

Private-Sector Lifelines in the Arctic

Predicting and Assessing Risk to Critical Infrastructure

Executive Summary



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TABLE OF CONTENTS

Purpose	3
Research at a Glance.....	3
Strategic Context: Why This Research Matters Now	4
Scenario Framework: The Dual-Theater Disruption.....	5
Methodology in Brief.....	7
Six Key Findings.....	8
<i>Finding 1: Fuel Is the Master Dependency</i>	<i>8</i>
<i>Finding 2: Sustainment Modes Cannot Substitute at the Volumes the Mission Requires</i>	<i>9</i>
<i>Finding 3: Cascades Are Fast, Non-Linear, and Compressed by Seasonal Asymmetry</i>	<i>10</i>
<i>Finding 4: Communications and Workforce Are Cross-Cutting Force Degraders</i>	<i>11</i>
<i>Finding 5: Medical Capacity Becomes a Day-Zero Adjudication Problem</i>	<i>12</i>
<i>Finding 6: Paper Redundancy and Coordination Gaps Are the Organizing Risk</i>	<i>13</i>
Bottom Line.....	15
Recommendations at a Glance.....	16
<i>Near-Term Recommendations (0-12 Months).....</i>	<i>16</i>
<i>Mid-Term Recommendations (12-36 Months)</i>	<i>17</i>
<i>Long-Term Recommendations (36 Months or More)</i>	<i>18</i>
Strategic Implications	19
Connective Infrastructure: From Recommendations to Implementation ...	21
Continuation, Limitations, and Forward Linkage.....	22
Reader’s Guide to the Full Final Report	23
Closing Source Note	24

Purpose

This Executive Summary is a standalone, 25-page companion to the *Private-Sector Lifelines in the Arctic: Predicting and Assessing Risk to Critical Infrastructure* Final Report. It is designed for decision-maker, NORAD/USNORTHCOM leadership, the Homeland Defense Institute, FEMA, CISA, Alaska DHS&EM, and private-sector lifeline operators, who require an operationally precise synthesis of the research without engaging the full Final Report on first read.

Every section of this document points back to the corresponding section of the Final Report by section title. The findings, recommendations, and analytical framing presented here are drawn directly from the Final Report; no new analysis is introduced. Where the body of the Final Report provides the operational specificity, the Executive Summary provides the decision frame.

Target audience: senior decision-makers operating under time constraints who need to know what was found, what it means for Arctic homeland defense, and what should be done, in that order.

Final Report Reference: Executive Summary (full development of all material summarized here).

Research at a Glance

A one-page orientation for the reader. Four questions, in plain language, with a pointer back to the Final Report for full development.

What is this research?

A federally commissioned study examining how privately operated lifeline systems, fuel, food, transportation, communications, medical supply, and supply-chain distribution, sustain Arctic homeland defense under contested conditions. It was conducted by the Private Sector Emergency Management Association (PSEMA) in support of the Homeland Defense Institute and NORAD/USNORTHCOM Arctic mission assurance priorities. The research is analytically distinct from its companion study, *Continuity of Society in the North: Multi-Modal Resiliency in Arctic Defense*, which addresses the human-systems dimensions of the same disruption environment.

What did it set out to do?

Strengthen the resilience and adaptability of the Arctic homeland defense ecosystem by identifying interdependencies and capability gaps across critical infrastructure assets, systems, and networks, public and private. The work is directly responsive to *HDAS Research Focus Area 1: Predicting and Assessing Risk to Critical Infrastructure*, and to the NSM-22 and DoDD 3020.40 frameworks that recognize military readiness as inseparable from civilian critical infrastructure.

What did it find?

Arctic homeland defense depends on commercial systems that were not designed for the stress conditions a dual-theater disruption would impose. They fail faster than planners assume, cascade more broadly than frameworks anticipate, and leave decision-makers operating without adequate situational awareness during the Days 0–14 window when choices are most consequential. The twenty-two key findings developed in the Final Report consolidate into six operationally consequential conclusions, presented in Section 6 of this Executive Summary.

What is this research?

Layered investment across overlapping time horizons, pre-positioned reserves and pre-staged regulatory authority in the near term, distributed energy and coordination architecture maturity in the mid-term, and structural infrastructure and codified doctrine in the long term, operating concurrently, not sequentially. Section 8 presents the recommendation set in compact form.

Final Report Reference: Executive Summary and Strategic Implications

Strategic Context: Why This Research Matters

This section establishes a strategic frame. It draws directly from the Final Report's Introduction and Strategic Implications sections.

The Contested Homeland

The homeland is no longer a sanctuary. Adversaries can obstruct and disrupt power projection and sustainment operations from within and against the homeland through a combination of kinetic action, gray-zone activity, and exploitation of legally permitted but strategically harmful conduct. NORAD and USNORTHCOM's Arctic mission depends on a resilient homeland for force protection, power projection, and the sustained national will that enables both. The Arctic theater compresses these dependencies: the same lifeline systems that sustain remote civilian communities are the systems on which installation operations, family readiness, and contractor workforce availability all depend.

Defense Critical Infrastructure Is Privately Operated

DoDD 3020.40 (Mission Assurance) and NSM-22 (Critical Infrastructure Security and Resilience) both recognize that military readiness is inseparable from civilian critical infrastructure, most of it privately owned. This dependence intensifies in the Arctic, where lifeline systems are sparse, fragile, geographically constrained, and concentrated across a small number of operators. The implication is operational: *Arctic mission assurance cannot be planned, exercised, or sustained without sustained engagement with the private-sector entities that own and run the systems on which the mission depends.*

The Arctic Operating Environment

Limited deep-water ports and icebreakers; weather-restricted airfields; long distances between communities; communications fragility in high latitudes; limited redundancy in energy and fuel; cross-border dependencies with Canada; medical evacuation distance and weather constraints; tribal and local governance with varying authorities. Each is documented in the Final Report; each appears as a binding constraint in the dependency mapping, risk assessment, and substitution analysis that follow. The Arctic operating environment is not an austere version of CONUS infrastructure, it is a different infrastructure category, with different failure modes, recovery dynamics, and substitution limits.

