MADRID-BOSTON PROJECT
FINAL ENVIRONMENTAL IMPACT STATEMENT

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Glossary and Abbreviations

AWR	All-weather road
Archaeological Artifact	Any tangible evidence of human activity that is more than 50 years old and in respect of which an unbroken chain of possession or regular pattern of usage cannot be demonstrated (Nunavut Archaeological and Palaeontological Sites Regulations 2001)
Archaeological Site	A site or work within the Nunavut Settlement Area of archaeological, ethnological or historical importance, interest or significance or a place where an archaeological specimen is found (Nunavut Land Claims Agreement 1993, section 33.1.1)
Archaeology	The study of physical evidence to interpret past people's use of landscape and resources
Assemblage	The group of artifacts contained within a site
BP	Before present
CLEY	Department of Culture, Language, Elders and Youth (now Culture and Heritage)
Cache	A rock hollow covered with rocks, used for storage
Cairn	Pile of rocks, often used to store items, or to cover a burial
Culture history	A sequence of identifiable variations in certain artifacts and archaeological assemblages through time
EAA	Existing and Approved Authorizations
Ethnographic	The study of aboriginal people and their cultural activities
GN	Government of Nunavut
CH	Culture and Heritage Department (formerly CLEY)
GPS	Global positioning system
Historic period	Begins at the time of the arrival of people with written records; thus, the start of this period varies by region
IHT	Inuit Heritage Trust
INAC	Indigenous and Northern Affairs Canada (formerly Aboriginal Affairs and Northern Development Canada)
KIA	Kitikmeot Inuit Association
LSA	Local Study Area
Lithics	Stone tools and debris left from making stone tools

MOMB	Marine Outfall Mixing Box
NAPSR	Nunavut Archaeological and Palaeontological Sites Regulations
NPCTT	Nunavut Planning Commission Transition Team
NTKP	*Naonaiyaotit* Traditional Knowledge Project
PDA	Project Development Area
Palaeontology	The branch of science concerned with fossil animals and plants
Post-contact sites	Aboriginal sites dating to the historic period
Pre-contact	Pre-dates arrival of people with written records; also termed prehistoric
Prehistoric period	Pre-dates arrival of or influence of people with written records; also termed pre-contact
Proto-historic period	The period of indirect influence of people with written records prior to direct contact, seen in the influx of European manufactured tools
RSA	Regional Study Area
SDR	Systematic data recovery
Systematic data recovery	Actions taken to collect cultural information contained in a site; these may include mapping to scale, close surface examination, extensive photography, excavation and collection of artifacts
TMA	Tailings management area
Traditional Knowledge	Oral knowledge about use of the landscape passed down through an existing Aboriginal group
VSEC	Valued socio-economic components
WRR	Winter road route
Windbreak	Formation of three or four upright flat slab rocks, for protecting a small fire from the winds; when another flat slab is placed on top, a cooking surface is created (referred to as *kikhuk* [Thorpe *et al*. 2002:68])

2. Archaeology

Archaeological resources are non-renewable, finite resources. They are important sources of historical knowledge and cultural identity. Local communities, regional Inuit organizations, including the Kitikmeot Inuit Association (KIA), the Inuit Heritage Trust (IHT), and the Government of Nunavut (GN) all consider archaeological sites to be valuable. Archaeological sites are often not readily identifiable by the untrained eye and can be directly affected by any activity that causes ground surface disturbance.

Heritage resources are protected under Articles 33 and 34 of the Nunavut Agreement. Article 33.4.3 specifies the responsibilities of the Inuit Heritage Trust to support, encourage, and facilitate the conservation, maintenance, restoration and display of archaeological sites and specimens in the Nunavut Settlement Area. This protection is further clarified under the Nunavut Archaeological and Palaeontological Sites Regulations (NAPSR), which are administered by the Government of Nunavut (GN). These Regulations require a government issued permit be in place before searching for archaeological sites or artifacts, and excavating, altering, disturbing sites or removing artifacts from a site. The GN department of Culture and Heritage (GN-CH, formerly CLEY) reviews reports and approves final recommendations regarding site mitigation. The archaeologist conducting the investigations is bound by the legal requirements of NAPSR. The developer is responsible for ensuring that the archaeologist doing the work is qualified, funding is sufficient for all necessary archaeological investigations (including analysis, reporting and conservation), and the required mitigation measures are applied (CLEY 2003).

In addition to NASPR, the federal Territorial Land Use Regulations, administered by Indigenous and Northern Affairs Canada (INAC), prohibits activity within 30 m of a known or suspected archaeological site or burial ground located on federal Crown land.

Archaeological sites can be disturbed by any action that affects the ground surface. Specifically for the Hope Bay Project, archaeological sites can be directly affected by such activities as: surface excavations; construction of camps, docks and associated facilities; construction of both winter and all season roads; development of stockpile areas, quarries and borrow sites. Sites can also be affected by ongoing operations and road use, as well as by the mere presence of increased numbers of people moving about the area.

Important elements related to archaeological resources include the characteristics of the site assemblage and the integrity of archaeological resources within the site. There are different types of sites, and each site is unique. As a result, there are various degrees of possible information loss through displacement or loss of artifacts and features.

2.1 INCORPORATION OF TRADITIONAL KNOWLEDGE

This section will discuss how Traditional Knowledge has been incorporated in each section of this report.

2.1.1 Incorporation of Traditional Knowledge for Existing Environment and Baseline Information

Traditional knowledge has been used on the Hope Bay Project in designing archaeological field studies and for interpreting findings. Traditional knowledge information was drawn primarily from *Inuit Traditional Knowledge for TMAC Resources Inc. Proposed Hope Bay Project, Naonaiyaotit Traditional Knowledge Project (NTKP)* (Banci and Spicker 2016). Other reports containing traditional knowledge for this region that were consulted are Golder 2003, Riewe 1992, and Thorpe et al. 2002. Additional valuable information came from several Elder meetings with the Project archaeologist as well as input from local people who participated in the annual field investigations. Useful knowledge included how people used the region in the past, preferred hunting and fishing locations, important gathering areas, where people traveled, what were considered good camping spots, the types of activities that were conducted, how people hunted and fished specific animals. This information assisted in determining some important locations where inventory surveys would be needed. It also assisted with such tasks as identifying and/or confirming functions for some of the features and artifacts found and providing explanations on how those items were used in daily lives.

2.1.2 Incorporation of Traditional Knowledge for VSEC Selection

In all the traditional knowledge information sources consulted for this study, local people have expressed value and respect for the remains of their ancestors (cf. Banci and Spicker 2016, section 5). This shared information has made it clear that heritage resources are valued and must be an important consideration in the EIS. Furthermore, as the physical indications of past activities in the area, archaeological remains would serve as the appropriate VSEC to analyze Project interactions with heritage resources.

2.1.3 Incorporation of Traditional Knowledge for Spatial and Temporal Boundaries

The available traditional knowledge, past archaeological studies and historic reports have indicated that people travelled to different areas of the Kitikmeot region at different seasons each year in order to gather various resources needed for survival. Therefore, the locations used throughout the region were linked and it is necessary to consider this broader area in order to understand the Project study area. Using this available knowledge, the RSA for this VSEC was defined to incorporate most of the Kitikmeot region. This knowledge is also used to define the LSA.

2.1.4 Incorporation of Traditional Knowledge for Project Effects Assessment

In terms of assessment of the Project effects, traditional knowledge is used to determine where in the LSA specific types of activities may have occurred. In particular, it has been to identify if there are any special use areas or sites of cultural significance.

2.1.5 Incorporation of Traditional Knowledge for Mitigation and Adaptive Management

Respect for the remains of the activities of past people indicated in the traditional knowledge has figured significantly in the choices of mitigation measures. Overall, impacts to the sites will be avoided wherever feasible in order to preserve those remains of the past. Furthermore, where sites cannot be avoided, traditional knowledge can be incorporated during determination of appropriate site data recovery techniques to be used. Mitigation measures will be chosen with the input of the CH-GN and the Inuit Heritage Trust for each site that may be affected.

2.2 EXISTING ENVIRONMENT AND BASELINE INFORMATION

2.2.1 Data Sources

The initial documentary research stage comprised consultation of recorded archaeological site files held at the GN-CH, review of both published and unpublished reports on previous archaeological studies in the general region, and study of published reports from early travelers, explorers and ethnographers, and traditional knowledge studies. These sources form the documentary knowledge base for Central Arctic indigenous people's past lifestyles and cultural practices.

The central Arctic was among the last inhabited regions in the Arctic to experience direct contact with Euro-Canadian culture. There are several accounts of Kitikmiut encounters written by early explorers (e.g., Hearne, Franklin) during the late 1700s and 1800s. It was not until the 20th Century that this region was explored by scientific teams that included ethnographers who were specifically charged with gathering information about the indigenous people. These expeditions were:

- the Stefansson-Anderson expedition which was in the region between 1908 and 1912 on behalf of the American Museum of Natural History (Stefansson 1919);
- the Canadian Arctic Expedition between 1913 and 1918 (Jenness 1922); and
- the Danish Fifth Thule Expedition in 1921 to 1924 (Rasmussen 1932).

The accounts written by these researchers document the life of Kitikmiut prior to significant effects from Euro-Canadian influences. Traditional knowledge sources have become available more recently and include a study of knowledge relating specifically to caribou (Thorpe et al. 2002), a preliminary review of knowledge relating to the Doris North Project (Golder 2003), and a more extensive report on traditional knowledge of past lifeways within the larger Project area (Banci and Spicker 2016).

2.2.2 Methods

The investigation design developed for the conduct of the Hope Bay archaeological studies consists of up to six stages, which are: overview, reconnaissance, inventory, assessment, mitigation, surveillance and monitoring. These follow guidelines released by the GN-CH (CLEY 2003). Which stage is applied each field season depends on the Project requirements for each year.

- **Archaeological Overview Assessment:** An archaeological overview assessment is the preliminary stage of archaeological studies and is conducted early in the planning process. The objective of an overview assessment is to compile and evaluate relevant aspects of the existing biophysical and heritage knowledge of the study area. This provides an important knowledge base to assist in the determination of archaeological potential and the scope of future archaeological investigations.
- **Preliminary Field Reconnaissance**: Preliminary field reconnaissance is used to assess landscape features to determine if there is sufficient archaeological potential to justify further investigation, and the scope of the work required for further investigation. This stage can also assist in project planning to determine preferred routes or locations when alternates are identified or to recognise major archaeological issues. Preliminary field reconnaissance may be conducted as part of an archaeological overview assessment or as part of the archaeological inventory stage. Depending on the type, location and planning stage of the development as well as the terrain characteristics of the project area, reconnaissance may be limited to a visual (often aerial) examination or it may involve more detailed ground inspection. Any archaeological work involving ground reconnaissance must be conducted under a Class 1 or Class 2 Nunavut archaeologist permit.
- **Archaeological Inventory**: Archaeological inventory or detailed archaeological ground reconnaissance is conducted to find archaeological sites within a development area. Inventory generally involves surveying an area using intensive systematic pedestrian transects to locate and define archaeological sites. It may also include subsurface testing to find or further define sites. The intensity of the inventory varies depending on the terrain, archaeological potential and the stage of development planning. Inventory must be conducted under favorable weather conditions, that is, no snow cover or frozen ground. A Class 2 Nunavut archaeologist permit is required.

- **Site Assessment**: Once an archaeological site has been identified, a site assessment is conducted to determine its size, content, complexity and if it is threatened by the proposed development. Size, content and complexity are used to estimate the archeological significance of each site. Archaeological site significance provides the basis for recommendations of suitable site-specific archaeological mitigation measures. Because site assessment can be time consuming and often requires subsurface testing (which is a somewhat destructive process), it is preferable to assess in detail only those sites that cannot be avoided or protected. Site assessment field work requires a Class 2 Nunavut archaeologist permit.
- **Mitigation**: Mitigation refers to actions that will minimize or eliminate adverse impacts to archaeological resources. Possible mitigation measures include the following: avoidance through project redesign or relocation; protection through the erection of physical barriers; and recovery of archaeological data, also known as systematic data recovery. Site avoidance is the preferred mitigation measure. Systematic data recovery commonly consists of subsurface excavation and/or surface collection. Because this can be destructive, it is only recommended for sites that cannot be avoided. Detailed archaeological analysis and reporting is an integral part of mitigation. Mitigation must be conducted under a Class 2 Nunavut archaeologist permit and in consultation with the GN-CH and local Inuit associations, where appropriate.
- **Surveillance and Monitoring**: As part of a mitigation program, surveillance or monitoring may be recommended. Surveillance is conducted during the construction phase to ensure that site protection and avoidance recommendations have been followed and that no further archaeological resources are encountered. This is commonly recommended for areas of high archaeological potential, particularly close to sites considered to have archaeological significance. Monitoring may be undertaken during the construction phase (where excavation may uncover sites) or during the operations phase to assess indirect and/or long-term effects.

An important component of archaeological studies at the Hope Bay Project has been the gathering of sufficient data in order to assess the potential of specific terrain features to contain archaeological sites as well as develop expectations as to locations and types of heritage resources. Archaeological potential identifies areas that warrant further investigation. Background research initially conducted in 1996 included a variety of disciplines, such as geomorphology, paleoecology, surficial geology, ethnography, climate, wildlife and vegetation. A review of previous archaeological investigations and archaeological site records in the vicinity of the proposed development and in similar areas was also completed. This initial data base has been enhanced over the years as additional information has become available. In particular, later traditional knowledge studies have provided useful data. The background research for the Hope Bay Project emphasized archaeological, historical and ethnographic sources and was restricted to published and secondary documentary sources. The research encompassed a broader area than the Hope Bay Project Area to provide a regional cultural context required for data interpretation. Follow-up helicopter reconnaissance was used whenever possible to more accurately judge archaeological potential of specific terrain features.

A crucial aspect of the determination of heritage resource potential in any region is assessment of natural resources, environment and landscape features and how these combine in any specific area to provide possibilities for meeting basic human needs of food, water and shelter. The following factors are of primary importance to human location (not listed in any particular order):

- fresh water;
- level camping area of suitable size or other shelter possibilities, such as caves or rock overhangs;
- animal and plant resources;
- fuel for heating and cooking;

- reasonable travel routes;
- exposure (south facing often preferred);
- view of surrounding area, both for game sighting and defensive purposes; and
- sources of flakeable stone or other specific raw materials needed.

Generally, the more of these factors that combine in any particular location, the higher the potential for archaeological remains. In the case of the Central Arctic, some historic and ethnographic accounts are available; these were consulted to assist in estimating potential for archaeological sites to be present in certain areas and on specific landscape features encountered in this project area. Traditional knowledge information that has become available has also been incorporated into the potential ratings. Landforms and ground types would be rated low, moderate or high potential, depending on the location's specific features and setting. Given that hunting and fishing were the primary pursuits of past people in this area, the locations that would offer high archaeological potential in this region would be elevated landforms providing dry ground (for camping) overlooking lakes or river narrows or grassy meadows - wherever caribou and muskox could be frequently found and fish could be caught. Waterlogged or sloped land or very high, irregular bedrock outcrops would present low archaeological potential.

