



Final Site Inspection Report Death Valley National Park

Site Inspections of Abandoned Mineral Lands (AML) Sites
(Skidoo, Homestake, Journigan's, Starr, Tucki, Cashier and Gold Hill)
California and Nevada

Prepared under contract to U.S. Army Corps of Engineers
Contract No. W912PL-15-D-0016 Delivery Order 0001



October 2016

Prepared by
NOREAS, Inc.



Jeff Oslick, PhD, PG, Project Geologist

Essi Esmaili, PhD, PG, CHG, Project Manager



Table of Contents

List of Appendices iv

List of Figures iv

List of Tables iv

1 Introduction 1

 1.1 CERCLA and National Park Service Authority 1

 1.2 Purpose of Field Sampling 2

 1.3 Site Location 2

 1.4 Geologic Setting and Hydrogeology 3

 1.5 Climate and Topography 4

 1.6 Vegetation and Wildlife 4

 1.7 Milling and Ore Processing 5

 1.7.1 Milling and Ore Processing 5

 1.7.2 Cyanide Leaching 6

 1.7.3 Floatation Process 7

2 Site Description, Previous Investigations, and Conceptual Site Model 9

 2.1 Key Site Features 9

 2.1.1 Site Descriptions 9

 2.1.2 Skidoo Mill 9

 2.1.3 Homestake Mill 9

 2.1.4 Journigan’s Mill 10

 2.1.5 Starr Mill 10

 2.1.6 Tucki Mine and Mill 11

 2.1.7 Cashier Mill 11

 2.1.8 Gold Hill Mill 12

 2.2 Summary of Previous Investigations 12

 2.2.1 Contaminants of Potential Concern 12

 2.2.2 Media of Potential Concern 12

 2.3 Current and Future Property Use Scenarios 13

 2.4 Graphical Conceptual Site Model 13

3. Field Activities and Analytical Protocols 15

 3.1. Soil and Surface Water Sampling Procedures 15

 3.1.1. Soil Sampling 15



3.1.2.	Background Soil Samples	17
3.1.3.	Surface Water Sampling	17
3.2.	Skidoo Mill	17
3.3.	Homestake Mill.....	19
3.4.	Journigan’s Mill.....	20
3.4.1.	Starr Mill	21
3.5.	Tucki Mill	22
3.6.	Cashier Mill	23
3.7.	Gold Hill Mill.....	24
4.	Sampling Results	25
4.1.	Skidoo Mill	27
4.1.1.	Background Soil Sampling	27
4.1.2.	Mill Area (Mercury and Cyanide Processing Areas)	27
4.1.3.	Mill Tailings Impoundment	27
4.1.4.	Downgradient Wash.....	28
4.1.5.	Surface Water Samples.....	28
4.1.6.	Soil Leaching Analyses	28
4.1.7.	Data Quality Assessment	28
4.2.	Homestake Mill.....	32
4.2.1.	Background Soil Sampling	32
4.2.2.	Mill Area (Mercury and Cyanide Processing Areas)	32
4.2.3.	Mill Tailings Stockpile	32
4.2.4.	Mine Waste Stockpile.....	32
4.2.5.	Downgradient Mill Tailings.....	33
4.2.6.	Soil Leaching Analyses	33
4.2.7.	Data Quality Assessment	33
4.3.	Journigan’s Mill.....	35
4.3.1.	Background Soil Sampling	35
4.3.2.	Cyanide Processing Area	35
4.3.3.	Mill Foundation Area.....	36
4.3.4.	Mill Tailings Stockpile	36
4.3.5.	Mine Waste Stockpile.....	36
4.3.6.	Mill Tailings in North (DU-5) and South Washes (DU-6).....	36
4.3.7.	Soil Leaching Analyses	37
4.3.8.	Data Quality Assessment	37



4.4.	Starr Mill	40
4.4.1.	Background Soil Sampling	40
4.4.2.	Mill Area (Mill Foundation and Cyanide Processing Areas)	40
4.4.3.	Downgradient Discrete Samples	40
4.4.4.	Soil Leaching Analyses	41
4.4.5.	Data Quality Assessment	41
4.5.	Tucki Mill	43
4.5.1.	Background Soil Sampling	43
4.5.2.	Cyanide Processing Area	43
4.5.3.	Fine-Grained Mine Waste	43
4.5.4.	Soil Leaching Analyses	43
4.5.5.	Data Quality Assessment	44
4.6.	Cashier Mill	46
4.6.1.	Background Soil Sampling	46
4.6.2.	Mill Foundation Area.....	46
4.6.3.	Mill Tailings in Eastern and Western Drainages	46
4.6.4.	Mine Waste on Northern Slope	47
4.6.5.	Surface Water Analysis	47
4.6.6.	Soil Leaching Analyses	47
4.6.7.	Data Quality Assessment	47
4.7.	Gold Hill Mill.....	50
4.7.1.	Background Soil Sampling	50
4.7.2.	Mill Foundation Area.....	50
4.7.3.	Eroded Tailings in Wash (along Road).....	50
4.7.4.	Surface Water Analyses	51
4.7.5.	Data Quality Assessment	51
5.	Summary and Recommendations	55
6.	References	57



List of Appendices

Appendix A	Photographic Logs
Appendix B	Global Positioning System Coordinates for Features
Appendix C	Chain of Custody Records and Laboratory Reports
Appendix D	Data Validation Reports

List of Figures

Figure 1	General Vicinity Map
Figure 2	Skidoo Mill
Figure 3	Homestake Mill
Figure 4	Journigan’s Mill
Figure 5	Starr Mill
Figure 6	Tucki Mill
Figure 7	Cashier Mill
Figure 8	Gold Hill Mill
Figure 9	DEVA AML Sites Conceptual Site Model and Potential Exposure Pathways

List of Tables

Table 1	Summary Sampling Information
Table 2	Skidoo Mill Laboratory Soil Analyses
Table 3	Homestake Mill Laboratory Soil Analyses
Table 4	Journigan’s Mill Laboratory Soil Analyses
Table 5	Starr Mill Laboratory Soil Analyses
Table 6	Tucki Mill Laboratory Soil Analyses
Table 7	Cashier Mill Laboratory Soil Analyses
Table 8	Gold Hill Mill Laboratory Soil Analyses
Table 9	Summary of Surface Water Analyses
Table 10	Summary of Soil Leachability Analyses



List of Abbreviations and Acronyms

ABA	acid-base accounting
Ag	silver
AGP	acid-generating potential
AML	Abandoned Mineral Lands
ANP	acid-neutralization potential
As	arsenic
Ba	barium
Be	beryllium
CAM	California Administrative Manual
Cashier	Cashier Mill
Cd	cadmium
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Co	cobalt
COCs	Constituents of Concern
CSM	Conceptual Site Model
CSP	Contaminated Sites Program
Cr	chromium
Cu	copper
DEVA	Death Valley National Park
DL	detection level
DoD	Department of Defense
DQO	Data Quality Objective
DU	decision unit
ECM	Environmental Cost Management, Inc.
ELAP	Environmental Laboratory Accreditation Program
EPA	U.S. Environmental Protection Agency
ESV	Ecological Screening Value
FSP	Field Sampling Plan
Gold Hill	Gold Hill Mill
GPS	Global Positioning System
Hg	mercury
Homestake	Homestake Mill
HR	Hydrologic Region
ISM	Incremental Sampling Methodology
ITRC	Interstate Technology Regulatory Council
Journigan's	Journigan's Mill



LCS	laboratory control sample
LOQ	limit of quantitation
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
Mo	molybdenum
Mn	manganese
MS	matrix spike
MSD	matrix spike duplicate
Ni	nickel
NOREAS	NOREAS, Inc.
NPS	National Park Service
PA	Preliminary Assessment
pH	Hydrogen potential
Pb	lead
QAPP	Quality Assurance Project Plan
QA	Quality Assurance
QC	Quality Control
QSM	Quality Systems Manual
RPD	Relative percent difference
RSL	Regional Screening Level
SAP	Sampling and Analysis Plan
Sb	antimony
Se	selenium
Skidoo	Skidoo Mill
SI	Site Inspection
SU	sampling unit
TCLP	Toxicity Characteristics Leaching Procedure
TestAmerica	TestAmerica Laboratories, Inc.
Th	thallium
Tucki	Tucki Mill
UCL	upper confidence limit
USC	United States Code
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
V	vanadium
Water Board	California Regional Water Quality Control Board
Zn	zinc
µg/L	micrograms per liter
%	percent



1 Introduction

This document reports on the results of Site Inspections (SIs) performed at six Abandoned Mineral Lands (AML) Sites at Death Valley National Park (DEVA), located in California and Nevada (Figure 1). These sites include: Skidoo Mill (Skidoo) (Figure 2), Homestake Mill (Homestake) (Figure 3), Journigan's Mill (Journigan's) (Figure 4), Starr Mill¹ (Figure 5), Tucki Mill (Tucki) (Figure 6), Cashier Mill (Cashier) (Figure 7), and Gold Hill Mill (Gold Hill) (Figure 8). Sampling activities were conducted in February and March 2016.

These SIs were conducted based on the findings of a Preliminary Assessment (PA) of 27 AML sites at DEVA, conducted by Environmental Cost Management (ECM 2014).

1.1 CERCLA and National Park Service Authority

These SIs were conducted on behalf of the United States Department of the Army, Los Angeles District Corps of Engineers (USACE) as Task Order No. 0001 and as requested in the USACE's Performance Work Statement, dated July 13, 2015, under the Contract No. W912PL-15-D-0016.

DEVA is a unit of the National Park System, created by Congress on October 31, 1994, in the California Desert Protection Act. The National Park Service (NPS) has the responsibility under the Comprehensive Environmental Recovery, Compensation and Liability Act (CERCLA) to determine if potential hazardous substances exist within each NPS unit.

The SIs were conducted in accordance with the Sampling Analysis Plan, Death Valley National Park, Site Inspections of Abandoned Mineral Lands (AML) Sites, California and Nevada (NOREAS 2016). The NPS is authorized under CERCLA, 42 United States Code (USC) §§ 9601 et seq., to respond as the Lead Agency to a release or threatened release of hazardous substances and/or a release or threatened release of any pollutant or contaminant that may present an imminent and substantial danger to public health or welfare on NPS land.

NOREAS understands that the mine wastes and mill tailings at the DEVA AML sites investigated herein should qualify as ore "beneficiation" solid wastes under 40 Code of Federal Regulations (CFR) Chapter 1; qualifying for exemption from categorization as a hazardous wastes under Resource Conservation and Recovery Act (RCRA) Subtitle C regulation. However, this issue may require further review and confirmation.

¹ Starr Mill was not originally part of the SI activities. However, during the initial SI activities at Journigan's Mill, it was determined, with USACE and NPS approval, that sampling of Starr Mill, located approximately a mile west of Journigan's Mill and sharing both northern and the southern washes, would be included in the SI.



The NPS has a number of regulations that apply to the release of hazardous substances on NPS land (see NPS 2014a) including the NPS Organic Act of 1916 (16 USC §1, et seq. 36 Code of Federal Regulations Part 1), which requires that the NPS manage parks in order to conserve the scenery, natural and historic objects, and wildlife and to provide for their enjoyment by such means as leaving them unimpaired for the future generations. Therefore, whether the Site poses risks to organisms due to interactions with the environment is especially relevant to the NPS responsibility to protect park resources.

1.2 Purpose of Field Sampling

The goal of these SIs was to obtain and analyze environmental samples, to assess human and environmental exposure to hazardous substances, and to evaluate the basis for further actions, if needed. In accordance with the recommendations of the PA (ECM 2014), the SIs collected data for characterization of the mining/milling wastes and background (native) soil. A limited number of surface water samples were also obtained. This SI Report compares concentrations of constituents of concern (COCs) to risk screening values to evaluate potential risk to human health or the environment at the six subject sites. The results of the PA are documented in the PA report (ECM 2014). Complete delineation of the extent of contaminants was not a goal of these SI activities.

The NPS will use data collected during this field investigation to support potential response actions that may be undertaken by the NPS or other parties.

The following data was collected during the SIs:

- Soil samples using the Incremental Sampling Methodology (ISM) – The samples were analyzed for Title 22 metals (California Administrative Manual [CAM] 17 metals), cyanide, acid-base accounting (ABA) and soil pH;
- Surface water (where practical) – The samples were analyzed for Title 22 metals (CAM 17 metals);
- Testing of soil leaching characteristics by Toxicity Characteristics Leaching Procedure (TCLP).

1.3 Site Location

DEVA is located east of the Sierra Nevada Mountains between the Great Basin and Mojave Desert. The park is located primarily in the state of California within Inyo and San Bernardino counties (Figure 1). DEVA and surrounding area consists of approximately 3 million acres of badlands, valleys, canyons, and mountains. The area was declared a national monument in 1933 and formally became a national park in 1994. It includes the entire Death Valley, which runs for approximately 150 miles between the Amargosa and Panamint ranges. DEVA occupies an area



of physical extremes from Badwater Basin, located at 282 feet below sea level, to Telescope Peak, located at 11,049 feet above sea level. It is the hottest, lowest, and driest area in North America.

1.4 Geologic Setting and Hydrogeology

DEVA is located in the Basin and Range Geomorphic Province and is considered the westernmost part of the Great Basin. The province is characterized by subparallel, fault-bounded ranges separated by rotated and down-dropped basins which receive interior drainage resulting in lakes and playas. Death Valley, the lowest area in the United States (282 feet below sea level at Badwater), is one of these basins. DEVA is comprised of many geologic formations including alluvial fans and lacustrine deposits, salt flats, active volcanism, and mineral-rich rock formations. Carbonate rocks of Precambrian and Paleozoic age are extensively metamorphosed by folding and faulting and are highly fractured and fissured. A salt encrusted playa extends for 200 square miles in the southern portion of the valley.

