DRMS Recd:
1/3/2023

PITCH RECLAMATION PROJECT

Via Email to stephanie.baker@state.co.us

Attn: Stephanie Baker – Standards Unit Work Group Leader 23 December 2022
Colorado Dept. of Public Health and Environment
Water Quality Control Division
Standards Unit Work Group
4300 Cherry Creek Drive South Denver,
Colorado 80246-1530

RE: Water Management Alternatives Analysis – Pitch Mine Reclamation Project

Dear Ms. Baker,

Arcadis U.S., Inc., on behalf of Homestake Mining Company of California (HMC), has prepared the enclosed Water Management Alternatives Analysis Report. This report identifies and evaluates the feasibility of site-relevant alternatives to improve water quality at the Pitch Reclamation Project, in preparation for the development of a Discharger-Specific Variance.

Please let me know if you have any questions upon review of this Report. We look forward to your review, and we would be happy to set up a meeting in early 2023 discuss any questions or comments you may have.

Regards,

Clark Burton
Director of Closure Operations
Homestake Mining Company of California

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Homestake Mining Company

Water Management Alternatives Analysis

Pitch Reclamation Project

Outside of Sargents, Colorado

DRAFT – 12/23/2022

Water Management Alternatives Analysis

Pitch Reclamation Project

Draft – 12/23/2022

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Acronyms, Abbreviations, and Definitions

AEL	Alternate Effluent Limit
BCR	biochemical reactor
BMP	Best Management Practice
BOD	biological oxygen demand
°C	degrees Celsius
CCR	Code of Colorado Regulations
CDPHE	Colorado Department of Public Health and Environment
CDPS	Colorado Discharge Permit System
CDRMS	Colorado Division of Reclamation, Mining, and Safety
CFD	Chester Fault Drain
CFS	Chester Fault Springs
cfs	cubic feet per second
CMP	corrugated metal pipe
cP	centipoise
CSM	conceptual site model
CY	cubic yard
Discharge Permit	CDPS permit for water discharge (permit number CO0022756)
DSV	Discharger-Specific Variance
EIS	Environmental Impact Statement
ELG	effluent limitation guideline
EPA	United States Environmental Protection Agency
ETC	engineered treatment cell
EVO	emulsified vegetable oil
FML	flexible membrane liner
ft^2	square feet
ft^3	cubic feet
GCL	geosynthetic clay liner
GHG	greenhouse gas
gpm	gallon per minute
HAC	highest attainable water quality condition

HDPE	high-density polyethylene
HMC	Homestake Mining Company
HMWMD	Hazardous Materials and Waste Management Division
HRT	hydraulic residence time (alternatively, hydraulic retention time)
IRD	Indian Rock Dump
IX	ion exchange
LPL	Lowest Practical Level
µg/L	microgram per liter
MCL	Maximum Contaminant Level
MGD	million gallons per day
mg/kg	milligram per kilogram
mg/L	milligram per liter
MMBTU	million British Thermal Units
NEPA	National Environmental Policy Act
NO_x	nitrogen oxides
NPL	North Pit Lake
PBR	packed bed reactor
pCi/L	picoCuries per liter
PIMS	Phosphate-Induced Metals Stabilization
Pinnacle	Pinnacle Partners; Pinnacle Exploration, Inc.
PM10	particulate matter with diameter less than 10 micrometers
PMD	Pinnacle Mine Dump
psi	pounds per square inch
PTRU	Plan to Resolve Uncertainty
Reclamation Permit	CDRMS 112d-3 Designated Mining Operation Reclamation Permit (number M-1977-004)
RMLLRWB	Rocky Mountain Low Level Radioactive Waste Board
SAC	strong acid cation
SBA	strong base anion
SO_x	sulfur oxides
s.u.	standard unit
TCRD	Tie Camp Rock Dump
TENORM	Technologically-Enhanced Naturally Occurring Radioactive Material

TR	Technical Revision
TRM	Treatment Residuals Management
TVS	table value standard
USFS	United States Forest Service
UW	underground mine workings
WAC	weak acid cation
WET	Whole Effluent Toxicity
WQBEL	Water Quality-Based Effluent Limit
WQCC	Water Quality Control Commission
WQCD	Water Quality Control Division
ZVI	zerovalent iron

Executive Summary

Arcadis U.S., Inc. (Arcadis) prepared this Alternatives Analysis Report (Report) for sitewide water quality management at the former Pitch Uranium Mine Site (Site) for Homestake Mining Company of California (HMC), the owner of the Site.

The Site is located in Saguache County, Colorado, approximately six miles from the town of Sargents, within mountainous terrain at an elevation above 10,000 feet. Surface water from the Site discharges into Indian Creek, located within the Gunnison River basin. Historic uranium extraction at the Site included underground mining and subsequent solution mining by Pinnacle Partners intermittently between 1959 and 1972, followed by open pit mining by HMC between 1979 and 1984. Since the cessation of mining in 1984, HMC has completed key mine reclamation work that has improved water quality, including but not limited to:

- Plugging of the Pinnacle Adit, resulting in re-saturation of the underground mine workings and an improvement to long-term water quality;
- Buttressing via partial backfilling of the North Pit to stabilize the east wall of the North Pit;
- Regrading and revegetating the Indian and Tie Camp Rock Dumps, North Pit, and South Mine Areas, resulting in reduced storm-water infiltration into uranium source zones; and
- Improving and selectively lining stormwater ditches, surface-water drainages, and the sediment pond dam to minimize infiltration into uranium source zones.

As a result of the removal of high-grade uranium ore through mining (over 3.1 million pounds of uranium on a U_3O_8 basis), coupled with the reclamation work completed, uranium concentrations at the SW-33 outfall (Outfall) and within downstream Indian and Marshall Creeks have returned to pre-mining natural conditions. Despite uranium concentrations returning to pre-mining conditions, HMC has prepared this Report to identify feasible alternatives to further reduce uranium concentrations. Uranium concentrations in the segment of Marshall Creek between its confluences with Indian Creek and Tomichi Creek are frequently above the designated Water Supply Use standard of 0.030 milligrams per liter (mg/L). Importantly however, despite uranium concentrations above this standard, current water uses are protected as there is no evidence that domestic wells in Sargents are affected by Marshall Creek water.

In June 2022, through a formal rule-making process, the Water Quality Control Commission (WQCC) extended the Temporary Modification of the uranium water quality standard on Marshall Creek, which was set to expire in December 2022. The three-year extension applies the Temporary Modification through December 2025. During the extended Temporary Modification period, HMC, the Colorado Department of Public Health and Environment (CDPHE), and the United States Environmental Protection Agency (EPA) have agreed to cooperatively pursue a Discharger Specific Variance (DSV) from the water supply-based uranium water quality standard for Marshall Creek. In this Report, we summarize the alternatives evaluated to identify feasible strategies that may be used to further reduce uranium concentrations. HMC has pilot-tested several technology-based alternatives to support uranium load reduction at the Site since 2015. This Report provides an overview of the alternatives tested, results observed, and an assessment of full-scale feasibility or infeasibility.

Arcadis and HMC prepared this Report in accordance with CDPHE's DSV Guidance (CDPHE 2021a) and Regulation 31.7. This alternatives analysis involved identifying Site-relevant alternatives to attempt to achieve uranium load reduction in surface water.

As outlined in the DSV Guidance and Regulation 31.7, each alternative is to be evaluated based on three Feasibility Tests: Limits of Technology, Economics, and Other Consequences. Consistent with the guidance, a technology is considered infeasible if it fails any one of these three tests. In this Report, alternatives were not evaluated on the basis of economic feasibility, although this metric may be considered in a future update to this Report.

Following an initial screening of alternatives based on a high-level assessment of technological feasibility and Site applicability, the following seven alternatives were retained for more robust application of the Feasibility Tests:

1) Status Quo: No Further Action;
2) Status Quo: Maintain Current System;
3) Source Load Reduction: Mining;
4) Source Load Reduction: *In Situ* Geochemical Passivation with Phosphate;
5) Physical Water Management: Rock Dump/South Mine Area Regrading and Selective Lining;
6) *Ex Situ* Water Treatment: Semi-Active Treatment with Engineered Treatment Cells (ETCs); and
7) *Ex Situ* Water Treatment: Semi-Active Treatment with Ion Exchange.

Of these, HMC determined the No Further Action (#1), Maintain Current System (#2), and Rock Dump/South Mine Area Regrading and Selective Lining (#5) alternatives to be feasible based on the Limits of Technology and Other Consequences tests. The Maintain Current System status quo alternative is similar to the No Further Action alternative but includes monitoring and maintenance of the existing systems until it can be demonstrated that the systems are permanent in nature and require no additional maintenance to sustain the observed water-quality improvements they provide. Under the Maintain Current System alternative, uranium concentrations at the Outfall are anticipated to continue to decrease over time until reaching a steady-state concentration (with an estimated zero to 10-percent concentration reduction over the next 20 years), but without the risks associated with concentrating the uranium through semi-active water treatment. The Rock Dump/South Mine Area Regrading and Selective Lining alternative involves selective grading and lining to reduce infiltration of water into uranium source zones to achieve uranium load reduction. Estimates indicate that the regrading/selective lining alternative would likely result in additional uranium concentration decreases at the Outfall of up to five to 10 percent.

For various reasons, HMC determined that the other alternatives evaluated are infeasible based on technological limitations and/or other consequences. Specifically:

- Opening the Site to mining is considered feasible in principle but is not considered in detail here because it would require HMC to market and sell the Site property to a uranium mining company.
- *In situ* geochemical passivation with phosphate has been tested extensively at the Site since 2015. These tests have demonstrated that the technology cannot be feasibly extended further and that it fails the Other Consequences test with regard to potential phosphate breakthrough and negative downstream impacts.
- Semi-active treatment with ETCs has also been tested at the Site using biochemical reactor and other treatment cell-based technologies. Although effective to a limited extent, the technology is deemed infeasible because the treatment is only effective at relatively warm temperatures, it generates treatment byproducts requiring post-treatment, and it would generate large quantities of radiological waste that must be disposed of out of state.
- Similarly, HMC has demonstrated that semi-active treatment by ion exchange is technologically feasible (albeit limited to seasonal treatment of North Pit Lake water), but infeasible due to other consequences associated with in-perpetuity radiological-waste generation, transport, and out-of-state disposal.

Importantly, none of the alternatives that HMC evaluated would feasibly achieve HMC's best estimate of a future WQBEL, necessitating the need for a DSV or other regulatory mechanism.

1 Introduction and Objectives

Arcadis U.S., Inc. (Arcadis) prepared this Alternatives Analysis Report (Report) for sitewide water quality management at the former Pitch Uranium Mine (the Site) for Homestake Mining Company of California (HMC), the owner of the Site. Arcadis supports HMC in evaluating Best Management Practices (BMPs) and testing possible uranium reduction options associated with establishing the Lowest Practical Level (LPL) for uranium on Segment 20 of the Gunnison River Basin (Indian Creek), which flows from the Site (see **Figure 1**). In this Report, we summarize the alternatives analysis that Arcadis has conducted on behalf of and in collaboration with HMC to identify the strategies that may be used to define and achieve the Indian Creek LPL, as well as an Alternate Effluent Limit (AEL) that will support the Discharger-Specific Variance (DSV). This DSV is being developed for the Site under the oversight of the Colorado Department of Public Health and Environment (CDPHE) for review and approval by the Water Quality Control Commission (WQCC).

1.1 Regulatory Background and Alternatives Analysis Purpose

In June 2022, through a formal rule-making process, the WQCC extended the Temporary Modification[a] of the uranium water quality standard on Marshall Creek, which was set to expire in December 2022. The three-year extension applies the Temporary Modification through December 2025. During the extended Temporary Modification period, HMC, the Colorado Department of Public Health and Environment (CDPHE), and the United States Environmental Protection Agency (EPA) have agreed to cooperatively pursue a Discharger Specific Variance (DSV) from the water supply-based uranium water quality standard for Marshall Creek. The objectives of the DSV are (a) to satisfy the near-term goal of establishing an appropriate Marshall Creek water quality standard; and (b) to meet the longer-term goal of establishing an appropriate uranium limitation for HMC's Colorado Discharge Permit System (CDPS) permit (permit number CO0022756) (the "Discharge Permit"). HMC will develop this DSV and work to define an appropriate value or range of values for the AEL for uranium during this three-year extension to the Temporary Modification.

Concurrent with the DSV process, HMC will continue to work to define the LPL for Indian Creek. The LPL is the water quality standard for Indian Creek, but its value has not yet been defined.[b] Determination of the Indian Creek LPL and the AEL under the DSV both involve the same analyses and methodological components; specifically, determining and implementing feasible, practical, and sustainable BMPs to achieve the highest attainable water quality condition (HAC; i.e., the lowest concentration) that is feasible for uranium at Outfall 001 at the Site (SW-33

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[a] In Colorado, Temporary Modifications to an established numeric surface water quality standard may be defined for impacted waters under a process further described in Regulation 31.7 (3). Water Quality Control Commission regulations can be accessed at the following website: https://cdphe.colorado.gov/water-quality-control-commission-regulations

[b] As described in Regulation 35, the WQCC changed the Segment 20 (Indian Creek) uranium standards from 2.0 mg/L (chronic) and the Regulation 31 Table Value Standard (TVS; acute) to narrative LPL standards during the September 10, 2012, Rulemaking Hearing. In that same rulemaking hearing, a Type B Seasonal Temporary Modification was assigned to Indian Creek (modified to current condition) with an expiration date of June 30, 2015. In 2015, this Temporary Modification was allowed to expire, and the WQCC authorized removal of the Temporary Modification during the December 14, 2015, Rulemaking Hearing, allowing the uranium standard to default back to LPL. During the June 12, 2017, Rulemaking Hearing, it was acknowledged that the definition of LPL was erroneously deleted as the acute uranium standard, and the LPL standard was reinserted. Currently, Regulation 35 Appendix 35-1 lists the acute and chronic uranium standards for Segment 20 as "lowest practical level."

[the Outfall]; **Figure 1**). Accordingly, efforts to define the LPL and AEL are proceeding along the same path. HMC assumes that the AEL and LPL ultimately will be assigned the same value, which will represent the upper-limit discharge concentration at the Outfall (i.e., the maximum concentration anticipated at the Outfall, therefore ensuring that uranium concentrations in water at the Outfall at any given time do not exceed either the AEL or the LPL).

This Report sets out the alternatives analysis that HMC developed for the combined objective of defining both the LPL and the AEL. A summary of the timeline for the development of a DSV proposal is outlined in **Table 1-1** below, as originally submitted with the Plan to Resolve Uncertainty (PTRU) submitted with the 2022 Marshall Creek Temporary Modification extension request.

Table 1-1. DSV Proposal Schedule of Activities (From 2022 PTRU)

Timeline	Activity	Resulting Deliverables
June 2022 – Sept 2022	Complete ion exchange pilot testing	None
June 2022 – Dec 2022	Complete initial draft of AA	Draft AA
Jan 2023 – Mar 2023	Meet with stakeholders to discuss initial AA and evaluated alternatives	None
June 2023 – Sept 2023 June 2024 – Sept 2024	Complete additional pilot studies or investigations determined to be necessary	Update to draft AA
June 2023 – June 2024	Continue working with stakeholders on refinements to the DSV proposal, AA, and AELs	Updated AA and draft proposal documents
July 2024 – Dec 2024	Continue working with stakeholders towards agreement on final DSV proposal	Updated AA and draft proposal documents
Jan 2025 – June 2025	Rulemaking Hearing Process	Proposal documentation

1.2 Alternatives Analysis Objectives and Overview

CDPHE's DSV guidance document (DSV Guidance; CDPHE 2021a)[c] is a framework for establishing temporary changes to Colorado's water quality standards, which are otherwise established by regulation pursuant to the Clean Water Act. Arcadis developed this Report according to this Guidance and evaluated each alternative based on two of the three feasibility tests set out in the Guidance (the Technological and Other Consequences tests, but not the Economic test). This Report provides an overview of the uranium load reduction alternatives that were tested for the Site, along with performance results and other information informing feasibility and uranium load reduction potential.[d] The Report is organized to address the following objectives:

- Establish the sources and fate of uranium loading at the Site through a "Conceptual Site Model" (CSM; Section 2);
- Evaluate applicable alternatives for reducing uranium (Section 3);
- Perform a comprehensive evaluation of the retained alternatives (including combined technologies and approaches) that were considered and tested, with a summary of recent performance data and considerations for sustainability and closure associated with the retained alternative(s) (Section 4); and
- Provide a ranking of the alternatives based on the results of the feasibility tests (Section 5).

[c] Colorado Water Quality Control Commission Policy 13-1: https://drive.google.com/file/d/1yvJR3Dl-JZpT0c-cGftklmMzPc0-f-NL/view

[d] Uranium "load" (typically expressed here in units of kilograms per day [kg/day]) may be specifically defined as the uranium concentration in water multiplied by the water flow rate. Uranium "load reduction" may therefore be achieved by reducing either the uranium concentration in a flowing water body, the flow rate of that water, or both. In this Report, uranium "loading" is also more generally used to refer to the geochemical process of uranium release into water within uranium source zones by dissolution or desorption from solids.

2 Conceptual Site Model

As the DSV Guidance states, Step 1 of the recommended alternatives analysis involves identifying the source and fate of the pollutant. In this section of the Report, we provide an overview of the CSM, including a description of key Site features, Site history, surface water quality at and downstream of the Site, and changes in water quality over time (including a discussion of historical background uranium concentrations in surface water before any mining occurred at the Site). This section provides only very brief detail on the geologic and hydrogeologic setting of the Site; additional details can be found in the updated Reclamation and Closure Plan (HMC 2019).

2.1 Pitch Mine Overview

The Pitch Mine is located in Saguache County, Colorado, approximately six miles east of the town of Sargents (**Figure 1**). The mine site and associated disturbances occupy 702 acres of property owned by HMC, which is surrounded on all sides by United States Forest Service (USFS) land. The mine project (including the Site itself and surrounding permitted areas), is subject to Colorado Division of Reclamation, Mining and Safety (CDRMS) 112d-3 Designated Mining Operation Reclamation Permit (permit number M-1977-004; the "Reclamation Permit") and occupies approximately 2,912 acres comprising both USFS land and HMC property located within the CDRMS Reclamation Permit boundary shown in **Figure 2**.

Uranium was extracted from the Pitch Mine from the late 1950s through the early 1980s. This began when Pinnacle Partners (also known as Pinnacle Exploration, Inc., referred to herein as Pinnacle) operated an underground mine from 1959 through 1962, from which the company removed high-grade uranium minerals from the Chester Fault fracture zone. This was followed by solution mining within the underground mine workings network from 1968 through 1972, which further extracted a portion of the readily leachable uranium for beneficial use. HMC purchased the mine from Pinnacle in 1972 and conducted open-pit mining from 1979 through 1984. Both the underground mining conducted by Pinnacle and the open-pit mining conducted by HMC recovered uranium ore deposited along the north-south-oriented fracture zone of the Chester Fault. Over the Pinnacle and HMC mining periods, approximately 375,000 tons of high-grade uranium ore were removed from the Chester Fault zone, effectively removing approximately 3.1 million pounds of uranium from uranium source zones at the Site. The primary Site features and HMC's reclamation efforts to date are described below.

2.1.1 Site Features and Surface Water Bodies

The Site is located in remote, mountainous, alpine terrain at an elevation of more than 10,000 feet above sea level and receives snow seven months out of the year. At present, key features associated with the former mine include the North Pit and North Pit Lake (NPL), the partially saturated underground mine workings (UW), and two overburden rock dumps: the Indian Rock Dump (IRD) and Tie Camp Rock Dump (TCRD); **Figure 3**). The primary solid-phase sources of uranium load at the Site are currently understood to include the IRD, the TCRD, and mineralization along the Chester Fault zone including the UW. The NPL is not believed to be a source of uranium load because the North Pit walls do not contain exposed ore material. The NPL receives impacted groundwater flowing along the Chester Fault fractured zone and through the UW and therefore includes a combination of naturally elevated and anthropogenically induced aqueous uranium (i.e., uranium present in solution due to natural background conditions as well as uranium present in solution due to mining activities). The sources of aqueous uranium associated with both of these factors are deep beneath the surface (100 to over 300 feet underground) and widely dispersed. These factors substantially complicate Site water management and reclamation.

Surface water discharges from the Site at a single location, corresponding to the Discharge Permit compliance-point sampling location SW-33 (**Figures 1** and **3**), which is also the regulatory point defined as the headwaters of Indian Creek in Regulation 35. At sampling location SW-33, all regulated chemical constituents other than uranium meet water quality standards contained in Regulations 31 and 35.[e]

When surface water leaves the Site, it flows into Indian Creek, and flows from there into Marshall Creek (**Figure 1**). Marshall Creek passes along the northern edge of the town of Sargents before flowing into Tomichi Creek just west of town (**Figure 1**). Each of these three creeks is a separate stream segment with corresponding beneficial uses and water quality standards assigned to it (WQCC Regulation 35). Both Marshall Creek (from its headwaters to its confluence with Tomichi Creek) and Tomichi Creek carry a Water Supply Use designation with the corresponding water supply-based standard for total recoverable uranium of 0.0168 to 0.030 mg/L. In contrast, Indian Creek, which starts at SW-33, is not designated for water supply use and has a uranium water quality standard that historically was based on the less stringent standard of 2.0 mg/L total uranium, which was deemed sufficient to protect the aquatic life in the segment. The standard is currently characterized as the LPL, which will be defined as a result of the DSV process. In the Discharge Permit for the Site, effluent limitations have previously been based on either the 2 mg/L standard or the federal effluent limitation guidelines (ELGs) for uranium mining at 2.0 mg/L total uranium on a 30-day average basis and 4.0 mg/L total uranium on a daily maximum basis.

Under current conditions, uranium concentrations do not exceed the table value standard (TVS) for aquatic life, which is based on the hardness of the receiving stream water and do not exceed the water quality standard on Tomichi Creek. For Marshall Creek, however, uranium concentrations can seasonally exceed the Water Supply Use standard along Segment 21 of the creek. As described in Section 1 above, a Temporary Modification of the surface water quality standard for uranium was adopted in 2017 for the segment of Marshall Creek between its confluences with Indian Creek and Tomichi Creek (Segment 21). That Temporary Modification resulted in a temporary water-quality standard of “current condition” for Marshall Creek. This Temporary Modification was extended in 2022 to continue through December 2025.

2.1.2 HMC Reclamation Activities Conducted to Date

In addition to striving to meet Site water quality objectives, HMC is currently working with CDRMS to achieve final reclamation of the Site. Site grading and revegetation has improved water quality by reducing meteoric water infiltration into source zones. HMC has been working to ensure that water quality BMPs and Site reclamation and closure objectives are in alignment.

To date, HMC has conducted extensive reclamation work. The following is a high-level list of some of the key reclamation work and hydrologic system improvements that HMC has completed to date; these activities are also summarized further in the updated Reclamation and Closure Plan (HMC 2019):

- **Pinnacle Adit plug installation:** Based on multiple hydrogeological, geochemical, and North Pit stability studies, a hydraulic seal of the Pinnacle Adit was determined to be the most sustainable solution to reduce seepage from the underground workings and improve long-term downstream water quality.

[e] The water quality standards for creeks downstream of the Site are defined in the Code of Colorado Regulations (CCR) Water Quality Control Commission (1002 Series) Regulation 31 (The Basic Standards and Methodologies for Surface Water) and Regulation 35 (Classifications and Numeric Standards for Gunnison and Lower Dolores River Basins): https://cdphe.colorado.gov/water-quality-control-commission-regulations.

CDRMS approval of the Pinnacle Adit plug was granted under Technical Revision (TR) 3 to the Reclamation Permit (HMC 1995), and the Pinnacle Adit plug was installed in 1995. The plugging included placement of a hydraulic seal within the adit, followed by backfill and regrading.

- **North Pit and South Area backfilling, resloping, and drainage installation:**
  - Following mining, the North Pit was partially backfilled to buttress the north and east walls to enhance slope stability, which included raising the pit bottom elevation by approximately 110 feet;
  - Over 90 acres of the North Pit walls and access roads have been regraded and reclaimed, with construction of a clay, fabric, and riprap-lined ditch for surface water drainage (groundwater discharge and stormwater);
  - Resloping and revegetation of approximately 41 acres of the South Mine Area at the ground surface above the former underground mine workings has also been completed; and
  - Between 2020 and 2022, the NPL surface water diversion was extended with approximately 4,000 linear feet relined with geosynthetic clay liner (GCL) and riprap to reduce the volume of water percolating into uranium source zones, thereby decreasing downstream uranium loading.
- **Indian Rock Dump and Tie Camp Rock Dump regrading, reclamation, and waste consolidation:** Reclamation activities included the following actions that were conducted to improve surface water flows, reduce erosion, and promote positive drainage, while simultaneously keeping runoff and infiltration water away from localized uranium source zones:
  - Regrading and vegetation maintenance on approximately 36 acres of the TCRD and 105 acres of the IRD between 1985 and 2022;
  - Consolidation of low-grade ore into an approximately 2-acre stockpile on the TCRD and an approximately 5-acre stockpile on the IRD, each capped with sericite clay;
  - Bypassing and plugging/abandonment of existing corrugated metal pipe (CMP) culverts passing through the TRD and TCRD; and
  - Excavation and installation of 4,500 linear feet of above-ground and buried high density polyethylene (HDPE) and concrete pipe connecting Indian drainage flow with Tie Camp drainage below the TCRD. The current surface water drainage configuration following work completed in 2022 is shown in **Figure 4**.
- **Sediment pond operation and dam improvements:** The sediment pond is located upgradient of the surface water outfall at SW-33 (**Figure 3**). The pond allows suspended solids to settle out before water discharges from the Site. The sediment pond is regularly monitored and maintained. Major improvements following mining have included the following:
  - Excavation of sediment pond sludge in 1994, with emplacement of the removed sludge in a disposal cell at the foot of the IRD under TR-2 to the Reclamation Permit (HMC 1994); and
  - Water drain-down and construction in 2020 to reline the upstream face of the sediment pond dam to ensure its stability and effectiveness (approximately 29,000 square feet of the dam was lined with GCL), including installation of a new gate valve.

The major reclamation milestones described above are in addition to routine monitoring and maintenance conducted at the Site from 1995 through the present, including annual monitoring of water levels in the rock dumps and in the UW behind the Pinnacle Adit plug, regrading and plant seeding to fix and prevent erosion and to promote revegetation, and water quality monitoring to meet water quality compliance objectives. HMC has summarized the field work and analyses annually in its reclamation reports submitted to CDRMS.

In addition to the actions identified above, HMC also has been pursuing additional BMPs to reduce uranium loading. Since 2015, this work has included bench testing, pilot testing, and field-implementation-scale Site testing of uranium load reduction alternatives including source zone load reduction via phosphate injection, zerovalent iron and biochemical reactor engineered treatment cells, and ion exchange (IX) for semi-active water treatment. This work is described in more detail in Section 4.

2.2 Climate and Surface Water Dynamics at the Site

The climate at the Site is typical for the Southern Rockies in Colorado, with low humidity, high evapotranspiration, and relatively cool temperatures. Precipitation (rainfall and snowpack) and air temperature at the Site are currently monitored with an on-site weather station that was installed in August 2019. Prior to this, a rain gauge was in operation at the Site between 2006 and 2010, with intermittent on-site data collected after 2010. A continuous record of precipitation and air temperature from October 1978 to the present is also available from the Porphyry Creek SNOTEL station, located approximately 5.5 miles north of the Site.[f]

2.2.1 Temperature, Precipitation, Evaporation, and Snow Dynamics

Based on the Porphyry Creek SNOTEL data, precipitation in the region during the 22 water years spanning from October 2001 through September 2022 ranged from 16 to 31 inches (25 inches on average) with between 48 and 90 percent of that occurring as snowfall from October through May, and the remainder occurring as rain through the remainder of the year (**Figure 2-1**). The annual maximum snowpack contained the equivalent of approximately 16 inches of water on average. Over the 22-year timeframe, 2002 and 2018 appeared to be particularly dry years from a total precipitation perspective, followed by 2012 and then 2013. These years also had relatively low snowpacks. No years appear to strongly stand out as particularly wet relative to the average, although 2008, 2017, and 2019 exhibited relatively high snowpacks.

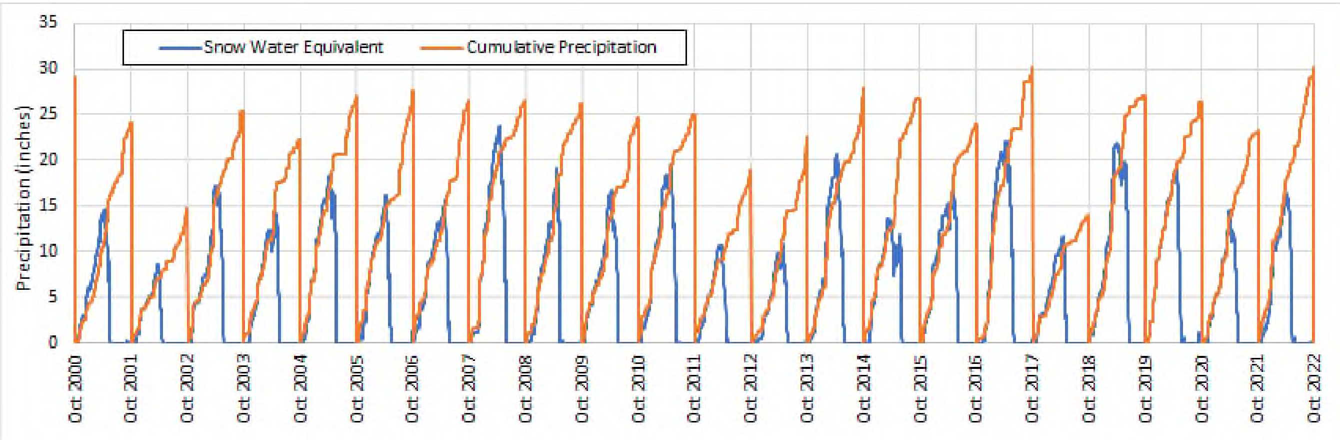


Figure 2-1. Porphyry Creek Snow Water Equivalent and Total Precipitation, 2001–2022 Water Years

Average daily temperatures at the Porphyry Creek station ranged from -11 to 62 degrees Fahrenheit (°F) between 2001 and 2022. Average daily temperatures at the Site weather station from October 2019 through September 2022 ranged between -8 and 65 (°F) and were typically very close to the Porphyry Creek temperatures.

[f] Accessible online at: https://wcc.sc.egov.usda.gov/nwcc/site?sitenum=701

Snow that falls on the Site tends to accumulate in different areas depending on the effects of sun exposure, wind, and topographic relief (i.e., slope and elevation). Particularly on the rock dumps, which do not have significant tree cover, snow tends to accumulate on flat portions of the engineered benches[g] and in surface water drainages, while tending to blow off of the steeper slopes. This pattern is evident based on snowmelt photographic observations and snow tube surveys, conducted in Spring 2022. **Figure 2-2** shows the pattern of snow melt-off through April 2022 on the IRD. These photos show exposure of the steeper southwestern-facing slopes by April 4, with snow remaining on benches and flatter high-elevation portions of the dump. By April 26, much of the snow is melted from lower elevations, but snow on the benches remains, particularly at higher elevations. This later melt-off on the benches is largely a function of greater snow depth on these flat portions due to windblown accumulation.

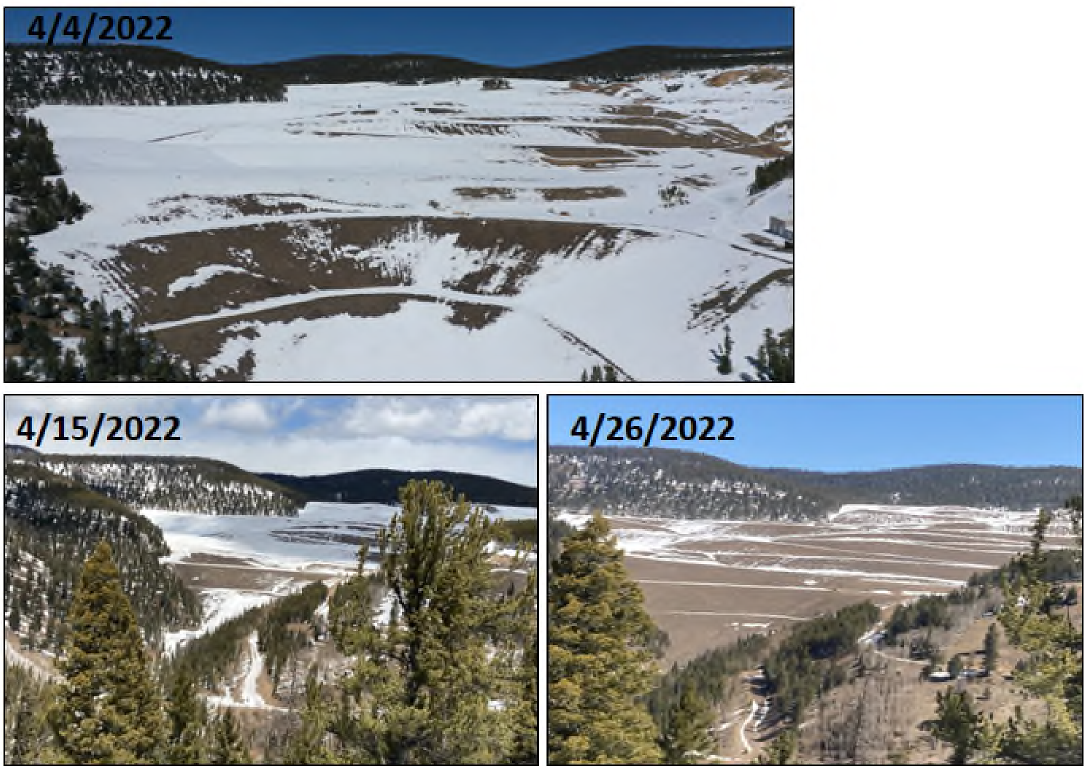


Figure 2-2. Snow on the Indian Rock Dump, Spring 2022

Evaporation is not measured at the Site weather station or at the Porphyry Creek SNOTEL station, but a good approximation of Site evaporation (closely accounting for effects of elevation, sun exposure, temperature, wind, etc.) can be estimated from Colorado pan-evaporation data available through the Colorado Climate Center website (WRCC 2005). The closest pan evaporation station to the Site is the Twin Lakes Reservoir outside of Leadville, Colorado, located approximately 47 miles from the Site and residing at a similar elevation (9200 feet above sea level). Data from this station indicate an annual pan-evaporation rate of 39.6 inches per year, occurring

[g] In this context, “bench” is used to refer to relatively flat strips of land or terraces that are cut in or placed between steeper slopes. The rock dumps were constructed with benches at different elevations to provide access, control stormwater runoff, and maintain slope stability.

predominantly as open water evaporation from May through October. An evaporation rate of 57 inches per year for open water bodies can be assumed, using a pan-evaporation coefficient of 0.7 (Jensen 2010, Kohler 1958).

2.2.2 Surface Water Flow

As noted above, the Site features are contained within a single topographically well-defined watershed, with all surface waters at the Site leaving the watershed at a single point, the Outfall at SW-33 (**Figures 1** and **3**). This watershed includes two subbasins, the Indian subbasin and the Tie Camp subbasin, each with natural surface water drainages that converge upstream of the Outfall within the sediment pond (**Figure 3**). The IRD and TCRD were each constructed as cross-valley fill rock dumps, situated over the original surface water drainages within these respective subbasins. At present, surface water at higher elevations above the rock dumps is diverted around them, while groundwater discharging underneath the dumps and water that infiltrates through dump material runs along the bottom of the dumps through the buried former drainages and expresses to the surface as toe seepage and/or alluvial discharge downstream of the dumps (**Figure 4**).

Surface water flow at the Outfall exhibits a very strong saw-toothed seasonal pattern that includes a sharp rise in late May/early June with snow melt (the “high flow” period), followed by a gradual return to baseflow conditions within approximately 2 to 3 months following snowmelt (the “low flow” period). Surface water flow at the Outfall varies between approximately 50 and 200 gallons per minute (gpm) under baseflow conditions (between August and May) depending on the amount of snow during the previous winter, while flows may increase above 1500 gpm during snowmelt (**Figure 2-3**). The maximum peak flow at the Outfall may be buffered to some extent by varying the amount of storage within the NPL and the sediment pond (i.e., drawing the water level down by increasing discharge immediately prior to peak snowmelt, and then using this storage to decrease the discharge rate during peak flow).

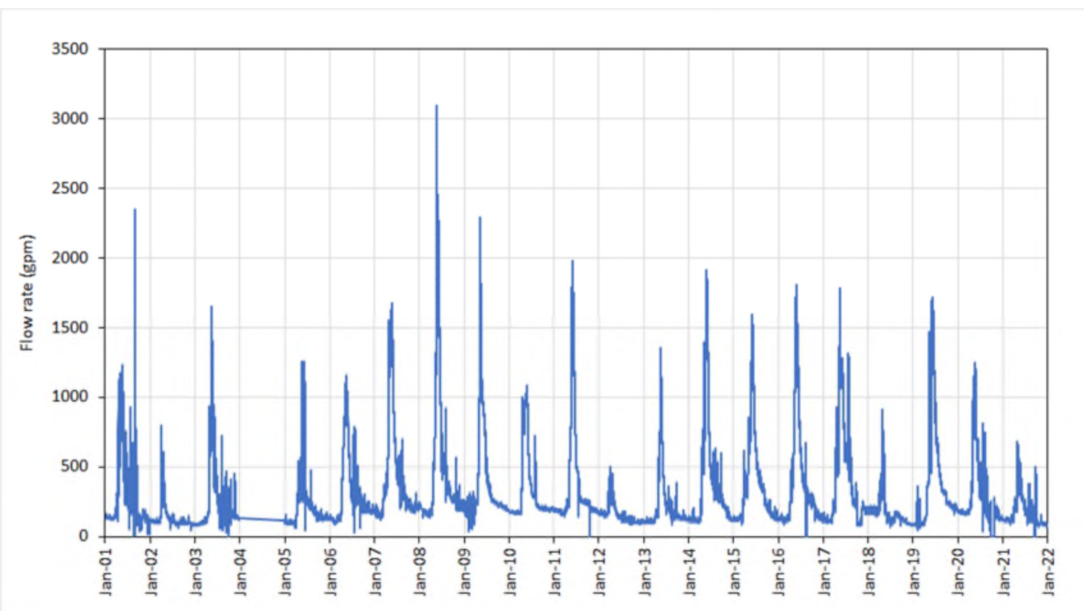


Figure 2-3. SW-33 Outfall Flow, 2001–2022

Surface water discharging from the Site during high flow includes a combination of direct snow melt runoff, shallow infiltration, and groundwater discharge from deeper zones. Flow from deeper zones increases during spring snowmelt as a result of increased water levels due to infiltration of snowmelt. The influences of precipitation infiltration, water-table increases, and groundwater flow through uranium source zones on the discharge of uranium into surface water are discussed further in Section 2.4.2.

2.3 Uranium in Surface Water

HMC has monitored water quality (including uranium and other major constituents) at least twice per year across the Site and in Indian and Marshall Creeks for more than two decades: annually during high flow (late May/early June) and annually during low flow (early October). In addition, HMC has compiled available historical data on Indian and Marshall Creeks dating back to the late 1970s, which was collected as part of the development of the Environmental Impact Statement (EIS) that facilitated HMC's mining permit (USFS 1979). HMC has also compiled available on-site historical data that date back to the 1950s, before Pinnacle began mining operations at the Site. HMC has used this information, described below, to develop an understanding of pre- and post-mining Indian and Marshall Creek surface water quality, and to characterize the on-site uranium sources and their relative contributions.

2.3.1 HMC Mining/Reclamation Activities and Surface Water Uranium: 1977 to Present

HMC has measured uranium concentrations at the Outfall routinely (multiple times per year) since 1976, approximately three years before HMC began open-pit mining operations. A plot of total and dissolved uranium concentrations at the Outfall is shown in **Figure 5**, annotated with key mining and reclamation activities. The plot illustrates that, although uranium concentrations have fluctuated throughout HMC's ownership of the Site, the current discharge concentrations are now similar to or slightly less on average than before HMC began mining operations. The results also demonstrate that several of the short-term changes (both increases and decreases) in uranium concentrations at the Outfall can be attributed to specific mining and/or reclamation activities. Specific observations include the following:

- In the three years immediately before HMC began mining, uranium concentrations at the Outfall fluctuated between 0.5 and 2.5 mg/L, exhibiting a seasonal pattern similar to what occurs today (higher concentrations are observed during the high-flow/snowmelt period, and lower concentrations are observed in the fall and winter under baseflow conditions).
- Uranium concentrations varied widely during and immediately following mining, including during a period from 1984 through 1986 in which uranium concentrations at the Outfall were very low, possibly associated with pit filling and/or radium treatment plant operation.
- During the post-mining period from 1987 through 1994, uranium at the Outfall appeared to stabilize between approximately 0.7 and 1.6 mg/L.
- Plugging the Pinnacle Adit resulted in a slow re-saturation of the UW (HMC 2022). During that time, uranium concentrations at the Outfall sharply increased (likely due to a flushing of oxidized, highly soluble uranium into solution in the previously unsaturated zone; see Section 2.4.2) up to values above 2 mg/L, but then slowly decreased back to pre-plugging concentrations through 2010 as this readily soluble fraction moved out of the saturated UW. From 2010 through 2017, uranium concentrations continued to decline, except for a temporary increase in summer/fall 2017 associated with NPL investigations that involved partial draining of the lake.

- Since 2018, uranium concentrations have continued to decline and have reached their lowest overall range since monitoring began in 1976. The lowest observed annual range in uranium concentrations occurred in 2021: between approximately 0.4 and 1 mg/L. In addition, the uranium dataset from measurements at the Outfall between 2010 and 2022 exhibits a statistically significant decreasing trend at a 95 percent confidence level based on a Mann-Kendall trend test.[h] Much of this continued decrease is likely the result of continued diminishment of the readily soluble uranium component within source zones following reclamation work by HMC. In particular, it is likely an indication that the full effects of plugging the adit and re-saturating the UW are still being realized, resulting in an even lower uranium load over the long term than what was observed before the adit was plugged. It is also likely that uranium load reduction strategies (such as phosphate injection, which was initiated in 2017) have also resulted in small reductions to the uranium load.
- The similarity between uranium concentrations at the Outfall before and after HMC mining is also confirmed by data collected further downstream on Indian and Marshall Creeks in the late 1970s, as compared to current data. These include data collected at monitoring point SW-4 (located on Indian Creek upstream of the confluence with Marshall Creek), where concentrations are typically between 0.1 and 0.2 mg/L, and monitoring point SW-10 (on Marshall Creek, approximately 1.5 miles downstream of the confluence with Indian Creek), where concentrations typically are between 0.02 and 0.06 mg/L, frequently below the 0.03 mg/L (30 µg/L) upper range of the Water Supply standard (**Appendix 1**). These results inform the conceptual understanding of uranium load sources, demonstrating that HMC's mining of higher-grade mineralization coupled with the reclamation and closure of the facilities have been successful at reducing uranium load to pre-mining concentrations. This point is discussed further in Section 2.4 below.

2.3.2 Pre-Mining Water Quality

Historically, it was thought that no data existed that reflect the concentration of uranium in Indian Creek before all mining activities began, including any land disturbances by Pinnacle starting in 1959. However, evidence was recently uncovered that demonstrates that uranium concentrations in Indian Creek were significantly elevated in surface water due to discharge of groundwater from mineralized zones in the area, even prior to Pinnacle mining in 1959. As reported in a Pinnacle Exploration, Inc. memorandum dated March 13, 1970 (discovered in the Pitch historical document archive and included here as **Appendix 2-1**), the Atomic Energy Commission (AEC) collected measurements along the "Indian Creek drainage system" in 1959, immediately prior to the start of mining by Pinnacle, and measured dissolved uranium concentrations that "varied from 0.25 to 1.60 parts per million in the stream" on a U_3O_8 basis (equivalent to aqueous uranium concentrations between 0.21 and 1.36 mg/L).

This discovery is significant because it indicates that dissolved-uranium concentrations in Indian Creek before mining commenced in 1959 were similar to current conditions. Specifically, these concentrations are strikingly close to the concentration range currently observed on Indian Creek, with concentrations at the Outfall similar to the upper historical value and the farthest downgradient monitoring point on Indian Creek (SW-4, located

[h] The Mann-Kendall trend test was conducted on quarterly averages of Outfall uranium concentrations between January 2010 and January 2022. The quarterly averages were used to obtain a uniformly spaced dataset to avoid temporal bias. The quarterly averages were obtained on a combination of total and dissolved data (whichever was available for a given monitoring date). For monitoring dates where both total and dissolved uranium were collected, the maximum of the two values was retained for the quarterly average. The Mann-Kendall test was conducted using ProUCL Version 5.1 (EPA 2022).

immediately upstream of the confluence with Marshall Creek; see **Appendix 1**) similar to the lower historical value. This comparison is illustrated visually in **Figure 2-4** below.

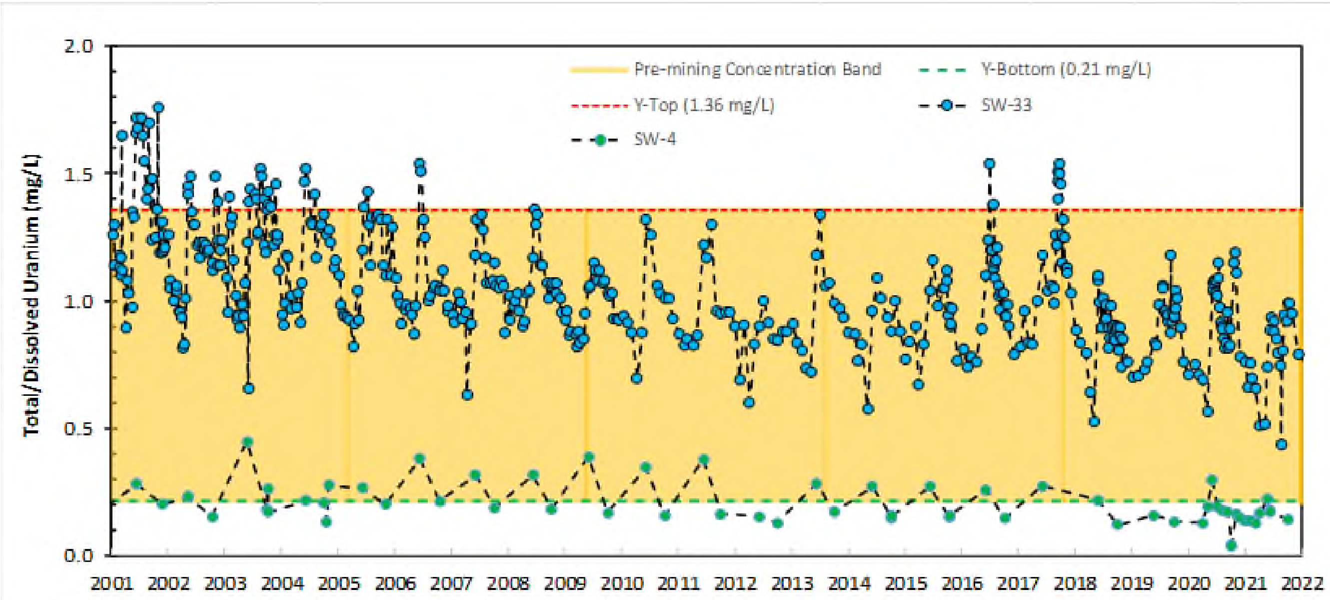


Figure 2-4. 1959 Pre-Mining Uranium Concentrations on Indian Creek Relative to Current SW-33 and SW-4 Concentrations

Additional documentation from the late 1970s and early 1980s provides further evidence that uranium concentrations in Indian Creek were elevated prior to mining activities in the area:

- In a draft response to EPA comments on the Draft Environmental Statement submitted by HMC in 1978 (**Appendix 2-2**), HMC provided uranium mass load calculations pointing out that only approximately 14 to 38 percent of the dissolved uranium in Indian Creek could be attributed to discharge from the Pinnacle Adit (see **Appendix 2-2**, document page 4, item 14). At the time (pre-HMC mining), the North Pit, IRD, and TCRD did not exist, and any mining-induced aqueous uranium in Indian Creek would have been expressing at the Pinnacle Adit, which drained the underground workings. The conclusion at the time was therefore that the additional uranium load in Indian Creek was attributable to naturally occurring sources of dissolved uranium from undisturbed mineralized zones at the Site. sources of dissolved uranium from undisturbed mineralized zones at the Site.
- In the Summary of Rationale for the Site Discharge Permit dated June, 1980 (**Appendix 2-3**), the WQCD acknowledged the likely contribution of natural-background uranium present in Indian Creek ("*We have no data which shows that this portion of Indian Creek did not contain elevated uranium levels prior to any mining activities. The geology of the area indicates that high natural uranium levels were likely.*" Item h/2., Summary of Rationale Page 3, **Appendix 2-3**).
- In February 1981, the law firm Kirkland & Ellis (on behalf of HMC) submitted a document entitled "Summary of Evidence Re Segment 21 of the Upper Gunnison River Basin – Indian Creek" to the WQCC in response to proposed classifications and uranium standards for Indian Creek (**Appendix 2-4**). In this document, HMC further notes that uranium concentrations on Indian Creek can be attributed to background levels and notes that WQCD was in concurrence with this assertion, following testimony presented at hearings held in Montrose regarding the site discharge permit ("*…the levels of uranium found in Indian Creek are essentially background levels – levels that the Pitch Mine and Homestake*

cannot significantly influence. The Division has recognized that essential fact when it renewed the Homestake NPDES Permit in June 1981." **Appendix 2-4**, document page 4). This document goes on to provide data and arguments (document pages 5 through 9; **Appendix 2-4**) indicating that uranium concentrations on Indian Creek downstream of the Outfall were largely due to natural sources.

2.4 Site Uranium Loading and Dynamics

HMC has used surface water flow and uranium concentration measurements to understand the source zones from which uranium is entering surface water at the Site. Based on these observations, along with historical information and Site-characterization results, HMC has developed a CSM describing the uranium release areas and mechanisms at the Site. This CSM is discussed below.

2.4.1 Uranium Source Zones

Based on HMC's evaluation of Site surface water flows and uranium mass loads (calculated as water flow multiplied by uranium concentration), the following four primary source zones[i] contributing uranium to surface water at the Site have been identified (**Figure 3**):

- NPL and UW: Uranium in surface water at this location originates from the UW and Chester Fault fracture zone and discharges into the NPL via springs and groundwater. From 2010 through 2015 (following stabilization of water levels but prior to phosphate injection), concentrations in UW monitoring wells P4 and P5 varied between 2 and 10 mg/L. Although this is referred to as the "NPL load" below, the North Pit itself is not a significant load contributor; rather, it is a conduit: the uranium load originating from the deep Chester Fault and UW system expresses to surface water through the NPL. Importantly, the uranium load from this source zone likely includes a significant background component associated with ambient flow of groundwater through undisturbed Chester Fault fractures, which has been occurring since well before any mining activities occurred at the Site, as discussed above (see Section 2.3.2). A uranium resource review completed in 2022 (**Appendix 3**) identifies a measured and indicated uranium resource of nearly 11 million tons of uranium resource totaling over 5 million pounds of uranium (U_3O_8 basis) based on an estimated ore grade of 0.2 to 0.26 percent U_3O_8. In addition,1.6 million tons of additional resource, containing upwards of 8 million pounds of uranium (U_3O_8 basis) is inferred.
- IRD: The IRD is another primary source of uranium. Within the IRD, low-grade uranium from mining overburden leaches into water percolating through the dump. Uranium concentrations range from approximately 1.5 to 3 mg/L in seepage water collected from monitoring wells screened at the bottom of the dump. Note that this load likely also includes deep groundwater discharge into the bottom of the dump, which also likely contains background dissolved uranium (particularly any flow originating from the east, which likely contacted the Chester Fault fractured zone uranium deposits).
- TCRD: The TCRD also contributes uranium due to leaching from mining overburden. Uranium concentrations range from approximately 1.2 to 6 mg/L in seepage water collected from monitoring wells screened at the bottom of the dump. As with the NPL and IRD, this load likely includes background

[i] The term "source zone" in this Report may refer generally to any area where uranium release into water from source material may be occurring. Where possible, if the term refers to one of the four specific source zones as defined in this section, that source zone is referred to specifically.

originating from groundwater discharge into the bottom of the dump resulting from Chester Fault fractured zone uranium deposits running through and to the south of the dump.

- “Downstream” Load: This includes residual uranium discharging to the sediment pond, calculated as the uranium mass load at SW-33 minus the mass load at monitoring points IC and TCC (**Figure 3**). The source of this uranium is unknown; HMC suspects that this uranium originates from the rock dumps but bypasses the IC and TCC weirs within shallow alluvial groundwater flow in the Indian and Tie Camp drainages and as such likely also contains a background aqueous uranium component.

These flows and uranium sources are illustrated schematically in **Figure 6**. The mechanism by which these sources contribute uranium is described further in Section 2.4.2 below.

The 2010 through 2019 biannual monitoring dataset was used to develop a water flow and uranium load balance model that is representative of high-flow and low-flow conditions at the Site.[j] The uranium load components from each source are presented for individual years (2010 through 2019) in **Figure 2-5**. The uranium loads tend to be similar from year to year, but there are markedly lower uranium loads during lower-than-normal high flows in the relatively dry years (2012, 2013, and 2018). This is consistent with the relatively low snowpacks observed in those years (Section 2.2.1).

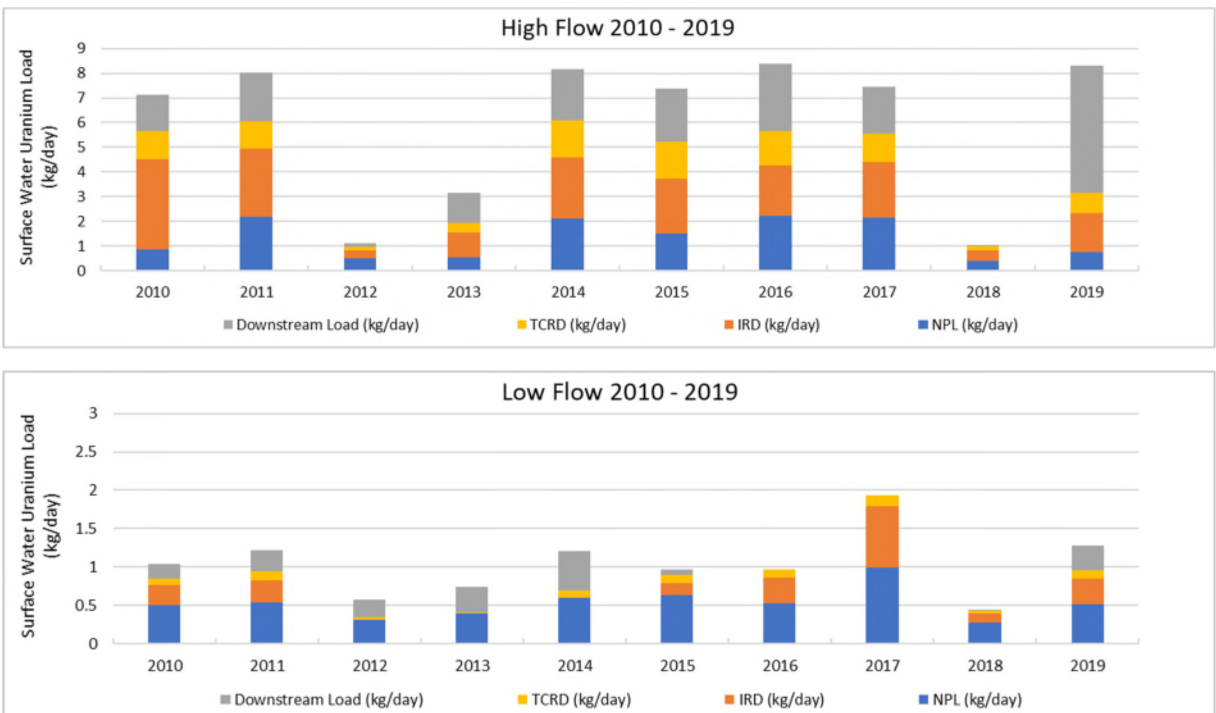
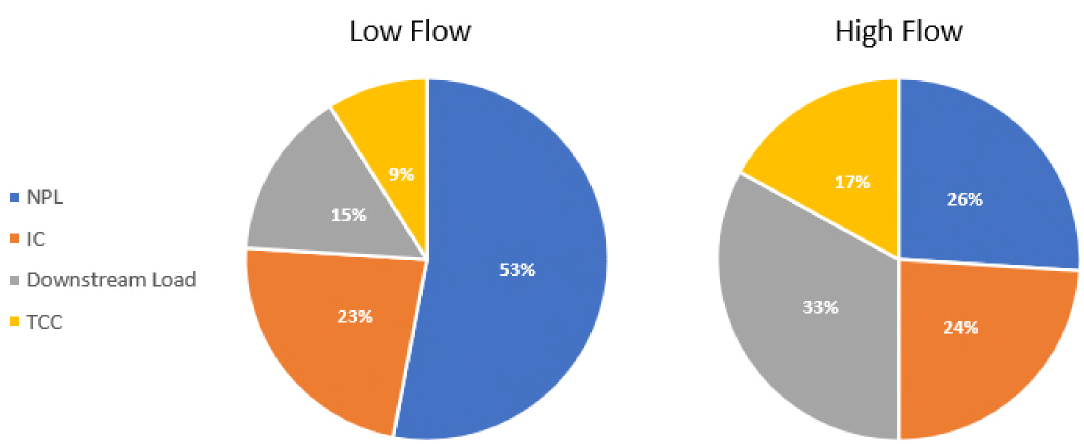


Figure 2-5. Load Contributions During High Flow and Low Flow

[j] Surface water flow and uranium concentration data collected from 2020 through 2022 were generally consistent with the observations presented for the 2010 through 2019 period but were not included in the evaluations due to reclamation activities temporarily modifying the Site water balance. Specifically, several of the flows were highly variable during this period due to drainage bypassing, rerouting via pumping, and/or partial filling and draining of the NPL and sediment pond to accommodate work in the drainages. It was therefore difficult to collect accurate, reliable, and continuous water flow measurements during this period.

For the purposes of developing a flow and load balance for use in evaluating water management alternatives, the 2016 high-flow event was chosen as an appropriately conservative representation of typical conditions, whereas the 2010–2019 low-flow average was used to represent the baseflow condition. Specifically, a conservatively high condition for high flow was preferred to understand the upper limit of potential water flow demands (particularly given the greater variability of the high-flow condition), but this level of conservatism was not considered necessary for the baseflow condition, where considering the longer-term average condition was preferred. The high-flow and low-flow uranium loads related to the four uranium sources described above and representative of this 10-year period are provided in **Figure 2-6**. The biannual dataset was also used to estimate the annual-average water flow, uranium concentration, and uranium load based on a weighted average of the high-flow and low-flow values. Based on a comparison of high-flow, low-flow, and true annual-average results for the Outfall (for which continual data-logged flow data and monthly uranium concentration data are available), an adequate annual average was obtained by applying a two-month weight to the high-flow results and a 10-month weight to the low-flow results. The high-flow, low-flow, and annual-average water/uranium mass balance results are included in **Table 1**.



Notes:
Uranium load source zones include a contribution from naturally-occurring background uranium.

Figure 2-6. Uranium Loading Sources During High Flow (2016) and Low Flow (2010–2019 average)

Uranium concentrations and water flow rates from each of the four source zones vary seasonally (**Table 1**). Under high-flow conditions, uranium concentrations tend to be slightly higher, likely due to flushing from source zones that have seasonally variable saturation. Note that access to the Site is difficult during the winter months until significant snowmelt has occurred, so HMC typically cannot monitor surface water flows until slightly after they peak. Therefore, the actual high-flow uranium load may be higher than that represented in **Table 1**. Moreover, the difference in overall uranium mass load (i.e., concentration multiplied by flow) between high-flow and low-flow conditions is much greater than the difference in uranium concentrations under high- vs. low-flow conditions. This is because, although the concentrations are relatively similar, the flow rates associated with the spring snow melt are much higher, and therefore the high-flow uranium load (flow multiplied by concentration) is much higher than the low-flow uranium load. Following the snowmelt peak, surface water flows from the rock dumps decrease more sharply than flows from the UW/NPL system do, indicating that snowmelt infiltration strongly influences flows from the relatively large and permeable rock dumps. For this reason, the rock dumps are proportionately larger contributors of the overall uranium mass load to the Site under high flow conditions (**Figures 2-4** and **2-5**).

As noted in Section 2.3, the current uranium concentrations at the Outfall are similar to concentrations observed at the Outfall before open-pit mining began in the late 1970s (**Figure 5**), and they are also similar to concentrations in Indian Creek before mining began in the late 1950s, based on measurements collected by the AEC (**Appendix 2-1**). This indicates that HMC's reclamation and closure work that has been completed to date has been successful at reducing uranium concentrations to pre-mining levels. With regard to the NPL system, this result is consistent with the observation that the NPL is a conduit that conveys uranium from the underground Chester Fault fractured fault zone and UW but is not itself a source of uranium. Nonetheless, this result is surprising, given the apparent specific contributions of uranium from the IRD and TCRD, which are observed at monitoring points IC and TCC, respectively. These results indicate that, while the rock dumps represent a "new" (post-HMC mining) uranium source to surface water,[k] this new load is offset by a decrease in uranium loading from the Chester Fault/UW system over time, following the end of active mining of high-grade ore materials within the fracture zone and the progress of HMC's reclamation and closure efforts.

2.4.2 Conceptual Model of Uranium Release

The water flow and uranium concentration data presented above demonstrate that the Chester Fault/UW system, IRD, and TCRD represent the major known source zones that release uranium into water at the Site. In this section, we describe HMC's conceptual understanding of the nature of these source zones and the mechanisms by which uranium is released.

2.4.2.1 Geochemistry of Uranium

One of the most important factors governing the geochemical behavior of uranium at the Site is its oxidation state. The oxidation state of an element refers to the number of negatively-charged electrons within the electron cloud of the atom relative to the number of positively-charged protons in its nucleus. Uranium has 92 protons in its nucleus, but it is most stable in the environment with fewer than 92 electrons. The most stable oxidation states of uranium in the environment are +IV and +VI (oxidation states are most commonly expressed using Roman numerals), meaning it has a deficit of either 4 or 6 electrons.

As with other redox (reduction/oxidation)-active elements in the environment, the most stable oxidation state is dependent on the redox state of the other constituents present within the local environment. This is because all of these constituents will tend to move toward equilibrium with respect to one another (albeit often with significant kinetic limitations) by exchanging electrons with one another through reduction-oxidation (i.e., "redox) reactions. Elements become more "reduced" when they gain electrons and more "oxidized" when they lose electrons.

Under geochemically reducing conditions (particularly in the absence of dissolved oxygen gas, O_2), uranium will tend to be in the +IV oxidation state. Uranium-IV, or U(IV), is highly insoluble and is likely to be present in a given system as the mineral phase uraninite, UO_2. At the Site, uranium in the ore is present as uraninite (historically referred to as pitchblende, which may also contain some U_3O_8 due to partial oxidation), as well as the U(IV)-silicate mineral coffinite ($USiO_4 \cdot H_2O$). However, in the presence of dissolved oxygen, uranium is more stable as

[k] As noted above and in Section 2.4.2, the IRD and TCRD loads likely also include some background component of dissolved uranium that is present in groundwater that discharges into the dumps at depth.

U(VI), because molecular oxygen has a stronger preference for those electrons. U(IV) may be oxidized by direct reaction with dissolved oxygen when it is present in water via the following reaction:

$$2\ UO_2 + O_2 + 4\ H^+ \Leftrightarrow 2\ UO_2^{2+} + 2\ H_2O$$

In this reaction, dissolved oxygen gas takes electrons from solid-phase uraninite, forming U(VI) and water. U(VI) is much more soluble in water than U(IV), but it is not actually present in water as a dissolved ion[l] with a +6 charge; rather, it is typically present in the dissolved phase strongly bound to two oxygens as the “uranyl” ion, UO_2^{2+}. In solution, this uranyl cation can be electrostatically attracted to negatively-charged anions, such as dissolved carbonate (CO_3^{2-}), and the actual uranium species in solution may be a combination of uranium, carbonate, hydroxide (OH^-), and other anions in solution. These anions in the “coordination sphere” surrounding UO_2^{2+} can attract other cations. Under the geochemical conditions at the Site (pH is slightly above neutral with dissolved calcium and bicarbonate in equilibrium with the mineral calcite), some of the most prevalent forms of dissolved uranium include “ternary” (three-component) complexes that include calcium, carbonate, and either calcium or magnesium; for example (Dong and Brooks 2006):

$$UO_2^{2+} + 2\ Ca^{2+} + 3\ HCO_3^- \Leftrightarrow Ca_2UO_2(CO_3)_3^0 + 3\ H^+$$

These factors are all relevant to the current evaluation of uranium at the Site for the following reasons:

- The release of uranium from source zones at the Site is strongly controlled by redox chemistry. Naturally occurring uranium is present in low-solubility U(IV) minerals. Uranium is released into solution within these source zones by exposure to water containing dissolved oxygen gas, which causes the oxidative dissolution of the uranium minerals.
- Oxidized U(VI) is soluble in solution and is therefore highly mobile; it can be transported by groundwater and discharged into surface water. Aqueous “complexation” with other ions enhances this mobility by partially limiting the ability of the uranyl cation to adsorb[m] to mineral surfaces in the ground.
- The aqueous speciation of uranium has further implications for its treatability. For example, the electrostatic charge of the uranium complex affects how uranium interacts with ion exchange resins and what type of resin should be used. This point is discussed further in Section 4.

2.4.2.2 Chester Fault, Underground Workings, and the North Pit Lake

Chester Fault Geology, Hydrogeology, and Groundwater Flow

Uranium mineralization at the Site is present along a 300 to 400-foot wide zone known as the Chester Fault, a fractured zone along which Belden Formation and Leadville Dolomite units west of the fault contact Precambrian granite on the east. Deposition of uranium within the Belden and Leadville units occurred historically with hydrothermal fluid flow, followed by leaching and redeposition within the fracture zones with flowing groundwater (Goodknight and Ludlum 1981; Nash 1988). Mining activities at the Site were focused within the Chester Fault zone where uranium mineralization occurred (**Figure 3**).

Figure 7 shows an east-west cross section within the Chester Fault at the southern end of the UW, which HMC prepared in 1975 as part of exploration drilling. The location of this cross section relative to the UW and NPL is

[l] Ions are atoms or molecules that carry an electrostatic charge as a result of an excess or deficiency of electrons relative to protons. Positively charged ions are called cations, and negatively charged ions are called anions.
[m] In this context, “adsorption” is a process by which chemical constituents dissolved in water adhere to the surface of a solid, such as a mineral in the ground or a water treatment product. This process may be distinguished from “absorption,” which involves the taking up of the constituent within the body of the solid.

shown in **Figure 8**. This cross section provides a good illustration of the complexity of the fracture network, geology, and distribution of uranium mineralization. Although the UW were installed to a lower depth of 10,300 feet above sea level, the exploration boreholes illustrate uranium mineralization extending below this depth.

An overview of the bedrock hydrogeology is contained in the EIS (USFS 1979). Fractures within the Chester Fault exert a dominant control on groundwater movement in this portion of the Site, with north/south groundwater flow along the fault as evidenced by seeps and springs observed prior to open pit mining. Specifically, as described in the EIS, 27 seeps and springs were observed along a one-mile-long stretch of the Chester Fault zone with cumulative measured flow rates of approximately 16 gpm (USFS 1979). The majority of flow and water storage is believed to be dominated by fractures, which are more prevalent near the surface and in the vicinity of faults, with a relatively small amount of water storage in the bedrock. Much of the groundwater that flows along the Chester Fault comes into the fracture zone from the east; wells installed prior to open-pit mining confirm a westward groundwater gradient in the Precambrian rock, toward the Chester Fault (USFS 1979). Recharge to groundwater also occurs through infiltration of snowmelt from above.

In the portion of the Chester Fault surrounding the UW, groundwater flows to the north into the NPL. Following re-saturation of the UW with installation of the Pinnacle Adit plug, water levels rose within the UW, providing a hydraulic gradient to the north. The NPL serves as a local groundwater sink because the NPL water level is lower than the water table in the surrounding bedrock. This concept is illustrated in **Figure 8**, which shows the water levels in the UW/Chester Fault during high-flow and low-flow periods relative to the NPL, with the groundwater gradient toward the north. This cross section also illustrates the extent of excavation during open pit mining and the backfill reclamation work that has been conducted since mining ended. HMC assumes that groundwater flow within the Chester Fault fracture zone and unconsolidated saturated backfill residing north of the NPL is toward the south, with flow into the NPL. However, the groundwater gradient in this area is unknown, as there are currently no groundwater piezometers installed north of the NPL.

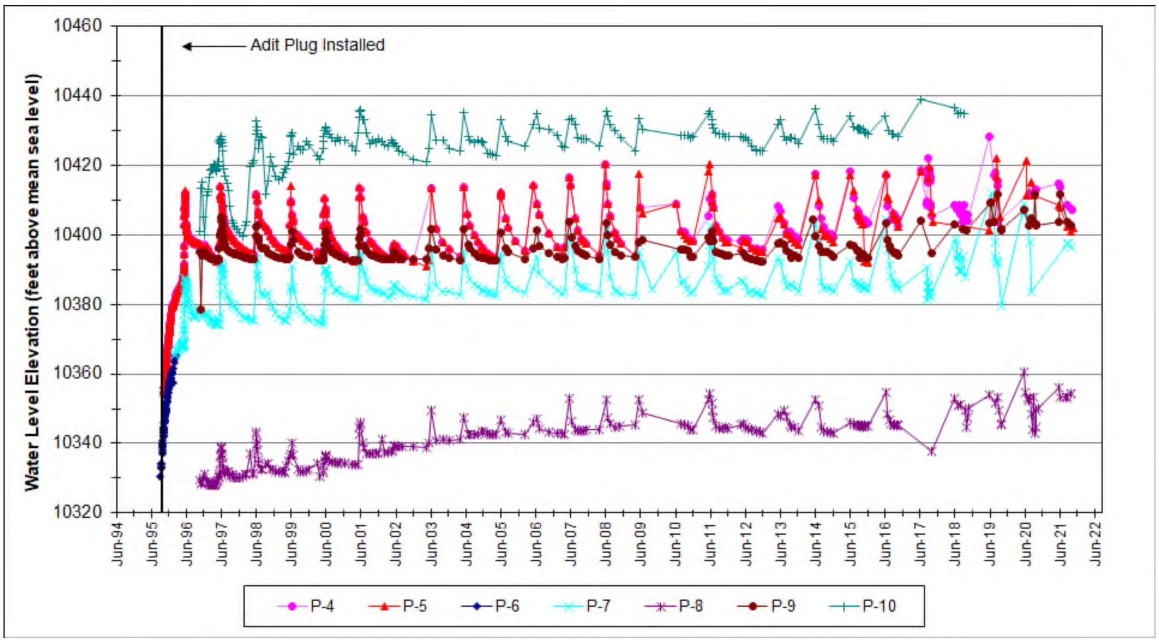
Additional details on the hydrogeologic CSM for the Site can be found in the updated Reclamation and Closure Plan (HMC 2019).

Uranium Release in the Chester Fault/Underground Workings Source Zone

Uranium release into groundwater occurs via water contact and oxidative dissolution of uranium-bearing minerals present within the fracture zone associated with the Chester Fault. This is likely occurring within the UW themselves, which are believed to channelize water flow and contain disturbed and collapsed uranium-containing rock. But it also likely continues to occur within portions of the Chester Fault fracture network that were undisturbed by mining. This hydraulic connection and uranium release and discharge pathway is supported by uranium concentrations measured in piezometers within and surrounding the UW, as well as uranium concentrations in springs expressing to the NPL on the south wall of the North Pit. Specifically, historical uranium concentrations in piezometers P4 and P5 prior to phosphate injections were between 2 and 10 mg/L, which were similar to historical concentrations in the Chester Fault Springs (CFS) (see **Figure 8** for locations).

Water levels within and adjacent to the UW have come up approximately 45 feet since the Pinnacle Adit was plugged and fluctuate seasonally in response to snowmelt, moving up and down approximately 10 to 20 feet each year (**Figure 2-7**; piezometer locations provided in **Figure 3**). This seasonal sawtooth pattern (exhibiting a sharp rise, followed by a slower decline) reflects the water table rise due to the infiltration of snowmelt from the immediate vicinity, as well as increased groundwater inflow (likely predominantly from the east) due to snowmelt infiltration upgradient of this zone. Uranium release into solution is therefore likely to be occurring in three zones within the UW/Chester Fault:

- Within the overlying unsaturated zone, uranium is released into solution as rain and snowmelt percolates down through unconsolidated fill material and weathered bedrock, and then through fractured bedrock on its way to the water table;
- Within the water table "smear zone" (representing rock that desaturates and re-saturates seasonally as the water table moves up and down), uranium release is likely particularly pronounced due to this wet-dry cycling, which exposes rock to oxygenated air and water; and
- Below the smear zone, release of uranium into solution may be less than in the smear zone, but still significant as oxygen in the groundwater is chemically consumed.



Notes:

High water levels associated with phosphate injections were removed.

Figure 2-7. Water Levels in Underground Workings Piezometers, 1995 through 2021

Saturation of the UW and the surrounding Chester Fault zone has resulted and continues to result in a benefit, reducing uranium loading from the UW/Chester Fault zone into surface water. With regard to the uranium release zones above, this can be conceptualized as reducing the unsaturated source volume (the first bullet above) while increasing the saturated zone volume (third bullet above), which reduces the volume of source material exposed to oxygen, thereby reducing the extent of oxidative uranium dissolution within this source zone. Although material in the unsaturated zone may be exposed to high concentrations of oxygen present in pore gas (gas that exists in the void space between rocks), oxidation of uranium within the saturated zone is limited by the dissolved oxygen present in the water flowing through this zone. Oxidation reactions consume this dissolved oxygen, limiting further oxidation.[n]

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[n] Typical dissolved oxygen concentrations in groundwater adjacent to the UW (monitoring wells P-4 through P-10) range from 0 to 5 mg/L, averaging approximately 2 mg/L, with an average groundwater temperature approximately 7.5 °C. At this

This groundwater then flows out of the Chester Fault fracture network into the NPL, as illustrated conceptually in **Figure 8**.

North Pit and North Pit Lake

As described above, uranium loads to the NPL derive from groundwater flowing through fractures associated with the Chester Fault system, rather than from surface water runoff from the pit walls. Based on measurements of surface water chemistry within the NPL diversion channel that wraps around the north, east, and southern walls of the North Pit (**Figure 4**), pit wall rock runoff is understood to be a negligible component. The diversion captures groundwater seepage and runoff from exposed wall rock above this diversion (which has a surface area of approximately 22 acres). The concentration of uranium in this water has historically ranged from 0.002 to 0.007 mg/L.

This concept is further supported by depth measurements of the NPL, which demonstrate that the NPL is stratified. The lake chemistry with depth is illustrated schematically in **Figure 9**, along with water quality results from depth sampling conducted in August 2020. Field parameter depth trends illustrate both a thermocline and a chemocline (corresponding to sharp transitions in temperature and water composition, respectively) at approximately the same depth, which at the time of sampling was approximately 13 to 14 feet below the lake surface. This chemocline represents the transition between a well-mixed “epilimnion” (upper lake level) and “hypolimnion” (lower lake level). The water quality results show that the epilimnion and hypolimnion have distinct water chemistries, with the hypolimnion exhibiting reducing conditions (elevated iron and manganese and lower dissolved oxygen and ORP), while the epilimnion is relatively oxic. Surface flow measurements demonstrate that the lake is net-gaining with respect to groundwater flow (i.e., there is more groundwater inflow to the lake than groundwater outflow from the lake), because the surface water outflows (measured at monitoring point NPL; **Figure 3**) are consistently greater than measured surface water inflows, while the volume of the lake does not change. The fact that uranium concentrations are higher at depth in the lake suggests that uranium-containing groundwater inflows primarily occur into the bottom of the lake. In contrast, the upper layer tends to be more dilute as a result of relatively uranium-free surface water inputs, including runoff from non-mineralized highwalls, and/or shallow groundwater discharge containing lower concentrations of uranium.

Groundwater discharge into the bottom of the lake results in water flow from the hypolimnion into the epilimnion, where iron and manganese drop out of solution due to oxidation and precipitation. Uranium is either removed from solution (possibly due to coprecipitation with iron and manganese) or tends to be lower in the epilimnion due to dilution. This conceptual model for the NPL highlights another important point regarding the lake system: specifically, the lake itself improves water quality. Although it is not clear whether the lake is removing substantial quantities of uranium, the lake stratification does help to remove iron and manganese present in deep groundwater by providing a reservoir in which oxidation, precipitation, and settling of solids can occur.

2.4.2.3 Indian and Tie Camp Rock Dumps

The IRD and TCRD contain mining overburden that was excavated during underground and open-pit mining. The majority of the material in the dumps consists of low-uranium-concentration overburden rock present above and between the uranium-mineralized fracture zones that was removed to access the uranium ore during open-pit

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temperature and at an altitude of 10,000 feet above sea level, dissolved oxygen at saturation is approximately 8.3 mg/L, suggesting that Chester Fault groundwater in the vicinity of the UW exhibits dissolved oxygen less than 25 percent of saturation with air. This result suggests consumption of oxygen in the subsurface. A dissolved oxygen concentration of 8.3 mg/L in water would have the potential to oxidize and liberate a dissolved uranium concentration equivalent to approximately 120 mg/L.

mining. However, the IRD is also known to contain rock that was removed during underground mining by Pinnacle (referred to as the Pinnacle Mine Dump [PMD]); this material contains slightly higher concentrations of uranium than most of the overburden rock in the IRD because it includes low-grade uranium ore that was beneath the cutoff grade at the time of Pinnacle mining. Because of the more selective underground mining methods, this material contains a higher proportion of uranium-containing material from the Chester Fault zone and less overburden.

The maximum thickness of the IRD is approximately 200 feet at its center, tapering to zero at its edges. As described above, the IRD was constructed by filling in a former valley. The majority of the dump material is unsaturated, but water currently runs along the former drainage beneath the dump. This saturated portion of the dump is approximately five to 20 feet thick, with high water levels reached in the spring during snowmelt. The saturated zone includes water from groundwater discharge occurring from the sides and beneath the dump, as well as rainfall and snowmelt water that percolates in from above (i.e., from the dump surface). A representative cross section of the rock dump, showing the vertical profile along the deepest portion intersecting the valley bottom along the 10300 bench, is shown in **Figure 10**.

Uranium release from this source zone occurs through oxidative weathering of residual uranium minerals present in the overburden rock dump. Just as in the Chester Fault as described above, this may be occurring above the water table (with oxygen exposure and uranium dissolution into water that infiltrates vertically downward and carries uranium down into the saturated zone), within the variably saturated “smear zone” (fully saturated under high-flow conditions and unsaturated under low-flow conditions), and in the continually saturated portions of rock residing in the buried surface water channels. Water levels in wells located on the 10300 bench (**Figure 2-8** below), corresponding to the same wells shown in **Figure 3** and in the cross section in **Figure 10**, demonstrate a sawtooth pattern similar to that observed for the UW/Chester Fault piezometer data. In these wells, seasonal water level rise varies between approximately 3 and 12 feet depending on location within the former drainage, with a greater water level rise observed in relatively wet years (including 2019).

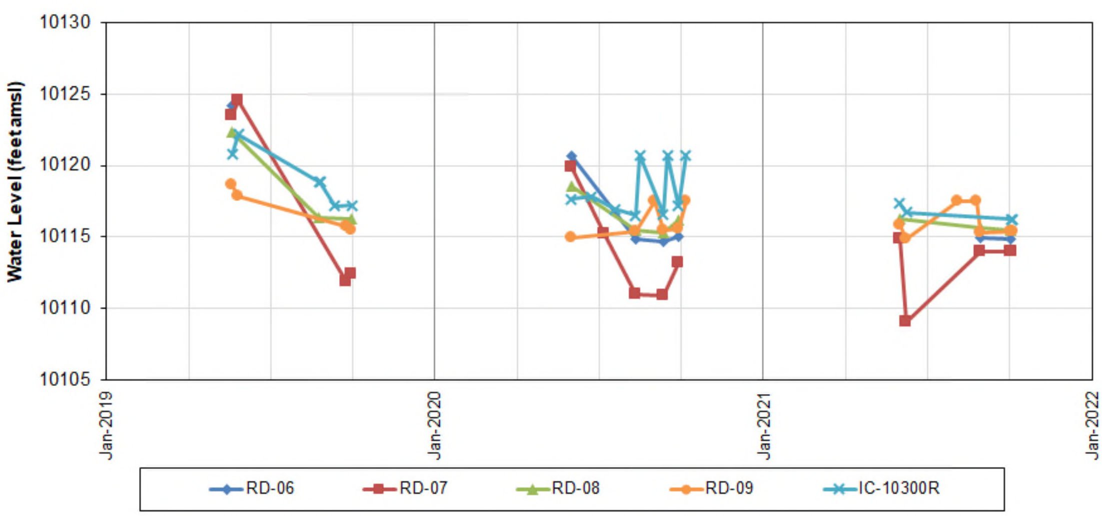


Figure 2-8. Water Levels in 10300-Level Indian Rock Dump Piezometers, 2019 through 2021

This seasonal wet-dry cycling in the smear zone likely increases the oxidative weathering of uranium minerals, particularly in the PMD, which is also located at the bottom of the dump within a former valley and exhibits seasonal saturation. As noted above, water collected from piezometers screened within the saturated portion of the dump indicates uranium concentrations are approximately 1.5 to 3 mg/L. Importantly, some of the water that enters the buried drainage also includes groundwater flowing in from the east from undisturbed portions of the Chester Fault and groundwater moving through the Leadville and Belden units. This groundwater may contain background dissolved uranium (i.e., uranium in solution not associated with mining disturbance).

