To: **Alaska Department of Natural Resources, Division of Mining, Land and Water**

Date **November 17, 2021**

From: **Teck American Incorporated**

Subject: **Lisburne (Red Dog) Mining District Exploration Drilling Program Impacts and Mitigation**

Introduction

Teck American Incorporated (TAI) is planning to advance exploration on several claims in the Lisburne (Red Dog) Mining District, approximately 10 miles from the Red Dog Mine (Appendix A – Map 1). Lisburne (Reg Dog) Mining District was previously described as Noatak District. The goal of TAI's exploration projects is to test new areas of zinc mineralization. The exploration claims held by TAI in the Lisburne (Red Dog) Mining District cover approximately 182 square miles and are on state land. The claims for which work activities are currently permitted under Miscellaneous Land Use Permit (MLUP) number 9339 for the Lisburne (Red Dog) Mining District cover approximately 15 square miles (Appendix A – Map 2) (hereinafter, Noatak claims). TAI has been conducting exploration in the Lisburne (Red Dog) Mining District under the current permit issued in 2017 and amended most recently in 2021 (ADNR, 2021).

Surface disturbance from exploration activities each year is typically less than 4 acres, and reclamation is conducted concurrently and when exploration activities are completed. Proposed field activities for 2022 include diamond drilling as described in the 2022-2026 Hardrock Exploration/Reclamation Permit Renewal Program Detail submitted to the Alaska Department of Natural Resources (ADNR) (TAI, 2021).

Objective

The objective of this document is to provide an overview of the current conditions in the areas around the Noatak claims and a summary of TAI's environmental controls to mitigate actual or potential negative environmental impacts associated with the proposed exploration activities. This information is being provided to ADNR to support the permit evaluation process, including any obligations on ADNR to take a "hard look" at TAI's exploration activities under the *REDOIL* precedent.

Natural Environment

Surface Water Bodies

The exploration area is in the foothills of the DeLong Mountains approximately 10 miles north-northwest of the Red Dog Mine. The claims permitted for exploration under MLUP number 9339 are

within the Ikalukrok Creek Drainage, Hydrologic Unit Classification (HUC) drainage number 1905040408, the Headwaters Wulik River drainage, HUC number 1905040407, and the West Fork Wulik River, HUC number 1905040406. Surface water bodies in the exploration area include the Wulik River, West Fork of the Wulik River, Ikalukrok Creek, and tributaries (Appendix A – Map 3).

Virtually all flow occurs in the five-month period beginning with spring thaw in May and ending with winter freeze in October. Storm water runoff is also highly variable depending on topography, degree of soil saturation, and depth to permafrost. Small tributary streams typically freeze to the bottom in the winter months, whereas larger rivers can sometimes continue to flow beneath an ice covering (Tetra Tech, 2009).

Geochemistry and Water Quality

The soils of the area sit over shale and siltstone bedrock. Soils consist of surface organics followed with silty, clayey, and sandy mineral soils. All horizons are ice rich material. A shallow active layer thaws each summer, and permanent permafrost exists in deep layers between the bedrock and shallow active layer (Tetra Tech 2009).

The geochemistry of the region is naturally active. Naturally occurring minerals in the project area have the potential to release harmful constituents (e.g., lead, zinc, cadmium, sulfur) when exposed to water and oxygen. This process occurs naturally in exposed outcrops throughout the region and is not associated with any industrial activity. For example, constituent concentrations have been documented in surface water exceeding water quality standards since before mining has taken place in the region. The presence of these chemicals (e.g., iron sulfide, lead sulfide, zinc sulfide) is visible at the surface and on aerial photography by the dark iron evidenced in nearby streams (e.g., Cub Creek) (Stantec, 2018).

Vegetation

Plant communities in the region are varied, including wet and moist tundra, dense shrubs in floodplains and low stream terraces, shrub communities on hillsides and in sloping drainages, sparse alpine communities on mountaintops or rock outcrops, and barren rock and gravel areas (Kuna, 2020).

Wildlife

Five species of large terrestrial mammals are known to occur in the area: caribou (Rangifer tarandus), moose (Alces alces), muskoxen (Ovibos moschatus), Dall's sheep (Ovis dalli), and brown bear (Ursus arctos). Caribou are a key species, important to local and regional communities for subsistence purposes.

The Western Arctic Herd (WAH) is the largest caribou herd in the State of Alaska and is of both biological and subsistence importance to local communities. The WAH had a population estimate of 244,000 animals based on the 2019 photo census (Hansen, 2020). The herd experiences large peaks and troughs (e.g., 490,000 animals in 2003; 201,000 in 2016). The herd uses a large section of Northwest Alaska, including the exploration area.

Satellite collar data (1988–2006) reveal the general WAH caribou distribution providing migration date approximations, which vary year to year (CARMA 2018). Caribou occupy the vicinity of the exploration area in dispersed winter densities between September 1–May 31, leave between June 1–June 30 for calving in the north, return July 1–July 31 for bug relief, and disperse August 1–August 31 for the Brooks Range to feed before dispersing for the winter season.

Caribou are considered especially sensitive during the fall southern migration to winter range. Since 1996, most individuals have wintered south of the exploration area, on the Seward Peninsula. Satellite collar data also revealed a few individuals of the Teshekpuk Lake Herd may be present during the winter (CARMA 2018). These data suggest caribou can be present in the exploration area at any time, except for the spring calving seasons (Stantec, 2018).

Birds

Most of the habitat in the area can potentially be utilized by seasonal migrants which breed and raise their young during the short arctic summers (Audubon Alaska 2016, Tibbitts et al 2005). All these species, and their nests and eggs, are protected under the Migratory Bird Treaty Act except for the resident Willow and Rock ptarmigan.

Bald and Golden eagles may occupy the area and are protected by the Bald and Golden Eagle Protection Act. Higher elevation cliffs, rock outcrops, and hill outcroppings in the region provide potential suitable breeding habitat for these and other raptors (Alaska Department of Fish and Game [ADF&G] 2008a; BLM 1999).

The original 1984 EIS for the Red Dog Mine indicated the region provides suitable habitat for cliff nesting raptors, such as the Rough-legged hawk, Gyre-falcon, and Peregrine falcon (Dames & Moore 1983a, b). Nest surveys confirmed the nesting of all these species except the Peregrine falcon (Dames & Moore 1983b; SRK 2007). Several nests were in the vicinity of the Red Dog mine in similar habitats, eight miles to the south and east of the proposed facility area, and along the DMTS. In 2005, three Rough-legged hawk nests were reported in the mine area near the DD-2 materials site, one near the confluence of the North Fork and Middle Fork Red Dog Creek and another approximately two miles downstream from the North Fork and Middle Fork confluence (Tetra Tech 2009). The nearest recorded Peregrine falcon nest is located on the Omikviorok River bridge on the DMTS road (SRK 2007). Two Golden eagle nests were also documented in the vicinity of the Red Dog Mine in 1982 (Dames & Moore 1983a). The nests were inactive in 1982 and subsequent surveys over the past 16 years have not documented Golden eagles using the area (Tetra Tech 2009). Other raptor species observed include merlin, Northern harriers, and the Short-eared owl (Stantec, 2018).

Fish Habitat

Fish presence in streams is monitored and catalogued by ADF&G. The ADF&G has conducted long-term studies in the Wulik River, Ikalukrok Creek and Red Dog Creek drainages for monitoring of conditions around the Red Dog Mine since 1990. Fish observed in streams in the vicinity of permitted claims include Arctic Grayling, Dolly Varden, and Slimy Sculpin (ADF&G 2008b, c, 2017b, c, d).

Critical fish habitat in the Lisburne (Red Dog) Mining District includes spawning areas for anadromous fish species. The anadromous fish species with the widest extent in the region is Dolly Varden.

Review of the ADF&G anadromous species map catalog indicated Dolly Varden presence throughout the Wulik River and Ikalukrok Creek drainages and many tributary streams throughout the area, except for the Ikalukrok Creek Drainage above the confluence of the East Fork of Ikalukrok Creek (ADF&G 2008b, c, 2017b, c, d). Fish have not been observed in this part of the Ikalukrok Creek drainage since 2000, likely because of natural mineral seeps in Cub Creek, a tributary above the confluence with the East Fork of Ikalukrok Creek (ADF&G, 2020b).

Critical fish habitat in the area includes anadromous fish spawning areas. These areas in the Ikalukrok Creek and Wulik River are represented by the extent of Dolly Varden spawning habitat, which in some areas is also salmon spawning habitat. Map 4 in Appendix A shows the extent of the documented Dolly Varden spawning habitat.

