

CUMULATIVE IMPACT ANALYSIS

STAK Energy Campus

Dalton Highway Milepost 390, North Slope, Alaska

State of Alaska Land Lease Application under AS 38.05.070

Prepared for:

Alaska Department of Natural Resources

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1. Executive Summary

This Cumulative Impact Analysis (CIA) has been prepared in support of STAK Energy Corporation's (STAK) land lease application to the Alaska Department of Natural Resources (DNR), for the proposed STAK Energy Campus, also referred to as "Aaka" (the "Project"), on the North Slope of Alaska.

The STAK Energy Campus is a proposed natural gas-powered high-performance computing (HPC) facility located approximately 26 road miles south of Deadhorse, Alaska, at Dalton Highway Milepost 390. The project would occupy approximately 715 acres of state land under a surface lease and includes a gravel pad, a 1.8-mile access road, modular HPC buildings, natural gas power generation equipment producing approximately 1-3 gigawatts (GW) of electrical power, and associated gas pipeline infrastructure connecting to existing or developing North Slope gas fields within 25 to 90 miles of the site.

This CIA evaluates the potential cumulative effects of the STAK Energy Campus in combination with past, present, and reasonably foreseeable future actions within the defined study area. The analysis addresses impacts to the following valued ecosystem components (VECs): terrestrial habitat and vegetation, including wetlands and tundra; wildlife, with emphasis on caribou (Central Arctic Herd) and migratory birds; surface and subsurface hydrology; permafrost integrity; air quality and greenhouse gas emissions; subsistence use and resources; cultural and archaeological resources; and visual and noise environment.

This analysis is based on existing published studies, publicly available data, and regulatory records. The analysis concludes that while the STAK Energy Campus will contribute incremental impacts to a landscape that has experienced over five decades of industrial development, the project's location within an existing development corridor, its use of best management practices, and the proposed mitigation measures will minimize cumulative effects to levels consistent with the public interest as required under Article VIII of the Alaska Constitution and the standards established in *Sullivan v. Resisting Environmental Destruction on Indigenous Lands (REDOIL)*, 311 P.3d 1015 (Alaska 2013).

2. Regulatory and Legal Framework

2.1 Alaska Constitutional Requirements

Article VIII of the Alaska Constitution mandates that the state's natural resources be made available for maximum use consistent with the public interest. The Alaska Supreme Court's decision in *Sullivan v. REDOIL* (2013) established that DNR must take a "hard look" at all factors material and relevant to the public interest when authorizing the use of state resources, including the cumulative impacts of a project throughout all phases of development.

The November 2025 decision in *Orutsararmiut Native Council v. Boyle* clarified that the REDOIL cumulative impact requirement applies to state-owned resources on state lands. Accordingly, this CIA is prepared to satisfy the constitutional "hard look" standard.

2.2 Statutory Authority

The proposed lease is processed under AS 38.05.070, which authorizes the DNR to issue leases for commercial and industrial purposes on state land. The application requires a development plan, environmental risk questionnaire, and supporting documentation. DNR solicits competitive interest in the proposed lease area and then distributes the application to agency review participants and conducts a public notice process. The Preliminary Decision (PD) and Final Finding and Decision (FFD) must address comments received and demonstrate that the proposed use is consistent with applicable area plans and the public interest.

2.3 Applicable Area Plans and Policies

The project area falls within the North Slope Area Plan administered by DNR. The CIA has been prepared with reference to the management guidelines and resource allocation decisions in that plan. Additionally, the project must comply with North Slope Borough municipal code provisions related to land use, zoning, and environmental protections, as well as applicable federal and state permits (e.g., Section 404 of the Clean Water Act administered by the U.S. Army Corps of Engineers, air quality permits from ADEC, and any applicable pipeline authorizations).

3. Project Description

3.1 Project Location and Setting

The STAK Energy Campus is located approximately 26 road miles south of Deadhorse, Alaska, at Dalton Highway Milepost 390, on the Arctic Coastal Plain of the North Slope. The project site is situated approximately 1 mile west of the Dalton Highway, west of the Alaska Gasline Development Corporation (AGDC) right-of-way and the Trans-Alaska Pipeline System (TAPS). The site is near 65-9-099-2 Mine Site at MP390. The surrounding landscape is characterized by low-relief tundra with polygonal ground, thaw lakes, and poorly drained complexes typical of continuous permafrost terrain. Elevations at the site range from approximately 600 to 750 feet above sea level.

3.2 Physical Footprint

The following table details the physical footprint of each project component:

Component	Approximate Acreage	Dimensions	Gravel Depth
Main Gravel Pad (HPC modules, power generation, operations buildings)	~640 acres	Irregular polygon; final dimensions to be set in detailed engineering design	5–7 ft minimum
Gravel Access Road (Dalton Highway to site)	~25 acres (1.8 mi × ~36 ft width + shoulders)	1.8 miles long; 36 ft driving surface + 6 ft shoulders	5–6 ft
Maintenance Buffers	~50 acres	Perimeter setbacks around pad and road	3–5 ft
On-Site Utility Corridors (internal roads, pipe racks, cable trays)	Included in main pad acreage	Various	As pad
TOTAL (pad, road, buffers — excluding pipeline ROW)	~715 acres		

The proposed 715-acre footprint (road and pad) represents a large gravel pad on the North Slope and warrants direct comparison to existing benchmarks to put its scale in perspective. By way of comparison, the central processing facility (CPF) pads at Prudhoe Bay, Kuparuk, and Alpine—which house gas compression, oil and water separation, power generation, and control rooms—generally fall in the 60- to 150-acre range. The ConocoPhillips Willow Master Development Plan, approved by the Bureau of Land Management in 2023, authorized three drill pads (BT1, BT3, and BT5), an operations center, and approximately 25 miles of gravel roads within NPR-A, with a combined gravel demand of approximately 4.2 million cubic yards distributed across roughly 385 acres of new pad and road footprint. The Alpine field, often cited as a benchmark for compact development, was originally constructed on approximately 97 acres of gravel pad to support 154 wells and full processing infrastructure. At the upper end of historical North Slope development, the Prudhoe Bay Operations Center and adjacent gathering centers collectively occupy several hundred acres but were built incrementally over more than four decades.

The STAK Energy Campus's 715-acre scale approaches the cumulative footprint of full satellite field developments on the North Slope. This scale is not a function of conventional drilling or hydrocarbon processing requirements; rather, it reflects the spatial demands of three distinct co-located industrial systems that must operate as an integrated whole. First, 1-3 GW of natural gas-fired power generation requires pad area for the turbine hall or modular turbine enclosures, gas conditioning and metering equipment, fuel gas knockout drums, exhaust stack arrays with mandated separation distances, electrical switchyards, step-up transformers, and the auxiliary systems (lube oil, water treatment, fire suppression) typical of a generation facility. For reference, a comparable 1-3 GW combined-cycle gas plant in the Lower 48 typically occupies 80 to 150 acres on its own; Arctic siting requirements—including expanded snow storage, heated equipment shelters, and wider equipment spacing for cold-weather access—materially increase that baseline. Second, the high-performance computing facility itself requires pad area for modular data halls arranged to support efficient ambient air cooling. Third, an industrial campus of this complexity in a remote Arctic setting requires ancillary footprints for workforce housing and life-support modules for 50- to 150-person operations crew, warehousing for spare parts and consumables that cannot be quickly resupplied, a fuel storage area for emergency diesel generators, vehicle and heavy equipment maintenance shops, fire and emergency response staging, and substantial laydown and snow storage areas. Each of these support functions is typically distributed across separate buildings on a North Slope facility, with adequate setbacks for fire protection and operational access, rather than being consolidated into a single multi-story structure as would be common in milder climates.

The footprint is also influenced by Arctic-specific engineering constraints that increase pad area beyond what equipment dimensions alone would suggest. Continuous permafrost terrain requires a thermally stable gravel pad of 5 to 7 feet minimum depth with additional perimeter buffers to prevent thaw bulb migration from heated structures into adjacent tundra. Finally, construction requires that the full pad be constructed before all equipment is installed, for equipment staging and laydown and so that subsequent phases can be added without disturbing operational systems or requiring additional winter construction seasons of tundra-impacting work.