Uranium loading from the TCRD proceeds according to the same mechanisms at work in the IRD. The majority of the material in this cross-valley-fill dump resides above the saturated zone, but with some saturated rock residing at the bottom of the dump. The uranium source zone includes unsaturated rock that receives rain and snowmelt infiltration, seasonally saturated rock between water table high and low levels, and the continually saturated zone within the former drainage. Water input to the source zone includes water infiltration from above, as well as groundwater inputs from the sides and bottom. Potential localized zones containing rocks with higher uranium concentrations include a low-grade ore stockpile and a CDRMS-approved disposal cell associated with the radium treatment plant removal. However, these potential sources are located on the dump surface (above the water table) and have been capped with sericite (a clay material found locally and stockpiled at the Site). There are no known discrete zones of elevated-concentration rock in the bottom saturated portion of the dump (analogous to the PMD at the bottom of the IRD). Nonetheless, concentrations in piezometers and seeps within the TCRD exhibit uranium concentrations between 1.2 and 6 mg/L. As with the IRD, there is also a high likelihood of elevated background uranium in Belden and Leadville bedrock unit groundwater seepage at the TCRD, particularly in this area since the Chester Fault continues south from the mined areas and extends underneath the upgradient end of the TCRD (**Figure 3**).

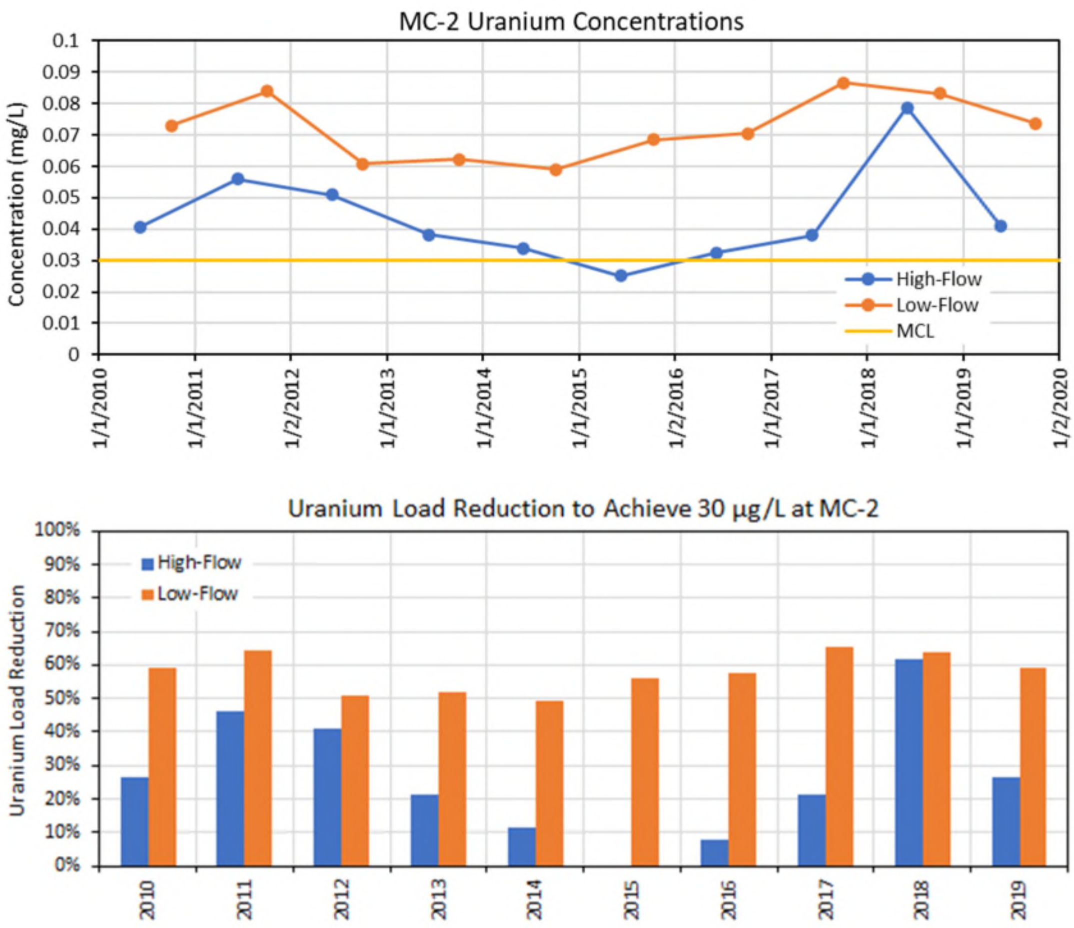
2.5 Anticipated Downstream Effects of Uranium Load Reduction

Reductions in Site uranium that passes through the Outfall would result in a proportional decrease in uranium concentrations downstream in Indian and Marshall Creeks. In this section, we estimate the amount of uranium load reduction that would be required seasonally to achieve the Water Supply Use standard for Marshall Creek.

2.5.1 Comparison to the Marshall Creek Water Quality Standard

HMC has conducted studies on Indian and Marshall Creeks since 2013 to establish how much water is “gained” by the water bodies (by surface water tributaries and groundwater discharge) vs. how much water is “lost” (through groundwater recharge). These studies illustrate that both creeks are primarily gaining between the Site and the town of Sargents. In addition, although the uranium concentration decreases with distance on Indian and Marshall Creeks due to dilution by clean water inputs, the overall uranium mass load (concentration multiplied by creek flow) remains the same. Accordingly, the decreases in surface water uranium concentrations in response to on-site uranium load reduction are expected to be proportional throughout. In other words, the percent uranium concentration reduction observed on Indian and Marshall Creeks would be the same as the percent uranium concentration reduction observed at the Outfall.

Based on an evaluation of Marshall Creek uranium concentration results from 2010 through 2019, HMC estimates that the uranium concentration at the Outfall would need to be reduced by a range of 0 to 62 percent during high flow conditions and 49 to 64 percent during low flow conditions to meet the 0.030 mg/L Water Supply Use standard on Marshall Creek (**Figure 2-9**). This corresponds to uranium concentration reductions at values between 0.37 and 1.1 mg/L under high flow and values between 0.32 and 0.46 mg/L under low flow.[o] These load reduction requirements were estimated based on the actual measured uranium concentrations at monitoring point MC-2 (located on Marshall Creek approximately 200 feet downstream of the confluence with Indian Creek; see **Appendix 1**) compared to the 0.030 mg/L total recoverable uranium standard. Although the required load reduction percentage in 2018 was relatively high, 2018 also was a relatively dry year with a lighter snowpack and lower spring flows (i.e., the overall high-flow uranium load from the Site was relatively low, more closely resembling typical baseflow conditions).



Notes:

MC-2 is the sample location downstream of the Indian Creek confluence.

2018 is excluded due to unseasonably low snowpack and flow.

MCL is the Maximum Contaminant Level, which also corresponds to the Water Supply Use designation on Marshall Creek

Figure 2-9. MC-2 Uranium Concentrations and Uranium Load Reduction that would be Required to Achieve Water Supply Use Standard on Marshall Creek

[o] Note that concentration reductions to these levels may not be consistent with the natural background condition described in Section 2.3.2.

2.5.2 Comparison to a Potential Water Quality Based Effluent Limit

The evaluations described above consider the proportion of uranium load reduction that would be required to meet existing water quality standards for uranium in Marshall Creek.[p] However, these reductions alone would not be sufficient to achieve a water quality-based effluent limit (WQBEL) calculated by the WQCD Permits Unit. Currently, based on the Water Supply Use standard, the WQBEL for Marshall Creek would be 0.030 mg/L, with no available assimilative capacity instream. If the Water Supply Use classification on Marshall Creek were to be removed, the Permits Section indicated, during a meeting with HMC in February 2022, that the water supply standard from the next downstream segment (i.e., Tomichi Creek) may be used to calculate the WQBEL.

To determine the WQBEL for uranium on Tomichi Creek, flow data from USGS Gage Station 09115500 were obtained for a period of record from January 1, 2010, to January 31, 2021.[q] These data were run through the WQCD's DFLOW model (provided directly to HMC by WQCD) to determine the chronic low flow of Tomichi Creek. However, since the gage station is located downstream of the Marshall Creek confluence, and daily flow data for Marshall Creek do not exist, this represents an overestimation of the amount of dilution flow that Tomichi Creek would provide. The chronic low flow was calculated through the DFLOW model to be 12.25 cubic feet per second (cfs). Ambient water quality data for Tomichi Creek was obtained from EPA STORET's 21COL001_WQX station 10305 for a period of record from July 2014 to June 2017, with a total of 10 data points.[r] Because the standard for uranium is based on the total recoverable fraction, the 50th percentile is the statistic that defines ambient water quality, which was calculated here to be 0.012 mg/L.

WQBELs are generated by estimation of a mass balance according to the following equation

$$M_2 = \frac{M_3 Q_3 - M_1 Q_1}{Q_2}$$

where *Q* represents water flow rate and *M* represents in-stream concentration. Quantities with subscript 1 refer to the upstream receiving water (in this case, Tomichi Creek above the confluence with Marshall Creek); quantities with subscript 2 refer to the effluent discharge (Indian Creek at the Outfall); and quantities subscript 3 refer to the downstream receiving water (Tomichi Creek downstream of the Marshall Creek confluence). Specific to the Site, these parameters were assigned the following values:

Q_1 = 12.25 cfs = Upstream low flow (Tomichi Creek).

Q_2 = 4.02 cfs = Total effluent flow (design capacity; permitted Outfall flow rate).

Q_3 = 16.27 cfs = Downstream flow (Q_1 + Q_2).

M_1 = 0.012 mg/L = Instream background pollutant concentrations at the existing quality.

M_2 = Calculated WQBEL.

M_3 = 0.0168 mg/L = Water quality standard, or other maximum allowable pollutant concentration.

Using these values, the WQBEL is estimated to be 0.065 mg/L, noting that the low flow is overestimated at the gage station, since it includes Marshall Creek flows, not just Tomichi Creek; therefore, the WQBEL could be lower.

Ideally, this WQBEL calculation should also account for dilution available in Marshall Creek. However, ambient water quality in Marshall Creek exceeds the water quality standard; therefore, there is no available dilution. Even

[p] Note that Tomichi Creek meets the existing water quality standard under current condition.
[q] Accessed online at: https://waterdata.usgs.gov/monitoring-location/09115500/
[r] Accessed online at: https://www.waterqualitydata.us/

if uranium concentrations on Marshall Creek are reduced, Marshall Creek has a very small low flow above the confluence with Indian Creek (approximately 1 cfs), so assimilative capacity on Marshall Creek is negligible.

Meeting the WQBEL of 0.065 mg/L would require HMC to reduce the uranium concentration at the Outfall by at least 87 percent under high-flow conditions and up to 95 percent under low-flow conditions, based on an approximate SW-33 uranium concentration range of 0.5 to 1.2 mg/L measured since 2020. Given the evidence indicating that concentrations of uranium in Indian Creek were above these concentrations prior to the start of mining in the 1950s (see Section 2.3.2 and **Appendix 2**), achieving this WQBEL at the Outfall would not be sustainable or consistent with the natural, pre-mining conditions. Note that the Permits Unit indicated during the February 2022 meeting noted above that this WQBEL would apply in establishing the Discharge Permit limit (in the absence of a DSV) even though uranium concentrations are already below the established Water Supply Use standard of 0.030 mg/L at all times of the year on Tomichi Creek under current conditions.

3 Water Management Alternatives and Screening Approach

HMC has developed a comprehensive list of potential water management alternatives to reduce uranium loading at the Site, considering both the default required alternatives described in the DSV Guidance and additional alternatives that have been evaluated pursuant to Site and condition-specific considerations. The DSV Guidance mandates that the alternatives analysis should involve testing and evaluation of each alternative according to three overarching parameters: technological feasibility, economic feasibility, and other consequences (the “Feasibility Tests”; CDPHE 2021a). In Section 3.1, we summarize the Feasibility Tests and how each is applied to evaluate the various alternatives. We then present a comprehensive alternatives list in Sections 3.2 and 3.3. In those sections, we set out HMC’s initial screening of the alternatives based on Site applicability and a high-level evaluation of technological feasibility. The alternatives that remain following this initial screening were then subjected to more detailed Feasibility Test evaluations, as detailed in Section 4.

3.1 Feasibility Tests and Application

As outlined in Regulation 31.7(4)(a)[s] and summarized in the DSV Guidance (CDPHE 2021a), the alternatives analysis must include a demonstration of feasibility according to three Feasibility Tests: “Limits of Technology,” “Economics,” and “Other Consequences.” Specifically, these tests are used to determine the need for a variance, but they are also applied to each alternative within an alternatives analysis to identify feasible alternatives. An alternative is deemed feasible if it passes *all three* Feasibility Tests, and an alternative may be deemed infeasible if it fails *any one or more* of the three tests (CDPHE 2021a). In the following subsections, we provide a summary of each test and how it was applied to the alternatives.

3.1.1 Limits of Technology Test

The Limits of Technology Feasibility Test is applied first (Regulation 31.7 (4)(a)(i)(A)). Under the DSV Guidance, the following two factors may be considered to evaluate technological feasibility of each alternative:

1. The technology may be deemed “feasible to implement,” yet meeting the established WQBEL may be deemed “infeasible” if: (a) the technology cannot reliably treat the constituent to the discharge level required, or (b) it involves a new technology or technology developed for a different industry that has not yet been sufficiently demonstrated in the proposed application.
2. The technology is “infeasible to implement” based on site-specific factors that preclude effective installation or functioning.

The first factor above is applied to determine whether a DSV is needed (DSV Guidance, Section V.A). Specifically, if no feasible alternatives are identified to meet the anticipated WQBEL, then the DSV may be advanced for CDPHE approval (with a proposed AEL to replace the established WQBEL). Otherwise, if alternatives do exist that would simultaneously meet the WQBEL while also passing the other Feasibility Tests, then a DSV would not be required (DSV Guidance, Section V and Regulation 31.7 (4)(a)). Where meeting a WQBEL is not possible, then the AEL must represent the highest degree of protection of the watershed that is feasible within a 20-year timeframe. This timeframe in turn promotes a hybrid standard by which a discharger can

[s] https://cdphe.colorado.gov/water-quality-control-commission-regulations

meet the Clean Water Act's long-term water quality goal of fully protecting all designated uses of the receiving water body, while temporarily authorizing a Site and pollutant-specific variance (CDPHE 2021a). As noted in Section 2.5 above, under the circumstances, one can characterize meeting water quality requirements as achieving established surface water quality standards. This could either be interpreted as Marshall Creek having water quality that meets the Water Supply Use standard (which would require reducing the uranium concentration at the Outfall by up to 64 percent depending on time of year) or meeting a potential WQBEL to be assigned as the Discharge Permit limit at the Outfall (which could require up to a 95-percent concentration reduction at that outfall). Note that Marshall Creek itself meeting the water supply standard would not result in a permit limitation that could be met at the outfall based on Permit Section practices.

CDPHE sets out several factors in the DSV Guidance that might influence whether it is feasible to implement an alternative (DSV Guidance, Section V.A). Some of these factors that are potentially applicable to the Site include, but are not limited to: an alternative's incompatibility with the wastewater matrix and/or existing treatment, facility size, water retention time (analogous to the hydraulic retention time, as defined herein), existing and potential new treatment processes, seasonal/variable influent water quality and quantity, land availability, topography, climate, site access, local land use concerns, and generation of sludge/biosolids relative to disposal/beneficial reuse options. HMC interprets "sludge/biosolids" to include a large variety of treatment solids applicable to the alternatives we describe in this Report, including (but not limited to) biochemical reactor media, IX resin, and mineral precipitates formed during water treatment (including phosphate precipitate solids and well rehabilitation solids).

Although many of these factors may be more relevant to some alternatives than to others, factors such as land availability, site access, topography, and climate are critical at the Site and affect consideration of each of the alternatives that HMC considered.

Based on the site-specific factors described below, HMC's Limits of Technology evaluation assumes the following constraints, which correspond to essential ambient Site conditions:

1. The alternative must be implemented, operated, and maintained with little-to-no winter access, because system operation and maintenance requiring frequent and routine winter access is not feasible.[t]

Primary access to the Site is via Marshall Pass Road, which is owned by the USFS. An access road, located primarily within the Reclamation Permit boundary, connects Marshall Pass Road to the Site. Minimal access to the Site is maintained throughout the year to facilitate sampling and Site maintenance. Although vehicle (car or truck) access is possible from late spring through early fall, winter access is typically limited to snowcat and/or snowmobiles due to the high elevation (over 10,000 feet above sea level) and heavy winter snowpack. Winter Site activities are typically limited to water quality sampling. Winter access can be unreliable: severe storms and avalanche danger often restrict access and present possibly significant safety risks. Accordingly, one cannot rely on routine access in the winter for system operation and maintenance or otherwise.

2. Activities and infrastructure associated with the alternative must be contained within the existing HMC private property boundary.

As described above in Section 2, the Site and associated disturbances are contained within private property owned by HMC, which is surrounded on all sides by USFS property. HMC assumes for the purpose of this evaluation that uranium load reduction alternatives, particularly those involving land disturbance, installation of

[t] Throughout this document, the "active field season" is used to refer to the time period from June through October when the Site can be relatively easily accessed by truck.

water treatment infrastructure, and/or long-term water treatment and treatment byproduct generation and management, cannot be conducted off site on USFS land. HMC assumes that this restriction on activities applies to off-property areas even if they are within the CDRMS Reclamation Permit boundary (described in Section 2.1 and shown in **Figure 2**), because the Site's permitted area is predominantly on USFS property, and the intention is to release this property from the CDRMS Reclamation Permit as part of the reclamation plan.

3. The alternative does not require lined connection to a power grid.

The Site, due to its remote location, is not connected to any public utilities, including electric power. Although HMC currently operates small, low-power systems on site using a combination of solar and propane/gasoline generators, and the Site presents some opportunity for limited hydroelectric power, larger-scale water treatment systems require larger power demands that cannot be met. A conventional, local power utility connection to the Site does not exist, and making such a connection would be unduly challenging due to the remote location and distance from the Site to the nearest distribution point. Moreover, installation of a power line would require installation of approximately 15 linear miles of infrastructure, requiring deforestation and other disturbance of USFS property. In addition, bringing permanent line power to the Site is contrary to the objectives of ultimately closing the Site pursuant to CDRMS regulations. Therefore, HMC evaluated alternate power sources for water management alternatives, as set out in Section 4, but any alternative requiring line power is considered technologically infeasible.

3.1.2 Limits of Economy Test

The Limits of Economy Feasibility Test also may be applied to each alternative to determine feasibility (Regulation 31.7 (4)(a)(i)(B)). According to the DSV Guidance, an alternative may be deemed economically infeasible if the cost of the alternative has either a "substantial" or "widespread" impact, according to the following two factors:

1. Costs may be considered to have "substantial" impacts if they affect an organization's ability to continue operations; and
2. Costs may be considered to have "widespread" impacts depending on how they affect stakeholders in the surrounding communities.

As formulated in Regulation 31.7 and in the DSV Guidance, the economic feasibility test is most applicable when community taxpayers or small businesses are responsible for financing an alternative. No entity other than HMC would be responsible for financing any alternative. Accordingly, HMC has chosen not to apply the Limits of Economy Feasibility Test to evaluate the feasibility of the alternatives in this Report. However, this Feasibility Test may be considered in a future update to this Alternatives Analysis.

3.1.3 Other Consequences Test

The Other Consequences Feasibility Test (Regulation 31.7 (4)(a)(i)(C)) considers whether implementation of the alternative would result in negative impacts that outweigh the benefits of that alternative; for example, this Feasibility Test asks whether the alternative would negatively affect human health and the environment more than maintaining current water quality.

HMC considered a number of Site-relevant factors that inform the Other Consequences test (discussed in more detail in Section 4), including the following:

- The potential for generation of treatment byproducts that themselves increase the possible risk that HMC would exceed downstream water quality standards;
- The potential for generation, transport, disposal, and long-term management of concentrated radiological waste, which is considered a licensed radiological material under the Site radioactive materials license (CDPHE RML 150-01), and that would increase the environmental, health and safety risk profile of an alternative (e.g., concentrated radiological waste could be a potentially greater health and environmental hazard than the dilute uranium currently in surface water) or result in long-term sustainability challenges; and
- The potential for resource consumption and greenhouse gas (GHG) and other air emissions, which would increase as greater levels of effort and energy are required to implement and operate an alternative.

Arcadis used the program SiteWise Version 3.2 (U.S. Navy 2018) to quantitatively estimate environmental footprints. The SiteWise software was developed jointly by the United States Navy, the United States Army Corps of Engineers, and Battelle (a science-and-technology company) as a tool for estimating environmental footprints for remedial alternatives, and it is currently an industry-standard tool for this application. In this evaluation, the tool was used to evaluate the following environmental and sustainability metrics:

- Greenhouse gas (GHG) generation;
- Criteria air pollutants including sulfur oxides (SO_x), nitrogen oxides (NO_x), and particulate matter (PM); and
- Energy consumption.

The analysis accounts for material manufacturing, construction, operation, transportation, and waste generation and disposal for each alternative. The values generated using SiteWise were used comparatively to evaluate the relative environmental footprints for alternatives over 20-year and 100-year timeframes.

One of the specific challenges presented by each water treatment alternative is that any water treatment residuals or waste products (e.g., sludge/solids, spent treatment media, brines, etc.) that uranium treatment generates at the Site are regulated under the RML. Generally, solids at the Site may be considered “licensed material” if they contain natural uranium in concentrations above the Source Material licensing threshold of 339 pCi/L or 500 milligrams per kilogram (mg/kg). However, the CDPHE Hazardous Materials and Waste Management Division (HMWMD) Radioactive Materials Unit has recently clarified that RML 150-01 for the Site should be interpreted to mean that, from 2022 onward, and specifically as it relates to any full-scale water treatment remedy, <u>any</u> waste products generated via water treatment at the Site are considered licensed material, regardless of the uranium content (**Appendix 4**). HMWMD has further clarified that such licensed waste products cannot be disposed of on site and must be sent to a licensed radiological waste disposal facility, noting that there are currently no such facilities in the State of Colorado that can accept waste above Source Material limits (CDPHE 2007).[u]

[u] Section 1.1 of the Interim Policy and Guidance Pending Rulemaking for Control and Disposition of Technologically-Enhanced Naturally Occurring Radioactive Materials [TENORM] In Colorado (CDPHE 2007) specifically confirms that “In some cases, there are no easy answers for safe, economical disposition. Disposal of most commercial low-level radioactive waste (LLRW) is prohibited in Colorado. One Colorado facility is licensed to accept a subset of low-level radioactive waste (LLRW) that is limited only to TENORM.” Although the guidance does not specifically state as much, it is assumed that the guidance is referring to the Clean Harbors facility in Deer Trail, Colorado. This interim guidance has since been superseded by the Guidance for Implementation of the Final Rule, “Registration and Licensing of Technologically Enhanced Naturally occurring Radioactive Material (TENORM)” 6 CCR 1007-1 Part 20 (CDPHE 2021b). However, this updated guidance remains silent on the subject of in-state disposal of radiological waste, while further clarifying that “Source materials (uranium or thorium)” are not considered TENORM under Colorado regulations.

For example, Clean Harbors in Deer Trail, Colorado is a hazardous waste facility that is licensed to accept low-level radioactive waste, but it places strict upper limits on radionuclide content and cannot accept materials with uranium above the 500 mg/kg limit. Accordingly, any waste products that HMC generates through a water treatment alternative must be collected and disposed of outside of Colorado at a licensed facility. Currently, two facilities in the United States accept this type of waste: Energy Solutions in Clive, Utah, and Waste Control Specialists in Andrews County, Texas. Facilitating waste transportation to and disposal at these locations requires regulatory coordination including, but not limited to:

- Acquiring a Rocky Mountain Low-Level Radioactive Waste Board (RMLLRWB) permit to export licensed material waste outside of Colorado. Fees for this permit are based on the volume of licensed material being sent to the disposal facility;
- Adhering to DOT Class 7 special packaging and shipping requirements; and
- Engaging waste “brokerage” services conducted by the waste disposal facility and/or affiliates of the facility to ensure waste is packaged, screened, and transported to the disposal facility in a manner that meets state, federal, and local-landfill regulations.

Further, transportation of the waste from the Site to a licensed disposal facility could increase the environmental, health and safety-risk profiles for the communities located along the transportation routes and might have environmental-justice implications. HMC has used EPA’s Environmental Justice Screening Tool to assess and generate reports for those communities along the transportation route(s).

3.2 Default DSV Alternatives

The DSV Guidance sets out 15 alternatives that a DSV applicant must consider when developing the site-specific list of water management alternatives. Of these, HMC screened out eight of these as either technologically infeasible or inapplicable to the Site and carried forward the remaining seven onto the site-specific alternatives list presented in Section 3.3. The CDPHE-requested alternatives and results of the screening are provided in **Table 3-1**, including a note on whether the alternative was retained (i.e., kept for additional evaluation later in the Report).

Table 3-1. DSV-Provided Alternatives Screening

Implementation Strategy (Provided Verbatim and Numbered According to the DSV Guidance)	Retained?	Basis
1. Alternative locations for the discharge including moving the outfall to a water body with more assimilative capacity.	No	Moving the outfall to Marshall Creek would require a 4-mile pipeline through mountainous terrain, and due to the low flow and ambient water quality, this would not make a difference in the ability to meet a permit limitation for uranium. There would be no change to instream concentrations. Moving the discharge to Tomichi Creek would require the same 4-mile pipeline, plus an additional 9 miles of pipeline across private property. As shown in Section 2.5.2, this also would not result in a limitation that could be met. Although this would bypass Marshall Creek, and therefore improve conditions on Marshall Creek, it would not reduce the uranium loading to Tomichi Creek.
2. Consolidation with other wastewater treatment facilities.	No	The nearest wastewater treatment facility is located in the city of Gunnison, over 40 miles downstream. Even if it were feasibly located, although there would be additional dilution available on the Gunnison River, that facility would experience the same difficulties in managing and disposing of solids.
3. Reduction in scale of the proposed discharge or activity.	No	Not technologically feasible. The scale (i.e., the flow rate) of the discharge through the Outfall is outside of HMC's control, because naturally occurring hydrologic inputs from groundwater discharges and surface-water drainage features across the Site make up the flow. Even if flows could be managed, there would be little if any influence on WQBELs and the ability to meet permit limitations.
4. Water recycling measures within the facility.	No	There is no consumptive water use at the Site and therefore no opportunity for recycling. Additionally, any water that is kept on Site would be subject to replacement due to downstream water rights issues.
5. Reclaimed water use (see Regulation 84).[v]	No	There is no consumptive water use at the Site and therefore no opportunities for reclaimed water use. Additionally, any water that is kept on site would be subject to replacement due to downstream water rights issues.
6. Process changes, raw material substitution, or alternative technology that could minimize the source of the pollutant.	Yes	Inapplicable with respect to production or existing water-treatment facilities, which do not exist at the Site. The sources of the uranium include both undisturbed and disturbed areas containing naturally occurring uranium and are not the result of currently active mining operations. This alternative is applicable and retained for further screening with respect to *in situ*/source-load reduction strategies and infiltration management, including:

[v] https://cdphe.colorado.gov/water-quality-control-commission-regulations

Implementation Strategy (Provided Verbatim and Numbered According to the DSV Guidance)	Retained?	Basis
		• *In situ* passivation/treatment • Source removal (mining) • *In situ* stabilization/grouting • Selective lining to minimize water infiltration
7. Standard treatment methods.	Yes	Alternative is applicable and retained for further screening with respect to surface water/shallow groundwater treatment downgradient of Pitch source zones: • Engineered treatment cells/reactive barriers • Standard water treatment (e.g., chemical precipitation, ion exchange (IX))
8. Innovative or alternative methods of treatment and advanced treatment including new designs, stages, components, capacity for treatment plant replacement, or upgrades of current plant.	No	There is no current treatment other than a sediment pond for removal of suspended solids. Upgrading or optimizing the sediment pond to provide additional treatment would not be effective, since the total recoverable uranium at the Outfall is primarily in the dissolved form. Building new treatment on site is limited by space, lack of power, and reclamation activities.
9. Improved operation of existing facilities to maximize treatment or removal of the pollutant.	Yes	Alternative is applicable and retained for further screening with respect to physical water management alternatives (many of which have already been implemented), including: • Segregation of impacted vs. unimpacted surface water streams • Limiting infiltration into source zones (i.e., “keeping clean water clean”)
10. Seasonal or controlled discharge options to minimize discharging during critical water quality periods.	No	This strategy is not effective or applicable at the Site, as there is no dilution capacity in downstream Indian and Marshall Creek segments. The low flow for Indian Creek is considered to be zero for all months as Indian Creek is considered to start at the discharge point.
11. Watershed trading.	No	Not applicable. Would not result in a change of uranium loading to surface water at the Site, and no options exist for upstream trading partners.
12. Land application of wastewater.	No	Not technologically feasible. Hydrologically impractical to reduce surface-water flow because surface-water flows include significant groundwater discharge (i.e., any land-applied water that finds its way underground would ultimately flow back to surface water). Would not result in a change of uranium load discharging from the Site. Additionally, there may be water rights impacts associated with this option.
13. Total containment of wastewater.	Yes	Although this option would likely be considered infeasible based on water rights concerns, this alternative is retained for further screening with respect to active water treatment via evaporation.
14. Any other alternative to minimize the effects of the proposed discharge or activity.	Yes	Alternative is applicable and retained for further screening within the Maintain Current System alternative set out below. This

Implementation Strategy (Provided Verbatim and Numbered According to the DSV Guidance)	Retained?	Basis
		alternative would involve continuing to ensure that uses of downstream waterways (Indian and Marshall Creeks) are protected.
15. No action (maintain status quo).	Yes	Alternative is applicable and retained for further screening under two separate alternatives: • Maintain Current System • No Further Action

3.3 Site-Relevant Alternatives and Initial Screening

HMC has developed a list of Site-specific water management/treatment alternatives based on Site knowledge regarding uranium sources and uranium release mechanisms, known technologies for uranium treatment and/or uranium load mitigation, and the required DSV alternatives outlined in **Table 3-1**. In this section, we present a summary of the Site-relevant alternatives that HMC considered, grouped into the following categories:

- Status quo;
- Source load reduction;
- *In situ*/downgradient water treatment;[w]
- *Ex situ* water treatment; and
- Physical water management.

The full list of potential uranium load reduction alternatives that HMC considered for the Site is provided in **Table 3-2** below, followed by the results of an initial high-level screening conducted to focus and refine the list of alternatives for more in-depth analysis, as set out in Section 4. During this initial screening, many of the alternatives listed in **Table 3-2** were screened out if one of the following two conditions was met:

- The alternative is infeasible based on relatively simple or obvious technological feasibility considerations; and
- The alternative is similar to but inferior to another alternative or alternatives that HMC has chosen to retain as an option.

The results of this preliminary screening are provided below, focusing on the rationale for removing alternatives from further consideration. The alternatives that HMC retained for further analysis are described in more detail in Section 4.

[w] In this context, "*in situ*" treatment remedies involve treatment in the ground within the uranium source zone, but may also include belowground treatment downgradient of source zones. "*Ex situ*" treatment refers to aboveground downgradient treatment of water after uranium-impacted groundwater has expressed to the surface.

Table 3-2. Alternative Technology Categories

Alternative Category	Water Management Alternative	Retained?
Status Quo	- No Further Action	Yes
	- Maintain Current System	Yes
Source-Load Reduction	*Geochemical stabilization*	
	- Passivation with phosphate injection ("oxic" approach)	Yes
	- Organic carbon/chemical reductant injection ("reducing" approach)	No
	Source material removal	
	- Source removal via mining	Yes
	- Source removal with on-site disposal	No
	In situ physical stabilization/bypass	
	- Physical mixing of permeability reducing material	No
	- Injection grouting	Yes
In Situ/Downgradient Water Treatment	- Surface water (NPL or Sediment Pond) chemical precipitation	No
	- Permeable reactive barriers	No
Ex Situ Water Treatment	*Semi-Active Technologies*	
	- Ion exchange (IX)	Yes
	- Solid-reagent biochemical reactors	Yes
	- Aqueous-reagent biochemical reactors	Yes
	- Abiotic/chemical sorption engineered treatment cells (ETCs)	Yes
	Active Technologies	
	- IX	No
	- Biochemical fluidized-bed reactor	No
	- Chemical precipitation	No
	- Evaporation pond	No
	- Reverse osmosis	No

Alternative Category	Water Management Alternative	Retained?
Physical Water Management	*Uranium Load Segregation/Clean Surface Water Diversion*	
	- Rock dump toe drains	Yes
	- Chester Fault seepage capture	Yes
	- North Pit diversion and rock dump channel upgrades	Yes
	Infiltration Management	
	- Rock dump/underground workings cap/cover	No
	- Groundwater diversion walls	No
	- Rock dump channel upgrades/selective lining	Yes
	Source Zone Water Management	
	- Drain and backfill North Pit Lake	No
	- Increase NPL capacity	No
	- Drain underground workings	No
	- Deep well injection	No

3.3.1 Status Quo

To date, HMC has invested significant time and resources into Site improvements to achieve closure and reclamation objectives and to investigate uranium load reduction BMPs, including improvements that may require some future maintenance. Accordingly, maintaining the "status quo"—meaning, generally, the state of the Site as it exists today—may actually take on different meanings depending on the extent to which these systems are maintained. "No further action" assumes no maintenance of existing improvements or continued Site monitoring is required, as the systems are assumed to be permanent in nature. The Maintain Current System status quo alternative is similar to the No Further Action alternative but includes monitoring and maintenance of the existing systems until it can be demonstrated that the systems are permanent in nature and require no additional maintenance to sustain the observed water-quality improvements they provide. HMC retained both alternatives ("no further action" and "maintain current system") for analysis, and they are discussed further in Section 4.

3.3.2 Source Load Reduction

Source load reduction involves reducing or eliminating the continued release of uranium at the Site, which occurs when uranium in solid form is released into solution on contact with water in the uranium source zones. This reduction or elimination of the uranium dissolution reduces the amount of uranium discharging to Site surface water. Generally, this may be accomplished in two ways: either (1) by physically removing or stabilizing the source of the uranium load, or (2) by leaving the uranium in place but passivating (i.e., coating, armoring, or occluding) mineral surfaces to minimize continued release of uranium into solution. Of the uranium load reduction strategies, source load reduction is more sustainable than downgradient water treatment options because source load reduction would not need to be conducted in perpetuity. That said, source load reduction alternatives can be among the most difficult remedies to successfully implement, given the depth and widespread distribution of the sources of uranium at the Site, as described above in Section 2.

HMC considered the following six source-load reduction alternatives, representing variations on three general strategies:

1. Chemical injection: *In situ* geochemical passivation using phosphate;
2. Chemical injection: Uranium reduction and mineral stabilization using dissolved organic carbon and/or a chemical reductant;
3. Source material removal by uranium ore extraction via mining;
4. Source material removal by excavation, followed by on-site disposal;
5. *In situ* physical stabilization: Physical mixing; and
6. *In situ* physical stabilization: Injection grouting.

Of these six, HMC has retained alternative options 1 and 3 for further evaluation, which we discuss later in Section 4.

Alternative options 2, 4, 5, and 6, on the other hand, have been screened out and rejected based on the rationale provided below.

Source Load Reduction Option # 2, Chemical injection of organic carbon and/or chemical reductant: Rejected

Uranium minerals at the Site occur within fractured bedrock and mining overburden materials primarily containing the U(IV) minerals uraninite (uranium oxide) and coffinite (uranium silicate; Nash 2002). Although uranium in the +IV oxidation state is insoluble, release of uranium into solution may occur via oxidative dissolution of U(IV) minerals, yielding the more soluble U(VI), which is present in solution as the uranyl ion (UO_2^{2+}). Any *in situ* chemical stabilization alternative therefore could either take the form of a "reductive approach" in which uranium is stabilized as U(IV) to prevent dissolution, or it could take the form of an "oxic approach" in which uranium is stabilized in the U(VI) form. Additional details on uranium redox chemistry and mineral dissolution/precipitation are provided in Section 2.4.2.

Of these two approaches, HMC screened out the reductive strategy based on both technological infeasibility and because it is redundant with the oxic strategy. A reduction-based approach to *in-situ* stabilization presents possible high risk for failure because there is long-term potential for reoxidation. At present, uranium release into solution within the source zones results from the introduction of oxygen that causes oxidative dissolution of reduced-phase minerals (see Section 2.4.2). The oxic approach (involving injection of soluble phosphate and discussed in more detail in Section 4.4) effectively accomplishes the same goal using nearly identical implementation infrastructure (i.e., reagent dosing systems, injection/extraction wells, pumps, and piping), while presenting a likely lower long-term risk of uranium re-release. Meanwhile, the technological limitations of the phosphate injection strategy (Option #1, which was retained and is discussed in Section 4.4) would not be overcome by switching to a reducing strategy. The *in-situ* reducing approach was therefore screened out in favor of the oxic approach.

Source Load Reduction Option # 4, Source material removal with on-site disposal: Rejected

Given the extreme depth (between 100 and 300 feet below the ground surface), spatial distribution, and material volumes of uranium at the Site, physical removal of the residual uranium sources would require extensive land disturbance, earth movement (and the associated carbon footprint), and cost. The level of effort would be akin to reopening the Site and actively mining it. Therefore, actually mining the Site to extract the remaining uranium would better offset the extremely high level of physical disturbance and associated energy requirements and waste production that would be required under this alternative than the alternative itself.

Restarting mining operations at the Site remains technologically feasible and would focus on the remaining ore-grade resource present within the Chester Fault fractured zone. Processing the mining overburden rock in the existing dumps is not technically feasible, however, due to the diffuse and low-concentration nature of the uranium in this material, although opening the Site to mining would likely provide opportunity to optimize mining overburden rock management. This could be palatable to HMC and others if doing so would not create major onsite disposal or stabilization issues following excavation. In contrast, onsite disposal of excavated ore-grade material along with mining overburden, given the volumes of material that would be displaced, would require substantial additional land disturbance, overburden rock-dump permitting and lining/capping, and associated challenges to achieving ultimate closure and reclamation. Therefore, although HMC has retained the “mining” alternative, which we discuss further in Section 4.3, the alternative of source material removal with onsite disposal is screened out here as both redundant with and much less favorable than mining.

Source Load Reduction Option # 5, In situ stabilization/permeability reduction via physical mixing: Rejected

Physical *in situ* soil stabilization involves introduction of a permeability reducing material (e.g., clay or cement) via mechanical mixing. While this is technologically feasible for relatively shallow source materials, *in situ* physical stabilization at the Site would involve challenges similar to those associated with physical source removal. The only feasible approach for achieving mechanical mixing in source zones at the Site based on currently available technologies would involve full excavation of all of the uranium contained in the source zones, crushing that rock/ore into a mixable consistency, mixing that with clay or cement at the surface, and then placing that mixture in the holes created by excavation. Although methods exist for mechanical *in situ* soil stabilization using large augers (which can mix low-permeability mixtures directly in the ground with less excavation), such auger technologies are not feasible at the Site due to the depths, volumes/lateral distributions, and fractured-bedrock nature of the uranium source zones at the Site. Because physical mixing would involve levels of land disturbance and excavation similar to or greater than those associated with source material removal, HMC removed this alternative from consideration as a redundant-but-inferior alternative to physical removal. HMC retained the less-invasive approach to *in situ* stabilization involving injection grouting, which we discuss in Section 4.

Source Load Reduction Option # 6, In situ stabilization/permeability reduction via injection grouting: Rejected

In situ stabilization via injection grouting is a technique commonly used to reduce permeability in contaminant source areas to reduce the mobilization of contaminants. Grout is injected directly into the subsurface as a cement slurry to fill pore space and reduce permeability. When the grout solidifies, its presence reduces water flow through the contaminated area. Although injection of the grout fills pore space, some voids in the grouted region may remain. Thus, grout injection does not create a completely impermeable monolith, but would be expected to substantially reduce the flux of water through the contaminated zone (Truex et al. 2011).

When designing an injection grouting approach, there are two major factors to consider: (1) the selected grouting agent and (2) the grout placement method. Various cement- and chemical-based grouting materials are available.

Injection grouting would target the UW, IRD, and/or TCRD source zones. For *in situ* stabilization of these zones, an acrylamide chemical grout likely would be most appropriate. It has a lower viscosity (resistance to flow) and greater flexibility for solidification time relative to other cement- or chemical-based grouts. Acrylamide grouts solidify through polymerization reactions, so the reaction time varies based on how the grout is formulated to increase solidification times up to a few hours (Truex et al. 2011). Relatively lower viscosity and longer solidification time can yield greater distribution of the grout within subsurface areas after it is injected.

Jet grouting and permeation grouting are two widely used methods for grout placement. Jet grouting is the high-pressure injection of cement grout to promote immediate distribution within the subsurface. Permeation grouting is injection of a liquid grout that seeps into void spaces before solidifying to form a solid matrix. Jet grouting is a well-established technology for shallow subsurface stabilization, in which pressurized injection of cement can cause physical displacement of unconsolidated soil or sediment, resulting in physical mixing. Permeation grouting (which does not rely on physical displacement or movement of the soil/sediment) can be used to distribute grout more broadly at greater depths (Truex et al. 2011); this would be the more appropriate method at the Site, given the depth of uranium source zones. Typically, grout would be injected into the subsurface under pressure with a vertical push probe, with lances on injection push rods that can provide openings for grout flow over a selected interval (Moridis et al. 1999). However, this approach would not work well for injection into the fractured bedrock at the UW or in rock dump material, given the depths involved. Typically, users make multiple overlapping injections over a given area to target the source zones.

HMC has determined that injection grouting is infeasible due to the depth, spatial extent, and diffuse nature of the complex source zone environment, which cannot be fully accessed with injection-based technologies. Although injection grouting has not been tested at the Site, the results of extensive aqueous injection testing at the Site inform the technical feasibility of grout injecting. Achieving widespread distribution of injectate into the complex fracture zones of the UW and the partially saturated zones of the rock dumps has proven to be infeasible, as outlined further in Section 4.4.2 below. The viscosity of the aqueous phosphate injection solution is approximately 1 centipoise (cP). The aqueous-injection solution was injected over months to achieve distribution. Nonetheless, even though HMC injected a low-viscosity solution, and had the advantage of long diffusion times to distribute the dissolved reagent, reagent distribution through source zones was insufficient to achieve significant downstream uranium load reduction.

For comparison, the acrylamide grout that would be used for injection grouting can be formulated to initial viscosities as low as 1 to 2 cP, and for solidification times up to 1 hour (Guyer et al. 2015). But HMC anticipates that the challenges to adequate grout distribution into source zones would be even greater than those associated with distribution of a dissolved reagent (as employed with phosphate injections). For example, because the solidification time of acrylamide grout is approximately 1 hour, this would mean that an extremely small radius of influence (i.e., lateral distribution away from the injection point) would be achieved upon injection (particularly with increasing viscosity as the grout cures). Therefore, an injection well network far denser than the one used for phosphate injection would be needed. Moreover, as noted above, the direct-push approach is not expected to be viable at the 100- to 300-foot source zone depths involved, and particularly in fractured bedrock. Based on the limited extent to which aqueous injections at 1 cP were effective, HMC concludes that the source zones are not compatible with distribution of higher-viscosity, faster-reacting injection grout. Therefore, HMC concludes that this alternative is technologically infeasible.

3.3.3 In-Situ/Downgradient Water Treatment

In situ/downgradient water treatment can in principle be a passive, low-energy means of achieving water treatment at remote sites. However, the perceived advantages of *in situ* water treatment must be weighed against practical limitations to its sustainability and long-term feasibility. Specifically, at the Site, there are two complications that significantly limit the practicability of *in situ*/downgradient water treatment:

1. Water treatment residuals and waste products, including sludge and spent treatment media, are considered licensed material under the Site RML. As described in Section 3.1.3, these materials cannot be legally disposed on site or anywhere in the State of Colorado and must be sent to an out-of-state licensed facility.
2. If not coupled with a true source load reduction strategy (as discussed in Section 3.2.2), any water treatment approach (whether *in situ* or *ex situ*) would effectively require treatment in perpetuity (or until source loads of uranium attenuate/dissipate to levels suitable for discharge).

Based on these limitations, the *in situ*/downgradient options that HMC considered for the Site offer no real advantages over *ex situ* water treatment. Specifically:

- Chemical precipitation within on-site water bodies (such as the NPL or Sediment Pond) is technologically feasible but offers no practical advantage over an *ex situ* engineered chemical-precipitation system. An engineered aboveground system, despite requiring more extensive infrastructure, would provide more flexibility and options for collecting and handling licensed waste products.
- *In situ* permeable reactive barriers, while passive, offer no practical advantage over aboveground engineered treatment cells (described in Sections 3.3.4 and 4.7). If HMC were to implement in-ground reactive barriers, these barriers would need to be filled with reactive media that would remove uranium from solution. The treatment media that HMC considered and tested at the Site for the aboveground engineered treatment cells (ETC) would be the same media that would be used in the in-ground reactive barriers. In other words, the treatment technology is the same in both cases; the difference is simply whether the treatment cell has water piped into it (as with an ETC) or whether the treatment cell is placed in the ground in the path of groundwater flow (the in-ground reactive barrier). In-ground reactive barriers have a finite lifetime and would require changing the barrier media when it is exhausted. Although this is also true for aboveground ETCs, the aboveground configuration provides a simpler and more-efficient means of media exchange/replenishment, particularly given the complexities of handling and disposing of licensed material. In addition, due to the extensive topographic relief at the Site, aboveground engineered treatment cells can be operated through gravity flow equally as well as an in-ground barrier could.

For these reasons, HMC has rejected *in situ*/downgradient water treatment options that do not include a source load reduction component in favor of *ex situ* water treatment.

3.3.4 *Ex Situ* Water Treatment

HMC sorted alternatives for *ex situ* water treatment into the categories of “active” and “semi-active,” depending on the level of power and active operation required for each water treatment option. Specifically, for the purposes of this evaluation, the most distinguishing feature between active and semi-active water treatment technologies is whether actively pumping water is necessary. Active water treatment technologies generally require a continual (daily) operator presence and relatively high power demands, in large part due to the need to pump water through the treatment system. In contrast, the semi-active *ex situ* treatment alternatives that HMC considered can (at least in principle) be operated by using the hydrostatic pressure created by gravity, as driven by the significant topographic relief at the Site. Although semi-active *ex situ* options can be operated under “passive” flow conditions, such alternatives are not truly passive because they require regular maintenance (weekly to monthly, but not daily), monitoring, and adjustments, and may still require low levels of power for ancillary systems (such as remote monitoring/data logging, heating, and lighting).

We describe the active and semi-active water-treatment alternatives that HMC considered for the Site in more detail below.

3.3.4.1 Active *Ex Situ* Water Treatment

HMC evaluated five active *ex situ* water-treatment technologies:

1. Ion Exchange (IX);
2. Biochemical fluidized bed reactor;
3. Chemical precipitation;
4. Reverse osmosis; and
5. Evaporation pond.

Each of these technologies is demonstrably effective for treating uranium in traditional water treatment applications and is capable of very high uranium removal capacities. However, HMC ultimately considers none of the active *ex situ* water treatment options technologically feasible for the Site due to high power requirements that would require line power to work and to make them sustainable.

The technological feasibility evaluation first considers the possible technologies with respect to one another. Of the five alternatives HMC considered, IX presents significant implementation and operational advantages over the other four with respect to power demand, waste generation, hydraulic retention time, and effluent water quality. As we describe further in Section 4.7, IX has been tested extensively at the Site and has demonstrated the capability to remove more than 99.9 percent of uranium from Site surface water run through the treatment system. On this basis, HMC rejected the other four potential remedies at this stage as redundant-and-inferior alternatives to IX. We discuss further details about the technical challenges of these four options below. We then set out HMC’s evaluation of the technological feasibility of IX as part of a water treatment system dependent on actively pumping water.

Active Ex Situ Water Treatment Option #2, Biochemical fluidized bed reactor: Rejected

A biochemical fluidized bed reactor removes dissolved uranium from water. The technology employs active microbial reduction via supply of an electron donor (typically a soluble organic carbon substrate), resulting in the reductive precipitation and removal of uranium from solution. In other words, U(VI) is reduced to U(IV). The donated electrons transferred to the uranium (see Section 2.4.2) come from the organic carbon, resulting in oxidation of the organic carbon to carbon dioxide through a process that is facilitated by bacteria. The rate and extent of this microbial reduction are optimized through a highly engineered process involving a high-surface-area substrate to which the microbes attach. Fluidization of the media bed enhances water contact with the biofilm-coated media, increasing the rate of microbial reduction. In other words, the speed at which the uranium reduction occurs is increased when there are more microbes in the water. Adding solid surfaces onto which the microbes can attach and grow, and then suspending those solids in the water to distribute the microbes throughout the solution, can speed up the process.

At best, this technology would be expected to remove uranium to levels similar to those associated with IX. Disadvantages of this technology relative to IX, however, include the following:

- A greater level of operator involvement and maintenance is required because active operation and monitoring would be necessary to maintain optimal organic carbon dosing, water recycling ratios, and bed fluidization;
- Power requirements would be significantly higher than for IX; and
- The addition of organic carbon and nutrient substrates presents the potential for creation of undesirable byproducts (such as excess residual nutrients and increased biochemical oxygen demand) in the treated effluent water flowing out of the system, which would require additional management or treatment.

HMC therefore rejects this option as inferior to the IX alternative.

Active Ex Situ Water Treatment Option #3, Chemical precipitation: Rejected

Chemical precipitation involves removing uranium from solution by adding reagents to combine with the uranium and form a low-solubility precipitate. As noted above, the oxidized U(VI) form of uranium (present in solution as the UO_2^{2+} ion) is highly soluble, and there are not many options for effectively precipitating it. Traditional chemical precipitation approaches, such as the addition of ferric iron or aluminum, are not completely effective without significant water pretreatment. Specifically, under the ambient alkaline conditions in Site surface water, UO_2^{2+} is bound to calcium and carbonate in solution in varying proportions (see Section 2.4.2), and these aqueous uranium complexes show limited potential to adsorb to the iron and aluminum oxyhydroxide solid minerals which are generated with iron and aluminum addition (e.g., Fox et al. 2006). However, as noted above, phosphate is a highly effective reagent for precipitating U(VI). If a chemical precipitation strategy were used at the Site, it would likely require a two-stage process involving the initial precipitation of uranium with phosphate, followed by a ferric iron or aluminum stage to remove the residual phosphate following uranium precipitation. The system itself would include precipitation reactor vessels followed by clarification tanks. Although technologically feasible in principle, such a chemical precipitation system would have several disadvantages relative to IX (and was therefore rejected):

- It would require more-active operator maintenance and monitoring than IX would to ensure proper chemical dosing, uranium-removal performance, sludge settling and management, and system operation (e.g., sludge recycling);
- It involves a greater degree of complexity in sludge management including active sludge handling and dewatering of a low-density treatment sludge (that likely would require use of a filter press, centrifuge, or evaporation techniques). The sludge it would produce would be considered a licensed material and would require complete dewatering (via drying, desiccant addition, or cement solidification) before either disposal site (Energy Solutions or WCS) would accept it. Depending on the treatment efficiency and HMC's ability to dewater the sludge, the volumes of radiological waste generated by chemical precipitation would likely be higher than with IX; and
- It involves a greater potential for the presence of treatment residuals in effluent water due to the addition of chemical treatment reagents (including iron, aluminum, or phosphate, each of which are themselves subject to surface water-quality regulatory limits under the Clean Water Act).

Active Ex Situ Water Treatment Option #4, Reverse osmosis: Rejected

Reverse osmosis involves treating uranium-impacted water by applying hydrostatic pressure across a semi-permeable reverse osmosis membrane to remove uranium ions.[x] Pretreatment is generally required in the form of multimedia filtration, pH adjustment, and/or addition of an anti-scalant to minimize membrane fouling.

Reverse osmosis is technologically infeasible due to numerous challenges that could not be effectively overcome at the Site. Despite the ability of reverse osmosis to reduce uranium concentrations to very low levels, there are several disadvantages to using this technology relative to using IX. The three primary issues with use of reverse osmosis at the Site include the following:

- Reverse osmosis generates a liquid waste product that cannot feasibly be disposed. Specifically, reverse osmosis would generate a water-treatment brine that would make up a substantial fraction (typically on the order of 25 percent) of the incoming (influent) water flow. On-site disposal of liquid waste is infeasible, and even if it were feasible, it is impermissible because the waste would be classified as Licensed Material (see Section 3.1.3). Off-site transport and disposal of such a brine is not practical due to the volume (130,000 gallons per day if treating full flow from the Outfall) and because it would be a licensed radiological material requiring solidification and out-of-state disposal. An alternative is using a crystallizer to dewater the brine to generate a dry, solid waste; however, this alternative is also impractical because of its high energy demands (requiring line power), water volumes, and the volume of radiological waste generated. The infeasibility of evaporation ponds for handling the brine is described below.
- Because reverse osmosis is non-selective (i.e., it removes all ions from the water), the treated water that emerges from a reverse-osmosis system contains extremely low total dissolved solids, which would substantially affect the quality of water discharged from the Site. The treated water would have impacts on whole effluent toxicity (WET) testing, requiring adjustment of the water chemistry to pass WET tests. Even with some degree of blending, this change in water quality would likely significantly affect downstream aquatic ecology and various species' habitats.
- The high pressure required to operate a reverse-osmosis system equates to high energy demand relative to IX. The requirement for line power also contributes to the technological infeasibility of this alternative.

Active Ex Situ Water Treatment Option #5, Evaporation ponds: Rejected

Evaporation as a means of water management can span a broad spectrum of configurations, from fully passive systems involving evaporation basins to highly active systems involving sprayers and/or heaters to accelerate evaporation. The greatest challenge presented by evaporation as a water management strategy at the Site is the extremely large volume of water that would have to be evaporated. And after the water has evaporated, an extremely large quantity of solids would remain. From this perspective, the evaporation alternative is deemed inferior to the IX treatment alternative described below.

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[x] In reverse osmosis, water molecules pass through a membrane from the high-pressure (high dissolved solids) side to the low-pressure (low dissolved solids) side, leaving ions behind the membrane. This is in contrast to osmosis, where if the water was at the same pressure on each side of the membrane, water would move the opposite direction across the membrane (from the low dissolved-solid side to the high dissolved-solid side) to hydrate ions, yielding a lower thermodynamic energy state. Reverse osmosis can be loosely conceptualized as "filtering" the ions out of the water (as one would filter particles with a screen). However, this analogy does not hold at this molecular scale because the separation of water from the hydrated ions relies on principles of osmosis and chemical thermodynamics rather than a physical screening process.

Moreover, this alternative can likely be deemed infeasible in any event based on water rights concerns; if surface water was not discharged from the Site, water rights owners downstream would be impacted. Regardless, the technical infeasibility of evaporation based on water quantities relative to evaporation rates is described below.

- As we detailed in Section 2, the average water flow rate at the Outfall is estimated at 370 gpm, which amounts to a total annual water volume of more than 190 million gallons per year.
- The open-water evaporation rate at Pitch is estimated at approximately 57 inches per year, compared to an annual average precipitation of 25 inches per year (Section 2.2.1). Ambient evaporation of a volume of water equivalent to the annual Outfall discharge would require an open pond with an area of 220 acres (an area approximately twice the size of the IRD). Such a lined pond could not be constructed due to Site topographic limitations, but even if it could, an impermeable surface of that areal extent would be better utilized to minimize infiltration into source zones (see Section 3.3.5.2). Even a pond designed to receive only 10 percent of the Outfall flow (requiring a 22-acre pond footprint, an area over seven times the size of the current Sediment Pond) would still be infeasible, because the evaporation rate would decrease as dissolved solids accumulate in the water due to evapoconcentration.[y]
- Active evaporation, therefore, would be required (and would involve using sprayers and/or heat inputs, which require power), along with a large disturbance area for the evaporation ponds, and efforts to manage and dispose of brine or salt that would remain after evaporation (requiring off-site and out-of-state disposal; Section 3.1.3). For example, the addition of an active spraying system with a 100-kilowatt (kW) power demand would likely require a 50-acre pond footprint. And the requirement for line power contributes to the technological infeasibility of this alternative. Additional evaporation pond components also would be required, including pumps (requiring additional power to operate), pipes, a leak-recovery system, an embankment berm, and a solids-recovery system.
- The volume of concentrated brine or salt generated would be infeasible to manage. Assuming evaporation to complete dryness, evaporation of 100 percent of the Outfall discharge (which has typical total dissolved solids [TDS] concentration of approximately 800 mg/L) would generate between 600 and 700 tons of precipitated salt per year, requiring off-site disposal as radiological waste (60 to 70 tons of salt with evaporation of 10 percent of total flow).

Fully Active-system IX: Rejected

Based on the above analyses and the performance evaluation results presented in Section 4.7, HMC has determined that IX represents the most-appropriate strategy for active *ex situ* water treatment. As we describe further in Section 4.7, an IX system, implemented in a semi-active (gravity-flow) configuration, can be used to treat select flows at the Site, but full-scale treatment at the Outfall (which would be required to achieve the 65- to 95-percent uranium load reductions described in Section 2.3) would require powered pumping to drive water through the IX resin bed.

A full-scale IX treatment system at the Outfall would be required to accommodate a water flow rate of 185 to 1,300 gpm. The power demand associated with pumping water at such flow rates would be up to 55 kilowatts, which would be most effectively delivered long-term using line power. As noted in Section 3.1.1, a line connection

[y] Almost all water existing in nature contains dissolved solids including major ions (e.g., calcium, sodium, magnesium, sulfate, chloride, etc.). Water at the Site is no different, but also contains dissolved uranium. As H_2O evaporates, these ions are left behind and accumulate and become more concentrated, resulting in a brine. And as the water becomes more saline as evaporation continues, the evaporation rate becomes slower. When the water is completely removed, a salt, consisting of these major ions plus uranium at the Site, is left behind.

to the power grid is not technologically feasible at the Site due to the offsite disturbance required for connection to its remote location, which conflicts with Site reclamation and closure objectives. Full-scale active IX treatment would also require regular maintenance and access to the site. As noted in Section 3.1.1, winter access is unreliable due to heavy snowpack, severe storm events, and avalanche susceptibility. In addition to these technological feasibility-based concerns, the active IX system is deemed infeasible based on the other consequences set out in our analysis of a semi-active IX system in Section 4.7. Specifically, this alternative would result in the in-perpetuity generation, transport, and disposal of highly concentrated radiological waste. The environmental footprint and environmental-justice evaluations set out in Section 4.7 apply; the waste volumes, environmental footprints, and possible safety risks would be substantially higher if a fully active alternative were implemented. Therefore, HMC considers fully active IX to be infeasible at the Site.

3.3.4.2 Semi-Active *Ex Situ* Water Treatment

Although HMC has rejected fully active *ex situ* water treatment systems requiring active pumping of water as technically infeasible for the Site, semi-active systems that can be operated via gravity flow may be technologically feasible. The alternatives in this category that HMC considered include engineered treatment cells (ETCs) with varying types of adsorptive/reactive media including:

- Ion exchange (IX) resin;
- Microbial biochemical reactor (BCR) media including solid reagent and aqueous reagent-based reactors; and
- Abiotic/chemical adsorption media (other than IX resin).

Because HMC retained each of these technologies for further evaluation, we provide additional technology descriptions, details about application of the feasibility tests, and results of pilot testing conducted to date at the Site in Section 4. Microbial BCR-based and abiotic/chemical sorption-based ETCs are evaluated in Section 4.6, and IX resin-based treatment systems are evaluated in Section 4.7.

3.3.5 Physical Water Management

Physical water management includes numerous strategies ultimately aimed at either preventing water from contacting uranium source zones at the Site by preventing infiltration (i.e., percolation of water from above) and/or flow of clean groundwater into these source zones, or by segregating uranium-impacted from unimpacted water. While the latter category (segregation) would not in itself result in uranium load reduction, this strategy may improve the efficiency or decrease the scope of water treatment by minimizing the treatment flow rate and maintaining clean water for dilution, which would result in cleaner flows downstream.

The approaches for physical water management that HMC evaluated include uranium load segregation and clean-water diversion, infiltration management, and source zone water management. We describe the specific alternatives associated with each of these categories below.

3.3.5.1 Uranium Load Segregation and Clean-Water Diversions

Uranium load segregation strategies include means of capturing uranium-impacted water as it exits source zones before it mixes with clean water. Systems that have been investigated include rock-dump toe drains and a Chester Fault seepage capture system. Rock-dump toe drain installation would involve installing French drains to capture rock-dump leachate at the bottom of the dumps and conveying the water to a water treatment system, thereby preventing it from entering the Indian and Tie Camp drainages. The Chester Fault seepage capture system would involve collection and diversion of surface and subsurface flows emanating from the Chester Fault to the extent possible, on the southern end of the NPL before it mixes with surface water in the NPL.

In both cases, the strategy would be to consolidate impacted water flows, generating a high-concentration/low-flow water stream for more efficient water treatment. Importantly, note that these solutions would not result in uranium load reduction on their own; therefore, HMC has not evaluated them as standalone alternatives. However, these approaches could be useful because they can be combined with treatment systems requiring a relatively high hydraulic residence time (HRT),[z] including the BCR-based ETCs, to minimize the required size of the treatment system. HMC has therefore retained this alternative as a potential component of the semi-active treatment alternatives evaluated in Section 4.6.

Clean surface-water diversion alternatives focus on improvements to surface water drainages at the Site. These surface diversions positively influence water quality and reduce uranium loads by minimizing the mixing of clean and impacted water (which is useful in optimizing potential water treatment alternatives) and preventing infiltration of clean water into source zones where uranium may be released. HMC has retained this option, but we do not discuss it further in Section 4 because this alternative has already been implemented at the Site. The drainage improvements that HMC has already completed and their implications for uranium load reduction include the following:

- **North Pit diversions**: HMC's work in 2020 included extension of the drainage channel previously installed on the east wall of the North Pit to wrap around the north wall and to capture additional wall runoff and surface water flow from the upper Indian drainage (**Figure 4**). The existing segment of this diversion extending along the south wall and reconnecting with the Indian drainage downstream of the NPL also was relined with geosynthetic clay liner (GCL) and riprap in 2020. In 2022, the south end of the North Pit diversion was extended approximately 1500 feet to prevent infiltration into the IRD and Chester Fault fractured zone. These diversion improvements reduce the amount of water infiltrating into the Chester Fault fractured zone and reduce flows into the NPL (thereby concentrating uranium-impacted NPL water for potential treatment). This reduced infiltration results in increased slope stability while also reducing the flow of water into uranium source zones associated with the fault.
- **Rock-dump diversions**: As noted in Section 2.1.2, HMC's work included abandonment of the degraded and leaking corrugated-metal pipe (CMP) culverts that were originally installed to route surface water through the IRD and TCRD. HMC installed new GCL-lined diversions, HDPE pipelines, and concrete channels across the Site in 2021 to re-route water over and around the rock dumps (**Figure 4**). This work eliminated a pathway by which water was infiltrating into rock-dump material.

The effects of this work on reducing uranium load are and will continue to be evaluated through continued surface water monitoring across the Site.

3.3.5.2 Infiltration Management

Infiltration management alternatives involve reducing water flowing into uranium source zones to reduce water contact with uranium-containing minerals and uranium dissolution into groundwater, thereby reducing discharge

[z] The "hydraulic residence time" (or alternatively, the "hydraulic retention time") is the average amount of time that water spends in the treatment cell, equal to the water volume within the cell (calculated as the total volume times the porosity) divided by the flow rate. This can be distinguished from the "empty bed contact time" (EBCT), which is similar but is based on the total volume rather than the water-filled volume.

of uranium into surface water downgradient of source zones. This strategy is analogous to the source load reduction we discuss in Section 3.3.2, but instead focuses on reducing flows upstream rather than reducing them within a source zone. As we discussed in Section 2, sources of the water to source zones include both infiltration from above and lateral flows of upgradient groundwater. The alternatives for infiltration management that HMC considered include strategies for reducing water from each of these sources.

Selective Lining, Channel Upgrades, and Cap/Cover System

HMC has evaluated the possibility of managing infiltration into deep underground source zones from above (i.e., from the overlying unsaturated zone) under two alternatives: one is a full cap/cover system, and the other is a selective lining system. Each alternative includes installation of low-permeability cover materials at the surface to minimize infiltration of rain and snowmelt water into the uranium source zones associated with the IRD, TCRD, and South Mine Area overlying the UW. The difference between selective lining and installing a full cap-and-cover system is simply the spatial extent of the cap that would be installed. Selective lining would focus on areas of high snow accumulation and infiltration by snowmelt (which corresponds to flat benches and areas with relatively low slope) as well as improvements/upgrades to the stormwater drainage channels as required (re-sloping and re-emplacement of riprap after lining). A full cap-and-cover alternative, conversely, would involve covering the entire exposed surface of the IRD and TCRD (approximately 170 acres), as well as potentially the South Mine Area.

Although HMC expects that lining larger areas would result in correspondingly lower water infiltration, this correlation would not be linear. As we discuss further in Section 4.5, snow survey evaluations conducted at the Site demonstrate that snow accumulates on flatter bench areas, suggesting that infiltration is greatest on these areas, particularly because the majority of the precipitation at the Site falls as snow. Of these two options, HMC has retained selective lining with drainage-channel improvements for further evaluation in Section 4. HMC has rejected a full cap-and-cover system as technologically infeasible for the following reasons:

- As noted above, lining steep slopes would have minimal benefit compared to lining benches.
- Selective lining of benches and improving drainage channels can be completed with relatively minimal disturbance. But lining steep slopes would more significantly impact reclamation and delay Site closure. Applying stable cover systems on steep slopes (up to the 2:1 slopes on several portions of the rock dumps) is technologically more challenging than lining flat areas and includes the possible risk that the cover material would not stay in place. In addition, emplacement of low-permeability covers on slopes would create significant revegetation challenges, limiting the types of vegetation that could grow on the slopes.
- Although a full cap-and-cover system would result in less infiltration than the selective lining of benches would, the full-capping option still would not result in a complete reduction in uranium loading because lateral groundwater inflow also is an important source of water into uranium source zones.

Given the diminishing returns from steep slope lining, possible risks of long-term instability, the larger extent of land disturbance involved, and increased challenges to mine reclamation, all for an alternative that would result in only incremental additional uranium load reduction, HMC considers the full cap-and-cover alternative technologically infeasible. We discuss the selective-lining and drainage improvements further in Section 4.5.

In situ stabilization/water bypass via barrier wall emplacement

This alternative focuses on reducing water flow into source zones by limiting or eliminating the lateral flow of groundwater from upgradient areas of the Site. This may be achieved by installation of low-permeability barrier walls, which would redirect groundwater flow around the source zones, so groundwater does not flow through them.

Barrier wall emplacement is a very common means of achieving hydraulic control at contaminated sites. It typically includes emplacement of a slurry wall, which can be installed using technologies similar to those used for *in situ* physical stabilization (including excavation and re-emplacement or *in situ* mixing using augers), or in many environments, by driving sheet-pile walls into the ground. Barrier walls (as well as permeable reactive barriers) are often installed using large one-pass trenchers, which minimize the amount of excavation required.

HMC evaluated the technological feasibility of this alternative for the Site based on site-specific implementability and anticipated effectiveness. The greatest challenge to implementation includes the deep and widespread nature of the uranium source zones, as described and illustrated in Section 2.4. At the UW, the depth to groundwater is approximately 200 feet, while the bedrock fault zones contributing uranium load are likely to extend to at least 300 feet deep, corresponding to the deepest portions of the mine workings and the undisturbed portions of the Chester Fault fracture zone. These depths far surpass the capabilities of one-pass trenchers and *in situ* stabilization augers, and sheet-pile wall installation within fractured bedrock is impossible. The only option that could be considered technologically feasible in principle would be excavation and direct emplacement of a barrier-wall material. This is highly impractical because the amount of excavation that would be required to install a barrier wall would be approximately the same as that required to remove the uranium sources. In fact, the sloping that would be required to excavate to these depths while minimizing the possible risk of slope failures adjacent to the source zones would involve excavating much of the source material itself. At this level of mechanical and engineering effort, the source-removal alternatives, which would require similar work, would be much more effective than leaving the source in place and attempting to create a hydraulic barrier wall. Accordingly, HMC considers this option technologically infeasible (and redundant with source load reduction).

Similar challenges at the IRD and TCRD make this alternative technologically infeasible for those source zones as well. As described in Section 2.4, some groundwater is likely entering the rock dumps along the upgradient edges through shallow alluvium and fractured bedrock. Along these dump edges, it may be feasible to install a shallow (20-foot) trenched wall to limit groundwater infiltration. However, this is likely only a minor component of the groundwater entering the dumps through the former valleys, and groundwater discharge from below along the former valley bottoms would still be too deep to access.

3.3.5.3 Source Zone Water Management

In the past, HMC considered additional water-management alternatives for their potential to reduce the uranium load discharging off site. HMC considers the four alternatives listed in **Table 3-2** as technologically infeasible due to either infeasibility of implementation or anticipated ineffectiveness for reducing uranium loading. Each of these options is described further below.

Draining and backfilling the NPL

This alternative involves the draining and partial backfilling of the North Pit with dump rock, blasted wall rock, or other material. HMC considers this alternative technologically infeasible because it is not anticipated to result in uranium load reduction. As noted in Section 2.4, the North Pit itself is not a source of uranium load; the actual source of uranium to the NPL includes groundwater discharging from disturbed and undisturbed bedrock associated with the Chester Fault, along with rubble within the already partially backfilled pit. If the NPL were drained and further backfilled, doing so would not cut off the flow of impacted groundwater. It would continue to discharge into surface water drainages within or downstream of the pit.

Draining and backfilling the NPL has been proposed as a potentially necessary reclamation measure to achieve closure of the Site under HMC's agreement with CDRMS. Importantly, however, the NPL serves an important benefit to surface water quality at the Site, effectively serving as a "pretreatment" reservoir that removes naturally occurring iron and manganese, which is present in uranium-impacted groundwater. As we noted in Section 2.4, the NPL is stratified, exhibiting reducing conditions and elevated iron and manganese at depth. The more oxic conditions observed at the surface are likely due to the oxidative precipitation of metal oxyhydroxides within the more oxygen-rich upper layer of the lake. The lake therefore serves an important function under current conditions, retaining iron and manganese oxidation products in the bottom of the lake and keeping them out of surface water drainages (i.e., it is therefore a beneficial component under the Maintain Current System alternative). The function of the lake as an oxidation and sedimentation basin could also benefit IX implementation if it were carried forward, given the sensitivity of IX resin to these constituents. Maintaining the NPL in its current form is therefore also retained as part of the Semi-Active Ion Exchange Treatment alternative discussed in Section 4.

NPL capacity increase

This alternative involves installation of a dam on the southwest corner of the NPL to increase the water storage capacity of the lake. Importantly, this would not be a standalone technology for achieving uranium load reduction, since increasing the storage capacity would not affect the overall uranium mass load that would ultimately exit the lake. Although this alternative may be considered in conjunction with other water treatment alternatives (e.g., semi-active water treatment), HMC does not consider significantly increasing the NPL's storage capacity beyond the current existing capacity necessary to implement any of the treatment alternatives considered here. Further, installing a dam may be considered technologically infeasible due to possible slope-stability risks. Although installation of the dam and raising the water level may not present significant risks in themselves, the possible slope-stability risk may increase when using the lake for short-term storage, particularly as the lake is drained below maximum capacity, due to water saturation and pore pressure on the surrounding steep, loose pit walls.

Desaturation of the underground mine workings

This alternative involves desaturating the underground mine workings, likely by removing the Pinnacle Adit plug. HMC considers this alternative technologically infeasible because it is not anticipated to result in uranium load reduction. As we described in Section 2.3 and 2.4, installation of the Pinnacle Adit plug appears to have had a net-neutral effect on the uranium loads recorded at the Outfall so far, but re-saturation of the UW is likely to have a greater positive impact on longer-term uranium load reduction due to the submersion of reduced-phase uranium-bearing minerals, which prevents oxidation (see Section 2.4.2). In addition, re-saturation of the UW has had a positive effect on decreasing radium concentrations in surface water. Based on historical water quality results and the Site CSM, maintaining saturation of the UW is a more effective long-term strategy for limiting uranium release than desaturation.

Deep well injection

Another alternative that HMC considered for reducing the off-site discharge of uranium-impacted surface water is deep well injection. Impacted surface water would be collected and routed into an injection well screened in deep groundwater. This alternative is considered technologically infeasible for the following reasons:

- The flow rate of water requiring injection would be very large, corresponding to the currently measured flow rate at the Outfall (between 180 and 1300 gpm).

- Long-term injection likely would be unsustainable, given the rate at which the fractured bedrock formation would accept the required flow rates (in other words, depending on the specific capacity of the aquifer, injection may be slower and require higher pressures as more water is pumped into the aquifer over time).
- Injection likely would require significant, continual electric power, because the gravity pressures provided by topographic relief at the Site would not be sufficient to drive deep injection within the Site property boundary.
- Injection would have to be very deep (considering the depth of uranium source zones which discharge to surface water). And, if HMC injected water in the lower-elevation, downstream portions of the Site, there would be very high likelihood that the injected water would discharge into surface water outside of the Site property boundary.
- Injection would require Underground Injection Control approval by EPA, which the agency is unlikely to grant, given the possible risks noted above.
- Additionally, injection of this water would have water rights implications and would require finding replacement water.

4 Analysis of Retained Alternatives

The alternatives that HMC has retained following the initial screening described in Section 3 and outlined in **Table 3-1** are presented below. For these alternatives, we apply a more detailed Feasibility Test evaluation and provide estimates of the anticipated uranium load-reduction. For those alternatives that have been pilot-tested at the Site, we present a brief overview of the testing activities and results.

4.1 No Further Action

The No Further Action alternative is a variation of the Status Quo option. Under this alternative, HMC would complete existing permit requirements, but would move quickly to achieve resolution on the Reclamation Permit. This alternative is very similar to the Maintain Current System alternative that we discuss further in Section 4.2 below, but it assumes that ongoing monitoring and maintenance of current systems would not be required to maintain the existing systems and sustain the realized water quality improvements they provide.

Specifically, adopting this alternative would mean:

- No maintenance, monitoring, or repairs of existing reclamation work at the Site, assuming that these activities would not be required for maintaining the current water quality condition at the Outfall;
- Rapid movement toward closure and release of the Site pursuant to the Reclamation Permit; and
- Water quality compliance monitoring at the Outfall, but with no additional upstream water quality monitoring.

This alternative is technologically feasible because it involves no further active implementation.

Table 4-1. Feasibility Test Results for the No Further Action Alternative

Feasibility Criterion	Result
Additional Uranium Load Reduction	0-10% (including anticipated continued concentration reductions as a result of water quality improvements already implemented at the Site)
Able to Meet WQBEL (estimated at either 0.030 or 0.065 mg/L at the Outfall)	No
Technologically Implementable	Feasible
Other Consequences	Feasible

As noted in Section 2.3.1 and shown in Figure 5, uranium concentrations at the Outfall have been declining over the past several years. Regression of the quarterly-averaged data suggests that the data from 2010 through 2022 are well-fit by a straight line (i.e., an exponential-decay curve does not yield a better fit of the data), with a decreasing slope of approximately 0.0094 mg/L per year. Extrapolating this linear decrease over a 20-year timeframe would predict a 23-percent decrease in the uranium concentration from current condition under the status-quo alternatives (an approximately 0.19 mg/L decrease from a current average of 0.8 mg/L). This level of decrease is likely an overestimate because it is anticipated that the uranium concentration at the Outfall will eventually reach a steady-state, non-zero value, as was the condition pre-mining. However, it may be reasonable to expect that the Outfall concentration will continue to decrease by some fraction of the projected linear decrease over the next several years. For the purposes of this Report, HMC assumes that the continued decrease in uranium concentration at the Outfall will be greater than zero but less than the projected linear decrease, with an assumed range of zero to 10 percent provided as an estimate.

4.2 Maintain Current System

The Maintain Current System alternative is a “Status Quo” option that would include continued effort and involvement by HMC to maintain existing reclaimed areas until improvements demonstrate sustainability without further maintenance, meet regulatory obligations, ensure that downgradient water uses are protected into the future, and continue to maintain uranium concentrations at pre-mining levels.

As outlined in Section 2.1, HMC has completed significant work since the cessation of mining in 1984 to close the Site. Key Site features that comprise the current water management system include the following:

- The North Pit Lake, which removes dissolved iron and manganese from discharging groundwater;
- The Sediment Pond, which removes sediment load before discharging into Indian Creek;
- North Pit diversion, which routes clean water around the NPL and prevents clean water from infiltrating into the mineralized Chester Fault fracture zone;
- IRD and TCRD regrading and revegetation, which prevent surface ponding and infiltration;
- Covering of low-grade uranium stockpiles, which prevents water exposure and uranium release;
- Plugging and abandonment of leaking CMP culverts passing through the IRD and TCRD, which reduces infiltration of water into uranium source zones;
- Maintaining stormwater diversions, which reduces infiltration of water into uranium source zones; and
- Pinnacle Adit plugging, which resulted in re-saturation of the UW and corresponding long-term water quality improvements.

HMC’s ultimate objective is to bring the Site to a stable and sustainable reclaimed state, with minimal ongoing presence of HMC or its consultants on site. As such, it is important that the systems advanced for reclamation and closure are sustainable, permanent, and require less maintenance over time.

Recent reclamation work has been developed with a specific focus on long-term effectiveness. For example, the degraded CMP culverts conveying surface water through the IRD and TCRD were recently replaced with aboveground drainages where feasible and longer-lasting concrete piping where underground conveyances were still required, substantially extending the lifetime of these drainage systems. Importantly, many of these kinds of activities have gone above and beyond what would be strictly required to achieve Site closure. This is one of the key features that distinguishes this Maintain Current System alternative from the No Further Action alternative described above. In addition, it is anticipated that regrading work conducted to date will require less maintenance over time as revegetated areas become more mature.

Because the Site is in a remote area surrounded on all sides by USFS property enjoyed by recreational users, bringing the Site to a successful closure with minimal and diminishing active HMC presence is in the best interest of all stakeholders. HMC acknowledges, however, that some maintenance and monitoring will likely be required to maintain reclaimed systems and to continue to meet water quality compliance requirements until it can be demonstrated that the systems are self-sustaining and require no further maintenance. In the near term, then, as the Site is further advanced toward closure, HMC is committed at minimum to the following activities:

- Annual inspection of surface improvements (e.g., regraded and revegetated areas) and maintenance of any compromised or degraded surface features;
- Continued monitoring of slope movement and stability per CDRMS requirements;
- Annual high-flow and low-flow monitoring to advance and maintain Site knowledge, including documenting water quality improvements that continue to play out as a result of HMC reclamation activities to date (for example, observing whether the apparent decreasing uranium concentration trend at the Outfall following Pinnacle Adit plugging as noted in Section 2.3.1 continues), and identifying any significant changes to the hydrogeologic/geochemical system on Site;
- Continued surface water flow and water quality monitoring to meet regulatory compliance obligations under the Discharge Permit;
- Continued engagement and collaboration with CDPHE on all regulatory matters including Discharge Permit renewals, Discharge Permit-related water quality reporting, water quality standards reviews under the DSV process, and periodic renewal of the RML;
- Continued commitment to ensuring the protection of public health, which HMC proposes should include:
    - Replacement of domestic wells screened in alluvium with bedrock-screened wells for residents in the town of Sargents at HMC's expense;
    - Advancement of a Saquache County ordinance placing restrictions on the future installation of alluvial wells along Marshall Creek, which was adopted in 2022; and
    - Placement of conservation easements on land overlying Marshall Creek alluvium, which was completed in 2022.

Based on HMC's application of the Feasibility Tests and other feasibility criteria, the Maintain Current System alternative is considered feasible. The results of the Feasibility Tests are provided in **Table 4-2**, with additional details and rationale provided in subsequent sections.