Why Now

The 2025 National Defense Strategy identifies simultaneity, the prospect of multiple, overlapping disruptions, as a primary planning challenge. The dual-theater scenario this research models is structurally consistent with that planning challenge, calibrated to Arctic geographic and seasonal realities. The Days 0–14 decision window, during which planning assumptions fail and consequential decisions must be made under uncertainty, is the period for which preparatory investment yields the highest operational return. It is also the period for which preparatory investment must be made before disruption occurs; once the window opens, the options narrow with each passing day.

Final Report Reference: Strategic Implications and Introduction

Scenario Framework: The Dual-Theater Disruption

This section summarizes the scenario that grounds the research. It is a planning stress test, not a prediction.

The Scenario in One Sentence

An adversary disables major West Coast port operations (Days 0–14) concurrent with an Arctic escalation requiring rapid mobilization through limited northern corridors (Days 10–45).

Why This Scenario

West Coast ports, principally the Seattle/Tacoma gateway complex and the Los Angeles/Long Beach complex, are the maritime gateways through which most Alaska-bound freight, fuel, and population-supporting supply flows. An adversary acting to disable or degrade those gateways simultaneously affects the maritime supply that sustains Alaska's commercial inventory architecture and the strategic flow that would otherwise support an Arctic mobilization. Arctic escalation forces the system to draw on the same constrained logistics architecture that the port degradation has already strained. Days 0–14 is the period when planning assumptions fail and consequential decisions must be made under uncertainty. The scenario is calibrated to be operationally realistic,

consistent with the threat picture in the published, open-source defense literature, not a worst-case theoretical construction.

Arctic Sustainment Modes Examined

Five sustainment modes are examined for their operational reality under stress: maritime resupply (primary, and the only mode capable of moving freight at scale into Alaska); aviation sustainment (constrained by weather, fuel, runway, and crew); ALCAN Highway overland movement (constrained by Canadian sovereignty, weather, and chokepoints); pre-positioned stocks (limited, seasonal, and unevenly distributed); and substitution across modes (constrained at every level by the binding limits of each mode in isolation). The Substitution Inventory developed in the Final Report documents what can and cannot substitute for what, under what conditions, and at what capacity.

Seasonal Asymmetry

The vulnerability is not uniform across the year. Alaska's downstream distribution network serving western and northern communities is seasonal and ice-constrained. A disruption between October and April operates against already-depleted reserve margins with no barge resupply option, compressing time-to-shortage from weeks to days. The same disruption in June or July, with the barge season active and reserves replenished, presents a substantially different operational picture. Mission assurance planning that does not differentiate seasonally underestimates winter vulnerability by an operationally significant margin.

Historical Analog: The Berlin Airlift

Operation Vittles, the 1948–49 Berlin Airlift, is the most analytically relevant historical case for sustained, aviation-only sustainment of a contested theater. Its operational record, the volume of cargo, the aircrew requirements, the fuel and maintenance burden, the airfield-throughput limits, and the duration of the effort, provides the empirical baseline against which aviation-based Arctic sustainment must be evaluated. The Final Report treats the analog in detail. The summary conclusion: aviation-only sustainment of an Arctic theater of the scale this research examines is not feasible at the cargo volumes Arctic operations require and was not feasible in the Berlin case either except under conditions (short distance, high aircraft density, dedicated airfields, single-mission focus) that do not obtain in the Arctic.

Final Report Reference: Scenario Development (full framework, stressors, and Operations Vittles analog)

Methodology in Brief

This section summarizes the analytical approach, validation anchors, and limits. It is drawn from the Final Report's Research Foundation and Methodology sections.

Five-Deliverable Architecture

The research was structured as five integrated deliverables, each building on the prior:

- *Scenario Development*: establishes the dual-theater disruption environment and the seasonal, geographic, and operational parameters within which the analysis proceeds.
- *Targeted Dependency Mapping*: identifies what is connected to what across three layers of Arctic infrastructure (physical, organizational, and coordination).
- *Focused Risk and Vulnerability Assessment*: establishes where and when connections break, how failure cascades, and where the operational window for intervention closes.
- *Preliminary Mitigation and Cost–Benefit Prioritization*: evaluates high-impact resilience options against realistic parameters, with explicit treatment of which options yield Days 0–14 benefit and which yield longer-horizon resilience.
- *Stakeholder Engagement*: validates findings through structured engagement across the seven lifeline sectors examined; non-attributed, aggregated.

Analytical Posture

Arguments lead; research corroborates. The analytical posture throughout is operational, not theoretical. Vulnerabilities are framed in operational terms: what fails first, how fast, with what cascading effect, and at what point intervention is no longer feasible. The framing is deliberate. Arctic mission assurance is not advanced by cataloguing risks in the abstract; it is advanced by identifying the specific operational thresholds at which intervention becomes possible, becomes urgent, or becomes too late.

Validation Anchors

Findings are corroborated against a body of independent, published, validated work including: the RAND Plan Blue 21 wargame; the FEMA Supply Chain Resilience and Public-Private Partnership maturity frameworks; the CNA Supply Chain Operational Engagement methodology; Dewberry infrastructure dependency research; Alaska Task Force and Alaska Federal Senior Operational Group operational records; NSM-22 and DoDD 3020.40; Air Force Petroleum Center processing-capacity data; Caton's (2024) contested-logistics framework; and Fox and Shaffer-Miles tribal and Arctic Native scholarship. The convergence of these independent sources on the same operational conclusions is one of the principal indicators of analytical robustness.

Limits and Boundaries

The research was conducted within a three-month performance period. The analytical window is bounded at Days 0–14 of the dual-theater disruption; extended sustainment beyond Day 14, the recovery dynamics, structural reconstitution, and multi-month sustainment trajectories, is identified as the single most consequential follow-on research

priority and is not delivered within this engagement. Stakeholder engagement is non-attributed; no proprietary, sensitive, or classified data was requested or used. Conclusions are operationally specific where the evidence supports operational specificity and are deliberately framed in conditional language where the evidence does not.

Final Report Reference: Research Foundation, Analytical Framework, and Methodological Validation Anchors.