It is important to bear in mind that potential ratings are simply estimates of the chances of encountering heritage resources based on available data. It does not imply that sites will definitely be found in high potential areas or that no sites will be found in low potential areas. The emphasis in field investigations is generally placed on areas judged to exhibit moderate to high potential for heritage resources. However, since human behavior can be unpredictable, it is acknowledged that sites can occur in unexpected locations. Consequently, examination of a sample of areas rated as low potential is commonly included in the research strategy.

During each year of field work conducted at the Hope Bay Project, various areas have required different levels of research based on exploration, project permitting and construction needs. Because detailed assessment and excavation stages of archaeological investigations are invasive, progress to the next stage has been carried out only as needed, as project plans evolve. Consequently, due to the changing project requirements over the years, not all investigation stages have been applied equally over the entire Project area.

For all sites recorded, archaeological site inventory forms are completed, sketch maps drawn and photographs taken. Completed site forms have been submitted to the Canadian Museum of History in Ottawa and the Department of Culture and Heritage, Government of Nunavut for inclusion in the national and territorial inventories. Temporary site numbers are assigned in the field, and the permanent Borden designations (based on latitude and longitude) are provided by the GN-CH.

2.2.3 Characterization of Baseline Conditions

This section will first describe the knowledge of past people's lives in this area as gleaned from documentary research. This will be followed by description of the known archaeological resources based on archaeological field work conducted thus far. The following summary of Kitikmiut lifeways at the time of contact is largely based on Jenness (1922), Rasmussen (1932) and the NTKP report (Banci and Spicker 2016).

The Hope Bay Project is on the eastern portion of the Kitikmiut ethnographic territory, as it has been defined by anthropologists (Damas 1984). Copper Inuit was the name given these people by early explorers due to their use of native copper (cf. Stefansson 1914:33). This is one of the five groups that were classified as Central Eskimo by ethnographers (Damas 1984), so designated because they lived in the area that is the approximate center of the region traditionally occupied by the people who were the ancestors of current Inuit residents.

The Kitikmiut traditional range is generally considered to be from Wise Point on the west, to the southern shore of Banks Island in the north, including most of Victoria Island to the eastern shore and along a line to Perry River on the mainland, and south almost to Back River and Contwoyto Lake (Damas 1984:398).

Early researchers identified several distinct groups within the Kitikmiut, the names of which represented location or subsistence focus (cf. De Coccola and King 1986; Jenness 1922; Rasmussen 1932). Present day Kitikmiut describe three subgroups: Ocean people living along the Coronation Gulf coast and Victoria Island, Inlanders living primarily near large inland lakes such as Contwoyto, and those living around Bathurst Inlet (Banci and Spicker 2016:17).

According to Rasmussen, the people living on the east side of Bathurst Inlet were known as Umingmaktormiut "People of the Musk-ox" (1932:78 – also in Banci and Spicker 2016:18); he noted that the vicinity of Hope Bay once abounded with muskox (1932:35). The settlement on the east side of Bathurst Inlet was called Umingmaktok, translated as "where musk-oxen are many" (Rasmussen 1932:12). In spite of these references, the main subsistence focus of these people was caribou which were also plentiful in the area. The Bathurst Inlet people made short distance trips inland to hunt caribou and muskox (cf. Riewe 1992), and some long distance trips to trade with the Netsilik people to the east were reported (Stefansson 1914).

The subsistence cycle of the Kitikmiut was based on seasonal movements to harvest specific resources within the region. From December until May, the main focus was breathing-hole sealing. Because this activity involved the cooperative efforts of a number of hunters, groups aggregated in winter snowhouses on the sea ice (Banci and Spicker 2016:23).

During the second half of May, the people dispersed to the land and began to exploit resources such as caribou, fish, birds and small game. In spring and early summer, fishing through ice on lakes was more important, while caribou hunting dominated from the beginning of August to November, when the animals were fairly fat and their skins most suitable for making clothing. Lake and river narrows were prime hunting locations since caribou typically chose to cross open water at those points (Banci and Spicker 2016:26). In late summer, fishing for arctic char was carried out by using stone weirs in the streams to which the char returned from the ocean (Banci and Spicker 2016:19). Two areas were identified by traditional knowledge consultants as rich in wildlife: the vicinities of Bathurst Inlet and Contwoyto Lake (Banci and Spicker 2016:21).

For a period of two to four weeks beginning in November, the Kitikmiut subsisted mainly on cached frozen and dried foods (Damas 1984:398). This was a period when summer hunting groups aggregated at traditional locations (known as finishing places [Damas 1984:400]) at the coast to permit the women to concentrate on sewing the winter garments. They stayed at those places until the sea ice became solid enough to move out to the winter snowhouses and sealing locations. The closest of these finishing places to the current study area was reported in Bathurst Inlet (Jenness 1922:278).

In general, the Kitikmiut's social focus was the nuclear family. No consistent larger groups, such as tribes, were known, nor was there a group hierarchy or leadership. In fact, historically, Kitikmiut were said to have believed in equality (Stevenson 1997:289-305). Summer hunting typically involved a single family, or two related families, travelling inland, with occasional larger groupings when people gathered at particularly good fishing or caribou hunting locations. Sometimes related people came together, other times, friends or acquaintances gathered. Usually, the fall sewing and winter sealing groups were the largest (Damas 1984:400).

The dispersal of family groups over the summer means that many summer sites would consist of one or two tents, marked by rings of stone which were used to hold down the edges of the tent. Because winter houses were composed of snow and ice, the only evidence left behind may be increased concentrations of organic matter and possibly, some artifact concentrations. Sometimes two or more houses were joined, both in winter and summer, which could result in adjoining stone rings (see Jenness 1922:85). Some stone rings may have served to hold down drying skins (Jenness 1922:82).

Other types of structures commonly constructed of the plentiful rocks included hunting blinds, caches, traps, graves, supports for kayaks or meat/fish drying racks, and signal rocks, or *inukshuit*. Prior to the acceptance of Christianity, Inuit graves simply involved wrapping the body in skins and placing it on the ground surface (Banci and Spicker 2016:28), sometimes surrounded by a ring of rocks. Graves covered with rocks to make a large cairn have been suggested to be from earlier times (Jenness 1992:174; see also McGhee 1972:66).

Lines of rock cairns or *inukshuit* were sometimes constructed for funneling caribou toward waiting hunters. Simpler propped-up rocks were used to mark locations or as guideposts (Jenness 1922:148).

Technology of the Kitikmiut at the time of contact was composed primarily of bone and antler implements with some stone and copper elements. Sealing was carried out with harpoons made of bone and wood. Caribou were hunted with bows and arrows, the former made of wood, antler or horn or often a combination of these materials, held together with sinew. Arrows were tipped with copper, bone, antler or iron. Fishing through ice was by copper, bone or iron hooks attached to a line. A variety of household implements such as lamps, cooking pots, baskets, scrapers, needles and knives were made of bone, stone, soapstone, wood and copper. Clothing, bedding and tents were made primarily from caribou skins. Transportation was by sled pulled by dogs and humans in winter while in summer, dogs and people would walk with packs on their backs. For summer hunting trips, most belongings were cached at the coast and only the necessities would be carried inland. According to Damas, in this central region, kayaks were used mainly for hunting caribou at lake and stream crossings rather than as a form of transportation (1984:405).

The historic period in the Bathurst Inlet region began with John Franklin's expedition passing along the coast in 1821 and touching on Roberts Bay and Hope Bay. The scientific expeditions of the early 1900s signified the beginning of more sustained contact. No fur trade posts were established within the project area, the closest being in Bathurst Inlet, Cambridge Bay, and Perry River. Consequently, there has been little European or Euro-Canadian presence in this specific project area until mineral exploration began in the 1960s by the Roberts Mining Company.

2.2.3.1 Previous Archaeological Investigations

Prior to 1995, no archaeological investigations had been conducted in the inland region immediately east of Bathurst Inlet. Within the larger Kitikmeot region, some previous work was completed west of Bathurst Inlet, both on the mainland coast and inland southwest of the inlet, with particular focus on the Burnside River and Back River; research was also conducted on Banks and Victoria islands to the north and northwest.

Early archaeological investigations in the Kitikmeot region occurred at the west end of Coronation Gulf where some house excavations were conducted by Capt. Bernard at Cape Krusenstern (reported by Jenness [1922:248]). Robert McGhee completed several years of archaeological research in coastal western Coronation Gulf and wrote extensively about Copper Inuit prehistory (1970, 1971, 1972). The work closest to the Hope Bay Project area was a survey of southern Bathurst Inlet by Morrison (1978) who recorded 61 sites.

A number of development-related archaeological studies have been completed in the Kitikmeot region west of Bathurst Inlet, including Blower 2003; Bussey 2005; Damkjar 1994; Fedirchuk 1999, 2001, 2003;

Prager 2006b, 2007b, 2009, 2013b; Rescan 2014; Tischer 2002. In 1994, a joint archaeology-oral history project was conducted on the lower Back River (Stewart 1994), and a similar project is ongoing at Iqaluktuuq on Victoria Island (Keith and Friesen n.d.)

The only archaeological site recorded in the immediate Project area prior to initiation of the Hope Bay Project archaeological investigations is NaNi-1 which is an undetermined site on the northeast shore of Hope Bay, reported by a geologist.

Local residents reported numerous archaeological and/or traditional sites in the surrounding area to the Nunavut Planning Commission Transition Team (NPCTT) (1996). Their report identifies a number of campsites and *inukshuit* on eskers within 10 km east and 20 km south of Aimaokatalok; it was reported that this area was used extensively for caribou hunting in the early 1900s or earlier. In the Nunavut Atlas, a number of archaeological sites are plotted along the Hope Bay and Melville Sound coast and some distance inland; the Koignuk River is identified as of considerable importance in resource gathering and a year round camp was reported there (Riewe 1992:167).

Archaeological field studies were conducted at Hope Bay in 1995, 1996, 1997, 2000, and every year since 2003 (Bussey 1995a, 1995b; Green 2008; Prager and Bussey 1997; Prager 1998, 2001, 2004, 2005, 2006a, 2007a, 2008, 2010, 2011a, 2012, 2013a, 2013b, 2014, 2016, 2017). These studies focused on planned exploration programs as well as proposed developments associated with Boston, Doris and Madrid deposits and in Roberts Bay. Over these years, much of the general study area has had some overview level assessment, but for the most part, the archaeological field studies have been focussed on proposed disturbance zones. Proposed development areas are the only locations examined intensively. Consequently, a large proportion of the Hope Bay greenstone belt remains not surveyed for archaeological resources.

2.2.3.2 Culture History

Culture history refers to a sequence of identifiable variations in archaeological assemblages through time. In this region, the culture history has not been well defined due to the limited amount of archaeological research focused on this problem throughout the region. However, a basic sequence can be identified. Since no archaeological studies were conducted in the area east of Bathurst Inlet prior to initiation of the Hope Bay Project investigations in 1995, it was necessary to extrapolate from adjacent areas to provide a preliminary culture history framework.

There is virtually no evidence for occupation of this central Arctic region prior to 3,500 years ago (McGhee 1972). That date marks the appearance of pre-Dorset (Maxwell 1984), also called Arctic Small Tool Tradition, in the central Arctic mainland (McGhee 1978). This is so named due to the small size of the finely made stone tools typically found. Archaeological field studies in the Hope Bay Belt have discovered shale artifacts at several sites. Such artifacts are typical of a cultural period known as Taltheilei which is well documented in the Barrenlands and northern boreal forest. Dates for this tradition in the central Barrenlands range from 2200 to 1800 years B.P. (Noble 1977). Subsequently, sites ascribed to Thule Tradition began appearing in the central Arctic approximately 1,000 years ago (McGhee 1984). Although a maritime whaling culture in other portions of the Arctic, Thule people adapted to the lack of whales in Coronation Gulf by focussing on ringed seals, caribou and fish. The latest confirmed Thule sites in the region are dated to 500 years ago. It is presently unclear if another group of people moved in later, or if some undated sites represent transition between Thule and the people historically called Copper Inuit. The historic inhabitants were identified as Copper Inuit by the first European visitor to the Coppermine River, Samuel Hearne, in 1771-72 (Hearne 1911); therefore, they were present in the region at least 250 years ago.

2.2.3.3 Hope Bay Archaeological Knowledge to Date

Field investigations conducted throughout the Hope Bay Belt combined with the background knowledge acquired during literature review and from available traditional knowledge studies have resulted in a good base of knowledge about where heritage resources are most likely to occur and the types of remains to be expected. In this project area, archaeological sites typically occur on low to moderate height terrain features along rivers, streams, and lakes (particularly at narrows), or on medium sized bedrock outcrops overlooking grassy meadows. These locations provided the best opportunities for caribou or muskox hunting as well as fishing. Low lying terrain, particularly muskeg or tussock tundra, is less likely to contain archaeological sites. Very high and rugged bedrock outcrops also have fewer archaeological sites. Stone features that have been recorded include stone circles representing tent rings, smaller skin drying circles, hunting blinds, caches, traps, hearths or windbreaks, pairs of piled rocks for drying racks or boat supports, and cairns. Several sites contain evidence of stone tool making, indicating greater age.

The 19 seasons of field studies completed in the Hope Bay Belt to 2017 have resulted in recording of 306 archaeological sites (Table 2.2-1). Overall, this region appears to have been well used seasonally throughout the known period of human occupation of approximately the past 3,500 years. It is not difficult to offer a reasonable hypothesis for this high level of use. The region is typified by large tracts of open tundra offering plentiful grazing areas for caribou and muskox together with frequent bodies of fresh water containing a variety of fish. The scattered bedrock outcrops provide excellent campsites and lookout sites, the plentiful rocks of various sizes supply building materials for structures and associated elements. The terrain offers comparatively easy travel routes.

