravel road access connection to Alpine would allow for additional operational safety and risk reduction by providing redundancies and additional contingencies for each project and would provide support for reasonably foreseeable future actions described in Table E.19.1 in Appendix E.19, *Cumulative Effects Technical Appendix*. Table D.4.13 provides a summary of Project components and their associated footprint for Alternative B.

Table D.4.13. Summary of Components for Alternative B: Proponent's Project

Project Component	Description
Drill site gravel pads	Five (79.8 acres total): BT1, BT2, and BT3 (17.0 acres each) and BT4 and BT5 (14.4 acres each)
WPF gravel pad	22.8-acre pad
WOC gravel pad	31.3-acre pad
Water source access gravel pads	Two water source access pads (2.6 acres total) at the CFWR (1.3 acres) and Lake L9911 (1.3 acres)
CFWR	16.4-acre excavation (reservoir and connecting channel) and 3.9-acre perimeter berm
Other gravel pads	Four valve pads (1.3 acres total); two pads at Judy (Iqalliqpik) Creek pipeline crossing (0.7 acres) and two pads at Fish Creek pipeline crossing (0.6 acres) HDD pipeline pads (two total) at Colville River crossing (1.5 acres total) Tie-in pad near Alpine CD4N (0.7 acre) Pipeline crossing pad near GMT-2 (0.5 acre) Kuparuk CPF2 pad expansion (1.0 acre) Communications tower pad (0.5 acre)
Single-season ice pads	Used during construction at the gravel mine site, bridge crossings, the Colville River HDD crossing, and other locations as needed in the Project area (936.6 total acres)
Multi-season ice pads	10.0-acre multi-season ice pad near GMT-2 (Q1 Year 1 to Q2 Year 2, Q1 Year 2 to Q2 Year 3, Q1 Year 3 to Q2 Year 4, and Q1 Year 4 to Q2 Year 5) 10.0-acre multi-season ice pad near the WOC (Q1 Year 1 to Q2 Year 2) 10.0-acre multi-season ice pad at the Tiŋmiaqsiuġvik Gravel Mine Site (Q1 Year 1 to Q2 Year 2 and Q1 Year 2 to Q2 Year 3)
Infield pipelines	43.4 total miles: BT1 to WPF (4.3 miles); BT2 to BT1 (4.7 miles); BT3 to WPF (4.2 miles); BT4 to BT2 (10.2 miles); BT5 to WPF (9.8 miles); GMT-2 to WPF (10.2 miles)
Willow export pipeline	33.3 total miles (WPF to tie-in pad near Alpine CD4N)
Other pipelines	64.3-mile seawater pipeline (Kuparuk CPF2 to WPF); includes Colville River HDD crossing 34.4-mile diesel pipeline (Kuparuk CPF2 to Alpine CD1); includes Colville River HDD crossing 2.8-mile fuel gas pipeline (WOC to WPF) 4.9-mile freshwater pipeline (CFWR to WPF to WOC) 2.8-mile treated water pipeline (WOC to WPF)
Gravel roads	37.4 miles (258.8 acres, including vehicle turnouts) total connecting drill sites to the WPF, WOC, airstrip access road, water source access roads, and GMT-2 Eight turnouts with subsistence tundra access ramps (3.0 acres total)
Bridges	Seven total at Judy (Iqalliqpik) Creek, Judy (Kayyaaq) Creek, Fish Creek, Willow Creek 2, Willow Creek 4, Willow Creek 4A, and Willow Creek 8
Airstrip	5,700 × 200–foot airstrip and apron (42.2 acres total); would also require airstrip access road

Project Component	Description
Subsistence boat ramps	1.8 acres at Ublutuoch (Tiŋmiaqsiuġvik)River 2.0 acres at Judy (Iqalliqpik) Creek 2.1 acres at Fish Creek 5.9 acres total
Oliktok Dock modifications	Modifications to the existing dock include adding structural components and a gravel ramp within the existing developed footprint 2.5 acres of screeding at Oliktok Dock 9.6 acres of screeding at the barge lightering area
Ice roads	Approximately 495.2 total miles (3,590.7 total acres) over nine construction seasons
Total footprint and gravel fill volume[a]	484.0-acre gravel footprint using 4.9 million cy of gravel fill and 25,000 cy of native fill 119.4-acre gravel mine site excavation 16.4-acre excavation at the CFWR 12.1-acre screeding area
Gravel source	Two mine site cells (119.4 total acres) in Tiŋmiaqsiuġvik area (Mine Site Area 1 would be 90.5 acres and Mine Site Area 2 would be 28.9 acres)
Total freshwater use	1,662.4 million gallons over the life of the Project (30 years)
Ground traffic (number of trips)[b,c]	3,188,910
Fixed-wing air traffic (number of trips)[b, d]	12,101 total flights Willow: 11,809 Alpine: 292
Helicopter air traffic (number of trips)[b]	2,421 total flights Willow: 2,321 Alpine: 100
Marine traffic (number of trips)[b,e]	319 total trips Sealift barges: 24 Tugboats: 37 Support vessels: 258
Infrastructure in special areas	Teshekpuk Lake Special Area: 10.8 miles of gravel road and gravel pads (106.3 total acres); 11.4 miles of pipeline Colville River Special Area: 1.0 mile of gravel road; 8.1 acres of gravel infrastructure; and 1.4 miles of pipelines
Fish-bearing waterbody setback overlap (ROP E-2)	2.2 acres of gravel footprint, 0.2 mile of gravel road, and 1.7 miles of pipelines
Less than 500-foot pipeline-road separation (ROP E-7)	24.0 miles of pipelines and road with less than 500 feet of separation
Yellow-billed loon setback overlap (ROP E-11)	10.8 acres of gravel infrastructure and 1.7 miles of pipelines within 0.5 mile of a nest 52.7 acres of gravel infrastructure and 7.6 miles of pipelines within 1,625 feet of occupied lakes
River setback overlap (LS K-1)	Colville River: 0.0 acres of gravel infrastructure and 0.0 miles of pipelines Fish Creek: 12.2 acres of gravel infrastructure and 1.6 miles of pipelines Judy (Kayyaaq) Creek: 18.7 acres of gravel infrastructure and 6.2 miles of pipelines
Deepwater lake setback overlap (LS K-2)	3.2 acres of gravel infrastructure and 0.0 mile of pipelines; 14.5 acres of the constructed freshwater reservoir would be within the setback and 1.4 acres of the reservoir connection would be within the lake

Note: BT1 (Bear Tooth drill site 1); BT2 (Bear Tooth drill site 2); BT3 (Bear Tooth drill site 3); BT4 (Bear Tooth drill site 4); BT5 (Bear Tooth drill site 5); CFWR (constructed freshwater reservoir); cy (cubic yards); GMT-2 (Greater Mooses Tooth 2); HDD (horizontal directional drilling); LS (lease stipulation); Q1 (first quarter); Q2 (second quarter); ROP (required operating procedure);VSM (vertical support member); WPF (Willow Processing Facility); WOC (Willow Operations Center).

[a] Values may not sum to totals due to rounding.

[b] Total traffic for 30-year life of the Project (not including reclamation activity). Ground traffic trips are one-way; a single flight is defined as a landing and subsequent takeoff; and a vessel trip is defined as a docking and subsequent departure.

[c] Number of trips includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Construction ground traffic also includes gravel hauling (e.g., B-70/Maxi Haul dump trucks).

[d] Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse); includes Q400, C-130, Twin Otter/CASA, Cessna, and DC-6 or similar aircraft.

[e] Includes crew boats, tugboats supporting sealift barges, screeding barges, and other support vessels.

4.3.1 Project Facilities and Gravel Pads

Project facilities proposed for the WPF, drill sites, and the WOC for Alternative B are described in Section 4.2.1, *Project Facilities and Gravel Pads*. Under Alternative B, the WPF would be located approximately 3.5 miles northeast of BT3 and the WPF would be located approximately 9.3 miles by road from GMT-2. At least two Class I UIC disposal wells would be installed at the WOC; an existing UIC well at Alpine would provide backup, as needed.

4.3.2 Pipelines

Alternative B pipelines (Figure D.4.13) would include infield pipelines connecting each drill site (and GMT-2) to the WPF and the Willow Pipeline (oil export) connecting the WPF to existing facilities at Alpine. Additional pipelines would include a seawater import pipeline from Kuparuk CPF2 to the WPF, a diesel import pipeline from Kuparuk CPF2 to the ACF (located at Alpine CD1; diesel fuel would be trucked from Alpine to the Project area), and a freshwater pipeline from the CFWR access pad to the WPF and the WOC (Figure D.4.13). VSMs would be installed using the drill-set-slurry method. Alternative B would require approximately 13,000 total VSMs with an estimated 0.8-acre total disturbance footprint. Alternative B would include 12 VSMs installed below OHW at crossings east of the NPR-A boundary (i.e., the west bank of the Niġliq Channel). Pipeline design would be as described in Section 4.2.2, *Pipelines*.

All Project area pipelines would parallel gravel roads to facilitate routine visual observation and investigation of pipelines. Conducting visual observation and investigation of pipelines from a gravel road would reduce the number and frequency of aircraft flights required to visually inspect pipelines.

The Willow Pipeline (oil export) and seawater pipeline would be constructed on new VSMs from the WPF to the tie-in pad near Alpine CD4N (Willow Pipeline) and Kuparuk CPF2 (seawater pipeline), as described in Section 4.2.2. The diesel pipeline would be placed on new VSMs (shared with the seawater pipeline) between Kuparuk CPF2 and Alpine CD4N and on existing VSMs from Alpine CD4N to the ACF located at Alpine CD1. From Alpine CD1, diesel fuel would be trucked to the WOC, WPF, and other facilities. In total, 314.2 miles of pipelines would be constructed with 311.1 miles of pipelines on new VSMs (approximately 99%) and 3.1 miles of pipelines on existing VSMs (approximately 1%) using 97.5 miles of new and existing pipeline corridors. Infield pipelines would connect each drill site to the WPF. Where practicable, infield pipelines would tie into other infield pipelines (Section 4.2.2.1, *Infield Pipelines*) to minimize redundant parallel pipelines. Water pipelines would connect the CFWR to the WOC and WPF, and a fuel gas pipeline would connect the WPF to the WOC.

Table D.4.14 summarizes pipeline infrastructure under Alternative B by pipeline segment.

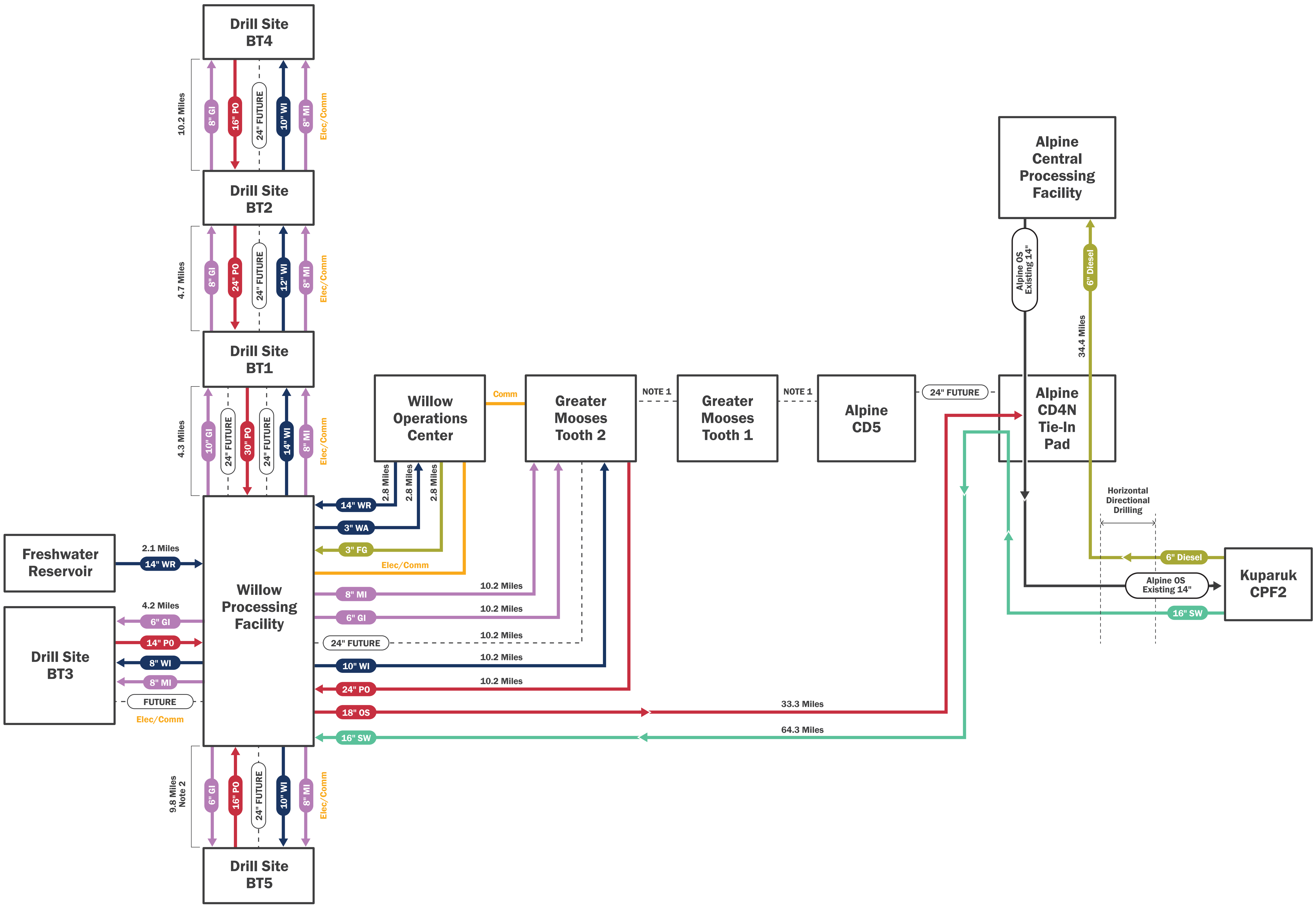
Table D.4.14. Alternative B Pipeline Segments Summary

Pipeline	Pipeline Segment	Segment Length (miles)	Notes
BT4 infield[a]	BT4 to BT2	10.2	Pipelines on new set of VSMs
BT2 infield[a]	BT2 to BT1	4.7	Pipelines on new set of VSMs; would also transport BT4 materials
BT1 infield[a]	BT1 to WPF	4.3	Pipelines on new set of VSMs; would also transport BT4 and BT2 materials
BT3 infield[a]	BT3 to WPF	4.2	Pipelines on new set of VSMs
BT5 infield[a]	BT5 to WPF	9.8	Pipelines on new VSMs; would share VSMs with BT3 infield pipeline from BT5 junction to WPF (2.8 miles)
GMT-2 infield[a]	GMT-2 to WPF	10.2	Would share new VSMs with Willow export and seawater import pipelines from GMT-2 to WPF (10.2 miles)
Freshwater	CFWR to WPF to WOC	4.9	Would share new VSMs with BT3 infield pipelines from the CFWR junction to WPF (1.7 miles) and treated water and fuel gas pipelines from WPF to WOC (2.8 miles)
Treated water	WOC to WPF	2.8	Would share new VSMs with freshwater and fuel gas pipelines from WPF to WOC (2.8 miles)
Fuel gas	WPF to WOC	2.8	Would share new VSMs with freshwater and treated water pipelines from WOC to WPF (2.8 miles)
Willow export	WPF to CD4N tie-in pad	33.3	Would share new VSMs with seawater pipeline from WPF to CD4N (33.0 miles)

Pipeline	Pipeline Segment	Segment Length (miles)	Notes
Seawater	CPF2 to WPF	64.3	Would share new VSMs with Willow Pipeline from WPF to CD4N (33.0 miles) and diesel pipeline from CD4N to CPF2 (31.3 miles); includes new HDD crossing of the Colville River near existing HDD crossing
Diesel	CPF2 to CD1	34.4	Would share new VSMs with seawater pipeline from CPF2 to CD4N (31.3 miles) and existing VSMs from CD4N to CD1 (3.1 miles); includes new HDD crossing of the Colville River near existing HDD crossing

Note: BT1 (Bear Tooth drill site 1); BT2 (Bear Tooth drill site 2); BT3 (Bear Tooth drill site 3); BT4 (Bear Tooth drill site 4); BT5 (Bear Tooth drill site 5); CD1 (Alpine CD1); CD4N (Alpine CD4N); CFWR (constructed freshwater reservoir); CPF2 (Kuparuk CPF2); GMT-2 (Greater Mooses Tooth 2); HDD (horizontal directional drilling); VSM (vertical support member); WOC (Willow Operations Center); WPF (Willow Processing Facility).

[a] Infield pipelines include produced fluids, injection water, gas, and miscible-injectant pipelines.



Legend

Elec/Comm	34.5kV Power and Communications Cables
Diesel	Diesel
FG	Fuel Gas
GI	Gas Injection
MI	Miscible Injection
PO	Production Oil
OS	Sales Oil
SW	Seawater
WA	Water Fresh
WF	Fire Protection Water
WI	Injection Water
WP	Potable Water
WR	Raw Water

Notes

1. Alignment contains one empty pipeline slot on pipe supports.
2. Pipeline size, service, and length is assumed at this time.

Figure D.4.13

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4.3.3 Access to the Project Area

Alternative B would include seasonal ice road access to support construction; access to the WPF from the GMT and Alpine developments via an all-season gravel road; access from the WPF to individual drill sites via all-season gravel roads; helicopter and fixed-wing aircraft to the Project and Alpine airstrips; and barge delivery of small modules and bulk construction materials to Oliktok Dock. Table D.4.15 provides a summary of total traffic volumes anticipated for the Project under Alternative B by transportation type and year; Table D.4.16 provides a detailed traffic breakdown by season.

Table D.4.15. Alternative B Total Project Traffic Volumes Summary for the Life of the Project (number of trips)

Year	Ground[a]	Fixed-Wing Trips Alpine[b,c]	Fixed-Wing Trips Willow[b,c]	Helicopter Trips Alpine[d]	Helicopter Trips Willow[d]	Barges to Oliktok Dock[e]	Tugboats to Oliktok Dock[f]	Support Vessels to Oliktok Dock[g]
Year 0	0	0	0	25	0	0	0	0
Year 1	55,300	60	0	50	0	0	0	0
Year 2	137,270	122	31	25	25	6	9	66
Year 3	274,030	75	168	0	82	8	12	88
Year 4	363,620	35	751	0	82	5	8	52
Year 5	387,490	0	707	0	82	0	0	0
Year 6	282,570	0	738	0	82	5	8	52
Year 7	242,900	0	738	0	82	0	0	0
Year 8	185,090	0	724	0	82	0	0	0
Year 9	113,200	0	560	0	82	0	0	0
Year 10	54,640	0	352	0	82	0	0	0
Year 11 to Year 30	1,092,800	0	7,040	0	1,640	0	0	0
Total	**3,188,910**	**292**	**11,809**	**100**	**2,321**	**24**	**37**	**258**

Note: Ground trips are defined as one-way; a single fixed-wing or helicopter flight is defined as a landing and subsequent takeoff; and a single vessel trip is defined as a docking and subsequent departure.
[a] Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B-70/Maxi Haul dump trucks).
[b] Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse).
[c] Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Cessna, or similar.
[d] Typical helicopters include A-Star and 206 Long Ranger models, although other similar types of helicopters may be used. Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all Project phases. Helicopter flights in Year 0 would occur in the fourth quarter and would support the start of Project construction in the first quarter of Year 1. Note: Helicopter flights within the NPR-A are authorized under approved right-of-way FF097411 valid through December 31, 2023.
[e] Includes sealift barges for bulk materials and small modules.
[f] Includes tugboats accompanying sealift barges.
[g] Includes crew boats, screeding barge, and other support vessels.

Alternative B would have a total of 12,101 fixed-wing flights (including landings and departures at the Project airstrip and Alpine), 2,421 helicopter flights (including landings and departures at the Project airstrip and Alpine), and 24 barge and 37 tugboat trips from Dutch Harbor to Oliktok Dock.

During construction, ice roads would be constructed to support Project pipeline, gravel pad and gravel road construction, and gravel source (Tiŋmiaqsiuġvik Gravel Mine Site) access over nine winter construction seasons. During drilling, planned ice road use would be limited to drilling rig mobilization. (The Project would receive annual resupply via the Alpine ice road, which is constructed annually between Kuparuk and Alpine to support Alpine operations. This ice road mileage is not included in the Project's analyses as it would be constructed regardless in support of Alpine.) Ice road design and mileage is described in Section 4.2.3.1, *Ice Roads*.

Table D.4.16. Alternative B Detailed Project Ground and Aircraft Traffic Volumes by Season for the Life of the Project (number of trips)

Season and Year	Ground[a]	Fixed-Wing Trips Alpine[b]	Fixed-Wing Trips Willow[b]	Helicopter Trips Alpine[c]	Helicopter Trips Willow[c]
Summer Year 0	0	0	0	25	0
Winter Year 1	33,180	36	0	0	0
Spring Year 1	11,060	12	0	12	0
Summer Year 1	11,060	12	0	38	0
Fall Year 1	0	0	0	0	0
Winter Year 2	92,127	81	21	0	0
Spring Year 2	31,554	28	7	25	0
Summer Year 2	11,055	10	3	0	25
Fall Year 2	1,690	2	0	0	0
Winter Year 3	184,754	52	114	0	0
Spring Year 3	62,991	17	39	0	25
Summer Year 3	22,068	6	13	0	57
Fall Year 3	3,376	0	2	0	0
Winter Year 4	234,083	21	457	0	0
Spring Year 4	82,013	7	169	0	25
Summer Year 4	35,572	3	72	0	57
Fall Year 4	9,096	0	18	0	0
Winter Year 5	237,297	0	435	0	0
Spring Year 5	86,366	0	158	0	25
Summer Year 5	42,027	0	77	0	57
Fall Year 5	17,566	0	32	0	0
Winter Year 6	167,540	0	430	0	0
Spring Year 6	60,752	0	158	0	25
Summer Year 6	39,566	0	103	0	57
Fall Year 6	15,666	0	40	0	0
Winter Year 7	147,474	0	443	0	0
Spring Year 7	52,813	0	160	0	25
Summer Year 7	31,653	0	96	0	57
Fall Year 7	12,530	0	38	0	0
Winter Year 8	106,234	0	409	0	0
Spring Year 8	39,470	0	154	0	25
Summer Year 8	27,238	0	106	0	57
Fall Year 8	12,274	0	48	0	0
Winter Year 9	57,077	0	276	0	0
Spring Year 9	22,640	0	112	0	25
Summer Year 9	22,640	0	112	0	57
Fall Year 9	11,320	0	56	0	0
Winter Year 10	30,248	0	187	0	0
Spring Year 10	10,928	0	71	0	25
Summer Year 10	10,928	0	72	0	57
Fall Year 10	5,464	0	36	0	0
Winter Year 11–Year 30	549,132	0	3,538	0	0
Spring Year 11–Year 30	218,560	0	1,408	0	500
Summer Year 11–Year 30	218,560	0	1,408	0	1,140
Fall Year 11–Year 30	109,280	0	704	0	0
Total[d]	**3,188,922**	**287**	**11,806**	**100**	**2,321**

Note: Seasons are defined as follows: summer (122 days; June, July, August, September); fall (61 days; October, November); winter (121 days; December, January, February, March); and spring (61 days; April, May). Trips are defined as one-way; a single flight is defined as a landing and subsequent takeoff.

[a] Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B-70/Maxi Haul dump trucks).

[b] Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse). Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Cessna, or similar.

[c] Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all phases of the Project.

[d] Values may not match other summary traffic values presented in the Final EIS due to rounding.

Gravel roads would provide year-round access between the GMT and Alpine developments and the Project area and from the WPF to individual drill sites. Alternative B gravel roads would require construction of seven bridges (Table D.4.17) following the design described in Section 4.2.3.2.1, *Bridges*. Five of the seven bridges would require the placement of 36 total piles (ranging from 36 to 48 inches in diameter) below OHW (Table D.4.17). Alternative B would also require 11 culverts or culvert batteries at swale crossings (Figure D.4.1) and 202 cross-drainage culverts.

Table D.4.17. Alternative B Bridges Summary

Waterbody Crossing	Bridge Length (± feet)[a]	Piles below Ordinary High Water (number)[b]	Latitude (°North)	Longitude (°West)
Judy (Iqalliqpik) Creek	380	16	70.1462	152.0914
Judy (Kayyaaq) Creek	75	4	70.1848	152.1211
Fish Creek	420	16	70.2526	152.1787
Willow Creek 2	80	0	70.1413	151.9557
Willow Creek 4	130	0	70.0816	152.1302
Willow Creek 4a	50	0	70.0360	152.2015
Willow Creek 8	40	0	70.2635	152.1806

[a] Bridge lengths are approximations based on the interpretation of available aerial imagery and are subject to change.
[b] In-stream pile diameters are assumed to be 48 inches; diameter excludes any potential surface casing required for installation.

The airstrip (Section 4.2.3.3, *Airstrip and Associated Facilities*) would be located near the WOC and construction would begin during the winter construction season of Year 1 and be completed in summer of Year 2. Prior to Project airstrip availability, the Alpine airstrip (located at Alpine CD1) would be used to support the Project. Helicopters would be used to support ice road construction, environmental monitoring, and surveying. Following construction of gravel roads, and during the drilling and operations phases, Project helicopter use would be limited primarily to ongoing environmental monitoring and spill response support.

Sealift barges would be used to deliver bulk construction materials and small modules to Oliktok Dock to support Project construction (Section 4.2.3.4, *Sealift Barge Delivery to Oliktok Dock*). Additionally, sealift barges would be used to deliver large processing and drill site modules to the North Slope (Section 4.8, *Sealift Module Delivery Options*). No additional or regular use of barges is proposed over the life of the Project following construction.

4.3.4 Other Infrastructure and Utilities

4.3.4.1 Ice Pads

Single- and multi-season ice pads would be used to support Project construction. Single- and multi-season ice pads are described in Section 4.2.4.1, *Ice Pads*.

Alternative B would require 936.6 acres of single-season ice pads over the Project's construction phase (9 years). Additionally, Alternative B would include the use of three multi-season ice pads to store equipment through the summer to support ice road construction and other temporary construction activities. The following 10.0-acre multi-season ice pads would be constructed under Alternative B:

- Near GMT-2 (Q1 Year 1 to Q2 Year 5)
- Near the WOC (Q1 Year 1 to Q2 Year 2)
- At the Tiŋmiaqsiuġvik Gravel Mine Site (Q1 Year 1 to Q2 Year 3)

4.3.4.2 Camps

Table D.4.18 details Alternative B camp requirements to support construction, drilling, and operations.

Table D.4.18. Alternative B Camps Summary

Project Phase	Camp	Location	Capacity	Use Schedule
Construction	Temporary camp	Ice pad near the WOC	250	Q1 Year 1 to Q4 Year 1
Construction	K-Pad Camp[a]	K-Pad[b]	450	Q1 Year 1 to Q4 Year 5
Construction	Alpine Operations Camp[a]	Alpine central processing facility (at Alpine CD1)[b]	250 to 300	Q1 Year 1 to Q2 Year 4
Construction	Temporary camp[c]	WOC pad	250	Q1 Year 2 to Q2 Year 4
Construction	Sharktooth Camp[a]	Kuparuk[b]	220	Q1 Year 2 to Q2 Year 4

Project Phase	Camp	Location	Capacity	Use Schedule
Drilling	Drill rig camp(s)	Drill site(s) or WOC pad	150	Q1 Year 4 to Q4 Year 9
Construction, operations	Willow Camp[c]	WOC pad	500	Q2 Year 4 to Q4 Year 7
Operations	Willow Camp[c]	WOC pad	200	Q1 Year 8 to Q4 Year 30

Note: Q1 (first quarter); Q2 (second quarter); Q4 (fourth quarter); WOC (Willow Operations Center).
[a] Existing camp.
[b] Existing gravel pad.
[c] During construction, up to 60 bed spaces may be used at the existing Kuukpik Hotel in Nuiqsut in lieu of bed spaces identified at or near the WOC.

4.3.4.3 Utilities, Waste Handling, and Fuel and Chemical Storage

Power generation and distribution, communications, potable water systems and use, domestic wastewater, solid waste, and drilling waste handling, as well as fuel and chemical storage, would be as described under Section 4.2.4, *Other Infrastructure and Utilities*.

4.3.5 Water Sources and Use

As described for all action alternatives in Section 4.2.5, *Water Sources and Use*, freshwater would be needed during construction for domestic use at construction camps, construction and maintenance of ice roads and ice pads, and hydrostatic testing of pipelines. During drilling, freshwater would be required for domestic use at the drill rig camps and to support drilling activities. Water for construction and drilling would be withdrawn from lakes in the Project area. Freshwater for domestic use during operations would be sourced from the CFWR and Lake L9911 using the freshwater intake infrastructure (Section 4.2.4.5*, Potable Water*). However, year-round water withdrawal at Lake L9911 would occur only during construction; during operations, Lake L9911 water withdrawal would be limited to winter months. Anticipated freshwater use for Alternative B is detailed by year and Project phase in Table D.4.19.

Seawater would also be required, as described in Section 4.2.5, and would be sourced from the existing Kuparuk seawater treatment plant and transported via seawater pipeline to the Project area (Section 4.2.2.3, *Other Pipelines*).

Table D.4.19. Alternative B Estimated Freshwater Use by Project Phase and Year (million gallons)

Year (season)	Construction[a]	Drilling[b]	Operations[c]	Total
Year 0–Year 1 (winter)	72.4	0.0	0.0	**72.4**
Year 1 (summer)	1.1	0.0	0.0	**1.1**
Year 1–Year 2 (winter)	129.7	0.0	0.0	**129.7**
Year 2 (summer)	3.2	0.0	0.0	**3.2**
Year 2–Year 3 (winter)	241.0	0.0	0.0	**241.0**
Year 3 (summer)	9.5	0.0	0.0	**9.5**
Year 3–Year 4 (winter)	315.1	21.5	0.0	**336.6**
Year 4 (summer)	12.8	43.0	0.0	**55.8**
Year 4–Year 5 (winter)	104.5	43.9	0.0	**148.4**
Year 5 (summer)	19.7	44.8	0.9	**65.4**
Year 5–Year 6 (winter)	111.3	8.8	1.8	**121.9**
Year 6 (summer)	2.3	8.8	4.3	**15.4**
Year 6–Year 7 (winter)	103.8	8.8	3.2	**115.8**
Year 7 (summer)	2.6	8.8	5.1	**16.5**
Year 7–Year 8 (winter)	48.5	8.8	4.1	**61.4**
Year 8 (summer)	4.2	8.8	5.1	**18.1**
Year 8–Year 9 (winter)	23.5	8.8	4.1	**36.4**
Year 9 (summer)	2.1	8.8	5.1	**16.0**
Year 9–Year 10 (winter)	0.2	4.4	4.1	**8.7**
Year 10 (summer)	0.0	0.0	5.1	**5.1**
Year 10–Year 11 (winter)	0.0	0.0	4.1	**4.1**
Year 11 (summer)	0.0	0.0	5.1	**5.1**
Year 11–Year 12+ (19 winters)[d]	0.0	0.0	77.9	**77.9**

Year (season)	Construction[a]	Drilling[b]	Operations[c]	Total
Year 12+ (19 summers)[e]	0.0	0.0	96.9	**96.9**
Total	**1,207.5**	**228.0**	**226.9**	**1,662.4**

Note: "+" indicates total seasonal use from the indicated year to the end of Project operations (Year 30).
[a] The construction phase would include ice road construction (1.0 million gallons [MG] per mile for 35-foot-wide road, 1.4 MG per mile for a 50-foot-wide-road; and 2.0 MG per mile for 70-foot-wide road), ice pad construction (0.25 MG per acre), dust suppression, hydrostatic testing, and camp supply (100 gallons per person per day).
[b] The drilling phase would include drilling water (1.4 MG per month per drilling rig prior to Willow Processing Facility startup and 0.4 MG per drill rig per month after facility startup), hydraulic fracturing (1.0 MG per well prior to Willow Processing Facility startup), and camp supply (100 gallons per person per day).
[c] The operations phase would include dust suppression and camp supply (100 gallons per person per day).
[d] Annual winter water use for operations would be 4.1 MG.
[e] Annual summer water use for operations would be 5.1 MG.

4.3.6 Gravel and Other Fill Requirements

Project roads and pads would be constructed with gravel obtained from the Tiŋmiaqsiuġvik Gravel Mine Site and the perimeter berm surrounding the CFWR would be constructed from material excavated from the reservoir and capped in gravel. Table D.4.20 lists the estimated quantity of fill materials anticipated for each Project component.

Table D.4.20. Alternative B Estimated Fill Material Requirements by Project Component

Component	Footprint (acres)[a]	Fill Quantity (cubic yards)[a]	Fill Type	Notes and Assumptions
Drill pads (five total)	79.8	1,108,000	Gravel	Based on five drill sites with an average pad thickness of 9 feet and 2:1 side slopes
Willow Processing Facility pad	22.8	346,000	Gravel	Based on an average pad thickness of 10 feet with 2:1 side slopes
Willow Operations Center pad	31.3	487,000	Gravel	Based on an average pad thickness of 10 feet with 2:1 side slopes
Valve pads (4 total) and pipeline pads (4 total)	4.0	48,000	Gravel	Based on four valve and four pipeline pads with an average pad thickness of 7 feet and 8 feet (respectively) with 2:1 side slopes
Water source access pads (2 total)	2.6	24,000	Gravel	Based on two pads with an average pad thickness of 7 feet with 2:1 side slopes
Communications tower pad	0.5	5,000	Gravel	Based on an average pad thickness of 7 feet with 2:1 side slopes
CPF2 pad expansion	1.0	13,000	Gravel	Based on an average pad thickness of 8-feet and 2:1 side slopes
Airstrip (includes airstrip and apron)	42.2	593,000	Gravel	Based on an average pad thickness of 9.5 feet with 2:1 side slopes
Gravel roads	256.7	2,169,000	Gravel	Based on an average road surface width of 24 to 32 feet and an average thickness of 7 feet with 2:1 side slopes; includes water source and airstrip access roads
Vehicle turnouts (8 total)	3.0	32,000	Gravel	Eight subsistence tundra access road pullouts (one located every 2.5 to 3.0 miles) with an average thickness of 7 feet
CFWR perimeter berm	3.9	25,000	Overburden	Constructed from overburden material excavated during construction of the freshwater reservoir; based on an average thickness of 7 feet with 2:1 side slopes
CFWR perimeter berm	0.0	6,000	Gravel	Capping material for the overburden perimeter berm
Mine site perimeter berm[b]	30.3	292,000	Overburden	Based on a minimum 5-foot thickness with 3:1 side slopes
Oliktok Dock upgrades	0.0	5,200	Gravel	All gravel would be placed within the existing developed footprint
Ublutuoch (Tiŋmiaqsiuġvik) River boat ramp and access road	1.8	20,000	Gravel	Boat ramp and 0.1-mile-long access road from the GMT-1 access road
Judy (Iqalliqpik) Creek boat ramp and access road	2.0	20,000	Gravel	Boat ramp and 0.1-mile-long access road from the drill site BT1 access road

Component	Footprint (acres)[a]	Fill Quantity (cubic yards)[a]	Fill Type	Notes and Assumptions
Fish Creek Boat ramp and access road	2.1	21,000	Gravel	Boat ramp and 0.1-mile-long access road from the drill site BT4 access road
Total[c]	**484.0**	**5,214,200**	**NA**	**NA**

Note: 2:1 (2 horizontal to 1 vertical ratio); 3:1 (3 horizontal to 1 vertical ration); CFWR (constructed freshwater reservoir); CPF2 (Kuparuk CPF2); GMT-1 (Greater Mooses Tooth 1); NA (not applicable).
[a] Values are approximate and are subject to change.
[b] In the Final Environmental Impact Statement (BLM 2020), the mine site perimeter berms were included in the total disturbance footprint but not in the table of fill quantities.
[c] Values may not total due to rounding; 4,897,200 cubic yards of gravel fill and 317,000 cubic yards of overburden fill.

4.3.7 Spill Prevention and Response

Spill prevention and response would be consistent with prevention measures and response procedures described in Section 4.2.8, *Spill Prevention and Response*. The WOC would provide a centralized facility to support Project drill sites in a variety of ways, including equipment, personnel, and other support materials, to respond to potential emergencies. Under Alternative B, CPAI would conduct regular ground-based visual inspections of facilities and pipelines, including the Willow Pipeline (oil export) and seawater pipeline from the WPF to GMT-2 from proposed gravel roads. The gravel road connection to the GMT development would also facilitate faster emergency response times to GMT-2 and GMT-1, as emergency response equipment at the Alternative B WOC would be closer to GMT-2 than the existing ACF.

4.3.8 Schedule and Logistics

Detailed schedule and logistics information is provided in Section 4.2.10, *Schedule and Logistics*. Figure D.4.14 provides an estimated general schedule for key construction, drilling, and operations milestones, subject to the qualifications described in Section 4.2.10. Production from BT1, BT2, and BT3 would begin in Year 6. Production from BT4 could begin as early as Year 9 and from BT5 as early as Year 10. The schedule presented in Figure D.4.14 may be modified as detailed design progresses or as circumstances require.

4.3.9 Project Infrastructure in Special Areas

As described in Section 4.2.11, *Project Infrastructure in Special Areas*, Alternative B would include 1.0 mile of road (8.1 acres) and 1.4 miles of pipelines within the CRSA just southwest of GMT-2. Approximately 106.3 acres of the Project, including BT2 and BT4 and their associated roads (10.8 miles), 11.4 miles of pipeline, and the Fish Creek boat ramp would be located within the TLSA. As described in Section 4.2.11, *Project Infrastructure in Special Areas*, these special area designations allow for oil and gas development in these areas (BLM 2008a, 2013).

4.3.10 Compliance with Required Operating Procedures*

As described in Section 4.2.12, Alternative B would require exceptions to existing LSs and ROPs, including LSs K-1 and K-2 and ROPs A-5, B-2, E-2, E-7, and E-11 under the NPR-A IAP (BLM 2022). Exceptions for the following LSs and ROPs would be required for Alternative B:

- ROP A-5: Exceptions may be required to support refueling and fuel storage for marine vessels and large equipment that is not readily moveable (e.g., drill rigs, cranes) during construction. (Specific waterbodies where exceptions may be required have not yet been identified.)
- ROP B-2: Exceptions may be requested to allow for ice aggregate collection from waterbodies with bedfast ice that would exceed regulatory withdrawal limits for liquid water and ice aggregate. Removal of water as ice from areas with grounded ice would not reduce the quantity of potential resistant overwintering fish habitat. Exception requests would not exceed ADNR water withdrawal criteria which ensure that recharge will occur each spring. (Specific waterbodies where exceptions may be required have not yet been identified.)
- ROP E-2: Alternative B would include essential road and pipeline crossings of fish-bearing waterbodies and freshwater access infrastructure within 500 feet of fish bearing lakes (0.2 mile of gravel road, 1.7 miles of pipelines, and 2.2 acres of gravel infrastructure).
- ROP E-7: Alternative B would include a total of 24.0 miles of pipeline located within 500 feet of gravel roads within the NPR-A. This mileage would be spread over several short road-pipeline stretches where separating roads from pipelines may not be feasible, such as within narrow land corridors between lakes or where pipelines and roads converge on a drill pad or near a bridged creek crossing. CPAI would continue to

seek opportunities to avoid placement of pipelines within 500 feet of roads as Project engineering progresses.

- ROP E-11: Alternative B would include 10.8 acres of proposed gravel footprint and 1.7 miles of pipeline within 0.5 mile of an observed yellow-billed loon nest and 52.7 acres of gravel footprint and 7.6 miles of pipelines within 1,625 feet of an occupied lake shoreline in the NPR-A.
- LS K-1: Alternative B would include essential road and pipeline crossings of Judy (Kayyaaq) Creek and Fish Creek, including valve pads and boat ramps. Alternative B would require exceptions for 18.7 acres of gravel infrastructure and 6.2 miles of pipelines within the Judy (Kayyaaq) Creek setback, and 12.2 acres of gravel infrastructure and 1.6 miles of pipelines within the Fish Creek setback.
- LS K-2: Alternative B would include a CFWR and associated water source access infrastructure within 0.25 mile of Lake M0015, an identified deepwater lake, which would require 3.2 acres of gravel infrastructure and 15.8 acres of excavation.

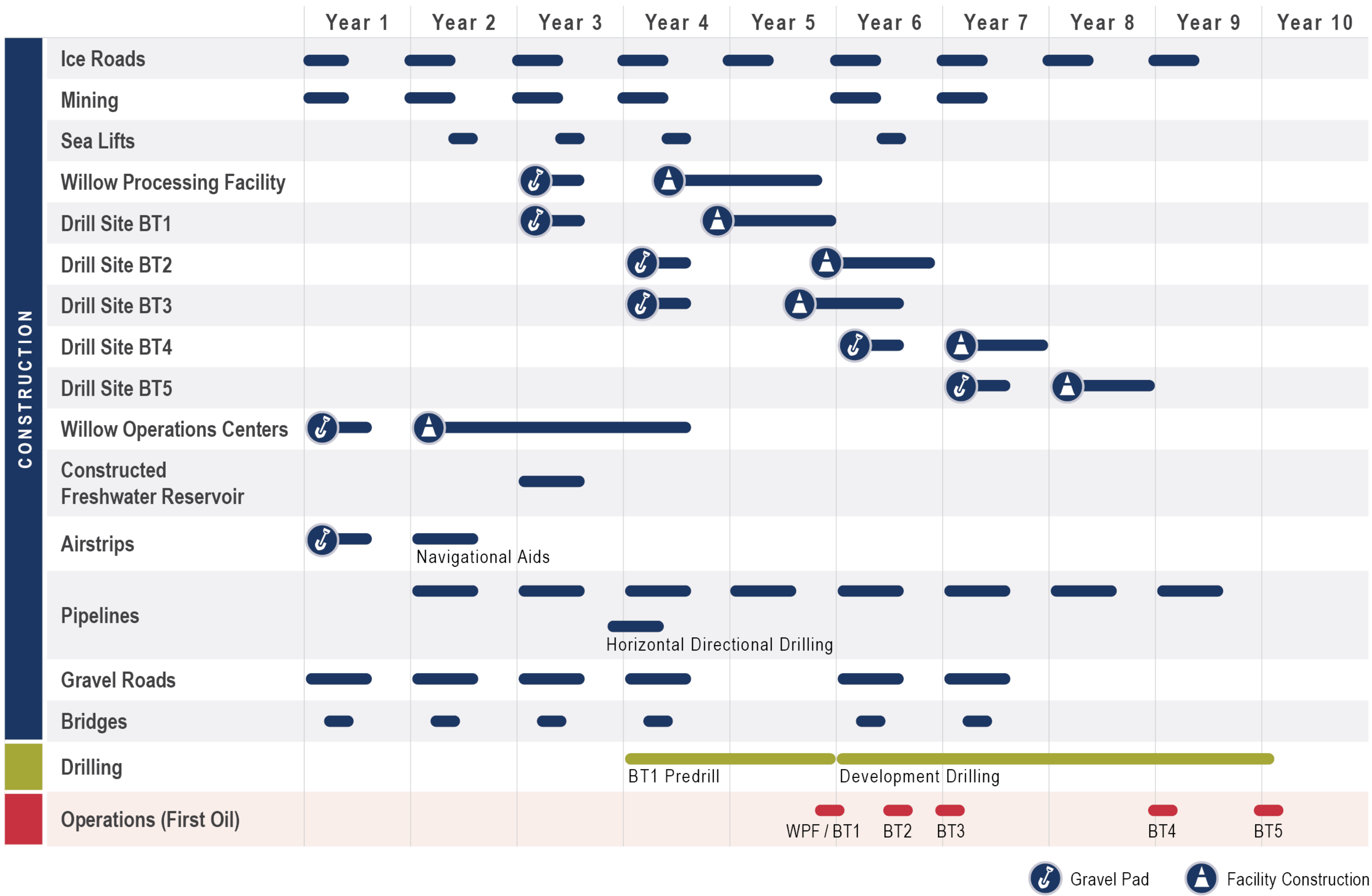
When exceptions are granted, they are typically specified to stated Project actions or locations and are not granted for all project actions. BLM may not approve an exception that does not meet the objective of the LS or ROP. Exceptions from LSs and ROPs anticipated for Alternative B are described in more detail in Table D.4.11, Section 4.2.12, *Compliance with Bureau of Land Management Lease Stipulations, Required Operating Procedures, and Supplemental Practices*.

4.3.11 Boat Ramps for Subsistence Users

CPAI would construct up to three boat ramps (Figures D.4.1 and D.4.12) for subsistence use as part of its effort to mitigate Project effects on the community of Nuiqsut (Section 4.2.13, *Boat Ramps for Subsistence Users*) under Alternative B. The three boat ramps would be constructed at the following locations:

- Ublutuoch (Tiŋmiaqsiuġvik) River, along the existing gravel road between Alpine CD5 and GMT-1
- Judy (Iqalliqpik) Creek, near the proposed bridge crossing
- Fish Creek, near the proposed bridge crossing

The three boat ramps would have a total gravel footprint of 5.9 acres using 61,000 cy of gravel fill.
The Ublutuoch (Tiŋmiaqsiuġvik) River boat ramp would be constructed during the first year of Project construction, and the boat ramps at Judy (Iqalliqpik) Creek and Fish Creek would be constructed within 2 years of constructing the BT1 and BT4 access roads, respectively, after site visits and input from local stakeholders.



Notes: BT1/2/3/4/5 (Bear Tooth drill sites 1/2/3/4/5); WPF (Willow Processing Facility)

Figure D.4.14. Alternative B Estimated General Schedule

4.4 Alternative C: Disconnected Infield Roads

Alternative C would have the same gravel access road between GMT-2 and the Project area as Alternative B, but it would disconnect gravel road access between the WPF to BT1 (Figure D.4.2). Thus, there would be no gravel road between the two facilities or a bridge across Judy (Iqalliqpik) Creek; however, a gravel road would connect BT1 with BT2, BT4, and additional support infrastructure. A second airstrip, storage and staging facilities, and a WOC would be located west of BT2 to accommodate the movement of personnel and materials between the South WOC and the North WOC and BT1/BT2/BT4. A 3.6-mile-long annual ice road would be constructed along the Alternative B gravel road alignment for the life of the Project to allow for the movement of large equipment and consumable materials to BT1/BT2/BT4.

Additional Project infrastructure and facilities would include six bridges, four valve pads (two would be sized to be helicopter accessible at Judy [Iqalliqpik] Creek), four pipeline pads, CFWR, three water source access pads (at the CFWR and Lakes L9911 and M0235, eight road turnouts (with subsistence access ramps), HDD pipeline pads at the Colville River, and one boat ramp along the Ublutuoch (Tiŋmiaqsiuġvik) River. Infield pipelines would connect all drill sites to the WPF. Import and export pipelines would connect BT1, BT2, and BT4 to the WPF and would connect the WPF to existing infrastructure on the North Slope. Diesel and seawater pipelines would extend from Kuparuk CPF2 to the Project area.

Under Alternative C, the WPF, South WOC, and primary Project airstrip would be located similarly to their locations in Alternative B, near the GMT and BT Unit boundaries. Alternative C (unlike Alternative B) would require a diesel pipeline connection from Kuparuk CPF2 to Alpine to the Project area due to the need to regularly supply fuel to the three disconnected drill sites; piped diesel fuel would be made available to support the Project at the WPF and South and North WOCs.

Sealift module delivery to the Project area would be required under Alternative C (Section 4.8, *Sealift Module Delivery Options*).

The intent of this alternative is to reduce effects to caribou movement and decrease the number of stream crossings required; this is also intended to further reduce impacts to subsistence users of these resources. This alternative would remove a portion of the road (versus Alternative B) that crosses Judy (Iqalliqpik) Creek, which could impede caribou movement across linear features (i.e., this alternative would avoid the junction of two roads, which could be a pinch point that deflects caribou movement). This alternative would also reduce linear infrastructure in the Project area, which would reduce some impacts to hydrology (e.g., sheet flow) and wetlands (e.g., direct fill, fugitive dust). The alternative would reduce summer ground traffic but would increase air traffic (versus Alternative B).

Table D.4.21 provides a summary of Project components and their associated impacts for Alternative C.

