Nanushuk Development Project

Project Description

Submitted by:

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TABLES

FIGURES

SHEETS

Abbreviations

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
Armstrong	Armstrong Energy, LLC
ASRC	Arctic Slope Regional Corporation
CFR	Code of Federal Regulations
CPF	central processing facility
cy	cubic yards
USDOT	U.S. Department of Transportation
DS1	drill site 1
DS2	drill site 2
DS2M	drill site 2M [Kuparuk River Unit]
DS3	drill site 3
EPA	U.S. Environmental Protection Agency
FRP	Facility Response Plan
HSM	horizontal support member
mcy	million cubic yards
MG	million gallons
NSB	North Slope Borough
ODPCP	Oil Discharge Prevention and Contingency Plan
OHW	ordinary high water
Project	Nanushuk Development Project
RCRA	Resource Conservation and Recovery Act
SPCC Plan	Spill Prevention, Control, and Countermeasure Plan
UIC well	underground injection control well
USACE	U.S. Army Corps of Engineers
VSM	vertical support member
WAP	Waste Analysis Plan
WOUS	waters of the U.S.

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1.0 INTRODUCTION

Armstrong Energy, LLC (Armstrong) is proposing development of hydrocarbon deposits from its State of Alaska oil and gas leasehold on the North Slope of Alaska. The Nanushuk Development Project (Project) targets oil deposits in the Alpine C and Nanushuk reservoirs. Armstrong will drill wells and construct and operate infrastructure and facilities to produce and transport sales-quality oil to the Trans-Alaska Pipeline System.

1.1 Location

The Project is located approximately 52 miles west of Deadhorse and, at its closest point, is approximately 7 miles northeast of the community of Nuiqsut (Figure 1; Sheet 1) on Armstrong-operated State of Alaska oil and gas leases southeast of the East Channel of the Colville River. The Project is located southwest of the existing Oooguruk Development Project, west of the existing Kuparuk River Unit (Kuparuk), and east of the existing Alpine and Alpine Satellite Development Projects. Table 1 and Sheet 4 detail the location of project components.

Table 1: Project Components and Locations

Project Component	Township[a]	Range	Section(s)
Nanushuk Pad consisting of drill site 1 (DS1) and a central processing facility (CPF)	12 North	6 East	25, 26, 35
Drill site 2 (DS2)	11 North	6 East	05
Drill site 3 (DS3)	11 North 11 North	5 East 6 East	36 31
Operations center	12 North 11 North	6 East 6 East	35, 36 01
Access road	11 North 11 North 11 North 12 North	6 East 7 East 8 East 6 East	01, 12 07, 17, 18, 20, 25, 26, 27, 28, 29, 34, 35 29, 30, 32, 33 25, 36
Miluveach River bridge	11 North	7 East	34
Infield roads	11 North 11 North 12 North	6 East 5 East 6 East	02, 03, 04, 05, 09, 10, 11, 14, 15, 20, 21, 22, 29, 30, 31 25, 36 35, 36
Kachemach River bridge	11 North	6 East	20
Infield pipelines	11 North 12 North	6 East 6 East	02, 03, 04, 05, 09, 11, 14, 15, 20, 21, 22, 29, 30, 31 26, 35
Nanushuk Pipeline	11 North 11 North 11 North 11 North 12 North	6 East 7 East 8 East 9 East 6 East	01, 12 07, 17, 18, 20, 21, 25, 26, 27, 28, 34 23, 24, 26, 27, 28, 29, 30, 33 19, 20, 21, 29 26, 35, 36
Potable water system	11 North 12 North	6 East 6 East	02, 03, 04, 05, 09 26, 35, 36
Tie-in pad	11 North	9 East	21
Oliktok Dock screeding area	13 North	9 East	05

[a] All locations are based on the Umiat Meridian.

The Project is located in the North Slope Borough (NSB). Kuukpik Corporation owns the surface estate of lands at the drill sites and lands traversed by the infield roads and infield pipelines, and portions of the access road and Nanushuk Pipeline (Sheets 2 and 3). The State of Alaska, through the Alaska Department of Natural Resources (ADNR), manages the majority of surface lands traversed by the Nanushuk Pipeline and access road. The Project will access subsurface mineral resources that are shared by the State of Alaska and the Arctic Slope Regional Corporation (ASRC). None of the project facilities are located on or near Native allotments.

1.2 Site Conditions

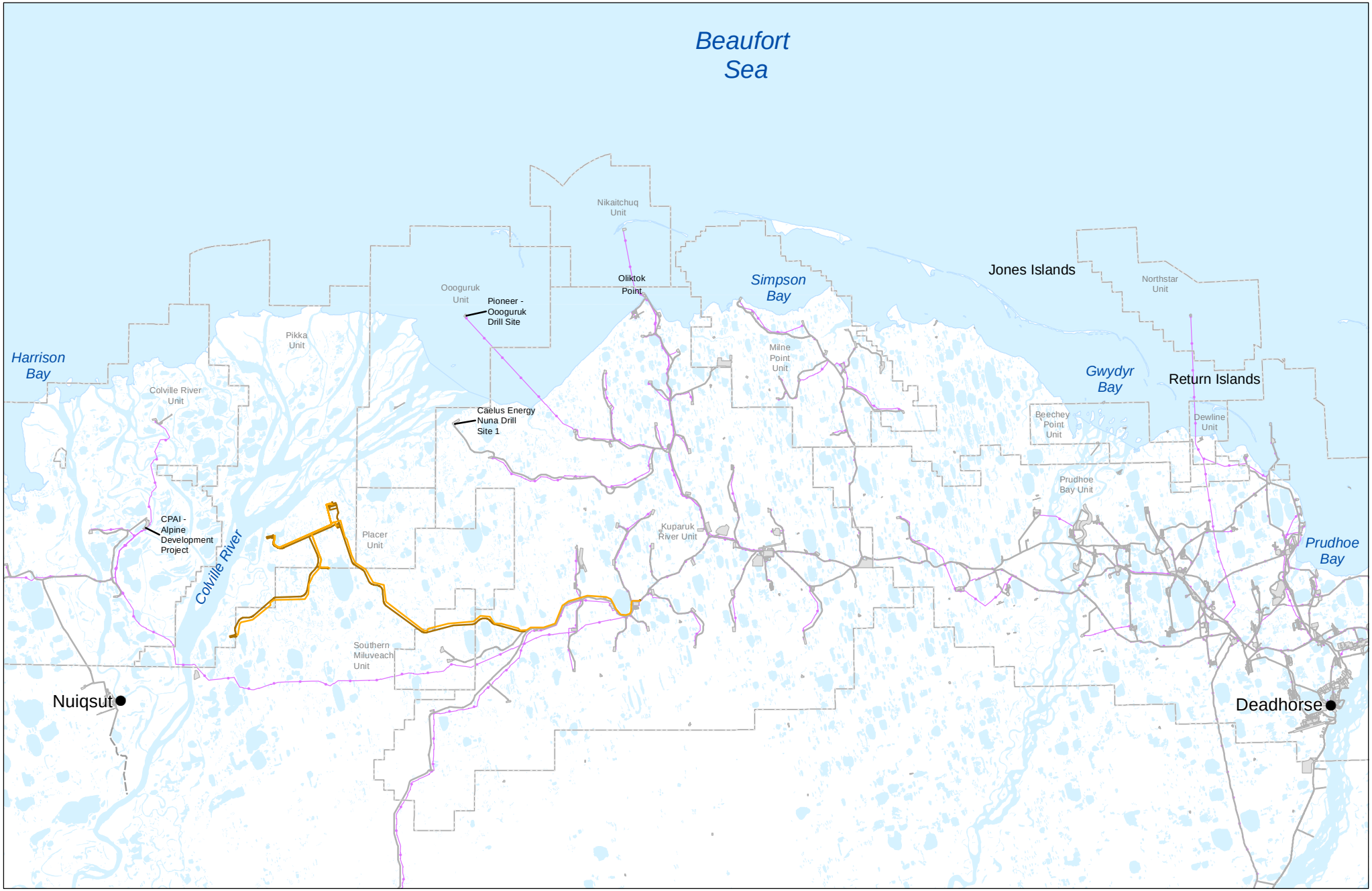
The Project is within the Arctic Coastal Plain physiographic region at elevations ranging from sea level to 100 feet above sea level. The landscape of the Arctic Coastal Plain is generally flat with landforms between drainages dominated by patterned ground, shallow lakes and ponds, and wetlands resulting from poorly drained soils. As is typical on the North Slope, the Project is located on permafrost where the subsurface is perennially frozen to a depth of approximately 2,000 feet.