Table 2.2-1. Archaeological Sites Record

Content	Sites	Investigation Status
Roberts Bay-Hope Bay		
stone circle	NbNh-4, 22	recorded
stone circles	NbNh-24	recorded
stone circle(s) + hearth(s)	NbNh-1,2	recorded
	NbNh-16	mapped, evaluated
	NbNh-23	mitigated
stone circle(s) + artifacts	NaNi-3, 5, 10; NbNh-3, 17, 29, 31	recorded
	NbNh-14	mapped, evaluated
	NbNh-13	mitigated
single rock feature	NbNh-6, 7, 11, 33, 45, 46	recorded
	NbNh-15	mapped, evaluated
multiple rock features	NaNi-9, 12; NbNh-8, 9, 34, 44, 49, 50, 51	recorded
	NbNh-27, 28, 47	mitigated
	NbNh-12	partly mitigated
multiple rock features + artifacts/bone	NaNi-4, 6, 7, 8; NbNh-5, 10, 18, 19, 21, 25, 30, 32	recorded
	NbNh-48	mitigated
lithic scatter	none	

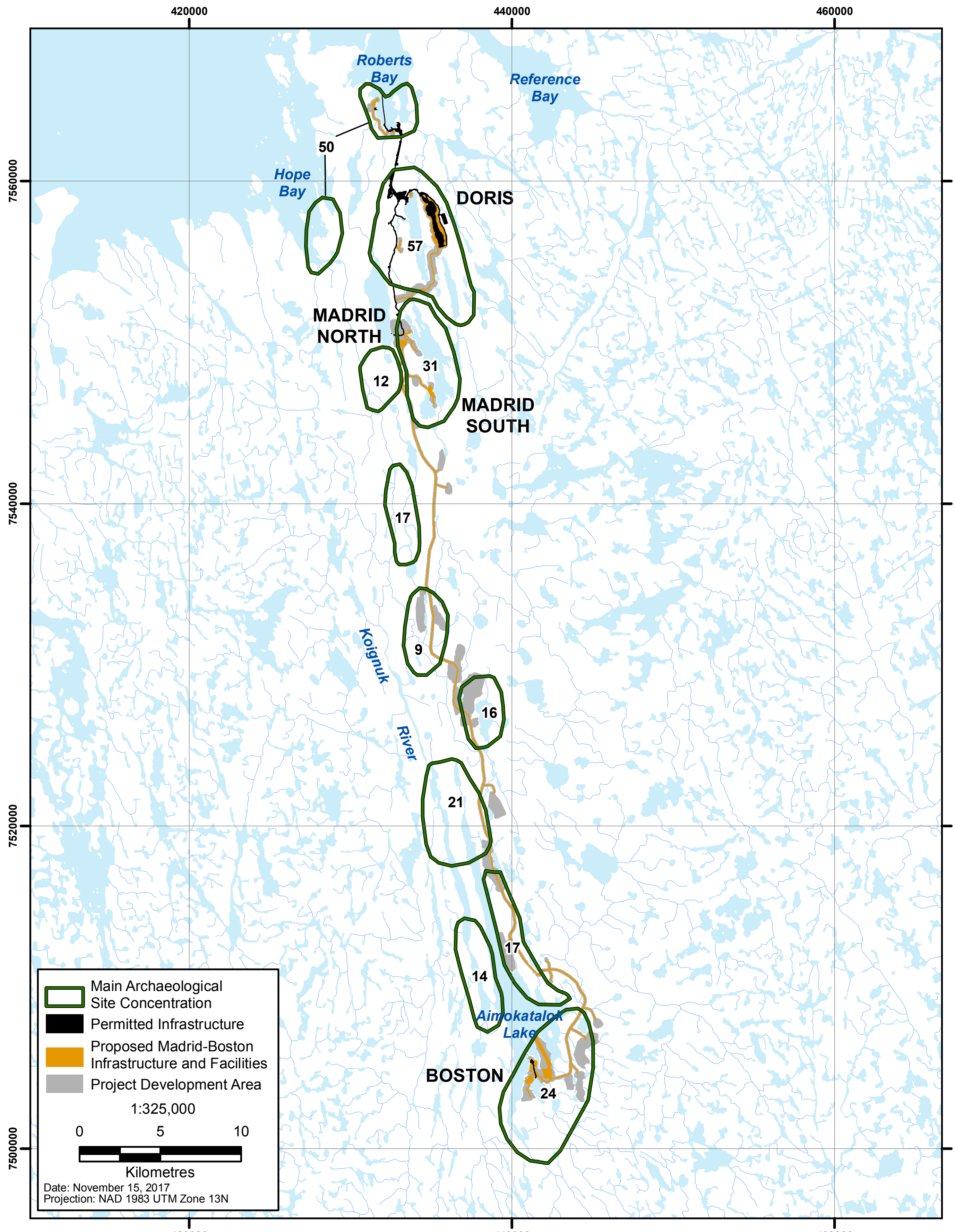
Content	Sites	Investigation Status
Doris-Tail-Patch Lakes + North Koignuk River		
stone circle	NaNh-15, 99	mapped, evaluated
	NaNh-19, 20, 24, 25, 26, 31, 32, 37, 46, 48, 72, 79, 80, 82, 106	recorded
	NaNh-30, 74, 85	mitigated
stone circles	NaNh-11, 13, 38, 39, 53, 81	recorded
stone circle(s) + hearth(s)	NaNh-6, 12, 34, 65, 67, 73, 89, 96, 101, 105	recorded
stone circle(s) + artifacts	NaNh-16	recorded
single rock feature	NaNh-27, 43, 50, 51, 52, 54, 56, 66, 68, 70, 75, 86, 91, 103; NbNh-43	recorded
	NaNh-28, 58, 62, 86	mitigated
multiple rock features	NaNh-3, 18, 23, 33, 35, 36, 42, 44, 55, 57, 77, 83, 84, 93, 94, 95, 97, 98, 102, 104, 107, 108, 109; NaNi-2	recorded
	NaNh-17, 100, 59	mapped, evaluated
	NaNh-7, 14, 49,63, 64, 90	mitigated
multiple rock features + artifacts/bone	NaNh-1, 2	mapped, evaluated
	NaNh-4, 8, 40, 76	mitigated
	NaNh-5, 10, 22, 29, 41, 45, 78, 87, 92; NaNi-11; NbNh-20, 26	recorded
lithic scatter	NaNh-21	recorded
non-features	NaNh-60, 61	delete from inventory
Central-North		
stone circle	MlNh-3, 4, 9, 11, 12, 13, 19, 28, 33, 35, 40, 47, 49, 53, 54; NaNh-9	recorded
stone circles	MlNh-2, 5, 6, 15, 16, 23, 25, 31, 32, 41, 43, 44, 56, 57	recorded
stone circle(s) + hearth(s)	MlNh-42	recorded
stone circle(s) + artifacts	MlNh-7, 8	recorded
single rock feature	MlNh-46; NaNh-88	recorded
multiple rock features	MlNh-10, 17, 18, 20, 21, 27, 29, 30, 34, 36, 37, 38, 39, 45, 48, 50, 51, 52, 55, 58; MlNi-1; NaNh-47	recorded
multiple rock features + artifacts/bone	MlNh-1	mapped, evaluated
	MlNh-14, 26; NaNh-69, 71	recorded
lithic scatter	MlNh-22, 24	recorded
Central-South		
stone circle	MkNh-9, 15, 24, 38, 43, 53	recorded
stone circles	MkNh-2, 6, 7, 17	recorded
stone circle(s) + hearth(s)	none	
stone circle(s) + artifacts/bone	MkNh-13, 27, 28	recorded
single rock feature	none	

Content	Sites	Investigation Status
Central-South (cont'd)		
multiple rock features	MkNh-16, 21, 22, 25, 41, 47, 48, 54, 55, 56, 57, 58	recorded
multiple rock features + artifacts/bone	MkNh-18, 19, 20, 23, 26, 40, 42, 51, 52	recorded
	MkNh-8	mapped, evaluated
lithic scatter	MkNh-37, 14, 29, 39	recorded
Aimaokatalok-South		
stone circle	MjNh-1	mitigated
	MjNh-17, 18; MkNh-32, 49, 50	recorded
stone circles	MjNh-11, 12, 16, 31, 35	recorded
stone circle(s) + hearth(s)	none	
stone circle(s) + artifacts	MjNg-2	recorded
	MjNh-3, 5; MkNh-1, 4, 5	mapped, evaluated
single rock feature	MjNh-15, 20, 21, 22; MkNh-46	recorded
single rock feature	MjNh-8	mitigated
multiple rock features	MjNg-3; MjNh-10, 13, 14; MkNh-10, 33, 34, 36, 44	recorded
	MjNh-4	mapped, evaluated
multiple rock features + artifacts/bone	MjNg-1, 4; MjNh-2, 19; MkNg-1; MkNh-3, 11, 12, 30, 45	recorded
	MjNh-6, 9	mapped, evaluated
lithic scatter	MkNg-2	recorded
isolated find	MjNh-7	mitigated

The distribution of the 306 archaeological sites recorded thus far provides interesting clues as to important use localities during various occupation periods (Figure 2.2-1). Sites are heavily concentrated in the vicinity of Aimaokatalok (Spyder Lake) and the southern section of the Koignuk River particularly at its confluence with Aimaokatalok (n = 76). Along the Arctic coast of Roberts Bay and Hope Bay, 50 sites have been recorded. Within the broad corridor containing Doris, Tail, Windy, and Patch lakes, 100 sites have been recorded. The remaining 80 archaeological sites have been found throughout the various portions of the Belt that have been spot checked; two additional focal points are around Gas Cache/Midway Lake (n = 16) and along the north-central section of the Koignuk River (n = 17). It must be noted that archaeological inventory surveys have been limited to potential development and exploration areas. Although it could be argued that the site distribution is at least partly due to the locations of archaeological surveys, the high site numbers indicate that these localities were important use areas. This is supported by information provided in the traditional knowledge study (Banci and Spicker 2016). It should be further noted that since a sizeable proportion of the Hope Bay Belt has not been surveyed, it is highly probable that unrecorded sites are still present elsewhere.

Representations of all cultural phases known in the central Arctic have been found in the Hope Bay Belt. The earliest archaeological sites, probably relating to the Pre-Dorset culture, have been found some distance inland, as have several sites suspected, on the basis of structural elements, to be from the early Thule period. These early sites, particularly those exhibiting evidence of stone tool making, are more frequent in the southern half of the study area, predominantly around Aimaokatalok. The

Figure 2.2-1
Main Archaeological Site Concentrations



several Taltheilei sites have also been recorded along the arms of Aimaokatalok. The sites along the Roberts Bay shoreline generally appear to be more recent, with a number of them containing historic artifacts. Historic period sites are also found around Aimaokatalok, indicating that location's ongoing resource importance. Traps are more frequent in the north half of the study area, particularly near Roberts Bay, suggesting later fur trade period use. This is supported by comments in the TK study (Banci and Spicker 2016:27). Although burial grounds are highly unlikely in this area due to the lack of long term habitation sites, isolated burials could be present and may be represented by elongated stone circles or cairns. There are no confirmed burials in the study area to date.

There is a notable lack of artifacts in the majority of the archaeological sites found thus far in the Hope Bay Belt. This appears to support the seasonal use pattern recorded by ethnographers for the Inuit of this region, a pattern that could be extended well into the past; that is, these remains represent short term summer hunting and/or fishing camps. Because people had to be very mobile, they carried as few tools and equipment as were absolutely necessary and those they did bring were carefully saved. The dominance of caribou bones and lesser amounts of muskox found within sites confirms the main subsistence focus. Due to the preliminary state of investigation of most of the recorded sites, it should be noted that careful surface inspection and subsurface testing may reveal some artifacts in some of these apparently empty sites; artifacts found in this situation could be even more meaningful due to their scarcity.

Because archaeological site excavations are destructive in themselves, sites are only mitigated when it is clear that they will be impacted, either directly or indirectly, and that there are no options for avoidance or adequate protection. The only exceptions to this are sites that are limited to a single surface feature with no possibility for additional remains. Such sites with low scientific value may be mitigated readily by detailed mapping if they are close to project activities. Over the history of the Hope Bay Project, 29 of the 306 sites have been mitigated by mapping to scale, surface examination/collection and excavations where judged necessary: 19 sites were mitigated around Roberts Bay and Doris-Patch lakes due to the Doris North mine development, and one site in Roberts Bay was partially mitigated with the remainder being protected by a barrier; four sites north of Patch Lake were mitigated due to intensive levels of exploration, two sites were fully mitigated and one partially in advance of Madrid developments; and, three sites were mitigated south of Boston camp due to their closeness to camp and limited information content. Two recorded features were recommended for removal from the site inventory because upon further assessment, it was concluded they are recent, not archaeological, features. Other sites have been assessed in detail (see Table 2.2-1) by careful inspection and subsurface testing, where necessary, due to their proximity to potential work areas. One of these sites was flagged for avoidance by exploration activities and is monitored periodically. The remaining sites have been simply recorded in a preliminary manner that involves marking the GPS coordinates, preparing a sketch map and taking photographs of all visible features and any surface artifacts. Each year, the exploration program and proposed developments have been and will continue to be compared to recorded site locations, potential for effects on recorded sites is assessed, and additional mitigation will be undertaken as necessary.

2.3 VALUED COMPONENTS

2.3.1 Potential Valued Components and Scoping

Valued Socio-economic Components (VSECs) are those components of the archaeological environment considered to be of scientific, cultural, or heritage importance (Volume 2, Section 4). The selection and scoping of VSECs considers heritage conditions and trends that may interact with the proposed Project, variability in heritage conditions over time, and data availability as well as the ability to measure heritage conditions that may interact with the Project and are important to the communities potentially impacted by the Project.

2.3.1.1 The Scoping Process and Identification of VSECs

The scoping of VSECs follows the process outlined in the Assessment Methodology (Volume 2, Section 4). VSECs considered for inclusion in the heritage resources effects assessment are based on an understanding of past, present and future environmental, economic, and social trends in the region with respect to heritage resources from a scientific and cultural perspective (NIRB 2012).

Heritage resources include archaeological sites, cultural use sites and areas identified as being of special significance by local people. Heritage resources are important sources of historical knowledge and cultural identity. Local communities, regional Inuit organizations, including the Kitikmeot Inuit Association (KIA), the Inuit Heritage Trust (IHT), and the Government of Nunavut (GN) all consider archaeological sites to be valuable.

The identified VSECs represent an appropriate starting point to guide the identification and scoping of VSECs (NIRB 2012). The selection of VSECs began with those proposed in the EIS guidelines and was further informed through consultation with communities, regulatory agencies, available TK, professional expertise, and the NIRB's final scoping report (Appendix B of the EIS Guidelines). For an interaction to occur there must be spatial and temporal overlap between a VEC or VSEC and Project component and/or activities. The determination of VSECs and potential effects for inclusion in this effects assessment considered and was informed by:

- Review of recently completed Nunavut EAs;
- Review of Doris North EIS;
- Requirements of the Department of Culture and Heritage;
- Consultation and engagement with local Inuit on site;
- The Environmental Impact Statement (EIS) guidelines and appendices (NIRB 2012b); and
- The public, during public consultation and open house meetings held in the Kitikmeot communities in May 2016 (see Volume 2, Section 3 Public Consultation).

2.3.1.2 NIRB Scoping Sessions

Scoping sessions hosted by NIRB (NIRB 2012) with key stakeholders and local community members (i.e., the public) focused on identifying the components that are important to local residents, as related to the Project. Comments made during these sessions were compiled and analysed as part of VEC or VSEC scoping. Questions regarding potential effects of the Project on archaeological sites were raised (see Table 4.3-1 in Volume 2, Section 4).

2.3.1.3 TMAC Consultation and Engagement Informing VSEC Selection

Community meetings for the Madrid-Boston Project were conducted in each of the five Kitikmeot communities as described in Volume 2, Section 3. The meetings are a central component of engagement with the public and an opportunity to share information and seek public feedback. Overall, the community meetings were well attended. Public feedback (questions, comments, and concerns) about the proposed Project was obtained through open dialogue during Project presentations, through discussions that arose during the presentation of Project materials and comments provided in feedback forms. Questions, comments, and concerns about archaeological sites related to:

- concerns regarding locations of and impacts on archaeological sites such as tent rings; and
- concerns about sites near the Project.

2.3.2 Valued Components Included in the Assessment

The factors selected to guide the assessment of the potential effects of the Project on heritage resources are those:

- that have potential to interact with the activities and components of the Project;
- identified as important by local communities, Inuit organizations, governments, regulators, and other stakeholders during consultation and engagement; and
- informed by Inuit IQ (Volume 2, Section 2) and professional judgement.

The scoping analysis identified archaeological remains as a VSEC for inclusion in the assessment. Archaeological sites represent the remains of past human activities and in Nunavut, must be older than 50 years where no ongoing use has occurred; consequently, these are considered the specific indicator VSEC for project effects on heritage resources.

