Appendix III

Alternatives Development

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List of Acronyms

Applicant	Armstrong Energy, LLC
CEQ	Council on Environmental Quality
CWA	Clean Water Act
EIS	Environmental Impact Statement
NEPA	National Environmental Policy Act
Project	Nanushuk Project
USACE	U.S. Army Corps of Engineers

1.0 INTRODUCTION

This appendix describes the process used to develop a reasonable range of alternatives for the Nanushuk Project (Project) and contains information on those alternatives considered but eliminated from further evaluation.

1.1 Overview of the Alternatives Development Process

Regulations governing the National Environmental Policy Act (NEPA) state that the alternatives section "is the heart of the environmental impact statement" (40 CFR 1502.14). The regulations require federal agencies to "rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated." The Council on Environmental Quality (CEQ) guidance in *NEPA's Forty Most Asked Questions* (CEQ 1981) states the following:

> *In determining the scope of alternatives to be considered, the emphasis is on what is "reasonable" rather than on whether the proponent or applicant likes or is itself capable of carrying out a particular alternative. Reasonable alternatives include those that are practical or feasible from the technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant.*

In addition to evaluating Armstrong Energy LLC's (Applicant's) proposed project under NEPA, the U.S. Army Corps of Engineers (USACE) will be evaluating the Applicant's permit application pursuant to Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act (CWA). The Record of Decision will rely on information provided by the Applicant and contained in the Environmental Impact Statement (EIS), and in addition to the requirements under NEPA, it will include a 404(b)(1) analysis (40 CFR 230) and Public Interest Review (33 CFR 320). According to USACE's NEPA Implementation Procedures (33 CFR 325, Appendix B), the alternatives analysis should be thorough enough to use for both the NEPA review and the 404(b)(1) guidelines analysis. The process used to develop a reasonable range of alternatives for analysis in the EIS included five steps:

1. Develop an initial range of potential alternatives
2. Develop screening criteria
3. Evaluate potential alternatives against the screening criteria
4. Document rationale for those alternatives considered but eliminated from further analysis
5. Carry remaining alternatives forward as a reasonable range of alternatives for full analysis in the EIS

Following scoping, USACE convened a series of alternatives-development meetings with the EIS cooperating agencies. The first meeting identified a range of options for various Project components to address issues raised during scoping. These initial options included various road and pipeline access configurations with the potential to use existing infrastructure, including existing roads and corridors, as well as the potential to reduce additional footprint and gravel fill. Also considered were several roadless options with the potential to reduce construction of new gravel roads and use of gravel fill. Similarly, six different drill site and drill pad options were considered in order to reduce the footprint and gravel fill and, in some cases, to move infrastructure farther away from the Colville River or out of the 50- or 200-year floodplains. Finally, several options were considered for using existing or proposed hydrocarbon processing facilities in an attempt to avoid constructing new or redundant infrastructure.

1.2 Alternatives Screening Criteria

The USACE and the EIS cooperating agencies developed alternatives screening criteria and used them to develop the range of reasonable alternatives. The four basic criteria included the following:

1. Purpose and Need: Alternatives not meeting the USACE's overall Project purpose were eliminated from further analysis in the EIS.
2. Feasible and Practicable: Alternatives that clearly are not feasible, or are impractical from a technological or economic standpoint, were eliminated from further analysis in the EIS.
3. Substantive Issues: Alternatives should address substantive issues identified during public and agency scoping.
4. Relative Environmental Effects: Feasible alternatives having the potential to result in less adverse environmental effects when compared with the Applicant's proposed project were advanced for further analysis in the EIS.

1.2.1 Purpose and Need

The USACE requires that the underlying goals, or purpose, of a project be examined in three ways: the Applicant's stated purpose and need; a basic project purpose defined by USACE to specifically address a project's water dependency for purposes of the Department of the Army (DA) permit (CWA Section 404) application evaluation; and an overall project purpose, which is determined by USACE but is informed by the Applicant's perspective for the particular type of activity involved. The overall project purpose is then used during alternatives development.

The Applicant's stated purpose and need, as referenced in their DA permit (CWA Section 404) application is:

> *to safely produce commercial quantities of liquid hydrocarbons in its oil and gas leasehold by operating from a site east of the Colville River Delta; to process hydrocarbons on or near the drill sites; and to transport sales-quality oil through a new export pipeline to the Kuparuk sales oil pipeline, and then to TAPS [Trans-Alaska Pipeline System]*.

A secondary stated purpose of the Project:

> *is to further delineate geologic features and hydrocarbon accumulations in Armstrong's leasehold utilizing the proposed infrastructure*.

The Applicant's stated need is as follows:

> *The primary need for the project is to maximize economic benefit to Armstrong as lessee of record, the State of Alaska and ASRC [Arctic Slope Regional Corporation] as subsurface owners, and other parties having agreements with one or more subsurface owners. A secondary need is to provide workforce and business development opportunities in local, state, national, and international markets.*

The USACE's basic Project purpose is to produce, process, and transport hydrocarbon liquids to market. In general, production and transport of hydrocarbon resources do not require access or proximity to a special aquatic site. Therefore, USACE finds that the basic purpose of the Project is not water dependent.

The overall purpose of the Project, as defined by USACE, is

> *to safely produce, process, and transport commercial quantities of liquid hydrocarbons to market via pipeline from the Alpine C and Nanushuk reservoirs.*

1.2.2 Feasible and Practicable

The CEQ guidance expands on 40 CFR 1502.14 (*Alternatives Including the Proposed Action*) and directs the EIS preparer that "reasonable alternatives" are "*those that are practical 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 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 404(b)(1) may be thought of as a more specific and finer filter than the broader "reasonable" threshold under CEQ guidance, the intent was to not separate or exclude reasonable options under either definition. Therefore,

considering the broader CEQ guidance (CEQ 1981), and 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 described below:

1. Cost Feasibility: Alternatives should not involve components with potential costs exceeding reasonable or practical limits. CWA regulations enumerate cost as one of the considerations to be factored into whether an alternative is practicable.
2. 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.
3. Technological Feasibility: Alternatives should not involve components that are overly complex, 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.