2.0 PROJECT COMPONENTS

The Project will include construction of the Nanushuk Pad consisting of drill site 1 (DS1) and a central processing facility (CPF), drill site 2 (DS2), drill site 3 (DS3), an operations center, infield pipelines, the export/import Nanushuk Pipeline, infield roads, an access road, a tie-in pad, and a potable water system (Figure 2; Sheet 4). The Project also includes screeding[1] activities in front of the existing Oliktok Dock and trenching activities for electrical and fiber optic cables at pipeline-road crossings. Maintenance to the existing road system may also be required to facilitate transportation of sealift modules. Gravel material for project development will be sourced from one or more existing gravel mine sites (see Section 3.1), which will be permitted and operated independent of the Project. The footprint and quantity of fill needed for each project component are summarized in Section 2.9. Support infrastructure is discussed in Section 3.0.

All project facilities are designed and will be constructed to meet federal, state, and local regulatory requirements; industry standards; arctic oil field best practices; and other Armstrong internal standards. Gravel pads will have a minimum gravel thickness of 6 feet and side slopes of 2 to 1. Gravel roads will have a minimum gravel thickness of 5 feet and side slopes of 2 to 1. Gravel infrastructure located in the floodplain will be built to more conservative elevations based on hydrologic conditions.[2] Placement of the roads and pads will be optimized to minimize ponding to the extent practical and road and pad elevations will be designed as appropriate to prevent overtopping. In areas where ponding next to a pad cannot be avoided during flood events or where flowing water may occur adjacent to the gravel embankment, erosion potential will be determined and erosion control will be provided as needed.

[1] Screeding is a process of redistributing sediment to smooth the seafloor to facilitate barge offloading.
[2] Based on field conditions, pads are estimated to be an average of 9 to 9.5 feet thick and roads are estimated to be an average of 6.5 to 7.5 feet. Thicknesses could be greater in floodplains.


Beaufort Sea
Nikaitchuq Unit
Oliktok Point
Simpson Bay
Jones Islands
Northstar Unit
Oooguruk Unit
Pioneer - Oooguruk Drill Site
Pikka Unit
Harrison Bay
Milne Point Unit
Gwydyr Bay
Return Islands
Colville River Unit
Caelus Energy Nuna Drill Site 1
Beechey Point Unit
Dewline Unit
Prudhoe Bay Unit
CPAI - Alpine Development Project
Colville River
Placer Unit
Kuparuk River Unit
Prudhoe Bay
Southern Miluveach Unit
Nuiqsut
Deadhorse
Project Facilities
Access and Infield Gravel Roads
Pipeline Systems
Communities
Existing Facilities
Existing Roads
Existing Pipelines
Oil and Gas Unit Boundaries
Proposed Colville River Access Road
0 5 10 20 Kilometers
0 4 8 16 Miles
N
Notes:
CRS: Alaska State Plane, NAD83, Zone 4
ARMSTRONG Energy, LLC
Armstrong Energy, LLC
Nanushuk Project
General Project Location
Figure 1
By: HDR Inc.
Date: 6/30/2017

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Proposed Project Components

- Export/Import Pipeline
- Infield Pipeline
- Freshwater Pipeline
- Access Gravel Road
- Infield Gravel Road
- Nanushuk Pad*
- Drill Site 2 and Drill Site 3
- Operations Center Pad
- Tie-in Pad at CPF2

Other Infrastructure

- Existing Facilities
- Existing Roads
- Existing Pipelines

*Nanushuk Pad includes Drill Site 1 and the Central Processing Facility

0 1 2 4 Kilometers

0 0.5 1 2 Miles

Notes:
CRS: Alaska State Plane, NAD83, Zone 4

N

ARMSTRONG Energy, LLC

Nanushuk Project

Proposed Project

Figure 2

By: HDR Inc.

Date: 6/30/2017

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Gravel infrastructure will be constructed during the winter months. After the gravel footprint is surveyed and staked, all snow and ice in excess of 4 inches will be removed from the tundra surface in the work area; the tundra surface will not be otherwise disturbed. Pit-run gravel will be placed in lifts using large-capacity dump trucks and will be spread out with bulldozers or similar heavy earthmoving equipment. Each lift will be compacted by a heavy roller. During summer months, ice that is present in the gravel will melt, leading to further consolidation and settlement. To enhance this process, the gravel will be farmed[3] and re-compacted during the summer months after each year that gravel placement occurs. No infrastructure will be placed on gravel pads and roads until re-grading and compaction is completed.

2.1 Drill Sites

The Project includes three gravel drill sites: DS1, DS2, and DS3. DS1 is located on the Nanushuk Pad with the CPF (see Section 2.2; Sheets 5 and 6), while DS2 and DS3 are stand alone drill sites (Sheets 7 to 10). The number and locations of the drill sites are dictated by the configuration of the oil reservoirs defined by previous exploration efforts, with consideration for site accessibility requirements; and operational constraints. Drill sites are also oriented with the long axis parallel to the prevailing northeast/southwest wind direction to minimize snow drifting.

The three drill sites will accommodate up to 146 total production and injection wells (32 at DS1, 60 at DS2, and 54 at DS3) with 20-foot spacing between wellheads. DS1, DS2, and DS3 will also include an additional well slot to accommodate a Class 1 underground injection control (UIC) disposal well (see Section 3.6). Each drill site will accommodate drilling equipment and support facilities, including well stimulation equipment, drilling mud and cement tanks, production gathering facilities, diesel storage tanks, a communication tower, cold storage, emergency response equipment, and drilling laydown areas. Each drill site also includes space for temporary camps (see Section 3.2). An access corridor will be maintained generally around the edge of each pad to provide egress and ingress in the event of an emergency. This corridor serves a secondary function of providing access to facilities and infrastructure for maintenance and service. Power generated at the CPF, located at the Nanushuk Pad, will be supplied to each drill site through a power cable, which will be attached to infield pipelines (see Section 2.5.1). No processing of multiphase product—a mixture of crude oil, natural gas, and water—beyond routine well testing and process fluid heating, will occur at DS2 and DS3.

2.2 Nanushuk Pad

The Nanushuk Pad comprises DS1 and the processing and utilities facilities that make up the CPF (Sheets 5 and 6). Multiphase product from the three drill sites will be transported to the Nanushuk Pad via multiphase pipelines for processing. Facilities at the Nanushuk Pad will have capacity to process approximately 120,000 barrels per day of cumulative oil production. Water separated from the oil will be transported back to the drill sites via water injection pipelines to be re-injected into the subsurface formation to help with crude oil production. Separated gas will be used for fuel at the CPF, and the remainder will be transported back to the drill sites via pipelines for gas lift. Excess gas, if any, will be injected into dedicated injection wells at the drill sites, or made available for market. Sales-quality oil processed at the Nanushuk Pad will be transported to the tie-in pad (Section 2.4) at the Kuparuk CPF2 via the Nanushuk Pipeline

[3] Farming, also called seasoning, consists of turning the upper layers of gravel to expose buried areas and facilitate drying.