There are different types of archaeological sites and each site is unique. Important elements related to heritage resources include the characteristics of the site assemblage and the integrity of archaeological resources (both features and artifacts) within the site. As a result, there are various degrees of possible information loss through disturbance of site remains.

In terms of cultural resources, the traditional knowledge study (Banci and Spicker 2016) identified travel routes and areas used in the past for resource gathering within the study area, and these are included in consideration of the archaeological resources. There are no communities within the Project area and no currently used camp sites. Occasional transitory hunting occurs through the Project area during winter, and the Roberts Bay area may periodically be used for hunting and fishing.

2.4 SPATIAL AND TEMPORAL BOUNDARIES

The spatial boundaries selected to shape this assessment are determined by the Project's potential impacts on the heritage resource. The potential disturbance to archaeological sites varies depending on distance from an activity and the type of activity.

Temporal boundaries that are selected consider the different phases of the Project and their durations. The Project's temporal boundaries reflect those periods during which various planned activities will occur and have potential to affect heritage resources.

The determination of spatial and temporal boundaries also takes into account the development of the entire Hope Bay Greenstone Belt. The assessment considers both the incremental potential effects of the Project as well as the total potential effects of the additional Project activities in combination with the existing and approved Projects including the Doris Project and advanced exploration activities at Madrid and Boston.

2.4.1 Project Overview

The Madrid-Boston Project consists of proposed mine operations at the Madrid North, Madrid South and Boston deposits. The Madrid-Boston Project is part of a staged approach to continuous development of the Hope Bay Project, comprised of existing operations at Doris and bulk samples followed by commercial mining at Madrid North, Madrid South, and Boston deposits. The Madrid-Boston Project would use and expand upon the existing Doris Project infrastructure.

The Madrid-Boston Project is the focus of this application. Because the infrastructure of existing and approved projects will be utilized by the Madrid-Boston Project, and because the existing and approved projects have the potential to interact cumulatively with the Madrid-Boston Project, existing and approved projects are described below.

2.4.1.1 Existing and Approved Projects

Existing and approved projects include:

- the Doris Project (NIRB Project Certificate 003, NWB Type A Water Licence 2AM-DOH1323);
- the Hope Bay Regional Exploration Project (NWB Type B Water Licence 2BE-HOP1222);
- the Madrid Advanced Exploration Program (NWB Type B Water Licence 2BB-MAE1727); and
- the Boston Advanced Exploration Project (NWB Type B Water Licence 2BB-BOS1727).

<u>The Doris Project</u>

The Doris Project was approved by NIRB in 2006 (NIRB Project Certificate 003) and licenced by NWB in 2007 (Type A Water Licence 2AM-DOH0713). The Type A Water Licence was amended in 2010, 2011 and 2012 and received modifications in 2009, 2010, and 2011.

Construction of the Doris Project began in early 2010. In early 2012, the Doris Project was placed into care and maintenance, suspending further Project-related construction and exploration activity along the Hope Bay Greenstone Belt. Following TMAC's acquisition of the Hope Bay Project in March of 2013, NWB renewed the Doris Project Type A Water Licence (Type A Water Licence 2AM-DOH1323), and TMAC advanced planning, permitting, exploration, and construction activities. In 2016, NIRB approved an amendment to Project Certificate 003 and NWB granted Amendment No. 1 to Type A Water Licence 2AM-DOH1323, extending operations from two to six years through mining two additional mineralized zones (Doris Connector and Doris Central zones) to be accessed via the existing Doris North portal. Amendment No. 1 to Type A Water Licence 2AM-DOH1323 authorizes a mining rate of approximately 2,000 tonnes per day of ore and a milling throughput of approximately 2,000 tonnes per day of ore. The Doris Project began production early in 2017.

The Doris Project includes the following components and facilities:

- The Roberts Bay offloading facility: marine jetty, barge landing area, beach laydown area, access roads, weather havens, fuel tank farm/transfer station, waste storage facilities and incinerator, and quarry;
- The Doris site: 280 person camp, laydown areas, service complex (e.g., workshop, wash bay, administration buildings, mine dry), two quarries (mill site platform and solid waste landfill), core storage areas, batch plant, brine mixing facilities, vent raise (3), air heating units, reagent storage, fuel tank farm/transfer station, potable water treatment, waste water treatment, incinerator, landfarm and handling/temporary hazardous waste storage, explosives magazine, and diesel power plant;
- Doris Mine works and processing: underground portal, overburden stockpile, temporary waste rock pile, ore stockpile, and ore processing plant (mill);
- Tailings Impoundment Area (TIA): Schedule 2 designation for Tail Lake with two dams (North and South dams), sub-aerial deposition of flotation tailings, emergency tailings dump catch basins, pump house, and quarry;

- All-season main road with transport trucks: Roberts Bay to Doris site (4.8 km, 150 to 200 tractor and 300 fuel tanker trucks/year);
- Access roads from Doris site used predominantly by light-duty trucks to: the TIA, the explosives magazine, Doris Lake float plane dock (previously in use), solid waste disposal site, and to the tailings decant pipe, from the Roberts Bay offloading facility to the location where the discharge pipe enters the ocean; and
- All-weather airstrip (914 m), winter airstrip (1,524 m), helicopter landing site and building, and Doris Lake float plane and boat dock.

Water is managed at the Doris Project through:

- freshwater input from Doris Lake for mining, milling, and associated activities and domestic purposes;
- freshwater input from Windy Lake for domestic purposes;
- process water input primarily from the TIA reclaim pond;
- surface mine contact water discharged to the TIA;
- underground mine contact water directed to the TIA or to Roberts Bay via the marine outfall mixing box (MOMB);
- treated waste water discharged to the TIA; and
- water from the TIA treated and discharged to Roberts Bay via a discharge pipeline, with use of a MOMB.

<u>Hope Bay Regional Exploration Project</u>

The Hope Bay Regional Exploration Project has been renewed several times since 1995. The current extension expires in June 2022. Much of the previous work for the program was based out of Windy Lake and Boston camps. These camps were closed in October 2008 with infrastructure either decommissioned or moved to the Doris site. All exploration activities are now based from the Doris site. Components and activities for the Hope Bay Regional Exploration Project include:

- operation of helicopters from Doris; and
- the use of exploration drills, which are periodically moved by roads and by helicopter as required.

<u>Madrid Advanced Exploration</u>

In 2017, the NWB issued a Type B Water Licence (2BB-MAE1727) for the Madrid Advanced Exploration Program to support continued exploration and a bulk sample program at the Madrid North and Madrid South sites, located approximately 4 km south of the Doris site. The program includes extraction of a bulk sample totaling 50 tonnes from each of the Madrid North and South locations, which will be trucked to the mill at the Doris site for processing and placement of tailings in the tailings impoundment area (TIA). All personnel will be housed in the Doris camp. The Madrid Advanced Exploration Program includes the following components and activities.

- Use of existing infrastructure associated with the Doris Project:
    - camp facilities to support up to 70 personnel as required to undertake the advanced exploration activities;
    - mill to process ore;

    - TIA;
    - landfill and hazardous waste areas, particularly if closure and remediation becomes required for the Madrid Advanced Exploration Program infrastructure;
    - fuel tank farms; and
    - Doris airstrip and Roberts Bay facility for transport of personnel and supplies.
- Use of existing infrastructure at the Madrid and Boston areas:
    - borrow and rock quarry facilities: existing Quarries A, B, and D along the Doris-Windy all-weather road (AWR);
    - AWR between Doris and Windy Lake for transportation of personnel, ore, waste, fuel, and supplies; and
    - future mobilization of existing exploration site infrastructure, should it become necessary.
- Construction of additional facilities at Madrid North and South:
    - access portals and ramps for underground operations at Madrid North and at Madrid South;
    - 4.7 km extension of the existing AWR originating from the Doris to the Windy exploration area (Madrid North) to the Madrid South deposit, with branches to Madrid North, Madrid North vent raise, and the Madrid South portal;
    - development of a winter road route (WRR) from Madrid North to access Madrid South until AWR has been constructed;
    - borrow and rock quarry facilities; two quarries referenced as Quarries G and H;
    - waste rock and ore stockpiles;
    - water and waste management structures; and
    - additional site infrastructure, including compressor building, brine mixing facility, saline storage tank, air heating facility, four vent raises, workshop and office, laydown area, diesel generator, emergency shelter, fuel storage facility/transfer station.
- Undertaking of advanced exploration access to aforementioned deposits through:
    - continue field mapping and sampling, as well as airborne/ground/downhole geophysics;
    - diamond drilling from the surface and underground; and
    - bulk sampling through underground mining methods and mine development.

<u>Boston Advanced Exploration</u>

The Boston Advanced Exploration Project Type B Water Licence No. 2BB-BOS1217 was renewed as Water Licence No. 2BB-BOS1727 in July 2017 and includes:

- the Boston camp (65 person), maintenance shops, workshops, laydown areas, water pumphouse, vent raise, warehouse, site service roads, sewage and greywater treatment plant, fuel storage and transfer station, landfarm, solid waste landfill and a heli-pad;
- mine works, consisting of underground development for exploration drilling and bulk sampling, waste rock and ore stockpiles;
- potable water and industrial water from Aimaokatalok Lake; and
- treated sewage and greywater discharged to the tundra.

2.4.1.2 The Madrid-Boston Project

The Madrid-Boston Project includes: the Construction and Operation of commercial mining at the Madrid North, Madrid South, and Boston sites; the continued operation of Roberts Bay and the Doris site to support mining at Madrid and Boston; and the Reclamation and Closure and Post-closure phases of all sites. Excluded from the Madrid-Boston Project for the purposes of the assessment are the Reclamation and Closure and Post-closure components of the Doris Project as currently permitted and approved.

<u>Construction</u>

Madrid-Boston construction will use the infrastructure associated with Existing and Approved Projects. This may include:

- an all-weather airstrip at the Boston exploration area and helicopter pad;
- seasonal construction and/or operation of a winter ice strip on Aimaokatalok Lake;
- Boston camp with expected capacity for approximately 65 people during construction
- Quarry D Camp with capacity for up to 180 people;
- seasonal construction/operation of Doris to Boston WRR;
- three existing quarry sites along the Doris to Windy AWR;
- Doris camp with capacity for up to 280 people;
- Doris airstrip, winter ice strip, and helicopter pad;
- Roberts Bay offloading facility and road to Doris; and
- Madrid North and Madrid South sites and access roads.

Additional infrastructure to be constructed for the proposed Madrid-Boston Project includes:

- expansion of the Doris TIA (raising of the South Dam, construction of West Dam, development of a west road to facilitate access, and quarrying, crushing, and screening of aggregate for the construction);
- construction of a cargo dock at Roberts Bay (including a fuel pipeline, mooring points, beach landing and gravel pad, shore manifold);
- construction of an additional tank farm at Roberts Bay (consisting of two 10 ML tanks);
- expansion of Doris accommodation facility (from 280 to 400 person), mine dry and administrative building, water treatment at Doris site;
- expansion of the Doris mill to accommodate concentrate handling on the south end of the building facility and rearrangement of indoor crushing and processing within the mill building;
- complete development of the Madrid North and Madrid South mine workings;
- incremental expansion of infrastructure at Madrid North and Madrid South to accommodate production mining, including vent raise, access road, process plant buildings;
- construction of a 1,200 tpd concentrator, fuel storage, power plant, mill maintenance shop, warehouse/reagent storage at Madrid North;
- all weather access road and tailings line from Madrid North to the south end of the TIA;
- AWR linking Madrid to Boston (approximately 53 km long, nine quarries for permitting purposes, four of which will likely be used);
- all-weather airstrip, airstrip building, helipad and heliport building at Boston;
- construction of a 2,400 tpd process plant at Boston;

- all infrastructure necessary to support mining and processing activities at Boston including construction of a new 300-person accommodation facility, mine office and dry and administration buildings, additional fuel storage, laydown area, ore pad, waste rock pad, diesel power plant and dry-stack tailings management area (TMA);
- infrastructure necessary to support ongoing exploration activities at both Madrid and Boston; and
- wind turbines near the Doris (2), Madrid (2), and Boston (2) sites.

Operation

The Madrid-Boston Project Operation phase includes:

- mining of the Madrid North, Madrid South, and Boston deposits by way of underground portals and Crown Pillar Recovery;
- operation of a concentrator at Madrid North;
- transportation of ore from Madrid North, Madrid South, and Boston to the Doris process plant, and transporting the concentrate from the Madrid North concentrator to the Doris process plant;
- extending the operation at Roberts Bay and Doris;
- processing the ore and/or concentrate from Madrid North, Madrid South, and Boston at the Doris process plant with disposal of the detoxified tailings underground at Madrid North, flotation tailings from the Doris process plant pumped to the expanded Doris TIA, and discharge of the TIA effluent to the marine environment;
- operation of a concentrator at Madrid North and disposal of tailings at the Doris TIA;
- operation of a process plant and wastewater treatment plant at Boston with disposal of flotation tailings to the Boston TMA and a portion placed underground and the detoxified leached tailings placed in the underground mine at Boston;
- operation of two wind turbines for power generation; and
- ongoing maintenance of transportation infrastructure at all sites (cargo dock, jetty, roads, and quarries).

Reclamation and Closure

Areas which are no longer needed to carry out Madrid-Boston Project activities may be reclaimed during Construction and Operation.

At Reclamation and Closure, all sites will be deactivated and reclaimed in the following manner:

- Camps and associated infrastructure will be disassembled and/or disposed of in approved non-hazardous site landfills.
- Non-hazardous landfills will be progressively covered with quarry rock, as cells are completed. At final closure, the facility will receive a final quarry rock cover which will ensure physical and geotechnical stability.
- Rockfill pads occupied by construction camps and associated infrastructure and laydown areas will be re-graded to ensure physical and geotechnical stability and promote free-drainage, and any obstructed drainage patterns will be re-established.
- Quarries no longer required will be made physically and geotechnically stable by scaling high walls and constructing barrier berms upstream of the high walls.

- Landfarms will be closed by removing and disposing of the liner, and re-grading the berms to ensure the area is physically and geotechnically stable.
- Mine waste rock will be used as structural mine backfill.
- The Doris TIA surface will be covered waste rock. Once the water quality in the reclaim pond has reached the required discharge criteria, the North Dam will be breached and the flow returned to Doris Creek.
- The Madrid to Boston AWR and Boston Airstrip will remain in place after Reclamation and Closure. Peripheral equipment will be removed. Where rock drains, culverts or bridges have been installed, the roadway or airstrip will be breached and the element removed. The breached opening will be sloped and armoured with rock to ensure that natural drainage can pass without the need for long-term maintenance.
- A low permeability cover, including a geomembrane, will be placed over the Boston TMA. The contact water containment berms will be breached and the liner will be cut to prevent collecting any water. The balance of the berms will be left in place to prevent localized permafrost degradation.

2.4.2 Spatial Boundaries

Three levels of spatial boundaries are used to assess potential effects of the Project on heritage resources.

2.4.2.1 Project Development Area

The Project Development Area (PDA) is shown in Figure 2.4-1 and is defined as the area which has the potential for infrastructure to be developed as part of the Madrid-Boston Project. The PDA includes engineering buffers around the footprints of structures. These buffers allow for latitude in the final placement of a structure through later design and construction phases, reflecting the certainty of design and construction. Compounds with buildings and other infrastructure in close proximity are defined as pads with buffers whereas roads are defined as linear corridors with buffers. The buffers for pads vary depending on the local physiography and other buffered features such as sensitive environments or riparian areas. The average engineering buffer for roads is 100 m either side.