In aggregate, the 715-acre footprint reflects the convergence of three distinct industrial uses—utility-scale power generation, large-scale computing, and a remote Arctic operations base—on a single co-located site, rather than an allocation driven by any single one of these functions. Importantly, the 715-acre figure represents the gross lease area that STAK is requesting from DNR to accommodate the Project and is not equivalent to the area of tundra that will be covered by gravel or otherwise directly disturbed. STAK is actively pursuing a site layout that minimizes actual tundra coverage within the leased boundary by optimizing for a non-contiguous pad configuration—preserving native tundra in interstitial areas between buildings, equipment clusters, and ancillary functions wherever Arctic engineering, snowdrift management, fire protection, and operational access requirements permit. Final pad geometry and the resulting actual gravel-covered acreage will be established during detailed engineering design and reflected in subsequent permitting submittals; STAK's working objective is to deliver a covered tundra area materially less than the gross lease acreage. STAK has also pursued footprint minimization elsewhere in the project's design: the access road has been routed along the shortest practicable alignment from the Dalton Highway (1.8 miles) and is co-located with the existing TAPS/Dalton corridor to avoid creating new disturbance in undisturbed tundra.

3.3 Facility Operations: Data Center and Power Plant Integration

3.3.1 Power Generation System

The on-site power generation system will consist of multiple high-efficiency natural gas turbine units with a combined nameplate capacity of approximately 1-3 gigawatts (GW), operating in a behind-the-meter configuration that serves the co-located HPC facility exclusively. The generation system is the largest physical component of the project from an air quality, greenhouse gas, and fuel consumption perspective, and is described here in detail to support agency review.

Scale in the Alaska Context. A 1-3 GW power generation facility represents new generating capacity in Alaska and will require a preconstruction Prevention of Significant Deterioration air permit as required under the Clean Air Act administered by the Alaska Department of Environmental Conservation as delegated from the EPA. The project will fall within the required emission thresholds and will demonstrate compliance through the required testing. The STAK facility will serve a single behind-the-meter industrial load and does not affect any existing power generation or distribution grids or communities. The facility does not displace electricity available to Alaska residents, businesses, or other industrial users; it is a self-contained generation-and-load system that exists solely to power the HPC operations described in Section 3.3.2.

The power generation scale reflects the unique siting opportunity that the North Slope offers: proximity to abundant, currently underutilized natural gas resources; a cold-climate environment that materially reduces the parasitic energy load associated with HPC cooling; and a remote location that places the facility outside the population centers and grid systems where new large-load development has met persistent siting and capacity constraints in the Lower 48.

Turbine Configuration and Technology. The generation facility will employ multiple high-efficiency natural gas combustion turbine units, configured in a modular arrangement to support phased construction, operational flexibility, and load-following responsiveness to HPC demand variation. STAK is currently evaluating both heavy-frame industrial turbine designs (in the approximate 250 to 600 MW per-unit class, similar to those deployed in modern combined-cycle plants in the Lower 48) and aeroderivative designs (in the approximate 50 to 150 MW per-unit class, similar to the LM6000 and LM9000 platforms commonly used in remote and modular applications). The final selection will balance unit efficiency, cold-weather performance, modular delivery feasibility via Dalton Highway, maintenance interval requirements, and load-following capability. Final unit count, model selection, and emission characteristics will be specified in the ADEC Prevention of Significant Deterioration (PSD) construction permit application.

The facility will initially operate in a simple-cycle configuration, with combustion turbine exhaust vented to atmosphere through stacks designed to meet ADEC dispersion modeling requirements. The site layout, foundation design, and pad configuration will preserve the ability to retrofit the turbines into a combined-cycle configuration in the future through the addition of heat recovery steam generators (HRSGs) and steam turbines. A combined-cycle retrofit could increase overall plant thermal efficiency from approximately 35–42 percent (typical simple-cycle range) to 55–62 percent (typical combined-cycle range), with corresponding reductions in fuel consumption and CO₂ emissions per MWh of HPC load served. STAK has not committed to a combined-cycle retrofit at this stage because the additional lead time and schedule impact, proof of arctic concept operability, capital cost, water requirements (HRSGs require treated boiler-quality water, which would partially offset the dry-cooling water savings discussed in Section 3.3.4), and complexity must be evaluated against fuel cost, emissions trajectories that will become clearer as the facility ramps to full operation and uptime reliability.

Operational Profile. The gas turbines will operate in continuous baseload service in support of the HPC facility, with scheduled maintenance rotations to ensure uninterrupted power supply. The modular configuration allows individual turbines to be taken offline for inspection, hot-section maintenance, or major overhaul while the remaining units carry the active HPC load, eliminating the need for facility-wide outage events. STAK anticipates a planned maintenance schedule designed around the manufacturers' recommended hot-section, combustor, and major inspection intervals. Capacity factor at the facility level is anticipated to be high — likely in the range of 85 to 95 percent of nameplate — reflecting the continuous nature of HPC workloads, though instantaneous output will modulate with HPC load.

Fuel Supply. Natural gas will be supplied to the facility via one or more dedicated pipelines from producing fields or developing prospects within approximately 25 to 90 miles of the site. The North Slope contains substantial proved and probable natural gas reserves — the Prudhoe Bay field is estimated to contain up to 26 trillion cubic feet (tcf) recoverable natural gas reserves that have historically been reinjected for reservoir pressure maintenance or used for in-field fuel and processing rather than monetized for export. The development of the Alaska LNG Project and associated gas treatment infrastructure would provide additional context for North Slope gas monetization, though the STAK facility's fuel demand is structured around dedicated pipeline supply from producing or developing fields rather than reliance on the AK LNG system.

Estimated fuel consumption at full simple-cycle operation is on the order of 350 to 500 million standard cubic feet per day (MMscf/day), depending on final turbine selection, ambient temperature, and operating efficiency. This consumption volume is small relative to North Slope gas reserves and to the gas volumes contemplated under AK LNG (the system will handle roughly 3.3 billion cubic feet of gas per day). Gas composition, heating value, and contaminant levels will be specified in supply agreements with the upstream producer(s).

Standby Generation. Standby diesel generators will provide emergency and transitional power during gas supply interruptions, scheduled turbine maintenance windows that exceed the redundancy of the primary turbine fleet, and startup/shutdown sequences. Standby generator capacity will be sized to support critical loads (life-safety systems, building environmental controls, controlled HPC shutdown) rather than full nameplate operation. Diesel fuel will be stored on-site in tanks designed to applicable ADEC standards, with secondary containment, leak detection, and spill prevention controls. Standby generators will be permitted as discrete emergency engines under ADEC air quality authorizations; their cumulative annual operating hours are expected to be limited and are not anticipated to be a significant contributor to facility air emissions, but will be quantified in the PSD application.

Grid Independence and System Integration. As noted above and in Section 3.3.3, the facility will not be interconnected to existing power grids and transmission systems.

Fuel Market and Indirect Effects. While the STAK facility will not directly affect electricity supply to other Alaska users, its natural gas demand could have indirect effects on the North Slope gas market. Specifically, project gas demand may incentivize accelerated development of currently stranded or underutilized gas resources, may affect gas commitment decisions for the Alaska LNG project or other monetization pathways, and may influence pricing in any North Slope gas market that develops. These indirect effects are difficult to quantify in advance and depend on the evolving structure of North Slope gas markets but are flagged here for completeness in the cumulative impact framework.

3.3.2 High-Performance Computing Operations

The HPC facilities will be housed in a series of modular, purpose-built computing buildings distributed across the gravel pad in a configuration optimized for ambient air cooling, electrical distribution efficiency, and phased construction. The HPC component of the facility is the principal load served by the on-site power generation system described in Section 3.3.1, and its design parameters drive the overall scale, layout, and operational characteristics of the campus.

Computing Module Configuration. The facility will consist of multiple individual computing modules, each comprising a prefabricated or site-assembled building envelope housing high-density server racks, in-row cooling infrastructure, electrical distribution equipment, and local network aggregation gear. Individual modules are anticipated to range from approximately 20 to 75 megawatts (MW) of IT load each, with the total number of modules and per-module capacity to be finalized during detailed engineering design and as computing equipment generations evolve over the multi-year buildout. Modules will be arranged in rows with sufficient inter-module spacing to support ambient air intake and warm air exhaust without short-circuiting (i.e., recirculation of exhaust air back into intake plenums), to provide service access for crane lifts and equipment replacement, and to manage snowdrift accumulation in the prevailing wind regime. The modular approach allows STAK to commission, operate, and expand computing capacity incrementally as additional power generation is brought online, rather than requiring full-campus completion before any operations can begin.