Table D.4.21. Summary of Components for Alternative C: Disconnected Infield Roads

Project Component	Description
Drill site gravel pads	Five (88.3 acres total): BT1 (23.3 acres), BT2 (18.1 acres), BT3 (17.0 acres), BT4 (15.5 acres), and BT5 (14.4 acres)
WPF gravel pad	22.8-acre pad located near the South Airstrip
WOC gravel pads	Two WOC pads (50.2 acres total): South WOC (33.4 acres) North WOC (16.8 acres)
Water source access gravel pads	Three water source access pads (3.9 acres total) at the CFWR (1.3 acres), Lake L9911 (1.3 acres), and Lake M0235 (1.3 acres)
CFWR	16.4-acre excavation (reservoir and connecting channel) and 3.9-acre perimeter berm
Other gravel pads	Four valve pads (1.7 acres total); two helicopter-accessible pads at Judy (Iqalliqpik) Creek pipeline crossing (1.1 acres) and two pads at Fish Creek pipeline crossing (0.6 acre) HDD Pipeline pads (two total) at Colville River crossing (1.5 acres total) Tie-in pad near Alpine CD4N (0.7 acre total) Pipeline crossing pad near GMT-2 (0.5 acre total) Kuparuk CPF2 pad expansion (1.0 acre) Communications tower pad (0.5 acre)
Single season ice pads	Used during construction at the gravel mine site, bridge crossings, the Colville River HDD crossing, and other locations as needed in the Project area (1,166.4 total acres)

Project Component	Description
Multi-season ice pads	10.0-acre multi-season ice pad near GMT-2 (Q1 Year 1 to Q2 Year 2, Q1 Year 2 to Q2 Year 3, Q1 Year 3 to Q2 Year 4, and Q1 Year 4 to Q2 Year 5) 10.0-acre multi-season ice pad near the South WOC (Q1 Year 1 to Q2 Year 2) 10.0-acre multi-season ice pad at the Tiŋmiaqsiuġvik Gravel Mine Site (Q1 Year 1 to Q2 Year 3)
Infield pipelines	47.0 total miles (on new VSMs): BT1 to WPF (6.0 miles); BT2 to BT1 (4.5 miles); BT3 to WPF (5.9 miles); BT4 to BT2 (9.9 miles); BT5 to WPF (11.5 miles); and GMT-2 to WPF (9.2 miles)
Willow export pipeline	32.2 total miles (WPF to tie-in pad near Alpine CD4N)
Other pipelines	63.3-mile seawater pipeline from Kuparuk CPF2 to WPF; includes Colville River HDD crossing 82.0-mile diesel pipeline from Kuparuk CPF2 to South WOC to WPF to North WOC; includes Colville River HDD crossing 1.7-mile fuel gas pipeline (WPF to South WOC) 5.6-mile freshwater pipeline (CFWR to WPF to South WOC) 12.9-mile treated water pipeline (South WOC to WPF to North WOC)
Gravel roads	35.4 miles (240.6 acres, including vehicle turnouts) total connecting: BT5, BT3, CFWR, South Airstrip access road, South WOC to WPF; and WPF to GMT-2 BT1, BT2, and BT4, water source access road, North Airstrip access road, and the North WOC Eight vehicle turnouts with subsistence tundra access ramps (3.0 acres total)
Bridges	Six total: at Judy (Kayyaaq) Creek, Fish Creek, Willow Creek 2, Willow Creek 4, Willow Creek 4A, and Willow Creek 8
Airstrips	Two airstrips (87.6 acres total) North Airstrip: 5,700 × 200–foot airstrip and apron (43.8 acres); would also require airstrip access road South Airstrip: 5,700 × 200–foot airstrip and apron (43.8 acres); would also require airstrip access road
Subsistence boat ramp	1.8 acres at Ublutuoch (Tiŋmiaqsiuġvik) River
Oliktok Dock modifications	Modifications to the existing dock include adding structural components and a gravel ramp within the existing developed footprint 2.5 acres of screeding at Oliktok Dock 9.6 acres of screeding at the barge lightering area
Ice roads	Approximately 650.1 total miles (4,411.6 total acres): 574.5 miles (4,090.3 acres) over nine construction seasons (Year 1 to Year 9) 3.6 miles (15.3 acres) of an annual resupply ice road (Year 10 to Year 30; 75.6 total miles; 321.3 total acres)
Total footprint and gravel fill volume[a]	545.9-acre gravel footprint using 5.8 million cy of gravel fill and 387,000 cy of native fill 189.8-acre gravel mine site excavation 16.4-acre excavation at the CFWR 12.1-acre screeding area
Gravel source	Two mine site cells (189.8 total acres) in Tiŋmiaqsiuġvik area (Mine Site Area 1 would be 109.3 acres and Mine Site Area 2 would be 80.5 acres)
Total freshwater use	1,914.3 million gallons over the life of the Project (30 years)
Ground traffic (number of trips)[b,c]	4,212,510
Fixed-wing air traffic[b,d]	19,574 total flights South Willow: 13,201 North Willow: 6,081 Alpine: 292
Helicopter air traffic[b]	2,910 total flights South Willow: 2,421 North Willow: 357 Alpine: 132
Marine traffic (number of trips)[b,e]	319 total trips Sealift barges: 24 Tugboats: 37 Support vessels: 258
Infrastructure in special areas	Teshekpuk Lake Special Area: 179.6 acres of gravel road and gravel pads; 12.5 miles of pipeline Colville River Special Area: 1.0 mile of gravel road; 8.1 acres of gravel infrastructure; and 1.4 miles of pipelines

Project Component	Description
Fish-bearing waterbody setback overlap (ROP E-2)	4.0 acres of gravel footprint, 0.2 mile of gravel road, and 1.9 mile of pipelines
Less than 500-foot pipeline-road separation (ROP E-7)	22.7 miles of pipelines with less than 500 feet of separation
Yellow-billed loon setback overlap (ROP E-11)	3.8 acres of gravel infrastructure and 1.7 miles of pipelines within 0.5 mile of a nest 44.4 acres of gravel infrastructure and 7.5 miles of pipelines within 1,625 feet of occupied lakes
River setback overlap (LS K-1)	Colville River: 0.0 acres of gravel infrastructure and 0.0 miles of pipelines Fish Creek: 12.9 acres of gravel infrastructure and 1.5 miles of pipelines Judy (Kayyaaq) Creek: 1.1 acres of gravel infrastructure and 6.2 miles of pipelines
Deepwater lake setback overlap (LS K-2)	3.2 acres of gravel infrastructure and 0.0 mile of pipelines; 14.5 acres of the constructed freshwater reservoir would be within the setback and 1.4 acres of the reservoir connection would be within the lake

Note: BT1 (Bear Tooth drill site 1); BT2 (Bear Tooth drill site 2); BT3 (Bear Tooth drill site 3); BT4 (Bear Tooth drill site 4); BT5 (Bear Tooth drill site 5); CFWR (constructed freshwater reservoir); cy (cubic yards); GMT-2 (Greater Mooses Tooth 2); HDD (horizontal directional drilling); LS (lease stipulation); Q1 (first quarter); Q2 (second quarter); ROP (required operating procedure); VSM (vertical support member); WPF (Willow Processing Facility); WOC (Willow Operations Center).
[a] Values may not sum to totals due to rounding.
[b] Total traffic for the 30-year life of the Project (not including reclamation activity). Ground traffic trips are one-way; a single flight is defined as a landing and subsequent takeoff; and a vessel trip is defined as a docking and subsequent departure.
[c] Number of trips includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Construction ground traffic also includes gravel hauling (e.g., B-70/Maxi Haul dump trucks).
[d] Flights outlined are additional flights required beyond projected travel to/from non-Project airstrips (e.g., Anchorage, Fairbanks, Deadhorse); includes Q400, C-130, Twin Otter/CASA, Cessna, and DC-6 or similar aircraft.
[e] Includes crew bats, tugboats supporting sealift barges, screeding barges, and other support vessels.

4.4.1 Project Facilities and Gravel Pads

Project facilities proposed for the WPF, drill sites, and South WOC for Alternative C are described in Section 4.2.1, *Project Facilities and Gravel Pads*. Under Alternative C, the WPF and South WOC would be located near the east end of the Project area along the BT Unit and GMT Unit boundary, approximately 5 miles northeast of BT3 and 8 miles from GMT-2.

Due to the disconnected drill sites (BT1, BT2, and BT4) under this alternative (i.e., no gravel road connection to the remaining Project area or Alpine), additional equipment and facilities would be required, including a second WOC (North WOC) to accommodate equipment storage, shop space, and a camp serving BT1, BT2, and BT4 (Figure D.4.2). The North WOC would include facilities and associated infrastructure similar to the South WOC (Section 4.2.1.3, *Willow Operations Center*). Additional facilities required due to the disconnected gravel infield road would include the following:

- Three Class I UIC disposal wells at the North WOC, in addition to two Class I UIC disposal wells at the South WOC; disposal wells would accommodate drilling, wastewater, and grind and inject materials from the northern drill sites.
- The North WOC would include a grind and inject facility, a mud plant, and additional maintenance shops.
- BT1 and BT2 would be larger under Alternative C to accommodate additional storage, equipment laydown, and a wire coil maintenance shop.
- The pipeline valve pads at Judy (Iqalliqpik) Creek would be helicopter accessible due to there being no road connection at this location, making them larger at 1.1 total acres (versus the Alternatives B and C 0.7-acre valve pads at this creek crossing).

The South WOC would not include a mud plant to avoid construction of two mud plants for the Project; instead, muds for the southern drill sites would be trucked to and from Alpine. Additional storage space would be required at the WPF for cuttings prior to being hauled to Alpine for disposal.

In addition to the CFWR, Alternative C would construct water source access gravel roads and pads to Lake L9911 (near GMT-2) and Lake M0235 (near the North WOC) (Figure D.4.2)

4.4.2 Pipelines

Alternative C pipelines (Figure D.4.15) would include infield pipelines connecting each drill site to the WPF and the Willow Pipeline (oil export) connecting the WPF to existing facilities at Alpine. Additional pipelines would include seawater import pipelines from Kuparuk CPF2 to the WPF and a diesel import pipeline from Kuparuk CPF2 to the South WOC and WPF. Alternative C would also extend a diesel pipeline from the WPF to the North WOC. A freshwater pipeline would connect the CFWR to the South WOC and WPF, and a treated freshwater pipeline would connect the WPF to the North WOC. A fuel gas pipeline would connect the WPF with the South WOC.

All pipelines would parallel gravel roads to facilitate routine visual observation and investigation of pipelines, except the infield pipelines along the ice road-only segment (approximately 4 miles) between the WPF and BT1, including the Judy (Iqalliqpik) Creek crossing. The absence of a parallel gravel road would result in the following changes from Alternative B:

- The infield pipelines crossing Judy (Iqalliqpik) Creek would not be attached to a bridge but would instead require the placement of 10 VSMs below OHW.
- Pipeline valve pads at Judy (Iqalliqpik) Creek would be helicopter accessible (1.1 total acres).
- The infield pipeline segment would not allow for daily visual inspection, although routine observation and investigation of pipelines would occur as part of CPAI's operational practices, as well as be in compliance with regulatory requirements for pipeline inspection.
- Increased air traffic (number and frequency) due to the need to visually inspect pipelines.

Alternative C would require approximately 13,000 total VSMs with an estimated 0.8-acre total disturbance footprint. Alternative C would also include 12 additional VSMs installed below OHW at crossings east of the NPR-A boundary (i.e., the west bank of the Niġliq Channel). All VSMs would be installed using the drill-set-slurry method. Pipeline design would be as described in Section 4.2.2, *Pipelines*.

From the WPF, the Willow Pipeline (oil export), seawater pipeline, and diesel pipeline would be located on a single set of new VSMs to Alpine CD4N; from Alpine CD4N to Kuparuk CPF2, the seawater and diesel pipelines would be placed on new VSMs, as described in Section 4.2.2. The diesel pipeline would be placed on existing VSMs from Alpine CD4N to the ACF, located at Alpine CD1. In total, 383.7 miles of pipeline would be constructed with 377.5 miles of pipelines on new VSMs (approximately 98.4%) and 6.2 miles of pipelines on existing VSMs (approximately 1.6%) using 98.5 miles of new and existing pipeline corridors. Infield pipelines would connect each drill site to the WPF. Where practicable, infield pipelines would tie into other infield pipelines (Section 4.2.2.1, *Infield Pipelines*) to minimize redundant parallel pipelines.

Table D.4.22 summarizes pipeline infrastructure under Alternative C by pipeline segment.

Table D.4.22. Alternative C Pipeline Segments Summary

Pipeline	Pipeline Segment	Segment Length (miles)	Notes
BT4 infield[a]	BT4 to BT2	9.9	Pipelines on new set of VSMs
BT2 infield[a]	BT2 to BT1	4.5	Pipelines on new set of VSMs; would also transport BT4 materials
BT1 infield[a]	BT1 to WPF	6.0	Pipelines on new set of VSMs; would also transport BT4 and BT2 materials; would require 10 VSMs below ordinary high water at Judy (Iqalliqpik) Creek crossing
BT3 infield[a]	BT3 to WPF	5.9	Pipelines on new set of VSMs
BT5 infield[a]	BT5 to WPF	11.5	Pipelines on new set of VSMs; would share VSMs with BT3 infield pipeline from the BT5 junction to the WPF (4.6 miles)
GMT-2 infield[a]	GMT-2 to WPF	9.2	Would share new VSMs with Willow export, diesel, and seawater pipelines from GMT-2 to the WPF (9.1 miles)
Freshwater	CFWR to WPF to South WOC	5.6	Would share new VSMs with BT3 infield pipelines from the CFWR pipeline junction to the WPF (3.4 miles) and treated water, fuel gas, and diesel pipelines from the WPF to the South WOC (1.7 miles)
Treated water	South WOC to WPF to North WOC	12.9	Would share new VSMs with freshwater, fuel gas, and diesel pipelines from the South WOC to the WPF (1.7 miles) and the BT1 and BT2 infield pipelines from the WPF to the BT2 pipeline junction (10.4 miles)
Fuel gas	WPF to South WOC	1.7	Would share new VSMs with freshwater and treated water pipelines from the WPF to the WOC (1.7 miles)
Willow export	WPF to CD4N tie-in pad	32.2	Would share new VSMs with seawater and diesel pipelines from the WPF to the CD4N tie-in pad (31.9 miles)

Pipeline	Pipeline Segment	Segment Length (miles)	Notes
Seawater	CPF2 to WPF	63.3	Would share new VSMs with the Willow export and diesel pipelines from the WPF to the Alpine CD4N tie-in pad and CPF2 (63.3 miles); includes a new HDD crossing of the Colville River
Diesel	CPF2 to CD1 to South WOC to WPF to North WOC	82.0	Would share new VSMs with the seawater pipeline from CPF2 to the South WOC pipeline junction; would share new VSMs with the freshwater, fuel gas, and treated water pipeline from the South WOC pipeline junction to the WPF (2.4 miles); would share new VSMs with BT1 and BT2 infield and treated water pipelines from the WPF to the BT2 pipeline junction (10.4 miles); would use existing VSMs from CD4N to CD1 (6.2 miles); would include a new HDD crossing of the Colville River

Note: BT1 (Bear Tooth drill site 1); BT2 (Bear Tooth drill site 2); BT3 (Bear Tooth drill site 3); BT4 (Bear Tooth drill site 4); BT5 (Bear Tooth drill site 5); CD1 (Alpine CD1); CD4N (Alpine CD4N); CFWR (constructed freshwater reservoir); CPF2 (Kuparuk CPF2); GMT-2 (Greater Mooses Tooth 2); HDD (horizontal directional drilling); VSM (vertical support member); WOC (Willow Operations Center); WPF (Willow Processing Facility).

[a] Infield pipelines include produced fluids, injection water, gas, and miscible-injectant pipelines.

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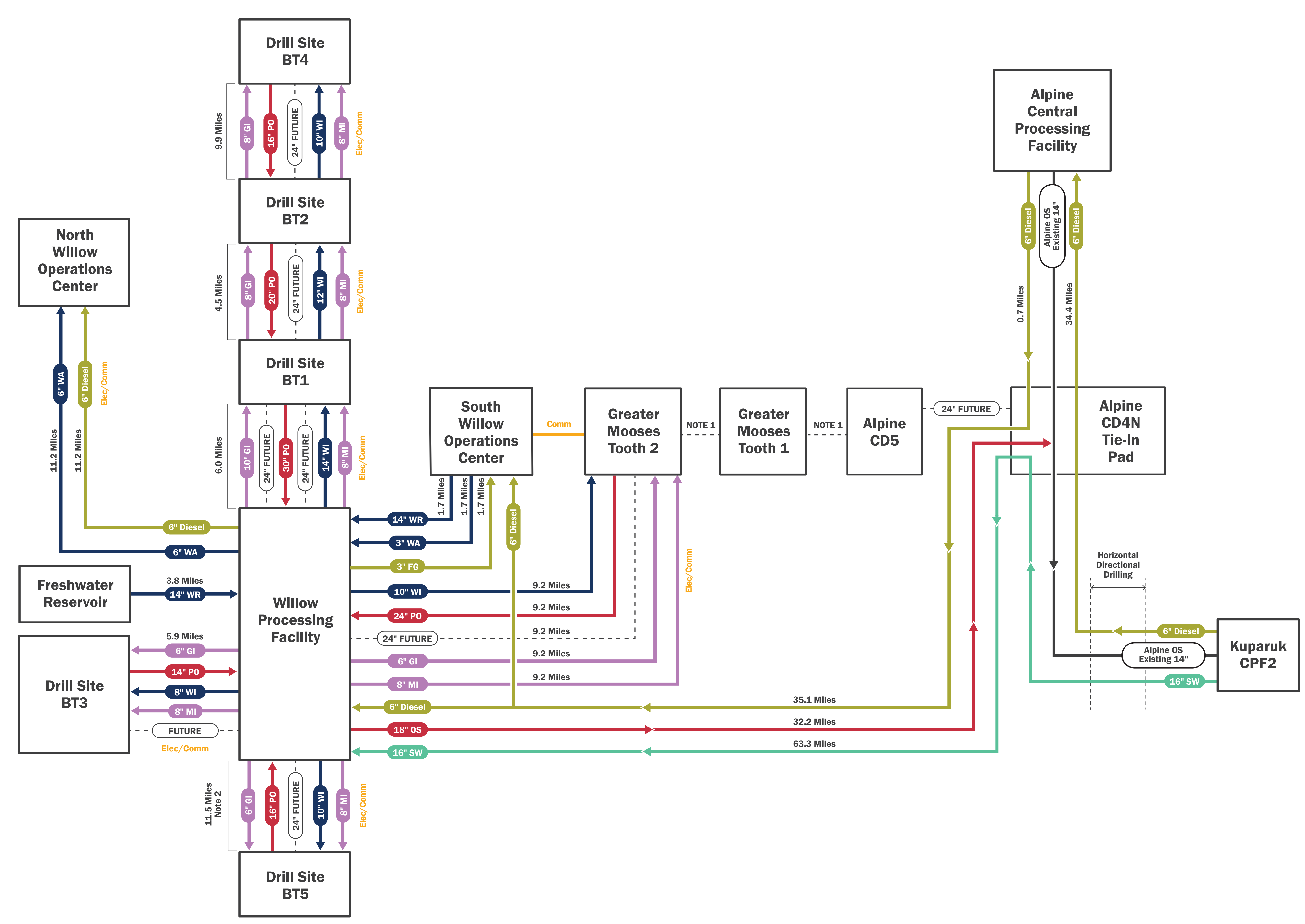

Legend

Elec/Comm	34.5kV Power and Communications Cables
Diesel	Diesel
FG	Fuel Gas
GI	Gas Injection
MI	Miscible Injection
PO	Production Oil
OS	Sales Oil
SW	Seawater
WA	Water Fresh
WF	Fire Protection Water
WI	Injection Water
WP	Potable Water
WR	Raw Water

Notes

1. Alignment contains one empty pipeline slot on pipe supports.
2. Pipeline size, service, and length is assumed at this time.

Figure D.4.15

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4.4.3 Access to the Project Area

Alternative C would include barge delivery of small modules and bulk construction materials to Oliktok Dock and seasonal ice road access to support construction; access to BT1, BT3, the WPF, and the South WOC via all-season gravel road from the GMT and Alpine developments; seasonal access (ice road) to BT1, BT2, BT4, and the North WOC; and helicopter and fixed-wing aircraft to the Project (North and South Airstrips) and Alpine airstrip.

Table D.4.23 provides a summary of total traffic volumes anticipated for the Project under Alternative C by transportation type and year; Table D.4.24 provides a detailed traffic breakdown by season.

Alternative C would have a total of 19,574 fixed-wing flights (including landings and departures at Alpine and the North and South Airstrips), 2,910 helicopter flights (including landings and departures at Alpine and the North and South Airstrips), and 24 barge and 37 tugboat trips from Dutch Harbor to Oliktok Dock.

During construction, approximately 574.5 miles of ice roads would be constructed to support Project pipeline, gravel pad and gravel road construction, and gravel source (Tiŋmiaqsiuġvik Gravel Mine Site) access over nine winter construction seasons (Table D.4.3). During drilling and operations, planned ice road use would be limited to drill rig mobilization and an annual resupply 3.6-mile road connection to BT1, BT2, and BT4 for the life of the Project. Approximately 75.6 total miles of annual ice road would be constructed through Project Year 30, for a total of 650.1 miles of ice road over the life of the Project (30 years). (The Project would also use the annual resupply ice road between Alpine and Kuparuk. This ice road mileage is not included in the Project's analyses as it would be constructed regardless in support of Alpine.) Ice road design and mileage is described in Section 4.2.3.1, *Ice Roads*.

Gravel roads would provide year-round access between the GMT and Alpine developments and the southern Project area (e.g., WPF, South WOC, BT3, BT5, and CFWR). An additional gravel road would connect BT1, BT2, BT4, the North WOC, and the North Airstrip with each other, but not the rest of the Project area. Alternative C gravel roads would require the construction of six bridges (Table D.4.25) following the design described in Section 4.2.3.2.1, *Bridges*. Two of the six bridges would require the placement of 20 total piles (48 inches in diameter) below OHW. Alternative C would also require 10 additional culverts or culvert batteries at swale crossings (Figure D.4.2) and 187 cross-drainage culverts.

Under Alternative C, two airstrips would be constructed: the South Airstrip would serve as the primary Project airstrip and would be located near the WPF and the South WOC (near the boundary between the BT and GMT Units); and the North Airstrip, which would be located near the North WOC and would provide year-round access to BT1, BT2, BT4, and the North WOC (Figure D.4.2). Both airstrips would be larger than the airstrip under Alternative B (43.8 acres versus Alternative B's 42.2 acres) to provide more apron space to accommodate additional fuel storage, parking space for multiple aircraft, and space for solid waste storage prior to air transport for disposal off-site.

The South Airstrip would be started in the winter construction season of Year 1 and completed in Year 2; the North Airstrip would be started in the winter construction season of Year 3 and completed in Year 4. Prior to Project airstrip availability, the Alpine airstrip (located at Alpine CD1) would be used to support the Project.

Helicopters would be used during the Project's construction phase to support ice road construction, environmental monitoring, and surveying. Following the construction of gravel roads and during the drilling and operations phases, helicopter use to support the Project would primarily be limited to ongoing environmental monitoring and spill response support.

Table D.4.23. Alternative C Total Project Traffic Volumes Summary for the Life of the Project (number of trips)

Year	Ground[a]	Fixed-Wing Trips Alpine[b]	Fixed-Wing Trips South Willow[b]	Fixed-Wing Trips North Willow[b]	Helicopter Trips Alpine[c]	Helicopter Trips South Willow[c]	Helicopter Trips North Willow[c]	Barges to Oliktok Dock[e]	Tugboats to Oliktok Dock[f]	Support Vessels to Oliktok Dock[g]
Year 0	0	0	0	0	25	0	0	0	0	0
Year 1	55,300	60	0	0	50	0	0	0	0	0
Year 2	138,650	122	31	0	57	57	0	6	9	66
Year 3	309,730	75	196	0	0	145	0	8	12	88
Year 4	402,250	35	558	440	0	145	0	5	8	52
Year 5	490,860	0	1,121	1,230	0	87	58	0	0	0
Year 6	204,740	0	1,017	1,009	0	94	40	5	8	52
Year 7	308,390	0	1,124	675	0	116	29	0	0	0
Year 8	311,140	0	693	672	0	116	29	0	0	0
Year 9	250,760	0	691	186	0	107	12	0	0	0
Year 10	82,890	0	370	89	0	74	9	0	0	0
Year 11–Year 30	1,657,800	0	7,400	1,780	0	1,480	180	0	0	0
Total	**4,212,510**	**292**	**13,201**	**6,081**	**132**	**2,421**	**357**	**24**	**37**	**258**

Note: Ground trips are defined as one-way; a single fixed-wing or helicopter flight is defined as a landing and subsequent takeoff; and a single vessel trip is defined as a docking and subsequent departure.

[a] Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B-70/Maxi Haul dump trucks).

[b] Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse).

[c] Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Cessna, or similar.

[d] Typical helicopters include A-Star and 206 Long Ranger models, although other similar types of helicopters may be used. Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all Project phases. Helicopter flights in Year 0 would occur in the fourth quarter and would support the start of Project construction in the first quarter of Year 1. Note: Helicopter flights within the NPR-A are authorized under approved right-of-way FF097411 valid through December 31, 2023.

[e] Includes sealift barges for bulk materials and small modules.

[f] Includes tugboats accompanying sealift barges.

[g] Includes crew boats, screeding barge, and other support vessels.

Table D.4.24. Alternative C Detailed Project Ground and Aircraft Traffic Volumes by Season for the Life of the Project (number of trips)

Season and Year	Ground[a]	Fixed Wing to Alpine[b]	Fixed Wing to South Willow[b]	Fixed Wing to North Willow[b]	Alpine Helicopter[c]	Willow South Helicopter[c]	Willow North Helicopter[c]
Summer Year 0 (total)	0	0	0	0	25	0	0
Winter Year 1 (total)	33,180	36	0	0	0	0	0
Spring Year 1 (total)	11,060	12	0	0	12	0	0
Summer Year 1 (total)	11,060	12	0	0	38	0	0
Fall Year 1 (total)	0	0	0	0	0	0	0
Winter Year 2(total)	92,781	81	0	0	0	0	0
Spring Year 2 (total)	31,829	28	0	0	57	0	0
Summer Year 2 (total)	11,327	10	8	0	0	57	0
Fall Year 2 (total)	1,680	2	16	0	0	0	0
Winter Year 3 (total)	209,754	52	139	0	0	0	0
Spring Year 3 (total)	71,461	17	45	0	0	45	0
Summer Year 3 (total)	23,872	6	16	0	0	100	0
Fall Year 3 (total)	3,646	0	2	0	0	0	0
Winter Year 4 (total)	245,327	21	340	0	0	0	0
Spring Year 4 (total)	89,211	8	124	46	0	45	0
Summer Year 4 (total)	45,389	4	63	256	0	100	0
Fall Year 4 (total)	16,086	2	22	92	0	0	0
Winter Year 5 (total)	311,229	1	704	805	0	0	0
Spring Year 5 (total)	110,604	0	253	277	0	27	14
Summer Year 5 (total)	46,748	0	111	118	0	60	44
Fall Year 5 (total)	19,084	0	44	50	0	0	0
Winter Year 6 (total)	118,360	0	562	561	0	0	0
Spring Year 6 (total)	43,395	0	216	214	0	31	10
Summer Year 6 (total)	31,146	0	155	154	0	63	30
Fall Year 6 (total)	14,244	0	71	70	0	0	0
Winter Year 7 (total)	198,885	0	734	455	0	0	0
Spring Year 7 (total)	69,479	0	253	152	0	39	7
Summer Year 7 (total)	30,482	0	111	67	0	77	22
Fall Year 7 (total)	11,115	0	41	24	0	0	0
Winter Year 8 (total)	197,444	0	448	427	0	0	0
Spring Year 8 (total)	70,082	0	156	151	0	39	7
Summer Year 8 (total)	31,059	0	69	67	0	77	22
Fall Year 8 (total)	12,240	0	27	26	0	0	0
Winter Year 9 (total)	135,644	0	370	108	0	0	0
Spring Year 9 (total)	52,597	0	145	39	0	35	0
Summer Year 9 (total)	40,349	0	111	30	0	72	12
Fall Year 9 (total)	18,845	0	52	14	0	0	0
Winter Year 10 (total)	46,723	0	193	47	0	0	0

Season and Year	Ground[a]	Fixed Wing to Alpine[b]	Fixed Wing to South Willow[b]	Fixed Wing to North Willow[b]	Alpine Helicopter[c]	Willow South Helicopter[c]	Willow North Helicopter[c]
Spring Year 10 (total)	16,578	0	74	18	0	22	0
Summer Year 10 (total)	16,578	0	74	18	0	52	9
Fall Year 10 (total)	8,289	0	37	9	0	0	0
Winter Year 11 – Year 30 (total)	833,045	0	3,719	896	0	0	0
Spring Year 11–Year 30 (total)	331,560	0	1,480	356	0	480	0
Summer Year 11–Year 30 (total)	331,560	0	1,480	356	0	1,000	180
Fall Year 11–Year 30 (total)	165,780	0	740	178	0	0	0
Total[d]	**4,210,808**	**292**	**13,202**	**6,081**	**132**	**2,421**	**357**

Note: Seasons are defined as follows: summer (122 days; June, July, August, September); fall (61 days; October, November); winter (121 days; December, January, February, March); and spring (61 days; April, May). Trips are defined as one-way; a single flight is defined as a landing and subsequent takeoff.

[a] Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B-70/Maxi Haul dump trucks).

[b] Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse). Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Cessna, or similar.

[c] Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all phases of the Project.

[d] Values may not match other summary traffic values presented in the Final EIS due to rounding.

Table D.4.25. Alternative C Bridges Summary

Waterbody Crossing	Bridge Length (± feet)[a]	Piles below Ordinary High Water (number)[b]	Latitude (North)	Longitude (West)
Judy (Kayyaaq) Creek	75	4	70.1848	152.1211
Fish Creek	420	16	70.2526	152.1787
Willow Creek 2	80	0	70.1413	151.9557
Willow Creek 4	130	0	70.0816	152.1302
Willow Creek 4A	50	0	70.0360	152.2015
Willow Creek 8	40	0	70.2635	152.1806

[a] Bridge lengths are approximations based on the interpretation of available aerial imagery and are subject to change.
[b] In-stream pile diameters are assumed to be 48 inches; diameter excludes any potential surface casing required for installation.

Sealift barges would be used to deliver bulk construction materials and small modules to Oliktok Dock to support Project construction (Section 4.2.3.4, *Sealift Barge Delivery to Oliktok Dock*). Additionally, sealift barges would be used to deliver large processing and drill site modules to the North Slope (Section 4.8, *Sealift Module Delivery Options*). No additional or regular use of barges is proposed over the life of the Project following construction.

4.4.4 Other Infrastructure and Utilities

4.4.4.1 Ice Pads

Single- and multi-season ice pads would be used to support Project construction. Single- and multi-season ice pads are described in Section 4.2.4.1, *Ice Pads*.

Alternative C would require 1,166.4 acres of single-season ice pads over the life of the Project (30 years). Additionally, Alternative C would include the use of three multi-season ice pads to support temporary camps and stage equipment and materials, as needed. The following 10.0-acre multi-season ice pads would be constructed under Alternative C:

- Near GMT-2 (Q1 Year 1 to Q2 Year 2, Q1 Year 2 to Q2 Year 3, Q1 Year 3 to Q2 Year 4, and Q1 Year 4 to Q2 Year 5)
- Near the South WOC (Q1 Year 1 to Q2 Year 2)
- At the Tiŋmiaqsiuġvik Gravel Mine Site (Q1 Year 1 to Q2 Year 3)

4.4.4.2 Camps

Table D.4.26 details Alternative C camp requirements to support construction, drilling, and operations.

Table D.4.26. Alternative C Camps Summary

Project Phase	Camp	Location	Capacity	Use Schedule
Construction	Temporary camp	Ice pad near the South WOC	250	Q1 Year 1 to Q4 Year 1
Construction	K-Pad Camp[a]	K-Pad[b]	450	Q1 Year 2 to Q2 Year 5
Construction	Alpine Operations Camp[a]	Alpine central processing facility (at Alpine CD1)[b]	250 to 300	Q1 Year 1 to Q2 Year 4
Construction	Temporary camp[c]	North WOC	250	Q1 Year 2 to Q2 Year 4
Construction	Sharktooth Camp[a]	Kuparuk[b]	220	Q1 Year 2 to Q4 Year 4
Drilling	Drill rig camp(s)	Drill site(s) or WOC (South and/or North)	150	Q1 Year 4 to Q4 Year 9
Construction, operations	South Willow Camp[c]	South WOC	500	Q2 Year 4 to Q4 Year 7
Operations	South Willow Camp[c]	South WOC	200	Q1 Year 8 to Q4 Year 30
Construction, operations	North Willow Camp	North WOC	200	Q3 Year 4 to Q4 Year 8
Operations	North Willow Camp	North WOC	200	Q1 Year 9 to Q4 Year 30

Note: Q1 (first quarter); Q2 (second quarter); Q3 (third quarter); Q4 (fourth quarter); WOC (Willow Operations Center).
[a] Existing camp.
[b] Existing gravel pad.
[c] During construction, up to 60 bed spaces may be used at the existing Kuukpik Hotel in Nuiqsut in lieu of bed spaces identified at or near the South WOC.

4.4.4.3 Utilities, Waste Handling, and Fuel and Chemical Storage

Power generation and distribution, communications, potable water systems and use, domestic wastewater, solid waste, and drilling waste handling, as well as fuel and chemical storage, would be as described in Section 4.2.4, *Other Infrastructure and Utilities*.

4.4.5 Water Sources and Use

As described for all action alternatives in Section 4.2.5, *Water Sources and Use*, freshwater would be needed during construction for domestic use at construction camps, construction and maintenance of ice roads and ice pads, and hydrostatic testing of pipelines. During drilling, freshwater would be required for domestic use at the drill rig camps and to support drilling activities. Water for construction and drilling would be withdrawn from lakes in the Project area. Freshwater for domestic use during operations would be sourced from the CFWR and Lakes L9911 and M0235 using the freshwater intake infrastructure (Section 4.2.4.5, *Potable Water*). Alternative C would also require construction of an annual 3.6-mile-long ice road connecting the north and south portions of the Project area. Anticipated freshwater use for Alternative C is detailed by year and Project phase in Table D.4.27.

Seawater would also be required, as described in Section 4.2.5, and would be sourced from the existing Kuparuk seawater treatment plant and transported via seawater pipeline to the Project area (Section 4.2.2.3, *Other Pipelines*).

Table D.4.27. Alternative C Estimated Freshwater Use by Project Phase and Year (million gallons)

Year (season)	Construction[a]	Drilling[b]	Operations[c]	Total
Year 0–Year 1 (winter)	71.9	0.0	0.0	**71.9**
Year 1 (summer)	1.1	0.0	0.0	**1.1**
Year 1–Year 2 (winter)	130.5	0.0	0.0	**130.5**
Year 2 (summer)	3.2	0.0	0.0	**3.2**
Year 2–Year 3 (winter)	339.3	0.0	0.0	**339.3**
Year 3 (summer)	10.0	0.0	0.0	**10.0**
Year 3–Year 4 (winter)	269.7	21.5	0.0	**291.2**
Year 4 (summer)	12.8	43.0	0.0	**55.8**
Year 4–Year 5 (winter)	188.2	43.9	0.0	**232.1**
Year 5 (summer)	20.0	44.8	0.9	**65.7**
Year 5–Year 6 (winter)	32.5	8.8	1.8	**43.1**
Year 6 (summer)	2.4	8.8	4.3	**15.5**
Year 6–Year 7 (winter)	116.5	8.8	3.2	**128.5**
Year7 (summer)	2.6	8.8	5.1	**16.5**
Year7–Year 8 (winter)	132.3	8.8	4.1	**145.2**
Year 8 (summer)	4.1	8.8	5.1	**18.0**
Year 8–Year 9 (winter)	29.0	8.8	6.7	**44.5**
Year 9 (summer)	2.3	8.8	5.1	**16.2**
Year 9–Year 10 (winter)	0.2	4.4	8.3	**12.9**
Year 10 (summer)	0.0	0.0	5.1	**5.1**
Year 10–Year 11 (winter)	0.0	0.0	8.3	**8.3**
Year 11 (summer)	0.0	0.0	5.1	**5.1**
Year 11–Year 12+ (19 winters)[d]	0.0	0.0	157.7	**157.7**
Year 12+ (19 summers)[e]	0.0	0.0	96.9	**96.9**
Total	**1,368.6**	**228.0**	**317.7**	**1,914.3**

Note: "+" indicates total seasonal use from the indicated year to the end of Project operations (Year 30).

[a] The construction phase would include ice road construction (1.0 million gallons [MG] per mile for a 35-foot-wide road, 1.4 MG per mile for a 50-foot-wide road, and 2.0 MG per mile for a 70-foot-wide road), ice pad construction (0.25 MG per acre), dust suppression, hydrostatic testing, and camp supply (100 gallons per person per day).

[b] The drilling phase would include drilling water (1.4 MG per month per drilling rig prior to Willow Processing Facility startup and 0.4 MG per drill rig per month after facility startup), hydraulic fracturing (1.0 MG per well prior to Willow Processing Facility startup), and camp supply (100 gallons per person per day).

[c] The operations phase would include dust suppression, camp supply (100 gallons per person per day), and an annual ice road (1.0 MG per mile for a 35-foot-wide road).

[d] Annual winter water use for operations would 8.3 MG.

[e] Annual summer water use for operations would be 5.1 MG.

4.4.6 Gravel and Other Fill Requirements

Project roads and pads would be constructed with gravel obtained from the Tiŋmiaqsiuġvik Gravel Mine Site and the perimeter berm surrounding the CFWR would be constructed from material excavated from the reservoir and would be capped in gravel. Table D.4.28 lists the estimated quantity of fill material anticipated for each Project component under Alternative C.

Table D.4.28. Alternative C Estimated Fill Material Requirements by Project Component

Component	Footprint (acres)[a]	Fill Quantity (cubic yards)[a]	Fill Type	Notes and Assumptions
Drill pads (five total)	88.3	1,263,000	Gravel	Based on five drill sites with an average pad thickness of 9 feet and 2:1 side slopes
Willow Processing Facility pad	22.8	346,000	Gravel	Based on an average pad thickness of 10 feet with 2:1 side slopes
Willow Operations Center pads (two total)	50.2	780,000	Gravel	Two Willow Operations Centers (North and South) with an average pad thickness of 10 feet with 2:1 side slopes
Valve pads (four total) and pipeline pads (four total)	4.4	52,000	Gravel	Based on four valve pads and four pipeline pads with an average pad thickness of 7 feet and 8 feet (respectively) and 2:1 side slopes; Judy (Iqalliqpik) Creek valve pads would be sized to accommodate helicopter access
Water source access pads (three total)	3.9	36,000	Gravel	Based on three pads with an average pad thickness of 7 feet with 2:1 side slopes
Communications tower pad	0.5	5,000	Gravel	Based on an average pad thickness of 7 feet with 2:1 side slopes
CPF2 pad expansion	1.0	13,000	Gravel	Based on an average pad thickness of 8 feet with 2:1 side slopes
Airstrips (two total; includes aprons and airstrips)	87.6	1,236,000	Gravel	Based on two airstrips with an average thickness of 9.5 feet with 2:1 side slopes
Gravel roads	240.1	2,013,000	Gravel	Based on an average road surface width of 24 to 32 feet and thickness of 7 feet with 2:1 side slopes; includes water source access and airstrip access roads
Vehicle turnouts (eight total)	3.0	32,000	Gravel	Eight subsistence tundra access road pullouts every 2.5 to 3 miles with an average thickness of 7 feet
CFWR perimeter berm	3.9	25,000	Overburden	Constructed from overburden material excavated during construction of the freshwater reservoir; based on an average thickness of 7 feet with 2:1 side slopes
CFWR perimeter berm	0.0	6,000	Gravel	Capping material for the overburden perimeter berm
Mine site perimeter berm[b]	38.4	387,000	Overburden	Based on a minimum 5-foot thickness with 3:1 side slopes
Oliktok Dock upgrades	0.0	5,200	Gravel	Upgrades would be within the existing footprint
Ublutuoch (Tiŋmiaqsiuġvik) River boat ramp and access road	1.8	20,000	Gravel	Boat ramp and 0.1-mile-long access road from the GMT-1 access road
Total[c]	**545.9**	**6,219,200**	**NA**	**NA**

Note: 2:1 (2 horizontal to 1 vertical ratio); CFWR (constructed freshwater reservoir); CPF2 (Kuparuk CPF2); NA (not applicable).
[a] Values are approximate and are subject to change.
[b] In the Final Environmental Impact Statement (BLM 2020), the mine site perimeter berms were included in the total disturbance footprint but not in the table of fill quantities.
[c] Values may not total due to rounding; 5,807,200 cubic yards of gravel fill and 412,000 cubic yards of overburden fill.

4.4.7 Spill Prevention and Response

Spill prevention and response would be consistent with prevention measures and response procedures described in Section 4.2.8, *Spill Prevention and Response*. The WPF would provide a centralized facility to support Project area drill sites in a variety of ways, including equipment, personnel, and other emergency response support. Without a gravel access road connecting all drill sites to the South WOC, emergency response equipment would be duplicated at the North and South WOCs; this would require additional gravel pad space (versus Alternative B) to accommodate duplicated equipment. Outside of ice road season, additional response personnel and materials could be transferred to the north Project area as needed by helicopter, fixed-wing aircraft, and/or low-ground-pressure vehicles (e.g., Rolligons), although these modes limit cargo and passenger capacity. Under Alternative C, response to a significant spill at BT1, BT2, or BT4 could result in the following challenges specific to Alternative C:

- The need to make multiple trips to transport personnel and/or equipment would further inhibit response time
- Helicopter use could be limited by weather restrictions
- The use of all-terrain vehicles (in the event other transportation methods are unavailable) has the potential to create additional tundra damage

Under Alternative C, CPAI would conduct regular ground-based visual inspections of facilities and pipelines, including the seawater, diesel, and Willow export pipelines from the WPF to GMT-2 from proposed gravel roads. For the cross-country portion of the pipelines without a parallel gravel road between the Project access road and BT1, routine pipeline inspections and emergency response when the annual resupply ice road is not in place would be conducted using aircraft. Infield and import pipelines from BT1 to BT4 would be regularly inspected from the parallel gravel roadway.

The lack of a parallel gravel road to BT2 would result in approximately 3.6 miles of infield, diesel, and seawater pipelines unavailable for routine daily observation of these pipelines to detect leaks or other problems that could result in a spill incident. Routine observation and investigation of pipelines would occur as part of CPAI's operational best practices as well as be in compliance with regulatory requirements to conduct pipeline inspections.

Substantial truck traffic by ice road over the life of the Project would pose additional health, safety, and environmental hazards, as vehicles unintentionally leaving the roadway are more likely to occur on ice roads than gravel roads. This poses additional risk to Project personnel and increases the risk of minor spills associated with vehicle accidents.

The gravel road connection to the GMT development may also facilitate faster emergency response times to GMT-2 and GMT-1 as emergency response equipment at the Alternative C South WOC would be available in addition to the equipment staged at the existing ACF. Under Alternative C, equipment staged at Willow would also be available to provide mutual aid in the event of a fire, medical, or spill response at Alpine or in Nuiqsut.

4.4.8 Schedule and Logistics

Detailed schedule and logistics information for Alternative C is provided in Section 4.2.10, *Schedule and Logistics*. Figure D.4.16 provides a general schedule for key construction, drilling, and operations milestones. Alternative C would require an additional year of gravel mining relative to Alternative B. Production from BT1, BT2, and BT3 would begin in Year 6. BT4 production would begin in Year 9 and BT5 production would begin in Year 10. The schedule presented in Figure D.4.16 is based on the current best available information, and the schedule may be modified as detailed design progresses or as circumstances require.

4.4.9 Project Infrastructure in Special Areas

As described in Section 4.2.11, *Project Infrastructure in Special Areas*, Alternative C would include 1.0 mile of road (8.1 acres) and 1.4 miles of pipelines within the CRSA just southwest of GMT-2. Approximately 179.6 acres of the Project under Alternative C, including BT2 and BT4 and their associated roads (12.5 miles), the North WOC and North Airstrip, the Lake M0235 access road and pad, and 12.2 miles of pipeline, would be located within the TLSA. These designations allow for oil and gas development in these areas.

4.4.10 Compliance with Required Operating Procedures*

As described in Section 4.2.12, *Compliance with Bureau of Land Manage Lease Stipulations, Required Operating Procedures, and Supplemental Practices*, Alternative C would require exceptions to existing LSs and ROPs, including LSs K-1 and K-2 and ROP's A-5, B-2, E-2, E-7, and E-11 under the NPR-A IAP (BLM 2022). Exceptions for the following LSs and ROPs would be required for Alternative C:

- ROP A-5: Exceptions may be required to support refueling and fuel storage for marine vessels and large equipment that is not readily moveable (e.g., drill rigs, cranes) during construction. (Specific waterbodies where exceptions may be required have not yet been identified.)

- ROP B-2: Exceptions may be requested to allow for ice aggregate collection from waterbodies with bedfast ice that would exceed regulatory withdrawal limits for liquid water and ice aggregate. Removal of water as ice from areas with grounded ice would not reduce the quantity of potential resistant overwintering fish habitat. Exception requests would not exceed ADNR water withdrawal criteria which ensure that recharge will occur each spring. (Specific waterbodies where exceptions may be required have not yet been identified.)
- ROP E-2: Alternative C would include essential road and pipeline crossings of fish-bearing waterbodies and freshwater access infrastructure within 500 feet of fish-bearing lakes (4.0 acres of gravel infrastructure, 0.2 mile of gravel road, and 1.9 miles of pipeline).
- ROP E-7: Alternative C would include 22.7 miles of pipeline located within 500 feet of gravel roads. This mileage would be spread over several short road-pipeline stretches where separating roads from pipelines and roads converge on a drill pad or near bridged creek crossings. CPAI would continue to seek opportunities to avoid placement of pipelines within 500 feet of roads as Project engineering progresses.
- ROP E-11: Alternative C would include 3.8 acres of gravel infrastructure and 1.7 miles of pipeline within 0.5 mile of an observed yellow-billed loon nest and 44.4 acres of gravel infrastructure and 7.5 miles of pipeline within 1,625 feet of an occupied lake shoreline within the NPR-A.
- LS K-1: Alternative C would include essential road and/or pipeline crossings of Judy (Kayyaaq) Creek and Fish Creek, including valve pads. Alternative C would require exceptions for 1.1 acres of gravel infrastructure and 6.2 miles of pipelines within the Judy (Kayyaaq) Creek setback, and 12.9 acres of gravel infrastructure and 1.5 miles of pipelines within the Fish Creek setback
- LS K-2: Alternative C would include a CFWR and associated water source access infrastructure within 0.25 mile of Lake M0015, an identified deepwater lake, which would require 3.2 acres of gravel infrastructure and 15.8 acres of excavation.

When exceptions are granted, they are typically specified to stated Project actions or locations and are not granted for all project actions. BLM may not approve an exception that does not meet the objective of the LS or ROP. Exceptions from LSs and ROPs anticipated for Alternative C are described in more detail in Table D.4.11, Section 4.2.12.

4.4.11 Boat Ramps for Subsistence Users

CPAI would construct one boat ramp for subsistence use as part of its effort to mitigate Project effects on the community of Nuiqsut (Section 4.2.13, *Boat Ramps for Subsistence Users*) under Alternative C (Figures D.4.2 and D.4.12). The boat ramp would be constructed on the Ublutuoch (Tiŋmiaqsiuġvik) River along the existing gravel road between Alpine CD5 and GMT-1. The boat ramp would have a gravel footprint of 1.8 acres and require 20,000 cy of gravel fill. The boat ramp would be constructed during the first year of Project construction.