(Section 2.5.2), where it will tie into the Kuparuk Sales Pipeline for transportation to the Trans-Alaska Pipeline System.

Processing facilities on the Nanushuk Pad will comprise a combination of truckable and sealift modules.[4] These include equipment designed for phase separation, heating and cooling, pumping, gas treatment and compression for gas lift injection, and water treatment for injection. The Nanushuk Pad also includes metering and pigging facilities; power generation facilities; a truck fill station; construction material and equipment staging areas; and a central control room. The Nanushuk Pad will house a tank farm consisting of diesel, refined fuel, crude oil, injection water, production chemicals, glycol, and methanol storage tanks (see Section 3.5).

The Nanushuk Pad will include either a single or dual flares to support both high and low pressure safety relief systems. The flares will be designed in accordance with regulatory requirements. The height and width of the flare stacks has not yet been determined.

2.3 Operations Center

The operations center (Sheets 11 and 12) will include facilities to support field-wide operations. Operations center infrastructure includes:

- A 200-bed operations camp to house operations and maintenance personnel, including living quarters, housekeeping, a recreation area, food service facilities, and a small medical clinic
- Office, warehouse, and maintenance buildings
- Warm and cold storage buildings
- Water/wastewater treatment plants and temporary waste storage areas
- Communication structures including a communication tower
- Diesel-fired back-up power generators and fuel storage
- A helicopter landing pad (helipad; note, routine helicopter use is not planned under normal operating conditions)
- A UIC disposal well

The operations center pad may also house construction camps during the construction phase. Following construction, the camps will be decommissioned and removed from the site. The area vacated on the pad will then be used by operations for outdoor storage or for other uses.

2.4 Tie-in Pad

The Project includes a tie-in pad located on new gravel fill adjacent to the existing Kuparuk CPF2 facility (Sheets 13 and 14). The tie-in pad provides space for tie-in of the Nanushuk Pipeline to existing North Slope facilities. Tie-in pad infrastructure will include a pig launcher and receiver, a metering skid, pipe rack, pumping infrastructure, shut down valve, laydown area, and a communications tower.

[4] Truckable processing facility modules are generally smaller modules fabricated off site and transported to the North Slope and the Nanushuk Pad location by truck. Sealift modules are larger processing facility modules constructed off site and delivered to the North Slope by barge.

2.5 Pipelines

The Project includes two types of pipelines: infield pipelines, which connect DS2 and DS3 to the processing facilities at the Nanushuk Pad; and the Nanushuk Pipeline, which connects the Nanushuk Pad to existing infrastructure on the North Slope via the tie-in pad (see Section 2.4). Specific infrastructure planned for each pipeline is described below.

All pipelines will rest on horizontal support members (HSMs) supported by one or two (such as at anchor supports) 8- to 24-inch-diameter pipe pile vertical support members (VSMs) spaced approximately 55 to 60 feet apart. Standard VSMs will typically be embedded a minimum of 15 feet. Pipelines will also include Z-style expansion loops to allow for thermal expansion and contraction. Where feasible, pipelines will be located parallel to gravel roads (see Section 2.6) at a distance of between 500 and 1,000 feet to minimize caribou disturbance and excessive snow drift while facilitating access for visual pipeline inspection, monitoring, repairs, modifications, and testing.

Both the infield pipelines and the Nanushuk Pipeline will include power and fiber optic cables to transmit power and facilitate communication between the Nanushuk Pad, the drill sites, operations center, and tie-in pad to avoid the need to install power poles. Cables will be installed on the HSMs using messenger cables. All pipelines, HSMs, and suspended cables will be a minimum of 7 feet above the tundra surface except where pipelines intersect a road or pad or are constructed within 100 feet of an existing pipeline that is elevated less than 5 feet. External pipe walls will be coated with fusion bonded epoxy. Pipelines containing temperature controlled fluids and multiphase product will include an insulation system consisting of polyurethane foam insulation covered with an interlocked sheet metal jacket. Pipelines will have a non-reflective finish to reduce reflectivity and potential impacts to wildlife.

Pipeline construction activities will occur via ice road during two to three winter construction seasons. VSM locations will be surveyed and drilled, followed by VSM installation into the pre-drilled holes using sand slurry fill. Drilling will occur from an ice road and will result in cuttings sidecast onto the ice around each VSM. The cuttings will then be removed.

Where pipelines cross road embankments, coated and insulated pipelines will be encased in structural steel pipe casings buried within the roadway section (Sheet 43 and 44). Casings for pipeline-road crossings will extend at least 2 feet beyond the road embankment toe. The power and fiber optic cables will cross under the road prism via a trench located parallel to each pipeline-road crossing (Sheet 45). Trenching will occur during the winter. Trenched materials will be temporarily sidecast onto an ice pad adjacent to the trench. This will avoid a discharge of fill material into waters of the U.S. (WOUS), since the sidecasting will not change the bottom elevation of a WOUS or replace any portion of a WOUS with dry ground. Trenched materials will be taken off the ice pad and backfilled into the excavation once trenching is complete.

2.5.1 Infield Pipelines

Infield pipelines include two pipelines connecting the Nanushuk Pad to drill sites—one to DS2 and one to DS3 (Sheets 15 to 20, 37 to 40).

Both the DS2 and DS3 infield pipelines include:

- A multiphase pipeline to deliver multiphase product from the drill sites to the CPF at the Nanushuk Pad
- A water injection pipeline to transport produced water from the Nanushuk Pad to the drill sites for reinjection

- A gas lift pipeline to transport treated gas from the Nanushuk Pad to the drill sites
- A gas injection pipeline to transport excess gas to dedicated injection wells at the drill sites
- An infield power cable to transmit power produced at the Nanushuk Pad to the drill sites
- An infield fiber optic cable to transmit signals and communications between the Nanushuk Pad and the drill sites

In addition, a freshwater pipeline will transport water from the water intake structure at Lake L9211 (Section 2.7, Sheet 41) to the operations center and Nanushuk Pad. The freshwater pipeline will be placed on dedicated VSMs between Lake L9211 and DS2. The pipeline will then share the DS2 infield pipeline VSMs to the operations center and Nanushuk Pad to the extent practicable.

2.5.2 Nanushuk Pipeline

The import/export Nanushuk Pipeline (Sheets 21 to 29, 35 to 36) includes:

- An oil export pipeline to transport sales-quality oil from the Nanushuk Pad to the tie-in pad at the Kuparuk CPF2
- A make-up water pipeline to transport make-up injection water from the tie-in pad to the Nanushuk Pad
- A bi-directional make-up gas pipeline to transport make-up gas from the tie-in pad to the Nanushuk Pad or excess gas from the Nanushuk Pad to the tie-in pad
- A power cable to transmit power produced at the Nanushuk Pad to the tie-in pad
- A fiber optic cable to transmit signals and communications between the Nanushuk Pad and the tie-in pad

The Nanushuk Pipeline will be located parallel to the access road (see Section 2.6) between the Nanushuk Pad and Kuparuk drill site 2M (DS2M). Between DS2M and the Kuparuk CPF2, the Nanushuk Pipeline will parallel existing pipelines and gravel roads associated with the Kuparuk River Unit. The Nanushuk Pipeline cannot be located on existing VSMs due to insufficient space on existing pipe racks. However, co-location with the existing pipeline and road corridor minimizes impacts to the aquatic environment compared to having the two features spaced farther apart.

2.5.3 Pipeline River Crossings

The Nanushuk Pipeline and the DS3 infield pipeline will cross the Miluveach River and Kachemach River, respectively. The pipeline crossings may require placement of VSMs below ordinary high water (OHW; Sheet 47). All pipelines, HSMs, and suspended cables will be elevated at river crossings to maintain adequate freeboard. VSMs placed within known floodplains will be designed to withstand the effects of scour, bank migration, and forces from ice floe impacts.