Aquatic resources in the Wulik River drainage are described in Weber Scannell et al (2000). Bio-monitoring studies in support of the Red Dog Mine provide detailed fisheries and invertebrate baseline reports for the Ikalukrok Creek drainage to just above the confluence with Red Dog Creek, most recently for monitoring conducted during 2019 (ADF&G, 2020a). Studies were also conducted at Ikalukrok Creek above the confluence with Red Dog Creek in (ADF&G, 2020b).

Threatened and Endangered Species

TAI reviewed the US Fish and Wildlife Service website and the Alaska Department of Fish and Game website on January 14, 2021, for information on both state and federally classified endangered, threatened, and special status species. According to our search, there are no state or federally endangered or threatened species ranges, nor are there any specially designated critical habitats for any species of concern that range within 2,000 feet of the Noatak claims permitted for exploration work.

Noise

Most existing noises within the project area are from the natural environment. The loudest natural noise within the undeveloped project area are sounds from storms. Transportation used to support subsistence activities throughout the region (e.g., snow machines, aircraft) are also likely to periodically contribute noise to the environment. The most frequent anthropogenic noise in most of the area is from intermittent helicopter operations to support exploration and environmental studies. Industrial noise (e.g., heavy equipment, blasting) occurs in areas near the existing Red Dog Mine. Noise from these activities attenuate with distance from the Red Dog Mine. Noises from industrial activities have taken place since the development of the Red Dog Mine in 1987, while noise from subsistence activities in the area have taken place for much longer (Stantec, 2018).

Cultural Resources

Northwest Alaska has been occupied by humans for at least the last 10,000 years. Archaeological investigations intended to identify archaeological resources have included background research and

pedestrian field investigations within the Lisburne (Red Dog) Mining District, primarily related to the Anarraaq and Aktigiruq exploration area, (Potter et al, 2001; WHPacific, 2017; Walking Dog Archaeology, 2015, 2018a, b, 2019, 2020). Research included literature reviews, archival research, and identification of expected resources. Field results included initial aerial overflights and pedestrian surveys at high probability areas. Prehistoric and historic sites were identified, and site boundaries were identified in cultural resource reports. No historical structures were identified in the study areas. The extent of the area in which archaeological surveys were completed is shown on Map 5 in Appendix A. The archaeological investigation reports were provided to the ADNR, Office of History and Archaeology.

Communities

Kivalina and Noatak are the closest communities to the exploration area (Map 1). Information on the communities is summarized below.

Kivalina

The City of Kivalina is a traditional Inupiaq village with a population of 427 (as of 2019) (Alaska Department of Commerce, Community and Economic Development [ADCCED], 2021), 94% of whom are Alaska Native / American Indian alone or in combination (Northwest Arctic Borough [NAB], 2021). Kivalina is located at the tip of an eight-mile barrier reef located between the Chukchi Sea and the Kivalina River, 80 miles northwest of Kotzebue. The current town site has a long history as a stopping point for seasonal travelers and hunters but was not the original location of the community. In 1847, the Russian Navy recorded the existence of a community named Kivualinamut, located at the north end of the Kivalina Lagoon. The current town site was settled as a permanent community in 1905 when the Bureau of Indian Affairs constructed a school on the island and mandated compulsory attendance. Kivalina was incorporated as a city in 1969. The community is primarily accessed by small plane and small boats; snow machines and all-terrain vehicles (ATV) are common forms of local transportation (Tetra Tech, 2009). The community has barge access during summer months. The top employers in Kivalina include the McQueen School, the Kivalina Clinic, Maniilaq Association, City of Kivalina, and the Kivalina Native Village (NAB, 2021).

Public facilities in Kivalina include two churches, a recreation center, post office, community hall, and a village clinic operated by Maniilaq Association (Maniilaq, 2021). Community and public facilities include the washeteria, the City Office, the Tribal Office, the U.S. Post Office, the Alaska Village Electric Cooperative (AVEC) facility, airport snow removal equipment building, and community halls. Water is hauled from a treated water storage tank to residences (Stantec 2018). One-third of homes have tanks to provide running water (Maniilaq, 2021). Residential sewage is hauled from residences in “honey buckets” to disposal bunkers located throughout the community (Stantec, 2018).

Noatak

Noatak was established as a fishing and hunting camp in the 19th century. Noatak is an Inupiat village with a population of 583 (as of 2019) (ADCCED, 2021), 99% of whom are Alaska Native / American Indian alone or in combination (NAB, 2021). The village of Noatak is located on the west bank of the Noatak

River, 55 miles north of Kotzebue. The village was established on its current site in the 19th century as a subsistence fishing and hunting camp, although the location was used for several hundred years before that time (Maniilaq, 2021). A post office was built in 1940. The village is currently unincorporated and has no official city government; community decisions are made by the Noatak IRA Council. The community is primarily accessed by small plane, and small boats; snow machines and all-terrain vehicles (ATV) are common forms of local transportation (Tetra Tech, 2009).

The top employers in Noatak include the Napaaqtugmiut School, the Noatak IRA Main Office, Noatak Native Village, and the Federal Aviation Administration. Noatak currently has four general stores, a post office, community hall, and a village clinic operated by Maniilaq Association (Maniilaq, 2021). Water is obtained from the Noatak River, treated, and then piped into homes and businesses by way of a recirculating water system. Sewage is removed from homes by way of a parallel piped system, which serves the same structures as the piped water system. The piped sewer system leads to a disposal system in a sewage lagoon with three lift stations (Tetra Tech 2009). One-third of homes have tanks to provide running water (Maniilaq, 2021). Residential sewage is hauled from residences in "honey buckets" to disposal bunkers located throughout the community (Stantec, 2018).

Current Land Use

Subsistence

Subsistence activities are an important cultural component of the area communities. Caribou are the principal subsistence resource in the Lisburne (Red Dog) Mining District. The Western Arctic Herd (WAH) provides food to communities throughout the North Slope Borough, Northwest Arctic Borough, Nome Borough, and unincorporated interior Alaska communities. As a result, potential disturbances to migration patterns are a significant risk to food security.

The most complete summaries of subsistence activities are from ADF&G's surveys of community subsistence practices (ADF&G 2010). Kivalina and Noatak are summarized here due to their proximity to the project and ability to represent a typical coastal and inland subsistence community.

Inland Noatak subsistence is dominated by caribou, freshwater fish, and saltwater resources they trade for or travel to the coast to capture. Caribou is by far the most important resource and are customarily taken during the fall southern migration past town. Subsistence users have traditional locations they hunt caribou and are sensitive to changes in migration patterns which may take the herd outside of their reach.

Coastal Kivalina subsistence is dominated by reliance on freshwater and saltwater seafood and terrestrial caribou. Saltwater seal, beluga, and cod are accessible from boats and sea ice. Trout (primarily Dolly Varden) is an important subsistence resource. The Wulik River produces the State's largest Dolly Varden, and resident of Kivalina harvest large quantities of these anadromous fish. Caribou are also important, and residents often must travel up the Wulik River to intercept the herd as it migrates south in the fall. This can make residents very sensitive to changes in the herd's movements from customary migration routes (Stantec, 2018).

Mining

Mineral exploration activities in the vicinity of the mine began in the 1970s with passage of the Alaska Native Claim Settlement Act (ANCSA), which started an evaluation of the area's mineral resources. TAI has conducted exploration in the Lisburne (Red Dog) Mining District since the late 1970s.

Recreation and Tourism

The Lisburne (Red Dog) Mining District is known to have some, albeit limited, recreational or tourism visits by outsiders, but primarily hunting and fishing along the Wulik River. The Noatak National Preserve and Cape Krusenstern National Monument, both managed by the National Park Service, are the primary recreation and tourism areas in the wider region.

Summary of the Main Proposed Permitted Exploration Activities

Summary

Mineral exploration is the search for materials in the earth's crust that appear in high enough concentrations and amounts to be extracted and processed for economic gain. Exploration projects can vary in scope and stage from one year to the next. The type of work carried out on a specific program depends on multiple variables. Mineral exploration can take many years, ranging from one to greater than ten years and does not always result in a mine, even if geologists find something prospective. The odds of a project becoming a mine are rare, as many factors affect a deposit becoming economically viable. The information below provides detailed information on some of the main activities and actions related to mineral exploration:

Core Drilling

Exploration core drilling is required to obtain samples of rock that allow geologists to examine the minerals present in the rock, the way different rock layers are located relative to each other, and other rock properties. Drilling allows for testing of the soil and rock at depth for mineral and metal content. Drilling locations are identified and selected based on prior data and information geologists have collected. Environmental factors are considered in the selection of drilling locations, and if appropriate, locations are adjusted to prevent or mitigate actual or potential impacts to socially and environmentally sensitive areas.

The drill site is prepared by first installing a wooden drilling platform. The platform supports the drilling equipment, termed a drill rig, and provides a level and hard work area while minimizing disturbance to the natural ground surface. The platform requires wooden supports, or "cribbing" to be installed and anchored to the ground surface; however, the ground disturbance for these supports is small and is repaired, or reclaimed, after drilling is complete.