Average annual precipitation over the last 30 years in DEVA has been 2.5 inches, with higher elevations receiving over 15 inches per year. Surface water is scarce at DEVA. Dry washes of all sizes flow only after thunderstorms or heavy winter rains. Surface water drains into enclosed desert basins, where it is lost to evaporation and infiltration. Near Gold Hill Mill, a stream is present that flows from Warm Springs (Figure 8).

DEVA is located in the South Lahontan Hydrologic Region (HR) which covers approximately 21 million acres in eastern California. The HR is bounded on the west by the crest of the Sierra Nevada, on the north by the watershed divide between Mono Lake and East Walker River drainages, on the east by Nevada, and the south by the crest of the San Gabriel and San Bernardino mountains and the divide between watersheds draining south toward the Colorado River and those draining northward. This HR includes the Owens, Mojave, and Amargosa river systems, the Mono Lake drainage system, and many other internally drained basins. Runoff is about 1.3 million acre-feet per year. Areas within the South Lahontan HR where groundwater occurs outside alluvial groundwater basins are called groundwater source areas. These areas are associated with the igneous intrusive and extrusive, metamorphic, and sedimentary rocks that underlie the mountainous regions of the HR. Because many of the bedrock regions of the HR consist of mineralized metamorphic rock containing ores of copper, gold, silver, lead, mercury, zinc, and other metals, potential impacts to groundwater are anticipated to predominantly derive from these natural sources. Only a very minor cumulative contribution is expected from the historic mining and milling operations, including those sites evaluated in this PA (ECM 2014).

Seventy-six groundwater basins are delineated in the South Lahontan HR, including the Langford Valley Groundwater Basin, which is divided into two sub-basins. The groundwater basins underlie about 11.6 million acres (18,100 square miles) or about 55 percent of the HR. In most of the smaller basins, groundwater is found in unconfined alluvial aquifers; however, in some of



the larger basins, or near dry lakes, aquifers may be separated by aquitards that cause confined groundwater conditions. Depths of the basins range from tens or hundreds of feet in smaller basins to thousands of feet in larger basins. The thickness of aquifers varies from tens to hundreds of feet. Well yields vary in this region depending on aquifer characteristics and well location, size, and use.

The chemical character of the groundwater varies throughout the region, but most often is calcium or sodium bicarbonate. Near and beneath dry lakes, sodium chloride and sodium sulfate-chloride water is common. In general, groundwater near the edges of valleys contains lower total dissolved solids content than water beneath the central part of the valleys or near dry lakes.

Additional details of the hydrology of the AML site regions are presented in the PA (ECM 2014).

1.5 Climate and Topography

Death Valley National Park covers over 3 million acres of Mojave and Great Basin Desert terrain, with elevations ranging from 282 feet below mean sea level at Badwater Basin to 11,049 feet on the summit of Telescope Peak. Temperatures in the valley range from over 120 degrees Fahrenheit (°F) in the summer to an average of 40°F in the winter but often dip below freezing. Annual precipitation varies from a 2.5-inch 30-year average on the valley floor to over 15 inches in the higher mountains.

NPS maintained a climate station at Furnace Creek in Death Valley until 2007. Although exact wind speeds were not archived, daily wind movement, which measures the total distance the wind moves each day, was recorded. According to these records, average daily wind movement is lowest during the winter and peaks during the early spring. Within DEVA, it not uncommon for fine-grained material to become airborne and re-distribute great distances from its source.

Prevalent wind direction is from the south; however, conditions vary greatly in specific locations. The PA (ECM 2014) presents an analysis of wind conditions at select locations. High winds (estimated in excess of 40 miles per hour) and wind-transport of fine-grained material were observed at Skidoo Mill during Site Inspection work.

1.6 Vegetation and Wildlife

Death Valley National Park contains a great diversity of plants. Vegetation zones include creosote bush, desert holly, and mesquite at the lower elevations. At the higher elevations, shad scale, black brush, Joshua tree, pinyon-juniper, to sub-alpine limber pine and bristlecone pine woodlands can be observed. The saltpan in the middle portion of the valley is devoid of vegetation and the slopes along the valley's alluvial fans have sparse cover.

Death Valley's range of elevations and habitats support a variety of wildlife species. The PA (ECM 2014) presents more detailed information on which species occur in the vicinity of each AML site.



1.7 Milling and Ore Processing

The mineral resources of the Death Valley area have been accessed and investigated since the days of the great California gold rush. From the 1850s to 1900, mining in Death Valley was sporadic and many mining endeavors were unsuccessful for a variety of reasons, including lack of finances, inefficient mining techniques, scarcity of water, and insufficient transportation. By the early 1900s, new technology enabled large-scale mining operations for gold, silver, and other metals and renewed interest in mining in the area.

Milled ore was most commonly processed using mercury amalgamation and/or cyanide leaching to extract gold. Amalgamation followed by cyanidation increased the amount of gold recovered from ore. These extraction methods generated piles of pulverized rock or mill tailings which could potentially contain hazardous materials such as cyanide, mercury, and other metals. An alternative extraction method used in DEVA silver mine sites was a flotation method.

The PA (ECM 2014) concluded that historical milling operations and ore processing practices used in Death Valley National Park have the potential to impact the environment. The following is a description of various ore processing methods used at the DEVA mill sites.

1.7.1 Milling and Ore Processing

Amalgamation is one of the oldest gold extraction processes and was commonly used in the early days of mining in Death Valley. The process is based on the fact that mercury forms a chemical bond with gold, called an amalgam. A saturated solution of mercury with gold contains 13.5 percent of gold. The process is inefficient because less than 30 percent of the available gold is recovered and 25 to 30 percent of the mercury used in the process is lost, potentially to the environment. More modern operations followed amalgamation with cyanidation or flotation.

The amalgamation process comprises several steps. First, ore is crushed, then milled, usually in water, to create fine size particles that will pass through a number 14 or 20 size mesh. The fine-grained ore was then entered into the recovery portion of the process. Several recovery processes were used to slowly pass the fine-grained ore over copperplates coated with mercury. The gold-mercury amalgam was then removed at regular intervals and the plates were re-dressed with mercury. Finally, the mercury was distilled from the amalgam to produce nearly pure gold. Mercury was an expensive commodity, and as much as possible it was recaptured for later use. Mercury lost during the process potentially ended up in the mill tailings.

Grinding ore for mercury amalgamation purposes started with crushing by a jaw crusher, then pulverized using large mechanical devices called stamp mills. The basic design of a stamp mill has been used for thousands of years for a variety of crushing applications, but is most commonly used for the processing of ore for mineral extraction. Typical stamp mill construction consisted of a series of heavy metal stamps arranged in a wooden frame called a battery. The stamp mills



used in DEVA during the gold rush era were usually powered by water, steam engines, or internal combustion engines. A system of belts, rotating shafts, and cams raised then dropped the stamps and crushed coarser grain ore into finer grain material for further processing.

1.7.2 Cyanide Leaching

Cyanide leaching originated around 1890 and was commonly used in conjunction with amalgamation to extract gold from ore. Cyanide leaching is more economical than amalgamation because approximately 90 percent of the gold that is present can be recovered. Early in its development, the process was used on the waste tailings from amalgamation. Because of the improved recovery, many of the tailing piles from other processes were reprocessed by cyanide leaching to extract gold. By 1925, cyanidation processing technology was applied to both gold and silver ores without using amalgamation first.

Gold is soluble in dilute solutions of potassium or sodium cyanide, and the dissolved gold can be precipitated from the cyanide solution using metallic zinc. The process typically comprises the following steps. The ore is ground or pulverized to a suitable size for use in a cyanide solution, or mixed with water to form a slurry or “pulp.” Sodium cyanide and lime are added to the slurry to create and maintain a cyanide solution with an alkaline condition (pH near 11). The pulp is agitated through a series of tanks or stirred to cause dissolution of the gold from the pulverized ore. The gold is precipitated from the cyanide solution by passing it over zinc shavings, or agitating it with zinc dust. The gold-zinc precipitate is refined, producing gold bullion. If silver is present, the gold and silver are separated by dissolving the silver with sulfuric or nitric acid. The bullion could be melted and cast into bars for shipment.

Not all gold ores are suitable for cyanidation processes. Arsenic and antimony-rich ores, such as some ores in the Panamint district, are problematic. Gold ores that contain copper are more soluble in a cyanide solution and increased cyanide consumption makes the process economically impractical. The flotation process is a more economical alternative for extraction of gold from these ores.

Typically, cyanide does not persist in arid environments at the surface or in aerobic conditions. Under aerobic conditions, microbial activity can degrade cyanide to ammonia, which then oxidizes to nitrate. This process has been shown effective with cyanide concentrations of up to 200 parts per million. Although biological degradation also occurs under anaerobic conditions, cyanide concentrations greater than 2 parts per million are toxic to these microorganisms. Although cyanide reacts readily in the environment and degrades or forms complexes and salts of varying stabilities, it is toxic to many living organisms at very low concentrations.



1.7.3 Flotation Process

Flotation methods came into widespread use because they can recover almost all forms of gold, including fine, free gold, gold associated with any form of sulfides, and gold-oxidized lead and gold-copper ores. When gold or silver is recovered using flotation, the high grade concentrate contains the precious metal. The concentrate may be ground, with or without roasting, treated with cyanide solution, or shipped to a smelter for further processing.

Extraction using the flotation method was completed according to the following general steps. Ore was brought into a mill, and crushed. This milled ore was mixed with water to form a slurry and then passed through a ball and/or rod mill, which used cast iron balls or long iron rods to further crush the ore into a finer powder.

The different metals in the milled ore were then separated using flotation cells. A mix of reagents and flocculants were introduced to the ore slurry to cause the desired metals to float to the top of the tank solution while at the same time sinking the other metals. In these systems, lead, copper, and other precious metals could be recovered.



This page is intentionally blank



2 Site Description, Previous Investigations, and Conceptual Site Model

This section summarizes the known environmental information and historical activities that have occurred at the six subject sites and presents this information in the form of a graphical Conceptual Site Model (CSM). The CSM was developed in the SAP (NOREAS 2016), and was revised as presented in this report, based on the findings of the SI field activities. Figure 9 is a graphical CSM that illustrates the potential exposure pathways relevant for the subject sites.

2.1 Key Site Features

The following sections describe the key site features of the six subject AML sites. Additional details for each mill site are included in the PA (ECM 2014).

2.1.1 Site Descriptions

Descriptions of the six subject sites are presented below, including general site operational background and geographic and environmental setting. No prior sampling for constituents of concern had been performed at any of the six subject sites.

2.1.2 Skidoo Mill

Skidoo Mill (Figure 2) is located near the top of a broad ridge in the Panamint Mountains (Latitude: 36.4368° North, Longitude: -117.1549° West). The site is currently fully open to the public and experiences low to moderate annual visitation. The mill and process areas are located on a steep canyon wall and cover approximately 5 acres. The mill is well preserved and displays many intact features. Tanks, mercury tables, and a large portion of the mill operations are well preserved and visible. To the northwest and down the canyon, the slope goes over a shear “dry falls.” To the east and west are steep to moderately sloped canyon walls. Both mercury amalgamation and cyanide-leaching operations took place in large scale. Tailings are found in many of the operations tanks at the mill and upstream/upslope to an area that is suspected to be an impoundment area. Based on operational history and information gathered during the PA (ECM 2014), the preliminary COCs identified were cyanide and metals, including mercury.

2.1.3 Homestake Mill

Homestake Mill (Figure 3) is located in the Bullfrog Hills, in the Nevada portion of DEVA (Latitude: 36.9395° North, Longitude: -116.8886° West) in an area known as the “Nevada Triangle.” The site sits at an elevation of approximately 4,950 feet above sea level and is located on a steep south-



sloping hillside overlooking broad deposits of alluvium. The mill site contains a series of five, reinforced-concrete foundations that are between 66 and 100 feet long, 3 feet thick at the base, and up to 16 feet high. Homestake Mill covers approximately 5 acres and experiences low annual visitation. The Homestake-King mine was one of the only mines (and the largest producer) in the famous Bullfrog Mining District that is contained within the park. Based on the operational history and results gathered during the PA (ECM 2014), the preliminary COCs identified at the site were cyanide and metals, including mercury.

2.1.4 Journigan's Mill

Journigan's Mill (Figure 4) is located in the Panamint Range, 1 mile south of Emigrant Springs and 13.5 miles south of Stovepipe Wells, California (Latitude: 36.4135° North, Longitude: -117.1822° West) at an elevation of 4,398 feet above sea level. The site is open to the public and is located on the west side of Emigrant Canyon/Wildrose Canyon Road. Although the ruins at the site are not substantial, the highly visible location on the west side of paved Emigrant Canyon Road attracts visitors, including many who are unfamiliar with mining, milling, and the associated hazards. Journigan's Mill experiences moderate annual visitation. Scattered mill tailings are found around the mill foundations on all of the levels and in most of the tanks. The site includes the largest ruin of an amalgamation and cyanide plant of the 1930s-1950s period left within the park. Based on operational history and results gathered during the PA (ECM 2014), the preliminary COCs identified were cyanide and metals.

2.1.5 Starr Mill

During initial SI activities it was determined, with USACE and NPS approval, that sampling of Starr Mill, located approximately a mile northwest of Journigan's Mill and sharing both the northern and the southern washes², would be included in the SI. Collection and analysis of data from Starr Mill was recommended to better evaluate the potential origin of mill tailing within these washes.

Starr Mill (Figure 5) is located at 4,009 feet above sea level and bound on the west by steep canyon walls and on the east by Emigrant Canyon Road and the eastern canyon wall. The wash slopes gently to the north and towards the city of Stovepipe Wells, California (13 miles south). The entire site covers an area of less than 0.5 acre. Access to the site is via paved road, which is open to the public. Starr Mill experiences low annual visitation. The site consists of four terraced, in-ground process "pools" and/or tank foundations with stacked rock walls or "dug-in" perimeters, and a concrete grout interior liner. Starr Mill was operated during the 1930s (ECM 2014). The site currently has concrete foundations from a few of the cyanide tanks and a mound

² Northern and southern washes were designated as Decision Units (DUs) 5 and 6. Decision Units are described in detail in Section 3.



of tailings on bedrock above the road. Based on operational history and information gathered during the PA, the preliminary COCs were identified as cyanide and metals.