Six Key Findings

The Final Report develops twenty-two key findings in full, organized into eight analytical clusters that move from the master dependency (fuel), through the lifeline architecture, into the cascade dynamics that connect them, and finally to the governance and coordination conditions that determine whether intact infrastructure can be coordinated under stress. The six findings presented here are the consolidated, operationally most consequential conclusions, each absorbing several of the underlying twenty-two. Each finding follows the same structure: headline statement, why it matters, what the evidence shows, and a reference to the Final Report section where it is developed in full. Readers who require the full twenty-two findings in their cluster groupings, with the underlying analytical record, should consult the Key Findings section of the Final Report.

Finding 1: Fuel Is the Master Dependency

Headline

Fuel is not one vulnerability among several. It is the foundational dependency whose degradation initiates cascades across the entire Arctic lifeline architecture.

Why it matters

Fuel disruption does not stay in the energy sector. It simultaneously disables transportation, heating, power generation, and aviation, all of which depend on imported fuel products with limited regional storage and no rapid resupply alternative when maritime supply is degraded. Every other failure mode identified in this research is accelerated when fuel availability is constrained. The cascade from fuel scarcity to medical evacuation limits to workforce degradation to mission impact is not theoretical; it is the operationally expected trajectory under the scenario.

What the evidence shows

Alaska's fuel architecture is structurally concentrated, seasonally constrained, and dependent on a small number of West Coast and in-state pathways. In-state refining capacity, approximately 164,200 barrels per day, is distributed across a small number of facilities operating under thin margins and tightly coupled to a single crude source; there is no parallel refining architecture in-state that can absorb the loss of a single facility, and any disruption to refined product output cascades immediately into aviation, ground transportation, heating, and power generation. The maritime fuel chain that feeds western and northern Alaskan communities depends on a sole or near-sole commercial avgas importer and a small number of fuel and freight carriers; the underlying market

structure is consolidated, the assets are specialized (ice-class, shallow-draft, fuel-rated), and there is no substitution path that does not require the same vessels under a different flag. Stockpile depth across the system is measured in days, not weeks. A West Coast port disruption affecting refined-product flow into Anchorage compounds against in-state refining concentration and against the seasonal closure of downstream barge resupply to compress the operational window to a point well inside the Days 0–14 analytical horizon.

This finding consolidates three of the twenty-two underlying findings, fuel as the master dependency, in-state refining concentration, and maritime fuel resupply concentration.

Final Report Reference: Key Findings Cluster 1 (Fuel as the Master Dependency); Targeted Dependency Mapping (Layers 1–2); Focused Risk and Vulnerability Assessment.

Finding 2: Sustainment Modes Cannot Substitute at the Volumes the Mission Requires

Headline

West Coast maritime gateways are no-fail nodes with no rapid substitute; aviation cannot replace maritime sustainment at scale; and the Jones Act waiver architecture adds friction to the one substitution path that is structurally available.

Why it matters

The contingency planning literature consistently treats aviation as the alternative when maritime routes are disrupted. The operational record contradicts that assumption at the cargo volumes Arctic sustainment requires. Maritime sustainment is the only mode capable of moving freight at scale into Alaska, and the West Coast gateway complex through which that maritime flow originates is concentrated, congestion-sensitive, and without a rapid rerouting alternative within a fourteen-day window. The Jones Act waiver process, designed for incident-by-incident administrative review, was not designed for the compressed timelines of an Arctic-Pacific dual-theater event. Each sustainment mode examined in this research has a binding constraint that either eliminates it as a Days 0–14 option or reduces its capacity to a fraction of what mission requirements demand.

What the evidence shows

The Port of Alaska is the single intermodal hub through which most of Alaska's freight, fuel, and population-supporting supply flows from the Pacific Northwest gateway complex. Peer-reviewed computable general equilibrium modeling of a compound disruption at the twin ports of Los Angeles and Long Beach finds GDP losses propagating well beyond the port region through commercial supply-chain transmission, with no rerouting alternative available at sufficient scale within the operational window; those national-level figures exclude Alaska entirely, so Arctic mission-assurance consequences are additive to the modeled losses, not captured within them. The RAND Plan Blue 21 wargame documents directly that the aviation-as-substitute-for-maritime assumption is operationally wrong at scale, and the *Operation Vittles* historical record confirms that air-only sustainment requires conditions (short distance, high aircraft density, dedicated airfields, single-mission focus) that do not obtain in the Arctic. Replacing one week of

Port of Alaska cargo throughput by air would require the equivalent of seven hundred wide-body 747 cargo landings, a figure that does not yet account for fuel, de-icing, crew, or runway capacity, and that makes the substitution argument operationally implausible on its face. Cabotage requirements under the Jones Act constrain the universe of vessels available for emergency Alaska resupply to U.S.-flagged, U.S.-built, U.S.-crewed bottoms; waivers are administratively available but are time-limited, require demonstration of national defense necessity, and were not designed to activate within the compressed timeline of a dual-theater event.

This finding consolidates three of the twenty-two underlying findings, West Coast gateways as no-fail nodes, aviation as inadequate maritime substitute, and the Jones Act friction point.

Final Report Reference: Key Findings Cluster 2 (Maritime and Aviation Sustainment Limits); Arctic Sustainment Modes and Lifeline Constraints; Scenario Development (*Operation Vittles* analog).

Finding 3: Cascades Are Fast, Non-Linear, and Compressed by Seasonal Asymmetry

Headline

Failure pathways are non-linear, fast-cascading, and self-reinforcing. The window for effective intervention closes faster than linear degradation models suggest, and seasonal conditions compress that window further.

Why it matters

The representative failure cascade, port throughput degradation, then delayed cargo, then inventory drawdown, then aviation surge, then fuel constraints, then medical evacuation limitations, then workforce degradation, then mission impact, is not a worst-case scenario. It is the operationally expected trajectory under the dual-theater disruption modeled in this research. Each link accelerates the next; the failure dynamics are non-linear once threshold conditions are reached, and the self-reinforcing character of the cascade takes over from that point. Planning frameworks built around linear, additive degradation models underestimate the speed of failure and overestimate the window during which intervention remains operationally feasible. The seasonal dimension is decisive: the same disruption produces materially different operational pictures in October–April versus June–July.