2.6 Gravel Roads

The Project includes 11.9 miles of gravel infield roads, including a 3.8-mile DS2 road and 7.6-mile DS3 road, to provide all-season ground transport between the Nanushuk Pad and DS2 and DS3 (Sheets 15 to 20), and a 0.5-mile Nanushuk Pad secondary access loop to provide secondary egress on and off the Nanushuk Pad (Sheet 16). The Project also includes a

13.6-mile gravel access road to provide all-season ground transport between the Nanushuk Pad and the existing road network at Kuparuk DS2M (Sheets 21 to 29).

The access road will be constructed with minimum top widths sufficient to accommodate sealift module transport from the existing road network to the Nanushuk Pad (a minimum of 35 feet wide at the surface and minimum 55 feet at the base; Sheet 30). Infield roads will be constructed with minimum top widths sufficient to accommodate drill rig movement to DS2 and DS3 (a minimum of 34 feet wide at the surface and minimum 54 feet at the base; Sheet 30). Six road turnouts (four along the access road, one on the DS2 road, and one on the DS3 road) will be included to allow safe access to project facilities during movement of large equipment, including modules and drilling rigs (Sheet 31). Access and infield roads are designed to accommodate two-way traffic and will be used during facility construction, drilling, and operations for mobilization of construction materials; drill rigs and drilling materials; supplies; personnel; and, if necessary, emergency spill response equipment.

Proposed gravel roads will parallel the proposed pipelines to facilitate year round access for maintenance; repair; monitoring; and, if necessary, emergency response (see Section 2.5). Gravel roads will maintain a separation distance from pipelines of 500 feet or more, where practicable, but no greater than 1,000 feet in order to reduce risk of vehicle impacts, ensure access during a spill or fire, and expedite snow removal. All roads will also include 4-foot-high flexible reflective markers along the sides spaced approximately 50 to 75 feet apart and 1 foot from the road shoulder. Where pipelines cross gravel roads, they will be buried within the roadway section and encased with structural pipe sized appropriately for required loads (Section 2.5).

2.6.1 Bridges and Culverts

The access road crosses the Miluveach River and the DS3 infield road crosses the Kachemach River on 337 and 330-foot bridges, respectively. Both bridges will be multi-span structures and include pipe pile foundations at sheet pile abutments, and several sets of intermediate pier piles between abutments. Piers may be set in both the floodplains and the main river channel below OHW (Sheets 48 to 51). The Miluveach River bridge is designed to accommodate sealift module transport. The Kachemach River bridge is designed to accommodate drill rig movements. Both bridges will consist of steel girders with precast concrete decks with a 34-foot clear width between the faces of a removable steel railing. Both the Miluveach and Kachemach River bridges are designed to maintain adequate freeboard.

The access road will also cross five small streams or concentrated drainages[5] using culverts. The DS3 infield road will have two concentrated drainage crossings. Drainage culverts (both size and number) will be sited and designed at streams and concentrated drainages to pass the 50-year flood event with a headwater elevation not exceeding the diameter of the culvert. Prior to construction, an engineer will walk and slope-stake the roads to determine precise location of drainage structures and determine on-site conditions for final layout.

Typical drainage culverts will be structural steel pipe (Sheet 33). Fish passage culverts (Sheet 34) will be designed at stream crossings where the Alaska Department of Fish and Game (ADF&G) determine fish are present and design will be in accordance with ADF&G Title 16 fish passage standards. Flow velocities at culvert outlets will be analyzed, and outlet erosion control measures will be designed as necessary to prevent channel degradation. Downstream scour

[5] Concentrated drainages are defined as relatively saturated areas that lack an OHW mark but are likely to convey flow during breakup, or an incised thermokarst-polygon field that may potentially convey flow.

protection, where required, may consist of articulated concrete block mats or other appropriate material (such as riprap). Typically, steel pipe culverts will be constructed during the winter months. Multi-plate culverts will be installed during the summer months to allow proper compaction of gravel around the culverts; however, temporary passage structures can be installed during the winter allowing continued flow during construction of the permanent multi-plate structure.

Cross-drainage culverts will be installed within the infield and access roads to reduce impoundment and allow conveyance of surface water flow that intersects the road, in order to maintain natural drainage patterns (Sheet 32). As a general guideline, cross-drainage culverts will be sited approximately every 500 feet along the alignment during initial design efforts, although exact placement of culverts will depend on actual in-field local drainage patterns.

2.7 Potable Water System

Lake L9211 will be the primary source of fresh water for operations camp needs. Water will be recovered using a water intake structure and electric skid mounted pump (Sheets 41 to 42). The intake structure will be supported on concrete pipe support anchors. Water will be circulated between the water intake structure, the operations center, and the Nanushuk Pad via two freshwater pipelines located within an insulated carrier pipeline. The carrier pipeline will be placed on dedicated VSMs to DS2. The pipeline will then share the DS2 infield pipeline VSMs to the operations center and the Nanushuk Pad for treatment and storage.

2.8 Oliktok Point Dock Screeding

Sealift modules for the processing facilities at the Nanushuk Pad will be transported to the North Slope via barge and will be offloaded at the existing dock at Oliktok Point during the open water season. Barge offloading is accomplished by temporarily grounding barges at the dock face, which requires a relatively flat area in front of the dock face to avoid creation of barge stress by point loading due to bathymetric irregularities. The Project includes preparation of the barge landing area within a 500-foot-wide by 500-foot-long (5.7 acre) area in front (seaward) of the dock face through screeding just prior to the arrival of the first barge (Sheet 52).

The screeding process includes scraping or dragging sediments within the proposed area to a desired depth of 8.0 to 8.5 feet below Mean Lower Low Water. Sediments will not be removed from the water, nor will they leave the general dock area. Approximately 2,000 to 3,000 cubic yards (cy) of seafloor may be redistributed, with the final volume dependent on site conditions prior to commencement of activities.

2.9 Summary of Temporary and Permanent Discharge to Waters of the U.S.

In total, the Project will result in unavoidable temporary and permanent discharges into jurisdictional WOUS located within the project area. Permanent discharges will affect a total of 271.6 acres WOUS, including 271.0 acres of gravel infrastructure, 0.6 acre of pipeline VSMs, and less than 0.1 acre bridge pilings in WOUS (Sheet 53). Project development will require approximately 2.74 million cubic yards (mcy) of clean gravel fill and 14,520 cy of sand slurry. The Project will also affect a total of 0.5 acre of non-jurisdictional uplands. Table 2 includes a summary of project fill requirements.