2.1.6 Tucki Mine and Mill

Tucki Mill (Figure 6) is located on the southeast slope of the Tucki Mountains in the Panamint Range (Latitude: 36.4526° North, Longitude: -117.0906° West), east of the summit. The site is located 4 miles north-northeast of Skidoo and 10 miles by road from Emigrant Canyon via Telephone Canyon. Tucki Mine experiences low annual visitation. Steep peaks surround the Tucki process area, but the site is located on a gently sloping, steep-sided wash. The wash slopes to the east and then drops off a steep mountain edge approximately 0.5 mile from the site. The site operations covered approximately 3 acres. Cyanide processing operations were conducted on the southern side of the wash. Additionally, one "pool" foundation is at the eastern end of this row. The southern side of the wash is dominated by 2,000 to 3,000 cubic yards of ¾-inch crushed rock that the four former cyanide-leaching tanks reside on. The 100-cubic yard-capacity leach tanks are of steel-lined rectangular concrete block construction and ¾-full of ore. Several feet above and to the west of the leach tanks is a second "pool" foundation. At the bottom of the wash, to the west of the cyanide-leach tanks, is a small former pump pad. Based on operational history and information gathered during the PA (ECM 2014), the preliminary COCs identified were cyanide and metals.

2.1.7 Cashier Mill

Cashier Mill (Figure 7) is located 17 miles south of Stovepipe Wells, California, in the Panamint Mountains (Latitude: 36.3615°, Longitude: -117.1107°) at an elevation of 5,089 feet above sea level. The site is open to the public and can be reached via a 1.5-mile-long graded dirt road accessed east of Emigrant Canyon/Wildrose Canyon Road. This is one of the more heavily visited mine and mill sites in DEVA. Cashier Mill experiences moderate annual visitation. The mill site is located on the southeastern side of Providence Ridge, an east-west-trending hill standing approximately 200 feet above a wide valley. The alluvial plain surrounding Providence Ridge extends over 4 miles to the northwest and gently slopes to the north. Gold ore supplying the mill was taken from the Cashier and Eureka Mines, located in the extreme northeastern extent of the ridge. An entrance to the Eureka Mine is found upslope of the mill ruins. Approximately 100 cubic yards of medium-grained pink sand tailings occur in the vicinity and down slope of the mill foundation where cyanide and mercury processing took place. A separate tailing deposit is present up slope of the mill site. Mine waste is present on the hillside to the west and south of the mill ruins. Many foot paths intersect the tailing deposits in the mill and mine areas. Based on the operational history and information gathered during the PA (ECM 2014), the preliminary COCs for the site were cyanide and metals, including mercury.



2.1.8 Gold Hill Mill

Gold Hill Mill (Figure 8) is located 35 miles south of Furnace Creek, California, in Warm Spring Canyon (Latitude: 35.9687°, Longitude: -116.9317°) at an elevation of 2,360 feet above sea level. The Gold Hill Mining District is one of the oldest mining areas within DEVA, with prospecting and work dating from the 1870s. The Gold Hill region is located within DEVA in the southwest corner, in the Panamint Mountain Range, at the northeastern end of Butte Valley and north of Warm Spring. Gold Hill Mill is heavily visited due to its location next to the Warm Spring Mining Camp and along the road to Butte Valley. This site is accessed via 14 miles of infrequently graded dirt roads requiring high clearance four-wheel drive vehicles. Gold Hill Mill experiences moderate annual visitation. The site covers less than 1 acre and consists of a complete and well-preserved mill with evidence of mercury amalgamation. A spring and an abandoned mining camp are located south of the mill ruins. Minor mill tailings from the amalgamated mercury process used to extract the gold have accumulated in and around the mill workings, primarily on the east side, scattered in and around the equipment, and comingling with native rock. Based on operational history and information gathered during the PA (ECM 2014), the preliminary COCs for the site were identified as metals, including mercury.

2.2 Summary of Previous Investigations

Preliminary Assessments of the seven above-mentioned AML sites was conducted by ECM in February 2014 (ECM 2014a). The PAs described the historical uses of the sites, current state of the sites, and approximated by visual means-only the extent of various waste rock and mill tailings at each of the sites. No chemical sampling for COCs had previously been performed at the sites.

2.2.1 Contaminants of Potential Concern

Based on operational history and information gathered during the PA (ECM 2014), the preliminary COCs for the site are metals, including mercury, and cyanide.

2.2.2 Media of Potential Concern

Soils are the primary media of concern at the subject AML sites. At Gold Hill Mill, a stream is present that flows from Warm Spring (Figure 8). Therefore, surface water samples were collected from the stream at Gold Hill Mill. In addition, samples of surface water were collected at Skidoo Mill and Cashier Mill in areas where standing water was observed during sampling following recent rain events during the sampling period.



2.3 Current and Future Property Use Scenarios

As described in Section 2.1, the subject sites are visited by a low volume of DEVA visitors each year, with the more remote sites receiving fewer visitations. Visits by site workers are also infrequent. Land uses are unlikely to change in the future.

2.4 Graphical Conceptual Site Model

The potential human and ecological exposure routes are illustrated in the CSM presented on Figure 9. The principal human exposure pathways are through dermal contact and inhalation (wind-blown material).

The potential exposure pathways for aquatic receptors are assumed to be limited to sites with significant nearby standing or running waters. At this time, potential aquatic receptors are likely to be only present near Gold Hill Mill. Depth of occurrence of groundwater at the subject sites is unknown. The presence of Warm Springs near Gold Hill Mill suggest this site may support relatively shallow groundwater. The likelihood of realization of beneficial use of groundwater, if present, at the subject sites is very low due to the remoteness of the sites and protections from future site development.



This page is intentionally blank



3. Field Activities and Analytical Protocols

This section summarizes the SI field activities performed at Skidoo, Homestake, Journigan's, Starr, Tucki, Cashier, and Gold Hill between February 16, 2016 and March 9, 2016. The goal of these SIs was to obtain and analyze environmental samples, to assess human and environmental exposure to hazardous substances, and to evaluate the basis for further actions, if needed (NOREAS 2016). Complete delineation of the extent of contaminants, if present, was not a goal of these SI activities. Figures 2 through 8 illustrates the information detailed in the following sections. Table 1 summarizes sample collection for all sites. Tables 2 through 8 summarize soil sampling analytical results at individual sites. Table 9 summarizes surface water analytical results. Table 10 summarizes soil leachability testing results.

Soil samples were labeled and preserved on ice in coolers during the sampling week, and submitted to TestAmerica Laboratories, Inc., Irvine, California facility at the end of each sampling week. The Irvine facility repackaged samples for shipping to the TestAmerica's Arvada, Colorado facility, which maintains the appropriate Department of Defense (DoD) laboratory certifications in accordance with the project Sampling and Analysis Plan (SAP), (NOREAS 2016). Acid-Base Accounting (ABA) analyses were subcontracted by TestAmerica to SVL Analytical, Inc.'s laboratory in Kellogg, Idaho.

3.1. Soil and Surface Water Sampling Procedures

The following sections summarize soil and surface water sampling procedures performed at each site as described in the SAP (NOREAS 2016). Samples collected consisted of ISM soil samples, discrete background soil samples, and surface water grab samples. Photographs of ISM sampling areas, discrete samples, surface water samples and general site areas are logged and presented in Appendix A, and GPS coordinates are documented in Appendix B. Samples were collected from each Decision Unit (DU) prior to moving to next DU. Soil and surface water sample collection was conducted in accordance with SAP requirements (NOREAS 2016). A DU refers to a specific soil area, such as mill tailing impoundment, cyanide processing area, mine waste stockpile, or background native soil area, designated for sampling.

3.1.1. Soil Sampling

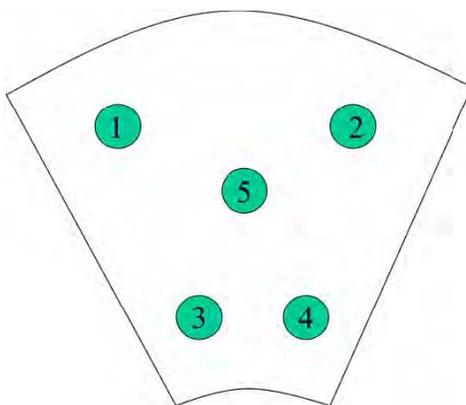
ISM provides representative samples of a DU by collecting numerous increments of soil (30 increments were used at DEVA) that are combined, processed, and subsampled according to specific protocols. Detailed procedures for ISM sampling are presented in Incremental Sampling Methodology (ITRC, 2012).



ISM sampling was implemented in two stages per the SAP (NOREAS 2016): 1) DU boundary and grid demarcation, and 2) sample collection. Once the DU boundaries were delineated and staked, each DU was then subdivided into 30 approximately equally sized sampling units (SUs). Survey “whiskers” were used to define the edges of each SU.

Once the ISM SU delineation was complete, a systematic random sampling approach was used to collect samples from each DU. ISM samples were collected using the following procedure:

- Five positions, one at each corner of the SU and one at the center of a SU were established and assigned a number as shown below;



- A single six-sided dice was rolled to determine the random sample locations. Sampling proceeded clockwise to the next position as each ISM sample was collected separately.
- The incremental sampling equipment was decontaminated prior to sampling and between each DU sample.
- Immediately before collecting soil samples and between each DU sample, a new pair of disposable nitrile gloves was donned.
- Approximately 35 grams of soil from between 0 and approximately 6 inches below ground surface was collected at each SU. Materials larger than 2 millimeters such as stones and roots were avoided. The soil was immediately placed into a clean plastic bag. Each ISM sample submitted to the laboratory consisted of approximately 1 kilogram of soil.

The ISM sampling tools were decontaminated between each DU sample using a triple-rinse method, and rinsate source blanks and equipment rinsate samples were collected and analyzed in accordance with the SAP (NOREAS 2016).



3.1.2. Background Soil Samples

To obtain defensible background results for each site, the background area at each site was delineated and sampled in the same manner as a DU. The background areas were located upgradient and outside but adjacent to the area potentially affected by the milling operations. The areal extent of the background sampling area was of similar scale to the DUs at each site. In addition to the ISM samples, discrete background samples were collected from randomly selected locations within the background ISM grid from Skidoo Mill and Journigan's Mill sites. These discrete sample results are compared to ISM sampling results in Section 4. Skidoo Mill was selected for this purpose due to the prevalence of metal ores in the vicinity of the mill site, which may impact the distribution of metals concentrations in native soils. Journigan's Mill was also selected for background discrete sampling because it is known that Journigan's Mill received ore metals from other mining sites in the general area; therefore, ISM results alone may not appropriately capture the range of background metals concentrations present in the mining region.

3.1.3. Surface Water Sampling

When encountered, surface water samples were collected using a grab sampling technique and filtered manually on site using a dedicated syringe, tubing, and a 0.45 micrometer capsule filter into lab provided bottles (NOREAS 2016). Following filtering, the samples were acidified with nitric acid to a pH of <2, double-bagged and iced immediately per SAP requirements (NOREAS 2016).

Surface waters were also tested for pH using a field-calibrated pH meter. The pH meter was calibrated or calibration-checked prior to sampling, on the day of sampling. Documentation of pH readings were recorded in field book

3.2. Skidoo Mill

SI field activities at Skidoo Mill were performed beginning on February 16 and through February 19, 2016. Information presented in the PA and defined in the SAP (NOREAS 2016) identified five DUs present at Skidoo Mill: DU-1 cyanide processing area, DU-2 mercury amalgamation area, DU-3 mill tailing impoundment, DU-4 mill tailings in wash, and DU-5 background native soils (Figure 2). Soil sampling results discussed in Section 4.1 and are presented in Table 2; sample summary information is summarized in Table 1.

Initial SI activities involved establishing the DU-5 background native soil sampling area. Two areas were identified as representative background native soils (Figure 2): an area located at the top of the ridge southeast and up slope from the mill, and an area upgradient within the wash east



the mill. Once the two background areas were identified and delineated, the ISM sampling grids were delineated. The DU was then subdivided into 30 approximately equally sized sampling units (SUs), with each area divided into 15 SUs. The ridge background sampling area and the upgradient wash background sampling area have a combined area of approximately 28,000 ft² [Appendix A (Skidoo - Photo 41-48)]. A total of 3 ISM samples (SKID-05-001 thru SKID-05-003) and 15 discrete samples [7 discrete samples from the ridge background sampling area and 8 discrete samples from the upgradient wash background area (SKID-BG-001 thru SKID-BG-015)] were collected from DU-5.

The cyanide processing area (DU-1) ISM area is approximately 13,000 square feet and consists of the cyanide processing tanks and foundations, and extends approximately 75 feet below the tank area along the slope (Figure 2). A total of four ISM samples (SKID-01-001 thru SKID-01-004) were collected from DU-1 [Appendix A (Skidoo - Photo 5-10)].

The mercury amalgamation area (DU-2) ISM area is approximately 1,500 square feet and consists of the mercury amalgamation tables and areas in and around the mill foundations in the vicinity of the tables (behind and beneath) (Figure 2). The ISM grids were evenly distributed throughout this area [Appendix A (Skidoo - Photo 11-17)]. A total of four ISM samples (SKID-02-001 thru SKID-02-004) were collected from DU-2.

The mill tailings impoundment area (DU-3) ISM area is approximately 22,000 square feet and consists of the area at the bottom of the slope beneath the mill and within the wash bounded by a rock dam to the west and extends approximately 500 feet to the east (Figure 2) [Appendix A (Skidoo - Photo 18-22)]. A total of four ISM samples (SKID-03-001 thru SKID-03-004) were collected from DU-3.