1.2.3 Substantive Issues

The development of alternatives must consider whether they address substantive issues identified during public and agency scoping. A summary of substantive issues identified during scoping is included in the Scoping Summary Report (Appendix II, *Scoping Summary Report*; Chapter 3.0, *Issues Identified during Scoping*). These issues are then further considered in the evaluation of the next criteria, Relative Environmental Effects.

1.2.4 Relative Environmental Effects

The EIS evaluates alternatives for their impacts on the physical, biological, and social environments. Feasible alternatives having the potential to result in less adverse environmental effects when compared with the Applicant'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 for effects on terrestrial and aquatic habitats, including wetlands, hydrology and water quality, wildlife, public safety, human health, air quality, subsistence, and socioeconomic benefits. Therefore, the development of reasonable alternatives considered the potential for each alternative to:

- Reduce footprint
- Reduce potential health impacts (especially those relating to air emissions)
- Reduce development in floodplains
- Maximize use of existing infrastructure
- Reduce impacts to subsistence resources (especially those relating to caribou)
- Reduce risks related to spills or accidental releases

- Maximize socioeconomic benefits to the public
- Reduce effects to hydrology and aquatic resources

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.

1.3 Options Considered during Alternatives Screening Process

The following section contains a summary description of the 36 options considered during alternatives development (Table III-1). Options are organized by Project component: access, drill sites, pipelines, hydrocarbon processing, material sources, and utilities. Those options that were carried forward and incorporated into action alternatives for analysis in the EIS are depicted in bold text in Table III-1.

1.3.1 Access Options

Several options were considered to reduce the Project's impacts related to Project access. Reducing new road infrastructure, either by using existing roads or by using roadless access, would lessen the direct impacts from road construction. It would also reduce gravel needs, reducing impacts at mine sites used to provide gravel for Project construction. A smaller road footprint would reduce impacts to wetlands in the Project area, including hydrological resources and connections, and potential impacts to wildlife, especially caribou.

Several roadless options were considered. Roadless options included limiting access to the Project area to ice roads, airfields, or both; eliminating all infield roads; accessing the area via barging; and limiting activity to only winter months when ice roads could be used exclusively to access the Project.

Each of the access options is described in Table III-1.

1.3.2 Drill Site Options

Several different drill-site configuration options were considered to reduce and minimize the environmental impacts related to the Project's footprint. These options sought to reduce Project impacts by reducing the overall number of drill pads, altering drill site locations, or phasing the drill site development.

Each of the drill site options is described in Table III-1.

Exhibit 1, *Alaska Department of Natural Resources, Division of Oil and Gas Review of Proposed and Alternative Drill Site Locations and Use of Shared Processing Facilities*, is included at the end of this appendix. The Alaska Department of Natural Resources, Division of Oil and Gas completed a review of documents provided by the Applicant at

the request of USACE related to the potential of locating drill site 2 outside of the Colville River floodplain.

1.3.3 Pipeline and Hydrocarbon Processing Options

Alternative options were considered for the processing and transport of produced fluids to reduce the overall direct impacts from the Project. Shorter pipeline corridors and use of existing processing facilities could reduce placement of fill in wetlands and the material quantities to be mined, as well as impacts to subsistence users and wildlife. Alternative locations for the central processing facility were also considered to reduce the effects of noise, light, and air quality emissions. Alternatives to constructing new pipelines were considered to reduce the Project's direct impacts, as well as to reduce the construction of new linear corridors and impacts to wildlife, particularly caribou.

Each of the pipeline and hydrocarbon processing options is described in Table III-1.

Exhibit 1, *Alaska Department of Natural Resources, Division of Oil and Gas Review of Proposed and Alternative Drill Site Locations and Use of Shared Processing Facilities*, is included at the end of this appendix. The Alaska Department of Natural Resources, Division of Oil and Gas completed a review of documents provided by the Applicant at the request of USACE related to the potential sharing the use of the existing central processing facilities.

1.3.4 Material Source Options

Several options were considered for sourcing the gravel material required for Project construction. Establishing new mine sites would likely involve the excavation of resources in wetlands. Three options that could potentially reduce these impacts were considered.

Each of the material source options is described in Table III-1.

1.3.5 Utilities Options

Two utilities options were considered to minimize the environmental footprint of the Project through the use of existing infrastructure or through processes designed to reduce the environmental impact of operations.

Each of the utilities options is described in Table III-1.

1.3.6 Options Incorporated into Alternatives

Of the 36 options evaluated in the alternatives screening process, 8 were carried forward and combined into 4 action alternatives to be evaluated in the EIS. For example, Option 3 (Southern Access), Option 3B (Southern Access Using the Full Extent of Mustang Road), and Option 9B (Use Alpine Pipeline Corridor with New Parallel Pipeline System) were packaged into Alternative 3 (Southern Access) for analysis in the

EIS. As described in Chapter 2.0 (*Alternatives*), Alternative 3 combines the intent of Options 3, 3B, and 9B into one action alternative to maximize the use of existing infrastructure in the area by providing Project access from the south using the existing Mustang Road, to the greatest extent possible.

In developing these alternatives, several of the similar options were comparatively screened against one another to result in a single action alternative that still meets the intent of the option. For example, Option 4 (Northern Access via Nuna Access Road with an Upstream Crossing of Miluveach River) and Option 4B (Northern Access via Nuna Access Road with a Downstream Crossing of Miluveach River) were both considered as a way to use the existing and permitted Nuna road network in order to reduce additional footprint and gravel fill. However, when comparatively screened against each other, Option 4B would require crossing a sensitive subsistence use area. It would also result in a substantially longer bridged crossing than Option 4, thereby requiring substantial fill and significantly greater bridge construction within the floodplain. In this example, one northern access alternative was developed (Alternative 4), which would use the existing and permitted Nuna road network.

Options that have been incorporated into action alternatives and carried forward for analysis in the EIS are depicted in bold text in Table III-1.