What the evidence shows

Commercial inventory buffers in Alaska are measured in days, not weeks. Just-in-time supply chain architecture, pervasive across food, pharmaceuticals, fuel, and consumer goods, produces a structural fragility under disruption: community-level shortages appear within days, not the multi-week adjustment periods that planning frameworks often assume. A West Coast port disruption occurring between October and April operates against already-depleted reserves with no barge resupply option available; depleted reserves cannot be replenished until thaw, compressing the time from port degradation to critical shortage from weeks to days. The same disruption in June presents

a different operational picture, with the barge season active and reserves replenishing. Medical evacuation, which depends on the same constrained aviation, fuel, and weather-window resources as logistics aviation, faces competitive pressure for those resources from the moment the cascade begins. The Days 0–14 window must be planned for as a period of near-complete supply constraint, not as a transitional period before backup arrangements stabilize. Any intervention designed to take effect after Day 14 arrives too late for the populations whose sustainment determines whether the installation workforce can report.

This finding consolidates three of the twenty-two underlying findings, non-linear cascading dynamics, inventory buffers measured in days, and seasonal asymmetry. The implication for planning is structural: the appropriate planning unit for Arctic mission assurance under the dual-theater scenario is not the 30-day or 90-day horizon common in CONUS contingency planning. It is the 14-day window, and the preparatory posture must be in place before that window opens.

Final Report Reference: Key Findings Cluster 3 (Seasonal and Inventory Asymmetry) and Cluster 7 (Cascade Dynamics); Focused Risk and Vulnerability Assessment; Cascading Failure Analysis.

Finding 4: Communications and Workforce Are Cross-Cutting Force Degraders

Headline

Communications degradation and civilian workforce degradation each operate as force degraders on every other failure mode, not as discrete failures within their own sectors. The cyber-physical convergence point amplifies both.

Why it matters

Communications failure eliminates the visibility into logistics status, infrastructure performance, and resource availability that every other response system depends on. The cascade does not require kinetic action on communications infrastructure; adversary gray-zone tactics, interference with commercial satellite service, exploitation of cyber-physical convergence in lifeline operational technology, or disruption of the terrestrial fiber paths that high-latitude communications depend on, make this an exploitable failure mode, not a passive one. The lifeline systems on which Arctic mission assurance depends are increasingly cyber-physical: supervisory control, fuel terminal automation, refinery process control, electrical grid management, and logistics dispatching all depend on networked control systems with varying defensive hardening, and a kinetic disruption to a fuel terminal and a cyber disruption to its control system are convergent vectors against the same operational outcome. Civilian and contractor workforce, the people who actually run the systems, live in the same communities experiencing the disruption; their household-level access to food, fuel, and services degrades within the first week, and their availability falls with it. Intact infrastructure that no one can operate is not operational infrastructure. This is the failure mode that mission assurance frameworks most consistently miss.

What the evidence shows

Commercial satellite operators may alter service availability during a crisis under their commercial terms of service, with no governance framework currently requiring sustained service to defense or emergency management nodes. High-latitude communications depend on a small number of satellite constellations, with limited bandwidth, intermittent reliability above certain latitudes, and meaningful weather sensitivity. The contractor workforce that sustains base operations, fuel distribution, medical services, and lifeline systems is not modeled in most mission assurance frameworks as a constraint, yet its availability is directly tied to the household-level access that supply chain disruption degrades, and that thinness is amplified in specific sectors (seafood processing, maritime crewing, aviation maintenance, fuel terminal operations) where the labor force is both numerically thin and seasonally migratory. A disruption that occurs during a labor turnover window, or that prevents the inbound movement of seasonal workers, compounds the household-level workforce constraint with a labor-supply shock that has no rapid substitute. The cyber-physical convergence point is increasingly important: supervisory control, fuel terminal automation, refinery process control, satellite ground stations, and electrical grid management are now cyber-physical systems whose attack surface extends beyond the defense sector.

This finding consolidates four of the twenty-two underlying findings, communications as force degrader, cyber-physical convergence, workforce as under-modeled dependency, and workforce thinness in seasonal-labor sectors. The recommendation implications run through both the near-term (anti-jam capability, redundant satellite pathways, service-continuity commitments) and the mid-term (sustained workforce-availability modeling, distributed and dual-use communications architecture).

Final Report Reference: Key Findings Cluster 4 (Communications and Cyber-Physical Convergence) and Cluster 5 (Workforce as Critical Dependency); Targeted Dependency Mapping (Layers 3–5); Focused Risk and Vulnerability Assessment.

Finding 5: Medical Capacity Becomes a Day-Zero Adjudication Problem

Headline

Medical evacuation and pharmaceutical cold-chain are not separable from the broader cascade; under the dual-theater scenario, both produce population-level consequences within the first week and create resource-allocation conflicts that require pre-defined adjudication before the disruption begins.

Why it matters

Arctic medical evacuation depends on the same constrained airfield, fuel, weather-window, and crew resources that logistics aviation requires. Under normal conditions, these systems coexist without significant competition. Under the dual-theater scenario, they become directly competitive: every airframe and airfield slot allocated to logistics surge is one not available for medical evacuation, and the resulting allocation decisions are made without a pre-defined adjudication mechanism. The civil–military adjudication gap in medical evacuation prioritization is a Day 0 problem, not a Day 14 problem. The

pharmaceutical cold-chain failure mode runs on an even shorter clinical timeline: a substantial fraction of the population in Alaska depends on temperature-controlled medications whose supply chain depends on continuous power, refrigerated transport, and timely resupply, and disruption to any one of those components produces a population-level health consequence within days, not weeks. The cold-chain failure concentrates risk in populations already disproportionately remote from acute-care capacity.