Discrete samples of the eroded tailings in the wash (DU-4) extended from the top of the dry fall to approximately 2,000 feet west down the wash (Figure 2). A total of 15 discrete samples (SKID-04-001 thru SKID-04-015) were collected from DU-4 [Appendix A (Skidoo - Photo 23-40)]. Thick sections of eroded mill tailings were observed in the wash (Skidoo - Photo 23-40)]. Discrete samples, photos, and GPS coordinate information was collected from each sample location prior to moving to next location and per SAP requirements (NOREAS 2016).

Surface water was observed in DU-2 mercury amalgamation area and DU-3 mill tailing impoundment, the result of an overnight rain storm (Figure 2). DU-2 surface water sample was collected from the mercury amalgamation table trough (SKID-02-SW1) and the DU-3 surface water sample was collected from a low lying area within the tailings impoundment (SKID-03-SW1) [Appendix A (Skidoo - Photos 50-54)].



3.3. Homestake Mill

SI field activities at Homestake Mill were performed beginning March 7 through March 9, 2016. Information presented in the PA and defined in the SAP (NOREAS 2016) identified five DUs present at Homestake Mill: DU-1 mill foundations, DU-2 mill tailings stockpile, DU-3 mine waste stockpile, DU-4 downgradient mill tailings, and DU-5 background native soils (Figure 3). Sampling results are discussed in Section 4.2 and presented in Table 3. Sample summary information is summarized in Table 1.

Initial SI activities involved establishing the DU-5 background native soil sampling area. The area identified as representative background native soils is located approximately 500 feet northwest of the mill is a wash (Figure 3) with a total area of 11,500 square feet. Once the background area was identified and delineated, the ISM sampling grids were delineated. The DU was then subdivided into 30 approximately equally sized SUs [Appendix A (Homestake - Photos 47-48)]. A total of 3 ISM samples (HOME-05-001 thru HOME-05-003) were collected from DU-5.

The mill foundations (DU-1) consist of five, reinforced concrete foundations that are between 66 and 100 feet long (Figure 3). Four of the five foundations were identified as representative and delineated for ISM sampling. The mill foundations ISM area is approximately 11,000 square feet. A total of four ISM samples (HOME-01-001 thru HOME-01-004) were collected from DU-1 [Appendix A (Homestake - Photos 4-10)].

The mill tailings stockpile (DU-2) ISM area is approximately 240 feet downslope beneath the mill foundations to the east and has an area of approximately 8,200 square feet (Figure 3) [Appendix A (Homestake - Photos 11-12)]. A total of four ISM samples (HOME-02-001 thru HOME-02-004) were collected from DU-2.

During delineation of DU-3 mine waste stockpiles, it was observed that the mine waste stockpiles were more extensive than what was originally described in the PA (Figure 3). Mine waste stockpiles (DU-3) are located on the north and south sides of the mill foundations with a total area of approximately 17,500 square feet (Figure 3). A total of 15 discrete samples (HOME-03-001 thru HOME-03-015) were collected from DU-3 [Appendix A (Homestake - Photos 13-28)]. Only fine-grained material within the mine waste stockpile was sampled.

During delineation of DU-4 eroded downgradient mill tailings, it was observed that the eroded mill tailings were more extensive than what was originally described in the PA. Thick sections of tailings were observed in the wash for approximately 0.75 miles or 3,900 feet from the mill and that thin out and continue across the access road onto BLM land (Figure 3) [Appendix A (Homestake - Photos 29-30)]. Discrete samples of the eroded downgradient mill tailings (DU-4)



extended from approximately 500 feet downslope from the mill to approximately 0.75 miles where the wash meets the access road and are spaced approximately 300 feet apart (Figure 3). A total of 15 discrete samples (HOME-04-001 thru HOME-04-015) were collected from DU-4 [Appendix A (Homestake - Photos 32-46)].

3.4. Journigan's Mill

SI field activities at Journigan's Mill were performed beginning March 1 through March 3, 2016. Information presented in the PA and defined in the SAP (NOREAS 2016) identified seven DUs present at Journigan's Mill: DU-1 cyanide processing area, DU-2 mill foundations, DU-3 mill tailings large bermed stockpile, DU-4 southern mine waste stockpile, DU-5 eroded mill tailings in northern wash, DU-6 eroded mill tailings in southern wash, and DU-7 background soils (Figure 4). During initial SI activities it was determined, with USACE and NPS approval, that sampling of Starr Mill, located approximately a mile west of Journigan's Mill and sharing both the northern (DU-5) and the southern (DU-6) washes, would be included in the SI. Collection and analysis of data from Starr Mill was recommended to better evaluate the potential origin of mill tailing within these washes. Sample results are discussed in Section 4.3 and presented in Table 4; sample information is summarized in Table 1.

Initial SI activities involved establishing the DU-7 background native soil sampling area. Two areas south of the mill were identified as representative background native soils (Figure 4): an area located along a slope and an area upgradient within a wash south of the mill. Once the two background areas were identified and delineated, the ISM sampling grids were delineated. The DU was then subdivided into 30 approximately equally sized sampling units, with each area divided into 15 SUs. The sloped background sampling area and the upgradient wash background area have a combined area of approximately 11,600 square feet [Appendix A (Journigan's - Photo 58-63)]. A total of 3 ISM samples (JOUR-07-001 thru JOUR-07-003) and 19 discrete samples [7 discrete samples from the slope background sampling area and 7 discrete samples from the upgradient wash background area (JOUR-07-004 thru JOUR-07-017)] were collected from DU-5. To further evaluate the background native soils, two additional discrete background samples were collected from the northern (JOUR-07-018) and southern (JOUR-07-019) washes upgradient and east of the mill (Figure 4).

The cyanide processing area (DU-1) ISM area is approximately 7,600 square feet and consists of the cyanide processing tanks and foundations, and extends approximately 30 feet below the tank area to the toe of the slope (Figure 4). A total of four ISM samples (JOUR-01-001 thru JOUR-01-004) were collected from DU-1 [Appendix A (Journigan's - Photo 5-9)].



The mill foundations (DU-2) ISM area consists of two areas of foundations with a combined area of approximately 3,800 square feet (Figure 4) [Appendix A (Journigan's - Photo 10-13)]. A total of four ISM samples (JOUR-02-001 thru JOUR-02-004) were collected from DU-2.

The mill tailings large bermed stockpile (DU-3) ISM area consists of three areas and has a total combined area of approximately 11,300 square feet (Figure 4). The DU-3 area begins at the base of the mill foundations and extends northwest down slope toward Emigrant Canyon Road (Figure 4). The DU was subdivided into 30 approximately equally sized sampling units, with each of the three areas divided into 10 SUs [Appendix A (Journigan's - Photo 14-18)]. A total of four ISM samples (JOUR-03-001 thru JOUR-03-004) were collected from DU-3.

The southern mine waste stockpile (DU-4) ISM area is located at the top of the hill where the former mills ore chute was located (Figure 4). DU-4 extends down the western slope approximately 20 feet and is approximately 400 square feet [Appendix A (Journigan's - Photos 19-22)]. Only the fine grained material within the mine waste pile was sampled. A total of four ISM samples (JOUR-04-001 thru JOUR-04-004) were collected from DU-4.

Discrete samples of possible eroded mill tailings (based on visual characteristics) in the northern wash (DU-5) were identified extended from approximately 500 feet east of the mill along the northern shoulder of Emigrant Canyon Road to approximately 1.5 miles northwest of the mill (Figure 4). To further evaluate the fine grained material within the wash, two additional samples were collecting from the northern wash at the intersection of Emigrant Canyon Road and Highway 190 (Figure 4) approximately 4.7 miles from the site. A total of 20 discrete samples (JOUR-05-001 thru JOUR-05-020) were collected from DU-5 [Appendix A (Journigan's - Photos 23-42)]. Thick sections of eroded mill tailings were observed in the wash approximately 400 feet northwest of the mill within the northern wash (Journigan's - Photos 27-28)].

Discrete samples of the suspected eroded mill tailings in the southern wash (DU-6) extended from approximately 500 feet east of the mill along the southern shoulder of Emigrant Canyon Road to approximately 2.1 miles west of the mill (Figure 4). A total of 14 discrete samples (JOUR-06-001 thru JOUR-06-014) were collected from DU-6 [Appendix A (Journigan's - Photos 43-57)].

3.4.1. Starr Mill

As discussed in Section 3.1, Starr Mill was added to SI activities due to the mills proximity to the northern and southern washes of Journigan's Mill (Figure 5). SI field activities at Starr Mill were performed on March 3, 2016. Information presented in the PA identified two areas of concern at Starr Mill: tailings stockpiled at the mill foundation/cyanide processing area and eroded tailings



in the washes (Figure 5). Sample results are discussed in Section 4.4 and presented in Table 5; sample information is summarized in Table 1.

The mill foundations / cyanide process area (DU-1) ISM area consists of three areas with a combined area of approximately 800 square feet and includes the mill tailings stockpile and processing tanks (Figure 5) [Appendix A (Starr - Photos 1-7)]. A total of four ISM samples (STAR-01-001 thru STAR-01-004) were collected from DU-1.

A total of 3 discrete samples (STAR-01-001 thru STAR-01-003) were collected from an area where eroded mill tailings appeared to have settled/ponded, located approximately $\frac{3}{4}$ of a mile north of the mill on the west side of Emigrant Canyon Road at the 5-Mile marker [Appendix A (Starr - Photos 8-12)]. The settlement/ponded area was approximately 5,000 square feet.

3.5. Tucki Mill

SI field activities at Tucki Mill were performed on February 22 and February 23, 2016. Information presented in the PA and defined in the SAP (NOREAS 2016) identified three DUs present at Tucki Mill: DU-1 cyanide processing area, DU-2 fine-grained mine waste, and DU-3 background native soils (Figure 6). Sample results are discussed in Section 4.5 and presented in Table 6; sample information is summarized in Table 1.

Initial SI activities involved establishing the DU-3 background native soil sampling area. An area approximately 1,000 feet west of the mill on the south side of the access road was identified as representative background native soils and consists of an area of approximately 300 square feet (Figure 6) [Appendix A (Tucki - Photos 10-11)]. A total of 3 ISM samples (TUCK-03-001 thru TUCK-01-003) were collected from DU-3.

The cyanide processing area (DU-1) ISM area is approximately 11,300 square feet and consists of the cyanide processing tanks, the crushed ore/ mill foundation, and slope area (Figure 6) [Appendix A (Tucki - Photos 1, 2, 5, & 6)]. Only fine-grained material within the crushed rock pile was sampled. A total of four ISM samples (TUCK-01-001 thru TUCK-01-004) were collected from DU-1.

The fine-grained mine waste (DU-2) ISM area consists of three separate stockpiles [Appendix A (Tucki - Photos 7-9)]. The three areas have a total combined area of approximately 1,500 square feet, with one stockpile located 20 feet north and two stockpiles located approximately 45 feet east of DU-1 (Figure 6). Only the fine grained material within the mine waste piles was sampled. A total of four ISM samples (TUCK-02-001 thru TUCK-02-004) were collected from DU-2.



3.6. Cashier Mill

SI field activities at Cashier Mill were performed beginning February 23 through February 25, 2016. Information presented in the PA and defined in the SAP (NOREAS 2016) identified five DUs present at Cashier Mill: DU-1 mill foundations, DU-2 mill tailings in eastern wash, DU-3 mill tailing in western wash, DU-4 mine waste on northern slope, and DU-5 background native soils (Figure 7). Sample results are discussed in Section 4.6 and presented in Table 7; sample information is summarized in Table 1.

Initial SI activities involved establishing the DU-5 background native soil sampling area. Two areas were identified as representative background native soils (Figure 7): an area located along the top of the ridge approximately 350 feet northwest of the mill and an area within a wash approximately 250 feet south of the mill. Once the two background areas were identified and delineated, the ISM sampling grids were delineated. The DU was then subdivided into 30 approximately equally sized sampling units (SUs), with each area divided into 15 SUs. The ridge background sampling area and the wash background sampling area have a combined area of 530 square feet [Appendix A (Cashier - Photos 27-28)]. A total of 3 ISM samples (CASH-05-001 thru CASH-05-003) were collected from DU-5.

The mill foundations (DU-1) ISM area is approximately 3,200 square feet and consists of the cyanide and mercury processing area and foundations (Figure 7). A total of four ISM samples (CASH-01-001 thru CASH-01-004) were collected from DU-1 [Appendix A (Cashier - Photos 1-3)].

The mill tailings in the eastern drainage (DU-2) ISM area is approximately 250 square feet and is located approximately 450 feet northeast of the mill (Figure 7). A total of four ISM samples (CASH-02-001 thru CASH-02-004) were collected from DU-2 [Appendix A (Cashier - Photos 4-5)].

The mill tailings in the western drainage (DU-3) ISM area is approximately 600 square feet and is located approximately 45 feet southwest of the mill (Figure 7). A total of four ISM samples (CASH-03-001 thru CASH-03-004) were collected from DU-3 [Appendix A (Cashier - Photos 6-9)].

Discrete samples of the mine waste on the northern slope (DU-4) were collected from stockpile from the toe of the slope to the top of the ridge (Figure 7). A total of 15 discrete samples (CASH-04-001 thru CASH-04-015) were collected from DU-4 [Appendix A (Cashier – Photos 10-26)]. Only fine-grained material within the mine waste stockpiles was sampled.

Surface water was observed in DU-1 mill foundation area (Figure 7), the result of an overnight rain storm. DU-1 surface water sample was collected from a depression in one of the concrete mill foundations (CASH-01-SW1).



3.7. Gold Hill Mill

SI field activities at Gold Hill Mill were performed on February 26 and February 29, 2016. Information presented in the PA and defined in the SAP (NOREAS 2016) identified three DUs present at Gold Hill Mill: DU-1 mill foundations, DU-2 eroded mill tailings in wash along road, and DU-3 background native soils (Figure 8). Warm Spring is located approximately 850 feet upslope and south of the mill. The spring actively discharges water at a rate of 50 gallons per minute, providing a stream that infiltrates approximately 500 feet downstream (ECM 2014). Sample results are discussed in Section 4.7 and presented in Table 8; sample information is summarized in Table 1.