Table III-1. Options Considered during Alternatives Development

Option Category	Option Number	Option Considered	Description	Why Considered
All	**1**	**No Action Alternative**	No action. **Alternative 1** in Chapter 2.0, *Alternatives*.	NEPA requirement
	2	**Applicant's Proposed Action**	Proposed action. **Alternative 2** in Chapter 2.0, *Alternatives*.	Applicant's Proposed Action
Access	**2B**	**Applicant's Proposed Action Variation Using Mustang Road**	This option is similar to Option 2 (Alternative 2), except the gravel access road would use approximately 3.5 miles of the existing Mustang Road before turning north to rejoin the Option 2 alignment east of the Miluveach River Bridge. This option would require upgrading the Mustang Road base width by approximately 19 feet. The 23-mile-long export/import pipeline would parallel the access road. This option has been incorporated into **Alternative 3 (Southern Access)** and **Alternative 5 (Reconfigured Infield Roads),** which include substantial use of Mustang Road for access.	Potential to use existing road to reduce additional footprint and gravel fill
	2C	Applicant's Proposed Action Variation Using a Northern Crossing of the Miluveach River	This option is a variation of Option 2 (Alternative 2), except it would cross the Miluveach River approximately 1.2 miles downstream from the Option 2 location. After the river crossing, the alignment would be routed north, paralleling the Option 2 alignment, but farther east and closer to the Miluveach River. This option would rejoin the Option 2 alignment approximately 2 miles south of the Nanushuk Pad (DS1 and CPF combined). The 21-mile-long export/import pipeline would parallel the access road.	Potential to use existing road to reduce additional footprint and gravel fill
	3	**Southern Access**	This option has been incorporated into **Alternative 3 (Southern Access)** in Chapter 2.0, *Alternatives*. Under this alternative, the access road would use 4.7 miles of the existing Mustang Road before paralleling the Alpine Pipeline Corridor and turning north to reach the Project. Drill sites would be the same as for Option 2, but the CPF would be moved south and would not be colocated with DS1.	Potential to limit development of new infrastructure corridors by using existing Alpine Pipeline Corridor and to use existing road to reduce additional footprint and gravel fill
	3B	**Southern Access Using the Full Extent of Mustang Road**	This option would use 4.9 miles of the existing Mustang Road and would construct 21.6 new miles of gravel road. This option would require upgrading the Mustang Road base width by approximately 19 feet to meet the Project's design standards. The export/import pipeline would parallel the new and existing gravel roadways. This option has been incorporated into **Alternative 3 (Southern Access)** in Chapter 2.0, *Alternatives*.	Potential to use existing road to reduce additional footprint and gravel fill

Option Category	Option Number	Option Considered	Description	Why Considered
Access	3C	Southern Access with Road North of Alpine Pipeline Corridor	This option would construct a gravel access road following the same alignment as Option 2 (Alternative 2) to the Miluveach River crossing, where it would then head west toward the Project, roughly parallel to but approximately 2 miles north of the Alpine Pipeline Corridor. This option would colocate the CPF with DS3. The export/import pipeline would parallel existing and proposed gravel roads.	Potential to limit development of new infrastructure corridors by using existing Alpine Pipeline Corridor
	3D	Southern Access with Road and Pipeline South of the Alpine Pipeline	This option would construct a gravel access road roughly following the Alpine ice road toward the East Channel of the Colville River, where it would turn north, crossing the Alpine Sales Pipeline, before reaching the Project area. The export/import pipeline would parallel the access road.	Potential to limit development of new infrastructure corridors by using previously disturbed ice-road corridor
	4	**Northern Access via Nuna Access Road with an Upstream Crossing of Miluveach River**	This option has been incorporated into **Alternative 4 (Northern Access)** in Chapter 2.0, *Alternatives*. Under this alternative, access to the Project would be from the northeast, using both the existing and the permitted (but not constructed) Nuna Road. This option would move the CPF north. The export/import pipeline would initially parallel the access road and then travel cross-country to the tie-in pad at Kuparuk.	Potential to use existing road to reduce additional footprint and gravel fill
	4B	Northern Access via Nuna Access Road with a Downstream Crossing of the Miluveach River	This option would use the existing and permitted (but not constructed) Nuna Road, similar to Option 4 (Alternative 4), but would make a downstream crossing of the Miluveach River, approximately 2 miles upstream from its confluence with the East Channel of the Colville River.	Potential to use existing road to reduce additional footprint and gravel fill
	5	**Reconfigured Infield Roads**	This option has been incorporated into **Alternative 5 (Reconfigured Infield Roads)** in Chapter 2.0, *Alternatives*. This alternative would access the Project area using the existing Mustang Road before heading northwest to reach the drill site locations. The CPF would be moved south, and infield roads would be reconfigured to meet near the CPF.	Potential to avoid "fencing" of caribou migration along the Colville River; uses existing road to reduce additional footprint and gravel fill

Option Category	Option Number	Option Considered	Description	Why Considered
Access	6A	Roadless Access with a New Airstrip at Nanushuk and Gravel Infield Roads	This option would eliminate the need for a gravel access road and would instead include an airstrip at the Project to provide year-round access. Gravel infield roads would be used to connect the Project facilities with one another, and an annual ice road would be constructed in the winter to aid in resupply operations. Drill sites would be expanded in size to accommodate additional storage for supplies and equipment. The export/import pipeline would be routed cross-country to reach the tie-in pad at Kuparuk. This option would include an additional diesel fuel pipeline from Kuparuk to supply Project fuel requirements year-round.	Potential to reduce construction of new gravel roads and use of gravel fill
	6B	Roadless Using Alpine Airstrip, Gravel Infield Roads, and Ice Road Access	This option would be similar to Option 6A, except the Project would use the Alpine airstrip instead of an airstrip at the Project site. Personnel and materials would be transported to the Project area via helicopter or ice road (when available).	Potential to reduce construction of new gravel roads and airstrips and use of gravel fill
	6C	Roadless Using Nuiqsut Airstrip, Gravel Infield Roads, and Ice Road Access	This option would be similar to Option 6A, except the Project would use the existing airstrip at Nuiqsut instead of an airstrip at the Project site. Personnel and materials would be transported to the Project area via helicopter or ice road (when available).	Potential to reduce construction of new gravel roads and airstrips and use of gravel fill
	6D	Roadless with Airstrips and only Ice Roads for Access and Infield Roads	This option would construct three Project airstrips (one at each drill site pad) but no year-round gravel roadways (access or infield). All overland connections would be limited to seasonal ice roads. Year-round connections would be completed by fixed-wing aircraft or helicopters. An annual ice road would be constructed for material resupply operations, connecting the Project to Deadhorse seasonally. The export/import pipeline would travel cross-country to reach the tie-in pad at Kuparuk. This option would include a diesel fuel pipeline from Kuparuk to supply Project fuel requirements year-round.	Potential to reduce construction of new gravel roads and use of gravel fill
	6E	Roadless with Seasonal Drilling and only Ice Road Access	This option would construct gravel pads at the three drill sites, but it would not construct any gravel roads or airstrips. Access to the Project would be seasonal through the use of ice roads. As a result, all Project activity would be seasonal. The export/import pipeline would travel cross-country to reach the tie-in pad at Kuparuk. This option would include a diesel fuel pipeline from Kuparuk to supply Project fuel requirements.	Potential to reduce construction of new gravel roads and airstrips and use of gravel fill