What the evidence shows

Medical evacuation in Alaska is weather-, fuel-, and crew-limited under normal operations; under the scenario, those constraints become immediate and zero-sum competition with logistics surge. The temperature-controlled pharmaceutical chain (insulin, biologics, refrigerated antibiotics, dialysis-related medications) depends on continuous power, refrigerated transport, and timely resupply; the cold-chain failure mode is structurally similar to the food cold-chain but operates on a shorter clinical timeline. Pharmacy and clinic-level inventory buffers in Alaska are thin, particularly in rural and tribal communities served by the Indian Health Service and regional health corporations. Receiving-facility capacity at Anchorage and Seattle tertiary care centers is finite, and pre-defined coordination across those receiving facilities, the rural sending facilities, and the aviation assets that connect them does not currently exist at the maturity the scenario requires. The medical cascade is not a downstream consequence of the lifeline cascade; it begins simultaneously and competes for the same scarce resources.

This finding consolidates two of the twenty-two underlying findings, medical evacuation as zero-sum competitor with logistics aviation, and pharmaceutical cold-chain as a first-week population-level failure mode. The recommendation architecture identifies medevac surge capacity in the mid-term and pharmaceutical cold-chain pre-positioning in the near-term.

Final Report Reference: Key Findings Cluster 6 (Medical and Pharmaceutical Cascades); Focused Risk and Vulnerability Assessment (Medical Evacuation and Pharmaceutical Cold Chain subsections).

Finding 6: Paper Redundancy and Coordination Gaps Are the Organizing Risk

Headline

Across every lifeline sector and every coordination architecture examined, the redundancies embedded in planning documents do not function under Arctic stress. The absence of pre-defined civil–military adjudication, a sustained sector-neutral intermediary, and exercised coordination doctrine is a structural risk amplifier, not a passive backdrop.

Why it matters

Alternate routes are constrained by weather, ice, crew availability, and throughput limits. Backup fuel supplies exist on paper but are often already committed or seasonally inaccessible. The ALCAN Highway, cited in nearly every contingency planning document

as the overland alternative to maritime resupply, is limited by Canadian sovereignty, by infrastructure chokepoints along the corridor, and by the realistic throughput of overland trucking under winter conditions, a genuine redundancy at low intensity and a paper redundancy at the volumes contemplated under a dual-theater disruption. Satellite communications alternatives provide limited bandwidth with intermittent reliability and no governance framework requiring commercial providers to maintain service during a crisis. The most-likely and most-dangerous threat scenarios diverge in the Arctic operating environment, requiring distinct planning postures; current frameworks treat them as a single continuum, which is itself an analytical risk. Coordination architectures designed for predictable, single-incident response degrade under simultaneous, multi-theater stress, and most Arctic jurisdictions relevant to this research currently operate at the Basic or low-Intermediate tier of the FEMA P3 maturity model, where engagement is event-driven, charters are absent, and exercises against the dual-theater scenario have not occurred. The connective infrastructure Arctic mission assurance requires, non-attribution, sector-neutral, operationally credible, sustained across years rather than activated during incidents, does not currently exist within the federal architecture at the maturity the mission requires.

What the evidence shows

The Substitution Inventory developed in the Final Report documents the gap at the lifeline level: across maritime, aviation, overland, pre-positioned, and cross-modal substitution, each substitution path is bound by a constraint that either eliminates it as a Days 0–14 option or reduces its capacity to a fraction of what mission requirements demand. The distributed microgrid architecture that serves western, northern, and interior Alaskan communities, approximately 150 standalone microgrids, provides partial structural protection against statewide grid failure, but the same architecture concentrates fuel dependency at the community level, and the failure mode that would collapse multiple microgrids simultaneously is the fuel supply chain disruption identified in Finding 1.

The FEMA Public-Private Partnership maturity model documents the gap at the governance layer: most Arctic jurisdictions operate at Basic or low-Intermediate tier, characterized by episodic, transactional, incident-driven engagement insufficient for the sustained coordination Arctic mission assurance requires. The Jones Act waiver framework, the FEMA P3 maturity model, and the contested-logistics literature converge on the same conclusion: coordination architectures designed for predictable, single-incident response degrade under simultaneous, multi-theater stress. Across every lifeline sector examined, the same structural weakness recurs, there is no operationally-tested, sector-neutral intermediary positioned to translate between defense mission requirements and the privately operated systems that sustain them. Existing partnership frameworks are episodic, transactional, or limited to incident response.

This finding consolidates seven of the twenty-two underlying findings, paper redundancy across lifelines, ALCAN as paper redundancy at scale, distributed microgrid architecture as partial-but-fuel-bounded protection, most-likely/most-dangerous divergence, institutional coordination as risk amplifier, the missing trust-based intermediary, and coordination architecture as itself paper redundancy when unexercised. The

recommendation architecture in Section 8 organizes the response: tabletop validation of existing architectures in the near term, advancement to Advanced tier P3 maturity and a permanent cross-sector supply chain intelligence function in the mid-term, and codified DoD–private sector–nongovernmental coordination doctrine in the long term.

Final Report Reference: Key Findings Cluster 7 (Cascade Dynamics and Paper Redundancies) and Cluster 8 (Threat Scenarios and Governance Architecture); Arctic Sustainment Modes and Lifeline Constraints; From Recommendations to Implementation.

Bottom Line

A single page that distills the analytical record into the three structural conditions Arctic mission assurance requires, and that do not currently exist at adequate scale.

Arctic homeland defense cannot be sustained against the dual-theater disruption scenario this research models without three things:

1. Pre-positioned reserves of fuel, food, pharmaceuticals, and critical materiel sufficient to bridge the Days 0–14 window. Inventory buffers in days, seasonal compression in winter, and the operational impossibility of large-scale aviation substitution for maritime resupply combine to make pre-positioning the only mechanism that closes the early-phase supply gap inside the analytical window.
2. Multi-layer communications redundancy that does not depend on any single commercial provider or terrestrial pathway. Communications failure is a force degrader on every other failure mode; closing that gap requires architecture, not procurement of any single technology.
3. A pre-defined civilian-military coordination architecture, exercised against the dual-theater scenario before disruption requires it. Coordination architectures designed for single-incident response, and architectures that exist on paper but have not been exercised, do not function under simultaneous multi-theater stress.

None of the three is a capital investment problem in isolation. All three are systems problems requiring layered, multi-partner, multi-year investment, operating concurrently rather than sequentially. The recommendations in Section 8 organize the path forward.