Since the infrastructure for the Doris Project is in place, the PDA exactly follows the footprints of these features. In all cases, the PDA does not include the Madrid–Boston Project design buffers applied to potentially environmentally sensitive features. These are detailed in Volume 3, Section 2 (Project Design Considerations).

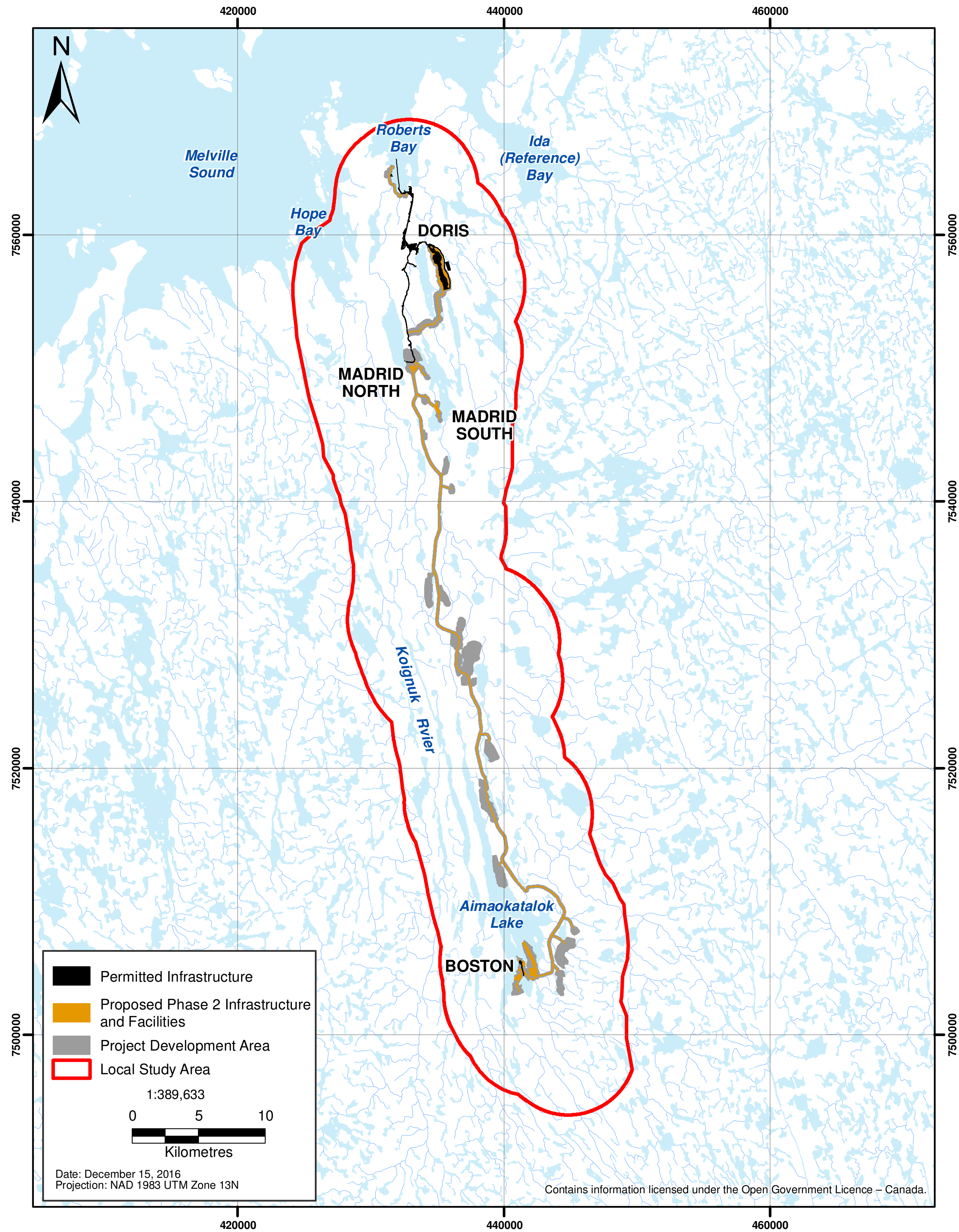
2.4.2.2 Local Study Area

The Local Study Area (LSA) is defined as the PDA and the area surrounding the PDA within which there is a reasonable potential for immediate effects on an archaeological site due to an interaction with a Project component(s) or physical activity.

The LSA for heritage resources comprises the proposed Project infrastructure with an approximate 5 km buffer (Figure 2.4-1). This is the area within which sites may be subject to indirect Project-related effects.

The PDA and LSA comprise the zone within which direct and indirect effects are most likely to occur. Impacts to archaeological sites are location-specific and direct impacts are unlikely outside the PDA, while indirect effects are not expected outside the LSA. The types of effects are defined in Section 2.5.2.

Figure 2.4-1
Archaeology Local Study Area



2.4.2.3 Regional Study Area

The Regional Study Area for heritage resources is only relevant to the cumulative effects analysis. Individual archaeological sites are limited in size and direct effects are localized to that specific location, therefore, a regional study area to assess direct impacts is not appropriate. However, to provide the necessary spatial and temporal context for cumulative effects analysis, the Regional Study Area (RSA) is here defined as the area traditionally used by the Copper Inuit (as defined by early ethnographers), now known as the Kitikmeot. This RSA is required because past inhabitants were semi-nomadic to nomadic, covering this large area each year to harvest specific natural resources. Therefore, those sites where remains were left behind throughout the region are linked. Consequently, the RSA extends from just west of Kugluktuk, north to encompass the southern portion of Victoria Island, east to include Kent Peninsula and Bathurst Inlet, and southeast to Contwoyto Lake, encompassing the northern portion of the Coppermine drainage system (Figure 2.4-2).

2.4.3 Temporal Boundaries

The Project represents a significant development in the mining of the Hope Bay Greenstone Belt. Even though this Project spans the conventional Construction, Operation, Reclamation and Closure, and Post-closure phases of a mine project, the Madrid-Boston Project is a continuation of development currently underway. The Project has four separate operational sites: Roberts Bay, Doris, Madrid (North and South), and Boston. The development of these sites is planned to be sequential. As such, the temporal boundaries of this Project overlap with a number of Existing and Approved Authorizations (EAAs) for the Hope Bay Project and the extension of activities.

For the purposes of the EIS, distinct phases of the Project are defined (Table 2.4-1). It is understood that construction, operation and closure activities will, in fact, overlap among sites; this is outlined in Table 2.4-1 and further described in Volume 3, Section 2 (Project Design Considerations).

Table 2.4-1. Temporal Boundaries for the Effects Assessment for Archaeology

Phase	Project Year	Calendar Year	Length of Phase (Years)	Description of Activities
Construction	1 - 4	2019 - 2022	4	• **Roberts Bay:** construction of access road (Year 1), marine dock and additional fuel facilities (Year 2 – Year 3) • **Doris**: expansion of the Doris TIA and accommodation facility (Year 1) • **Madrid North:** construction of concentrator and road to Doris TIA (Year 1 – Year 2) • **All-weather Road**: construction (Year 1 – Year 3) • **Boston**: site preparation and installation of all infrastructures including process plant (Year 2 – Year 5)
Operation	5 - 14	2023 - 2032	10	• **Roberts Bay**: shipping operations (Year 1 – Year 14) • **Doris**: processing and infrastructure use (Year 1 – Year 14) • **Madrid North:** mining (Year 1 – 13); ore transport to Doris process plant (Year 1 -13); ore processing and concentrate transport to Doris process plant (Year 2 – Year 13) • **Madrid South:** mining (Year 11 – Year 14); ore transport to Doris process plant (Year 11 – Year 14) • **All-weather Road**: operational (Year 4 – Year 14) • **Boston**: winter access road operating (Year 1 – Year 3) mining (Year 4 – Year 11); ore transport to Doris process plant (Year 4 – Year 6); and processing ore (Year 5 – Year 11)

Phase	Project Year	Calendar Year	Length of Phase (Years)	Description of Activities
Reclamation and Closure	15 - 17	2033 - 2035	3	• **Roberts Bay**: facilities will be operational during closure (Year 15 – Year 17) • **Doris**: camp and facilities will be operational during closure (Year 15 – Year 17); mine, process plant, and TIA decommissioning (Year 15 – Year 17) • **Madrid North:** all components decommissioned (Year 15 – Year 17) • **Madrid South:** all components decommissioned (Year 15 – Year 17) • **All-weather Road**: road will be operational (Year 15 – Year 16); decommissioning (Year 17) • **Boston**: all components decommissioned (Year 15 – Year 17)
Post-closure	18 - 22	2036 - 2040	5	• **All Sites:** Post-closure monitoring
Temporary Closure	Not Available	Not Available	Not Available	• **All Sites:** Care and maintenance activities, generally consisting of closing down operations, securing infrastructure, removing surplus equipment and supplies, and implementing on-going monitoring and site maintenance activities

The assessment also considers a Temporary Closure phase should there be a suspension of Project activities during periods when the Project becomes uneconomical due to market conditions. During this phase, the Project would be under care and maintenance. This could occur in any year of Construction or Operation with an indeterminate length (one- to two-year duration would be typical).

2.5 PROJECT-RELATED EFFECTS ASSESSMENT

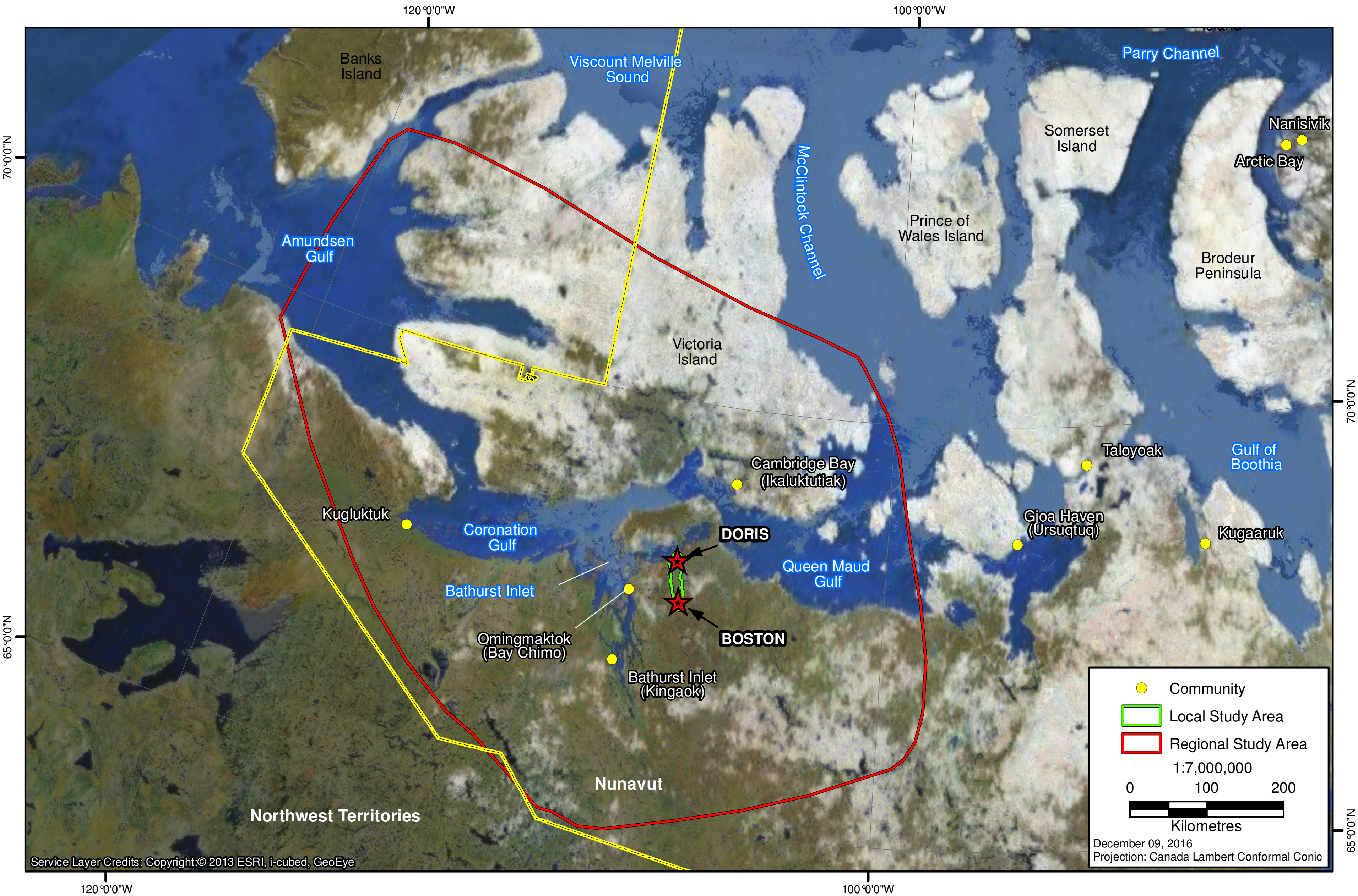
2.5.1 Methodology Overview

This assessment follows a methodology used to identify and assess the potential environmental effects of the Project, and is consistent with the requirements of Section 12.5.2 of the Nunavut Agreement and the EIS Guidelines. The effects assessment evaluates the potential direct and indirect effects of the Project on the environment and follows the general methodology provided in Volume 2, Section 4 (Effects Assessment Methodology), and comprises a number of steps that collectively assess the manner in which the Project will interact with the identified VSEC defined for this assessment (Section 2.3).

To provide a comprehensive understanding of the potential effects for the Madrid-Boston Project, Madrid-Boston components and activities are assessed on their own, as well as in the context of the Existing Projects within the Hope Bay greenstone belt. The effects assessment process is undertaken as summarized below:

- Identify potential interactions between the Madrid-Boston Project and the VECs or VSECs;
- Identify the resulting potential effects of those interactions;
- Identify mitigation or management measures to eliminate or reduce the potential effects;
- Identify residual effects (potential effects that would remain after mitigation and management measures have been applied) for Madrid-Boston in isolation;
- Identify residual effects of Madrid-Boston in combination with the residual effects of Approved Projects; and
- Determine the significance of combined residual effects.

Figure 2.4-2
Location of the Hope Bay Project within the Local and Regional Study Areas



Heritage Resources include archaeological sites, cultural use sites and areas identified as being of special significance by local people. In the past, the Hope Bay area was used primarily for seasonal hunting and fishing, and it has seen little such use in recent years. There are no reported or known localities of special significance to local communities. Consequently, consideration of effects on archaeological sites will encompass effects on heritage resources in general in the Project area.

In order to determine how best to protect and/or mitigate heritage resources, it is necessary to identify the possible impacts and their severity on those resources. To achieve this goal, the locations, sizes and contents of archaeological deposits must be identified. To this end, the field programs conducted over 19 seasons were focused on areas of potential development or exploration activities. Once archaeological sites are identified, the potential information content is evaluated, as described in the Baseline section, and the possibilities for avoidance or disturbance are determined.