Computing Workload Profile. The HPC facility is designed to support computationally intensive workloads characteristic of contemporary large-scale AI and cloud computing operations, including: (i) training of large-scale machine learning models, including foundation models and other AI systems that require sustained, high-density GPU or specialized accelerator computation over periods ranging from days to months; (ii) inference workloads serving deployed AI models to end users via long-haul fiber connections; (iii) general-purpose cloud computing services, including virtual machine hosting, container orchestration, and managed data services; and (iv) high-performance scientific and analytical computing as commercial demand develops. The mix of workloads across these categories may shift over the operational life of the facility based on customer demand and computing market conditions; however, for purposes of this CIA, the facility is conservatively assumed to operate at or near nameplate IT capacity on a continuous basis, with corresponding sustained power draw and heat rejection.

Computing Equipment. Each module will be populated with high-density server racks, anticipated to operate at rack power densities in the range of 50 to 200 kilowatts (kW) per rack — substantially higher than the 5 to 15 kW per rack typical of legacy enterprise data centers, and reflective of contemporary AI training infrastructure. Racks will house a mix of equipment classes that may include: GPU and AI accelerator nodes for training and inference; CPU-based compute nodes for general workloads; high-capacity storage arrays (SSD and HDD); high-speed networking equipment (top-of-rack switches, spine switches, and optical interconnects); and out-of-band management infrastructure. Specific server, accelerator, and networking models will be selected closer to commissioning based on then-current technology, and equipment will be refreshed on rolling cycles of approximately 3 to 6 years over the operational life of the facility. STAK does not anticipate that equipment refresh cycles will require pad expansion or additional gravel placement; refresh activities will occur within the existing module envelopes via Dalton Highway delivery and crane access.

Cooling and Heat Rejection. Each computing module is designed for direct or indirect ambient air cooling as the primary heat rejection pathway, taking advantage of the Arctic climate as

described in Section 3.3.4. Internal module cooling architectures may include hot-aisle/cold-aisle containment with air-side economization, rear-door heat exchangers, direct-to-chip liquid cooling loops with dry coolers rejecting heat to ambient air, or immersion cooling systems, depending on the rack densities and equipment generations deployed in each module. In all cases, final heat rejection is to the atmosphere via dry cooling — no evaporative cooling towers, cooling ponds, or once-through water cooling are proposed. During the limited summer periods when ambient temperatures approach or exceed equipment intake design limits (a small fraction of operating hours given the project's latitude), supplemental mechanical cooling (chillers) may be activated for brief periods; the facility's sizing and selection of supplemental cooling equipment will be designed to minimize both water consumption and parasitic electrical load.

Electrical Architecture and Reliability. Each module is served by redundant medium-voltage feeds from the on-site substation network described in Section 3.3.3, stepped down to rack-level voltages through power distribution units (PDUs) within the module. Uninterruptible power supply (UPS) and Battery Energy Storage System (BESS) systems — anticipated to be lithium-ion battery based — will provide ride-through capability during transient events and orderly shutdown capability in the event of a sustained loss of generation. Standby diesel generators will provide backup power for critical loads, including life-safety systems, building environmental controls, and a subset of computing infrastructure required for graceful workload checkpointing and shutdown; the standby generator population will be permitted under ADEC air quality authorizations as discrete emergency engines.

Network and Data Connectivity. The facility will be connected to long-haul telecommunications infrastructure via redundant fiber-optic cable, with the specific routing and carrier arrangements to be finalized during detailed design. Internal to the facility, modules will be interconnected by high-bandwidth optical fabric supporting east-west traffic between training clusters and storage systems. The facility's external bandwidth requirements are modest relative to its computing capacity — AI training workloads generate substantial internal network traffic but comparatively small external traffic — which makes the project less sensitive to telecommunications infrastructure constraints than a hyperscale cloud serving facility located near population centers.

Staffing and Operations. The HPC facility will be operated on a 24-hour-per-day, 365-day-per-year basis, with continuous staffing in the operations and control building. Anticipated permanent on-site staffing levels are in the range of 50 to 150 personnel, depending on the operational phase, with peaks during construction and commissioning phases and during major equipment refresh events. Staff functions will include: facility operations and electrical/mechanical systems supervision; computing operations (server provisioning, fault response, software and firmware management); network operations; physical security; safety, health, and environmental compliance; and logistics and supply. STAK anticipates a rotational workforce model consistent with other North Slope industrial operations, with personnel housed in on-site or nearby workforce accommodations during their work rotations. STAK will prioritize Alaska hire and, consistent with the community engagement commitments described in Section 7.7, will work with the North Slope Borough and regional workforce development organizations to develop training and recruitment pathways for North Slope residents.

Operational Byproducts and Emissions. The HPC operations themselves do not directly emit air pollutants or generate process wastewater; emissions associated with the project arise from the natural gas combustion that powers the HPC equipment (addressed in Section 7.6) and from standby diesel generators. The HPC facility will produce: (i) substantial low-grade waste heat, rejected to the atmosphere as discussed above and addressed in the permafrost analysis

in Section 7.5; (ii) low-frequency operational noise from cooling fans and electrical equipment, addressed in Section 7.9; (iii) electronic waste from equipment refresh cycles, which will be managed through manufacturer take-back programs, certified electronics recyclers, and ADEC-compliant solid waste handling; (iv) used lithium-ion batteries from UPS replacement cycles, managed under applicable hazardous waste regulations; and (v) routine solid and sanitary waste streams typical of a continuously occupied industrial facility, managed through licensed haul-out and disposal arrangements. The facility is not anticipated to produce process wastewater requiring discharge.

Future Modifications. The modular design allows for capacity expansion, equipment refresh, and technology evolution within the authorized 715-acre footprint without requiring additional gravel placement or pad expansion. Should future expansion beyond the authorized footprint become necessary — for example, to accommodate additional computing capacity beyond the currently planned 1-3 GW supported load — STAK would pursue separate authorizations at that time.

3.3.3 Power-to-Compute Integration

The data center and power plant are designed as a fully integrated, co-located system in which all generated electricity is consumed on-site by the HPC facility. This "behind-the-meter" architecture is fundamental to the project's regulatory posture, its operational reliability strategy, and its overall environmental footprint, and is described here in detail.

Behind-the-Meter Configuration and Grid Independence. The STAK Energy Campus is configured as an islanded, self-contained electrical system with all electrical infrastructure contained within the 715-acre footprint and the immediate substation yard. Therefore, the project does not affect the generation reserve margins, capacity adequacy, transmission constraints, or retail electricity rates of the Railbelt or any other Alaska utility system.

Should circumstances change in the future, any such interconnection would require separate regulatory approvals.

Electrical Architecture. The integrated power-to-compute system operates as follows:

- Gas turbine generators produce electricity at generator-terminal voltage (typically 13.8 kV for industrial frame turbines or 13.8–15 kV for aeroderivatives), which may be stepped up at the turbine pad to medium voltage (anticipated 34.5 kV) for distribution across the campus.
- A central or distributed substation network steps medium-voltage power down to utilization voltage at the computing modules through unit substations, with each module served by redundant feeds from independent substation buses.
- Within each computing module, power distribution units (PDUs) further step voltage down to rack-level distribution (typically 415 V three-phase or 480 V three-phase), with branch circuits serving individual server cabinets.
- Battery supplies will provide ride-through during transient events (turbine trips, switchgear operations, brief gas supply interruptions) and orderly shutdown capability during sustained generation loss.
- Standby diesel generators provide backup power for life-safety systems, building environmental controls, and a defined subset of computing infrastructure required for graceful workload checkpointing during sustained generation outages.

- Comprehensive supervisory control and data acquisition (SCADA) systems monitor and control the integrated generation and distribution system, with redundant control rooms providing 24/7/365 operator coverage.

Load-Following and Operational Coordination. The integrated configuration allows the generation system to ramp turbine output up or down in coordination with HPC load, rather than operating as a constant-output baseload plant disconnected from end-use demand. Computing load varies with the workload mix: large AI training runs draw substantial sustained power (often near rack nameplate for periods of days to months); inference workloads exhibit shorter-cycle fluctuations driven by user demand patterns; and idle or maintenance periods on individual modules reduce instantaneous load. Power management software continuously balances aggregate computing load against turbine dispatch decisions, optimizing for fuel efficiency (operating turbines near their best-efficiency points), maintenance flexibility (rotating turbines through service intervals without forcing curtailment), and ride-through capability (maintaining adequate spinning reserve for transient events). Anticipated facility-level capacity factor is in the range of 85 to 95 percent of nameplate, as discussed in Section 3.3.1.