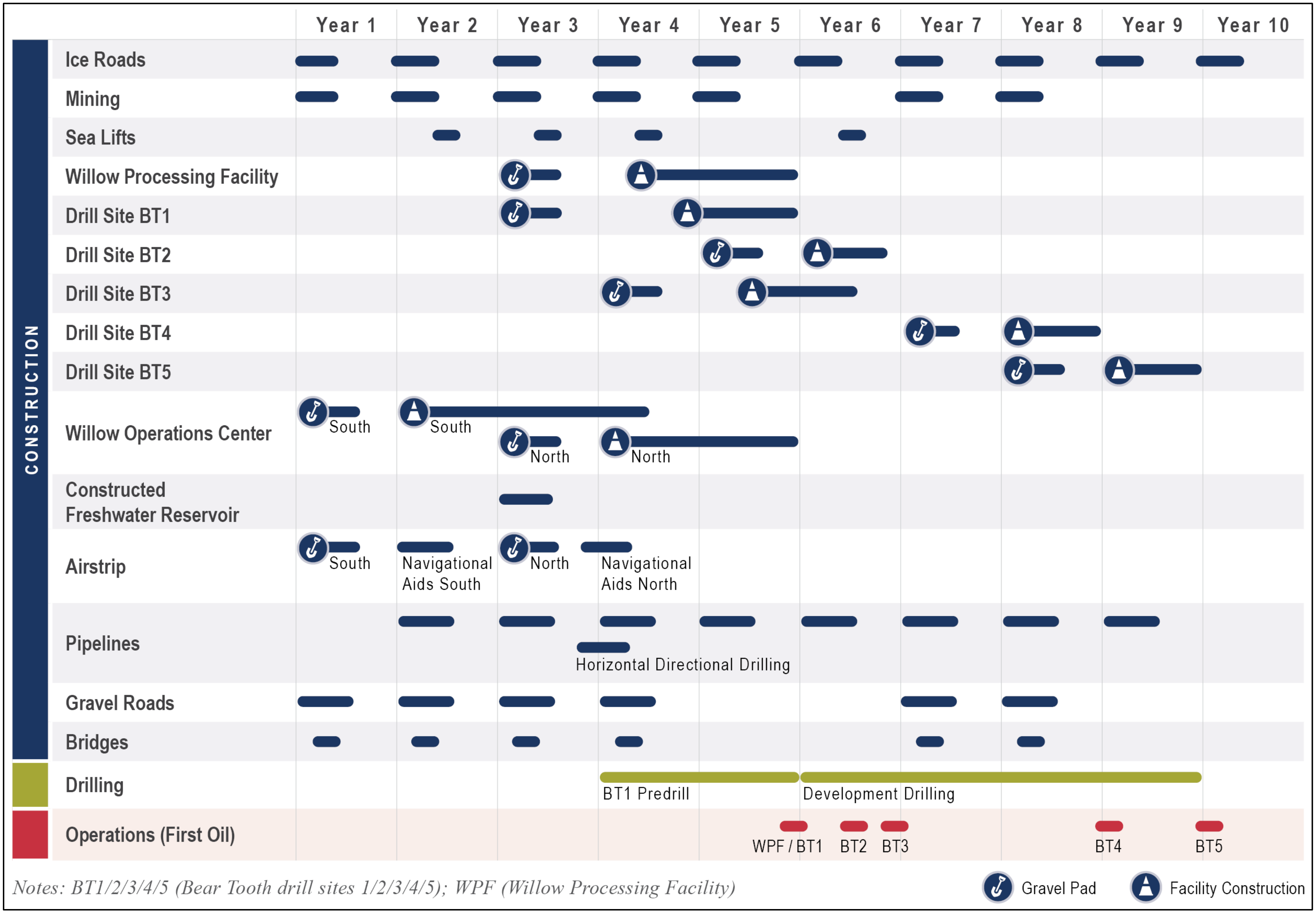


Figure D.4.16. Alternative C Estimated General Schedule

4.5 Alternative D: Disconnected Access

Alternative D would colocate the WPF with BT3, construct four additional drill sites, the WOC, pipeline and valve pads, CFWR, two water source access road and pads at the CFWR and Lake M0235, gravel roads connecting Project facilities, an airstrip, a staging pad near GMT-2, one boat ramp, and an expansion of the existing gravel pads at Alpine CD1 and Kuparuk CPF2. However, Alternative D would not be connected by an all-season gravel access road to the GMT and Alpine developments (Figure D.4.3); but it would employ the other gravel roads as proposed under Alternative B connecting drill sites and other Project infrastructure. Annual resupply access to the Project area would be provided by ice road connection between GMT-2 and the WPF (12.5 miles).

The lack of a gravel access road connection to Alpine would reduce the degree to which the Project could leverage existing Alpine infrastructure. As a result, additional facilities would be required in the Project area, duplicating some facilities currently at Alpine, including warehouse space; valve and fleet shops; emergency response equipment; biocide, methanol, and corrosion inhibitor storage tanks; and an incinerator. The addition of these facilities in the Project area would require additional gravel pad space at the WOC and WPF. Additionally, Alternative D would require a diesel pipeline connection from Kuparuk CPF2 to the WOC (similar to Alternative C) as fuel could not be trucked to the Project area throughout the year.

Alternative D would require sealift module delivery to the Project area (Section 4.8, *Sealift Module Delivery Options*).

The intent of Alternative D is to reduce the number of bridges, minimize the length of linear infrastructure on the landscape, and provide another strategy to decrease effects to caribou movement and subsistence. Additionally, this alternative would have the smallest overall gravel footprint, which would reduce impacts to hydrology (e.g., sheet flow) and wetlands (e.g., direct fill, indirect impacts from dust).

Table D.4.29 provides a summary of Project components and their associated impacts for Alternative D.

Table D.4.29. Summary of Components for Alternative D: Disconnected Access

Project Component	Description
Drill site gravel pads	Five (62.8 acres total): BT1 and BT2 (17.0 acres each), BT4 and BT5 (14.4 acres each), and BT3 (colocated with the WPF; acreage accounted for under WPF pad)
WPF gravel pad	WPF colocated with BT3; 64.7-acre pad
WOC gravel pad	62.2-acre pad
Water source access gravel pads	Two water source access pads (2.6 acres total) at the CFWR (1.3 acres) and at Lake M0235 (1.3 acres)
CFWR	16.4-acre excavation (reservoir and connecting channel) and 3.9-acre perimeter berm
Other gravel pads	Four valve pads (1.3 acres total): two pads at Judy (Iqalliqpik) Creek pipeline crossing and two pads at Fish Creek pipeline crossing HDD pipeline pads (two total) at Colville River crossing (1.5 acres total) Tie-in pad near Alpine CD4N (0.7 acre total) Pipeline crossing pad near GMT-2 (0.5 acre total) Kuparuk CPF2 pad expansion (1.0 acre) Communications tower pad (0.5 acre) Staging pad near GMT-2 (5.9 acres) Alpine CD1 pad expansion (1.3 acres)
Single-season ice pads	Used during construction at the gravel mine site, bridge crossings, the Colville River HDD crossing, and other locations as needed in the Project area (1,241.4 total acres)
Multi-season ice pads	10.0-acre multi-season ice pad near GMT-2 (Q1 Year 1 to Q2 Year 2, Q1 Year 2 to Q2 Year 3, Q1 Year 3 to Q2 Year 4, and Q1 Year 4 to Q2 Year 5) 10.0-acre multi-season ice pad near the WOC (Q1 Year 1 to Q2 Year 2) 10.0-acre multi-season ice pad at Tiŋmiaqsiuġvik Gravel Mine Site (Q1 Year 1 to Q2 Year 3)
Infield pipelines	46.5 total miles: BT1 to WPF (10.0 miles); BT2 to BT1 (4.7 miles); BT4 to BT2 (10.2 miles); BT5 to WPF (6.5 miles); GMT-2 to WPF (15.1 miles)
Willow export pipeline	38.2 total miles (WPF to tie-in pad near Alpine CD4N)

Project Component	Description
Other pipelines	69.2-mile seawater pipeline from Kuparuk CPF2 to WPF; includes Colville River HDD crossing 77.0-mile diesel pipeline from Kuparuk CPF2 to Alpine CD1 to WOC; includes Colville River HDD crossing 1.5-mile fuel gas pipeline (WPF to WOC) 2.2-mile freshwater pipeline (CFWR to WOC to WPF) 1.5-mile treated water pipeline (WOC to WPF)
Gravel roads	27.2 miles (187.4 acres including turnouts) total connecting drill sites to BT3/WPF, the WOC, the airstrip access road, and water source access roads; there would be no gravel road connection to GMT-2 Six turnouts with subsistence tundra access ramps (2.2 acres total)
Bridges	Six total: at Judy (Iqalliqpik) Creek, Judy (Kayyaaq) Creek, Fish Creek, Willow Creek 4, Willow Creek 4A, and Willow Creek 8
Airstrip	5,700 × 200–foot airstrip and apron (44.6 acres total); would also require airstrip access road
Subsistence boat ramp	1.8 acres at Ublutuoch (Tiŋmiaqsiuġvik) River
Oliktok Dock modifications	Modifications to the existing dock include adding structural components and a gravel ramp within the existing developed footprint 2.5 acres of screeding at Oliktok Dock 9.6 acres of screeding at the barge lightering area
Ice roads	Approximately 962.4 total miles (5,893.4 total acres): 699.9 miles (4,780.4 acres) over 10 construction seasons (Year 1 to Year 10) 12.5 miles (55.7 acres) of annual resupply ice road (Year 11 to Year 31; 262.5 total miles; 1,113.0 total acres)
Total footprint and gravel fill volume[a]	482.8-acre gravel footprint using 5.9 million cy of gravel fill and 317,000 cy of native fill 189.8-acre gravel mine site excavation 16.4-acre excavation at the CFWR 12.1-acre screeding area
Gravel source	Two mine site cells (189.8 total acres) in Tiŋmiaqsiuġvik area (Mine Site Area 1 would be 109.3 acres and Mine Site Area 2 would be 80.5 acres)
Total freshwater use	2,286.3 million gallons over the life of the Project (31 years)
Ground traffic (number of trips)[b,c]	4,376,890
Fixed-wing air traffic (number of trips)[b,d]	19,038 total flights Willow: 15,387 Alpine: 3,651
Helicopter air traffic (number of trips)[b]	2,503 total flights Willow: 2,403 Alpine: 100
Marine traffic (number of trips)[b,e]	319 total trips Sealift barges: 24 Tugboats: 37 Support vessels: 258
Infrastructure in special areas	Teshekpuk Lake Special Area: 108.4 acres of gravel road (11.1 miles) and gravel pads; 11.4 miles of pipeline Colville River Special Area: 0.0 mile of gravel road; 0.5 acre of gravel infrastructure; and 1.4 miles of pipelines
Fish-bearing waterbody setback overlap (ROP E-2)	2.9 acres of gravel footprint, 0.2 mile of gravel road, and 1.7 miles of pipelines
Less than 500-foot pipeline separation (ROP E-7)	23.0 miles of pipelines and road with less than 500 feet of separation
Yellow-billed loon setback overlap (ROP E-11)	10.2 acres of gravel infrastructure and 1.7 miles of pipelines within 0.5 mile of a nest 39.9 acres of gravel infrastructure and 9.8 miles of pipelines within 1,625 feet of occupied lakes
River setback overlap (LS K-1)	Colville River: 0.0 acres of gravel infrastructure and 0.0 miles of pipelines Fish Creek: 12.6 acres of gravel infrastructure and 1.6 miles of pipelines Judy (Kayyaaq) Creek: 16.7 acres of gravel infrastructure and 6.2 miles of pipelines
Deepwater lake setback overlap (LS K-2)	3.2 miles of gravel infrastructure and 1.5 miles of pipelines; 14.5 acres of the constructed freshwater reservoir would be within the setback and 1.4 acres of the reservoir connection would be within the lake

Note: BT1 (Bear Tooth drill site 1); BT2 (Bear Tooth drill site 2); BT3 (Bear Tooth drill site 3); BT4 (Bear Tooth drill site 4); BT5 (Bear Tooth drill site 5); CFWR (constructed freshwater reservoir); cy (cubic yards); GMT-2 (Greater Mooses Tooth 2); HDD (horizontal directional drilling); LS (lease stipulation); Q1 (first quarter); Q2 (second quarter); ROP (required operating procedure); VSM (vertical support member); WOC (Willow Operations Center); WPF (Willow Processing Facility).
[a] Values may not sum to totals due to rounding.
[b] Total traffic for the 30-year life of the Project (not including reclamation activity). Ground-traffic trips are one-way; a single flight is defined as a landing and subsequent takeoff.
[c] Number of trips includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Construction ground traffic also includes gravel hauling (e.g., B-70/Maxi Haul dump trucks).
[d] Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse); includes Q400, C-130, Twin Otter/CASA, Cessna, and DC-6 or similar aircraft.
[e] Includes crew boats, tugboats supporting sealift barges, screeding barges, and other support vessels.

4.5.1 Project Facilities and Gravel Pads

Project facilities proposed for the WPF, drill sites, and the WOC for Alternative D are described in Section 4.2.1, *Project Facilities and Gravel Pads*. Under Alternative D, the WPF and BT3 would be colocated and in the same location as provided under Alternatives B and C for BT3. Freshwater access would be developed for the CFWR (Lake M0015) and Lake M0235.

Unlike Alternatives B and C, the Project area would not be connected to the GMT Unit by an all-season gravel road. Rather, air access (fixed-wing aircraft and helicopter) and tundra travel would provide the only year-round access to the Project area. Alternative D would include annual construction of a seasonal ice road connection from GMT-2 to the Project area to transport materials and supplies to the Project area and waste and other materials out of the Project area.

The lack of a year-round access road to Alpine would place additional constraints on Alternative D that are not present under Alternatives B, C, and E, including the ability to leverage resources and existing infrastructure at Alpine. As a result, Alternative D would require additional facilities in the Project area not needed under Alternatives B, C, and E. These additional facilities include a grind and inject facility; additional warehouse space; a wireline/coil maintenance shop; a light-duty fleet shop; storage space and equipment; laydown space; and biocide, methanol, and corrosion inhibitor tanks at the WOC. Alternative D would also require two additional Class I injection wells at the WOC (four total) for use as backup injection wells. The addition of these two wells would require additional gravel pad space at both the WPF and WOC.

Additional construction logistics, including the need to store equipment in the Project area over the summer, store substantially more diesel fuel on-site, and manage supplies and waste prior to WOC construction, would require additional gravel pad space during construction. As the Project and Alpine would not be able to share facilities, Alternative D would also require additional pad space at Alpine CD1 for a new heavy-duty fleet shop and additional warehouse and maintenance shop space at the ACF. Additionally, Alternative D would include a gravel pad near GMT-2 to store ice road construction equipment over the summer to facilitate construction of the annual resupply ice road.

4.5.2 Pipelines

Alternative D pipelines (Figure D.4.17) would include infield pipelines connecting each drill site to the WPF and the Willow Pipeline (oil export) connecting the WPF to existing facilities at Alpine. Additional new import pipelines would include a seawater import pipeline from Kuparuk CPF2 to the WPF and a diesel import pipeline from Kuparuk CPF2 to the WPF and WOC. Additional infield pipelines would include a freshwater pipeline from the CFWR to the WOC to the WPF, a treated water pipeline from the WOC to the WPF, and a fuel gas pipeline from the WPF to the WOC. Infield pipelines would connect each drill site to the WPF paralleling Project roads, minimizing redundant parallel pipelines to the extent practicable (Section 4.2.2.1, *Infield Pipelines*).

From the WPF to the tie-in pad near Alpine CD4N, the Willow Pipeline (oil export) would share a new set of VSMs with the seawater and diesel pipelines. From Kuparuk CPF2 to the WPF, the seawater pipeline would share new VSMs with the Willow export and diesel pipelines and would include a new HDD crossing of the Colville River. From the WOC to the tie-in pad at Alpine CD4N, the diesel pipeline would share new VSMs with the Willow export and seawater pipelines; from Alpine CD4N to Alpine CD1, the diesel pipeline would be placed on existing VSMs; and from Alpine CD4N to Kuparuk CPF2, the diesel pipeline would be on new VSMs shared with the seawater pipeline. The diesel pipeline would also include an HDD crossing of the Colville River

Approximately 10 miles of pipelines (Willow export, seawater, and diesel) would not parallel gravel roads due to the lack of a gravel road connection to GMT-2. The absence of a parallel gravel road would not allow daily visual inspection of these pipelines, although routine observations and investigations would occur as part of CPAI's operational practices as well as be in compliance with regulatory pipeline inspection requirements. The absence of a parallel gravel road would increase the number and frequency of aircraft flights needed to visually inspect pipelines.

In total, 373.9 miles of pipelines would be constructed with 367.7 miles of pipelines on new VSMs (approximately 98.3%) and 6.2 miles of pipelines on existing VSMs (approximately 1.7%) using 98.1 miles of new and existing pipeline corridors. Alternative D would require approximately 13,700 total VSMs with an estimated 0.9-acre total disturbance footprint. Alternative D would include 12 VSMs installed below OHW at crossings east of the NPR-A boundary (i.e., the west bank of the Niġliq Channel).

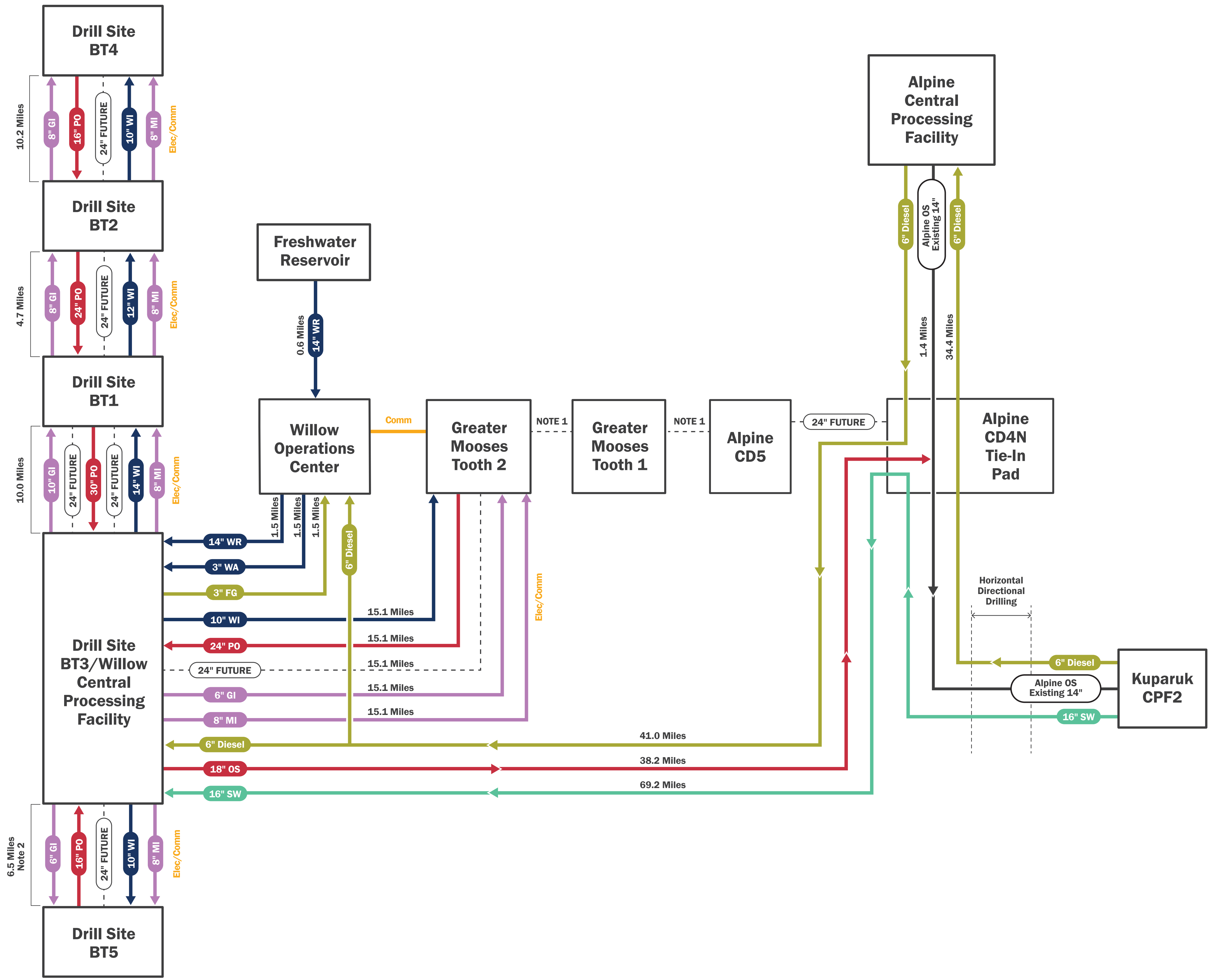
Pipeline design would be as described in Section 4.2.2, *Pipelines*.

Table D.4.30 summarizes pipeline infrastructure under Alternative D by pipeline segment.

Table D.4.30. Alternative D Pipeline Segments Summary

Pipeline	Pipeline Segment	Segment Length (miles)	Notes
BT4 infield[a]	BT4 to BT2	10.2	Pipelines on new set of VSMs
BT2 infield[a]	BT2 to BT1	4.7	Pipelines on new set of VSMs; would also transport BT4 materials
BT1 infield[a]	BT1 to WPF	10.0	Pipelines on new set of VSMs; would also transport BT2 and BT4 materials
BT5 infield[a]	BT5 to WPF	6.5	Pipelines on new set of VSMs; would share VSMs with BT1 infield pipelines from BT5 junction to WPF
GMT-2 infield[a]	GMT-2 to WPF	15.1	Would share new VSMs with Willow export, diesel, and seawater pipelines from GMT-2 to WPF
Freshwater	CFWR to WOC to WPF	2.2	Would share new VSMs with treated water, fuel gas, and diesel pipelines from WOC to WPF (1.5 miles)
Treated water	WOC to WPF	1.5	Would share new VSMs with freshwater, fuel gas, and diesel pipelines from WOC to WPF
Fuel gas	WPF to WOC	1.5	Would share new VSMs with freshwater, treated water, and diesel pipelines from WPF to WOC
Willow export	WPF to CD4N tie-in pad	38.2	Would share new VSMs with seawater and diesel pipelines from WPF to Alpine CD4N (37.9 miles)
Seawater	CPF2 to WPF	69.2	Would share new VSMs with Willow export and diesel pipelines; includes new HDD crossing of the Colville River
Diesel	CPF2 to CD1 to WOC	77.0	Would share new VSMs with seawater pipeline from CPF2 to WPF (69.2 miles); would share new VSMs with freshwater, fuel gas, and treated water pipelines from WPF to WOC (1.5 miles); would use existing VSMs from CD4N to CD1 (6.2 miles); includes new HDD crossing of Colville River

Note: BT1 (Bear Tooth drill site 1); BT2 (Bear Tooth drill site 2); BT4 (Bear Tooth drill site 4); BT5 (Bear Tooth drill site 5); CD1 (Alpine CD1); CD4N (Alpine CD4N); CFWR (constructed freshwater reservoir); CPF2 (Kuparuk CPF2); HDD (horizontal directional drilling); VSM (vertical support member); WOC (Willow Operations Center); WPF (Willow Processing Facility).
[a] Infield pipelines include produced fluids, injection water, gas, and miscible-injectant pipelines.



Legend

Elec/Comm	34.5kV Power and Communications Cables
Diesel	Diesel
FG	Fuel Gas
GI	Gas Injection
MI	Miscible Injection
PO	Production Oil
OS	Sales Oil
SW	Seawater
WA	Water Fresh
WF	Fire Protection Water
WI	Injection Water
WP	Potable Water
WR	Raw Water

Notes

1. Alignment contains one empty pipeline slot on pipe supports.
2. Pipeline size, service, and length is assumed at this time.

Figure D.4.17

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4.5.3 Access to the Project Area

Alternative D would include seasonal ice road access between the Project area and GMT-2 to support construction and annual Project resupply; access from BT3/WPF to individual drill sites via all-season gravel roads; helicopter and fixed-wing aircraft to Project and Alpine airstrips; and barge delivery of small modules and bulk materials via Oliktok Dock. Table D.4.31 provides a summary of total anticipated traffic volumes for the Project under Alternative D by transportation type and year; Table D.4.32 provides a detailed traffic breakdown by season.

Table D.4.31. Alternative D Total Project Traffic Volumes Summary for the Life of the Project (number of trips)

Year	Ground[a]	Fixed-Wing Trips Alpine[b,c]	Fixed-Wing Trips Willow[b,c]	Helicopter Trips Alpine[d]	Helicopter Trips Willow[d]	Barges to Oliktok Dock[e]	Tugboats to Oliktok Dock[f]	Support Vessels to Oliktok Dock[g]
Year 0	0	0	0	25	0	0	0	0
Year 1	52,500	70	0	50	0	0	0	0
Year 2	182,750	87	0	25	25	0	0	0
Year 3	308,550	258	336	0	82	6	9	66
Year 4	280,750	283	396	0	82	8	12	88
Year 5	307,460	259	995	0	82	5	8	52
Year 6	279,370	208	900	0	82	0	0	0
Year 7	273,750	272	1,084	0	82	5	8	52
Year 8	281,680	210	922	0	82	0	0	0
Year 9	308,500	272	958	0	82	0	0	0
Year 10	213,680	220	892	0	82	0	0	0
Year 11–Year 31	1,887,900	1,512	8,904	0	1,722	0	0	0
Total	**4,376,890**	**3,651**	**15,387**	**100**	**2,403**	**24**	**37**	**258**

Note: Trips are defined as one-way; a single flight is defined as a landing and subsequent takeoff; and a single vessel trip is defined as a docking and subsequent departure.
[a] Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B-70/Maxi Haul dump trucks).
[b] Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse).
[c] Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Cessna, or similar.
[d] Typical helicopters include A-Star and 206 Long Ranger models, although similar types of helicopters may be used. Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all Project phases. Helicopter flights in Year 0 would occur in the fourth quarter and would support the start of Project construction in the first quarter of Year 1. Note: Helicopter flights within the NPR-A are authorized under approved right-of-way FF097411 valid through December 31, 2023.
[e] Includes sealift barges for bulk materials and small modules.
[f] Includes tugboats accompanying sealift barges.
[g] Includes crew boats, screeding barge, and other support vessels.

Alternative D would have a total of 19,038 fixed-wing flights (including landings and departures at the Project airstrip and Alpine), 2,503 helicopter flights (including landings and departures at the Project and Alpine), and 24 barge and 37 tugboat trips to Oliktok Dock.

Table D.4.32. Alternative D Detailed Project Ground and Aircraft Traffic Volumes by Season for the Life of the Project (number of trips)

Season and Year	Ground[a]	Fixed Wing to Alpine[b]	Fixed Wing to Willow[b]	Alpine Helicopter	Willow Helicopter[c]
Summer Year 0	0	0	0	25	0
Winter Year 1	36,855	33	0	0	0
Spring Year 1	12,285	17	0	12	0
Summer Year 1	3,360	20	0	38	0
Fall Year 1	0	0	0	0	0
Winter Year 2	124,596	52	0	0	0
Spring Year 2	42,434	26	0	25	0
Summer Year 2	13,007	0	0	0	25
Fall Year 2	1,803	0	0	0	0
Winter Year 3	210,521	164	228	0	0
Spring Year 3	71,226	77	78	0	32

Season and Year	Ground[a]	Fixed Wing to Alpine[b]	Fixed Wing to Willow[b]	Alpine Helicopter	Willow Helicopter[c]
Summer Year 3	23,637	0	26	0	50
Fall Year 3	2,705	0	3	0	0
Winter Year 4	197,444	196	278	0	0
Spring Year 4	66,266	85	94	0	32
Summer Year 4	15,666	0	22	0	50
Fall Year 4	1,803	0	3	0	0
Winter Year 5	186,909	184	603	0	0
Spring Year 5	68,569	78	222	0	32
Summer Year 5	33,169	0	107	0	50
Fall Year 5	13,134	0	43	0	0
Winter Year 6	164,450	151	530	0	0
Spring Year 6	60,636	62	195	0	32
Summer Year 6	36,811	0	119	0	50
Fall Year 6	16,016	0	52	0	0
Winter Year 7	169,301	184	665	0	0
Spring Year 7	60,767	82	241	0	32
Summer Year 7	30,669	0	121	0	50
Fall Year 7	14,005	0	56	0	0
Winter Year 8	177,272	153	585	0	0
Spring Year 8	62,352	63	204	0	32
Summer Year 8	32,254	0	106	0	50
Fall Year 8	11,191	0	37	0	0
Winter Year 9	196,173	184	610	0	0
Spring Year 9	69,500	82	216	0	32
Summer Year 9	30,477	0	95	0	50
Fall Year 9	11,949	0	37	0	0
Winter Year 10	128,319	159	529	0	0
Spring Year 10	46,835	66	196	0	32
Summer Year 10	26,333	0	110	0	50
Fall Year 10	12,106	0	51	0	0
Winter Year 11–Year 31	971,053	1,080	4,580	0	0
Spring Year 11–Year 31	381,600	454	1,802	0	671
Summer Year 11–Year 31	359,600	0	1,700	0	1,051
Fall Year 11–Year 31	179,800	0	848	0	0
Total[d]	**4,374,858**	**3,651**	**15,387**	**100**	**2,403**

Note: Seasons are defined as follows: summer (122 days; June, July, August, September); fall (61 days; October, November); winter (121 days; December, January, February, March); and spring (61 days; April, May). Trips are defined as one-way; a single flight is defined as a landing and subsequent takeoff.

[a] Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B-70/Maxi Haul dump trucks).

[b] Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse). Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Cessna, or similar.

[c] Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all phases of the Project.

[d] Values may not match other summary traffic values presented in the Final EIS due to rounding.

During construction, approximately 699.9 miles of ice roads would be constructed to support Project pipeline, gravel pad and gravel road construction, and gravel source (Tiŋmiaqsiuġvik Gravel Mine Site) access over 10 winter construction seasons. During drilling and operations, a 12.5-mile-long annual resupply ice road would be constructed between GMT-2 and the Project's gravel infrastructure (following the same general alignment as the gravel road under Alternative B). Additional limited ice roads would be constructed as needed to accommodate drill rig mobilization. Ice road design and mileage is described in Section 4.2.3.1, *Ice Roads*.

Alternative D gravel roads connecting Project facilities would require the construction of six bridges (Table D.4.33) following the design described in Section 4.2.3.2.1, *Bridges*. Three of the six bridges would require the placement of 36 total piles (48 inches in diameter) below OHW. Alternative D would also require eight additional culverts or culvert batteries at stream or swale crossings (Figure D.4.3) and 143 cross-drainage culverts.

Table D.4.33. Alternative D Bridges Summary

Waterbody Crossing	Bridge Length (± feet)[a]	Piles below Ordinary High Water (number)	Latitude (North)	Longitude (West)
Judy (Iqalliqpik) Creek	380	16	70.1462	152.0914
Judy (Kayyaaq) Creek	75	4	70.1848	152.1211
Fish Creek	420	16	70.2526	152.1787
Willow Creek 4	130	0	70.0816	152.1302
Willow Creek 4A	50	0	70.0360	152.2015
Willow Creek 8	40	0	70.2635	152.1806

[a] Bridge lengths are approximations based on the interpretation of available aerial imagery and are subject to change.

Airstrip (Section 4.2.3.3, *Airstrip and Associated Facilities*) construction would begin during the winter construction season of 2021 and be completed during summer 2022. The airstrip would be located near the WOC and would require a larger apron space than those planned for Alternatives B and C to accommodate additional fuel storage, parking space for aircraft, and storage space for solid waste before it can be transported out of the Project area by aircraft. Prior to airstrip availability, the Alpine airstrip (located at Alpine CD1) may be used to support the Project.

Helicopters would be used during Project construction to support ice road construction, environmental monitoring, and surveying. Following the construction of gravel roads and during the drilling and operations phases, helicopters used to support the Project would primarily be limited to ongoing environmental monitoring and spill response support.

Sealift barges would be used to deliver bulk construction materials and small modules to Oliktok Dock to support Project construction (Section 4.2.3.4, *Sealift Barge Delivery to Oliktok Dock*). Additionally, sealift barges would be used to deliver large processing and drill site modules to the North Slope (Section 4.8, *Sealift Module Delivery Options*). No additional or regular use of barges is proposed over the life of the Project following construction.

4.5.4 Other Infrastructure and Utilities

4.5.4.1 Ice Pads

Single- and multi-season ice pads would be used to support Project construction. Single- and multi-season ice pads are described in Section 4.2.4.1, *Ice Pads*.

Alternative D would require 1,241.4 acres of single-season ice pads over the life of the Project (31 years). Additionally, Alternative D would include the use of three multi-season ice pads to support temporary camps and stage equipment and materials, as needed. The following 10.0-acre multi-season ice pads would be constructed under Alternative D:

- Near GMT-2 (Q1 Year 1 to Q2, Q1 Year 2 to Q2 Year 3, Q1 Year 3 to Q2 Year 4, and Q1 Year 4 to Q2 Year 5)
- Near the WOC (Q1 Year 1 to Q2 Year 2)
- At the Tiŋmiaqsiuġvik Gravel Mine Site (Q1 Year 1 to Q2 Year 3)

4.5.4.2 Camps

Table D.4.34 details Alternative D camp requirements to support Project construction, drilling, and operations.

Table D.4.34. Alternative D Camps Summary

Project Phase	Camp	Location	Capacity	Use Schedule
Construction	Temporary camp	Ice pad near WOC	250	Q1 Year 1 to Q2 Year 2
Construction	K-Pad Camp[a]	K-Pad[b]	150	Q1 Year 1 to Q4 Year 10
Construction	Alpine Operations Camp[a]	Alpine central processing facility (at Alpine CD1)[b]	250	Q1 Year 1 to Q4 Year 5
Construction	Temporary camp[c]	WOC	100	Q1 Year 2 to Q4 Year 6
Construction	Sharktooth Camp[a]	Kuparuk[b]	220	Q1 Year 2 to Q4 Year 4

Project Phase	Camp	Location	Capacity	Use Schedule
Drilling	Drill rig camp(s)	Drill site(s) or WOC	150	Q1 Year 4 to Q4 Year 10
Construction, operations	Willow Camp[c]	WOC	500	Q2 Year 4 to Q4 Year 10
Operations	Willow Camp[c]	WOC	200	Q1 Year 11 to Q4 Year 31

Note: Q1 (first quarter); Q2 (second quarter); Q4 (fourth quarter); WOC (Willow Operations Center).
[a] Existing camp.
[b] Existing gravel pad.
[c] During construction, up to 60 bed spaces may be used at the existing Kuukpik Hotel in Nuiqsut in lieu of bed spaces identified at or near the WOC.

4.5.4.3 Utilities, Waste Handling, and Fuel and Chemical Storage

Power generation and distribution, communications, potable water systems and use, domestic wastewater, solid waste, and drilling waste handling, as well as fuel and chemical storage, would be as described in Section 4.2.4, *Other Infrastructure and Utilities.*

4.5.5 Water Sources and Use

As described in Section 4.2.5, *Water Sources and Use*, freshwater would be needed during construction for domestic use at construction camps, construction and maintenance of ice roads and ice pads, and hydrostatic testing of pipelines. During drilling, freshwater would be required for domestic use at drill rig camps and to support drilling activities. Water for construction and drilling would be withdrawn from lakes in the Project area. Freshwater for domestic use during operations would be sourced from the CFWR and Lake M0235 using the freshwater intake infrastructure (Section 4.2.4.5, *Potable Water*). Alternative D would also require construction of an annual 12.5-mile-long ice road from GMT-2 to the Project for the life of the Project. Anticipated water use for Alternative D is detailed by year and Project phase in Table D.4.35.

Seawater would also be required, as described in Section 4.2.5, and would be sourced from the existing Kuparuk seawater treatment plant and transported via seawater pipeline (Section 4.2.2.3, *Other Pipelines*).

Table D.4.35. Alternative D Estimated Freshwater Use by Project Phase and Year (million gallons)

Year (season)	Construction[a]	Drilling[b]	Operations[c]	Total
Year 0–Year 1 (winter)	84.1	0.0	0.0	**84.1**
Year 1 (summer)	1.1	0.0	0.0	**1.1**
Year 1– Year 2 (winter)	225.8	0.0	0.0	**225.8**
Year 2 (summer)	3.2	0.0	0.0	**3.2**
Year 2–Year 3 (winter)	326.8	0.0	0.0	**326.8**
Year 3 (summer)	9.5	0.0	0.0	**9.5**
Year 3–Year 4 (winter)	330.2	0.0	0.0	**330.2**
Year 4 (summer)	9.0	0.0	0.0	**9.0**
Year 4–Year 5 (winter)	128.5	21.5	0.0	**150.0**
Year 5 (summer)	14.4	43.0	0.0	**57.4**
Year 5–Year 6 (winter)	52.6	43.9	0.0	**96.5**
Year 6 (summer)	10.0	44.8	0.9	**55.7**
Year 6–Year 7 (winter)	27.8	8.8	1.8	**38.4**
Year 7 (summer)	2.4	8.8	4.3	**15.5**
Year 7–Year 8 (winter)	125.8	8.8	3.2	**137.8**
Year 8 (summer)	4.5	8.8	5.1	**18.4**
Year 8–Year 9 (winter)	133.6	8.8	4.1	**146.5**
Year 9 (summer)	3.3	8.8	5.1	**17.2**
Year 9–Year 10 (winter)	28.7	8.8	7.4	**44.9**
Year 10 (summer)	2.1	8.8	5.1	**16.0**
Year 10–Year 11 (winter)	0.2	4.4	18.6	**23.2**
Year 11 (summer)	0.0	0.0	5.1	**5.1**
Year 11/Year 12+ (20 winters)	0.0	0.0	372.0	**372.0**
Year 12+ (20 summers)	0.0	0.0	102.0	**102.0**
Total	**1,523.6**	**228.0**	**534.7**	**2,286.3**

Note: "+" indicates annual use for the life of the Project (Year 31) for operations.
[a] The construction phase would include ice road construction (1.0 million gallons [MG] per mile for a 35-foot-wide road, 1.4 MG per mile for a 50-foot-wide road, and 2.0 MG per mile for a 70-foot-wide road), ice pad construction (0.25 MG per acre), dust suppression, hydrostatic testing, and camp supply (100 gallons per person per day).
[b] The drilling phase would include drilling water (1.4 MG per month prior to Willow Processing Facility startup and 0.4 MG per drill rig per month after startup), hydraulic fracturing (1.0 MG per well prior to Willow Processing Facility startup), and camp supply (100 gallons per person per day).
[c] The operations phase would include dust suppression, camp supply (100 gallons per person per day), and an annual ice road (1.0 MG per mile for a 35-foot-wide road).
[d] Annual winter water use for operations would 18.6 MG.
[e] Annual summer water use for operations would be 5.1 MG.

4.5.6 Gravel and Other Fill Requirements

Project roads and pads would be constructed with gravel obtained from the Tiŋmiaqsiuġvik Gravel Mine Site and the perimeter berm surrounding the CFWR would be constructed from material excavated from the reservoir and capped in gravel. Table D.4.36 lists the estimated quantity of fill material anticipated for each Project component under Alternative D.

Table D.4.36. Alternative D Estimated Fill Material Requirements by Project Component

Component	Footprint (acres)[a]	Fill Quantity (cubic yards)[a]	Fil Type	Notes and Assumptions
Drill sites pads (four total)	62.8	872,000	Gravel	Based on four drill sites with an average pad thickness of 9 feet and 2:1 side slopes
BT3/WPF pad	64.7	1,401,000	Gravel	Based on an average pad thickness of 13.5 feet with 2:1 side slopes
Willow Operations Center pad	62.2	1,168,000	Gravel	Based on an average pad thickness of 12 feet with 2:1 side slopes
Valve pads (four total) and pipeline pads (four total)	4.0	48,000	Gravel	Based on four valve pads and four pipeline pads with an average pad thickness of 7 feet and 8 feet (respectively) with 2:1 side slopes
Water source access pads (two total)	2.6	24,000	Gravel	Based on two pads with an average pad thickness of 7 feet with 2:1 side slopes
Communications tower pad	0.5	5,000	Gravel	Based on an average pad thickness of 7 feet with 2:1 side slopes
CPF2 pad expansion	1.0	13,000	Gravel	Based on an average pad thickness of 8 feet with 2:1 side slopes
CD1 pad expansion	1.3	19,000	Gravel	Based on an average pad thickness of 10 feet with 2:1 side slopes
GMT-2 staging pad	5.9	79,000	Gravel	Based on an average pad thickness of 9 feet with 2:1 side slopes
Airstrip (includes airstrip and apron)	44.6	631,000	Gravel	Based on an average thickness of 9.5 feet with 2:1 side slopes
Gravel roads	186.9	1,573,000	Gravel	Based on average road surface width of 24 to 32 feet and thickness of 7 feet with 2:1 side slopes; includes water source access and airstrip access roads
Vehicle turnouts (six total)	2.2	24,000	Gravel	Six subsistence tundra access road pullouts every 2.5 to 3 miles with an average thickness of 7 feet
CFWR perimeter berm	3.9	6,000	Gravel	Constructed from overburden material excavated during construction of the freshwater reservoir; based on an average thickness of 7 feet with 2:1 side slopes
CFWR perimeter berm	0.0	25,000	Overburden	Capping material for the overburden perimeter berm
Mine site perimeter berm[b]	38.4	387,000	Overburden	Based on a minimum 5-foot thickness with 3:1 side slopes
Oliktok Dock upgrades	0.0	5,200	Gravel	Upgrades would be within the existing footprint
Ublutuoch (Tiŋmiaqsiuġvik) River boat ramp and access road	1.8	20,000	Gravel	Boat ramp and 0.1-mile-long access road from the GMT-1 access road
Total[c]	**482.8**	**6,300,200**	**NA**	**NA**

Note: 2:1 (2 horizontal to 1 vertical ratio); BT3/WPF (Bear Tooth drill site 3/Willow Processing Facility); CD1 (Alpine CD1); CFWR (constructed freshwater reservoir); CPF 2 (Kuparuk CPF2); GMT-2 (Greater Mooses Tooth 2); NA (not applicable).

[a] Values are approximate and are subject to change.

[b] In the Final Environmental Impact Statement (BLM 2020), the mine site perimeter berms were included in the total disturbance footprint but not in the table of fill quantities.

[c] Values may not total due to rounding; 5,888,200 cubic yards of gravel fill and 412,000 cubic yards of overburden fill.

4.5.7 Spill Prevention and Response

Spill prevention and response would be consistent with prevention measures and response procedures described in Section 4.2.8, *Spill Prevention and Response*. The WOC would provide a centralized facility to support Project drill sites, including equipment, personnel, and other support to respond to potential emergencies. The lack of an all-season gravel road connection to the GMT and Alpine developments would pose additional challenges for spill response during the non-ice road season.

The lack of a gravel access road from GMT-2 parallel to approximately 12.5 miles of Willow export, diesel, and seawater pipelines would not allow for routine daily observation of these pipelines to detect leaks or other problems that could result in a spill incident. Routine observation and investigation of pipelines would occur as part of CPAI's operational best practices as well as be in compliance with regulatory requirements to conduct pipeline inspections.

Without an all-season gravel access road connection to GMT-2, existing emergency response equipment at Alpine would need to be duplicated at Willow, requiring additional gravel pad space. Construction of the Project would also provide no additional benefits for emergency response to any incidents that could occur at GMT-2 and other facilities within Alpine, and equipment at Willow would not be available to provide mutual aid in the event of a fire, medical, or spill response at Alpine or in Nuiqsut.

With the exception of the ice road season, spill response mobilization would be limited to helicopters and low-ground-pressure vehicles (e.g., Rolligons), both of which have limited cargo and/or passenger capacity. Response to a spill of any significant size would likely require multiple trips, further delaying response times. Additionally, helicopter response could be further limited by weather conditions. Summer travel by all-terrain vehicles during a response, in the event other transportation modes are not available, may also result in additional tundra damage during transport when compared to a spill located near a road.

Substantial truck traffic by ice road over the life of the Project would pose additional health, safety, and environmental hazards, as vehicles unintentionally leaving the roadway are more likely to occur on ice roads than gravel roads. This poses additional risk to Project personnel and increases the risk of minor spills associated with vehicle accidents.

4.5.8 Schedule and Logistics

Detailed schedule and logistics information is provided in Section 4.2.10, *Schedule and Logistics*.

The lack of a gravel access road connection under Alternative D would result in less flexibility to leverage existing infrastructure. which would result in less efficient construction in comparison to Alternatives B and C. The lack of flexibility would result in additional constraints on development construction and logistics that would extend the construction phase compared to Alternatives B, C, and E by 1 year (10 years total) and delay first oil by approximately 1 year to Year 6). Production from BT5 would begin in Year 10.

To help mitigate these logistical issues, initial construction activities would prioritize construction of the WOC, delaying installation of drill site facilities. Until construction of the diesel pipeline from Kuparuk CPF2 to the Project area is completed, the transport of diesel fuel would also be a limiting factor in construction logistics. This would specifically limit the opportunity to conduct early well pre-drilling.

Figure D.4.18 provides a general schedule for key construction, drilling, and operations milestones. The schedule presented in Figure D.4.18 is based on the current best available information; the schedule may be modified as detailed design progresses and as circumstances require.

4.5.9 Project Infrastructure in Special Areas

As described in Section 4.2.11, *Project Infrastructure in Special Areas*, Alternative D would include 0.5 acres of gravel infrastructure and 1.4 miles of pipelines within the CRSA just southwest of GMT-2. Alternative D also would have approximately 108.4 acres of the Project, including BT2 and BT4 and their associated roads (11.1 miles), and 11.4 miles of pipeline located within the TLSA. These designations do allow oil and gas development in these areas, and the Project would comply with ROPs associated with these two management areas (BLM 2008a, 2022).

4.5.10 Compliance with Required Operating Procedures*

As described in Section 4.2.12, *Compliance with Bureau of Land Management Lease Stipulations, Required Operating Procedures, and Supplemental Practices*, Alternative D would require exceptions to existing LSs and ROPs, including LSs K-1 and K-2 and ROPs A-5, B-2, E-2, E-7, and E-11 under the NPR-A IAP (BLM 2022). Exceptions for the following LSs and ROPs would be required for Alternative D:

- ROP A-5: Exceptions may be required to support refueling and fuel storage for marine vessels and large equipment that is not readily moveable (e.g., drill rigs, cranes) during construction. (Specific waterbodies where exceptions may be required have not yet been identified.)
- ROP B-2: Exceptions may be requested to allow for ice aggregate collection from waterbodies with bedfast ice that would exceed regulatory withdrawal limits for liquid water and ice aggregate. Removal of water as ice from areas with grounded ice would not reduce the quantity of potential resistant overwintering fish habitat. Exception requests would not exceed ADNR water withdrawal criteria which ensure that recharge will occur each spring. (Specific waterbodies where exceptions may be required have not yet been identified.)

- ROP E-2: Alternative D would include essential road and pipeline crossings of fish-bearing waterbodies and freshwater access infrastructure within 500 feet of fish bearing lakes (0.2 mile of gravel road, 1.7 miles of pipelines, and 2.9 acres of gravel infrastructure).
- ROP E-7: Alternative D would include a total of 23.0 miles of pipeline located within 500 feet of gravel roads within the NPR-A. This mileage would be spread over several short road-pipeline stretches where separating roads from pipelines may not be feasible, such as within narrow land corridors between lakes or where pipelines and roads converge on a drill pad or near a bridged creek crossing. CPAI would continue to seek opportunities to avoid placement of pipelines within 500 feet of roads as Project engineering progresses.
- ROP E-11: Alternative D would include 10.2 acres of proposed gravel infrastructure and 1.7 miles of pipelines within 0.5 mile of an observed yellow-billed loon nest and 39.9 acres of gravel infrastructure and 9.8 miles of pipeline within 1,625 feet of an occupied lake shoreline within the NPR-A.
- 8 miles of pipeline within 0.5 mile of an observed yellow-billed loon nest and 39.9 acres of gravel footprint and 9.8 miles within 1,625 feet of an occupied lake shoreline in the NPR-A.
- LS K-1: Alternative D would include essential road and pipeline crossings of Judy (Kayyaaq) Creek and Fish Creek, including valve pads. Alternative D would require exceptions for 16.7 acres of gravel infrastructure and 6.2 miles of pipelines within the Judy (Kayyaaq) Creek setback, and 12.6 acres of gravel infrastructure and 1.6 miles of pipelines within the Fish Creek setback
- LS K-2: Alternative D would include a CFWR and associated water source access infrastructure within 0.25 mile of Lake M0015, an identified deepwater lake, which would require 3.2 acres of gravel infrastructure and 15.8 acres of excavation.

When exceptions are granted, they are typically specified to stated Project actions or locations and are not granted for all project actions. BLM may not approve an exception that does not meet the objective of the LS or ROP. Exceptions from LSs and ROPs anticipated for Alternative D are described in more detail in Table D.4.11, Section 4.2.12.

4.5.11 Boat Ramps for Subsistence Users

CPAI would construct one boat ramp during the first year of Project construction for subsistence use as part of its effort to mitigate Project effects on the community of Nuiqsut (Section 4.2.13, *Boat Ramps for Subsistence Users*) under Alternative D (Figures D.4.3 and D.4.12). The boat ramp would be constructed on the Ublutuoch (Tiŋmiaqsiuġvik) River along the existing gravel road between Alpine CD5 and GMT-1. The boat ramp would have a gravel footprint of 1.8 acres and require 20,000 cy of gravel fill.