There are two study limitations that provide uncertainty in this impact assessment. One limitation is that, due to continuing refinement of Project plans up to this point, not all of the proposed Project components have been thoroughly examined by ground reconnaissance and there may be unrecorded archaeological sites present in those areas not intensively surveyed. This presents some uncertainty in terms of predicting impacts. The discussion to follow will point out the specific components where this is the case, primarily the road and quarries. This uncertainty will later be removed by ensuring all Project components are thoroughly examined once the exact limits of anticipated disturbance are determined as per the Heritage Resources Protection Plan.

The second source of uncertainty in this impact assessment is that the Project PDA encompasses a larger area than will be used for the Project infrastructure in order to permit some detailed design and in the field considerations. This uncertainty has been addressed in this impact assessment by conservatively describing all potential impacts considered possible at this time, but it is considered likely that some of the sites can be avoided prior to construction. The detailed design of the Phase 2 Project facilities may permit avoidance of some potential impacts, since archaeological sites are typically of limited size and can be readily avoided.

Over the 19 field seasons of archaeological survey completed in the Hope Bay Project area, most of the portions to be affected by the Madrid-Boston Project have been viewed to some degree and some sections have been examined intensively. Given the irregular landscape, the size of the Hope Bay Project area, and the nature of the archaeological sites, there will be some uncertainty with regard to whether all archaeological resources in a particular portion of the area have been recorded. This high degree of research on this ongoing project has provided a unique and intimate level of knowledge of not only the archaeological sites that have been recorded but also the potential for unrecorded archaeological resources across the landscape. Consequently, although there is always some uncertainty, this degree of uncertainty for the Madrid-Boston Project is considered comparatively low, and it will be readily managed by procedures (described in detail below) that have already been in place for a number of years that will ensure that all areas of proposed development will be thoroughly examined prior to disturbance and further, that the established mitigation measures (detailed below) will be applied.

2.5.2 Identification of Potential Effects

Archaeological sites are non-renewable resources that are sensitive to ground-disturbing activities. They are of limited size and can be disrupted easily. Conversely, the limited size of most sites makes them readily avoidable, if the presence of the archaeological deposits is known. Therefore, it is important to conduct inventory surveys prior to any proposed ground disturbance and, further, to continue to keep the potential presence of archaeological resources in mind as project development proceeds.

Several types of effects on archaeological sites may occur as the result of a development project. The physical disturbance of the location of an archaeological site or artifact by an activity causing ground disturbance such as those associated with construction or development is a direct effect (Table 2.5-1). These activities include clearing and levelling of the ground, excavations, erection of buildings and other facilities, blasting of quarries, grading and building of roads. These effects are permanent and irreversible. In this study the PDA represents the area within which direct effects on archaeological sites are possible. Because many of the sites in this study area are characterized by above ground stone features, such a site can be disturbed by activities that occur on the surface but do not necessary disturb the ground, such as travel by vehicles, particularly tracked vehicles. Indirect effects include disturbance caused by some peripheral activity, or simply by the proximity of the development. An example is the presence of higher numbers of people in the area, perhaps travelling off road, which can increase the potential for disturbance of sites at some distance from the actual development limits. These may result in the loss of part of a site, by collection of artifacts, for example. In this study, the LSA represents the area within which indirect effects are considered possible.

Table 2.5-1. Madrid-Boston Project Interaction with Heritage Resources

Project Component/Activity	Potential Effect*
Construction	
Roberts Bay	
Cargo dock and associated quarry	NbNh-24
Dock access road	NbNh-17, 49, 50; possible direct/indirect
Tank farm + quarry	NbNh-45
Doris	
Within PDA but outside proposed footprint	possible indirect
Raising TIA	NaNh-31, 32, 35, 36
TIA west dam	NaNh-31, 32, 35
TIA perimeter road extensions	possible direct
Road to TIA South Dam + quarry	NaNh-44, 56 ,57, 107, 108, 109; possible direct/indirect
Madrid North	
Existing infrastructure	NaNh-12
Within PDA but outside proposed footprint	NaNh-59, 104
Madrid South	
Ore stockpile	NaNh-101
Quarry	NaNh-8 (partial)
Site roads	possible direct/indirect
Doris-Madrid S road	NaNh-102
Within PDA	NaNh-1
Expansion of site pad	possible direct/indirect
Madrid-Boston Roads	
Roberts Bay-Madrid-Boston winter road	MlNh-17, NaNh-75, 102; possible direct/indirect
All-weather road	MlNh-4, 20, MkNg-2; + possible direct/indirect
Quarries	MlNh-14,15, 27, 29, 30, 31, 34, 42, 46, 48, 49, 57, 58; MkNh-40, 41, 43, 52, 53, 56; MjNg-4; + possible direct/indirect

Project Component/Activity	Potential Effect*
Construction	
Boston	
Within PDA	MjNh-9, MjNh-5
Ore stockpile	possible direct/indirect
Quarries	possible direct/indirect
Waste rock stockpile	possible direct/indirect
TMA	MjNh-3
Site roads	possible direct/indirect
Airstrip PDA	MkNh-1
Airstrip access road	possible direct/indirect
Operation	
Use of existing camps	indirect
Use of existing cargo dock/laydowns	indirect
Use of quarries	possible direct/indirect
Use of inter-site roads	possible direct/indirect
Use of Doris to Boston All Weather Road	indirect
Expansions of infrastructure	possible direct/indirect
Reclamation/Closure	
Regrading, covering footprint	possible direct/indirect
Quarrying for fill	possible direct/indirect

**All components listed here have been assessed to some level, and recorded sites are referenced in this table where conflicts are anticipated. Where Project components have not been surveyed fully to a detailed level, "possible direct/indirect" has been indicated. Full detailed surveys would occur prior to construction.*

The immediate effect of ground disturbance on specific archaeological resources is negative, since important context information is disturbed or lost. However, positive effects can occur prior to the actual disturbance. Many sites are now being recorded and investigated because of potential development. This provides the opportunity to add valuable information to the scientific and cultural knowledge of past inhabitants of a region which is a positive effect.

2.5.3 Characterization of Potential Project-related Effects

The potential effects of the Project on heritage resources are presented by Project phase. Of the 306 archaeological sites recorded thus far on the Hope Bay Belt, 51 undisturbed/partly protected sites fall within the Madrid-Boston PDA, that is, subject to possible direct impacts, while the number of sites within the LSA is 258. These totals exclude the 29 sites that are already fully mitigated due to previous Hope Bay Project activities and the two sites deemed non-archaeological.

Most of the sites recorded within the Hope Bay Belt contain stone structures such as rings (used to hold down the edges of tents or hides for drying), hearths, clusters representing traps or storage structures, and marker stones. There are several sites that contain stone tool making debris. Scattered bone fragments within sites are common, but formed tools occur less frequently. While there are certainly single feature sites (most often stone circles) recorded in the Hope Bay Project area, the majority of sites contain several features. Some sites cover a large area and contain a variety of features. To date no human remains have been identified. The potential effects on sites within the PDA are discussed below.

Construction Phase

The primary adverse environmental effects of the Project on heritage resources can be expected to result from construction of associated infrastructure. The clearing and levelling of ground for infrastructure pads, blasting of quarries, and the building of roads are the primary sources of disturbance within Roberts Bay, Madrid and Boston sites. Temporary facilities such as construction camps and staging areas also can affect archaeological sites.

In Roberts Bay, most of the infrastructure required for Madrid-Boston has already been built during the Doris project, and those affected sites are already fully mitigated. Two proposed Project components may affect five recorded sites. A proposed tank farm and quarry encompasses NbNh-45, and a cargo dock and associated access may affect NbNh-17, NbNh-24, NbNh-49 and NbNh-50. The cargo dock has been fully surveyed and a first pass survey of the access road was completed; there is some potential for additional resources along the road. If any sites are found during detailed ground surveys, appropriate mitigation would be proposed.

Current plans include higher water levels for the TIA from those proposed for Doris as well as an additional dam on the southwest side. This will result in two of the recorded sites being impacted (NaNh-31, 35) and they will be mitigated by systematic data recovery. Two other sites (NaNh-32, NaNh-36) are within the PDA for the TIA and may require some form of mitigation, either protection or data recovery, if they cannot be avoided by sufficient distance. There is only a small chance that any unrecorded sites are present within the proposed TIA area, but a thorough survey will be conducted prior to construction initiation.

Madrid North and Madrid South both include areas that have been subjected to past intensive exploration. The proposed location for Madrid N infrastructure was covered by ground reconnaissance in 2017. There are five known sites within the PDA for Madrid North, two of those have been mitigated (NaNh-40, NaNh-99), one has been assessed in detail (NaNh-59) and two are just recorded (NaNh-12, NaNh-104). All these sites except for NaNh-12 appear to be avoidable, but potential for impacts will be further assessed during the detailed design phase, and appropriate mitigation measures will be applied where needed. NaNh-12 is within a proposed vent raise area and will be mitigated. The Madrid South PDA contains five recorded archaeological sites: NaNh-74 and NaNh-7 are mitigated, NaNh-8 is partly mitigated, and NaNh-1 and NaNh-101 have been recorded. NaNh-8 is a site with nine features that are widely dispersed in three main clusters; two groups of features lie within the proposed quarry and those have been mitigated. The south two features are a sufficient distance that they can be protected and monitored. The status of NaNh-1 and NaNh-101 and consequent needs for further investigation and possible mitigation will be reassessed once the detailed design is complete.

A preliminary survey was completed in 2017 of a road route proposed between the south end of the TIA and the Doris-Windy road just north of the Madrid North PDA. The PDA for this road contains five sites: NaNh-44, NaNh-56, NaNh-57, NaNh-107, and NaNh-108. Because these are either small, easily avoided sites or located on elevated landforms and the road PDA provides some room for realignment, direct impact on the sites may be avoidable by careful design. One site was found within the associated quarry, NaNh-109. These sites will be assessed in detail to provide size and content parameters to assist in the assessment of avoidance possibilities or mitigation needs. This route will be closely examined once it is firmly sited.

Along the road between Madrid N and Madrid S, one site (NaNh-102) is within the PDA, about 75 m from the centre line. Slight realignment can increase the distance, but at the current distance, this site will be assessed in detail, and then be subject to periodic monitoring. There is one site (NaNh-76) within Quarry G along this road; because of the position of this site within the quarry, it is considered unavoidable and has been subjected to site data recovery. No additional unrecorded sites are expected within this quarry and the road as currently sited because these were carefully inspected.

Development of potential quarries will have the most potential to affect archaeological sites, both known and unknown, since the potential quarries encompass the bedrock outcrops typically favoured by past people for camping, travel, and lookouts. The PDA surrounding the all-weather road between Madrid North and Boston and the currently identified quarries along the road could potentially affect 23 of the known archaeological sites (see Table 2.5-1). This total is expected to be reduced during the detailed design phase since not all of these proposed quarries will be used, sizes of some quarries may be reduced, and there are opportunities to realign the road slightly to avoid archaeological sites. However, it must be noted that this road route and the potential quarries have not been fully covered by archaeological ground surveys; therefore, additional sites are likely to be present. Thorough surveys will be completed of the finalized road route and those specific portions of the quarries that are identified for use. Any sites that are found will be subjected to the same mitigation considerations as noted above.

From Madrid South to Boston, seven recorded sites that could be affected by the all-weather road are MlNh-4, MlNh-20, MlNh-34, MlNh-58, MkNh-40, MkNh-43, and MkNg-2. Some minor realignment can reduce the potential for direct effects on MlNh-4, MlNh-20, and MkNg-2, and this will be considered during detailed design. If avoidance can be achieved, these sites will be protected and periodically monitored as needed. The remaining sites are within quarries and will be less likely to be avoided by those effects.

Within the quarry PDAs along the road to Boston, there are 16 recorded sites in addition to the four sites listed above as potentially affected by the road (MlNh-34, MlNh-58; MkNh-40, MkNh-43), for a total of 20: MlNh-14, MlNh-15, MlNh-27, MlNh-29, MlNh-30, MlNh-31, MlNh-42, MlNh-46, MlNh-48, MlNh-49, MlNh-57, MkNh-41, MkNh-52, MkNh-53, MkNh-56, MkNg-4. Five sites (MlNh-30, MlNh-31, MkNh-52, MkNh-56, and MkNg-4) are near the edges of the quarry PDAs and direct effects potentially could be avoided by reducing the quarry size, if that is feasible. However, given the nature of quarrying and blasting activities, some effects such as debris fall could still impact the sites. Depending on proximity to the activities, mitigation measures to be considered could include special blasting procedures and protective covering and barriers, or alternatively, full site data recovery.

It is planned to use a winter road between Doris and Boston during the construction phase, following an established route that has been routinely used for past exploration activities. Several branches between Roberts Bay, Windy Lake, Doris Lake and Patch Lake have been used in the past and could be used again. Because winter roads are typically placed mainly on frozen water bodies, they are less likely to cross ground of good archaeological potential; however, the edges of water bodies can have elevated ground that may contain some archaeological remains. Most of the historic winter road routes were not been specifically inspected for archaeological resources, but the roads were positioned to avoid recorded archaeological sites. The winter road between Doris and Boston was assessed by aerial reconnaissance in 2017. It has several fairly long sections travelling over land and comes close to some recorded archaeological sites: at the south end of Doris Lake (NaNh-44); several near the south end of Wolverine-Patch lakes; at a pond (MlNh-4) and in a creek valley (MlNh-20) in the north-central section; and a cluster of sites at the north end of Aimaoktalok Lake. Therefore, those overland portions of the winter road route will require careful placement to ensure maximum avoidance distance, and nearby sites will be monitored as necessary. The route used must closely follow a GPS line, and some of the sites may require staking to ensure avoidance.

The Boston PDA contains five recorded sites, and it is unlikely that unrecorded sites are present within that area due to intensive archaeological surveys conducted during the 1990s and early 2000s. Two sites are likely to be directly impacted by the Boston infrastructure pad: site MjNh-8 is considered fully mitigated, and MjNh-9 was assessed in detail and will require a small amount of additional data recovery. Sites MjNh-3 and MkNh-1 are on the periphery of the proposed TMA and airstrip PDA, respectively. These sites were assessed, and determination as to mitigation required will follow the finalized detailed design. Site MjNh-5 was also subjected to detailed assessment. This site is within the outlined PDA and may be within 130 m of a vent raise and access road. It is currently staked for avoidance and continued monitoring and avoidance is recommended.

In summary, of the 306 sites recorded in the Hope Bay Project to date, 29 sites have already been mitigated, two are partly mitigated, and two recorded features were recommended for removal. This leaves 273 recorded sites that are intact. There are 258 known sites with the LSA that could be vulnerable to direct or indirect effects. The PDA contains 51 sites that may be subject to potential direct impacts due to construction activities. Of these sites, 21 are on the edge of the PDA or on much higher elevation landforms and may be avoidable during detailed design. It is concluded on the basis of this impact analysis that 30 of the recorded sites are potentially subject to direct effects. This total could be further reduced because not all of the quarries will be used. However, it must be remembered that some of the quarries and the all-weather road route have not been fully surveyed; therefore, more sites may be found by future reconnaissance.