Waste Heat Management. Waste heat from gas turbine combustion is released to the atmosphere through conventional exhaust stacks. No heat recovery steam generators (HRSGs), combined-cycle steam loops, or organic Rankine cycle systems are included in the initial facility design. STAK will continue to evaluate waste heat recovery for future consideration.

- *Combined-cycle conversion:* As discussed in Section 3.3.1, the facility's site layout preserves the option for future combined-cycle retrofit. Combined-cycle operation would convert a portion of the waste heat into additional electricity, increasing overall plant efficiency from ~35–42 percent (simple-cycle range) to ~55–62 percent (combined-cycle range), with corresponding reductions in fuel consumption and CO₂ emissions per unit of HPC computing output.
- *District heating to the HPC facility:* Waste heat could be used to maintain temperature in occupied buildings, gas-handling equipment, and freeze-protection systems. The facility will evaluate selective use of waste heat for these purposes during detailed design; however, the heat load required for facility operations is small relative to the waste heat output of 1-3 GWs of generation.
- *Export of waste heat to off-site users:* Potential applications include greenhouse heating, aquaculture, and adjacent industrial process heat. STAK is not aware of any existing off-site users within the project vicinity, and no off-site export is proposed at this time. STAK will continue to evaluate opportunities as the surrounding industrial corridor evolves.
- *Integration with HPC liquid cooling loops:* Direct-to-chip and immersion cooling systems within the HPC modules generate heated coolant at temperatures (typically 30–60°C) that are too low for practical conversion to additional electricity, but could support facility heating. STAK will evaluate this integration during detailed design.

The decision to begin operations in a simple-cycle configuration without significant heat recovery reflects the absence of practical export markets for low-grade Arctic waste heat, the water requirements of HRSG systems (which would partially offset the dry-cooling water savings discussed in Section 3.3.4), and the desire to commission the facility on a shorter schedule than a combined-cycle build-out would allow. Future evaluation of heat-recovery options is preserved by the facility's modular design.

Cooling System Coupling. The integration of HPC cooling and power generation is a defining feature of the project's environmental profile. As described in Section 3.3.4, the HPC facility is designed for ambient air cooling, taking advantage of the Arctic climate to reject computing waste heat directly to the atmosphere without evaporative water consumption. From the integrated-system perspective, this design has the following significance:

- The parasitic electrical load required to operate cooling systems (fans, pumps, control systems) is a small fraction — typically 5 to 15 percent — of total IT load, compared to 30 to 50 percent or more for evaporative or chiller-based cooling at lower-latitude facilities. This reduces the gross generation required to support a given amount of useful computing output, which in turn reduces fuel consumption, emissions, and gas pipeline demand for any given level of HPC capacity.
- The cooling system's reliance on ambient air rather than large volumes of water substantially reduces freshwater withdrawal and the supporting water-supply infrastructure that lower-latitude facilities require.
- Power generation waste heat (from turbine exhaust) and HPC waste heat (from computing equipment) are physically separated heat streams; they are not co-mingled in a common cooling loop. Each is rejected to atmosphere through dedicated infrastructure (turbine exhaust stacks for the former, air-cooled heat exchangers and module ventilation for the latter).

Communications Infrastructure Coupling. Fiber-optic communications infrastructure connects the HPC facility to long-haul telecommunications networks for data transmission to end users. Communications infrastructure is electrically powered through the same integrated power system that serves the HPC modules, with dedicated UPS and backup generator capacity sized to maintain network connectivity during electrical events. Loss of long-haul fiber connectivity is an operational concern (it limits the ability to serve external customers) but is not a safety concern and does not require facility shutdown.

Phased Energization. The integrated design supports phased commissioning: as each generation module and computing module reaches mechanical completion, it can be brought online and connected to the integrated electrical system without requiring the full campus to be commissioned. This approach allows STAK to begin generating revenue from initial computing capacity while later phases are still under construction and reduces the financial and operational risk associated with single-event full-campus commissioning. Phased energization is coordinated with construction sequencing as described in Section 3.4.

3.3.4 Cooling System and Water Use

A critical design advantage of the North Slope location is the ability to use ambient air for data center cooling. Average annual temperatures at the project site are approximately -11°C (12°F), with winter temperatures frequently below -30°C (-22°F) and summer maxima rarely exceeding 15°C (59°F). This climate allows the facility to employ dry air cooling, in sharp contrast to lower-latitude hyperscale data centers that rely on evaporative cooling and consume millions of gallons of water daily. At typical lower-latitude hyperscale facilities using evaporative cooling, daily water consumption can range from 3 to 5 million gallons per day per facility. The STAK Energy Campus's reliance on ambient air cooling is expected to reduce direct operational water consumption by 90 percent or more compared to industry norms. Operational water needs will be limited primarily to domestic use (potable water for on-site consumption), fire suppression systems, and minor process water for equipment washing and maintenance. Estimated operational water demand is to be quantified based on final staffing levels and fire system

design but anticipated to be on the order of tens of thousands of gallons per day rather than millions.

3.4 Construction Schedule and Sequence

Construction of the STAK Energy Campus will proceed in phases over an estimated six-year buildout period. The following table outlines the anticipated sequence of construction activities:

Phase	Estimated Timing	Activities	Key Considerations
Phase 1: Permitting & Pre-Construction	Year 1	Complete DNR lease; obtain Section 404 permits; submit ADEC air permit; geotechnical investigations; final engineering design; environmental surveys; gravel source confirmation	Ice road may be constructed for geotechnical access during winter.
Phase 2: Access Road & Initial Pad Construction	Year 2 (Winter)	Construct ice road from MP390 mine site to project site and ice pads for overburden layout and staging. Begin gravel hauling and placement for access road and initial pad area. Install temporary construction camp.	Winter-only tundra travel. Gravel placement on frozen ground to protect permafrost. Coordinate with DOT for Dalton Highway traffic management.
Phase 3: Pad Completion & Summer Compaction	Year 2 (Summer)	Completion of gravel placement and post-thaw compaction and grading of winter-placed gravel. Install culverts and drainage structures. Complete pad to design grade. Begin foundation preparation.	Summer construction window (June–Sept). Monitor permafrost response. Culvert placement critical for hydrology.
Phase 4: Gas Pipeline Construction	Year 2–3 (Winter/Summer)	Construct ice road from Prudhoe Bay tie-in location to MP390 pad (winter). Vertical Support Member (VSM) installation and pipe installation (setting and welding) from ice road (winter). Hydrostatic testing, and preservation until site is ready to commission (summer).	Ice road construction for pipeline access. Elevated crossings at caribou and waterway crossings. Route-specific permits required.
Phase 5: Facility Installation	Year 3–5	Install piles on the pad for equipment and modules. Install gas turbines and generators (modular delivery via Dalton Highway and sealifts through West Dock). Concrete installation for gas turbine stability. Install HPC modules. Erect operations buildings, substations, fiber-optic systems. Commission gas pipeline, power and communications systems.	Heavy equipment and modular delivery via Dalton Highway. Seasonal restrictions for caribou calving (May 20–July 15) for noise-intensive activities and breakup restrictions.
Phase 6: Commissioning & Operations	Year 4–6+	Phased turbine startup and HPC module energization. Performance testing. Full commercial operations. Ongoing expansion of computing capacity as additional power comes online.	Continuous operations 24/7/365 once commissioned. Ongoing environmental monitoring.

Note: The schedule above is preliminary and subject to refinement based on permitting timelines, final engineering design, and equipment procurement lead times. Winter construction seasons on the North Slope are typically limited to approximately December through April, when frozen ground conditions permit tundra travel and gravel hauling.

3.5 Gravel and Water Quantities

3.5.1 Gravel Requirements

North Slope gravel pad construction typically requires approximately 5 to 7 feet of gravel fill placed on the tundra surface to insulate underlying permafrost and provide a stable working surface. The following table provides a breakdown of estimated gravel quantities by project component:

Component	Acreage	Avg. Fill Depth (ft)	Est. Volume (cubic yards)
Main Gravel Pad	~640	6	~7,000,000
Access Road (1.8 mi)	~25	6	~100,000
Buffers	~50	0	
TOTAL ESTIMATED GRAVEL	715	—	~7,100,000

STAK will obtain a material sale authorization from DNR for gravel extraction from the 65-9-099-2 Mine Site at MP390. If the MP390 source is insufficient to meet total project demand, STAK will identify supplemental gravel sources in coordination with DNR and ADOT&PF, potentially including other permitted mine sites along the Dalton Highway corridor or a new mine site near the pad location. All gravel extraction will comply with ADF&G's North Slope Gravel Pit Performance Guidelines and applicable reclamation requirements.