Option Category	Option Number	Option Considered	Description	Why Considered
Access	6F	Roadless with River Barge Access	This option would provide access to the Project area by barge travel on the East Channel of the Colville River and by fixed-wing aircraft. Under this option, year-round gravel infield roads, an airstrip, and a barge landing and staging area would be constructed. Annual material resupply efforts would be completed via barge during the open-water season, and personnel would reach the Project area via fixed-wing aircraft and helicopters. The export/import pipeline would travel cross-country to reach the tie-in pad at Kuparuk. This option would include a diesel fuel pipeline from Kuparuk to supply Project fuel requirements year-round.	Potential to reduce construction of new gravel roads and use of gravel fill
Drill Sites/ Pads	7A	Drill from an Existing Alpine Pad (CD1 or CD4)	This option would not construct any new drill site pads east of the Colville River but would instead use the existing Alpine CD1 and CD4 pads. These pads are the closest existing infrastructure to the Applicant's oil and gas lease holdings. The existing pads would need to be expanded to accommodate the Project's requirements for wells, camps, and storage. The target reservoirs would require the use of ERD exceeding 45,000 feet of total reach to access the hydrocarbon resources.	Potential reduction of new gravel drill site pads and roads
	7B	Use Only One Drill Site Pad	This option would limit drilling to a single drill site (versus the three proposed under all action alternatives). For this option, a gravel access road and other support infrastructure as proposed in Option 2 (Alternative 2) would be required, though overall quantities would vary. ERD would be used to access the target reservoirs.	Potential reduction of new gravel drill site pads and roads
	7C	Use Only Two Drill Site Pads	This option would limit drilling to two drill sites (versus the three proposed under all action alternatives). For this option, a gravel access and infield road and other support infrastructure as proposed in Option 2 (Alternative 2) would be required, though overall quantities would vary. ERD would be used to access the target reservoirs.	Potential reduction of new gravel drill site pads and roads
	7D	Two Drill Site Pads with "V" Configuration Infield Roads and Relocated Operations Center	This option would limit drilling to two drill sites (versus the three proposed under all action alternatives) and reconfigure the infield roads to a "V" formation. A gravel access road and all other support infrastructure proposed in Option 2 (Alternative 2) would be required. ERD would be used to access the target reservoirs.	Potential reduction of new gravel drill site pads; potential to reduce "fencing" effect of caribou migration along the Colville River

Option Category	Option Number	Option Considered	Description	Why Considered
Drill Sites/ Pads	7E	Relocate Drill Site 2 Further East Using 2 Pads (2A and 2B)	This option is similar to Option 2 (Alternative 2), except DS2 would be use 2 pads (2A and 2B), with both located farther east of the Colville River, outside the floodplain. ERD would be used to access the target reservoirs.	Potential to increase distance from Colville River and reduce development within the floodplain
	8A	Staggered Development and Reclamation	This option would be similar to Option 2 (Alternative 2), except Project development would be staggered or phased, with one or two drill sites being initially constructed and the remaining sites not being constructed until an operating site has exhausted its production potential and reclamation efforts are under way. The gravel from the previous operating drill site would then be reused to construct the next drill site.	Potential to minimize or delay (or both) impacts from new gravel drill site pads; potential to reduce material mining requirements through reuse of gravel
Pipelines	9A	Use Existing Alpine Sales Pipeline for Oil Export	This option would use the existing Alpine Sales Pipeline to transport sales-quality crude from the Project to tie-in facilities in Kuparuk. This option is similar to Option 2 (Alternative 2), except an export pipeline from the Project to the Alpine Sales Pipeline would be constructed instead of following the Project's gravel access road from Kuparuk.	Potential to reduce new infrastructure
	9B	**Use Alpine Pipeline Corridor with New Parallel Pipeline System**	This option would construct the new export/import pipeline on new vertical support members parallel to the existing Alpine Sales Pipeline. This option was incorporated into **Alternative 3 (Southern Access)** in Chapter 2.0, *Alternatives*.	Potential to eliminate new linear infrastructure corridors
	9C	Bury Pipelines in Roadway Embankments	This option would bury one or more of the proposed pipelines within the gravel roadway embankment to eliminate the need for placing the pipeline on vertical support members.	Potential to avoid visible infrastructure; potential to reduce travel impacts to terrestrial mammals and subsistence users
	9D	Bury Pipelines Outside of Roadway Embankments	This option would bury one or more of the proposed pipelines underground (in the tundra, outside the roadway embankment).	Potential to avoid visible infrastructure; potential to reduce travel impacts to terrestrial mammals and subsistence users
Hydrocarbon Processing	10A	Use Existing Alpine Central Processing Facility	This option would use the Alpine CPF instead of constructing a new CPF for the Project.	Potential to reduce new gravel infrastructure (pads) and new dedicated central processing facility