The drill equipment is transported to the platform by lifting large components into place by helicopter and assembling on-site. Additional support equipment and supplies are also transported to the drill site by helicopter.

A pipe, called surface casing, is installed from the surface through soil and sealed into bedrock to prevent drilling fluids from leaking into the soil and loose surface material from falling into the hole. Drilling then proceeds through rock, using a drill bit open at the center to allow a column of rock to move up into the drill pipe and into a retrievable core barrel that can be brought to the surface. The drill bit grinds through the rock using a cutting surface consisting of industrial diamonds, and this drilling method for obtaining rock core is often referred to as diamond core drilling.

The diamond bit is rotated under pressure and lubricated with drilling fluids, often termed drilling mud, to prevent overheating and to carry away ground-up rock, called cuttings. The drilling fluid consists of water and additives to increase its viscosity to make it more effective in carrying cuttings to surface, to plug openings in the rock at the side of the drillhole where fluid may otherwise escape, and to make it a more effective lubricant. These additives consist of polymers and natural earth clay products.

After the drill core is retrieved it is placed in specially designed core boxes which are transported by helicopter to the TAI exploration facilities adjacent to the Red Dog Mine. The drill core is then logged and analyzed by a geologist.

Hole Abandonment

Hole abandonment procedures in the last 10 years or so generally involve the return of cuttings "down hole" when possible, cementing the top 50 feet of the hole, or setting a wood plug and filling the collar with a bentonite cap to prevent the hole and collar collapsing/subsiding. Additionally, cement is set roughly 300 feet above, within and below any potential ore zones encountered.

Drill pipe is completely removed at the end of drilling, unless problems occur in retrieving the pipes, in which case it is sometimes cut, and a length left in the hole. Detailed records exist for the last 5+ years of drill pipe left in any holes. For holes with temperature measurement instruments installed, a shallow surface casing is left in the hole usually sticking up 2-3 feet above the ground surface and used as a base for the solar-powered recording and transmitting equipment on surface. For holes without instruments, the casing is usually removed, and a bentonite plug is installed to prevent the collar from subsiding.

Drilling Fluid

Drilling fluids are a mixture of water and additives used to improve drilling performance, as previously described. Additives used are tracked daily by the drill crews and consist of polymers and natural earth clay products (bentonite) that are not hazardous or toxic when used for their intended purpose and in compliance with the product safety data sheets. At no time will drilling fluids be allowed to enter open water ways.

Drill Cuttings Separation and Disposal

The ground-up rock (cuttings) from the drillholes is brought to surface in the drilling fluid. To re-use the drilling fluid, it is necessary to separate the cuttings, and this is done using settling tanks and, starting in 2019, a solids recovery unit (SRU).

The settling tanks allow particles suspended in the water to settle down by gravity, allowing cleaner water out of the final tank to be used again for drilling. The SRU is a centrifuge that spins water through it to separate out the particles, capturing them as a paste that is collected in sacks to be transported to the Red Dog Mine for disposal, and allowing for much cleaner water than that from the settling tanks to be used again for drilling. Separated water that is not required for drilling is discharged in compliance with the MLUP.

Prior to July 2019, when use of the SRU was initiated, cuttings were disposed of by spreading out in a thin layer over an uplands area. The cuttings did not harm vegetation in these areas, as is apparent from the photographic information included in the annual restoration reports.

Site Access

Access to the current drill locations is strictly by helicopter based out of the Red Dog Mine. A helicopter pad and equipment staging area is located at the CC Camp beside the Red Dog Mine airport, as well as a second drill equipment staging area at the HJ pad just south of the tailings dam.

A local lay-down, staging area is located at the Aktigiruq site. It is used for temporary storage of drill equipment that will not fit on the existing pads but will be used within a few days. Usually, two helicopters are used for personnel and equipment transport to/from the drill sites and are available 24-hours a day when daylight permits, but generally are only airborne roughly 4-7 hours a day on average.

Work Season

The work season for exploration activities usually begins in mid- to late-May when snow has melted enough to allow the drill platforms to be built and there is low chance of inclement weather that would prevent helicopters from flying. The drill rigs are transported from storage at Red Dog Mine by helicopter to the drill pads, and setup for drilling through the summer. Exploration activities usually cease around the last week of September or first week of October, depending on when the weather turns consistently cold and snowy to prevent helicopters flying safely.

Worker Lodging

Workers for the exploration drilling program are lodged at the Red Dog Mine Contractor Camp, or at the personnel accommodation complex at the Red Dog Mine operations area, if space is not available at the contractor camp. The Contractor Camp is adjacent to the exploration offices and core logging facilities. Emergency shelters are provided at the drilling site only as a contingency if helicopters are unable to pick up field crews due to inclement weather.

Fuel Transport and Storage

Fuel for drilling activities (diesel) is provided by Red Dog Mine and transported to each drill site in 110-gallon, double walled tanks by helicopter. This is the maximum amount of fuel present at each drill site at any time. Fuel is stored within secondary containment that has 110% capacity of the amount of fuel stored within it. Additionally, fuel for water pump stations is stored within secondary containment at

each pump. Jet-A fuel for helicopters is primarily stored in 6,000-gallon tanks at the helipad at CC camp, which is part of the Red Dog Mine facility and is covered under their U.S. Environmental Protection Agency and Alaska Department of Environmental Conservation spill prevention and contingency plans. One 110-gallon double-wall tank of Jet-A is kept in 110% secondary containment at the equipment staging area at the field site for emergency use.

Solid Waste

Solid waste is controlled at the drill sites and lay down areas by use of appropriate containers or storage and removed to the Red Dog Mine for disposal. Wildlife attractants (food waste, etc.) are removed from the site after each shift at crew change. Recyclable waste is stored at Red Dog Mine and removed under their waste management protocols.

Environmental Impact Mitigation Controls

Surface Disturbance

Surface disturbance from the drill sites averages 1,200 square feet per pad, and depends on multiple factors, such as terrain, slope, and rig type used. This is primarily accounted for by the wooden platform constructed, as well as silt fences put in to capture drill cuttings down slope of the collar. All sites are fully broken down and reclaimed/rehabilitated once drilling is complete. The pad will not be used again in future.

Sites that are un-reclaimed include drill pads that will be reused for additional holes in the future, drill pads and pump stations that were not possible to fully reclaim at the end of the previous season due to lack of time, and some equipment/materials left at the lay-down that will be used on future drillholes. The status of reclamation of drilling sites from 2017 to the present is shown on Map 6. At the redrafting of this document, more reclamation has occurred and will be reported in the annual exploration report.

In general, drill sites are reclaimed concurrent to exploration (pad and refuse removed, tundra rehabilitated, collar plugged unless casing was left). In 2021, a detailed list/inventory of reclamation was undertaken. Reports and maps are currently being compiled and will be supplied in the 2021 annual exploration report.

Temporary disturbance, reclaimed land, and other areas of ground disturbance would be revegetated with regionally appropriate seed mix that minimizes introduction of noxious weeds where practicable. No impacts from drill cuttings deposited to ground surface have been identified, either by the presence of staining or stressed vegetation.

Water Use

Water for drilling is sourced from nearby streams/rivers. In accordance with ADF&G, intake pipes have mesh covers to prevent fish or debris from being taken into the pumps. From the pumps, water is either sent directly to the drill sites or to a secondary storage bladder/tank from where it can feed multiple drill rigs. Water gauges are located on the pumps and drill rigs to monitor water use.

Water use is permitted under temporary water use authorizations (TWUAs) issued by the ADNR. The ADNR permitting process includes review of TWUA applications by the ADF&G and may include stipulations to mitigate potential impacts to aquatic life.

The existing active TWUA permits to support drilling operations in the Lisburne (Red Dog) Mining District are described below, and the locations are shown on Map 7 and Map 8 – Appendix A:

- F2019-079 (Ikalukrok Creek) , -080 (Upper Wulik River), and -081 (West Fork Wulik): these three permits collectively cover 12 stream reaches for drilling in the Lisburne (Red Dog) Mining District outside of the Aktigiruq and Anarraaq area

Water is withdrawn from a small subset of the permitted reaches during a given drilling season. Generally, pumping is limited to no more than one stream reach for each active drill rig. There is no operational scenario considered where withdrawal from all permitted stream reaches would take place concurrently.

The water pump is checked daily to ensure all aspects of water withdrawals are operating properly. Additional drill helpers have been utilized in recent years to throttle pumps and prevent wasting water when bladders/tanks at the drill rig are full.

No detrimental impacts are known to have occurred from past water withdrawals.