Final Report Reference: Executive Summary (Bottom Line)

Recommendations at a Glance

This section presents the recommendation set in compact form. Recommendations are layered, not sequenced; all three tiers must run concurrently. Each is summarized in two to three sentences here; full development, partner architecture, cost-benefit framing, and implementation parameters appear in the Final Report's Recommendations section and Appendix H.

Near-Term Recommendations (0–12 Months)

Investments activatable within the current planning and budget cycle that materially compress the activation timeline of early-phase response. Return is realized before disruption occurs.

Pre-Position Strategic Stockpiles for the Days 0–14 Window.

Establish pre-positioned reserves of fuel, food, pharmaceuticals, cold-chain capacity, and critical materiel at Anchorage, Fairbanks, JBER, and rural community hubs whose seasonal resupply windows close with the fall barge season. This is the only mechanism that closes the inventory-buffer gap within the analytical window. Reserves should be sized against the dual-theater scenario, distributed against the geographic and seasonal stress points the dependency mapping surfaces, and managed through a sustained operations-and-rotation framework rather than as a one-time procurement.

Pre-Stage Jones Act Waiver and Regulatory Authority Documentation.

Develop and maintain pre-staged documentation packages supporting Jones Act waivers, transportation weight-limit waivers, hours-of-service waivers, CDL endorsement waivers, and Canadian provincial permitting for ALCAN trucking surge. Convert the waiver process from a capability that may exceed the operational window into a regulatory mechanism activatable within hours of a triggering event.

Initiate Pre-Defined Civil–Military Adjudication Protocols.

Develop protocols for adjudicating civilian and military claims on scarce fuel, food, transportation, and medical capacity. Address allocation across Title 10 authority, state emergency management authority, tribal sovereignty, and commercial cargo prioritization with clearly identified decision authorities, documented prioritization criteria, and pre-coordinated activation triggers.

Conduct Tabletop Exercise–Based Validation of Existing Coordination Architectures.

Test the Alaska Partnership for Infrastructure Protection (APIP), the Mass Care Group and Feeding Task Force, the Alaska Food Value Chain Coordination Council, and the federal-state-tribal-military coordination architecture against the dual-theater scenario. After-action findings convert paper-redundancy coordination architectures into operationally validated capacity, identify the specific decision points at which adjudication mechanisms must exist, and surface the relationships that must be built before they are needed.

Establish Communications Hardening Priorities for Multi-Layer Architecture.

Identify anti-jam capability for primary defense and emergency management nodes; redundant satellite pathways across LEO and GEO providers; high-frequency radio backup; and subsea cable protection. Establish service-continuity commitments with commercial satellite providers operating in Arctic latitudes, recognizing that current commercial terms do not require sustained service to defense or emergency management users during a crisis.

Final Report Reference: Near-Term Recommendations (0–12 Months). Additional near-term items including pharmaceutical cold-chain pre-positioning and sustained stakeholder engagement architecture are developed in full in the Final Report.

Mid-Term Recommendations (12–36 Months)

Sustained investments substantially completable within a three-year horizon. They build resilience above the early-phase floor that near-term recommendations establish.

Distribute Microgrid Capacity to Reduce Single-Point Energy Dependency.

Expand distributed microgrid capacity at rural Alaska communities, regional installations, and dual-use civilian-military sites where energy concentration risk is highest. Investment focuses on reliability: diesel-plus-renewable-plus-storage configurations sized for community and installation demand under disruption conditions, building on the existing baseline of approximately 150 standalone microgrids in Alaska.

Begin Alternate Port Resilience Investments.

Initiate the capital programs required to convert the six identified contingency alternatives to the Port of Alaska, Seward, Valdez, Kodiak, Homer, Whittier, and Mackenzie, into functional substitutes for containerized cargo handling. The return is strategic resilience over multi-year horizons rather than Days 0–14 benefit, but the investment is necessary for long-term reduction of the single-point-of-failure exposure that the dependency mapping surfaces.

Build Medical Evacuation Surge Capacity.

Expand medevac surge through pre-positioned aviation fuel reserves at key medevac airfields; redundant flight-following communications; pre-defined receiving-facility coordination at Anchorage and Seattle tertiary care centers; and crew availability programs that build depth in the thin specialty workforce on which Arctic medical evacuation depends.

Advance FEMA P3 Maturity Beyond Basic and Low-Intermediate Tier.

Progress Alaska's Partnership for Infrastructure Protection and the federal-state-tribal-military coordination mechanisms toward Advanced tier on the FEMA Public-Private Partnership maturity model. Investment includes formalized charters, sustained pre-incident engagement, regular exercise activity, and integration into commercial lifeline operator business processes.

Establish a Permanent Cross-Sector Supply Chain Intelligence Function.

Build, in coordination with the open-source Supply Chain Intelligence Center proposal in the contested-logistics literature, a permanent coordinating capability for anticipating and responding to cross-sector supply chain disruption. Leverages FEMA Defense Production Act authorities, CISA Critical Infrastructure Partnership frameworks, and peer-level coordination with DOT, Commerce, and ODNI.

Final Report Reference: Mid-Term Recommendations (12-36 Months). Additional mid-term items including tribal partner protocols and cold-chain infrastructure at tribal and community health nodes are developed in full in the Final Report.

Long-Term Recommendations (36 Months or More)

Multi-year construction, sustained policy commitment, or sustained research engagement beyond the current grant window. They address the structural conditions of the Arctic operating environment that no near- or mid-term investment alone can resolve.

Extended Sustainment Modeling Beyond the Days 0–14 Window.

Conduct extended sustainment modeling for the recovery dynamics, structural reconstitution, and multi-month sustainment trajectories that lie beyond the Days 0–14 analytical window of this research. Identified as the single most consequential follow-on research priority and the natural extension of the current engagement.

Operational Piloting of Recommended Coordination Architectures.

Pilot the coordination architectures identified in the near-term and mid-term recommendations under live operational conditions, federally declared emergencies, large-scale exercises, and Arctic-specific TTX programs. Converts coordination from validated-on-paper to validated-in-operations, with after-action records that update the doctrine base.