Table 4-2. Feasibility Test Results for the Maintain Current System Alternative

Feasibility Criterion	Result
Additional Uranium Load Reduction	0-10% (including anticipated continued concentration reductions as a result of water quality improvements already implemented at the Site, which will continue to be assured based on ongoing maintenance)
Able to Meet WQBEL	No
Technologically Implementable	Feasible
Other Consequences	Feasible

4.2.1 Technological Feasibility

From an implementation standpoint, HMC considers the Maintain Current System alternative technologically feasible because it would primarily involve maintenance and monitoring of systems that have already been implemented at the Site, with a level of active involvement by HMC considered to be sustainable over the 20-year timeframe considered in this evaluation.

As we noted in Sections 2.3 and 4.1, uranium concentrations in surface water at the Site are currently similar to pre-mining levels but appear to be exhibiting a continued decreasing trend following the reclamation work that HMC has completed. In particular, data from 2021 and 2022 demonstrate the lowest ambient average uranium concentrations ever recorded at the Outfall. These results indicate that uranium concentrations are likely to continue to decrease over time as HMC continues to maintain existing systems at the Site, with an estimated uranium concentration decrease between zero and 10 percent over the next several years (see Section 4.1). Regardless, because the Maintain Current System alternative does not involve doing work beyond maintaining the existing systems to achieve additional uranium load reduction, this alternative would not achieve the anticipated WQBEL over the 20-year timeframe considered in the evaluation.

4.2.2 Other Consequences

HMC anticipates that the Maintain Current System alternative would cause the fewest new/other negative impacts to the environment among all of the alternatives that were evaluated. Uranium load reduction measures associated with the other alternatives that HMC considered would, at a minimum, involve land disturbance and/or radiological-waste generation. This alternative includes completion of Site reclamation to achieve closure (including regrading and revegetation), consistent with requirements under the Reclamation Permit approved by CDRMS.

Arcadis calculated the environmental footprint for this alternative over 20-year and 100-year timeframes, assuming the following:

- Routine Site access for ongoing water quality monitoring (biannual high-flow/low-flow sitewide monitoring and monthly Outfall compliance monitoring) including minimal winter access via snowmobile/snowcat;
- Periodic (every 10 years) maintenance and improvements of slopes and revegetation areas, including access, use of equipment/supplies, and heavy machinery operation, including:
    - Mobilization and usage of labor and equipment for regrading approximately one acre of low-slope areas on the rock dump to prevent pooling and increased rock-dump water infiltration;
    - Labor, equipment, and road-base material usage for grading Site access roads and general erosion maintenance; and
- Replacement of 26 domestic wells screened in alluvium with bedrock-screened wells for all residents in the town of Sargents, installed to a depth of approximately 120 feet.

The results of this environmental footprint evaluation are provided in **Appendix 5**, including additional details on model input assumptions, procedures, and model outputs. A summary of the evaluation results is provided in **Table 4-3** below. Total results over the 20-year time period are presented along with the contributing years broken up into three intervals to present the difference between implementation and ongoing maintenance:

- Year 1: Domestic well replacement in Sargents and monthly site monitoring and bi-annual sampling events; and

- Years 1–20 and 1–100: Monthly site monitoring and bi-annual sampling events, site access maintenance and regrading of low-slope rock dump areas, and year-one events.

After 20 years, the system is assumed to become self-sustaining and little maintenance will be needed. The regrowth and vegetation mitigate erosion and reduce the need for regrading events.

Table 4-3. Environmental Footprint Evaluation Results for the Maintain Current System Alternative

	Year 1	Years 1-20	Years 1-100
GHG Emissions (metric tons)	168	371	1180
Total Energy Used (MMBTU)	77,100	79,400	88,200
Total NO_x Emissions (metric tons)	.403	0.668	1.63
Total SO_x Emissions (metric tons)	0.221	0.243	0.301
Total PM10 Emissions (metric tons)	0.0507	0.066	0.109

Notes:
1. GHG: greenhouse gas.
2. MMBTU: million British Thermal Units.
3. NO_x: nitrogen oxides.
4. SO_x: sulfur oxides.
5. PM10: particulate matter with diameter less than 10 micrometers.

HMC's final determination of feasibility with respect to other consequences therefore is based on whether this alternative would ensure that human and ecological health is maintained. Because this alternative would not result in any "new" impacts, this alternative is considered feasible based on the absence of other consequences.

4.3 Source Load Removal via Mining

Reopening the Site to active mining is an alternative that would result in long-term uranium load reduction, as it would achieve the objective of removing a significant portion of the remaining sources of uranium load to surface water. Specifically, this alternative would include mining the North and South Areas for beneficial use (i.e., open-pit mining to remove residual uranium ore contained within and around the UW). Although this alternative likely would not include mining of material in the rock dumps, mining could potentially create opportunities for rock-dump improvements to limit uranium release from other uranium source zones at the Site associated with the IRD and TCRD. Based on a resource evaluation conducted in 2022 by Mersch Ward (mining geologist for HMC during the HMC mining period), an estimated quantity of nearly 1 million tons of uranium resource (containing over 8 million pounds of uranium based on an ore grade of 0.2 to 0.26 percent U_3O_8) has been delineated in the North

Pit, South Area, and South Tie Camp areas through drilling. Furthermore, an additional 1.6 million tons of resource containing up to 8 million pounds of additional uranium is inferred by the Site geology (see **Appendix 3**).

HMC considers mining feasible in principle based on technological factors and other consequences (**Table 4-4**), but with the caveat that the level of technological effort, large environmental footprint, and potential social/community impacts (discussed more below) would only be justifiable when weighed against the economic value and beneficial use that would be derived from mining for resource recovery.

Importantly, HMC is not in a position to conduct mining, in large part because HMC is no longer a uranium mining company. If the Site were to be mined, HMC would pursue selling the property to a uranium mining company. For this reason (other potential consequences aside), it is not an alternative that HMC can directly pursue to meet its own regulatory obligations (rather, the Site would be sold to a mining company, and that liability would be passed to the new owner). HMC has therefore screened out this alternative at this time (i.e., for the purposes of this alternatives analysis), but does consider mining a potentially viable option for future consideration.

In principle, divestiture of the site to a uranium mining company is feasible. Although HMC has been approached by interested buyers recently, the potential liabilities associated with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) have outweighed the potential financial benefits associated with divesting the Site. However, divestiture and active mining may be considered in the future as a potential long-term remedy when compared to the potential for perpetual water treatment at the Site.

Table 4-4. Feasibility Test Results for the Source Load Removal/Mining Alternative

Feasibility Criterion	Result
Anticipated Uranium Load Reduction	Unknown/undefined; estimated at > 50%
Technologically Able to Meet WQBEL	Unknown
Technologically Implementable	Undetermined (feasible in principle)
Other Consequences	Undetermined (may be feasible in principle, when offset by the beneficial use of uranium).

4.3.1 Technological Feasibility

As noted above, HMC is not in a position to conduct mining operations. However, this section considers the technological feasibility of mining from a general perspective.

Although HMC considers mining to be technologically feasible, anyone doing so would encounter numerous challenges. Complete excavation of the uranium ore would likely require wall sloping and overburden removal at levels substantially greater than those in the original 1980's mine plan and require detailed engineering plans.

Following mining, the ultimate level of uranium load reduction that may be achieved is difficult to define, but HMC anticipates that it would be significant. Based on the Chester Fault/UW contribution to the uranium load, as summarized in Section 2, greater than a 50-percent load reduction may be anticipated. The amount of mining that would be needed to achieve the 87- to 95-percent uranium-load reduction required to meet the proposed WQBEL is unknown, however.

4.3.2 Other Consequences

Mining also would undermine reclamation and Site closure efforts, at least for the duration of the mining activities. Mining also would require new permitting, regulatory approvals, and economic-feasibility evaluations, all of which would need to be conducted by the future (new) owners of the Site. In addition, a new mining permit would be contingent on completion of an updated National Environmental Policy Act (NEPA) analysis, followed by a new EIS.

Although the new mining company would be required to ensure water quality is protected (likely via active treatment) during mining, it would have a large associated environmental (e.g., carbon emissions, water use, and ecological) footprint. Although HMC has not estimated what such an environmental footprint might be, we do suggest that the overall effort and associated impact of digging the uranium ore out of the ground is more justifiable if that ore is then recovered for beneficial use than it would be if the ore was removed and disposed. In other words, the environmental benefit of retrieving the uranium ore, which is primarily used in the power sector, would help to offset the large carbon footprint associated with mining, but this would not be the case if the uranium ore were simply placed in a landfill (as would be the case if HMC were conducting this effort and the ore were removed to meet water quality objectives without any resource recovery). Without this beneficial use component, the technology is considered infeasible when other consequences are weighed against the benefit of reducing uranium concentrations in surface water.

Beyond environmental factors, active mining would have socioeconomic implications that are currently difficult to define. For example, reopening the Site to mining would likely have a positive economic impact on the local community, although active mining may also have negative community implications associated with haul trucks, traffic, and social impacts.

4.4 *In Situ* Geochemical Passivation with Phosphate

The *in situ* geochemical-passivation alternative involves reagent injection into uranium source zones to alter the geochemical environment of the source zones. The alternative specifically involves the injection of dissolved phosphate to precipitate dissolved uranium within low-solubility uranium-phosphate minerals; these precipitates would “passivate” (i.e., coat or armor) other uranium minerals in the source zones which otherwise have a propensity to dissolve when exposed to oxygen. The primary goal is to prevent uranium minerals exposed to groundwater from continuing to dissolve, while a secondary goal is to sequester/contain the uranium that has already been released into groundwater. Successful containment of uranium through mineral passivation would result in source zone uranium load reduction without physical removal of the uranium.

HMC has extensively tested this technology at the bench scale and field pilot scales for applicability and effectiveness at the Site. HMC undertook field-implementation pilot-scale tests at the UW and IRD between 2017 and 2020. Although the technology is effective for treating uranium and achieving passivation and has proven technologically feasible within limited extents, HMC has determined that it is technologically infeasible as an overall technology at the Site due to limitations in the ability to deliver reagents via water injection to key uranium source zones, including fractured bedrock and unsaturated overburden rock material. A summary of the

Feasibility Test outcomes is provided in **Table 4-5**, and a discussion of technological and other consequences is provided further below.

Table 4-5. Feasibility Test Results for the In Situ Geochemical Passivation with Phosphate Alternative

Feasibility Criterion	Result
Anticipated Uranium Load Reduction	Minimal (< 10%) based on field pilot testing
Able to Meet WQBEL	No
Technologically Implementable	Infeasible (feasible to a limited extent; discussed in text)
Other Consequences	Infeasible beyond currently tested threshold due to risk of phosphate exceeding water quality standards.

4.4.1 Implementation Design Elements

Geochemical passivation with phosphate involves injecting soluble phosphate into groundwater within the UW, IRD, and potentially the TCRD source zones. Using a groundwater recirculation ("net-zero" water injection) approach, the injection system would include extraction wells that route water to a chemical dosing system, where a phosphate mixture composed of phosphoric acid (H_3PO_4) and monosodium phosphate (NaH_2PO_4) is added to the extracted groundwater, which is then redistributed to a series of injection wells. Alternatively, under a "net-positive" water injection approach, the sources of injection water would include on-site surface-water bodies instead of extracted groundwater.

At minimum, addition of phosphate to groundwater containing dissolved, oxidized uranium (i.e., UO_2^{2+}) would result in precipitation of uranyl phosphate minerals, such as the mineral chernikovite:

Dissolved species: Solid mineral phase:

$$UO_2^{2+} + HPO_4^{2-} + 4\ H_2O \quad \Leftrightarrow \quad H_3O(UO_2)(PO_4)\cdot 3H_2O$$

Precipitation of this solid mineral phase removes dissolved uranium from solution, while the mineral that forms also forms an armor coating on (i.e., "passivates") other reduced-uranium mineral phases (such as uraninite; UO_2), which have the potential to dissolve when exposed to oxygenated water. This mineral coating limits the contact of water and oxygen, thereby preventing dissolution.

Although precipitation of chernikovite is effective, the phosphate-precipitation strategy is more effective when the uranium can be sequestered in calcium-, sodium-, or potassium-uranyl-phosphate minerals, because these are less soluble than pure uranyl phosphate minerals (e.g., Mehta et al. 2014). In the presence of calcium, uranium may precipitate as autunite (a pure-phase calcium-uranyl-phosphate):

Dissolved species: Solid mineral phase:

$$Ca^{2+} + 2\ UO_2^{2+} + 2\ HPO_4^{2-} \quad \Leftrightarrow \quad Ca(UO_2)_2(PO_4)_2 \ + \ 2\ H^+$$

Otherwise, uranium can also be sequestered by coprecipitation in uranium-substituted hydroxyapatite and other calcium-phosphate solids (Mehta et al. 2014, Mehta et al. 2016, Kane 2018). These reactions are important, because they dictate the ultimate solubility of the uranium mineral phase that is formed.

This precipitation can be accomplished by injection of the co-ion (calcium or potassium) directly; however, this is not necessary at the Site, given the high abundance of calcium already present in groundwater, which can participate in the target sequestration reactions. At the UW and IRD, typical groundwater calcium concentrations are between approximately 150 and 300 mg/L, and water quality exhibits saturation or supersaturation with respect to calcite (reflecting the presence of calcium carbonate in the ground which can dissolve to yield more dissolved calcium).

Individually, the phosphoric acid and monosodium phosphate reagents effectively accomplish the same goal of delivering dissolved phosphate (as a combination of the protonated aqueous phosphate species $H_2PO_4^-$ and HPO_4^{-2} at circumneutral pH), but the combination of the two reagents allows for adjustment of the solution pH of the injectate solution. This is important, because setting the pH of the injection solution to a desired value can enhance release of additional calcium in the ground. The target injection solution pH is near neutral to mildly acidic (pH > 4 standard units [s.u.]) with reduced alkalinity to enhance *in situ* calcium release from calcite dissolution.

As informed by field-implementation pilot testing (described further in Section 4.4.2), routine system operation would include the following components:

- Management of treatment residuals, such as phosphate salts, that may migrate to surface water following phosphate injection. This would involve monitoring for the presence of phosphate residuals and use of a treatment residuals management (TRM) system to remove the phosphate from surface water.
- Electrical power for the injection systems, which could be supplied using generators.
- Maintenance/rehabilitation of extraction and injection wells. For injection wells, rehabilitation is required due to chemical fouling resulting from precipitation of injection chemicals within the well screen. Although this can be avoided to some extent with careful control of injection solution pH and injection reagent concentrations, pilot testing has demonstrated the need for significant well maintenance following reagent injection. Some physical cleaning was also required at extraction wells at the UW following extended pumping.
- Seasonal system operation. Due to winter conditions and limited access at the Site, the injection systems would only operate during the designated field season (approximately June through October).

The success of the technology would rely on the ability to achieve passivation of source zones after a series of phosphate injections, followed by less-frequent "maintenance" injections, as necessary. HMC considers this alternative technologically infeasible to implement if maintenance of the technology requires annual phosphate injections in perpetuity, because there would be little to no benefit to undertaking injections rather than treating downgradient surface water instead.

4.4.2 Technological Feasibility

Despite successful lab-scale results proving the technical viability of geochemical passivation with phosphate, HMC has determined that this alternative is infeasible to implement at full scale. The testing results and the technical evaluation that form the basis for this determination are included below.

4.4.2.1 Bench and Field Pilot Test Summary

Geochemical passivation with phosphate is an innovative technology that has been tested extensively in the laboratory and in the field at the Site. Results from HMC's tests conducted between 2015 and 2020 are included in **Appendix 6**. The tests and key results are summarized as follows:

- Following a series of laboratory batch tests conducted in 2014, small-scale (single-well injection) field pilot tests were conducted in 2015 and 2016 at the UW and IRD. These tests demonstrated the effectiveness of the technology in reducing uranium concentrations in groundwater within the radius of influence of the injection wells.
- A laboratory flow-through column test[aa] was conducted in 2020 to specifically evaluate the uranium mineral passivation mechanism with site-specific uranium source zone minerals. Results from the column tests demonstrated significant uranium immobilization and mineral passivation. Specifically, flow of phosphate-dosed water into the columns resulted in a greater-than-96-percent reduction in the dissolved uranium in the water leaving the column relative to a control column receiving water without phosphate. Importantly, this decreased uranium concentration was sustained following a switch back to water not dosed with phosphate in the test columns, providing confirmation of the passivation mechanism.
- HMC conducted field-scale testing at the Site from 2017 through 2020 with active injection systems staged at the UW and IRD. The UW injection system recirculated phosphate within openings in the UW to allow diffusion of dissolved phosphate into the surrounding fracture network. This system was operated by extracting water from downgradient extraction wells along the north end of the UW, and then reinjecting phosphate-dosed water into the upgradient central and southern portions. From 2017 through 2020, approximately 1,600 kg of phosphate was injected into the UW along with 1 million gallons of recirculated water. The system was effective at realizing significant local uranium concentration decreases at downgradient monitoring well P-8 and in Chester Fault seeps CFS-1 and CFS-2 (see **Appendix 6**).
- Like the UW injection system, the IRD injection system involved a back-recirculation approach, with extraction of water at the downgradient end of the dump and reinjection of phosphate-dosed groundwater into upgradient source zones. The IRD injection system initially targeted injection of phosphate within the saturated bottom of the dump using injection wells installed at the 10300 bench. In 2019, this system was modified to focus injections within a localized area of elevated uranium concentrations corresponding to the former Pinnacle Mine Dump (PMD). From 2017 through 2020, approximately 2,500 kg of phosphate was injected into the IRD/PMD within 2.4 million gallons of recirculated water. These tests resulted in temporary uranium concentration decreases, which were observed in IRD monitoring wells downgradient of the injection points.

4.4.2.2 Technological Feasibility Determination

The work that HMC has conducted to date has demonstrated that the phosphate injection approach effectively reduces uranium concentrations in groundwater downgradient of injection zones; however, limited reductions in downgradient surface water were observed following injection of substantial quantities of phosphate. HMC

[aa] "Column tests" are typically conducted by packing a cylindrical pipe or tube with solids (e.g., soil or water treatment media), capping both ends in such a way as to allow the flow of water, and then running water through the column and across the packed solids. Such columns are typically oriented vertically upright, and then operated in an "upflow" configuration (water flows in the bottom and out the top) or "downflow" configuration (water flows in the top and out the bottom).

attributes the low overall effectiveness observed in surface water despite localized effectiveness in groundwater to an inability to achieve adequate phosphate distribution throughout the extensive and diffuse source zone network. The UW injection system targeted injection into the former workings, relying on the hydraulic connection between the UW and the surrounding fracture network, because successfully installing wells and directly injecting into bedrock fractures would not be feasible. However, this did not prove effective at accessing the extensive network of complex bedrock fractures within the fault zone (described in Section 2.4.2). Although injecting phosphate into unconsolidated mining overburden rock material (PMD and IRD) was relatively straightforward compared to injecting it into the UW, adequate distribution of phosphate was limited because the source material resides in seasonally saturated or overlying unsaturated zones.

To summarize, HMC considers this alternative technologically feasible in the following environments:

- Saturated unconsolidated aquifer solids in which phosphate reagent may be delivered directly to major groundwater flow paths via groundwater recirculation (injection and extraction). This applies to collapsed underground mine workings and the saturated portions of the rock dumps.
- Low-permeability zones immediately surrounding these major groundwater flow paths. This applies to some extent to the fracture network in immediate hydraulic connection with underground mine workings.

However, the technology is considered technologically infeasible in these environments:

- Extensive bedrock fracture networks that represent significant groundwater flow and discharge but cannot feasibly be intersected with injection wells for delivery of reagent. This applies to the majority of the Chester Fault uranium source zone.
- Unsaturated vadose zones residing above the water table. This applies to much of the UW/Chester Fault uranium source zone, as well as the majority of the IRD and TCRD source zones.

Accordingly, the phosphate injections conducted to date were effective in achieving uranium load reduction where this load reduction was technologically feasible. But phosphate injection cannot be feasibly expanded beyond the current implementation, which did not have any significant impact on uranium concentrations at the Outfall. In other words, the technology as implemented during pilot testing was completed to the level that was considered technologically feasible; any additional implementation beyond that would yield substantially diminishing returns as well as possible increased risk of phosphate breakthrough (discussed below). Based on this assessment and the limited effectiveness observed in surface water during large-scale field-implementation pilot testing, HMC considers uranium-load reduction by chemical injection technologically infeasible.

4.4.3 Other Consequences

The phosphate injection alternative would require long-term infrastructure, including access roads, injection/extraction wells, piping, and reagent dosing systems. If the alternative was technologically feasible (i.e., if not for the issues regarding technical feasibility noted above), the areal footprint of these systems would not need to be large, and these systems would not be anticipated to interfere with slope maintenance and revegetation efforts required for Site reclamation and closure. This would be particularly true if active phosphate injections were to diminish to zero over time following source zone passivation (again, assuming the alternative was technologically feasible at the Site), allowing for closure of the Site and release of the Reclamation Permit.

The primary negative consequence of phosphate injection involves the potential for treatment byproducts to show up downgradient of injection zones, and full-scale injections pose a high risk for phosphate breakthrough into surface water. Because Regulation 85 does not apply to this type of discharge, the interim phosphorus standards from Regulation 31 were added to Indian, Marshall, and Tomichi Creeks in the June 2017 Gunnison Basin Rulemaking Hearing. Subsequently, the Permits Section required monitoring of phosphorus at the Outfall due to the groundwater phosphate injection activities and investigations, with requirements for remedial actions if phosphorus concentrations exceeded the interim standard of 0.011 mg/L. If full-scale implementation of phosphate injections were to proceed, the risks of exceeding this interim limitation or a future new phosphorus standard that may be even more stringent would significantly increase. Therefore, this alternative comes with possible non-compliance risks that involve swapping uranium compliance for phosphorus compliance. This would occur even though the downstream uranium concentrations do not have an impact on public or aquatic life health on Indian or Marshall Creek, and the uranium standard is met on Tomichi Creek. The risk of phosphate breakthrough is therefore a primary limitation for continuing to advance the technology at the Site to attempt greater distribution, even if more of the uranium sources were accessible via injection.

To manage potential discharges of phosphate to surface water, HMC installed a TRM system as part of the field implementation tests (mentioned in Section 4.4.1.). The TRM system included iron and aluminum-based additives (55-percent liquid ferric chloride and 45 percent liquid sodium aluminate), an organic polymer flocculant, and calcium hydroxide (lime) to remove phosphate, with systems for adding these chemicals to surface water. The iron and aluminum reagents coprecipitate dissolved phosphate within iron and aluminum oxyhydroxides, the organic polymer enhances flocculation and settling of the iron/aluminum precipitates, and the calcium hydroxide is used for pH control and calcium phosphate precipitation. Because dissolved phosphate would discharge directly into surface water drainages downgradient of injection zones, the TRM system was designed to treat phosphate directly in Site surface water features (i.e., within the drainages and in the sediment pond). The TRM was designed to be a last-resort contingency measure, however, not a standard post-treatment step. That is because implementation of the TRM system would itself present significant risks and complications, including:

- Risk of ineffective treatment of the phosphate, given that treatment would be implemented in Site drainage features, not in a highly engineered system;
- Risk of TRM-related byproducts remaining in surface water (particulate iron and aluminum, residual dissolved flocculant); and
- Generation of a treatment sludge containing coprecipitated uranium and/or radium and classified as a licensed radiological material that would require subsequent removal from Site drainages or the sediment pond and disposal off-site and outside of Colorado.

During field testing, HMC observed low levels of phosphate in surface water, even when dosing only a small portion of the overall Site, which highlighted the true risk involved in further expansion of this technology. In principle, phosphate exceedances can cause significant impacts to aquatic ecosystems. Elevated phosphorus can support algae and plant growth. In low-flow environments, this algal and plant growth can deplete dissolved oxygen to levels that can no longer sustain life (eutrophication). Although there is little risk of oxygen depletion in the rapidly flowing portions of Indian and Marshall Creeks downstream of the Outfall where oxygen would be quickly replenished, algal growth can still have a negative influence on the health of native fish and invertebrate populations. Throughout pilot testing, phosphate levels in surface water were monitored daily using field kits, and weekly analytical measurements were collected at the Outfall. In 2020 (during the final year of pilot testing), total phosphorus concentrations at the Outfall were occasionally measured at above 0.011 mg/L (up to approximately 0.04 mg/L). Although the median phosphorus concentration at the Outfall (calculated on a running-annual basis) remained well below the 0.011 mg/L standard throughout this period, and concentrations in 2021 following cessation of phosphate injections returned to below 0.011 mg/L. The results indicate that continued and upscaled phosphate injections would likely eventually cause exceedances of the phosphate water quality standard.

4.5 Rock Dump/South Mine Area Regrading and Selective Lining

This alternative involves surface grading and selective lining of stormwater channels and flat benches at the IRD, TCRD, and South Mine Area (see **Figure 3**) to promote drainage and to reduce infiltration of precipitation and snowmelt into source zones. As we outlined in Section 2.2, snow survey evaluations that HMC conducted at the Site demonstrate that snow accumulates mostly on flatter benches and in depression areas, suggesting that infiltration will be greatest in these areas. The accumulated snow, which infiltrates these benches and depressions during spring snowmelt, results in increased uranium loading downgradient of the benches and depressions (**Figure 2-2**).

HMC differentiates this alternative from the existing clean water diversions that segregate clean water from impacted surface water because it involves the direct management of precipitation that lands on rock-dump features. The existing diversions that HMC created in 2020 route upgradient clean water around the NPL and TCRD (see Section 3.3.5). Although these diversions prevent some mixing of clean and impacted surface water, selective lining would further reduce direct precipitation on disturbed areas from percolating and contacting source zone materials. This strategy would reduce uranium concentrations in surface water in two ways:

- During active snowmelt, clean water would be diverted as runoff, rather than infiltrating into the ground. This would result in immediate dilution when that runoff blends with impacted surface water; and
- Later in the season, the reduction of water infiltrating into the source zones would result in reduced impacted baseflow discharges to surface water.

Overall, HMC considers this alternative feasible, although the anticipated uranium load reduction may be minimal (see **Table 4-7**). Implementation details and the Feasibility Test rationale are below.

Table 4-7. Feasibility Test Results for the Rock Dump Upgrades and Selective Lining Alternative

Feasibility Criterion	Result
Anticipated Uranium Load Reduction	5-10% based on Site CSM and source load evaluation
Able to Meet WQBEL	No
Technologically Implementable	Feasible
Other Consequences	Feasible

4.5.1 Implementation Design Elements

Surface improvements involve regrading areas of the IRD and TCRD to eliminate pooling and to encourage shedding of snow and rainwater to drainages. HMC has already regraded the South Mine Area as part of Site reclamation efforts; however, opportunities exist for lining low-slope areas. Similar to prior Site regrading and reclamation efforts, material required for the grading can be sourced onsite, and revegetation would align with previous reclamation work.

Selective lining of IRD and TCRD would include lining the benches that currently receive heavy snow deposition and thus allow water infiltration into the rock dumps and the South Mine Area above the UW. Since these benches and stormwater drainages would exhibit frequent seasonal and storm-event wet-dry cycles, the preferred liner material would be an impermeable flexible membrane liner (FML) or similar.

Water collecting on benches would be funneled to stormwater drainages, which would convey the water to the existing perennial surface water drainages at the Site (see **Figure 4**). Before implementing this alternative, however, HMC would need to develop an engineering design to include a determination of specific areas targeted for lining or regrading, likely based on a specific slope-angle cutoff for regrading and an assessment of snow accumulation areas based on snow surveys. Whereas low-slope areas may be regraded, flat bench areas would receive the impermeable liner. As noted above, HMC has begun conducting snow tube and aerial surveys to evaluate snow accumulation and melt-off. As an example, some snow tube survey results collected on the IRD in spring, 2022 are provided in **Figure 4-2** below. HMC is planning to continue and expand on these snow surveys to evaluate snow accumulation areas and sequence of melt-off.

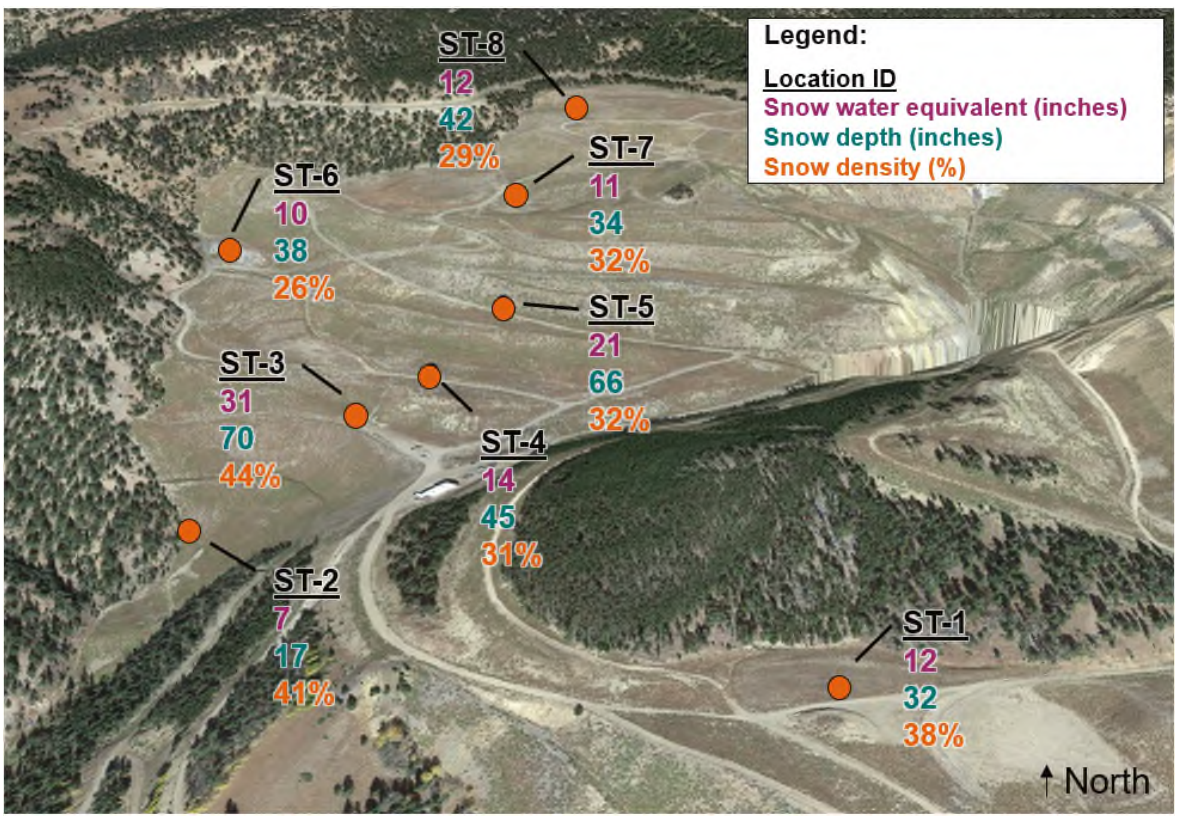

Figure 4-2. Spring 2022 IRD Snow Tube Survey Results

4.5.2 Technological Feasibility

Rock-dump drainage-channel upgrades and selective bench lining would not completely limit water infiltration. Because implementation of this solution would require minimal Site disturbance and ongoing maintenance, however, HMC concludes that this alternative represents a technologically feasible means of achieving some uranium load reduction using a system that does not require perpetual operation. Additional Site monitoring and evaluation would be required to design and optimize an effective system, however.

4.5.2.1 Anticipated Uranium Load Reduction

The level of uranium load reduction that may be achieved through such selective infiltration management is difficult to quantify, since the exact proportion of rain and snowmelt infiltration through the benches versus into the slopes is only qualitatively understood. It is also not precisely known how much of the water that accesses source zones comes from vertical infiltration or flows in laterally as groundwater. Nonetheless, we provide a rough estimate below based on the uranium mass load balance presented in Section 2.4 along with some high-level approximations of flow sources. This hypothetical example was constructed based on the following assumptions about the IRD load:

- The overall uranium load contribution from the IRD is approximately 25 to 60 percent of the total uranium load passing through the Outfall (assuming some contribution of the "downstream load" component comes from the IRD; **Figure 2-6**);
- More than half of the water entering the IRD is derived from vertical infiltration; and
- With selective lining, approximately 25 percent of the infiltration water may be diverted.

Using these hypothetical assumptions, lining of the IRD alone could achieve an approximately 5- to 10-percent uranium load reduction. Estimated load reductions at the South Mine Area and TCRD are likely lower, given that a larger proportion of water at the UW is likely derived from lateral groundwater flow, while the TCRD contributes less uranium to the overall uranium load passing through the Outfall (Section 2.4). However, because some incremental improvement may be realized by selective lining at the South Mine Area and TCRD, HMC believes that it is reasonable to predict that overall load reductions between five and 10 percent may be achievable by employing selective lining. Although this level of load reduction would be significant, it would be insufficient to meet the anticipated WQBEL or the surface water quality standard on Marshall Creek.

4.5.3 Other Consequences

Environmental impacts associated with regrading and selective lining primarily would include the energy footprints associated with regrading, the materials required for lining, and the temporary land disturbances associated with earthwork. This work would result in the need to re-establish vegetation in regraded areas and on lined bench areas, all depending on the type of lining material that is used, resulting in delays in the completion of Site reclamation and closure efforts under the Reclamation Permit. Regardless, HMC considers this alternative feasible with respect to other consequences, with no other major impacts.

Arcadis calculated the environmental footprint for this alternative over 20-year and 100-year timeframes, assuming the following:

- Actions associated with the Maintain Current System alternative (Section 4.2.2);
- Mobilization and on-site usage of equipment, materials, and labor to implement:
    - Backfill and grading of approximately five acres of low-slope areas on the IRD and TCRD;
    - Selective lining of stormwater channels and flat benches at the IRD, TCRD, and South Mine Area. Drainage improvements include approximately 35,000 linear feet of drainage, with 2-foot fill cover, geotextile cushion, HDPE liner, 3-inch sub cushion riprap within drainages, and flexible membrane liner (FML) on benches; and

- o Drainage maintenance every 10 years, assuming less than 2,000 linear feet of lined drainage requires minor earthwork and riprap amendments.

The results of this environmental footprint evaluation are provided in **Appendix 5**, including additional details on model input assumptions, procedures, and model outputs. A summary of the environmental footprint evaluation results is provided in **Table 4-8** below. To illustrate the differences between implementation and ongoing maintenance, the results are presented over the following three timeframes:

- Year 1: Domestic well replacement in Sargents, monthly Site monitoring, and bi-annual sampling events (4.2.2); regrading and drainage work on the IRD and TCRD; and
- Years 1-20 and 1-100: Monthly Site monitoring and bi-annual sampling events (4.2.2), site access maintenance and regrading of low-slope rock dump areas (4.2.2), drainage maintenance, minor earthwork and riprap amendments, and year-one events.

Table 4-8. Environmental Footprint Evaluation Results for the Regrading and Selective Lining Alternative

	Year 1	Years 1–20	Years 1–100
GHG Emissions (metric tons)	1,860	2,240	4,510
Total Energy Used (MMBTU)	110,000	115,000	147,000
Total NO_x Emissions (metric tons)	5.48	6.31	12.0
Total SO_x Emissions (metric tons)	6.57	7.2	12.4
Total PM10 Emissions (metric tons)	2.28	2.55	4.66

Notes:
See notes listed under Table 4-3.

4.6 Semi-Active Treatment: Engineered Treatment Cells

This alternative involves the use of *ex situ* ETCs for gravity-flow treatment of surface water at the Site. The ETCs are designed to require minimal pressure for water to flow through them, so that surface water can be routed to the cell passively with the gravity-driven hydraulic head provided by topographic elevation differences across the Site.

To determine the most effective reactive media for uranium removal at the Site, HMC tested multiple variations of solid- and aqueous-phase media. Based on pilot tests completed between 2016 and 2021 (described in Section 4.6.2 and in **Appendix 6**), BCR-based ETCs have been shown to be effective for treating uranium in surface water, and minimal pressure is required to maintain passive flow through the treatment cells. The pilot tests have demonstrated that the technology is effective in principle; however, numerous technological and environmental factors make this alternative infeasible at full scale, as described in more detail below. The outcome of the Feasibility Tests is summarized in **Table 4-9**.

Table 4-9. Feasibility Test Results for the Semi-Active Treatment with Engineered Treatment Cells Alternative

Feasibility Criterion	Result
Anticipated Uranium Load Reduction	48 percent (high-flow/snowmelt period) 61 percent (low flow) Hypothetical load reduction estimates based on combined UW, IRD, and TCRD loads for accessible field season only, assuming technical feasibility
Able to Meet WQBEL	No
Technologically Implementable	Infeasible
Other Consequences	Infeasible

4.6.1 Implementation Design Elements

As described in Section 3, the ETC concept can be employed using a variety of treatment media and biogeochemical approaches. Like the injection-based strategies described in Section 3, treatment of uranium within a treatment cell may follow either an oxic or reductive approach. Reduction-based ETC treatment relies on reduction of U(VI) to U(IV) in low-oxygen environments, which may be abiotically driven using a chemical reductant (i.e., using a chemical that would directly react with uranium to donate electrons without requiring bacteria to facilitate) or biologically catalyzed by a large variety of anaerobic microbes (i.e., bacteria which function in the absence of oxygen, including sulfate- and metal-reducing bacteria) under a range of geochemical conditions (Majumder and Wall 2017).

For biological treatment, the ETC media supply an organic carbon-based electron donor, nutrients, and potentially a natural microbial inoculum (i.e., something that would supply the microbial population to facilitate uranium reduction). Configurations that HMC pilot-tested at the Site (summarized in Section 4.6.2 below) include the following:

- Solid-phase organic BCR media typically comprising a mixture of alfalfa hay, wood chips, and manure/compost;
- Dissolved lactic acid, continually added into the treatment water, which is then supplied to an ETC containing inert (i.e., non-reactive) media; and
- Emulsified vegetable oil (EVO), periodically dosed into the influent solution to resupply the ETC as EVO entrained within the cell is depleted.

The solid and liquid organic-carbon approaches each have advantages. Although the solid-phase BCR can be operated more passively (not requiring active, continual addition of an organic carbon reagent during operation), the operator has less control over the lifetime of the ETC, which is instead driven by the longevity of the media initially placed in the cell. In contrast, the dissolved organic carbon-based ETC can continue to operate as long as electron donors and nutrients are supplied to the cell. The EVO approach represents an effective middle ground, whereby the reducing capacity of a solid-phase BCR can periodically be resupplied through EVO addition.

The oxic-based strategy involves treating uranium the the ambient oxygen-rich condition of the water, without attempting to affect a redox change. These strategies therefore involve removal of U(VI) (UO_2^{2+}) by adsorption (using an adsorbent media) or using a reagent that would cause uranium to precipitate as a mineral. Examples of adsorbents or reagents applicable to uranium include the following:

- Zeolite: A naturally occurring clay mineral used for ion exchange;
- Apatite: Variations include rock apatite and apatite derived from fish bones. Apatite supplies phosphate to achieve uranium adsorption and precipitation within phosphate minerals;
- Zerovalent iron (ZVI): ZVI can remove uranium via multiple oxic and reductive mechanisms. Under high-oxygen conditions, oxidation of the ZVI yields ferric iron for adsorption and coprecipitation of uranium within oxyhydroxide minerals. Under low-oxygen conditions, ZVI can act as a chemical reductant to reduce U(VI) to U(IV), promoting precipitation as the mineral uraninite (UO_2); and
- Synthetic IX resin: Engineered, synthetic IX resins can be very efficient at removing uranium from solution but require higher pressures to operate. Although this may be considered an ETC strategy, HMC evaluated use of IX resin in a semi-active configuration under a separate alternative scenario (Section 4.7).

Of the strategies described above, HMC determined that the BCR-based ETC, periodically supplemented by EVO, is the most effective at reducing uranium. An important consideration, however, is the effect that ETC effluent has on water quality. Although the organic carbon-based microbial reduction strategy can yield low concentrations of uranium, it also yields high concentrations of effluent byproducts, including residual dissolved organic carbon, which contributes to downstream biochemical oxygen demand (BOD), and phosphate and ammonia, which can impact aquatic life and potentially cause compliance problems. When present in high enough concentrations, these analytes can only be addressed with a post-treatment system.

At full-scale implementation, the semi-active ETC alternative for the Site would include the following components:

- Passive, gravity feeding of impacted water to a one-stage bioreactor cell with a 36-hour optimum HRT;
- A bioreactor that would contain BCR media consisting of, but not limited to:
  - Short-term and long-term carbon sources, such as wood chips, saw dust, and/or alfalfa hay;
  - Microbial inoculum (e.g., a ruminant manure, such as goat, cattle, or sheep manure, or a Site-specific abiotic inoculum, such as NPL sediment); or
  - Material for placement within the lower and upper portions of the treatment cell to facilitate flow distribution (e.g., pea gravel, pumice, or sand);
- ETCs that would be constructed using a series of aboveground modular metal containers (Conex box, roll-off bin, or similar); and
- To address and mitigate the treatment byproducts described above: a combination of dilution with untreated water, multimedia filtration, and aerobic microbial post-treatment. The effectiveness of these remedies, however, depends on overall system flow rates and the age of the treatment media. Specific post-treatment options that HMC pilot tested at the Site are summarized in Section 4.6.3.

Due to the long (36-hour) HRT required to achieve microbial reduction, the treatment cells would be very large and would occupy a large footprint to handle the required flow rates at full scale. This design challenge can be partially offset by combining the ETC technology with seepage capture systems designed to segregate impacted water from clean water before mixing (as we described in Section 3.3.5). Although undiluted impacted water tends to be of lower quality overall (e.g., elevated total dissolved and suspended solids, sulfate, iron, and manganese), the BCR media is not as sensitive to influent water quality as, for example, IX media is (as described in Section 4.7). In addition, one advantage of the long HRTs and very large cell volumes that would be required is that the pressure required to drive flow through the ETC is very low (hydraulic pressure head of less than five to 10 feet[bb]). This means that there would be an opportunity to install treatment systems relatively close to the discharge point of source zones, including the bottom of the rock dumps. Thus, this alternative incorporates the water segregation strategies described below, which would be used in the construction of up to three separate ETC systems to treat UW, IRD, and TCRD discharge (see **Figure 4-3**).

For the UW and TCRD ETCs, flow capture would include the following respective components:

- A Chester Fault Drain (CFD) to capture Chester Fault groundwater seepage before it discharges into and is diluted in the NPL; and
- A TCRD toe drain to capture overburden rock seepage before it discharges into the Tie Camp drainage.

Because HMC installed a drainage diversion in 2021 (**Figure 4**), no additional water segregation for the IRD seepage discharge would be considered necessary. The 2021 diversion rerouted upstream surface water flow away from this drainage, so the water currently expressing to this drainage is mostly groundwater discharge from the IRD. Rock dump seepage may therefore be collected directly from Indian drainage. For the purposes of this evaluation, HMC assumed that these systems would not capture the additional uranium load discharging to the sediment pond (the “Downstream Load” identified in **Figure 2-6**).

[bb] Hydrostatic pressure can be expressed in many units, but one convenient unit is feet of water, where the pressure is described as the pressure at the bottom of a column of water of a certain height. This is used here (instead of, say, pounds per square inch [psi]), because it literally reflects how high a water source would need to be elevation-wise above a treatment system to achieve a required pressure. In other words, if the required pressure to move water through a treatment system is 10 feet of head, this could be accomplished by placing the treatment system 10 feet lower than the water source and running the water through a pipe. In practice, it is also important to account for the fact that the flow of water through the pipe will reduce the amount of pressure that is actually felt at the bottom (the 10-foot pipe would have 10 feet of head at the bottom when the flow is zero, but this would decrease below 10 feet of head the faster the water flows through the pipe).

Figure 4-3. Plan View of Potential Site-wide ETC Treatment System

With implementation of these water segregation strategies, the anticipated system flow rates, number of cells, and areal footprint associated with ETC treatment of each source zone are summarized in **Table 4-10** below:

Table 4-10. ETC Flow Rate and Areal Footprint by Treatment Area

Area	Treatment Flowrate (gpm)	Cells Required	Media Required (ft^3)	Footprint (ft^2)[1]
CFD Treatment	12–46	25	35,000	17,000
IRD Treatment	22–216	117	165,000	80,000
TCRD	9–238	129	180,000	86,000

Notes:

1. Assumes that 250 square feet (ft^2) per cell is required for system infrastructure (process equipment, maintenance access, loading and unloading of media, etc.)

As shown in **Figure 4-3**, the CFD flow would be routed directly to the existing 10300 bench, which is already graded and has a sufficient footprint to accommodate the cell requirements for CFD treatment. IRD and TCRD treatment areas would be placed at the base of each respective rock dump and just upstream of the sediment pond. This would require extensive earthwork and grading due to the steep topography.

4.6.2 Technological Feasibility

Field-implementation pilot testing conducted at the Site from 2016 through 2021 demonstrated that the BCR-based ETC technology can achieve uranium load reduction at the Site during the active field season (i.e., from June to mid-October), but only with significant technical challenges related to operational temperature requirements and byproduct generation. These challenges make this alternative technologically impractical to implement. We provide the testing results and reasons for this determination below. Although HMC considers this technology impractical based on technological and other consequences (described further in Section 4.6.3), HMC's estimates of the theoretical uranium load reduction that may be achieved based on pilot cell performance are also provided below.

4.6.2.1 Field Pilot Test Summary

HMC tested ETCs from 2016 through 2021 in drum-scale tests and larger field-scale cells to evaluate various media types and the effects of cell dimensions, flow configurations, and temperature on uranium treatment and media longevity. The "drum-scale" tests were conducted using packed 55-gallon plastic drums as treatment cells, configured to operate in upflow (water inflow piped in at the bottom and outflow at the top). In 2016 and 2017, HMC used water collected from the Tie Camp drainage for influent (having a uranium concentration of approximately 1 mg/L). Starting in 2018, as the pilot tests were scaled up, influent water was collected from the Chester Fault springs (CFS and CFS-2; see **Appendix 6**) to test higher uranium concentrations in the influent water (ranging between 5 and 7.5 mg/L). Using CFS water required water collection and piping down to the 10300 bench adjacent to the Mine Shop, analogous to the configuration shown in **Figure 4-3**. The ETC pilot tests conducted at the Site are summarized in **Table 4-11** below.

Table 4-11. ETC Testing Summary

Year	ETC Test	Media / Conditions
2016	ZVI Reactor Drum	ZVI and pea gravel (50/50 mixture).
	Peat Soil Reactor Drum	Peat soil collected on site mixed with pea gravel (50/50 mixture).
	"PIMS" Reactor in-field column (8-inch diameter)	Fish-bone apatite (Phosphate-Induced Metals Stabilization [PIMS] product).
2017	BCR ETC Drum	Wood chips, sheep manure, alfalfa hay, ZVI.
	ZVI ETC	ZVI and sand (50/50 mixture) Below-surface installation in plastic-lined cell Up-flow configuration (influent water enters at the base of the cell and flows up through the media to an outlet at the top) Cell dimensions: 3 feet by 5 feet by 15 feet

Year	ETC Test	Media / Conditions
2018-2020	ETC-1 and ETC-2	Wood chips, alfalfa hay, and sheep manure Operated in series (designed to operate in series or in parallel) At/above-ground installation in identical high-density polyethylene (HDPE)-lined cells Up-flow configuration Cell dimensions (each cell): 30 feet by 60 feet by 2 feet
2019-2020	BCR1 Drum	Iron-supplemented BCR ETC test: Wood chips, alfalfa hay, sheep manure, yellow iron oxide.
	BCR2 Drum	BCR ETC test (control drum): Wood chips, alfalfa hay, sheep manure.
	BCR3 Drum	Liquid organic reagent PBR test: Pea gravel, sheep manure, lactic acid solution (dosed).
2020-2021	ETC-3	Wood chips, alfalfa hay, and sheep manure. EVO addition in 2021. Above-grade installation in metal roll-off container Up-flow configuration Cell dimensions: 7.8 feet by 9.3 feet by 8 feet
2021	Drum 1	BCR ETC temperature evaluation (control test): Wood chips, alfalfa hay, sheep manure, NPL sediment for microbial inoculation.
	Drum 2	EVO PBR test (control test): Inert media (sand) with solid-phase nutrient (ChitoREM); EVO dosed with influent solution.
	Drum 3	BCR ETC temperature evaluation: Wood chips, alfalfa hay, sheep manure, NPL sediment for microbial inoculation with cooled influent (target 6 degrees Celsius [°C]).
	Drum 4	EVO PBR test: Inert media (sand) with solid-phase nutrient (ChitoREM) and EVO with cooled influent.
	Drum 5	BCR effluent-recycle test: PBR with inert media, blended effluent of Drum 1 with untreated influent water (target 6°C).
	Drum 6	EVO supplement to BCR test: 2019 BCR-2 drum restarted with EVO addition.

Notes:
Drum tests were conducted in 55-gallon HDPE drums in an up-flow configuration.
PBR = Packed bed reactor.

The objectives, operation details, and results of each test are included in **Appendix 6**. Effective uranium removal of up to 98 percent relative to influent concentrations was observed in the organic-based ETCs containing the standard BCR ETC media. However, treatment performance was sensitive to several factors including residence time, cell geometry and path length, media age, water temperature, and microbial activity. Here is a summary of key observations from the pilot tests:

- During the drum-scale tests that HMC conducted in 2016 and 2017, the BCR and ZVI technologies were more effective at achieving uranium load reduction than other media that were tested. On-site peat soil (used to stimulate microbial reduction) was not effective, and the PIMS product exhibited short media lifetime (less than one field season).
- The ZVI media performed well at the drum scale but exhibited only short-term effectiveness and was exhausted within one field season when upscaled to a field-pilot cell implementation. The results were attributed to the ZVI's incompatibility with the alkaline Site water, which likely resulted in ZVI passivation by calcium carbonate.
- Drum-scale tests that HMC conducted in 2019 and 2020 demonstrated the enhanced performance of the BCR mixture when amended with an iron supplement (which was used to increase metal-reducing bacterial activity and diversity) and demonstrated the high performance of the liquid organic reagent ETC strategy.
- The BCR-based ETC technology continued to perform well when upscaled to the field pilot scale with in-ground ETCs 1 and 2. In the first and second testing years, overall uranium load reductions up to 84 percent (approximately 60 percent per cell) were realized with an approximately 48-hour HRT per cell. However, dye tracer tests conducted within ETC-2 revealed that that preferential flow/channeling within the cell was occurring (i.e., flow of a significant fraction of the water through narrow flow channels, rather than flowing uniformly through the full media bed), leading to diminished performance. HMC hypothesized that this effect was due to the wide and thin/flat geometry of the cells, which, despite their volume, only provided a 2-foot reaction path length.
- The ETC pilot cell design was revised in 2020 for ETC-3. The revised design optimized the reaction path length by narrowing the lateral dimension and increasing the height, while maintaining the up-flow configuration. This was accomplished by constructing the cell using a metal roll-off bin, which also in principle would contribute modularity for full-scale implementation (in other words, the treatment system could be constructed to a desired size simply by adding or subtracting individual cells).
- With the new configuration, ETC-3 demonstrated better uranium removal efficiency than ETCs 1 and 2 and was used to test HRT optimization and late-season performance. The results from ETC-3 are provided in **Figure 4-4**.
  - The ETC was run from August through September 2020 at a 48-hour HRT and demonstrated a 97-percent uranium removal efficiency observed.
  - In September, the HRT was reduced to 24 hours, resulting in a slow decrease of the uranium removal efficiency to an average of 65 percent. However, this period also coincided with a decrease in ambient air temperature that may have also played a role in the reduced efficiency.
  - Starting in October, the treatment efficiency diminished to zero, with testing of 12- and 24-hour HRT. This absence of uranium reduction is believed to be strongly influenced by influent water temperature

and ambient temperature (note the decrease in ambient air temperature to near zero degrees Celsius; **Figure 4-4**).

- The full-scale design HRT for high-flow conditions was selected to be 36 hours and assumed an associated 80-percent removal efficiency. The 36-hour HRT was selected to add a factor of safety to the 24-hour HRT for conservative full-scale operation, given the sharp drop in performance efficiency for HRT less than 24 hours (see **Figure 4-4**).

- Post-treatment tests on ETC effluent that HMC conducted in 2020 showed promising results for minimizing treatment residuals, but with implementation challenges at full scale. Specifically:
  - Aeration of effluent water within aerobic bioreactor can be used to consume residual BOD but may require long residence times (several days to weeks) to achieve surface water BOD effluent limits under full-scale operation.
  - Phosphate and ammonia concentrations did not attenuate within the aerobic bioreactor.
  - A technique by which BCR effluent is recycled as an organic carbon/nutrient source feeding a second inert-media ETC demonstrated effectiveness for additional uranium load reduction and consumption of some treatment byproducts but is subject to lower treatment efficiencies and longer required HRT.

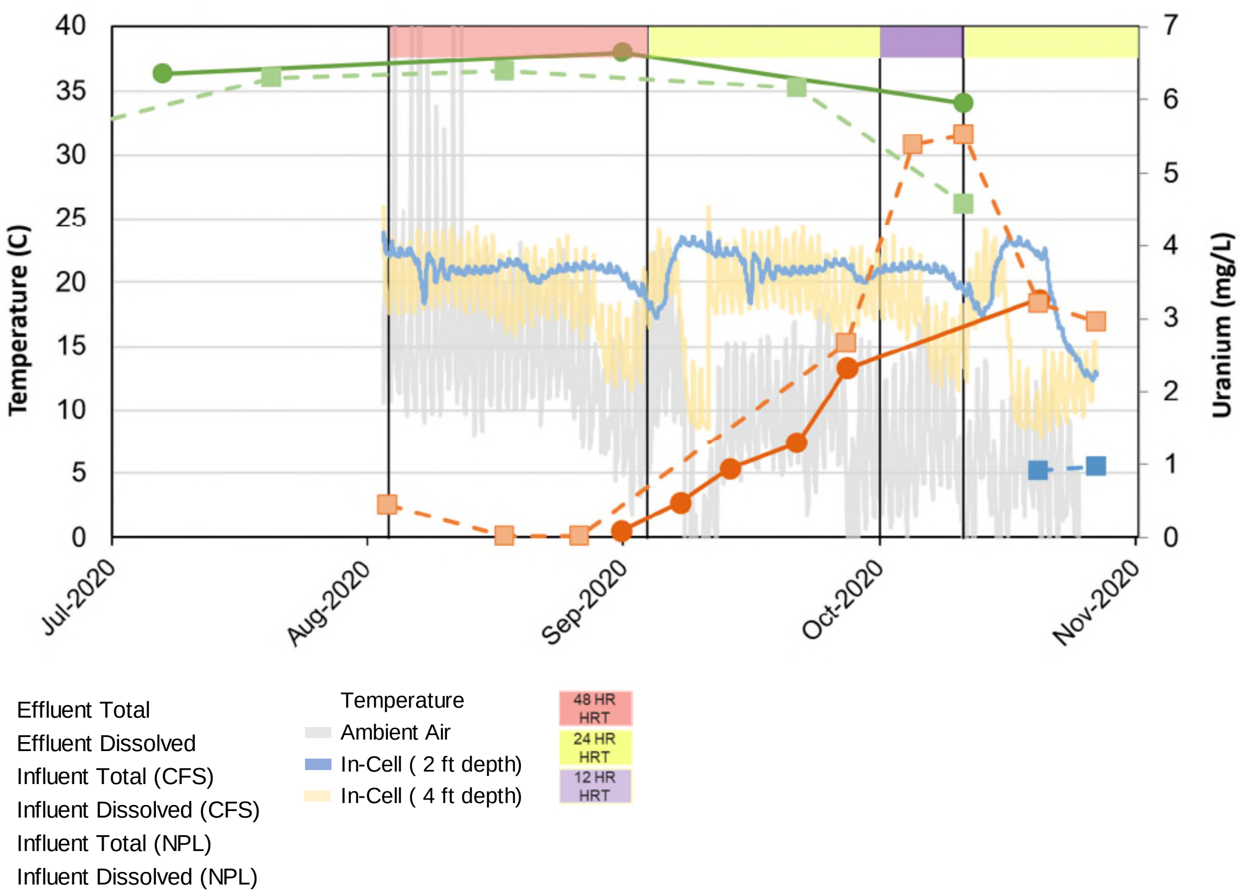

Figure 4-4. ETC3 Pilot Test Results

4.6.2.2 Technological Feasibility Determination

As demonstrated by the field pilot testing, one of the greatest technological challenges presented by the BCR-based ETC technology involves maintenance of influent water at sufficiently warm temperatures to sustain microbial growth. Although some heat may be generated within the cell by microbial activity, the temperature of the influent water is the key driving parameter for controlling in-cell temperature. The ambient air temperature plays an important secondary role, depending on how well the cell is insulated. Critically, the 2020 ETC-3 tests demonstrated that, as temperatures decreased in October, microbial activity slowed to the point at which biological uranium reduction ceased. Continued operation of the cells at this point would presents a high risk, because microbial consumption of dissolved oxygen also slows, resulting in the potential for uranium reoxidation.

Even though the alternative would only be run during the active field season based on technological feasibility arguments discussed in Section 4.1.1, the temperature factor places an even stricter logistical limitation on the ETC technology, particularly with respect to spring startup under high-flow conditions. Following a long winter shutdown, it would be technically impractical to use the cells to treat high-flow spring snowmelt due to the following issues:

- If the cells were not operated over the winter, water flow to the cells would need to be shut off to prevent uranium reoxidation and release.
- Given the volumes and areal extents of BCR media required for uranium load reduction (**Table 4-10**), keeping the cells warm over the winter would not be feasible. So, the cells would then either need to be drained over the winter (which would risk uranium reoxidation) or allowed to freeze (which would risk cell and pipe damage); both conditions result in the diminishment or dormancy of metal-reducing microbes needed to operate the system.
- Based on pilot test results, reducing activity can be revived in the cells, but only after a return of relatively warm surface water temperatures and an extended microbial incubation period within the cells to revive active reducing conditions (approximately 1 to 2 weeks were provided in pilot tests).
- Under full-scale operation, by the time cells could be accessed, refilled, and/or thawed under ambient conditions and by the time the microbes were allowed to incubate, the cells would not be restarted in time to treat significant high-flow water, nor would the temperature of snowmelt be amenable to microbial treatment.

Based on this site-specific assessment, the ETC semi-active treatment alternative is considered technologically infeasible.

4.6.2.3 Anticipated Theoretical Uranium Load Reduction

HMC estimated the anticipated uranium load reduction that would (in principle) be achievable through successful implementation of the ETC technology. Load reduction was estimated under the following hypothetical scenario and assumed parameters:

- ETCs would be implemented according to the design concept described in Section 4.6.1, which would target the UW/NPL, IRD, and TCRD loads, but would not be expected to capture the downstream load (**Figure 2-6**). The system would therefore target 67 percent of the total uranium load under high-flow conditions and 85 percent of the uranium load under low-flow conditions, noting that these load reductions would only apply when the system is in operation (June through October);

- For each system, a load capture efficiency of 90 percent was applied, assuming incomplete capture by the groundwater seepage capture systems; and
- The ETCs would target an HRT of 36 hours and an assumed 80-percent uranium concentration reduction efficiency.

Based on these parameters, the full-scale ETC system would hypothetically achieve approximately 48-percent uranium load reduction under high-flow conditions and approximately 61-percent uranium load reduction under low-flow conditions. However, these reductions would only apply when the system is operating (approximately five months out of the year), and these assumptions do not account for the challenges associated with treatment byproducts.

4.6.3 Other Consequences

Other consequences associated with the BCR-based ETC technology include the following:

- Substantial radiological waste generation based on the long HRT and correspondingly large volumes of treatment media required to achieve uranium removal;
- Correspondingly large areal footprints associated with treatment media cells, which would not be consistent with reclamation objectives;
- Environmental footprints associated with in-perpetuity water treatment; and
- Presence of biological treatment byproducts in the effluent (BOD, phosphate, and ammonia).

As shown in **Table 4-10**, the volume of media required for a single ETC implementation would be approximately 14,000 cubic yards (CY), or 380,000 cubic feet (ft^3). Although the lifetime of the media may be extended with injection of soluble/emulsified organic reagents such as EVO, HMC anticipates that the treatment media eventually would degrade, accumulate uranium treatment solids, and gradually exhibit poorer flow performance. Assuming a five-year lifetime of the treatment media, the waste generated from ETCs would be 2800 CY per year.

In addition to the infeasibility presented by waste generation and off-site disposal, the generation of treatment byproducts (BOD, ammonia, and phosphorus) presents possible and potentially significant water quality and water-discharge compliance concerns that would need to be managed if full-scale application proceeded. As described above, phosphorus is a nutrient that can feed the growth of algal blooms, which can have direct impacts on the ecological health of downstream surface waters. Similarly, nitrate and BOD support excessive growth of algae and other biota which lead to competition and oxygen consumption in freshwater systems. It is for these reasons that the nutrient surface water standards are in place.

HMC concludes that management and disposal of waste products of this magnitude and generation of treatment byproducts at full scale are infeasible when weighed against maintaining current water quality conditions, given that downstream water uses are currently protected. Specifically:

- As we have noted in previous sections, water treatment wastes generated on site would need to be disposed off-site and out of state in a licensed disposal facility. In addition to the costs associated with waste management and disposal, permitting, and other logistical challenges associated with such disposal, including compliance with U.S. Department of Transportation (DOT) Class 7 regulations for transport and packaging, requirements for dewatering the waste, waste-classification mandates, the need for truck transport, obtaining a permit for export with the RMLLRWB (including export permit fees based on the quantity of waste generated), and brokerage with the disposal facility. These logistical challenges grow as waste volumes increase.

- The treatment solids containing highly concentrated uranium and radium extracted from Site surface water could pose environmental or health and safety risks associated with contact and exposure. These risks are greater than the risks associated with the untreated water leaving the Outfall, which contains substantially diluted concentrations of these radionuclides. When surface water uses are protected (as they currently are in downstream water bodies), contact and exposure risks are minimal.
- As noted above, post-treatment reactor tests were conducted to evaluate strategies for byproduct removal at the pilot-test scale, with a focus on removal of BOD (see **Appendix 6**). Although these approaches were somewhat effective at removing BOD, the aerobic treatment strategy would require significant electric power and water retention to provide the oxygenation and residence time required. These tests were not effective at removing phosphorus and ammonia, which would require incorporation of a second-stage treatment system, likely defeating the purpose of the semi-active BCR-based approach.
- System operation, waste handling, and waste transportation are anticipated to have substantial associated environmental footprints. However, given the overall infeasibility of this scenario, a detailed environmental footprint was not estimated for this alternative.

4.7 Semi-Active Treatment: Ion Exchange

The semi-active IX treatment alternative involves using traditional IX resin technology to remove uranium from surface water while operating the system under gravity pressure-driven flow. Like the semi-active ETC alternative, surface water is collected and routed through treatment vessels, with the steep topographic relief providing the hydrostatic pressure necessary to drive flow.

This technology has proven highly effective at treating site-specific surface waters with a variety of synthetic anion-exchange resins, with more than 99-percent uranium removal observed in field pilot tests (Section 4.7.2 and **Appendix 6**). Due to the pressure requirements for IX vessel operation (described further below), this technology cannot be applied broadly across the Site to treat all potential water flows using gravity, which is key to the semi-active alternative (note that active pumping alternatives were screened out due to high power demands in Section 3.3.4). Although HMC considers the alternative technologically feasible, it is considered infeasible based on other consequences when the potential effectiveness at removing uranium is weighed against the impacts of waste generation and the increase in the risk profile associated with concentrating, transporting, and disposing of radiological waste in perpetuity. The rationale for this feasibility assessment is provided further below, and the Feasibility Test results are provided in **Table 4-12**.

Table 4-12. Feasibility Test Results for the Semi-Active Treatment with IX Alternative

Feasibility Criterion	Result
Anticipated Uranium Load Reduction	NPL load only: 26% (high flow/snowmelt) 53% (low flow) Load reduction estimates for active field season only
Able to Meet WQBEL	No
Technologically Implementable	Feasible (seasonal operation only)
Other Consequences	Infeasible

4.7.1 Implementation Design Elements

Ion exchange treatment of uranium involves the exchange of dissolved uranium ions (either the free uranyl ion or aqueous ion complexes) for an ion of similar size and charge that is loaded onto the IX resin before use. Several types of synthetic, highly engineered resin products are available that exhibit varying selectivity for different ions under different water quality conditions. In the first round of laboratory tests that HMC conducted in 2020, a wide variety of cation- and anion-exchange resins were tested with surface waters derived from the Site, using varying chemical "preconditioning" strategies (in other words, methods to pretreat or add reagents to the water to enhance performance of the IX resin; options considered here included pH adjustment, alkalinity neutralization, and lime softening to remove calcium). Ultimately, the most effective resin that HMC identified is a strong base anion (SBA) resin which exhibited high effectiveness without requiring any chemical preconditioning (making it a more efficient option for full-scale use). Given the alkaline pH of Site surface water and the effectiveness of this anion-exchange resin, HMC hypothesizes that uranium is directly adsorbing to anion-exchange sites in the form of negatively charged uranyl ion-carbonate complexes, such as the $UO_2(CO_3)_2^{2-}$ complex, which is more abundant at Site surface water pH values (near pH 8 to 8.4) than the free cationic UO_2^{2+} complex. This is important because it demonstrates that uranium can effectively be removed from Site surface waters without requiring chemical alteration of the water to change the form of uranium in solution.

In addition to evaluating the ideal resin type and water preconditioning requirements, laboratory and field column tests (described further in Section 4.7.2) were used to refine engineering design parameters for potential large-scale IX treatment. Specifically, the resin was designed for and saw optimum field performance with an empty bed contact time (EBCT)[cc] of between 5 and 15 minutes and column dimensions (width and height) to achieve a hydraulic loading rate[dd] of 6-18 gpm/ft^2. Based on the hydraulic loading rate and the observed permeability of the

[cc] As noted in the footnote on HRT, the "empty bed contact time" is an alternative way to express the HRT that uses the total volume of the reactor (i.e., the "empty bed" volume) rather than the water-filled volume. This convention is used more routinely in describing IX design and performance, in part due to the fact that the water content of a packed IX bed varies according to different resin types.
[dd] The "hydraulic loading rate" is defined as the volumetric flow rate divided by the cross-sectional area of the flow vessel (i.e., the area normal to the direction of flow). This value is expressed in units of distance per time and is proportional to the water velocity within the vessel.

IX resin, field tests determined that operating IX vessels within a full-scale system requires a working pressure of approximately 80 pounds per square inch (psi), equivalent to approximately 185 feet of gravity-head pressure to overcome the IX vessel pressure. With the addition of prefiltration requirements to remove turbidity (e.g., sand filters or bag filters) and accounting for hydraulic pressure losses with flowing water within the pipes, the elevation difference required at full scale to run a semi-passive system is estimated at between 200 and 220 feet. Although that is achievable at the Site given the high topographic relief, this requirement limits the sources of water that can be collected and treated via gravity feed within the Site. For reference, the elevation differences corresponding to different water collection and treatment location pairs across the Site are provided in **Table 4-13** below (refer to **Figure 4-5** for site locations). The “pairs” refer to the inflow point (water collection source) and the outflow point at the location of the treatment system, which provide the elevation difference to generate the hydrostatic head pressure.

Based on this assessment, HMC concludes that implementation of IX treatment under gravity flow is most feasible when water is collected at the NPL outlet; at the other locations, water collection for IX treatment via gravity feed (including the Indian drainage and the toe of the TCRD) would not be feasible on site. The full-scale system design considered here therefore includes NPL-only treatment using a system constructed at the foot of the IRD. This is the configuration that was tested with the 2021–2022 IX field-demonstration test described in Section 4.7.2.

Table 4-13. Potential Water Collection and Treatment Location Pairs

Surface water collection point	Treatment location	Elevation difference
NPL outlet	Mine Shop/10300 bench	40 feet
NPL outlet	Foot of IRD	300 feet
Indian drainage (monitoring point IC)	Foot of Sediment Dam	90 feet
Tie Camp drainage	Foot of Sediment Dam	190 feet
Sediment pond at maximum level	Foot of Sediment Dam	25 feet

Notes:
The minimum elevation difference required to operate the IX system is estimated at approximately 200 to 220 feet. Green boxes represent inlet/outlet pairs which meet this requirement, and pink shaded boxes represent inlet/outlet pairs that do not meet this requirement.

Figure 4-5. Potential Water Collection and Treatment Locations

The semi-active NPL water IX treatment alternative includes the following components and assumptions:

- NPL water would be conveyed via gravity to the IX system located on a shallow bench at the foot of the IRD (**Figure 4-5**);
- The full-scale system would be housed in a structure built in 2021 as part of the IX field demonstration. The existing pilot-scale system (designed for a maximum flow rate of 130 gpm) would be expanded to add a second in-parallel treatment stream for a total design-flow capacity of 260 gpm;
- Minimal electric power requirements would include lighting and heating of an enclosed treatment structure and operation of electronic flow monitoring, alarm, and data monitoring systems. Heat would be provided using propane (potentially supplemented with electricity generated from solar and/or hydro/turbine power);
- Based on observations derived from the column-scale and field-demonstration tests, prefiltration of the surface water before it enters the IX vessels is required to protect the resin bed from fouling. Prefiltration may involve a combination of bag filtration or sand filtration, along with chemical treatment via a microbicide to prevent biofouling;
- Each treatment stream would include two IX vessels operating in series in a lead-lag configuration, with each vessel containing 50 ft^3, for a total of 200 ft^3 of Purolite PGW6002E resin and operating at a minimum EBCT of 5 minutes;
- IX system effluent does not require filtration to meet water quality standards. However, effluent filtration would be used as a safety measure to prevent the discharge of resin beads in the event of equipment

failure within the IX vessels. As a water treatment product, following treatment of Site water, IX resin is considered licensed material under HMC's RML; and

- Following treatment, filtered IX system effluent would be discharged back into Indian drainage.

Although NPL flows during May and June have historically exceeded 260 gpm, a combination of surface water diversion (NPL diversion) and temporary storage within the NPL would allow most of the NPL flow to be treated through IX with minimal bypass.

4.7.2 Technological Feasibility

The IX technology has been demonstrated to remove uranium from Site surface water under current water quality conditions (dissolved solids content and water temperature), following prefiltration to remove suspended solids. HMC considers IX technologically feasible when used seasonally for NPL-only treatment.

4.7.2.1 Laboratory and Field Pilot-Test Summary

HMC began bench-scale IX testing in 2020 to evaluate different resin types, Site water sources, and water pretreatment strategies. Key findings from the laboratory tests include the following:

- Laboratory tests were conducted using SBA, strong acid cation (SAC), and weak acid cation (WAC) resins. Of these, the SBA resins were most effective for removing uranium from the Site surface waters that were tested, which included water from SW-33, CFS (seeps discharging into NPL), and RD-05 (a shallow well at the toe of the IRD, used to represent rock dump seepage discharging to surface water).
- HMC tested acidification of the CFS water to determine the effectiveness of the SAC resin in a pH regime where the uranyl cation (UO_2^{2+}) would become dominant. However, this configuration was less effective at removing uranium than use of the SBA resin at ambient, unamended pH levels was.
- HMC tested lime softening of the CFS water to remove calcium in order to destabilize the neutrally charged ternary calcium-uranyl-carbonate complex, $CaUO_2(CO_3)_2^0$, to yield a greater proportion of the negatively charged uranyl carbonate complex, $UO_2(CO_3)_2^{2-}$. This strategy was tested to evaluate whether the anion resin would be more effective with a shift of this neutral species to an anion form. This test was effective at improving the uptake capacity of the SBA resin in batch-jar tests. However, given the high performance of the SBA resin in column flow-through tests, this added preconditioning stage was not carried forward into pilot testing.

Following successful performance of the SBA resin in the laboratory, a series of field-column and large-scale field-demonstration pilot tests were completed as follows:

- An IX column test with the SBA resin Purolite PGW6002E was conducted at the Outfall in 2020 and successfully ran from November 2020 through June 2021, treating 44,000 bed volumes[ee] of water with up to 99-percent removal efficiency.
- An additional nine columns were constructed and operated during the 2021 active field season. The column tests were designed to obtain performance data on multiple IX resins and to evaluate the effect of water chemistry on treatment performance by testing multiple potential water sources. Water sources tested included NPL water, IRD seepage water, and TCRD seepage water.

[ee] The "bed volume" corresponds to the volume of the empty IX vessel. For the 2021 column test, this corresponds to a volume of 1.5 gallons, and 44,000 bed volumes corresponds to a total treated water volume of approximately 66,000 gallons.

- HMC constructed the IX field-demonstration system during the 2021 field season and operated it intermittently through the winter and spring, from October 2021 through July 2022. The IX system was placed at the IRD toe and received NPL surface water that was conveyed via aboveground HDPE piping. The IX field demonstration performed similarly to the column tests, and HMC observed greater than 99-percent uranium removal over 36,000 bed volumes (corresponding to a total treated water volume of 13 million gallons). The levels of uranium removal were similar for EBCTs from 3 minutes to 15 minutes (up to a 120-gpm flow rate) with routine pressure requirements at or below 80 psi.

In addition to the evaluation of treatment performance observed in the effluent from the IX system, the level of uranium load reduction was also evaluated downstream on Indian drainage and at the Outfall.

NPL surface water treated by the IX field-demonstration system was routed to the Indian drainage and discharged into the IRD culvert outlet stilling basin (**Figure 4**). This portion of Indian drainage runs past monitoring point IC to the sediment pond where all sitewide surface water is collected before discharging offsite at the Outfall (**Figure 4**). During 2021 and 2022 operation of the field implementation IX test, system flow varied between approximately 20 and 60 gpm during winter operation (from December through February), this treated water flow accounted for over 50 percent of the total flow recorded at the Outfall (**Figure 4-6**).

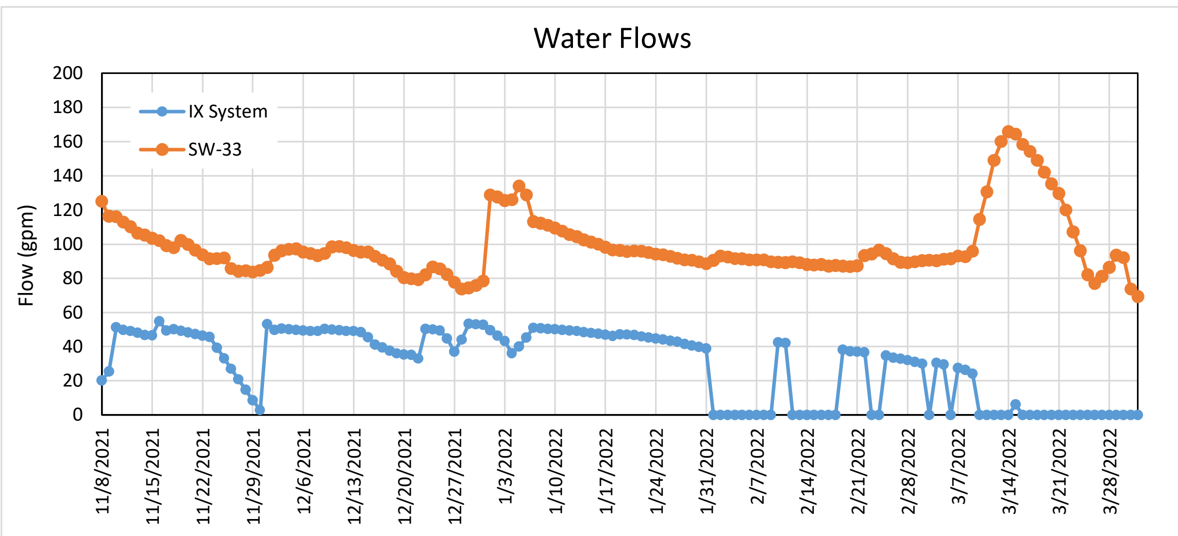

Figure 4-6. Comparison of SW-33 Outfall and IX Field Demonstration System Flows

Dissolved uranium concentrations at the Outfall from September 2018 through August 2022 are provided in **Figure 4-7**. A comparison of the winter 2021–2022 dataset with previous years indicates that the Outfall concentration was consistent with previous years (and in fact slightly higher than in previous years from January through April), showing no response to IX treatment, despite the fact that half of the overall discharge during the December 2021 through February 2022 timeframe represented water that was treated to remove uranium with a 99-percent uranium removal rate.

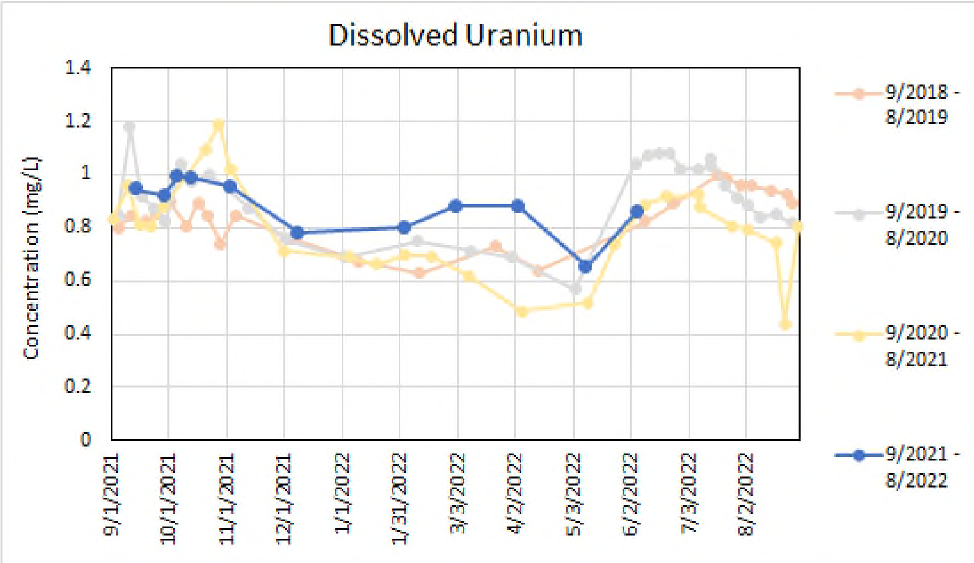

Figure 4-7. Dissolved Uranium Concentrations at the SW-33 Outfall, 2018-2022

Based on the measured flow rate at the Outfall between 80 and 120 gpm and assuming a sediment-pond volume of 8.2 million gallons, the average hydraulic residence time (HRT) over the winter was approximately 2 months. In other words, mixing and dilution of the IX system water with untreated water within the sediment pond would be expected to result in a delay in the observed decrease in uranium concentrations at the Outfall on the order of this two-month timeframe, but could not explain the lack of observed decrease over several months.

Uranium concentrations were also compared at monitoring point IC, which is upstream of the sediment pond and approximately 450 feet downstream of the IX discharge (**Figure 4**). In contrast to the Outfall, decreases in uranium concentration were observable and in proportion to the amount of treatment that was occurring at a given time (**Figure 4-8**), but were still surprisingly low (approximately 50-percent decrease) given that the flow at IC during this period was likely dominated by treatment flow.

The lack of an apparent decrease within the drainage may be due to uranium concentration buffering by sediments residing along the bottom of the drainage and within the sediment pond. This system buffering may be occurring as a result of desorption of surface-adsorbed uranium on the sediments in response to the addition of cleaner water into the drainage. HMC expects this concentration buffering process to be finite, with achievement of a new steady-state condition as readily desorbable uranium is removed from drainage and sediment pond sediments. However, this result has important implications for water treatment at the Site, as it demonstrates that the effectiveness of any uranium load reduction measures implemented at the Site may experience a delay.

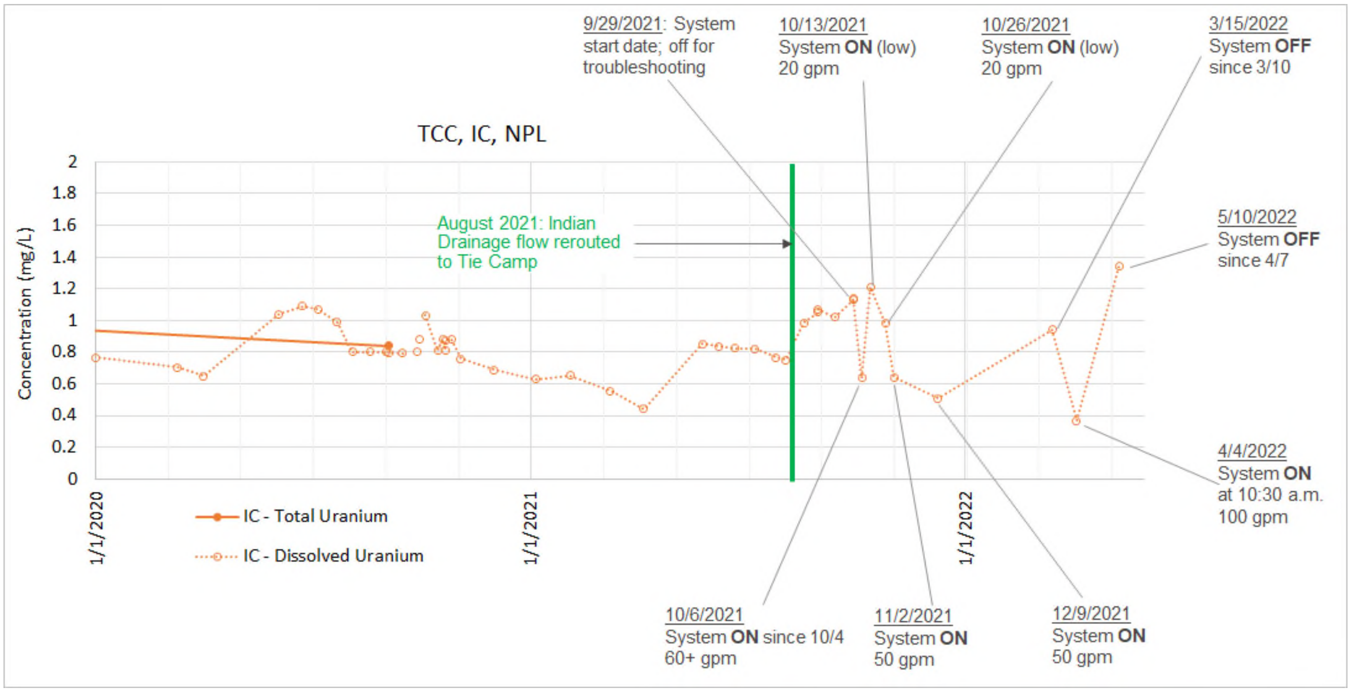

Figure 4-8. Dissolved Uranium Concentrations at Monitoring Point IC, 2021–2022.