Surface Water Quality

Surface water quality in the principal drainages in the area of the claims that are permitted for exploration activities is summarized below.

The 1984 EIS generally characterized the baseline water quality of the Wulik River as a clear water system typified by high dissolved oxygen and low levels of color, suspended solids, turbidity, and nutrients. The water was described as moderately hard with a pH ranging from 7.1 to 8.1 standard units (s.u.) (Tetra Tech, 2009).

Ikalukrok Creek, upstream of East Fork Ikalukrok Creek and downstream of West Fork Ikalukrok Creek, is directly impacted by natural seeps, the most visible being Cub Creek seep, located upstream of this section of Ikalukrok Creek. The pH of water samples from 2005-2019 in Cub Creek has ranged from 2.5 to 7.3 s.u., with a median value of 3.4 s.u. Substrate in this section of Ikalukrok Creek is stained red with iron flocculent and in some years the staining extends downstream for several miles. Specific element concentrations in this stretch of the Ikalukrok Creek were high (aluminum, cadmium, copper, iron, nickel, lead, and zinc) and often exceeded the US EPA chronic criteria for aquatic life. The pH was below the range for aquatic life in most of the water samples collected by Teck (ADF&G, 2020b).

Upper Ikalukrok Creek (upstream of West Fork Ikalukrok Creek) is a clear water system with fairly good water quality. From 2000 to 2002, the pH was near neutral and ranged from 6.5 to 8.1 s.u. Concentrations of all metals in Upper Ikalukrok Creek were substantially lower than in Ikalukrok Creek downstream of the Cub Creek seep (ADF&G, 2020b).

West Fork Ikalukrok Creek had a relatively high hardness combined with low alkalinity and higher concentrations of sulfate, which indicated this system was dominated by calcium sulfate rather than calcium bicarbonate. From 2000 to 2002, the pH in this creek was low and ranged from 4.3 to 6.8 s.u. West Fork Ikalukrok Creek had high concentrations of most elements analyzed, especially aluminum, cadmium, copper, nickel, and zinc. Since sampling began in the area, a white precipitate has been observed at the mouth of the creek as the waters mix with Ikalukrok Creek (ADF&G, 2020b).

During the 2020 summer season, significant surface water impacts in the form of water discoloration, high total dissolved solids (TDS) concentrations were observed over a large part of the Wulik and Ikalukrok watersheds. It is speculated this was caused by melting of the shallow permafrost, exposing, and allowing sulfide mineralization to encounter shallow groundwater that then discharges to surface waters. This is an evolving situation that TAI is continuing to monitor.

Thermal and Hydraulic Disturbance

The exploration area is a permafrost area, with permanently frozen soils and rock extending to a depth of approximately 600 feet. The drilling process introduces heat to the subsurface and melts permafrost adjacent to the drillhole. In 2018, several drillholes in the Anarraaq and Aktigiruq area were equipped with temperature sensors to monitor seasonal temperatures in the ground. Monitoring in 2018 showed the temperatures in the drillholes returned to freezing and stabilized within approximately one month, indicating thermal impacts are short term. As noted above, surface casing is used to keep drilling fluids from escaping into shallow sediments, which also limits thermal disturbance and prevents drilling fluids from entering shallow sediments.

No evidence of thermal or hydraulic disturbance has been identified at drillhole locations in the area. Disturbances would potentially include thermokarsting, water seeps from former drill locations, or erosion at old drill sites. Temperature measurements from drill locations in the area at which instruments were installed in the drillholes indicates temperatures drop quickly after drilling is complete as the ground “freezes-back” and temperatures stabilize to levels likely equivalent to pre-drilling conditions.

Reasonably Foreseeable Future Actions

Activities

The activities proposed for the Lisburne (Red Dog) Mining District are for mineral exploration. The purpose of the exploration program is to collect sufficient geological information to produce estimates of the amount of mineral resource present and the economic viability of a potential future mining operation to extract the mineral resource using currently available technology. Related to the viability of a future mine development, but entirely beyond the control of TAI, are external factors such as metal prices, energy costs, changes in regulation, and changes in technologies for mineral extraction and processing, among many others.

Mitigation Measures

Protection of Surface Water Bodies

Surface waters are protected from impacts by placing controls for runoff of drill fluid from drill equipment, providing containment for hazardous materials such as fuel, and locating drill sites away from surface water bodies.

Drill fluids are recycled by circulating through settling tanks at the rig sites, and silt fences put in place downslope from the tank locations to intercept stormwater that may wash down from the settling tank area. The silt fence is also a protective measure to keep cuttings material contained if there is a spill or overfill of drill mud at the settling tanks. Excavated mud pits will not be used.

Wetland specialist will conduct table-top reviews of air photographs of planned 2022 drill sites to check for potential wetlands. If required, field reconnaissance will be conducted to confirm the desktop findings. Exploration drill sites and support activities will be located to avoid or minimize impacts to wetlands to the extent practical.

Protection of Wildlife

Helicopter operations include measures to avoid disrupting wildlife and bird migration or subsistence activities, as safety allows, flying around spotted herds or flocks, flying at altitudes high enough to reduce noise and disturbance, limiting the numbers of flights per day, or temporarily suspending operations. Helicopter operations avoid areas where species sensitive to noise or movement are concentrated. As appropriate, the operations use horizontal and/or vertical buffers as appropriate while ensuring human safety.

TAI will make note of any Golden eagle activity in the area during exploration activities and take all practical steps to minimize disturbance of the birds. TAI will contact ADF&G if an active Golden eagle nest site is identified.

TAI also has a specific Caribou Policy and Guidelines, which includes the following points:

- Caribou have right of way;
- Work will stop if caribou approach closer than 300 feet to work areas, such as drill equipment;
- Caribou sighting card to be filled out when any caribou spotted and turned in to the Project Manager and Environmental department at Red Dog Mine;
- No hazing policy of any wildlife by helicopters;
- Increased helicopter flight heights to minimize noise disturbance;
- When migrating caribou are near or approaching the drill sites or work areas, all work must come to a stop when they are within 300 feet; and
- Work should not proceed again until the animals have moved safely away beyond the 300-foot distance.

Surface Water Quality, Quantity, and Aquatic Life

Water quantity required for drilling is minimized by use of the Solids Recovery Units (SRUs) at the drill sites. The SRUs maximize the amount of water that may be recovered from drill cuttings, thereby minimizing the amount of make-up water required from streams in the area.

The use of storage bladders allows peak water withdrawal rates from streams to be minimized, thereby reducing impact to the stream flow rate. The bladders can fill slowly from the creek over long periods of time, while the bladders can supply high rates of water over short periods to the drill equipment. Use of water gauges at pumps and rigs allows for good tracking of water consumption, ensuring we are within our permitted extraction allotment. Water withdrawal activity would be coordinated with ADF&G and ADNR.

Surface water is protected from drill fluids, cuttings, or sediments from the drill rig area using silt fence to filter fines if there is a spill at the rig, overfill of the mud tanks, or from stormwater from the drill rig area. Transfers of fuel to equipment tanks do not take place within 100 feet of water bodies.

Each water intake structure is screened to prevent entrapment of fish or other aquatic life. The effective screen openings may not exceed 1/4 inch. Water velocity at the screen/water interface may not exceed 0.5 feet per second when the pump is operating (ADF&G, 1998).

Surface Impacts

Surface impacts are minimized by the following:

- Use of wooden cribbing to construct drill pads instead of grading the ground surface;
- Use of the Solids Recovery Units to separate cuttings from drill fluid, and transport of the cuttings to the Red Dog Mine for disposal; and
- Reclamation of all drill sites in accordance with ADNR requirements after drilling is complete.

Surface reclamation of the pads and silt fences is conducted after the cessation of drilling at each hole. This involves taking photos of the drill site before the drill pad is built and the tundra is disturbed, when the drill rig is setup and drilling, and after the pad has been reclaimed. Reclaiming the site includes pulling down the wood drill pads, filling in the foundation holes, removing refuse, and removing the silt fences. The site is also checked a few months after reclaiming to ensure the collar is not subsiding.

Subsistence Activities

TAI continues to conduct exploration activities in a manner to minimize impacts to subsistence activities, including fishing, trapping, waterfowl hunting, egg gathering, berry picking and caribou hunting. Subsistence hunting of caribou during migration is of particular importance in the Lisburne (Red Dog) Mining District. During the migration of caribou, operations will be conducted to avoid diversion of the migration of caribou. Activity that may interfere with the migration, such as helicopter operations and ground surveys, will stop when migrating caribou are in the immediate vicinity (within 3/4 of a mile).