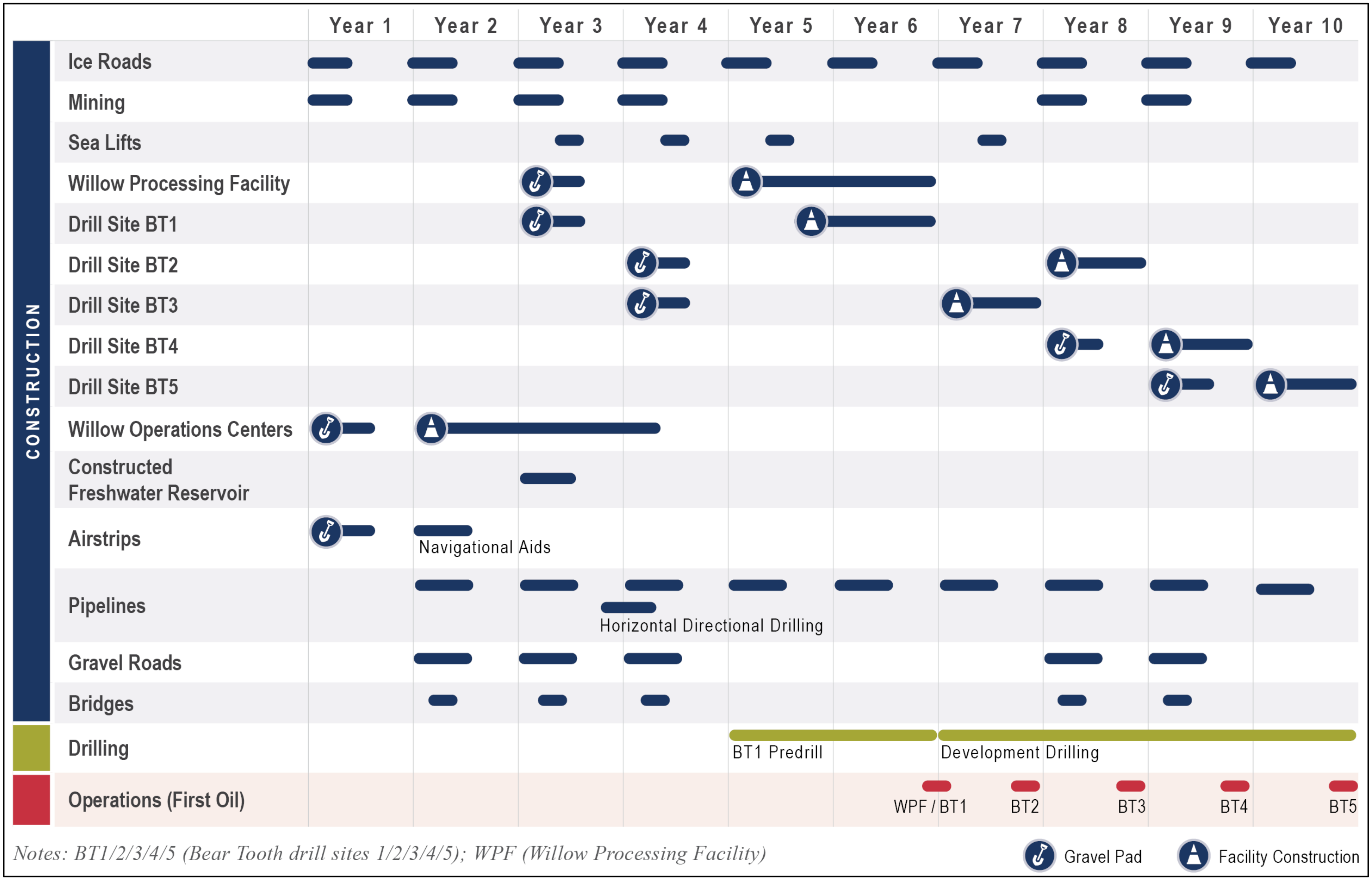

Figure D.4.18. Alternative D Estimated General Schedule

4.6 Alternative E: Three-Pad Alternative (Fourth Pad Deferred)*

Alternative E would include a WPF, WOC, and up to three drill sites (BT4 would be eliminated and any approval decision for BT5 would be deferred). Additional support facilities would include four valve pads, four pipeline pads, five water source access pads (at Lakes L9911, M0235, M0112, M0015, and M1523A), gravel roads connecting the Project to the GMT-2 and all drill sites to the WPF, an airstrip, and three subsistence boat ramps (Figure D.4.4). Under Alternative E, BT5 would be relocated approximately 1.8 miles to the northeast to avoid two yellow-billed loon buffer setbacks; this location would reduce the length of the BT5 infield road and pipelines (relative to Alternatives B, C, and D). This alternative was developed by BLM and cooperating agencies to reduce surface impacts, in response to the District Court's remand decision.

Alternative E would include approximately 219 total wells. Eliminating BT4 (included under Alternatives B, C, and D) from the Project would reduce the overall gravel footprint, though the BT1 and BT2 drill site pads would be approximately 100 feet longer to accommodate additional wells, which would allow access to portions of the resource that would otherwise be accessed from BT4 and the original BT2 location. Eliminating BT4 from the Project and relocating BT5 would reduce the overall length of infield pipelines, gravel and ice roads, and reduce freshwater use. The reductions in footprint and water use would occur within the TLSA.

Alternative E would include at least two Class I UIC disposal wells located at the WOC. The WPF and WOC locations are the same as those proposed under Alternative B. Alternative E would use an existing mud plant at the K-Pad in the Colville River Unit to produce drilling mud, which would eliminate the need to construct a new mud plant at the WOC. The existing K-Pad mud plant would be expanded on the existing gravel pad to support this use. Using this mud plant would result in a minor increase in truck traffic during drilling. This alternative would also include installation of two additional modules on the existing GMT-2 drill site pad to allow for the capability of transporting GMT-2 produced fluids to the WPF for processing.

Although Alternative E would evaluate the full development of the Willow reservoir with up to four satellite drill pads (initially up to three with the decision deferred on the fourth), BT5 would not be authorized in the Willow MDP ROD flowing from this Supplemental EIS and would require a separate future decision. In order to provide an accurate comparison of the full impacts of each alternative, BLM is evaluating BT5 in this analysis assuming the earliest possible construction start date (Year 7). This Year 7 construction scenario is assumed to be the most impactful scenario under Alternative E because it includes all four drill site pads including BT5 and would have the most overlap between the construction of BT5 and drilling phases at BT1, BT2, and BT3. If BT5 construction is deferred beyond Year 7, the anticipated impacts related to BT5 would be delayed, resulting in extended temporal impacts, but reducing the severity or intensity of the impacts due to there being less overall Project activity (i.e., other construction and drilling activity) occurring simultaneously. Tables presented in this Sections 4.6.1 through 4.6.11 include Project activity for all four drill sites and assume a Year 7 construction start date for BT5. Section 4.6.12, *Alternative E BT5 Deferral Activity Tables*, provides additional data breakdowns (e.g., traffic volumes, water use) that separate BT5 activity from the three other proposed drill sites so BT5-related activity and impacts can be viewed separately.

The intent of Alternative E is to reduce the amount of surface infrastructure within the TLSA and reduce the impacts to identified yellow-billed loon nests located near the previously proposed BT5 location. This alternative would reduce the amount of overall infrastructure (e.g., gravel footprint, miles of gravel road, miles of pipeline) that may impede caribou movement and impact subsistence users. Reduced gravel infrastructure would also lessen impacts to wetlands and vegetation, hydrology, gravel resources, and wildlife. Deferring authorization of BT5 may also reduce the intensity of impacts to surface resources by reducing the overlap of construction and drilling activity in the Project area.

Alternative E is BLM's preferred alternative. The identification of a preferred alternative does not constitute a commitment or decision; if warranted, BLM may select a different alternative than the preferred alternative or deferrals in its ROD. BLM is also considering, and may select from, variations on Alternative E that would be more environmentally protective, such as deferring more than one drill site pad. In order to help inform such consideration, Tables D.4.9 and D.4.10 (Section 4.2.10.3, *Operations Phase*) provide the daily and cumulative oil production for each individual drill site pad in the Alternative E configuration.

Table D.4.37 provides a summary of Project components and their associated impacts for Alternative E.

Table D.4.37. Summary of Components for Alternative E: Three-Pad Alternative (Fourth Pad Deferred)*

Project Component	Description
Drill site gravel pads	Four (68.0 acres total): BT1 (18.4 acres), BT2 (18.2 acres each), BT3 (17.0 acres), and BT5 (14.4 acres)
WPF gravel pad	22.8-acre pad
WOC gravel pad	31.3-acre pad
Water source access gravel pads	Five water source access pads (8.3 acres total) at Lakes L9911 (1.6 acres), M0015 (1.6 acres), M0235 (1.8 acres), Lake M0012 (1.8 acres), and Lake M1523A (1.5 acres)
Other gravel pads	Four valve pads (1.3 acres total): two pads at Judy (Iqalliqpik) Creek pipeline crossing and two pads at Fish Creek pipeline crossing HDD pipeline pads (two total) at Colville River crossing (0.9 acres total) Tie-in pad near Alpine CD4N (0.7 acre total) Kuparuk CPF2 pad expansion (1.0 acre) Communications tower pad (0.4 acre)
Single-season ice pads	Used during construction at the gravel mine site, bridge crossings, the Colville River HDD crossing, and other locations as needed in the Project area (830.6 total acres)
Multi-season ice pads	10.0-acre multi-season ice pad near GMT-2 (Q1 Year 1 to Q2 Year 2, Q1 Year 2 to Q2 Year 3, Q1 Year 3 to Q2 Year 4, and Q1 Year 4 to Q2 Year 5) 10.0-acre multi-season ice pad near the WOC (Q1 Year 1 to Q2 Year 2) 10.0-acre multi-season ice pad at Tiŋmiaqsiuġvik Gravel Mine Site (Q1 Year 1 to Q2 Year 3)
Infield pipelines	30.2 total miles: BT2 to BT1 (7.8 miles); BT1 to WPF (3.9 miles); BT3 to WPF (3.4 miles); BT5 to WPF (7.1 miles); GMT-2 to WPF (8.0 miles)
Willow export pipeline	32.5 total miles (WPF to tie-in pad near Alpine CD4N)
Other pipelines	64.4-mile seawater pipeline (total) from Kuparuk CPF2 to WPF and 0.1-mile spur pipeline to K-Pad; includes Colville River HDD crossing 35.1-mile diesel pipeline from Kuparuk CPF2 to Alpine CD1 to WOC; includes Colville River HDD crossing 2.3-mile fuel gas pipeline (WPF to WOC) 0.9-mile freshwater intake pipeline (Various lakes) 2.3-mile treated water pipeline (WOC to WPF)
Gravel roads	30.2 miles (220.6 acres including turnouts) total connecting drill sites to the /WPF, the WOC, the airstrip access road, water source access roads, and GMT-2 Seven turnouts with subsistence tundra access ramps (2.6 acres total)
Bridges	Six total at Judy (Iqalliqpik) Creek, Judy (Kayyaaq) Creek, Fish Creek, Willow Creek 2, Willow Creek 4, and Willow Creek 8
Airstrip	5,700 × 200–foot airstrip and apron (42.2 acres total); would also require airstrip access road
Subsistence boat ramp	1.8 acres at Ublutuoch (Tiŋmiaqsiuġvik)River 2.0 acres at Judy (Iqalliqpik) Creek 2.1 acres at Fish Creek 5.9 acres total
Oliktok Dock modifications	Modifications to the existing dock include adding structural components and a gravel ramp within the existing developed footprint 2.5 acres of screeding at Oliktok Dock 9.6 acres of screeding at the barge lightering area
Ice roads	Approximately 431.2 total miles (3,166.2 total acres) over 8 construction seasons (Year 1 to Year 8)
Total footprint and gravel fill volume[a]	428.4-acre gravel footprint using 4.4 million cy of gravel fill and 292,000 cy of native fill 115.0-acre gravel mine site excavation 12.1-acre screeding area
Gravel source	Two mine site cells (115.0 total acres) in Tiŋmiaqsiuġvik area (Mine Site Area 1 would be 86.1 acres and Mine Site Area 2 would be 28.9 acres)
Total freshwater use	1,478.7 million gallons over the life of the Project (30 years)
Ground traffic (number of trips)[b,c]	3,145,870
Fixed-wing air traffic (number of trips)[b,d]	11,983 total flights Willow: 11,691 Alpine: 292
Helicopter air traffic (number of trips)[b]	2,421 total flights Willow: 2,321 Alpine: 100

Project Component	Description
Marine traffic (number of trips)[b,e]	280 total trips Sealift barges: 21 Tugboats: 34 Support vessels: 225
Infrastructure in special areas	Teshekpuk Lake Special Area: 61.2 acres of gravel road and gravel pads; 5.0 miles of roads; 4.9 miles of pipeline Colville River Special Area: 1.0 mile of gravel road; 7.6 acres of gravel infrastructure; and 1.3 miles of pipelines
Fish-bearing waterbody setback overlap (ROP E-2)	7.3 acres of gravel footprint, 0.1 mile of gravel road, and 3.0 miles of pipelines
Less than 500-foot pipeline separation (ROP E-7)	21.6 miles of pipelines and road with less than 500 feet of separation
Yellow-billed loon setback overlap (ROP E-11)	9.4 acres of gravel infrastructure and 1.2 miles of pipelines within 0.5 mile of a nest 44.1 acres of gravel infrastructure and 5.8 miles of pipelines within 1,625 feet of occupied lakes
River setback overlap (LS K-1)	Colville River: 0.0 acre of gravel infrastructure and 0.0 mile of pipelines Fish Creek: 18.7 acres of gravel infrastructure and 1.7 miles of pipelines Judy (Kayyaaq) Creek: 21.2 acres of gravel infrastructure and 6.5 miles of pipelines
Deepwater lake setback overlap (LS K-2)	2.4 acres of gravel infrastructure and 0.2 mile of pipelines

Note: BT1 (Bear Tooth drill site 1); BT2 (Bear Tooth drill site 2); BT3 (Bear Tooth drill site 3); BT4 (Bear Tooth drill site 4); BT5 (Bear Tooth drill site 5); CFWR (constructed freshwater reservoir); cy (cubic yards); GMT-2 (Greater Mooses Tooth 2); HDD (horizontal directional drilling); LS (lease stipulation); Q1 (first quarter); Q2 (second quarter); ROP (required operating procedure); VSM (vertical support member); WOC (Willow Operations Center); WPF (Willow Processing Facility).

[a] Values may not sum to totals due to rounding.

[b] Total traffic for the 30-year life of the Project (not including reclamation activity). Ground-traffic trips are one-way; a single flight is defined as a landing and subsequent takeoff.

[c] Number of trips includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Construction ground traffic also includes gravel hauling (e.g., B-70/Maxi Haul dump trucks).

[d] Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse); includes Q400, C-130, Twin Otter/CASA, Cessna, and DC-6 or similar aircraft.

[e] Includes crew boats, tugboats supporting sealift barges, screeding barges, and other support vessels.

4.6.1 Project Facilities and Gravel Pads*

Project facilities proposed for the WPF, WOC, and drill sites are described in Section 4.2.1, *Project Facilities and Gravel Pads*, except that under Alternative E, there would be no drill site BT4, BT2 would be located further north (BT2 North), and BT5 would be located further northeast to avoid two yellow-billed loon setback buffers.

4.6.2 Pipelines*

Alternative E pipelines (Figure D.4.19) would include infield pipelines connecting each drill site and GMT-2 to the WPF and the Willow Pipeline (oil export) connecting the WPF to existing Alpine facilities. Additional pipelines would include a seawater pipeline from Kuparuk CPF2 to the WPF, a seawater spur pipeline to the K-Pad mud plant, and a diesel pipeline from Kuparuk CPF2 to the ACF (located at Alpine CD1; diesel fuel would be trucked from Alpine to the Project area). VSMs would be installed using the drill-set-slurry method. Alternative E would require approximately 12,500 total VSMs with an estimated 0.8-acre total disturbance footprint; Alternative E would include 12 VSMs installed below OHW at crossings east of the NPR-A boundary (i.e., the west bank of the Niġliq Channel). A total of 96 VSMs would be installed in five water source lakes below OHW to support freshwater intake pipelines. Pipeline design would be as described in Section 4.2.2, *Pipelines*.

All Project area pipelines would parallel gravel roads to facilitate routine visual observations and investigation of pipelines. Conducting visual observation and investigation of pipelines from a gravel road would reduce the number and frequency of aircraft flights required to visually inspect pipelines.

The Willow Pipeline (oil export) and seawater pipeline would be constructed on new VSMs from the WPF to the tie-in pad near Alpine CD4N (Willow Pipeline) and Kuparuk CPF2 (seawater pipeline), as described in Section 4.2.2. The diesel pipeline would be placed on new VSMs (shared with the seawater pipeline) between Kuparuk CPF2 and Alpine CD4N and on existing VSMs from Alpine CD4N to the ACF located at Alpine CD1. From Alpine CD1, diesel fuel would be trucked to the WOC, WPF, and other facilities. In total, 267.7 miles of pipelines would be constructed with 264.3 miles of pipelines on new VSMs (approximately 99%) and 3.4 miles of pipelines on existing VSMs (approximately 1%) using 90.2 miles of new and existing pipeline corridors. Infield pipelines would connect each drill site to the WPF and parallel Project area roads. Where practicable, infield pipelines would tie into other infield pipelines (Section 4.2.2.1, *Infield Pipelines*) to minimize redundant parallel pipelines. Water intake pipelines at Lakes L9911, M0235, M0112, M0015, and M1523A would connect to pumphouses located on the water source access pads. The treated water pipeline would connect the WOC to the WPF and a fuel gas pipeline would connect the WPF to the WOC.

Table D.4.38 summarizes the Alternative E pipeline infrastructure by pipeline segment.

Table D.4.38. Alternative E Pipeline Segments Summary*

Pipeline	Pipeline Segment	Segment Length (miles)	Notes
BT2 infield[a]	BT2 to BT1	7.8	Pipelines on new set of VSMs
BT1 infield[a]	BT1 to WPF	3.9	Pipelines on new set of VSMs; would also transport BT2 materials
BT3 infield[a]	BT3 to WPF	3.4	Pipelines on new set of VMSs
BT5 infield[a]	BT5 to WPF	7.1	Pipelines on new set of VSMs; would share VSMs with BT3 infield pipelines from BT5 junction to WPF (2.8 miles)
GMT-2 infield[a]	GMT-2 to WPF	8.0	Would share new VSMs with Willow export and seawater pipelines from GMT-2 to WPF (10.2 miles)
Freshwater intake	Various	0.9	Lakes L9911, M0235, M0112, M0015, and M1523A to pumphouses on their respective water source access pads
Treated water	WOC to WPF	2.3	Would share new VSMs with freshwater and fuel gas pipelines from the WPF to the WOC (2.8 miles)
Fuel gas	WPF to WOC	2.3	Would share new VSMs with freshwater and treated water pipelines from WPF to WOC (2.8 miles)
Willow export	WPF to CD4N tie-in pad	32.5	Would share new VSMs with the seawater pipeline from WPF to Alpine CD4N (33.0 miles)
Seawater	CPF2 to WPF	64.4	Would share new VSMs with Willow Pipeline from the WPF to Alpine CD4N (33.0 miles) and the diesel pipeline from Alpine CD4N to CPF2 (31.3 miles); includes new HDD crossing of the Colville River
Seawater spur	Existing seawater pipeline to K-Pad	0.1	Pipeline on new set of VSMs
Diesel	CPF2 to CD1	35.1	Would share new VSMs with seawater pipeline from CPF2 to CD4N (31.3 miles) and existing VSMs from CD4N to the Alpine central processing facility at CD1 (3.1 miles); includes new HDD crossing of Colville River

Note: BT1 (Bear Tooth drill site 1); BT2 (Bear Tooth drill site 2); BT4 (Bear Tooth drill site 4); BT5 (Bear Tooth drill site 5); CD1 (Alpine CD1); CD4N (Alpine CD4N); CFWR (constructed freshwater reservoir); CPF2 (Kuparuk CPF2); HDD (horizontal directional drilling); VSM (vertical support member); WOC (Willow Operations Center); WPF (Willow Processing Facility).
[a] Infield pipelines include produced fluids, injection water, gas, and miscible-injectant pipelines.

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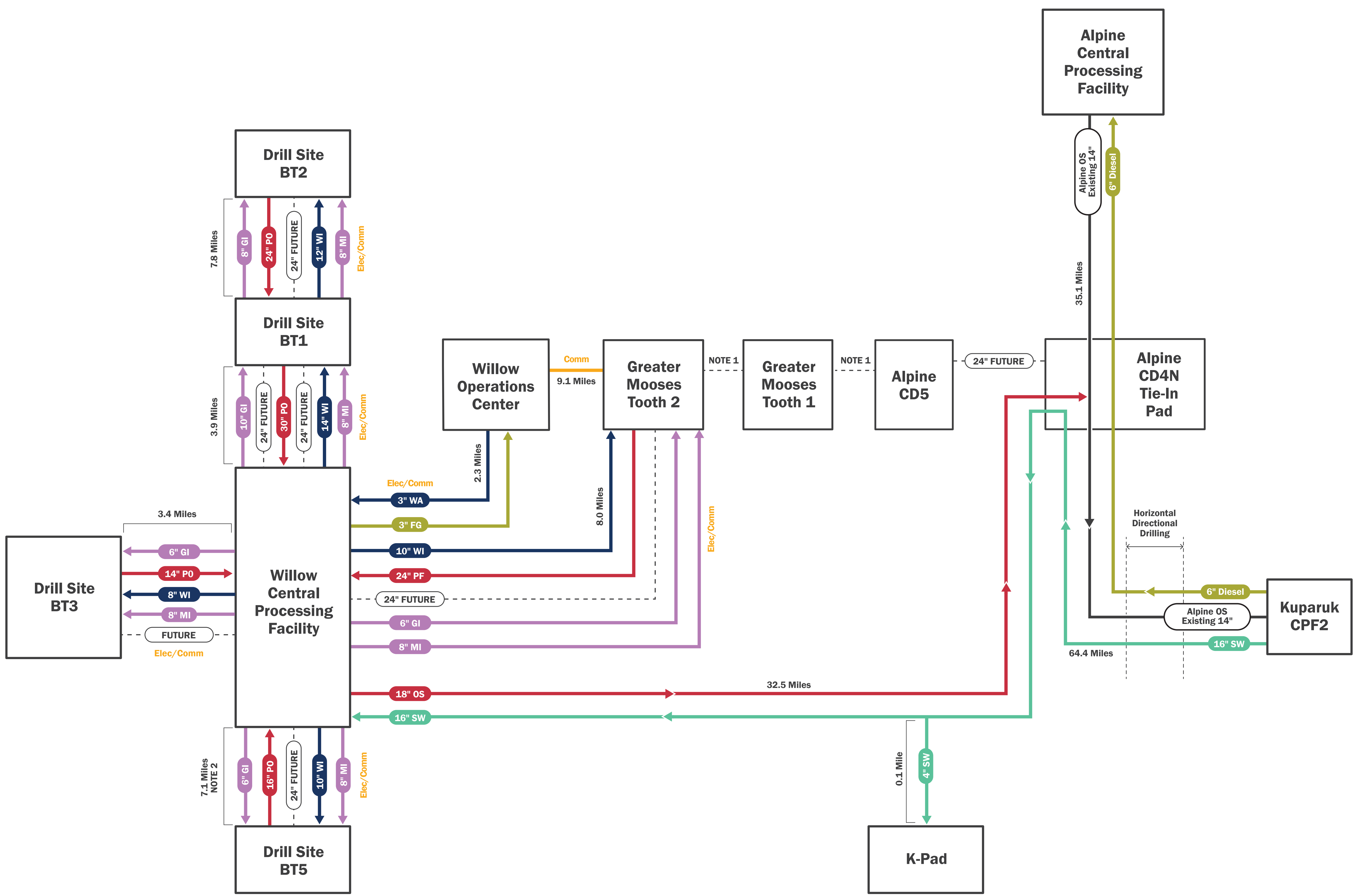

Legend

Elec/Comm	34.5kV Power and Communications Cables
Diesel	Diesel
FG	Fuel Gas
GI	Gas Injection
MI	Miscible Injection
PO	Production Oil
PF	Production Fluid
OS	Sales Oil
SW	Seawater
WA	Water Fresh
WF	Fire Protection Water
WI	Injection Water
WP	Potable Water
WR	Raw Water

Notes

1. Alignment contains one empty 24" pipeline slot on pipe supports.
2. Pipeline size, service, and length is assumed at this time.

Figure D.4.19

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4.6.3 Access to the Project Area*

Alternative E would include seasonal ice road access to support construction; access to the WPF from the GMT and Alpine developments via an all-season gravel road; access from the WPF to individual drill sites via all-season gravel roads; helicopter and fixed-wing aircraft to the Project and Alpine airstrips; and barge delivery of small modules and bulk construction materials to Oliktok Dock. Table D.4.39 provides a summary of total traffic volumes anticipated for the Project under Alternative E by transportation type and year; Table D.4.40 provides a detailed traffic breakdown by season.

Table D.4.39. Alternative E Total Project Traffic Volumes Summary for the Life of the Project (number of trips)*

Year	Ground[a]	Fixed-Wing Trips Alpine[b,c]	Fixed-Wing Trips Willow[b,c]	Helicopter Trips Alpine[d]	Helicopter Trips Willow[d]	Barges to Oliktok Dock[e]	Tugboats to Oliktok Dock[f]	Support Vessels to Oliktok Dock[g]
Year 0	0	0	0	25	0	0	0	0
Year 1	55,300	60	0	50	0	0	0	0
Year 2	137,270	122	31	25	25	6	9	66
Year 3	282,270	75	168	0	82	8	12	88
Year 4	371,640	35	751	0	82	5	8	52
Year 5	387,250	0	707	0	82	0	0	0
Year 6	254,440	0	738	0	82	2	5	19
Year 7	186,490	0	724	0	82	0	0	0
Year 8	158,330	0	620	0	82	0	0	0
Year 9	114,240	0	456	0	82	0	0	0
Year 10	114,240	0	456	0	82	0	0	0
Year 11 to Year 30	1,084,400	0	7,040	0	1,640	0	0	0
Total	**3,145,870**	**292**	**11,691**	**100**	**2,321**	**21**	**34**	**225**

Note: Ground trips are defined as one-way; a single fixed-wing or helicopter flight is defined as a landing and subsequent takeoff; and a single vessel trip is defined as a docking and subsequent departure.
[a] Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B-70/Maxi Haul dump trucks).
[b] Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse).
[c] Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Cessna, or similar.
[d] Typical helicopters include A-Star and 206 Long Ranger models, although other similar types of helicopters may be used. Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all Project phases. Helicopter flights in Year 0 would occur in the fourth quarter and would support the start of Project construction in the first quarter of Year 1. Note: Helicopter flights within the NPR-A are authorized under approved right-of-way FF097411 valid through December 31, 2023.
[e] Includes sealift barges for bulk materials and small modules.
[f] Includes tugboats accompanying sealift barges.
[g] Includes crew boats, screeding barge, and other support vessels.

Alternative E would have a total of 11,691 fixed-wing flights (including landings and departures at the Project airstrip and Alpine), 2,321 helicopter flights (including landings and departures at the Project airstrip and Alpine), and 21 barge and 34 tugboat trips from Dutch Harbor to Oliktok Dock.

During construction, ice roads would be constructed to support Project pipeline, gravel pad and gravel road construction, and gravel source (Tiŋmiaqsiuġvik Gravel Mine Site) access over eight winter construction seasons. During drilling, planned ice road use would be limited to drilling rig mobilization. (The Project would receive annual resupply via the Alpine ice road, which is constructed annually between Kuparuk and Alpine to support Alpine operations. This ice road mileage is not included in the Project's analyses as it would be constructed regardless in support of Alpine.) Ice road design and mileage is described in Section 4.2.3.1, *Ice Roads*.

Table D.4.40. Alternative E Detailed Project Ground and Aircraft Traffic Volumes by Season for the Life of the Project (number of trips)*

Season and Year	Ground[a]	Fixed-Wing Trips Alpine[b]	Fixed-Wing Trips Willow[b]	Helicopter Trips Alpine[c]	Helicopter Trips Willow[c]
Summer Year 0	0	0	0	25	0
Winter Year 1	33,180	36	0	0	0
Spring Year 1	11,060	12	0	12	0
Summer Year 1	11,060	12	0	38	0
Fall Year 1	0	0	0	0	0
Winter Year 2	92,126	82	21	0	0
Spring Year 2	31,554	28	7	25	0
Summer Year 2	11,055	10	3	0	25
Fall Year 2	1,690	2	0	0	0
Winter Year 3	190,285	51	113	0	0
Spring Year 3	64,885	17	39	0	25
Summer Year 3	22,731	6	13	0	57
Fall Year 3	3,478	1	2	0	0
Winter Year 4	239,564	23	482	0	0
Spring Year 4	83,863	8	170	0	25
Summer Year 4	36,192	3	73	0	57
Fall Year 4	9,176	1	19	0	0
Winter Year 5	237,230	0	434	0	0
Spring Year 5	86,318	0	158	0	25
Summer Year 5	41,978	0	77	0	57
Fall Year 5	17,541	0	32	0	0
Winter Year 6	150,105	0	426	0	0
Spring Year 6	54,487	0	158	0	25
Summer Year 6	36,494	0	106	0	57
Fall Year 6	14,750	0	43	0	0
Winter Year 7	108,412	0	414	0	0
Spring Year 7	39,683	0	154	0	25
Summer Year 7	27,750	0	108	0	57
Fall Year 7	12,016	0	47	0	0
Winter Year 8	93,935	0	368	0	0
Spring Year 8	34,118	0	134	0	25
Summer Year 8	21,886	0	86	0	57
Fall Year 8	9,599	0	38	0	0
Winter Year 9	56,207	0	224	0	0
Spring Year 9	22,848	0	91	0	25
Summer Year 9	22,848	0	91	0	57
Fall Year 9	11,424	0	46	0	0
Winter Year 10	57,120	0	228	0	0
Spring Year 10	22,848	0	91	0	25
Summer Year 10	22,848	0	91	0	57
Fall Year 10	11,424	0	46	0	0
Winter Year 11–Year 30	547,912	0	3,543	0	0
Spring Year 11–Year 30	216,880	0	1,408	0	500
Summer Year 11–Year 30	216,880	0	1,408	0	1,140
Fall Year 11–Year 30	108,440	0	704	0	0
Total[d]	**3,145,879**	**292**	**11,691**	**100**	**2,321**

Note: Seasons are defined as follows: summer (122 days; June, July, August, September); fall (61 days; October, November); winter (121 days; December, January, February, March); and spring (61 days; April, May). Trips are defined as one-way; a single flight is defined as a landing and subsequent takeoff.

[a] Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B-70/Maxi Haul dump trucks).

[b] Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse). Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Cessna, or similar.

[c] Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all phases of the Project.

[d] Values may not match other summary traffic values presented in the Final EIS due to rounding.

Gravel roads would provide year-round access between the GMT and Alpine developments and the Project area and from the WPF to the WOC and individual drill sites. Alternative E gravel roads would require construction of six bridges (Table D.4.41) following the design described in Section 4.2.3.2.1, *Bridges*. Three of the six bridges would require the placement of 36 total piles (ranging from 36 to 48 inches in diameter) below OHW (Table D.4.39). Alternative E would also require nine culverts or culvert batteries at swale crossings (Figure D.4.4) and 160 cross-drainage culverts.

Table D.4.41. Alternative E Bridges Summary*

Waterbody Crossing	Bridge Length (± feet)[a]	Piles below Ordinary High Water (number)[b]	Latitude (°North)	Longitude (°West)
Judy (Iqalliqpik) Creek	380	16	70.1462	152.0914
Judy (Kayyaaq) Creek	75	4	70.1848	152.1211
Fish Creek	420	16	70.2526	152.1787
Willow Creek 2	80	0	70.1413	151.9557
Willow Creek 4	130	0	70.0816	152.1302
Willow Creek 8	40	0	70.2635	152.1806

[a] Bridge lengths are approximations based on the interpretation of available aerial imagery and are subject to change.
[b] Judy (Iqalliqpik) Creek and Fish Creek in-stream pile diameters are assumed to be 48 inches and Judy (Kayyaaq) Creek in-stream pile diameters are assumed to be 36 inches; diameter excludes any potential surface casing required for installation.

The airstrip (Section 4.2.3.3, *Airstrip and Associated Facilities*) would be located near the WOC, and construction would begin during the winter construction season of Year 1 and be completed in summer of Year 2. Prior to Project airstrip availability, the Alpine airstrip (located at Alpine CD1) would be used to support the Project. Helicopters would be used to support ice road construction, environmental monitoring, and surveying. Following construction of gravel roads, and during the drilling and operations phases, Project helicopter use would be limited primarily to ongoing environmental monitoring and spill response support.

Sealift barges would be used to deliver bulk construction materials and small modules to Oliktok Dock to support Project construction (Section 4.2.3.4, *Sealift Barge Delivery to Oliktok Dock*). Additionally, sealift barges would be used to deliver large processing and drill site modules to the North Slope (Section 4.8, *Sealift Module Delivery Options*). No additional or regular use of barges is proposed over the life of the Project following construction.

4.6.4 Other Infrastructure and Utilities*

*4.6.4.1 Ice Pads**

Single- and multi-season ice pads would be used to support Project construction. Single- and multi-season ice pads are described in Section 4.2.4.1, *Ice Pads*.

Alternative E would require 830.6 acres of single-season ice pads over the Project's construction phase (8 years). Additionally, Alternative E would include the use of three multi-season ice pads to store equipment through the summer to support ice road construction and other temporary construction activities. The following 10.0-acre multi-season ice pads would be constructed under Alternative E:

- Near GMT-2 (Q1 Year 1 to Q2 Year 5)
- Near the WOC (Q1 Year 1 to Q2 Year 2)
- At the Tiŋmiaqsiuġvik Gravel Mine Site (Q1 Year 1 to Q2 Year 3)

*4.6.4.2 Camps**

Table D.4.42 details Alternative E camp requirements to support construction, drilling, and operations.

Table D.4.42. Alternative E Camps Summary*

Project Phase	Camp	Location	Capacity	Use Schedule
Construction	Temporary camp	Ice pad near the WOC	250	Q1 Year 1 to Q4 Year 1
Construction	K-Pad Camp[a]	K-Pad[b]	450	Q1 Year 1 to Q4 Year 5
Construction	Alpine Operations Camp[a]	Alpine central processing facility (at Alpine CD1)[b]	250 to 300	Q1 Year 1 to Q2 Year 4
Construction	Temporary camp[c]	WOC pad	250	Q1 Year 2 to Q2 Year 4
Construction	Sharktooth Camp[a]	Kuparuk[b]	220	Q1 Year 2 to Q2 Year 4

Project Phase	Camp	Location	Capacity	Use Schedule
Drilling	Drill rig camp(s)	Drill site(s) or WOC pad	150	Q1 Year 4 to Q4 Year 10
Construction, operations	Willow Camp[c]	WOC pad	500	Q2 Year 4 to Q4 Year 7
Operations	Willow Camp[c]	WOC pad	200	Q1 Year 8 to Q4 Year 30

Note: Q1 (first quarter); Q2 (second quarter); Q4 (fourth quarter); WOC (Willow Operations Center).
[a] Existing camp.
[b] Existing gravel pad.
[c] During construction, up to 60 bed spaces may be used at the existing Kuukpik Hotel in Nuiqsut in lieu of bed spaces identified at or near the WOC.

*4.6.4.3 Utilities, Waste Handling, and Fuel and Chemical Storage**

Power generation and distribution, communications, potable water systems and use, domestic wastewater, solid waste, and drilling waste handling, as well as fuel and chemical storage, would be as described under Section 4.2.4, *Other Infrastructure and Utilities*.

4.6.5 Water Sources and Use*

As described for all action alternatives in Section 4.2.5, *Water Sources and Use*, freshwater would be needed during construction for domestic use at construction camps, construction and maintenance of ice roads and ice pads, and hydrostatic testing of pipelines. During drilling, freshwater would be required for domestic use at the drill rig camps and to support drilling activities. Water for construction and drilling would be withdrawn from lakes in the Project area; use of the K-Pad mud plant would reduce the volume of freshwater required to support drilling prior to WPF startup.

Alternative E would not include a CFWR or its associated access road, pad, and freshwater pipeline, as proposed for the other action alternatives. Rather, gravel water source access roads and pads would be used to access Lakes L9911, M0235, M0112, M1523A, and M0015 during all Project phases (Section 4.2.4.5, *Potable Water*). Each of these water source access pads would accommodate a pumphouse that would be connected to intake piping that extends out into the deep portion of the lake on VSMs (96 total VSMs would be installed below OHW to support freshwater intake pipelines). Anticipated water use by year is detailed in Table D.4.43.

Seawater would also be required, as described in Section 4.2.5, and would be sourced from the existing Kuparuk seawater treatment plant and transported via seawater pipeline to the Project area (Section 4.2.2.3, *Other Pipelines*).

Table D.4.43. Alternative E Estimated Freshwater Use by Project Phase and Year (million gallons)*

Year (season)	Construction[a]	Drilling[b]	Operations[c]	Total
Year 0–Year 1 (winter)	72.3	0.0	0.0	**72.3**
Year 1 (summer)	1.1	0.0	0.0	**1.1**
Year 1–Year 2 (winter)	127.4	0.0	0.0	**127.4**
Year 2 (summer)	3.2	0.0	0.0	**3.2**
Year 2–Year 3 (winter)	238.3	0.0	0.0	**238.3**
Year 3 (summer)	9.3	0.0	0.0	**9.3**
Year 3–Year 4 (winter)	327.6	15.5	0.0	**343.1**
Year 4 (summer)	12.8	31.0	0.0	**43.8**
Year 4–Year 5 (winter)	112.1	31.9	0.0	**144.0**
Year 5 (summer)	19.8	32.8	0.9	**53.5**
Year 5–Year 6 (winter)	31.7	8.8	1.8	**42.3**
Year 6 (summer)	2.8	8.8	4.3	**15.9**
Year 6–Year 7 (winter)	90.7	8.8	3.2	**102.7**
Year 7 (summer)	1.0	8.8	5.1	**14.9**
Year 7–Year 8 (winter)	19.7	6.8	4.1	**30.6**
Year 8 (summer)	2.2	4.8	5.1	**12.1**
Year 8–Year 9 (winter)	0.2	4.8	4.1	**9.1**
Year 9 (summer)	0.0	4.8	5.1	**9.9**
Year 9–Year 10 (winter)	0.0	4.8	4.1	**8.9**
Year 10 (summer)	0.0	4.8	5.1	**9.9**
Year 10–Year 11 (winter)	0.0	2.4	4.1	**6.5**
Year 11 (summer)	0.0	0.0	5.1	**5.1**
Year 11–Year 12+ (19 winters)[d]	0.0	0.0	77.9	**77.9**
Year 12+ (19 summers)[e]	0	0	96.9	**96.9**
Total	**1,072.2**	**179.6**	**226.9**	**1,478.7**

Note: "+" indicates total seasonal use from the indicated year to the end of Project operations (Year 30).
[a] The construction phase would include ice road construction (1.0 million gallons [MG] per mile for 35-foot-wide road, 1.4 MG per mile for a 50-foot-wide-road; and 2.0 MG per mile for 70-foot-wide road), ice pad construction (0.25 MG per acre), dust suppression, hydrostatic testing, and camp supply (100 gallons per person per day).
[b] The drilling phase would include drilling water (0.4 MG per month per drilling rig), hydraulic fracturing (1.0 MG per well prior to Willow Processing Facility startup), and camp supply (100 gallons per person per day).
[c] The operations phase would include dust suppression and camp supply (100 gallons per person per day).
[d] Annual winter water use for operations would be 4.1 MG.
[e] Annual summer water use for operations would be 5.1 MG.

4.6.6 Gravel and Other Fill Requirements*

Project roads and pads would be constructed with gravel obtained from the Tiŋmiaqsiuġvik Gravel Mine Site. Table D.4.44 lists the estimated quantity of fill materials anticipated for each Project component.

Table D.4.44. Alternative E Estimated Fill Material Requirements by Project Component*

Component	Footprint (acres)[a]	Fill Quantity (cubic yards)[a]	Fill Type	Notes and Assumptions
Drill pads (four total)	68.0	973,000	Gravel	Based on four drill sites with an average pad thickness of 9 to 10 feet and 2:1 side slopes
Willow Processing Facility pad	22.8	346,000	Gravel	Based on an average pad thickness of 10 feet with 2:1 side slopes
Willow Operations Center pad	31.3	487,000	Gravel	Based on an average pad thickness of 10 feet with 2:1 side slopes
Valve pads (4 total) and pipeline pads (4 total)	4.0	48,000	Gravel	Based on four valve and four pipeline pads with an average pad thickness of 7 feet and 8 feet (respectively) with 2:1 side slopes
Water source access pads (2 total)	6.6	66,000	Gravel	Based on two pads with an average pad thickness of 7 to 10 feet with 2:1 side slopes
Communications tower pad	0.5	5,000	Gravel	Based on an average pad thickness of 7 feet with 2:1 side slopes
CPF2 pad expansion	1.0	13,000	Gravel	Based on an average pad thickness of 8-feet and 2:1 side slopes

Component	Footprint (acres)[a]	Fill Quantity (cubic yards)[a]	Fill Type	Notes and Assumptions
Airstrip (includes airstrip and apron)	42.2	593,000	Gravel	Based on an average pad thickness of 9.5 feet with 2:1 side slopes
Gravel roads	213.8	1,823,000	Gravel	Based on an average road surface width of 24 to 32 feet and an average thickness of 7 feet with 2:1 side slopes; includes water source and airstrip access roads
Vehicle turnouts (7 total)	2.6	28,000	Gravel	Seven subsistence tundra access road pullouts (one located every 2.5 to 3.0 miles) with an average thickness of 7 feet
Mine site perimeter berm	30.3	292,000	Overburden	Based on a minimum 5-foot thickness with 3:1 side slopes
Oliktok Dock upgrades	0.0	5,200	Gravel	All gravel would be placed within the existing developed footprint
Ublutuoch (Tiŋmiaqsiuġvik) River boat ramp and access road	1.8	20,000	Gravel	Boat ramp and 0.1-mile-long access road from the GMT-1 access road
Judy (Iqalliqpik) Creek boat ramp and access road	2.0	20,000	Gravel	Boat ramp and 0.1-mile-long access road from the drill site BT1 access road
Fish Creek Boat ramp and access road	2.1	21,000	Gravel	Boat ramp and 0.1-mile-long access road from the drill site BT2 access road
Total[b]	**429.0**	**4,740,200**	**NA**	**NA**

Note: 2:1 (2 horizontal to 1 vertical ratio); 3:1 (3 horizontal to 1 vertical ration); CPF2 (Kuparuk CPF2); GMT-1 (Greater Mooses Tooth 1); NA (not applicable).
[a] Values are approximate and are subject to change.
[b] Values may not total due to rounding; 4,448,200 cubic yards of gravel fill and 292,000 cubic yards of overburden fill.

4.6.7 Spill Prevention and Response*

Spill prevention and response would be consistent with prevention measures and response procedures described in Section 4.2.8, *Spill Prevention and Response*. The WOC would provide a centralized facility to support Project drill sites in a variety of ways, including equipment, personnel, and other support, to respond to potential emergencies. Under Alternative E, CPAI would conduct regular ground-based visual inspections of facilities and pipelines, including the Willow Pipeline (oil export) and seawater pipeline from the WPF to GMT-2 from proposed gravel roads. The gravel road connection to the GMT development would also facilitate faster emergency response times to GMT-2 and GMT-1, as emergency response equipment at the Alternative E WOC would be closer to GMT-2 than the existing ACF.

4.6.8 Schedule and Logistics*

Detailed schedule and logistics information is provided in Section 4.2.10, *Schedule and Logistics*. Figure D.4.20 provides an estimated general schedule for key construction, drilling, and operations milestones, subject to the qualifications described in Section 4.2.10. Production from BT1, BT2, and BT3 would begin in Year 6. Production from BT5 could begin as early as Year 9; this represents the earliest construction date for BT5. Development drilling results at BT1, BT2, and BT3 would provide information that could extend the BT5 construction duration.
The schedule presented in Figure D.4.20 may be modified as detailed design progresses or as circumstances require.

4.6.9 Project Infrastructure in Special Areas*

As described in Section 4.2.11, *Project Infrastructure in Special Areas*, Alternative E would include 1.0 mile of road (7.6 acres) and 1.3 miles of pipelines within the CRSA just southwest of GMT-2. Approximately 61.2 acres of the Project, including BT2 and its associated roads (5.0 miles), 4.9 miles of pipeline, and the Fish Creek boat ramp would be located within the TLSA. As described in Section 4.2.11, *Project Infrastructure in Special Areas*, these special area designations allow for oil and gas development in these areas (BLM 2008a, 2022).

4.6.10 Compliance with Required Operating Procedures*

As described in Section 4.2.12, *Compliance with Bureau of Land Management Lease Stipulations, Required Operating Procedures, and Supplemental Practices*, Alternative E would require exceptions to existing LSs K-1 and

K-2, and ROPs, including E-2, E-7, and E-11 under the NPR-A IAP (BLM 2022). Exceptions for the following LSs and ROPs would be required for Alternative E:

- ROP A-5: Exceptions may be required to support refueling and fuel storage for marine vessels and large equipment that is not readily moveable (e.g., drill rigs, cranes) during construction. (Specific waterbodies where exceptions may be required have not yet been identified.)
- ROP B-2: Exceptions may be requested to allow for ice aggregate collection from waterbodies with bedfast ice that would exceed regulatory withdrawal limits for liquid water and ice aggregate. Removal of water as ice from areas with grounded ice would not reduce the quantity of potential resistant overwintering fish habitat. Exception requests would not exceed ADNR water withdrawal criteria which ensure that recharge will occur each spring. (Specific waterbodies where exceptions may be required have not yet been identified.)
- ROP E-2: Alternative E would include essential road and pipeline crossings of fish-bearing waterbodies and freshwater access infrastructure within 500 feet of fish bearing lakes (0.1 mile of gravel road, 3.0 miles of pipelines, and 7.3 acres of gravel infrastructure).
- ROP E-7: Alternative E would include 21.6 miles of pipeline located within 500 feet of gravel roads. This mileage would be spread over several short road-pipeline stretches where separating roads from pipelines may not be feasible, such as within narrow land corridors between lakes or where pipelines and roads converge on a drill pad or near bridged creek crossings. CPAI would continue to seek opportunities to avoid placement of pipelines within 500 feet of roads as Project engineering progresses.
- ROP E-11: Alternative E would include 9.4 acres of gravel infrastructure and 1.2 miles of pipeline within 0.5 mile of an observed yellow-billed loon nest and 44.1 acres of gravel infrastructure and 5.8 miles of pipeline within 1,625 feet of an occupied lake shoreline within the NPR-A.
- LS K-1: Alternative E would include essential road/pipeline crossings of Judy (Kayyaaq) and Fish creeks, including valve pads and boat ramps. It would also include water source access pads at Lakes M0012, Lake M1523A, and Lake M0235 within the Fish Creek LS K-1 setback. Alternative B would require exceptions for 21.2 acres of gravel infrastructure and 6.5 miles of pipelines within the Judy (Kayyaaq) Creek setback, and 18.7 acres of gravel infrastructure and 1.7 miles of pipelines within the Fish Creek setback.
- LS K-2: Alternative E would also include a water source access pad within 0.25 mile of Lake M0015, an identified deepwater lake, which would require 2.4 acres of gravel infrastructure and 0.2 mile of pipelines.

When exceptions are granted, they are typically specified to stated Project actions or locations and are not granted for all project actions. BLM may not approve an exception that does not meet the objective of the LS or ROP. Exceptions from LSs and ROPs anticipated for Alternative E are described in more detail in Table D.4.11, Section 4.2.12.

4.6.11 Boat Ramps for Subsistence Users*

CPAI would construct up to three boat ramps (Figures D.4.4 and D.4.12) for subsistence use as part of its effort to mitigate Project effects on the community of Nuiqsut (Section 4.2.13, *Boat Ramps for Subsistence Users*) under Alternative E. The three boat ramps would be constructed at the following locations:

- Ublutuoch (Tiŋmiaqsiuġvik) River, along the existing gravel road between Alpine CD5 and GMT-1
- Judy (Iqalliqpik) Creek, near the proposed bridge crossing
- Fish Creek, near the proposed bridge crossing

The three boat ramps would have a total gravel footprint of 5.9 acres using 61,000 cy of gravel fill. The Ublutuoch (Tiŋmiaqsiuġvik) River boat ramp would be constructed during the first year of Project construction, and the boat ramps at Judy (Iqalliqpik) Creek and Fish Creek would be constructed within 2 years of constructing the BT1 and BT2 North access roads, respectively, after site visits and input from local stakeholders.

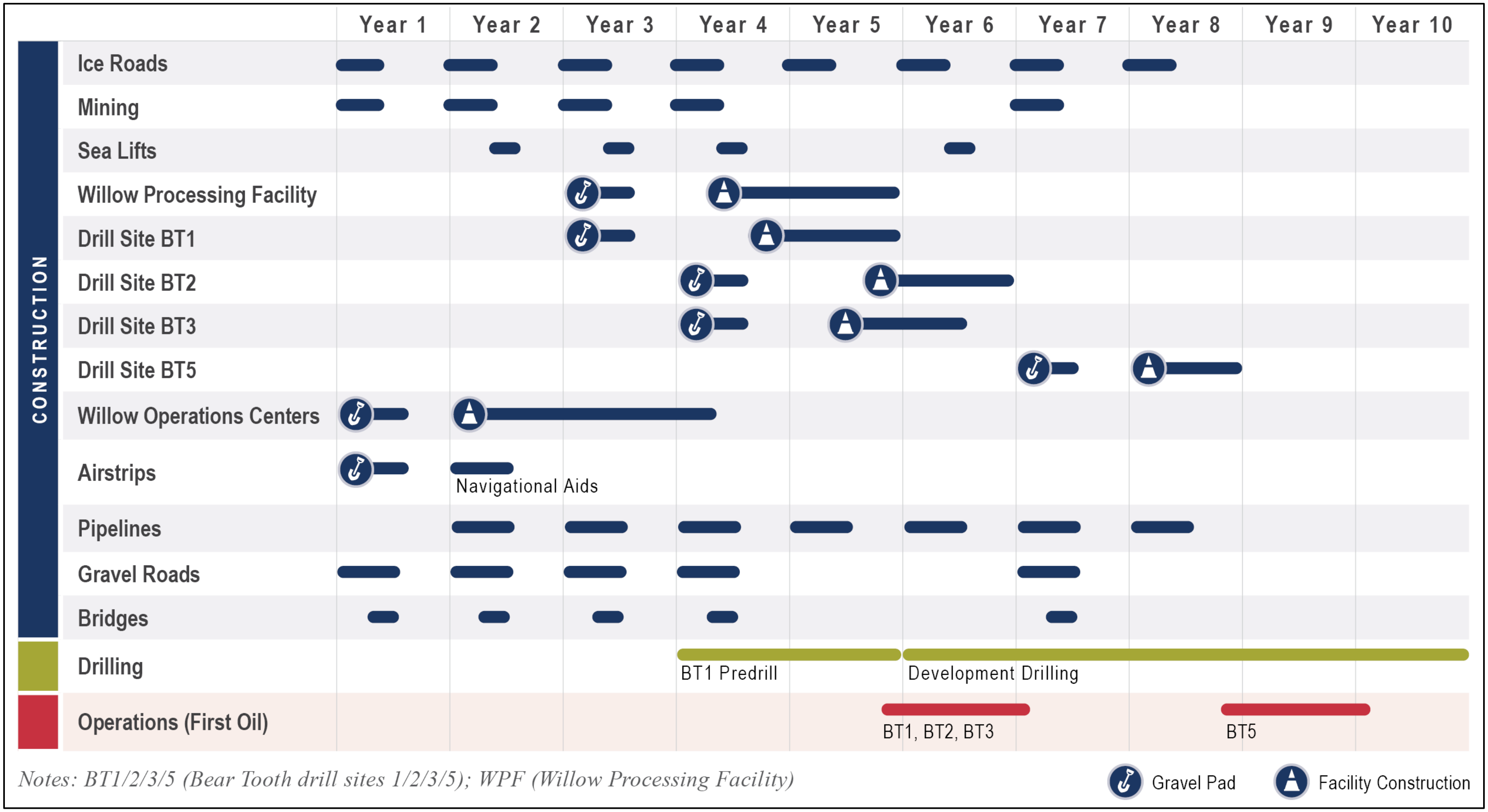

Figure D.4.20. Alternative E Estimated General Schedule*

4.6.12 Alternative E BT5 Deferral Activity Tables*

This section provides a summary of how the deferral to authorize construction of BT5 under Alternative E would impact Project activities and development (e.g., traffic, oil production). Tables D.4.45 through D.4.54 provide detailed Alternative E summaries of traffic volumes, ice infrastructure, water use, gravel volumes, and oil production; these tables break out the impacts associated with drill sites BT1, BT2, and BT3 from drill site BT5. These tables reflect construction of BT5 occurring in the earliest and most impactful year, Year 7; should authorization to construct BT5 be deferred beyond Year 7, the values presented for BT5 in year 7 and beyond would occur starting when construction of the drill site is authorized.