Table 2: Footprint of Project Components and Fill Requirements in WOUS					
Project Component	**Fill Type**	**Footprint (acres)**	**Footprint in WOUS (acres)**	**Fill Quantity (cy)**	**Notes/Dimensions**
Nanushuk Pad (DS1 and CPF)	Gravel	26.9	26.9	391,000	Approximately 2,050 to 2,062 feet long by 614 to 626 feet wide; minimum 6-foot thickness.
DS2	Gravel	19.1	19.1	263,000	Approximately 1,785 to 1,797 feet long by 583 to 595 feet wide; minimum 6-foot thickness.
DS3	Gravel	18.0	18.0	248,000	Approximately 1,665 to 1,677 feet long by 585 to 597 feet wide; minimum 6-foot thickness.
Operations center pad	Gravel	16.4	16.4	232,000	Approximately 996 to 1,008 feet long by 724 to 736 feet wide; minimum 6-foot thickness.
Tie-in pad	Gravel	0.6	0.6	8,000	Approximately 144 to 156 feet long by 144 to 156 feet wide; minimum 6-foot thickness.
Access road	Gravel	101.7	101.5	842,000	13.6 miles long; minimum 35-foot surface width (minimum 55 feet at the base); minimum 5-foot thickness. Includes four 100 to 210- by 40-foot turnouts.
Infield roads	Gravel	88.8	88.5	758,000	11.9 miles long; minimum 34-foot surface width (minimum 54 feet at the base); minimum 5-foot thickness. Includes two 100- by 40-foot turnouts.
Total gravel fill	**-**	**271.5**	**271.0**	**2,742,000**	
Miluveach River bridge	Pipe pile	<0.1	<0.1	-	337-foot long bridge with intermediate pipe piles.
Kachemach River bridge	Pipe pile	<0.1	<0.1	-	330-foot long bridge with intermediate pipe piles.
Nanushuk Pipeline VSMs	Sand slurry	0.4	0.4	8,400[a]	22.1-miles of pipeline requiring approximately 3,080 VSMs.
Infield pipeline VSMs	Sand slurry	0.2	0.2	5,900[a]	15.3-miles of pipeline requiring approximately 2,160 VSMs.
Potable water system	Sand slurry/ concrete pile	<0.1	<0.1	220[a]	Intake supported on concrete pipe support anchors. Pipeline requiring approximately 80 VSMs.
Total other fill	**-**	**0.6**	**0.6**	14,520	
Total fill	**-**	**272.1**	**271.6**	**2,756,520**	

Notes: WOUS: waters of the U.S.; cy: cubic yards; VSMs: vertical support members; DS1, DS2, DS3: drill sites 1, 2, and 3; CPF: central processing facilities; OHW: ordinary high water

[a] VSM fill quantity is estimated to be approximately 2.7 cy per VSM.

The Project will also include temporary discharges to 5.8 acres of jurisdictional WOUS as a result of screeding at the existing Oliktok Dock, and trenching of electrical and fiber optic cables in jurisdictional WOUS at each pipeline-road crossing (Table 3).

Table 3: Temporary Discharges in WOUS

Project Component	Footprint (acres)	Footprint in WOUS (acres)	Fill Quantity (cy)	Notes/Dimensions
Screeding footprint	5.7	5.7	2,000 to 3,000	500- by 500-foot screeding area to depth of 8.0 to 8.5 below MLLW.
Power/fiber optic cable trenching	0.1	0.1	420	Approximately 300-foot-long by 18-inch-wide by 5-foot-deep trench at each of 5 pipeline road crossings.
Total area of temporary impact	**5.8**	**5.8**		

Notes: WOUS: waters of the U.S.; cy: cubic yards; MLLW: Mean Lower Low Water

3.0 SUPPORT INFRASTRUCTURE

In addition to major components, the following infrastructure will be used to support construction, drilling, and operation of the Project.

3.1 Gravel Source

An estimated 2.74 mcy of gravel will be needed to construct proposed project facilities. Clean gravel material for project development will be obtained from one or more of the existing mine sites located on the North Slope in the vicinity of the project area. Likely sources include Mine Site F, owned and operated by the NSB, or the ASRC Mine Site. Both potential gravel sources are less than 15 miles from the Nanushuk Pad. Permitting and operation of existing mine sites would be conducted by the mine owner or designated operator.

Gravel will be hauled during the winter over two to three seasons depending on the quantity of gravel needed. All gravel mining, overburden and gravel stockpiling, and mine rehabilitation activities will be evaluated as part of the permitting and operation of the gravel mine independent of the Project. The mine operator will load gravel onto dump trucks for transport to the project site via a combination of existing gravel roads, new gravel roads, and/or ice roads. No gravel will be stockpiled at the project site outside of permitted footprint for gravel fill.

3.2 Camps

An operations camp will be located on the operations center. This will be the main base camp for operations and maintenance through the life of the Project. A number of additional temporary camps will be established to support construction and drilling activities. Camps are detailed in Table 4.

Table 4: Camps			
Camp	**Location**	**Capacity[a]**	**Project Year(s)[b]**
Operations camp	operations center	200 people	3 to life of the Project[c]
Temporary construction camp(s)	Project gravel pad(s)	800 people	2 to 5
Off-site pioneer construction camp(s)	ice pad or existing gravel pad	300 people	1 to 2
Drilling support camps	Nanushuk Pad, DS2, and DS3	120 to 150 people per rig	4 to 19

Notes: DS2, DS3: drill sites 2 and 3

[a] Based on the number of beds

[b] See project schedule (Section 6.0).

[c] The design life of the Project is 30 years.

The off-site pioneer construction camp(s) will be located near the selected mine site on an ice pad or on an existing gravel pad, pending available space. The pioneer construction camps will be used until the construction camps are installed and operational.

The construction camps will be located on one or more of the Project gravel pads and will provide space to accommodate construction personnel. The construction camps will remain in place through the completion of the construction and startup phase, after which the camps will be decommissioned and removed from the site.

A drilling support camp will be located on each drill site to support drilling activities. After completion of drilling activities on each pad, the associated camp will be decommissioned and removed from the drill site.

3.3 Water Use

During construction, non-potable fresh water from local permitted lakes will be used for ice road and pad construction and maintenance, and for possible hydrostatic testing of pipelines. Ice roads require approximately 1 million gallons (MG) of fresh water per mile. Ice pads require approximately 82,400 gallons of water per acre for a 6-inch thick pad. Hydrostatic test water could require up to 2.52 MG. Potable fresh water for domestic use at the construction camps will be trucked from Deadhorse or other existing facilities. Typical fresh water volumes for domestic water use during construction, drilling, and operations are approximately 100 gallons per worker per day.

During the drilling phase, approximately 10,000 gallons per day per rig of non-potable water will be obtained from locally permitted sources within the project area to support drilling activities. Potable fresh water for domestic use at the drilling camp will be trucked from Deadhorse or other existing facilities. In addition, approximately 4.9 MG of make-up water (likely seawater) are needed per year for production and injection well stimulation to improve well productivity.

During operations, approximately 5.5 MG of potable fresh water for the operations camp will be supplied by the potable water system (see Section 2.7). Non-potable fresh water used for dust suppression will be obtained from locally permitted lakes. A 0.25-inch water application for road dust control requires approximately 20,000 gallons of water per mile of gravel road per application. Approximately 150,000 barrels per day of make-up water will be used as injection water for reservoir pressure maintenance. Pending commercial agreements and availability of supply, make-up water will likely be purchased from a third party and will be transported from

the tie-in pad at the Kuparuk CPF2 to the Nanushuk Pad via a make-up water pipeline on the Nanushuk Pipeline VSMs (see Section 2.5).

Snowmelt and other run-off from project facilities will be managed through implementation of standard Best Management Practices under a site-specific Storm Water Pollution Prevention Plan (see Section 5.0). An Alaska Pollutant Discharge Elimination System determination will be undertaken as potential water discharges are identified during project planning. See Section 3.6 for details on disposal of project wastewater.

3.4 Ice Infrastructure

Single season ice roads will be used during construction of the pipelines, gravel roads, and bridges (Years 2 through 5). Table 5 lists the approximate mileage of ice roads planned during construction activities. Exact ice road routes may vary by up to 1 mile based on topography, other field conditions, and agency approvals. Single season ice roads do not require a Department of the Army permit.