Option Category	Option Number	Option Considered	Description	Why Considered
Hydrocarbon Processing	10B	Use Existing Kuparuk Central Processing Facility 2	This option would use the Kuparuk CPF2 instead of constructing a new CPF for the Project.	Potential to reduce new gravel infrastructure (pads) and new dedicated central processing facility
	10C	Use Proposed Mustang Central Processing Facility	This option would use the proposed Mustang CPF instead of constructing a new CPF for the Project.	Potential to reduce new gravel infrastructure (pads) and new dedicated central processing facility
	10D	Use Proposed Placer Central Processing Facility	This option would use the proposed Placer CPF instead of constructing a new CPF for the Project.	Potential to reduce new gravel infrastructure (pads) and new dedicated central processing facility
Material Sources	11A	Reclaim Gravel from Abandoned Pads, Roads, and Airstrips	This option would extract gravel from abandoned or decommissioned roads, pads, and airstrips to reduce new gravel mining for Project construction.	Potential to reduce gravel mining requirements
	11B	Maximize Gravel Extraction from Existing Mine Sites	This option would use existing permitted mine sites as gravel sources to the maximum extent possible to limit the establishment of new mine sites.	Potential to reduce new gravel mining infrastructure and effects from gravel mine sites
	11C	Mine Gravel from the Colville River	This option would mine gravel from the Colville River channel/complex to reduce disturbances related to opening new mine sites. Additionally, mining in the river channel was identified as a potential benefit to Nuiqsut residents, who have indicated that many portions of the river are getting clogged with silt; dredging/mining this material could create additional channel depth.	Potential to reduce new off-river mining infrastructure and effects from gravel mine sites
Utilities	12A	Use North Slope Borough Utilities	This option would use NSB utilities to the greatest extent possible. The NSB provides domestic water supply (potable and untreated), domestic wastewater acceptance and treatment, and a solid waste landfill.	Potential to reduce ground disturbance and impacts to air, soil, and water
	12B	Wastewater Management	This option would address domestic wastewater handling, treatment, and disposal, including consideration of haul and inject, holding tanks, and the discharge of only gray water.	Potential to reduce impacts to water quality

Notes: Applicant (Armstrong Energy, LLC); DS1(Drill Site 1); CPF (central processing facility); DS 3(Drill Site 3); CD1 (Alpine Drill Site 1); CD4 (Alpine Drill Site 4); ; ERD (extended reach drilling); DS2 (Drill Site 2); North Slope Borough. Those options that were carried forward and incorporated into action alternatives for analysis in the EIS are depicted in bold text

1.4 Options Considered but Eliminated from Further Analysis

As described above, USACE and the cooperating agencies considered a broad range of options for various Project components (access, drill sites, pipelines, hydrocarbon processing, material sources, and utilities). A total of 36 options were evaluated to determine whether they were reasonable in light of the Project's purpose. Of these, 28 options were eliminated from further analysis because they did not meet the overall Project purpose, were not considered feasible or practicable, did not address substantive issues raised during scoping, or were determined to be more appropriate as potential mitigation or minimization measures. After the 36 options were evaluated against the screening criteria, options were either 1) eliminated or 2) incorporated into an action alternative to be carried forward for analysis in the EIS. Options considered but eliminated from further analysis in the EIS are summarized in Table III-2, along with the rationale for elimination.

Table III-2. Options Considered but Eliminated from Further Analysis and Rationale for Elimination

Option Number	Option Considered	Rationale for Elimination	Reference(s)
2C	Applicant's Proposed Action Variation Using a Northern Crossing of the Miluveach River	**While practicable, does not have potential to result in less adverse environmental effects**: • Would not reduce footprint or gravel fill compared with the Applicant's Proposed Action. • Alignment would be routed near sensitive brown bear (*Ursus arctos*) denning habitat.	HDR 2015
3C	Southern Access with Road North of Alpine Pipeline Corridor	**While practicable, does not have potential to result in less adverse environmental effects**: • Additional impacts to wetlands due to the increased length of the gravel access roads, resulting in 30 to 46 additional acres of fill over all action alternatives carried forward. • Would increase development in the floodplains, primarily through the relocation of the CPF from the DS1 to the DS3 pad. • Relatively greater potential impacts to wildlife habitat and critical bird species (black brant [*Branta bernicla*], king eider [*Somateria spectabilis*], spectacled eider [*Somateria fischeri*], long-tailed duck [*Clangula hyemalis*], red-throated loon [*Gavia stellata*], and yellow-billed loon [*Gavia adamsii*]). • Would not minimize new gravel infrastructure and would not maximize the use of existing infrastructure.	HDR 2015

Option Number	Option Considered	Rationale for Elimination	Reference(s)
3D	Southern Access with Road and Pipeline South of the Alpine Pipeline	**Is not logistically feasible:** • Would require the access road to cross the Alpine Sales Pipeline. The Alpine Sales Pipeline would need to be either buried or bridged by the proposed gravel access road. • Burying a section of the existing and operating Alpine Sales Pipeline would present numerous challenges: it would create corrosion, accessibility, and thermal issues for the pipeline and would risk thermal degradation of the surrounding tundra. **Does not have potential to result in less adverse environmental effects**: • Would increase the access road footprint: The pipeline requires a minimum overhead clearance of 5 feet between the bottom of the bridge and the top of the pipeline, resulting in increased embankments to allow for transit of sealift modules and drilling rigs.	Armstrong 2016j; CPAI 2016
4B	Northern Access via Nuna Access Road with a Downstream Crossing of the Miluveach River	**Similar to Option 4, which has been incorporated into Alternative 4 (Northern Access).** **While practicable, does not have potential to result in less adverse environmental effects**: • Road alignment would cross an important subsistence and traditional use area located near the lower reaches of the Miluveach River. This traditional use area is considered important for subsistence harvesting, including by residents of Nuiqsut, of Arctic grayling, caribou, and eiders. Specific location information for traditional use in this area is documented in the Traditional Land Use Inventory maintained by NSB's Department of Iñupiat History, Language and Culture. • The crossing of the Miluveach River at this location would require the following: **-**Would be approximately 1,200 feet long, requiring substantial fill and the placement of bridge within the floodplain, while Option 4 (Alternative 4, Northern Access) would shorten the crossing length to approximately 200 feet and would take advantage of existing and previously permitted but not constructed sections of Nuna Road infrastructure. **-** Would be less than 2 miles upstream of the confluence with the East Channel of the Colville River, where the river has a wide floodplain requiring the placement of substantial fill or up to 20 bridge piers within the channel and floodplain. • The east-west alignment of the access road route would increase infrastructure located near or within caribou insect-relief habitat occurring along the banks of the East Channel of the Colville River. Post-calving caribou may avoid this habitat because of the presence of the road and disturbance by traffic.	SRB&A 2016