Operation

The operation of the mines is unlikely to further affect archaeological resources directly since the mines will be underground and no further surface disturbance is planned at this time. If additional facilities are required during operation, assessment will be conducted to determine if any known or unknown sites may be affected. It is possible some unanticipated event or malfunction during operation may require an immediate response that might preclude prior consideration of presence of archaeological sites, for example, an emergency requires travel off road or excavation of a large amount of fill as part of a spill clean-up in an area not assessed. This possibility will be avoided as much as possible by examining larger areas than are required for facilities construction/operations.

Increased human activity during the operations phase will be the most likely potential cause of indirect effects to archaeological sites. The presence of higher numbers of people in a confined area can increase the potential for disturbance of sites at some distance from the actual development zone. People living and working in an area may pick up artifacts or disturb rock features (despite this being prohibited by company orientation), or may unknowingly drive over sites during winter travel within the readily accessible area surrounding the camps. Management and training measures are in place to reduce such occurrences. Some sites near the Project footprint may be periodically monitored where necessary to ensure no inadvertent impacts have occurred.

Closure and Post-closure; Temporary Closure

The decommissioning process during the closure and post-closure phases would involve regrading and contouring the Project footprint and covering some facilities with fill or quarried materials. As long as fill or quarry materials come from already developed quarries and surface rehabilitation is restricted to already disturbed footprint, no additional adverse effects to archaeological sites are expected other than the ongoing indirect effects noted above during the operations phase.

It is planned to leave the Boston road in place and to remove culverts and bridges. The intact parts of road may increase the potential for post-closure visits to the area, either by hunters or tourists. This could provide a potential source of disturbance to archaeological sites following closure of the Project. Tourists walking over the sites may contribute to some disturbance of features or artifact locations, as could intentional artifact removal for souvenirs. However, it is unlikely that this would become a significant activity in this area due to the Project presence. Thus, tourism and hunters are not considered to offer a significant effect on heritage resources in this region.

A temporary closure that involves putting the site into care and maintenance is not expected to have any effects on archaeological sites since all activities would be restricted to the already-developed footprint.

Hope Bay Development

Over the 19 seasons of archaeological field work on the Hope Bay Project area, the focus has been on specific areas proposed for exploration or development, resulting in discovery of 306 archaeological sites to date. Various development plans were proposed over the years, prompting mitigation of 29 archaeological sites judged potentially vulnerable to impacts. Subsequently, plans changed or were halted. As a result, most of the sites that have been mitigated to date are still intact. Only eight sites (NbNh-12, NbNh-13, NbNh-47, NbNh-48, NaNh-60, NaNh-61, NaNh-62, and NaNh-63) have been affected thus far by Hope Bay Belt development or activities, and one of those (NbNh-12) only partially. Four more of the mitigated sites (NaNh-7, NaNh-8, NaNh-74, and NaNh-76) may be affected by Madrid North and South, and one (NaNh-90) by rising TIA levels. The mitigations completed at these 29 sites were approved by the CH-GN and the IHT; therefore, no further actions are considered necessary, except at two partly protected sites (NbNh-12, NaNh-8). Consequently, if any of the fully mitigated sites fall within the currently proposed footprint for Madrid-Boston, they are not considered in the impact assessment.

Outside of the PDA, exploration throughout the Hope Bay Project will provide the primary source of potential disturbance to archaeological resources, both known and unknown, during the life of the Hope Bay Project. The Hope Bay Belt is a large area (approximately 80 km long and 20 km wide). Preliminary overviews have been done in many parts, but sizeable proportions have not yet been surveyed in detail for archaeological sites. Furthermore, past inventory surveys have proven that there is a high density of sites virtually everywhere surveyed in the Hope Bay Belt. Exploration targets are assessed by an archaeologist prior to each season’s activities to determine inventory and assessment requirements. Through a combination of good communication between Hope Bay Project geologists and archaeologists and education of field crews, the potential effects of exploration activities on heritage resources have been managed so that there have been no effects on sites in recent years. Such established programs, together with monitoring of sites near Project components, will continue as long as exploration is ongoing. As a result, effects of exploration on heritage resources are not considered significant.

2.5.4 Mitigation and Adaptive Management

There are several methods whereby potential Project related effects on archaeological resources have been reduced. The established practice of screening by the Project archaeologist of proposed exploration or development plans prior to any ground disturbing activities being initiated and comparison to known site locations has significantly reduced the potential for inadvertent impacts on both recorded and unrecorded archaeological resources. It has also permitted consideration of avoidance options once sites have been identified. It should be understood that mitigation measures for archaeological sites are recommended on an individual site basis since each site is unique and, besides the site attributes, appropriate mitigation must take into consideration the specific location and Project activity being conducted.

The three stages of mitigation for archaeological sites comprise, first and foremost, avoidance by implementation of one of several management strategies discussed below, second: protection and monitoring which involves installation of a barrier and lastly, systematic data recovery (SDR) which involves careful mapping, recording and excavation of a site that cannot be avoided or protected. The Heritage Resource Protection Plan (Volume 8, Annex V8-6) provides more details concerning general and site specific mitigation measures.

2.5.4.1 Mitigation by Project Design

Throughout the design of this Project, the locations of known archaeological sites have been considered and the Project facilities have been designed to avoid those sites wherever feasible. This has included realigning roads to avoid archaeological sites and positioning proposed facilities with consideration of the required minimum buffer around archaeological sites. TMAC is committed to incorporating as large a buffer zone as is feasible within project design.

2.5.4.2 Best Management Practices

Best management practices in regard to archaeological resources begin with education and orientation of field personnel as to the presence of archaeological remains in the Project area, how to identify those remains, and the importance of leaving archaeological remains in place and undisturbed. To this end, detailed orientation presentations are provided to all employees and contractors working off the developed footprint.

Another best management practice is for travel to be on established roads, winter trails, or within already disturbed Project footprint areas. No off-road travel occurs outside of the winter season, at which time travel occurs on ice roads or with low pressure vehicles.

Finally, operational procedures are in place that describe the process to be implemented in the event of an unexpected discovery of archaeological or human remains during any ground-disturbing activities. These procedures are communicated to all supervisors of field crews.

2.5.4.3 Proposed Monitoring Plans and Adaptive Management

Since the Hope Bay area is rugged and archaeological sites are often small and not easily spotted, particularly by small crews walking some distance apart, unrecorded archaeological remains can still be present even in areas where a single pass survey has already been completed. Therefore, it is considered important that a final thorough survey be conducted of all areas within which ground disturbance is proposed.

In terms of adaptive management, the size of the buffer zone and mitigation measures required for individual archaeological sites will be adjusted relative to different Project components. This is because there are significant differences in the potential for impact due to the sizes of disturbance areas, intensity of activities, and frequency of the specific activity. Key factors that will be considered are the type, size and intensity of the use area, sizes of equipment during both construction and operations phases, and whether the component is a temporary or permanent facility, and whether the activity on ongoing or transitory. All sites between 0 m and 30 m from Project component disturbance boundaries will be mitigated by systematic data recovery. For sites between 30 m and 100 m from transitory use facilities such as roads or temporary small facilities, protection will be considered; if that is implemented, those sites will require surveillance and monitoring. Sites within 100 m of permanent or larger facilities such as camps, mine/mill sites and quarries will be mitigated by SDR. For sites between 100 m and 500 m, protection measures and periodic monitoring may be applied or selected sites may be subjected to SDR. All sites that are in close proximity to ongoing activities will be monitored periodically as necessary, depending on the proposed activity. These measures will be considered on an individual site basis in consultation with the Department of Culture and Heritage of the Government of Nunavut and the Inuit Heritage Trust. The Heritage Resource Protection Plan (Volume 8, Annex V8-6) identifies the impact potential for all recorded sites and presents guidelines for protection and mitigation measures for heritage resources in more detail.

2.5.5 Project-related Residual Effects

Project residual effects are the effects that are remaining after mitigation and management measures are taken into consideration. If the implementation of mitigation measures eliminates a potential effect and no residual effect is identified on that VEC or VSEC, the effect is eliminated from further analyses. If the proposed implementation controls and mitigation measures are not sufficient to eliminate an effect, a residual effect is identified and carried forward for additional characterization and a significance determination. Residual effects of the Project can occur directly or indirectly. Direct effects result from specific Project/environment interactions between Project activities and archaeological resources. Indirect effects are the result of direct effects on the environment that lead to secondary or collateral effects on archaeological resources.

2.5.6 Characterization of Project-related Residual Effects

Archaeology is a relative unique VSEC in consideration of residual effects. Residual effects are specifically defined as those remaining after all mitigation and management measures that are meant to reduce potential impacts have been applied. Systematic data recovery (SDR) does not prevent disturbance of the archaeological site: the excavation that is part of that measure actually removes at least part of the site being mitigated. However, because it involves recording the cultural information from a site before it is removed, the cultural information content of the site is preserved, if not the physical location or form. Therefore, this form of mitigation does not mitigate the effects of the Project on the physical remains of the site. Instead, the beneficial effect of this action is that the cultural information contained within the site is thoroughly recorded prior to its disturbance and that information is then available to future generations.

It is not possible to establish a numerical threshold for acceptable loss of archaeological resources. The GN determines, on a project-specific basis, whether the overall loss of resources is acceptable. In general, total loss of any archaeological site without data recovery is considered unacceptable. Through application of proper SDR techniques, few sites would be so important that they could not be impacted after the appropriate data recovery has taken place. Burial sites and large, long term settlements or exceedingly rare sites are exceptions. Most archaeological sites do not fall into those categories and, within the Madrid-Boston Project, there are no known burials or large settlements.

2.5.6.1 Definitions for Characterization of Residual Effects

In order to determine the significance of Project residual effect, each potential negative residual effect is characterized by a number of attributes consistent with those defined in the EIS guidelines (Section 7.14, Significance Determination for the Hope Bay Project; NIRB 2012a). A definition for each attribute and the contribution that it has on significance determination is provided in Table 2.5-2.

For the determination of significance, each attribute is characterized. The characterizations and criteria for the characterizations are provided in Table 2.5-3. Each of the criteria contributes to the determination of significance.

2.5.6.2 Characterization of Residual Effect for Archaeological Sites

The specific definitions for archaeology are provided here and the ratings are found below. The loss of archaeological sites is negative; however, retrieval of the cultural information within a site prior to the loss of the site is a positive effect. Consequently, direction is balanced.

Table 2.5-2. Attributes to Evaluate Significance of Potential Residual Effects

Attribute	Definition and Rationale	Impact on Significance Determination
Direction	The ultimate long-term trend of a potential residual effect - positive, neutral, or negative.	Positive, neutral, and negative potential effects on VECs or VSECs are assessed, but only negative residual effects are characterized and assessed for significance.
Magnitude	The degree of change in a measurable parameter or variable relative to existing conditions. This attribute may also consider complexity – the number of interactions (Project phases and activities) contributing to a specific effect.	The higher the magnitude, the higher the potential significance.
Duration	The length of time over which the residual effect occurs.	The longer the length of time of an interaction, the higher the potential significance.
Frequency	The number of times during the Project or a Project phase that an interaction or environmental/socio-economic effect can be expected to occur.	Greater the number times of occurrence (higher the frequency), the higher the potential significance.
Geographic Extent	The geographic area over which the interaction will occur.	The larger the geographical area, the higher the potential significance.
Reversibility	The likelihood an effect will be reversed once the Project activity or component is ceased or has been removed. This includes active management for recovery or restoration.	The lower the likelihood a residual effect will be reversed, the higher the potential significance.

Table 2.5-3. Criteria for Residual Effects for Environmental Attributes

Attribute	Characterization	Criteria
Direction	Positive	Beneficial
	Variable	Both beneficial and undesirable
	Negative	Undesirable
Magnitude	Negligible	No change on the exposed indicator/VEC
	Low	Differing from the average value for the existing environment to a small degree, but within the range of natural variation and well below a guideline or threshold value
	Moderate	Differing from the average value for the existing environment and approaching the limits of natural variation, but below or equal to a guideline or threshold value
	High	Differing from the existing environment and exceeding guideline or threshold values so that there will be a detectable change beyond the range of natural variation (i.e., change of state from the existing conditions)
Duration	Short	Up to 4 years (Construction phase)
	Medium	Greater than 4 years and up to 17 years (4 years Construction phase, 10 years Operation phase, 3 years Reclamation and Closure phase)
	Long	Beyond the life of the Project
Frequency	Infrequent	Occurring only occasionally
	Intermittent	Occurring during specific points or under specific conditions during the Project
	Continuous	Continuously occurring throughout the Project life

Attribute	Characterization	Criteria
Geographic Extent	Project Development Area (PDA)	Confined to the PDA
	Local Study Area (LSA)	Beyond the PDA and within the LSA
	Regional Study Area (RSA)	Beyond the LSA and within the RSA
	Beyond Regional	Beyond the RSA
Reversibility	Reversible	Effect reverses within an acceptable time frame with no intervention
	Reversible with effort	Active intervention (effort) is required to bring the effect to an acceptable level
	Irreversible	Effect will not be reversed

Specific to heritage resources, magnitude represents the degree to which the entire Hope Bay Project archaeological site inventory or site "population" and/or representations of specific rare site types within that group is lost or affected.

- *High*: an entire group of sites or site types is lost;
- *Medium*: good representations or significant proportions of the site inventory or site types are lost;
- *Low*: small proportion of site types within the inventory is lost; and
- *Negligible*: little or no portion of the available site population is lost.

For the Madrid-Boston Project, magnitude is rated as low because only a small proportion of comparatively common site types is expected to be affected.

Because effects on archaeological sites are permanent, duration is always long.

For archaeological sites within the PDA, frequency could be considered intermittent since the effects would occur mainly during the construction phase. Also, during the operations phase, the sites in the zone of possible indirect effects may occasionally be affected, again an intermittent effect.

For effects on specific archaeological sites, geographic extent is typically localized to the PDA due to the limited extent of sites.

Effects on archaeological sites are not reversible. Once a portion of a site is removed, it cannot be replaced.

2.5.6.3 Determining the Significance of Residual Effects

Section 7.4 of the EIS guidelines provides guidance, attributes, and criteria for the determination of significance for residual effects (NIRB 2012a). The Canadian Environmental Assessment Agency's *Determining Whether a Project is Likely to Cause Significant Adverse Environmental Effects* (CEA Agency 1992) also guides the evaluation of significance for identified residual effects. The significance of residual effects is based on comparing the predicted state of the environment with and without the Project, including a judgment as to the importance of the changes identified.

<u>Probability of Occurrence or Certainty</u>

Prior to the determination of the significance for negative residual effects, the probability of the occurrence or certainty of the effect is evaluated. For each negative residual effect, the probability of occurrence is categorized as unlikely, moderate or likely. Table 2.5-4 presents the definitions applied to these categories.

Table 2.5-4. Definition of Probability of Occurrence and Confidence for Assessment of Residual Effects

Attribute	Characterization	Criteria
Probability of occurrence or certainty	Unlikely	Some potential exists for the effect to occur; however, current conditions and knowledge of environmental trends indicate the effect is unlikely to occur.
	Moderate	Current conditions and environmental trends indicate there is a moderate probability for the effect to occur.
	Likely	Current conditions and environmental trends indicate the effect is likely to occur.
Confidence	High	Baseline data are comprehensive; predictions are based on quantitative predictive model; effect relationship is well understood.
	Medium	Baseline data are comprehensive; predictions are based on qualitative logic models; effect relationship is generally understood, however, there are assumptions based on other similar systems to fill knowledge gaps.
	Low	Baseline data are limited; predictions are based on qualitative data; effect relationship is poorly understood.