4.7.2.2 Technological Feasibility Determination

The laboratory and field pilot-test results demonstrate that semi-active IX treatment at the Site, with minimal power and infrastructure, is feasible. However, although HMC conducted the Outfall column and field-implementation pilot tests through the winter, these tests demonstrated that the alternative requires a high level of maintenance, particularly with respect to water pretreatment for suspended solids present in the water. Due to the natural turbidity of the water in the NPL (which can be highly variable depending on weather conditions, particularly wind which can stir up sediments at the bottom of the lake), prefiltration steps to reduce turbidity are required for successful IX operation. During the field-implementation test, prefiltration bag filters were generally replaced bi-weekly following solids accumulation, and flow to the system slowed to near zero on some occasions due to clogging of the influent filter system. Even with modification and optimization of a full-scale prefiltration system, routine system maintenance and on-site monitoring would be needed to ensure continual operation. However, routine access for system operation and maintenance cannot be relied upon in the winter (see Section 3.1.1), and seasonal system shutdown poses the risk of system freezing, which could compromise equipment and potentially cause resin release. During the pilot testing described above, the system was placed into standby/bypass mode due to excess turbidity in the NPL and risk of limited site access from March through May 2022. For these reasons, only operating IX during the active field season (from approximately June through October) is considered technologically feasible at the Site. However, unlike the ETC technology, rapid and minimal startup is anticipated for a winterized IX system, and it is anticipated that the alternative would be operable from the snowmelt period (pending safe Site access) through late fall.

4.7.2.3 Anticipated Uranium Load Reduction

With NPL discharge collected at the NPL outlet, the IX alternative can effectively treat most of the uranium load corresponding to the Chester Fault/UW sources. Accordingly, HMC anticipates the uranium load reduction to be 26 percent under high-flow/spring snowmelt conditions and 53 percent under low-flow conditions (with the low-flow number applying through late summer into the fall prior to seasonal shutdown).

These anticipated uranium load reduction estimates come with the caveat that upstream uranium removal may take significant time to be realized at the Outfall, based on the field-demonstration test results described above, which indicate that uranium buffering occurs in downstream drainages.

4.7.3 Other Consequences

Other consequences associated with semi-active water treatment via IX are similar to those related to the semi-active ETC technology (Section 4.6.3), which would generally apply to any water treatment approach that requires in-perpetuity operation and generates a licensed radiological waste product. Some of the general points that we noted above with regard to other alternatives are reiterated here, as well as key points specific to the IX technology.

- Compared to the ETC technology, the volume of water treatment waste generated annually by IX is substantially lower (estimated at approximately 300 ft^3 of resin per year for NPL treatment). Although this is positive from a transportation environmental footprint perspective (described below), this material may pose a substantially greater radiological health and safety risk to humans and the environment, especially because the waste must be transported out of state. The concentrations of uranium within the uranium-loaded resin are much higher than uranium concentrations in waste streams generated with other potential treatment options (e.g., total uranium concentrations of approximately 20,000 mg/kg for IX resin versus on the order of 1,000 mg/kg for BCR media).
- This elevated radiation risk would apply, at minimum, to the following:
  - Worker safety during resin handling, which would include slurry removal of loaded resin from vessels, dewatering, waste characterization sampling, and loading on transport vehicles. This presents an increased personal exposure risk.
  - Environmental safety and public health/exposure, with risks including transport-truck accidents and/or accidental spillage.
- Based on its characterization as a licensed radiological material, the resin cannot be disposed of on Site or anywhere in the State of Colorado and must be disposed of at a licensed radiological facility.
- Environmental footprints apply not only to the system operation and maintenance, transport, and disposal portions of the operation, but also to the IX resin manufacture process, as described below.
- The areal footprint associated with the IX treatment system would be substantially less than for the ETC alternative, and HMC believes that the IX system infrastructure would not complicate slope maintenance and revegetation efforts associated with Site reclamation and closure with CDRMS. However, it is currently unknown whether the presence of an in-perpetuity water treatment system at the Site would be compatible with Site closure and eventual release of the Reclamation Permit.

Whether an alternative is feasible based on the Other Consequences Test ultimately rests on the environmental harm caused by implementation of the alternative relative to maintaining water quality at the current condition, as well as other potential human health and community risks (DSV Guidance; CDPHE 2021a). Consequently, HMC concludes that the negative effects of in-perpetuity operation of the IX system, which would generate a high-activity radiological waste product, require out-of-state transport and disposal, create a significant environmental footprint associated with each step in the operation, and potentially complicate or preclude ultimate Site closure, outweigh the *de minimis* environmental and human-health benefits that IX treatment would produce. This is especially true because water uses are already protected in the downstream surface water. HMC therefore considers this alternative infeasible with respect to other consequences. To further support this assessment, a discussion of environmental footprint and environmental justice evaluations are provided below.

4.7.3.1 Environmental Footprint Evaluation

Arcadis calculated the environmental footprint for this alternative over 20-year and 100-year timeframes, assuming the following:

- Impacts associated with the Maintain Current System alternative (Section 4.2.2);
- Mobilization and on-site usage of equipment, materials, and labor to implement:
  - Installation of a 35-foot x 40-foot sprung structure located at the toe of the IRD that would house the full-scale IX treatment system;
  - The treatment system including two trains of two stainless steel IX vessels (in series) in a lead-lag configuration. Each vessel will be 3.5 feet in diameter with a 5.2-foot resin bed, operating with 50 ft^3 Purolite PGW6002E resin;
  - Pre-treatment systems for each train including stainless steel bag filtration housing and a dosing system to deliver microbicide upstream of the resin vessels. As noted in section 4.7.1, pre-treatment options require further evaluation, and these are assumed consumables based on current understanding;
  - A subsurface conveyance system, approximately 1,800 feet to convey NPL to the full-scale system through a new 6-inch HDPE subsurface pipeline from the NPL outfall; and
  - Direct-vent propane heater fueled by a 1,000-gallon propane tank;
- Annual seasonal operation of the IX System (June through October), including equipment and labor mobilization to:
  - Perform monthly system inspections and prefiltration system changeouts;
  - IX Resin replacement and removal of approximately 300 ft^3 of uranium-loaded resin;
  - Transportation and disposal of spent resin and filtration waste to a radiological disposal facility (assuming disposal at Energy Solutions in Clive, Utah); and
  - Operating consumables such as process equipment, bag filters, pre-treatment dosing chemicals, and propane for occasional heating of the structure.

The results of the environmental footprint evaluation are provided in **Appendix 5**, including additional details on model input assumptions, procedures, and model outputs. A summary of the evaluation results is provided in **Table 4-14** below. As with the other options presented above, the evaluation results are provided for the following three timeframes:

- Year 1: Domestic well replacement in Sargents, monthly Site monitoring, and bi-annual sampling events (4.2.2); construction of the IX treatment system, including transportation of construction materials; and
- Years 1–20 and 1–100: Year 1 items included above, plus monthly site monitoring and bi-annual sampling events (4.2.2), additional monthly sampling requirements and monthly operation and

maintenance, IX resin replacement, site access maintenance and regrading of low-slope rock dump areas (4.2.2), and system reconstruction once every 30 years.

Table 4-14. Environmental Footprint Evaluation Results for the Semi-Active Treatment with IX Alternative

	Year 1	Years 1-20	Years 1-100
GHG Emissions (metric tons)	542	6,048	30,000
Total Energy Used (MMBTU)	84,600	200,000	923,000
Total NO_x Emissions (metric tons)	1.27	12	60.6
Total SO_x Emissions (metric tons)	1.54	18.1	89.8
Total PM10 Emissions (metric tons)	0.315	3.7	18.2

Notes:
See notes listed under Table 4-3.

A visual comparison of the three alternatives included in the footprint evaluation is shown in **Figure 4-9** below, which shows the environmental footprint categories for each of the three alternatives evaluated for sustainability, normalized to the maximum value for each category. Semi-Active Treatment with IX has the highest footprint across all categories. This alternative involves greater materials consumption, more frequent worker mobilization, and off-site disposal of radiological waste.

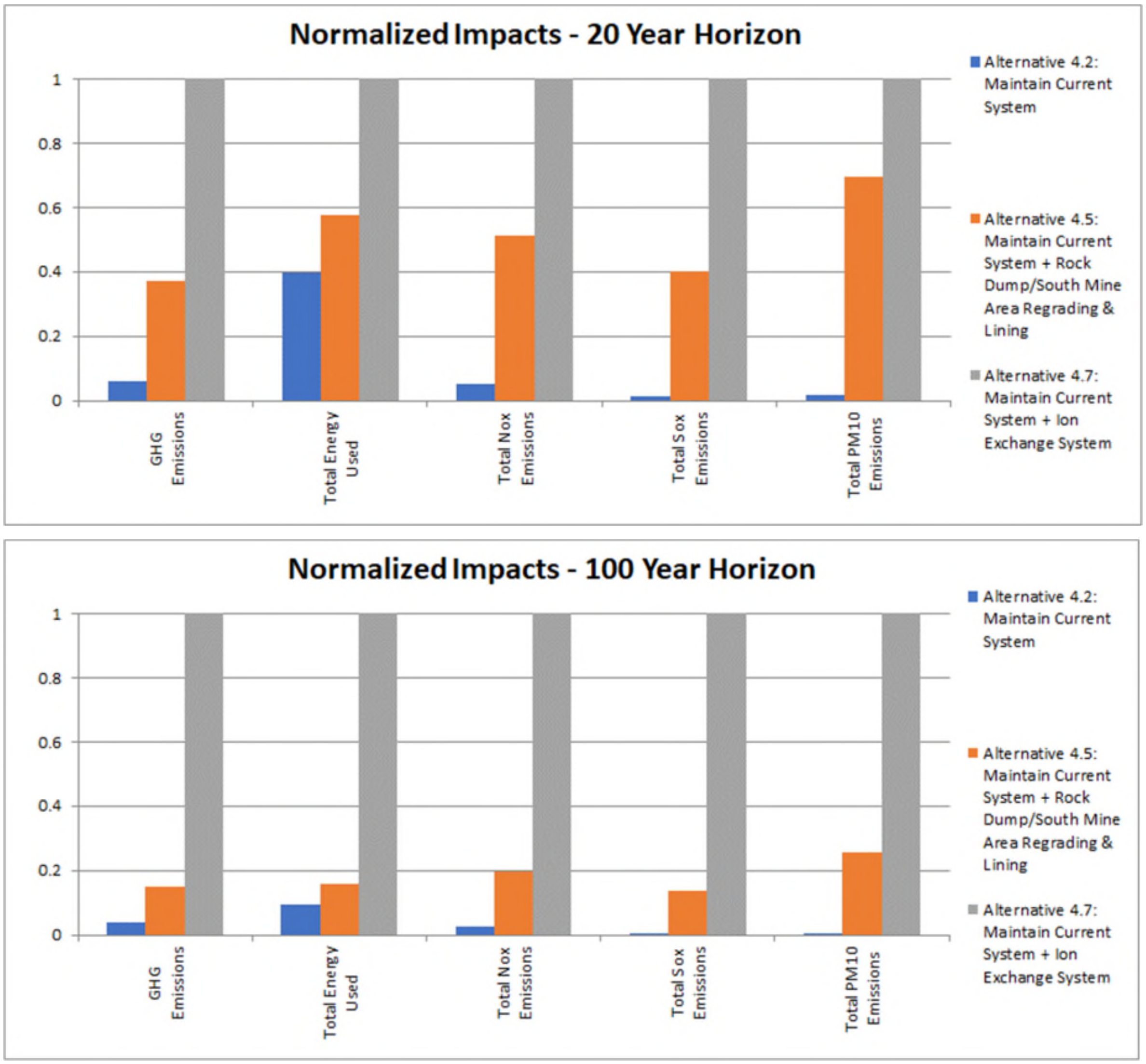

Figure 4-9. Environmental Footprint Comparison for Maintain Current System, Rock Dump/South Mine Area Regrading & Lining, and Semi-Active Treatment with IX

4.7.3.2 Environmental Justice

Transportation of the IX-generated waste, which consists of licensed radiological material, to an out-of-state disposal location could expose several communities through which the waste will travel to environmental and safety risks. HMC used EPA's Environmental Justice Screening Tool ("EJ Screen") to generate environmental-justice reports (referred to as "EJScreen Reports") and National Environmental Public Health Tracking Network Reports ("Public Health Reports") for the communities through which the waste from IX likely would pass on its routes from the Site to the disposal facility in Clive, Utah, and from the Site to the disposal facility in Andrews County, Texas. These reports are included in **Appendix 7**.

EJ Screen is EPA's "environmental justice mapping and screening tool that provides EPA with a nationally consistent dataset and approach for combining environmental and demographic socioeconomic indicators."[ff] Users select a geographic area on EJScreen, and the tool generates publicly available reports of demographic socioeconomic and environmental information for that area. EJScreen combines environmental and demographic indicators into "EJ Indices." There are twelve EJ indices. Each index combines demographic factors for a population with a single environmental factor. For example, the EJ index for traffic proximity is a function of the traffic indicator (which is a measurement of the average annual daily traffic at major roads within 500 meters of the location, divided by distances in meters), the percentage of the population for that geographic area that are identified as low-income, and the percentage of the population for that geographic area that are identified as people of color. EJScreen generates reports for a geographic area of these EJ indices and then compares the geographic area's EJ index to the rest of its state and to the rest of the country. It reports these comparisons out as percentiles. For example, if a geographic area has an EJ index for traffic proximity that is higher than 90% of the United States, the EJScreen report will state that the community is in the 90th percentile of the U.S.

EJScreen may also be used to generate National Environmental Public Health Tracking Reports ("Public Health Reports") for a geographic area. These reports are generated by the Centers for Disease Control and Prevention's National Environmental Public Health Tracking Network.[gg] Similarly, this tool will generate reports for specific geographic areas that a user selects on a map. These reports are generated from a collection of health and environmental data from national, state, and city sources. The reports include a variety of information, such as the percentage of a population that live under the poverty line, the percentage of a population that live within half a mile of a park, the rate of heart attacks in a community, and demographic breakdowns in age and gender in a community.

HMC generated both EJScreen and Public Health Reports for the following counties between the Site and Clive, Utah: (1) Saguache County, Colorado; (2) Gunnison County, Colorado; (3) Montrose County, Colorado; (4) Delta County, Colorado; (5) Mesa County, Colorado; (6) Grand County, Utah; (7) Emery County, Utah; (8) Carbon County, Utah; (9) Utah County, Utah, (10) Salt Lake County, Utah; and, finally, (11) the disposal location in Tooele County, Utah. A map of the anticipated truck route between the Site and Clive, Utah is provided in **Figure 4-10**; additional county-specific maps of the route are provided in **Appendix 7**. This anticipated truck route was confirmed with Energy Solutions personnel via email communication in September 2022.

[ff] *What is EJScreen?*, U.S. Environmental Protection Agency, accessible at: https://www.epa.gov/ejscreen/what-ejscreen (last visited November 9, 2022).
[gg] Accessed online at: https://ephtracking.cdc.gov/.

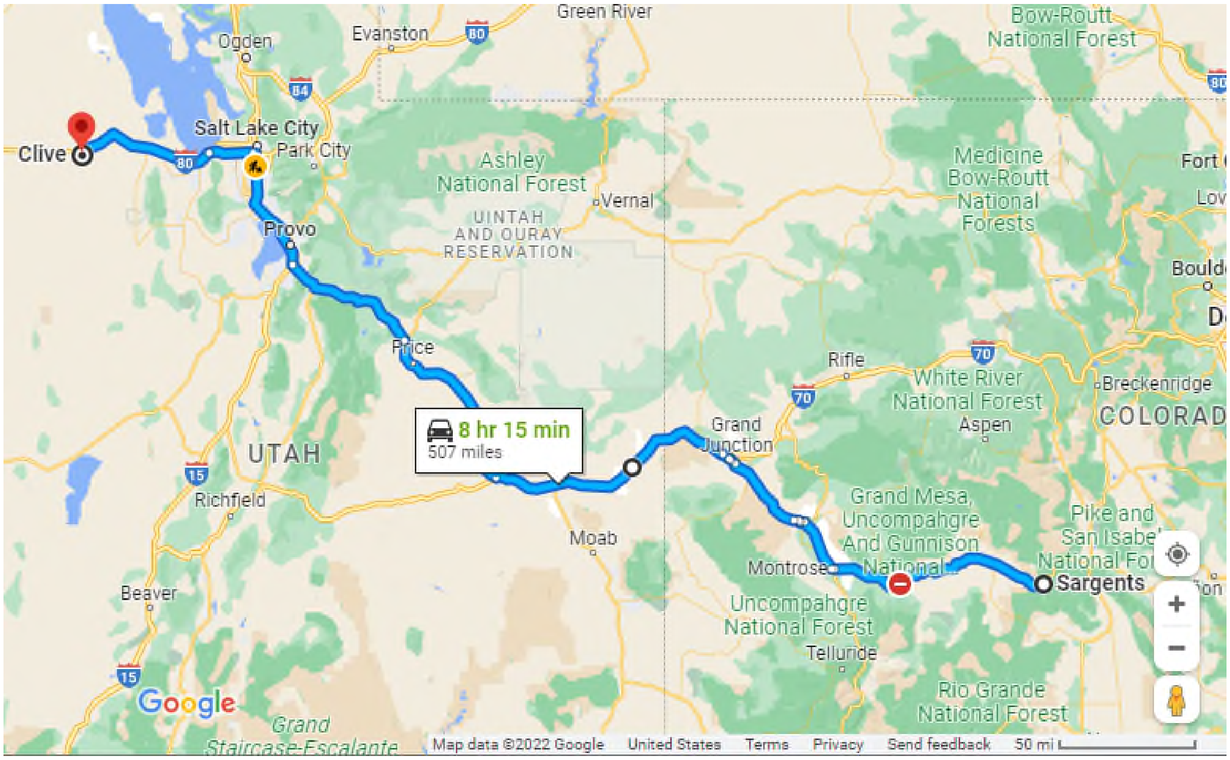

Figure 4-10. Truck Route for Disposal of IX Resin Radiological Waste at Energy Solutions, Clive, UT.

The reports for this route indicate that:

- All 11 counties have high indices for ozone, ranging from the lowest indices in Gunnison and Tooele Counties, which fall in the 69th percentile in the United States for ozone, to the highest index in Carbon County, which is in the 77th percentile in the United States for ozone (EJ Screen report for Clive, UT route; **Appendix 7**).
- Certain of these communities experience higher-than-average proximities to hazardous waste. Salt Lake County is in the 59th percentile for high proximity to hazardous waste in the United States. It is closely followed by Grand Junction, which is in the 55th percentile for proximity to hazardous waste. Tooele, Delta, and Montrose Counties are in the mid-to-upper 30th percentile in the country for proximity to hazardous waste (EJ Screen report for Clive, UT route; **Appendix 7**).
- Many of these counties also have populations with lower-than-average household incomes and higher-than-average percentages of residents who live below the poverty line. For example, the population of Saguache County has an average household income of $37,004—about half of Colorado's average household income of $77,104. And 25.4% of Saguache County residents live below the poverty line. Similarly, Montrose County, Gunnison County, and Mesa County have lower average household incomes compared to Colorado's average household income and 10–13% of residents of those communities live below the poverty line (Public Health report for Clive Utah route; **Appendix 7**).

HMC also generated EJScreen and Public Health Reports for the following counties located on the transportation route from the Site to Andrews County, Texas: (1) Saguache County, Colorado; (2) Alamosa County, Colorado; (3) Conejos County, Colorado; (4) Rio Arriba County, New Mexico; (5) Taos County, New Mexico; (6) Santa Fe County, New Mexico; (7) Torrance County, New Mexico; (8) Guadalupe County, New Mexico; (9) Lincoln County, New Mexico; (10) De Baca County, New Mexico; (11) Chaves County, New Mexico; (12) Lea County, New Mexico; (13) Yoakum County, Texas; (14) Gaines County, Texas; and (15) the disposal site in Andrews County, Texas. This route is shown in **Figure 4-11**.

These reports indicate that:

- All 15 counties have much higher indices for ozone than most of the United States, ranging from the lowest index in Lincoln County, New Mexico, which is in the 85th percentile in the United States for ozone, and the highest index in Rio Arriba County, New Mexico, which is in the 96th percentile in the United States for ozone (EJScreen report for Andrews County, TX route; **Appendix 7**).
- Two counties, in particular, rank high in several EJ indices. Rio Arriba County, New Mexico, is in the 96th percentile in the United States for ozone, the 84th percentile in the United States for Superfund site proximity, and the 80th percentile in the United States for wastewater discharge. Chaves County, New Mexico, is in the 93d percentile in the United States for ozone, the 90th percentile in the United States for Superfund proximity, and the 80th percentile in the United States for proximity to underground storage tanks (EJScreen report, **Appendix 7**). Rio Arriba County's socioeconomic indicators report that 88% of the county's population identify as people of color and 43% of the population are low income. And Rio Arriba's Public Health Report indicates that 18.2% of its population identify as Native American (Public Health report, **Appendix 7**). Chaves County's socioeconomic indicators report that 62% of the county's population identifies as people of color and 47% of the county's population is low income.

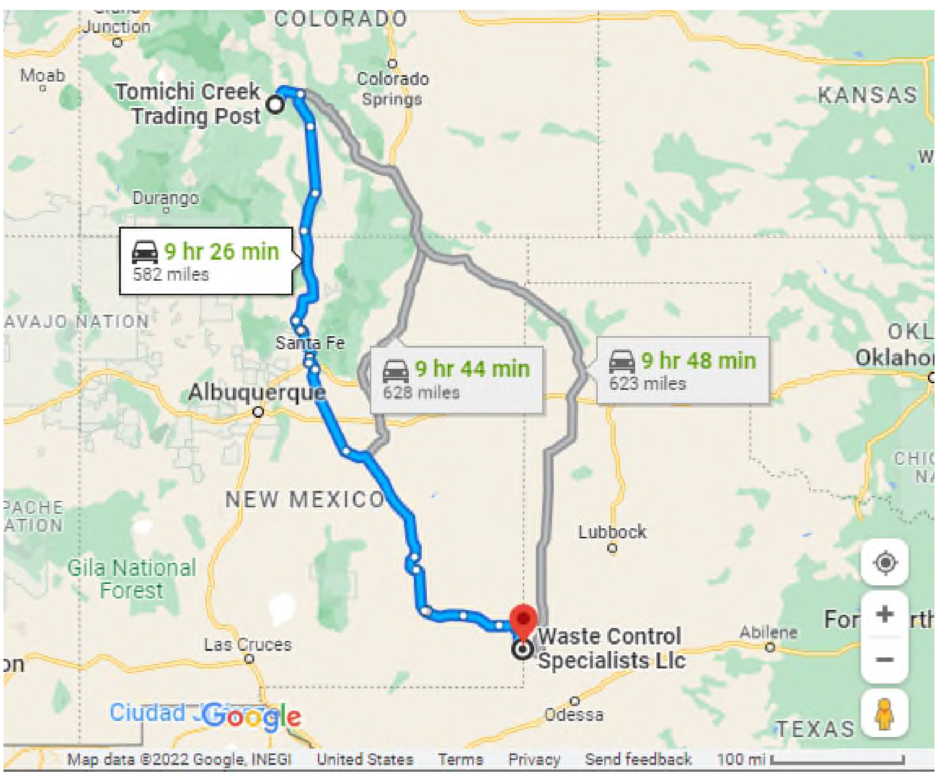

Figure 4-11. Truck Route for Disposal of IX Resin Radiological Waste at Waste Control Specialists, Andrews County, TX

All of the counties' reports indicate that 28 to 55 percent of their respective populations are low income (Public Health report, **Appendix 7**). In particular, the EJScreen report for Conejos County, Colorado, indicates that 55% of its population is low income. And the Public Health reports for many of the counties on this trucking route indicate that many of the counties have populations where approximately 20 percent or greater live below the poverty line. For example, the Public Health Report for Torrance County, New Mexico, indicates that 21.6% of its residents live below the poverty line (while 17.5% of the state of New Mexico's residents are below the poverty line).

5 Alternatives Summary and Rankings

Based on the alternatives analysis that HMC conducted to evaluate feasibility with respect to technology limits and other consequences, as we described throughout this Report, each of the water management alternatives identified as potentially applicable to the Site has been ranked according to the results of the Feasibility Tests and potential uranium load reduction that may be achieved. These ranking results are provided in **Table 5-1**, listed in order of potential uranium load reduction.

The results demonstrate that the No Further Action, Maintain Current System, and Rock Dump/South Mine Area Regrading and Selective Lining alternatives are the only alternatives that HMC can retain for possible implementation, based on both the Limits of Technology and Other Consequences Feasibility Tests. Using these alternatives, a potential anticipated uranium load reduction of 5 to 20 percent (which includes the anticipated 0 to 10 percent reduction under status quo) may be achievable, with the caveat that the ultimate effectiveness of regrading and selective lining is to be determined. Accordingly, HMC concludes that none of the options it has considered as “feasible” would achieve either the anticipated Tomichi Creek-based WQBEL or the Water Supply Use standard on Marshall Creek.[hh]

The analysis demonstrates that the Semi-Active IX Treatment alternative is technologically feasible but not feasible based on other consequences. The Source Zone Removal via Mining option may be feasible under the right circumstances, but it is considered outside the scope of this evaluation. The other alternatives evaluated in this Report are considered technologically infeasible.

[hh] More accurately, none of the alternatives would achieve the WQBEL at any time, while all of the alternatives would achieve the Water Supply Use standard on Marshall Creek some of the time but not all of the time, noting that the Water Supply Use standard is achieved on Marshall Creek during certain times of the year under current conditions.

Table 5-1. Alternatives Summary and Rankings,

Alternative	Potential Uranium Load Reduction	Technologically Feasible?	Feasible based on Other Consequences?
Semi-Active Treatment: Engineered Treatment Cells	48–61% (Accessible season only)	**No** Infeasible at full scale due to large footprint, waste disposal, and temperature limitations on uranium treatability.	**No** Significant licensed material/radiological waste generation and treatment byproduct management, environmental footprint, and Environmental Justice concerns.
Semi-Active Treatment: IX	25–53% (Accessible season only)	**Yes (Seasonally)** Proven successful for uranium removal at the Site. However, winter operation is not feasible due to Site limitations and system maintenance requirements.	**No** Highly concentrated licensed material/radiological waste generation, and Environmental Justice concerns.
Source Load Removal via Mining	Unknown, estimated at >50%	**Undetermined** Tentatively assumed to be feasible to implement but would require further investigation outside the scope of this alternatives analysis and would ultimately involve transferring the Site to a uranium mining company.	**Undetermined** Environmental impact would be significant but may be considered justifiable when recovering uranium ore for beneficial use.
Rock Dump/South Mine Area Regrading and Selective Lining	5–10%	**Yes** Feasible to implement with minimal Site disturbance and some load reduction anticipated.	**Yes** Low environmental and closure impacts.
In Situ Geochemical Passivation with Phosphate	<10%	**No** Extensive network of complex bedrock fractures in the source zone is infeasible to reach.	**No** Full-scale groundwater phosphate injections pose a high risk for phosphate breakthrough into surface water.
Maintain Current System	0-10% (including continuation of currently observed downward trend)	**Yes** Feasible to implement, involves maintenance and monitoring of systems that have already been implemented at the Site.	**Yes** Proposes no additional systems other than those required for reclamation to meet Site closure; anticipated to result in the fewest additional impacts to the environment relative to the other alternatives.

Alternative	Potential Uranium Load Reduction	Technologically Feasible?	Feasible based on Other Consequences?
No Further Action	0-10% (including continuation of currently observed downward trend)	**Yes** Feasible in principle because it involves no further active implementation.	**Yes** Proposes no additional systems other than those required for reclamation to meet Site closure; anticipated to result in the fewest additional impacts to the environment relative to the other alternatives.

6 Conclusions

HMC conducted open-pit uranium mining at the Pitch Uranium Mine Site (Site) between 1979 and 1984. Following the cessation of mining in 1984, HMC has completed substantial mine reclamation work, including but not limited to:

- Plugging of the Pinnacle Adit, resulting in re-saturation of the underground mine workings and an improvement to water quality;
- Buttressing via partial backfilling of the North Pit to stabilize the east wall of the North Pit;
- Regrading and revegetating of the Indian and Tie Camp Rock Dumps, North Pit, and South Mine Areas, resulting in reduced storm-water infiltration into uranium source zones; and
- Improvements to and selective lining of stormwater ditches, surface-water drainages, and the sediment-pond dam to minimize infiltration into uranium source zones.

As a result of the removal of over 3.1 million pounds of high-grade uranium through mining (on a U_3O_8 basis), coupled with the reclamation work completed, uranium concentrations at the Outfall and within downstream Indian and Marshall Creeks have returned to pre-mining natural conditions. Despite uranium concentrations returning to pre-mining conditions, HMC has prepared this Report to identify feasible alternatives to further reduce uranium concentrations. Uranium concentrations in the segment of Marshall Creek between its confluences with Indian Creek and Tomichi Creek are frequently above the designated Water Supply Use standard of 0.030 milligrams per liter (mg/L). Importantly however, despite uranium concentrations above this standard, current water uses are protected because there is no evidence that domestic wells in Sargents are affected by Marshall Creek water. In June 2022, the Water Quality Control Commission (WQCC) extended the Temporary Modification of the uranium water quality standard on Marshall Creek, which was set to expire in December 2022.

Arcadis and HMC prepared this Report for sitewide water quality management in accordance with CDPHE's DSV Guidance (CDPHE 2021a) and Regulation 31.7. This Alternatives Analysis identifies feasible Site-relevant alternatives to achieve sustainable uranium load reduction in surface water.

As outlined in the DSV Guidance and Regulation 31.7, each alternative is to be evaluated based on three Feasibility Tests: Limits of Technology, Economics, and Other Consequences. Consistent with the guidance, a technology is considered infeasible if it fails any one of these three tests. In this Report, alternatives were not evaluated on the basis of economic feasibility, although this metric may be considered in a future update to this Report.

Following an initial screening of alternatives based on a high-level assessment of technological feasibility and Site applicability, the following seven alternatives were retained for more robust application of the Feasibility Tests:

1) Status Quo: No Further Action;
2) Status Quo: Maintain Current System;
3) Source Load Reduction: Mining;
4) Source Load Reduction: *In Situ* Geochemical Passivation with Phosphate;
5) Physical Water Management: Rock Dump/South Mine Area Regrading and Selective Lining;
6) *Ex Situ* Water Treatment: Semi-Active Treatment with Engineered Treatment Cells (ETCs); and
7) *Ex Situ* Water Treatment: Semi-Active Treatment with Ion Exchange.

Of these alternatives, HMC considers the No Further Action, Maintain Current System, and Rock Dump/South Mine Area Regrading and Selective Lining alternatives to be feasible based on the Limits of Technology and Other Consequences tests:

- The Maintain Current System status quo alternative is similar to the No Further Action alternative but includes monitoring and maintenance of the existing systems until it can be demonstrated that the systems are permanent in nature and require no additional maintenance to sustain the observed water-quality improvements they provide. Under the Maintain Current System alternative, uranium concentrations at the Outfall are anticipated to continue to decrease over time at currently observed rates and decrease uranium concentrations from 0-10%, but without the risks associated with concentrating the uranium through semi-active water treatment.
- The Rock Dump/South Mine Area Regrading and Selective Lining alternative involves selective grading and lining to reduce infiltration of water into uranium source zones to achieve uranium load reduction. Estimates indicate that the regrading/selective lining alternative would likely result in additional uranium concentration decreases at the Outfall of up to five to 10 percent.

Importantly, none of the alternatives evaluated would feasibly achieve HMC's best estimate of a future WQBEL, necessitating the need for a DSV or another regulatory avenue in lieu of meeting a potential WQBEL.

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Table

Table 1
2010-2019 Water Balance
Pitch Reclamation Project
Sargents, Colorado

	2010-2019 Water Balance														
	High Flow[1]					Low Flow[2]					Average Flow[3]				
	Flow		Uranium Concentration	Uranium Mass load		Flow		Uranium Concentration	Uranium Mass Load		Flow		Uranium Concentration	Uranium Mass Load	
	gpm	% Total	mg/L	kg/day	% Total	gpm	% Total	mg/L	kg/day	% Total	gpm	% Total	mg/L	kg/day	% Total
North Pit Lake															
NPL Diversion[4]	110	8%	0	0	0%	30	16%	0	0	0%	43	12%	0	0	0%
+ Chester Fault Discharge[5,6]	46	4%	8.8	2.2	26%	12	7%	7.8	0.52	53%	18	5%	8.2	0.80	36%
+ Clean Groundwater[7]	211	16%	0	0	0%	57	31%	0	0	0%	82	22%	0	0	0%
= NPL	368	28%	1.1	2.2	26%	99	53%	0.97	0.52	53%	143	39%	1.0	0.80	36%
Indian Drainage															
NPL	368	28%	1.1	2.2	26%	99	53%	0.97	0.52	54%	143	39%	1.0	0.80	36%
+ Indian Rock Dump[8]	216	17%	1.7	2.1	24%	22	12%	1.8	0.22	22%	54	15%	1.8	0.53	24%
= IC	584	45%	1.3	4.3	51%	121	65%	1.1	0.75	76%	198	53%	1.2	1.3	60%
Tie Camp Drainage															
Upstream TC[9]	159	12%	0.1	0.1	1%	16	9%	0.1	0.01	1%	40	11%	0.1	0.02	1%
+ Tie Camp Rock Dump[10]	238	18%	1.0	1.3	15%	9	5%	1.6	0.08	8%	47	13%	1.1	0.28	13%
= TCC	397	31%	0.6	1.4	16%	25	14%	0.6	0.09	9%	87	23%	0.64	0.30	14%
Sediment Pond															
IC	584	45%	1.3	4.3	51%	121	65%	1.1	0.75	76%	198	53%	1.2	1.3	60%
+ TCC	397	31%	0.6	1.4	16%	25	14%	0.63	0.09	9%	87	23%	0.64	0.30	14%
+ Downstream Load[11]	319	25%	1.6	2.7	33%	39	21%	0.71	0.15	15%	85	23%	1.2	0.58	26%
= SW-33	1300	100%	1.2	8.4	100%	185	100%	1.0	0.99	100%	371	100%	1.1	2.2	100%

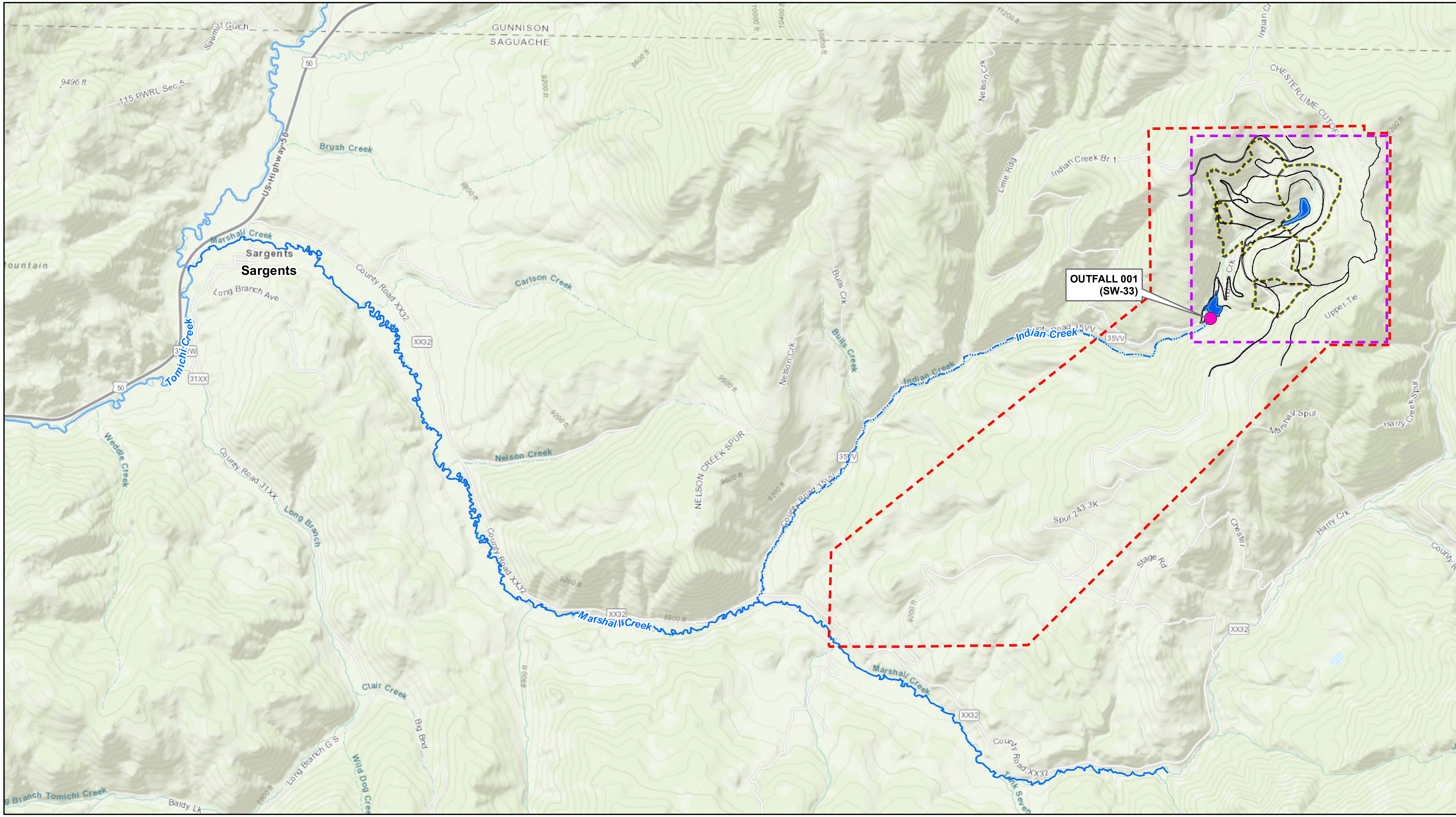
Notes:

1. High flow parameters are based on 2016 monitoring for design purposes.
2. Low flow parameters calculated as the average values from 2010-2019.
3. Average flows were calculated based on a weighted average of High Flows (2/12 months) and Low Flows (10/12 months).
4. NPL Diversion flow estimated as 30% of total NPL flow based on 2020 low flow monitoring.
5. The Chester Fault Discharge concentration is estimated as 8x the NPL concentration based on historical CFS and underground workings concentrations.
6. The Chester Fault Discharge is estimated at 12.5% of total NPL flow, based on an assumed 8x dilution of Chester Fault seepage concentrations relative to NPL discharge.
7. Clean groundwater to NPL is calculated by difference to close the NPL balance.
8. Indian Rock Dump flow and load estimated as IC reported flow/load minus NPL component. Effective concentration calculated based on estimated flow and load. The calculated flow likely includes groundwater discharge components not associated with the rock dump.
9. Upstream TC flow estimated as 40% and 65% of the total TCC flow under high-flow and low-flow, respectively, based on limited TCC-Culvert flow measurements from 2016 through 2019.
10. Tie Camp Rock Dump flow and load estimated as TCC reported flow/load minus upstream TC component. Effective concentration calculated based on estimated flow and load. The calculated flow likely includes groundwater discharge components not associated with the rock dump.
11. Downstream Load flow and uranium load are calculated from total flow/load minus IC and TCC components. This load may be associated with unknown uranium sources local to the sediment pond and/or rock dump discharge flowing beneath IC/TCC weirs.

gpm = gallons per minute

TCC = Tie Camp Creek

Figures

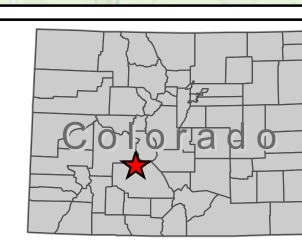


Legend

- Sampling Point
- Colorado Division of Reclamation, Mining, and Safety Permit Boundary
- Homestake Mining Property Boundary
- Facility Areas
- Marshall Creek
- Indian Creek
- Tomichi Creek

Note:

Source: USGS 7.5' Quadrangles of Sargents, Chester, Sargents Peak, and Paholone Peak, Colorado



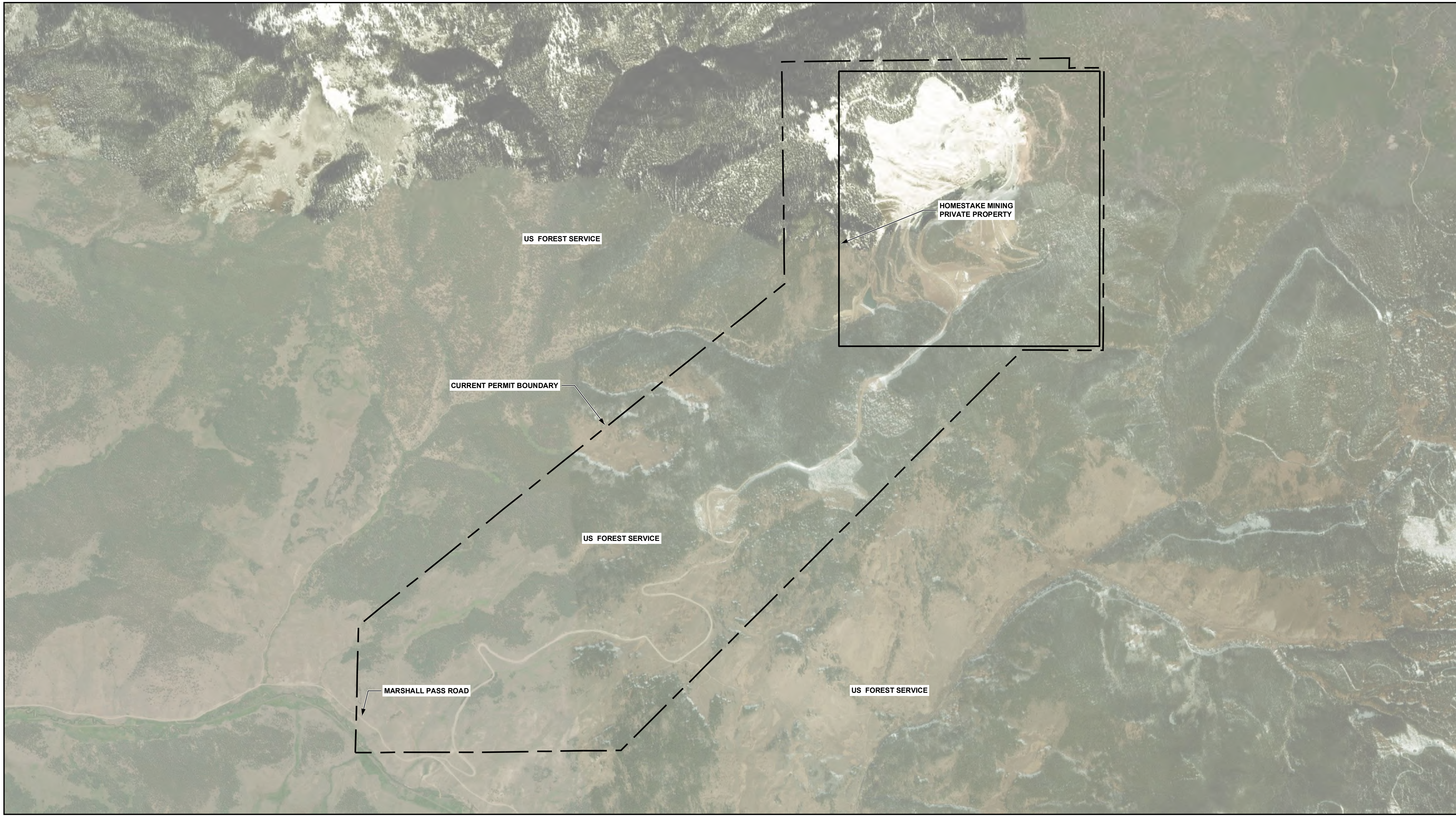
0 3,000 6,000 Feet

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

LOCATION MAP

ARCADIS

FIGURE 1

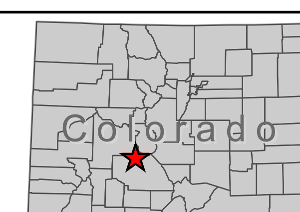


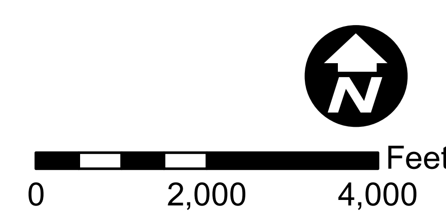
Path: T:_ENV\AO000102_Pitch\GIS\MXD\2022\2022-08\Figure 2 Detailed Property & Permit Boundary.mxd | Last Saved By: ski01076 | Last Saved On: 12/15/2022

Legend

- Current Permit Boundary
- Private Property Boundary
- Revised Permit Boundary Extension Area

Note:
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Copyright:© 2013 National Geographic Society, i-cubed



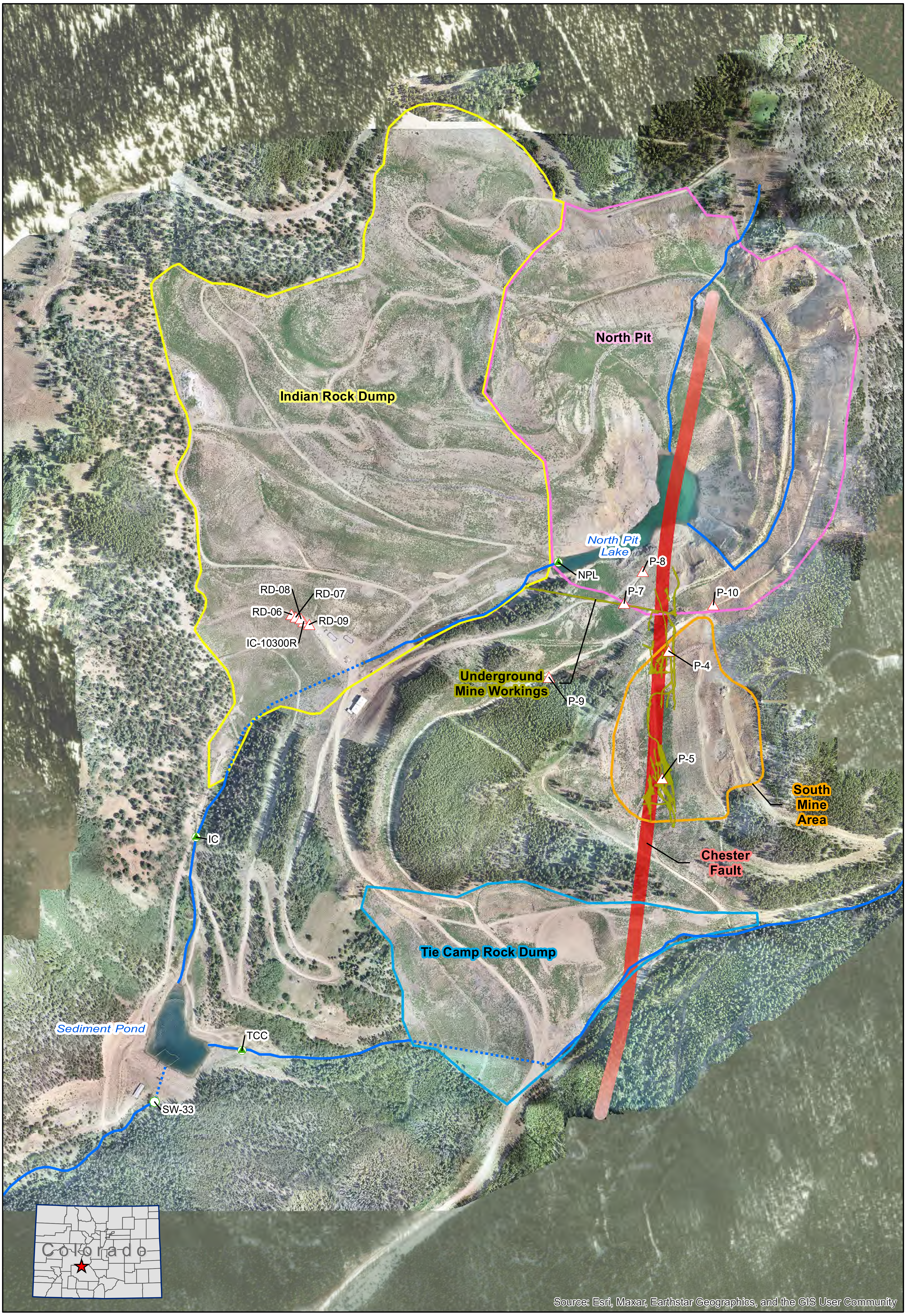


PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

DETAILED PROPERTY AND PERMIT BOUNDARY

ARCADIS

FIGURE
2



Legend

- Existing Recirculation/Monitoring Well
- Existing Surface Water Monitoring Location
- CDPS Permit Compliance Point
- Surface Water Drainages Pre-2021
- Surface Water Culverts Pre-2021

0 530 1,060 Feet

HOMESTAKE

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

SITE FEATURES

ARCADIS

FIGURE
3

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Legend

- Existing Surface Water Monitoring Location
- CDPS Permit Compliance Point
- Colorado Discharge Permit System Boundary
- Contours = 50 feet
- Drainage Installed/Improved in 2021
- Drainage Installed Pre-2021 and Currently Active
- Drainage Decommissioned in 2021
- Rock Dump Culverts Plugged and Abandoned in 2021

Notes:
1. Solid lines indicate surface water drainages
2. Dashed lines indicate culvert drainages

0 260 520 Feet

HOMESTAKE

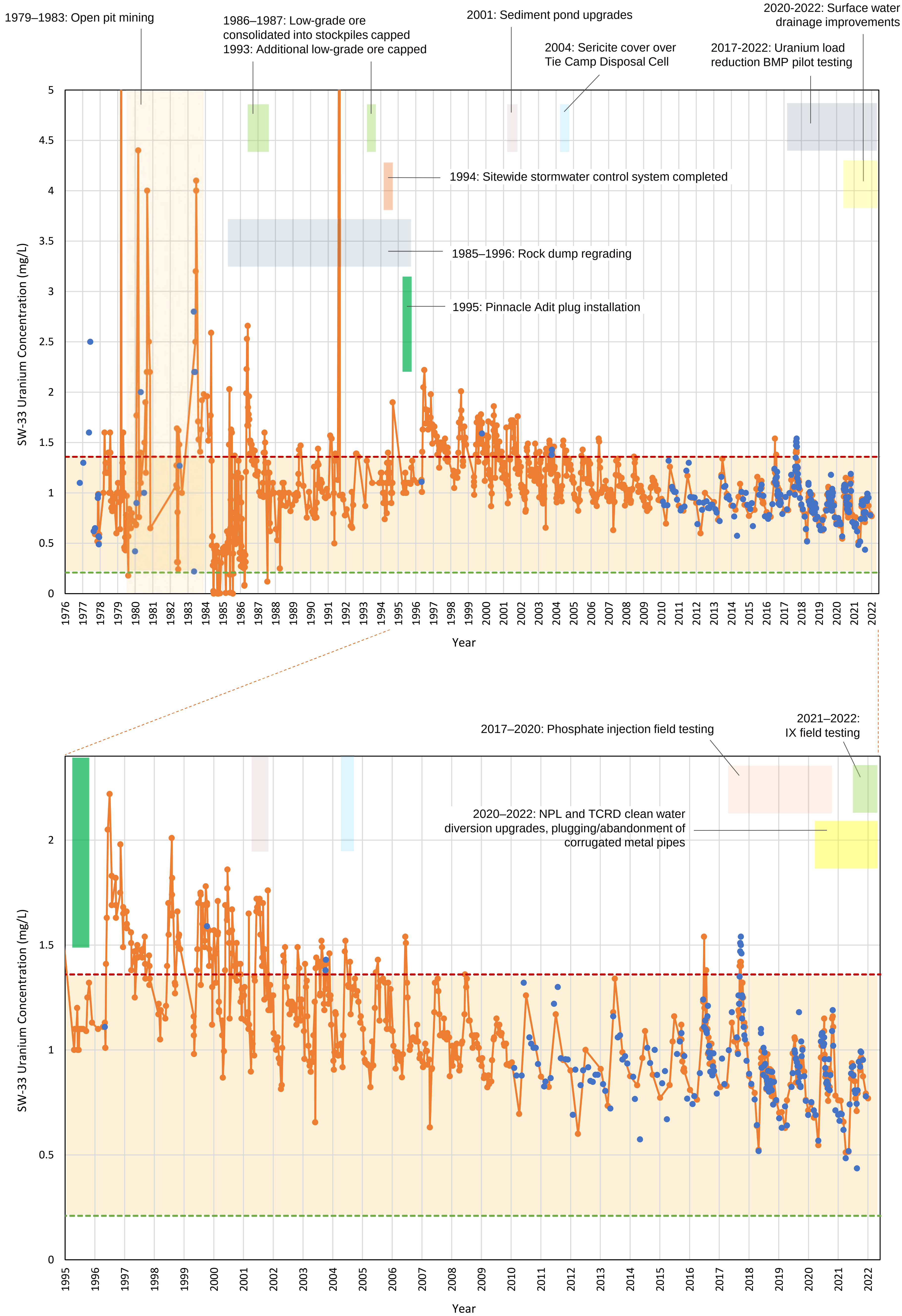
PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

SITE DRAINAGE FEATURES

ARCADIS

FIGURE
4

Path: T:_ENV\AO000102_Pitch\GIS\MXD\2022\2022-08\Figure 5 Site Drainage Features.mxd Date Saved: 8/30/2022 4:37:15 PM



Total uranium

Dissolved uranium

Lower-limit: Pre-mining uranium concentrations along Indian Creek (AEC)

Upper-limit: Pre-mining uranium concentrations along Indian Creek (AEC)

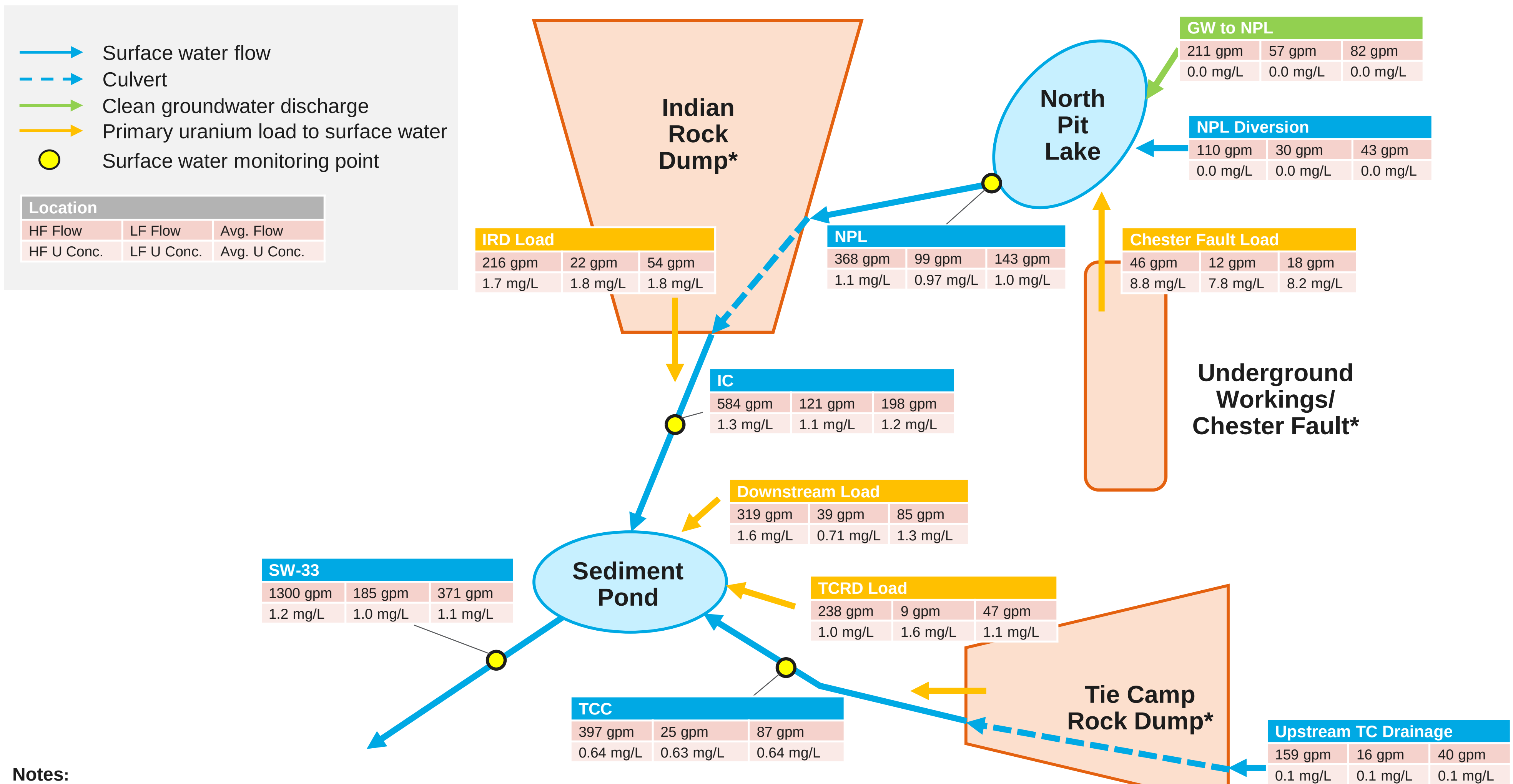
AEC = Atomic Energy Commission values

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

SITE ACTIVITIES AND SW-33 URANIUM CONCENTRATIONS, 1976–2021

ARCADIS

FIGURE
5



Notes:

1. High-flow parameters are based on 2016 monitoring. Low-flow parameters calculated as the average values from 2010-2019. Average flows/loads were calculated based on a weighted average of high flows (2/12 months) and low flows (10/12 months).

* Uranium concentrations and calculated loads associated with these features likely include contributions from background, including groundwater discharge from undisturbed bedrock containing uranium-bearing minerals.

Avg. = average
Conc. = concentration
gpm = gallon per minute
GW = groundwater
HF = high flow
IC = Indian Creek
IRD = Indian Rock Dump
kg/d = kilograms per day
LF = low flow
mg/L = milligram per liter
NPL = North Pit Lake
TC = Tie Camp
TCC = Tie Camp Creek
TCRD = Tie Camp Rock Dump
U = uranium

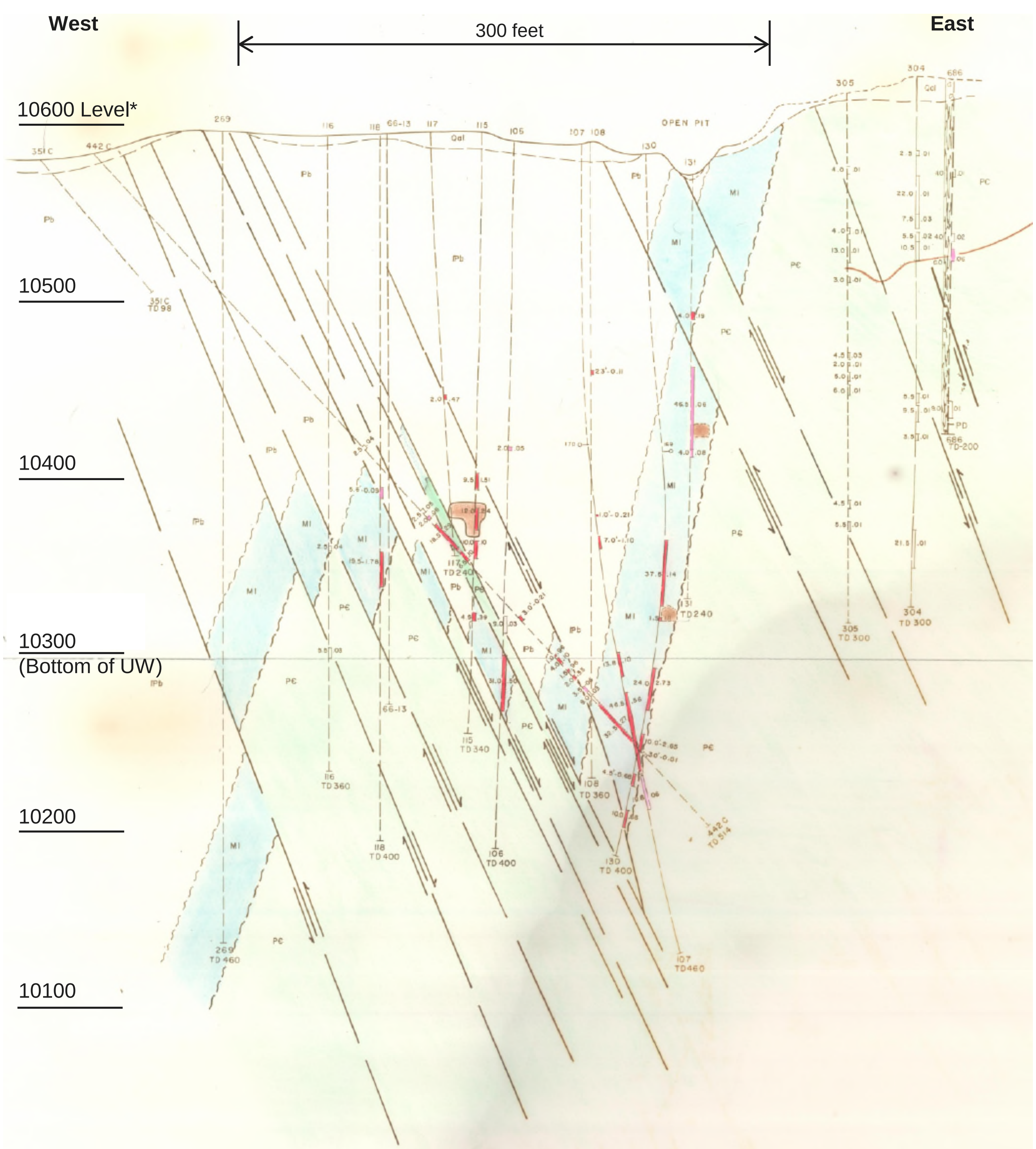
HOMESTAKE

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

SITE WATER AND URANIUM BALANCE

ARCADIS

FIGURE
6



LEGEND

Scale : 1" = 40'

Date : 7/24/75

Interpretation by : EBR

Drafted by : EBR, RLM, GAD

Surveyed by : RLM

Alluvium

Sandstone

Coal

Limestone

Shale

Dolomite

Siltstone

Precambrian complex : igneous and metamorphics

Fault lines ; arrows show direction of movement

8.0 .09
12.0 .17

Mineralized zone : thickness and grade

Qal	Alluvial deposits
Ml	Leadville formation
PC	Precambrian complex
Pb	Belden formation
	Underground Workings

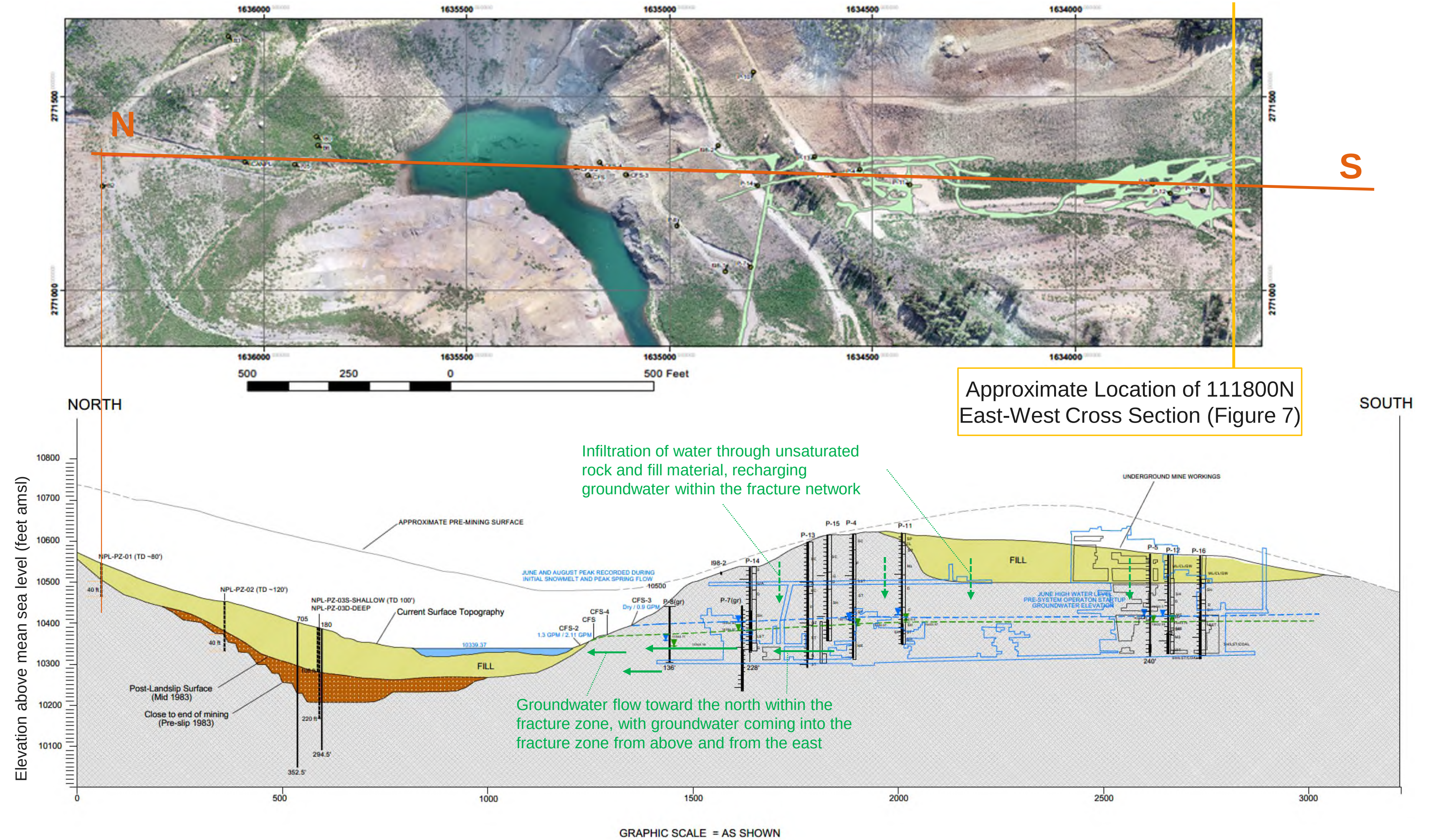
*Mine levels indicate elevation in approximate feet above sea level (in original mine coordinates)

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

CHESTER FAULT EAST-WEST CROSS SECTION (111800 N)

ARCADIS

FIGURE 7



LEGEND

- Piezometer Pair Location (Shallow / Deep)
- 10300 — Elevation above mean sea level (feet amsl)
- gpm — Gallons per minute
- Approximate Chester Fault Zone

- FILL MATERIAL
- LANDSLIP MATERIAL
- BASEMENT ROCK
- LAKE AREA

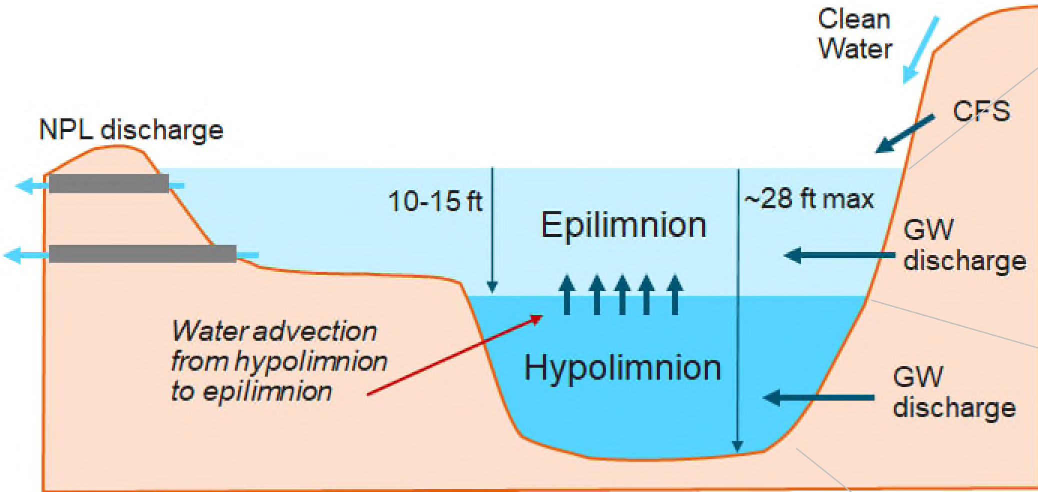
P-4 BORING/WELL IDENTIFICATION
LITHOLOGIC INTERPRETATION
HIGH FLOW GROUNDWATER ELEVATION
LOW FLOW GROUNDWATER ELEVATION

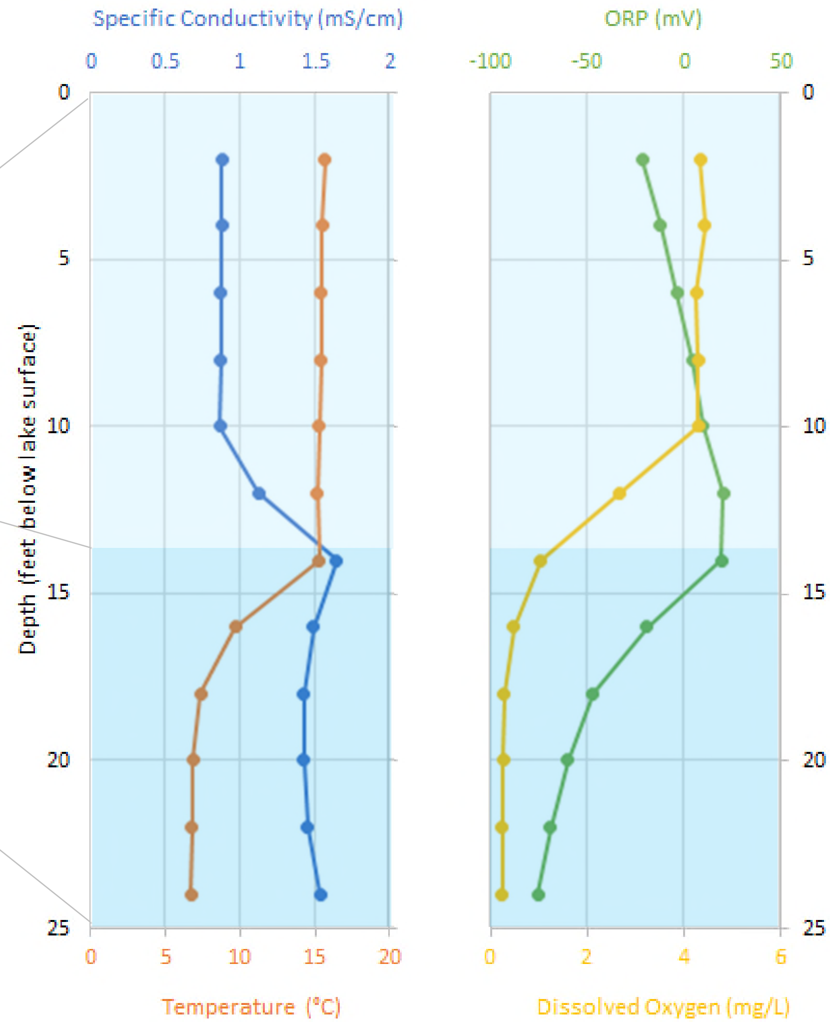
PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

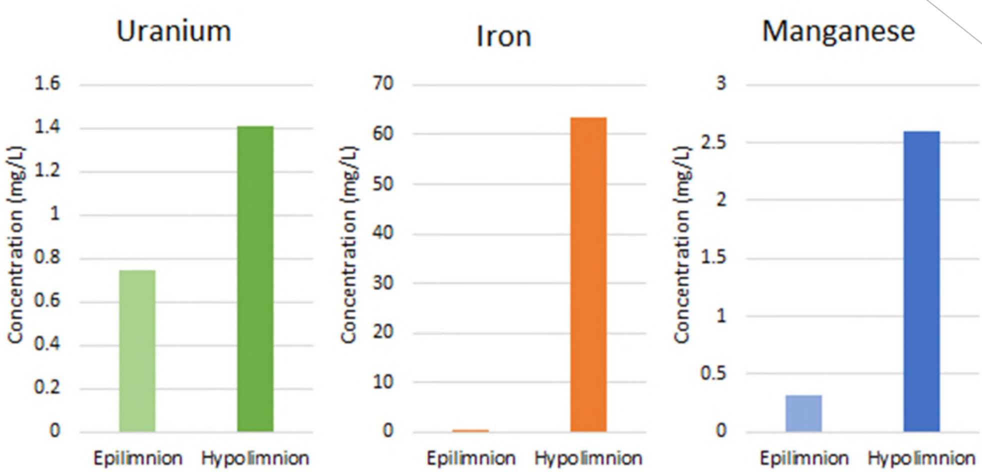
CHESTER FAULT AND NORTH PIT LAKE NORTH-SOUTH CROSS SECTION

ARCADIS

FIGURE 8







Notes:

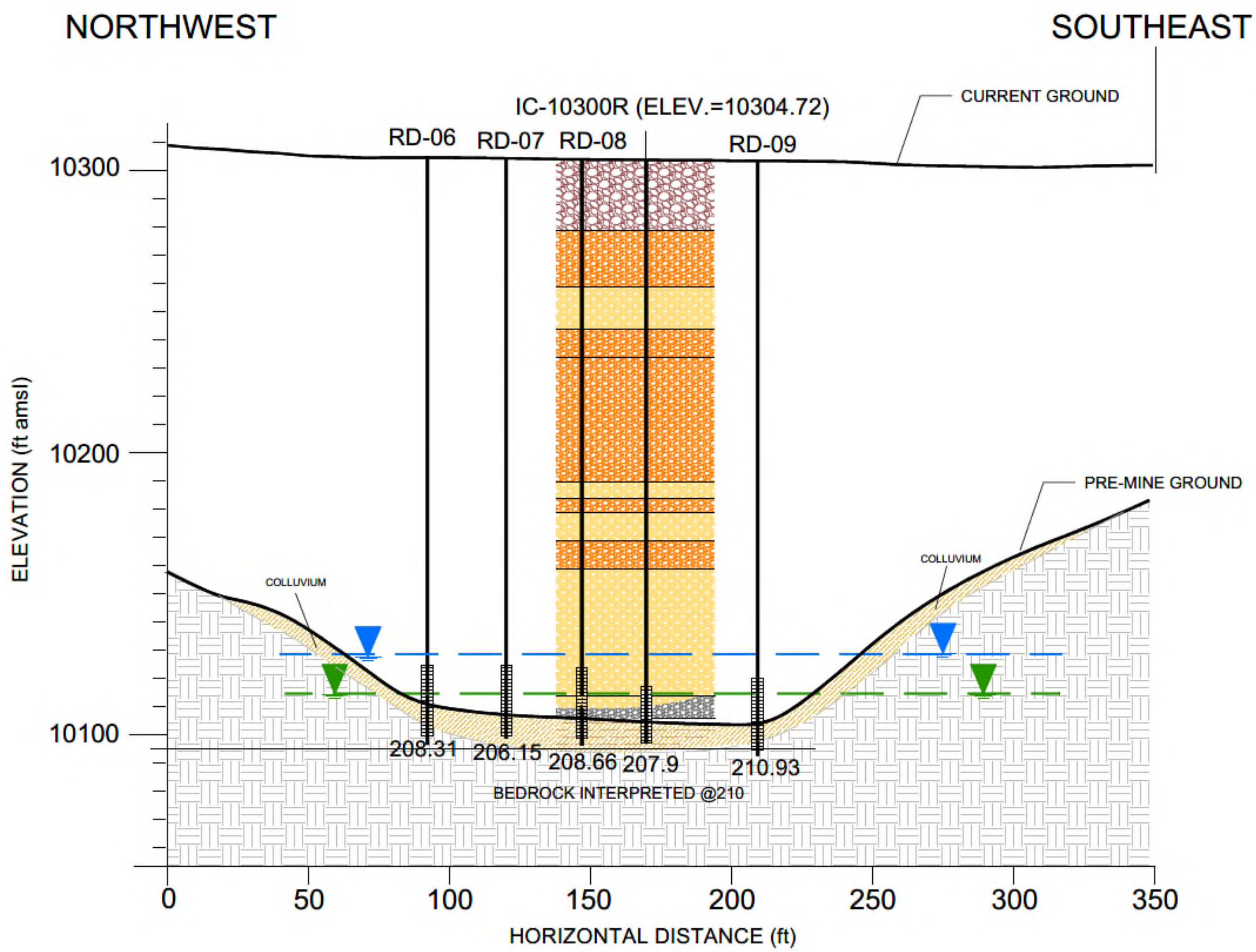
GW = Groundwater
mg/L = milligrams per liter
mS/cm = milliSiemens per centimeter
ORP = Oxidation-reduction potential
Field parameters and water quality samples were collected on August 11, 2020

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

NORTH PIT LAKE CONCEPTUAL MODEL AND 2020 DEPTH PROFILE RESULTS

ARCADIS

FIGURE
9



HIGH FLOW GROUNDWATER ELEVATION

LOW FLOW GROUNDWATER ELEVATION

COBBLES/GRAVEL/SILTY SAND

SILTY SAND/COARSE SAND

GRAVEL AND COARSE SAND

SILTY SAND / GRAVEL

GRAVEL AND COARSE SAND

SILTY SAND AND /WOOD/ORGANICS

BEDROCK INTERPRETED @210 bgs

HOMESTAKE

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

INDIAN ROCK DUMP 10300 BENCH CROSS SECTION

ARCADIS

FIGURE
10

Appendix 1

Historical Surface Water Quality (2022 PPHS Exhibit 2)

Appendix 2

Pitch Mine Historical Documents:

2-1: **Liability Insurance Memorandum, Pinnacle Exploration, Inc. (March 1970)**

2-2: **Draft Responses to EPA Comments on HMC Draft Environmental Statement (December 1978)**

2-3: **Discharge Permit and Summary of Rationale (June 1980)**

2-4: **Summary of Evidence Re Segment 21 of the Upper Gunnison River Basin – Indian Creek (February 1982)**

Appendix 3

Pitch Mine Resource Summary

Appendix 4

Waste Characterization Sample Results (Memo to CDPHE HMWMD, September 2022)

Appendix 5

SiteWise Environmental Footprint Evaluation

Appendix 6

Lowest Practical Level 2022 Update (2022 PPHS Exhibit 4)

Appendix 7

EJ Screen and Public Health Reports for Transport of IX Resin Radiological Waste

Arcadis U.S., Inc.
630 Plaza Drive, Suite 200
Highlands Ranch
Colorado 80129
Phone: 720 344 3500
Fax: 720 344 3535
www.arcadis.com

Appendix 1

Historical Surface Water Quality (2022 PPHS Exhibit 2)

INDIAN AND MARSHALL CREEK SURFACE WATER QUALITY

1. Introduction

Homestake Mining Company (HMC) has been conducting ongoing reclamation and monitoring activities at the Pitch Reclamation Site (Site) in compliance with the Colorado Division of Reclamation, Mining and Safety Reclamation Permit (No. M-77-004HR) and the CDPHE WQCD Colorado Discharge Permit System (CDPS) Permit (No. CO0022756). In addition, groundwater and surface water monitoring has been conducted since 1999 across the Site and adjacent areas, including surface water monitoring on Indian Creek and Marshall Creek down to where it passes through the Town of Sargents (Sargents), to further the understanding of surface water and groundwater characteristics in support of permitting and reclamation/closure planning. In addition to these data, some limited historical water quality results also exist. This exhibit provides a brief summary of historical and current surface water quality results obtained on Indian Creek and Marshall Creek (Figure 1).