Option Number	Option Considered	Rationale for Elimination	Reference(s)
6A	Roadless Access with a New Airstrip at Nanushuk and Gravel Infield Roads	**Does not have potential to result in less adverse environmental effects**: • Because of the necessity for a Project airstrip, this option would have a larger footprint (319 acres) than all other action alternatives (which range from 273 to 290 acres). • Pipeline spill risks would increase because of the need to include a diesel fuel pipeline connecting the Project area to existing North Slope infrastructure; this would include the construction of a tank farm located at Kuparuk DS2M. • As summarized in the DOWL 2016 memo, *Considerations for Elimination of Roadless Alternative 3,* this option would result in a significant increase in air traffic in the greater Project area: - Fixed-wing flight estimates include 24 flights per week during construction, up to 8 flights per week during drilling, and up to 8 flights per week during operations. - Helicopter flight estimates include up to17 roundtrips to the Project area per week during construction, drilling, and operations, plus an additional 28 annual flights to support ice-road construction. - Increased air traffic would potentially result in increased habitat impacts on caribou. • During an August 16, 2016, EIS cooperating agency meeting, the State of Alaska, including the Alaska Departments of Natural Resources, Environmental Conservation, and Fish & Game, recommended the elimination of the roadless option, noting that when compared with the other alternatives, a roadless alternative would: introduce issues with spill response; create a larger footprint; introduce more aircraft traffic that would result in disturbances to Nuiqsut residents, subsistence hunting activities, and caribou movement patterns; and generally introduce more potential for impacts to wildlife. • A recent and comparable NEPA analysis was completed for the BLM's Alpine Satellite Development Plan—GMT1 Supplemental EIS (BLM 2014)—in which Alternative D1 fully analyzed a roadless alternative similar to Nanushuk Option 6A. BLM concluded that Alternative D1 (and D2) would have the greatest impact to subsistence uses and activities of all the alternatives because of the additional air traffic–related impacts to subsistence; in particular, BLM noted that "air traffic is the most frequently reported caribou hunting impact associated with development." In addition, BLM found that Alternative D1 would have potentially greater adverse effects in terms of spill detection and spill response, noting that "Alternatives D1 and D2 would have the greatest potential risk of a spill or leak reaching fish bearing or marine waters before detection or before response teams could be mobilized to the spill site, given its lack of access via gravel road." • Since the export pipeline would not include an accompanying access road, all roadless options would introduce operational complexity and operational risk, as well as the potential for more adverse effects in terms of spill detection and spill response.	Armstrong 2016f; BLM 2014; DOWL 2016; HDR 2016

Option Number	Option Considered	Rationale for Elimination	Reference(s)
6B	Roadless Using Alpine Airstrip and Ice Road Access	**Does not have potential to result in less adverse environmental effects**: • Would increase air traffic, potentially creating negative impacts to local subsistence activities. As noted in the GMT1 Supplemental EIS (BLM 2014), additional air traffic is widely opposed within the region: "In comments and testimony received on the GMT1 Draft SEIS from North Slope residents, there is universal opposition to development options that include more airstrips and thus increased air traffic." • For 7 to 9 months per year, helicopter transport would be the only way to move personnel to and from the Project site, and the Applicant estimates that this would require 10 to 15 flights per day, except when inclement weather grounds flights, which could increase the number of flights to more than 30 per day when a weather window is available. • During the 4-year construction period, an estimated 350 million pounds of materials, consumables, and supplies would be shipped to the Project site, excluding sealift modules. Assuming one-third of the materials are moved by helicopter and the remaining two-thirds are moved via overland route, over 4,000 helicopter flights would be required during the construction period. • Pipeline spill risks would increase because of the need to include a diesel fuel pipeline connecting the Project area to existing North Slope infrastructure; this would include the construction of a tank farm located at Kuparuk DS2M. • Since the export pipeline would not include an accompanying access road, all roadless options would introduce operational complexity and operational risk, as well as the potential for more adverse effects in terms of spill detection and spill response.	Armstrong 2016f; BLM 2014; HDR 2016
6C	Roadless Using Nuiqsut Airstrip and Ice Road Access	**Does not have potential to result in less adverse environmental effects**: (Refer to Option 6B)	Armstrong 2016g; BLM 2014; HDR 2016

Option Number	Option Considered	Rationale for Elimination	Reference(s)
6D	Roadless with Airstrips and only Ice Roads for Access and Infield Roads	**Does not have potential to result in less adverse environmental effects:** • Would have a larger footprint (310 acres). • Would require the construction of three separate airstrips and aircraft support facilities (one at each constructed pad). • Would increase air traffic, potentially creating negative impacts to local subsistence activities: As noted in the GMT1 Supplemental EIS (BLM 2014), additional air traffic is widely opposed within the region: "In comments and testimony received on the GMT1 Draft SEIS from North Slope residents, there is universal opposition to development options that include more airstrips and thus increased air traffic." - During the 4-year construction period, the Applicant estimates over 350 million pounds of materials, consumables, and supplies would be shipped to the site, excluding the sealift modules. Assuming one-third of the materials are moved by helicopter and the remaining two-thirds are moved via overland route, over 4,000 helicopter flights would be required during the construction period. • Since the export pipeline would not include an accompanying access road, all roadless options would introduce operational complexity and operational risk, as well as the potential for more adverse effects in terms of spill detection and spill response.	Armstrong 2016g; BLM 2014; HDR 2016
6E	Roadless with Seasonal Drilling and only Ice Road Access	**Does not have potential to result in less adverse environmental effects**: (Refer to Option 6B)	Armstrong 2016g; BLM 2014; HDR 2016
6F	Roadless with River Barge Access	**Is not logistically feasible:** • Barge access would not be guaranteed given the draft requirements of vessels and seasonal flows of the Colville River. • Acquiring permits for river dredging activities from USACE, NSB, the State of Alaska, or all three may not be possible. **Does not have potential to result in less adverse environmental effects**: • Would require the construction of airstrips and aircraft support facilities at each constructed pad. • Since the export pipeline would not include an accompanying access road, all roadless options would introduce operational complexity and operational risk, as well as the potential for more adverse effects in terms of spill detection and spill response.	NA