2.5.7 Significance of Project-related Residual Effects

Table 2.5-5 summarizes the assessment of residual effects on heritage resources of the Project. Three related but slightly different potential effects have been identified.

The loss of 30 archaeological sites without any mitigation would by itself be considered a significant effect. Professional experience and knowledge of community perspectives recognises that loss of archaeological sites is considered to be significant by many individuals. However, all sites to be affected will be fully mitigated by site data recovery prior to disturbance. Therefore, the information content of those sites is not lost. Furthermore, the types of sites that will be affected by the Project are not rare, and the Project area has similar examples that are not expected to be affected. This number of 30 potentially affected sites represents less than 10% of the total 306 sites recorded thus far. The detailed site maps drawn, records taken, and all items collected during the site investigations are deposited in a museum designated by the Government of Nunavut and are available for future generations. For these reasons, while the loss of the resource is considered significant, the residual effect of this loss is considered not significant due to systematic data recovery and the knowledge gained and documented for those sites that would otherwise not be recovered.

The effects on unrecorded archaeological sites are similar to recorded sites. However, the probability of unrecorded sites being affected is considered unlikely since all areas proposed for development are intensively surveyed for archaeological sites prior to disturbance; therefore, major archaeological sites present are typically found before the Project activity begins, although there is always a slight chance that a small site or isolated feature may remain unrecorded. For those unlikely occurrences, TMAC has a procedure in place in the event that any unrecorded remains are found during Project activities that require all work to stop and the remains to be appropriately dealt with. Therefore, this is considered not significant.

Because all sites potentially to be disturbed by Project activities will be mitigated by site data recovery, the effect on the cultural information content of the sites is considered positive. Sites are being investigated that would not be without the Project, therefore, this data gathering is a benefit to both the scientific and the local communities. The loss of the information content of the sites is considered unlikely and therefore, the residual effect is not significant.

Table 2.5-5. Summary of Residual Effects and Overall Significance Rating for Heritage Resources - Phase 2

Residual Effect	Attribute Characteristic						Overall Significance Rating		
	Direction *(positive, variable, negative)*	**Magnitude** *(negligible, low, moderate, high)*	**Duration** *(short, medium, long)*	**Frequency** *(infrequent, intermittent, continuous)*	**Geographic Extent** *(PDA, LSA, RSA, beyond regional)*	**Reversibility** *(reversible, reversible with effort, irreversible)*	**Probability** *(unlikely, moderate, likely)*	**Significance** *(not significant, significant)*	**Confidence** *(low, medium, high)*
Effect on recorded archaeological sites	negative	low	long	intermittent	PDA	irreversible	likely	not significant*	high
Effect on unrecorded archaeological sites	negative	low	long	intermittent	LSA	irreversible	unlikely	not significant	high
Effect on cultural information content of sites	positive	low	long	intermittent	RSA	irreversible	unlikely	not significant	high

** Note: while the loss of archaeological resources is considered significant, the residual effect of this loss is considered not significant due to systematic data recovery which results in the knowledge gained and documented for those sites that would otherwise not be recovered. All cultural remains and artifacts recovered at sites are documented and provided to the museum mandated by the Government of Nunavut and remain the property of Nunavumiut.*

2.6 CUMULATIVE EFFECTS ASSESSMENT

The potential for cumulative effects arises when the potential residual effects of the Project affect (i.e., overlap and interact with) the same VEC or VSEC that is affected by the residual effects of other past, existing or reasonably foreseeable projects or activities.

2.6.1 Methodology Overview

2.6.1.1 Approach to Cumulative Effects Assessment

The general methodology for cumulative effects assessment (CEA) is described in Volume 2, Section 4, and focuses on the following activities:

- Identify the potential for Project-related (Phase 2 and the complete Hope Bay Development) residual effects to interact with residual effects from other human activities and projects within specified assessment boundaries. Key potential residual effects associated with past, existing, and reasonably foreseeable future projects were identified using publicly available information or, where data was unavailable, professional judgment was used (based on previous experience in similar geographical locations) to approximate expected environmental conditions.
- Identify and predict potential cumulative effects that may occur and implement additional mitigation measures to minimize the potential for cumulative effects.
- Identify cumulative residual effects after the implementation of mitigation measures.
- Determine the significance of any cumulative residual effects.

2.6.1.2 Types of Cumulative Effects

The type of cause-effect pathway specific to CEA for archaeology is “nibbling loss”, defined as the gradual disturbance and loss of a particular resource, in this case, archaeological sites.

Interacting projects and activities may combine to create additive or synergistic effects. An additive effect increases the effect in a linear way. This is the cumulative effect for archaeological sites.

2.6.1.3 Assessment Boundaries

The CEA considers the spatial and temporal extent of Project-related residual effects on VECs or VSECs combined with the anticipated residual effects from other projects and activities to assist with analyzing the potential for a cumulative effect to occur.

<u>Spatial Boundaries</u>

In order for the cumulative effects analysis for heritage resources to be most useful, the RSA encompasses most of the typical range of the Kitikmeot Inuit of the past. In terms of heritage resources, the Kitikmeot region is a distinctive cultural area. The subsistence patterns of past people in this area have always ranged over the entire region; therefore, all the sites in the region are considered linked. In order to understand the cultural remains in one part of the region, it is necessary to look at the remains in the entire region.

<u>Temporal Boundaries</u>

The temporal boundaries for the archaeological CEA are the past and present projects. Because the CEA is assessing the effects of all projects on the known archaeological data base it is not useful to include future projects where no archaeological field assessment has yet been conducted since their effects on the data base cannot be determined at this time.

2.6.2 Potential Interactions of Cumulative Effects with Other Projects

Only three operating mines exist in Nunavut, which accounts for the majority of industrial development in the territory of over 2 million square kilometres in size. Mineral exploration activities are targeting uranium, diamonds, gold and precious metals, base metals, iron, coal, and gemstones. In addition to mining and exploration development projects, other land use activities are also present in the territory. However, in terms of effects on the total archaeological sites assemblage, those activities are considered to have a minor effect. Therefore, only comparable mining and exploration projects are considered here. It is also important to choose projects that have already conducted some archaeological field work in order that an archaeological knowledge base is available. Finally, only projects in the Kitikmeot region have been included in this CEA for archaeology because the sites data base is specific to that region and to Nunavut only.

The identified mining and exploration projects that may potentially interact in terms of archaeological site assemblages are summarized in Table 2.7-1.

Table 2.7-1. Projects with the Potential to Interact Cumulatively with Archaeological Sites

Project	Location	Type	Proponent	Dates Active	Current Status
Jericho	Nunavut	Diamond mine	Shear Diamonds Ltd.	2006 to 2012	Care and maintenance
Back River (George Lake and Goose Lake)	Nunavut	Gold mine	Sabina Gold and Silver Corp.	2019 to 2029	Application submitted
Bathurst Inlet Port and Road	Nunavut	All-weather road	BIPR	20 years	Pre-application
Hackett River	Nunavut	Base metal mine	Glencore Plc.	15 years	Pre-application
Izok Corridor (High Lake and Izok Lake)	Nunavut	Copper, zinc, gold, silver mine	MMG Resources Inc.	14 years	Pre-application

It must be emphasized that for those projects that have not yet been developed, impact assessments are subject to change, as conceptual design of those projects continues prior to an application submitted for review and approval. Therefore, the site numbers listed in Table 2.7-2 are approximate numbers only. It must be noted that the Izok Corridor Project includes portions of the project study areas of the Izok mine, High Lake mine and Jericho mine projects, and a small number of sites may be included in both the impact assessments for the individual mine project as well as the Izok Corridor project. There is also some overlap in archaeological assessments between the Bathurst Inlet Port and Road Project and the road portion of the Izok project. For these reasons, the combined effects of all projects on the total assemblage of the Kitikmeot region may be overestimated to some degree. However, the overall effect of this possible double counting of a few sites is considered negligible.

It should be born in mind that studies undertaken on each project may have differed in survey effort (more time spent surveying a given area may result in more sites identified), the level of survey (more detailed surveys may also discover more sites), and in the level of focus of the study (studies which survey well beyond footprint areas may find more sites). These results still provide a reasonable understanding of cumulative effects of these projects on the overall archaeological site population.

Table 2.7-2. Cumulative Archaeological Results for Exploration and Mining Projects Comparable to Hope Bay

Project	# Sites Recorded	# Sites Possibly Affected	% Loss	Date of Data
Jericho	40	7	17.5	2003
Back River (George and Goose Lakes)	130	35	27	2013
Bathurst Inlet Port and Road	71	26	37	2007
High Lake	45	18	40	2006
Hackett River	65	9	14	-
Izok Mine Project	40	20	50	2002
Izok Corridor Project	150	50	34	2012
Hope Bay Madrid-Boston	258	51	19.7	2017
TOTAL (with Hope Bay Madrid-Boston to 2017)	**799**	**216**	**27**	**-**
Total known Kitikmeot Sites (with Hope Bay total known sites = 306)	**1,744**	**216**	**12**	**2016**

The Hope Bay Phase 2 site total of 258 represents the number of recorded sites in the LSA, that is, those sites within 5 km of the project footprint. The potentially affected sites total (51) is minus those already mitigated as part of the other Hope Bay developments. Those mitigated sites are included in the Hope Bay Development totals.

The cumulative effects of the Project (Madrid-Boston and the complete Hope Bay Development), which combined with other projects and developments, have the potential to cumulatively interact in terms of reducing the number of sites in the region. It can be seen from Table 2.7-2 that the cumulative effect of these Projects in the Kitikmeot region on the recorded archaeological resource amounts to the potential loss of approximately 12% of the recorded sites. Given that archaeological surveys on these projects have typically been focused on potential areas of development, it is noteworthy that only one quarter (216) of the total number of sites recorded to 2016 (799) on those projects may be affected. This is likely partly because, as planning proceeds, locations for specific components are adjusted, but it is also undoubtedly due to a concerted effort to avoid archaeological sites. A positive effect also worth noting is that almost half of the archaeological sites known in the Kitikmeot to date were recorded by archaeological surveys related to these development projects.

For the Hope Bay Madrid-Boston project, the effect on the total Kitikmeot site inventory may range between 1.7% and 2.9% loss of the identified Kitikmeot archaeological sites (n=1744), while the sites affected by the Hope Bay development (n=80, which includes the 29 already mitigated sites) may total up to 4.6% of the total recorded sites. Because this is not a total loss, that is, the cultural information within these sites is preserved, the cumulative effect is considered not significant. Furthermore, there are undoubtedly numerous unrecorded sites throughout the Kitikmeot region; therefore, in reality, the percentage of the total archaeological resource in the Kitikmeot that may be affected by these projects is considerably less.

2.6.3 Identification of Mitigation and Management Measures

Mitigation measures for cumulative effects involves taking further action, where possible, to avoid or minimize cumulative effects on archaeological resources. Because cumulative effects typically result from the combined effects of multiple developments, responsibility for their prevention and management is shared among the various developments that contribute to them. It is usually beyond the capability of any one party to implement all of the measures required to reduce or eliminate cumulative effects; therefore, measures often require collaborative efforts between projects or activities. Lack of control over operators of other projects or activities potentially confounds implementation of additional mitigation measures for cumulative effects. Proposed mitigation measures must take technical, environmental, and economical feasibility into consideration as well as the ability to influence the independent operators of other projects and activities.

It is standard practice on development projects in Nunavut to consider avoidance as the first measure for mitigation of potential effects on archaeological sites. In doing so, all projects will act collectively to reduce the overall adverse effects. It is also standard practice to have an archaeologist carefully record and gather cultural information from sites that cannot be avoided. In this manner, although some sites may be lost, the cultural content is preserved.

2.7 TRANSBOUNDARY EFFECTS

Transboundary effects are not relevant to this archaeological effects assessment. The Inuit who lived in the Kitikmeot region did not venture a significant distance south of the current Kitikmeot boundaries, that is, the Nunavut border. Furthermore, the site inventories are held separately by each Territory and therefore, the overall effects are restricted to that Territory. Consequently, there are no transboundary effects.

2.8 IMPACT STATEMENT

The potential effects of the Hope Bay Madrid-Boston Project on heritage resources are represented by disturbance of archaeological sites. Archaeological sites in this region can contain structural features made of rocks as well as artifacts. Any activity that affects the ground surface can affect archaeological remains. Direct effects on archaeological sites are expected primarily during the construction phase when most of the ground disturbance will occur. Indirect effects can occur during all Project phases and relate to higher levels of activity and increased numbers of people in the general area.

The study areas used here for analysis of effects on archaeological sites are the PDA, representing the Project infrastructure with an approximately 200 m buffer, within which direct impacts may occur; the LSA, an area encompassing about 5 km buffer around the Project developments which represents the area within which indirect effects could occur; and the RSA which is only used for cumulative effects analysis.

The entire Hope Bay Project area has 306 recorded site localities to date. The LSA contains 258 recorded sites which will be monitored where appropriate for indirect effects. At the present time, it is estimated that 51 sites fall within the PDA and could potentially be affected directly. It is anticipated that some of these sites can be avoided by project design (possibly as many as 21), but the road and associated quarries have not yet been carefully inspected for archaeological sites and, given the good potential for sites on those landforms, it is likely that some unrecorded sites exist. There are no known areas of special significance and no known or reported burials within the Hope Bay Project area.

The potential for effects on unrecorded sites is reduced by the established practice of routine screening of proposed activities prior to initiation, first against the inventory of known archaeological sites, and then, assessing the potential of the area for containing unknown archaeological sites. A second important factor is education of field personnel. Thirdly, TMAC has Operational Procedures in place to be implemented in the event of an unexpected discovery of archaeological or human remains during a project activity. These practices have and will continue to reduce the potential for inadvertent effects on archaeological sites.

Mitigation measures will be determined for archaeological sites on an individual site basis and take into consideration the site size, content and perceived significance, and the relative location, type and duration of project activity. The first consideration for mitigation will be avoidance, by project relocation or redesign wherever feasible. Next level of mitigation to be considered will be implementation of as large a buffer zone as possible, with some protection such as installation of barriers where needed. The third, and final, level of mitigation will be site data recovery. In the case of temporary or intermittent use facilities, such as construction camps or roads, any sites within 30 m will be mitigated, while those between 30 m and 100 m will be either mitigated or be protected and monitored. Sites within 100 m from major activity areas and permanent developments, such as camps, mines, mill sites, and active quarries, will be mitigated. Sites less than 500 m from the major project components will be periodically monitored, and selected sites may require SDR. Mitigation plans for each individual site judged to have some potential for impact will be developed in consultation with the Department of Culture and Heritage, Government of Nunavut and the Inuit Heritage Trust. Details for all sites recorded to date and management plans for each site are contained the Heritage Resource Protection Plan in Volume 8, Annex V8-6.

It has been estimated that between 12% and 19% of known sites within the Madrid-Boston LSA may be directly affected. This is balanced by the positive effect of the content of those sites being carefully mapped and recorded and pertinent cultural information extracted by scientific excavation. All information and items collected during site investigations are deposited in a museum designated by the Government of Nunavut and are available for future generations. Therefore, the overall residual effect of the Project on heritage resources is considered not significant.

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