Avoidance of Cultural Sites

Archaeological surveys have been conducted for areas associated with a potential future underground exploration project at the Aktigiruq and Anarraaq project area within the Lisburne (Red Dog) Mining District, and planned site operations in 2021 avoided known cultural sites identified from this work. A qualified archaeologist was brought to the other exploration drilling sites in theLisburne (Red Dog) Mining District to examine the proposed drill site locations and other work areas (freshwater storage tank locations, material laydown areas, water pumping stations) prior to the start of field activities.

Site workers receive training on protocols to follow if there is a chance find of a previously unknown cultural site, including stopping work immediately and notifying the Northwest Arctic Borough and the Alaska Office of History and Archaeology.

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Appendix A

List of Maps

Map 1 – Lisburne (Red Dog) Mining District

Map 2 – Lisburne (Red Dog) Mining District Claims

Map 3 – Lisburne (Red Dog) Mining District Surface Waters

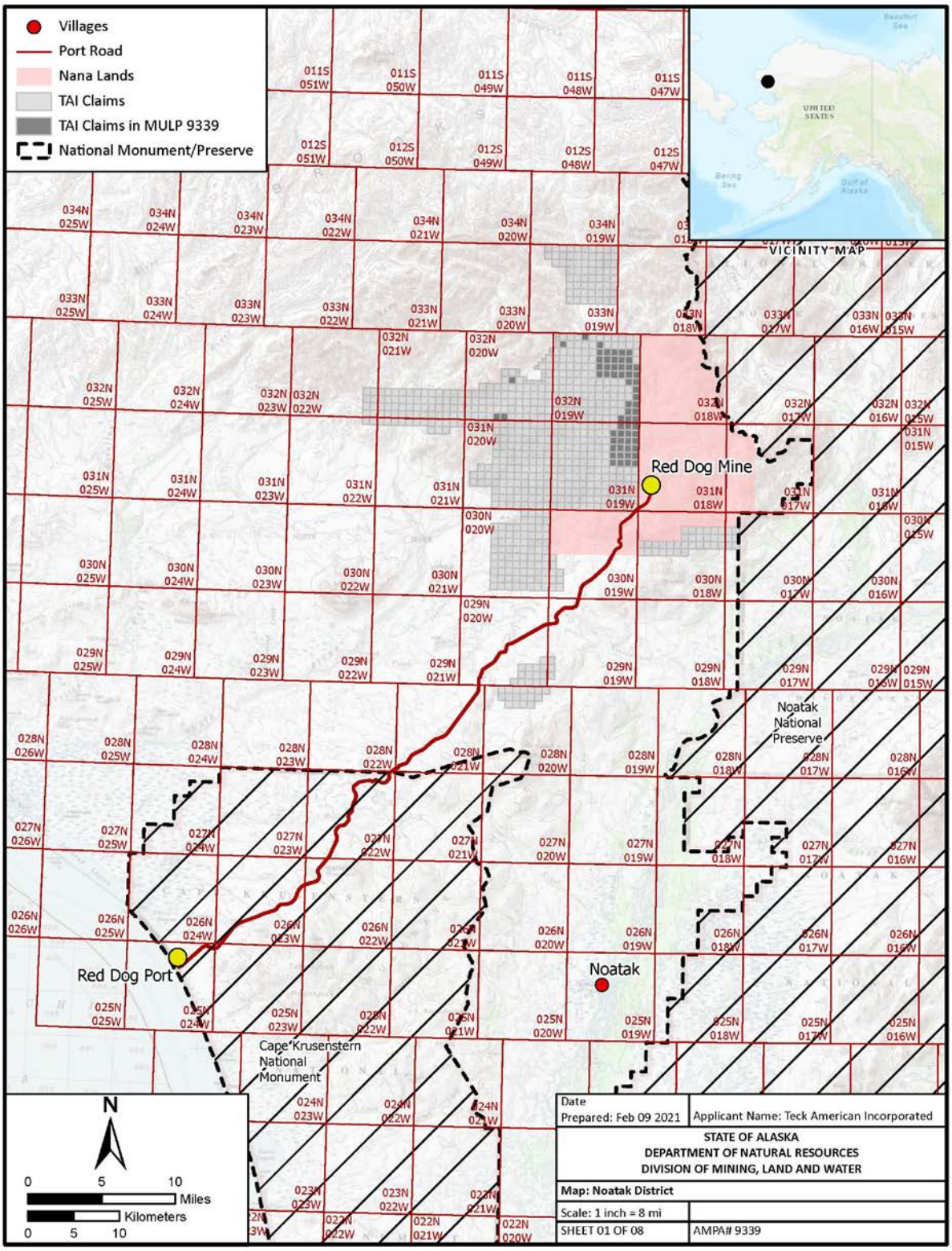
Map 4 – Lisburne (Red Dog) Mining District Dolly Varden Spawning Areas

Map 5 – Lisburne (Red Dog) Mining District Archaeological Survey

Map 6 – Lisburne (Red Dog) Mining District Holes Drilled and Reclaimed

Map 7 – Lisburne (Red Dog) Mining District Permitted Stream Reaches

Map 8 – Lisburne (Red Dog) Mining District Permitted Stream Reaches


Villages
Port Road
Nana Lands
TAI Claims
TAI Claims in MULP 9339
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Red Dog Mine
Red Dog Port
Noatak
Noatak National Preserve
Cape Krusenstern National Monument
N
0 5 10
Miles
Kilometers
0 5 10
Date Prepared: Feb 09 2021
Applicant Name: Teck American Incorporated
STATE OF ALASKA
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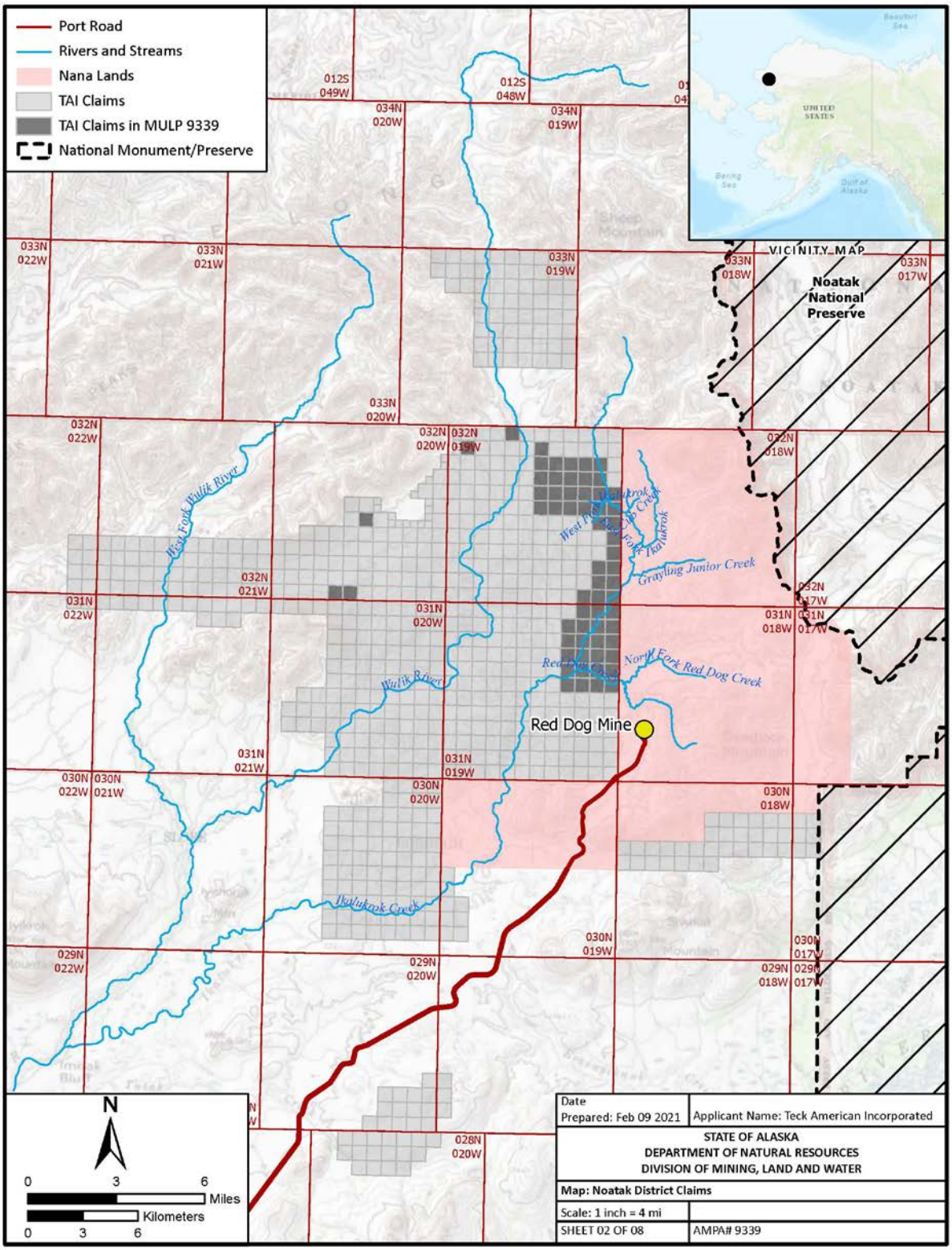
AMPA# 9339