Option Number	Option Considered	Rationale for Elimination	Reference(s)
7A	Drill from an Existing Alpine Pad (CD1 or CD4)	**Is not technologically feasible; does not meet overall Project purpose**: • The technological limitations of ERD would not meet the Project requirements or the overall Project purpose: **-** The longest successful extended reach well drilled on the North Slope is approximately 26,000 feet. Use of any Alpine pad would require well lengths in excess of 45,000 feet to appropriately produce the Project's target resources. **-** The development of the relatively shallow reservoirs (approximately 4,000 to 4,500 vertical feet depth) would create heavy torque and drag loads on the drill rig during drilling and completion of the wells, resulting in shorter overall ERD reach capabilities. **Is not logistically feasible**: • CPAI is the leaseholder for the Alpine oil field, and there are no legal requirements for it to provide access to the Applicant to produce a neighboring reservoir.	ADNR 2016; Armstrong 2016b
7B	Use Only One Drill Site Pad	**Is not technologically feasible; does not meet overall Project purpose:** • The technological limitations of ERD would not meet the Project requirements or the overall Project purpose: - The longest successful extended reach well drilled on the North Slope is approximately 26,000 feet. Use of one drill site would require well lengths in excess of 45,000 feet to appropriately produce the Project's target resources. - The development of the relatively shallow reservoirs (approximately 4,000 to 4,500 vertical feet depth) would create heavy torque and drag loads on the drill rig during drilling and completion of the wells, resulting in shorter overall ERD reach capabilities. • Under laws and regulations of the State of Alaska, the Applicant is required to develop the reservoirs to the maximum extent possible, but this would be precluded by the use of a single drilling pad.	ADNR 2016; Armstrong 2016a, 2016b
7C	Use Only Two Drill Site Pads	**Is not technologically feasible; does not meet overall Project purpose**: • The technological limitations of ERD would not meet the Project requirements or the overall Project purpose: - The longest successful extended reach well drilled on the North Slope is approximately 26,000 feet. Use of only two drill site would require well lengths in excess of 45,000 feet to appropriately produce the Project's target resources. - The development of the relatively shallow reservoirs (approximately 4,000 to 4,500 vertical feet depth) would create heavy torque and drag loads on the drill rig during drilling and completion of the wells, resulting in shorter overall ERD reach capabilities. • Under laws and regulations of the State of Alaska, the Applicant is required to develop the reservoirs to the maximum extent possible, but this would be precluded by the use of only two drilling pads.	ADNR 2016; Armstrong 2016a

Option Number	Option Considered	Rationale for Elimination	Reference(s)
7D	Two Drill Site Pads with "V" Configuration Infield Roads and Relocated Operations Center	**Is not technologically feasible; does not meet overall Project purpose**: • The technological limitations of ERD would not meet the Project requirements or the overall Project purpose: - The longest successful extended reach well drilled on the North Slope is approximately 26,000 feet. Use of only two drill site would require well lengths in excess of 45,000 feet to appropriately produce the Project's target resources. - The development of the relatively shallow reservoirs (approximately 4,000 to 4,500 vertical feet depth) would create heavy torque and drag loads on the drill rig during drilling and completion of the wells, resulting in shorter overall ERD reach capabilities. • Under laws and regulations of the State of Alaska, the Applicant is required to develop the reservoirs to the maximum extent possible, but this would be precluded by the use of only two drilling pads.	ADNR 2016
7E	Relocate Drill Site 2 Further East Using 2 Pads (2A and 2B)	**Is not technologically feasible; does not meet overall Project purpose**: • The technological limitations of ERD would not meet the Project requirements or the overall Project purpose: - The development of the relatively shallow reservoirs (approximately 4,000 to 4,500 vertical feet depth) would create heavy torque and drag loads on the drill rig during drilling and completion of the wells, resulting in shorter overall ERD reach capabilities. - The reservoirs would be hydraulically fracture stimulated to stimulate well production. The relatively shallow reservoirs would not produce enough hydrostatic pressure to assist in the fracture stimulation of the wells, reducing the overall length of horizontal well stimulation available for the Project.	ADNR 2016; Armstrong 2016a
8A	Staggered Development and Reclamation	**Does not meet overall Project purpose**: • Staggered development could have detrimental effects on reservoir production and could create drilling hazards and well-control challenges, resulting from unpredictable distribution of pressures and fluids in the reservoirs, which may result in the ineffective recovery of the resources. • Under the laws and regulations of the State of Alaska, the Applicant is required to develop the resource to the maximum extent possible, but this would be precluded by staggered development, which would result in ineffective resource recovery.	Armstrong 2016c
9A	Use Existing Alpine Sales Pipeline for Oil Export	**Is not technologically feasible**: • The Alpine Sales Pipeline has insufficient capacity to handle both Alpine's and the Project's production and could only accommodate the Project's anticipated production if CPAI reduced its own oil shipment. The Project would produce an estimated 120,000 bopd during peak production, and the Alpine Sales Pipeline has a current capacity limitation of 100,000 bopd. **Does not have potential to result in less adverse environmental effects**: • A new pipeline would need to be constructed across the Colville River to the west to connect to the Alpine Sales Pipeline.	Armstrong 2016h; Petrotechnical Resources Alaska 2004