2. Indian and Marshall Creek Water Quality: 2001-2016

Uranium concentrations at the Site outfall monitoring point SW-33 are shown on Figure 2, with either total (unfiltered) or dissolved (filtered) results shown on the figure, depending on which was higher for the given monitoring event. Historically, total and/or dissolved results were obtained for a given monitoring event, with very little difference observed between the two. These uranium concentrations were previously used to establish the current condition on Indian and Marshall Creeks as part of the 2017 Marshall Creek temporary modification application. Uranium dynamics on Indian and Marshall Creeks are briefly summarized here. The full available uranium concentration dataset for monitoring point SW-33 is included in Exhibit 2b.

The uranium concentration at SW-33 varied widely between 2001 and 2016; between 574 and 1,760 μg/L (median = 1,060 μg/L). The largest concentration variation is observed seasonally, with concentrations appearing to decrease or stabilize over longer timeframes. The highest concentrations are observed during the spring high-flow season, corresponding to snowmelt and higher flows discharging from the Site. The seasonality in water quality and correlation with spring snowmelt is the result of infiltrating water contacting the oxidized, weathered products of uranium-bearing

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Legend

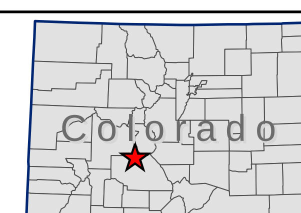
Main-Stem Flow Profile Location

Indian Creek

Marshall Creek

Tomichi Creek

Notes:
The precise location of SW-9A fluctuates east or west by approximately 0.1 miles depending on conditions at the time of monitoring.



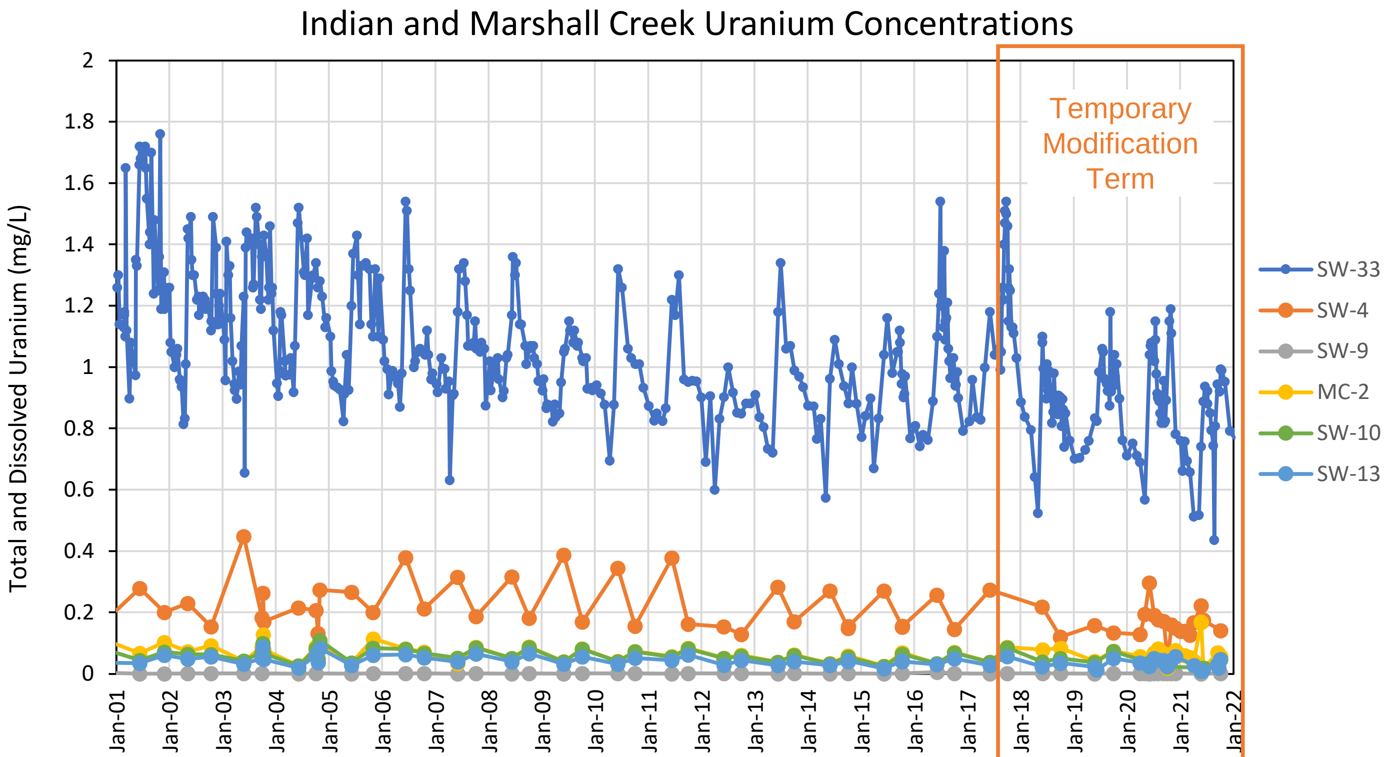
0 1 2 Miles

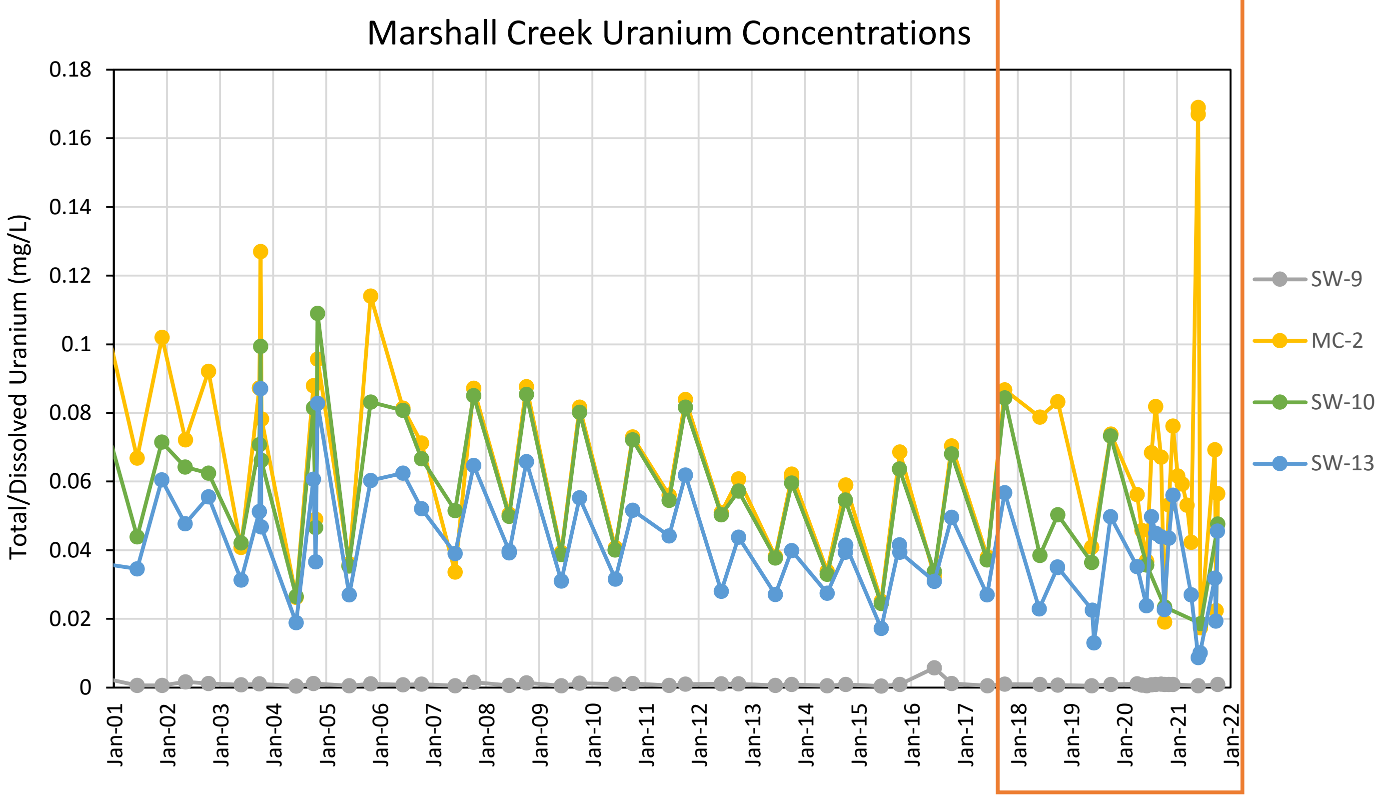
Homestake Mining Company
Sargents, CO
Pitch Reclamation Project

Stream Profile and Sample Locations

ARCADIS

FIGURE
1





NOTES:

1. Uranium concentrations shown are the maximum of the total and dissolved concentrations collected during a given monitoring event.

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Indian and Marshall Creek Uranium Concentrations, 2001-2021

ARCADIS

FIGURE
2

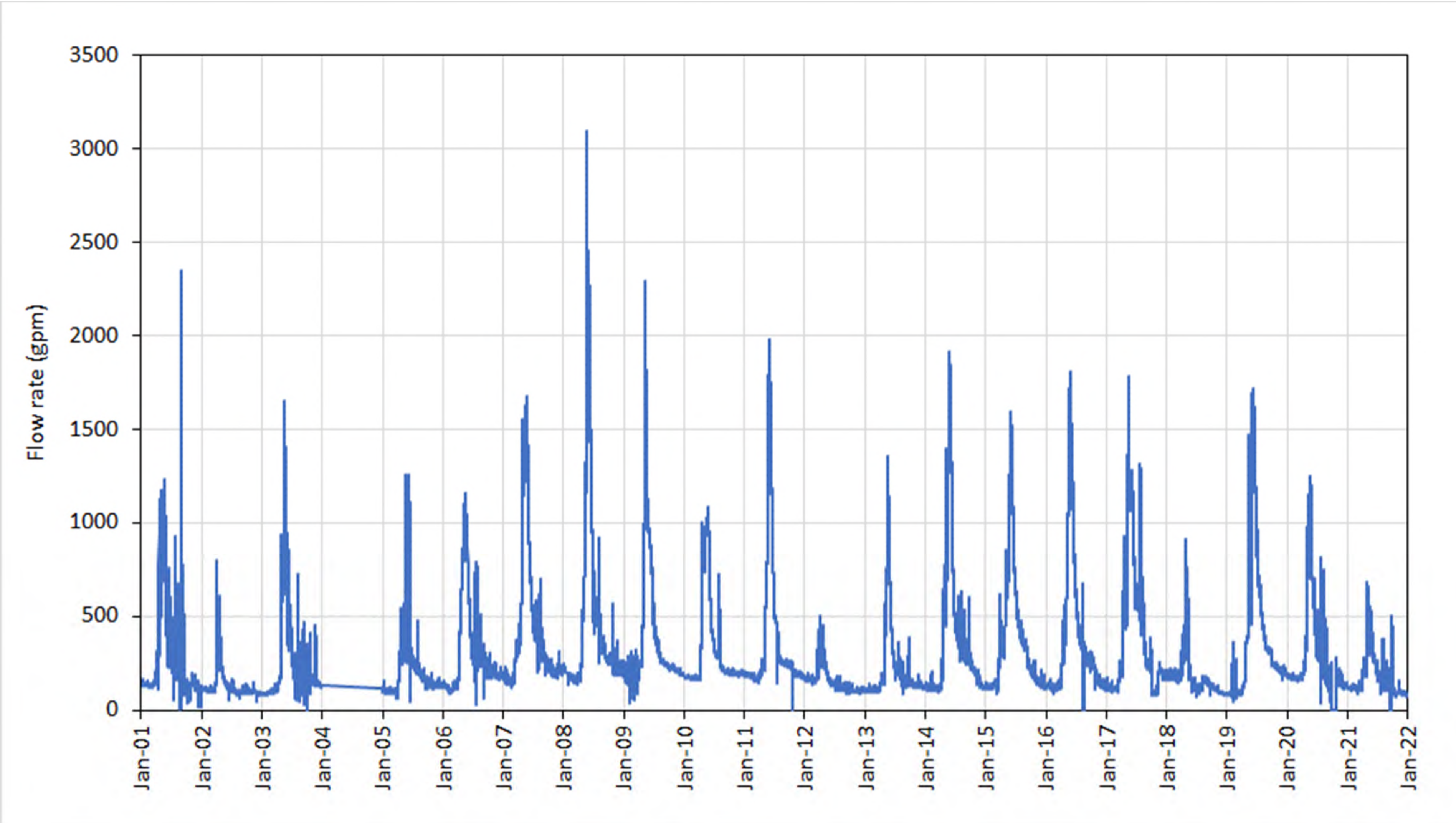
minerals. Specifically, it is hypothesized that the influx of oxygenated snowmelt results in further oxidation and dissolution of uranium-bearing minerals. The seasonality of the flow at SW-33 is consistent from year to year through this timeframe (Figure 3).

As Indian Creek water flows downstream, tributary inflows and groundwater recharge serve to substantially dilute uranium concentrations, with concentrations at monitoring point SW-4 between 128 and 448 μg/L from 2001 through 2016 (median = 204 μg/L; approximately 5-fold diluted from SW-33). The available uranium concentration dataset for monitoring point SW-4 from 2001 to the present is included in Exhibit 2b.

Discharge of Indian Creek into Marshall Creek results in further dilution of uranium. Monitoring point MC-2 immediately downstream of the Indian Creek/Marshall Creek confluence shows an approximate 3-fold dilution on average relative to SW-4, with additional dilution realized along Marshall Creek down to monitoring points SW-10 and SW-13 where Marshall Creek passes through Sargents (Figure 2). Uranium concentrations upstream of the confluence at SW-9 were detectable, but below 6 μg/L over the same period.

Seasonality in uranium concentrations is also observed in Marshall Creek; however, in contrast with Indian Creek, the highest uranium concentrations on Marshall Creek are measured during baseflow conditions (later summer through the fall and winter; Figure 2). This is due to the lower water flow rates in Marshall Creek during baseflow, which results in less dilution of uranium as Indian Creek discharges into Marshall Creek. Additional dilution of uranium concentrations in Marshall Creek are realized between MC-2 and SW-13 due to tributary inflow and groundwater discharge.

As noted in previous Rulemaking Hearing exhibits, although uranium concentrations decrease with flow along Indian and Marshall creeks, the overall uranium mass load does not exhibit a significant change. This suggests that tributary inflows and groundwater discharge do not add substantial uranium to the creeks, while groundwater recharge (i.e., creek loss to groundwater) that would result in loss of uranium load from the creeks is also not significant. In addition, as noted in the Proponent's Prehearing Statement and Exhibit 4, any uranium load reduction ultimately realized for the Site as part of the Indian Creek LPL plan would be anticipated to result in proportional uranium concentration reductions along Indian and Marshall creeks.



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SW-33 Flow Rate
(2001-2021)

ARCADIS

FIGURE
3

3. Indian and Marshall Creek Water Quality: 2017-2021

Water quality at monitoring points on Indian and Marshall Creeks during the 2017-2022 Temporary Modification term have thus far been similar to the "current conditions" concentrations observed prior to adoption of the Temporary Modification. Minimum, maximum, and median uranium concentrations for 2017 through the end of 2021 are compared to the 2001-2017 values in Table 1 below. Additional graphical comparisons are discussed in Section 4 below.

Table 1. Uranium Concentration Summary Statistics for Indian and Marshall Creeks

Monitoring Point	2001-2016			2017-2021		
	Minimum	Median	Maximum	Minimum	Median	Maximum
SW-33	574	1,060	1,760	436	922	1,700
SW-4	128	204	448	38.9	160	296
SW-9	0.4	0.95	5.7	0.5	0.9	1.1
MC-2	25.1	66.8	127	17.4	59.3	169
SW-10	24.5	61.1	109	18.6	37.9	84.4
SW-13	17.2	41.6	87.1	8.7	33.4	56.8

Notably, the uranium concentrations at SW-33 have been exhibiting a decreasing trend following Site reclamation work, with lower median uranium concentrations observed on Indian and Marshall Creeks in 2017 through 2021 relative to the 2001-2016 timeframe. Note that given the proximity of MC-2 to the Indian/Marshall Creek confluence, higher values are occasionally observed when samples are indicative of incomplete mixing of the creeks (e.g., May 2021). The August 23, 2021 uranium result at SW-33 was among the lowest concentrations observed since 2001 (436 μg/L; Figure 2).

4. Comparison with Historical Results

Water quality results on Indian and Marshall creeks prior to the start of open pit mining operations in 1979 demonstrate that uranium concentrations typically exceeded 0.030 mg/L (30 μg/L) on Marshall Creek (Dames and Moore, 1976), likely as a result of earlier underground mining and/or pre-mining geological conditions, as described in Exhibit 4.

Uranium concentrations on Marshall Creek at monitoring point SW-10 (co-located with the current SW-10 monitoring location; Figure 1) were up to 0.053 mg/L between November 1975 and June 1976 (Figure 4), which is within the more recently observed concentration range for SW-10 noted above. This is consistent with SW-4 concentrations between 0.10 and 0.22 mg/L at SW-4 from 1975 to 1976 (Figure 4), which are also close to the 2001-2021 range. Note that the 0.002 mg/L concentration reported for SW-10 on 6/28/1976 is likely a typographical error, since the concentrations at SW-3 and SW4 are similar to previous events (Figure 4).

The available SW-33, SW-10 and SW-4 uranium concentration results from 1975 through 1978 are compared with 2001 through 2016 and 2017 through 2021 results in Figure 5. The comparison highlights the overlap in surface water uranium concentrations before and after the start of open pit mining by HMC, particularly at SW-33, which is most representative of the actual uranium concentrations leaving the Site. These pre-HMC mining water quality results support the assertion that uranium concentrations in Marshall Creek are the result of natural and man-induced impacts, while the comparison with data from the Temporary Modification term (2017-present) illustrates continued decreasing uranium concentrations in Indian and Marshall Creeks.

5. References

Dames and Moore. 1976. Environmental Report, Pitch Project, Saguache County, Colorado, for Homestake Mining Company. October.

TABLE 2.9-5

RADIOMETRIC ANALYSIS OF SURFACE WATER IN THE VICINITY OF THE PITCH PROJECT, 11/75 to 6/76

Analysis Performed	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	SW-9	SW-10
	Sampling Station									
Gross Alpha (pCi/l)										
11/17/75	34±4	----[a]	137±10	60±6	0.9±0.8	----	----	----	0.8±0.7	27±4
12/22/75	12±2	----	126±9	56±6	1.3±0.9	----	----	----	0.7±0.7	21±3
1/26/76	27±3	----	122±8	50±6	2.1±1.0	----	----	----	0.0±0.4	28±4
2/25/76	13±2	----	120±10	56±6	2.7±1.2	----	----	----	0.6±0.6	29±4
3/17/76	14±2	----	120±10	62±6	2.6±1.2	----	----	----	2.6±1.2	24±4
4/22/76	7.5±1.9	0.1±0.6	91±8	42±5	1.7±1.0	----	0.2±0.5	----	0.3±0.6	17±3
5/19/76	7.8±2.0	0.6±0.9	150±10	83±8	1.4±1.0	----	0.0±0.5	0.4±0.8	0.8±0.9	4.7±1.8
6/28/76	14±3	0.4±1.0	160±10	71±7	0.5±0.7	----	0.0±0.6	----	0.6±0.8	21±3
Gross Beta (pCi/l)										
11/17/75	30±8	----	87±9	42±8	3±6	----	----	----	0±6	12±7
12/22/75	17±7	----	67±9	32±8	2±6	----	----	----	0±6	19±7
1/26/76	21±7	----	94±9	38±8	7±6	----	----	----	6±6	18±7
2/25/76	10±6	----	49±8	26±7	0±6	----	----	----	0±6	14±7
3/17/76	7±6	----	67±8	35±8	6±6	----	----	----	6±6	23±7
4/22/76	1±6	0±5	64±8	74±7	1±6	----	0±6	----	1±6	9±6
5/19/76	2±6	0±5	125±10	93±9	1±6	----	5±6	0±6	0±6	0±6
6/28/76	0±5	0±5	63±9	0±7	0±5	----	0±6	----	0±5	0±6
Uranium (total (mg/l)										
11/17/75	0.034	----	0.23	0.11	0.002	----	----	----	0.003	0.053
12/22/75	0.021	----	0.26	0.12	0.002	----	----	----	0.002	0.053
1/26/76	0.032	----	0.27	0.12	0.003	----	----	----	0.003	0.051
2/25/76	0.018	----	0.21	0.11	0.002	----	----	----	0.002	0.043
3/17/76	0.026	----	0.25	0.12	0.002	----	----	----	<0.002	0.045
4/22/76	0.013	0.002	0.24	0.10	0.007	----	<0.002	----	<0.002	0.031
5/19/76	0.012	<0.002	0.36	0.22	<0.002	----	<0.002	----	<0.002	0.030
6/28/76	0.019	<0.002	0.33	0.14	<0.002	----	<0.002	<0.002	0.002	0.002

[a]No analysis performed

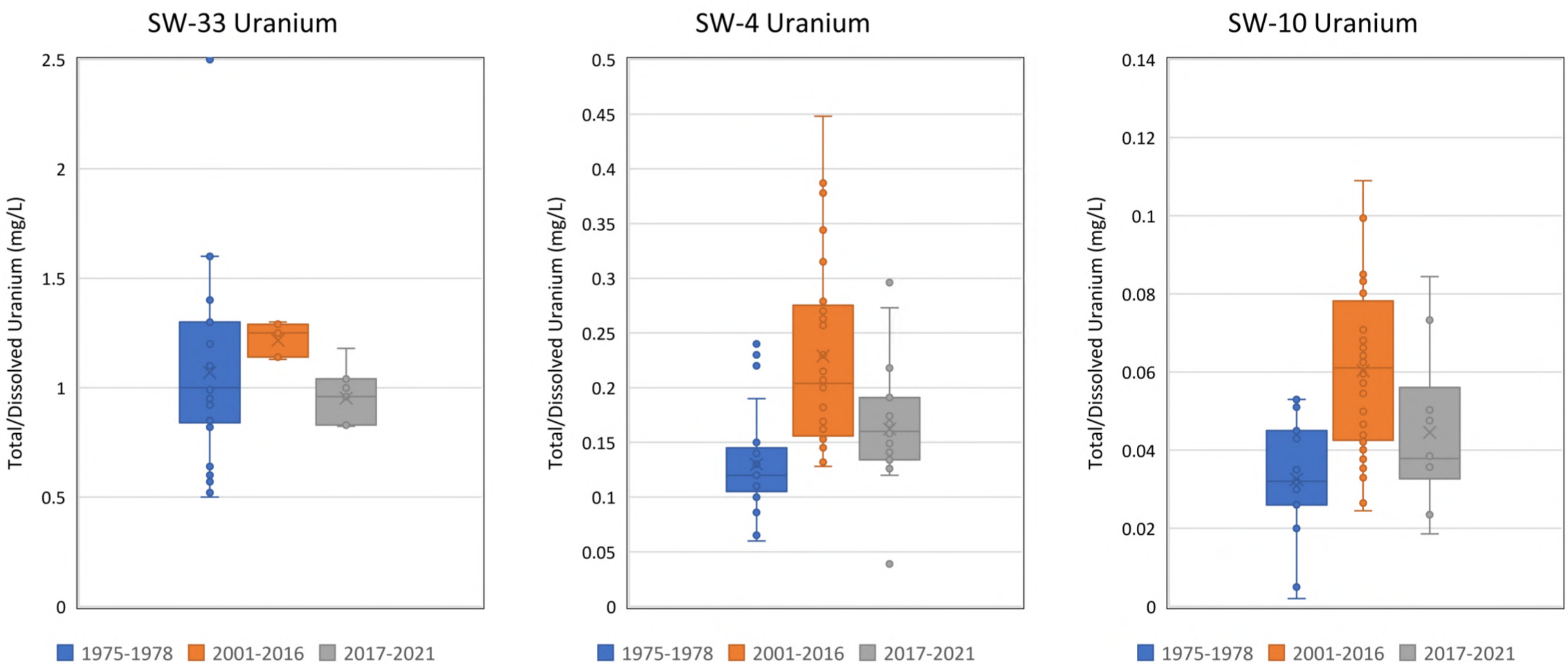
Source:
Environmental Report, Pitch Project, Saguache County, Colorado, for Homestake Mining Company. Prepared by: Dames & Moore, October, 1976.

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

Historical Indian Creek/Marshall Creek Monitoring Results

ARCADIS

FIGURE
4



Notes:
Box boundaries represent 25th percentile, median, and 75th percentiles of the dataset, and whisker ends represent 5th percentile and 95th percentile values of the dataset.

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Historical Surface Water Uranium Comparison

ARCADIS

FIGURE
5

Appendix 2

Pitch Mine Historical Documents:

2-1: Liability Insurance Memorandum, Pinnacle Exploration, Inc. (March 1970)

2-2: Draft Responses to EPA Comments on HMC Draft Environmental Statement (December 1978)

2-3: Discharge Permit and Summary of Rationale (June 1980)

2-4: Summary of Evidence Re Segment 21 of the Upper Gunnison River Basin – Indian Creek (February 1982)

Appendix 2-1

Liability Insurance Memorandum, Pinnacle Exploration, Inc. (March 1970)

Pinnacle Exploration, Inc.

TO: Mr. E. A. Salo
DATE: March 13, 1970

FROM: F. H. Brooks
COPIES: L. F. Marrs
R. H. Hodder
J. T. Hall

SUBJECT: Liability Insurance - Pitch Mine

Referring to your memo of February 19, 1970, I submit the following observations concerning possible insurance problems which could result from our solution mining operation at the Pitch Mine.

Prior to mining operations by Pinnacle, which began in 1959, the only known anomalous mineral in the Indian Creek drainage system was natural dissolved U_3O_8. This was measured by the AEC in 1959 and varied from .25 to 1.60 parts per million in the stream.

After cessation of normal mining operations but before the beginning of solution mining in 1967, samples of Indian Creek water varied from nil to 20 or 30 ppm depending upon flow rates and dilution.

Analyses of Lower Indian Creek monthly composites over the last twelve months averaged 1.6 ppm U_3O_8 or 1.4 ppm natural U. This compares with the maximum allowable concentrations, as set by the AEC and affirmed by the State of Colorado of 48 ppm natural U (or 2.0 X 10^{-5} micro-curie/ml).

The Pitch plant, although recycling mine water solution with strengths up to 60 ppm U_3O_8 (51 ppm natural U) yields only periodic effluent to the surface drainages and this tailing water is much less than the allowable, being less than 5 ppm.

The mine system, as near as can be determined, is a closed one with no detectable water or mineral escaping into the ground water system.

The only additives now introduced into the mine system are Sodium Carbonate and Hydrogen Peroxide. The former dissociates into Na and CO_3 ions. The latter dissociates into H_2O and oxygen, raising the oxidation potential of the solution but not changing the basic chemistry. The CO_3 concentration in the lower Indian Creek composites over the last six months has averaged 165 ppm.

The only potential problem, wherein mine system could contaminate the local water system, would be in the event that, through rupture of the underground reservoir or mechanical failure in the plant, all the solution, estimated to be 500,000 gallons, would be turned loose at one time. To preclude such a possibility, Pinnacle constructed, in 1969, a lower retention dam just below the old sawmill. This dam will contain the bulk of the mine solution, allowing gradual release to the Indian Creek drainage with sufficient dilution to render it harmless.

The Ion-Exchange Plant discharges periodic effluents into Indian Creek. These consist of:

1. Regular backwash of ion-exchange and clarifier tanks. This is chiefly mine water and mud with no extraneous chemicals.

2. Occasional backwash of clarifier tank to remove iron contamination. This effluent is acid in nature and contains quantities of iron sulfate.

3. Barren eluate. This solution is discharged to Indian Creek in quantities of 2,000 gallons/day more or less and contains sodium chloride and sodium sulfate.

The only other contaminants which could get into the effluent would be abnormal concnetrations of the radionuclides. The state requires that we monitor our effluents for natural Uranium, Radium 226 and Thorium 230.

The contaminants in all of the above can be expressed in terms of chloride and sulfate, carbonate, Natural U, and isotopes of Radium and Thorium.

The analyses of lower Indian Creek for the past six months show the following concentrations:

IONS	Six Months Average	Maximum Recommended
CO_3 (Carbonate)	165 ppm	no Maximum
Cl (Chloride)	30 ppm	250 ppm
SO_4 (Sulfate)	191 ppm	250 ppm
U (Natural)	1.4 ppm	48 ppm
Ra_{226} (Radium)	$.2 \times 10^{-8}$	3.0×10^{-8} micro-curie/ml
Th_{230} (Thorium)	$.2 \times 10^{-9}$	2.0×10^{-6} micro-curie/ml

In summary, the plant effluents to lower Indian Creek are all controlled and well below recommended maximum. In addition, the point in lower Indian Creek where these samples are taken is above the first point where any cattle would be drinking the water and some five miles above the first point where domestic wells are located. Between Lower Indian Creek and the nearest wells the water flow is diluted by a factor of 6 to 10.

In addition to chemical changes in the plant area, there is occasional minor subsidence above the mine workings due to settling in the caved stopes. This is shown by several small 12" to 18" shears which develop concentric to and 20-100 feet from the stopes. The likelihood of any one or thing suffering from tripping over or falling into any sink or subsidence is most remote.

FHB:cbd

Appendix 2-2

Draft Responses to EPA Comments on HMC Environmental/Design Reports (December 1978)

HOMESTAKE MINING COMPANY
7625 WEST 5TH AVENUE — SUITE 100D
LAKEWOOD, COLORADO 80226
URANIUM DIVISION
TELEPHONE (303) 238-1241

December 9, 1978

DEC 11 1978

Mr. A. B. Cozzens
Manager - Uranium Division
Homestake Mining Company
650 California Street
San Francisco, CA 94108

Dear Bailey:

The second draft of the responses to the EPA comments is enclosed. Please note that the attachment "Initial Design for Mine Wastewater Treatment Reservoir" by Bingham Engineers is not enclosed (Response #3). We may also include portions of the attachment "Plans and Specifications for the Construction of Mine Wastewater Treatment Reservoir". Kurt Gilg should have copies of these reports. It is planned to attach a copy of these reports to the Final EPA responses.

Response number 64 is not included. This is being formulated and will be forwarded to you as soon as it is complete.

A timely review and response will be appreciated. We plan to send these responses to the agencies by December 15, 1978.

Sincerely,

Harold A. Powers

Harold A. Powers
Manager - Uranium Development

HAP:bg
Enclosures
cc: C. E. Baker
A. B. Cozzens
T. N. Fiske
Kurt Gilg
John C. Kapsner
Gary Parker
K. R. Porter
H. A. Powers
Maurice Richard
George Simchuk
Gordon L. Steele
L. W. Swent
Jeff Thatcher
File

Homestake Mining Company
Response to:
EPA
September 13, 1978
Homestake Pitch DES
USDA-FS-R2-DES(ADM)FY-78-03
Project M-5

1. This is a licensing matter for consideration by applicable government regulatory agencies, particularly the Radiation and Hazardous Wastes Control Division of the Colorado Department of Health.

2. With respect to the diversion from Marshall Creek, by letter dated May 2, 1978, Homestake submitted plans of its proposed diversion to the U. S. Army Corps of Engineers for review and requested a determination of whether or not a "404 Permit" is required. By letter dated May 30, 1978 (copy attached), the Corps indicated that since no fill is to be placed below the ordinary high water elevation of Marshall Creek, a permit will not be required, provided all work is performed in accordance with the plans and criteria Homestake previously submitted.

   With respect to construction of the sedimentation pond, pursuant to 33 CFR 323.3(a), a 404 permit is required for the discharge of dredged or fill material into "waters of the United States." "Waters of the United States" is defined very broadly in 33 CFR 323.2(a). However, 323.4-2(a)(1) of 33 CFR provides that discharges of dredged or fill material into non-tidal rivers, streams and their impoundments, including adjacent wetlands that are located above the "headwaters," are permitted by regulation. The term "headwaters" is defined in 33 CFR 323.2(i) as the point on a non-tidal stream above which the average annual flow is less than five cubic feet per second (5cfs). An individual 404 permit is not required provided certain conditions, set forth in 33 CFR 323.4-2(b), are satisfied. Since the average annual flow at the sedimentation pond construction site is below 5 cfs and applicable conditions will be satisfied, a nationwide permit has already been issued. It will not be necessary to obtain an individual permit. As indicated in the preceding paragraph, a 404 permit is not required for the diversion from Marshall Creek, and thus the precedent referred to in the comment is inapplicable since a 404 permit is not required for any aspect of the project.

3. Subsequent to the completion of the ER, ~~considerable~~ additional knowledge of the hydrogeologic regime at the project site has been developed. It is derived from analysis of data from twenty-one wells, GW1 - GW5 and DM1 - DM14 (two wells each at DM3 and DM13), and water level measurements from four piezometers (582, 583, 587, and 588). The location of the wells is shown on Plate 2.6-1 of the Supplemental ER. The location of the piezometers is shown on Plate 2.6-5 of the

Supplemental ER. In addition, data regarding geology and electric logs were derived from more than 500 exploratory holes drilled by Homestake at the mine site. Examination of all of the above data has resulted in the revision of Figure 2.7, DES p. 2-14, and development of a potentiometric surface map for the mine area (see response to State of Colorado comment 20). The geology of the mine area is complex due to the north-south trending Chester, West and lesser parallel faults, as well as east-west trending faults, predominantly the Erie. The results of independent analyses conducted by Envirologic Systems, Inc.; Leeds, Hill and Jewett, Inc.; and David T. Snow, Ph.D. strongly indicate that a lake will form in the northern pit upon the cessation of active mining (see response to State of Colorado comment 20). Flow into the ultimate mine pit will be in excess of 190 gpm with excursions up to 500 gpm, due to surface runoff.

When necessary, Homestake will treat excess mine water for radium removal and suspended solids. The design of the sedimentation pond has been completed by Bingham Engineering, and a copy of Binghams's report is attached. The pond is designed to contain the deposited sediment over the life of the project, provide an operational retention time of 48 hours for mine dewatering, and totally contain a 25-year, 24-hour drainage runoff event (see response to State of Colorado comment 9). The sedimentation pond will be located below the existing pond and will intercept runoff from the waste dumps. Discharges will meet applicable state and federal limitations and will be in compliance with NPDES permit requirements.

4. An original map was supplied with the ER. Perhaps different reproduction techniques can make the map more legible. Homestake will, in this regard, render any assistance if requested by NRC/USFS.

5. The Supplemental ER (Table 2.6-3, page 2-29 and Plate 2.6-6, page 2-34) provides data on a full annual cycle of water level measurements in the Hale Gulch area. In addition, recent water level data for wells DM-1 through DM-14 from Februrary 1977 through September 1978 are provided in the attached table, "Water Level Data."

6. (See response to comment 56.)

7. Figure 2.7 has been redrafted (see response to comment 3) showing the location of the tailings pond, and a copy is attached. Well depths are set forth in Sec. 2.6.1.5.1 of the Supplemental ER.

8. Sampling stations GW-1 through GW-7 are not shown in Figure 2.8 as they are not located in the mill area. Stations GW-1, -2, -4, and -5 are located in the Hale Gulch area. Station GW-3 is at the portal of the old Pinnacle Mine. Stations GW-6 and -7 are water wells in Sargents. Station locations are shown on Plate 2.6-1 in the Supplemental ER, except for GW-6 and GW-7 which were not identified when the ER was developed.

Section 2.4.1.3 of the DES (page 2-15) indicates that the locations of the groundwater sampling stations are shown in Fig. 2.4. That reference should have been to Fig. 2.5 on page 2-8. See response to comment 4.

9. Per Table 2.6-9, page 2-52 of the Supplemental ER, total suspended solids and turbidity are high because the sample procedure agitated fine material in the bottom of the well. The pH values, ranging from 7.3 to 8.9, are shown in the Supplemental ER (Tables 2.6-9 and 2.6-12), along with several other parameters which are omitted from the tables in the DES.

   Values for Thorium-230, Radium-226, Gross Alpha, and Gross Beta are all in pCi/l; uranium is given in mg/l. Data collected on other proposed mine-mill sites have shown the same wide degree of variability between successive samples. No replicate sample analysis was deemed necessary since the laboratory providing the analytical services provided the quality assurance. The laboratory performing radiometric analytical services can supply the methodology if requested. Only those laboratories employing EPA approved methods are used by Homestake.

10. Table 2.6-4 (page 2-39) of the Supplemental ER provides the locations of these wells. Groundwater supports sub-irrigation for hay production along Marshall Creek. It is not directly pumped for sub-irrigation use.

11. The Pinnacle Mine is located on the western edge of the proposed open pit as indicated on the attached copy of Figure 2.9.

   The following is a description of the existing conditions at the Pinnacle Mine. The ion-exchange circuit is now dismantled. Most of the buildings remain and are being utilized for storage and some warehousing and maintenance shop usage. Areas utilized by the ion-exchange plant for the processing of yellowcake are presently boarded off and closed to entry. Some ore from Pinnacle mining remains in a stockpile constructed by Pinnacle. Very little waste was generated by previous underground mining by Pinnacle.

12. There are no flow measurements available for Hale Gulch, but it has been sampled for water quality during the spring runoff. Hale Gulch flows only during the spring and results primarily from snow melt. There are four springs, SP 54-57, located in the drainage area of Hale Gulch. They provide a maximum flow of approximately 2.5 gallons per minute, but do not flow in the winter months. In Section 2.6.1.5.2 of the Supplemental ER, the base flow in Hale Gulch has been calculated at 30 gallons per minute through a saturated section 880 feet long and 20 feet deep. This is an approximate value of flow based on an average transmissivity value (see Supplemental ER, Sec. 6.1.2.7) determined from pump tests on well DM-3A. The amount of groundwater moving down Hale Gulch at any time through a designated saturated thickness of tuff will vary from this estimate. In the spring, during surface runoff from snow melt, the groundwater flow is expected to be greater.

13. Flow data for April 1976 through November 1976 are presented in the Supplemental ER, p. 2-41, Table 2.6-5. Flow data for November 1977 to October 1978 are shown in the attached table, "Summary of Discharge Measurements." The flow monitoring program was not fully maintained from November 1976 to November 1977, and thus only limited and random data are available for that time period.

14. Uranium values were provided in the ER, Tables E-7, E-9, and E-12.

The high gross alpha and gross beta values for Indian Creek are due primarily to the presence of the large naturally occurring uranium ore body. Discharge from the old Pinnacle Mine is estimated to range between 30 and 50 gpm with an average dissolved uranium (as U) concentration of 2.9 mg/l (station GW-3, Table 2.6-12, page 2-62, Supplemental ER). Using an average discharge of 45 gpm, the uranium loading of Indian Creek from the mine discharge is 710 grams/day. The flow at station SW-3 (the 1 meter weir) downstream of the mine discharge ranges from 1257 to 3547 gpm (Table 2.6-5, Supplemental ER) with an average dissolved uranium concentration of 0.27 mg/l (Table A-2 Supplemental ER). The uranium loading at SW-3 ranges from 1847 to 5212 grams/day respectively or from 2.6 to 7.3 times the loading attributable to the mine discharge. Based upon the above information the old Pinnacle Mine discharge contributes only 14 to 38 percent of the uranium load of Indian Creek.

There is a discrepancy between the suspended sediment values stated on page 2-21, Section 2.4.2.4 and the TSS values in Table 2.7, page 2-22, because they reflect two different types of data collected at different times, using different sample collection techniques. The stated values in Section 2.4.2.4 represent 10 suspended solids samples collected over approximately a three-month period (see Table 2.6-7, page 2-46 of the Supplemental ER). These samples were collected using a DH-48 depth-integrated suspended sediment sampler. The TSS values as shown in Table 2.7 represent total suspended solids analysis that was part of the water quality monitoring program described in the ER and Supplemental ER.

15. The average concentration of pyrite (FeS_2) in the uranium ore is less than 3%.

Acid tailings problems in Canadian mills were all associated with acid leach milling processes. Current Canadian practices include elevation of pH of the tailings using lime or limestone. This practice eliminates the excess acid and stabilizes the heavy metals. Beaverlodge is the only known Canadian alkaline mill. Its ore contains pyrite, and no acid problems have been experienced. There are now no known acid seepage problems associated with operating Canadian mills.

Because the Pitch mill is an alkaline milling process, no problem is anticipated with pyrite conversion to acid. Laboratory tests conducted by Homestake and Hazen Research Institute indicate that approximately three times the maximum quantity of acid that could be produced would be neutralized without the addition of lime or limestone to the tailings.

16. The old mine workings were located in extremely unstable ground near the Chester Fault zone. As a result of the excavation of these unstable formations during open pit mining, support problems encountered in the previous underground operation will be eliminated. The pit walls will be established in more competent rock formations adjacent to the Chester Fault on the east and west sides. Where the Chester Fault intersects the pit walls, the design angle of the pit will be altered to provide the desired safety factor.

    Any new underground workings to extract small ore pods would be established from benches within the pit. They would be for short-term use and not subject to the problems associated with long-term underground mining. In addition, they would be directed toward production from ore pods which lie east and west of the Chester Fault zone, and not in the unstable formations. There is the possibility that deep-lying ore not removed from the open pit may be mined by a long adit from outside the pit limits. If ore is so mined, modern support techniques such as yieldable steel arches would be used.

17. Periodically, very small numbers of black bears are reported on the project site. The bear referenced in the question was intentionally attracted to the area by placement of meat and garbage. Normally, bears are not seen on the site and are not considered as frequenting the project site. The study area does include the entire project area.

18. The discussion presented in the DES is inconsistent with the statement presented in the ER. In the ER, the dose attributable to cosmic radiation <u>and</u> fallout was estimated to be 75 mrem, not 102 mrem as suggested in the DES.

    The dose attributable to fallout was <u>not</u> specifically identified as either 75 mrem or 102 mrem. Based on the discussion presented in NCRP Report No. 52 (1977), the annual dose attributable to fallout is estimated to be 1.0 mrem/yr.

19. Pre-operational stockpiles will be stored in the same manner as operational stockpiles, including deposition on clay pads.

20. When topsoil is encountered in sufficient thickness to justify storage and on workable slopes, it will be stockpiled and used in reclamation. A soil thickness of only about 2 to 3 inches generally exists, and this grades rapidly into rock particles within less than one foot of the ground surface. Tree roots in the heavily timbered areas will complicate topsoil removal, and steep mountain slopes over part of the mine site will make heavy mobile equipment operations hazardous. Reasonable efforts will be made, however, to segregate and retain topsoil for the reclamation program.

21. During initial dump construction, some lifts will be 240 feet. Final dump configuration design provides that the lifts will be only 80 feet,

although a particular face could be as much as 240 feet or more. The length of a dump face is dependent upon the natural slope of the underlying ground. With this understanding, Homestake agrees that the FES should include a statement that reflects dump lifts as great as 240 feet.

Very little water will flow through the underdrains since no springs or streams will be covered by the dumps. Only precipitation runoff and snow melt entering the exposed edges and minimal amounts of water infiltrating through the dump face will flow through the underdrain system. Precipitation and runnoff originating above the waste dumps will not flow through the underdrain. Natural segregation will inhibit clogging since fine material will remain near the top of the dumps and coarse material will settle near the bottom. To verify that the underdrains do not clog, piezometers will be installed in the waste dumps.

Through extensive rotary and core drilling programs conducted during the exploration and development phases of the operation, Homestake has determined the location of overburden deposits containing sufficient concentrations of toxic materials to be harmful to plants, and these deposits will be buried below the surface of the dump and away from underdrains.

There is no reason to assume that the overburden in areas of higher uranium content will contain higher levels of radionuclides. The waste-level cutoff will be the same regardless of the grade of associated ore. If the "overburden" is found to have high levels of uranium, it will be treated as ore, not waste.

Acid drainage from the relatively low levels of pyrites is not expected to occur due to the neutralizing effect of the alkaline overburden (see reponse to comment No. 15). The Colorado School of Mines Research Institute performed leaching studies on both barren overburden and low-grade waste material. Projected changes in water quality associated with the development of the dumps are addressed in Attachment B.

22. Low-grade waste (less than 0.02% U_3O_8) will be disposed of in "pockets" in the waste dumps, away from the underdrain system and covered by at least twenty feet of barren overburden. The second paragraph of the comment pertains to a licensing matter and is directed to the Colorado Department of Health.

23. The potential for acid drainage is not great due to the high carbonate content of the ore. As evidence of this statement, the present drainage from the old Pinnacle Mine is alkaline.

24. Reclamation potential is thoroughly addressed in the attached revegetation test plot report (Attachment A) and Homestake's response to comment No. 64. Homestake estimates that much of the area will be returned to

pre-project uses within one year after cessation of activity. With the exception of the tailings area and pit walls, the rest of the area should be useable within 2-4 years following mill decommissioning.

As stated in the first paragraph in Section 3.1.3, the long-term reclamation goal is to revegetate all disturbed areas. Reclamation of the pit slopes will be difficult, and revegetation will take a considerable amount of time. Experience with roadcuts of similar slopes and climatic conditions indicates that natural revegetation will occur over time.

Based on work subsequent to the publication of the ER, including an analysis of approximately 500 exploratory holes, there is a strong liklihood that a lake will form, and that the water in the lake will be of good quality (see response to State of Colorado comment 20). The lake would be expected to have almost no fluctuation in water level, as evidenced by the fact that groundwater levels within the vicinity exhibit very little fluctuation. (See data for wells DM 13, 13A, and 14 on attached table.) Access will be provided by haulage roads. The filling will begin immediately upon the cessation of dewatering activities, and should occur within the spring runoff period.

As indicated in Section 3.1.3 of the DES (page 3-12) and Homestake's application for a Colorado Mined Land Reclamation Permit, the southern section of the pit may be at least partially backfilled with overburden and waste from the north pit. The referenced statement on p. 3-10 is correct.

25. The grading will not attempt to restore the land to its original contours, but will blend the reclaimed area with the surrounding topography. Some of the natural slopes in the area are more than 1:1, and there are some near-vertical bluffs. (See response to State of Colorado comment 27 for a discussion of dump stability.)

A 1:500 slope on the surface of the stabilized tailings area will allow slow runoff across the reclaimed tailings area to the saddle dam, while promoting deposition and reducing erosion. Any water seeping through the stabilized structure will have to penetrate a clay cap on top of the tailings surface, as well as the clay liner on the bottom. Considering these physical barriers, and the reduced permeability imparted by sodium in the tailings, it is unlikely any large amount of liquid will seep through the reclaimed tailings area (seepage from the tailings pond is discussed in the responses to comments 31 and 36).

26. The basis for the statement is the results from on-going test plot programs (see Attachment A). Overburden used for cover has been evaluated during the exploration program, and only materials which do not

EPA

contain harmful amounts of toxic substances and radionuclides will be used for cover. Homestake has analyzed the content of the overburden (see response to comment 21).

CAN WE TAKE THIS OUT?

With a mill near the mine, a much lower grade of resource can be mined, and most of the material with any significant radioactivity will be removed from the pit.

?? LEAVE IN

After the pit has been completely mined, groundwater will circulate through material which contains significantly less U_3O_8 than at present. This should result in lower radionuclide concentrations than monitored in DM-13. Even without the 20-foot cover, water quality is expected to improve. As a precutionary measure, overburden will be deposted to minimize direct water contact with radioactive material.

The engineering properites of project area clay are ideally suited for liner material. Pacific Testing Laboratories performed permeability tests on representative clays from Hale Gulch and Site B which is the primary borrow source for clay. The tests indicate that the permeability of the clay is reduced by the mill effluent. Recommended permeability values for these clays are 0.01 ft/yr in mill tailings effluent and 0.1 ft/yr in fresh water.

27. Under present guidelines of the NRC reclamation and stabilization procedures are designed to eliminate the need for perpetual care. If there is proper containment and stabilization, there should be no future radiological hazards. As indicated in Appendix A of the ER, Homestake has taken into account all known physical factors which will bear on the long-term stabilization of the tailings area. The structure will be designed to accommodate the forces of the elements, such as waterflow, alternate freezing-heating, drying, wetting, wind action and seismic activity. Final reclamation will promote further deposition on top of the tailings over time.

28. As expected for overburden, organic matter, nitrogen, and phosphorus levels are low.

29. A copy of the existing NPDES permit is attached along with a copy of the letter extending it to December 31, 1980. The application for a renewal permit is pending with the Colorado Department of Health and the provisions of the renewal permit have not been determined.

The coarse overburden used for fill or other purposes will be utilized primarily in the early stages of the stripping activities. This material has been extensively drilled and the cores analyzed for toxic and radioactive content. Coarse overburden utilized in the construction of the settling pond dam and/or the fill for the remainder of the haulage road will be selectively analyzed for specific radioactive and toxic characteristics. Natural segregation will be utilized in filling the natural drainages to provide underdrains. Runoff from higher elevations will be diverted around the dumps, when necessary, during initial stages of the operation. The diversion structures will utilize roadways and the associated ditching to divert the water away from the overburden storage areas. The overburden dumps are located high on the drainage and consequently there is very little area located above the dumps to produce natural runoff (see response to State of Colorado comment 27).

A new sedimentation pond will be constructed on Indian Creek below the existing pond. Its location is such that runoff from all three waste dumps will flow into the pond. The sedimentation pond will be used primarily for settling out suspended solids. Excess mine water that is not used in the mill circuit will be treated for radium removal and then released to the sedimentation pond. The old Pinnacle Mine discharge is presently treated for radium removal before reaching the existing settling pond. (Also, see response to State of Colorado comment 9.)

30. Mine water from the open pit will be used in the mill circuit as needed. Only excess mine water that is not used in the mill circuit will be discharged. Prior to discharge the water will be treated, if necessary, for radium removal and then released to the new sedimentation pond for suspended solids removal. The units referred to in Figure 3.12 are acre-feet (see response to comment 29.)

31. The higher radioactivity levels in Indian Creek are attributable to the naturally occurring ore body and, to a minimal extent, the drainage from the old Pinnacle Mine (see response to comment 14.) There is no indication that the existing settling pond contributes to the higher radioactivity values. An effective settling pond will reduce the radioactivity in the effluent stream (see response to State of Colorado comment 9.)

To intercept potential seepage, a trench across Hale Gulch downstream from the tailings embankment will be constructed. The trench will extend through the alluvium and at least 2 feet into the underlying tuff. A perforated pipe, 6 inches in diameter, will be placed in the bottom of the trench. The trench will be backfilled with free-draining sand and gravel. At the low point of the trench a sump will be constructed and a pump capable of pumping water to the tailings reservoir will be installed.

The water which collects in the sump will be sampled regularly. If the water quality deteriorates below an applicable standard, it will be pumped back into the tailings reservoir. As required, water from the tailings reservoir will be pumped back to the mill.

Because of the natural drainage occurring at the site and the low rate of seepage from the tailings (see response to comment 36), the proposed system is expected to be very effective. It is expected to collect all of the small amount of seepage estimated.

32. The applicant has reviewed the referenced EPA Publication No. AP-42. As indicated in Section 4 (pages 4-1 and 4-25), fugitive dust emissions from vehicles moving along haul roads were calculated using EPA approved methods.

33. The referenced NPDES permit does include radionuclides.

34. See response to comment 32.

35. Curtailment of mining activities during winter does not necessarily mean that the mining will cease for a full six-month period. Stripping activities will continue on a year-round basis, but ore removal activities may cease during severe winter weather. The stripping will necessitate the removal of accumulated snowfall on a regular basis. Any snow remaining after the plowing for stripping will melt and be collected in the open pit sump. Water from the sump then will be pumped to the mill or treated for radium removal, if necessary, and then released to the proposed sedimentation pond.

36. The engineering properties of the on-site clay are ideally suited for liner material. Permeability tests on representative on-site clays were performed by Pacific Testing Laboratories. These tests showed that the permeability of the clay is reduced by the mill effluent. Calculated permeability values for these clays are 0.01 ft/yr in mill effluent and 0.1 ft/yr in fresh water. According to a study recently completed by Dames & Moore, over 6.1 million yards of clay are located on the project site. Since only 300,000 to 400,000 yards of clay are needed, the supply is adequate.

    The pump-back system will be operated until stabilization of the tailings area is achieved, and no significant seepage is occurring. The design and efficiency of the system are outlined in the response to comment 31.

    Based on revised tailings pond seepage rates, an assessment of the effect on Marshall Creek water quality due to 60 gpm leakage from the pond would be unrealistic. Permeability tests on the tailings pond clay liner materials conducted by Dames & Moore result in a revised average seepage rate of 5 gpm and a maximum of 10 gpm. Homestake will install an interceptor pump-back system to collect and return any significantly contaminated seepage detected from the tailings pond (see response to EPA comment 31).

    A leachate collection system under the tailings pond was considered, but it would provide relatively little benefit. The tailings reservoir will be lined with an extremely low permeability (0.01 ft/yr) clay. The tailings reservoir will be isolated hydraulically from the groundwater regime at the site. As indicated in the preceding paragraph, only 5 to 10 gpm or less is estimated to seep through the clay liner. This small amount of seepage will not create a water mound and therefore it will not affect the existing groundwater gradient. The seepage effluent is expected to intermingle with the groundwater and flow downgradient through the alluvium in Hale Gulch. A seepage interceptor system (see response to comment 31) will be constructed through the alluvium and across Hale Gulch downstream from the tailings dam. It is anticipated that almost all of the seepage will be collected in this system. It then will be pumped back into the tailings impoundment reservoir if significantly contaminated, and subsequently to the mill.

Details of the radon-222 release calculations are presented in Appendix E of the DES. The calculations utilize a state-of-the-art mathematical description of radon diffusion and data published subsequent to the references on which the generic figures in EPA/520/1-76-001 are based. The results presented in the DES do reflect specific site conditions.

37. Following cessation of mining activities, groundwater patterns within the present area will be similar to the existing condition, in which flow moves to the west from the recharge portion east of the Chester Fault. (For a discussion concerning lake formation, see response to State of Colorado comment 20.)

38. During active mining water flowing into the open pit will be utilized in the mill circuit to the extent needed, and the excess treated with $BaCl_2$ for radium removal, if necessary, and released to the sedimentation pond. This activity will ultimately eliminate the present poor quality discharge from the old Pinnacle Mine (GW-3). Upon cessation of mining, a lake is expected to form in the pit. The quality of the lake water will be a combination of water from the Precambrian Formation to the east of the Chester Fault and flow from the Leadville Formation north of the northern extension of the ultimate pit (see response to State of Colorado comment 20).

The percentage of acidic overburden to be disposed of in the waste dumps is anticipated to be minimal and will have no influence on any runoff or infiltration through the dumps (see Attachment B).

The Colorado School of Mines Research Institute has performed leaching tests on columns of low-grade waste (0.013% U_3O_8) and barren overburden material. Analyses show that molybdenum, selenium and pH will not be a problem. Concentrations measured during leachate analyses are shown below.

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Leachate Concentration
(mg/l)

Parameter	Bed Volume I	II	III & IV	V	VI	Material
Mo	< 0.1	0.4	< 0.1	0.2	< 0.1	Low-grade
Mo	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	Barren overburden
Se	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	Low-grade
Se	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	Barren overburden
pH	7.8	8.2	8.0	7.9	7.9	Low-grade
pH	7.8	8.3	8.1	7.7	7.9	Barren overburden

More details on these tests and leachate analyses for forty additional parameters are presented in Attachment B.

The waste dumps are designed to minimize water infiltration (see response to Department of Interior paragraph 10). However, any water entering and moving through the piles will follow the underdrain system formed by the naturally segregated coarse dump material. Water entering this drainage system will move as surface flow out the toe of the pile and enter the sedimentation pond.

A monitoring well has been constructed in Indian Creek valley immediately downslope from the maximum extent of the north overburden area. Another well will be installed at the base of the south overburden area before that area is utilized. Piezometric monitoring wells will also be installed in the dumps (see responses to Department of the Interior paragraph 10 and State of Colorado comment 18). Should monitoring wells indicate unacceptable levels of water contaminants from the waste piles, pumping of the wells downgradient of the waste piles will be initiated to intercept the contaminated water. This intercepted groundwater would be returned to the surface for treatment in the sedimentation basin.

~~Only~~ A a single sedimentation pond will be installed on Indian Creek below the waste dumps. Design criteria for this pond are presented in response to State of Colorado comment 9.

The projected 500 mg/l TSS does not consider treatment of the runoff in the new sedimentation pond. The proposed facility is sized to contain maximum runoff and provide sufficient retention time for discharge to be in compliance with NPDES permit requirements (see response to State of Colorado comment 34).

39. As needed, Homestake will use mine water in the milling process, even though Figure 3.12 shows this concept as an alternative. Mine water in

excess of that required in the mill circuit will be treated for radium removal, if necessary, and released to the sedimentation pond. Fresh water demands will be met using the fresh water storage pond. (See responses to comment 30 and State of Colorado comment 42.)

40. Bingham Engineering, Inc. has recently completed the design of the new sedimentation pond. The new pond is designed to meet all effluent requirements set forth in applicable state and federal regulations. The pond has been designed to adequately treat runoff when the mine is in full operation and the dumps are at their maximum size. (See response to State of Colorado comment 9 for pond design specifications; also see responses to State of Colorado comments 22 and 34.)

41. Initial design specifications are presented on page 52, Appendix A of the ER. The diversion ditch will be designed to divert at least 110 cfs of runoff (100-year flood). More detailed design information will be presented for review and approval by state agencies prior to construction (see response to State of Colorado comment 19).

42. Homestake anticipates that the lake formed in the nothern mine pit upon cessation of mining will be of good quality. This matter is thoroughly discussed in Homestake's response to State of Colorado comment 20. Should water quality analysis of the lake show that this is not the case, Homestake will fence the lake to prohibit wildlife and livestock consumption.

43. The trace element concentrations listed for Indian Creek in Table 2.8 of the DES represent measurements of water quality taken on November 17, 1975, February 25, 1976, and May 15, 1976, except for iron, manganese, lead and nickel which were also measured on December 22, 1975, January 26, 1976, March 17, 1976, April 22, 1976, and June 28, 1976. There are no flow records of Indian Creek prior to April 27, 1976. Thus, there are no specific flow measurements available for the times of sampling represented in Table 2.8 except for the last two of the eight observations. However, based on the chart of measured discharge for creeks in the vicinity of the project area (Plate 2.6-7 in the Supplemental ER) it is apparent that the highest flows in Indian Creek occur for a short period in the latter half of May. Therefore, with the exception of the May 19, 1976, and June 28, 1976, measurements it is assumed that all the measurements were taken during the low flow period of Indian Creek.

44. Homestake recognizes that a TSS concentration of 500 mg/l would violate the proposed Colorado Water Quality Standards. However, the reference to a 15-fold increase in TSS did not take into consideration utilization of the proposed sedimentation pond. The new sedimentation pond is designed to comply with the water quality standards for TSS (see responses to comment 40 and State of Colorado comments 9, 22 and 34).

EPA

Internal Reviewers: We would prefer to avoid this commitment, but it may be worth the cost for P.R. purposes.

Issue in

45. Homestake is not waiting until an adverse impact to the aquatic biota in Indian Creek is demonstrated before proceeding with the design and construction of the sedimentation pond. The design of the pond has recently been completed by Bingham Engineering and required approvals and clearances authorizing construction are being pursued. After these approvals and clearances have been obtained, construction will commence as soon as weather permits. Homestake will restock Marshall Creek with trout if their populations are adversely affected by the operation.

46. The reference for tailings discharge should have been to Sec. 3.3.4.2 of the ER. The reference for sanitary waste dispoal should have been to Sec. 3.5 of the ER. A detailed description of the sanitary waste disposal options and leach field will be included in the final design specifications for construction of the mill. These specifications will meet all Saguache County and State of Colorado requirements.

47. This comment pertains to a policy/licensing matter and is directed to the "State and/or Forest Service."

48. The yellowcake will be a sodium/ammonium diuranate, and the NRC should determine whether the suggested calculations should be made..

49. This comment pertains to a matter of content in the FES and is for the consideration of the NRC.

50. Sampling and analysis for Radon-222 were performed at six locations (see DES Fig. 6.1, p. 6-9) during the pre-operational monitoring program. Samples were collected during June, August and September 1976 (see DES Table 6.3, p. 6-12; Supplemental ER Table 2.9-4, p.2-208). Additional baseline measurements of radon-222 are planned for 1979 as soon as weather and soil conditions permit.

51. Current information indicates it is likely that a lake will form at the north end of the open pit and that the lake will fill with water of acceptable quality. This matter is thoroughly discussed in Homestake's response to State of Colorado comment No. 20. The final access road to the northern pit will be left in place to provide access to the lake. The shaping of the land surface will be such to create a lake which resembles a glacial cirque lake, which is considered by most people to be aesthetically pleasing. Pit rim elevations with respect to the lake surface, as well as the location of the access road, can be derived from DES Figure 3.7 (see responses to comment 24 and State of Colorado comment 20).

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There is no certainty that the costs of treating the lake water or draining will be unacceptable. The problem also could be eliminated by the use of fencing. The alternative of placing all waste overburden in the pit is thoroughly discussed in Homestake's response to comment 64.

To whom?

What is this about?

52. Access to the reclaimed tailings disposal area will be restricted by fencing.

When necessary during initial stages of the operation, water runoff from above will be diverted around the overburden dumps by the use of ditches and/or roads. The overburden benches will be sloped back so that rain and snowmelt will be drained to ditches which will carry the water back into the open pit sump. No free-standing water will remain in the dump areas.

53. The springs in the vicinity of the mine will be analyzed once a year for total dissolved solids and pH. If the total dissolved solids and pH fluctuations indicate that significant changes are taking place, the springs will be sampled for heavy metals.

54. Analyses of stream sediments at selected surface water monitoring stations on Indian Creek and on Marshall Creek below Hale Gulch will be conducted on an annual basis. The stream sediment sample will be representative of the stream cross-section at the sampling location and analyzed for total metals concentration by an acid digestion technique of a dried sediment sample. In particular, Co, Ni, Mo, As, Ag, Be, Ba, B, Cu, Pb, Hg, Mn and Fe will be analyzed to further define the stream sediment bedload.

55. Pre-operational groundwater sampling and analyses have been and are presently being conducted on all monitor wells in the vicinity of the open pit mine, overburden disposal area, mill site, and tailings disposal area.

56. A monitoring well has been constructed in Indian Creek Valley immediately downslope from the maximum extent of the north overburden disposal area. Additional wells will be installed at the base of remaining overburden disposal areas when utilization of those areas commences. The wells will be constructed utilizing Johnson well screens at various depth intervals to representatively sample the groundwater contained in the 150-foot holes.

Monitoring in the unsaturated zone of the waste dump piles is not planned at this time. The mitigating measures available are pumping contaminated water out of the wells, adjusting the drainage at the dump sites, and treatment of contaminated water as it enters the Indian Creek drainage, i.e., at the settling pond (see response to State of Colorado comment 18).

57. As shown on the attached revised Figure 2.7 (Plate 2.6-5 of the Supplemental ER), a reevaluation of previous data and interpretation of additional recently acquired data has provided improved knowledge of local groundwater movement in Hale Gulch. There is no evidence of near

surface fractures passing underneath the proposed tailing pond which could allow movement of contaminants offsite.

Additional information will be evaluated to further define the groundwater flow patterns prior to final design of a groundwater monitoring network. Existing monitoring wells and those to be constructed will accommodate a submersible sampling pump, which will be used when possible. Vacuum lysimeters can be installed, if necessary, at certain sites under and around the tailing pond. The exact number and location will depend on the results of additional analyses of data to be obtained (see responses to comments 12, 31 and 36).

58. Revised plates are enclosed.

59. Table 6.4, which outlines the operational environmental monitoring program is not completely labeled; it should be labeled operational radiological environmental monitoring programs. Stability or subsidence monitoring programs are not included.

Review of the groundwater regimes of the project area indicates that any seepage or drainage from the dump areas would eventually enter the sedimentation pond in Indian Creek which is well above the confluence with Marshall Creek. Table 6.4 of the DES indicates that Indian Creek will be monitored as part of the operational radiological monitoring program. (See response to State of Colorado comment 9.)

a. A groundwater monitoring program for the overburden dumps will be conducted. A monitoring well has been installed in the drainage downslope from the maximum extent of the overburden disposal area. Baseline data are presently being collected. Additional monitoring wells will be installed at the base of the other waste dumps (see responses to comments 38 and 56 and State of Colorado comment 18).

Stability programs for the pitwalls and overburden dumps will be conducted. The stability program for the overburden dumps has been approved by the Mined Land Reclamation Board. As the waste dumps develop, permanent reference markers will be established so that stability monitoring can be accomplished by surveying. Until reference markers are established, waste dumps will be visually examined for signs of instability. (See response to Department of Interior comment 10; see also, MLRB permit condition No. 2.)

b. The proposed operational monitoring plan, including sampling locations, is described in Sec. 6.2 of the ER and Supplemental ER. Some locations may be altered as a result of licensing conditions.

c. As noted above, the information presented in Table 6.4 is an operational radiological monitoring program. This is the radiological monitoring program as recommended by NRC (see Section 6.8.2 of the DES). All monitoring wells, DM1 - DM14, will be monitored during the life of the project. DM14 will be destroyed by the mining but will be replaced with another well.

d. Marshall Creek is presently being sampled at the designated three locations. SW-5 is upstream of Hale Gulch, SW-9 is downstream of Hale Gulch, and SW-10 is downstream of the confluence with Indian Creek.

e. Surface flow in Hale Gulch will be sampled when it exists.

f. Surface water samples will be collected and analyzed on a monthly basis during the first year of the operational period. This monthly operational monitoring may continue into the second year of operation or until such time as it can be documented that the quality is remaining constant. Currently, samples are analyzed for total uranium and radium-226. Dissolved uranium and radium-226 analyses will be conducted quarterly.

g. Bottom sediment samples have been collected and analyzed for radionuclides (see ER, p. 2-264) for baseline data. Sediment samples will be collected annually at the surface water monitoring stations (SW1, 3, 4, 5, 9, and 10) and analyzed for radionuclides (see ER, p. 6-6; also, see response to State of Colorado comment 46).

h. Seven soil sampling stations as shown on Plate 6.1-1 of the Environmental Report were sampled during June, August and October 1976 and analyzed for radionuclides. Samples will be collected and analyzed quarterly at these stations during the first year of mill operation. Annual soil sampling will be performed at the same stations in succeeding years. Maps showing monitoring locations have been redrafted in response to EPA comment 58. It is considered that seven sampling stations will be adequate.

60. Homestake agrees that a TSS increase to an estimated 500 mg/l would be unacceptable. That estimate does not consider treatment in the proposed sedimentation pond. A consultant to Homestake has recently completed designing the sedimentation pond that will be located downstream of the existing pond. The new sedimentation pond will control sediment runoff from the waste dump faces and will allow discharge in accordance with NPDES permit requirements (see response to comments 40 and 44; also, see responses to State of Colorado comments 9 and 34).

61. Consultants to Homestake have recently completed an evaluation of the existing and projected hydrogeologic conditions in the proposed mine area. These studies indicate that there will not be a deterioration of

groundwater in either the mine pit or waste dump areas. Much more specific information and discussion is included in responses to comments 3, 5, 24, 37, 38, and 51 and responses to State of Colorado comments 20 and 31.

The waste dumps are designed to minimize groundwater impacts. Design considerations are discussed in responses to comments 21 and 29 and the response to State of Colorado comment 27. (For leaching test results, see Attachment B.)

62. The Pitch Project is not visible from any major road system in the area. The waste dumps and open pit will not be visible to the general public. The area presently receives very little recreational traffic, most of which is due to hunting and fishing. The area is relatively remote and seldomly used for aesthetic purposes. The portion of the comment dealing with revegetation is addressed in Attachment A and in the response to comment No. 64. Matters addressed in the comment are also discussed in Homestake's responses to comments 24, 25, 26, 51 and 64.

63. Based on findings by independent consultants, it is estimated that groundwater water quality will not be degraded, but may be improved, especially with respect to radionuclide content (see responses to comments 38 and 61).

64. (Response being prepared)

65. A liner similar to the one proposed for Cotter Corporation was not evaluated in detail, but it was considered and rejected. It was concluded that an artificial liner placed over a relatively thin clay liner would not be significantly superior to the proposed two-foot clay liner with an interception and pump-back system.

66. Results of recent laboratory tests performed by Pacific Testing Laboratory indicate the permeability of the clay will be extremely low. The clay cap will have a permeability of 0.1 ft/yr or less, and the clay liner exposed to mill effluent will have a permeability of 0.01 ft/yr (see response to comment 36). Under normal operating conditions with a full reservoir and full hydrostatic head, the seepage rate through the liner has been estimated to be 5 to 10 gpm. Any signicant seepage which does occur will be captured and returned to the tailings reservoir (see reponse to comment No. 31). After reclamation, when a clay cap is in place and the hydrostatic head on the liner is very low, the seepage will be reduced to a negligible amount.

ATTACHMENT A

Appendix 2-3

Discharge Permit and Summary of Rationale (June 1980)

COLORADO DEPARTMENT OF HEALTH
Water Quality Control Division
4210 East 11th Avenue
Denver, Colorado 80220

DRAFT

SUMMARY OF RATIONALE
HOMESTAKE MINING COMPANY
PITCH PROJECT
PERMIT NUMBER: CO-0022756
SAGUACHE COUNTY

MAR 27 1981

S. L. HIGINBOTHAM

TYPE OF PERMIT:	Major Industrial
SIC. NO.:	1094
LOCATION:	In portions of Sections 15, 16, 20, 21, 22, 28, 29, 30, 31, and 32, Township 48 North, Range 6 East, 6th Principal Meridian, approximately 6 miles East of Sargents, Colorado as referenced in Figure 1, page 18 of the permit.
CONTACTS:	George J. Simchuk, Manager, Pitch Operations 320 North Main Street Gunnison, Colorado 81230 (303)+641-3295
RECEIVING WATER: CLASS:	Indian Creek B_1 An Effluent Limited Segment
DESIGN FLOW:	0.1 MGD Average - 0.75 MGD Maximum

FACILITY DESCRIPTION:

Homestake is developing a surface uranium mine at the site of the old Pinnacle Mine, which will produce up to 600 tons of ore per day. A mill is planned at the project, but to date the materials licence for the mill has not been received. Under Homestake's most optimistic schedule mill construction would not begin until the spring of 1981 and operation could not start before the spring of 1982. As there will be no milling during the term of this permit, the permit will address only the mining phase of the project.

The discharge consists of mine water from the Pinnacle Mine, any mine water from the pit and runoff from the overburden dumps. The mine waters are treated for radium removal by barium sulfate co-precipitation and byl filtrations prior to mixing with the runoff.

Based upon the Divisions Review of the background data from Homestakes and the Colorado Water Quality Control Divisions Monitoring efforts the permit will contain the following conditions and limitations.

Parameter	Daily Maximum	30-day Avg.	Monitoring
Flow a/	N/A	N/A	Continuous
pH b/	Between 6.5 and 9.0 mg/l	N/A	Daily or Continuous Insitu
Oil and Grease c/	10 mg/l with no visible sheen	N/A	Daily Visual Observation
Total Dissolved Solids d/	N/A	N/A	Weekly Grab
Total Suspended Solids e/	30 mg/l	20 mg/l	Weekly Grab
Total Ammonia as Nitrogen f/	0.5 mg/l	N/A	Monthly Grab
Total Nitrate as Nitrogen g/	10 mg/l	N/A	Monthly Grab
Total Uranium h/	4.0 mg/l	2.0 mg/l	Weekly Grab
Total Zinc i/	0.2 mg/l	0.1 mg/l	Weekly Grab
Total Radium 226 j/	15 pCi/l	10	Weekly Grab
Chemical Oxygen Demand k/	200 mg/l	100 mg/l	Weekly Grab
Dissolved Barium l/	1.0 mg/l	N/A	Monthly Grab

a/ Any flow from this facility comes from a combination of two sources, intercepted groundwater, and direct precipitation on the project area. Although accurate flow data is necessary for the measurement and control of other parameters, a flow limitation is neither practicable or desireable.

b/ The recommended aquatic life standards for pH should provide sufficient control. Frequent monitoring is necessary to establish an adequate data base.

c/ The main reason for a oil and grease limiations is to ensure proper control of any oil spills. Visual observation should be adequate.

d/ Monitoring for Total Dissolved Solids is required because of Regulations for Implementation of the Colorado River Salinity Standards Through the NPDES Permit Program.

e/ The current BPT standards of 20/30 for TSS should provide adequate protection from adverse effects from turbity and TSS.

f/ Homestake's background data shows no problem with Ammonia. However, it is felt an ammonia limitation is necessary to insure good management practices in the handling of explosives, primarily ANFO. The 0.5 mg/l comes from the drinking water standards. This limitation will insure unionized ammonia levels below 0.02 mg/l except at the higher temperatures and pH's so the aquatic life will be protected.

g/ The Nitrate limitation is also to ensure proper management practices in the handling of explosives.

h/ The rationale for the Uranium limitations is as follows:

1. Section 3.1.8(1) of Regulations Establishing Basic Standards and an Antidegradation Standard and Establishing a System for Classifying State Waters, for Assigning Standards, and for Granting Temporary Modifications, the Antidegradation Standard, states: "Existing uses shall be maintained as required by state and federal law. No further water quality degradation is allowable which would interfere with or become injurious to existing uses.

2. We have no data which shows that this portion of Indian Creek did not contain elevated uranium levels prior to any mining activities. The geology of the area indicates that high natural uranium levels were likely.

3. Currently the drainage from the Pinnacle Mine is within the range indicated by BPT and the old (1975) BAT limitations for total uranium.

4. The aquatic life in Indian Creek has been found at the existing levels of Uranium.

5. The uranium numbers that are proposed are based upon the data that is available.

i/ This zinc limitation is based upon non-degradation of Indian Creek at the point of discharge.

j/ These interim levels of 10/15 would provide a non-degradation of the existing quality. The renewal permit will reflect the levels necessary to meet the water quality standards as adopted by the commission. Presently this standard is 5 mg/l - daily maximum.

k/ The Chemical Oxygen Demand limitation is directly from BPT. There is no reason to suspect elevated COD from this facility.

l/ The Dissolved Barium limitation is included to assure proper management of the Barium-Radium Sulfate coprecipitation system.

In addition to the above numberical limitations Homestake will be required to develop a Best Management Practices Program.

This BMP program shall include, but not be limited to:

1. Diversion of uncontaminated runoff around the project water
2. Salinity Control
3. Groundwater monitoring
4. Segration of mine water for more efficient treatment
5. Treatment plant operation and maintanence
6. Operator training
7. Pilot plant testing of uranium and radium removal system
8. Biological and chemical monitoring of Indian and Marshall Creeks

The BMP program shall also incorporate a spill prevention and containment plan.

The permit will contain future limitation and a compliance schedule to assure the permittee will achieve an Uranium limitation of 0.3 mg/l 30-day average 0.6 mg/l Daily Maximum by January 28, 1985.

The permit will expire June 30, 1982 in order to allow for a reassessment of permit conditions.

Steven Snider
June 26, 1980

Permit No. CO-0022756

County: Saguache

AUTHORIZATION TO DISCHARGE UNDER THE

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et. seq.; the "Act"), and the Colorado Water Quality Control Act (25-8-101 et. seq., CRS, 1973 as amended)

Homestake Mining Company

is authorized to discharge from facilities associated with the Pitch Project Uranium Mine,

located in portions of Sections 15, 16, 20, 21, 22, 28, 29, 30, 31, and 32, Township 48 North, Range 6 East, 6th Principal Meridian, as referenced in Figure 1, page 18 of this permit,
to Indian Creek,

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Part I, II, and III hereof.

This permit shall become effective thirty (30) days after the date of receipt of this permit by the Applicant. Should the Applicant choose to contest any of the effluent limitations, monitoring requirements or other conditions contained herein, he must comply with Section 24-4-104 CRS 1973 and the Regulations for the State Discharge Permit System. Failure to contest any such effluent limitations, monitoring requirement, or other condition is consent to the condition by the Applicant.

This permit and the authorization to discharge shall expire at midnight,

December 31, 1982.

Signed this day of

COLORADO DEPARTMENT OF HEALTH

Gary G. Broetzman
Director
Water Quality Control Division

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - SEE ANY ADDITIONAL REQUIREMENTS UNDER PART III.

During the period beginning immediately and lasting through December 31, 1982 the permittee is authorized to discharge from outfall(s) serial number(s) 001, final outfall from the Treatment Plant and settling pond located near the center of Section 21, Township 48 North, Range 6 East, 6th Principal Meridian as referenced in Figure 2, page 16 of this permit.

1. Effluent Limitations

Effluent Parameter	Discharge Limitations			
	Maximum Weight kg/day (lbs/day)		Maximum Concentration	
	30-day avg a/	Daily max b/	mg/l 30-day avg a/	mg/l Daily max c/
Flow - m^3/Day (MGD)	N/A	N/A	N/A	N/A
Total Dissolved Solids	N/A	N/A	N/A	N/A
Total Suspended Solids	N/A	N/A	20	30
Total Ammonia as Nitrogen	N/A	N/A	N/A	0.5
Total Nitrates as Nitrogen	N/A	N/A	N/A	10
Total Uranium	N/A	N/A	2.0	4.0
Total Zinc	N/A	N/A	0.1	0.2
Total Radium 226 pCi/l	N/A	N/A	10	15
Chemical Oxygen Demand	N/A	N/A	100	200
Dissolved Barium	N/A	N/A	N/A	1.0

Oil and Grease shall not exceed 10 mg/l in any grab sample nor shall there be a visible sheen

The pH shall not be less than 6.5 standard units nor greater than 9.0 standard units c/

a/ This limitation shall be determined by the arithmetic mean of a minimum of three (3) consecutive samples taken on separate weeks in a 30-day period (minimum total of three (3) samples);

b/ This limitation means the total discharge by weight during any calendar day, as determined by an 8-hour composite sample.

c/ This limitation shall be determined by a single properly preserved sample as required under monitoring requirements - Sample Type.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (Continued)

2. Monitoring Requirements

In order to obtain an indication of the probable compliance or noncompliance with the effluent limitations specified in Part I, the permittee shall monitor and report all effluent parameters at the following required frequencies.

Effluent Parameter	Measurement Frequency d/e/	Sample Type f/h/
Flow - m^3/Day (MGD)	Daily	Continuous
Total Dissolved Solids mg/l g/	Weekly	Grab
Total Suspended Solids mg/l	Weekly	Grab
Total Ammonia as Nitrogen mg/l	Monthly	Grab
Total Nitrate as Nitrogen mg/l	Monthly	Grab
Total Uranium mg/l	Weekly	Grab
Total Zinc	Weekly	Grab
Total Radium 226 pCi/l	Weekly	Grab
Chemical Oxygen Demand mg/l	Weekly	Grab
Dissolved Barium mg/l	Monthly	Grab
pH	Daily	Grab or Insitu
Oil & Grease	Daily	Visual Observation

Self-monitoring samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Discharge 001, at the final outfall pipe from the settling pond and treatment plant prior to entering Indian Creek as referenced in Figure 2, page 19 of this permit.

d/ Monitoring is required only during periods of discharge. If "no discharge" occurs, this shall be reported at the specified frequency. (See Part B.)

e/ When the measurement frequency indicated is quarterly, the samples shall be collected during March, June, September, and December if a continual discharge occurs. If the discharge is intermittent, then samples shall be collected during the period that discharge occurs.

f/ See definitions, Part B.

g/ Analysis for salinity may be either as total dissolved solids (TDS) or by electrical conductivity where a satisfactory correlation with TDS has been established. The correlation shall be based on a minimum of five different samples.

h/ For self monitoring purposes only, the Permittee shall have the right at his option to substitute "composite" for "grab" sampling techniques. However, the Colorado Department of Health maintains the right to use "grab" samples for compliance monitoring programs.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

3. During the period beginning immediately and lasting through December 31, 1982, the permittee is authorized to discharge subject to the following additional requirements:

   The discharge shall consist only of treated mine drainage, and of treated runoff from overburden dumps and other disturbed areas.

   It shall be the responsibility of the permittee to collect, and to treat as necessary, any runoff from disturbed areas within the permittees area of operation, or any other waters contaminated as a result of the permittee's activities. If this collection and/or treatment of runoff will result in a point source discharge the permittee shall apply to the Colorado State Health Department, Water Quality Control Division to have the permit amended to reflect the additional discharge points.

   The permittee shall not practice in-situ or underground leaching or any mineral benefication steps other than simple physical separation of ore from the overburden, except as may be required to conduct research and development projects for evaluation of subsequent wastewater treatment programs. Any such changes in operation shall require a modification(s) in the discharge permit.

   The permittee shall segregate and appropriately pretreat any waste streams with a significantly higher than average concentration of toxic or hazardous pollutants where it can be demonstrated by the permittee, the USEPA, or the Colorado Water Quality Control Division that such segregation and pretreatment will significantly reduce the pollutant and loading to State Waters.