Port Road
Rivers and Streams
Nana Lands
TAI Claims
TAI Claims in MULP 9339
National Monument/Preserve
VICINITY MAP
Noatak National Preserve
Red Dog Mine
West Fork Wulik River
Wulik River
Grayling Junior Creek
North Fork Red Dog Creek
Ikaluktuk Creek
012S 049W
012S 048W
034N 020W
034N 019W
033N 022W
033N 021W
033N 020W
033N 019W
033N 018W
033N 017W
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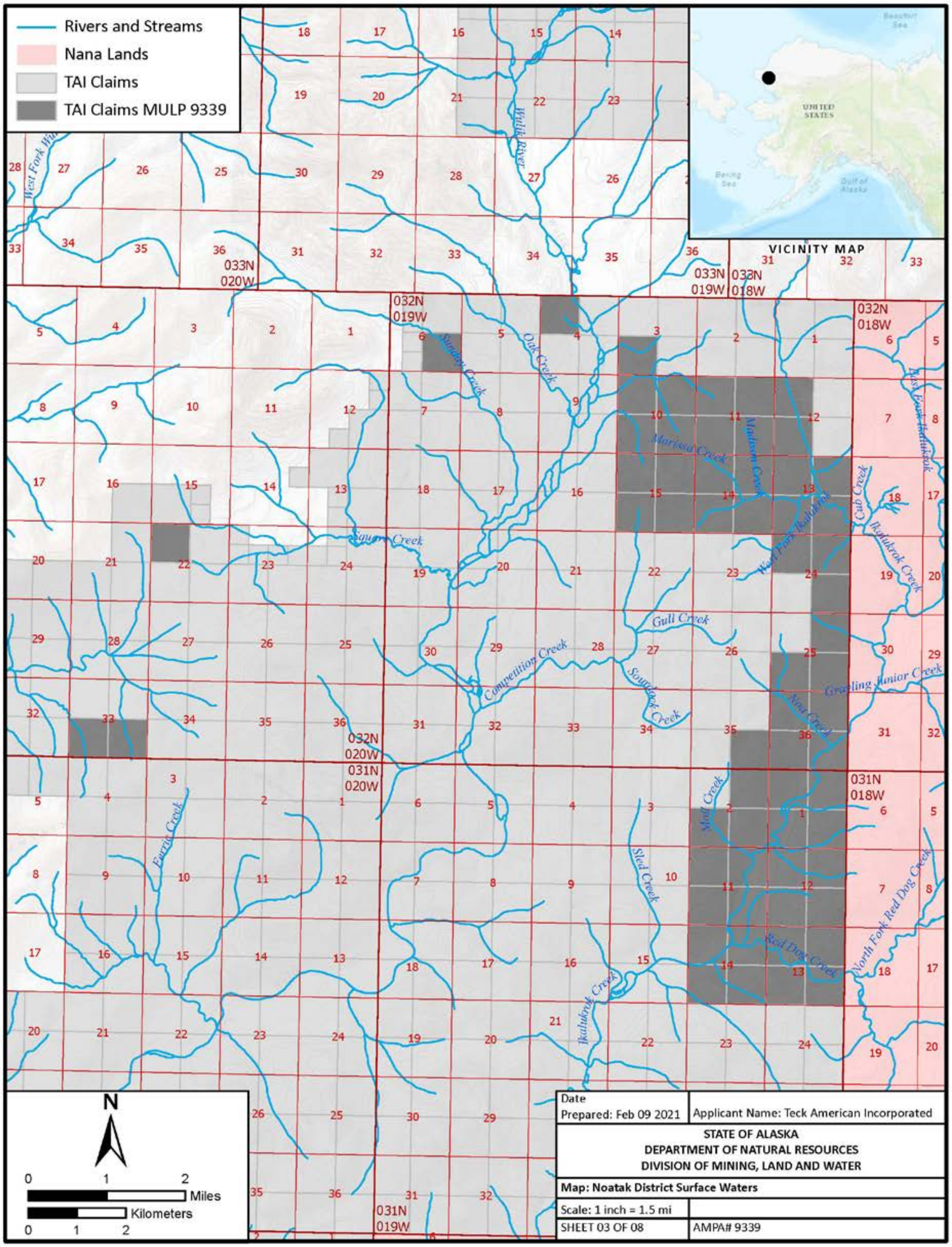
AMPA# 9339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Nana Lands
TAI Claims
TAI Claims MULP 9339
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033N 019W
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032N 019W
032N 018W
032N 020W
031N 020W
031N 018W
031N 019W
Wulik River
Oak Creek
Sunday Creek
Marissa Creek
Madison Creek
West Fork Ikalukrok
Cub Creek
Ikalukrok Creek
East Fork Ikalukrok
Square Creek
Gull Creek
Competition Creek
Sourdough Creek
Grayling Junior Creek
Nail Creek
Mall Creek
Sled Creek
Ferric Creek
Red Dog Creek
North Fork Red Dog Creek
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0 1 2 Kilometers
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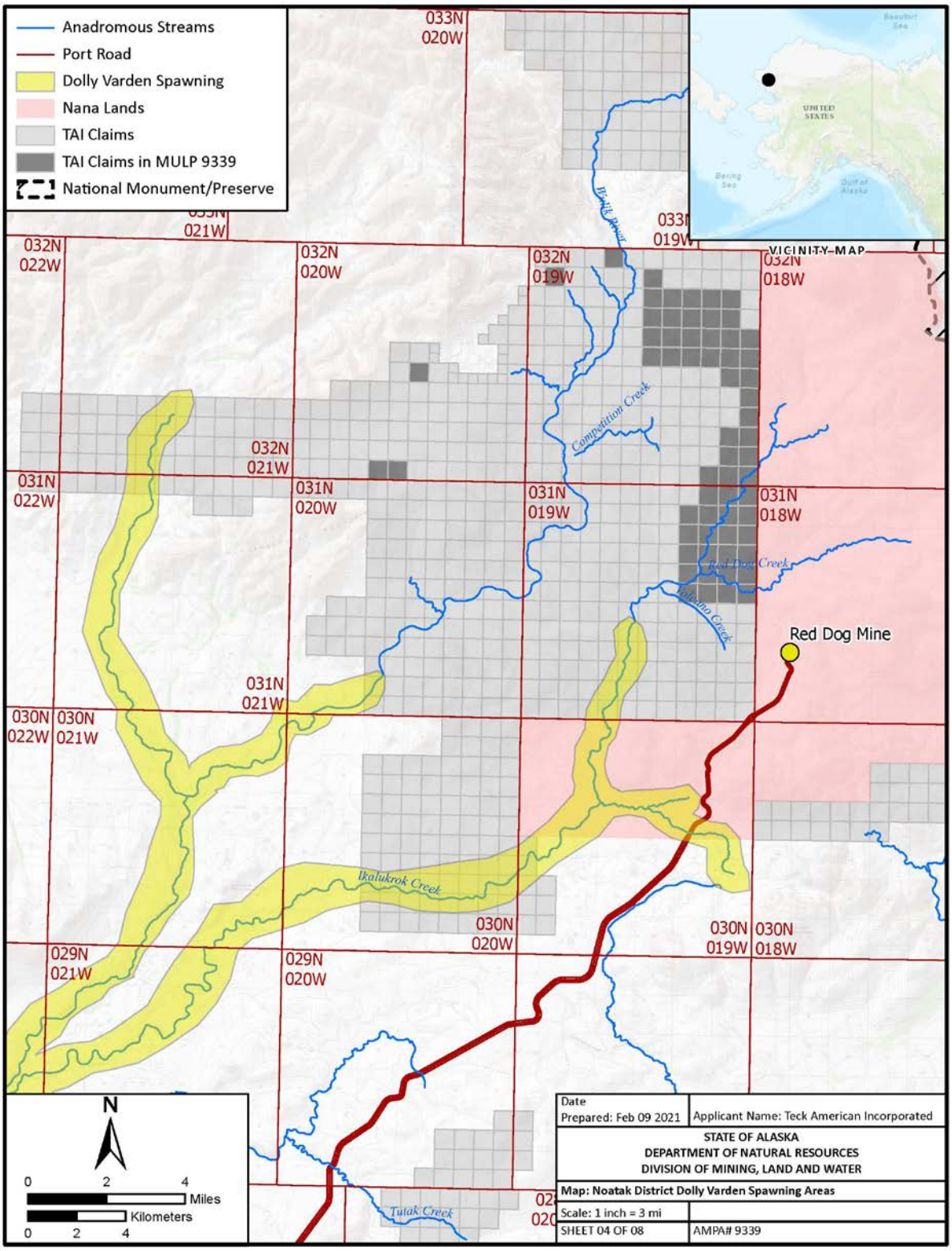
AMPA# 9339