The mill foundations (DU-1) ISM area is approximately 2,800 square feet and includes the ore crushing area and the ramp (Figure 8) [Appendix A (Gold Hill - Photos 1, & 4-9)]. A total of four ISM samples (GOLD-01-001 thru GOLD-01-004) were collected from DU-1.

Discrete samples of the mill tailings in the wash along the road (DU-2) were collected just north of the mill foundations and approximately 300 feet downgradient from the mill (Figure 8). A total of 7 discrete samples (GOLD-02-001 thru GOLD-02-007) were collected from DU-2 [Appendix A (Gold Hill - Photos 10-11)].

An area approximately 140 feet west of the mill on the north side of the road within a wash was identified as representative background native soils (DU-3) (Figure 8). The background native soil (DU-3) ISM area is approximately 3,000 square feet [Appendix A (Gold Hill - Photo 12-15)]. A total of 3 ISM samples (GOLD-03-001 thru GOLD-01-003) were collected from DU-3.

Two surface water samples were collected from the stream that flows from Warm Spring (Figure 8). The first sample was collected from the stream just at the foot of the slope located approximately 330 feet south of the mill (GOLD-SW1) and a second sample (and duplicate sample) was collected downgradient approximately 1,000 east of the mill next to Warm Springs Road (GOLD-SW2 and GOLD-SW3) [Appendix A (GOLD - Photos 16-18)].



4. Sampling Results

The following sections summarize the results of soil and, where applicable, surface water sampling at the subject mill sites.

Methods

Applicable for all sites, determination of 95-percent (%) upper confidence limit (UCL) concentration of soil sample results was performed for each DU, using USEPA ProUCL 5.1.002 software. The UCLs for each metal of potential concern is listed in the respective tables for each site, and 95% UCL for each DU are shown on the respective site figures. In cases where an analyte was not detected in a sample, a result equal to one-half of the analyte reporting limit was assumed for 95% UCL determination. The 95% UCL for all ISM samples was determined using the Chebyshev method, which is recommended for use in ISM-based samples, as this method provides a conservative estimate of the UCL (ITRC 2012). The Chebyshev method is based on non-parametric (no distributional) assumptions of the data set.

For discrete sampling performed within DUs, the ProUCL software was used to determine the data set properties (i.e., normal, gamma, non-parametric) and an appropriate UCL-determination method was selected based on the observed data set. In most cases, a normal distribution was assumed and a Student's-t 95% UCL was used. The respective site data tables (Tables 2 through 8) are notated regarding the method used for determining 95% UCL concentrations for each data set.

For Tier 1 risk screening purposes, sample results (95% UCL concentrations) in Tables 2 through 9 are compared with site screening values established in the SAP (NOREAS 2016), including USEPA Region 9 Regional Screening Levels (RSLs) (residential use assumption), NPS Ecological Screening Levels (ESVs) and California Regional Water Quality Control Board (Water Board) Environmental Screening Levels (ESLs). It should be noted that these screening levels represent conservative assumptions regarding human and ecological risk exposures. Due to their remote locations and short-term recreational visitor site uses, actual exposure duration at the subject sites is significantly less than the exposure time assumed for Tier 1 human health risk screening values used in this SI Report.

Acid-base accounting (ABA) was performed at selected DUs. ABA results measure the acid generating potential (AGP) and acid neutralization potential (ANP) of the soil. When the ratio of



ANP/AGP is greater than 1.2:1, the soil is considered to have minimal acid mine waste generation potential. In all cases described below, acid mine waste generation potential was very low.



4.1. Skidoo Mill

The following sections summarize the evaluation of the SI sampling results for Skidoo Mill. Results for Skidoo Mill are tabulated in Table 2 and summarized on Figure 2.

4.1.1. Background Soil Sampling

Background soil samples were collected using both ISM and discrete sampling methods at Skidoo Mill. Comparison of the results of 95% UCL concentrations between discrete and ISM sampling methods yielded excellent correlation ($R^2=0.998$), with the 95% UCL concentration from ISM samples yielding a higher result than discrete samples for all analytes except thallium. This apparent bias for higher 95% UCL concentrations from ISM results is consistent with the use of the conservative Chebyshev method for determination of the UCL.

For all metals except cadmium (Cd), cobalt (Co), selenium (Se), and silver (Ag), the background soil concentrations exceeded the NPS ESV (based on Screening Level Environmental Risk Assessment (SLERA) Chemicals of Potential Ecological Concern (COPEC) (NPS 2014b). Other Skidoo Mill DUs also exceed NPS ESVs for most metals analyzed.

USEPA Region 9 RSLs and Water Board ESLs were exceeded for arsenic in background soils. Arsenic (As) concentrations in California soils are commonly elevated above these screening levels, and the background (95% UCL) concentration of approximately 12 milligrams per kilogram (mg/kg) arsenic is consistent with values observed in many areas of California.

4.1.2. Mill Area (Mercury and Cyanide Processing Areas)

Elevated concentrations (above background) of antimony (Sb), As, lead (Pb), mercury (Hg), molybdenum (Mo), Ag, and zinc (Zn) were reported in soils collected from DU-1 (cyanide processing area) and DU-2 (mercury amalgamation area) samples. Notably, Pb is 1,359 mg/kg (95% UCL) in DU-2, which exceeds corresponding RSL (400 mg/kg) by a factor of 4, ESV (0.94 mg/kg) by approximately three orders of magnitude, and ESL (80 mg/kg) by approximately two orders of magnitude.

4.1.3. Mill Tailings Impoundment

The mill tailings impoundment area (DU-3) soils contain elevated (above background) concentrations of Sb, As, copper (Cu), Pb, Hg, Mo, Ag and Zn. Notably, the 95% UCL concentration of Pb in DU-3 is 1,477 mg/kg.



DU-3 soils have cyanide concentration (95% UCL) of 12.1 mg/kg, above the NPS ESV (0.1 mg/kg), Water Board ESL (0.0036 mg/kg) and USEPA RSL (2.7 mg/kg).

Mill tailings soils were reported to have slightly basic pH of approximately 9.4 (standard units). Results of ABA tests on mill tailing impoundment samples indicates that soils in this DU do not have net acid-generating potential [AGP; AGP < acid neutralization potential (ANP)].

4.1.4. Downgradient Wash

Discrete soil samples (15) were collected in the wash area downgradient of Skidoo Mill (DU-4). The 95% UCL concentrations of the DU-4 samples exceeded background concentrations for Sb, As, Cu, Pb, Hg, Mo, Se, Ag and Zn. Notably, the 95% UCL concentration of Pb in DU-4 is 2,083 mg/kg; the range of Pb in DU-5 discrete soil samples is from 1,150 mg/kg to 2,640 mg/kg.

4.1.5. Surface Water Samples

Surface water sample results are summarized in Table 9. Sample DEVA-SKID-02-SW1 was collected from the Hg-amalgamation tables (DU-2) within the mill structure. This sample exceeded the NPS ESV for surface waters for barium (Ba), Cu, Pb, Hg, Ag and Zn. The surface water sample collected from the Hg amalgamation tables contained Pb [10.5 micrograms per liter ($\mu\text{g/L}$)] and Hg (0.27 $\mu\text{g/L}$) at approximately an order of magnitude above their NPS ESVs (0.92 $\mu\text{g/L}$ and 0.026 $\mu\text{g/L}$, respectively). Sample DEVA-SKID-03-SW1 was collected from a small area of ponded water within the mill tailings (DU-3) impoundment. The DU-3 surface water sample reported concentrations of As, Ba, Cu, Pb, Hg, Ag and Zn above NPS ESVs, including Pb at 891 $\mu\text{g/L}$ and Hg at 1.02 $\mu\text{g/L}$. The presence of water at both of these sample locations was highly ephemeral, having accumulated the night before during a rain event, and largely dried by the end of the day of collection.

4.1.6. Soil Leaching Analyses

One Skidoo Mill soil sample, DEVA-SKID-01-003 (684 mg/kg Pb) was analyzed for leachability using the Toxicity Characteristic Leaching Procedure (TCLP) for Pb. The resulting leachate was reported with a concentration of 9.25 milligrams per liter (mg/L) Pb.

4.1.7. Data Quality Assessment

This section describes the quality and usability of analytical data collected during the February 2016 site inspection sampling conducted at Skidoo Mill. General data quality assessment



procedures used were the same for all sites. Field sampling and laboratory analytical activities for all SI sites were performed in accordance with the Sampling and Analysis Plan (NOREAS 2016).

At Skidoo Mill, a total of 29 discrete soil, 2 surface water, 2 source blank, and 2 equipment blank samples were collected on February 17 through 19, 2016. In addition, 15 grab soil samples were collected using ISM. Environmental samples were analyzed for Title 22 metals (California Administrative Manual [CAM] 17 metals (EPA Method 6020A and 7470A/7471), cyanide (EPA 9012A), soil pH (EPA 9045D) and ABA (Modified Sobek Method). All samples were received in good condition and technical holding time requirements were met.

Analysis of groundwater and soil samples from all SI sites were performed by Test America Denver Laboratory, Inc. located in Arvada, Colorado. Test America is an approved laboratory facility in accordance with California Department of Health Services Environmental Laboratory Accreditation Program (ELAP), State of Nevada Department of Conservation and Natural Resources, and Department of Defense (DoD) ELAP. A third-party validation firm, Laboratory Data Consultants, Inc. (LDC), performed data validation on the chemical analyses for the project samples.

The overall data quality was determined based on the analytical results generated for field and laboratory quality assurance/quality control (QA/QC) samples during this project. QA/QC for field activities was ensured through standardized sampling methods, rigorous documentation, and the collection of field QC samples as described in the project SAP (NOREAS 2016). Additionally, laboratory performed QC analyses to assess precision and accuracy of the analytical processes as determined by method-required laboratory QC samples, calibration and verification standards, instrument and method blanks. Results from field blanks and method blanks were evaluated to assess the possibility of contamination of environmental samples that may have been introduced during sampling and laboratory activities. Field duplicates could not be collected at this site due to insufficient surface water available during sampling at Skidoo Mill site.

Field Blanks

In accordance with the SAP, two equipment blanks, identified as DEVA-SKID-EB-021816 and DEVA-SKID-EB-021916, were collected to assess if non-disposable equipment decontamination procedure was effective and if cross-contamination of soil samples occurred during soil sampling activities. No target analytes were detected in the equipment blanks with the exception of thallium, beryllium, chromium, cobalt, and/or molybdenum. Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly greater (>5X) than the concentrations found in the associated



field blanks except for three soil (DEVA-SKID-01-001, DEVA-SKID-01-002, and DEVA-SKID-03-001) and two surface water samples (DEVA-SKID-02-SW1 and DEVA-SKID-03-SW1), for which the detected concentrations were adjusted to “not detected (ND)” at the reported concentrations.

An equipment rinsate source blank identified as DEVA-SB-021816 was also collected. No target analytes were detected in the source blank except for antimony at a trace concentration. The sample concentrations were either not detected or were significantly greater (>5X) than the concentration found in the source blank. No data qualification was required.

Laboratory Quality Control Analyses

Laboratory QC samples for all SI sites were prepared and analyzed by the laboratory to monitor the analytical process. The laboratory QC samples for this event included method blanks, initial and continuing calibration blanks, laboratory control samples (LCSs), instrument tune and calibration verifications (ICVs and CCVs), interference check, and matrix spike (MS) and matrix spike duplicate (MSD) samples. The laboratory analyzed all instrument tune, calibration, and QC samples at the method-required frequency. The analyses were performed within all specifications of the methods. The QC criteria were met and are considered acceptable. The following samples were qualified as estimated due to QC exceedances:

No contaminants were found in the laboratory blanks except for molybdenum in DEVA-SKID-EB-021816 and/or antimony in DEVA-SKID-02-SW1 and DEVA-SKID-03-SW1. Accordingly, the detection was adjusted to ND at the reported concentration.

Select metals (arsenic, beryllium, cadmium, chromium, cobalt, copper, lead, molybdenum, nickel, selenium, thallium, vanadium, and/or zinc) exceeded MS, MSD or post spike % recovery criteria. Spiked samples (DEVA-SKID-BG-014, DEVA-SKID-03-001, and DEVA-SKID-04-015) were qualified using “UJ” for not detected and “J” for detected results.

Data Validation Results

Analytical data collected during SI activities (at all sites) were reviewed and validated by LDC in Carlsbad, California. Data validation was performed in accordance with USEPA SW-846 Test Methods (EPA 1986 and final updates), DoD Quality Systems Manual (QSM) for Environmental Laboratories, version 5.0 (July 2013), modified USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review (January 2010), and QA/QC criteria specified in the project-specific SAP (NOREAS 2016).



Data were subjected to approximately 10 percent Level IV and 90 percent Level III validation. Data validation included a review of sample preservation/condition, cooler temperature, and technical holding times; detection limits/sensitivity; instrument tune, calibration and verifications; laboratory blanks; LCS and MS/MSD; and field QC sample data (as applicable), including a review of chromatograms and quantitation reports. In addition, chain-of-custody records were reviewed to assess the potential for any field conditions that adversely impact data quality. Relevant data validation qualifiers are defined as follows:

U – (Not detected): The compound or analyte was analyzed for and positively identified by the laboratory; however, the compound or analyte should be considered non-detected at the reported concentration due to presence of contaminants detected in the associated blank(s).

J – (Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however, the reported concentrations is estimated due to nonconformances discovered during data validation.

UJ – (Not-detected estimated): The compound or analyte was reported as not detected by the laboratory; however, the reported detection limit is estimated due to nonconformances discovered during data validation.

Third-party validation reports indicate that data associated with samples collected during the SI sampling in February 2016 are usable and acceptable. No results were rejected in this report. All technical holding time requirements were met. Overall precision and accuracy goals were met. Copies of the analytical laboratory reports, including COC forms are provided in Appendix C. Data validation reports are provided in Appendix D.