   Any untreated overflow which is discharged from facilities designed, constructed, and operated to contain or treat as applicable all process generated wastewater and the surface runoff to the treatment facility from a 10-year, 24-hour precipitation event shall not be subject to the limitations set forth in this section. The 10-year, 24-hour precipitation event for this facility is 2.4 inches. The official precipitation gage station identified with the facility shall be Sargents, Index Number 7460.

   The permittee has the option of operating and maintaining a precipitation gage at the facility.

FUTURE PERMIT LIMITATIONS AND COMPLIANCE SCHEDULE

The Permittee is aware that, based on available data, there is an apparent need to evaluate the feasibility of, and necessity for, reducing the total uranium and radium concentrations in the discharged effluent.

Therefore, the permittee shall immediately initiate a program of research and development to determine the feasibility of reducing the total uranium concentration in the discharge. The above mentioned research and development program shall be subject to the approval of the Division and shall comply with the conditions established by the Division. The research and development program shall be submitted to the Division no later than (6) six months after the effective date of the permit. If the said research and development program is not acceptable to the Division target levels established by the Division shall be used as goals for the study.

September 30, 1982; completion of research and development, including any pilot plant testing.

September 30, 1983; completion of engineering and treatment plant design.

September 30, 1984; completion of treatment plant construction

December 31, 1984, attainment of operational level

The timetable is designed to accomplish attainment of targeted operational levels by December 31, 1984, unless data becomes available which show that it is not technologically feasible and/or necessary to attain the targeted levels to afford protection of aquatic life. The feasability and the necessity of achieving these levels must be presented to the Water Quality Control Division for their approval before any adjusted levels can be used in this permit. At that time, the Department of Health and Permittee will renegotiate appropriate effluent discharge limitations for these parameters.

The permittee shall submit semi-annual progress reports to the Colorado Water Quality Control Division of sufficient detail to keep the Division aware of the status of the program. These status reports will be due by the following dates.

January 28, 1981
July 28, 1981
January 28, 1982
July 28, 1982
January 28, 1983
July 28, 1983
January 28, 1984
July 28, 1984
January 28, 1985

B. MONITORING AND REPORTING

1. Representative Sampling

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge.

2. Reporting

Monitoring results obtained during the previous month shall be summarized for each month and reported on applicable discharge monitoring report forms, postmarked no later than the 28th day of the second month following the completed reporting period. The first report is due on February 28, 1981. If no discharge occurs, "No Discharge" shall be reported. Duplicate signed copies of these, and all other reports required herein, shall be submitted to the Regional Administrator and the State at the following addresses:

Colorado Department of Health
Water Quality Control Division
4210 East 11th Avenue
Denver, Colorado 80220

U.S. Environmental Protection Agency
1860 Lincoln Street - Suite 103
Denver, Colorado 80295
Attn: Enforcement - Permit Program

3. Definitions

a. A "composite" sample, for monitoring requirements, is defined as a minimum of four (4) grab samples collected at equally spaced two (2) hour intervals and proportioned according to flow.

b. A "grab" sample, for monitoring requirements, is defined as a single "dip and take" sample collected at a representative point in the discharge stream.

c. An "instantaneous" measurement, for monitoring requirements, is defined as a single reading, observation, or measurement using existing monitoring facilities.

4. Test Procedures

Test procedures for the analysis of pollutants shall conform to regulations published pursuant to Section 304(h) of the Act, and Colorado State Effluent Limitations (10.1.4), under which such procedures may be required.

5. Recording of Results

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:

a. The exact place, date, and time of sampling;

b. The dates the analyses were performed;

c. The person(s) who performed the analyses;

d. The analytical techniques or methods used; and

e. The results of all required analyses.

6. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Discharge Monitoring Report Form (EPA No. 3320-1), or other forms as required by the Division. Such increased frequency shall also be indicated.

7. Records Retention

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed and calibration and maintenance of instrumentation and recordings from continuous monitoring instrumentation shall be retained for a minimum of three (3) years, or longer if requested by the Regional Administrator or the State Water Quality Control Division.

A. MANAGEMENT REQUIREMENTS

1. Change in Discharge

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit more frequently than or at a level in excess of that authorized shall constitute a violation of the permit. Any anticipated change in discharge location and/or facility expansions, production increases, or process modifications which will result in new, different, or increased discharges or pollutants must be reported by submission of a new NPDES application or, if such changes will not violate the effluent limitations specified in this permit, by notice to the State Water Quality Control Division of such changes. Process modifications include, but are not limited to, the introduction of any new pollutant not previously identified in the permit, or any other modifications which may result in a discharge of a quantity or quality different from that which was applied for. Following such notice, the permit may be modified to specify and limit any pollutants not previously limited.

2. Noncompliance Notification

a. If, for any reason, the permittee does not comply with any maximum effluent limitation specified in this permit the permittee shall provide the Regional Administrator and the State Water Quality Control Division with the following information, in writing, within five (5) days of becoming aware of such condition:

(1) A description of the discharge and cause of noncompliance; and

(2) The period of noncompliance, including exact dates and time; or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate and prevent recurrence of the noncomplying discharge.

b. The permittee, as soon as it has knowledge thereof, shall notify the State Water Quality Control Division of any spill or discharge of any pollutant, not otherwise authorized in this permit, which may cause pollution of waters of the State.

3. Facilities Operation

The permittee shall at all times maintain in good working order and operate as efficiently as possible all treatment or control facilities or systems installed or used by the permittee to achieve compliance with the terms and conditions of this permit.

4. Adverse Impact

The permittee shall take all reasonable steps to minimize any adverse impact to waters of the State resulting from noncompliance with any effluent limitations specified in this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

5. Bypassing (see additional requirements under Part III)

   Any diversion from or bypass of facilities necessary to maintain compliance with the terms and conditions of this permit, or any activity that results in the avoidance of any required treatment for any process or run-off water, is prohibited, except (i) where unavoidable to prevent loss of life or severe property damage, or (ii) where excessive storm drainage or runoff would damage any facilities necessary for compliance with the effluent limitations and prohibitions of this permit. The permittee shall promptly notify the Regional Administrator and the State Water Quality Control Division in writing of each such diversion or bypass.

6. Removed Substances

   Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering waters of the State.

7. Power Failures

   In order to maintain compliance with the effluent limitations and prohibitions of this permit, the permittee shall either:

   a. Provide an alternative power source sufficient to operate the wastewater control facilities;

      or, if such alternative power source is not in existence, and no date for its implementation appears in Part I,

   b. Halt, reduce or otherwise control production and/or all discharges upon the reduction, loss, or failure of the primary source of power to the wastewater control facilities.

8. Any discharge to the waters of the State from a point source other than specifically authorized is prohibited.

B. RESPONSIBILITIES

1. Right of Entry

   The permittee shall allow the Director of the State Water Quality Control Division, the EPA Regional Administrator, and/or their authorized representative, upon the presentation of credentials:

   a. To enter upon the permittee's premises where an effluent source is located or in which any records are required to be kept under the terms and conditions of this permit; and

   b. At reasonable times to have access to and copy any records required to be kept under the terms and conditions of this permit and to inspect any monitoring equipment or monitoring method required in the permit.

   c. To enter upon the permittee's premises to reasonably investigate any actual, suspected, or potential source of water pollution, or any violation of the Colorado Water Quality Control Act. The investigation may include, but is not limited to, the following: sampling of any discharge and/or process waters, the taking of photographs, interviewing of any persons having any knowledge related to the discharge, permit, or alleged violation, and access to any and all facilities or areas within the permittee's premises that may have any affect on the discharge, permit, or alleged violation.

2. Transfer of Ownership or Control

In the event of any change in control or ownership of facilites from which the authorized discharges emanate, the permittee shall notify the succeeding owner or controller of the existence of this permit by letter, a copy of which shall be forwarded to the Regional Administrator and the State Water Quality Control Division.

3. Availability of Reports

Except for data determined to be confidential under Section 308 of the Act, Section 25-8-405 of C.R.S. 1973 and Regulations for the State discharge permit system 6.1.0, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the State Water Quality Control Division and the Regional Administrator.

As required by the Act, effluent data shall not be considered confidential. Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in Section 309 of the Act, and CRS (1973) 25-8-610.

4. Permit Modification

After notice and opportunity for a hearing, the permit may be modified, suspended, or revoked in whole or in part during its term for cause including, but not limited to, the following:

a. Violation of any terms or conditions of this permit;

b. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or

c. A change in any condition that required either a temporary or permanent reduction or elimination of the authorized discharge. Changes in water quality standards, control regulation or duly promulgated plans would qualify as "a change in any condition."

5. Toxic Pollutants

Notwithstanding Part II, B-4 above, if a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307 (a) of the Act for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, this permit shall be revised or modified in accordance with the toxic effluent standard or prohibition and the permittee so notified.

6. Civil and Criminal Liability

Except as provided in permit conditions on "Bypassing" (Part II, A-5) and "Power Failures" (Part II, A-7), nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

7. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Act.

8. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Act.

9. Permit Violations

Failure to comply with any terms and/or conditions of this permit shall be a violation of this permit.

10. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

11. Severability

The provisions of this permit are severable, and if any provisions of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

12. At the request of a permittee, the Division may modify or terminate a permit and issue a new permit if the following conditions are met:

(a) The Regional Administrator has been notified of the proposed modification or termination and does not object in writing within thirty (30) days of receipt of notification, and

(b) The Division finds that the permittee has shown reasonable grounds consistent with the Federal and State statutes, and regulations for such modification or termination and

(c) Requirements of public notice have been met.

OTHER REQUIREMENTS

Additional Bypassing Requirements

If, for other reasons, a partial or complete bypass is considered necessary, a request for such bypass shall be submitted to the State Water Quality Control Division and to the Environmental Protection Agency at least sixty (60) days prior to the proposed bypass. If the proposed bypass is judged acceptable to the State Water Quality Control Division and by the Environmental Protection Agency, the bypass will be allowed subject to limitations imposed by the State Water Quality Control Division and the Environmental Protection Agency.

If, after review and consideration, the proposed bypass is determined to be unacceptable by the State Water Quality Control Division and the Environmental Protection Agency, or if limitations imposed on an approved bypass are violated, such bypass shall be considered a violation of this permit; and the fact that application was made, or that a partial bypass was approved, shall not be defense to any action brought thereunder.

Testing

Test procedures shall conform with those procedures specified in the Federal Register, Volume 38, Number 199, October 16, 1973. These procedures involve the use of the latest edition of one of the following references:

1. "Standard Methods for the Examination of Water and Waste Water",
2. "ASTM", Annual Book of Standards, Part 23, Water, Atmosphere Analysis,
3. "Methods for Chemical Analysis of Waters and Wastes", Environmental Protection Agency.

Discharge Point(s)

Discharge points shall be so designed or modified that a sample of the effluent can be obtained at a point after the final treatment process and prior to discharge to State waters.

OTHER REQUIREMENTS (Continued)

Within three (3) months after the effective date of this permit, a flow-measuring device shall be installed to give representative values of effluent volume at some point in the plant circuit, if not already a part of the wastewater plant.

The following locations of flow-measuring devices are required:

1. Facilities with detention times within the treatment system of 24 hours or less: on the influent or effluent line, or within the system.

2. Facilities with detention times within the treatment system of 24 hours or more: on the effluent line.

If permittee desires to locate a flow-measuring device in a location other than in 1 or 2 above, then permittee shall submit a request to the Division giving the specific location (by map). The request shall include a justification that the location will give accurate measurements within ten (10) percent of the actual flow being discharged. Installation shall be subject to approval by the Division prior to installation.

At the request of the Regional Administrator of the Environmental Protection Agency or the Director of the State Water Quality Control Division, the permittee must be able to show proof of the accuracy of any flow-measuring device used in obtaining data submitted in the monitoring report. The flow-measuring device must indicate values within ten (10) percent of the actual flow being discharged from the facility.

The limitations stated in PART I, Section A, are calculated on the basis of gross measurements of each parameter in the designated discharge regardless of the quantity and quality of these parameters in the plant flow unless otherwise specified.

If the permittee desires to continue to discharge, he shall re-apply at least one hundred-eighty (180) days before this permit expires.

Within sixty (60) days of the effective date of this permit, the permittee shall file a statement with the Environmental Protection Agency and the State Water Quality Control Division which shall contain the names of the person or persons who are designated to report conditions as noted in PART II, Section A, Paragraph 2a (Noncompliance Notification), and as noted in PART II, Section B, Paragraph 7 (Oil and Hazardous Substance Liability). The permittee shall continually update this list as changes occur at the facility.

The permittee is required to submit an annual fee as set forth in Section 25-8-502 C.R.S. 1973 as amended. Failure to submit the required fee is a violation of this permit and will result in the suspension of said permit and enforcement action pursuant to Section 25-8-601 et. seq., 1973 as amended.

OTHER REQUIREMENTS

Termination of Operations

a. The permittee shall initiate and complete a study of the control of pollution of surface and subsurface waters from tailings storage areas from overburden dumps, from any leaching or erosion of residual materials deposited or existing as a result of the permittee's operation, and from any materials deposited in waterways as a result of fugitive dust or other causes resulting from the permittee's operations. The study shall include an analysis of the feasibility of total elimination of tailings seepages, and other possible pollution sources upon termination of the permittee's operations at this facility.

   The study shall address but not be limited to the following:

   (1) Construction of permanent runoff diversion structures above tailings storage areas.

   (2) Plugging of decant structures and elimination of tailings pools.

   (3) Revegetation and/or permanent stabilization by physical or chemical techniques of tailings surfaces and dam faces to control erosion and leaching of contaminants into surface or subsurface waters.

b. The permittee shall complete and submit a final report on the topics noted above in Section (a) to the State of Colorado no later than June 30, 1981 The final report shall review the economic and technical feasibility of all alternatives noted in the study. It shall include a plan which details the permittee's course of action to permanently control or eliminate all sources of pollution of waters upon termination of the operation of the permittee's facility. The intended course of action shall include interim dates and the final date for completion of all necessary activities. The final date shall in no case be later than two years following cessation of production from the facility.

OTHER CONDITIONS (Continued)

Best Management Practices (BMP) Program

The permittee shall prepare a Best Management Practices (BMP) program for control of toxic and hazardous substances at the facility. This BMP program shall effectively satisfy the requirements for such programs listed under Subpart K, 40 CFR 125 of the U.S. EPA's NPDES program. The permittee shall submit this BMP program to the Colorado Water Quality Control Division within 180 days after the effective date of the above noted EPA regulation.

This BMP program shall:

1. Address the permittee's ancillary activities which are associated with toxic and hazardous substances, such substances as are being regulated under Sections 307 and 311, respectively, of the Federal Clean Water Act Amendments of 1977. The ancillary activities to be addressed shall include, but not be limited to: materials handling areas, loading and unloading operations, plant and mine site runoff, and sludge and waste disposal areas.

2. Be documented in narrative form and shall include any necessary plot plans, drawings or maps.

3. Establish specific objectives for the control of toxic and hazardous pollutants.

   a. Each facility component or system shall be examined for its potential for causing a release of toxic or hazardous pollutants to waters of the State of Colorado due to equipment failure, improper operation, natural phenomena such as rain, snowfall, seismic events, seepage, etc., or any other causes.

   b. Where experience indicates a reasonable potential for equipment failure, natural condition, or other circumstances to result in significant amounts of toxic or hazardous pollutants reaching surface waters, the program shall include a prediction of the direction, rate of flow and total quantity of toxic or hazardous pollutants which could be discharged from the facility as a result of each condition or circumstance;

4. Establish specific best management practices to meet the objectives identified in paragraph (3) of this section, addressing each component or system capable of causing a release of toxic or hazardous pollutants to the waters of the State of Colorado;

5. Shall address the following points for the facility and any ancillary activities:

   a. Statement of Policy;
   b. Spill Control Committee;
   c. Material Inventory;
   d. Material Compatibility;
   e. Employee Training;
   f. Operator Certification;
   g. Reporting and Notification Procedures;
   h. Visual Inspections;
   i. Preventive Maintenance;
   j. Housekeeping; and
   k. Security

6. Shall address control and treatment of all runoff from any area within the permittee's project area which is disturbed or affected by the permittee's activity.

7. May include specific elements of the facility's spill prevention control and countermeasure (SPCC) plan for the Section 311 hazardous substances, once the Federal EPA regulations for such plans are finalized. Such plan elements may address:

   a. A history of spills which have occurred in the three (3) years preceding the effective date of this permit. The history shall include causation of the spills and a discussion of preventive measures designed to prevent them from reoccurring;

   b. A description of the reporting system which will be used to alert responsible facility management, the Colorado Water Quality Control Division, the U.S. Environmental Protection Agency, downstream water users, and local health officials;

   c. A description of preventive facilities (including overall facility plot) which will prevent, contain, or treat, spills and unplanned discharges;

   d. A list of all materials used, processed, or stored, at the facility which represent a potential spill threat to surface waters;

   e. An implementation schedule for additional facilities which might be required in (3) above, but which are not yet operational;

   f. A list of available outside contractors, agencies, or other bodies which could be utilized in the event of a spill in order to clean up its effects;

g. Provision for periodic review and updating of the SPCC plan.

8. The permittee shall submit the ground water monitoring results presently being conducted along with the submittal of the BMP program.

Proposed modifications to the BMP program which effect the discharger's permit obligation shall be submitted to the Division for approval at least 180 days prior to any change.

If the BMP program proves to be ineffective in achieving the general objective of preventing the release of significant amounts of toxic or hazardous pollutants to waters of the State of Colorado, the permit and/or the BMP program shall be subject to modification to incorporate revised BMP requirements.

OTHER CONDITIONS (Continued)

Stream Monitoring Programs - Indian and Marshall Creeks

The permittee shall initiate chemical and biological monitoring of the effluent receiving streams, Indian Creek and Marshall Creek.

Homestake Mining Company has engaged Dr. Robert Pennak to begin the initial phase of a macrobenthic sampling program. The first set of samples were taken on September 30, 1980. Sampling stations are located on Indian, Marshall, Little Indian, and Tomichi Creeks. Five benthic samples are to be collected from each station on each sampling date. In addition, the following chemical parameters will be monitored at each of the biological stations on each collection date. The chemical parameters monitored include pH, temperature, alkalinity, hardness, TSS, TDS, and total and dissolved uranium and zinc.

Homestake has also contracted with Western Aquatics Inc. to perform acute chemical toxicity tests on uranium introduced as uranyl sulfate. Data from these tests should be helpful in interpreting the effects of inorganic complexing capacity on the toxicity of uranium to brook trout (*Salvelinus fontinalis*).

OTHER CONDITIONS (Continued)

Ground Water Monitoring Programs

(NOTE: This section should be included in the permit only if the CDOH believes that it must be included; if not, it should be eliminated completely.)

The permittee shall, within 180 days of the effective date of this permit initiate a ground-water monitoring plan for any aquifers for which a reasonable potential for effect from the permittees activities exists.

This plan shall include any proposed and/or existing ground water monitoring program designed to monitor any movement of pollutants into the ground water in the area. Monitoring wells should be situated so as to monitor in each dominant direction of ground water movement away from the site, and background entering the site. The design report shall also contain the following information as a minimum:

1. A large-scale topographic map of the treatment plant site and surrounding area. This map shall show the location and estimated water levels of the proposed and/or existing ground water monitoring points, including an estimate of permeabilities and a piezometric surface of water table map.

2. A description of the proposed and/or existing monitoring wells including casing size and the perforated zone of the casing, the method installation, and sampling equipment, techniques, and frequencies. Lithologic logs should be included when available.

3. A description of the method of sampling and a listing of the analyses performed on water removed from background and down gradient ground water quality monitoring points. As a minimum, the following analyses shall be performed on a quarterly basis and reported on a quarterly basis for each monitoring point:

   a. Nitrate and Ammonia Nitrogen, mg/l
   b. Total Dissolved Solids, mg/l
   c. COD, mg/l
   d. Gross Alpha Radiation, pCi/l
   e. pH, Standard Units
   f. Total Radium 226
   g. Total Uranium

   Before sampling, all monitoring wells must be pumped until consistent values of conductivity are obtained. Wells should be capped and located when not sampling.

4. Ground water uses in the area showing location of all wells (domestic), irrigation, etc.), springs, ditches, streams or other water conveyances in or within one-half mile (½ mile) of site.

5. SCS soil classification of surface layer and soil profile to a 10-foot depth.

6. Evaportransipiration rates and average annual rainfall of site, with specific references to data sources.

FIGURE 2
DISCHARGE LOCATION MAP
HOMESTAKE MINING CO.-
PITCH PROJECT

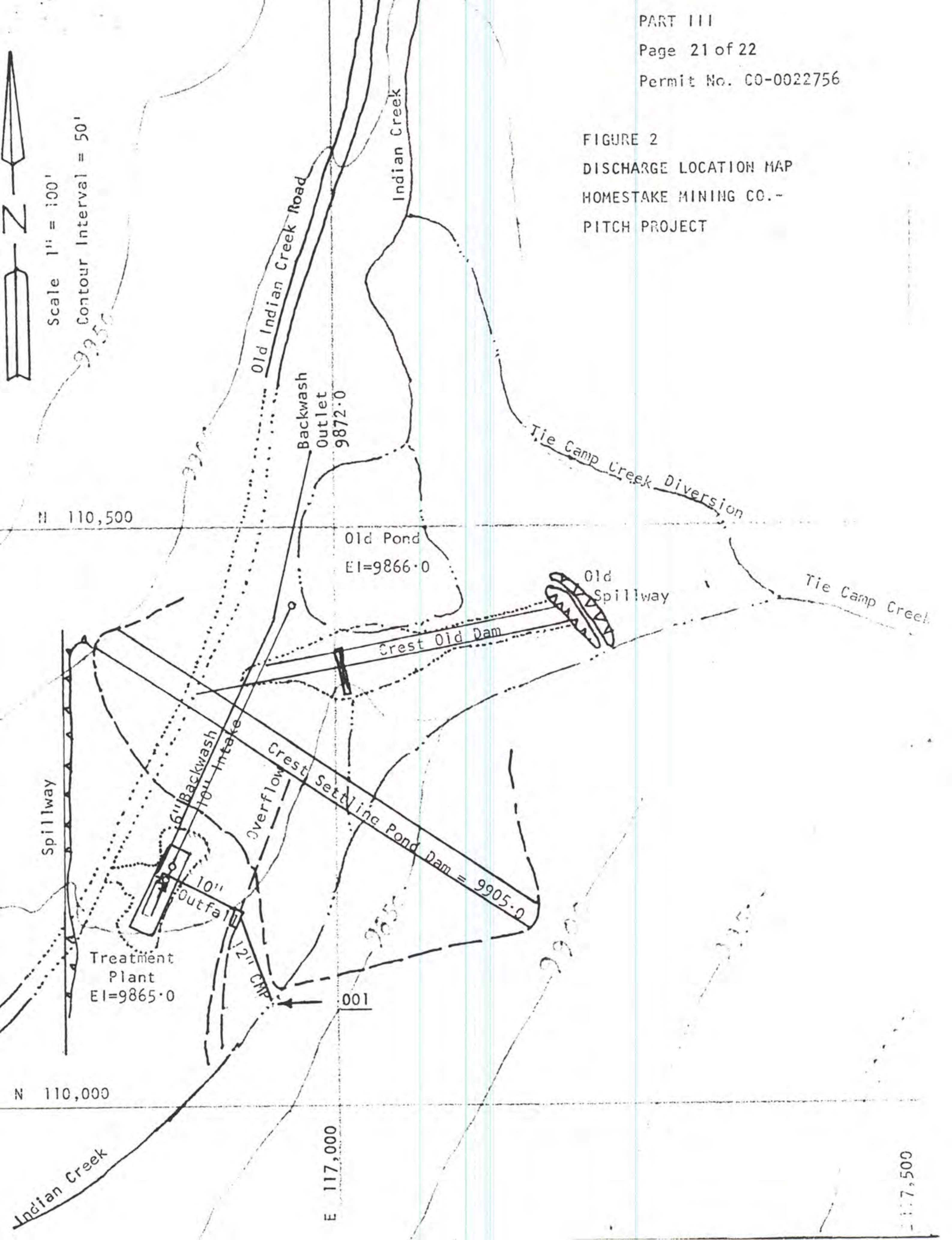

FIGURE 1 PERMIT AREA MAP HOME STAKE MINING CO.-PITCH PROJECT

Appendix 2-4

Summary of Evidence Re Segment 21 of the Upper Gunnison River Basin – Indian Creek (February 1982)

BEFORE THE COLORADO WATER QUALITY CONTROL COMMISSION

SUMMARY OF EVIDENCE RE SEGMENT 21 OF THE UPPER GUNNISON RIVER BASIN - INDIAN CREEK

IN RE PROPOSED REGULATIONS ESTABLISHING BASIC STANDARDS AND AN ANTI-DEGRADATION STANDARD AND ESTABLISHING A SYSTEM FOR CLASSIFYING STATE WATERS, FOR ASSIGNING STANDARDS, AND FOR GRANTING TEMPORARY MODIFICATIONS FOR THE GUNNISON AND LOWER DOLORES RIVERS AND THEIR TRIBUTARIES

I. INTRODUCTION

On September 16, 1981, the Water Quality Control Division of the Colorado Department of Health (the "Division") published its Rationale for Recommended Stream Classifications and Standards for the Gunnison-Lower Dolores River Basin (the "Rationale" or "Statement of Rationale"). The proposed classifications included Indian Creek (Segment 21 of the Upper Gunnison River Basin) and the mainstem of Marshall Creek from its confluence with Indian Creek to the confluence with Tomichi Creek (Segment 22 of the Upper Gunnison River Basin). All of Indian Creek was classified as a Class 1 cold water fishery and a Class 1 recreation resource. To support and sustain those proposed classifications and uses, the Division requested that ambient levels of certain chemicals in Indian Creek be maintained at recommended levels. The level for uranium proposed by the Division for all of Indian Creek is 0.3 mg/l.

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chronic toxic effects on the resident populations, and, consequently, the Commission should not adopt the obviously over-restrictive standard being proposed by the Division.

IV. THE HOMESTAKE ALTERNATE PROPOSAL

As indicated above, Homestake introduced an alternate proposal for the uranium standard for Indian Creek which it believes is compatible with the use classifications proposed by the Division and the operation of the Pitch Mine in accordance with the NPDES Permit currently in effect at the mine. The proposal submitted by Homestake on October 27, 1981 requested that the stream standard for uranium between SW33 and SW3 be set at 4.0 mg/1, and at 0.45 mg/1 between SW3 and WQCD Station 149. The proposed standard was offered to the Division in the belief that (i) it amply supports the protection of the aquatic environment in Indian Creek, and (ii) Lower Marshall Creek, Segment 22 of the Upper Gunnison River Basin, would not be jeopardized as a drinking water supply on the basis of the historic data available; that is, the available data suggests that the levels of uranium at WQCD Station 149 on Indian Creek and at SW10 on the Lower Marshall Creek will be well below the levels the Division believes are necessary to protect Lower Marshall Creek as a drinking water supply if the Homestake alternate proposal is adopted.

With respect to item (i), it is uncontradicted that levels of uranium in Indian Creek of 9.1 mg/1 will not have any significant effect on the aquatic environment in either the acute or chronic sense.

Further, with respect to (ii), it is obvious from the studies and monitoring conducted by Homestake and the Division that the operation of the Pitch Mine does not have any observable adverse effect on the levels of uranium in Indian Creek at WQCD Station 149 and at SW10 on Marshall Creek. The evidence presented by Homestake and the Division at the Montrose hearings simply confirms the Division's earlier conclusions which were reached in the summary of rationale for the Homestake NPDES Permit that the levels of uranium being detected in Indian Creek are essentially background levels, and that Homestake has little, if any, ability to reduce those levels to the concentrations being proposed by the Division.

On the contrary, the alternate proposal submitted by Homestake takes into account and merely adopts the realty of the situation historically found on Indian Creek.

Finally, as set forth above, Homestake is most concerned that the stream standards being proposed in this matter will eventually become the effluent limitations for the Homestake Pitch Mine NPDES Permit. C.R.S. 1973, Section 25-8-102(5) requires the Division to assess and consider the economic reasonableness of pollution control measures it proposes. That same section requires that such measures have a reasonable relationship to the economic, environmental, energy, and public health costs and impacts of such measures, and that before a final action is taken, consideration be given to the economic reasonableness of the action. The statute requires that the consideration with respect to economic reasonableness include an evaluation of the benefits to be derived from achieving the goals of the particular proposal and of the economic, environmental, public health and energy impacts to the public and the affected persons.

Homestake demonstrated in the additional information it submitted in this matter on December 8, 1981, the cost of a water treatment facility designed to treat 750 gallons per minute for uranium at the Pitch Mine has been estimated at $492,313.00. Based on the historic data, the cost of such a facility cannot be justified because the levels of uranium in Indian Creek and Lower Marshall Creek would not be significantly affected by requiring treatment of Pitch Mine effluent for uranium to the levels being proposed by the Division. That conclusion has been demonstrated beyond a reasonable doubt by the comparison drawn in Homestake Exhibit G and by the assay results of the samples taken from the spring which arise immediately below the Homestake NPDES discharge point.

V. CONCLUSIONS

For all of the reasons set forth above, Homestake respectfully requests that its alternate proposal for the uranium standard for Indian Creek (Segment 21 of the Upper Gunnison River Basin) be adopted because (i) the adoption of the uranium standard proposed by the Division for Indian Creek is much more stringent than is necessary or practical to achieve the protection of Lower Marshall Creek (Segment 22 of the Upper Gunnison River Basin) as a drinking water supply, and (ii) the uranium standard proposed by the Division is at least 30 times more stringent than necessary to protect the resident trout populations from the acute or chronic effects of uranium. As Mr. Anderson testified at the hearing in Montrose, the discharge of effluent by Homestake into Indian Creek in accordance with its NPDES Permit is totally consistent with the classifications and uses the Division has proposed for Indian Creek and that the classifications and uses, including the protection of Lower Marshall Creek as a drinking water supply, will not be jeopardized if the stream standard for uranium proposed by Homestake is met. Based upon the foregoing, the Commission should adopt the alternate proposal for uranium tendered by Homestake.

Respectfully submitted,

KIRKLAND & ELLIS

By Keith M. Crouch

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Attorneys for Homestake Mining Company

CERTIFICATE OF MAILING

I hereby certify that a copy of the foregoing SUMMARY OF EVIDENCE RE SEGMENT 21 OF THE UPPER GUNNISON RIVER BASIN ON INDIAN CREEK SUBMITTED BY HOMESTAKE MINING COMPANY was mailed, postage prepaid, to:

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Daniel Lutz Recht
Friedman, Hill & Robbins
730 17th Street
220 Equitable Bldg.
Denver, Colorado 80202

this 11th day of February 1982.

Linda C. Slocum

Linda C. Slocum

Homestake Mining Company ("Homestake") requested and was granted party status to participate in the Upper Gunnison Stream Classification hearings by the Water Quality Control Commission (the "Commission"). Homestake owns and operates the Pitch Mine which is located in Saguache County, Colorado. Homestake discharges treated mine effluent into Indian Creek. The discharge is authorized by NPDES Permit No. CO-0022756 which is due to expire on December 31, 1982.

In its Statement of Rationale for Indian Creek, the Division indicated that Indian Creek was not classified as a drinking water supply because there are no known water supplies on the Creek and because the data base showed that water quality was insufficient for that use. The Rationale also stated that Indian Creek is considered to be a good trout fishery. The Rationale also indicated that "[T]he uranium standard of 0.3 mg/l was based on bioassay data and on the need for protection of Segment 22 (lower Marshall Creek) water supply classification."

In its Statement of Rationale for Lower Marshall Creek, the Division stated that "[A]ccording to Saguache County officials, approximately two dozen shallow wells for drinking water exist on this segment. Because of these wells and the sufficient water quality, this segment was classified for water supply."

In its request for party status, Homestake stated its belief that the proposed uranium standard of 0.3 mg/l for Indian Creek was too stringent based upon the Rationale which the Division offered, and that the proposed use classifications of Indian Creek and Marshall Creek could be achieved with a less stringent standard for uranium. In its request for party status, Homestake also expressed the concern that future NPDES permits for the Pitch Mine would out of necessity include a more stringent water quality related effluent limitation for uranium if the Division's uranium standard were adopted.

On October 27, 1981, Homestake submitted a proposed alternative for the uranium standard for Indian Creek which protects the proposed use classifications, and, at the same time, insures that Homestake will be in the position to continue to operate the Pitch Mine in accordance with its NPDES Permit. In its alternate proposal, Homestake suggested that the stream standard for uranium from SW33, the NPDES outfall for the Pitch Mine, to SW3 be established at 4.0 mg/l, and at 0.45 mg/l from SW3 to SW4 which is also the location of Water Quality Control Division Station 149. (SW4 and Water Quality Control Division Station 149, are hereinafter collectively referred to as "WQCD Station 149.") Historic operation of the Pitch Mine has demonstrated that if the levels of uranium in Indian Creek and Lower Marshall Creek are maintained in accordance with the Homestake alternate proposal, the use classifications for Indian Creek by the Division will not be jeopardized.

II. PROTECTION OF LOWER MARSHALL CREEK AS A DRINKING WATER SUPPLY

As Mr. Dennis Anderson of the Division testified at the Montrose hearings, the proposed uranium standard for Indian Creek is based on the need to protect Lower Marshall Creek as a drinking water supply. To achieve that objective, the Division recommended a uranium standard for all of Indian Creek of 0.3 mg/l.

Mr. Anderson indicated, however, the Division's actual objective was to achieve the recommended uranium level at WQCD Station 149 which is on Indian Creek just above the confluence with Marshall Creek. (See lines 14-24, page 237 of Volume II of the transcript). In order to achieve that objective, the Division has chosen to establish an ambient uranium standard for <u>all</u> of Indian Creek, and the establishment of such a standard is not necessary to accomplish that objective of the Division.

Further, as Homestake pointed out during the testimony it presented at the Montrose hearings, the levels of uranium found in Indian Creek are essentially background levels - levels that the Pitch Mine and Homestake cannot significantly influence.

The Division has recognized that essential fact when it renewed the Homestake NPDES Permit in June 1981. In its original proposal concerning the renewal of the Homestake NPDES Permit for the Pitch Mine, the Division proposed a uranium effluent limitation of 0.3 mg/l as a 30-day average and 0.6 mg/l as a daily maximum. The proposal was based on the need to protect the aquatic environment from perceived effects of uranium.

During the course of the NPDES Permit renewal process, Homestake demonstrated to the Division that a uranium effluent limitation of 0.3 mg/l was much more stringent than necessary to achieve the stated objectives of the Division, and the effluent limitations in the permit for uranium were set at 2.0 mg/l (30-day average) and 4.0 mg/l (daily maximum). However, the Division, in the summary of rationale supporting the effluent limitations in the NPDES Permit, stated that the limitations, including the uranium limitations of 2.0 mg/l (30-day average) and 4.0 mg/l (daily maximum), were being promulgated pursuant to Section 3.1.8(1) of the regulations which established Basic Standards and an Anti-Degradation Standard. The Division determined that uranium effluent limitations of 2.0 mg/l (30-day average) and 4.0 mg/l (daily maximum) would not result in water quality degradation which would interfere with or become injurious to existing uses. (See Homestake Exhibit B, "Summary of Rationale, Permit Number CO-0022756").

The summary of rationale for the NPDES Permit also stated, in substance, that the Division had no data which shows that Indian Creek did not contain elevated uranium levels prior to mining activities. The summary of rationale for the NPDES Permit states that "[T]he geology of the area indicated that high natural uranium levels were likely." Finally, the summary of rationale concludes that the uranium limitations of 2.0 mg/l (30-day average) and 4.0 mg/l (daily maximum) were based upon the data that was available in June 1981.

Since the Division's summary of rationale for the NPDES Permit was prepared, Homestake has acquired additional data which demonstrates that the levels of uranium existing in Indian Creek at SW3 (approximately 2 miles below the Homestake

NPDES discharge point) and at WQCD Station 149 (on Indian Creek just above the confluence of Indian Creek and Marshall Creek) are indeed natural background levels.

That additional data consists primarily of two items. First, in Homestake Exhibit G introduced at the hearings held in connecton with this matter in Montrose, there are three tables which show average uranium levels in Indian Creek water at SW3 and SW4 and in Marshall Creek at SW10 just below the confluence with Indian Creek at three different periods of time. The first such period is 1975 - 1976 when Homestake was not discharging from the Pitch Project site. The second period of time is 1979 - 1980 when Homestake was discharging effluent from the mining operation into Indian Creek, and the third period of time referenced in Exhibit G is 1981 when there was no discharge from the Pitch Mine.

AVERAGE URANIUM CONCENTRATIONS IN
MG/L IN INDIAN CREEK AND MARSHALL CREEK

	1975-1976 (Before Discharge)	1979-1980 (During Discharge)	1981 (No Discharge)
SW3	0.27	0.21	0.23
SW4 [WQCD STATION 149]	0.13	0.12	0.15
SW10	0.04	0.03	0.06

As can be readily seen from the summary taken from Homestake Exhibit G, the Homestake Pitch mining operation does not appear to affect the levels of uranium at SW3, WQCD Station 149 or SW10 in any significant manner, and it is also readily apparent that the levels of uranium being detected at WQCD Station 149 are significantly below the Division's stated objective of 0.3 mg/l at WQCD Station 149.

In an effort to verify that the levels of uranium being detected in Indian Creek are background levels, Homestake sampled two springs which arise approximately 200 feet below SW33. The springs are the headwaters of Indian Creek when there is no discharge from the Homestake Pitch Mine to Indian Creek. A third sample of the combined flow was taken, and the results of those samples were furnished to the Commission and the Division and are restated here for convenience:

Homestake Sample No.	Total Uranium-Mg/l
1 - Upper spring	0.929
2 - Lower spring	1.108
3 - Combined flow	0.846

As can readily be seen from the materials included in Homestake Exhibit G and the results of the assays of the samples collected from the springs, the levels of uranium found in Indian Creek between SW33 and SW3 naturally exceed the numeric standard being proposed by the Division, and the operation of the Pitch Mine by Homestake has no affect on the levels of uranium found in Indian Creek at SW3 and WQCD Station 149.

At the same time, it is also clear, given natural conditions and/or the operation of the Pitch Mine by Homestake in accordance with its NPDES Permit, that water quality stream standards being proposed by the Division in this matter for uranium must be exceeded at some point on the Creek because water being introduced to the Creek naturally or from SW33 contains levels of uranium in excess of the proposed standard.

The essential point of the foregoing is that the uranium standard being proposed by the Division does not accurately reflect natural conditions being encountered in Indian Creek. In his opening testimony dealing with the Rationale for the proposed uranium standard for Indian Creek, Mr. Anderson clearly indicated that the Division needed to achieve 0.3 mg/l of uranium at WQCD Station 149. In order to ensure accomplishing that goal, the Division has prepared a uranium standard that simply does not recognize or take into account the site specific situation at the headwaters of Indian Creek.

As Homestake indicated at the Montrose hearings, the primary concern in this proceeding is the impact the stream classifications process will have on its future NPDES permits for the Pitch Mine. If the Division's proposal for uranium is adopted, the Permits Section of the Division would be in an almost impossible position to issue an NPDES Permit with effluent limitations which will result in a violation of the stream standard set by the Commission for uranium. Consequently, it is not illogical to assume that the Permits Section of the Division will set effluent limitations for uranium which will ensure that the stream standards set by the Commission will be met. In the case of uranium, the stream standard set by the Commission must almost automatically become the effluent limitations. That was indeed the case in the NPDES Permit renewal process Homestake was engaged in during 1979 and 1980.

As Homestake demonstrated at the hearings, its operation of the Pitch Mine in accordance with its NPDES Permit does not affect the levels of uranium in Indian Creek, and if its effluent limitations for uranium was reduced to 0.3 mg/l, there would be no corresponding upgrading of the quality of Indian Creek. In setting the uranium standards for Indian Creek, the Commission must look at the Creek as a whole; the Division has simply looked at WQCD Station 149. The data there shows that the levels of uranium in the Creek are largely unaffected by Homestake and that historically there has been absolutely no problem in meeting the 0.3 mg/l at that point on the stream. To take the 0.3 mg/l requirement at WQCD Station 149 and apply it to all of Indian Creek ignores the historic record on the stream and its tributaries, and it is arbitrary.

The conclusion that must be drawn from the data is that a uranium standard for all of Indian Creek which does <u>not</u> take into account historic condition is unnecessary and unfair.

III. AQUATIC TOXICOLOGY

The second reason tendered by the Division for its proposal for the uranium standard for Indian Creek is the need to protect the aquatic environment from the perceived toxic effects, both acute and chronic, of uranium to the resident Indian Creek trout population.

The basis of the proposed uranium standard by the Division is the bioassay work done by Mr. Robert P. McConnell in Fort Collins in 1979 (the "CDOH Study"). The report of that work was transmitted to the Division in a memorandum dated December 3, 1979. The report of the bioassay work included provisional recommendations for an instream concentration of uranium.

That recommendation was that a safe instream concentration range would be 0.31 mg/l to 0.39 mg/l total uranium. The report included several caveats which dealt with the provisional nature of the recommendations.

The first caveat is that the determination of the 96-hour LC50's of uranium to the test trout populations were "determined by a graphical interpolation and were not derived from a rigorous statistical evaluation of the test data."

Second, as Mr. McConnell acknowledged on page 2 of the report, a safe instream concentration cannot be properly determined until long-term testing can be completed. However, in order to arrive at a predicted instream concentration of uranium which would not be harmful to the resident trout population in Indian Creek, Mr. McConnell used a "somewhat arbitrary application factor" of 0.05. The application factor was selected because it was similar to application factors found in the literature for heavy metals. Finally, the provisional recommendation was stated in the report to apply only to water with hardness and alkalinity in the 0 mg/l - 100 mg/l range.

As Mr. Benjamin R. Parkhurst, an expert in aquatic toxicology, testified at the Montrose hearings, the CDOH study formed the basis for the recommended 0.3 mg/l (30-day average) and 0.6 mg/l (daily maximum) uranium effluent limitations for the Homestake NPDES renewal permit, and as Mr. Parkhurst testified, he was asked to determine whether those recommended limitations were indeed justified.

Mr. Parkhurst's initial study consisted of a set of acute toxicity tests in which the acute toxicity of uranium to Brook trout in hard and soft water was compared. The CDOH study was conducted in soft water (total alkalinity of 26.0 mg/l and total hardness of 30.0 mg/l), and Mr. Parkhurst's initial study was an effort to determine the toxic effects of uranium in hard and soft water.

As Mr. Parkhurst testified at the Montrose hearings, there is a significant inverse relationship between the toxic effects of uranium to Brook trout and water hardness. The results of the 96-hour LC50 tests conducted by Mr. Parkhurst in 1980 demonstrate the relationship.

The results of that work are summarized in Homestake Exhibit K and indicate that the 96-hour LC50 of uranium to the test trout population was 5.5 mg/l in soft water and 23 mg/l in hard water. The 96-hour LC50 results for the soft water tests are consistent with the results of the CDOH study. However, the CDOH study did not attempt to ascertain the 96-hour LC50 of uranium to Brook trout in hard water, and the 1980 work done by Mr. Parkhurst for Homestake represents pioneering effort in that area of research. The 1980 work done by Mr. Parkhurst did not consider the possible effects of alkalinity on the toxicity of uranium.

At about the time Mr. Parkhurst was performing the 1980 comparison 96-hour LC50 tests, Homestake requested Dr. William T. Waller to conduct a literature search to evaluate any data available dealing with the effects of hardness and alkalinity on the toxicity of uranium to trout. The results of Dr. Waller's study were summarized in a report dated December 15, 1980 entitled, "Effects of Alkalinity and Hardness on the Acute Chemical Toxicity of Uranium." The report was introduced as Homestake Exhibit H at the Montrose hearings.

Dr. Waller's report concludes that there is a strong relationship between acute chemical toxicity, alkalinity and hardness, and indicated that <u>as hardness and alkalinity increase, acute chemical toxicity decreases</u>. (See page 4 of Homestake Exhibit H).

Dr. Waller predicted on the basis of his literature research that the 96-hour LC50 of uranium would be 55.8 mg/l for a stream with 150 mg/l alkalinity and 200 mg/l hardness.

Based upon the work done by Dr. Waller in 1980, the Division revised its proposed effluent limitations for uranium in the Pitch NPDES Permit from 0.3 mg/l (30-day average) and 0.6 mg/l (daily maximum) to 2.0 mg/l (30-day average) and 4.0 mg/l (daily maximum).

Homestake asked Mr. Parkhurst to continue his work evaluation on the effects of alkalinity and hardness on the chemical toxicity of uranium to trout in anticipation of these proceedings.

As Mr. Parkhurst testified at the hearings, the 1980 96-hour LC50 tests did not take into account the possible effects of alkalinity on the toxicity of uranium to trout. The alkalinity of the water in the 96-hour LC50 test performed by Mr. Parkhurst was only 7.4 mg/l. Further, Mr. Parkhurst was able to conduct an Early Life Stage test ("ELS") to determine the chronic toxicity of uranium to the test trout population. As Mr. Parkhurst testified at the Montrose hearings, Indian Creek contained hardness and alkalinity levels of approximately 200 mg/l and 189 mg/l, respectively. (See lines 19-25, page 279 and line 1, page 280 of Volume II of the transcript). The test was performed in an attempt to respond to Mr. McConnell's comment in the CDOH study that a safe instream concentration of uranium could not be determined until a long-term test was conducted.

The results of Mr. Parkhurst's ELS test are summarized in Homestake Exhibit L which was introduced at the Montrose hearings. As Mr. Parkhurst testified, the water used in the ELS test contained 200 mg/l hardness and 189 mg/l alkalinity, and simulated as closely as possible the chemical charateristics of the water found in Indian Creek.

The results of the ELS test indicate that instream concentrations of uranium of 9.1 mg/l would have no significant effects on resident trout populations in water with high alkalinity and hardness values such as Indian Creek. The obvious conclusion to be drawn from this report is that the uranium standard of 0.3 mg/l proposed by the Division for all of Indian Creek is drastically low and completely ignores the effects of the chemistry of the water of Indian Creek on the toxicity of uranium.

Finally, Mr. Parkhurst was asked by Homestake to conduct the final study in July 1981. That study was a second acute 48-hour LC50 test conducted in the summer of 1981. The results of the study were summarized in a report entitled, "Acute Toxicity of Uranium to Brook Trout Determined in a Flow-Through Test." The report is dated July 31, 1981 and was introduced at the hearings as Homestake Exhibit M.

As was the case with the ELS test, the chemical characteristics of the water used in the test were very similar to the naturally-occurring water in Indian Creek; that is, alkalinity was 146 mg/l and hardness was 184 mg/l. The results of the 1981 48-hour LC50 test are remarkably similar to the predictions made by Dr. Waller in December 1980 as set forth and reported in Exhibit I. The 48-hour LC50 of uranium to Brook trout in hard water was determined to be 58.5 mg/l in the 1981 test conducted by Mr. Parkhurst. Using Dr. Waller's multiple regression equation, Mr. Parkhurst predicted that the 96-hour LC50 of uranium to Brook trout in water of similar quality to Indian Creek would be 53.8 mg/l. (See page 4 of Homestake Exhibit N).

In October 1981, Mr. Parkhurst prepared a summary report of the studies he performed for Homestake. That report was submitted at the Montrose hearings as Homestake Exhibit N. On page 3 of the report, Mr. Parkhurst has summarized in table form the results of the 1980 96-hour LC50 test which was performed in hard and soft water, the ELS test and the 1981 48-hour LC50 test performed in water with hardness and alkalinity values very similar to Indian Creek.

That summary clearly demonstrates that a safe instream concentration of uranium in Indian Creek would be in excess of 9.0 mg/l and that the uranium standard of 0.3 mg/l being proposed by the Division is much more restrictive than necessary to protect the resident Indian Creek trout population from the possible acute or chronic effects of uranium.

It is also important to note that Mr. Parkhurst does not disagree with the CDOH study or the results obtained by Mr. McConnell in the 96-hour LC50 tests performed in that test. For example, on page 288 of the transcript, Mr. Parkhurst testified that the 96-hour LC50 results obtained by Mr. McConnell in the soft water were very similar to the results of the soft water 96-hour LC50 test conducted by Homestake. The difference between the results of those two soft water tests and the 48-hour LC50 values reached by Mr. Parkhurst is that the 48-hour test was conducted using water which simulated the alkalinity and hardness conditions found in Indian Creek. The tests conducted by Mr. McConnell did not take into account the effects of alkalinity and hardness on the toxicity of uranium.

In summary, Homestake produced evidence at the Montrose hearings which was uncontradicted and which clearly demonstrated that the uranium standard being proposed by the Division for Indian Creek cannot be justified on the necessity to protect the resident trout populations from the acute and chronic toxic effects of uranium. The evidence introduced by Homestake demonstrates beyond a reasonable doubt that levels of uranium in Indian Creek far in excess of 4.0 mg/l will have no acute or chronic toxic effects on the resident populations, and, consequently, the Commission should not adopt the obviously over-restrictive standard being proposed by the Division.

IV. THE HOMESTAKE ALTERNÁTE PROPOSAL

As indicated above, Homestake introduced an alternate proposal for the uranium standard for Indian Creek which it believes is compatible with the use classifications proposed by the Division and the operation of the Pitch Mine in accordance with the NPDES Permit currently in effect at the mine. The proposal submitted by Homestake on October 27, 1981 requested that the stream standard for uranium between SW33 and SW3 be set at 4.0 mg/1, and at 0.45 mg/1 between SW3 and WQCD Station 149. The proposed standard was offered to the Division in the belief that (i) it amply supports the protection of the aquatic environment in Indian Creek, and (ii) Lower Marshall Creek, Segment 22 of the Upper Gunnison River Basin, would not be jeopardized as a drinking water supply on the basis of the historic data available; that is, the available data suggests that the levels of uranium at WQCD Station 149 on Indian Creek and at SW10 on the Lower Marshall Creek will be well below the levels the Division believes are necessary to protect Lower Marshall Creek as a drinking water supply if the Homestake alternate proposal is adopted.

With respect to item (i), it is uncontradicted that levels of uranium in Indian Creek of 9.1 mg/1 will not have any significant effect on the aquatic environment in either the acute or chronic sense.

Further, with respect to (ii), it is obvious from the studies and monitoring conducted by Homestake and the Division that the operation of the Pitch Mine does not have any observable adverse effect on the levels of uranium in Indian Creek at WQCD Station 149 and at SW10 on Marshall Creek. The evidence presented by Homestake and the Division at the Montrose hearings simply confirms the Division's earlier conclusions which were reached in the summary of rationale for the Homestake NPDES Permit that the levels of uranium being detected in Indian Creek are essentially background levels, and that Homestake has little, if any, ability to reduce those levels to the concentrations being proposed by the Division.

On the contrary, the alternate proposal submitted by Homestake takes into account and merely adopts the realty of the situation historically found on Indian Creek.

Finally, as set forth above, Homestake is most concerned that the stream standards being proposed in this matter will eventually become the effluent limitations for the Homestake Pitch Mine NPDES Permit. C.R.S. 1973, Section 25-8-102(5) requires the Division to assess and consider the economic reasonableness of pollution control measures it proposes. That same section requires that such measures have a reasonable relationship to the economic, environmental, energy, and public health costs and impacts of such measures, and that before a final action is taken, consideration be given to the economic reasonableness of the action. The statute requires that the consideration with respect to economic reasonableness include an evaluation of the benefits to be derived from achieving the goals of the particular proposal and of the economic, environmental, public health and energy impacts to the public and the affected persons.

Homestake demonstrated in the additional information it submitted in this matter on December 8, 1981, the cost of a water treatment facility designed to treat 750 gallons per minute for uranium at the Pitch Mine has been estimated at $492,313.00. Based on the historic data, the cost of such a facility cannot be justified because the levels of uranium in Indian Creek and Lower Marshall Creek would not be significantly affected by requiring treatment of Pitch Mine effluent for uranium to the levels being proposed by the Division. That conclusion has been demonstrated beyond a reasonable doubt by the comparison drawn in Homestake Exhibit G and by the assay results of the samples taken from the spring which arise immediately below the Homestake NPDES discharge point.

V. CONCLUSIONS

For all of the reasons set forth above, Homestake respectfully requests that its alternate proposal for the uranium standard for Indian Creek (Segment 21 of the Upper Gunnison River Basin) be adopted because (i) the adoption of the uranium standard proposed by the Division for Indian Creek is much more stringent than is necessary or practical to achieve the protection of Lower Marshall Creek (Segment 22 of the Upper Gunnison River Basin) as a drinking water supply, and (ii) the uranium standard proposed by the Division is at least 30 times more stringent than necessary to protect the resident trout populations from the acute or chronic effects of uranium. As Mr. Anderson testified at the hearing in Montrose, the discharge of effluent by Homestake into Indian Creek in accordance with its NPDES Permit is totally consistent with the classifications and uses the Division has proposed for Indian Creek and that the classifications and uses, including the protection of Lower Marshall Creek as a drinking water supply, will not be jeopardized if the stream standard for uranium proposed by Homestake is met. Based upon the foregoing, the Commission should adopt the alternate proposal for uranium tendered by Homestake.

Respectfully submitted,

KIRKLAND & ELLIS

By Keith M. Crouch

Keith M. Crouch

1625 Broadway, Suite 300
Denver, Colorado 80202
(303) 628-3000

Attorneys for Homestake Mining Company

CERTIFICATE OF MAILING

I hereby certify that a copy of the foregoing SUMMARY OF EVIDENCE RE SEGMENT 21 OF THE UPPER GUNNISON RIVER BASIN ON INDIAN CREEK SUBMITTED BY HOMESTAKE MINING COMPANY was mailed, postage prepaid, to:

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730 17th Street
220 Equitable Bldg.
Denver, Colorado 80202

this 11th day of February 1982.

Linda C. Slocum

Linda C. Slocum

Appendix 3

Pitch Mine Resource Summary

Technical Memorandum

To: Clark Burton
From: J Mersch Ward
Date: December 15, 2022
Subject: Pitch Mine Resource Summary

Exploration History and Remaining Resources

Uranium was first discovered in the Marshall Pass Mining District in 1955. Radioactivity noted in the Belden formation of Pennsylvanian age led early prospectors to more significant occurrences in the Harding Quartzite of Ordovician age and the eventual discovery of ore grade uranium on the property later called the Little Indian 36 Mine. Underground mining occurred at this site between 1957 to1959. Coinciding with the discovery of the ore at the Little Indian property, uranium was discovered in the Precambrian rocks in the Harry Creek drainage east and south of the project area known as the Marshall Pass and Lookout 22 properties.

Additional geologic investigations one mile south of the Little Indian Mine, along the prominent north-south fault system, resulted in the discovery of the Erie Mine in 1959 where uranium ore was identified in the Belden formation. Concurrently and in the same proximity, the Pinnacle Mine was developed in the Leadville limestone. Both properties were mined underground between 1959 to1962. Ore produced from the above operations was trucked to Canyon City, Colorado for milling.

In 1968 an ion exchange plant was built to recover uranium from solutions that were first injected into the old Pinnacle Mine workings and then recovered from the out flow of the Pinnacle Mine access portal. Solution mining continued from 1968 to 1972.

Between 1975 and 1984 Homestake developed open pit mines extending north and south of the Pinnacle Mine workings. Ore produced from this operation was trucked to Homestake's mill in Milan, New Mexico.

Historic Production, Marshall Creek District

Location	Year	Tons	Grade % U_3O_8	Pounds U_3O_8	Mine type
Erie	1959	100	0.27	540	Underground
Pinnacle	1959-1962	98,600	0.50	1,030,120	Underground
	1968-1971	Ion Exch.		100,000	Mine Water
	1972 HMC	Ion Exch.		3,696	Mine Water
Pitch Mine	1975 HMC	1,334	0.22	5,848	Open Pit
	1978-1984 HMC	275,000	0.40	2,000,000	Open Pit
Total Mined Tons		375,034	0.41	3,140,204	

Geology

The Pitch project is on the southern flank of the Sawatch Range and is located within the Marshall Pass Mining District. This area is part of an exposed remnant of gently folded sedimentary rocks of Paleozoic age approximately 3 miles in diameter. Roughly, the circular patch of sedimentary rocks is bounded by Precambrian rocks on the north and east and is covered by Tertiary age volcanic rocks to the west and south. The eastern Precambrian -Paleozoic contact is a high-angle reverse fault - - the Chester Fault. This fault formed during the Laramide Orogeny, which was subsequently mineralized with uranium throughout much of the fault zone.

Three general rock types occur within the project area: 1) Precambrian meta-sedimentary, meta-igneous, and igneous; 2) Paleozoic sedimentary; 3) Tertiary volcanic rock (Table 1 Stratigraphic Column)

The oldest and most common Precambrian rock type is a series of meta-sedimentary units composed of predominantly quartz-biotite schist with variable amounts of plagioclase, hornblende, orthoclase, muscovite, and sillimanite. Weakly foliated granite gneiss occurs as lenses, which are parallel to foliation, within the schist. The youngest Precambrian rock is coarse-grained granite. Pegmatites which may have been a later phase of the same granitic magma, intrude all the other Precambrian rocks. In the Chester Fault zone, some of the Precambrian rocks have been both mechanically and chemically altered to chloritized and serpentinized calcsilicate hornfels.

The Paleozoic sedimentary rocks are the result of periodic transgressions and regressions of epicontinental seas and their lithologies reflect a wide variety of depositional environments. These rocks range form limestone to dolomite, to quartzite to sandstone of Ordovician to the Mississippian age, to a deltaic depositional environment of shale, coaly shale, arkosic sandstone to limestone during the Pennsylvanian time. Uranium mineralization is associated with all the district sedimentary rocks where these rocks come in contact with the Chester Fault.

ROCK UNITS WITHIN THE PROJECT AREA

(From: Ranspot, 1958; Malan, 1959; Ward, 1974)

Era	Formation	Thickness (feet)	Description
CENOZOIC ERA	Rawley Andesite	1000-2000 (305-610 m)	Highly jointed, prophyritic, augite-andesine to biotite-hornblende andesite; interfingers with tuffs
	Tuff	50-500 (15-152 m)	Variable sequence of water-laid and welded, ash-fall tuffs
	Major Unconformity		
PALEOZOIC ERA	Belden Formation	500-750 (152-229 m)	Extremely variable sequence of sandstone, quartzite, silestone, mudstone, limestone, dolomite, shale, and carbonaceous shale
	Leadville Limestone	0-430 (0-131 m)	Blue-gray, thinly bedded to massive, crystalline limestone and dolomite with local silicification; basal quartzite in places; karstic top surface; has been completely removed in some areas; upper limit to thickness varies among investigators
	Chaffee Formation		
	Dyer Dolomite	150 (46m)	Alternating limestone and dolomite with variable amounts of sand
	Parting Quartzite	10-15 (3-5 m)	Multi-colored, interbedded mudstone and sandstone
	Fremont Dolomite	175 (53 m)	Hard, crystalline blue-gray dolomite with some chert; sandy and less resistant in top part
	Harding Quartzite	35-45 (11-14 m)	Conglomeratic, medium to coarse-grained quartzose sandstone; locally silicified to quartzite; contained uranium ore at Little Indian No. 36 Mine
	Manitou Dolomite	250-300 (76-91 m)	Bluish-gray to buff, thinly to thickly bedded dolomite with numerous nodules of chert in basal part
	Sawatch Formation	0-10 (0-3 m)	Medium to coarse-grained quartzose sandstone; possibly small remnant on Lime Ridge
	Major Unconformity		
PRE-CAMBRIAN	Precambrian		Quartz-mica schist and granite gneiss with pegmatite dikes

Stratigraphic Column

Table 1

Rocks of the Mesozoic Era are not present in the project area.

Volcanic rocks of Tertiary age cover the southern portion of the project area. The volcanic units have no relationship to the ore deposits. They are part of the Bonanza volcanic center, which is a northeastern extension of the much larger San Juan volcanic field. The rocks are andesitic in nature ranging from augite-andesine to biotite-hornblende and are contained within multiple pyroclastic flows. Lying above, interstitial and below the andesites are tuffs made up of biotite, plagioclase, and sanidine. These units were lain down as water-laid tuffs, with interbedded siltstones and sandstones, ash-fall tuffs, and alluvial channels filled with gravel consisting mostly of andesite, reworked tuff, and Precambrian rock fragments. (Map 1, Geology Map)

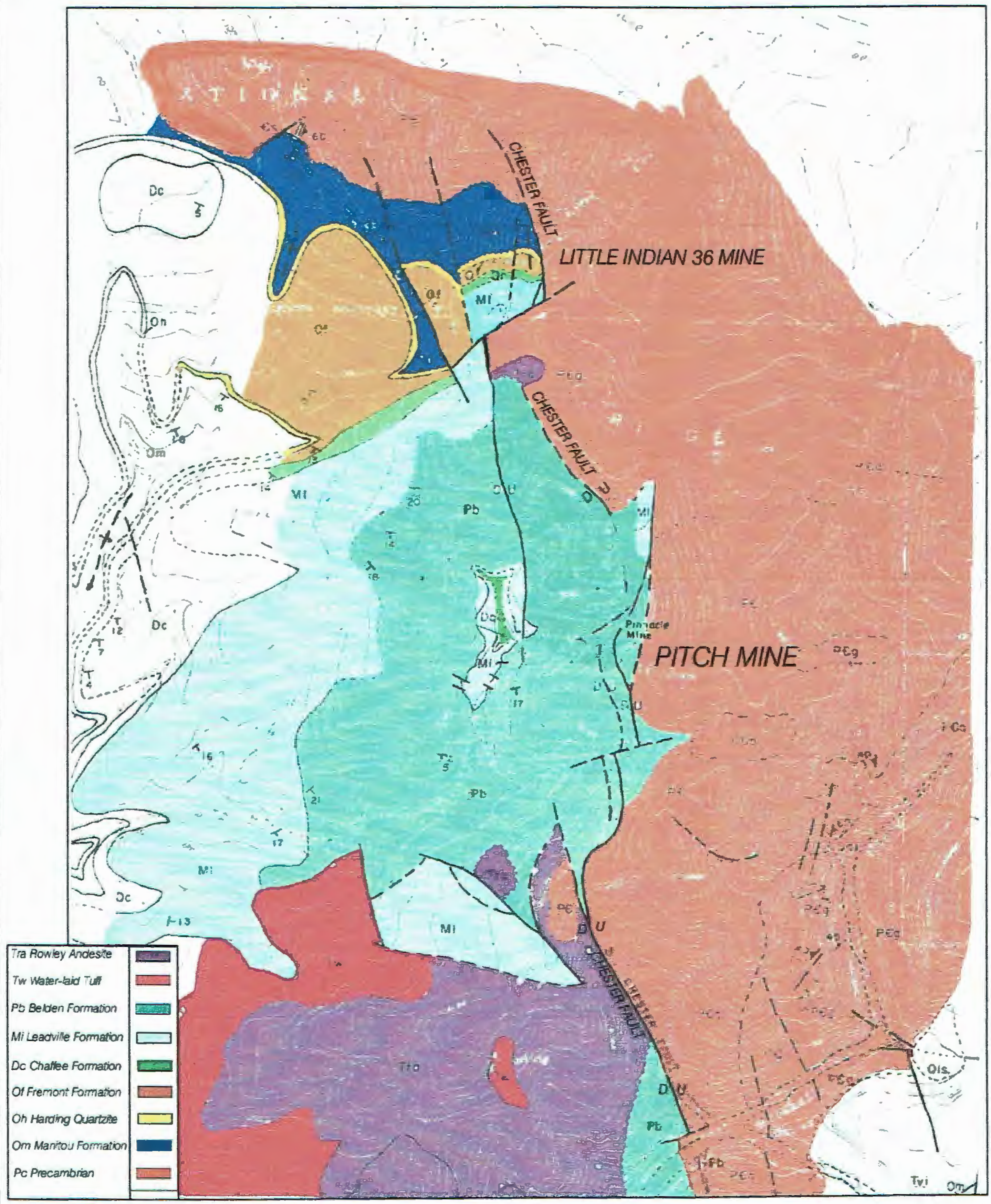
Structure

The most significant structure within the project area is the Chester Fault, a high-angle reverse fault along which Precambrian rocks from the east have been pushed up and over sedimentary units of the Paleozoic age. The surface trace of the fault is quite undulatory but strikes generally in a north-south direction. It can be traced almost continuously from Marshall Creek to the south to Lime Ridge north of the project area. To the north the fault trace is lost within the Precambrian units and to the south the surface trace is covered by the younger volcanic rock cover. The dip on the fault varies from 40 degrees to the east to practically vertical. At least 1,400 feet and upward to 2,000 feet of displacement has been reported. The fault is assumed to be Laramide in age.

Sedimentary rocks in the fault zone have been highly deformed. The "crush zone" is 300 to 400 feet wide. Within the fault zone, the more brittle limestones and dolomites have been brecciated; whereas the more plastic units of the Belden formation have been squeezed, contorted, and sheared. Also along the crush zone are a series of north-south striking horst/graben fault offsets.

The Paleozoic sedimentary formations on the western side of the fault have a regional dip to the south of about 12 degrees upon which gentle folds have been superimposed. Fold axes in the area appear to strike in a northerly to northeasterly directions. The eastern flank where truncated by the Chester Fault the sedimentary rocks have been drug upward to near vertical to slightly overturned.

In addition to the high-angle reverse faults, there are also several normal faults in the area that have offset the Chester fault. These faults do not appear to have any influence on the mineralization. The most noted of these faults in the Erie Fault which bisects the resources at Pitch Mine. (Map 2, Key to Cross Sections)

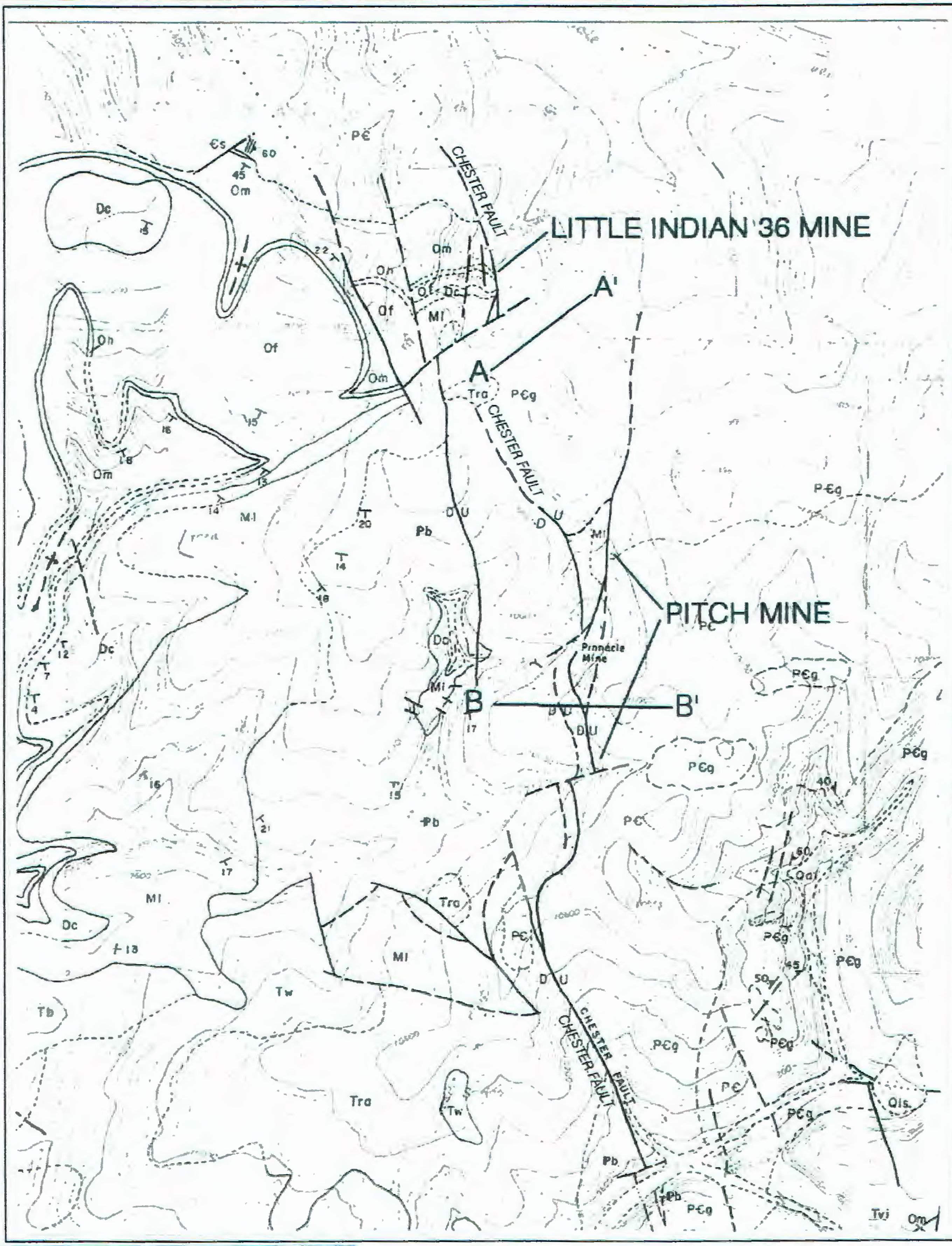


PROJECT:	DATE: January 2008
PITCH MINE Saguache and Gunnison County, Colorado	Contour Interval: 80 DRAWN BY: K. Auchampach PATH: Pitch\ExecutiveSummaryMaps_1-2008\Geology Map.dwg

HOMESTAKE

GEOLOGY MAP

Map 1



PROJECT:	DATE: January 2008
	SCALE: N/A
PITCH MINE	DRAWN BY: K. Auchambach
Saguache and Gunnison County, Colorado	PATH: Pitch/ExecutiveSummaryMaps_1-2008/CrossSectionKey.dwg

KEY TO CROSS SECTIONS

Map 2

Mineralization

Several interpretations of the method of ore emplacement and depositional or localization controls have been developed. The most prevalent of these suggest brecciation and fracturing which took place during the formation of and subsequent movement along the Chester Fault, especially within the more brittle carbonate units of the Leadville limestone provided a host for solutions migrating along the fault. Later faulting resulted in offsets of the original orebody and scattering of the ore pods.

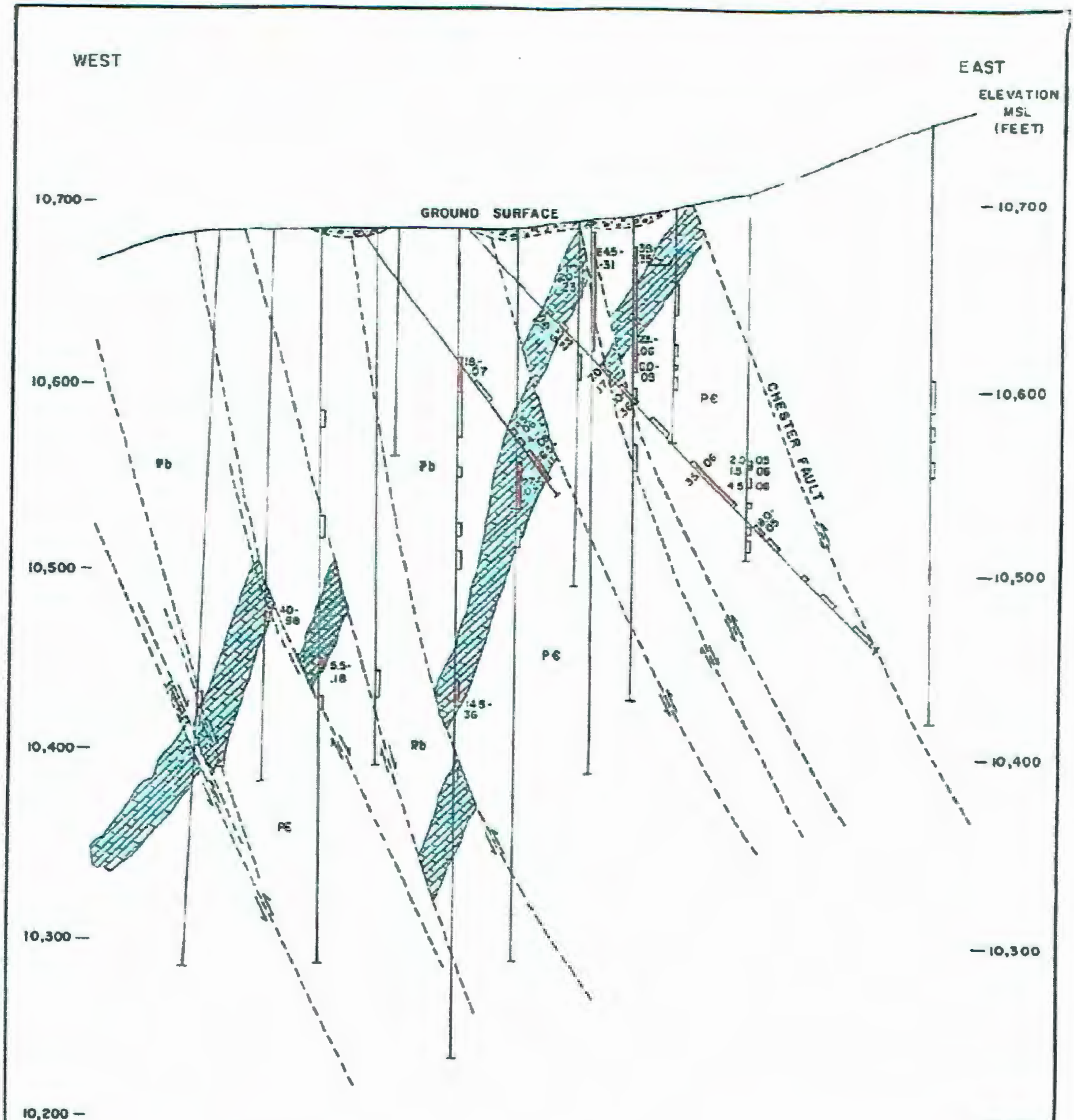
An east west Cross-Section B-B' near the middle of the Pitch resource area illustrates this history. The Chester Fault forms the eastern boundary. After mineralization was placed into the Leadville limestone, renewed faulting occurred within the fault zone. This faulting was more or less parallel and sympathetic to the Chester Fault and created a series of wedges or slices having a 'horst and graben" configuration with associated drag folding (Cross Section B-B').

Cross Section A-A' in the area of Little Indian 36 Mine displays a similar association to the Chester Fault. However, at this location the Chester Fault takes on the appearance of a thrust fault with very low angled fault plane. Mineralization is again tied to the fault preparation of the much older Paleozoic sediments consisting of dolomite, limestone and quartzite. Drag structures, as well as, sympathetic faulting, again parallels the Chester Fault zone (Cross Section A-A').

The age of the ore emplacement is not certain but has been concluded to be of Laramide Age on the basis of associated alteration, mineral assemblages, and spatial relationship to the fault. Hydrothermal solutions probably were responsible for the dolomitization of the Paleozoic carbonate rocks and the silicification, chloritization, and serpentinization of the older Precambrian rocks within the fault zone.

The erosion of the uplifted Precambrian rocks on the east side of the Chester Fault and subsequent transport of material and solutions over the fault zone to the west may have contributed significant uranium resources to the target areas.

Uraninite is the most common uranium ore mineral found along the Chester fault and within the Precambrian rocks to the east. Numerous oxide minerals of uranium have been identified throughout the project area.



LEGEND

ALLUVIUM

Pb BELDEN FORMATION : ALTERNATING SEQUENCE OF PREDOMINANTLY SANDSTONE, SILTSTONE, MUDSTONE, AND SHALE WITH SOME COAL, LIMESTONE, AND DOLOMITE.

LEADVILLE FORMATION: BASAL CARBONATE UNIT; BRECCIATED BROWN TO GRAY DOLOMITE

P€ PRECAMBRIAN COMPLEX: UNDIFFERENTIATED METAMORPHIC ROCKS (SCHIST AND GNEISS WITH SOME AMPHIBOLITE) AND GRANITE AND PEGMATITE

FAULT: ARROWS INDICATE RELATIVE DIRECTION OF MOVEMENT

DRILL HOLE SHOWING LOCATION OF MINERALIZED ZONES (INDICATES ONLY VERTICAL EXTENT OF MINERALIZATION) MINERALIZATION $\geq$ .05% eU_3O_8 SHOWN.

NO VERTICAL EXAGGERATION

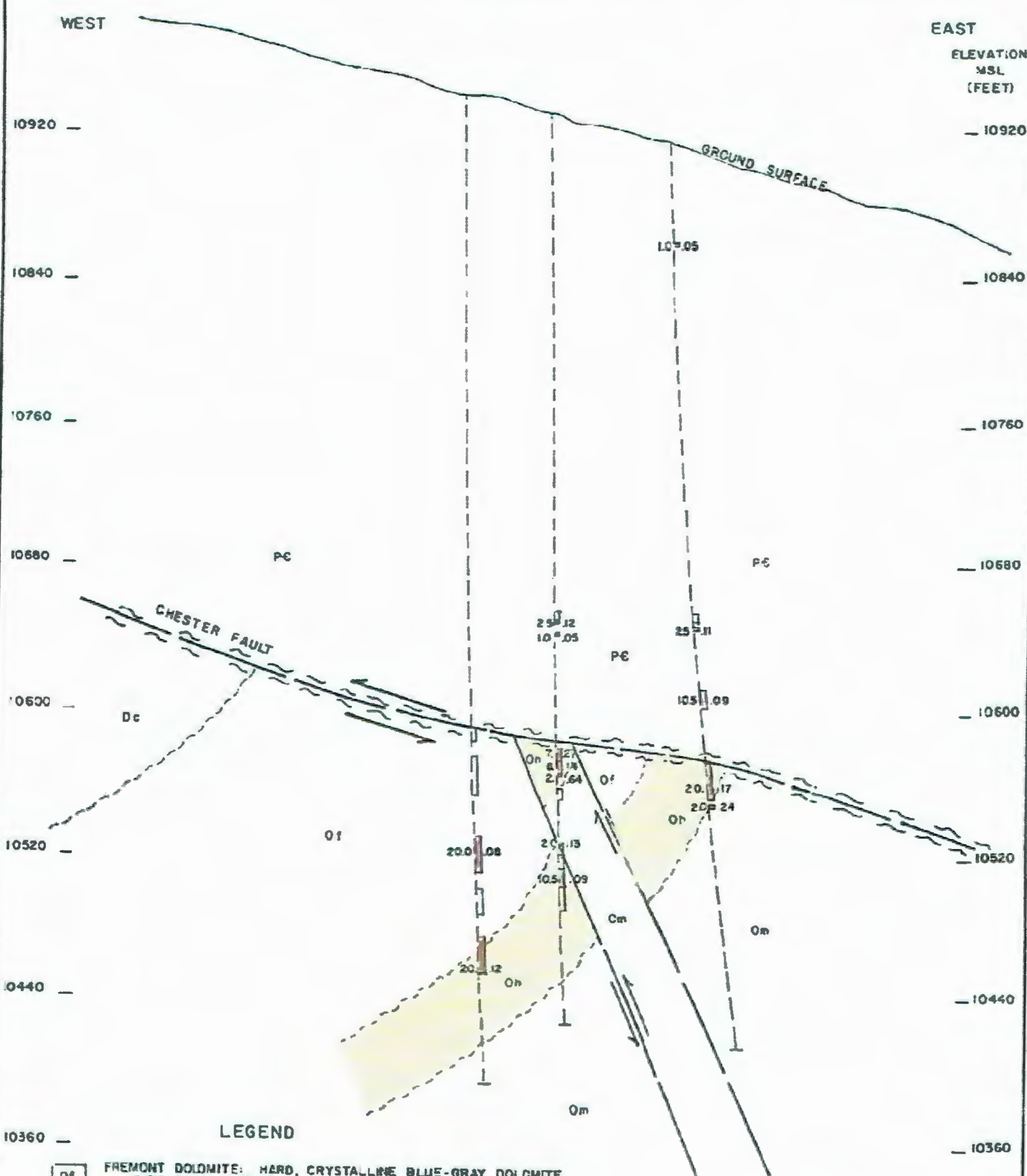
ALL ASSAY VALUES ARE eU_3O_8

GEOLOGIC CROSS-SECTION B - B'

Pre Homestake Pit Development

PROJECT:	DATE: January 2008
PITCH MINE Saguache and Gunnison County, Colorado	SCALE: N/A DRAWN BY: K. Auchambach PATH: Pitch/ExecutiveSummaryMaps_1-2008 CrossSectionB-B.dwg

CROSS SECTION B - B'



LEGEND

Of — FREMONT DOLOMITE: HARD, CRYSTALLINE BLUE-GRAY DOLOMITE WITH SOME CHERT

Oh — HARDING QUARTZITE: CONGLOMERATIC, MEDIUM TO COARSE-GRAINED QUARTZOSE SANDSTONE; LOCALLY SILICIFIED TO QUARTZITE.

Om — MANITOU DOLOMITE: BLUISH-GRAY TO BUFF, THINLY TO THICKLY BEDDED DOLOMITE WITH NUMEROUS NODULES OF CHERT IN BASAL PART.