3.5.2 Water Requirements

Water will be required for the following project purposes:

- Construction: Dust control on gravel roads and pad during summer compaction; gravel processing (washing/crushing if required); ice road construction (if used for pipeline access); concrete mixing for foundations.
- Operations: Domestic water supply for on-site consumption (potable and sanitary); fire suppression system filling and maintenance; minor equipment washing and process water;

Estimated water requirements are as follows:

Purpose	Estimated Volume	Source / Timing
Construction dust control (per summer season)	5–15 million gallons/season (estimate)	Permitted surface water source; summer only

Ice road/pad construction (per winter, if applicable)	1–3 million gallons per mile of ice road	Permitted lake source; winter withdrawal per ADFG protocols
Operational domestic water (annual)	~2–5 million gallons/year (based on staff of 50–150 persons)	On-site well or permitted surface source
Fire suppression (one-time fill + maintenance)	~0.5–1 million gallons initial fill	On-site storage tanks
Data center cooling	Minimal — facility designed for dry air cooling	Ambient Arctic air is primary coolant; negligible operational water for cooling
HRSG, water treatment and condensate system make-up (only if a combined-cycle retrofit is pursued; not part of initial simple-cycle design — see Sections 3.3.1 and 3.3.3)	40–100 million gallons annually	Permitted surface water source

All water withdrawals will be permitted through DNR’s water use authorization process and will comply with ADF&G in-stream flow requirements and seasonal restrictions on lake withdrawals to protect overwintering fish habitat. STAK will work with DNR and ADF&G to ensure withdrawals do not exceed sustainable levels.

3.6 Carbon Capture, Utilization, and Storage (CCUS)

DNR has inquired about STAK’s plans for carbon capture, utilization, and storage (CCUS) in connection with the 1–3 GW natural gas generation facility. STAK confirms that CCUS is not included in the current project design. The facility as proposed will vent combustion exhaust to the atmosphere through conventional exhaust stacks, with emissions controlled by best available control technology (BACT) as determined through the ADEC Prevention of Significant Deterioration (PSD) permitting process.

The decision not to incorporate CCUS at this stage reflects the following considerations:

- There is currently no CO₂ transportation or sequestration infrastructure on the North Slope that would receive captured carbon.
- Subsurface geological characterization for CO₂ storage in the project vicinity has not been completed, and the suitability of local formations for long-term sequestration is undemonstrated.
- The capital and operating costs of CCUS at this scale would materially affect project economics and timeline without a demonstrated storage pathway.
- Regulatory frameworks for CO₂ injection on the North Slope (Class VI well permitting under the Safe Drinking Water Act, primacy determinations, etc.) are not yet fully developed for this region.

STAK does not foreclose the possibility of incorporating CCUS technology in the future if subsurface storage opportunities are identified, CO₂ transportation infrastructure becomes available, or regulatory and economic conditions change. STAK will monitor developments in CCUS technology and North Slope geological characterization and will evaluate CCUS feasibility as the project matures.

In the absence of CCUS, STAK will quantify and annually report greenhouse gas emissions from the facility as required by EPA greenhouse gas reporting rules and will evaluate other GHG mitigation strategies, including high-efficiency turbine technology, and operational optimization to minimize fuel consumption.

3.7 Connected Actions

For the purposes of this cumulative impact analysis, connected actions include the natural gas pipeline(s) from source fields to the project site (25–90 miles), the use of gravel from the 65-9-099-2 Mine Site at MP390, any required upgrades or modifications to the Dalton Highway intersection, and fiber-optic communication corridors. These connected actions are addressed in the cumulative effects analysis even where they may require separate permits or authorizations.

4. Data Center Industry Context

DNR has requested information regarding existing data center environmental impacts and the hyperscaler development model to provide context for evaluating the STAK Energy Campus. This section summarizes the current state of the industry and situates the STAK proposal within national and global trends.

4.1 Hyperscaler Data Center Models

The term “hyperscaler” refers to companies that operate computing infrastructure on a larger scale to support cloud services, artificial intelligence, and internet platforms. Major hyperscalers include Amazon Web Services (AWS), Microsoft Azure, Google Cloud, and Meta. These companies have driven a new generation of data center construction characterized by facilities of unprecedented size and power demand. A single hyperscale data center today typically draws 100 megawatts (MW) or more of electricity, with the largest campuses planned at multiple gigawatts. As of 2026, the United States has over 4,000 data centers representing approximately 37 percent of global capacity (Synergy Research Group; LBNL 2024). U.S. data center energy demand is projected to nearly double between 2025 and 2028, from approximately 80 GW to 150 GW of total combined demand, driven primarily by artificial intelligence workloads. (Bloom Energy, January 2026; Consumer Reports, March 2026.)

Hyperscale campuses are increasingly large in physical footprint. Some of the largest facilities under construction or planned in the United States cover hundreds or thousands of acres. For example, Meta’s 5 GW Hyperion campus in Louisiana encompasses approximately 3,650 acres. The scale of the STAK Energy Campus (715 acres, 1-3 GW) is consistent with this emerging class of facilities, though differentiated by its Arctic location and integrated behind-the-meter power generation.

4.2 Existing Data Center Environmental Impacts

4.2.1 Energy Consumption

Data centers are significant consumers of electricity. In 2022, U.S. data centers consumed approximately 4.4 percent of the nation’s electricity; projections suggest this could reach 6.7 to 12 percent by 2028.

4.2.2 Water Consumption

The STAK project’s unique environmental profile—specifically, the elimination of water-intensive cooling—represents a meaningful departure from the environmental impact patterns documented at lower-latitude facilities. Water use is one of the most significant and publicly scrutinized environmental impacts of data centers. Evaporative cooling is the predominant cooling method at lower-latitude facilities and is not proposed for this project. In 2023, U.S. data centers directly consumed approximately 17.4 billion gallons of water, primarily for cooling. A typical hyperscale facility using evaporative cooling can consume 3 to 5 million gallons of water per day. Hyperscale facilities have largely moved beyond conventional evaporative cooling technologies and are increasingly deploying Direct Liquid Cooling (DLC), which dramatically reduces water use. As a result, once the system is initially filled, ongoing operational water consumption is near zero, aside from infrequent maintenance activities such as heat-exchanger flushing. Initial system filling is a one-time requirement and can be on the order of 8 million gallons for a 1 GW IT load. Another emerging trend is immersion, which fully submerges servers in a synthetic hydrocarbon based dielectric fluid instead of water and rejects heat

through closed loop dry coolers. Early Data Centers used Fluorinated Hydrocarbons, but STAK will not use these obsolete fluids.

The STAK Energy Campus's North Slope location provides a distinct advantage in this regard. Ambient air cooling in an Arctic climate is expected to reduce direct water consumption by an order of magnitude compared to evaporative-cooled facilities at lower latitudes. This is a material environmental benefit of the project's siting.

4.2.3 Land Use and Community Impacts

The rapid expansion of hyperscale data centers has generated significant community opposition in many parts of the United States, driven by concerns about increased electricity costs, water consumption, noise, land conversion, and the displacement of agricultural and residential uses. Between 2025 and 2026, community opposition contributed to the blocking or delay of billions of dollars in data center projects nationally. Concerns have been particularly acute in regions with existing concentrations of data centers, such as Northern Virginia, central Oregon, and parts of the Sun Belt.

The STAK Energy Campus differs from these contested projects in several important respects: the project generates its own power behind the meter and does not draw from or compete with the local electrical grid or residential energy supply; the Arctic location eliminates the water consumption driven by evaporative cooling opposition in arid and semi-arid regions; and the remote North Slope location avoids conflicts with residential, agricultural, or suburban land uses that characterize opposition in the Lower 48.

4.3 Relevance to Cumulative Impact Assessment

The data center industry context summarized in this Section 4 is relevant to the cumulative impact assessment that follows in two respects. First, the environmental impact profile of the Project should be evaluated in light of the industry trend toward increasingly large, power-intensive facilities; the proposed 1–3 GW facility is at the upper end of currently proposed industry capacity and is consistent with the trajectory of the sector. Second, the Project's environmental profile—specifically, the elimination of water-intensive cooling and the behind-the-meter power configuration—represents a meaningful departure from the impact patterns documented at lower-latitude facilities. These framing observations inform the cumulative-effects analysis in Section 7, particularly the analyses of hydrology (Section 7.4), air quality and greenhouse gas emissions (Section 7.6), and visual and noise environment (Section 7.9).