Table 5: Ice Road Infrastructure

Year	Approximate Mileage	Routes
Years 1 to 2	60 to 70	• Access road construction (DS2M to operations center) • Gravel source(s) access (TBD)
Years 2 to 3	58 to 70	• Access road construction (operations center to Nanushuk Pad) • Infield road construction (Nanushuk Pad to DS2) • Nanushuk and infield VSM and pipeline installation • Gravel source(s) access (TBD)
Years 3 to 4	36 to 70	• Infield road construction (DS2 to DS3) • Nanushuk and infield VSM and pipeline installation • Gravel source(s) access (TBD)
Years 4 to 5	36 to 70	• Nanushuk and infield pipeline installation and hydrostatic testing

Notes: DS2, DS2M, DS3: drill sites 2, 2M, and 3; TBD: to be determined; VSMs: vertical support members

Standard-duty ice roads on the North Slope are a minimum of 6 inches thick and average approximately 12 inches thick due to terrain features. Ice roads for construction, materials, and personnel transportation will be constructed to support expected loads and protect the vegetation and organic soil beneath. Ice roads will also be constructed to avoid ice-road sensitive vegetation, such as willows, that extend above the snow level, per NSB permit stipulations. Ice roads will be wide enough to safely accommodate two-way vehicular traffic (minimum of 20 feet), drill rig access (minimum of 30 feet), and other traffic, as required. The ice road season each year varies depending on weather conditions and ice road completion times. The tundra-based ice road season lasts from approximately January through late April; however, it can be longer or shorter depending upon snow depth and soil temperature, and

early-access approval (USACE 2012). In accordance with permits, ice road crossings of designated streams and rivers will be slotted, breached, or weakened upon completion of use.

Seasonal ice pads will also be used to support construction activities including gravel placement and pipeline and bridge installation. Ice pads will likely be located adjacent to bridges, at each major gravel pad, and every 3 to 4 miles along access/infield roads and export/infield pipelines. Construction support ice pads will house field offices, break shacks, enviro-vacs, and field shops, and will stage construction equipment, vehicles, materials, and supplies until gravel pads become available for use. Each construction support ice pad will be a minimum of 6 inches thick and 1 acre or less in size.

If space on an existing gravel pad is not available, an ice pad may be used to house the off-site pioneer construction camp in the first winter season of construction.

Water for ice roads and ice pads will be obtained from permitted surface water sources (see Section 3.3).

3.5 Fuel and Hazardous Substances

The Project will require the transport of diesel and gasoline from Deadhorse to the project area to support activities during construction, drilling, and operations. During construction, dedicated temporary storage areas for diesel and gasoline will be defined and placed on ice pads and, once complete, moved onto the project gravel pads. Permanent diesel fuel storage tank infrastructure will be located on the Nanushuk Pad and the operations center. Storage at the operations center will be in a bulk tank and/or in ISO tanks. Emergency generators located at the operations center will have day tanks that will be refilled as needed from the bulk storage tank. The operations center will also have storage tanks or ISO tanks for gasoline storage and dispensing. The primary storage location for production chemicals will be at the operations center with smaller amounts at the Nanushuk Pad and drill sites.

All fuel and hazardous substances used by the Project will be handled and stored on site in compliance with state and federal regulatory guidance and the Project's Oil Discharge Prevention and Contingency Plan (ODPCP) and Spill Prevention, Control, and Countermeasure (SPCC) Plan. The ODPCP will comply with State of Alaska requirements in Alaska Statute 46.04.030 and 18 AAC 75 as well as U.S. Department of Transportation (USDOT) requirements in 49 Code of Federal Regulations (CFR) 194. The SPCC Plan will comply with U.S. Environmental Protection Agency (EPA) regulations in 40 CFR 112. All fuels and chemicals will be stored in appropriate primary containment. Secondary containment areas will be designed in compliance with all applicable permits and regulations. If required, two Facility Response Plans (FRPs) will also be prepared: an EPA FRP and a USDOT FRP. The USDOT FRP will address federal regulations of the Nanushuk Pipeline under 49 CFR 195.

3.5.1 Spill Prevention and Response

Armstrong will design and develop the Project to avoid and minimize the possibility of spills. Spill prevention measures considered throughout the design and engineering phase include a maintenance and inspection program as well as an employee spill prevention training program. Hydrostatic testing will validate the integrity of the pipelines prior to operation.

Armstrong has internal standards in place that provide guidance to spill prevention measures. These, in combination with compliance with all state, federal, and local regulations, reduce the likelihood of a spill occurring.

Pipeline spill prevention measures include multiple forms of leak detection, isolation valves or vertical loops, and regular maintenance and cleaning. Leak detection systems and surveillance will be compliant with American Society of Mechanical Engineers (ASME) codes and state and federal standards. For pipeline-river crossings, either isolation valves or vertical loops will be used, depending on the type of pipeline. Pipeline facilities will include pig launchers and receivers capable of handling in-line inspection tools, and maintenance and cleaning tools.

The Project will include dedicated oil spill response equipment positioned throughout the field. The locations and types of oil spill response equipment, and equipment deployment times will be identified in detail in the project ODPCP and staged before startup. Equipment and support infrastructure will be managed and maintained by Armstrong in coordination with Alaska Clean Seas. In the case of a leak, pipeline operations would shut down immediately, and appropriate agency notifications would be made. The cause of the incident would be identified, and repairs would be implemented after regulatory approval. Spill containment and mechanical cleanup would begin as soon as possible.

3.6 Waste Management and Disposal

A range of wastes will be generated during construction, drilling, and operations. A Waste Management Plan will be prepared to address the types and quantities, regulatory controls, and management options for solid and liquid wastes. Armstrong will also use other resources, such as the Alaska Waste Disposal and Reuse Guide (commonly known as the Redbook), to guide waste management decisions. Key elements of the waste management approach will include:

- Full compliance with federal, state, and NSB waste management regulations
- Waste minimization through careful project planning and beneficial reclamation, reuse, and recycling when practicable
- Subsurface disposal of authorized waste streams
- Planning for changing types and volumes of wastes and seasonal transportation restrictions, particularly during the construction phase
- Evaluating opportunities for product substitution to reduce hazardous waste
- Training staff on waste management and spill prevention procedures

3.6.1 Class 1 Disposal Wells

A Class 1 UIC waste disposal well will be permitted and located at each drill site and the operations center. The Class 1 wells will be used to dispose of Resource Conservation and Recovery Act (RCRA) exempt and non-hazardous waste and treated domestic wastewater from Project camps. During the period of time before the domestic wastewater treatment facilities are commissioned and/or if disposal wells are not available, domestic wastewater will be managed in compliance with all federal, state, and local standards.

A Waste Analysis Plan (WAP) will be prepared to fulfill the requirements of UIC and Solid Waste Disposal permits. The WAP will outline procedures for classifying, sampling, and analyzing wastes prior to downhole disposal. The purpose of the WAP is to ensure that wastes are properly characterized before deciding whether they may be accepted for injection/disposal in the Class 1 well.

3.6.2 Solid Waste

Non-hazardous solid waste will be trucked off site and disposed of at the NSB landfill. Any waste receptacles stored outside will be managed to avoid potential wildlife interactions via

methods such as waste segregation and the covering of dumpsters, and will be outlined in Armstrong's Wildlife Interaction Plan.

3.6.3 Hazardous and Universal Waste

Hazardous and universal waste, as defined by RCRA, will be managed on site in appropriate locations and containers prior to transport off site for disposal or recycling. All hazardous waste generated by the Project will be handled by qualified persons and disposed of in accordance with regulations.

3.7 Communications

Communications between project facilities will occur via fiber optic cables installed on infield and export/import pipeline HSMs using messenger cables (see Section 2.5). Communication towers will be located at the Nanushuk Pad, DS2, DS3, the operations center, and the tie-in pad. Communication tower height and design will be determined as part of project engineering. Communication towers are not anticipated to require guy-wires. Towers will be equipped with Federal Aviation Administration compliant lighting, if required.

3.8 Power Generation

Power generation facilities, located at the Nanushuk Pad, will consist of gas-powered turbines. Power will be supplied to other project facilities via power cables installed on infield and export/import pipeline HSMs using messenger cables (see Section 2.5).