P€ — PRECAMBRIAN COMPLEX: UNDIFFERENTIATED METAMORPHIC ROCKS (SCHIST AND GNEISS WITH SOME AMPHIBOLITE) AND GRANITE AND PEGMATITE.

FAULT: ARROWS INDICATE RELATIVE DIRECTION OF MOVEMENT

DRILL HOLE SHOWING LOCATION OF MINERALIZED ZONES. (INDICATES ONLY VERTICAL EXTENT OF MINERALIZATION) MINERALIZATION ≥ .05% eU_3O_8 SHOWN.

GEOLOGIC CROSS-SECTION A - A'

LITTLE INDIAN 36 MINE

NO VERTICAL EXAGGERATION.

ALL ASSAY VALUES ARE eU_3O_8.

PROJECT:	DATE: January 2008
PITCH MINE	SCALE: N/A
Saguache and Gunnison County, Colorado	DRAWN BY: K. Aucharnoach
	PATH: Pitch\ExecutiveSummaryMaps_1-2008\CrossSectionA-A.dwg

CROSS SECTION A - A'

Homestake History

Homestake acquired its first interest in the project in 1973 at which time it launched a substantial exploration program in and around the old Pinnacle Mine, as well as, north along the Chester fault to the Little Indian Mine and south to Marshall Creek.

After several seasons of drilling more than 900 rotary and core holes, the Company delineated, in the area of the Pinnacle operation, a uranium resource of 2.8 million tons at a grade of 0.19% U_3O_8 for a contained 11.1 million pounds. Subsequent mine studies and plans for constructing a mill, identified a mineable diluted resource of 1.7 million tons at 0.17% U3O8 for a contained 5,780,000 pounds.

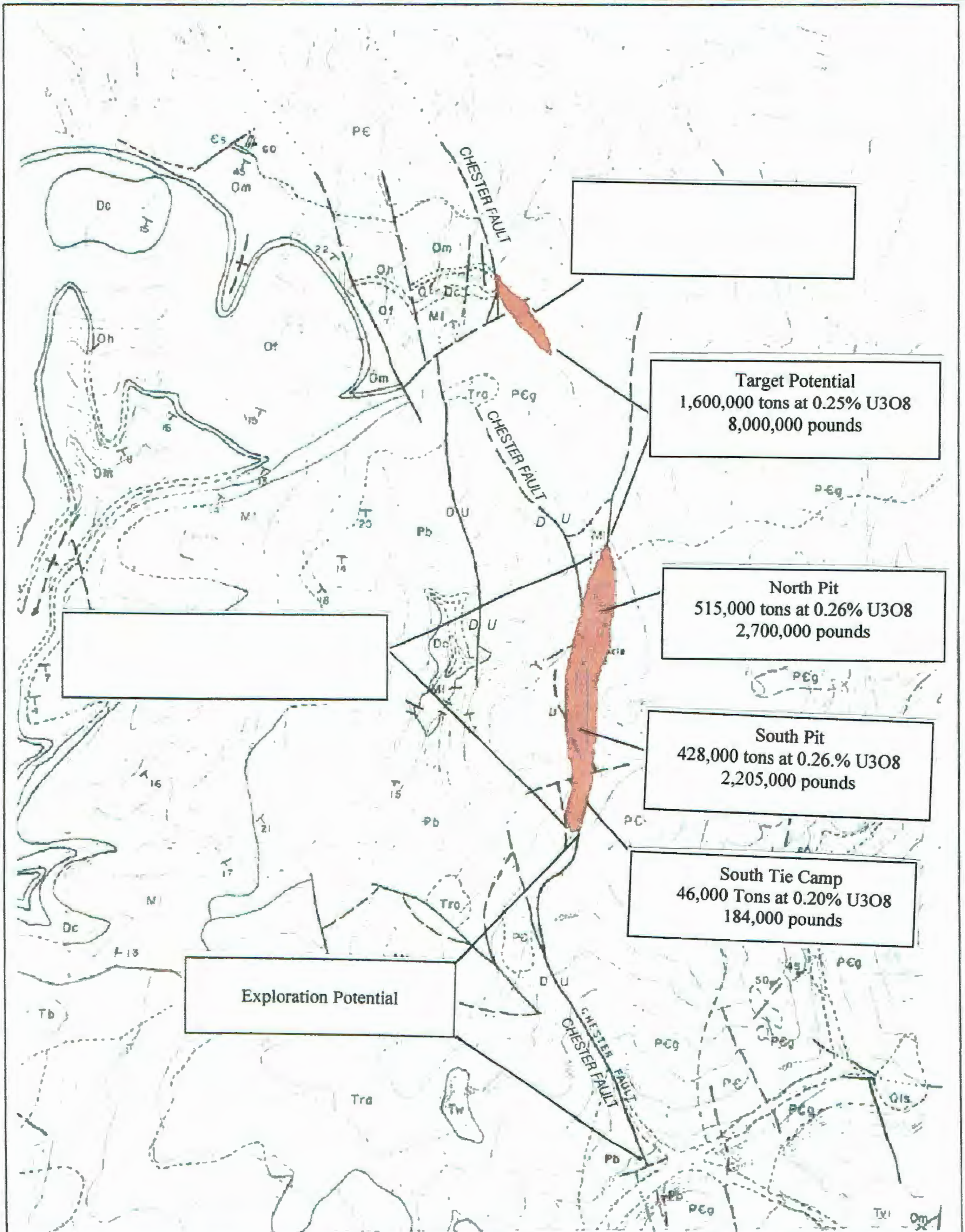
Homestake initiated the development of the open pit mine in 1978 and operated the property into early 1984. The mill construction was cancelled, and all ore was trucked to Homestake's mill in Milan, New Mexico. Operations ceased in 1984 due to declining uranium prices.

Current Uranium Resources

The open pit mine that Homestate Mining Company had planned at the start of production in 1978 was not completed when mining ceased in 1984. Uranium resources remained in both the North and South Pit areas, as well as, south of Tie Camp Creek. The table below outlines those remaining resources containing the then proven, probable and possible resources of that period and nomenclature.

In the vicinity of the Little Indian 36 Mine and extending southeast along the Chester Fault, 2.0 million pounds were delineated by drilling during the renewed exploration program.

There are several exploration targets identified within the project. Between the Little Indian 36 defined resource and the North Pit northern boundary there are very few drill holes. This area is similar in geology and structure as to those areas from which uranium resources have been produced at both the Pitch Mine and that of Little Indian 36 Mine. Using the Little Indian 36 resource as a model and noting that at Little Indian 36 the drill indicated resource of 2,000,000 pounds extended a linear distance of 1,000 feet equating to 2,000 pounds per foot. The distance between the two drilled resources is 4,000 feet which would equate to a target potential of 8,000 000 pounds at a grade of 0.25%U3O8 (Map 3 Resource Map).



PROJECT:	DATE: January 2008
PITCH MINE Saguache and Gunnison County, Colorado	Contour Interval: 50 DRAWN BY: K. Aucnambach PATH: Pitch/ExecutiveSummaryMaps_1-2008/ResourceMap.dwg

HOMESTAKE

RESOURCE MAP

Map 3

The above-mentioned resource and potential developments are summarized below as well as located on the Resource Map.

Location	Area	Pitch Project Remaining Resources Resource	Tons M	%U3O8	Pounds M
Pitch Mine					
	North Pit	End of Mining	515.60	0.262	2,700.14
	South Pit	End of Mining	428.56	0.257	2,205.40
	South Tie Camp	End of Mining	45.53	0.200	183.46
		Total Resource			5,089.00
Target Potential			1,600	0.25	8,000.00

The Chester Fault trace between Tie Camp Creek at the south end of the South Pit area to Marshall Creek has had very little exploration drilling and remains an exploration target for future work.

Appendix 4

Waste Characterization Sample Results (Memo to CDPHE HMWMD, September 2022)

PITCH RECLAMATION PROJECT

Colorado Dept. of Public Health and Environment 13 September 2022
Hazardous Materials and Waste Management Division
Radiation Management Program
4300 Cherry Creek Drive South Denver,
Colorado 80246-1530

Attn: Shiya Wang

RE: Waste Characterization Sample Results – Pitch Mine Reclamation Project – Radioactive Materials License Number Colo. 150-01, Amendment 21

Dear Dr. Wang,

Homestake Mining Company of California (HMC) continues to perform work at the Pitch Reclamation Project located in Saguache County, Colorado. Work related to handling of licensed materials (LM) is performed under Radioactive Materials License (RML) 150-01, Amendment 21. The purpose of this letter is to document the following information as it relates to characterization and disposal of waste which is considered LM under the RML:

- Confirmation of LM disposal options
- Documentation of waste characterization results as documented in the CDPHERM_HAZ_ADM SW-846 worksheet;
- Confirmation of CDPHE reciprocity requirements for transporters of LM waste.

Licensed Material Waste Disposal
The 2022 field implementation efforts at Pitch include characterization and disposal of certain LM generated during pilot testing of water treatment technology evaluations at the Site. Arcadis U.S., Inc. (Arcadis), on behalf of HMC, contacted you via e-mail on June 10th, 2022 (Anna Hagemeister to Shiya Wang) to inquire whether LM waste could be disposed of at an industrial landfill if the LM analytical results indicated that concentrations of natural uranium were below the Source Material of 500 mg/kg and the concentrations/activities of all radionuclides were below industrial landfill acceptance criteria. Your June 23, 2022 e-mail to Mike Hay of Arcadis (Attachment 1) confirmed that LM disposal of specific waste related to pilot testing can be disposed of at an industrial landfill, pending waste characterization analytical results. HMC understands that this approval relates only to LM generated through June 2022, and that future LM generated at the site will need to be disposed at a regulated radioactive materials disposal facility regardless of final concentration (i.e., regardless of whether natural uranium is above or below 500 mg/kg).

Licensed Material Waste Characterization Analytical Results

Arcadis, on behalf of HMC, collected waste characterization samples of LM waste in June and July of 2022. The following LM waste was identified as material which would be likely to have uranium below the Source Material cutoff and concentrations/activities of uranium and radium at levels below the acceptance criteria of the Waste Connections Southside Landfill Facility in Pueblo, Colorado:

- 2018 biochemical reactor media (wood chips, sheep manure, alfalfa hay)
- 2017 zerovalent iron (ZVI) media mixed with sand.

Waste Connections waste acceptance criteria for radiological analytes are as follows:

Table 1: Waste Connections Landfill Acceptance Criteria

Radiological Analyte	Landfill Acceptance Limit
Uranium	339 picocuries per gram (pCi/g) above background
Radium 226 and Radium 228	3 pCi/g above background
Thorium	3 pCi/g above background

In accordance with your June 23, 2022 e-mail to Mike Hay, a minimum of 3 samples were collected from the 2017 and 2018 LM waste streams. Analytical results were entered into the CDPHERM_HAZ_ADM SW-846 worksheet ("Standard Analysis of Data to Determine Adequate Number of Samples and the Upper Confidence Interval") to determine whether an appropriate number of samples were collected, and whether the material meets landfill acceptance criteria. While this spreadsheet is typically used for TENORM (radium and its progeny), your June 23, 2022 e-mail confirmed that it can also be used for uranium, and that data entry is required in the "SW-846 Data Evaluation" tab only. Spreadsheets were completed for the following analytes for each waste stream:

- Uranium
- Radium-226
- Radium 228

Note that Thorium results for each waste stream were non-detect.

Waste stream analytical data are provided in Table 2:

Table 2: 2017 ZVI and 2018 BCR Analytical Results.

Waste Stream Type	# of Samples Collected	Uranium	Ra-226	Ra-228	Appropriate Number of Samples collected? (Y/N)**	Material Concentration Lower than Landfill Acceptance Limit? (Y/N)***
		Concentration range pCi/g	Concentration range pCi/g	Concentration range pCi/g		
2017 ZVI	6	14.7 – 32.5	0.04* - 0.07	0.3* - 0.04*	Y	Y
2018 Biochemical Reactor Media	6	83 - 175	0.3 – 0.7	0.3* - 0.3*	Y	Y

Notes:

*Sample reported as non-detect. Result provided is the Minimum Detection Concentration (MDC).

** As determined by CDPHERM_HAZ_ADM SW-846 worksheet.

*** Limit provided in Table 1

Summary of Analytical Results
As outlined above, and shown in the attached SW-846 worksheets (Attachment 2, raw Excel files available upon request), an appropriate number of characterization samples were collected from the 2017 ZVI cell and the 2018 in-ground BCR cells. Analytical results for radiological components (Radium 226, Radium 228, Thorium, and Uranium) are beneath the Waste Connections Southside landfill acceptance criteria. Following landfill review and approval of a waste profile, HMC intends to send this LM to Waste Connections Southside Landfill.

Confirmation of CDPHE Reciprocity Requirements
As part of the waste transportation and disposal scope, HMC is subcontracting to the following companies:

- ERG and its subcontractors:
    - Transportation of LM to Waste Connections Southside Landfill
- Energy Solutions and its affiliate (Hittman Transport Services, Inc.):
    - Brokerage and transportation of LM to the Energy Solutions Clive, Utah facility.

It is HMC's understanding that subcontractors performing survey measurements associated with transportation and disposal can do so without a radiological service provider license (i.e., without Colorado Reciprocity), provided these contractors are not physically handling any LM. In addition, subcontractors may only perform surveys when escorted and overseen by an Authorized User. Authorized Users are personnel who have been trained by the site Radiation Safety Officer (RSO) to recognize risks and handle LM in accordance with the site RML, radiation protection program, and radiation work permit.

At your convenience, we would appreciate your review and concurrence with the items noted above. Please reach out if you have any questions upon review of letter.

Regards,

David Wykoff

Dave Wykoff
(970) 641-4541
P.O. Box 40
Sargents, CO 81248
Closure Supervisor, Pitch Reclamation Project
Homestake Mining Company of California (Generator, Entity Seeking Export)

Attachments:

1. June 23, 2022 Email exchange between S. Wang (CDPHE) and M. Hay (Arcadis)
2. SW-846 worksheets

ATTACHMENT 1

Hagemeister, Anna

From:	Wang - CDPHE, Shiya <shiya.wang@state.co.us>
Sent:	Thursday, June 23, 2022 2:44 PM
To:	Hay, Michael
Cc:	Hagemeister, Anna; Wykoff, David; Randy Whicker
Subject:	Re: 2022 Waste disposal - Pitch Reclamation Project (150-01)

All,

Thank you all for your patience. It took us a while to make our decision because normally once the materials are licensed, they need to be disposed of as licensed materials. But we do understand that materials generated from early pilot tests may not reach the licensing limit because you were still testing how effective those treatment methods were and some of them may not even need a license in the first place if it would never produce anything above the licensing limit. For those materials, we are okay with you not disposing of them as licensed materials if the characterization data show that they are below the exemption/licensing limit. We would however ask for at least 3 samples per type of materials and ask you use our SW-846 spreadsheet to evaluate whether the material is exempt (https://oitco.hylandcloud.com/CDPHERMPop/docpop/docpop.aspx?clienttype=html&docid=5555318). This is a spreadsheet for TENORM (radium and its progeny) but you can also use it for uranium - directly use the third tab and input the proper uranium limit (no need to subtract background for uranium because the licensing limit includes background). We can discuss how to use this spreadsheet for uranium if needed.

However, from this point on, materials generated from any future treatment will need to be disposed of as licensed materials regardless of concentrations.

Let me know if you have any other questions.

Shiya

On Wed, Jun 22, 2022 at 1:06 PM Hay, Michael <Michael.Hay@arcadis.com> wrote:

> Hi Shiya,
>
> Yes, absolutely. Please see attached. We made a couple minor updates based on where things currently stand. Please let us know if you would like to discuss again or have any questions.
>
> Thank you again for looking into this!
>
> Mike
>
> **Michael Hay, Ph.D.** | michael.hay@arcadis.com

ATTACHMENT 1

Arcadis | T. +1 720 409 0684

www.arcadis.com

From: Wang - CDPHE, Shiya <shiya.wang@state.co.us>
Sent: Tuesday, June 21, 2022 1:14 PM
To: Hagemeister, Anna <Anna.Hagemeister@arcadis.com>
Cc: Hay, Michael <Michael.Hay@arcadis.com>
Subject: Re: 2022 Waste disposal - Pitch Reclamation Project (150-01)

Hi Anna,

Do you mind sharing you and Mike's presentation about what you expect to have in terms of wastes and how you plan to dispose of those (I remember seeing values about anticipated uranium concentrations and volume)? I mean the presentation you showed me during our last call. We are discussing your question internally and we are going back and forth on licensed material vs. solid wastes so I want to check what you presented last time and that might help us make our decision. Thanks!

Shiya

On Fri, Jun 10, 2022 at 10:57 AM Hagemeister, Anna <Anna.Hagemeister@arcadis.com> wrote:

> Hi Shiya, we just wanted to check in again. Have you been able to connect with Program Management on the question regarding industrial landfill disposal of "licensed material" that is at or below landfill waste acceptance radiological activities?
>
> As you're aware, we have a short weather window to perform this work, and are aiming to have the waste off-site by early September at the latest. While we don't mean to push too hard, we wanted to clarify that the ultimate waste disposal decision does have fairly significant consequences for our program and schedule this year.:
>
> - The selection of an appropriately qualified waste transporter could vary based on which disposal facilities will be allowed.
> - The selection of the appropriate waste containers is dependent on the selection of a transporter. A delay in the procurement of containers will result in a delay in the loading and off-site disposal schedule.

ATTACHMENT 1

- HMC is required to acquire a permit to comply with export requirements under the Rocky Mountain Low-Level Radioactive Waste Board. The application requires HMC to provide the specific waste disposal facility (or facilities) being used, as well as the specific volume of waste being sent to each facility. This permit requires 3-4 weeks of review time, and submittal is dependent upon clarification of the allowable disposal facility. When incorporating the time for obtaining lab results and preparing the permit (2-3 weeks), this puts our schedule out at least 1.5-2 months.

A few specific questions just to summarize:

- First and foremost, can material characterized as "licensed material" under the RML be re-characterized as waste, which would then simply be governed by the waste acceptance criteria for the landfill?
- If this is not the case, can you help us understand where specifically in the solid waste regulations this is described/clarified?
    - We are digging back into the solid waste regulations as well, but any clarification on regulations interpretation is always extremely helpful!
- Related to that, is there something particular about the (for example) Energy Solutions waste acceptance criteria or permit which allows them to receive waste initially characterized as licensed material under the RML?

Thank you again for your help!

--Anna

Anna Hagemeister PE

Certified Project Manager 2

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ATTACHMENT 2

Standard Analysis of Data to Determine Adequate Number of Samples and the Upper Limit of the Confidence Interval
SW-846 statistical determination of adequate characterization

Entity/Company Name: Homestake Mining Company
Site/Facility Name: Pitch Reclamation Project
Isotope: Ra-226
Materials Description: 2018 Biochemical Reactor Media (Wood chips, sheep manure, alfalfa hay)
Concentration Limit or Threshold: 3

Appropriate Number of Samples? YES
Is the Material Concentration Lower then the Threshold or Limit? YES

Estimate $\bar{X}$ (x bar) / sample mean
(straight average of previous measurements)

Upper limit of the Confidence Interval (Reportable Value) 0.57 **pCi/g**

	estimated	calculated
Sample Mean equals	**6**	**0.4667**

Estimate S^2 Variance of sample

	S^2
Variance of sample	**0.026666667**

Sample Number or Date	X	X^2	sum of X^2	sum of X	(sum of X)^2	n (number of samples)	(sum of X)^2/n	(sum of X^2) - [(sum of X)^2]/n	{(sum of X^2) - [(sum of X)^2]/n}/ n-1
IG-ETC-WA-COMP1-1_20220531	0.4	0.16	1.44	2.8	7.84	6	1.306666667	0.133333333	0.026666667
IG-ETC-WA-COMP1-2_20220531	0.3	0.09							
IG-ETC-WA-COMP1-3_20220531	0.3	0.09							
IG-ETC-WA-COMP2-1_20220531	0.6	0.36							
IG-ETC-WA-COMP2-2_20220531	0.5	0.25							
IG-ETC-WA-COMP2-3_20220531	0.7	0.49							
7		0							
8		0							
9		0							
10		0							
11		0							
12		0							
13		0							
14		0							
15		0							
16		0							
17		0							
18		0							
19		0							
20		0							
21		0							
22		0							
23		0							
24		0							
25		0							

Appropriate number of samples to be collected

Δ=RT - X bar
RT = regulatory threshold
$n = t^2_{.20} * S^2 / \Delta^2$
$t_{.20}$ from table 9-2

RT	Δ	Δ^2	$t_{.20}$	$t^2_{.20}$	S^2	n
3	2.5333	6.417777778	1.476	2.178576	0.026666667	**0.009052255**

Confidence interval
$S=\sqrt{S^2}$
$S_{xbar} = S/\sqrt{n}$
CI = Confidence interval
$CI = X_{bar} \pm t_{.20} * S_{Xbar}$

S	S_{xbar}	CI		
0.16	0.07	0.47	±	0.10

Upper limit of CI	0.57

TABLE 9-2. TABULATED VALUES OF STUDENT'S "t" FOR EVALUATING Solid Waste

Degrees of freedom (n-1)	Tabulated "t" Value
	80%
1	**3.078**
2	**1.886**
3	**1.638**
4	**1.533**
5	**1.476**
6	**1.440**
7	**1.415**
8	**1.397**
9	**1.393**
10	**1.372**
11	**1.363**
12	**1.356**
13	**1.350**
14	**1.345**
15	**1.341**
16	**1.337**
17	**1.333**
18	**1.330**
19	**1.328**
20	**1.325**
21	**1.323**
22	**1.321**
23	**1.319**
24	**1.318**
25	**1.316**
26	**1.315**
27	**1.314**
28	**1.313**
29	**1.311**
30	**1.310**
40	**1.303**
60	**1.296**
120	**1.289**
Greater than 120	**1.282**

ATTACHMENT 2

Standard Analysis of Data to Determine Adequate Number of Samples and the Upper Limit of the Confidence Interval
SW-846 statistical determination of adequate characterization

Entity/Company Name: Homestake Mining Company
Site/Facility Name: Pitch Reclamation Project
Isotope: Ra-228
Materials Description: 2018 Biochemical Reactor Media (Wood chips, sheep manure, alfalfa hay)
Concentration Limit or Threshold: 3

Appropriate Number of Samples? YES
Is the Material Concentration Lower then the Threshold or Limit? YES

Upper limit of the Confidence Interval (Reportable Value) 0.30 **pCi/g**

Estimate $\overline{X}$ (x bar) / sample mean
(straight average of previous measurements)

	estimated	calculated
Sample Mean equals	**6**	**0.3000**

Estimate S^2 Variance of sample

	S^2
Variance of sample	**0**

Sample Number or Date	X	X^2	sum of X^2	sum of X	(sum of X)^2	n (number of samples)	(sum of X)^2/n	(sum of X^2) - [(sum of X)^2]/n	{(sum of X^2) - [(sum of X)^2]/n}/ n-1
IG-ETC-WA-COMP1-1_20220531	0.3	0.09	0.54	1.8	3.24	6	0.54	0	0
IG-ETC-WA-COMP1-2_20220531	0.3	0.09							
IG-ETC-WA-COMP1-3_20220531	0.3	0.09							
IG-ETC-WA-COMP2-1_20220531	0.3	0.09							
IG-ETC-WA-COMP2-2_20220531	0.3	0.09							
IG-ETC-WA-COMP2-3_20220531	0.3	0.09							
7		0							
8		0							
9		0							
10		0							
11		0							
12		0							
13		0							
14		0							
15		0							
16		0							
17		0							
18		0							
19		0							
20		0							
21		0							
22		0							
23		0							
24		0							
25		0							

Appropriate number of samples to be collected

Δ=RT - X bar
RT = regulatory threshold
$n = t^2_{.20} * S^2 / \Delta^2$
$t_{.20}$ from table 9-2

RT	Δ	Δ^2	$t_{.20}$	$t^2_{.20}$	S^2	n
3	2.7000	7.29	1.476	2.178576	0	0

Confidence interval
$S=\sqrt{S^2}$
$S_{xbar} = S/\sqrt{n}$
CI = Confidence interval
$CI = X_{bar} \pm t_{.20} * S_{Xbar}$

S	S_{xbar}	CI		
0.00	0.00	0.30	±	0.00

Upper limit of CI	0.30

TABLE 9-2. TABULATED VALUES OF STUDENT'S "t" FOR EVALUATING Solid Waste

Degrees of freedom (n-1)	Tabulated "t" Value
	80%
1	3.078
2	1.886
3	1.638
4	1.533
5	1.476
6	1.440
7	1.415
8	1.397
9	1.393
10	1.372
11	1.363
12	1.356
13	1.350
14	1.345
15	1.341
16	1.337
17	1.333
18	1.330
19	1.328
20	1.325
21	1.323
22	1.321
23	1.319
24	1.318
25	1.316
26	1.315
27	1.314
28	1.313
29	1.311
30	1.310
40	1.303
60	1.296
120	1.289
Greater than 120	1.282

ATTACHMENT 2

Please note that these results are for Uranium. SW-846 sheet does not allow Uranium to be selected.

Standard Analysis of Data to Determine Adequate Number of Samples and the Upper Limit of the Confidence Interval
SW-846 statistical determination of adequate characterization

Entity/Company Name: Homestake Mining Company
Site/Facility Name: Pitch Reclamation Project
Isotope: Ra-226
Materials Description: 2018 Biochemical Reactor Media (Wood chips, sheep manure, alfalfa hay)
Concentration Limit or Threshold: 339

Appropriate Number of Samples? YES
Is the Material Concentration Lower then the Threshold or Limit? YES

Estimate X̅ (x bar) / sample mean
(straight average of previous measurements)

Upper limit of the Confidence Interval (Reportable Value) 145.27 **pCi/g**

	estimated	calculated
Sample Mean equals	**6**	**127.6667**

Estimate S^2 Variance of sample

	S^2
Variance of sample	**853.4666667**

Sample Number or Date	X	X^2	sum of X^2	sum of X	$(\text{sum of } X)^2$	n (number of samples)	$(\text{sum of } X)^2/n$	$(\text{sum of } X^2) - [(\text{sum of } X)^2]/n$	$\{(\text{sum of } X^2) - [(\text{sum of } X)^2]/n\}/ n-1$
IG-ETC-WA-COMP1-1_20220531	130	16900	102060	766	586756	6	97792.66667	4267.333333	853.4666667
IG-ETC-WA-COMP1-2_20220531	83	6889							
IG-ETC-WA-COMP1-3_20220531	123	15129							
IG-ETC-WA-COMP2-1_20220531	129	16641							
IG-ETC-WA-COMP2-2_20220531	126	15876							
IG-ETC-WA-COMP2-3_20220531	175	30625							
		0							
		0							
		0							
10		0							
11		0							
12		0							
13		0							
14		0							
15		0							
16		0							
17		0							
18		0							
19		0							
20		0							
21		0							
22		0							
23		0							
24		0							
25		0							

Appropriate number of samples to be collected

Δ=RT - X bar
RT = regulatory threshold
$n = t^2_{.20} * S^2 / \Delta^2$
$t_{.20}$ from table 9-2

RT	Δ	Δ^2	$t_{.20}$	$t^2_{.20}$	S^2	n
339	211.3333	44661.77778	1.476	2.178576	853.4666667	0.041631616

Confidence interval
$S=\sqrt{S^2}$
$S_{xbar} = S/\sqrt{n}$
CI = Confidence interval
$CI = X_{bar} \pm t_{.20} * S_{Xbar}$

S	S_{xbar}	CI		
29.21	11.93	127.67	±	17.60

Upper limit of CI	145.27

TABLE 9-2. TABULATED VALUES OF STUDENT'S "t" FOR EVALUATING Solid Waste

Degrees of freedom (n-1)	Tabulated "t" Value
	80%
1	**3.078**
2	**1.886**
3	**1.638**
4	**1.533**
5	**1.476**
6	**1.440**
7	**1.415**
8	**1.397**
9	**1.393**
10	**1.372**
11	**1.363**
12	**1.356**
13	**1.350**
14	**1.345**
15	**1.341**
16	**1.337**
17	**1.333**
18	**1.330**
19	**1.328**
20	**1.325**
21	**1.323**
22	**1.321**
23	**1.319**
24	**1.318**
25	**1.316**
26	**1.315**
27	**1.314**
28	**1.313**
29	**1.311**
30	**1.310**
40	**1.303**
60	**1.296**
120	**1.289**
Greater than 120	**1.282**

ATTACHMENT 2

Standard Analysis of Data to Determine Adequate Number of Samples and the Upper Limit of the Confidence Interval
SW-846 statistical determination of adequate characterization

Entity/Company Name: Homestake Mining Company
Site/Facility Name: Pitch Reclamation Project
Isotope: Ra-226
Materials Description: Zerovalent iron Cell
Concentration Limit or Threshold: 3

Appropriate Number of Samples? YES
Is the Material Concentration Lower then the Threshold or Limit? YES

Estimate $\bar{X}$ (x bar) / sample mean
(straight average of previous measurements)

Upper limit of the Confidence Interval (Reportable Value) 0.06 **pCi/g**

	estimated	calculated
Sample Mean equals	**6**	**0.0517**

Estimate S^2 Variance of sample

	S^2
Variance of sample	**9.66667E-05**

Sample Number or Date	X	X^2	sum of X^2	sum of X	(sum of X)^2	n (number of samples)	(sum of X)^2/n	(sum of X^2) - [(sum of X)^2]/n	{(sum of X^2) - [(sum of X)^2]/n}/ n-1
FS17-ZVI-WA-Comp1-2_20220614	0.05	0.0025	0.0165	0.31	0.0961	6	0.016016667	0.000483333	9.66667E-05
FS17-ZVI-WA-Comp1-3_20220614	0.05	0.0025							
FS17-ZVI-WA-Comp2-2_20220614	0.07	0.0049							
FS17-ZVI-WA-Comp2-1_20220614	0.05	0.0025							
FS17-ZVI-WA-Comp2-3_20220614	0.05	0.0025							
FS17-ZVI-WA-Comp1-1_20220620	0.04	0.0016							
7		0							
8		0							
9		0							
10		0							
11		0							
12		0							
13		0							
14		0							
15		0							
16		0							
17		0							
18		0							
19		0							
20		0							
21		0							
22		0							
23		0							
24		0							
25		0							

TABLE 9-2. TABULATED VALUES OF STUDENT'S "t" FOR EVALUATING Solid Waste

Degrees of freedom (n-1)	Tabulated "t" Value
	80%
1	3.078
2	1.886
3	1.638
4	1.533
5	1.476
6	1.440
7	1.415
8	1.397
9	1.393
10	1.372
11	1.363
12	1.356
13	1.350
14	1.345
15	1.341
16	1.337
17	1.333
18	1.330
19	1.328
20	1.325
21	1.323
22	1.321
23	1.319
24	1.318
25	1.316
26	1.315
27	1.314
28	1.313
29	1.311
30	1.310
40	1.303
60	1.296
120	1.289
Greater than 120	1.282

Appropriate number of samples to be collected

Δ=RT - X bar
RT = regulatory threshold
$n = t^2_{.20} * S^2 / Δ^2$
$t_{.20}$ from table 9-2

RT	Δ	$Δ^2$	$t_{.20}$	$t^2_{.20}$	S^2	n
3	2.9483	8.692669444	1.476	2.178576	9.66667E-05	2.42268E-05

Confidence interval
$S=\sqrt{S^2}$
$S_{xbar} = S/\sqrt{n}$
CI = Confidence interval
$CI = X_{bar} \pm t_{.20} * S_{Xbar}$

S	S_{xbar}	CI		
0.01	0.00	0.05	±	0.01

Upper limit of CI	0.06

ATTACHMENT 2

Standard Analysis of Data to Determine Adequate Number of Samples and the Upper Limit of the Confidence Interval
SW-846 statistical determination of adequate characterization

Entity/Company Name: Homestake Mining Company
Site/Facility Name: Pitch Reclamation Project
Isotope: Ra-228
Materials Description: Zerovalent iron Cell
Concentration Limit or Threshold: 3

Appropriate Number of Samples? YES
Is the Material Concentration Lower then the Threshold or Limit? YES

Upper limit of the Confidence Interval (Reportable Value) 0.36 **pCi/g**

Estimate $\bar{X}$ (x bar) / sample mean
(straight average of previous measurements)

	estimated	calculated
Sample Mean equals	**6**	**0.3333**

Estimate S^2 Variance of sample

	S^2
Variance of sample	**0.002666667**

Sample Number or Date	X	X^2	sum of X^2	sum of X	(sum of X)^2	n (number of samples)	(sum of X)^2/n	(sum of X^2) - [(sum of X)^2]/n	{(sum of X^2) - [(sum of X)^2]/n}/ n-1
FS17-ZVI-WA-Comp1-2_20220614	0.3	0.09	0.68	2	4	6	0.666666667	0.013333333	0.002666667
FS17-ZVI-WA-Comp1-3_20220614	0.3	0.09							
FS17-ZVI-WA-Comp2-2_20220614	0.4	0.16							
FS17-ZVI-WA-Comp2-1_20220614	0.4	0.16							
FS17-ZVI-WA-Comp2-3_20220614	0.3	0.09							
FS17-ZVI-WA-Comp1-1_20220620	0.3	0.09							
7		0							
8		0							
9		0							
10		0							
11		0							
12		0							
13		0							
14		0							
15		0							
16		0							
17		0							
18		0							
19		0							
20		0							
21		0							
22		0							
23		0							
24		0							
25		0							

TABLE 9-2. TABULATED VALUES OF STUDENT'S "t" FOR EVALUATING Solid Waste

Degrees of freedom (n-1)	Tabulated "t" Value
	80%
1	3.078
2	1.886
3	1.638
4	1.533
5	1.476
6	1.440
7	1.415
8	1.397
9	1.393
10	1.372
11	1.363
12	1.356
13	1.350
14	1.345
15	1.341
16	1.337
17	1.333
18	1.330
19	1.328
20	1.325
21	1.323
22	1.321
23	1.319
24	1.318
25	1.316
26	1.315
27	1.314
28	1.313
29	1.311
30	1.310
40	1.303
60	1.296
120	1.289
Greater than 120	1.282

Appropriate number of samples to be collected

Δ=RT - X bar
RT = regulatory threshold
$n = t^2_{.20} * S^2 / \Delta^2$
$t_{.20}$ from table 9-2

RT	Δ	Δ^2	$t_{.20}$	$t^2_{.20}$	S^2	n
3	2.6667	7.111111111	1.476	2.178576	0.002666667	0.000816966

Confidence interval
$S=\sqrt{S^2}$
$S_{xbar} = S/\sqrt{n}$
CI = Confidence interval
$CI = X_{bar} \pm t_{.20} * S_{Xbar}$

S	S_{xbar}	CI		
0.05	0.02	0.33	±	0.03

Upper limit of CI	0.36

ATTACHMENT 2

Please note that these results are for Uranium. SW-846 sheet does not allow Uranium to be selected.

Standard Analysis of Data to Determine Adequate Number of Samples and the Upper Limit of the Confidence Interval
SW-846 statistical determination of adequate characterization

Entity/Company Name: Homestake Mining Company
Site/Facility Name: Pitch Reclamation Project
Isotope: Ra-226
Materials Description: Zerovalent iron cell
Concentration Limit or Threshold: 339

Appropriate Number of Samples? YES
Is the Material Concentration Lower then the Threshold or Limit? YES

Upper limit of the Confidence Interval (Reportable Value) 28.01 **pCi/g**

Estimate $\bar{X}$ (x bar) / sample mean
(straight average of previous measurements)

	estimated	calculated
Sample Mean equals	**6**	**24.1583**

Estimate S^2 Variance of sample

	S^2
Variance of sample	**40.86241667**

Sample Number or Date	X	X^2	sum of X^2	sum of X	(sum of X)^2	n (number of samples)	(sum of X)^2/n	(sum of X^2) - [(sum of X)^2]/n	{(sum of X^2) - [(sum of X)^2]/n}/ n-1
FS17-ZVI-WA-Comp1-2_20220614	28.5	812.25	3706.0625	144.95	21010.5025	6	3501.750417	204.3120833	40.86241667
FS17-ZVI-WA-Comp1-3_20220614	26.8	718.24							
FS17-ZVI-WA-Comp2-2_20220614	32.5	1056.25							
FS17-ZVI-WA-Comp2-1_20220614	20	400							
FS17-ZVI-WA-Comp2-3_20220614	22.4	501.76							
FS17-ZVI-WA-Comp1-1_20220620	14.75	217.5625							
7		0							
8		0							
9		0							
10		0							
11		0							
12		0							
13		0							
14		0							
15		0							
16		0							
17		0							
18		0							
19		0							
20		0							
21		0							
22		0							
23		0							
24		0							
25		0							

TABLE 9-2. TABULATED VALUES OF STUDENT'S "t" FOR EVALUATING Solid Waste

Degrees of freedom (n-1)	Tabulated "t" Value
	80%
1	3.078
2	1.886
3	1.638
4	1.533
5	1.476
6	1.440
7	1.415
8	1.397
9	1.393
10	1.372
11	1.363
12	1.356
13	1.350
14	1.345
15	1.341
16	1.337
17	1.333
18	1.330
19	1.328
20	1.325
21	1.323
22	1.321
23	1.319
24	1.318
25	1.316
26	1.315
27	1.314
28	1.313
29	1.311
30	1.310
40	1.303
60	1.296
120	1.289
Greater than 120	1.282

Appropriate number of samples to be collected

Δ=RT - X bar
RT = regulatory threshold
$n = t^2_{.20} * S^2 / \Delta^2$
$t_{.20}$ from table 9-2

RT	Δ	Δ^2	$t_{.20}$	$t^2_{.20}$	S^2	n
339	314.8417	99125.27507	1.476	2.178576	40.86241667	0.000898074

Confidence interval
$S=\sqrt{S^2}$
$S_{xbar} = S/\sqrt{n}$
CI = Confidence interval
$CI = X_{bar} \pm t_{.20} * S_{Xbar}$

S	S_{xbar}	CI		
6.39	2.61	24.16	±	3.85

Upper limit of CI	28.01

Appendix 5

SiteWise Environmental Footprint Evaluation

Memo

SUBJECT
Comparative Sustainability Assessment
Pitch Mine, Sargents, Colorado

FROM
Arcadis Technical Team

DATE
December 21, 2022 - **DRAFT**

Arcadis has prepared this memorandum to summarize the comparative sustainability assessment performed for the remedial alternatives being considered for the Pitch Mine Site located in Sargents, Colorado (Site) in support of the Water Management Alternatives Analysis Report

Regulatory Background

Green and Sustainable Remediation (GSR) is the practice of considering environmental impacts associated with remediation activities to maximize the net environmental benefit of a cleanup, thereby limiting the stress on the environment during cleanup actions (United States Environmental Protection Agency, USEPA, 2008a). The goal of remedial activities is to protect human health and the environment from contaminants. Historically, remedies have been implemented without consideration of green or sustainable concepts to meet this goal. GSR considers site-specific remedial alternatives in the context of balancing goals and net environmental effects. Through this approach components of remedial actions that can be altered to optimize site remediationand/or minimize or reduce emissions and resource usage while maintaining overall protectiveness can be identified and prioritized for incorporation into a remedial plan, as may be appropriate.

Green and Sustainable Remediation Tool and Metrics

Remedial alternatives currently proposed for the Pitch Mine Site were evaluated consistent with green remediation guidance from the USEPA (2008a) and the Interstate Technology and Regulatory Council (ITRC, 2011). In accordance with the GSR principles, a quantitative sustainability assessment was conducted using SiteWise™ version 3.2 to serve as an additional differentiator in the evaluation of the proposed remedial alternatives. SiteWise™ is a widely accepted GSR Tool developed jointly by US Navy, US Army Corps of Engineers (USACE), and Battelle. SiteWise™ provides quantification of the onsite environmental footprint of remedial actions using a consistent set of metrics to measure greenhouse gas emissions, energy use, air emissions of criteria pollutants, water consumption and worker safety (US Navy, 2018).

The comparative quantitative sustainability assessment for the selected proposed remedial alternatives evaluation included (1) greenhouse gas (GHG) emissions; (2) energy use; (3) air emissions of criteria pollutants (total emissions and onsite emissions) including nitrogen oxide (NOx), sulfur oxide (SOx), and particulate matter (PM); (4) water consumption, (5) resource consumption and waste generation; and (6) worker safety. Additional information on the metrics that were used to complete the quantitative sustainability assessment of the alternatives follows:

1. **GHG Emissions** were calculated for each alternative by quantifying the GHG emissions expressed in carbon dioxide equivalent units, measured in tons, for on-site equipment use and transportation of material, waste, and personnel to and from the Site. The USEPA Climate Leaders Program (USEPA, 2008b, 2008c,) provides a GHG Inventory Guidance that is used by industry to document emissions

of GHGs including carbon dioxide (CO_2), methane (CH4), and nitrous oxide (N_2O). The U.S. EPA Climate Leaders GHG Inventory Guidance is a modification of the GHG protocol developed by the World Resources Institute and the World Business Council for Sustainable Development. SiteWise™ also uses emission factors developed by Argonne National Laboratory's Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model, US EPA's Mobile 6 model, and USEPA's Non-road model (US Navy, 2018). Emission factors for consumables (e.g., asphalt, ion exchange, PVC) are life cycle based and obtained from sources that provide life cycle inventories (e.g., the life cycle inventory provided by National Renewable Energy Laboratory [NREL]).

2. **Energy usage** was calculated by quantifying the power and fuel requirements of machinery to be used for remedy implementation and operation based on engineering design assumptions and manufacturers specifications. The energy embodied in fuels is obtained from Argonne National Laboratory's GREET model that provides life-cycle energy consumption. Energy usage associated with materials utilized onsite such as gravel, polyvinyl chloride (PVC) plastic, and high-density polyethylene (HDPE) plastic were also included (US Navy, 2018). No onsite electrical usage was expected for these alternatives and the treatment system was expected to operate using propane for heat and electricity generated by existing solar panels, supplemented by an onsite generator.
3. **Air emissions** inventories were developed using Mobile 6 and non-road, two computer programs developed by the U.S. EPA's Office of Transportation and Air Quality that calculate oxides of nitrogen (NOx), sulfur oxides (SOx), carbon monoxide (CO), volatile organic compounds, and particulate matter (PM10) emission factors for mobile and non-road equipment, respectively (US Navy, 2018). Like the GHGs, air emissions were calculated for each alternative by quantifying the emissions expressed in tons, for on-site equipment use and transportation of material, waste, and personnel to and from the Site.

4. **Water consumption and impacts** were evaluated for each alternative based on expected onsite activities; however, water impacts were not quantified as no overall water usage was anticipated for the implementation of the remedies. Extracted groundwater produced during well installation and sampling and any surface water treated onsite as part of the remedies was expected to be returned to the same aquifer. In addition, dewatering or dust suppression activities were not expected to be needed for remedy implementation.

5. **Resource consumption and waste generation** were quantified by estimating the amount of the key materials to be consumed and waste created for each remedial alternative at the Site during implementation and operation of the activities based on material consumption and waste generation expected in comparable remedial technologies. Material volumes were determined based on the amount of material needed for gravel and lining placements and system construction and operation. Waste generated included spent ion exchange (IX) resin generated from the treatment system operation. Transportation impacts associated with these materials and wastes to and from the Site are quantified under GHG emissions and air emissions.

6. **Worker Safety (potential risk of fatality, injury, and lost hours):** Several organizations (including the Department of Transportation, the Air Transport Association, the Federal Railroad Administration, and

the Bureau of Labor Statistics) provide statistics of both fatalities and recordable workplace injuries that occur during various activities including transportation by automobile, airplane, and rail. Potential accident risks were quantified based on the number of workers, transportation, work durations, and the risk associated with their occupation and exposure to equipment. Additional details on the sources of these statistics are provided in the SiteWise Manual Table 2h (included in Attachment 1). The results represent the relative probabilities of an accident or fatality occurring during remedial activities.

Comparative Quantitative Sustainability Assessment

A GSR assemment was conducted on three remedial alternative idenfied for the Site.The assement was based on engineering design assumptions and input values developed by the project team for the proposed remedial alternatives. The baseline lifetime for the three remedies was estimated to be 20 years, with extrapolation to 100 years based on assumptions provided below. The following three remedial alternatives were considered for this assessment:

Alternative 4.2: This alternative included the installation of 26 deep monitoring wells, sampling, and monthly inspections. This alternative also included limited rock dump erosion repairs (every 10 years). It was estimated that approximately 40 tons of gravel/riprap would be needed for this alternative to prevent erosion in stormwater drainages. Long-term monitoring and monthly inspection activities to ensure protectiveness were also expected.

As revegetation is established and erosion is stabilized, the system is assumed to become self-sustaining after 20 years, and less maintenance is required. The 100-year footprint is included to estimate the long-term footprint, accounting for changes in ongoing maintenance. The 100-year footprint was calculated by summing the following components:

- Years 1 through 20 footprint: Includes implementation, monthly site monitoring and bi-annual sampling events, and upgrades on year 11, and
- Years 21 through 100: Includes monthly site monitoring and bi-annual sampling events.

Alternative 4.5: This alternative incorporated all the activities included as part of alternative 4.2 but involved more extensive site maintenance (every 10 years), with more extensive rock dump erosion repairs and selective lining of low-slope areas to limit infiltration and to enhance runoff to the drainages. It was estimated that approximately 73,000 tons of gravel/riprap was needed for this alternative to provide erosion control, along with 35,000 linear feet of 15-foot-wide HDPE and non-woven geotextile cushion as an impermeable barrier to decrease infiltration and enhance runoff. The more extensive site maintenance also would require more extensive onsite usage of large fuel-powered equipment and worker's mobilization. Long-term monitoring and monthly inspection activities to ensure system performance were also assumed for this alternative.

The 100-year footprint was calculated by summing the following components:

- Years 1 through 20 footprint: Includes implementation, monthly site monitoring and bi-annual sampling events, and upgrades on year 11;
- The Year 11 footprint applied every 10 years for site access maintenance and regrading of low-slope rock dump areas, drainage maintenance, minor earthwork, and riprap amendments; and
- Years 21 through 100: Includes monthly site monitoring and bi-annual sampling events.

<u>Alternative 4.7:</u> This alternative incorporated all the activities included as part of alternative 4.2, as well as the construction and operation and mainteance (O&M) of a semi-active ion exchange (IX) system for the treatment of impacted North Pit Lake water. The surface water was assumed to be conveyed to the treatment system by gravity, and thesystem would be operated using propane for heat and electricity generated by existing solar panels, supplemented by an onsite generator. Monthly O&M visits and semi-annual changeouts were assumed for the operation of the system. In addition, the IX resin is assumed to require chemical treatmeant during operation to limit microbial growth. It was assumed that the system would be taken offline during the winter months, requiring additional maintenance activities for winterization. It was assumed that spent resin was going to be trucked to the Energy Solutions facility in Clive, Utah for radiological waste disposal.

The 100-year footprint was calculated by summing the following components:

- Years 1 through 20 footprint: Includes implementation, system operation and maintenance, IX resin replacement, monthly site monitoring, bi-annual sampling events, and upgrades on year 11;
- The Year 1 footprint every 30 years to account for total replacement of system infrastructure, assuming a 30-year lifespan of the system.
- Years 20 through 100: Includes system operation and maintenance, IX resin replacement, monthly site monitoring, and bi-annual sampling events.

Comparative Quantitative Sustainability Assessment Results

The result of the overall assessment is a relative comparison of the potential remedial alternatives developed for the Site, which provides an evaluation of the commonly accepted GSR principles to aid in the final remedy selection.

A summary of the comparative sustainability assessment results for the selected metrics is included in **Table 1**. A summary of the sustainability assessment results for each of the three remedial alternatives is included in **Tables 2 through 4**. The list of the key engineering design assumptions used to develop the assessment is included in **Table 5**.

For all alternatives, it was assumed that remedies were to be implemented using standard construction equipment and standard engineering practices. Minor impacts common to each remedial alternative, such as routine management and reporting, were not included in this sustainability assessment; accordingly, the overall environmental footprint of each alternative is not fully comprehensive. Instead, a focus was maintained on activities that vary between alternatives, with significant associated impacts that could be used as differentiators in a comparative assessment of the alternatives.

The impacts associated with these activities are primarily driven by the duration of heavy equipment operation, maintenance frequency, and varying volumes of material consumption. Due to the remote location, substantial impacts are associated with transportation activities. Key contributors to these areas included:

- Mobilization of workers, equipment, and waste to and from the Site due to the Site's remote location;
- Operation of large fuel-powered equipment to complete the proposed regrading and selective lining installation to enhance runoff and to limit infiltration;
- Consumption of materials and resources such as gravel, PVC, steel, HDPE, IX, for regrading and system construction; and

- Periodic changeouts requiring resource consumption, mobilization of workers and materials, and the creation of waste (spent ion exchange) and transportation to the disposal site.

Based on the result from the sustainability evaluation, Alternative 4.7 presents the highest environmental impacts and potential worker risks. This alternative involves a greater consumption of materials, the highest mobilization of workers and materials, and frequent off-site disposal of spent resin. Alternative 4.5 presents less overall environmental impacts when compared to Alternative 4.7. Alternative 4.5 includes consumption of a lower quantity of materials, fewer mobilizations of workers and materials, and no off-site disposal; however, alternative 4.5 requires more extensive onsite usage of large fuel-powered equipment than the other two alternatives. Alternative 4.2 presents the lowest environmental impacts when compared to Alternatives 4.5 and 4.7, which is expected based on the reduced onsite activities and material consumption. The relative differences between alternatives are summarized in **Table 1**.

References

Interstate Technology and Regulatory Council, 2011. Green and Sustainable Remediation: State of the Science and Practive, May 2011.

United States Navy, United States Army Corps of Engineers, and Battelle, 2018. Naval Facilities Engineering Command, SiteWiseTM Version 3.2 User Guide, October 2018.

United States Environmental Protection Agency, 2005. Climate Leaders Greenhouse Gas Inventory Protocol Core Module Design Principles, Office of Solid Waste and Emergency Response, EPA 542-R-08-002, May 2005.

United States Environmental Protection Agency, 2008a. Technology Primer - Green Remediation: Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites, Office of Solid Waste and Emergency Response, EPA 542-R-08-002, April 2008.

United States Environmental Protection Agency, 2008b. Climate Leaders Program Direct Emissions from Mobile Combustion Sources. May 2008.

United States Environmental Protection Agency, 2008c. Climate Leaders Program Direct Emissions from Stationary Combustion Sources. May 2008.

Enclosures

Table 1 – Summary of the Comparative Sustainability Assessment Results

Table 2 – Sustainability Footprint Summary for Alternative 4.2 – Maintain Current System

Table 3 – Sustainability Footprint Summary for Alternative 4.5 – Rock Dump/South Mine Area Regrading and Selective Lining

Table 4 – Sustainability Footprint Summary for Alternative 4.7 – Ion Exchange Full System

Table 5 – Summary of Assumptions and Inputs

Attachment 1 – SiteWise

Table 1
Comparative Summary of Sitewise Footprint Evaluation: 20 Year Timeframe
Pitch Reclamation Project
Sargents,CO

ARCADIS Design & Consultancy for natural and built assets

Remedial Alternatives	GHG Emissions	Total energy Used	Electricity Usage	Onsite NO_x Emissions	Onsite SO_x Emissions	Onsite PM_{10} Emissions	Total NO_x Emissions	Total SO_x Emissions	Total PM_{10} Emissions
	metric ton	MMBTU	MWH	metric ton	metric ton	metric ton	metric ton	metric ton	metric ton
Alternative 4.2 - Maintain Current System	371	79391	0.00	0.28	0.03	0.03	0.67	0.24	0.07
Alternative 4.5 - RD/SMA Regrading & Selective Lining	2240	114906	0.00	0.55	0.10	0.05	6.30	7.23	2.54
Alternative 4.7 - Ion Exchange Full System	6048	200201	0.00	0.64	0.06	0.06	12.34	18.09	3.66

Additional Sustainability Metrics

Remedial Alternatives	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	*Probable Hours Lost - Injury	*Accident Risk Fatality	*Accident Risk Injury
	tons	tons	Hours		
Alternative 4.2 - Maintain Current System	21000	0	3.09	3.31E-03	0.39
Alternative 4.5 - RD/SMA Regrading & Selective Lining	26400	0	3.79	4.07E-03	0.47
Alternative 4.7 - Ion Exchange Full System	92600	360	13.90	1.86E-02	1.74

Relative Impact

Remedial Alternatives	GHG Emissions	Energy Usage	Water Usage	Onsite NOx Emissions	Onsite SOx Emissions	Onsite PM10 Emissions	Total NOx emissions	Total SOx Emissions	Total PM10 Emissions
Alternative 4.2 - Maintain Current System	Low	Medium	Low	Low	Medium	Medium	Low	Low	Low
Alternative 4.5 - RD/SMA Regrading & Selective Lining	Medium	Medium	Low	Low	High	High	Medium	Medium	Medium
Alternative 4.7 - Ion Exchange Full System	High	High	Low	Low	Medium	High	High	High	High

Remedial Alternatives	*Accident Risk Fatality	*Accident Risk Injury
Alternative 4.2 - Maintain Current System	Low	Low
Alternative 4.5 - RD/SMA Regrading & Selective Lining	Low	Low
Alternative 4.7 - Ion Exchange Full System	High	High

Notes:
*The results represent the relative probabilities of a recordable-injury accident or fatality occurring during remedial activities. Accident Risk is an estimate of how many accidents may occur due to remedial activities, including potential risks associated with travel and equipment operation. References to accident statistics are included in Attachment 1 (Table 2h from the SiteWise manual).

Table 2
Environmental Footprint Summary For Alternative 4.2 - Maintain Current System
Pitch Reclamation Project
Sargents,CO

Phase	Activities	GHG Emissions	Total Energy Used	Water Consumption	Electricity Usage	Onsite NOx Emissions	Onsite SOx Emissions	Onsite PM10 Emissions	Total NOx Emissions	Total SOx Emissions	PM10 Emiss	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	MWH	metric ton	metric ton	metric ton	metric ton	metric ton	metric ton		
Year 1	Consumables	114.08	7.6E+04	NA	NA	NA	NA	NA	1.4E-01	1.9E-01	2.5E-02	NA	NA
	Transportation-Personnel	12.24	1.5E+02	NA	NA	NA	NA	NA	5.5E-03	1.1E-04	7.9E-04	2.6E-04	2.1E-02
	Transportation-Equipment	14.74	1.9E+02	NA	NA	NA	NA	NA	5.9E-03	1.8E-04	4.1E-04	2.7E-05	2.2E-03
	Equipment Use and Misc	26.93	3.4E+02	0.0E+00	0.0E+00	2.4E-01	2.6E-02	2.2E-02	2.6E-01	3.4E-02	2.4E-02	5.8E-05	2.6E-02
	Residual Handling	0.00	0.0E+00	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	168.09	7.71E+04	0.00E+00	0.00E+00	2.41E-01	2.62E-02	2.19E-02	4.03E-01	2.21E-01	5.07E-02	3.42E-04	4.86E-02
Years 2-10	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	NA	NA
	Transportation-Personnel	62.52	7.8E+02	NA	NA	NA	NA	NA	2.5E-02	6.2E-04	4.1E-03	1.3E-03	1.1E-01
	Transportation-Equipment	30.77	2.4E+02	NA	NA	NA	NA	NA	8.3E-02	6.0E-03	7.4E-04	1.2E-05	9.7E-04
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.4E-05	4.2E-02
	Residual Handling	0.00	0.0E+00	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	93.28	1.02E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.09E-01	6.58E-03	4.86E-03	1.36E-03	1.48E-01
Year 11	Consumables	0.31	5.2E+00	NA	NA	NA	NA	NA	1.2E-03	1.5E-03	6.2E-04	NA	NA
	Transportation-Personnel	8.77	1.1E+02	NA	NA	NA	NA	NA	3.6E-03	9.2E-05	5.7E-04	1.9E-04	1.5E-02
	Transportation-Equipment	3.90	4.8E+01	NA	NA	NA	NA	NA	2.5E-03	1.2E-04	1.1E-04	8.0E-06	6.5E-04
	Equipment Use and Misc	5.59	8.1E+01	0.0E+00	0.0E+00	3.7E-02	5.3E-03	3.6E-03	4.1E-02	7.2E-03	4.1E-03	5.5E-05	2.6E-02
	Residual Handling	0.00	0.0E+00	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	18.57	2.44E+02	0.00E+00	0.00E+00	3.72E-02	5.32E-03	3.58E-03	4.82E-02	8.99E-03	5.43E-03	2.51E-04	4.20E-02
Years 12-20	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	NA	NA
	Transportation-Personnel	62.52	7.8E+02	NA	NA	NA	NA	NA	2.5E-02	6.2E-04	4.1E-03	1.3E-03	1.1E-01
	Transportation-Equipment	28.51	2.1E+02	NA	NA	NA	NA	NA	8.2E-02	5.9E-03	6.8E-04	5.9E-06	4.7E-04
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.4E-05	4.2E-02
	Residual Handling	0.00	0.0E+00	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	91.02	9.91E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.08E-01	6.57E-03	4.79E-03	1.35E-03	1.48E-01
Total		**3.7E+02**	**7.9E+04**	**0.0E+00**	**0.0E+00**	**2.8E-01**	**3.1E-02**	**2.6E-02**	**6.7E-01**	**2.4E-01**	**6.6E-02**	**3.3E-03**	**3.9E-01**

Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Lost Hours - Injury
	tons	tons	
Year 1	0.0E+00	0.0E+00	3.9E-01
Years 2-10	0.0E+00	0.0E+00	1.2E+00
Year 11	0.0E+00	0.0E+00	3.4E-01
Years 12-20	0.0E+00	0.0E+00	1.2E+00
Total	**0.0E+00**	**0.0E+00**	**3.1E+00**

Table 3
Environmental Footprint Summary For Alternative 4.5 - Regrading and Selective Lining
Pitch Reclamation Project
Sargents,CO

Phase	Activities	GHG Emissions	Total Energy Used	Water Consumption	Electricity Usage	Onsite NOx Emissions	Onsite SOx Emissions	Onsite PM10 Emissions	Total NOx Emissions	Total SOx Emissions	PM10 Emis	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	MWH	metric ton	metric ton	metric ton	metric ton	metric ton	metric ton		
Year 1	Consumables	1,462.72	1.0E+05	NA	NA	NA	NA	NA	4.8E+00	6.5E+00	2.2E+00	NA	NA
	Transportation-Personnel	12.24	1.5E+02	NA	NA	NA	NA	NA	5.5E-03	1.1E-04	7.9E-04	2.6E-04	2.1E-02
	Transportation-Equipment	327.72	4.3E+03	NA	NA	NA	NA	NA	1.0E-01	1.9E-03	9.2E-03	5.6E-04	4.5E-02
	Equipment Use and Misc	61.95	9.3E+02	0.0E+00	0.0E+00	4.6E-01	8.0E-02	4.4E-02	5.1E-01	1.0E-01	5.1E-02	1.4E-04	5.0E-02
	Residual Handling	0.00	0.0E+00	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	1,864.53	1.10E+05	0.00E+00	0.00E+00	4.65E-01	7.97E-02	4.43E-02	5.48E+00	6.57E+00	2.28E+00	9.61E-04	1.16E-01
Years 2-10	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	NA	NA
	Transportation-Personnel	62.52	7.8E+02	NA	NA	NA	NA	NA	2.5E-02	6.2E-04	4.1E-03	1.3E-03	1.1E-01
	Transportation-Equipment	28.51	2.1E+02	NA	NA	NA	NA	NA	8.2E-02	5.9E-03	6.8E-04	5.9E-06	4.7E-04
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.4E-05	4.2E-02
	Residual Handling	0.00	0.0E+00	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	91.02	9.91E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.08E-01	6.57E-03	4.79E-03	1.35E-03	1.48E-01
Year 11	Consumables	123.38	2.1E+03	NA	NA	NA	NA	NA	4.9E-01	6.2E-01	2.5E-01	NA	NA
	Transportation-Personnel	11.11	1.4E+02	NA	NA	NA	NA	NA	4.5E-03	1.2E-04	7.0E-04	2.3E-04	1.9E-02
	Transportation-Equipment	45.36	5.9E+02	NA	NA	NA	NA	NA	1.5E-02	3.5E-04	1.3E-03	8.1E-05	6.5E-03
	Equipment Use and Misc	13.38	2.2E+02	0.0E+00	0.0E+00	8.6E-02	1.7E-02	8.4E-03	9.6E-02	2.2E-02	9.8E-03	8.5E-05	3.7E-02
	Residual Handling	0.00	0.0E+00	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	193.23	3.01E+03	0.00E+00	0.00E+00	8.57E-02	1.72E-02	8.36E-03	6.09E-01	6.40E-01	2.59E-01	4.00E-04	6.25E-02
Years 12-20	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	NA	NA
	Transportation-Personnel	62.52	7.8E+02	NA	NA	NA	NA	NA	2.5E-02	6.2E-04	4.1E-03	1.3E-03	1.1E-01
	Transportation-Equipment	28.51	2.1E+02	NA	NA	NA	NA	NA	8.2E-02	5.9E-03	6.8E-04	5.9E-06	4.7E-04
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.4E-05	4.2E-02
	Residual Handling	0.00	0.0E+00	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	91.02	9.91E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.08E-01	6.57E-03	4.79E-03	1.35E-03	1.48E-01
Total		**2.2E+03**	**1.1E+05**	**0.0E+00**	**0.0E+00**	**5.5E-01**	**9.7E-02**	**5.3E-02**	**6.3E+00**	**7.2E+00**	**2.5E+00**	**4.1E-03**	**4.7E-01**

Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Lost Hours - Injury
	tons	tons	
Year 1	0.0E+00	0.0E+00	9.3E-01
Years 2-10	0.0E+00	0.0E+00	1.2E+00
Year 11	0.0E+00	0.0E+00	5.0E-01
Years 12-20	0.0E+00	0.0E+00	1.2E+00
Total	**0.0E+00**	**0.0E+00**	**3.8E+00**

Table 4
Environmental Footprint Summary For Alternative 4.7 - Ion Exchange
Pitch Reclamation Project
Sargents,CO

Phase	Activities	GHG Emissions	Total Energy Used	Water Consumption	Electricity Usage	Onsite NOx Emissions	Onsite SOx Emissions	Onsite PM10 Emissions	Total NOx Emissions	Total SOx Emissions	PM10 Emis	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	MWH	metric ton	metric ton	metric ton	metric ton	metric ton	metric ton		
Year 1	Consumables	402.26	8.3E+04	NA	NA	NA	NA	NA	9.2E-01	1.5E+00	2.8E-01	NA	NA
	Transportation-Personnel	24.56	3.0E+02	NA	NA	NA	NA	NA	1.1E-02	2.2E-04	1.6E-03	5.6E-04	4.5E-02
	Transportation-Equipment	75.54	9.8E+02	NA	NA	NA	NA	NA	3.4E-02	1.9E-03	2.7E-03	1.6E-04	1.3E-02
	Equipment Use and Misc	37.57	5.1E+02	0.0E+00	0.0E+00	2.8E-01	3.3E-02	2.6E-02	3.0E-01	4.5E-02	2.9E-02	1.7E-04	7.7E-02
	Residual Handling	1.89	2.7E+01	NA	NA	0.0E+00	0.0E+00	0.0E+00	1.8E-03	6.8E-04	3.6E-03	8.1E-06	6.5E-04
	Sub-Total	541.92	8.46E+04	0.00E+00	0.00E+00	2.82E-01	3.31E-02	2.60E-02	1.27E+00	1.54E+00	3.15E-01	9.00E-04	1.36E-01
Years 2-10	Consumables	1,752.89	4.4E+04	NA	NA	NA	NA	NA	4.6E+00	7.8E+00	1.5E+00	NA	NA
	Transportation-Personnel	295.07	3.6E+03	NA	NA	NA	NA	NA	1.4E-01	2.3E-03	1.9E-02	7.4E-03	6.0E-01
	Transportation-Equipment	483.37	6.1E+03	NA	NA	NA	NA	NA	2.3E-01	8.5E-03	1.3E-02	9.8E-04	7.9E-02
	Equipment Use and Misc	62.20	9.3E+02	0.0E+00	0.0E+00	1.5E-01	1.2E-02	1.5E-02	1.9E-01	3.4E-02	1.9E-02	8.0E-05	8.1E-02
	Residual Handling	17.03	2.4E+02	NA	NA	0.0E+00	0.0E+00	0.0E+00	1.6E-02	6.1E-03	3.3E-02	7.3E-05	5.9E-03
	Sub-Total	2,610.56	5.48E+04	0.00E+00	0.00E+00	1.53E-01	1.15E-02	1.51E-02	5.23E+00	7.84E+00	1.58E+00	8.53E-03	7.61E-01
Year 11	Consumables	195.07	4.9E+03	NA	NA	NA	NA	NA	5.2E-01	8.7E-01	1.7E-01	NA	NA
	Transportation-Personnel	21.19	2.6E+02	NA	NA	NA	NA	NA	9.2E-03	2.0E-04	1.4E-03	4.9E-04	4.0E-02
	Transportation-Equipment	54.44	7.1E+02	NA	NA	NA	NA	NA	1.8E-02	4.0E-04	1.5E-03	1.2E-04	9.3E-03
	Equipment Use and Misc	12.50	1.8E+02	0.0E+00	0.0E+00	5.4E-02	6.6E-03	5.3E-03	6.2E-02	1.1E-02	6.2E-03	6.0E-05	3.1E-02
	Residual Handling	1.89	2.7E+01	NA	NA	0.0E+00	0.0E+00	0.0E+00	1.8E-03	6.8E-04	3.6E-03	8.1E-06	6.5E-04
	Sub-Total	285.10	6.06E+03	0.00E+00	0.00E+00	5.42E-02	6.60E-03	5.26E-03	6.10E-01	8.79E-01	1.80E-01	6.77E-04	8.03E-02
Years 12-20	Consumables	1,752.89	4.4E+04	NA	NA	NA	NA	NA	4.6E+00	7.8E+00	1.5E+00	NA	NA
	Transportation-Personnel	295.07	3.6E+03	NA	NA	NA	NA	NA	1.4E-01	2.3E-03	1.9E-02	7.4E-03	6.0E-01
	Transportation-Equipment	483.37	6.1E+03	NA	NA	NA	NA	NA	2.3E-01	8.5E-03	1.3E-02	9.8E-04	7.9E-02
	Equipment Use and Misc	62.20	9.3E+02	0.0E+00	0.0E+00	1.5E-01	1.2E-02	1.5E-02	1.9E-01	3.4E-02	1.9E-02	8.0E-05	8.1E-02
	Residual Handling	17.03	2.4E+02	NA	NA	0.0E+00	0.0E+00	0.0E+00	1.6E-02	6.1E-03	3.3E-02	7.3E-05	5.9E-03
	Sub-Total	2,610.56	5.48E+04	0.00E+00	0.00E+00	1.53E-01	1.15E-02	1.51E-02	5.23E+00	7.84E+00	1.58E+00	8.53E-03	7.61E-01
Total		**6.0E+03**	**2.0E+05**	**0.0E+00**	**0.0E+00**	**6.4E-01**	**6.3E-02**	**6.1E-02**	**1.2E+01**	**1.8E+01**	**3.7E+00**	**1.9E-02**	**1.7E+00**

Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Lost Hours - Injury
	tons	tons	
Year 1	0.0E+00	1.8E+01	1.1E+00
Years 2-10	0.0E+00	1.6E+02	6.1E+00
Year 11	0.0E+00	1.8E+01	6.4E-01
Years 12-20	0.0E+00	1.6E+02	6.1E+00
Total	**0.0E+00**	**3.6E+02**	**1.4E+01**

Table 5
Sitewise Carbon Footprint Summary of Assumptions and Inputs
Pitch Reclamation Project
Sargents,CO

Alternatives		Alternative 4.2 - Maintain Current System	Alternative 4.5 - Rock Dump/South Mine Area Regrading and Selective Lining	4.7 - Ion Exchange Full System	Assumptions
	Alternative Description	Annual sampling, monthly inspections, occasional rock dump erosion repairs (grading/reseeding). One-time Sargents well installation.	Selective reagrading to enhance runoff to drainage ditches. Selective lining of low-slope areas on rock dumps and South Mine areas to limit infiltration and enhance runoff. Includes Alt 4.2 activities.	IX System for semi-active treatment of North Pit Lake water. Includes Alt 4.2 activities.	
	Main Operation (contributors)	- Personnel and material transport - Sargents well drilling - Some heavy machinery	- Personnel and materials transport - Sargents well drilling - Additional, more extensive heavy machinery operation	- Personnel and materials transport - Sargents well drilling - Some heavy machinery - Treatment system construction - System parts transportation - System material consumption - OM&M - System electricity consumption	
	Lifetime Remedy	20	20	20	
	Water consumption (500 gals/day) - dust sup.	0	0	0	
Well Drilling - assumes driller brings sand/cement etc; no additional material tran		**Alt. 4.2**	**Alt. 4.5**	**Alt. 4.7**	**Assumptions**
	Method	Mud	Mud	Mud	
	Production Rate (ft/day)	150.0	150.0	150.0	
	Drill time per well (hr)	5.2	5.2	5.2	
	Number of Wells	25	25.0	25.0	
	Diameter (in)	4	4.0	4.0	
	Borehole Diameter (in)	6	6.0	6.0	
	Total Depth (ft)	130	130.0	130.0	
	Total linear ft	3,250	3,250.0	3,250.0	
	Well material (40 /80 PVC or SS)	SS	SS	SS	
	Drilling cutting generated ft3	638	638.1	638.1	
	Drilling cutting generated CY	23.6	23.6	23.6	
	Drilling cutting generated ton (1.5 CY/Ton)	15.8	15.8	15.8	
	Water injected during drilling - mud rotatory (gals)	1,380	1,380	1,380	
	Water in all wells (1 Volume) - gals	3,345	3,345	3,345	
	Number of Well Flushings	5	5	5	
	Development Water & water injected (gals)	18,107	18,107	18,107	
	55 gals	329	329	329	
	total weight purge water (ton)	68.8	68.8	68.8	
Dewatering		**Alt. 4.2**	**Alt. 4.5**	**Alt. 4.7**	**Assumptions**
	Generator Assumed 6 hp (days operation)	0	0	0	
	Generator Assumed 6 hp (hrs operation, assume 6hrs/day)	0	0	0	
Project Timeframe		**Alt. 4.2**	**Alt. 4.5**	**Alt. 4.7**	**Assumptions**
	Estimate Length of Site Prep & Clean-Up (days)	0	0	0	
	Estimate Length of Sampling (days) - every year	10	10	10	
	Estimate Length of Monthly Inspections (days) - every year	12	12	12	
	Estimate Length of Rock Dump Regrading (days) - every 10 years	10	10	10	
	Estimate Length of Drilling (days) - first year for all	15	15	15	
	Estimate Length of Regrading and Drainage (days) - every 10 year for 4.6 altern	0	10	0	
	Estimate Length of System Construction (days) - first year	0	0	60	
	Estimated Length of OM&M (days) - every year	0	0	22	2 days per month during May through October, 5 days each f
	Estimate Length of Changeout (days)	0	0	8	4 days per resin changeout event
	Total Days	**47**	**57**	**137**	

ARCADIS Design & Consultancy for natural and built assets

Alternatives	Alternative 4.2 - Maintain Current System	Alternative 4.5 - Rock Dump/South Mine Area Regrading and Selective Lining	4.7 - Ion Exchange Full System	Assumptions
Personnel Transportation- Includes Mobilization from Denver to Salida and Daily C	**Alt. 4.2**	**Alt. 4.5**	**Alt. 4.7**	**Assumptions**
Mob to Salida from Denver (mileage)				
Mob to Site from Salida (mileage)				
Biannual Sampling Crew (Mob to Salida) - Every Year				
# days	2	2	2	
type transportation	Car	Car	Car	
Distance (mileage RT)	300	300	300	
# of cars:	6	6	6	
# of Total RT trips	12	12	12	
# people per car	1	1	1	
Biannual Sampling Crew (Mob to Site) - Every Year				
# days	10	10	10	
type transportation	truck - diesel	truck - diesel	truck - diesel	
Distance (mileage RT)	88	88	88	
# of cars:	3	3	3	
# of trips	30	30	30	
# people per car	2	2	2	
Contractor #1 Monthly Inspections and Compliance Sampling - (Mob to Salida) - Every Year				
# days	12	12	12	
type transportation	car	car	car	
Distance (mileage RT)	300	300	300	
# of cars:	2	2	2	
# of trips	24	24	24	
# people per car	1	1	1	
Contractor #1 Monthly Visits - Monthly Inspections and Compliance Sampling - (Mob to Site) - Every Year - Nov. through April				
# days	6	6	6	
type transportation	SnowCat	SnowCat	SnowCat	
Assume gal/mileage -7.4 gal/m	5	5	5	
Distance (mileage RT)	88	88	88	
# of cars:	1	1	1	
# of trips	6	6	6	
# people per car	1	1	1	
Contractor #1 Monthly Inspections and Compliance Sampling - (Mob to Site) - Every Year - May through Oct.				
# days	12	12	12	
type transportation	truck - diesel	truck - diesel	truck - diesel	
Distance (mileage RT)	88	88	88	
# of cars:	1	1	1	
# of trips	12	12	12	
# people per car	2	2	2	
Contractor #2 - Rock Dump Erosion/Vegetation Maintenance - (Mob to Salida) - Year 1 and Year 11				
# days	1	1	1	
type transportation	car	car	car	
Distance (mileage RT)	300	300	300	
# of cars:	4	4	4	
# of trips	4	4	4	
# people per car	1	1	1	
Contractor #2 - Rock Dump Erosion/Vegetation Maintenance - (Mob to Site) - Year 1 and Year 11				
# days	10	10	10	
type transportation	truck - diesel	truck - diesel	truck - diesel	
Distance (mileage RT)	88	88	88	
# of cars:	2	2	2	
# of trips	20	20	20	
# people per car	2	2	2	

Table 5
Sitewise Carbon Footprint Summary of Assumptions and Inputs
Pitch Reclamation Project
Sargents,CO

Alternatives	Alternative 4.2 - Maintain Current System	Alternative 4.5 - Rock Dump/South Mine Area Regrading and Selective Lining	4.7 - Ion Exchange Full System	Assumptions
Contractor #3 - Drillers - (Mob to Salida) - First Year only				
# days	3	3	3	
type transportation	truck - diesel	truck - diesel	truck - diesel	
Distance (mileage RT)	300	300	300	
# of cars:	4	4	4	
# of trips	12	12	12	
# people per car	1	1	1	
Contractor #3 - Drillers - (Mob to Site) - First Year only				
# days	15	15	15	
type transportation	truck - diesel	truck - diesel	truck - diesel	
Distance (mileage RT)	88	88	88	
# of cars:	2	2	2	
# of trips	30	30	30	
# people per car	2	2	2	
Contractor #4 - Regrading and selective lining - mob- For Alt. 4.6 only - (Mob to Salida) - Year 11				
# days	0	2	0	
type transportation	0	car	0	
Distance (mileage RT)	0	300	0	
# of cars:	0	4	0	
# of trips	0	8	0	
# people per car	0	1	0	
Contractor #4 - Regrading and selective lining - For Alt. 4.6 only - (Mob to Site) - Year 11				
# days	0	10	0	
type transportation	0	truck diesel	0	
Distance (mileage RT)	0	88	0	
# of cars:	0	2	0	
# of trips	0	20	0	
# people per car	0	2	0	
Contractor #5- IX System Construction - (Mob to Salida) - First Year Only				
# days	0	0	3	
type transportation	0	0	car	
Distance (mileage RT)	0	0	300	
# of cars:	0	0	4	
# of trips	0	0	12	
# people per car	0	0	1	
Contractor #5 - System Construction - (Mob to Site) - First Year Only				
# days	0	0	60	
type transportation	0	0	truck diesel	
Distance (mileage RT)	0	0	88	
# of cars:	0	0	2	
# of trips	0	0	120	
# people per car	0	0	2	
Contractor #6 - System O&M - (Mob to Salida)				
# days			8	6 times May through Nov. for 2 days, twice for winterization/
type transportation			car	
Distance (mileage RT)			300	
# of cars:			2	
# of trips			16	
# people per car			1	
Contractor #6 - System O&M - May through Nov				
# days			8	6 times May through Nov. for 2 days, twice for winterization/
type transportation			truck diesel	
Distance (mileage RT)			88	
# of cars:			1	
# of trips			8	
# people per car			2	
Contractor #8 - Resin Changeout - (Mob to Salida)				
# days			8	
type transportation			car	
Distance (mileage RT)			300	
# of cars:			2	
# of trips			16	
# people per car			1	
Contractor #8 - Resin Changeout - (Mob to Site)				
# days			8	
type transportation			truck diesel	
Distance (mileage RT)			0	
# of cars:			1	
# of trips			8	
# people per car			2	
Contractor #9 - Waste Broker for Resin Changeout - (Mob to Salida)				
# days			2	2 changeout events per year
type transportation			car	
Distance (mileage RT)			300	
# of cars:			1	
# of trips			2	
# people per car			1	
Contractor #9 - Waste Broker for Resin Changeout - (Mob to Site)				4 days per changeout event
# days			8	
type transportation			car	
Distance (mileage RT)			88	
# of cars:			1	
# of trips			8	
# people per car			1	
Contractor #10 - Truck Driver for Resin Changeout - (Mob to Energy Solutions)				
# days			2	
type transportation			semi-truck	
Distance (mileage RT)			1,038	519 miles to Energy Solutions
# of cars:			1	
# of trips			2	
# people per car			1	
Equipment Transportation - Transportation of all major heavy equipment to the S	**Alt. 4.2**	**Alt. 4.5**	**Alt. 4.7**	**Assumptions**
Equipment Transportation - truck				
Mileage to Rental Facility (assumed, one way)	151			Mileage to nearest United Rentals
# of trips (2 trips per equipment) - Excavator - Year 1	2	2	4	
Distance (mileage RT)	151	151	151	
# of trips (2 trips per equipment) - Excavator - Year 11	2	4	2	
Distance (mileage RT)	151	151	151	

Table 5
Sitewise Carbon Footprint Summary of Assumptions and Inputs
Pitch Reclamation Project
Sargents,CO

Alternatives	Alternative 4.2 - Maintain Current System	Alternative 4.5 - Rock Dump/South Mine Area Regrading and Selective Lining	4.7 - Ion Exchange Full System	Assumptions
# of trips (2 trips per equipment) -Dump truck - Year 1 and Year 11	2	2	2	
Distance (mileage one way)	151	151	151	
# of trips (2 trips per equipment) - Grader/Tillage Tractor - Year 1	2	2	4	
Distance (mileage one way)	151	151	151	
# of trips (2 trips per equipment) - Grader/Tillage Tractor - Year 11	2	4	2	
Distance (mileage one way)	151	151	151	
# of trips (2 trips per equipment) - Loader - Year 1	2	4	4	
Distance (mileage one way)	151	151	151	
# of trips (2 trips per equipment) -Loader - Year 11	2	4	2	
Distance (mileage one way)	151	151	151	
# of trips (2 trips per equipment) -Porta potties - Year 1	2	2	4	
Distance (mileage one way)	42	42	42	Assumes transport from Gunnison
# of trips (2 trips per equipment) -Porta potties - Year 11	2	4	2	
Distance (mileage one way)	42	42	42	Assumes transport from Gunnison
# of trips (2 trips per equipment) - Drilling Rig (2 rigs) -3 mobilization - Year 1	6	6	6	
Distance (mileage RT)	200	200	200	Mobilization from near Fairplay, CO
# of trips (2 trips per equipment) - Trencher - 1 mob - Year 1			2	
Distance (mileage RT)			151	
# of trips (2 trips per equipment) - other SYSTEM EQUIPMENT - Year 1			1	
Distance (mileage RT)			88	Assumes transport from Gunnison
# of equipment - generators, etc			3	

Table 5
Sitewise Carbon Footprint Summary of Assumptions and Inputs
Pitch Reclamation Project
Sargents,CO

Alternatives		Alternative 4.2 - Maintain Current System	Alternative 4.5 - Rock Dump/South Mine Area Regrading and Selective Lining	4.7 - Ion Exchange Full System	Assumptions
Summary Total on site Hrs. of Operation per Equipment		**Alt. 4.2**	**Alt. 4.5**	**Alt. 4.7**	**Assumptions**
	Type of fuel				
	Excavator	36	380	76	to delete at the end
	Skid steer	36	70	76	to delete at the end
	Loader	36	400	76	to delete at the end
	10 CY Dump Truck	36	36	36	to delete at the end
	120 Grader/Tillage Tracktor	36	450	76	to delete at the end
	Trencher	0	0	40	to delete at the end
	Diesel Generator (10 hp, 8 hrs per week) - every year			416	
Rock Dump Regrading - Total Hrs of Operation - year 1					
	Type of fuel	Diesel	Diesel	Diesel	
	Skid steer (hours)	36	70	36	
	Excavator (hours)	36	380	36	
	10 CY Dump Truck - (hours)	36	36	36	
	Loader -4 CY (hours)	36	400	36	
	120 Grader/Tillage Tractor (hours)	36	450	36	
Rock Dump drainage - Total Hrs of Operation - year 11					
	Type of fuel	Diesel	Diesel	Diesel	
	Skid steer (hours)	36	36	36	
	Excavator (hours)	36	96	36	
	10 CY Dump Truck - (hours)	36	36	36	
	Loader -4 CY (hours)	36	96	36	
	120 Grader/Tillage Tractor (hours)	36	156	36	
Treatment System Construction - Total Hrs of On site Heavy Equipment Operation					
	Type of fuel				
	Skid steer			40	
	Excavator			40	
	10 CY Dump Truck -			0	
	Loader -4 CY			40	
	120 Grader/Tillage Tractor			40	
	Tencher			40	
	Vacuum Truck (soft digging excavation only)			0	

Table 5
Sitewise Carbon Footprint Summary of Assumptions and Inputs
Pitch Reclamation Project
Sargents,CO

Alternatives	Alternative 4.2 - Maintain Current System	Alternative 4.5 - Rock Dump/South Mine Area Regrading and Selective Lining	4.7 - Ion Exchange Full System	Assumptions
Material Usage and Transportation	**Alt. 4.2**	**Alt. 4.5**	**Alt. 4.7**	**Assumptions**
Material/ Equipment Transportation - assumes cargo air				
Coolers - every year				
# of trips (1 trips per equipment) -Cooler	48	48	84	
Mileage to Rental Facility (assumed, RT)	444	444	444	Samples shipped to Casper, WY (444 miles)
Weight (lbs/cooler)	30	30	30	
Material/ Equipment Manufacture and Transport by Train				
Stainless Steel - first year				
Weight (tons)			8.25	
Weight (lbs)			16500	
Procurement distance (mileage)			1,550	Sourced from TIGG in Coraopolis, PA (1550 miles)
Material Usage and Transportation - Truck				
160				
Gravel/rip rap - Year 1				
Weight (tons)	20	65,000	60	
Weight (lbs)	40,000	130,000,000	120,000	
Procurement distance (mileage)	42	42	42	Sourced from Gunnison
# of trips (assumes 30 CY truck or 40 ton truck)	1	1,625	3	
Tons per trip	20	40	20.0	
16				
Gravel/rip rap - Year 11				
Weight (tons)	20	8,000	20	
Weight (lbs)	40,000	16,000,000	40000	
Procurement distance (mileage)	42	42	42	Sourced from Gunnison
# of trips (assumes 30 CY truck or 40 ton truck)	1	200	1	
Tons per trip	20	40	20	
16				
Concrete - first year				
Weight (tons)			36	
Weight (lbs)			72,000	
Procurement distance (mileage)			194	Sourced from Denver
# of trips (assumes 30 CY truck or 40 ton truck)			2	
Tons per trip			18.0	
16				
16 oz/SY Non-Woven Geotextile Cushion - Year 1				
Linear ft		35,000		
Volume (CY)		---		
Weight (tons)		5.8		
Weight (lbs)		11,660		
Procurement distance (mileage)		42		Sourced from Gunnison
# of trips (assumes 30 CY truck)		1		
HDPE Liner - Year 1				
Linear ft		35,000		
Volume (CY)		---		
Weight (tons)		126		
Weight (lbs)		252,780		
Procurement distance (mileage)		42		Sourced from Gunnison
# of trips (assumes 30 CY truck)		5		
Tons per trip		25		
HDPE - first year				
Weight (tons)			40	
Weight (lbs)			8000	
Procurement distance (mileage)			194	Sourced from Denver
# of trips (assumes 30 CY truck)			1	
Tons per trip				
LDPE - first year				
Weight (tons)			0.1	
Weight (lbs)			20	
Procurement distance (mileage)			194	Sourced from Denver
# of trips (assumes 30 CY truck)			1	
Tons per trip				
PVC pipe - first year				
Weight (tons)			1.49	
Weight (lbs)			2980	
Procurement distance (mileage)			194	Sourced from Denver
# of trips (assumes 30 CY truck)			2	
Steel - first year				
Weight (Tons)			48	
Weight (lbs)			96000	
Procurement distance (mileage)			194	Sourced from Denver
# of trips (assumes 30 CY truck)			2	
Tons per Trip			24	

Table 5
Sitewise Carbon Footprint Summary of Assumptions and Inputs
Pitch Reclamation Project
Sargents,CO

Alternatives	Alternative 4.2 - Maintain Current System	Alternative 4.5 - Rock Dump/South Mine Area Regrading and Selective Lining	4.7 - Ion Exchange Full System	Assumptions
Ion Exchange Resin - every year				
Cubic ft			300	Resin changeout for seasonal operation
Weight (lbs)			18720	
Weight (ton)			9.36	
Procurement distance (mileage)			1820	Sourced from King of Prussia, PA (1820 miles)
# of trips (assumes 30 CY truck)			2	
Sulfuric Acid (assumes high impact material) - every year				Assumed ion exchange pre-treament requirements
Volume (gals)			18840	
Weight (lbs)			282600	
Weight (ton)			141.3	
Procurement distance (mileage)			1,790	Sourced from Reading, PA (1790 miles away)
# of trips (assumes 40 ton truck)			3.5	
Tons per Trip				
Sodium Hydroxide - every year				Assumed ion exchange pre-treament requirements
Volume (gals)			5000	
Weight (lbs)			52000	
Weight (ton)			26	
Procurement distance (mileage)			1,790	Sourced from Reading, PA (1790 miles)
# of trips (assumes 40 ton truck)			1	
Tons per Trip				
Liquid propane - every year				Assumed 1,000 gal of propane required for intermittent struc
Volume (gals)			1000	
Weight (lbs)			4110	
Weight (ton)			2.055	
Procurement distance (mileage)			194	Sourced from Denver
# of trips (assumes 30 CY truck)			1	
Tons per Trip				
Top Soil distance (mileage)				
# of trips (assumes 16.5 CY truck)				
Topsoil imported (cy)				
Clean Soil distance (mileage one way)				
# of trips (assumes 16.5 CY truck)				
Disposal	**Alt. 4.2**	**Alt. 4.5**	**Alt. 4.7**	**Assumptions**
Non-Haz disposal (Soil cuttings) - first year	Truck Only	Truck Only	Truck Only	
Amount of waste disposed (ton)	0.0	0	0	Assumes placed on site in exisiting disposal cell or scatted on
Distance2 - one way	150	150	150	
#of trips (assumes 24 ton/truck)	2	2	2	
Add return trip				
Non-Haz disposal (Drilling/development) - first year	Truck Only	Truck Only	Truck Only	
Amount of waste disposed (ton)	0.0	0	0	
Amount of waste disposed (gals)	11,416.0	11416	11416	
Distance2 - one way	150	150	150	
# of trips (assumes 24 ton/truck)	2	2	2	
Add return trip				
Radiological waste disposal (IEX) - every year				
Amount of waste disposed (CF)			300	
Amount of waste disposed (lbs)			18,720	
Amount of waste disposed (ton)			9	
Distance2 - one way			519	Disposed at Energy Solutions (519 miles)
#of trips (assumes 24 ton/truck)			2	
Add return trip			yes	
Haz disposal (truck to Rail)				
Amount of waste disposed (ton)				
Distance2 - one way				
#of trips (assumes 24 ton/truck)				
Add return trip				
Haz disposal (Rail)				
Amount of waste disposed (ton)				
Distance - one way				
Risk Estimation				
Oversight (Number of man-hours onsite)	400	600	400	
Operators (Number of man-hours onsite)	480	960	480	
Scientific/Technical services (Number of man-hours onsite)	840	840	1,080	
Waste Management Services (Number of man-hours)			40	
Notes				
Information was based on engineering design assumptions developed by project team for the relative evaluation for each alternative.				
Purge water for well development or sampling is not included as it is assumed to be discharged to ground.				
Soil cuttings or waste water from the well installation was not included in the assessment.				
Minor impacts common to each remedial alternative, such as routine management and reporting, were not included in this sustainability assessment.				
Dewatering was not included in the assesment.				