Table D.4.45. Alternative E Drill Site BT1, BT2, and BT3 Project Traffic Volumes Summary for the Life of the Project (number of trips)*

Year	Ground[a]	Fixed-Wing Trips Alpine[b,c]	Fixed-Wing Trips Willow[b,c]	Helicopter Trips Alpine[d]	Helicopter Trips Willow[d]	Barges to Oliktok Dock[e]	Tugboats to Oliktok Dock[f]	Support Vessels to Oliktok Dock[g]
Year 0	0	0	0	25	0	0	0	0
Year 1	55,300	60	0	50	0	0	0	0
Year 2	137,270	122	31	25	25	6	9	66
Year 3	282,270	75	168	0	82	8	12	88
Year 4	371,640	35	751	0	82	5	8	52
Year 5	387,250	0	707	0	82	0	0	0
Year 6	254,440	0	738	0	82	0	0	0
Year 7	108,890	0	560	0	82	0	0	0
Year 8	76,440	0	456	0	82	0	0	0
Year 9	50,220	0	352	0	82	0	0	0
Year 10	50,220	0	352	0	82	0	0	0
Year 11 to Year 30	1,004,400	0	7,040	0	1,640	0	0	0
Total	**2,778,340**	**292**	**11,155**	**100**	**2,321**	**19**	**29**	**206**

Note: Ground trips are defined as one-way; a single fixed-wing or helicopter flight is defined as a landing and subsequent takeoff; and a single vessel trip is defined as a docking and subsequent departure.

[a] Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B-70/Maxi Haul dump trucks).

[b] Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse).

[c] Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Cessna, or similar.

[d] Typical helicopters include A-Star and 206 Long Ranger models, although other similar types of helicopters may be used. Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all Project phases. Helicopter flights in Year 0 would occur in the fourth quarter and would support the start of Project construction in the first quarter of Year 1. Note: Helicopter flights within the NPR-A are authorized under approved right-of-way FF097411 valid through December 31, 2023.

[e] Includes sealift barges for bulk materials and small modules.

[f] Includes tugboats accompanying sealift barges.

[g] Includes crew boats, screeding barge, and other support vessels.

Table D.4.46. Alternative E Drill Site BT5 Project Traffic Volumes Summary for the Life of the Project (number of trips)*

Year	Ground[a]	Fixed-Wing Trips Alpine[b,c]	Fixed-Wing Trips Willow[b,c]	Helicopter Trips Alpine[d]	Helicopter Trips Willow[d]	Barges to Oliktok Dock[e]	Tugboats to Oliktok Dock[f]	Support Vessels to Oliktok Dock[g]
Year 0	0	0	0	0	0	0	0	0
Year 1	0	0	0	0	0	0	0	0
Year 2	0	0	0	0	0	0	0	0
Year 3	0	0	0	0	0	0	0	0
Year 4	0	0	0	0	0	0	0	0
Year 5	0	0	0	0	0	0	0	0
Year 6	0	0	0	0	0	2	5	19
Year 7	77,600	0	164	0	0	0	0	0
Year 8	81,890	0	164	0	0	0	0	0
Year 9	64,020	0	104	0	0	0	0	0
Year 10	64,020	0	104	0	0	0	0	0
Year 11 to Year 30	80,000	0	0	0	0	0	0	0
Total	**367,530**	**0**	**536**	**0**	**0**	**2**	**5**	**19**

Note: Ground trips are defined as one-way; a single fixed-wing or helicopter flight is defined as a landing and subsequent takeoff; and a single vessel trip is defined as a docking and subsequent departure.
[a] Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B-70/Maxi Haul dump trucks).
[b] Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse).
[c] Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Cessna, or similar.
[d] Typical helicopters include A-Star and 206 Long Ranger models, although other similar types of helicopters may be used. Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all Project phases. Helicopter flights in Year 0 would occur in the fourth quarter and would support the start of Project construction in the first quarter of Year 1. Note: Helicopter flights within the NPR-A are authorized under approved right-of-way FF097411 valid through December 31, 2023.
[e] Includes sealift barges for bulk materials and small modules.
[f] Includes tugboats accompanying sealift barges.
[g] Includes crew boats, screeding barge, and other support vessels.

Table D.4.47. Detail Breakdown Alternative E Total and Daily Ground Traffic (number of trips) by Season and Year*

Season and Year	Alternative E: BT1/BT2/BT3	Alternative E: BT5	Alternative E: Total
Summer Year 0 (total)	0	0	0
Summer Year 0 (daily)	0.0	0.0	0.0
Winter Year 1 (total)	33,180	0	33,180
Winter Year 1 (daily)	274.2	0.0	274.2
Spring Year 1 (total)	11,060	0	11,060
Spring Year 1 (daily)	181.3	0.0	181.3
Summer Year 1 (total)	11,060	0	11,060
Summer Year 1 (daily)	90.7	0.0	90.7
Fall Year 1 (total)	0	0	0
Fall Year 1 (daily)	0.0	0.0	0.0
Winter Year 2 (total)	92,127	0	92,126
Winter Year 2 (daily)	761.4	0.0	761.4
Spring Year 2 (total)	31,554	0	31,554
Spring Year 2 (daily)	517.3	0.0	517.3
Summer Year 2 (total)	11,055	0	11,055
Summer Year 2 (daily)	90.6	0.0	90.6
Fall Year 2 (total)	1,690	0	1,690
Fall Year 2 (daily)	27.7	0.0	27.7
Winter Year 3 (total)	190,286	0	190,285
Winter Year 3 (daily)	1,572.6	0.0	1,572.6
Spring Year 3 (total)	64,886	0	64,885
Spring Year 3 (daily)	1,063.7	0.0	1,063.7

Season and Year	Alternative E: BT1/BT2/BT3	Alternative E: BT5	Alternative E: Total
Summer Year 3 (total)	22,731	0	22,731
Summer Year 3 (daily)	186.3	0.0	186.3
Fall Year 3 (total)	3,478	0	3,478
Fall Year 3 (daily)	57.0	0.0	57.0
Winter Year 4 (total)	239,564	0	239,564
Winter Year 4 (daily)	1,979.9	0.0	1,979.9
Spring Year 4 (total)	83,863	0	83,863
Spring Year 4 (daily)	1,374.8	0.0	1,374.8
Summer Year 4 (total)	36,191	0	36,192
Summer Year 4 (daily)	296.6	0.0	296.7
Fall Year 4 (total)	9,176	0	9,176
Fall Year 4 (daily)	150.4	0.0	150.4
Winter Year 5 (total)	237,229	0	237,230
Winter Year 5 (daily)	1,960.6	0.0	1,960.6
Spring Year 5 (total)	86,318	0	86,318
Spring Year 5 (daily)	1,415.0	0.0	1,415.0
Summer Year 5 (total)	41,979	0	41,978
Summer Year 5 (daily)	344.1	0.0	344.1
Fall Year 5 (total)	17,542	0	17,541
Fall Year 5 (daily)	287.6	0.0	287.6
Winter Year 6 (total)	150,104	0	150,105
Winter Year 6 (daily)	1,240.5	0.0	1,240.5
Spring Year 6 (total)	54,486	0	54,487
Spring Year 6 (daily)	893.2	0.0	893.2
Summer Year 6 (total)	36,494	0	36,494
Summer Year 6 (daily)	299.1	0.0	299.1
Fall Year 6 (total)	14,750	0	14,750
Fall Year 6 (daily)	241.8	0.0	241.8
Winter Year 7 (total)	56,377	52,036	108,412
Winter Year 7 (daily)	465.9	430.0	896.0
Spring Year 7 (total)	21,779	17,905	39,683
Spring Year 7 (daily)	357.0	293.5	650.5
Summer Year 7 (total)	21,780	5,972	27,750
Summer Year 7 (daily)	178.5	49.0	227.5
Fall Year 7 (total)	10,890	1,126	12,016
Fall Year 7 (daily)	178.5	18.5	197.0
Winter Year 8 (total)	39,853	54,082	93,935
Winter Year 8 (daily)	329.4	447.0	776.3
Spring Year 8 (total)	15,283	18,835	34,118
Spring Year 8 (daily)	250.5	308.8	559.3
Summer Year 8 (total)	15,298	6,588	21,886
Summer Year 8 (daily)	125.4	54.0	179.4
Fall Year 8 (total)	7,634	1,964	9,599
Fall Year 8 (daily)	125.1	32.2	157.4
Winter Year 9 (total)	26,416	29,791	56,207
Winter Year 9 (daily)	218.3	246.2	464.5
Spring Year 9 (total)	10,044	12,804	22,848
Spring Year 9 (daily)	164.7	209.9	374.6
Summer Year 9 (total)	10,044	12,804	22,848
Summer Year 9 (daily)	82.3	105.0	187.3
Fall Year 9 (total)	5,022	6,402	11,424
Fall Year 9 (daily)	82.3	105.0	187.3
Winter Year 10 (total)	25,110	32,010	57,120
Winter Year 10 (daily)	207.5	264.5	472.1
Spring Year 10 (total)	10,044	12,804	22,848

Season and Year	Alternative E: BT1/BT2/BT3	Alternative E: BT5	Alternative E: Total
Spring Year 10 (daily)	164.7	209.9	374.6
Summer Year 10 (total)	10,044	12,804	22,848
Summer Year 10 (daily)	82.3	105.0	187.3
Fall Year 10 (total)	5,022	6,402	11,424
Fall Year 10 (daily)	82.3	105.0	187.3
Winter Year 11 (total)	25,110	39,201	64,311
Winter Year 11 (daily)	207.5	324.0	531.5
Spring Year 11–Year 30 (total)	200,880	16,000	216,880
Spring Year 11–Year 30 (daily)	164.7	13.1	177.8
Summer Year 11–Year 30 (total)	200,880	16,000	216,880
Summer Year 11–Year 30 (daily)	82.3	6.6	89.6
Fall Year 11–Year 30 (total)	100,440	8,000	108,440
Fall Year 11–Year 30 (daily)	82.3	6.6	88.9
Winter Year 12–Year 30 (total)	479,601	4,000	483,601
Winter Year 12–Year 30 (daily)	208.6	1.7	210.3
Season Total	**2,778,354**	**367,530**	**3,145,880**

Note: Ground trips are defined as one-way. Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B-70/Maxi Haul dump trucks). Daily values assume equal 24-hour distribution for each day of the season. Seasons are defined as follows: summer (122 days; June, July, August, September); fall (61 days; October, November); winter (121 days; December, January, February, March); and spring (61 days; April, May).

Table D.4.48. Detailed Alternative E Estimated Total Ice Road Mileage by Year*

Year	Alternative E: BT1/BT2/BT3	Alternative E: BT5	Alternative E: Total
Year 1	32.6	0.0	32.6
Year 2	42.0	0.0	42.0
Year 3	98.1	0.0	98.1
Year 4	146.9	0.0	146.9
Year 5	47.5	0.0	47.5
Year 6	12.6	0.0	12.6
Year 7	0.0	43.6	43.6
Year 8	0.0	7.9	7.9
Year 9	0.0	0.0	0.0
Total	**379.7**	**51.5**	**431.2**

Note: BT1/BT2/BT3/BT5 (drill sites BT1, BT2, BT3, and BT5).

Table D.4.49. Detailed Alternative E Estimated Total Ice Road Acreage by Year*

Year	Alternative E: BT1/BT2/BT3	Alternative E: BT5	Alternative E: Total
Year 1	181.4	0.0	181.4
Year 2	338.9	0.0	338.9
Year 3	743.0	0.0	743.0
Year 4	1,051.1	0.0	1,051.1
Year 5	403.0	0.0	403.0
Year 6	106.9	0.0	106.9
Year 7	0.0	274.9	274.9
Year 8	0.0	67.0	67.0
Year 9	0.0	0.0	0.0
Total	**2,824.3**	**341.9**	**3,166.2**

Note: BT1/BT2/BT3/BT5 (drill sites BT1, BT2, BT3, and BT5).

Table D.4.50. Detailed Alternative E Estimated Total Ice Pad Acreage by Year*

Year	Alternative E: BT1/BT2/BT3	Alternative E: BT5	Alternative E: Total
Year 1	112.7	0.0	112.7
Year 2	172.2	0.0	172.2
Year 3	201.9	0.0	201.9
Year 4	276.0	0.0	276.0
Year 5	31.7	0.0	31.7
Year 6	8.4	0.0	8.4
Year 7	0.0	92.4	92.4
Year 8	0.0	5.3	5.3
Year 9	0.0	0.0	0.0
Total	**802.9**	**97.7**	**900.6**

Note: BT1/BT2/BT3/BT5 (drill sites BT1, BT2, BT3, and BT5).

Table D.4.51. Alternative E Detailed Estimated Freshwater Use by Project Phase and Year (million gallons)*

Year (season)	BT1/BT2/BT3 Construction[a]	BT5 Construction[a]	BT1/BT2/BT3 Drilling[b]	BT5 Drilling[b]	BT1/BT2/BT3 Operations[c]	BT5 Operations[c]	Total
Year 0–Year 1 (winter)	72.3	0.0	0.0	0.0	0.0	0.0	**72.3**
Year 1 (summer)	1.1	0.0	0.0	0.0	0.0	0.0	**1.1**
Year 1–Year 2 (winter)	127.4	0.0	0.0	0.0	0.0	0.0	**127.4**
Year 2 (summer)	3.2	0.0	0.0	0.0	0.0	0.0	**3.2**
Year 2–Year 3 (winter)	238.3	0.0	0.0	0.0	0.0	0.0	**238.3**
Year 3 (summer)	9.3	0.0	0.0	0.0	0.0	0.0	**9.3**
Year 3–Year 4 (winter)	327.6	0.0	15.5	0.0	0.0	0.0	**343.1**
Year 4 (summer)	12.8	0.0	31.0	0.0	0.0	0.0	**43.8**
Year 4–Year 5 (winter)	112.1	0.0	31.9	0.0	0.0	0.0	**144.0**
Year 5 (summer)	19.8	0.0	32.8	0.0	0.9	0.0	**53.5**
Year 5–Year 6 (winter)	31.7	0.0	8.8	0.0	1.8	0.0	**42.3**
Year 6 (summer)	2.8	0.0	8.8	0.0	4.3	0.0	**15.9**
Year 6–Year 7 (winter)	0.5	90.2	8.1	0.7	3.2	0.0	**102.7**
Year 7 (summer)	0.0	1.0	7.4	1.4	4.8	0.3	**14.9**
Year 7–Year 8 (winter)	0.0	19.7	6.1	0.7	4.1	0.0	**30.6**
Year 8 (summer)	0.0	2.2	4.8	0.0	4.8	0.3	**12.1**
Year 8–Year 9 (winter)	0.0	0.2	2.4	2.4	4.1	0.0	**9.1**
Year 9 (summer)	0.0	0.0	0.0	4.8	4.8	0.3	**9.9**
Year 9–Year 10 (winter)	0.0	0.0	0.0	4.8	4.1	0.0	**8.9**
Year 10 (summer)	0.0	0.0	0.0	4.8	4.8	0.3	**9.9**
Year 10–Year 11 (winter)	0.0	0.0	0.0	2.4	4.1	0.0	**6.5**
Year 11 (summer)	0.0	0.0	0.0	0.0	4.8	0.3	**5.1**
Year 11–Year 12 (winter)	0.0	0.0	0.0	0.0	4.1	0.0	**4.1**
Year 12 (summer)	0.0	0.0	0.0	0.0	5.1	0.0	**5.1**
Year 12–Year 13+ (18 winters)[d]	0.0	0.0	0.0	0.0	4.1	0.0	**4.1**
Year 13+ (18 summers)[e]	0.0	0.0	0.0	0.0	4.8	0.3	**4.8**
Total	**958.9**	**113.3**	**157.6**	**22.0**	**220.0**	**6.9**	**1,478.7**

Note: "+" indicates total seasonal use from the indicated year to the end of Project operations (Year 30). BT1/BT2/BT3/BT5 (drill sites BT1, BT2, BT3, and BT5).
[a] The construction phase would include ice road construction (1.0 million gallons [MG] per mile for 35-foot-wide road, 1.4 MG per mile for a 50-foot-wide-road; and 2.0 MG per mile for 70-foot-wide road), ice pad construction (0.25 MG per acre), dust suppression, hydrostatic testing, and camp supply (100 gallons per person per day).
[b] The drilling phase would include drilling water (0.4 MG per month per drilling rig), hydraulic fracturing (1.0 MG per well prior to Willow Processing Facility startup), and camp supply (100 gallons per person per day).
[c] The operations phase would include dust suppression and camp supply (100 gallons per person per day).
[d] Annual winter water use for operations would be 4.1 MG.
[e] Annual summer water use for operations would be 5.1 MG.

Table D.4.52. Alternative E Detailed Estimated Fill Material Requirements by Project Component*

Component	Footprint (acres)[a]	Fill Quantity (cubic yards)[a]	Fill Type	Notes and Assumptions
Drill pads (three total)	53.6	773,000	Gravel	Based on three drill sites with an average pad thickness of 9 to 10 feet and 2:1 side slopes
Willow Processing Facility pad	22.8	346,000	Gravel	Based on an average pad thickness of 10 feet with 2:1 side slopes
Willow Operations Center pad	31.3	487,000	Gravel	Based on an average pad thickness of 10 feet with 2:1 side slopes
Valve pads (4 total) and pipeline pads (4 total)	2.9	48,000	Gravel	Based on four valve and four pipeline pads with an average pad thickness of 7 feet and 8 feet (respectively) with 2:1 side slopes
Water source access pads (5 total)	8.3	66,000	Gravel	Based on five pads with an average pad thickness of 7 to 10 feet with 2:1 side slopes
Communications tower pad	0.4	5,000	Gravel	Based on an average pad thickness of 7 feet with 2:1 side slopes
CPF2 pad expansion	1.0	13,000	Gravel	Based on an average pad thickness of 8-feet and 2:1 side slopes
Airstrip (includes airstrip and apron)	42.2	593,000	Gravel	Based on an average pad thickness of 9.5 feet with 2:1 side slopes
Gravel roads	184.5	1,588,00	Gravel	Based on an average road surface width of 24 to 32 feet and an average thickness of 7 feet with 2:1 side slopes; includes water source and airstrip access roads
Vehicle turnouts (5 total)	1.9	20,000	Gravel	Five subsistence tundra access road pullouts (one located every 2.5 to 3.0 miles) with an average thickness of 7 feet
Mine site perimeter berm	29.7	292,000	Overburden	Based on a minimum 5-foot thickness with 3:1 side slopes
Oliktok Dock upgrades	0.0	5,200	Gravel	All gravel would be placed within the existing developed footprint
Ublutuoch (Tiŋmiaqsiuġvik) River boat ramp and access road	1.8	20,000	Gravel	Boat ramp and 0.1-mile-long access road from the GMT-1 access road
Judy (Iqalliqpik) Creek boat ramp and access road	2.0	20,000	Gravel	Boat ramp and 0.1-mile-long access road from the drill site BT1 access road
Fish Creek Boat ramp and access road	2.1	21,000	Gravel	Boat ramp and 0.1-mile-long access road from the drill site BT2 access road
BT1, BT2, and BT3 Total	**384.5**	**4,297,200**	**NA**	**NA**
Drill pad (one total)	14.4	200,000	Gravel	Based on one drill site with an average pad thickness of 9 to 10 fee and 2:1 side slopes
Gravel roads	28.8	235,000	Gravel	Based on an average road surface width of 24 feet and an average thickness of 7 feet with 2:1 side slopes
Vehicle turnouts (2 total)	0.7	8,000	Gravel	Two subsistence tundra access road pullouts (located every 2.5 to 3.0 miles) with an average thickness of 7 feet
BT5 Total	**43.9**	**443,000**	**NA**	**NA**
Alternative E Total[b]	**428.4**	**4,740,200**	**NA**	**NA**

Note: 2:1 (2 horizontal to 1 vertical ratio); 3:1 (3 horizontal to 1 vertical ration); BT1/BT2/BT3/BT5 (drill sites BT1, BT2, BT3, and BT5); CPF2 (Kuparuk CPF2); GMT-1 (Greater Mooses Tooth 1); NA (not applicable).
[a] Values are approximate and are subject to change.
[b] Values may not total due to rounding; 4,448,200 cubic yards of gravel fill and 292,000 cubic yards of overburden fill.

Table D.4.53. Detailed Average Daily Oil and Non-Gas Liquids Estimated Production Profiles for Alternative E (thousands of barrels of oil per day)*

Year	Alternative E: BT1/BT2/BT3	Alternative E: BT5	Alternative E: Total
Year 6	165.2	0.0	**165.2**
Year 7	183.2	0.0	**183.2**
Year 8	164.9	0.0	**164.9**
Year 9	136.8	4.9	**141.7**
Year 10	115.5	9.6	**125.1**
Year 11	99.3	8.8	**108.0**
Year 12	88.7	8.2	**96.9**
Year 13	77.8	7.7	**85.5**
Year 14	69.2	7.1	**76.3**
Year 15	62.9	6.3	**69.2**
Year 16	57.5	5.7	**63.2**
Year 17	52.3	5.1	**57.3**
Year 18	46.5	4.6	**51.0**
Year 19	39.6	4.2	**43.7**
Year 20	34.4	3.8	**38.2**
Year 21	29.4	3.5	**32.8**
Year 22	25.4	3.2	**28.7**
Year 23	22.4	3.0	**25.4**
Year 24	19.9	2.8	**22.8**
Year 25	18.1	2.7	**20.7**
Year 26	16.5	2.5	**19.0**
Year 27	13.7	2.4	**16.1**
Year 28	13.6	2.3	**15.9**
Year 29	12.1	2.2	**14.3**
Year 30	11.1	2.1	**13.3**

Note: BT1/BT2/BT3/BT5 (drill sites BT1, BT2, BT3, and BT5).

Table D.4.54. Detailed Cumulative Oil and Non-Gas Liquids Estimated Production Profiles for Alternative E (million barrels of oil)*

Year	Alternative E: BT1/BT2/BT3	Alternative E: BT5	Alternative E: Total
Year 6	60.4	0.0	60.4
Year 7	127.4	0.0	127.4
Year 8	187.6	0.0	187.6
Year 9	237.6	1.8	239.4
Year 10	279.9	5.3	285.2
Year 11	316.1	8.5	324.7
Year 12	348.6	11.5	360.1
Year 13	377.0	14.3	391.3
Year 14	402.3	16.9	419.2
Year 15	425.3	19.2	444.5
Year 16	446.3	21.3	467.6
Year 17	465.4	23.1	488.5
Year 18	482.4	24.8	507.2
Year 19	496.8	26.3	523.1
Year 20	509.4	27.7	537.1
Year 21	520.1	29.0	549.1
Year 22	529.4	30.2	559.6
Year 23	537.6	31.3	568.8
Year 24	544.9	32.3	577.2
Year 25	551.5	33.3	584.7
Year 26	557.5	34.2	591.7
Year 27	562.5	35.1	597.6
Year 28	567.5	35.9	603.4
Year 29	571.9	36.7	608.6
Year 30	576.0	37.5	613.5
Total	**576.0**	**37.5**	**613.5**

Note: BT1/BT2/BT3/BT5 (drill sites BT1, BT2, BT3, and BT5).

4.7 Comparison of Action Alternatives*

Table D.4.55 provides a summary comparison of impacts by action alternative. As presented in Table D.4.55, Alternative E reflects the development of four pads (BT1, BT2, BT3, and BT5) regardless of any deferrals to provide comparison of the action alternatives under the most impactful scenario. Figures D.4.21A and D.4.21B provides a comparison of the action alternatives.

Table D.4.55. Summary Comparison of Impacts by Action Alternatives*

Project Component	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)
Drill site gravel pads	Five pads (79.8 acres total) Three 17.0-acre pads (51.0 acres total): BT1, BT2, and BT3 Two 14.4-acre pads (28.8 acres total): BT4 and BT5	Five pads (88.3 acres total): BT1 (23.3 acres), BT2 (18.1 acres), BT3 (17.0 acres), BT4 (15.5 acres), and BT5 (14.4 acres)	Five pads (62.8 acres total): Two 17.0-acre pads (34.0 acres total): BT1 and BT2 Two 14.4-acre pads (28.8 acres total): BT4 and BT5 BT3 (colocated with WPF; acreage accounted for under WPF pad)	Four pads (68.0 acres total): BT1 (18.4 acres), BT2 North (18.2 acres), BT3 (17.0 acres), and BT5 (14.4 acres)
WPF gravel pad	22.8-acre pad	22.8-acre pad	64.7-acre pad (colocated with BT3)	22.8-acre pad
WOC gravel pad	31.3-acre pad	Two WOC pads (50.2 acres total): South WOC (33.4 acres) North WOC (16.8 acres)	62.2-acre pad	31.3-acre pad
Constructed freshwater reservoir	16.4-acre excavation (reservoir and connecting channel) and 3.9-acre perimeter berm	16.4-acre excavation (reservoir and connecting channel) and 3.9-acre perimeter berm	16.4-acre excavation (reservoir and connecting channel) and 3.9-acre perimeter berm	No constructed freshwater reservoir
Water source access gravel pads	Two water source access pads (2.6 acres total) at the CFWR (1.3 acres) and Lake L9911 (1.3 acres)	Three water source access pads (3.9 acres total) at the CFWR (1.3 acres) and Lakes L9911 (1.3 acres) and M0235 (1.3 acres)	Two water source access pads (2.6 acres total) at the CFWR (1.3 acres) and Lake M0235 (1.3 acres)	Five water source access pads (8.3 acres total) at lakes L9911 (1.6 acres), M0015 (1.6 acres), M0112 (1.8 acres), M0235 (1.8 acres), and M1523A (1.5 acres)

Project Component	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)
Other gravel pads	Four valve pads (1.3 acres total); two pads at Judy (Iqalliqpik) Creek pipeline crossing and two pads at Fish Creek pipeline crossing Two HDD pipeline pads at Colville River crossing (1.5 acres total) Tie-in pad near Alpine CD4N (0.7 acre) Pipeline crossing pad near GMT-2 (0.5 acre) Communications tower pad (0.5 acre) Kuparuk CPF2 pad expansion (1.0 acre)	Four valve pads (1.7 acres total); two helicopter accessible pads at Judy (Iqalliqpik) Creek pipeline crossing and two pads at Fish Creek pipeline crossing Two HDD pipeline pads at Colville River crossing (1.5 acres total) Tie-in pad near Alpine CD4N (0.7 acre) Pipeline crossing pad near GMT-2 (0.5 acre) Communications tower pad (0.5 acre) Kuparuk CPF2 pad expansion (1.0 acre)	Four valve pads (1.3 acres total): two pads at Judy (Iqalliqpik) Creek pipeline crossing and two pads at Fish Creek pipeline crossing Two HDD pipeline pads at Colville River crossing (1.5 acres total) Tie-in pad near Alpine CD4N (0.7 acre) Pipeline crossing pad near GMT-2 (0.5 acre) Communications tower pad (0.5 acre) GMT-2 staging pad (5.9 acres) Kuparuk CPF2 pad expansion (1.0 acre) Alpine CD1 pad expansion (1.3 acres)	Four valve pads (1.3 acres total): two pads at Judy (Iqalliqpik) Creek pipeline crossing and two pads at Fish Creek pipeline crossing Two HDD pipeline pads at Colville River crossing (0.9 acres total) Tie-in pad near Alpine CD4N (0.7 acre) Communications tower pad (0.4 acre) Kuparuk CPF2 pad expansion (1.0 acre)
Single-season ice pads	Used during construction at the gravel mine site, bridge crossings, the Colville River HDD crossing, and other locations as needed in the Project area (936.6 total acres)	Used during construction at the gravel mine site, bridge crossings, the Colville River HDD crossing, and other locations as needed in the Project area (1,166.4 total acres)	Used during construction at the gravel mine site, bridge crossings, the Colville River HDD crossing, and other locations as needed in the Project area (1,241.4 total acres)	Used during construction at the gravel mine site, bridge crossings, the Colville River HDD crossing, and other locations as needed in the Project area (830.6 total acres)
Multi-season ice pads	Three 10.0-acre pads (30.0 acres total): 10.0-acre multi-season ice pad near GMT-2 (Q1 Year 1 to Q2 Year 5) 10.0-acre multi-season ice pad near WOC (Q1 Year 1 to Q2 Year 2) 10.0-acre multi-season ice pad at the Tiŋmiaqsiuġvik Gravel Mine Site (Q1 Year 1 to Q2 Year 3)	Three 10.0-acre pads (30.0 acres total): 10.0-acre multi-season ice pad near GMT-2 (Q1 Year 1 to Q2 Year 5) 10.0-acre multi-season ice pad near the South WOC (Q1 Year 1 to Q2 Year 2) 10.0-acre multi-season ice pad at the Tiŋmiaqsiuġvik Gravel Mine Site (Q1 Year 1 to Q2 Year 3)	Three 10.0-acre pads (30.0 acres total): 10.0-acre multi-season ice pad at GMT-2 (Q1 Year 1 to Q2 Year 5) 10.0-acre multi-season ice pad at the WOC (Q1 Year 1 to Q2 Year 2) 10.0-acre multi-season ice pad at Tiŋmiaqsiuġvik Gravel Mine Site (Q1 Year 1 to Q2 Year 3)	Three 10.0-acre pads (30.0 acres total): 10.0-acre multi-season ice pad near GMT-2 (Q1 Year 1 to Q2 Year 5) 10.0-acre multi-season ice pad near WOC (Q1 Year 1 to Q2 Year 2) 10.0-acre multi-season ice pad at the Tiŋmiaqsiuġvik Gravel Mine Site (Q1 Year 1 to Q2 Year 3)
Infield pipelines	43.4 total segment miles: BT1 to WPF (4.3 miles) BT2 to BT1 (4.7 miles) BT3 to WPF (4.2 miles) BT4 to BT2 (10.2 miles) BT5 to WPF (9.8 miles) GMT-2 to WPF (10.2)	47.0 total segment miles: BT1 to WPF (6.0 miles) BT2 to BT1 (4.5 miles) BT3 to WPF (5.9 miles) BT4 to BT2 (9.9 miles) BT5 to WPF (11.5 miles) GMT-2 to WPF (9.2 miles)	46.5 total segment miles: BT1 to WPF (10.0 miles) BT2 to BT1 (4.7 miles) BT4 to BT2 (10.2 miles) BT5 to WPF (6.5 miles) GMT-2 to WPF (15.1 miles)	34.0 total segment miles: BT1 to WPF (3.9 miles) BT2 North to BT1 (7.8 miles) BT3 to WPF (3.4 miles) BT5 to WPF (7.1 miles) GMT-2 to WPF (8.0 miles)
Willow export pipeline	33.3 total miles (WPF to tie-in pad near Alpine CD4N)	32.2 total miles (WPF to tie-in pad near Alpine CD4N)	38.2 total miles (WPF to tie-in pad near Alpine CD4N)	32.5 total miles (WPF to tie-in pad near Alpine CD4N)

Project Component	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)
Other pipelines	64.3-mile seawater pipeline (Kuparuk CPF2 to WPF); includes Colville River HDD crossing 34.4-mile diesel pipeline (Kuparuk CPF2 to Alpine CD1); includes Colville River HDD crossing; diesel would be trucked 33.0 miles from Alpine CD1 to the WOC 2.8-mile fuel gas pipeline (WOC to WPF) 4.8-mile freshwater pipeline (CFWR to WPF to WOC) 2.8-mile treated water pipeline (WOC to WPF)	63.3-mile seawater pipeline from Kuparuk CPF2 to WPF; includes Colville River HDD crossing 82.0-mile diesel pipeline from Kuparuk CPF2 to South WOC to WPF to North WOC 1.7-mile fuel gas pipeline (WPF to South WOC) 5.6-mile freshwater pipeline (CFWR to WPF to South WOC) 12.9-mile treated water pipeline (South WOC to WPF to North WOC)	69.2-mile seawater pipeline from Kuparuk CPF2 to WPF; includes Colville River HDD crossing 77.0-mile diesel pipeline from Kuparuk CPF2 to Alpine CD1 to WOC; includes Colville River HDD crossing 1.5-mile fuel gas pipeline (WPF to WOC) 2.2-mile freshwater pipeline (CFWR to WOC to WPF) 1.5-mile treated water pipeline (WOC to WPF)	64.3-mile seawater pipeline (Kuparuk CPF2 to WPF and 0.1-mile spur to K-Pad); includes Colville River HDD crossing 35.1-mile diesel pipeline (Kuparuk CPF2 to Alpine CD1); includes Colville River HDD crossing; diesel would be trucked 33.1 miles from Alpine CD1 to the WOC 2.3-mile fuel gas pipeline (WOC to WPF) 0.9-mile freshwater pipeline (various) 2.3-mile treated water pipeline (WOC to WPF)
Total miles of pipeline alignment without a parallel road (i.e., greater than 1,000 feet of separation)	38.3	42.4	45.2	35.7
VSMs	Approximately 13,000 total VSMs with a 0.8-acre disturbance footprint	Approximately 13,000 total VSMs with a 0.8-acre disturbance footprint	Approximately 13,700 total VSMs with a 0.9-acre disturbance footprint	Approximately 12,500 total VSMs with a 0.8-acre disturbance footprint
Pipeline VSMs below ordinary high water (number)	12	22	12	108
Gravel roads	37.4 miles (258.8 total acres, including vehicle turnouts) total connecting drill sites to the WPF, WOC, airstrip access road, water source access roads, and GMT-2 Eight vehicle turnouts with subsistence/tundra access ramps (3.0 acres total)	35.4 miles (240.6 total acres, including vehicle turnouts) total connecting: BT5, BT3, CFWR, South Airstrip access road, and South WOC to the WPF; and WPF to GMT-2 BT1, BT2, and BT4, water source access road, North Airstrip access road, and the North WOC Eight vehicle turnouts with subsistence/tundra access ramps (3.0 acres total)	27.2 miles (187.4 total acres, including vehicle turnouts) total connecting four drill sites to BT3/WPF, WOC, airstrip access road, and water source access roads; there would be no gravel road connection to GMT-2 Six vehicle turnouts with subsistence/tundra access ramps (2.2 acres total)	30.3 miles (215.4 total acres, including vehicle turnouts) total connecting drill sites to the WPF, WOC, airstrip access road, water source access roads, and GMT-2 Seven vehicle turnouts with subsistence/tundra access ramps (2.6 acres total)
Bridges	Seven total bridges: Judy (Iqalliqpik) Creek, Judy (Kayyaaq) Creek, Fish Creek, Willow Creek 2, Willow Creek 4, Willow Creek 4A, and Willow Creek 8	Six total bridges: Judy (Kayyaaq) Creek, Fish Creek, Willow Creek 2, Willow Creek 4, Willow Creek 4A, Willow Creek 8	Six total bridges: Judy (Iqalliqpik) Creek, Judy (Kayyaaq) Creek, Fish Creek, Willow Creek 4, Willow Creek 4A, and Willow Creek 8	Six total bridges: Judy (Iqalliqpik) Creek, Judy (Kayyaaq) Creek, Fish Creek, Willow Creek 2, Willow Creek 4, and Willow Creek 8

Project Component	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)
Bridge piles below ordinary high water (number)	36 total: 16 at Judy (Iqalliqpik) Creek 4 at Judy (Kayyaaq) Creek 16 at Fish Creek	20 total: 4 at Judy (Kayyaaq) Creek 16 at Fish Creek	36 total: 16 at Judy (Iqalliqpik) Creek 4 at Judy (Kayyaaq) Creek 16 at Fish Creek	36 total: 16 at Judy (Iqalliqpik) Creek 4 at Judy (Kayyaaq) Creek 16 at Fish Creek
Culverts or culvert batteries (number)	11	10	8	9
Cross-drainage culverts (number)	197	187	144	159
Airstrip	5,700 × 200–foot airstrip and apron (42.2 acres total); would also require airstrip access road	Two airstrips (87.6 acres total): North Airstrip: 5,700 × 200–foot airstrip and apron (43.8 acres total); would also require an airstrip access road South Airstrip: 5,700 × 200–foot airstrip and apron (43.8 acres total); would also require an airstrip access road	5,700 × 200–foot airstrip and apron (44.6 acres total); would also require an airstrip access road	5,700 × 200–foot airstrip and apron (42.2 acres total); would also require airstrip access road
Boat ramps	Three boat ramps (5.9 acres total): 1.8 acres at Ublutuoch (Tiŋmiaqsiuġvik) River 2.0 acres at Judy (Iqalliqpik) Creek 2.1 acres at Fish Creek	1.8 acres at Ublutuoch (Tiŋmiaqsiuġvik) River	1.8 acres at Ublutuoch (Tiŋmiaqsiuġvik) River	Three boat ramps (5.9 acres total): 1.8 acres at Ublutuoch (Tiŋmiaqsiuġvik) River 2.0 acres at Judy (Iqalliqpik) Creek 2.1 acres at Fish Creek
Oliktok Dock modifications	Modifications to the existing dock include adding structural components and a gravel ramp within the existing developed footprint 2.5 acres of screeding at Oliktok Dock 9.6 acres of screeding at the barge lightering area	Modifications to the existing dock include adding structural components and a gravel ramp within the existing developed footprint 2.5 acres of screeding at Oliktok Dock 9.6 acres of screeding at the barge lightering area	Modifications to the existing dock include adding structural components and a gravel ramp within the existing developed footprint 2.5 acres of screeding at Oliktok Dock 9.6 acres of screeding at the barge lightering area	Modifications to the existing dock include adding structural components and a gravel ramp within the existing developed footprint 2.5 acres of screeding at Oliktok Dock 9.6 acres of screeding at the barge lightering area
Ice roads	Approximately 495.2 total miles (3,590.7 total acres) over nine construction seasons (Year 1 through Year 9)	Approximately 650.1 total miles (4,411.6 total acres) 574.5 miles (4,090.3 acres) over nine construction seasons (Year 1 through Year 9) 3.6 miles (15.3 acres) of annual resupply ice road (Year 10 to Year 30; 75.6 total miles; 321.3 total acres)	Approximately 962.4 total miles (5,893.4 total acres) 699.9 miles (4,780.4 acres) over 10 construction seasons (Year 1 to Year 10) 12.5 miles (55.7 acres) of annual resupply ice road (Year 10 to Year 31; 262.5 total miles; 1,113.0 total acres)	Approximately 431.2 total miles (3,166.2 total acres) over eight construction seasons (Year 1 through Year 8)

Project Component	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)
Total footprint and gravel fill volume[a]	484.0-acre gravel footprint using 4.9 million cy of gravel fill and 317,000 cy of native fill 119.4-acre gravel mine site excavation 16.4-acre excavation at the CFWR 12.1-acre screeding area	545.9-acre gravel footprint using 5.8 million cy of gravel fill and 412,000 cy of native fill 189.8-acre gravel mine site excavation 16.4-acre excavation at the CFWR 12.1-acre screeding area	482.8-acre gravel footprint using 5.9 million cy of gravel fill and 412,000 cy of native fill 189.8-acre gravel mine site excavation 16.4-acre excavation at the CFWR 12.1-acre screeding area	428.4-acre gravel footprint using 4.4 million cy of gravel fill and 292,000 cy of native fill 115.0-acre gravel mine site excavation 12.1-acre screeding area
Gravel source	Two mine site cells (119.4 total acres) in Tiŋmiaqsiuġvik area (Mine Site Area 1 would be 90.5 acres and Mine Site Area 2 would be 28.9 acres)	Two mine site cells (189.8 total acres) in Tiŋmiaqsiuġvik area (Mine Site Area 1 would be 109.3 acres and Mine Site Area 2 would be 80.5 acres)	Two mine site cells (189.8 total acres) in Tiŋmiaqsiuġvik area (Mine Site Area 1 would be 109.3 acres and Mine Site Area 2 would be 80.5 acres)	Two mine site cells (115.0 total acres) in Tiŋmiaqsiuġvik area (Mine Site Area 1 would be 86.1 acres and Mine Site Area 2 would be 28.9 acres)
Total freshwater use	1,662.4 million gallons over the life of the Project (30 years)	1,914.3 million gallons over the life of the Project (30 years)	2,286.3 million gallons over the life of the Project (31 years)	1,478.7 million gallons over the life of the Project (30 years)
Ground traffic (number of trips)[b,c]	3,188,910	4,212,510	4,376,890	3,145,870
Fixed-wing air traffic[b,d]	12,101 total flights Willow: 11,809 Alpine: 292	19,574 total flights South Willow: 13,201 North Willow: 6,051 Alpine: 292	19,038 total flights Willow: 15,387 Alpine: 3,651	11,983 total flights Willow: 11,691 Alpine: 292
Helicopter air traffic[b,e]	2,421 total flights Willow: 2,321 Alpine: 100	2,910 total flights South Willow: 2,421 North Willow: 357 Alpine: 132	2,503 total flights Willow: 2,403 Alpine: 100	2,421 total flights Willow: 2,321 Alpine: 100
Marine traffic (number of trips)[b,f]	319 total trips Sealift barges: 24 Tugboats: 37 Support vessels: 258	319 total trips Sealift barges: 24 Tugboats: 37 Support vessels: 258	319 total trips Sealift barges: 24 Tugboats: 37 Support vessels: 258	280 total trips Sealift barges: 21 Tugboats: 34 Support vessels: 225
Project duration	30 years (9 years of construction)	30 years (9 years of construction)	31 years (10 years of construction)	30 years (8 years of construction)
Infrastructure in special areas	Colville River Special Area: 1.0 mile (8.1 acres) of gravel road; 1.4 miles of pipeline Teshekpuk Lake Special Area: 10.8 miles of gravel road and gravel pads (106.3 acres total); 11.4 miles of pipeline	Colville River Special Area: 1.0 mile (8.1 acres) of gravel road; 1.4 miles of pipeline Teshekpuk Lake Special Area: 12.5 miles of gravel road and gravel pads (179.6 acres total); 12.2 miles of pipeline	Colville River Special Area: 0.5 acre of gravel infrastructure; 1.4 miles of pipeline Teshekpuk Lake Special Area: 11.1 miles of gravel road and gravel pads (108.4 acres total); 11.4 miles of pipeline	Colville River Special Area: 1.0 mile of gravel road (7.6 acres); 1.3 miles of pipelines Teshekpuk Lake Special Area: 5.0 miles of gravel road and gravel pads (61.2 acres total); 4.9 miles of pipeline
Fish-bearing waterbody setback overlap (ROP E-2)	2.2 acres of gravel footprint, 0.2 mile of gravel road, and 1.7 miles of pipelines	4.0 acre of gravel footprint, 0.2 mile of gravel road, and 1.9 miles of pipelines	2.9 acres of gravel footprint, 0.2 mile of gravel road, and 1.7 miles of pipelines	7.3 acres of gravel footprint, 0.1 mile of gravel road, and 3.0 miles of pipelines
Less than 500-foot pipeline-road separation (ROP E-7)	24.0 miles of pipelines and road with less than 500 feet of separation	22.7 miles of pipelines and road with less than 500 feet of separation	23.0 miles of pipelines and roads with less than 500 feet of separation	21.6 miles of pipelines and road with less than 500 feet of separation

Project Component	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)
Yellow-billed loon setback overlap (ROP E-11)	10.8 acres of gravel infrastructure and 1.7 miles of pipelines within 0.5 mile of a nest 52.7 acres of gravel infrastructure and 7.6 miles of pipelines within 1,625 feet of occupied lakes	3.8 acres of gravel infrastructure and 1.7 miles of pipelines within 0.5mile of a nest 44.4 acres of gravel infrastructure and 7.5 miles of pipelines within 1,625 feet of occupied lakes	10.2 acres of gravel infrastructure and 1.7 miles of pipelines within 0.5 mile of a nest 39.9 acres of gravel infrastructure and 9.8 miles of pipelines within 1,625 feet of occupied lakes	9.4 acres of gravel infrastructure and 1.2 miles of pipelines within 0.5 mile of a nest 44.1 acres of gravel infrastructure and 5.8 miles of pipelines within 1,625 feet of occupied lakes
River setback overlap (LS K-1)	Colville River: 0.0 acres of gravel infrastructure and 0.0 miles of pipelines Fish Creek: 12.2 acres of gravel infrastructure and 1.6 miles of pipelines Judy (Kayyaaq) Creek: 18.7 acres of gravel infrastructure and 6.2 miles of pipelines	Colville River: 0.0 acres of gravel infrastructure and 0.0 miles of pipelines Fish Creek: 12.9 acres of gravel infrastructure and 1.5 miles of pipelines Judy (Kayyaaq) Creek: 1.1 acres of gravel infrastructure and 6.2 miles of pipelines	Colville River: 0.0 acres of gravel infrastructure and 0.0 miles of pipelines Fish Creek: 12.6 acres of gravel infrastructure and 1.6 miles of pipelines Judy (Kayyaaq) Creek: 16.7 acres of gravel infrastructure and 6.2 miles of pipelines	Colville River: 0.0 acres of gravel infrastructure and 0.0 miles of pipelines Fish Creek: 18.7 acres of gravel infrastructure and 1.7 miles of pipelines Judy (Kayyaaq) Creek: 21.2 acres of gravel infrastructure and 6.5 miles of pipelines
Deepwater lake setback overlap (LS K-2)	3.2 acres of gravel infrastructure and 0.0 mile of pipelines; 14.5 acres of the constructed freshwater reservoir would be within the setback and 1.4 acres of the reservoir connection would be within the lake	3.2 acres of gravel infrastructure and 0.0 mile of pipelines; 14.5 acres of the constructed freshwater reservoir would be within the setback and 1.4 acres of the reservoir connection would be within the lake	3.2 acres of gravel infrastructure and 1.5 miles of pipelines; 14.5 acres of the constructed freshwater reservoir would be within the setback and 1.4 acres of the reservoir connection would be within the lake	2.4 acres of gravel infrastructure and 0.2 mile of pipelines

Note: BT1 (Bear Tooth drill site 1); BT2 (Bear Tooth drill site 2); BT3 (Bear Tooth drill site 3); BT4 (Bear Tooth drill site 4); BT5 (Bear Tooth drill site 5); CD1 (Alpine CD1); CD4N (Alpine CD4N); CFWR (constructed freshwater reservoir); cy (cubic yard); GMT-2 (Greater Mooses Tooth 2); HDD (horizontal directional drilling); LS (lease stipulation); MTI (module transfer island); Q1 (first quarter); Q2 (second quarter); ROP (required operating procedure); VSM (vertical support member); WPF (Willow Processing Facility); WOC (Willow Operations Center). Ground trips are defined as one-way; a single flight is defined as a landing and subsequent takeoff; and a single vessel trip is defined as a docking and subsequent departure.

[a] Values may not sum to totals due to rounding.

[b] Total traffic is for the life of the Project (Alternative B and C, 30 years; Alternative D, 31 years) and does not include any reclamation activity.

[c] Number of trips includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Construction ground traffic also includes gravel hauling (e.g., B-70/Maxi Haul dump trucks).

[d] Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse); includes Q400, C-130, Twin Otter/CASA, Cessna, and DC-6 or similar aircraft.

[e] Typical helicopters include A-Star and 206 Long Ranger models, although other similar types of helicopters may be used. Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all phases of the Project

[f] Includes crew bats, tugboats supporting sealift barges, screeding barges, and other support vessels.