3.9 Lighting

A lighting plan will be developed as part of project engineering. Project facilities will be lit in accordance with applicable regulations and best practices. Outdoor lighting will be designed to be adequate for the location and the tasks being performed as defined in the *Illuminating Engineering Society: Lighting Handbook* (IES 2011). Armstrong will minimize light visible from outside of project facilities by using downward illumination such as downcast floodlights and excluding use of horizontally aimed floodlights; locating mast poles away from the pad edge; using lighting fixtures with lamps contained within the reflector; and shading externally facing windows on buildings.

3.10 Workforce

The on-site project workforce will be the highest during the construction phase. Construction employment will increase from Year 1, to a peak of approximately 1,000 personnel in Year 4. The size of the drilling workforce will depend upon the number of drill rigs operating on site with approximately 150 personnel per rig. The on-site operations workforce will be approximately 200 people.

4.0 LOGISTICS

Project area access will be required for:

- Pad, pipeline, and facilities construction
- Transportation of construction; drilling; and operations supplies, materials, and personnel to project pads and facilities
- Transport of solid waste to existing waste facilities in Deadhorse or elsewhere

- Emergency medical transportation
- Emergency response for spills and other events

Project access to the North Slope and the Nanushuk Pad, operations center, and other drill sites will occur via a combination of ground (gravel and ice roads), marine, and air transport. The access road will be the primary means of transport for personnel, equipment, and supplies from existing facilities, including Deadhorse and the Dalton Highway, to the project area during construction, drilling, and operation. Infield roads will provide year-round access from the Nanushuk Pad and operations center to DS2 and DS3 (see Section 2.6). Ice roads will be used during the ice road season until the gravel roads can be constructed (see Section 3.4). Ground transportation vehicles include long haul trucks (semi-trailers), single unit short haul trucks, crew cab pickup trucks, passenger vans, personnel buses, light commercial trucks, water/fuel/waste tanker trucks, field service trucks, heavy haul tractor/trailers, self-propelled motorized transports, and wheel mounted cranes.

During construction, marine transport will support delivery of larger modules that cannot be transported to the North Slope by road. Sealift modules will be transported to the North Slope and offloaded at the Oliktok Dock by a minimum of six barges. The barges will follow standard routes of travel along the western Alaska coast to Oliktok Point. Typical barge speeds are around 7 knots. After offloading, sealift modules will be transported by self-propelled motorized transports along gravel roads to the Nanushuk Pad. No additional use of marine transport is planned during drilling and operations.

During construction, drilling, and operations, the commercial airport in Deadhorse, located approximately 52 miles away, will support air transport of project personnel and small materials and supplies to the North Slope. No new airstrip is proposed for the Project. Personnel and materials flown into Deadhorse will be driven to the project area via the existing road system and ice roads until the proposed gravel access road is completed.

The operations center includes space for a helipad. During construction, helicopters will be used to support ice road layout, survey, and summer clean-up efforts. These activities usually take place in July or early August and last approximately 4 weeks with daily helicopter traffic during that time. Helicopters may be used in the event of health or safety emergencies over the life of the project; however, routine helicopter use is not planned under normal operating conditions.

5.0 OPERATIONAL PLANS

Armstrong will develop a variety of construction and operational plans to provide guidance to Armstrong employees and contractors. Proposed plans include the following:

- Cultural Resources Management Plan
- ODPCP, FRP, and SPCC Plans
- Snow Removal Plan
- Dust Control Plan
- Wildlife Avoidance and Interaction Plan
- Polar Bear Interaction Plan
- Waste Management Plan
- Waste Analysis Plan
- Storm Water Pollution Prevention Plan

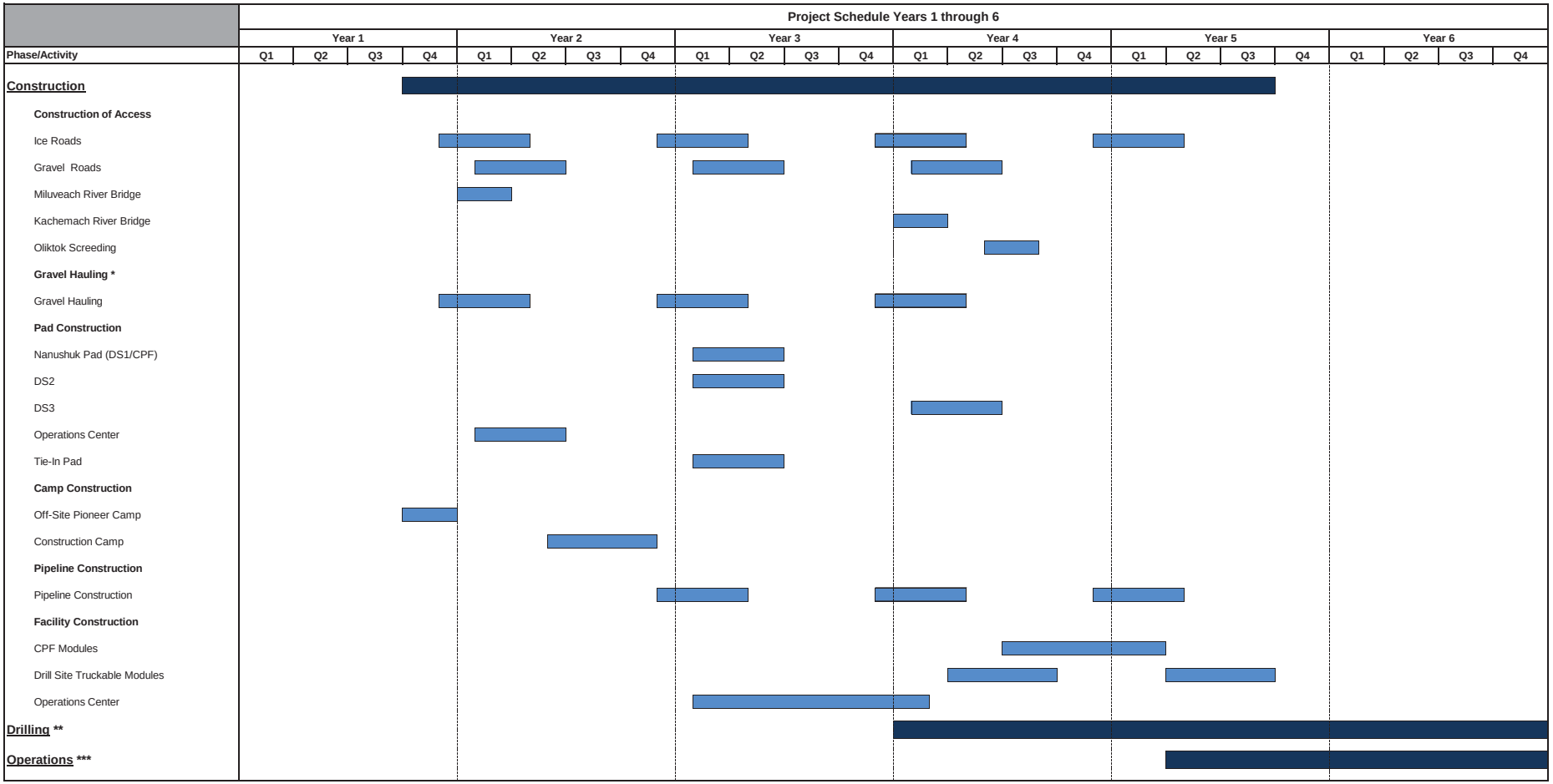
Additional plans may be developed as project permitting progresses.

6.0 SCHEDULE

Construction will begin in Q4 of Year 1 (2018) and will end in Q3 of Year 5 (2022), a three and a half year period.

Drilling activities will begin in Year 4. The drilling program will include as many as 3 rigs drilling for up to 15 years. The first rig will be mobilized to the site as soon as gravel compaction has been achieved. The number of rigs used will be subject to market conditions and rig availability on the North Slope.