Integrated Arctic Logistics Testbed.

Establish, in partnership with DoD, DOT, MARAD, FEMA, the State of Alaska, tribal governments, and private-sector lifeline operators, an integrated testbed for operational evaluation of mitigation investments, coordination architectures, and emerging logistics technologies under realistic Arctic conditions.

Codified DoD–Private Sector–Nongovernmental Coordination Doctrine.

Develop, in coordination with NORAD, USNORTHCOM, OSD, FEMA, and the broader emergency management and private-sector partnership community, codified doctrine for DoD–private sector–nongovernmental coordination under contested-logistics conditions. Builds on NSM-22, the FEMA P3 maturity model, the Jones Act waiver framework, and the contested-logistics literature.

Long-Horizon Infrastructure Investments, Polar Icebreakers, Processing Capacity, Refining.

Sustain investments in polar icebreaker fleet recapitalization through the Polar Security Cutter program and the April 2025 RFI for Arctic Security Cutters; in-state food processing capacity expansion; and in-state refining capacity assessment. None of these is a Days 0–14 mitigation; all are necessary for the resilience baseline against which future disruption will be measured.

Final Report Reference: Long-Term Recommendations (36 or More Months) and Continuation and Extension.

Strategic Implications for NORAD/USNORTHCOM and Mission Partners

This section translates the findings and recommendations into the language of mission assurance, planning cycles, and partner equities. Each subsection identifies what the analytical record implies for a specific mission partner and where in the Final Report the partner-specific material is developed.

For NORAD / USNORTHCOM

The dual-theater scenario is structurally consistent with the simultaneity problem the 2025 National Defense Strategy identifies as a primary planning challenge. Arctic mission assurance planning should integrate the Days 0–14 decision window at the operational specificity that command-level decisions require, not as a generalized resilience concept but as a defined planning horizon with named dependencies, identified failure thresholds, and pre-defined adjudication authorities. The connective infrastructure framing in Section 10 of this Executive Summary, developed at length in the Final Report, identifies the institutional architecture under which sustained Arctic mission assurance coordination becomes operationally executable.

For the Homeland Defense Institute

This research provides the analytical foundation for follow-on commissioned work in extended sustainment modeling, operational piloting, and the integrated Arctic logistics testbed identified in the long-term recommendations. The connective infrastructure framing identifies the institutional architecture under which subsequent research commissioned by HDI can be executed at the cross-sector specificity Arctic mission assurance requires. The companion study *Continuity of Society in the North: Multi-Modal Resiliency in Arctic Defense*, extends the analytical record into the human-systems dimension.

For FEMA, CISA, and DOT

The findings reinforce the relevance of the FEMA Public-Private Partnership maturity model, the CISA Critical Infrastructure Partnership framework, and the Jones Act waiver process, and identify where each currently sits relative to Arctic operational

requirements. Advancement from Basic and low-Intermediate maturity toward Advanced tier is the mid-term institutional priority. Pre-staging of waiver documentation, identified in the near-term recommendations, converts a regulatory mechanism that may otherwise activate too late into an operationally usable tool within the Days 0–14 window.

For Alaska DHS&EM and the State of Alaska

Alaska's Partnership for Infrastructure Protection (APIP), the Mass Care Group and Feeding Task Force, the Alaska Food Value Chain Coordination Council, and the State's coordination architecture with federal, tribal, and military partners are the operational platforms on which Days 0–14 response will run. Tabletop validation against the dual-theater scenario is the near-term priority. The mid-term investment is in advancing P3 maturity across those platforms; the long-term commitment is in sustaining the coordination architecture so that it remains exercised, current, and operationally credible.

For Tribal Governments and Alaska Native Organizations

Engagement is governed by sovereignty, consent, and reciprocity protocols, consistent with the framework PSEMA applied throughout the research. This report identifies the absence of pre-existing relationships between non-tribal institutions and tribal governments as a structural coordination gap and a primary risk-amplifier condition. The implementation parameters, protocols, timelines, and the role of sustained relationship over event-driven engagement, are addressed in detail in the companion study *Continuity of Society in the North: Multi-Modal Resiliency in Arctic Defense*, which treats tribal and Alaska Native resilience under sovereignty, consent, and reciprocity framing.

For Private-Sector Lifeline Operators

Engagement throughout this research has been non-attributed, aggregated, and operationally credible. The connective infrastructure framing identifies the architecture under which lifeline operators can engage Arctic mission assurance planning without disclosure of proprietary information, competitive data, or operational specifics that fall outside the scope of mission assurance coordination. Sustained engagement architecture is identified as a near-term recommendation; lifeline operator participation in mid-term P3 maturity advancement and long-term doctrine development is the natural extension.

Final Report Reference: Strategic Implications and From Recommendations to Implementation.

Connective Infrastructure: From Recommendations to Implementation

This section names the institutional finding the research surfaces and the role PSEMA is positioned to play. The compact form here is supported by the full institutional case developed in the Final Report.

Every recommendation in this report identifies multiple external partners: HDI, NORAD/USNORTHCOM, Alaska DHS&EM, FEMA, CISA, tribal governments and Alaska Native organizations, academic institutions, and the private-sector operators across the seven lifeline sectors examined. The recommendations are operationally executable. What requires explicit articulation is the connective infrastructure under which they become operationally executable at scale and across years.

The most analytically significant institutional finding of this research is that the architecture necessary to translate between defense mission requirements and the privately operated systems that sustain them, non-attribution, sector-neutral, operationally credible, sustained across years rather than activated during incidents, does not currently exist within the federal architecture at the maturity Arctic mission assurance requires. Federal entities, by virtue of their statutory mandates and regulatory roles, cannot occupy the sector-neutral intermediary position; commercial operators cannot occupy it across competitors; nongovernmental and academic partners can occupy parts of it but do not have the cross-sector reach across all seven lifeline categories that Arctic mission assurance requires.