4.2. Homestake Mill

The following sections summarize sampling results for the SI performed at Homestake Mill. Table 2 presents results of soil analyses from Homestake Mill, and results are summarized on Figure 3.

4.2.1. Background Soil Sampling

Background soil samples were collected using ISM sampling methods at Homestake Mill. For all metals except Co, Cu, nickel (Ni), Se and silver (Ag), the background soil concentrations exceeded the NPS ESV. Other site DUs also exceed NPS ESVs for most metals analyzed.

USEPA Region 9 RSLs and Water Board ESLs were exceeded for arsenic in background soils. Arsenic (As) concentrations in California soils are commonly elevated above these screening levels, and the background (95% UCL) concentration of approximately 10 mg/kg arsenic is consistent with values observed in many areas of California.

4.2.2. Mill Area (Mercury and Cyanide Processing Areas)

The mill foundation area (DU-1) soils contain elevated (above background) concentrations of Sb, beryllium (Be), Cd, Cu, Pb, Hg, Se, Ag, thallium (Th) and Zn. The 95% UCL concentration of Pb in DU-1 is 725 mg/kg.

DU-3 soils have cyanide concentration (95% UCL) of 61.4 mg/kg (ISM sample range of 10.7 to 48.6 mg/kg), above the NPS ESV, Water Board ESL, and USEPA RSL (2.7 mg/kg).

Mill tailings soils were reported to have slightly basic pH of approximately 9.4 (standard units). Results of ABA tests on mill tailing impoundment samples indicates that soils in DU-3 do not have net acid-generating potential (AGP < ANP).

4.2.3. Mill Tailings Stockpile

The mill tailings stockpile (DU-2) soils contain elevated (above background) concentrations of Sb, Be, Cd, Cu, Hg, Se, Ag, vanadium (V) and Zn, based on comparison to 95% UCL concentrations. Notably, lead concentrations in DU-2 soils are only 18.1 mg/kg (95% UCL).

4.2.4. Mine Waste Stockpile

Mine waste stockpile (DU-3) soils were analyzed using 15 discrete soil samples. The 95% UCL concentrations of Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Se, Ag, V and Zn in DU-3 are above background (DU-5) concentrations.



4.2.5. Downgradient Mill Tailings

Downgradient mill tailings (DU-4) soils were evaluated from 15 discrete soil sample locations in the wash areas downgradient from the site. Comparison of 95% UCL concentrations from DU-4 soils to background soils (DU-5) indicates the Be, Cu, Hg, Se, Ag and Zn are above background in DU-4.

4.2.6. Soil Leaching Analyses

Soil leaching assessment via TCLP was performed for Pb in soil samples DEVA-HOME-01-003 (566 mg/kg pb) (and DEVA-HOME-01-004 (168 mg/kg Pb) (mill foundation area). The TCLP results for these samples were 0.448 J and 0.0564 J, respectively, indicating low leaching potential from these soils. Samples DEVA-HOME-03-002 (4.3 mg/kg Hg) and DEVA-HOME-04-012 (6.28 mg/kg Hg) were analyzed for Hg leachability using TCLP. Both TCLP results were for only trace (estimated values) of Hg, indicating very low leaching potential for Hg from these soils.

4.2.7. Data Quality Assessment

This section describes the quality and usability of analytical data collected during the March 2016 site inspection (SI) sampling conducted at the Homestake Mill.

A total of 11 grab samples of soils were collected using ISM. In addition, 31 discrete soils, 2 source blanks, 2 equipment blanks, and 7 sets of MS/MSD samples were collected on March 7 through 9, 2016 at this site. Environmental samples were analyzed for metals, cyanide, soil pH ABA. All samples were received in good condition and technical holding time requirements were met.

Results from field blanks and method blanks were evaluated to assess the possibility of contamination of environmental samples that may have been introduced during sampling and laboratory activities.

Field Blanks

In accordance with the SAP, two equipment blanks, identified as DEVA-HOME-EB-030716 and DEVA-HOME-EB-030816, were collected to assess the effectiveness of the non-disposable equipment decontamination procedure and if cross-contamination of samples occurred during sampling activities. Two source blanks identified as DEVA-SB-021816 and DEVA-SB-031116 were also collected. No target analytes were detected in the equipment or source blanks with the exception of trace concentrations of barium, silver, thallium, mercury, manganese, and antimony. Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly greater (>5X) than the



concentrations found in the associated field blanks. No data qualification was necessary for any of the samples.

Laboratory Quality Control Analyses

The analyses were performed within all specifications of the methods. The QC criteria were met and are considered acceptable. The following samples were qualified as estimated due to QC exceedances:

- Laboratory blanks for metals analysis were free of contaminants except for detections of antimony, silver, thallium, mercury, and manganese. As a result, these detections were adjusted to ND at the reported concentrations in seven associated samples.
- Arsenic, antimony, barium, beryllium, lead, mercury, and/or silver exceeded MS/MSD and post spike % recovery criteria. Spiked samples were qualified using “J” for detected results for these analytes. This condition may be attributed to matrix interference.
- Cyanide exceeded MS/MSD % recovery criteria. Spiked sample DEVA-HOME-02-004 was qualified using “J” for detected results for cyanide. This condition may be attributed to matrix interference.
- Technical holding time (28 days) was exceeded for TCLP analysis of mercury in two samples identified as DEVA-HOME-03-002 and DEVA-HOME-04-012 for which mercury results are qualified as estimated using “J.”

Data Validation Results

Third-party validation reports indicate that data associated with samples collected at Journigan’s Mill during the SI sampling on March 7 through 9, 2016 are usable and acceptable. No results were rejected in this report. All technical holding time requirements were met with the exception of mercury in two samples, which were qualified as estimated. Copies of the analytical laboratory reports, including COC forms are provided in Appendix C. Data validation reports are provided in Appendix D.



4.3. Journigan's Mill

The following sections summarize sampling results for the SI performed at Journigan's Mill. Table 3 presents results of soil analyses from Journigan's Mill, and results are summarized on Figure 4.

4.3.1. Background Soil Sampling

Background soil samples were collected using both ISM and discrete sampling methods at Journigan's Mill. Comparison of the results of 95% UCL concentrations between discrete and ISM sampling methods yielded excellent correlation, with the 95% UCL concentration from ISM samples generally yielding similar or higher result than the 95% UCL concentration determined for discrete samples, except for arsenic. This apparent bias for higher 95% UCL concentrations from ISM results is consistent with the use of the conservative Chebyshev method for determination of the UCL. The higher arsenic concentration reported in the discrete background samples appears to be biased due results from 2 of 15 background samples, DEVA-JOUR-07-018 and DEVA-JOUR-07-019, with 53.4 and 29.0 mg/kg arsenic reported, respectively.

For all metals except Cd, Se and silver (Ag), the background soil concentrations exceeded the NPS ESV (based on Screening Level Environmental Risk Assessment (SLERA) Chemicals of Potential Ecological Concern (COPEC) (NPS 2014b). Other Skidoo Mill DUs also exceed NPS ESVs for most metals analyzed.

USEPA Region 9 RSLs and Water Board ESLs were exceeded for arsenic in background soils. Arsenic (As) concentrations in California soils are commonly elevated above these screening levels, and the background (95% UCL) concentration of approximately 4 mg/kg arsenic in the ISM samples is consistent with values observed in many areas of California. The 95% UCL concentration of 20.8 mg/kg arsenic derived from the discrete background sample data is on the upper end of normal background concentrations; however, given the types of naturally-occurring minerals in this area, elevated localized arsenic concentrations are not unexpected.

4.3.2. Cyanide Processing Area

The cyanide processing area (DU-1) soils contain elevated (above background) concentrations of Sb, As, Ba, Cd, Pb, Hg, Mo, Ag and Zn. The 95% UCL concentration of Pb in DU-1 is 776 mg/kg.

DU-1 soils have cyanide concentration (95% UCL) of 25.3 mg/kg, above the NPS ESV, Water Board ESL, and USEPA RSL (2.7 mg/kg).

Cyanide processing area soils were reported to have slightly basic pH of approximately 8.4.



4.3.3. Mill Foundation Area

The mill foundation area (DU-2) soils contain elevated (above background) concentrations of Sb, As, Ba, Cd, Cr, Cu, Pb, Hg, Mo, Se, Ag and Zn. The 95% UCL concentration of Pb in DU-2 is 348 mg/kg.

DU-2 soils have cyanide concentration (95% UCL) of 9.48 mg/kg, above the NPS ESV, Water Board ESL, and USEPA RSL (2.7 mg/kg).

Mill foundation soils were reported to have slightly basic pH of approximately 8.4. Results of ABA tests on mill tailing impoundment samples indicates that soils in DU-2 do not have net acid-generating potential (AGP < ANP).

4.3.4. Mill Tailings Stockpile

Soils from the mill tailings stockpile (DU-3) at Journigan's contained the following metals above background soils (95% UCL concentration comparison): Sb, Cd, Pb, Hg, Mo, Ag, Th and Zn. The 95% UCL concentration of Pb in DU-3 soils was 472 mg/kg.

Cyanide concentrations in DU-3 (95% UCL) is 29.6 mg/kg, above the NPS ESV, Water Board ESL, and USEPA RSL (2.7 mg/kg).

Mill tailings soils were reported to have slightly basic pH of approximately 8.6. Results of ABA tests on mill tailing impoundment samples indicates that soils in DU-3 do not have net acid-generating potential (AGP < ANP).

4.3.5. Mine Waste Stockpile

Mine waste stockpiles (DU-4) contain the following metals above background concentrations (95% UCL concentration comparison): Sb, Be, Cd, Cr, Cu, Pb, Hg, Ag, Th, V and Zn. The 95% UCL concentration of Pb in DU-4 is 503 mg/kg.

4.3.6. Mill Tailings in North (DU-5) and South Washes (DU-6)

Mill tailings in the north wash area (DU-5) contain the following metals above background concentrations (95% UCL concentration comparison): Sb, As, Ba, Be, Cd, Cr, Pb, Hg, Mo, Ag, Th and Zn. The 95% UCL concentration of Pb in DU-5 is 703 mg/kg; however, this result is skewed by the results of a single discrete sample, DEVA-JOUR-05-003, which reported Pb at 2,540 mg/kg. This sample is located close to mill site (Figure 4) and based on the results of the 14 other discrete



samples in the north wash area, widespread Pb contamination throughout the north wash area does not appear to have occurred.

Mill tailings in the south wash area (DU-6) contain the following metals above background concentrations (95% UCL concentration comparison): Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Hg, Mo, Ni, Ag, Th and Zn. The 95% UCL concentration of Pb in DU-6 is 381 mg/kg; however, similar to DU-5, this result is skewed by the results of a single discrete sample, DEVA-JOUR-06-002, which reported Pb at 890 (J) mg/kg. This sample is located close to mill site (Figure 4) and based on the results of the 14 other discrete samples in the south wash area, widespread Pb contamination throughout the south wash area does not appear to have occurred.

4.3.7. Soil Leaching Analyses

Soil leaching analyses by TCLP were performed on five (5) samples from Journigan's Mill.

- Sample DEVA-JOUR-02-002 (309 mg/kg Pb) was tested for TCLP Pb, with a result of 0.184 J mg/L, indicating low leaching potential.
- Sample DEVA-JOUR-01-002 (656 mg/kg Pb) was tested for TCLP Pb with a result of 0.618 mg/L, indicating low leaching potential.
- Sample DEVA-JOUR-03-003 (445 mg/kg Pb) was tested for TCLP Pb with a result of 0.247 J mg/L, indicating low leaching potential.
- Sample DEVA-JOUR-04-001 (482 mg/kg Pb) was tested for TCLP Pb with a result of 0.0251 J mg/L, indicating low leaching potential.
- Sample DEVA-JOUR-06-002 (890 mg/kg Pb) was tested for TCLP Pb with a result of 13 mg/L, indicating a high leaching potential.
- Sample DEVA-JOUR-05-003 (7.99 mg/kg Hg) was tested for TCLP Hg with a reported result of 0.000738 J mg/L, indicating a low leaching potential for Hg from this sample. It should be noted that the Pb concentration of 2,540 mg/kg in this sample is likely to exhibit similar leaching characteristic for lead as determined for sample DEVA-JOUR-06-002.

4.3.8. Data Quality Assessment

This section describes the quality and usability of analytical data collected during the March 2016 SI sampling conducted at the Journigan's Mill.

A total of 19 grab samples of soils were collected using ISM. In addition, 38 discrete soils, 1 source blank, 2 equipment blanks, and 5 sets of MS/MSD samples were collected on March 1 through 3,



2016 at this site. Environmental samples were analyzed for metals, cyanide, , soil pH and ABA. All samples were received in good condition and technical holding time requirements were met.

Results from field blanks and method blanks were evaluated to assess the possibility of contamination of environmental samples that may have been introduced during sampling and laboratory activities.

Field Blanks

In accordance with the SAP, two equipment blanks, identified as DEVA-JOUR-EB-030116 and DEVA-JOUR-EB-030216, were collected to assess the effectiveness of the non-disposable equipment decontamination procedure and if cross-contamination of samples occurred during sampling activities. A source blank identified as DEVA-SB-030116 was also collected. No target analytes were detected in the equipment or source blanks with the exception of trace concentrations of lead, barium, manganese, zinc, and antimony. Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly greater (>5X) than the concentrations found in the associated field blanks. No data qualification was necessary for any of the samples.

Laboratory Quality Control Analyses

Laboratory QC samples were prepared and analyzed by the laboratory to monitor the analytical process. The analyses were performed within all specifications of the methods. The QC criteria were met and are considered acceptable. The following samples were qualified as estimated due to QC exceedances:

- Laboratory blanks for metals analysis were free of contaminants except for detections of silver, thallium, molybdenum, and manganese. As a result, these detections were adjusted to ND at the reported concentrations in 16 affected samples.
- Arsenic, chromium, copper, lead, mercury, molybdenum, nickel, selenium, and/or vanadium exceeded MS/MSD and post spike % recovery criteria. Spiked samples DEVA-JOUR-07-007, DEVA-JOUR-04-002, DEVA-JOUR-05-014, and DEVA-JOUR-06-002 were qualified using "J" for detected results for these analytes. This condition may be attributed to matrix interference.
- Cyanide exceeded MS/MSD % recovery criteria. Spiked sample DEVA-JOUR-02-001 and DEVA-JOUR-01-001 were qualified using "J" for detected results for these analytes. This condition may be attributed to matrix interference.