Anadromous Streams
Port Road
Dolly Varden Spawning
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TAI Claims
TAI Claims in MULP 9339
National Monument/Preserve
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Beaufort Sea
Bering Sea
Gulf of Alaska
033N 020W
033N 019W
032N 022W
032N 020W
032N 019W
032N 018W
032N 021W
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031N 018W
031N 021W
030N 022W
030N 021W
030N 020W
030N 019W
030N 018W
029N 021W
029N 020W
Red Dog Mine
Competition Creek
Red Dog Creek
Aqqaluk Creek
Ikalukrok Creek
Tutak Creek
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0 2 4 Kilometers
Date Prepared: Feb 09 2021
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STATE OF ALASKA
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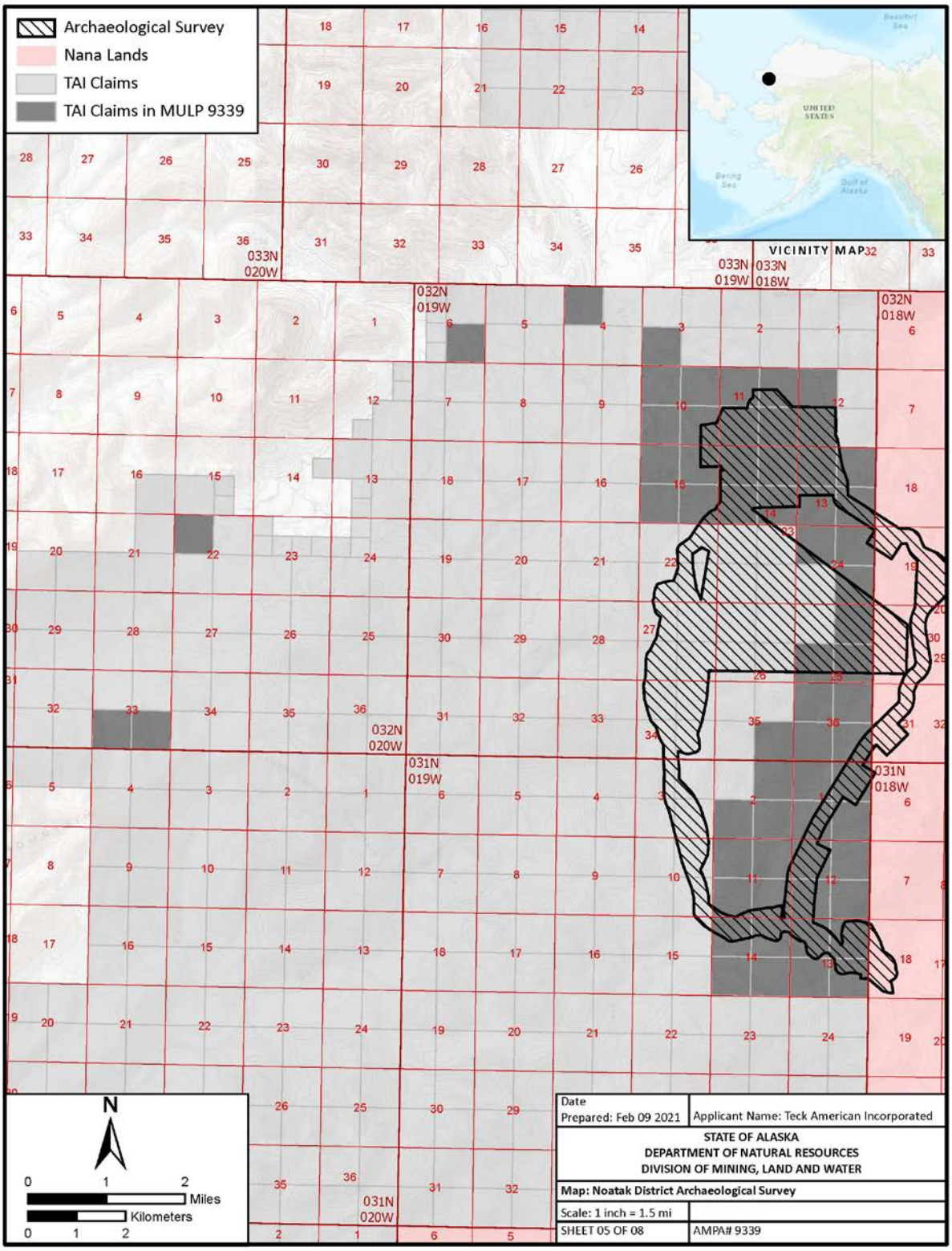
AMPA# 9339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TAI Claims
TAI Claims in MULP 9339
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033N 018W
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031N 019W
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031N 020W
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0 1 2 Kilometers
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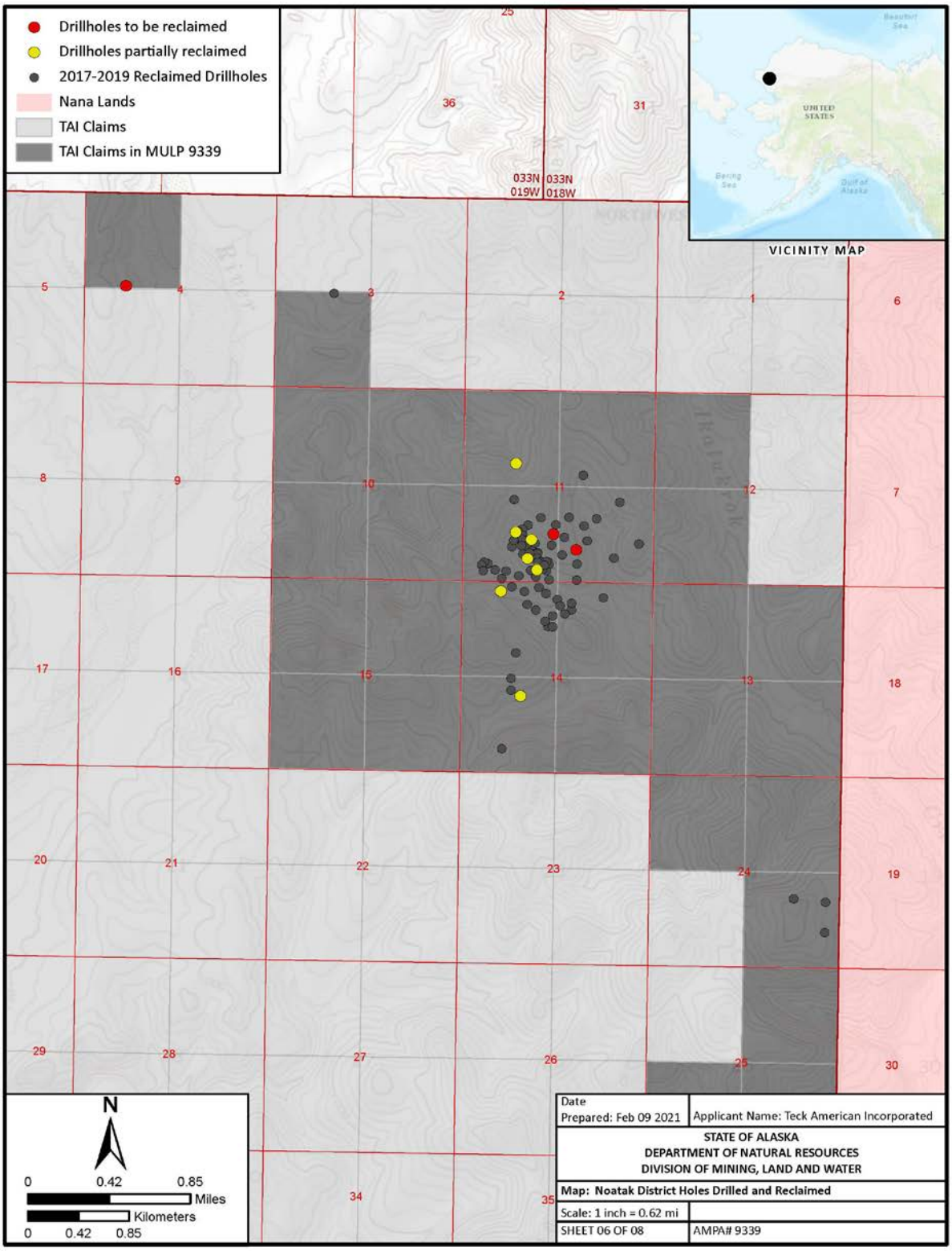
AMPA# 9339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Drillholes partially reclaimed
2017-2019 Reclaimed Drillholes