5. Cumulative Impact Assessment Methodology

5.1 Approach

This CIA follows the framework established by the Council on Environmental Quality (CEQ) guidance document, *Considering Cumulative Effects Under the National Environmental Policy Act (1997)*, adapted to the Alaska state constitutional standard articulated in REDOIL. The analysis proceeds through the following steps:

- Identification of valued ecosystem components (VECs) and resources of concern.
- Definition of spatial and temporal boundaries for each VEC.
- Inventory of past, present, and reasonably foreseeable future actions.
- Assessment of baseline conditions for each VEC using existing data.
- Analysis of incremental contribution of the proposed project.
- Evaluation of the aggregate cumulative effect in combination with other actions.
- Identification of mitigation measures and monitoring commitments.

5.2 Data Sources and Limitations

This analysis relies exclusively on existing published studies, publicly available datasets, and regulatory records. No new field surveys were conducted for this CIA. Principal data sources include:

- Alaska Department of Fish and Game (ADF&G) Central Arctic Caribou Herd surveys, population estimates, and telemetry data.
- U.S. Fish and Wildlife Service (USFWS) migratory bird surveys and National Wetlands Inventory (NWI) data.
- U.S. Army Corps of Engineers (USACE) Section 404 permit records for the North Slope development corridor.
- Alaska Department of Environmental Conservation (ADEC) air quality monitoring data, emissions inventories, and permits.
- Bureau of Land Management (BLM) NPR-A Integrated Activity Plan and associated environmental impact statements.
- North Slope Borough technical reports on oil and gas planning and cumulative impacts.
- Published peer-reviewed literature on Arctic ecology, permafrost dynamics, caribou behavior, and climate change.
- DNR land status records, area plans, and prior lease and permit decisions in the project vicinity.
- TAPS environmental monitoring reports and renewal EIS documentation.
- Lawrence Berkeley National Laboratory 2024 U.S. Data Center Energy Usage Report and other industry publications.

The reliance on existing data is a limitation. Certain VECs—particularly site-specific wetland delineation, nesting bird surveys, and archaeological field surveys—would benefit from project-specific field work that could not be completed within the timeframe of this response. Where data gaps exist, they are identified, and conservative assumptions are applied.

5.3 Study Area Boundaries

Spatial and temporal boundaries are defined individually for each VEC:

VEC	Spatial Boundary	Temporal Boundary
Terrestrial Habitat / Wetlands	Project footprint + 2-mile buffer; gas pipeline corridor with 500-ft buffer	1968 (initial North Slope exploration) through decommissioning
Caribou (Central Arctic Herd)	CAH range: Colville River east to Canning River, coast to Brooks Range foothills	1975 (first CAH surveys) through 30 yrs post-construction
Migratory Birds	Project footprint + 1-mile buffer; Dalton corridor	Construction through operational life
Surface / Subsurface Hydrology	Local watershed; downstream to 5 miles	Construction through decommissioning + 10 yrs
Permafrost	Project footprint + 500-ft thermal zone	Construction through 50 yrs post-construction
Air Quality	50-km radius for criteria pollutants	Operational life
Subsistence Resources	Traditional use areas of Nuiqsut, Deadhorse, Anaktuvuk Pass	1968 through decommissioning
Cultural / Archaeological	Project footprint + 1-mile buffer; pipeline corridor	Precontact through present
Visual / Noise	5-mile radius viewshed; noise propagation zone	Operational life

6. Past, Present, and Reasonably Foreseeable Future Actions

6.1 Past Actions

The North Slope development corridor has been subject to industrial activity since the late 1960s. Key past actions include:

- Prudhoe Bay oil field discovery (1968) and subsequent development of the Prudhoe Bay Unit, including production pads, gathering pipelines, processing facilities, and road network.
- Construction and operation of TAPS (completed 1977), traversing approximately 800 miles from Prudhoe Bay to Valdez.
- Construction of the Dalton Highway (1974), providing the primary overland corridor to the North Slope.
- Development of the Kuparuk River Unit, Milne Point Unit, Endicott, and other satellite fields (1980s–1990s).
- Development of the Alpine field (Colville River Unit), beginning in the late 1990s, demonstrating roadless development techniques.
- Gravel extraction from permitted mine sites along the Dalton Highway corridor, including the 65-9-099-2 Mine Site at MP390.
- Historical exploration activities including seismic surveys, exploration wells, and ice road construction.

6.2 Present Actions

- Continued oil and gas production at Prudhoe Bay, Kuparuk, Alpine, and satellite fields.
- TAPS operations, integrity management, and ongoing monitoring.
- Dalton Highway maintenance, including winter snow removal and gravel resurfacing.
- Active gravel extraction from permitted mine sites.
- Oil and gas exploration, including winter seismic surveys and exploration drilling.
- North Slope Borough community operations and subsistence activities.
- Scientific research and environmental monitoring programs.

6.3 Reasonably Foreseeable Future Actions

- AGDC Alaska LNG Project, including the approximately 800-mile gas pipeline from the North Slope to Nikiski, with infrastructure adjacent to the project site.
- Continued oil and gas development in the greater Prudhoe Bay area, including drilling and heavy oil development.
- NPR-A development activities, including the Willow Master Development Plan.
- Potential additional data center or industrial facility proposals on the North Slope, as cold-climate and energy advantages attract similar projects.
- Climate change–driven environmental changes, including permafrost thaw, coastal erosion, and shifts in wildlife distribution.
- Potential Dalton Highway upgrades to support increased industrial traffic.

7. Cumulative Effects Analysis by Valued Ecosystem Component

7.1 Terrestrial Habitat, Vegetation, and Wetlands

The project area lies within the Arctic Coastal Plain, characterized by continuous permafrost, low-growing tundra vegetation, and extensive wetland complexes. Over five decades of development have resulted in the direct conversion of approximately 12,000 to 20,000 acres of tundra to gravel infrastructure across the North Slope. The STAK Energy Campus will directly convert approximately 715 acres of tundra and wetland habitat to gravel surfaces, with additional indirect effects from dust deposition, altered drainage, and edge effects within the 2-mile buffer. The gas pipeline corridor will create additional linear disturbance (25–90 miles). Compensatory mitigation for wetland fill may be required under Section 404 of the Clean Water Act.

The 715-acre footprint represents a measurable but proportionally small increment against existing regional disturbance. However, cumulative habitat loss in the Dalton Highway corridor is concentrated, and this project contributes to that trend. The proportion of North Slope wetlands directly affected by oil and gas development to date represents a small fraction of the total wetland resource (USFWS National Wetlands Inventory; USACE Section 404 permit records); the STAK Project will increase this proportion but is not anticipated to fundamentally alter the regional ratio. STAK will quantify project-specific wetland conversion through site-specific delineation in support of the Section 404 permit application (see Section 9).

7.2 Wildlife: Caribou (Central Arctic Herd)

The project site is within the range of the Central Arctic Caribou Herd (CAH). Extensive research has documented behavioral avoidance of roads and pipelines during calving, displacement from preferred habitat, and altered movement patterns near infrastructure. The STAK Energy Campus will introduce a 715-acre industrial facility and associated pipelines into an area used for seasonal movements along the Dalton Highway corridor. The project's location approximately 26 miles south of Deadhorse places it outside the core coastal calving zone but within the range used for post-calving movements and fall migration. Co-location within the existing TAPS/Dalton corridor limits spatial expansion of disturbance relative to projects in undeveloped areas. Mitigation measures including minimum 7-foot clearance between the bottom of the pipeline and the tundra to allow for animals including caribou to move freely and traffic management are essential.

7.3 Wildlife: Migratory Birds

The Arctic Coastal Plain supports globally significant populations of nesting shorebirds, waterfowl, and passerines. Direct habitat loss from the 715-acre footprint will eliminate nesting habitat. Operational noise and artificial lighting from 24-hour HPC operations during the polar night may create ongoing disturbance and attract migratory birds. STAK will implement downward-directed, shielded exterior lighting and comply with USFWS avian protection guidelines. Preconstruction nesting surveys will be conducted if construction occurs during the May–July breeding season.

7.4 Surface and Subsurface Hydrology

Gravel placement on 715 acres will alter local drainage patterns. Culvert spacing and design will be critical to maintaining cross-drainage and preventing upstream impoundment. Water withdrawals for construction and operations will be permitted through DNR and coordinated with ADF&G to protect fish habitat. The cumulative effect of water withdrawals across the North Slope—particularly winter lake withdrawals—is a regulatory concern that STAK will address through careful planning and monitoring.