Data Validation Results



Third-party validation reports indicate that data associated with samples collected at Journigan's Mill during the SI sampling on March 1 through 3, 2016 are usable and acceptable. No results were rejected in this report. All technical holding time requirements were met. Copies of the analytical laboratory reports, including COC forms are provided in Appendix C. Data validation reports are provided in Appendix D.



4.4. Starr Mill

The following sections summarize sampling results for the SI performed at Starr Mill. Table 4 presents results of soil analyses from Starr Mill, and results are summarized on Figure 5.

4.4.1. Background Soil Sampling

Site-specific background samples for Starr Mill were not collected. Based on proximity to Journigan's Mill, it is assumed that background concentrations at Starr Mill are similar to those reported at Journigan's Mill. Table 4 contains DU-7 ISM background sample concentrations from Journigan's Mill sampling for reference in the evaluation of Starr Mill results.

4.4.2. Mill Area (Mill Foundation and Cyanide Processing Areas)

Soils from the mill foundation and cyanide processing areas (DU-1, sample -001 through 004) at Starr Mill contained the following metals above (Journigan's Mill DU-7) background soils (95% UCL concentration comparison): Sb, As, Be, Cd, Cu, Pb, Hg, Mo, Se, Ag, Th and Zn. The 95% UCL concentration of Pb in Starr Mill foundation/cyanide processing area soils was 199 mg/kg.

The mill foundation/cyanide processing area soils at Starr Mill have cyanide concentration (95% UCL) of 2.9 mg/kg, above the NPS ESV, Water Board ESL, and USEPA RSL (2.7 mg/kg).

Mill foundation/cyanide processing area soils were reported to have slightly basic pH of approximately 9.4. Results of ABA tests on mill tailing impoundment samples indicates that soils in DU-1 do not have net acid-generating potential (AGP < ANP).

4.4.3. Downgradient Discrete Samples

Three (3) discrete soils collected from Starr Mill, close to and downgradient from the mill site (DU-1, sample -005 through 007) at Starr Mill contained the following metals above (Journigan's Mill DU-7) background soils (95% UCL concentration comparison): Sb, As, Be, Cr, Co, Cu, Pb, Mn, Hg, Mo, Ni, Ag, Th and Zn. The 95% UCL concentration of Pb in Starr Mill foundation/cyanide processing area soils was 23 mg/kg. These results are comparable to those found for the north and south wash discrete samples for Journigan's Mill, except for the noted elevated concentrations samples at Journigan's Mill discussed in Section 4.36.



4.4.4. Soil Leaching Analyses

One sample, DEVA-STAR-01-003, reporting 177 (J) mg/kg Pb and 6.61 (J) mg/kg Hg was analyzed for TCLP Pb, with a result of 0.0581 J mg/L and TCLP Hg, with a result of 0.000112 J mg/L. Both of these results indicate a low leaching potential for this sample.

4.4.5. Data Quality Assessment

A total of 3 discrete soil, 1 source blank, and 1 equipment blank samples were collected on March 3, 2016 at Starr Mill. In addition, four grab samples of soils were collected using ISM. Environmental samples were analyzed for metals, cyanide, soil pH and ABA. All samples were received in good condition and technical holding time requirements were met.

Results from field blanks and method blanks were evaluated to assess the possibility of contamination of environmental samples that may have been introduced during sampling and laboratory activities.

Field Blanks

In accordance with the SAP, one equipment blank, identified as DEVA-STAR-EB-030316, was collected to assess the effectiveness of the non-disposable equipment decontamination procedure and if cross-contamination of samples occurred during sampling activities. A source blank identified as DEVA-SB-021816 was also collected. No target analytes were detected in the equipment blank or source blank with the exception of antimony. Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly greater (>5X) than the concentrations found in the associated field blank except for the equipment blank DEVA-STAR-EB-030316 for which the detected concentration for antimony was adjusted to “not detected (ND)” at the reported concentration.

Laboratory Quality Control Analyses

The analyses were performed within all specifications of the methods. The QC criteria were met and are considered acceptable. The following samples were qualified as estimated due to QC exceedances:

- Laboratory blank was free of contaminants except for detections of antimony and molybdenum in DEVA-STAR-EB-030316. As a result, these detections were adjusted to ND at the reported concentrations.



- Antimony and molybdenum exceeded MS and MSD % recovery and RPD criteria. Spiked sample DEVA-STAR-01-003 were qualified using “J” for detected results. This condition may be attributed to matrix interference.
- MSMSD % recovery criteria for total cyanide exceeded acceptance limits. Cyanide result was qualified using “J” in DEVA-STAR-01-003. This condition may be attributed to matrix interference.

Data Validation Results

Third-party validation reports indicate that data associated with samples collected at Starr Mill during the SI sampling on March 3, 2016 are usable and acceptable. No results were rejected in this report. All technical holding time requirements were met. Overall precision and accuracy goals were met. Copies of the analytical laboratory reports, including COC forms are provided in Appendix C. Data validation reports are provided in Appendix D.



4.5. Tucki Mill

The following sections summarize sampling results for the SI performed at Tucki Mill. Table 5 presents results of soil analyses from Tucki Mill, and results are summarized on Figure 6.

4.5.1. Background Soil Sampling

Background soil samples were collected using ISM sampling methods at Tucki Mill. For all metals except Co, Se and silver (Ag), the background soil concentrations exceeded the NPS ESV. Other site DUs also exceed NPS ESVs for most metals analyzed.

USEPA Region 9 RSLs and Water Board ESLs were exceeded for arsenic in background soils. Arsenic (As) concentrations in California soils are commonly elevated above these screening levels, and the background (95% UCL) concentration of 15.9 mg/kg arsenic is consistent with values observed in many areas of California.

4.5.2. Cyanide Processing Area

Results from the DU-1 cyanide processing area at Tucki Mill indicates that the 95% UCL concentrations of Sb, As, Pb, manganese (Mn), Hg, Se, Ag and Zn are above the background 95% UCL concentrations of these constituents in soil. Notably, the As concentration (95% UCL) is 230 mg/kg in DU-1. Only low concentrations of cyanide were detected in DU-1 soils (ranging from 0.158 to 0.257 mg/kg). Soil pH was slightly basic at approximately 9.2.

4.5.3. Fine-Grained Mine Waste

The DU-2 Mine waste piles 95% UCL concentrations exceed background (DU-3) concentrations for the following metals: Sb, As, Ba, Cd, Cu, Pb, Mn, Hg, Se, Ag and Zn. Notably, the As concentration (95% UCL) is 111 mg/kg in DU-2. Results of ABA testing of DU-2 soils indicates no net potential for acid generation (ANP > AGP). Soil pH in DU-2 was slightly basic at approximately 9.0. Low concentrations of cyanide were reported in DU-2 soils (ranging from 0.113 to 0.197 mg/kg).

4.5.4. Soil Leaching Analyses

Sample DEVA-TUCK-02-001, reporting 89.2 mg/kg As and 0.404 mg/kg Hg was analyzed using TCLP for these two metals, with results of As at 0.0574 J mg/L and Hg not detected. Based on these results, these soils are considered to have a low leaching potential.



4.5.5. Data Quality Assessment

A total of 11 grab samples of soils were collected using the ISM. In addition, 1 source blank and 1 equipment blank were collected on February 22-23, 2016 at this site. Environmental samples were analyzed for Title 22 metals, cyanide, soil pH and ABA. All samples were received in good condition and technical holding time requirements were met.

Field Blanks

In accordance with the SAP, one equipment blank, identified as DEVA-TUCK-EB-022216, was collected to assess the effectiveness of the non-disposable equipment decontamination procedure and if cross-contamination of samples occurred during sampling activities. A source blank identified as DEVA-SB-021816 was also collected. No target analytes were detected in the equipment or source blank samples with the exception of antimony. Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly greater (>5X) than the concentrations found in the associated field blanks except for the equipment blank DEVA-TUCK-EB-022216 for which the detected concentration for antimony was adjusted to “not detected (ND)” at the reported concentration. The background contamination is believed to have resulted from the rinsate water.

Laboratory Quality Control Analyses

The analyses were performed within all specifications of the methods. The QC criteria were met and are considered acceptable. The following samples were qualified as estimated due to QC exceedances:

- Due to ICPMS tune (mass calibration), data for all metals except for mercury and manganese were qualified as estimated in sample DEVA-TUCK-EB-022216.
- Laboratory blank was free of contaminants except for detections of lead, manganese, molybdenum, thallium, and mercury in DEVA-TUCK-EB-022216. As a result, these detections were adjusted to ND at the reported concentrations.
- Antimony, copper, molybdenum, selenium, and vanadium exceeded MS/MSD % recovery criteria. Spiked sample DEVA-TUCK-02-002 was qualified using “J” for detected results. This condition may be attributed to matrix interference.
- Technical holding time (14 days) was exceeded by one day for total cyanide in DEVA-TUCK-02-001, DEVA-TUCK-02-002, DEVA-TUCK-02-003, and DEVA-TUCK-02-004. Cyanide results for these four samples are qualified as estimated using “J.”



- MS/MSD % recovery criteria for total cyanide exceeded acceptance limits in DEVA-TUCK-02-002. Cyanide result for this sample was qualified using "J." This condition may be attributed to matrix interference.

Data Validation Results

Third-party validation reports indicate that data associated with samples collected at Tucki Mill during the SI sampling on February 22-23, 2016 are usable and acceptable. No results were rejected in this report. All technical holding time requirements were met except for total cyanide in four samples which exceeded by one day. Cyanide results for these samples were qualified as estimated. Overall precision and accuracy goals were met. Copies of the analytical laboratory reports, including COC forms are provided in Appendix C. Data validation reports are provided in Appendix D.



4.6. Cashier Mill

The following sections summarize sampling results for the SI performed at Cashier Mill. Table 6 presents results of soil analyses from Cashier Mill, and results are summarized on Figure 7.

4.6.1. Background Soil Sampling

Background soil samples were collected using ISM sampling methods at Cashier Mill. For all metals except Cd, Co, Se and silver (Ag), the background soil concentrations exceeded the NPS ESV. Other site DUs also exceed NPS ESVs for most metals analyzed.

USEPA Region 9 RSLs and Water Board ESLs were exceeded for arsenic in background soils. Arsenic (As) concentrations in California soils are commonly elevated above these screening levels, and the background (95% UCL) concentration of 24.4 mg/kg arsenic is consistent with the upper end of background values observed in California. Given the types of naturally-occurring minerals in this area, elevated localized arsenic concentrations are not unexpected.

4.6.2. Mill Foundation Area

Soils from the mill foundation area (DU-1) at Cashier Mill contained the following metals above background soils (95% UCL concentration comparison): Sb, As, Ba, Be, Cd, Cu, Pb, Mn, Hg, Mo, Ag and Zn. The 95% UCL concentration of Pb in Starr Mill foundation/cyanide processing area soils was 1,326 mg/kg.

The mill foundation/cyanide processing area soils at Cashier Mill have cyanide concentration (95% UCL) of 1.62 mg/kg, above the NPS ESV and Water Board ESL but below the USEPA RSL (2.7 mg/kg).

Mill foundation/cyanide processing area soils were reported to have slightly basic pH of approximately 9.0. Results of ABA tests on mill tailing impoundment samples indicates that soils in DU-1 do not have net acid-generating potential (AGP < ANP).

4.6.3. Mill Tailings in Eastern and Western Drainages

Mill tailings soils from the east drainage area (DU-2) at Cashier Mill contained the following metals above background soils (95% UCL concentration comparison): Sb, As, Be, Cd, Cu, Pb, Mn, Hg, Mo, Ag and Zn. The 95% UCL concentration of Pb in Cashier Mill DU-2 was 333 mg/kg. The 95% UCL concentration of As in Cashier Mill DU-2 was 274 mg/kg.



Mill tailings soils from the west drainage area (DU-3) at Cashier Mill contained the following metals above background soils (95% UCL concentration comparison): Sb, As, Ba, Be, Cd, Cu, Pb, Mn, Hg, Mo, Ag and Zn. The 95% UCL concentration of Pb in Cashier Mill DU-3 soils was 953 mg/kg. The 95% UCL concentration of As in Cashier Mill DU-2 was 298 mg/kg.

4.6.4. Mine Waste on Northern Slope

It is noted that several areas of mine waste were identified in the PA (ECM 2014) at Cashier Mill. Sample locations (Figure 6) were collected in areas along the north slope representative of the largest volumes of mine waste observed at the site.

Mine waste piles (DU-4) at Cashier Mill were sampled using 15 discrete soil sampling points, and contained the following metals above background soils (95% UCL concentration comparison): Sb, As, Ba, Be, Cd, Co, Cu, Pb, Mn, Hg, Mo, Ni, Ag and Zn. The 95% UCL concentration of Pb in Cashier Mill DU-3 soils was 1,098 mg/kg. The 95% UCL concentration of As in Cashier Mill DU-2 was 10,960 mg/kg. Highly elevated As concentrations in the DU-4 soils were reported in 5 of the 15 DU-4 discrete soil samples, DEVA-CASH-04-011, -012, -013, -014 and -015.

4.6.5. Surface Water Analysis

A surface water sample was collected from accumulated water in a depression within the Cashier Mill foundation area (Table 9). This sample reported As, Ba, Cu, Pb, Hg and Ag above NPS ESVs. Results for notable COPECs include As (78.0 J $\mu\text{g/L}$; NPS ESV 3.1 $\mu\text{g/L}$), Cu (20.9 $\mu\text{g/L}$; NPS ESV 0.23 $\mu\text{g/L}$); Pb (9.6 $\mu\text{g/L}$; NPS ESV 0.92 $\mu\text{g/L}$) and Hg (0.585 $\mu\text{g/L}$; NPS ESV 0.026 $\mu\text{g/L}$).