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TAI Claims in MULP 9339
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Miles
Kilometers
0 0.42 0.85
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Applicant Name: Teck American Incorporated
STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
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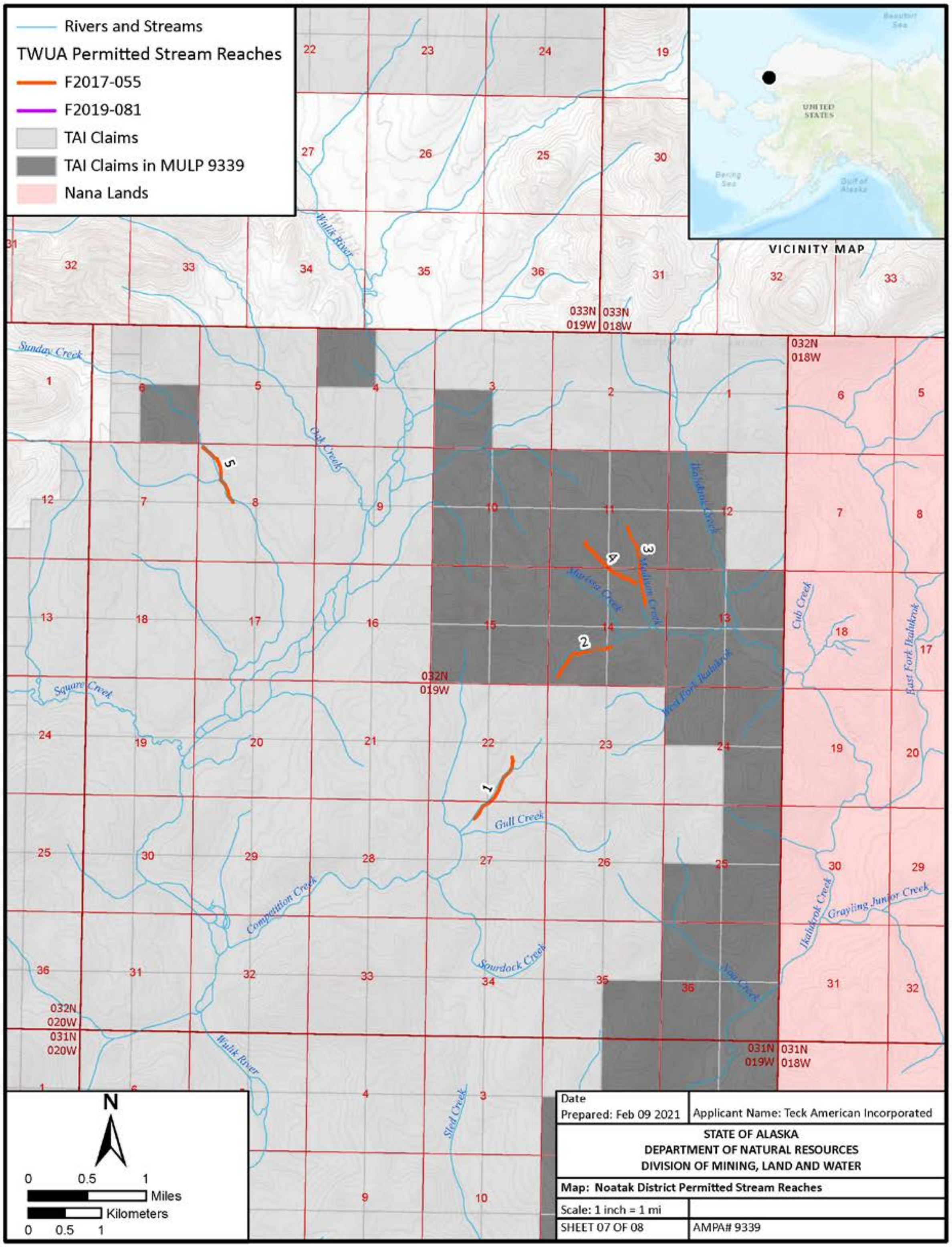
AMPA# 9339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F2019-081
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Nana Lands
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Bering Sea
Gulf of Alaska
Sunday Creek
Square Creek
Wulik River
Competition Creek
Gull Creek
Sourdock Creek
Sled Creek
Cub Creek
East Fork Ikalukrok
West Fork Ikalukrok
Ikalukrok Creek
Grayling Junior Creek
Nas Creek
Rachael Creek
Marvera Creek
Shelly Creek
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Kilometers 0 0.5 1
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Prepared: Feb 09 2021
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STATE OF ALASKA
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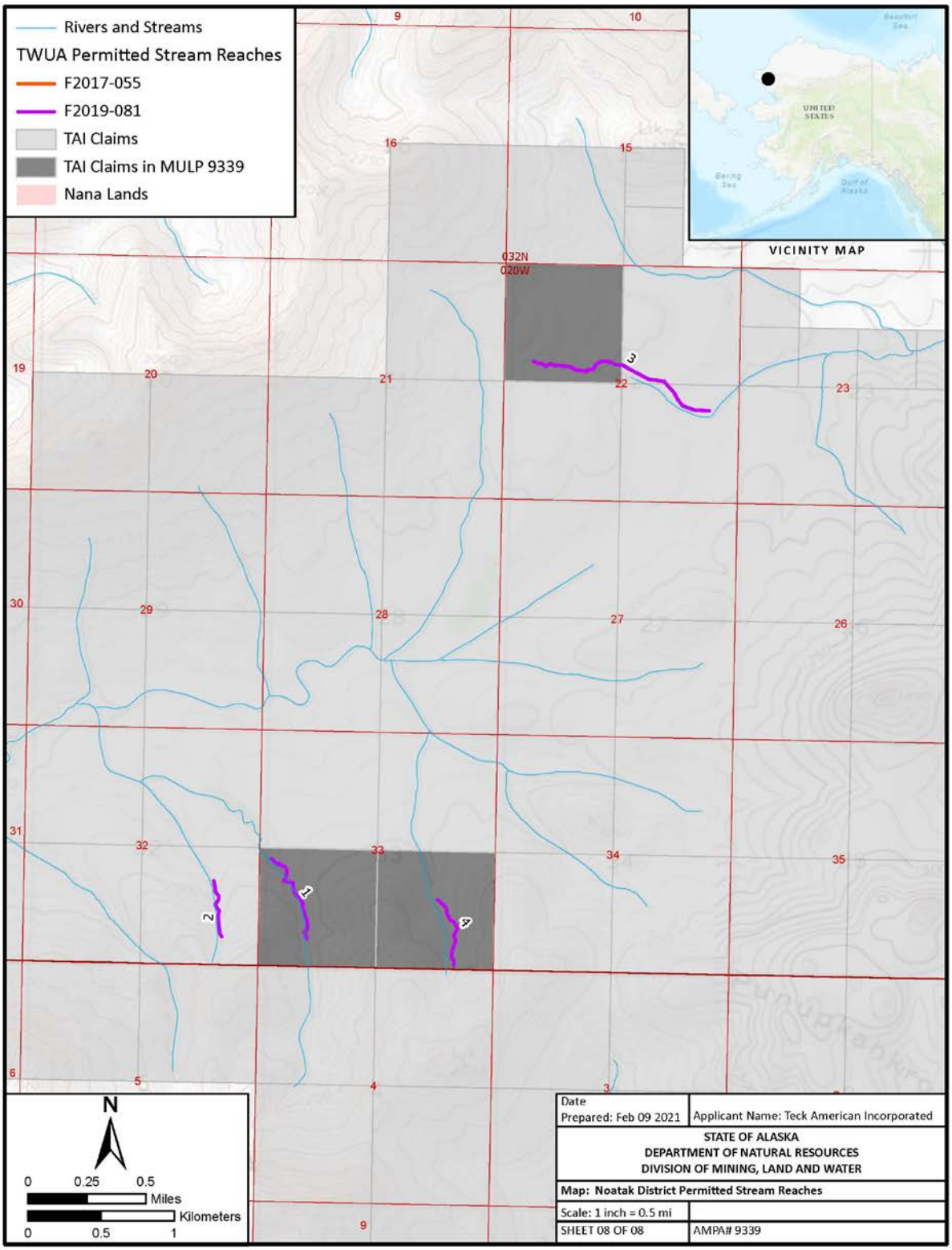
SHEET 07 OF 08
AMPA# 9339


Rivers and Streams
TWUA Permitted Stream Reaches
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STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINING, LAND AND WATER
Map: Noatak District Permitted Stream Reaches
Scale: 1 inch = 0.5 mi
SHEET 08 OF 08
AMPA# 9339