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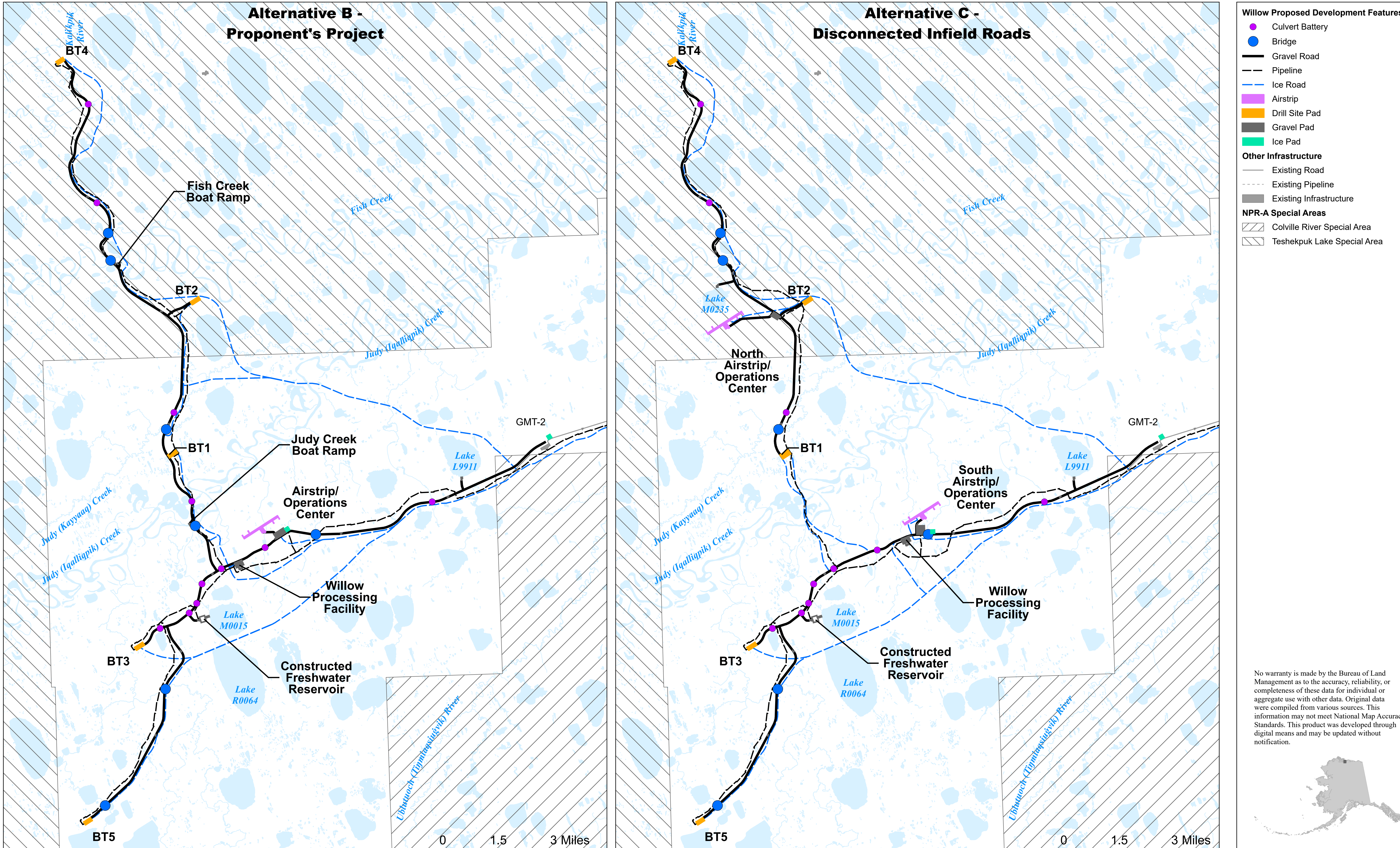

Figure D.4.21A

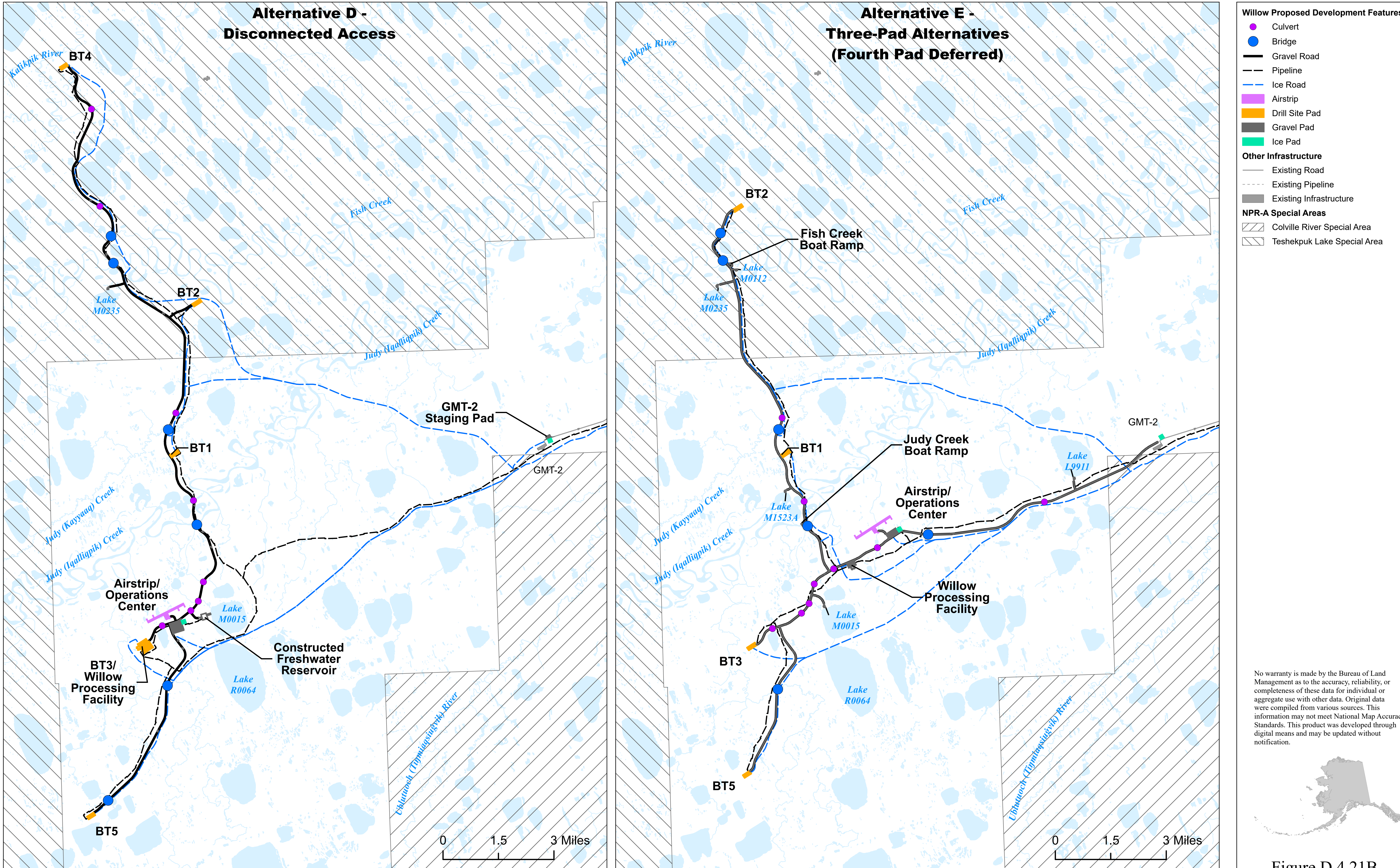

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Figure D.4.21B

4.8 Sealift Module Delivery Options

CPAI proposes to use large, prefabricated modules for Project components like the WPF and drill site facilities. These large modules would be fabricated at an off-site location and transported to the North Slope via sealift barge. Modules for the WPF and drill sites are anticipated to weigh between 3,000 and 4,000 tons and up to 1,000 tons, respectively. As a result, the large modules are too heavy to be transported across the Colville River on the annual resupply ice road and other options to transport the modules to the Project area are evaluated in this EIS. To facilitate off-loading and mobilization to the Project area, the following three module delivery options are presented for detailed analysis:

- Option 1: Atigaru Point Module Transfer Island
- Option 2: Point Lonely Module Transfer Island
- Option 3: Colville River Crossing

The first two options for module transport would deliver the large modules to an MTI west of the Colville River (eliminating this required crossing) and then use ice roads to transport the modules to their gravel pads. Based on discussions with stakeholders, CPAI developed a third option to deliver the large modules to the Project area that would use the existing Oliktok Dock. Option 3 would use existing Kuparuk gravel roads and ice roads to move the large modules to the Project area, with a new Colville River crossing location near Ocean Point.

Sealift delivery of the large WPF and drill site modules would occur during two open-water seasons. Under Alternatives B, C, and E, the modules would be delivered during the summers of Year 4 and Year 6; under Alternative D, the modules would be delivered during the summers of Year 5 and Year 7. The three module delivery options are detailed below. The large WPF and drill site module delivery barges would be in addition to the vessel traffic required to delivery small modules and bulk materials to Oliktok Dock, as described in Section 4.2.3.4, *Sealift Barge Delivery to Oliktok Dock*.

The origins of the modules and sealift barges are not currently known, but transit routes would follow existing, regularly used marine transportation routes. Any of the module delivery options could be combined with any of the action alternatives.

4.8.1 Option 1: Atigaru Point Module Transfer Island

4.8.1.1 Module Transfer Island Construction

Option 1 would include construction of an MTI with a design life of 5 to 10 years in State of Alaska–owned waters in Harrison Bay, approximately 2 miles north of Atigaru Point, to support sealift module delivery for the Project (Figure D.4.5). Modules for the WPF, BT1, BT2, and BT3 would be delivered by sealift barges to the MTI during the summer of Year 4 (Alternatives B, C, and E) or Year 5 (Alternative D). A second sealift would deliver modules for BT4 (Alternatives B, C, and D) and BT5 in Year 6 (Alternatives B, C, and E) or Year 7 (Alternative D). Modules would be stored on the MTI and mobilized from the MTI to their gravel pads via ice road the following winter ice road season.

The MTI would be built through the placement of gravel fill from the Tiŋmiaqsiuġvik Gravel Mine Site in approximately 8 to 10 feet of water to a height of approximately 13 feet above mean lower low water (MLLW). The MTI would include a 600-foot-square (8.3-acre) gravel work surface surrounded by 3:1 side slopes with gravel bag armor slope protection and a 200-foot-long sheet-pile dock with a top surface at 16 feet above MLLW to facilitate barge offloading (Figure D.4.5). The resulting island footprint would be approximately 12.8 acres (based on an assumed 8.5-foot depth) on the seafloor.

Gravel haul and placement to construct the MTI would occur via an ice road during the Year 2–Year 3 winter construction season under Alternatives B, C, and E and the Year 3–Year 4 winter season under Alternative D as soon as the ice roads have been constructed. Winter MTI construction would occur from a grounded sea ice pad surrounding the MTI. Sea ice within the MTI footprint, surrounding the MTI footprint, and the associated sea ice road would be bottom-fast (frozen to the seafloor) before construction of the MTI would begin. Sea ice within the MTI footprint would be cut and removed and gravel would be placed into the opening until the design volume and approximate shape of the MTI is attained. Installation of the sheet-pile offload dock would occur in winter once the initial gravel placement is sufficient to support pile-driving activities and the staging of materials and equipment. Sheet pile would be installed over approximately 25 to 30 days, with approximately 3 to 6 hours of actual pile driving occurring per day, using vibratory driving equipment. After completion of the sheet-pile bulkhead, a 24-inch-diameter pipe pile would be installed to support the dock face and provide barge mooring using both vibratory and impact pile-driving equipment. Pipe pile installation would take approximately 2 days with approximately 2 hours of pile driving per day (estimated at 1.5 hours of vibratory driving and 0.5 hour of impact driving per day). Winter pile driving for dock construction would cease prior to sea ice breakup. Because the MTI footprint and sea ice immediately surrounding the MTI would be bottom-fast during construction, turbid water would be contained within the grounded-ice footprint.

On-site equipment and facilities to support winter construction would include an office, a break room, an envirovac (bathroom), an emergency camp, mobile light plants, a helipad, navigational aids, and a tripwire perimeter alarm and surveillance camera. An approximately 195-foot-tall communications tower would be erected on a multi-season ice pad near Atigaru Point at the start of MTI construction and would remain in place until after the first module delivery season is complete; the tower would be reinstalled for the second module delivery season and remain in place until MTI decommissioning. One additional tower (i.e., repeater) would be erected on a multi-season ice pad to relay communications signals to the Project area. On-site facilities would also include a fuel storage area to hold and store multiple fuel tanks filled via ice road to support MTI construction. Workers to support winter construction would be housed at a 100-person construction camp located on a multi-season ice pad near Atigaru Point (Figure D.4.5). Except for equipment needed for summer construction activities, equipment would be removed from the MTI at the end of the winter construction season and transported via ice road to designated onshore staging areas.

During the following summer’s open-water season (Year 3 for Alternatives B, C, and E and Year 4 for Alternative D), construction equipment would be transported to the MTI by barge, likely from Oliktok Point. Workers to support summer construction would be housed at a 100-person camp located on a barge moored at or near the MTI. Work on the MTI would recommence around early to mid-July once the risk of ice encroachment has passed. The gravel surface would be reworked and compacted to eliminate interstitial ice and then graded to the final design. Large prefabricated filter fabric panels would be installed on the side slopes by crane, and slope protection, in the form of 4-cubic-yard gravel-filled bags, would be installed on the fabric-covered side slopes from the seafloor to the work surface. Concrete footings would then be installed on the compacted work surface to support module storage. All construction equipment not needed for subsequent activities on the MTI would be demobilized as soon as summer construction activities are completed.

4.8.1.2 Module Delivery

To facilitate module delivery, barge lightering would be used to reduce the required vessel draft at the MTI dock face. Prior to sealift barge arrival, the barge lightering area and the area in front of the MTI dock face would require screeding (14.5 total acres; Figure D.4.5). (Screeding is described in Section 4.2.3.4, *Sealift Barge Delivery to Oliktok Dock*. Preparation of the barge lightering area and lightering process would be the same, except the screeding area adjacent to the MTI [4.9 acres] would be larger than that required for Oliktok Dock [2.5 acres].)

Modules would be offloaded from eight sealift barges onto the MTI in summer Year 4 (Alternatives B, C, and E) or Year 5 (Alternative D). Modules, riding on self-propelled module transporters (SPMTs), would be stored on the concrete footings installed during the previous summer construction season. The SPMTs would be skirted to prevent snow and wildlife from moving underneath the staged modules. During the winter season of Year 4–Year 5 (Alternatives B, C, and E) or Year 5–Year 6 (Alternative D), heavy-haul ice roads would be constructed onshore and offshore to support module transport (Figure D.4.5). All modules would be transported using SPMTs via sea ice road from the MTI to a staging area located on an onshore ice pad located near the shoreline (location to be determined). From the staging area, all modules would be transported over a land-based ice road to the WPF for installation. Modules for BT4 (Alternatives B, C, and D) and BT5 would be delivered via a second sealift in summer Year 6 (Alternatives B, C, and E) or Year 7 (Alternative D) and moved to the Project area in the same manner as the modules for the WPF, BT1, BT2, and BT3 the following winter.

4.8.1.3 Module Transfer Island Maintenance and Decommissioning

The MTI would be inspected on an annual basis shortly after breakup to identify and repair any consequential damage for its service life (5 years). Following module mobilization from the MTI to the WPF, all work-surface facilities would be removed from the MTI.

At the end of the MTI service life, all gravel slope protection materials and other anthropogenic materials would be removed from the MTI, including removal of all sheet and pipe piles.

It is expected that after the island is abandoned, it would be naturally reshaped by waves and ice. Based on observations from two exploratory islands (Resolution and Goose islands) at similar water depths in the Beaufort Sea that have been decommissioned using similar methods, the MTI would be expected to be reshaped to a crescent reminiscent of a natural barrier island within 10 to 20 years. (Resolution Island is located in the Sagavanirktok River Delta, and Goose Island is located in Foggy Island Bay.) The top of the MTI would likely drop to or below the water surface within the 10- to 20-year period following island abandonment. Based on previous North Slope experience, navigational aids would not be installed on the abandoned and decommissioned island due to the potential of the navigational aids being rendered inoperable due to damage (i.e., wave or ice impacts, erosion of the unarmored gravel material). In keeping with precedent for islands previously abandoned on the North Slope, the location, shape, and maximum island elevation would be documented by one or more post-abandonment surveys and reported to the U.S. Coast Guard for publication in Notices to Mariners and inclusion in pertinent navigational charts. This practice would ensure that mariners are made aware of the shoal and would minimize the possibility mariners would depend on a navigational aid that may be inoperable.

4.8.1.4 Ice Roads

Ice roads would be used for gravel hauling operations required to construct the MTI and for sealift module delivery from the MTI to the Project area. Portions of the ice roads would be constructed across the TLSA between both the gravel mine site and the Project area to complete construction of the MTI and deliver the sealift modules to their respective pads. These ice roads would be temporary and would not occurring during sensitive times for caribou or birds. Ice road widths would vary based on their intended use, with gravel hauling ice roads being 50 feet wide and module hauling routes ranging from 60 to 120 feet wide, for tundra-based and sea ice–based roads, respectively. Gravel haul ice roads would connect the MTI to the Tiŋmiaqsiuġvik Gravel Mine Site for MTI construction and the heavy haul ice roads would connect the MTI to the Project area to support module transport to the Project area. An exception would be needed for ROP C-1 as the sea ice roads would be greater than 12 feet wide to support gravel hauling and module transfer.

Ice road needs for the Atigaru Point MTI are described and summarized in Table D.4.56.

Table D.4.56. Option 1: Atigaru Point Module Transfer Island Ice Road Route Summary

Ice Road Type	Total Length (miles)[a]	Width (feet)	Total Area (acres)[a]	Description
Tundra heavy haul and support	68.4[b]	60	497.4[b]	Onshore module delivery (SPMTs) and support vehicle traffic
Sea ice heavy haul	4.8	120	69.8	Offshore module delivery
Tundra gravel haul	35.2	50	213.3	Gravel haul route to construct the MTI
Sea ice gravel haul	2.4	50	14.5	Gravel haul route to construct the MTI
Total	**110.8**	**NA**	**795.0**	**NA**

Note: MTI (module transfer island); NA (not applicable); SPMT (self-propelled module transporter).
[a] Total value includes all years of ice road segment construction (i.e., some routes would be constructed more than once).
[b] Alternative D would require an additional 5.4 total miles of 60-foot-wide heavy-haul ice road (39.3 acres) to reach the Willow Processing Facility gravel pad.

The Proponent's MTI would require a total of approximately 110.8 miles of ice roads (103.6 miles onshore, 7.2 miles offshore) resulting in a total ice road area of 795.0 acres (710.7 acres onshore, 84.3 acres offshore). No seawater would be used to construct onshore ice roads; a combination of seawater and freshwater would be used to construct offshore ice roads. Ice road mileage and footprint is summarized by year in Table D.4.57.

Table D.4.57. Option 1: Atigaru Point Module Transfer Island Estimated Total Ice Road Mileage and Footprint by Year (tundra based and sea ice based)

Year	Ice Road Length (miles)	Ice Road Footprint (acres)
Year 1	0.0	0.0
Year 2	0.0	0.0
Year 3	37.6	227.8
Year 4	0.0	0.0
Year 5	36.6	283.6
Year 6	0.0	0.0
Year 7	36.6	283.6
Total[a]	**110.8**	**795.0**

[a] Alternative D would require an additional 5.4 total miles of 60-foot-wide heavy-haul ice road (39.3 acres) to reach the Willow Processing Facility gravel pad.

4.8.1.5 Ice Pads

Single-season and multi-season ice pads would be used to support the construction of the MTI and the delivery of the sealift modules to the Project area. Single- and multi-season ice pads are described in Section 4.2.4.1, *Ice Pads*.

Option 1 would require 118.9 acres of single-season ice pads to support MTI construction, ice road construction, and module delivery. Additionally, three 10.0-acre multi-season ice pads would be required to construct the gravel haul ice roads and module heavy-haul ice roads for both sealift delivery events. They would be located at BT1, near Atigaru Point, and midway between BT1 and Atigaru Point. The ice pads would be used to stage equipment at strategic locations along ice road routes.

4.8.1.6 Water Use

Freshwater would be required to support construction of the MTI, ice roads, and ice pads and provide domestic water supply for camps. Seawater would be needed for construction of the gravel haul and module haul sea ice road and for use as barge ballast. Option 1 water use is summarized by year and season in Table D.4.58. Total freshwater requirements for the Atigaru Point MTI would be 307.9 MG and seawater requirements would be 376.0 MG.

Table D.4.58. Option 1: Atigaru Point Module Transfer Island Freshwater and Seawater Use by Year (million gallons)

Year (season)	Freshwater – Ice Pads[a]	Freshwater – Ice Roads[b]	Freshwater – Camp Supply[c]	Freshwater Total	Seawater Total[d]
Year 1–Year 2 (winter)	5.0	0.0	0.5	**5.5**	**0.0**
Year 2 (summer)	0.0	0.0	0.0	**0.0**	**0.0**
Year 2–Year 3 (winter)	11.3	53.7	2.3	**67.3**	**74.0**
Year 3 (summer)	0.0	0.0	1.4	**1.4**	**0.0**
Year 3–Year 4 (winter)	7.5	0.0	0.5	**8.0**	**0.0**
Year 4 (summer)	0.0	0.0	0.9	**0.9**	**4.0**
Year 4–Year 5 (winter)	11.7	93.5[e]	3.2	**108.4**	**147.0**
Year 5 (summer)	0.0	0.0	0.0	**0.0**	**0.0**
Year 5–Year 6 (winter)	7.5	0.0	0.5	**8.0**	**0.0**
Year 6 (summer)	0.0	0.0	0.9	**0.9**	**4.0**
Year 6–Year 7 (winter)	11.7	93.5[e]	2.3	**107.5**	**147.0**
Year 7 (summer)	0.0	0.0	0.0	**0.0**	**0.0**
Total	**54.7**	**240.7[e]**	**12.5**	**307.9**	**376.0**

[a] Ice pad construction uses 0.25 million gallons (MG) of water per acre.
[b] Ice road construction uses 1.5 MG of water per mile for a 35-foot-wide road and 2.5 MG of water per mile for a 60-foot-wide road.
[c] Camp supply assumes 100 gallons of water per person per day.
[d] Includes ballast water and sea ice road construction.
[e] Alternative D would require an additional 6.7 MG of freshwater for each module mobilization (13.4 MG total).to support ice road construction.

4.8.1.7 Traffic

Construction of the MTI and delivery of the sealift modules to the Project area would require ground, air, and marine traffic. Rolligons would be used to deliver ice pad construction equipment to strategic points along the ice road route where the equipment would be staged on multi-season ice pads. Additional ground traffic would include light-duty trucks, passenger trucks, gravel hauling trucks, and miscellaneous support vehicles. Fixed-wing aircraft would be used for security and MTI and module monitoring. Helicopters would be used for security and to transport personnel or equipment to Atigaru Point or the MTI. Tugboats and sealift barges would bring the modules from points outside of Alaska and support vessel traffic would be between Atigaru Point and Oliktok Dock.

Traffic volumes to support construction of the Atigaru Point MTI and delivery of the sealift modules is summarized by year in Table D.4.59; Table D.4.60 provides a summary of traffic volumes to Atigaru Point by year and season.

Table D.4.59. Option 1: Atigaru Point Module Transfer Island Traffic Volumes Summary (number of trips)

Year	Ground[a]	Fixed-Wing Trips Alpine[b]	Fixed-Wing Trips Willow[b]	Fixed-Wing Trips Atigaru[b]	Helicopter Alpine[c]	Helicopter Willow[c]	Sealift Barges at Atigaru[d]	Support Vessels[e]	Tugboats at Atigaru[d]
Year 2	43,680	25	0	0	15	0	0	0	0
Year 3	140,670	0	35	36	0	210	0	140	0
Year 4	43,790	0	85	12	0	65	8	88	12
Year 5	1,082,620	0	30	18	0	55	0	0	0
Year 6	43,770	0	35	12	0	60	1	21	4
Year 7	951,580	0	20	18	0	45	0	10	0
Total	**2,306,110**	**25**	**205**	**96**	**15**	**435**	**9**	**259**	**16**

Note: Ground trips are defined as one-way; a single flight is defined as a landing and subsequent takeoff; and a single vessel trip is defined as a docking and subsequent departure.

[a] Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B-70/Maxi Haul dump trucks) and module delivery (i.e., self-propelled module transporter).

[b] Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse). Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Cessna, or similar.

[c] Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all phases of the Project. Typical helicopters include A-Star and 206 Long Ranger models, although other similar types of helicopters may be used.

[d] Table indicates the arrival month at Atigaru Point and assumes the vessels departed Dutch Harbor approximately 4 weeks prior.

[e] Includes crew boats, tugboats supporting sealift barges, and other support vessels.

Option 1 would include 326 total fixed-wing aircraft flights, 450 total helicopter flights, 25 tugboat and barge trips, and 259 support vessel trips.

Table D.4.60. Option 1: Atigaru Point Module Transfer Island Traffic Volume Summary by Season (number of trips)

Season and Year	Ground[a]	Fixed Wing to Alpine[b]	Fixed Wing to Willow[b]	Fixed Wing to Atigaru[b]	Alpine Helicopter[c]	Willow Helicopter[c]	Sealift Barges at Atigaru[d]	Support Vessels[e]	Tugboats at Atigaru[d]
Winter Year 2	32,760	15	0	0	0	0	0	0	0
Spring Year 2	10,920	10	0	0	0	0	0	0	0
Summer Year 2	0	0	0	0	15	0	0	0	0
Winter Year 3	105,504	0	7	18	0	78	0	0	0
Spring Year 3	35,168	0	3	6	0	42	0	0	0
Summer Year 3	0	0	0	12	0	90	0	140	0
Fall Year 3	0	0	16	0	0	0	0	0	0
Winter Year 4	32,844	0	37	0	0	0	0	0	0
Spring Year 4	10,948	0	17	0	0	0	0	0	0
Summer Year 4	0	0	16	12	0	40	8	88	12
Fall Year 4	0	0	16	0	0	20	0	0	0
Winter Year 5	811,965	0	26	13	0	50	0	0	0
Spring Year 5	270,655	0	12	5	0	10	0	0	0
Winter Year 6	32,829	0	7	0	0	24	0	0	0
Spring Year 6	10,943	0	3	0	0	12	0	0	0
Summer Year 6	0	0	0	12	0	16	1	21	4
Fall Year 6	0	0	16	0	0	8	0	0	0
Winter Year 7	713,685	0	24	13	0	34	0	0	0
Spring Year 7	237,895	0	5	5	0	11	0	0	0
Summer Year 7	0	0	0	0	0	0	0	10	0
Total	**2,306,116**	**25**	**205**	**96**	**15**	**435**	**9**	**259**	**16**

Note: Trips are defined as one-way; a single flight is defined as a landing and subsequent takeoff; and a single vessel trip is defined as a docking and subsequent departure.
[a] Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B-70/Maxi Haul dump trucks) and module delivery (i.e., self-propelled module transporters).
[b] Flights outlined are additional flights required beyond projected travel to/from existing airstrips. Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Cessna, or similar.
[c] Typical helicopters include A-Star and 206 Long Ranger models, although other similar types of helicopters may be used. Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all phases of the Project.
[d] Table indicates the arrival month at Atigaru Point and assumes the vessels departed Dutch Harbor approximately 4 weeks prior.
[e] Includes crew boats, tugboats supporting sealift barges, and other support vessels.

4.8.1.8 Schedule

Figure D.4.22 provides a schedule for Option 1: Atigaru Point Module Transfer Island.

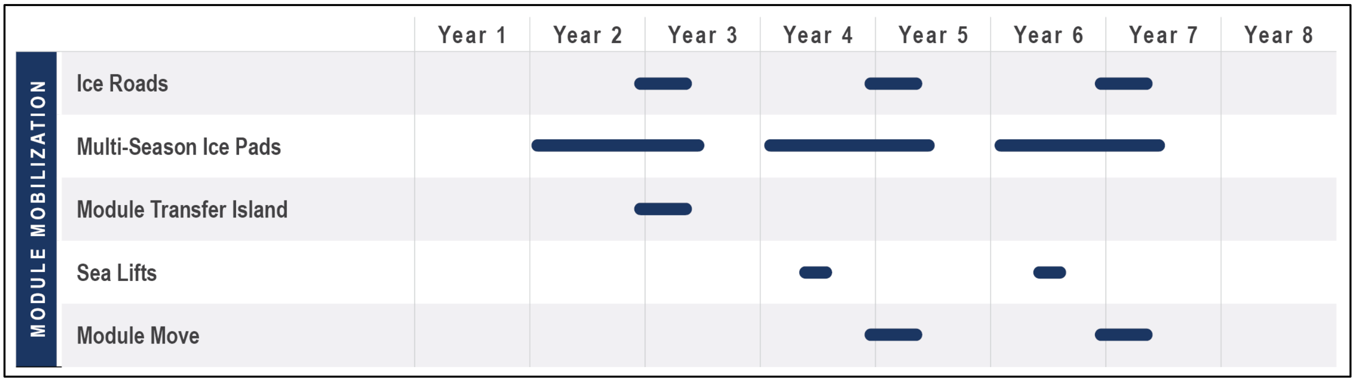

Figure D.4.22. Schedule of Activity for Option 1: Atigaru Point Module Transfer Island

Note: Sea Lift 1 would include the Willow Process Facility and Bear Tooth drill sites 1, 2, and 3 facilities; Sea Lift 2 would include Bear Tooth drill sites 4 and 5 facilities. Schedule shown is for Alternative B.

4.8.1.9 Option 1: Atigaru Point Module Transfer Island Design Summary

Table D.4.61 summarizes the design characteristics of the Proponent's MTI.

Table D.4.61. Option 1: Atigaru Point Module Transfer Island Design Characteristics Summary

Element	Description
Location	Southwestern Harrison Bay, approximately 2.2 nautical miles offshore near Atigaru Point
Water depth	Approximately 8 feet, MLLW
Work surface	600 feet by 600 feet (8.3 acres) at +13 feet, MLLW
Design life	5 to 10 years
Dock	200-foot-long dock face at +16 feet, MLLW
Gravel fill volume	397,000 cy from Tiŋmiaqsiuġvik Gravel Mine Site
Seafloor footprint	12.8 acres
Screeding area	4.9 acres adjacent to dock face; 9.6 acres at the barge lightering area (14.5 acres total)
Side slopes	3 horizontal to 1 vertical ratio (3:1)
Side slope armor	6,000 total 4-cy gravel filled bags
Ice ramp	7 horizontal to 1 vertical ratio (7:1) slope; 120 feet wide
Gravel haul ice roads	Tundra based: 35.2 total miles of 50-foot-wide ice road (213.3 acres) Sea ice based: 2.4 total miles of 50-foot-wid ice road (14.5 acres)
Module haul ice roads[a]	Tundra based: 68.4 total miles of 60-foot-wide ice road (497.4 acres)[a] Sea ice based: 4.8 total miles of 120-foot-wid ice road (69.8 acres)
Single-season ice pads	Ice pads (110.8 total acres) constructed at MTI site (approximately 2.4 miles offshore) and to support ice road construction
Multi-season ice pads	Three 10.0-acre multi-season ice pads (30.0 acres total) to support module mobilization and gravel hauling at BT1, near Atigaru Point, and midway between BT1 and Atigaru Point
Camps	100-person camp for winter ice road construction each season 100-person camp for module offload and transport for each sealift 100-person vessel-based camp for summer construction at MTI
Freshwater use[a]	307.9 million gallons for camps, ice roads, and ice pads[a]
Total seawater use	376.0 million gallons for ice roads and ballast water

Note: BT1 (Bear Tooth drill site 1); cy (cubic yards); MLLW (mean lower low water); MTI (module transfer island).
[a] Alternative D would require an additional 2.7 miles of 60-foot-wide heavy-haul ice road to reach the Willow Processing Facility gravel pad for each year of module mobilization. This additional ice road would require an additional 6.7 million gallons of freshwater in each year of module mobilization (13.4 million gallons of freshwater).

4.8.2 Option 2: Point Lonely Module Transfer Island

Option 2 would include construction of an MTI at Point Lonely (Figure D.4.6). Point Lonely is a former U.S. Department of Defense site approximately 15 miles east of Smith Bay that is no longer in operation and has been decommissioned from its historical use. The site is located approximately 40 air miles northwest of the Option 1 Atigaru Point MTI location, north of Teshekpuk Lake along the coast of the Beaufort Sea. The site still contains gravel infrastructure, including roads, pads, and an airstrip, although most structures have been removed or are otherwise abandoned. The site is now under the management of the BLM.

4.8.2.1 Module Transfer Island Construction

A new MTI, with a design life of 5 to 10 years, would be constructed at Point Lonely (approximately 0.6 miles offshore in State of Alaska–owned waters) to support sealift module delivery for the Project (Figure D.4.6). Modules for the WPF, BT1, BT2, and BT3 would be delivered by sealift barges to the MTI during the summer of Year 4 (Alternatives B, C, and E) or Year 5 (Alternative D). A second sealift would deliver modules for BT4 (Alternatives B, C, and E) and BT5 in Year 6 (Alternatives B, C, and E) or Year 7 (Alternative D). Modules would be stored on the MTI and mobilized from the MTI to the WPF via ice road the following winter ice road season.

The MTI would be built through placement of gravel fill from the Tiŋmiaqsiuġvik Gravel Mine Site in approximately 9.8 to 11.2 feet of water (an average of 10.5 feet) to a height of approximately 13 feet above MLLW. The MTI would consist of a 600-foot-square (8.3-acre) gravel work surface surrounded by 3:1 side slopes with gravel bags and a 200-foot-long sheet-pile dock with a top surface 16 feet above MLLW to facilitate barge offloading (Figure D.4.6). The resulting island footprint would be approximately 13.0 acres (based on the average 10.5-foot depth) on the seafloor.

Gravel haul and placement to construct the MTI would occur via ice road during the Year 2–Year 3 winter construction season under Alternatives B, C, and E and the Year 3–Year 4 winter season under Alternative D as soon as the ice roads have been constructed. Winter MTI construction would occur from a grounded sea ice pad surrounding the MTI. Sea ice within the MTI footprint, surrounding the MTI footprint, and the associated off-shore ice road would be bottom-fast (frozen to the seafloor) before construction of the MTI would begin. Sea ice within the MTI footprint would be cut and removed and gravel would be placed into the opening until the design volume and approximate shape of the MTI is attained. Installation of the sheet-pile offload dock would occur in winter once the initial gravel placement is sufficient to support pile-driving activities and staging of materials and equipment. Sheet pile would be installed over a period of approximately 25 to 30 days, with approximately 3 to 6 hours of pile driving occurring per day, using vibratory driving equipment. After completion of the sheet-pile bulkhead, a 24-inch-diameter pipe pile would be installed to support the dock face and provide barge mooring, using both vibratory and impact pile-driving equipment. Pipe pile installation would take approximately 2 days with approximately 2 hours of pile driving per day (estimated at 1.5 hours of vibratory driving and 0.5 hour of impact driving per day). Winter pile driving for dock construction would cease prior to sea ice breakup. Because the MTI footprint and sea ice immediately surrounding the MTI would be bottom-fast during construction, turbid water would be contained within the grounded ice footprint.

On-site equipment and facilities to support winter construction would include an office, a break room, an envirovac (bathroom), an emergency camp, mobile light plants, a helipad, navigational aids, and a tripwire perimeter alarm and surveillance camera. An approximately 195-foot-tall communications tower would be erected at the start of MTI construction and would remain in place until after the first module delivery season is complete; the tower would be reinstalled for the second module delivery season and remain in place until MTI decommissioning. Two additional towers (i.e., repeaters) would be erected on a multi-season ice pads to relay communications signals to the Project area. On-site facilities would also include a fuel storage area to hold multiple fuel tanks filled via ice road to support MTI construction. Workers to support winter construction would be housed at a 100-person construction camp located on the existing gravel pad at the Point Lonely site (Figure D.4.6). Except for equipment needed for summer construction activities, equipment would be removed from the MTI at the end of the winter construction season and transported via ice road to designated onshore staging areas.

During the following summer's open-water season (Year 3 for Alternatives B, C, and E and Year 4 for Alternative D), construction equipment would be transported to the MTI by barge, likely from Oliktok Point. Work on the MTI would recommence around early to mid-July once the risk of ice encroachment has passed. The gravel surface would be reworked and compacted to eliminate interstitial ice and then graded to the final design configuration. Large, prefabricated filter fabric panels would be installed on the side slopes by crane, and slope protection, in the form of 4-cy gravel-filled bags, would be installed on the fabric-covered side slopes from the seafloor to the work surface. Concrete footings would then be installed on the compacted work surface to support module storage. All construction equipment not needed for subsequent activities on the MTI would be demobilized as soon as summer construction activities are completed.

4.8.2.2 Module Delivery

To facilitate module delivery, barge lightering would be used to reduce the required vessel draft at the MTI dock face. Prior to sealift barge arrival, the barge lightering area and the area in front of the MTI dock face would require screeding (14.5 total acres; Figure D.4.6). (Screeding is described in Section 4.2.3.4, *Sealift Barge Delivery to Oliktok Dock*. Preparation of the barge lightering area and lightering process would be the same, except the screeding area adjacent to the MTI [4.9 acres] would be larger than that required for Oliktok Dock [2.5 acres].)

Modules, riding on SPMTs, would be offloaded from eight sealift barges onto the MTI in summer Year 4 (Alternatives B, C, and E) or Year 5 (Alternative D). Modules would be stored on the concrete footings installed during the previous summer construction season. The SPMTs would be skirted to prevent snow and wildlife from moving underneath the staged modules. During the winter season of Year 4–Year 5 (Alternatives B, C, and D) or Year 5–Year 6 (Alternative D), heavy-haul ice roads would be constructed onshore and offshore to support module delivery (Figure D.4.6). All modules would be transported using SPMTs via sea ice road from the MTI to a staging area located on the existing gravel Point Lonely East Pad. From this gravel staging pad, all modules would be transported over land-based ice road to the WPF for installation. Modules for drill sites BT4 (Alternatives B, C, and E) and BT5 would be delivered via a second sealift in summer Year 6 (Alternatives B, C, and D) or Year 7 (Alternative D) and moved to the Project area in the same manner as the modules for the WPF, BT1, BT2, and BT3 the following winter.

4.8.2.3 Module Transfer Island Maintenance and Decommissioning

The MTI would be inspected on an annual basis shortly after breakup to identify and repair any observed damage for its service life (5 years). Following module mobilization from the MTI to the WPF, all on-pad facilities would be removed from the MTI.

At the end of the MTI service life, all gravel slope protection materials and other anthropogenic materials would be removed from the MTI, including the removal of all sheet and pipe piles.

It is expected that after the island is abandoned, it would be naturally reshaped by waves and ice. Based on observations from two exploratory islands (Resolution and Goose islands) at similar water depths in the Beaufort Sea that have been decommissioned using similar methods, the MTI would be expected to be reshaped to a crescent reminiscent of a natural barrier island within 10 to 20 years. (Resolution Island is located in the Sagavanirktok River Delta, and Goose Island is located in Foggy Island Bay.) The top of the MTI would likely drop to or below the water surface within the 10- to 20-year period following island abandonment. Based on previous North Slope experience, navigational aids would not be installed on the abandoned and decommissioned island due to the potential of the navigational aids being rendered inoperable due to damage (i.e., wave or ice impacts, erosion of the unarmored gravel material). In keeping with precedent for islands previously abandoned on the North Slope, the location, shape, and maximum island elevation would be documented by one or more post-abandonment surveys and reported to the U.S. Coast Guard for publication in Notices to Mariners and inclusion in pertinent navigational charts. This practice would ensure that mariners are made aware of the shoal and would minimize the possibility that mariners would depend on a navigational aid that may be inoperable.

4.8.2.4 Ice Roads

Ice roads would be used for gravel hauling operations required to construct the MTI and for sealift module delivery from the MTI to the Project area. Portions of the ice roads would be constructed across the TLSA between both the gravel mine site and the Project area to complete construction of the MTI and deliver the sealift modules to their respective pads. These ice roads would be temporary and would not occur during sensitive times for caribou or birds. Ice road widths would vary based on their intended use, with gravel hauling ice roads being 50 feet wide and module hauling routes ranging from 60 to 120 feet wide, for tundra-based and sea ice–based roads, respectively. Gravel haul ice roads would connect the MTI to the Tiŋmiaqsiuġvik Gravel Mine Site for MTI construction and heavy-haul ice roads would connect the MTI to the Project area to support module transport to the Project area. A deviation would be needed for ROP C-1 as the sea ice roads would be greater than 12 feet wide to support gravel hauling and module transfer.

Ice road needs for the Point Lonely MTI are described in Table D.4.62.

Table D.4.62. Option 2: Point Lonely Module Transfer Island Ice Road Route Summary

Ice Road Type	Total Length (miles)[a]	Width (feet)	Total Area (acres)[a]	Description
Tundra heavy haul and support	146.0[b]	60	1,061.8[b]	Onshore module delivery (SPMTs) and support vehicle traffic
Sea ice heavy haul	1.2	120	17.4	Offshore module delivery
Tundra gravel haul	77.4	50	469.1	Gravel haul route to construct MTI
Sea ice gravel haul	0.6	50	3.6	Gravel haul route to construct MTI
Total	**225.2**	**NA**	**1,551.9**	**NA**

Note: MTI (module transfer island); NA (not applicable); SPMT (self-propelled module transporter).
[a] Total ice road area includes all years of ice road segment construction (i.e., some routes would be constructed more than once).
[b] Alternative D would require an additional 5.4 total miles of 60-foot-wide heavy-haul ice road (39.3 acres) to reach the Willow Processing Facility gravel pad.

The Point Lonely MTI would require a total of approximately 225.2 miles of ice roads (223.4 miles onshore, 1.8 miles offshore) resulting in a total ice road area of 1,551.9 acres (1,530.9 acres onshore, 21.0 acres offshore). No seawater would be used to construct onshore ice roads; a combination of seawater and freshwater would be used to construct offshore ice roads. Ice road mileage by year is summarized in Table D.4.63.

Table D.4.63. Option 2: Point Lonely Module Transfer Island Estimated Total Ice Road Mileage and Footprint by Year (tundra based and sea ice based)

Year	Ice Road Length (miles)	Ice Road Footprint (acres)
Year 1	0.0	0.0
Year 2	0.0	0.0
Year 3	78.0	472.7
Year 4	0.0	0.0
Year 5	73.6	539.6
Year 6	0.0	0.0
Year 7	73.6	539.6
Total[a]	**225.2**	**1,551.9**

[a] Alternative D would require an additional 5.4 total miles of 60-foot-wide heavy-haul ice road (39.3 acres) to reach the Willow Processing Facility gravel pad.

4.8.2.5 Ice Pads

Single-season and multi-season ice pads would be used to support the construction of the MTI and the delivery of the sealift modules to the Project area. Single- and multi-season ice pads are described in Section 4.2.4.1, *Ice Pads*.

Option 2 would require 195.2 acres of single-season ice pads to support MTI construction, ice road construction, and module delivery. Additionally, three 10.0-acre multi-season ice pads would be required to construct the gravel haul ice roads and module heavy-haul ice roads for both sealift delivery events. One would be located at BT1 and two would be located between BT1 and Point Lonely. The ice pads would be used to stage equipment at strategic locations along the ice road routes.

4.8.2.6 Water Use

Freshwater would be required to support construction of the MTI, ice roads, and ice pads and provide domestic water supply for camps. Seawater would be needed for construction of the gravel haul and module haul sea ice roads, and for use as barge ballast. Option 2 water use is summarized by year and season in Table D.4.64. Total freshwater requirements for the Point Lonely MTI would be 572.0 MG and seawater requirements would be 185.0 MG.

Table D.4.64. Option 2: Point Lonely Module Transfer Island Freshwater Use by Year (million gallons)

Year (season)	Freshwater – Ice Pads[a]	Freshwater – Ice Roads[b]	Freshwater – Camp Supply[c]	Freshwater Total	Seawater Total[d]
Year 1–Year 2 (winter)	7.5	0.0	0.5	**8.0**	0.0
Year 2 (summer)	0.0	0.0	0.0	**0.0**	0.0
Year 2–Year 3 (winter)	18.6	111.5	3.2	**133.3**	59.0
Year 3 (summer)	0.0	0.0	1.4	**1.4**	0.0
Year 3–Year 4 (winter)	7.5	0.0	0.5	**8.0**	0.0
Year 4 (summer)	0.0	0.0	0.9	**0.9**	4.0

Year (season)	Freshwater – Ice Pads[a]	Freshwater – Ice Roads[b]	Freshwater – Camp Supply[c]	Freshwater Total	Seawater Total[d]
Year 4–Year 5 (winter)	17.9	184.2	4.1	**206.2**	59.0
Year 5 (summer)	0.0	0.0	0.0	**0.0**	0.0
Year 5–Year 6 (winter)	7.5	0.0	0.5	**8.0**	0.0
Year 6 (summer)	0.0	0.0	0.9	**0.9**	4.0
Year 6–Year 7 (winter)	17.9	184.2	3.2	**205.3**	59.0
Year 7 (summer)	0.0	0.0	0.0	**0.0**	**0.0**
Total	**76.9**	**479.9**	**15.2**	**572.0**	**185.0**

[a] Ice pad construction uses 0.25 million gallons (MG) of water per acre.
[b] Ice road construction uses 1.5 MG of water per mile for a 35-foot-wide road and 2.5 MG of water per mile for a 60-foot-wide road.
[c] Camp supply assumes 100 gallons of water per person per day.
[d] Includes ballast water and sea ice road construction.
[e] Alternative D would require an additional 6.7 MG of freshwater for each module mobilization (13.4 MG total).to support ice road construction.

4.8.2.7 Traffic

Construction of the Point Lonely MTI and delivery of the sealift modules to the Project area would require ground, air, and marine traffic. Rolligons would be used to deliver ice pad construction equipment to strategic points along the ice road route where the equipment would be staged on multi-season ice pads. Additional ground traffic would include light-duty trucks, passenger trucks, gravel hauling trucks, and miscellaneous support vehicles. Fixed-wing aircraft would be used for security and MTI and module monitoring. Helicopters would be used for security and to transport personnel or equipment between Point Lonely and the MTI and the Project area and Alpine. Tugboats and sealift barges would bring the modules from points outside of Alaska and support vessel traffic would be between Point Lonely and Oliktok Dock.

Traffic volumes to support construction of the Point Lonely MTI and delivery of the sealift modules is summarized by year in Table D.4.65; Table D.4.66 provides a summary of traffic volumes to Atigaru Point by year and season.

Table D.4.65. Option 2: Point Lonely Module Transfer Island Traffic Volumes Summary (number of trips)

Year	Ground[a]	Fixed-Wing Trips Alpine[b]	Fixed-Wing Trips Willow[b]	Fixed-Wing Trips Point Lonely[b]	Helicopter Trips Alpine[c]	Helicopter Trips Willow[c]	Sealift Barges to Point Lonely[d]	Support Vessels[e]	Tugboats to Point Lonely[d]
Year 2	43,680	25	0	0	15	0	0	0	**0**
Year 3	288,450	0	35	36	0	210	0	140	**0**
Year 4	43,790	0	85	12	0	65	8	88	**12**
Year 5	1,475,740	0	30	18	0	55	0	0	**0**
Year 6	43,770	0	35	12	0	60	1	21	**4**
Year 7	1,301,020	0	20	18	0	45	0	10	**0**
Total	**3,196,450**	**25**	**205**	**96**	**15**	**435**	**9**	**259**	**16**

Note: Ground trips are defined as one-way; a single flight is defined as a landing and subsequent takeoff; and a single vessel trip is defined as a docking and subsequent departure.
[a] Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B-70/Maxi Haul dump trucks) and module delivery (i.e., self-propelled module transporters).
[b] Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse). Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Cessna, or similar.
[c] Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all phases of the Project. Typical helicopters include A-Star and 206 Long Ranger models, although other similar types of helicopters may be used.
[d] Table indicates the arrival month at Point Lonely and assumes the vessels departed Dutch Harbor approximately 4 weeks prior.
[e] Includes crew boats, tugboats supporting sealift barges, and other support vessels.

Option 1 would include 326 total fixed-wing aircraft flights, 450 total helicopter flights, 25 tugboat and barge trips, and 259 support vessels.