4.6.6. Soil Leaching Analyses

Soil leachability analyses using TCLP were performed on four (4) soil samples from Cashier Mill; DEVA-CASH-01-004 (TCLP As), DEVA-CASH-02-001 (TCLP As and Pb), DEVA-CASH-03-002 (TCLP As and Pb), DEVA-CASH-04-011 (TCLP As, Pb and Hg). As summarized on Table 11, all of the above soil samples indicated low leaching potential using TCLP.

4.6.7. Data Quality Assessment

This section describes the quality and usability of analytical data collected during the February 2016 site inspection (SI) sampling conducted at Cashier Mill.

A total of 15 discrete soil, 1 surface water, 1 source blank, and 1 equipment blank samples were collected on February 23 through 25, 2016 at this site. In addition, 15 grab samples of soils were



collected using ISM. Environmental samples were analyzed for metals, cyanide, soil pH and ABA. All samples were received in good condition and technical holding time requirements were met.

Results from field blanks and method blanks were evaluated to assess the possibility of contamination of environmental samples that may have been introduced during sampling and laboratory activities. Field duplicates could not be collected at this site due to insufficient surface water present during sampling.

Field Blanks

In accordance with the SAP, one equipment blank, identified as DEVA-CASH-EB-022416 was collected to assess if non-disposable equipment decontamination procedure was effective and if cross-contamination of samples occurred during soil sampling activities. No target analytes were detected in the equipment blank with the exception of trace concentrations of thallium, manganese, molybdenum, and vanadium. Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly greater (>5X) than the concentrations found in the associated field blank. Therefore, data qualifying was not required.

A source blank identified as DEVA-SB-021816 was also collected. No target analytes were detected in the source blank except for antimony at a trace concentration. The sample concentrations were either not detected or were significantly greater (>5X) than the concentration found in the source blank. Therefore, data qualifying was not required.

Laboratory Quality Control Analyses

The analyses were performed within all specifications of the methods. The QC criteria were met and are considered acceptable. The following samples were qualified as estimated due to QC exceedances:

- Due to mass calibration, data for affected metals were qualified as estimated in 18 samples.
- Laboratory blanks were free of contaminants except for detections of molybdenum in DEVA-CASH-01-SW1; manganese, molybdenum, thallium, and mercury in DEVA-CASH-EB-022416; and thallium in DEVA-CASH-04-011. As a result, these detections were adjusted to ND at the reported concentrations.
- Select metals (arsenic, antimony, barium, cadmium, chromium, cobalt, copper, lead, molybdenum, nickel, selenium, thallium, vanadium) exceeded MS and MSD % recovery criteria. This condition may be attributed to matrix interference. Spiked samples for these



analytes (DEVA-CASH-01-SW1, DEVA-CASH-01-003, DEVA-CASH-04-010) were qualified using “UJ” for not detected and “J” for detected results.

- MS/MSD % recovery and RPD criteria for total cyanide exceeded acceptance limits. Cyanide result was qualified using “J” in DEVA-CASH-01-003.
- Technical holding time for mercury in the TCLP sample run from DEVA-CASH-04-011 was exceeded; therefore, mercury result for this sample was qualified using “J.”
- Percent recovery in LCS for lead was slightly outside the acceptance limit. Lead result in DEVA-CASH-02-001 was qualified using “J.”

Data Validation Results

Third-party validation reports indicate that data associated with samples collected at Cashier Mill during the SI sampling in February 2016 are usable and acceptable. No results were rejected in this report. All technical holding time requirements were met except for mercury in the TCLP extraction for DEVA-CASH-04-011, which was qualified as estimated. Overall precision and accuracy goals were met. Copies of the analytical laboratory reports, including COC forms are provided in Appendix C. Data validation reports are provided in Appendix D.



4.7. Gold Hill Mill

The following sections summarize sampling results for the SI performed at Gold Hill Mill. Table 7 presents results of soil analyses from Cashier Mill, and results are summarized on Figure 8.

4.7.1. Background Soil Sampling

Background soil samples were collected using ISM sampling methods at Gold Hill Mill. For all metals except Cd, Co, Cu, Ni, Se and silver (Ag), the background soil concentrations exceeded the NPS ESV. Other site DUs also exceed NPS ESVs for most metals analyzed.

USEPA Region 9 RSLs and Water Board ESLs were exceeded for arsenic in background soils. Arsenic (As) concentrations in California soils are commonly elevated above these screening levels, and the background (95% UCL) concentration of 4.37 mg/kg arsenic is consistent with background values commonly observed in California.

4.7.2. Mill Foundation Area

Soils from the mill foundation area (DU-1) at Gold Hill Mill contained the following metals above background soils (95% UCL concentration comparison): Sb, As, Ba, Be, Cr, Cu, Pb, Mn, Hg, Mo, Ni, Se, Ag, Th, V and Zn. The 95% UCL concentration of Pb at the Gold Hill Mill foundation area soils was 14,661 mg/kg. Other metals, including Sb (1,124 mg/kg), As (654 mg/kg) and Hg (28.4 mg/kg), reported high concentrations in the DU-1 soils, which are particularly notable as no clear evidence of high production volumes was observed at or near the mill site, and the milling mechanisms did not appear to be designed for high production volumes.

The mill foundation/cyanide processing area soils at Gold Hill Mill have cyanide concentration (95% UCL) of 0.618 mg/kg, above the NPS ESV and Water Board ESL but below the USEPA RSL (2.7 mg/kg).

Mill foundation/cyanide processing area soils were reported to have slightly basic pH of approximately 8.8. Results of ABA tests on mill tailing impoundment samples indicates that soils in DU-1 do not have net acid-generating potential (AGP < ANP).

4.7.3. Eroded Tailings in Wash (along Road)

Visually observable mill tailings in the wash (DU-2) were of limited extent. Only seven (7) discrete samples were collected in the wash due to the limited observable material. One discrete sample, DEVA-GOLD-02-007 was of uncertain origin, and was collected to determine if the soils that could not clearly be visually identified as mill tailings exhibited the chemical signature of mill tailings.



Based on the comparative results of this sample compared to samples DEVA-GOLD-02-001 through -006, sample -007 is considered to be downgradient background material, and was excluded from the determination of the 95% UCL concentrations for DU-2 discussed below, as inclusion in this data set would create a low-bias in the data set.

Mill tailings in the wash (DU-2) at Gold Hill Mill contained all CAM 17 metals above background soils (95% UCL concentration comparison). The 95% UCL concentration of Pb at the Gold Hill Mill foundation area soils was 12,579 mg/kg. Other metals, including Sb (1,540 mg/kg) , As (851 mg/kg) and Mn (12,447 mg/kg), reported high concentrations in the DU-1 soils, above the EPA Region 9 RSLs (Table 7).

4.7.4. Surface Water Analyses

Surface water samples were collected at two locations at Gold Hill Mill. Sample DEVA-GOLD-SW1 was collected as a background sample from near the source of Warm Spring. Samples DEVA-GOLD-SW2 and -SW3 were collected as a surface water sample and field duplicate sample from surface waters present in the stream bed downgradient from Gold Hill Mill. Results from near the spring source reported As, Ba, and Se above NPS ESVs (Table 10). Results from the downgradient surface water sample (SW-2 is the primary sample) reported As, Ba and Se above NPS ESVs. Surface water sampling does not indicate an influence of contaminants from Gold Hill Mill directly impacting surface waters downgradient of the site.

4.7.5. Data Quality Assessment

This section describes the quality and usability of analytical data collected during Gold Hill Mill.

A total of 7 grab samples of soils were collected using ISM. In addition, 7 discrete soils, 3 surface waters, 1 source blank, 1 equipment blank, 1 set of field duplicates, and 4 sets of MS/MSD samples were collected on February 26 and 29, 2016 at this site. Environmental samples were analyzed for metals, cyanide, soil pH and ABA. All samples were received in good condition and technical holding time requirements were met.

Results from field blanks and method blanks were evaluated to assess the possibility of contamination of environmental samples that may have been introduced during sampling and laboratory activities.

Field Duplicates

Field sampling precision is evaluated by analyzing field duplicate samples which are collected and analyzed at a frequency of 10 percent for surface water samples. Field duplicates consist of two



collocated samples of the same matrix collected at the same time and location, to the extent possible, using the same sampling techniques.

In accordance with the project SAP, a set of field duplicate samples identified as DEVA-GOLD-SW2 and DEVA-GOLD-SW3 were collected and analyzed for the constituents of concern during surface water sampling at this site. The field duplicate results met the SAP requirement of 30 relative percent difference (RPD) for the detected constituents of concern at concentrations approximately above 10 x limit of quantitation (LOQ). RPDs ranged from 1 to 22 percent indicating excellent agreement for the field duplicate samples. Higher RPDs 35 and 41 percent were exhibited for low-level analytes nickel and copper, respectively. No data were qualified based on field duplicate results.

Field Blanks

In accordance with the SAP, one equipment blank, identified as DEVA-GOLD-EB-022916, was collected to assess the effectiveness of the non-disposable equipment decontamination procedure and if cross-contamination of samples occurred during sampling activities. A source blank identified as DEVA-SB-021816 was also collected. No target analytes were detected in the equipment blank. Source blank sample was reported having trace concentration of antimony. Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly greater (>5X) than the concentrations found in the associated field blanks. No data qualification was necessary.

Laboratory Quality Control Analyses

The analyses were performed within all specifications of the methods. The QC criteria were met and are considered acceptable. The following samples were qualified as estimated due to QC exceedances:

- Laboratory blanks for metals analysis were free of contaminants except for detections of antimony, molybdenum, and silver. As a result, these detections were adjusted to ND at the reported concentrations in the affected samples (DEVA-GOLD-03-001 through -003, DEVA-GOLD-SW1 through -SW3).
- Laboratory blank for cyanide analysis was free of contaminants except for trace detections of cyanide. As a result, detections of cyanide were adjusted to ND at the reported concentrations in the affected samples DEVA-GOLD-SW1 and DEVA-GOLD-SW3.
- Lead, vanadium, and zinc exceeded MS/MSD % recovery criteria. Spiked sample DEVA-GOLD-03-002 was qualified using "J" for detected results for these analytes. This condition may be attributed to matrix interference.



- All technical holding time requirements were met with the exception of mercury in sample DEVA-GOLD-02-004, which was prepared and analyzed two days outside of the holding time of 28 days. Mercury result for this sample is qualified as estimated using a "J."

Data Validation Results

Third-party validation reports indicate that data associated with samples collected at Gold Hill Mill during the SI sampling on February 26 and 29, 2016 are usable and acceptable. No results were rejected in this report. All technical holding time requirements were met with the exception of mercury in only one sample DEVA-GOLD-02-004 for which the result is qualified as estimated. Overall precision and accuracy goals were met. Copies of the analytical laboratory reports, including COC forms are provided in Appendix C. Data validation reports are provided in Appendix D.



This page is intentionally blank



5. Summary and Recommendations

Site inspections were performed at seven (7) mill sites at DEVA, including Skidoo Mill, Homestake Mill, Journigan's Mill, Starr Mill, Tucki Mill, Cashier Mill and Gold Hill Mill. The results of the soil sampling indicate that all seven sites contain metals in soil above local background concentrations and above Tier 1 human and ecological risk screening criteria. A principal contaminant of concern at all sites is lead (Pb). In addition, arsenic was found at several sites at significantly elevated concentrations. Metals in ephemeral surface water at Skidoo Mill and Cashier Mill exceed NPS ESVs. Surface water impacts downgradient of Gold Hill Mill were not detected. Soil testing for acid-base accounting indicated that none of the site soils tested had potential for generation of acid-mine wastes.

The screening levels used in this report are not site-specific and do not consider the actual site conditions, site background concentrations and potential specific receptors. Therefore, the following further investigations are recommended for the sites:

- Perform additional sampling at the subject sites to document the extent and volume of impacted soils (mine waste rock and mill tailings);
- Complete site-specific Ecological Risk Assessments (ERA) and Human Health Risk Assessments (HHRA) for the subject DEVA AML sites, which include considering site-specific conditions, receptors, exposure durations, etc. The results of the ERA and HHRA will be used to evaluate risks and develop site-specific risk-based screening levels. These site specific screening levels and additional site data documenting impacted soil volumes and extent would be used to support the preparation of an Engineering Evaluation/Cost Analysis.



This page is intentionally blank



6. References

- California Regional Water Quality Control Board, San Francisco Region. 2016. *Environmental Screening Levels (ESLs)* http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/esl.shtml. February.
- Environmental Cost Management (ECM). 2014. Preliminary Assessment 27 Abandoned Mineral Lands Sites Death Valley National Park Inyo and San Bernardino Counties, California and Nye County, Nevada. November.
- Interstate Technology Regulatory Council (ITRC). 2012. Technical and Regulatory Guidance: Incremental Sampling Methodology. February.
- National Park Service (NPS). 2014a. National Park Service (NPS). 2014a. NPS-Specific CERCLA ARARs and TBCs.
- National Park Service. 2014b. NPS Protocol for the Selection and Use of Ecological Screening Values for Non-Radiological Analytes. Revision 1. January 13.
- NOREAS, Inc. 2016. Sampling and Analysis Plan, Death Valley National Park, Site Inspections of Abandoned Mineral Lands (AML) Sites, California and Nevada. February.
- United States Environmental Protection Agency (USEPA). 2016. USEPA Region 9, Regional Screening Levels (RSLs). <http://www.epa.gov/region9/superfund/prg/>. May.



This page is intentionally blank



Figures



Tables



Appendix A – Photographic Log



Appendix B – Global Positioning System Survey Data



Appendix C – Chain of Custody Records and Laboratory Reports (Provided on CD)



Appendix D – Data Validation Report (Provided on CD)