Operations will begin in Year 5 and will continue through the 30-year design life of the Project. Figure 3 provides additional details of the project schedule for Years 1 through 6 by quarter.



* Gravel mining would be conducted by the mine site owner

** Drilling would continue through Year 19

*** Operations would continue for the Life of the Project

Figure 3. Project Schedule Years 1-6

7.0 PERMIT REQUIREMENTS

Table 6 lists the permits, authorizations, and approvals from federal, state, and local agencies that may be required by the Project.

Table 6: Potential Permits, Authorizations, and Approvals

Agency	Permits/Authorizations/Plans	Scope and Jurisdiction
FEDERAL		
USACE	Department of the Army Clean Water Act (CWA) Section 404 / Rivers and Harbors Act Section 10 Permit	Section 404: discharge of fill into waters of the U.S., including wetlands. Section 10: structures or work in navigable waters
EPA	Class I Underground Injection Control (UIC) Wells	Construction of disposal wells for non-hazardous liquids and municipal wastewater
EPA	Spill Prevention, Control and Countermeasure Plan	For any facility with storage of over 1,320 gallons of petroleum hydrocarbons
EPA	Facility Response Plan	Substantial Harm Determination to be completed to determine scope
USCG	Rivers and Harbors Act Section 9 Bridge Permit	Bridges or pipelines crossing navigable waters
USDOT	Facility Response Plan	Addresses federal regulations of oil export pipeline under 49 CFR 194 (Pipeline and Hazardous Materials Safety Administration)
USFWS	Marine Mammal Protection Act (MMPA) Letter of Authorization/Incidental Take	For activities occurring within polar bear habitat
USFWS	Endangered Species Act (ESA) Section 7 consultation	Consultation regarding threatened and endangered species under USFWS jurisdiction
NMFS	ESA Section 7 consultation	Consultation regarding threatened and endangered species under NMFS jurisdiction
STATE		
ADEC DAQ	Minor Air Permits	Air quality permits
ADEC DEH	Solid Waste General Permit	Temporary storage of Resource Conservation and Recovery Act (RCRA)-exempt oil and gas related waste and RCRA non-exempt, non-hazardous waste
ADEC DEH	Grind and Inject Facility Approval	Approval of the facility. EPA regulates the well (see Class I UIC well)
ADEC SPAR	Oil Discharge Prevention and Contingency Plan	Spill response planning
ADEC DW	Alaska Pollutant Discharge Elimination System North Slope General Permit AKG332000	General permit for specific discharges
ADEC DEH	Drinking Water Design Plan Review	Review of drinking water system
ADEC DW	Wastewater Design Plan Review	Review of wastewater system
ADEC DW	CWA Section 401 Water Quality Certificate	Water quality concurrence/waiver needed for USACE Section 404 permit

Table 6: Potential Permits, Authorizations, and Approvals		
Agency	**Permits/Authorizations/Plans**	**Scope and Jurisdiction**
ADF&G DH	Title 16 Fish Habitat Permit	For activities that may affect fish habitat or passage
ADNR DMLW	Temporary Land Use Permit	For temporary activities, such as construction of ice infrastructure and tundra travel, across State lands
ADNR DMLW	Temporary Water Use Authorization	Approval of temporary water uses, including ice infrastructure needs
ADNR DOG	Lease Plan of Operations Authorization	Approval of activities on state oil and lease outside of the Pikka Unit
ADNR DOG	Unit Plan of Operations Authorization	Approval of activities within the Pikka Unit
ADNR DOG	AS 38.05.850 Easement	For project components located on State lands outside of the state oil and gas lease (i.e., Nanushuk access road)
ADNR SPCS	Pipeline Right-of-Way Lease AS 38.35	Easement for Nanushuk Pipeline across State lands
ADNR DMLW	Tidelands Permit (Temporary Land Use Permit)	Screeding in State waters at Oliktok Dock
AOGCC	Permit to Drill	Approval for each well drilled
AOGCC	Class II UIC Enhanced Oil Recovery Well Area Injection Order	Approval of fluid injection for the purpose of enhanced oil recovery
LOCAL		
NSB	Industrial Development & Use Permit	Approval for development project in NSB
NSB	Rezone and Master Plan Approval	Approval to zone specific area for resource development and conduct activities described in Master Plan within the NSB
NSB	Certificate of Inupiat History, Language, and Culture/Traditional Land Use Inventory(TLUI) Clearance (Form 500)	Confirmation that project area does not have identified TLUI sites/establishment of buffer zones for identified TLUI sites

Notes: USACE: U.S. Army Corps of Engineers; EPA: Environmental Protection Agency; USCG: U.S. Coast Guard; USDOT: U.S. Department of Transportation; USFWS: U.S. Fish and Wildlife Service; NMFS: National Marine Fisheries Service; ADEC: Alaska Department of Environmental Conservation; DAQ: (ADEC) Division of Air Quality; DEH: ADEC Division of Environmental Health; SPAR: ADEC Spill Prevention and Response; DW: ADEC Division of Water; ADF&G DH: Alaska Department of Fish and Game Division of Habitat; ADNR: Alaska Department of Natural Resources; DMLW: ADNR Division of Mining Land & Water; DOG: ADNR Division of Oil and Gas; SHPO: ADNR State Historic Preservation Office; SPCS: ADNR State Pipeline Coordinator's Section; AOGCC: Alaska Oil and Gas Conservation Commission; NSB: North Slope Borough

8.0 SITE CLOSURE

As leaseholder and operating entity of the Nanushuk Project, Armstrong, in conjunction with other Working Interest Owners, will assume primary responsibility for site closure upon completion of production activities. Site closure will be conducted in accordance with federal and state leases and permits including the requirements of the Pikka Unit Approval, general requirements in the ADNR Division of Oil and Gas North Slope Areawide Lease Mitigation Measures, requirements stipulated by the NSB as part of the development permit, and other

permit conditions and stipulations required by state and federal agencies with regulatory authority over the Project.

The ADNR Division of Oil and Gas North Slope Areawide Lease Mitigation Measures require that:

> *Upon abandonment of material sites, drilling sites, roads, buildings or other facilities, such facilities must be removed and the site rehabilitated to the satisfaction of the Director, unless the Director, in consultation with DMLW, ADF&G, ADEC, NSB, and any non-state surface owner, determines that such removal and rehabilitation is not in the state's interest.*

Upon completion of project activities and in compliance with permit and lease requirements, Armstrong will commence dismantlement, removal, and rehabilitation (DR&R) activities, which are generally expected to include:

- Notification and coordination with Kuukpik Corporation, ADNR, NSB, and other regulatory agencies to discuss specific DR&R requirements and timeframes.
- Plugging and abandonment of wells in accordance with general industry best practices and compliance with Alaska Oil and Gas Conservation Commission requirements identified in 20 AAC 25.105 to 20 AAC 25.172. Abandonment of specific wells may occur throughout the life of the Project.
- Development of a restoration plan that includes required elements identified by permitting agencies.
- Dismantlement and removal of installed equipment and infrastructure, unless coordination with landowners or agencies indicates otherwise.
- Enactment of restoration activities identified in the restoration plan in accordance with goals and objectives identified in the plan.
- Initiation of regular monitoring and reporting of site recovery based on performance standards and according to the schedule and requirements identified in the plan.

The timeframe of these activities will be identified through coordination with landowners and agencies.

9.0 REFERENCES

IES (Illuminating Engineering Society). 2011. The Lighting Handbook, 10th Edition.

USACE (U.S. Army Corps of Engineers). 2012. *Point Thomson Project Final Environmental Impact Statement*. U.S. Army Corps of Engineers, Alaska District, Alaska Regulatory Division, Anchorage, AK.