7.5 Permafrost Integrity

The 1-3 GW power generation facility will be sited on a gravel pad. STAK will design the gravel pad to minimum 5–7 foot depth per geotechnical recommendations to keep the tundra thermally insulated. The project design will account for potential heat impacts and will ensure the permafrost integrity is not affected by the project. Designs could include installation of thermosyphons where heat loading is concentrated.

Heat-Load Magnitude. The cumulative thermal effect of the Project on underlying permafrost is the principal permafrost-related concern raised by this CIA. The Project will reject heat to the environment from two distinct categories of sources: (i) waste heat from natural gas combustion in the on-site generation system, dissipated through turbine exhaust stacks at high elevation and dispersed downwind by atmospheric mixing; and (ii) low-grade waste heat from HPC equipment, rejected through air-cooled heat exchangers at or near grade level. The first category presents limited direct thermal coupling to underlying permafrost because the heat is released aloft and advected away from the pad surface. The second category is more directly coupled to the pad and surrounding terrain because rejected air temperatures, while modest (typically 30–60°C above ambient), are released continuously near grade across the operational footprint. Aggregate continuous heat rejection from a 1–3 GW HPC facility is on the order of 0.7–2.0 GW of low-grade thermal output once turbine and electrical losses are accounted for; this represents a step change in local thermal loading relative to undeveloped tundra and is the primary driver of the permafrost cumulative impact analysis below.

Pad and Foundation Design. Consistent with established North Slope industrial practice, the Project will employ a thick gravel pad (5–7 ft minimum) as the primary thermal buffer between facility operations and underlying permafrost. The gravel pad insulates the active layer from direct equipment heat and from anthropogenic disturbance to the natural snow regime. Major heat-emitting equipment—turbine generators, transformers, and dense computing modules—will be founded on piled foundations with adequate ventilated airspace beneath, in accordance with standard cold-regions engineering practice and consistent with the foundation strategies used at Prudhoe Bay and Kuparuk processing facilities. Where pile-supported foundations alone are insufficient to manage thermal loading—particularly beneath continuously warm equipment such as transformers and computing modules—passive thermosyphons will be installed in the pile foundations to extract heat from the soil during winter months and maintain permafrost in a frozen state. Thermosyphon design will be based on site-specific geotechnical and thermal modeling completed during detailed engineering, as identified in Section 9.

Cumulative Effects Against the Climate Baseline. North Slope permafrost is on a warming trajectory independent of any individual project. Mean annual ground temperatures at the surface of the permafrost (measured at depths of 10–20 m) on the Arctic Coastal Plain have increased by approximately 2–4°C since the late 1970s based on monitoring at Prudhoe Bay, Deadhorse, and other established observation sites (Jorgenson et al. 2010; subsequent ADNRC and DOI permafrost monitoring data). Active-layer thickness has increased over the same interval, and thermokarst processes—ground subsidence, polygon degradation, thaw-lake expansion—are observable at multiple monitored locations. The Project's heat-rejection

footprint will be superimposed on this warming baseline, and the cumulative effect must accordingly be assessed against the climate-warming trajectory rather than a stationary historical baseline. STAK's permafrost monitoring program (described below) will measure absolute ground temperatures so that Project-attributable thermal effects can be distinguished from regional warming.

Monitoring Program. STAK will implement a permafrost thermal monitoring program comprising: (i) thermistor strings installed in pad and pile foundations beneath major heat-emitting equipment, with continuous data logging at the surface, in the active layer, and at depths of 5, 10, and 20 m; (ii) thermistor strings installed in undisturbed reference locations within the 500-ft thermal-zone buffer to establish a control baseline; (iii) annual end-of-summer thaw-depth surveys along established transects across the pad and into the buffer zone; and (iv) settlement monitoring of pad surface elevations and equipment foundations using survey benchmarks read at minimum twice per year (immediately post-thaw and pre-freeze-up). Monitoring data will be reported annually to ADNIR and made available to ADF&G and the North Slope Borough on request. Monitoring will continue for the operational life of the Project and for at least 10 years following decommissioning. Trigger thresholds and adaptive management responses (e.g., supplemental thermosyphon installation, foundation modification) will be defined in the construction-phase permafrost management plan submitted to ADNIR.

7.6 Air Quality

The STAK Energy Campus will meet all air quality requirements. This section provides agency reviewers with the framing necessary to evaluate cumulative effects; a full Prevention of Significant Deterioration (PSD) dispersion modeling analysis and emissions inventory will be developed in connection with the ADEC air permit application and is identified as a data gap in Section 9.

Regional Air Quality Baseline. The North Slope is currently in attainment status for all National Ambient Air Quality Standards (NAAQS) criteria pollutants — ozone, particulate matter (PM10 and PM2.5), nitrogen dioxide, sulfur dioxide, carbon monoxide, and lead. Background concentrations of most criteria pollutants are very low, reflecting the absence of population centers, the limited number of stationary sources outside the existing Prudhoe Bay industrial area, and the well-mixed Arctic atmosphere. Existing emission sources in the project airshed include the Prudhoe Bay, Kuparuk, Alpine, and satellite oilfield processing facilities and associated turbines and heaters; the TDX-operated North Slope Generating plant in Deadhorse; pipeline pump stations; transportation sources on the Dalton Highway; and intermittent construction and exploration activity. The introduction of a 1-3 GW continuous combustion source will materially alter the local emissions inventory.

Criteria Pollutant Emissions. Combustion of natural gas in modern industrial gas turbines produces, in approximate descending order of regulatory significance: nitrogen oxides (NO_x, including NO and NO₂); carbon monoxide (CO); particulate matter (PM10 and PM2.5, predominantly PM2.5); volatile organic compounds (VOCs); sulfur dioxide (SO₂); and various trace constituents including formaldehyde and other hazardous air pollutants (HAPs). Specific emission rates depend on turbine model, combustor design (dry low-NO_x vs. diffusion flame), post-combustion controls (selective catalytic reduction for NO_x, oxidation catalyst for CO and VOCs), operating load, and ambient conditions. STAK will pursue Best Available Control Technology (BACT) determinations through the ADEC PSD permitting process, which for modern gas turbines typically results in:

- NOx: 2 to 25 ppmvd at 15% O₂ CO: 4 to 25 ppmvd at 15% O₂ (with oxidation catalyst)
- VOCs: 1 to 5 ppmvd at 15% O₂ (with oxidation catalyst)
- PM_{2.5}: limited primarily by combustion design; additional control generally not required for natural gas firing
- SO₂: limited by pipeline gas sulfur content; typically <100 ppm in fuel
- Formaldehyde and other HAPs: limited by oxidation catalyst (HAPs reductions follow CO/VOC reductions)

The facility will be a PSD major source subject to BACT requirements, ambient impact analysis, Class I and Class II area protection analysis, additional impact analysis (visibility, soil, vegetation), and Title V operating permit requirements. Single-source dispersion modeling will be required to demonstrate compliance with NAAQS and PSD increment standards at the facility property line and at sensitive receptors. The mandatory federal Class I areas in Alaska under the Clean Air Act are Denali National Park, the Bering Sea Wilderness, the Simeonof Wilderness, and the Tuxedni Wilderness; none is within close proximity to the project, and Denali National Park is the nearest at approximately 500 miles to the south. The Mollie Beattie Wilderness within the Arctic National Wildlife Refuge (ANWR) is a Class II area located approximately 100 to 150 miles east of the project site. Visibility and acid deposition impacts at ANWR and at the nearest Class I areas will be evaluated as part of the PSD analysis as required by ADEC. Gates of the Arctic National Park and Preserve, which includes the designated Gates of the Arctic Wilderness, lies to the south of the project site; the eastern boundary of the park comes within approximately 5 miles of the Dalton Highway south of the Brooks Range. Although Gates of the Arctic is a Class II area under the Clean Air Act (the park was established after the August 1977 cutoff for mandatory Class I designation), its proximity warrants explicit consideration in the PSD analysis for visibility, soil, and vegetation impacts.

Carbon Capture, Utilization, and Storage. As described in Section 3.6, CCUS is not included in the facility's initial design due to the absence of CO₂ transportation and sequestration infrastructure on the North Slope, undemonstrated subsurface storage suitability, and incomplete regulatory frameworks. The facility's modular design preserves the ability to retrofit post-combustion carbon capture in the future if these conditions change. STAK will continue to evaluate this option as the facility matures and as North Slope CCUS infrastructure develops.

Cumulative Air Quality Effects. In the cumulative effects framework, the STAK facility's air emissions interact with several other past, present, and reasonably foreseeable future actions:

- Existing North Slope oilfield combustion sources contribute baseline criteria pollutant emissions. The STAK facility would increase the regional inventory of criteria pollutants relative to current baseline conditions.