PSEMA is positioned to fill that gap. The institutional case is developed in full in the Final Report. The summary points:

- What the gap is, episodic, transactional partnership frameworks insufficient for sustained Arctic mission assurance coordination across the seven lifeline sectors and the multi-year horizons the recommendation architecture requires.
- Why a sector-neutral, non-attribution intermediary is the operational requirement, and why federal entities cannot fill that role within their statutory mandates.
- How PSEMA's membership architecture, engagement protocols, and connective relationships across the seven lifeline sectors align with the requirement, with operational credibility established through the research engagement itself.
- Where PSEMA connects to external partners across near-term, mid-term, and long-term recommendations, including the institutional architecture under which subsequent research commissioned by HDI can be executed at the cross-sector specificity Arctic mission assurance requires.
- What continuation availability looks beyond the May 2026 final submission, sustained engagement, follow-on research, operational piloting, and the integrated testbed identified in the long-term recommendations.

Final Report Reference: From Recommendations to Implementation and The PSEMA Network as Connective Infrastructure.

Continuation, Limitations, and Forward Linkage

An honest accounting of what this research is, what it is not, and where it goes next.

What This Research Is

An analytical foundation for operational planning, organized around five integrated deliverables and validated through structured stakeholder engagement across the seven lifeline sectors examined. The recommendations are operationally specific, the partner architecture is identified, and the time horizons are realistic. The findings are corroborated against an independent body of published, validated research; the analytical posture is operational, not theoretical.

What This Research Is Not

It is not operational planning. It is not classified analysis. It is not a comprehensive solution set for every gap identified. It does not assign blame or attribution to any individual organization. The Days 0–14 analytical window is bounded; extended sustainment beyond Day 14, recovery dynamics, structural reconstitution, multi-month sustainment trajectories, is identified as a follow-on research priority, not delivered within this engagement.

Forward Linkage to the June 2026 HDAS Briefing

The findings, recommendations, and connective infrastructure framing carry forward to the Homeland Defense Awareness Symposium briefing in Colorado Springs in June 2026. The presentation will be positioned against the operational planning cycles of the audience institutions, with the cross-cutting institutional coordination question, the connective infrastructure gap and the PSEMA network framing, surfaced for direct discussion.

Companion Study

Continuity of Society in the North: Multi-Modal Resiliency in Arctic Defense addresses the human-systems dimensions of the same dual-theater disruption environment, military families, civilian and contractor workforce, tribal and Alaska Native communities under sovereignty, consent, and reciprocity framing, and governance architecture. The integrated picture across the two studies positions the homeland defense research community to engage Arctic resilience as the systems-design and institutional-coordination challenge the analytical record establishes it to be.

Continuation Availability

PSEMA views this engagement as a foundational exploration that establishes the analytical baseline for the follow-on work the long-term recommendations identify, extended sustainment modeling, operational piloting, the integrated Arctic logistics testbed, and codified DoD–private sector–nongovernmental coordination doctrine. PSEMA is committed to that work and welcomes the opportunity to discuss with HDI, NORAD/USNORTHCOM, and mission partners how this research can be extended and

deepened in support of Arctic homeland defense and the commercial and community systems that make it possible.

Final Report Reference: Conclusion

Reader's Guide to The Full Final Report

A navigation aid for readers moving from the Executive Summary into the Final Report. Section references correspond to the May 2026 Final Report.

List of Acronyms and Glossary.

Recommended first stop for readers new to Arctic homeland defense terminology.

Strategic Implications.

Introduction, strategic context, scope and boundaries, and methodology overview. The starting point for readers who want the full strategic frame before engaging the analytical chapters.

Research Foundation.

Analytical framework, posture, methodological validation anchors, and limits. Recommended for readers evaluating the analytical robustness of the research.

Scenario Development.

Dual-theater disruption framework, West Coast port degradation, Arctic escalation, sustainment modes, stressors, and the Operation Vittles historical analog. Recommended for readers focused on the scenario calibration and historical baseline.

Key Findings.

All twenty-two findings developed in full, in their eight-cluster groupings (Fuel as the Master Dependency; Maritime and Aviation Sustainment Limits; Seasonal and Inventory Asymmetry; Communications and Cyber-Physical Convergence; Workforce as Critical Dependency; Medical and Pharmaceutical Cascades; Cascade Dynamics and Paper Redundancies; Threat Scenarios and Governance Architecture). Recommended for readers who need the detailed analytical record underlying the six consolidated findings in this Executive Summary.

Targeted Dependency Mapping.

Five-layer dependency framework, critical dependencies, cross-sector chokepoints, and coordination architecture. The longest analytical section of the Final Report and the empirical foundation for the fuel, communications, and workforce findings.

Focused Risk and Vulnerability Assessment.

Time-phased degradation, cascading failure analysis, cross-border risk amplifiers, tribal community risk amplifiers, and mission impact. The empirical foundation for the cascade, seasonal asymmetry, and medical findings.

Arctic Sustainment Modes and Lifeline Constraints.

Substitution Inventory, paper vs. operational redundancy, institutional coordination, Jones Act waiver framework, FEMA P3 maturity model, and contested logistics. The empirical foundation for the sustainment substitution and paper-redundancy findings.

Preliminary Mitigation and Cost–Benefit Prioritization.

Prioritization framework, seven priority mitigation categories, and integrated final ranking. The empirical foundation for the recommendation architecture in Section 8 of this Executive Summary.

Stakeholder Engagement.

Engagement methodology, sector coverage, and synthesized findings carried forward from non-attributed stakeholder input.

Recommendations.

Near-term, mid-term, and long-term recommendation architecture in full, with partner mapping and implementation parameters.

From Recommendations to Implementation.

Institutional coordination architecture, the connective infrastructure finding, and the PSEMA network framing.

Conclusion.

End-state framing, continuation availability, and the companion study linkage.

Final Report Reference: Table of Contents

Closing Source Note

This Executive Summary is a synthesis of material developed in full in the *Private-Sector Lifelines in the Arctic: Predicting and Assessing Risk to Critical Infrastructure* (May 2026), Final Report. No new analysis, no new findings, and no new recommendations are introduced in this document. The Final Report is the authoritative source for the substantive material summarized here, including the full reference list, the citation-supported development of each finding, and the partner-specific implementation parameters of the recommendation architecture.