Table D.4.66. Option 2: Point Lonely Module Transfer Island Traffic Volumes by Season (number of trips)

Season and Year	Ground[a]	Fixed Wing to Alpine[b]	Fixed Wing to Willow[b]	Fixed Wing to Point Lonely[b]	Alpine Helicopter[c]	Willow Helicopter[c]	Sealift Barges to Point Lonely[d]	Support Vessels[e]	Tugboats to Point Lonely[d]
Winter Year 2	32,760	15	0	0	0	0	0	0	0
Spring Year 2	10,920	10	0	0	0	0	0	0	0
Summer Year 2	0	0	0	0	15	0	0	0	0
Winter Year 3	216,339	0	7	18	0	78	0	0	0
Spring Year 3	72,113	0	3	6	0	42	0	0	0
Summer Year 3	0	0	0	12	0	90	0	140	0
Fall Year 3	0	0	16	0	0	0	0	0	0
Winter Year 4	32,844	0	37	0	0	0	0	0	0
Spring Year 4	10,948	0	17	0	0	0	0	0	0
Summer Year 4	0	0	16	12	0	40	8	88	12
Fall Year 4	0	0	16	0	0	20	0	0	0
Winter Year 5	1,106,805	0	26	13	0	50	0	0	0
Spring Year 5	368,935	0	12	5	0	10	0	0	0
Winter Year 6	32,829	0	7	0	0	24	0	0	0
Spring Year 6	10,943	0	3	0	0	12	0	0	0
Summer Year 6	0	0	0	12	0	16	1	21	4
Fall Year 6	0	0	16	0	0	8	0	0	0
Winter Year 7	975,765	0	24	13	0	34	0	0	0
Spring Year 7	325,255	0	5	5	0	11	0	0	0
Summer Year 7	0	0	0	0	0	0	0	10	0
Total	**3,196,456**	**25**	**205**	**96**	**15**	**435**	**9**	**259**	**16**

Note: Trips are defined as one-way; a single flight is defined as a landing and subsequent takeoff; and a single vessel trip is defined as a docking and subsequent departure.
[a] Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B-70/Maxi Haul dump trucks) and module delivery (i.e., self-propelled module transporters).
[b] Flights outlined are additional flights required beyond projected travel to/from existing airstrips. Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Cessna, or similar.
[c] Typical helicopters include A-Star and 206 Long Ranger models, although other similar types of helicopters may be used. Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all phases of the Project.
[d] Table indicates the arrival month at Point Lonely and assumes the vessels departed Dutch Harbor approximately 4 weeks prior.
[e] Includes crew boats, tugboats supporting sealift barges, and other support vessels.

4.8.2.8 Schedule

Figure D.4.23 provides a schedule for Option 2: Point Lonely Module Transfer Island.

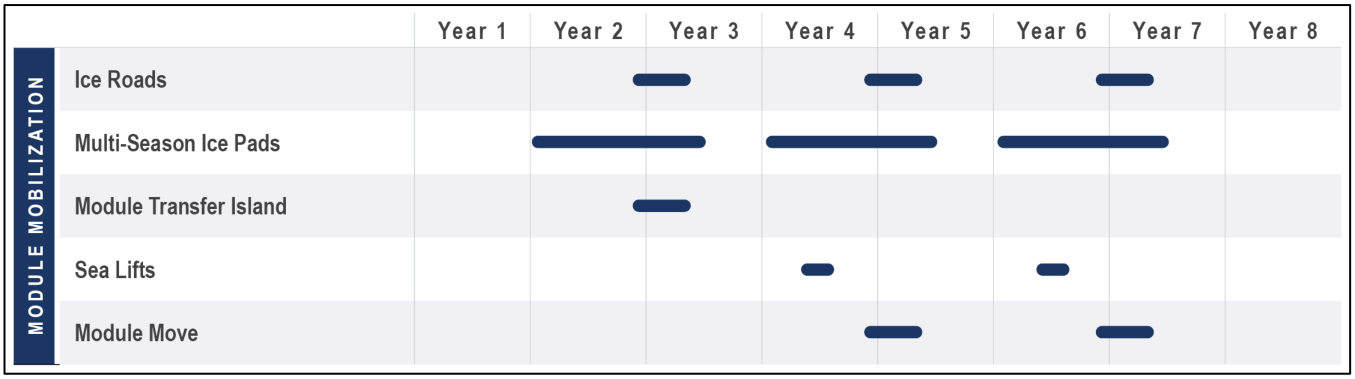

Figure D.4.23. Schedule of Activity for Option 2: Point Lonely Module Transfer Island

Note: Sea Lift 1 includes the Willow Processing Facility and Bear Tooth drill sites 1, 2, and 3 facilities; Sea Lift 2 includes Bear Tooth drill sites 4 and 5 facilities. Schedule shown is for Alternative B.

4.8.2.9 Option 2: Point Lonely Module Transfer Island Design Summary

Table D.4.67 summarizes the design characteristics of the Point Lonely MTI.

Table D.4.67. Option 2: Point Lonely Module Transfer Island Design Characteristics Summary

Element	Description
Location	Approximately 3,500 feet (0.6 mile) northwest of the Point Lonely former Distant Early Warning Line site
Water depth	Approximately 10.5 feet, MLLW
Work surface	600 feet by 600 feet (8.3 acres) at +13 feet, MLLW
Design life	5 to 10 years
Dock	200-foot-long dock face at +16 feet, MLLW
Gravel fill volume	446,000 cy from Tiŋmiaqsiuġvik Gravel Mine Site
Seafloor footprint	13.0 acres
Screeding area	4.9 acres at the dock face; 9.6 acres at the barge lightering area (14.5 acres total)
Side slopes	3 horizontal to 1 vertical (3:1)
Side slope armor	6,900 total 4-cy gravel filled bags
Ice ramp	7 horizontal to 1 vertical (7:1) slope; 120 feet wide
Gravel haul ice roads	Tundra based: 77.4 total miles of 50-foot-wide ice road (469.1 acres) Sea ice based: 0.6 total miles of 50-foot-wid ice road (3.6 acres)
Module haul ice roads[a]	Tundra based: 146.0 total miles of 60-foot-wide ice road (1,061.8 acres) Sea ice based: 1.2 total miles of 120-foot-wid ice road (17.4 acres)
Single-season ice pads	Ice pads (195.2 total acres) constructed at MTI site (approximately 0.6 miles offshore) and to support ice road construction
Multi-season ice pads	Three 10.0-acre multi-season ice pads (30.0 acres total) to support module mobilization and gravel hauling: one at BT1 and two between BT1 and Point Lonely
Camps	100-person camp for winter ice road construction each season 100-person camp for module offload and transport for each sealift 100-person vessel-based camp for summer construction at MTI
Freshwater use[a]	572.0 million gallons for camps, ice roads, and ice pads
Seawater use	185.0 million gallons for ice roads and ballast water

Note: BT1 (Bear Tooth drill site 1); cy (cubic yards); MLLW (mean lower low water); MTI (module transfer island).
[a] Alternative D would require an additional 2.7 miles of 60-foot-wide heavy-haul ice road to reach the Willow Processing Facility gravel pad for each year of module mobilization. This additional ice road would require an additional 6.7 million gallons of freshwater in each year of module mobilization (13.4 million gallons of freshwater).

4.8.3 <u>Option 3: Colville River Crossing*</u>

Module delivery Option 3 would use the existing Oliktok Dock to receive the sealift barges containing the WPF and large drill site modules. From Oliktok Dock, the modules would be transported over existing gravel roads using SPMTs from Oliktok Dock to Kuparuk DS2P. From Kuparuk DS2P, the modules would then be moved by heavy-haul ice roads to GMT-2, crossing the Colville River on a partially grounded ice crossing near Ocean Point (Figure D.4.7). From GMT-2, the modules would be transported to the Project area over Project gravel roads (Alternatives B and C) or ice roads (Alternative D) to reach the WPF and drill site gravel pads.

Option 3 is BLM's preferred module delivery option. The identification of a preferred module delivery option does not constitute a commitment or decision; if warranted, BLM may select a different module delivery option than the preferred module delivery option in its ROD.

4.8.3.1 Oliktok Dock, Barge Lightering Area, and Summer Staging Area

Option 3 would make use of the existing Oliktok Dock for module delivery and offload. The lightering process and screeding activity would be the same as described for the smaller modules and bulk construction materials in Section 4.2.3.4, *Sealift Barge Delivery to Oliktok Dock*. The screeding for both the offshore lightering area and at the face of Oliktok Dock would be completed once for each sealift season.

After delivery to Oliktok Dock, modules would be moved to and stored at the existing 12.0-acre gravel pad located approximately 2 miles south of the dock. The staging area pad would be the same pad as used under all action alternatives (Section 4.2.3.4) to receive bulk materials and smaller modules. The staging pad is approximately 3 to 4 feet thick and the area where the modules would be stored would be improved with new gravel to increase its thickness up to 5 feet. Rig mats would then be installed on the surface to provide additional structural support for sealift module storage. There would be no expansion of the gravel pad footprint; all gravel work would be completed within the existing footprint. The sealift modules would be skirted to prevent drifting snow from accumulating under the modules.

4.8.3.2 Module Delivery and Colville River Crossing

In the January following each sealift arrival, the modules would be transported via existing gravel roads from the gravel staging pad to an ice pad located near Kuparuk DS2P while the Colville River ice crossing is constructed. The 60-foot-wide, 40.1-mile-long heavy-haul ice road for module transport would be constructed from both the east and west ends, at Kuparuk DS2P and GMT-2, respectively (Figure D.4.7.). The two segments would meet at the Colville River crossing near Ocean Point. Engineering factors considered when selecting the ice road route for module transport included the following:

- The maximum allowable ice road grades for SPMT operation
- Assumed SPMT dimensions of 27 feet wide by 200 feet long
- Suitable Colville River crossing location (as described below)

At Ocean Point on the Colville River, an engineered ice crossing would be constructed to provide sufficient load-carrying capacity to support the sealift modules and SPMTs. The partially **grounded ice** crossing would be approximately 1 river mile downstream of Ocean Point, as defined by the U.S. Geological Survey (1955 Harrison Bay, A3 quad topographic map). The specific crossing location was selected based on favorable hydrological, topographical, and bathymetric conditions. The crossing was also sited so that it would be far enough upstream from the Colville River Delta to minimize potential impacts to fish passage. For the purposes of this description of Option 3, partially grounded ice refers to ice crossing the river channel that is primarily frozen fast to the riverbed. However, there would be some pockets of deep, free flowing water present that would be narrower than the length of the SPMTs, which would bridge the liquid water channels with their load being supported by the grounded ice sections (Figure D.4.7, detail A). Overflow is expected and would be managed both passively with snow berms or other diversion structures, or in combination with high-volume pumps and/or rapid response heavy equipment to clear new pathways for water to flow away from the ice structure (Appendix D.3, *Ice Bridge Report*). Management of flowing water under the partially grounded ice bridge may result in the need to pump water around the ice bridge, which would require an exception to ROP B-1.

The proposed crossing location was also sited so that it is upstream of the influence of saltwater intrusion and tidal backwatering from the Colville River Delta and thus is not expected to be used by fish in winter. CPAI will continue to monitor the proposed Colville River crossing location for fish presence over the coming winters prior to construction to gain additional baseline data. CPAI would work with ADF&G through the permitting process if fish presence is found during the winter months when module transport would occur; should it be necessary, CPAI will consult with ADF&G on how fish would be transported around the ice bridge.

The Colville River ice crossing would be approximately 2,800 feet long from the top of the bank to the top of the bank (approximately 700 feet long from the edge of the water to the edge of the water) and 65 feet wide at the surface. Ramps entering and exiting the river channel may be wider depending on the amount of ice fill required. The total ice thickness of the ramp and crossing would range up to 7.1 feet from the riverbed (natural ice thickness in this area varied from 0.5 to 6.2 feet thick in April 2019 [CPAI 2019]; additional details on the existing conditions of the crossing location are described in Section 3.8.1.1, *Rivers*, and in Appendix E.8A, *Water Resources Technical Appendix*).

4.8.3.3 Access and Traffic

Module transport from Oliktok Dock to the Project area would occur by existing gravel road between the dock and Kuparuk DS2P, by ice road (including the Colville River crossing) from near Kuparuk DS2P to GMT-2, and by the Project's gravel access road (Alternatives B and C) from GMT-2 to the Project area. Alternative D would require an additional 13.1 miles of 60-foot-wide heavy-haul ice road between GMT-2 and the Project area for module mobilization (2026 and 2028).

The 2-mile-long existing gravel road between Oliktok Dock and the summer staging area pad is approximately 3-feet thick on average and would need to be improved to a depth of 5 feet to support summer transport of the sealift modules. This improvement would require approximately 40,300 cy of gravel and would increase the existing footprint by less than 0.1 acre. An estimated 12 culverts (about 5 culverts per mile) would be extended within this road segment to accommodate the thicker roadway section.

Existing gravel roads between the summer staging pad and Kuparuk DS2P would be used during winter conditions, and the roads would not require additional gravel to increase thickness. However, CPAI anticipates that several curves along the route would require widening to accommodate the turning radius of the 200-foot-long SPMTs (Figure D.4.24). Approximately 5.0 acres of additional gravel fill would be placed to widen the identified curves along the existing Kuparuk gravel road network (Section 4.8.3.6, *Gravel Requirements*). Culverts would be extended as needed. Improvements to gravel roads and pads associated with Option 3 would be completed in summer.

Ground, air, and marine traffic associated with construction of the ice road and bridge, modifications to existing gravel roads and pads, and transport of the sealift modules to the Project area is summarized in Table D.4.68. Table D.4.68 details Option 3 traffic by year and season.

Table D.4.68. Option 3: Colville River Crossing Traffic Volumes Summary (number of trips)

Year	Ground[a]	Fixed Wing Trips Kuparuk[b]	Fixed Wing Trips Alpine[b]	Helicopter Trips Alpine[c]	Sealift Barges to Oliktok[d]	Support Vessels[e]	Tugboats to Oliktok[d]
Year 2	0	0	0	0	0	0	0
Year 3	4,590	6	0	0	0	0	0
Year 4	300	4	0	0	8	54	12
Year 5	264,990	14	14	8	0	0	0
Year 6	300	4	0	0	1	6	4
Year 7	264,980	14	14	8	0	0	0
Total	**535,160**	**42**	**28**	**16**	**9**	**60**	**16**

Note: Ground trips are defined as one-way; a single flight is defined as a landing and subsequent takeoff; and a single vessel trip is defined as a docking and subsequent departure.
[a] Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B-70/Maxi Haul dump trucks) and module delivery (i.e., self-propelled module transporters).
[b] Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse). Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Cessna, or similar.
[c] Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all phases of the Project. Typical helicopters include A-Star and 206 Long Ranger models, although other similar types of helicopters may be used.
[d] Table indicates the arrival month at Oliktok Dock and assumes the vessels departed Dutch Harbor approximately 4 weeks prior.
[e] Includes crew boats, tugboats supporting sealift barges, and other support vessels.

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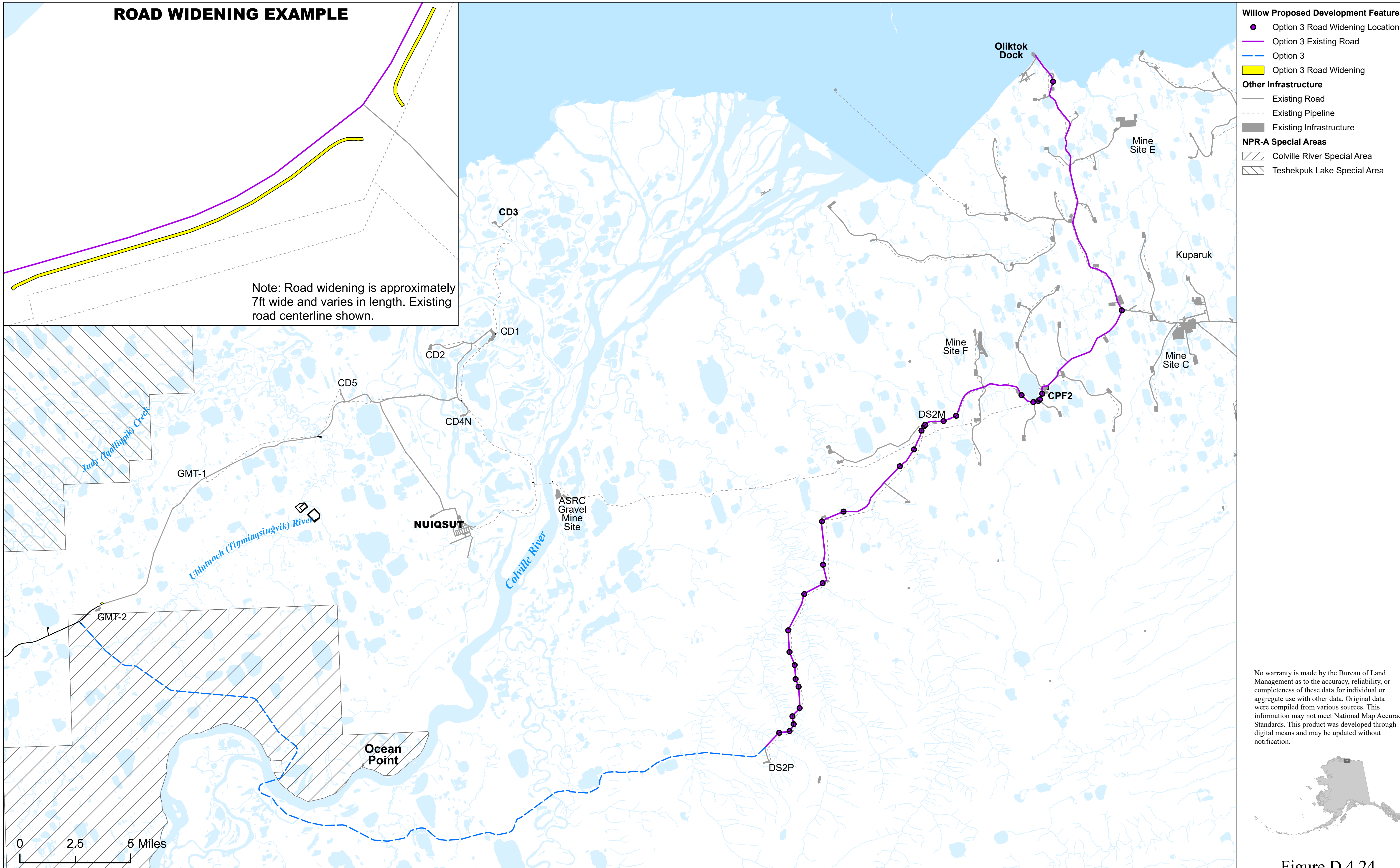
ROAD WIDENING EXAMPLE
Note: Road widening is approximately 7ft wide and varies in length. Existing road centerline shown.
Willow Proposed Development Features
Option 3 Road Widening Locations
Option 3 Existing Road
Option 3
Option 3 Road Widening
Other Infrastructure
Existing Road
Existing Pipeline
Existing Infrastructure
NPR-A Special Areas
Colville River Special Area
Teshekpuk Lake Special Area
Oliktok Dock
Mine Site E
Kuparuk
Mine Site F
Mine Site C
CPF2
DS2M
CD3
CD1
CD2
CD5
CD4N
GMT-1
GMT-2
NUIQSUT
ASRC Gravel Mine Site
Colville River
Judy (Iqalliqpik) Creek
Ublutuoch (Tiŋmiaqsiuġvik) River
Ocean Point
DS2P
0
2.5
5 Miles
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Figure D.4.24

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Table D.4.69. Option 3: Colville River Crossing Traffic Volume Summary by Season (number of trips)

Season and Year	Ground[a]	Fixed Wing to Kuparuk[b]	Fixed Wing to Alpine[b]	Fixed Wing to Willow[b]	Alpine Helicopter[c]	Willow Helicopter[c]	Sealift Barges to Oliktok[e]	Support Vessels[d]	Tugboats to Oliktok[e]
Summer Year 3	4,590	6	0	0	0	0	0	0	0
Summer Year 4	300	4	0	0	0	0	8	54	12
Winter Year 5	198,736	9	9	0	0	0	0	0	0
Spring Year 5	66,252	5	5	0	0	0	0	0	0
Summer Year 5	0	0	0	0	8	0	0	0	0
Summer Year 6	300	4	0	0	0	0	1	6	4
Winter Year 7	198,734	9	9	0	0	0	0	0	0
Spring Year 7	66,248	5	5	0	0	0	0	0	0
Summer Year 7	0	0	0	0	8	0	0	0	0
Total	**535,160**	**42**	**28**	**0**	**16**	**0**	**9**	**60**	**16**

Note: Trips are defined as one-way; a single flight is defined as a landing and subsequent takeoff; and a single vessel trip is defined as a docking and subsequent departure.
[a] Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B70/maxi dump trucks) and module delivery (i.e., self-propelled module transporters).
[b] Flights outlined are additional flights required beyond projected travel to/from existing airstrips. Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Cessna, or similar.
[c] Typical helicopters include A-Star and 206 Long Ranger models, although other similar types of helicopters may be used. Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all phases of the Project.
[d] Table indicates the arrival month at Atigaru Point and assumes the vessels departed Dutch Harbor approximately 4 weeks prior.
[e] Includes crew boats, tugboats supporting sealift barges, and other support vessels.

4.8.3.4 Other Infrastructure

Module delivery under Option 3 would require 40.1 miles of 60-foot-wide ice roads (291.6 acres) to be constructed twice to support large module delivery in Year 5 and Year 7 (for Alternatives B, C, and E; Year 6 and Year 8 for Alternative D). This would result in a total of 80.2 miles (583.2 acres) of ice roads.

Single-season ice pads would be used to support ice road construction and camp placement. Single-season ice pads are described in Section 4.2.4.1, *Ice Pads*. Option 3 would require 41.7 acres of single-season ice pads in Year 5 and Year 7 (83.4 total acres) under Alternatives B, C, and E (Year 6 and Year 8 for Alternative D).

Option 3 would require a 100-person camp located on the 15.0-acre ice pad near Kuparuk DS2P[7] to support sealift module transport. Ice road crews for the eastern ice road segment would be based out of the camp near Kuparuk DS2P; ice road crews for the western portion in the NPR-A would be based out of one of the construction camps already proposed for Project action alternatives (i.e., K-Pad). The previously proposed camp is included as a component of Alternatives B, C, D, and E in the alternatives analysis and is therefore not included as a component specific to the Option 3 analysis.

4.8.3.5 Water Use

Freshwater would be needed to construct the Colville River ice crossing, ice roads, and ice pads, as well as for domestic use at construction camps (100 gallons per person per day). The water would be supplied from nearby lakes that would be permitted for such use. For ice built between the Colville River banks, some of the water for the ice crossing may come from the Colville River. Option 3 anticipated water use is summarized in Table D.4.70 by year and season and Project component.

Table D.4.70. Option 3: Colville River Crossing Freshwater Use by Year (million gallons)

Year (season)	Ice Pads[a]	Ice Roads[b]	Camp Supply[c]	Total
Year 0–Year 1 (winter)	0.0	0.0	0.0	**0.0**
Year 1 (summer)	0.0	0.0	0.0	**0.0**
Year 1–Year 2 (winter)	0.0	0.0	0.0	**0.0**
Year 2 (summer)	0.0	0.0	0.0	**0.0**
Year 2–Year 3 (winter)	0.0	0.0	0.0	**0.0**
Year 3 (summer)	0.0	0.0	1.0	**1.0**
Year 3–Year 4 (winter)	0.0	0.0	0.0	**0.0**
Year 4 (summer)	0.0	0.0	0.5	**0.5**
Year 4–Year 5 (winter)	10.4	115.0	1.4	**126.8**
Year 5 (summer)	0.0	0.0	0.9	**0.9**
Year 5–Year 6 (winter)	0.0	0.0	0.0	**0.0**
Year 6 (summer)	0.0	0.0	0.3	**0.3**
Year 6–Year 7 (winter)	10.4	115.0	1.4	**126.8**
Year 7 (summer)	0.0	0.0	0.9	**0.9**
Total	**20.8**	**230.0**	**6.4**	**257.2**

[a] Ice pad construction uses 0.25 million gallons (MG) of water per acre.
[b] Ice road construction uses 1.5 MG of water per mile for a 35-foot-wide road and 2.5 MG of water per mile for a 60-foot-wide road.
[c] Camp supply assumes 100 gallons of water per person per day.

Seawater (4.0 MG) would be used as ballast water by marine vessels for each sealift delivering the sealift modules (2024 and 2026).

4.8.3.6 Gravel Requirements

Gravel would be used to raise the heights of the existing Oliktok Dock, improve the existing summer staging pad south of Oliktok Dock, and modify portions of existing gravel roads to accommodate module transport. Gravel would be sourced from an existing gravel source in Kuparuk (e.g., Mine Site C, Mine Site E, Mine Site F). Table D.4.71 summarizes new gravel footprint and volumes for Option 3.

[7] Well production from Kuparuk DS2P has ceased and surface facilities have been decommissioned. Wells on the pad will be plugged and abandoned in the future. CPAI will consider using available Kuparuk DS2P gravel pad space to support module mobilization if gravel pad space is available and there are no conflicting activities taking place.

Table D.4.71. Option 3: Colville River Crossing New Gravel Footprint and Volumes

Project Component	New Footprint (acres)	Gravel Volume (cubic yards)
Upgrades to existing gravel road from Oliktok Dock to summer staging area pad	0.1	40,300
Upgrades to summer staging area pad	0.0	43,700
Upgrades to existing gravel road from the summer staging area pad to Kuparuk DS2P	4.9	34,700
Total	**5.0**	**118,700**

Note: DS2P (Kuparuk drill site 2P).

4.8.3.7 Schedule

Gravel haul and placement to modify the existing gravel roads and pads would occur during the Year 3 summer season under Alternatives B, C, and E (summer Year 4 under Alternative D). During the summer open-water season before sealift arrival (Year 4 and Year 6 for Alternatives B, C, and E; Year 5 and Year 7 for Alternative D), screeding of the barge lightering area and the area in front of the dock face would occur about mid-July, once the risk of ice encroachment has passed.

Modules for the WPF, BT1, BT2, and BT3 would be delivered by sealift barges to Oliktok Dock during the summer of Year 4 (Alternatives B, C, and E) or Year 5 (Alternative D). A second sealift barge delivery for BT4 (Alternatives B, C, and E) and BT5 modules would occur in summer Year 6 (Alternatives B, C, and E) or Year 7 (Alternative D). Modules would be stored on the summer staging pad south of Oliktok Dock and mobilized to the Project area the following the winter construction season.

Figure D.4.25 provides an overview of the Option 3 activity schedule.

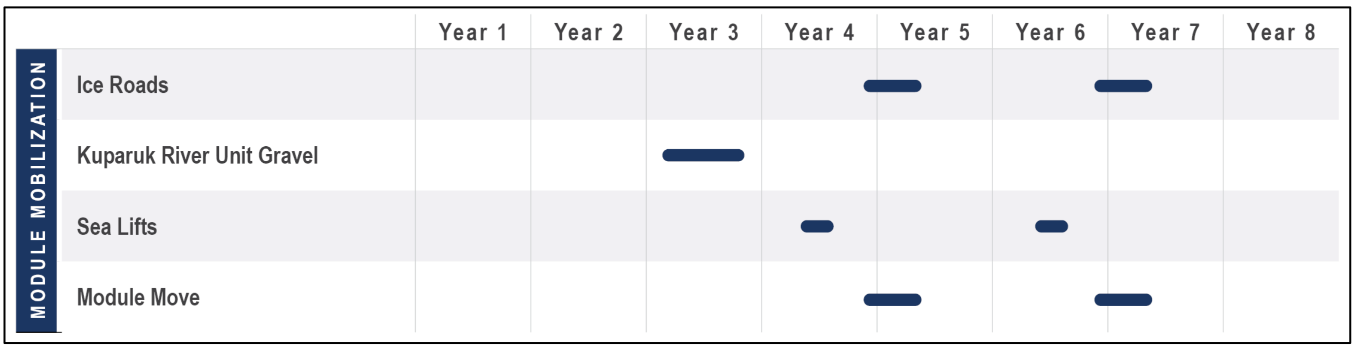

Figure D.4.25. Schedule of Activity for Option 3: Colville River Crossing

Note: Sea Lift 1 would include the Willow Process Facility and Bear Tooth drill sites 1, 2, and 3 facilities; Sea Lift 2 would include Bear Tooth drill sites 4 and 5 facilities. Schedule shown is for Alternative B.

4.8.3.8 Option 3: Colville River Crossing Design Summary

Table D.4.72 summarizes the module delivery Option 3 components.

Table D.4.72. Summary of Components for Option 3: Colville River Crossing

Element	Description
Screeding	No additional screeding needed beyond activity described in Section 4.2.3.4, *Sealift Barge Delivery to Oliktok Dock*
Summer staging area	Existing 12.0-acre gravel pad approximately 2 miles south of Oliktok Dock; would require the addition of 43,700 cy of gravel within the pad's existing footprint
Single-season ice pads	Ice pads (83.4 total acres) constructed near Kuparuk DS2P and to support ice road construction
Multi-season ice pads	No multi-season ice pads
Gravel roads	Use approximately 46 miles of existing Kuparuk gravel roads between Oliktok Dock and Kuparuk DS2P; would require curve widening at select locations to address the self-propelled module transporter turning radius. Curve widening would include: Less than 0.1 acre (43,000 cy of gravel) between Oliktok Dock and the 12.0-acre staging area 4.9 acres (34,700 cy of gravel) between the 12.0-acre summer staging area to Kuparuk DS2P Use Project gravel access road (Alternatives B and C) or Project annual ice road (Alternative D) between GMT-2 and the Project area
Module transport ice road	40.1-mile-long, 60-foot-wide heavy-haul ice road would be constructed twice to support module moves in Year 5 and Year 7 (80.2 total miles and 583.2 total acres) in two segments: Kuparuk DS2P to the east side of the Colville River near Ocean Point West side of the Colville River near Ocean Point to GMT-2
Colville River crossing	Heavy-haul partially grounded ice crossing near Ocean Point
Camps	100-person camp for winter ice road construction at a single-season ice pad near Kuparuk DS2P
Total new gravel footprint and gravel volume	5.0 acres; 118,700 cy
Gravel source	Existing gravel mine in Kuparuk (Mine Site C, Mine Site E, or Mine Site F)
Freshwater use	257.2 MG for camps, ice pads, and ice roads[a]
Seawater use	8.0 MG for ballast water

Note: cy (cubic yards); DS2P (drill site 2P); GMT-2 (Greater Mooses Tooth 2); MG (million gallons).

[a] Alternative D would require an additional 13.1-mile-long, 60-foot-wide heavy-haul ice road for module transport between the Project area and Greater Mooses Tooth 2. This ice road would require an additional 32.7 MG of freshwater for each year of module mobilization (65.4 MG of total additional freshwater).

4.9 Comparison of Module Delivery Options

Table D.4.73 provides a summary comparison of impacts by module delivery option.

Table D.4.73. Summary Comparison of Impacts by Sealift Module Delivery Option

Component	Option 1: Atigaru Point Module Transfer Island	Option 2: Point Lonely Module Transfer Island	Option 3: Colville River Crossing
Gravel footprint (acres)	12.8	13.0	5.0
Gravel fill volume (cubic yards)	397,000	446,000	118,700
Screeding footprint	14.5 total acres 4.9 acres adjacent to dock face 9.6 acres at the barge lightering area	14.5 total acres 4.9 acres adjacent to dock face 9.6 acres at the barge lightering area	No additional screeding needed beyond activity for action alternatives described in Section 4.2.3.4, *Sealift Barge Delivery to Oliktok Dock*
Ice roads	110.8 total miles (795.0 total acres) Gravel haul: 35.2 miles on tundra; 2.4 miles on sea ice Module delivery: 68.4 total miles on tundra; 4.8 miles on sea ice over two module delivery seasons[a]	225.2 total miles (1,551.9 total acres) Gravel haul: 77.4 miles on tundra; 0.6 miles on sea ice Module delivery: 146.0 total miles on tundra; 1.2 miles on sea ice over two module delivery seasons[a]	80.2 total miles (583.2 total acres)[b]
Single-season ice pads	118.9 total acres	195.2 total acres	83.4 total acres
Multi-season ice pads	Three 10.0-acre multi-season ice: One at BT1 One near Atigaru Point One midway between Atigaru Point and BT1	Three 10.0-acre multi-season ice pads: One at BT1 Two along ice road between BT1 and Point Lonely	NA
Sealift delivery schedule (years)	Alternatives B, C, and E: Year 4 and Year 6 Alternative D: Year 5 and Year 7	Alternatives B, C, and E: Year 4 and Year 6 Alternative D: Year 5 and Year 7	Alternatives B, C, and E: Year 4 and Year 6 Alternative D: Year 5 and Year 7
Module mobilization (years)	Alternatives B, C, and E: Year 5 and Year 7 Alternative D: Year 6 and Year 8	Alternatives B, C, and E: Year 5 and Year 7 Alternative D: Year 6 and Year 8	Alternatives B, C, and E: Year 5 and Year 7 Alternative D: Year 6 and Year 8
Total freshwater usage (MG)	307.9[a]	572.0[a]	257.2[b]
Total seawater usage (MG)	376.0	185.0	8.0
Ground traffic (number of trips)[c]	2,306,110	3,196,450	535,160
Fixed-wing traffic (number of trips)[d]	326 total flights Willow: 205 Alpine: 25 Atigaru: 96	326 total flights Willow: 205 Alpine: 25 Point Lonely: 96	70 total flights Alpine: 28 Kuparuk: 42
Helicopter traffic (number of trips)[e]	450 total flights Willow: 435 Alpine: 15	450 total flights Willow: 435 Alpine: 15	16 total flights to/from Alpine
Marine traffic (number of trips)[f]	284 total trips Sealift barges: 9 Tugboats: 16 Support vessels: 259	284 total trips Sealift barges: 9 Tugboats: 16 Support vessels: 259	85 total trips Sealift barges: 9 Tugboats: 16 Support vessels: 60

Component	Option 1: Atigaru Point Module Transfer Island	Option 2: Point Lonely Module Transfer Island	Option 3: Colville River Crossing
Construction camps (100-person capacity)	Camp for winter ice road construction (each ice road year) on a multi-season ice pad Camp for module offload and transport on a multi-season ice pad at Atigaru Point Camp for summer construction and module receipt would be located on a barge (i.e., Floatel) at the module transfer island	Camp for winter ice road construction (each ice road year) on the existing gravel pad Camp for module offload and transport at Point Lonely on the existing gravel pad Camp for summer construction and module receipt at Point Lonely on the existing gravel pad	Camp for winter ice road construction (each ice road year) on a single-season ice pad

Note: BT1 (Bear Tooth drill site 1); MG (million gallons); NA (not applicable). Traffic trips are defined as one-way; a single flight is defined as a landing and subsequent takeoff; and a single vessel trip is defined as a docking and subsequent departure.

[a] Alternative D would require an additional 2.7 miles of 60-foot-wide heavy-haul ice road to reach the Willow Processing Facility gravel pad for each year of module mobilization. This additional ice road would require an additional 6.7 MG of freshwater for each year of module mobilization (13.4 MG of freshwater).

[b] Alternative D would require an additional 13.1-mile-long, 60-foot-wide heavy-haul ice road for module transport between the Project area and Greater Mooses Tooth 2. This ice road would require an additional 32.7 MG of freshwater for each year of module mobilization (65.4 MG of total additional freshwater).

[c] Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B-70/Maxi Haul dump trucks) and module delivery (i.e., self-propelled module transporters).

[d] Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse) and include flights to the Alpine and Willow airstrips. Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Cessna, or similar.

[e] Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all phases of the Project. Typical helicopters include A-Star and 206 Long Ranger models, although other similar types of helicopters may be used.

[f] Includes crew boats, tugboats supporting sealift barges, and other support vessels.

5.0 SUMMARY COMPARISON TABLES FOR ANALYSIS

This section provides a comparison of action alternatives and module delivery options for select Project components (Tables D.5.1 through D.5.18); some tables provide a comparison of both alternatives and module delivery options together. These tables are intended to assist reviewers in the identification of overall Project impacts using select quantifiable data (e.g., footprint, water use, traffic).

5.1 Ice Road and Ice Pad Comparisons*

Table D.5.1. Summary of Ice Road Length (miles) by Year for Each Action Alternative and Module Delivery Option*

Year	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)	Option 1: Atigaru Point Module Transfer Island[a]	Option 2: Point Lonely Module Transfer Island[a]	Option 3: Colville River Crossing
Year 1	32.7	32.2	41.0	32.6	0.0	0.0	0.0
Year 2	43.9	44.6	92.0	42.0	0.0	0.0	0.0
Year 3	99.3	155.2	151.6	98.1	37.6	78.0	0.0
Year 4	137.6	109.0	150.9	146.9	0.0	0.0	0.0
Year 5	44.0	77.7	62.1	47.5	36.6	73.6	40.1
Year 6	56.2	14.7	27.9	12.6	0.0	0.0	0.0
Year 7	50.2	59.6	17.4	43.6	36.6	73.6	40.1
Year 8	21.0	65.8	68.6	7.9	0.0	0.0	0.0
Year 9	10.3	15.7	69.1	0.0	0.0	0.0	0.0
Year 10	0.0	3.6	19.3	0.0	0.0	0.0	0.0
Year 11+	0.0	3.6	12.5	0	0.0	0.0	0.0
Year 11 – Life of Project[b]	0.0	72.0[c]	262.5[d]	0	0.0	0.0	0.0
Total	**495.2**	**650.1**	**962.4**	**431.2**	**110.8**	**225.2**	**80.2**

Note: "+" indicates annual use from Year 11 to end of the Project life in Year 30 (Alternatives B, C, and E) or Year 31 (Alternative D).

[a] Includes sea ice and tundra-based ice roads.

[b] Life of the Project for Alternatives B, C, and E is Year 30; life of the Project for Alternative D is Year 31.

[c] Assumes 3.6-mile-long annual ice road between Bear Tooth (BT) drill sites 1 (BT1) and 2 (BT2) for the life of the Project.

[d] Assumes 12.5-mile-long annual ice road between existing gravel road at Greater Mooses Tooth 2 and the Project area for the life of the Project.

Table D.5.2. Summary of Ice Road Area (acres) by Year for Each Action Alternative and Module Delivery Option*

Year	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)	Option 1: Atigaru Point Module Transfer Island[a]	Option 2: Point Lonely Module Transfer Island[a]	Option 3: Colville River Crossing
Year 1	181.8	180.0	224.7	181.4	0.0	0.0	0.0
Year 2	347.0	350.0	719.9	338.9	0.0	0.0	0.0
Year 3	753.7	1,130.6	1,076.6	743.0	227.8	472.7	0.0
Year 4	1,004.2	832.2	1,061.0	1,051.1	0.0	0.0	0.0
Year 5	373.4	570.7	476.9	403.0	283.6	539.6	291.6
Year 6	346.6	108.6	183.7	106.9	0.0	0.0	0.0

Year	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)	Option 1: Atigaru Point Module Transfer Island[a]	Option 2: Point Lonely Module Transfer Island[a]	Option 3: Colville River Crossing
Year 7	318.4	365.6	94.6	274.9	283.6	539.6	291.6
Year 8	178.2	434.6	405.1	67.0	0.0	0.0	0.0
Year 9	87.4	118.0	427.2	0.0	0.0	0.0	0.0
Year 10	0.0	15.3	110.7	0.0	0.0	0.0	0.0
Year 11+	0.0	15.3	55.7	0.0	0.0	0.0	0.0
Year 11 – Life of Project[b]	0.0	306.0	1,113.0	0.0	0.0	0.0	0.0
Total	**3,590.7**	**4,411.6**	**5,893.4**	**3,166.2**	**795.0**	**1,551.9**	**583.2**

Note: "+" indicates annual use from Year 11 to end of the Project life in Year 30 (Alternatives B, C, and E) or Year 31 (Alternative D).
[a] Includes sea ice and tundra-based ice roads.
[b] Life of the Project for Alternatives B, C, and E is Year 30; life of the Project for Alternative D is Year 31.
[c] Assumes 3.6-mile-long annual ice road between Bear Tooth (BT) drill sites 1 (BT1) and 2 (BT2) for the life of the Project.
[d] Assumes 12.5-mile-long annual ice road between existing gravel road at Greater Mooses Tooth 2 and the Project area for the life of the Project.

Table D.5.3. Summary of Single-Season Ice Pad Area (acres) by Year for Each Action Alternative and Module Delivery Option*

Year	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)	Option 1: Atigaru Point Module Transfer Island	Option 2: Point Lonely Module Transfer Island	Option 3: Colville River Crossing
Year 1	82.8	82.5	88.0	82.7	0.0	0.0	0.0
Year 2	153.5	153.9	185.2	152.2	0.0	0.0	0.0
Year 3	192.7	230.0	227.5	191.9	40.1	67.0	0.0
Year 4	259.8	240.8	269.1	266.0	0.0	0.0	0.0
Year 5	29.3	178.3	41.0	31.7	39.4	64.1	41.7
Year 6	100.8	9.8	19.0	8.4	0.0	0.0	0.0
Year 7	96.8	103.0	12.0	92.4	39.4	64.1	41.7
Year 8	14.0	107.2	109.3	5.3	0.0	0.0	0.0
Year 9	6.9	10.5	109.3	0.0	0.0	0.0	0.0
Year 10	0.0	2.4	13.0	0.0	0.0	0.0	0.0
Year 11+	0.0	2.4	8.0	0.0	0.0	0.0	0.0
Year 11 – Life of Project[a]	0.0	48.0	168.0	0.0	0.0	0.0	0.0
Total	**936.6**	**1,166.4**	**1,241.4**	**830.6**	**118.9**	**195.2**	**83.4**

Note: "+" indicates annual use from Year 11 to end of the Project life in Year 30 (Alternatives B, C, and E) or Year 31 (Alternative D).
[a] Life of the Project for Alternatives B, C, and E is Year 30; life of the Project for Alternative D is Year 31.

5.2 Freshwater Use Comparison*

Table D.5.4. Summary of Freshwater Use (million gallons) by Year for Each Action Alternative and Module Delivery Option*

Year (Season)	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)	Option 1: Atigaru Point Module Transfer Island	Option 2: Point Lonely Module Transfer Island	Option 3: Colville River Crossing
Year 0/Year 1 (Winter)	72.4	71.9	84.1	72.3	0.0	0.0	0.0
Year 1 (Summer)	1.1	1.1	1.1	1.1	0.0	0.0	0.0
Year 1/Year 2 (Winter)	129.7	130.5	225.8	127.4	5.5	8.0	0.0
Year 2 (Summer)	3.2	3.2	3.2	3.2	0.0	0.0	0.0
Year 2/Year 3 (Winter)	241.0	339.3	326.8	238.3	67.3	133.3	0.0
Year 3 (Summer)	9.5	10.0	9.5	9.3	1.4	1.4	1.0
Year 3/Year 4 (Winter)	336.6	291.2	330.2	343.1	8.0	8.0	0.0
Year 4 (Summer)	55.8	55.8	9.0	43.8	0.9	0.9	0.5
Year 4/Year 5 (Winter)	148.4	232.1	150.0	144.0	108.4	206.2	126.8
Year 5 (Summer)	65.4	65.7	57.4	53.5	0.0	0.0	0.9
Year 5/Year 6 (Winter)	121.9	43.1	96.5	42.3	8.0	8.0	0.0
Year 6 (Summer)	15.4	15.5	55.7	15.9	0.9	0.9	0.3
Year 6/Year 7 (Winter)	115.8	128.5	38.4	102.7	107.5	205.3	126.8
Year 7 (Summer)	16.5	16.5	15.5	14.9	0.0	0.0	0.9
Year 7/Year 8 (Winter)	61.4	145.2	137.8	30.6	0.0	0.0	0.0
Year 8 (Summer)	18.1	18.0	18.4	12.1	0.0	0.0	0.0
Year 8/Year 9 (Winter)	36.4	44.5	146.5	9.1	0.0	0.0	0.0
Year 9 (Summer)	16.0	16.2	17.2	9.9	0.0	0.0	0.0
Year 9/Year 10 (Winter)	8.7	12.9	44.9	8.9	0.0	0.0	0.0
Year 10 (Summer)	5.1	5.1	16.0	9.9	0.0	0.0	0.0
Year 10/Year 11 (Winter)	4.1	8.3	23.2	6.5	0.0	0.0	0.0
Year 11 (Summer)	5.1	5.1	5.1	5.1	0.0	0.0	0.0
Year 11/Year 12+ (Winter)	77.9	157.7	372.0	77.9	0.0	0.0	0.0
Year 12+ (Summer)	96.9	96.9	102.0	96.9	0.0	0.0	0.0
Total	**1,662.4**	**1,914.3**	**2,286.3**	**1,478.7**	**307.9**	**572.0**	**257.2**

Note: "+" indicates annual use from Year 11 to end of the Project life in Year 30 (Alternatives B, C, and E) or Year 31 (Alternative D); Options 1, 2, and 3 are only to support construction and would end in Year 7.

5.3 Ground Traffic Comparisons*

Table D.5.5. Summary of Ground Traffic (number of trips) by Year for Each Action Alternative and Module Delivery Option*

Year	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)	Option 1: Atigaru Point Module Transfer Island	Option 2: Point Lonely Module Transfer Island	Option 3: Colville River Crossing
Year 1	55,300	55,300	52,500	55,300	0	0	0
Year 2	137,270	138,650	182,750	137,270	43,680	43,680	0
Year 3	274,030	309,730	308,550	282,270	140,670	288,450	4,590
Year 4	363,620	402,250	280,750	371,640	43,790	43,790	300
Year 5	387,490	490,860	307,460	387,250	1,082,620	1,475,740	264,990
Year 6	282,570	204,740	279,370	254,440	43,770	43,770	300
Year 7	242,900	308,390	273,750	186,490	951,580	1,301,020	264,980
Year 8	185,090	311,140	281,680	158,330	0	0	0
Year 9	113,200	250,760	308,500	114,240	0	0	0
Year 10	54,640	82,890	213,680	114,240	0	0	0
Year 11 – Life of Project[a]	1,092,800	1,657,800	1,887,900	1,084,400	0	0	0
Total	**3,188,910**	**4,212,510**	**4,376,890**	**3,145,870**	**2,306,110**	**3,196,450**	**535,160**

Note: "+" indicates annual use from Year 11 to the end of the Project life in Year 30 (Alternatives B, C, and D) or Year 31 (Alternative D). Ground trips are defined as one-way. Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B-70/Maxi Haul dump trucks).

[a] Life of the Project for Alternatives B, C, and E is Year 30; life of the Project for Alternative D is Year 31.