Mitigation and Monitoring. STAK's air quality mitigation commitments are summarized in Section 8 and include: BACT controls on all combustion sources as determined by ADEC; selection of the highest-efficiency turbine technology consistent with operational requirements; continuous emissions monitoring systems (CEMS) for NO_x and CO at major combustion sources per ADEC requirements; annual GHG emissions inventory and reporting through the EPA Greenhouse Gas Reporting Program; evaluation of operational optimization strategies to minimize fuel consumption per unit of computing output; preservation of the option to retrofit combined-cycle generation and post-combustion carbon capture in the future; and evaluation of carbon offset, renewable energy procurement, and other voluntary GHG mitigation programs as the facility matures and as such markets develop in Alaska.

Conclusion on Air Quality Cumulative Effects. The STAK Energy Campus will contribute to Alaska's air emissions inventory. With BACT controls, continuous emissions monitoring, and full compliance with ADEC and EPA regulatory frameworks, criteria pollutant impacts can be managed to levels consistent with NAAQS attainment and PSD increment protection at sensitive receptors, subject to confirmation through detailed dispersion modeling. GHG impacts are inherent to the project's design as a 1-3 GW gas-fired industrial facility, are not fully mitigable through current commercially available technology absent CCUS deployment.

7.7 Subsistence Use and Resources

North Slope communities depend on subsistence harvesting as a cultural, nutritional, and economic foundation. Cumulative impacts to subsistence from industrial development are well documented and include access restrictions, changes to caribou distribution, noise and air pollution, and community stress. The STAK Energy Campus will contribute incrementally through its physical presence, noise, emissions, and Dalton Highway traffic. Meaningful consultation with affected communities and the North Slope Borough is essential. STAK will engage with community stakeholders to address subsistence concerns and will develop a community benefits agreement.

7.8 Cultural and Archaeological Resources

STAK will conduct a records search of the Alaska Heritage Resources Survey (AHRs) database and a Phase I archaeological survey of the project footprint and pipeline corridor prior to ground disturbance. An inadvertent discovery plan will be implemented during all ground-disturbing activities. This survey has not yet been completed and represents a data gap.

7.9 Visual and Noise Environment

The project will introduce a major industrial facility visible from the Dalton Highway at approximately 1 mile distance. The 1-3 GW power generation facility will produce continuous noise from gas turbines, cooling systems, and equipment. Noise propagation in flat Arctic terrain can extend several miles. STAK will install noise-attenuating enclosures on gas turbines, minimize facility height profile, use earth-tone colors, and conduct post-construction noise monitoring.

8. Mitigation Measures and Monitoring Commitments

STAK Energy Corporation commits to the following mitigation measures:

Resource	Mitigation Measure	Monitoring / Performance Standard
Terrestrial Habitat / Wetlands	Minimize gravel footprint. Section 404 compensatory mitigation. Dust suppression. Engineered drainage structures.	Annual vegetation monitoring in buffer zone. Post-construction wetland delineation. Dust monitoring.
Caribou	Elevate all pipelines to min. 7-ft clearance. Calving season construction restrictions (May 20–July 15). Traffic speed/volume management.	Participate in ADF&G CAH monitoring. Annual traffic counts. Caribou observation reporting.
Migratory Birds	Preconstruction nesting surveys (May–July). Shielded, downward-directed lighting. USFWS avian protection compliance.	Bird monitoring for first 5 operational years. Document bird strikes.
Hydrology	Engineered culvert spacing. SWPPP. Permitted water withdrawals.	Annual drainage structure inspection. Water level monitoring at culverts.
Permafrost	Min. 5–7 ft gravel pad depth. Thermosyphons at heat-concentrated locations. Insulated facility foundations.	Thermistor strings. Annual thaw depth measurements. Settlement monitoring.
Air Quality	BACT on all sources per ADEC PSD. High-efficiency turbines.	CEMS per ADEC. Annual EPA required GHG inventory. Facility operating reports to ADEC.
Subsistence	Community consultation. Community benefits agreement. Coordinate with subsistence calendar. Local hire.	Annual community meetings. Track local employment.
Cultural Resources	AHRS records search. Phase I survey before disturbance. Inadvertent discovery plan. Crew training.	Archaeologist monitors initial disturbance. Report per state protocols.
Visual / Noise	Minimize height profile. Earth-tone colors. Noise-attenuating enclosures. Noise modeling.	Post-construction noise monitoring. Visual compliance inspection.

9. Data Gaps and Recommended Additional Studies

- Site-specific wetland delineation of the 715-acre footprint and gas pipeline corridor (required for Section 404).
- Nesting bird surveys during the June–July season to document species composition and listed species presence.
- Phase I cultural resources survey (AHRs records search followed by pedestrian survey).
- Full PSD-level air quality dispersion modeling based on specific turbine models and emission rates.
- Geotechnical investigation (boreholes, permafrost characterization) for pad, foundation, and pipeline design.
- Gas pipeline routing study and route-specific environmental analysis once source field connections are determined.
- Noise propagation modeling based on final equipment specifications and site layout.
- Detailed emission inventory based on specific turbine models, capacity factors, and operational parameters.
- Thermal modeling of permafrost response to facility waste heat loading, incorporating climate change scenarios.

10. Cumulative Effects Summary and Conclusions

The summary table below characterizes the cumulative effect for each VEC using a four-tier qualitative scale (Low, Low–Moderate, Moderate, Moderate–High, High) applied within the spatial and temporal boundaries defined in Section 5.3. The scale is intended as an integrative judgment that incorporates both quantitative measures (e.g., footprint percentage relative to regional baseline, emissions tonnage relative to airshed inventory) and qualitative factors (e.g., reversibility, ecological significance, regulatory triggers). The supporting data and rationale for each rating appear in the corresponding VEC discussion in Section 7. Quantitative rating thresholds, where available from agency-published criteria or from project-specific modeling, will be incorporated into subsequent permitting submittals as that work is completed; data gaps that currently prevent quantitative scoring are identified in Section 9.

VEC	Existing Condition	Project Increment	Aggregate Cumulative	Residual After Mitigation
Habitat / Wetlands	Moderate: ~12,000–20,000 acres converted	715 ac direct; pipeline corridor additional	Moderate-High in corridor	Moderate with Sec. 404 mitigation
Caribou (CAH)	Moderate: displacement documented	Moderate: new corridor infrastructure	Moderate-High in corridor	Moderate with crossings/timing
Migratory Birds	Low-Moderate	Low-Moderate: 715 ac nesting habitat	Moderate	Low-Moderate with lighting controls
Hydrology	Low-Moderate	Moderate: 715-ac impervious area	Moderate	Low-Moderate with drainage engineering
Permafrost	Low-Moderate: warming trend	Moderate: 1-3 GW heat load	Moderate-High: thermal + climate	Moderate with thermal management
Air Quality	Low: NAAQS attainment	High: major new source	Moderate for criteria (pending emission inventory)	Moderate-High: BACT reduces criteria pollutants
Subsistence	Moderate-High	Low-Moderate	Moderate-High	Moderate with engagement
Cultural Resources	Unknown: data gap	Unknown pending survey	To be determined	To be determined
Visual / Noise	Low-Moderate: industrial corridor	Moderate-High: large continuous facility offset ~1 mi from Dalton Highway	Moderate-High nearby	Moderate with attenuation

10.1 Overall Conclusions

The STAK Energy Campus will contribute measurable incremental impacts to the North Slope cumulative effects environment. The most significant cumulative effects are associated with air quality (1-3 GW gas-fired generation), terrestrial habitat and wetland conversion (715 acres plus

pipeline corridor), and permafrost thermal management (interaction of facility heat and climate warming).

The project benefits from co-location within the Dalton Highway/TAPS corridor, limiting spatial expansion of disturbance. Its behind-the-meter power model avoids impacts to the regional electrical grid. Its Arctic siting eliminates the water-intensive cooling that drives environmental opposition to data centers in other regions. The proposed mitigation measures, combined with compliance with existing regulatory frameworks, will reduce cumulative effects to levels that are manageable and consistent with the public interest standard articulated in *Sullivan v. REDOIL*.

Data gaps remain regarding site-specific wetlands, cultural resources, detailed air quality modeling, and permafrost thermal response. STAK commits to addressing these through future field work and engineering studies, and to continuing assessment of cumulative impacts at each subsequent permitting phase consistent with the REDOIL standard.

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