Option Number	Option Considered	Rationale for Elimination	Reference(s)
9C	Bury Pipelines in Roadway Embankments	**Is not technologically practicable:** • Buried pipelines would pose increased challenges for corrosion monitoring and maintenance: - Buried pipelines should be protected from corrosion through the use of cathodic protection systems, which require electricity, and providing power along the length of the pipeline would increase the Project's footprint. - Buried pipelines on the North Slope pose challenges to monitoring and reduce the ability to detect spills or other incidents. • Burying pipelines would require insulation or other thermal protection measures to prevent permafrost thawing, and the dimensions of the final product (bedding material, pipe, and insulation) would likely interfere with culverts required across the roadway, because the road structure is typically only built to an elevation of 6 feet above the surrounding ground surface. **Does not have potential to result in less adverse environmental effects**: • Buried pipelines would increase the response time in the event of spills or other incidents because of the need to excavate around the pipeline, which would increase the risk of further damage to the asset while trying to make emergency repairs. • Pipelines on the North Slope transport warm fluids that have significant potential to negatively affect frozen soils (permafrost), creating potential for thawing and differential settlement actions, upheaval, buckling, and thermokarsting.	Armstrong 2016i; ExxonMobil Production Company 2010a, 2010b; NSB 2002

Option Number	Option Considered	Rationale for Elimination	Reference(s)
9D	Bury Pipelines Outside of Roadway Prisms	**Is not technologically practicable:** • Buried pipelines would pose increased challenges for corrosion monitoring and maintenance: - Buried pipelines should be protected from corrosion through the use of cathodic protection systems, which require electricity, and providing power along the length of the pipeline would increase the Project's footprint. - Buried pipelines on the North Slope pose challenges to monitoring and reduce the ability to detect spills or other incidents. • Burying pipelines would require insulation or other thermal protection measures to prevent permafrost thawing, and the dimensions of the final product (bedding material, pipe, and insulation) would likely interfere with culverts required across the roadway, because the road structure is typically only built to an elevation of 6 feet above the surrounding ground surface. **Does not have potential to result in less adverse environmental effects**: • Buried pipelines would increase the response time in the event of spills or other incidents because of the need to excavate around the pipeline, which would increase the risk of further damage to the asset while trying to make emergency repairs. - Pipelines on the North Slope transport warm fluids that have significant potential to negatively affect frozen soils (permafrost), creating potential for thawing and differential settlement actions, upheaval, buckling, and thermokarsting.	ExxonMobil Production Company 2010a, 2010b; NSB 2002
10A	Use Existing Alpine Central Processing Facility	**Is not technologically feasible**: • The Alpine CPF does not have sufficient capacity to meet the needs of the Project, and it would require either expanding the facility or eliminating processing of Alpine production if it were to accommodate the estimated production of the Project. • CPAI has additional drill site plans for the Alpine oil field, and it anticipates keeping the CPF operating at or near capacity for many years to come (GMT1, GMT2, etc.). • The Alpine CPF is located on the west side of the Colville River, and use of this facility would require produced hydrocarbons to be shipped, via a new pipeline crossing, west across the river from the Project to be processed, before being shipped back east, thereby introducing additional operational complexity and operational risk.	Armstrong 2016d, 2016e; Petrotechnical Resources Alaska 2004
10B	Use Existing Kuparuk Central Processing Facility 2	**Is not technologically feasible**: • Kuparuk CPF2 is already at or near capacity limits: - Current gas treating/compression would be insufficient to handle Nanushuk production, even if the Kuparuk production were removed entirely: - Currently at capacity for produced water inlet and water injection. - Currently at total inlet fluids capacity (separator limits). - Currently at gas compression/dehydration capacity (lift gas). - Electrical production is at capacity and not available for export.	ADNR 2016; Armstrong 2016d, 2016e; Petrotechnical Resources Alaska 2004

Option Number	Option Considered	Rationale for Elimination	Reference(s)
10C	Use Proposed Mustang Central Processing Facility	**Does not meet the overall Project purpose and is considered speculative**: • The proposed Mustang CPF has not been constructed and is considered speculative at this time.	NA
10D	Use Proposed Placer Central Processing Facility	**Does not meet the overall Project purpose and is considered speculative**: • A CPF has not been formerly proposed by ASRC for the Placer Unit and is speculative at this time.	NA
11A	Reclaim Gravel from Abandoned Pads, Roads, and Airstrips	**Is not logistically feasible:** • The quantity of abandoned gravel infrastructure would likely be insufficient to meet the needs of the Project. • Abandoned, or otherwise no longer operational, sites are located throughout the North Slope; to maximize efficiency, suitable sites would need to be located reasonably close. Many of the abandoned sites are located beyond a reasonable distance to haul material to the Project or are not connected by gravel roads; therefore, the construction of an ice road would be required to reach the site. • The quality of the material is unknown and may not meet the design standards required by the Project. • The material available from abandoned pads, roads, and airstrips has potential to be contaminated from previous activities, making it unusable for the Applicant's Project.	NA
11B	Maximize Gravel Extraction from Existing Mine Sites	This option will be considered during development of mitigation measures but is not considered an alternative.	NA
11C	Mine Gravel from the Colville River	**Is not logistically feasible:** • NSB Title 19 restricts development in the floodplain (NSB 19.70.050(K)(4)), requiring the maintenance of buffers between active channels and work areas; the avoidance of in-stream work, permanent channel shifts, and ponding water; the clearing of riparian vegetation; and the disturbance of natural banks. **Does not have potential to result in less adverse environmental effects:** • Could result in in-stream impacts to aquatic resources within the Colville River. • Would not reduce new infrastructure in the floodplain.	NA
12A	Use North Slope Borough Utilities	This option is considered a potential best management practice and not an alternative.	NA
12B	Wastewater Management	This option is considered a best management practice and not an alternative; it is included under all action alternatives.	NA

Note: Applicant (Armstrong Energy, LLC); NA (not applicable); CPF (central processing facility); DS1 (Drill Site 1); DS3 (Drill Site 3); NSB (North Slope Borough); Kuparuk DS2M (Kuparuk Drill Site 2M); EIS (Environmental Impact Statement); NEPA (National Environmental Policy Act); BLM (Bureau of Land Management); GMT1 (Greater Mooses Tooth 1); SEIS (Supplemental Environmental Impact Statement); USACE (U.S. Army Corps of Engineers); ERD (extended reach drilling); CPAI (ConocoPhillips Alaska, Inc.); bopd (barrels of oil per day); GMT2 (Greater Mooses Tooth 2); ASRC (Arctic Slope Regional Corporation); NA (not applicable)

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