Table D.5.6. Comparison of Alternatives Total and Daily Ground Traffic (number of trips) by Season and Year*

Season and Year	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)
Summer Year 0 (total)	0	0	0	0
Summer Year 0 (daily)	0.0	0.0	0.0	0.0
Winter Year 1 (total)	33,180	33,180	36,855	33,180
Winter Year 1 (daily)	274.2	274.2	304.6	274.2
Spring Year 1 (total)	11,060	11,060	12,285	11,060
Spring Year 1 (daily)	181.3	181.3	201.4	181.3
Summer Year 1 (total)	11,060	11,060	3,360	11,060
Summer Year 1 (daily)	90.7	90.7	27.5	90.7
Fall Year 1 (total)	0	0	0	0
Fall Year 1 (daily)	0.0	0.0	0.0	0.0
Winter Year 2 (total)	92,127	92,781	124,596	92,126
Winter Year 2 (daily)	761.4	766.8	1,029.7	761.4
Spring Year 2 (total)	31,554	31,829	42,434	31,554
Spring Year 2 (daily)	517.3	521.8	695.6	517.3
Summer Year 2 (total)	11,055	11,327	13,007	11,055
Summer Year 2 (daily)	90.6	92.8	106.6	90.6
Fall Year 2 (total)	1,690	1,680	1,803	1,690
Fall Year 2 (daily)	27.7	27.5	29.6	27.7
Winter Year 3 (total)	184,754	209,754	210,521	190,285
Winter Year 3 (daily)	1,526.9	1,733.5	1,739.8	1,572.6
Spring Year 3 (total)	62,991	71,461	71,226	64,885
Spring Year 3 (daily)	1,032.6	1,171.5	1,167.6	1,063.7
Summer Year 3 (total)	22,068	23,872	23,637	22,731
Summer Year 3 (daily)	180.9	195.7	193.7	186.3
Fall Year 3 (total)	3,376	3,646	2,705	3,478
Fall Year 3 (daily)	55.3	59.8	44.3	57.0
Winter Year 4 (total)	234,083	245,327	197,444	239,564
Winter Year 4 (daily)	1,934.6	2,027.5	1,618.4	1,979.9
Spring Year 4 (total)	82,013	89,211	66,266	83,863
Spring Year 4 (daily)	1,344.5	1,462.5	1,086.3	1,374.8
Summer Year 4 (total)	35,572	45,389	15,666	36,192
Summer Year 4 (daily)	291.6	372.0	128.4	296.7
Fall Year 4 (total)	9,096	16,086	1,803	9,176
Fall Year 4 (daily)	149.1	263.7	29.6	150.4
Winter Year 5 (total)	237,297	311,229	186,909	237,230
Winter Year 5 (daily)	1,961.1	2,572.1	1,544.7	1,960.6
Spring Year 5 (total)	86,366	110,604	68,569	86,318
Spring Year 5 (daily)	1,415.8	1,813.2	1,124.1	1,415.0
Summer Year 5 (total)	42,027	46,748	33,169	41,978
Summer Year 5 (daily)	344.5	383.2	271.9	344.1
Fall Year 5 (total)	17,566	19,084	13,134	17,541
Fall Year 5 (daily)	288.0	312.8	215.3	287.6
Winter Year 6 (total)	167,540	118,360	164,450	150,105
Winter Year 6 (daily)	1,384.6	978.2	1,359.1	1,240.5
Spring Year 6 (total)	60,752	43,395	60,636	54,487
Spring Year 6 (daily)	995.9	711.4	994.0	893.2
Summer Year 6 (total)	39,566	31,146	36,811	36,494
Summer Year 6 (daily)	324.3	255.3	301.7	299.1
Fall Year 6 (total)	15,666	14,244	16,016	14,750
Fall Year 6 (daily)	256.8	233.5	262.6	241.8

Season and Year	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)
Winter Year 7 (total)	147,474	198,885	169,301	108,412
Winter Year 7 (daily)	1,218.8	1,643.7	1,399.2	896.0
Spring Year 7 (total)	52,813	69,479	60,767	39,683
Spring Year 7 (daily)	865.8	1,139.0	996.2	650.5
Summer Year 7 (total)	31,653	30,482	30,669	27,750
Summer Year 7 (daily)	259.5	249.9	251.4	227.5
Fall Year 7 (total)	12,530	11,115	14,005	12,016
Fall Year 7 (daily)	205.4	182.2	229.6	197.0
Winter Year 8 (total)	106,234	197,444	177,272	93,935
Winter Year 8 (daily)	878.0	1,631.8	1,465.1	776.3
Spring Year 8 (total)	39,470	70,082	62,352	34,118
Spring Year 8 (daily)	647.0	1,148.9	1,022.2	559.3
Summer Year 8 (total)	27,238	31,059	32,254	21,886
Summer Year 8 (daily)	223.3	254.6	264.4	179.4
Fall Year 8 (total)	12,274	12,240	11,191	9,599
Fall Year 8 (daily)	201.2	200.7	183.5	157.4
Winter Year 9 (total)	57,077	135,644	196,173	56,207
Winter Year 9 (daily)	471.7	1,121.0	1,621.3	464.5
Spring Year 9 (total)	22,640	52,597	69,500	22,848
Spring Year 9 (daily)	371.1	862.3	1,139.3	374.6
Summer Year 9 (total)	22,640	40,349	30,477	22,848
Summer Year 9 (daily)	185.6	330.7	249.8	187.3
Fall Year 9 (total)	11,320	18,845	11,949	11,424
Fall Year 9 (daily)	185.6	308.9	195.9	187.3
Winter Year 10 (total)	30,248	46,723	128,319	57,120
Winter Year 10 (daily)	250.0	386.1	1,060.5	472.1
Spring Year 10 (total)	10,928	16,578	46,835	22,848
Spring Year 10 (daily)	179.1	271.8	767.8	374.6
Summer Year 10 (total)	10,928	16,578	26,333	22,848
Summer Year 10 (daily)	89.6	135.9	215.8	187.3
Fall Year 10 (total)	5,464	8,289	12,106	11,424
Fall Year 10 (daily)	89.6	135.9	198.5	187.3
Winter Year 11–Year 30 (total)	549,132	833,045	971,053	547,912
Winter Year 11–Year 30 (daily)	226.9	344.2	382.2	226.4
Spring Year 11–Year 30 (total)	218,560	331,560	381,600	216,880
Spring Year 11–Year 30 (daily)	179.1	271.8	297.9	177.8
Summer Year 11–Year 30 (total)	218,560	331,560	359,600	216,880
Summer Year 11–Year 30 (daily)	89.6	135.9	140.4	88.9
Fall Year 11–Year 30[a] (total)	109,280	165,780	179,800	108,440
Fall Year 11–Year 30[a] (daily)	89.6	135.9	70.2	88.9
Season Total	**3,188,922**	**4,210,808**	**4,374,858**	**3,145,879**

Note: Ground trips are defined as one-way. Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B-70/Maxi Haul dump trucks). Daily values assume equal 24-hour distribution for each day of the season. Seasons are defined as follows: summer (122 days; June, July, August, September); fall (61 days; October, November); winter (121 days; December, January, February, March); and spring (61 days; April, May).

[a] Under Alternative D, this period would be Year 11 through Year 31.

Table D.5.7. Comparison of Alternatives Ground Traffic That Exceeds 15.0 Vehicles per Hour and the Number of Days of Exceedance by Season and Year*

Season and Year	Alternative B Trips per hour	Alternative B No. of Days	Alternative C Trips per hour	Alternative C No. of Days	Alternative D Trips per hour	Alternative D No. of Days	Alternative E Trips per hour	Alternative E No. of Days
Winter Year 2	31.7	121	31.9	121	42.9	121	31.7	121
Spring Year 2	21.6	122	21.7	61	29.0	61	21.6	61
Winter Year 3	63.6	121	72.2	121	72.5	121	65.5	121
Spring Year 3	43.0	61	48.8	61	48.7	61	44.3	61
Winter Year 4	80.6	121	84.5	151	67.4	121	82.5	121
Spring Year 4	56.0	61	60.9	61	45.3	61	57.3	61
Summer Year 4	NA	NA	15.5	122	NA	NA	NA	NA
Winter Year 5	81.7	121	107.2	121	64.4	121	81.7	121
Spring Year 5	59.0	61	75.5	61	46.8	61	59.0	61
Summer Year 5	NA	NA	16.0	122	NA	NA	NA	NA
Winter Year 6	57.7	121	40.8	121	56.6	121	51.7	121
Spring Year 6	41.5	61	29.6	61	41.4	61	37.2	61
Winter Year 7	50.8	121	68.5	121	58.3	121	37.3	121
Spring Year 7	36.1	61	47.5	61	41.5	61	27.1	61
Winter Year 8	36.6	121	68.0	121	61.0	121	32.3	121
Spring Year 8	27.0	61	47.9	61	42.6	61	23.3	61
Winter Year 9	19.7	121	46.7	121	67.6	121	19.4	121
Spring Year 9	15.5	61	35.9	61	47.5	61	15.6	61
Winter Year 10	NA	NA	1.5	121	44.2	121	19.7	121
Spring Year 10	NA	NA	NA	NA	32.0	61	15.6	61
Winter Year 11–Year 31	NA	NA	NA	NA	15.9	2,541	NA	NA
Total	**NA**	**1,517**	**NA**	**1,851**	**NA**	**4,179**	**NA**	**1,638**

Note: NA (not applicable). Ground trips are defined as one-way. Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B-70/Maxi Haul dump trucks). Daily values assume equal 24-hour distribution for each day of the season. Seasons are defined as follows: summer (122 days; June, July, August, September); fall (61 days; October, November); winter (121 days; December, January, February, March); and spring (61 days; April, May).

Table D.5.8. Comparison of Module Delivery Options Total and Daily Ground Traffic (number of trips) by Season and Year

Season and Year	Option 1: Atigaru Point Module Transfer Island	Option 2: Point Lonely Module Transfer Island	Option 3: Colville River Crossing
Winter Year 2 (total)	32,760	32,760	0
Winter Year 2 (daily)	270.7	270.7	0.0
Spring Year 2 (total)	10,920	10,920	0
Spring Year 2 (daily)	179.0	179.0	0.0
Summer Year 2 (total)	0	0	0
Summer Year 2 (daily)	0.0	0.0	0.0
Winter Year 3 (total)	105,504	216,339	0
Winter Year 3 (daily)	871.9	1,787.9	0.0
Spring Year 3 (total)	35,168	72,113	0
Spring Year 3 (daily)	576.5	1,182.2	0.0
Summer Year 3 (total)	0	0	4,590
Summer Year 3 (daily)	0.0	0.0	37.6
Fall Year 3 (total)	0	0	0
Fall Year 3 (daily)	0.0	0.0	0.0
Winter Year 4 (total)	32,844	32,844	0
Winter Year 4 (daily)	271.4	271.4	0.0
Spring Year 4 (total)	10,948	10,948	0
Spring Year 4 (daily)	179.5	179.5	0.0
Summer Year 4 (total)	0	0	300
Summer Year 4 (daily)	0.0	0.0	2.5
Fall Year 4 (total)	0	0	0
Fall Year 4 (daily)	0.0	0.0	0.0
Winter Year 5 (total)	811,965	1,106,805	198,736
Winter Year 5 (daily)	6,710.5	9,147.1	1,642.4
Spring Year 5 (total)	270,655	368,935	66,252
Spring Year 5 (daily)	4,437.0	6,048.1	1,086.1
Summer Year 5 (total)	0	0	0
Summer Year 5 (daily)	0.0	0.0	0.0
Winter Year 6 (total)	32,829	32,829	0
Winter Year 6 (daily)	271.3	271.3	0.0
Spring Year 6 (total)	10,943	10,943	0
Spring Year 6 (daily)	179.4	179.4	0.0
Summer Year 6 (total)	0	0	300
Summer Year 6 (daily)	0.0	0.0	2.5
Fall Year 6 (total)	0	0	0
Fall Year 6 (daily)	0.0	0.0	0.0
Winter Year 7 (total)	713,685	975,765	198,734
Winter Year 7 (daily)	5,898.2	8,064.2	1,642.4
Spring Year 7 (total)	237,895	325,255	66,248
Spring Year 7 (daily)	3,899.9	5,332.0	1,086.0
Summer Year 7 (total)	0	0	0
Summer Year 7 (daily)	0.0	0.0	0.0
Season Total	**2,306,116**	**3,196,456**	**535,160**

Note: Ground trips are defined as one-way. Includes buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation also includes gravel hauling operations (i.e., B-70/Maxi Haul dump trucks). Daily values assume equal 24-hour distribution for each day of the season. Seasons are defined as follows: summer (122 days; June, July, August, September); fall (61 days; October, November); winter (121 days; December, January, February, March); and spring (61 days; April, May).

5.4 Fixed-Wing Aircraft Traffic Comparisons*

Table D.5.9. Summary of Fixed-Wing Air Traffic (total number of trips) by Location for Each Action Alternative and Module Delivery Option*

Year	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)	Option 1: Atigaru Point Module Transfer Island	Option 2: Point Lonely Module Transfer Island	Option 3: Colville River Crossing
Fixed wing to/from Willow[a]	11,809	19,282	15,387	11,691	205	205	0
Fixed wing to/from Alpine[b]	292	292	3,651	292	25	25	28
Fixed wing to/from Kuparuk[b]	0	0	0	0	0	0	42
Fixed wing to/from Atigaru Point	0	0	0	0	96	0	0
Fixed wing to/from Point Lonely	0	0	0	0	0	96	0
Total fixed-wing trips	**12,101**	**19,574**	**19,038**	**11,983**	**326**	**326**	**70**

Note: Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Q400, Cessna, or similar. A single fixed-wing trip is defined as a landing and subsequent departure.
[a] Alternative C fixed-wing trips includes use of both the North and South Airstrips.
[b] Only includes flights to support the Project.

Table D.5.10. Comparison of Alternatives Total and Daily Fixed-Wing Aircraft Traffic to/from the Project (number of trips) by Season and Year*

Season and Year	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads, South Airstrip	Alternative C: Disconnected Infield Roads, North Airstrip	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)
Summer Year 0 (total)	0	0	0	0	0
Summer Year 0 (daily)	0.0	0.0	0.0	0.0	0.0
Winter Year 1 (total)	0	0	0	0	0
Winter Year 1 (daily)	0.0	0.0	0.0	0.0	0.0
Spring Year 1 (total)	0	0	0	0	0
Spring Year 1 (daily)	0.0	0.0	0.0	0.0	0.0
Summer Year 1 (total)	0	0	0	0	0
Summer Year 1 (daily)	0.0	0.0	0.0	0.0	0.0
Fall Year 1 (total)	0	0	0	0	0
Fall Year 1 (daily)	0.0	0.0	0.0	0.0	0.0
Winter Year 2 (total)	21	0	0	0	21
Winter Year 2 (daily)	0.2	0.0	0.0	0.0	0.2
Spring Year 2 (total)	7	0	0	0	7
Spring Year 2 (daily)	0.1	0.0	0.0	0.0	0.1
Summer Year 2 (total)	3	8	0	0	3
Summer Year 2 (daily)	0.0	0.1	0.0	0.0	0.0
Fall Year 2 (total)	0	16	0	0	0
Fall Year 2 (daily)	0.0	0.3	0.0	0.0	0.0
Winter Year 3 (total)	114	139	0	228	113
Winter Year 3 (daily)	0.9	1.1	0.0	1.9	0.9
Spring Year 3 (total)	39	45	0	78	39
Spring Year 3 (daily)	0.6	0.7	0.0	1.3	0.6
Summer Year 3 (total)	13	16	0	26	13
Summer Year 3 (daily)	0.1	0.1	0.0	0.2	0.1
Fall Year 3 (total)	2	2	0	3	2
Fall Year 3 (daily)	0.0	0.0	0.0	0.0	0.0
Winter Year 4 (total)	481	340	0	278	482
Winter Year 4 (daily)	4.0	2.8	0.0	2.3	4.0
Spring Year 4 (total)	169	124	46	94	170
Spring Year 4 (daily)	2.8	2.0	0.8	1.5	2.8
Summer Year 4 (total)	72	63	256	22	73
Summer Year 4 (daily)	0.6	0.5	2.1	0.2	0.6
Fall Year 4 (total)	18	22	92	3	19
Fall Year 4 (daily)	0.3	0.4	1.5	0.0	0.3
Winter Year 5 (total)	435	704	805	603	434
Winter Year 5 (daily)	3.6	5.8	6.7	5.0	3.6
Spring Year 5 (total)	158	253	277	222	158
Spring Year 5 (daily)	2.6	4.1	4.5	3.6	2.6
Summer Year 5 (total)	77	111	118	107	77
Summer Year 5 (daily)	0.6	0.9	1.0	0.9	0.6
Fall Year 5 (total)	32	44	50	43	32
Fall Year 5 (daily)	0.5	0.7	0.8	0.7	0.5
Winter Year 6 (total)	430	562	561	530	426
Winter Year 6 (daily)	3.6	4.6	4.6	4.4	3.5
Spring Year 6 (total)	158	216	214	195	158
Spring Year 6 (daily)	2.6	3.5	3.5	3.2	2.6
Summer Year 6 (total)	103	155	154	119	106
Summer Year 6 (daily)	0.8	1.3	1.3	1.0	0.9
Fall Year 6 (total)	40	71	70	52	43
Fall Year 6 (daily)	0.7	1.2	1.2	0.8	0.7

Season and Year	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads, South Airstrip	Alternative C: Disconnected Infield Roads, North Airstrip	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)
Winter Year 7 (total)	443	734	455	665	414
Winter Year 7 (daily)	3.7	6.1	3.8	5.5	3.4
Spring Year 7 (total)	160	253	152	241	154
Spring Year 7 (daily)	2.6	4.2	2.5	3.9	2.5
Summer Year 7 (total)	96	111	67	121	108
Summer Year 7 (daily)	0.8	0.9	0.5	1.0	0.9
Fall Year 7 (total)	38	41	24	56	47
Fall Year 7 (daily)	0.6	0.7	0.4	0.9	0.8
Winter Year 8 (total)	409	448	427	585	368
Winter Year 8 (daily)	3.4	3.7	3.5	4.8	3.0
Spring Year 8 (total)	154	156	151	204	134
Spring Year 8 (daily)	2.5	2.6	2.5	3.3	2.2
Summer Year 8 (total)	106	69	67	106	86
Summer Year 8 (daily)	0.9	0.6	0.6	0.9	0.7
Fall Year 8 (total)	48	27	26	37	38
Fall Year 8 (daily)	0.8	0.4	0.4	0.6	0.6
Winter Year 9 (total)	276	370	108	610	224
Winter Year 9 (daily)	2.3	3.1	0.9	5.0	1.9
Spring Year 9 (total)	112	145	39	216	91
Spring Year 9 (daily)	1.8	2.4	0.6	3.5	1.5
Summer Year 9 (total)	112	111	30	95	91
Summer Year 9 (daily)	0.9	0.9	0.2	0.8	0.7
Fall Year 9 (total)	56	52	14	37	46
Fall Year 9 (daily)	0.9	0.9	0.2	0.6	0.7
Winter Year 10 (total)	187	193	47	529	228
Winter Year 10 (daily)	1.5	1.6	0.4	4.4	1.9
Spring Year 10 (total)	71	74	18	196	91
Spring Year 10 (daily)	1.2	1.2	0.3	3.2	1.5
Summer Year 10 (total)	72	74	18	110	91
Summer Year 10 (daily)	0.6	0.6	0.1	0.9	0.7
Fall Year 10 (total)	36	37	9	51	46
Fall Year 10 (daily)	0.6	0.6	0.1	0.8	0.7
Winter Year 11–Year 30 (total)	3,538	3,719	896	4,580	3,543
Winter Year 11–Year 30 (daily)	1.5	1.5	0.4	1.8	1.5
Spring Year 11–Year 30 (total)	1,408	1,480	356	1,802	1,408
Spring Year 11–Year 30 (daily)	1.2	1.2	0.3	1.4	1.2
Summer Year 11–Year 30 (total)	1,408	1,480	356	1,700	1,408
Summer Year 11–Year 30 (daily)	0.6	0.6	0.1	0.7	0.6
Fall Year 11–Year 30 (total)	704	740	178	848	704
Fall Year 11–Year 30 (daily)	0.6	0.6	0.1	0.3	0.6
Season Total	**11,806**	**13,202**	**6,081**	**15,387**	**11,691**

Note: A single flight is defined as a landing and subsequent takeoff. Daily values assume equal 24-hour distribution for each day of the season. Seasons are defined as follows: summer (122 days; June, July, August, September); fall (61 days; October, November); winter (121 days; December, January, February, March); and spring (61 days; April, May). Total values may not match annual values presented elsewhere due to rounding. Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse). Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Cessna, or similar.

Table D.5.11. Comparison of Module Delivery Options Total and Daily Fixed-Wing Aircraft Traffic to/from the Project (number of trips) by Season and Year

Season and Year	Option 1: Atigaru Point Module Transfer Island	Option 2: Point Lonely Module Transfer Island	Option 3: Colville River Crossing
Winter Year 2 (total)	0	0	0
Winter Year 2 (daily)	0.0	0.0	0.0
Spring Year 2 (total)	0	0	0
Spring Year 2 (daily)	0.0	0.0	0.0
Summer Year 2 (total)	0	0	0
Summer Year 2 (daily)	0.0	0.0	0.0
Winter Year 3 (total)	7	7	0
Winter Year 3 (daily)	0.1	0.1	0.0
Spring Year 3 (total)	3	3	0
Spring Year 3 (daily)	0.0	0.0	0.0
Summer Year 3 (total)	0	0	0
Summer Year 3 (daily)	0.0	0.0	0.0
Fall Year 3 (total)	16	16	0
Fall Year 3 (daily)	0.3	0.3	0.0
Winter Year 4 (total)	37	37	0
Winter Year 4 (daily)	0.3	0.3	0.0
Spring Year 4 (total)	17	17	0
Spring Year 4 (daily)	0.3	0.3	0.0
Summer Year 4 (total)	16	16	0
Summer Year 4 (daily)	0.1	0.1	0.0
Fall Year 4 (total)	16	16	0
Fall Year 4 (daily)	0.3	0.3	0.0
Winter Year 5 (total)	26	0	0
Winter Year 5 (daily)	0.2	0.0	0.0
Spring Year 5 (total)	12	26	0
Spring Year 5 (daily)	0.2	0.2	0.0
Summer Year 5 (total)	0	12	0
Summer Year 5 (daily)	0.0	0.2	0.0
Winter Year 6 (total)	7	7	0
Winter Year 6 (daily)	0.1	0.1	0.0
Spring Year 6 (total)	3	3	0
Spring Year 6 (daily)	0.0	0.0	0.0
Summer Year 6 (total)	0	0	0
Summer Year 6 (daily)	0.0	0.0	0.0
Fall Year 6 (total)	16	16	0
Fall Year 6 (daily)	0.3	0.3	0.0
Winter Year 7 (total)	24	24	0
Winter Year 7 (daily)	0.2	0.2	0.0
Spring Year 7 (total)	5	5	0
Spring Year 7 (daily)	0.1	0.1	0.0
Summer Year 7 (total)	0	0	0
Summer Year 7 (daily)	0.0	0.0	0.0
Season Total	**205**	**205**	**0**

Note: A single flight is defined as a landing and subsequent takeoff. Daily values assume equal 24-hour distribution for each day of the season. Seasons are defined as follows: summer (122 days; June, July, August, September); fall (61 days; October, November); winter (121 days; December, January, February, March); and spring (61 days; April, May). Total values may not match annual values presented elsewhere due to rounding. Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse). Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Cessna, or similar.

Table D.5.12. Comparison of Alternatives Total and Daily Fixed-Wing Aircraft Traffic to/from the Alpine Development (number of trips) by Season and Year*

Season and Year	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)
Summer Year 0 (total)	0	0	0	0
Summer Year 0 (daily)	0.0	0.0	0.0	0.0
Winter Year 1 (total)	36	36	33	36
Winter Year 1 (daily)	0.3	0.3	0.3	0.3
Spring Year 1 (total)	12	12	17	12
Spring Year 1 (daily)	0.2	0.2	0.3	0.2
Summer Year 1 (total)	12	12	20	12
Summer Year 1 (daily)	0.1	0.1	0.2	0.1
Fall Year 1 (total)	0	0	0	0
Fall Year 1 (daily)	0.0	0.0	0.0	0.0
Winter Year 2 (total)	81	81	52	82
Winter Year 2 (daily)	0.7	0.7	0.4	0.7
Spring Year 2 (total)	28	28	26	28
Spring Year 2 (daily)	0.5	0.5	0.4	0.5
Summer Year 2 (total)	10	10	0	10
Summer Year 2 (daily)	0.1	0.1	0.0	0.1
Fall Year 2 (total)	2	2	0	2
Fall Year 2 (daily)	0.0	0.0	0.0	0.0
Winter Year 3 (total)	52	52	164	51
Winter Year 3 (daily)	0.4	0.4	1.4	0.4
Spring Year 3 (total)	17	17	77	17
Spring Year 3 (daily)	0.3	0.3	1.3	0.3
Summer Year 3 (total)	6	6	0	6
Summer Year 3 (daily)	0.0	0.0	0.0	0.1
Fall Year 3 (total)	0	0	0	1
Fall Year 3 (daily)	0.0	0.0	0.0	0.0
Winter Year 4 (total)	21	21	196	23
Winter Year 4 (daily)	0.2	0.2	1.6	0.2
Spring Year 4 (total)	8	8	85	8
Spring Year 4 (daily)	0.1	0.1	1.4	0.1
Summer Year 4 (total)	4	4	0	3
Summer Year 4 (daily)	0.0	0.0	0.0	0.0
Fall Year 4 (total)	2	2	0	1
Fall Year 4 (daily)	0.0	0.0	0.0	0.0
Winter Year 5 (total)	1	1	184	0
Winter Year 5 (daily)	0.0	0.0	1.5	0.0
Spring Year 5 (total)	0	0	78	0
Spring Year 5 (daily)	0.0	0.0	1.3	0.0
Summer Year 5 (total)	0	0	0	0
Summer Year 5 (daily)	0.0	0.0	0.0	0.0
Fall Year 5 (total)	0	0	0	0
Fall Year 5 (daily)	0.0	0.0	0.0	0.0
Winter Year 6 (total)	0	0	151	0
Winter Year 6 (daily)	0.0	0.0	1.2	0.0
Spring Year 6 (total)	0	0	62	0
Spring Year 6 (daily)	0.0	0.0	1.0	0.0
Summer Year 6 (total)	0	0	0	0
Summer Year 6 (daily)	0.0	0.0	0.0	0.0
Fall Year 6 (total)	0	0	0	0
Fall Year 6 (daily)	0.0	0.0	0.0	0.0
Winter Year 7 (total)	0	0	184	0

Season and Year	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)
Winter Year 7 (daily)	0.0	0.0	1.5	0.0
Spring Year 7 (total)	0	0	82	0
Spring Year 7 (daily)	0.0	0.0	1.3	0.0
Summer Year 7 (total)	0	0	0	0
Summer Year 7 (daily)	0.0	0.0	0.0	0.0
Fall Year 7 (total)	0	0	0	0
Fall Year 7 (daily)	0.0	0.0	0.0	0.0
Winter Year 8 (total)	0	0	153	0
Winter Year 8 (daily)	0.0	0.0	1.3	0.0
Spring Year 8 (total)	0	0	63	0
Spring Year 8 (daily)	0.0	0.0	1.0	0.0
Summer Year 8 (total)	0	0	0	0
Summer Year 8 (daily)	0.0	0.0	0.0	0.0
Fall Year 8 (total)	0	0	0	0
Fall Year 8 (daily)	0.0	0.0	0.0	0.0
Winter Year 9 (total)	0	0	184	0
Winter Year 9 (daily)	0.0	0.0	1.5	0.0
Spring Year 9 (total)	0	0	82	0
Spring Year 9 (daily)	0.0	0.0	1.3	0.0
Summer Year 9 (total)	0	0	0	0
Summer Year 9 (daily)	0.0	0.0	0.0	0.0
Fall Year 9 (total)	0	0	0	0
Fall Year 9 (daily)	0.0	0.0	0.0	0.0
Winter Year 10 (total)	0	0	159	0
Winter Year 10 (daily)	0.0	0.0	1.3	0.0
Spring Year 10 (total)	0	0	66	0
Spring Year 10 (daily)	0.0	0.0	1.1	0.0
Summer Year 10 (total)	0	0	0	0
Summer Year 10 (daily)	0.0	0.0	0.0	0.0
Fall Year 10 (total)	0	0	0	0
Fall Year 10 (daily)	0.0	0.0	0.0	0.0
Winter Year 11-Year 30 (total)	0	0	1,080	0
Winter Year 11-Year 30 (daily)	0.0	0.0	0.4	0.0
Spring Year 11-Year 30 (total)	0	0	454	0
Spring Year 11-Year 30 (daily)	0.0	0.0	0.4	0.0
Summer Year 11-Year 30 (total)	0	0	0	0
Summer Year 11-Year 30 (daily)	0.0	0.0	0.0	0.0
Fall Year 11-Year 30 (total)	0	0	0	0
Fall Year 11-Year 30 (daily)	0.0	0.0	0.0	0.0
Season Total	**292**	**292**	**3,651**	**292**

Note: A single flight is defined as a landing and subsequent takeoff. Daily values assume equal 24-hour distribution for each day of the season. Seasons are defined as follows: summer (122 days; June, July, August, September); fall (61 days; October, November); winter (121 days; December, January, February, March); and spring (61 days; April, May). Total values may not match annual values presented elsewhere due to rounding. Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse). Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Cessna, or similar.

Table D.5.13. Comparison of Module Delivery Options Total and Daily Fixed-Wing Air Traffic to/from the Alpine Development (number of trips) by Season and Year

Season and Year	Option 1: Atigaru Point Module Transfer Island	Option 2: Point Lonely Module Transfer Island	Option 3: Colville River Crossing
Winter Year 2 (total)	15	15	0
Winter Year 2 (daily)	0.1	0.1	0.0
Spring Year 2 (total)	10	10	0
Spring Year 2 (daily)	0.2	0.2	0.0
Summer Year 2 (total)	0	0	0
Summer Year 2 (daily)	0.0	0.0	0.0
Winter Year 3 (total)	0	0	0
Winter Year 3 (daily)	0.0	0.0	0.0
Spring Year 3 (total)	0	0	0
Spring Year 3 (daily)	0.0	0.0	0.0
Summer Year 3 (total)	0	0	0
Summer Year 3 (daily)	0.0	0.0	0.0
Fall Year 3 (total)	0	0	0
Fall Year 3 (daily)	0.0	0.0	0.0
Winter Year 4 (total)	0	0	0
Winter Year 4 (daily)	0.0	0.0	0.0
Spring Year 4 (total)	0	0	0
Spring Year 4 (daily)	0.0	0.0	0.0
Summer Year 4 (total)	0	0	0
Summer Year 4 (daily)	0.0	0.0	0.0
Fall Year 4 (total)	0	0	0
Fall Year 4 (daily)	0.0	0.0	0.0
Winter Year 5 (total)	0	0	9
Winter Year 5 (daily)	0.0	0.0	0.1
Spring Year 5 (total)	0	0	5
Spring Year 5 (daily)	0.0	0.0	0.1
Summer Year 5 (total)	0	0	0
Summer Year 5 (daily)	0.0	0.0	0.0
Winter Year 6 (total)	0	0	0
Winter Year 6 (daily)	0.0	0.0	0.0
Spring Year 6 (total)	0	0	0
Spring Year 6 (daily)	0.0	0.0	0.0
Summer Year 6 (total)	0	0	0
Summer Year 6 (daily)	0.0	0.0	0.0
Fall Year 6 (total)	0	0	0
Fall Year 6 (daily)	0.0	0.0	0.0
Winter Year 7 (total)	0	0	9
Winter Year 7 (daily)	0.0	0.0	0.1
Spring Year 7 (total)	0	0	5
Spring Year 7 (daily)	0.0	0.0	0.1
Summer Year 7 (total)	0	0	0
Summer Year 7 (daily)	0.0	0.0	0.0
Season Total	**25**	**25**	**28**

Note: A single flight is defined as a landing and subsequent takeoff. Daily values assume equal 24-hour distribution for each day of the season. Seasons are defined as follows: summer (122 days; June, July, August, September); fall (61 days; October, November); winter (121 days; December, January, February, March); and spring (61 days; April, May). Total values may not match annual values presented elsewhere due to rounding. Flights outlined are additional flights required beyond projected travel to/from non-Project airports (e.g., Anchorage, Fairbanks, Deadhorse). Fixed-wing aircraft includes Q400, C-130, DC-6, Twin Otter/CASA, Cessna, or similar.

5.5 Helicopter Traffic Comparisons*

Table D.5.14. Summary of Helicopter Air Traffic (total number of trips) by Location for Each Action Alternative and Module Delivery Option*

Year	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)	Option 1: Atigaru Point Module Transfer Island	Option 2: Point Lonely Module Transfer Island	Option 3: Colville River Crossing
Helicopter to/from Willow[a]	2,321	2,778	2,403	2,321	435	435	0
Helicopter to/from Alpine[b]	100	132	100	100	15	15	16
Total helicopter trips	**2,421**	**2,910**	**2,503**	**2,421**	**450**	**450**	**16**

Note: A single helicopter trip is defined as a landing and subsequent departure.
[a] Alternative C helicopter trips includes use of both the North and South Airstrips.
[b] Only includes flights to support the Project.

Table D.5.15. Comparison of Alternatives Total and Daily Helicopter Traffic to/from the Project (number of trips) by Season and Year*

Season and Year	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads, South Airstrip	Alternative C: Disconnected Infield Roads, North Airstrip	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)
Summer Year 0 (total)	0	0	0	0	0
Summer Year 0 (daily)	0.0	0.0	0.0	0.0	0.0
Winter Year 1 (total)	0	0	0	0	0
Winter Year 1 (daily)	0.0	0.0	0.0	0.0	0.0
Spring Year 1 (total)	0	0	0	0	0
Spring Year 1 (daily)	0.0	0.0	0.0	0.0	0.0
Summer Year 1 (total)	0	0	0	0	0
Summer Year 1 (daily)	0.0	0.0	0.0	0.0	0.0
Fall Year 1 (total)	0	0	0	0	0
Fall Year 1 (daily)	0.0	0.0	0.0	0.0	0.0
Winter Year 2 (total)	0	0	0	0	0
Winter Year 2 (daily)	0.0	0.0	0.0	0.0	0.0
Spring Year 2 (total)	0	0	0	0	0
Spring Year 2 (daily)	0.0	0.0	0.0	0.0	0.0
Summer Year 2 (total)	25	57	0	25	25
Summer Year 2 (daily)	0.2	0.5	0.0	0.2	0.2
Fall Year 2 (total)	0	0	0	0	0
Fall Year 2 (daily)	0.0	0.0	0.0	0.0	0.0
Winter Year 3 (total)	0	0	0	0	0
Winter Year 3 (daily)	0.0	0.0	0.0	0.0	0.0
Spring Year 3 (total)	25	45	0	32	25
Spring Year 3 (daily)	0.4	0.7	0.0	0.5	0.4
Summer Year 3 (total)	57	100	0	50	57
Summer Year 3 (daily)	0.5	0.8	0.0	0.4	0.5
Fall Year 3 (total)	0	0	0	0	0
Fall Year 3 (daily)	0.0	0.0	0.0	0.0	0.0
Winter Year 4 (total)	0	0	0	0	0
Winter Year 4 (daily)	0.0	0.0	0.0	0.0	0.0
Spring Year 4 (total)	25	45	0	32	25
Spring Year 4 (daily)	0.4	0.7	0.0	0.5	0.4
Summer Year 4 (total)	57	100	0	50	57
Summer Year 4 (daily)	0.5	0.8	0.0	0.4	0.5
Fall Year 4 (total)	0	0	0	0	0
Fall Year 4 (daily)	0.0	0.0	0.0	0.0	0.0
Winter Year 5 (total)	0	0	0	0	0
Winter Year 5 (daily)	0.0	0.0	0.0	0.0	0.0
Spring Year 5 (total)	25	27	14	32	25
Spring Year 5 (daily)	0.4	0.4	0.2	0.5	0.4
Summer Year 5 (total)	57	60	44	50	57
Summer Year 5 (daily)	0.5	0.5	0.4	0.4	0.5
Fall Year 5 (total)	0	0	0	0	0
Fall Year 5 (daily)	0.0	0.0	0.0	0.0	0.0
Winter Year 6 (total)	0	0	0	0	0
Winter Year 6 (daily)	0.0	0.0	0.0	0.0	0.0
Spring Year 6 (total)	25	31	10	32	25
Spring Year 6 (daily)	0.4	0.5	0.2	0.5	0.4
Summer Year 6 (total)	57	63	30	50	57
Summer Year 6 (daily)	0.5	0.5	0.2	0.4	0.5
Fall Year 6 (total)	0	0	0	0	0
Fall Year 6 (daily)	0.0	0.0	0.0	0.0	0.0

Season and Year	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads, South Airstrip	Alternative C: Disconnected Infield Roads, North Airstrip	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)
Winter Year 7 (total)	0	0	0	0	0
Winter Year 7 (daily)	0.0	0.0	0.0	0.0	0.0
Spring Year 7 (total)	25	39	7	32	25
Spring Year 7 (daily)	0.4	0.6	0.1	0.5	0.4
Summer Year 7 (total)	57	77	22	50	57
Summer Year 7 (daily)	0.5	0.6	0.2	0.4	0.5
Fall Year 7 (total)	0	0	0	0	0
Fall Year 7 (daily)	0.0	0.0	0.0	0.0	0.0
Winter Year 8 (total)	0	0	0	0	0
Winter Year 8 (daily)	0.0	0.0	0.0	0.0	0.0
Spring Year 8 (total)	25	39	7	32	25
Spring Year 8 (daily)	0.4	0.6	0.1	0.5	0.4
Summer Year 8 (total)	57	77	22	50	57
Summer Year 8 (daily)	0.5	0.6	0.2	0.4	0.5
Fall Year 8 (total)	0	0	0	0	0
Fall Year 8 (daily)	0.0	0.0	0.0	0.0	0.0
Winter Year 9 (total)	0	0	0	0	0
Winter Year 9 (daily)	0.0	0.0	0.0	0.0	0.0
Spring Year 9 (total)	25	35	0	32	25
Spring Year 9 (daily)	0.4	0.6	0.0	0.5	0.4
Summer Year 9 (total)	57	72	12	50	57
Summer Year 9 (daily)	0.5	0.6	0.1	0.4	0.5
Fall Year 9 (total)	0	0	0	0	0
Fall Year 9 (daily)	0.0	0.0	0.0	0.0	0.0
Winter Year 10 (total)	0	0	0	0	0
Winter Year 10 (daily)	0.0	0.0	0.0	0.0	0.0
Spring Year 10 (total)	25	22	0	32	25
Spring Year 10 (daily)	0.4	0.4	0.0	0.5	0.4
Summer Year 10 (total)	57	52	9	50	57
Summer Year 10 (daily)	0.5	0.4	0.1	0.4	0.5
Fall Year 10 (total)	0	0	0	0	0
Fall Year 10 (daily)	0.0	0.0	0.0	0.0	0.0
Winter Year 11–Year 30 (total)	0	0	0	0	0
Winter Year 11–Year 30 (daily)	0.0	0.0	0.0	0.0	0.0
Spring Year 11–Year 30 (total)	500	480	0	671	500
Spring Year 11–Year 30 (daily)	0.4	0.4	0.0	0.5	0.4
Summer Year 11–Year 30 (total)	1,140	1,000	180	1,051	1,140
Summer Year 11–Year 30 (daily)	0.5	0.4	0.1	0.4	0.5
Fall Year 11–Year 30 (total)	0	0	0	0	0
Fall Year 11–Year 30 (daily)	0.0	0.0	0.0	0.0	0.0
Season Total	**2,321**	**2,421**	**357**	**2,403**	**2,321**

Note: A single flight is defined as a landing and subsequent takeoff. Daily values assume equal 24-hour distribution for each day of the season. Seasons are defined as follows: summer (122 days; June, July, August, September); fall (61 days; October, November); winter (121 days; December, January, February, March); and spring (61 days; April, May). Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all phases of the Project. Values may not match the Annual totals presented elsewhere due to rounding. Typical helicopters include A-Star and 206 Long Ranger models, although other similar types of helicopters may be used.

Table D.5.16. Comparison of Module Delivery Options Total and Daily Helicopter Traffic to/from the Project (number of trips) by Season and Year

Season and Year	Option 1: Atigaru Point Module Transfer Island	Option 2: Point Lonely Module Transfer Island	Option 3: Colville River Crossing
Winter Year 2 (total)	0	0	0
Winter Year 2 (daily)	0.0	0.0	0.0
Spring Year 2 (total)	0	0	0
Spring Year 2 (daily)	0.0	0.0	0.0
Summer Year 2 (total)	0	0	0
Summer Year 2 (daily)	0.0	0.0	0.0
Winter Year 3 (total)	78	78	0
Winter Year 3 (daily)	0.6	0.6	0.0
Spring Year 3 (total)	42	42	0
Spring Year 3 (daily)	0.7	0.7	0.0
Summer Year 3 (total)	90	90	0
Summer Year 3 (daily)	0.7	0.7	0.0
Fall Year 3 (total)	0	0	0
Fall Year 3 (daily)	0.0	0.0	0.0
Winter Year 4 (total)	0	0	0
Winter Year 4 (daily)	0.0	0.0	0.0
Spring Year 4 (total)	0	0	0
Spring Year 4 (daily)	0.0	0.0	0.0
Summer Year 4 (total)	40	40	0
Summer Year 4 (daily)	0.3	0.3	0.0
Fall Year 4 (total)	20	20	0
Fall Year 4 (daily)	0.3	0.3	0.0
Winter Year 5 (total)	50	0	0
Winter Year 5 (daily)	0.4	0.0	0.0
Spring Year 5 (total)	10	50	0
Spring Year 5 (daily)	0.2	0.4	0.0
Summer Year 5 (total)	0	10	0
Summer Year 5 (daily)	0.0	0.2	0.0
Winter Year 6 (total)	24	24	0
Winter Year 6 (daily)	0.2	0.2	0.0
Spring Year 6 (total)	12	12	0
Spring Year 6 (daily)	0.2	0.2	0.0
Summer Year 6 (total)	16	16	0
Summer Year 6 (daily)	0.1	0.1	0.0
Fall Year 6 (total)	8	8	0
Fall Year 6 (daily)	0.1	0.1	0.0
Winter Year 7 (total)	34	34	0
Winter Year 7 (daily)	0.3	0.3	0.0
Spring Year 7 (total)	11	11	0
Spring Year 7 (daily)	0.2	0.2	0.0
Summer Year 7 (total)	0	0	0
Summer Year 7 (daily)	0.0	0.0	0.0
Season Total	**435**	**435**	**0**

Note: A single flight is defined as a landing and subsequent takeoff. Daily values assume equal 24-hour distribution for each day of the season. Seasons are defined as follows: summer (122 days; June, July, August, September); fall (61 days; October, November); winter (121 days; December, January, February, March); and spring (61 days; April, May). Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all phases of the Project. Values may not match the Annual totals presented elsewhere due to rounding. Typical helicopters include A-Star and 206 Long Ranger models, although other similar types of helicopters may be used.

Table D.5.17. Comparison of Alternatives Total and Daily Helicopter Traffic to/from the Alpine Development (number of trips) by Season and Year*

Season and Year	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)
Summer Year 0 (total)	25	25	25	25
Summer Year 0 (daily)	0.2	0.2	0.2	0.2
Winter Year 1 (total)	0	0	0	0
Winter Year 1 (daily)	0.0	0.0	0.0	0.0
Spring Year 1 (total)	12	12	12	12
Spring Year 1 (daily)	0.2	0.2	0.2	0.2
Summer Year 1 (total)	38	38	38	38
Summer Year 1 (daily)	0.3	0.3	0.3	0.3
Fall Year 1 (total)	0	0	0	0
Fall Year 1 (daily)	0.0	0.0	0.0	0.0
Winter Year 2 (total)	0	0	0	0
Winter Year 2 (daily)	0.0	0.0	0.0	0.0
Spring Year 2 (total)	25	57	25	25
Spring Year 2 (daily)	0.4	0.9	0.4	0.4
Summer Year 2 (total)	0	0	0	0
Summer Year 2 (daily)	0.0	0.0	0.0	0.0
Fall Year 2 (total)	0	0	0	0
Fall Year 2 (daily)	0.0	0.0	0.0	0.0
Winter Year 3 (total)	0	0	0	0
Winter Year 3 (daily)	0.0	0.0	0.0	0.0
Spring Year 3 (total)	0	0	0	0
Spring Year 3 (daily)	0.0	0.0	0.0	0.0
Summer Year 3 (total)	0	0	0	0
Summer Year 3 (daily)	0.0	0.0	0.0	0.0
Fall Year 3 (total)	0	0	0	0
Fall Year 3 (daily)	0.0	0.0	0.0	0.0
Winter Year 4 (total)	0	0	0	0
Winter Year 4 (daily)	0.0	0.0	0.0	0.0
Spring Year 4 (total)	0	0	0	0
Spring Year 4 (daily)	0.0	0.0	0.0	0.0
Summer Year 4 (total)	0	0	0	0
Summer Year 4 (daily)	0.0	0.0	0.0	0.0
Fall Year 4 (total)	0	0	0	0
Fall Year 4 (daily)	0.0	0.0	0.0	0.0
Winter Year 5 (total)	0	0	0	0
Winter Year 5 (daily)	0.0	0.0	0.0	0.0
Spring Year 5 (total)	0	0	0	0
Spring Year 5 (daily)	0.0	0.0	0.0	0.0
Summer year 5 (total)	0	0	0	0
Summer Year 5 (daily)	0.0	0.0	0.0	0.0
Fall Year 5 (total)	0	0	0	0
Fall Year 5 (daily)	0.0	0.0	0.0	0.0
Winter Year 6 (total)	0	0	0	0
Winter Year 6 (daily)	0.0	0.0	0.0	0.0
Spring Year 6 (total)	0	0	0	0
Spring Year 6 (daily)	0.0	0.0	0.0	0.0
Summer Year 6 (total)	0	0	0	0
Summer Year 6 (daily)	0.0	0.0	0.0	0.0
Fall Year 6 (total)	0	0	0	0
Fall Year 6 (daily)	0.0	0.0	0.0	0.0
Winter Year 7 (total)	0	0	0	0

Season and Year	Alternative B: Proponent's Project	Alternative C: Disconnected Infield Roads	Alternative D: Disconnected Access	Alternative E: Three-Pad Alternative (Fourth Pad Deferred)
Winter Year 7 (daily)	0.0	0.0	0.0	0.0
Spring Year 7 (total)	0	0	0	0
Spring Year 7 (daily)	0.0	0.0	0.0	0.0
Summer Year 7 (total)	0	0	0	0
Summer Year 7 (daily)	0.0	0.0	0.0	0.0
Fall Year 7 (total)	0	0	0	0
Fall Year 7 (daily)	0.0	0.0	0.0	0.0
Winter Year 8 (total)	0	0	0	0
Winter Year 8 (daily)	0.0	0.0	0.0	0.0
Spring Year 8 (total)	0	0	0	0
Spring Year 8 (daily)	0.0	0.0	0.0	0.0
Summer Year 8 (total)	0	0	0	0
Summer Year 8 (daily)	0.0	0.0	0.0	0.0
Fall Year 8 (total)	0	0	0	0
Fall Year 8 (daily)	0.0	0.0	0.0	0.0
Winter Year 9 (total)	0	0	0	0
Winter Year 9 (daily)	0.0	0.0	0.0	0.0
Spring Year 9 (total)	0	0	0	0
Spring Year 9 (daily)	0.0	0.0	0.0	0.0
Summer Year 9 (total)	0	0	0	0
Summer Year 9 (daily)	0.0	0.0	0.0	0.0
Fall Year 9 (total)	0	0	0	0
Fall Year 9 (daily)	0.0	0.0	0.0	0.0
Winter Year 10 (total)	0	0	0	0
Winter Year 10 (daily)	0.0	0.0	0.0	0.0
Spring Year 10 (total)	0	0	0	0
Spring Year 10 (daily)	0.0	0.0	0.0	0.0
Summer Year 10 (total)	0	0	0	0
Summer Year 10 (daily)	0.0	0.0	0.0	0.0
Fall Year 10 (total)	0	0	0	0
Fall Year 10 (daily)	0.0	0.0	0.0	0.0
Winter Year 11–Year 30 (total)	0	0	0	0
Winter Year 11–Year 30 (daily)	0.0	0.0	0.0	0.0
Spring Year 11–Year 30 (total)	0	0	0	0
Spring Year 11–Year 30 (daily)	0.0	0.0	0.0	0.0
Summer Year 11–Year 30 (total)	0	0	0	0
Summer Year 11–Year 30 (daily)	0.0	0.0	0.0	0.0
Fall Year 11–Year 30 (total)	0	0	0	0
Fall Year 11–Year 30 (daily)	0.0	0.0	0.0	0.0
Season Total	**100**	**132**	**100**	**100**

Note: A single flight is defined as a landing and subsequent takeoff. Daily values assume equal 24-hour distribution for each day of the season. Seasons are defined as follows: summer (122 days; June, July, August, September); fall (61 days; October, November); winter (121 days; December, January, February, March); and spring (61 days; April, May). Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all phases of the Project. Values may not match the Annual totals presented elsewhere due to rounding. Typical helicopters include A-Star and 206 Long Ranger models, although other similar types of helicopters may be used.

Table D.5.18. Comparison of Module Delivery Options Total and Daily Helicopter Traffic to/from the Alpine Development (number of trips) by Season and Year

Season and Year	Option 1: Atigaru Point Module Transfer Island	Option 2: Point Lonely Module Transfer Island	Option 3: Colville River Crossing
Winter Year 2 (total)	0	0	0
Winter Year 2 (daily)	0.0	0.0	0.0
Spring Year 2 (total)	0	0	0
Spring Year 2 (daily)	0.0	0.0	0.0
Summer Year 2 (total)	15	15	0
Summer Year 2 (daily)	0.1	0.1	0.0
Winter Year 3 (total)	0	0	0
Winter Year 3 (daily)	0.0	0.0	0.0
Spring Year 3 (total)	0	0	0
Spring Year 3 (daily)	0.0	0.0	0.0
Summer Year 3 (total)	0	0	0
Summer Year 3 (daily)	0.0	0.0	0.0
Fall Year 3 (total)	0	0	0
Fall Year 3 (daily)	0.0	0.0	0.0
Winter Year 4 (total)	0	0	0
Winter Year 4 (daily)	0.0	0.0	0.0
Spring Year 4 (total)	0	0	0
Spring Year 4 (daily)	0.0	0.0	0.0
Summer Year 4 (total)	0	0	0
Summer Year 4 (daily)	0.0	0.0	0.0
Fall Year 4 (total)	0	0	0
Fall Year 4 (daily)	0.0	0.0	0.0
Winter Year 5 (total)	0	0	0
Winter Year 5 (daily)	0.0	0.0	0.0
Spring Year 5 (total)	0	0	0
Spring Year 5 (daily)	0.0	0.0	0.0
Summer Year 5 (total)	0	0	8
Summer Year 5 (daily)	0.0	0.0	0.1
Winter Year 6 (total)	0	0	0
Winter Year 6 (daily)	0.0	0.0	0.0
Spring Year 6 (total)	0	0	0
Spring Year 6 (daily)	0.0	0.0	0.0
Summer Year 6 (total)	0	0	0
Summer Year 6 (daily)	0.0	0.0	0.0
Fall Year 6 (total)	0	0	0
Fall Year 6 (daily)	0.0	0.0	0.0
Winter Year 7 (total)	0	0	0
Winter Year 7 (daily)	0.0	0.0	0.0
Spring Year 7 (total)	0	0	0
Spring Year 7 (daily)	0.0	0.0	0.0
Summer Year 7 (total)	0	0	8
Summer Year 7 (daily)	0.0	0.0	0.1
Season Total	**15**	**15**	**16**

Note: A single flight is defined as a landing and subsequent takeoff. Daily values assume equal 24-hour distribution for each day of the season. Seasons are defined as follows: summer (122 days; June, July, August, September); fall (61 days; October, November); winter (121 days; December, January, February, March); and spring (61 days; April, May). Includes support for ice road construction, pre-staged boom deployment, hydrology and other environmental studies, and agency inspection during all phases of the Project. Values may not match the Annual totals presented elsewhere due to rounding. Typical helicopters include A-Star and 206 Long Ranger models, although other similar types of helicopters may be used.

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