Attachment 1. Fatality and injury rates and references. (From: SiteWise™ Version 3.2 User Guide)

Table 2h. Fatality and injury rates

Item	Fatality	Injury	Units	References	Lost Hours	Reference
Construction laborers	9.15E-08	2.30E-05	per hour	a,b	10	g, used "Construction and extraction…"
Operating engineers	5.35E-08	2.30E-05	per hour	a,b	10	g, used "Construction and extraction…"
Waste management services	5.95E-08	2.70E-05	per hour	a,b	8	g, used Total
Scientific and technical services	4.50E-09	5.50E-06	per hour	a,b	3	g, used Architecture and engineering…"
Other occupation						
Road Transportation	7.80E-09	6.28E-07	per passenger mile	c,d	8	g, used Total
Road Transportation - Equipment	7.80E-09	6.28E-07	per passenger mile	c,d	17	g, used "Truck drivers…"
Air Transportation	1.00E-10	2.67E-11	per passenger mile	c,e	8	g, used Total
Rail Transportation	4.00E-10	5.16E-08	per passenger mile	c,f	8	g, used Total

[a] Fatality rates from Bureau of Labor Statistics, Hours-based fatal injury rates by industry, occupation, and selected demographic characteristics, 2009 data. http://www.bls.gov/iif/oshwc/cfoi/cfoi_rates_2009hb.pdf. Site visited 10/4/2010. Values were converted from fatal occupational injuries per 100,000 FTEs to fatal occupational injuries per hour.

[b] Injury rates from Bureau of Labor Statistics, News Release, 10/29/2009, "Workplace Injuries and Illnesses - 2008", USDL-09-1302, Table 5. Values were converted from injuries per 100 FTEs to injuries per hour.

[c] Fatality rates from Air Transportation Association presentation, October 4, 2010. http://www.airlines.org/Economics/ReviewOutlook/Documents/ATAIndustryReview.pdf. Site visited 10/5/2010. Values were converted from rate/100,000,000 passenger miles to rate/passenger mile.

[d] Injury rate from NHTSA "Traffic Safety Facts: 2008 Data", DOT HS 811 162, page 3, Table 2. Values were calculated from average of 1998-2008 data. Calculation assumes 1.59 passengers per vehicle. This value is from Victoria Transport Policy Institute, TDM Encyclopedia, Table 6. http://www.vtpi.org/tdm/tdm58.htm. Site visited 10/5/2010.

[e] Injury rate from U.S. Department of Transportation, Research and Innovation Technology Administration, Bureau of Transportation Statistics. *National Transportation Statistics 2010*, Table 2-9. Values were calculated from average of 1996-2009 data. Calculation assumes 162 passengers per aircraft.

[f] Injury rate from Federal Railroad Administration, Office of Safety Analysis. http://safetydata.fra.dot.gov/OfficeofSafety/publicsite/query/statsSas.aspx. Site visited 10/5/2010. Values were calculated from average of 1996-2009 data.

[g] Lost hours from Bureau of Labor Statistics, News Release, 11/24/2009, "Nonfatal Occupational Injuries and Illnesses Requiring Days Away from Work, 2008", USDL-09-1454, Tables 9 and 10. Used median days away from work.

Appendix 6

Lowest Practical Level 2022 Update (2022 PPHS Exhibit 4)

Homestake Mining Company

Exhibit 4 – Update on Activities Related to Uranium Mass Load Reductions and Marshall Creek Evaluations

Pitch Reclamation Project
Former Pitch Uranium Mine
Sargents, Colorado

March 2022

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Appendix

Appendix A Photograph Log

Acronyms and Abbreviations

°C	degrees Celsius
BCR	biochemical reactor
BMP	best management practices
BOD	biochemical oxygen demand
CDPHE	Colorado Department of Public Health and Environment
CDPS	Colorado Discharge Permit System
CFS	Chester Fault Springs
CMP	corrugated metal pipe
CSM	conceptual site model
ETC	engineered treatment cell
EVO	emulsified vegetable oil
gpm	gallons per minute
HMC	Homestake Mining Company of California
IRD	Indian Rock Dump
IX	ion exchange
LPL	lowest practical level
MCL	maximum contaminant level
MG	million gallons
mg/L	milligrams per liter
NPL	North Pit Lake
PBR	packed-bed bioreactor
PIMS	phosphate-induced metal stabilization
PMD	Pinnacle Mine Dump
SBA	strong base anion
SEM-EDS	scanning electron microscopy/energy dispersive x-ray spectroscopy
TCRD	Tie Camp Rock Dump
TRM	treatment residuals management
TSP	triple super phosphate
WQCD	Water Quality Control Division
ZVI	zero valent iron

Executive Summary

Homestake Mining Company of California (HMC) is currently evaluating Best Management Practices (BMPs) to establish the lowest practical level (LPL) for uranium at the Pitch Reclamation Project (Site) located in Saguache County, Colorado. HMC is advancing these efforts to achieve the LPL on Segment 20 of the Gunnison River Basin (Indian Creek; Figure 1), based on uranium concentration measured at the Colorado Discharge Permit System compliance point (permit number CO0022756 Outfall 001A). In addition, HMC is evaluating surface water and groundwater dynamics along Indian Creek and Marshall Creek (Segment 21; Figure 1), upstream and within the Town of Sargents. This work is being conducted in support of the Temporary Modification on Marshall Creek, which was granted in 2017 and is currently in effect through December 2022. This document provides an overview of work conducted during the Temporary Modification period from 2017 through 2021.

To achieve practical uranium load reduction, BMPs for the Site have focused on identifying passive, sustainable alternatives that are compatible with reclamation and closure objectives and fit within the constraints of the Site (limited seasonal accessibility and off-grid electricity restricted to solar and generators). BMPs considered for the Site fall into two categories: source zone load prevention and passive water treatment/diversion. While some passive water treatment alternatives may be effective for reducing site uranium discharge, source zone load prevention alternatives are the most sustainable, as they limit the need for in-perpetuity water treatment and limit the generation of aboveground radiological waste.

Since the Temporary Modification on Marshall Creek was granted in 2017, the following BMP evaluation activities were conducted:

- Characterization of uranium source zones at the Site
- Evaluations for optimizing onsite physical water management
- Improvements to site surface water channels and regrading of ponding areas on the Indian Rock Dump (IRD)
- Operation of phosphate injection systems at the underground mine workings and IRD
- Operation of Engineered Treatment Cells (ETCs) with various media in drum-scale and field demonstration pilot-scale applications
- Laboratory and in-field testing of ion exchange (IX) resins for passive uranium removal from surface water
- Stand-by operation of a treatment residuals management system
- Surface water and groundwater monitoring along Indian and Marshall Creeks for evaluating gain/loss.

Based on the results of BMP evaluations to-date, HMC discontinued the phosphate injection program due to limited observed uranium load reduction in offsite discharge. ETC testing was also discontinued, primarily because disposal of spent ETC media at full-scale implementation is currently infeasible. HMC has therefore more recently focused on IX, which has demonstrated a high degree of effectiveness for treating uranium in Site water. IX field testing will continue through the 2022 field season to fill data gaps associated with a potential full-scale implementation of IX at the Site. Ultimately, several challenges and data gaps remain regarding practical implementation of the IX technology to define the Indian Creek LPL, particularly as it relates to remedy sustainability and long-term practicality. The objective of the LPL program in 2022 and in the near future is to resolve these data gaps to support LPL definition and resolution of uncertainty on Marshall Creek.

1 Introduction

Homestake Mining Company of California (HMC) is currently evaluating Best Management Practices (BMPs) associated with establishing the lowest practical level (LPL) for uranium at the Pitch Reclamation Project (Site) located in Saguache County, Colorado. HMC is currently advancing these efforts to achieve the LPL on Segment 20 of the Gunnison River Basin (Indian Creek; Figure 1), based on uranium concentration measured at the Colorado Discharge Permit System (CDPS) compliance point (permit number CO0022756 Outfall 001A, also known as SW-33), as stipulated in the CDPS draft permit compliance schedule. In addition, HMC is working to evaluate surface water and groundwater dynamics along Indian Creek and Marshall Creek (Segment 21; Figure 1), upstream and within the Town of Sargents. This work is being conducted in support of the Temporary Modification on Marshall Creek, which was granted in 2017 and is currently in effect through December 2022. To support the request for an extension of the temporary modification, this document provides an overview of work conducted since 2017 for LPL/BMP advancement and characterization of Indian/Marshall Creek surface water/groundwater dynamics. Specifically, this document provides overviews of the conceptual model for Site uranium sources, the BMPs chosen for advancement toward establishing the LPL, field testing, characterization, and implementation of BMPs, the results of Marshall Creek evaluations, and remaining data gaps for establishing the LPL.

2 Uranium Load Conceptual Model

A conceptual site model (CSM) describing site features contributing uranium loading to surface water was developed to identify potential BMPs for achieving uranium load reduction. Results of this initial evaluation were provided to the Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Division (WQCD) in a report dated August 12, 2014 (Arcadis 2014), with additional CSM details provided in subsequent LPL updates (Arcadis 2015, 2016a, 2016b, 2018, 2020). This CSM, including a description of the primary uranium load sources at the Site, is summarized here to provide a rationale for the LPL work currently being conducted.

The Site is in Township 48 North, Range 6 East, Saguache County, Colorado; approximately 12 miles east of Highway 50 and the Town of Sargents (Figure 1). The Site lies near 11,000 feet in elevation, in heavily timbered, moderately mountainous terrain. Disturbances associated with historical mining are located within a single self-contained and well-defined watershed basin. This basin comprises two drainage sub-basins (the Indian drainage and the Tie Camp drainage), which converge at the Sediment Pond and drain into Indian Creek at SW-33 (Figure 2). Uranium sources within the basin receive groundwater flow that follows surface and bedrock topography toward surface water drainages, such that mine-influenced groundwater discharges to surface water within the permitted boundary. Uranium-influenced water from Site-related mine disturbances is ultimately realized at a single surface water outfall (SW-33) that drains into Indian Creek, which joins Marshall Creek approximately 4 miles southwest of the permitted property boundary (Figure 1). Both Indian and Marshall creeks are part of the Gunnison River Basin.

The primary anthropogenic sources of uranium to surface water include the underground mine workings via the North Pit Lake (NPL), the Indian Rock Dump (IRD), and the Tie Camp Rock Dump (TCRD; Figure 2). Evidence for these loads is apparent based on surface water uranium concentrations and flow rates that have been measured biannually across the Site for over two decades. A summary of the site flow and uranium balance is presented on Figure 3 and a comparison of uranium loading from site sources during high-flow and low-flow conditions is presented on Figure 4. Additional conceptual understanding for these primary uranium load sources is as follows:

- **Underground Mine Workings via NPL**. Residual unmined uranium minerals associated with the Chester Fault are believed to be the primary source of uranium load in this area, with the Pinnacle Mine Workings (underground mine workings) exacerbating this load by providing a conduit for water flow and contact with minerals. Although this is sometimes referred to as the "NPL load" (e.g., on Figure 4), the North Pit is not a significant load contributor *per se.* Rather the uranium load originating from the deep Chester Fault and underground workings system expresses to surface water via the NPL. This load source expresses mainly to the Indian drainage at the NPL, although, it is possible that a smaller component expresses within the Tie Camp drainage to the south. This understanding is based on the following lines of evidence:
    - Elevated uranium concentrations at the Chester Fault Springs (Figure 2, labeled as CFS) are fed by the underground mine workings and are historically similar in composition to underground mine workings monitoring well water quality.
    - Fluorescent dye tracer tests conducted as part of phosphate injections (described below) support a predominantly northward flow direction in the underground mine workings; tracer dye injected into the southern portion of the workings has been observed in monitoring wells to the north and tracer dye injected in the northern portion of the workings has been observed in springs and surface water at the NPL.
    - Uranium concentrations in surface water and seeps/springs located on the north and east walls of the North Pit are low.

- **IRD.** Flow and concentration measurements along the length of Indian drainage between the IRD culvert and the Sediment Pond demonstrate that the drainage gains flow and load through seeps, springs, and groundwater discharge. In 2018, the Pinnacle Mine Dump (PMD), located beneath waste rock associated with the IRD, was identified as a localized uranium source zone. The IRD represents a source of uranium due to leaching through the waste rock.

- **TCRD.** The TCRD contribution functions similarly to that of the IRD, with uranium release due to leaching from waste rock. It is also possible that some uranium load reporting below the TCRD represents uranium released from unmined mineralized zones within the Tie Camp subbasin, with groundwater discharge occurring beneath the rock dump.

Downstream of the IRD and TCRD at the Sediment Pond (sampling location SW-33; Figure 2), the surface water uranium load typically exceeds the sum of those measured upstream (i.e., surface water uranium loads measured from the underground mine workings, IRD, and TCRD), indicating that there is additional uranium loading that is not directly accounted for. The source of this load is uncertain, but it is suspected to represent additional loading from the rock dumps, which bypasses surface water monitoring points along Indian and Tie Camp drainages (i.e., representing shallow alluvial flow within the drainages). This load does not represent a separate source from the primary sources identified above, but it is identified separately as "downstream load" on Figures 3 and 4.

The relative contribution of each of these uranium sources is summarized graphically on Figure 4. High-flow uranium loads were based on 2016 (representative high-flow year). Low-flow uranium loads were based on average values from 2010 through 2019. The results indicate that under high-flow conditions, the North Pit Lake/underground mine workings system (approximately 26 percent) and the IRD (approximately 24 percent) contribute relatively equal uranium loads, with a lower uranium load contribution from the TCRD (approximately

15 percent). Under low-flow conditions, as water drains out of the rock dumps, the NPL/underground mine workings system contributes a higher proportion of the uranium load (approximately 53 percent), although the total load decreases substantially (Figure 3).

3 Identified Best Management Practices

To achieve practical uranium load reduction, BMPs for the Site have focused on identifying passive, sustainable alternatives that fit within the constraints of the Site (remote, high elevation, limited seasonal accessibility, and limited available electricity restricted to off-grid solar and generators) and are ultimately compatible with achieving reclamation and closure objectives. A description of the alternatives considered to date and the BMPs chosen for advancement were summarized in the Draft Alternatives Analysis and Update on Progress toward Establishing the Lowest Practical Level for Uranium Report (Arcadis 2016b). The BMPs considered for the Site fall into two categories: source zone load prevention strategies and passive water treatment/diversion strategies.

Source zone load prevention:

- Source zone load prevention includes strategies to limit release of uranium by either removing the source, altering the chemistry to limit dissolution, or preventing water flow through the source. In principle, these strategies are the most sustainable, as they limit the need for in-perpetuity water treatment.
- Removal of the source has been deemed impractical, given the depths below ground surface, diffuse distribution, and volumes of the source materials. Furthermore, there are limited practical options for limiting water infiltration into the source.
- Load prevention has therefore focused on geochemical alteration of the source zone via phosphate injections in the underground workings and IRD, conducted at a field demonstration scale from 2017 through 2020 (described below). This method of source zone treatment has been shown to successfully reduce uranium concentrations downgradient of injection zones; however, significant reduction in uranium at SW-33 has not yet been observed, indicating the practicality of meaningful uranium load reduction using this strategy is limited.

Passive water treatment/diversion:

- Passive water treatment/diversion includes strategies for aboveground water management and treatment of impacted water. Although these strategies can be more straightforward to implement than source control and have the potential to passively remove uranium (i.e., in a manner not requiring power or continual maintenance while operating), the relative disadvantage is that water treatment would need to continue as long as the source releases uranium (effectively in perpetuity) and generates an aboveground, concentrated radiological waste product that must be managed and disposed off-site.
- Strategies investigated to date have included engineered treatment cells (ETCs) and ion exchange (IX) systems for passively treating uranium-bearing water. The ETCs contain solid-phase reactive media with the ability to remove dissolved uranium. The most promising strategies investigated to-date include biochemical reactor (BCR)-based ETCs and IX resin. Other ETC media have been tested but were screened out due to limited effectiveness. These included zerovalent iron (ZVI) and fish bone apatite.
- Passive water treatment can further be optimized with toe drainage systems for the collection and segregation of uranium-containing water for enhancing passive treatment.

Based on data collected to-date, HMC continues to evaluate IX with minimal power requirements as the leading passive treatment technology for reducing uranium loads in surface water. However, several data gaps (summarized in Section 4.6) remain before the LPL can be established.

4 Summary of LPL Activities

This section provides a summary of field testing, characterization, and implementation of BMPs, the results of Marshall Creek evaluations, and remaining data gaps for establishing the LPL. A photograph log, highlighting some of the primary activities completed in support of establishing the LPL, is included as Appendix A.

4.1 Source Zone Characterization

While the primary uranium source zones on Site were known at the time BMPs were first identified, additional characterization was conducted in 2018 to further delineate and refine the understanding of site uranium sources. Specifically, during June and July 2018, a source zone characterization study was completed to identify subsurface materials and potential discrete sources of dissolved uranium within the TCRD and IRD. Five potential discrete sources of uranium were identified within the rock dumps that may be contributing uranium load to groundwater and surface water; these included a low-grade ore stockpile along the west side of the IRD, a similar low-grade ore stockpile and a disposal cell on the TCRD, the pond sediment storage area, and a landfill/low grade ore storage area located within the eastern portion of the IRD associated with Pinnacle underground mining predating HMC activities (PMD; Figure 5). Ten boreholes were advanced into the potential source areas and soil and groundwater samples were collected. Results of the study indicated that the PMD is most likely a source of uranium in the IRD, particularly given its location in the saturated zone with influent groundwater from upgradient. Additionally, the low-grade ore stockpiles in the IRD and TCRD and the sediment storage area within the IRD, to the west of RD-04 (Figure 5), may potentially contribute uranium to subsurface water based on the observation of higher total and leachable uranium concentrations in materials collected from these zones. However, these zones are above the water table and only receive limited infiltration from rain and snowmelt from directly above, and as such are likely a small source of dissolved uranium relative to the total uranium load from the dumps. Based on the results of this source zone characterization, the IRD phosphate injection system was expanded to target the PMD in 2019 and 2020 (Section 4.3).

4.2 Physical Water Management

While some physical water management strategies can directly result in uranium load reductions (e.g., rock dump surface water channel upgrades reducing infiltration into uranium sources zones), physical water management actions identified in the Alternatives Analysis (Arcadis 2016b) are primarily considered to support/optimize other primary load reduction measures. As summarized below, since 2017, numerous evaluations and reclamation activities have been conducted to improve Site understanding and improve physical water management.

- **NPL Drawdown.** In 2017, the NPL water level was drawn down 8 feet to evaluate the potential for manipulating the lake water level in support of management options. The drawdown of the NPL was successful in providing useful information on the feasibility of lake level manipulation for water treatment and potential closure and reclamation purposes, as well as for informing lake recharge dynamics. Within the 8 feet of drawdown, no additional seeps were identified along the Chester Fault area similar to the existing seeps, indicating that any additional uranium-influenced groundwater discharge was occurring at depth along the bottom of the lake.

- **IRD High-Resolution Topographic Survey.** A detailed drone topographic survey was conducted in August 2018. Review of the survey revealed three notable topographic low points on the IRD. The maximum pond volumes within these low points were calculated and estimated to have only a nominal impact on the quantity of deep-percolation water into the dump. Furthermore, none of the areas appear to be located directly upgradient of identified uranium source zones and, therefore, are not expected to have a notable impact on uranium loading. The drone survey was also used to evaluate flow and potential percolation into site stormwater ditches. Similar to the topographic low points, the stormwater management ditches are presumed to have only a nominal influence on deep percolation potential and are not expected to have a notable impact on uranium loading.
- **NPL Diversion Channel.** While diversion of water away from the NPL will not result in uranium source load reduction, the reduction of input volumes has the potential to improve the effectiveness of some treatment-based BMPs (e.g., biochemical reactor engineered treatment systems [BCR ETCs]), which benefit from higher concentration and lower flow rate influent streams. In 2017, clean runoff inflow to the NPL was temporarily routed around the lake resulting in the diversion of approximately 37 percent of total lake inflow. This diversion resulted in the rapid drawdown of NPL (discussed above) and served as a pilot test of the integrity of the existing channel for transmitting water around the NPL. The test indicated that additional channel lining would be required to limit infiltration into the pit wall. Construction of a permanent clean water diversion around the NPL (“NPL diversion”) was completed from June through August 2020. The NPL diversion captures surface water runoff from the north and east sides of the pit and diverts the flow around the NPL into the Indian Drainage near the Mine Shop (Figure 6). Lining of this drainage as it passes over the Chester Fault zone has helped to limit infiltration of water into the fault in this area, which further prevents uranium release. Preliminary data suggest that the NPL diversion may reduce NPL flows 30 to 50 percent during peak runoff conditions. Additional work on this diversion channel is planned for 2022, including lining the portion of the NPL diversion connecting to Indian Drainage.
- **IRD and TCRD Culvert Decommissioning and Surface Water Channel/Slope Improvements.** Prior to 2021, water flowing from upgradient of the rock dumps in Indian Drainage and Tie Camp Drainage flowed through corrugated metal pipe (CMP) culverts buried beneath IRD and TCRD, respectively (Figure 6). Based on water balance data, it was suspected that the CMP culverts had deteriorated, allowing hydraulic communication between water flowing through the culvert and dump groundwater. In June 2018, a video inspection of the IRD and TCRD culverts was conducted, revealing significant deterioration and damage. In 2021, as part of broader rock dump surface water channel upgrades, the CMP culverts beneath IRD and TCRD were decommissioned, and surface water runoff was re-routed through new surface water channels and a concrete culvert (Figure 6). Decommissioning of the old culverts and surface water channel improvement has resulted in less contact of surface water runoff with potential uranium source material within the rock dumps. While this work was being conducted, topographic low points on the IRD identified with the high-resolution topographic survey were addressed with regrading.
- **Rock Dump Alluvial Flow and Toe Drain Evaluation.** Rock dump toe drains are a potential alternative to capture rock dump leachate and convey it to a water treatment system before it mixes with other clean water sources. Benefits of this approach would include separating rock dump leachate from mixing with other clean water inputs, reducing the overall volume of water needing treatment, and conveying the leachate directly to the designated treatment area. A field investigation was conducted in 2020 to evaluate the extent of rock

dump leachate flow within shallow alluvium downstream of the rock dumps and to fill data gaps related to rock dump toe drain feasibility. The investigation confirmed that significant quantities of groundwater are flowing through overburden and weathered bedrock downstream of both the IRD and TCRD toe drain areas and that, if needed, groundwater collection via toe drain installation is a viable option for water management before treatment, if necessary, based on the treatment technology.

- **Chester Fault Drain.** A Chester Fault Drain and conveyance piping is a potential alternative to divert uranium-impacted water emanating from the Chester Fault Springs (CFS) and associated groundwater before it enters the NPL. In this alternative, uranium-impacted groundwater emanating from the Chester Fault (through surface expression and the CFS and subsurface flow) would be captured via the installation of a French drain and conveyed to a treatment system. In reducing the volume of treatment flows, this option offers significant advantages for some ex-situ treatment technologies, for example BCR ETCs. Drilling and installation of monitoring wells beneath the NPL was conducted in 2021 to refine the NPL conceptual model generally, and to specifically evaluate the feasibility of future segregation of groundwater seepage with higher uranium concentrations from other water inputs to the NPL. Based on high water yields observed during well development and high localized uranium concentrations observed in select piezometers, collection of groundwater seepage before discharge and dilution within the lake is a potentially viable option for water management to enhance the efficiency of a passive treatment system, if required.

The primary objectives of physical water management have been to further advance toward site reclamation and closure and to investigate potential means of enhancing the effectiveness of other potential uranium load reduction BMPs. The physical water management BMPs pursued from 2017 through 2021 were not specifically designed to and have not resulted in uranium load reduction, but they have resulted in site surface water management improvements and enhanced site understanding.

4.3 Phosphate Injection Systems

In-situ source passivation with phosphate was tested at the Site from 2016 through 2020 as the primary means of potentially achieving source zone uranium load reduction. The overall objectives of the phosphate injection program were two-fold:

- To precipitate uranium dissolved in groundwater near source zones (treatment)
- To reduce the continued release of uranium from source minerals (passivation).

Stabilization of uranium occurs through the injection of a phosphate reagent comprised of phosphoric acid and/or monosodium phosphate which causes uranium to precipitate out of solution.

The work conducted to date has demonstrated the phosphate injection approach effectively reduces uranium concentrations in groundwater downgradient of injection zones; however, limited reductions in downgradient surface water were also observed following injection of significant quantities of phosphate. Based on the limited effectiveness observed in surface water during pilot testing, as well as the risks associated with injection of significant quantities of phosphate (considering that dissolved phosphorus is also a regulated compound with associated surface water standards), in 2020 HMC opted to suspend phosphate injections, while continuing to monitor downgradient data following suspension of the program. This section provides a summary the activities undertaken to advance the phosphate injection BMP.

4.3.1 Laboratory Column Testing

From July through September 2020, Arcadis oversaw a laboratory column test designed to evaluate uranium passivation via phosphate injection with site-specific uranium source-zone minerals. The column tests included two duplicate columns receiving a phosphate-amended artificial groundwater and one control column receiving unamended groundwater. Each column test was run under three flow phases: (1) artificial groundwater influent with no phosphate amendment to evaluate uranium leachability, (2) addition of phosphate to artificial groundwater influent (test columns only) to precipitate aqueous uranium and armor mineral surfaces with phosphate precipitates, (3) additional flow of unamended artificial groundwater to observe phosphate washout and to determine whether uranium release into solution decreased due to mineral passivation/armoring. In addition to the flow-through column tests, solid-phase characterization was conducted including grain size analyses, total metals analyses, and scanning electron microscopy/energy dispersive x-ray spectroscopy (SEM-EDS) characterization before and after phosphate amendment.

Results from the column tests demonstrated significant uranium attenuation and source passivation; the phosphate injection resulted in a greater than 96 percent reduction in dissolved uranium concentrations (relative to the control column), which was sustained over 21 pore flushes (Figure 7). SEM-EDS results demonstrated a correlation in uranium and phosphate in the source-zone solids following reaction with phosphate, which is consistent with the uranium passivation through phosphate mineral precipitation. This test indicated that phosphate injection into site source zones can be effective for uranium attenuation and passivation.

4.3.2 Underground Workings Phosphate Injection System

The underground workings phosphate injection system consists of 8 injection/extraction wells (P4, P-5, P-7, P-11, P-12, P-13, P-15, and P-16; Figure 8). While wells P-4 and P-5 date back to 1995, the remainder of the injection/extraction wells were installed between 2015 and 2018. Small-scale pilot tests of underground workings phosphate injections were conducted in 2015 and 2016, with construction and operation of a field demonstration-scale pilot test system from 2017 through 2020. Each season, injections occurred during the summer season (when accessible), from approximately June through September, and downgradient groundwater and surface water was monitored. Due to precipitate build-up on well screens, injections were routinely suspended, and injection wells were rehabilitated using a combination of acid washing, surging, and bailing. Throughout operation of the underground workings phosphate injection system approximately 3.3 million gallons (MG) of water and 6,000 kilograms of phosphate were injected.

Phosphate injection into the underground workings resulted in effective treatment of the Chester Fault zone surrounding the underground mine workings, as seen in uranium concentrations in water sampled from the Chester Fault Springs and monitoring well P-8 (Figures 8, 9, and 10). The Chester Fault Springs and groundwater at P-8 showed reduced uranium concentrations compared to pre-injection concentrations. Additionally, containment of injected reagents and treatment residuals was successful as demonstrated by the low concentrations of phosphate (Figures 9 and 10) and lack of observed secondary effects (such as arsenic desorption/mobilization or decreased pH) downgradient of the injection zones. Despite successful uranium treatment near the injection area, decreases in uranium concentrations at SW-33 were not observed (Figure 11), most likely suggesting inadequate delivery and distribution of phosphate throughout the contributing source zones. Observance of total phosphorus at SW-33 in 2020 highlights the risk of excessive phosphate injections into groundwater source zones. Note that while individual total phosphorus concentrations were occasionally measured above 0.011 mg/L, the running annual median phosphorus concentration at SW-33 has remained below the 0.011 mg/L surface water standard, and concentrations in 2021 following cessation of phosphate injections were lower than 2020.

4.3.3 Indian Rock Dump Phosphate Injection System

The IRD phosphate injection system targeted two separate areas of the IRD: the 10300 bench and the PMD (Figure 12). Five injection wells are located on the 10300 bench (RD-06, RD-07, RD-08, RD-09, and IC-10300R) and four extraction wells are located at the toe of the IRD (RD-01, RD-02, RD-03, and RD-05). An additional two injection wells (PMD-IW-01 and PMD-IW-02) target the PMD (Figure 12). Injection and extraction wells were installed in 2016 and 2017, except for IC-10300R, which was installed in 2011, and the PMD injection wells, which were installed in 2019. System installation and pilot testing began in 2016, and system operation and expansion continued through 2020. From 2016 through 2018, groundwater was extracted from the toe of the IRD and injected on the 10300 bench (Figure 12). Following identification of the PMD as a uranium source zone in 2018 (Section 4.1), the system was expanded to include PMD injection wells in 2019, and in 2019 and 2020, groundwater was extracted from the toe of the IRD and injected into PMD injection wells (Figure 12). Throughout operation of the IRD phosphate injection system, approximately 6.8 MG of water and 8,000 kilograms of phosphate were injected into the IRD (split between the 10300 bench and the PMD).

Through 2018, decreasing uranium concentrations in downgradient extraction well RD-05 suggested that some uranium treatment was occurring as a result of IRD injections. However, the residual dissolved uranium observed at this well coinciding with low levels of phosphate breakthrough suggests substantial desorption of adsorbed uranium downgradient of the target injection zone. As described above, in 2019, the focus of the injection program shifted to target the PMD via injection wells PMD-IW-01 and PMD-IW-02. Phosphate injections into the PMD in 2019 and 2020 demonstrated phosphate reagent distribution and initial uranium concentration reductions in PMD dose/response monitoring piezometers (PMD-PZ-01 and PMD-PZ-02), but with subsequent rebound to pre-injection levels (Figure 13). Following injections, uranium concentrations at downgradient monitoring well IRD-MD-01 was not substantially different than pre-injection levels and decreases in uranium concentrations at SW-33 were not observed (Figure 11).

4.4 Engineered Treatment Cells

ETCs using a variety of media were tested at the Site from 2016 through 2021. BCR ETCs use organic matter to stimulate bioreduction; in this case, yielding geochemical reduction and precipitation of dissolved uranium. Standard BCR media tested at the Site include natural, readily available organic matter, nutrient, and microbial sources (alfalfa hay, wood chips, and manure/compost), while other organic matter sources (lactic acid, and emulsified vegetable oil [EVO]) have also been tested in packed bed reactor (PBR) configurations. Other media tested at the Site include zero valent iron (ZVI) and fish bone apatite, which promote abiotic chemical reactions that precipitate uranium. BCR ETCs have been shown to be effective for treatment of uranium in site water at drum and larger scales. However, there are significant obstacles to full-scale implementation of BCR ETCs. Most importantly, spent BCR ETC media disposal has recently been deemed infeasible, given that onsite disposal will not be allowed by CDPHE, while off-site disposal of the volumes required for full-scale treatment is cost-prohibitive. Additionally, BCR ETC media appears to have a limited effective lifespan, the ability of BCR ETCs to operate at colder temperatures (i.e., operate using groundwater influent and/or through the winter) reduces treatment effectiveness, and full-scale implementation of BCR ETCs would require much larger media volume/operating areas than IX (Section 4.6). Ultimately, while BCR ETCs may be an effective uranium treatment strategy, HMC discontinued BCR ETC testing following 2021 to focus on IX as the primary passive treatment BMP. This section provides a summary the activities undertaken to advance ETC technology for uranium load reduction at the Site during the Temporary Modification period.

4.4.1 Drum-Scale Engineered Treatment Cells

Drum-scale ETCs were tested from 2016 through 2021 to evaluate the effectiveness of various media for treating uranium in site water under various conditions. Table 1, below, summarizes the drum-scale ETCs that were tested.

Table 1. Drum-Scale ETC Summary

Year	ETC Name	Media / Conditions
2016	ZVI Reactor	ZVI and pea gravel.
	Peat Soil Reactor	Peat soil collected on-Site mixed with pea gravel.
	“PIMS” Reactor	Fish bone apatite (Phosphate Induced Metals Stabilization [PIMS] product).
2017	BCR ETC	Wood chips, sheep manure, alfalfa hay, ZVI.
2019-2020	BCR1	Wood chips, alfalfa hay, sheep manure, yellow iron oxide.
	BCR2	Wood chips, alfalfa hay, sheep manure.
	BCR3	Pea gravel, sheep manure, lactic acid solution (dosed).
2021	Drum 1	Wood chips, alfalfa hay, sheep manure, NPL sediment for microbial inoculation.
	Drum 2	Inert media (sand) with solid-phase nutrient (ChitoREM) and EVO.
	Drum 3	Wood chips, alfalfa hay, sheep manure, NPL sediment for microbial inoculation with cooled influent (target 6 degrees Celsius [°C]).
	Drum 4	Inert media (sand) with solid-phase nutrient (ChitoREM) and EVO with cooled influent.
	Drum 5	PBR with inert media, blended effluent of Drum 1 with untreated influent water (target 6°C).
	Drum 6	Wood chips, alfalfa hay, sheep manure with EVO addition.

Overall, effective uranium reduction was observed in the drum-scale ETCs containing the standard BCR ETC media (alfalfa hay, wood chips, and manure/compost). In these drums, uranium removal of up to 98 percent was observed; however, treatment performance was sensitive to several factors, including residence time, water temperature, and microbial activity. The drum tests did demonstrate enhanced uranium removal and extended media longevity with injection of EVO, including enhanced performance at low temperature. A residence time between 24 and 48 hours was identified as optimal for uranium removal. ZVI, site peat soil, and fish bone apatite were less effective than the standard BCR media or not effective at all for treating uranium in site water. Based on the results of the drum-scale tests, below-grade and above-grade ETCs were constructed to test the technology at a larger scale.

4.4.2 Large-Scale Engineered Treatment Cells

Four large-scale ETCs were constructed and operated at the Site from 2017 through 2021, testing ZVI and standard BCR media for uranium treatment. In addition to evaluating different ETC media, the ETCs were used to test the effects of cell dimensions/configuration and temperature on uranium treatment and BCR media longevity. A summary of the larger-scale ETCs constructed and operated at the Site is provided in Table 2, below.

Table 2. Large-Scale ETC Summary

Year	ETC Name	Media / Conditions
2017	ZVI ETC	• ZVI and sand • Below-grade installation • Cell dimensions: 3 feet by 5 feet by 15 feet
2018-2020	ETC-1 and ETC-2	• Wood chips, alfalfa hay, and sheep manure • Operated in series (designed to operate in series or in parallel) • At/above-grade installation • Cell dimensions (each cell): 30 feet by 60 feet by 2 feet
2020-2021	ETC-3	• Wood chips, alfalfa hay, and sheep manure. EVO addition in 2021. • Above-grade installation • Up-flow configuration • Cell dimensions: 7.8 feet by 9.3 feet by 8 feet

Initial results for the ZVI ETC in 2017 were promising, with near complete uranium removal. However, within a single season the treatment performance diminished to approximately 40 percent uranium removal, less than can be achieved with organic-based ETCs. Subsequent testing after 2017 focused on organic-based ETCs instead of ZVI.

An above-grade field implementation scale ETC bioreactor system consisting of two cells was constructed adjacent to the mine shop in 2018 as part of continued evaluation of the effectiveness of uranium removal via passive water flow. Water from the CFS was routed via above-ground piping and directed through the approximately 30-foot by 60-foot ETCs. In 2019, ETC-1 and ETC-2 were operated in series for approximately 2 months, with the effluent of ETC-1 used as the influent for ETC-2. In 2020, the two cells were started up in mid-June and ran in series at a 24-hour hydraulic residence time through early October, treating more than 480,000 gallons of CFS water during the field season. Uranium was reduced from an average influent concentration of

6.06 milligrams per liter (mg/L) to 2.5 mg/L when discharged to Indian Drainage (Figure 14), which equates to an overall 61 percent reduction. Decreases in dissolved oxygen, oxidation-reduction potential, and sulfate (due to biological sulfate reduction) were further evidence for the geochemically reducing conditions in the ETCs necessary for uranium reductive precipitation (Figure 14).

While significant uranium reduction was observed in ETC-1 and ETC-2, the configuration of the cells (upflow through a relatively thin cell with a large lateral cell footprint) resulted in substantial channeling, as demonstrated by dye tracer testing, which diminished treatment performance. In 2020, an additional treatment cell, ETC-3, was constructed in an up-flow configuration to evaluate different cell dimensions and configuration for minimizing flow channelling, enhancing water contact with media and uranium removal. The system operated from the beginning of August through mid-October, treating more than 50,000 gallons of CFS water, then was switched to NPL water treatment to evaluate winter operation. Operation continued in 2021 (June through October), treating an additional 100,000 gallons. Operation of ETC-3 demonstrated effective uranium load reduction with a dependence on residence time, but with little to no uranium removal under cold water temperatures with the onset of winter in October/November 2020 (Figure 15).

BCR ETCs generate byproducts, including biochemical oxygen demand (BOD), ammonia, and phosphorus, that would need to be managed at full-scale application. During 2020, two post-treatment reactors and several media evaluation buckets tests were conducted to test post-treatment strategies for byproduct removal, with a focus on removal of BOD. Post-treatment reactors included an aerobic activated sludge reactor and an anaerobic PBR for BOD removal. Both post-treatment systems displayed varying levels of effectiveness, depending on influent BOD concentrations. The aerobic activated sludge reactor displayed BOD reductions when influent concentrations were below 1,000 mg/L. Although the anaerobic PBR reactor demonstrated that anaerobic BOD removal was ineffective, it did demonstrate that high-BOD ETC effluent could be recycled to achieve additional uranium load reduction by blending with impacted water. In 2021, it was further demonstrated that EVO-based cells (either in an inert-media PBR configuration or as a means of regenerating BCR ETCs) exhibit lower concentrations of byproducts in effluent than traditional BCR media-based cells.

4.4.3 Engineered Treatment Cell Media Stabilization

To evaluate options for onsite disposal of spent ETC media, preliminary tests were conducted in 2020 to identify the optimal combination of physical and chemical stabilization for reducing uranium leachability from spent BCR media. Stabilization testing was completed by mixing BCR drum media with Portland cement (physical stabilization) and triple super phosphate (TSP; chemical stabilization). Three combinations of physical and chemical stabilization were tested in addition to one control, which consisted of unstabilized BCR drum media collected from the bottom-section homogenate.

Overall, the results of the stabilization testing indicated that combined physical and chemical stabilization of spent BCR media can be highly effective at reducing uranium leachability, with preliminary test results suggesting up to 99.6 percent reduction in uranium leachability relative to untreated samples. However, CDPHE has since indicated that onsite disposal of licensed radiological material (including ETC media) will not be permitted, and disposal at an out-of-State licensed radiological disposal facility would be required (noting that offsite disposal of the extremely large volumes of ETC media that would be required for full-scale treatment would be cost-prohibitive). Testing of ETC media stabilization was therefore not pursued following preliminary testing in 2020.

4.5 Treatment Residuals Management System

To minimize the potential to exceed regulatory limits in downstream receiving water, contingencies for removal of residual phosphate discharging from groundwater treatment zones into downgradient surface water were implemented using a treatment residuals management (TRM) system. In 2016 and 2017, TRM laboratory and field studies confirmed the ability to directly dose iron- and aluminum-based reagents to surface water to remove residuals from solution via precipitation and settling in the event that management was needed to reduce concentrations of phosphate or by-product constituents (e.g., arsenic released via desorption/mineral surface exchange with phosphate). The TRM system was located along Indian Drainage between the IRD and the sediment pond (Figure 2) and included reagents of iron and aluminum (ferric chloride and sodium aluminate) and polymer flocculant (Mineral Master MM-2480). Load reduction field activities in 2015 through 2021 successfully controlled phosphate and secondary treatment byproducts; therefore, field implementation of the TRM system has not been necessary.

4.6 Ion Exchange Treatment

Evaluation of IX technology for ex-situ treatment of uranium in site surface water began in 2020 and is ongoing. IX testing has progressively scaled up from laboratory-based batch tests in 2020 to a field demonstration system capable of treating up to 130 gallons per minute (gpm). IX has been demonstrated to be highly effective for treating uranium in site water, including the NPL, IRD groundwater, TCRD groundwater, and Indian Creek surface water at multiple scales, ranging from laboratory batch tests to the ongoing IX field demonstration. The IX technology has several advantages over ETC-based technologies, including effectiveness at cold temperatures and substantially lower media volumes/treatment footprints. Disadvantages/challenges relative to ETC technologies include a greater sensitivity to influent water quality (including suspended solids and presence of competing/interfering ions) and significantly higher required operating pressures. Although the higher operating pressure requirements may limit the widespread use of IX as a passive treatment technology sitewide, ongoing IX field demonstration confirms that IX can be operated under passive conditions using gravity flow where sufficient elevation differences are present. The IX field demonstration system uses the elevation drop from the NPL to the toe of the IRD. This section provides a summary the activities undertaken to advance IX treatment technology at the Site and remaining data gaps for identification of the LPL.

4.6.1 Initial Resin and Sorptive Media Screening

In 2020, a laboratory bench-scale test was performed to identify IX resin and sorptive media compatibility with site-specific water. Laboratory tests included batch jar tests on five potential IX resins and three sorptive media, including biochar (charcoal), zeolite (kaolinate clay), and activated alumina (aluminum oxide). During 2020 laboratory-scale IX testing, several major categories of IX resins were tested, including strong base anion (SBA), strong acid cation, and weak acid cation resins. The 2020 results demonstrated that SBA IX resins were most effective for removing uranium from site water sources, including Indian Drainage (SW-33), IRD groundwater (RD-05), and NPL water (specifically, the CFS). This outcome is consistent with geochemical modeling, which predicted that under ambient conditions, the neutral di-calcium species would make up 60 to 70 percent of the aqueous uranium species, with the negatively charged mono-calcium/magnesium uranyl carbonate species making up most of the remaining 30 to 40 percent, and other cationic and anionic species making up only a small fraction. While preconditioning (acidification) of the source water improved the performance of the cationic resins by shifting the speciation toward more cationic species, SBA resins still demonstrated greater uranium removal without requiring any chemical preconditioning. Based on the resin screening, the SBA resin Purolite PGW6002E was identified as the strongest performing resin and was retained for laboratory and field-scale column testing.

4.6.2 Field-Scale Column Testing

As a result of the 2020 laboratory bench-scale batch and column testing that indicated that anionic IX resins were highly effective at removing uranium from site water, an IX field pilot test column was installed at the SW-33 shed in November 2020 to treat water collected at the outfall. The objectives of this column test were to test resin uptake capacity and regeneration, uptake kinetics/contact times, and fouling potential in a flow-through system. The SBA IX resin, Purolite PGW6002E, was selected for the SW-33 column test based on positive results from 2020 laboratory testing. Column influent water was pumped directly from the sediment pond (sampling location SW-33) into the column. Additional field column tests were run in 2021 at three site locations as a progression of the IX technology testing. The additional column testing was designed to obtain performance data on multiple IX resins, including treatment performance and overall uranium uptake capacity, and to evaluate the effect of water chemistry on treatment performance by testing multiple potential water sources.

Primary takeaways from the field-scale testing are summarized below:

- Uranium treatment of up to 99 percent was observed in the SW-33 column and sustained treatment of greater than 80 percent uranium removal was observed through 35,000 bed volumes (Figure 16). SW-33 column operation was concluded when influent and effluent uranium concentrations were equal, indicating the resin was fully loaded (approximately 44,000 bed volumes).
- Five different SBA resins were tested in identical columns using NPL water as the influent. Through 6,000 bed volumes, greater than 99 percent uranium treatment was observed for each resin (Figure 17).
- A comparison of three columns using the same two resins provided an initial indication of the effect of site source water on uranium treatment performance. The results showed reduced uranium treatment performance at the Indian Creek location (influent water consisted of IRD groundwater; Figure 18), demonstrating that IX treatment does not exhibit the same level of effectiveness for all water types encountered onsite.

4.6.3 Field Demonstration System

In 2021, the IX field demonstration was installed to treat NPL surface water using a modular design configuration that may be expanded for full-scale treatment. NPL surface water was selected for treatment for the IX field demonstration to use the available elevation loss at the Site to achieve passive treatment of water. Specifically, the IX field demonstration was placed at the base of the IRD because this is a suitable location for construction of a full-scale system and the elevation loss from NPL (approximately 300 feet) provides sufficient pressure head to passively operate the IX treatment vessels. The IX field demonstration was designed to achieve the following objectives:

- Evaluate the system’s ability to operate passively with minimal power and infrastructure
- Continue to optimize influent filtration to maximize resin bed life and minimize operation and maintenance
- Obtain performance data on resin capacity and associated resin changeout frequency specific to the NPL water

The IX field demonstration consists of two down-flow IX vessels operating in series (lead/lag configuration) with dual influent bag filters screening solids to 25 microns. Each vessel is 3.5 feet in diameter with a resin bed height of 5.2 feet and operates with 50 cubic feet Purolite PGW6002E resin. The system was designed for a range of 3- to 8-minute empty bed contact times per vessel and has a maximum capacity of 130 gpm. Influent NPL water is piped approximately 2,000 feet from the outlet of the NPL, and effluent is routed to the IC-CULV stilling basin on the Indian Drainage. Operation began on September 29, 2021 and has continued to date.

Analytical samples were collected from the system influent, midpoint (between the lead and lag vessels), and effluent to evaluate uranium treatment performance. Results from system start-up through November 2, 2021, which corresponds to approximately 3,000 bed volumes per vessel, are summarized on Figure 19. Influent uranium concentrations were consistent at approximately 0.8 mg/L, while midpoint and effluent uranium concentrations ranged from non-detect (less than 0.0003 mg/L) to 0.0019 mg/L. For each set of sampling results, system uranium removal was greater than 99 percent (Figure 19).

Overall, as of January 30, 2022, the IX field demonstration has treated approximately 18,000 bed volumes (6.7 million gallons). Initial pressure readings and flow results demonstrate the viability of passive IX treatment technology at the Site with minimal power and infrastructure, although frequent bag filter changeouts (approximately once every two weeks) are currently needed to maintain adequate system flow. System flows and pressures will continue to be monitored through the winter and into the 2022 field season to evaluate system performance.

4.6.4 Data Gaps and Challenges with Full-Scale Operation

While IX has been demonstrated to be highly effective for treating uranium in site water, including the NPL, IRD groundwater, TCRD groundwater, and Indian Drainage surface water at multiple scales, there are several data gaps and full-scale, long-term operational challenges that would need to be resolved prior to selection of IX as the primary uranium load reduction BMP.

- **Winter operation.** The ability of the field demonstration to continue to treat water under passive conditions is currently being evaluated given the limited accessibility and cold temperatures at the Site during the winter months.
- **Fouling.** Results from the SW-33 column and preliminary results from the field demonstration indicate that fouling of the resin is a potential challenge. An evaluation of the SW-33 column concluded that inorganic sediments were likely the primary driver of column fouling with biological growth potentially contributing as well. Continued operation of the field demonstration system in 2022 will address this data gap.
- **Resin loading capacity.** An initial resin loading capacity was calculated for the SW-33 column; however, continued operation of the field demonstration system will be used to estimate resin loading capacity under the full-scale design configuration.
- **Spent IX resin disposal.** The greatest challenge associated with operation of the IX system as the LPL scenario involves the prospect of unsustainable, *in perpetuity* water treatment accompanied by the generation of a concentrated radiological waste product requiring management and disposal. In addition to the effectiveness of the IX technology for obtaining uranium load reduction, the overall practicality of the remedy as a component of the Indian Creek LPL will need to consider long-term sustainability and risks associated with radiological waste transport and disposal and perpetual site activities. These risks will continue to be evaluated as the LPL for Indian Creek is investigated.

5 Marshall Creek Evaluations

In addition to the BMP activities currently underway to evaluate uranium load reduction and establish the LPL, characterization of surface water dynamics on Indian and Marshall creeks and groundwater/surface water interactions near Sargents have been conducted to support the Marshall Creek Temporary Modification and to expand on the Sargents Area CSM provided to WQCD and the Water Quality Control Commission in June 2017. Understanding the local hydrology of Sargents and Marshall Creek will aid in determining the extent (or lack of extent) to which the surface water in Marshall Creek impacts alluvial groundwater in the Sargents Area. Results from gain/loss assessments indicate that Marshall Creek is a gaining or stable creek without significant loss to groundwater, indicating that Marshall Creek is not likely to be impacting the alluvial groundwater in the Sargents area. Additionally, domestic wells in Sargents exhibit groundwater uranium concentrations that are less than the 0.03 mg/L Water Supply Use Standard for surface water (also corresponding to the USEPA maximum contaminant level [MCL] for drinking water), with no apparent influence from Marshall Creek. While impacts to domestic wells associated with Marshall Creek have not been observed, HMC is moving forward with installing deeper domestic wells for Sargents residents. This section provides a summary of the Marshall Creek evaluations conducted between 2017 and 2021 as they relate to establishing the LPL.

Marshall Creek gain/loss investigations were initiated in 2013 and continue to date. The investigations have included the following:

- Surface water sampling and flow measurements along Indian Creek and Marshall Creek have been collected at key monitoring points during high-flow and low-flow conditions (Figure 20). Although water quality has been sampled along Indian and Marshall creeks for several decades, collection of more detailed concentration and flow measurements at the monitoring locations shown on Figure 21 began in 2013 to support gain/loss evaluations.
- Stilling wells, drive-point piezometers, and groundwater monitoring wells were installed in and adjacent to Marshall Creek to evaluate creek gain/loss in the vicinity of Sargents based on surface water/groundwater hydraulic gradients. Specifically, drive point piezometers were installed directly beneath the creek within creek sediment (screened approximately 3 to 5 feet below the sediment-water interface) to quantify differences in water levels between creek surface water (based on water levels in stilling wells placed within the creek) and sediment pore water. Groundwater monitoring wells were installed between 20 and 80 feet from the creek bank to evaluate hydraulic gradients between groundwater and creek water/sediment pore water. The stilling well/piezometer/well sets were installed in 2018 and 2019 and were monitored through 2021 (MC-ELEV-01, 03, 05, and 07; Figure 21).
- Groundwater and sediment pore water samples were collected from monitoring wells, Marshall Creek drive-point piezometers, and Sargents domestic wells (Figure 21) during high-flow and low-flow conditions to further evaluate potential hydraulic connection between Marshall Creek and Sargents alluvial groundwater.

Flow and uranium loads (flow multiplied by uranium concentration) along Indian and Marshall creeks from 2018 through 2021 are provided on Figures 22a and 22b. Surface water flow measurements along Indian Creek indicated an increase in flow rate between SW-33 and the confluence with Marshall Creek, while surface water flow on Marshall Creek through Sargents were generally stable (exhibiting neither significant loss nor gain in flow) in 2021, within measurement uncertainty. Gaining or stable flow measurements along Marshall Creek are consistent with the alluvial groundwater potentiometric surface, which suggests groundwater flow occurs primarily parallel to Marshall Creek (to the west) rather than perpendicular/away from it, as might be expected if there were significant losing conditions. These results are consistent with estimations of uranium load (in kg/day) along Indian and Marshall creeks (Figures 22a and 22b). Although the uranium load appears to fluctuate during some years, these fluctuations are believed to be within measurement uncertainty associated with manual creek flow estimates, overall suggesting little to no significant gain or loss of the uranium present in surface water following discharge at SW-33 (i.e., exhibiting no significant loss to groundwater as Marshall Creek passes through Sargents.

Water level measurements at co-located surface water stilling wells, drive-point piezometers, and groundwater monitoring wells confirm that Marshall Creek is generally either neutral or slightly gaining (hydraulic gradients from groundwater toward surface water) as it passes through Sargents, particularly in the spring (high-flow conditions; Figures 25 and 26). Under low-flow conditions, there tends to be a much smaller gradient between groundwater and surface water, suggesting little to no creek gain or loss. Some locations along Marshall Creek (e.g., MC-ELEV-03 and MC-ELEV-07) exhibit gradients from surface water to groundwater, most likely due to their positions on the interior edges of creek oxbows, suggesting a highly localized gain/loss dynamic adjacent to creek bends. Despite these localized effects, surface water flow measurements (Figure 22) do not indicate that there are significant losses of Marshall Creek to groundwater. This is consistent with uranium concentrations in Marshall Creek piezometers and adjacent monitoring wells, which are consistently less than the MCL (Figures 27 and 28). Domestic wells in Sargents have consistently exhibited groundwater uranium concentrations less than the MCL (Figure 27), further confirming no apparent water quality influence from Marshall Creek on alluvial groundwater in Sargents.

6 Summary

Since the Temporary Modification on Marshall Creek was granted in 2017 the following activities were conducted to continue the advancement of BMPs toward establishing the Indian Creek LPL and to gain understanding of the Indian/Marshall Creek systems to support the resolution of uncertainty on the Marshall Creek uranium concentration:

- Characterization of uranium source zones at the Site
- Evaluations for optimizing onsite physical water management
- Improvements to site surface water channels and regrading of ponding areas on the IRD
- Operation of phosphate injection systems at the underground mine workings and IRD
- Operation of ETCs with various media in drum-scale and field demonstration pilot-scale applications
- Laboratory bench-scale and in-field pilot testing of IX resins for uranium removal from surface water within a passive treatment system
- Stand-by operation of a treatment residuals management system in the event of excess phosphate loading to surface water
- Surface water monitoring along Indian and Marshall Creeks to support creek gain/loss evaluations
- Gain/loss evaluations and water quality monitoring within the Town of Sargents.

Based on the results of BMP evaluations to-date, HMC discontinued the phosphate injection program due to limited observed uranium load reduction in offsite discharge, as well as the ETC testing program due to impracticalities of expanding the technology to full-scale. This has allowed HMC to focus on IX, which has been demonstrated to be highly effective for treating uranium in site water. The IX field demonstration system will continue operation through the 2022 field season to fill data gaps associated with a potential full-scale implementation of IX at the Site. Ultimately, several challenges and data gaps remain regarding practical implementation of the IX technology to define the Indian Creek LPL, particularly as it relates to remedy sustainability and long-term practicality. The objective of the LPL program in 2022 and in the near future is to resolve these data gaps to support LPL definition and resolution of uncertainty on Marshall Creek.

7 References

Arcadis. 2014. Lowest Practical Level Plan Development Activities. Prepared for the Colorado Department of Public Health and the Environment (CDPHE) WQCD on behalf of Homestake Mining Company of California. August.

Arcadis.2015. Update on Activities Related to Uranium Mass Load Reduction to Determine the Lowest Practical Level of Uranium, Pitch Reclamation Project, Saguache County, Colorado. Prepared for the CDPHE WQCD on behalf of Homestake Mining Company of California. May.

Arcadis. 2016a. Update on Activities Related to Uranium Mass Load Reduction to Establish the Lowest Practical Level for Uranium, Pitch Reclamation Project, Saguache County, Colorado. Prepared for the CDPHE WQCD on behalf of Homestake Mining Company of California. April.

Arcadis 2016b. Pitch Reclamation Project DRAFT Alternatives Analysis and Update on Progress toward Establishing the Lowest Practical Level for Uranium. Prepared for Homestake Mining Company of California. December.

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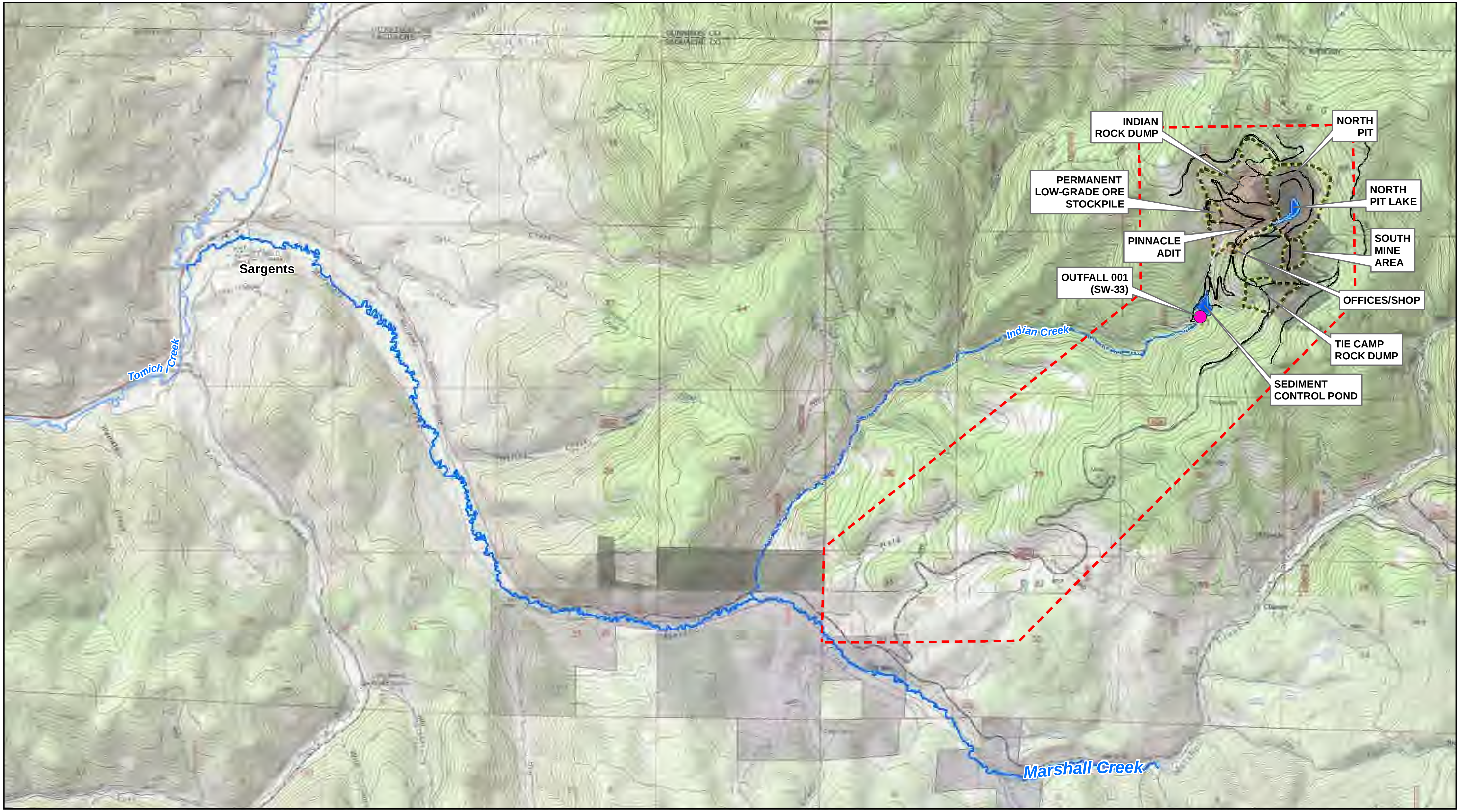
Arcadis. 2020. Update on Activities Related to Uranium Mass Load Reduction to Determine the Lowest Practical Level for Uranium and Marshall Creek Evaluations, Pitch Reclamation Project, Saguache County, Colorado. Prepared for the CDPHE WQCD on behalf of Homestake Mining Company of California. July.

Figures

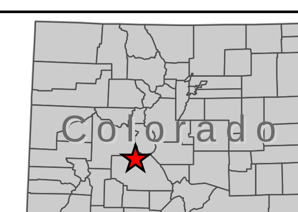


Legend

- Sampling Point
- Colorado Division of Reclamation, Mining, and Safety Permit Boundary
- Facility Areas
- Marshall Creek
- Indian Creek
- Tomichi Creek

Note:

Source: USGS 7.5' Quadrangles of Sargents, Chester, Sargents Peak, and Paholone Peak, Colorado



Feet
0 3,000 6,000

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

LOCATION MAP

ARCADIS

FIGURE
1

Legend

- Surface Water Sampling Point
- Active Seep/Spring
- Colorado Discharge Permit System Compliance Point
- Colorado Discharge Permit System Boundary
- Contours = 50 feet
- Ion Exchange Pilot Locations
- Bioreactor Engineered Treatement Cell Locations
- Phosphate Injection System Locations

TRM = Treatment Residuals Management
IRD = Indian Rock Dump
ETC = Engineered Treatment Cell
UW = Underground Workings
PMD = Pinnacle Mine Dump
IX = Ion Exchange

N

0 260 520 Feet

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PITCH RECLAMATION PROJECT
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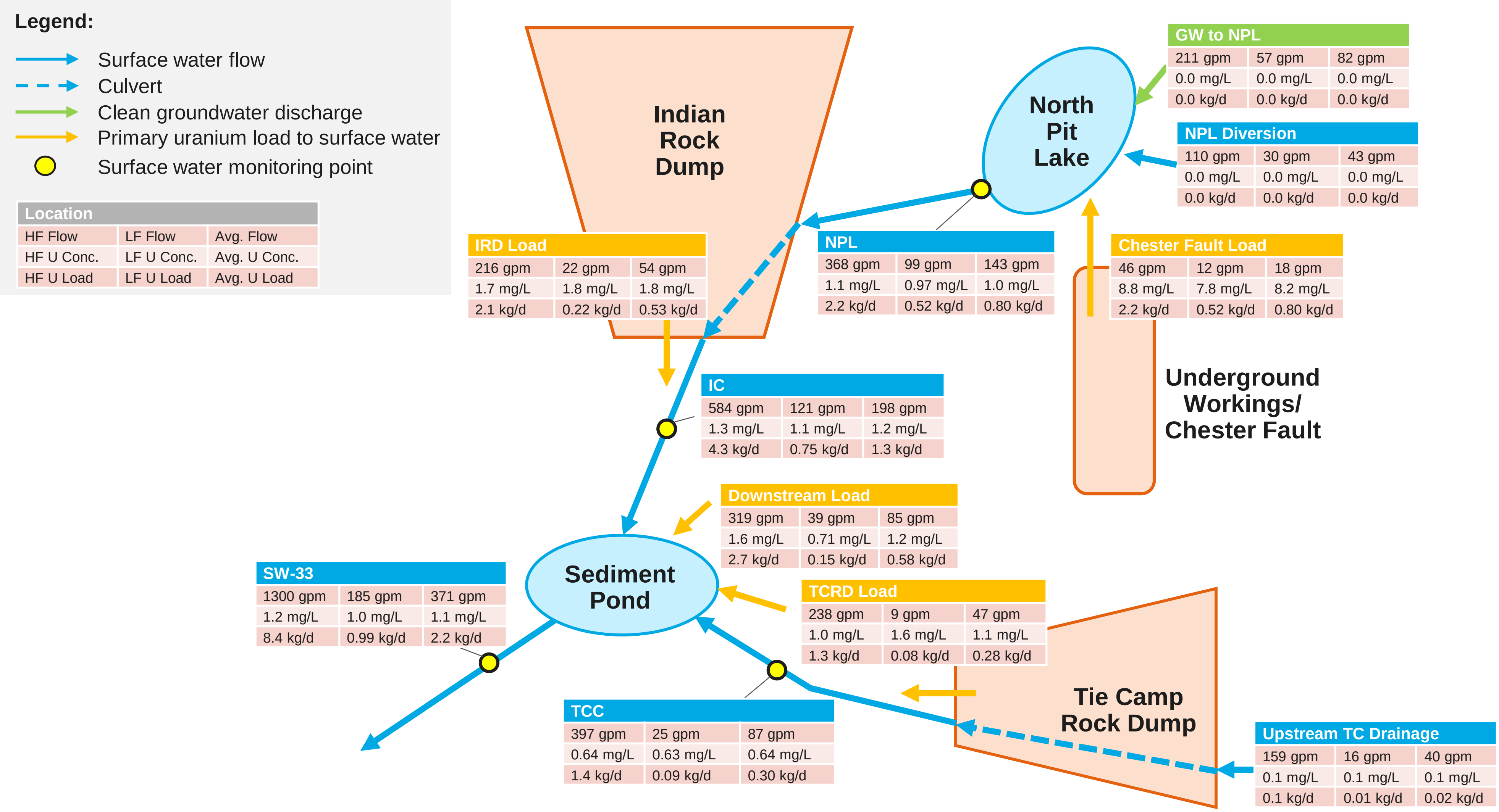
SARGENTS, COLORADO

SYSTEMS AND SELECT SURFACE WATER MONITORING LOCATIONS

ARCADIS

FIGURE
2

Path: T:_ENVAQ000102_Pitch\GIS\MXD\2021\2021-05\Fig_2_System_Select_Monitoring_Locations.mxd Date Saved: 3/2/2022 11:25:07 AM



Notes:

1. High-flow parameters are based on 2016 monitoring. Low-flow parameters calculated as the average values from 2010-2019. Average flows/loads were calculated based on a weighted average of high flows (2/12 months) and low flows (10/12 months).

Avg. = average
Conc. = concentration
gpm = gallon per minute
GW = groundwater
HF = high flow
IC = Indian Creek
IRD = Indian Rock Dump
kg/d = kilograms per day
LF = low flow
mg/L = milligram per liter
NPL = North Pit Lake
TC = Tie Camp
TCC = Tie Camp Creek
TCRD = Tie Camp Rock Dump
U = uranium

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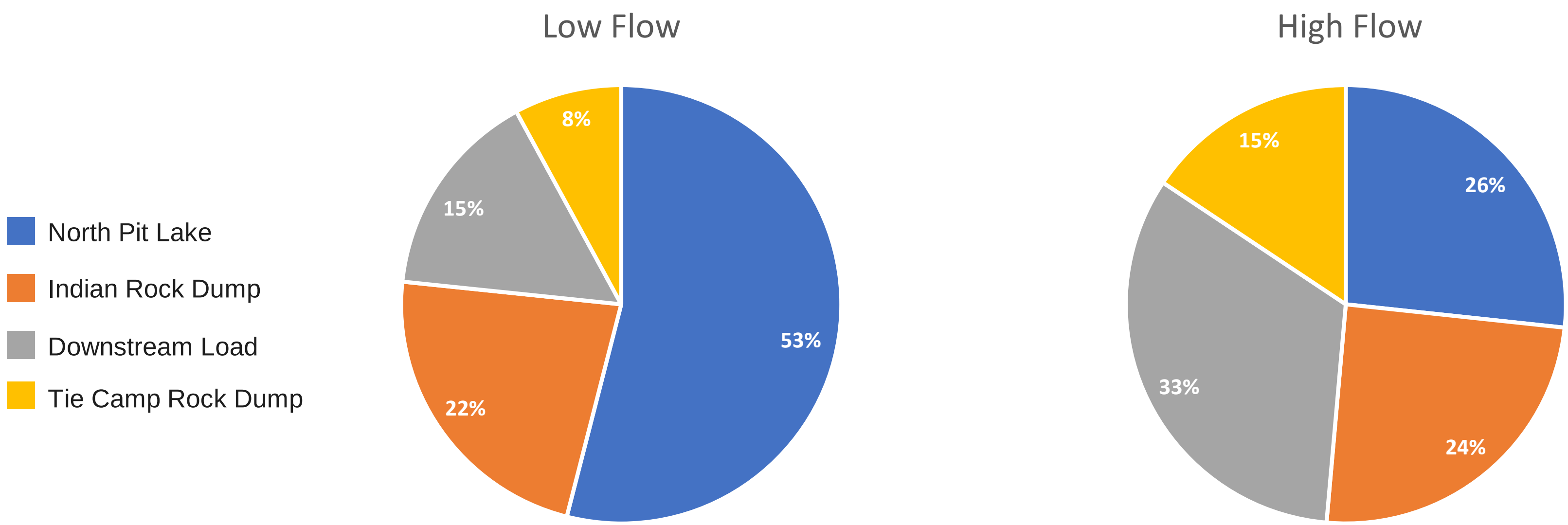
SITE WATER AND URANIUM BALANCE

ARCADIS

FIGURE
3



Notes:

1. Uranium loading distribution is based on mass loading rate.
2. Low-flow load distribution is based on 2010-2019 low-flow average.
3. High flow load distribution based on data from 2016, which was chosen as an appropriately conservative year to represent typical conditions.

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HIGH- AND LOW-FLOW URANIUM LOAD DISTRIBUTION BY SOURCE

ARCADIS

FIGURE
4

LEGEND:

- Existing Surface Water Monitoring Location
- Existing Well
- Exploratory Borehole
- New Well Installation
- Cross Section Line
- Contour 10 feet
- Former Surface Water Drainages
- Roads
- Potential Uranium Load Source Features
- Underground Workings

0 530 1,060 Feet

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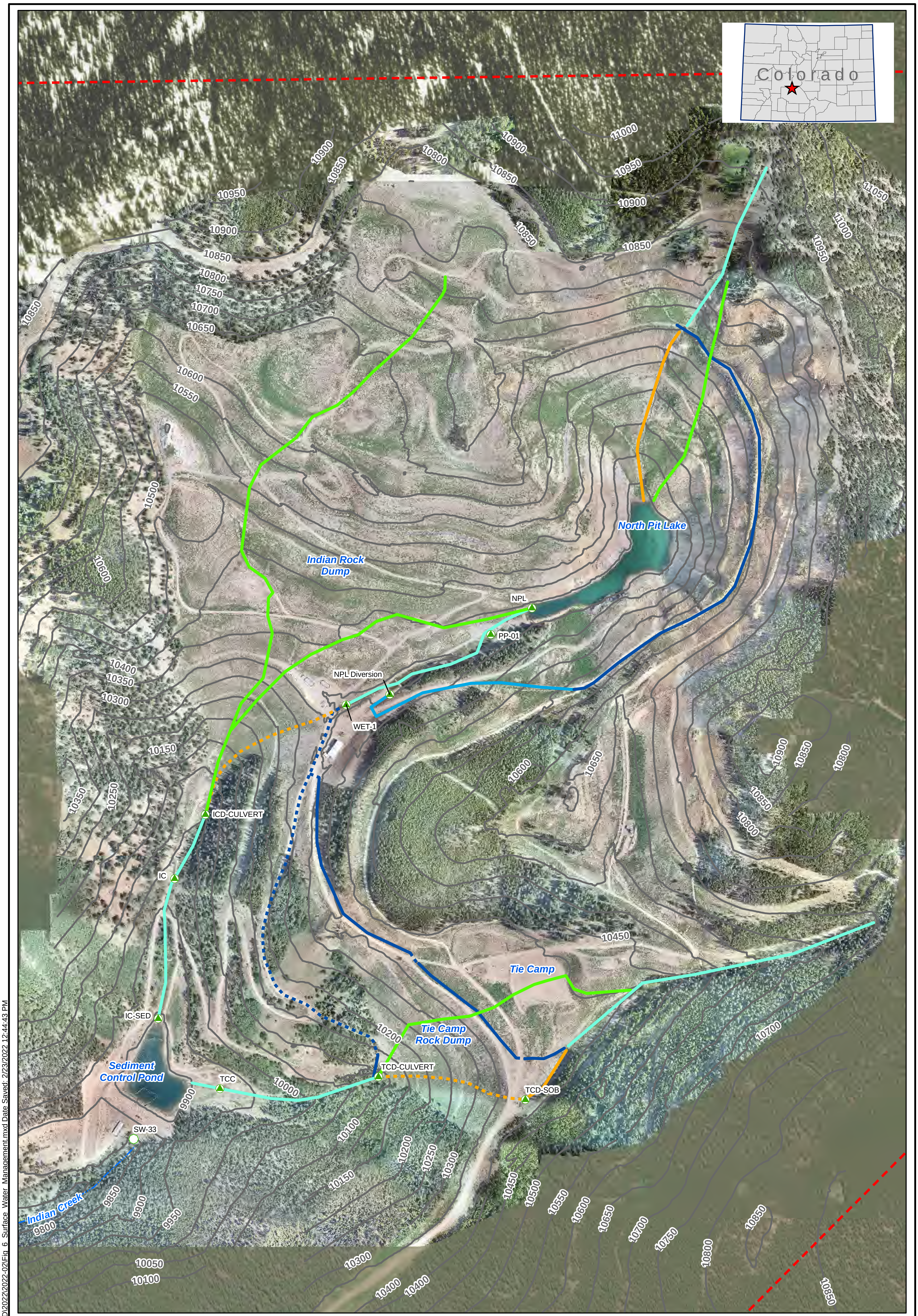
SARGENTS, COLORADO

URANIUM SOURCE ZONE CHARACTERIZATION – SITE FEATURES

ARCADIS

FIGURE 5

Last Saved By: ldrum
T:_ENVAO000102_Pitch\GIS\MXD\2022\2022-02\Fig_5_Uranium_Source_Zone_Characterization_Site_Features.mxd 2/23/2022 12:52:06 PM



Legend

- Surface Water Sampling Point
- Colorado Discharge Permit System Compliance Point
- Colorado Discharge Permit System Boundary
- Contours = 50 feet
- Surface Water Drainage: Installed/Improved in 2021
- Surface Water Drainage: Brought Online in 2021 (Unlined)
- Surface Water Drainage: Bypassed in 2021
- Culvert Installed in 2021
- Culvert Decommissioned in 2021
- Surface Water Drainage: Currently Active
- Historical Surface Water Drainage (Pre-Open Pit Mining)

Feet
0 260 520

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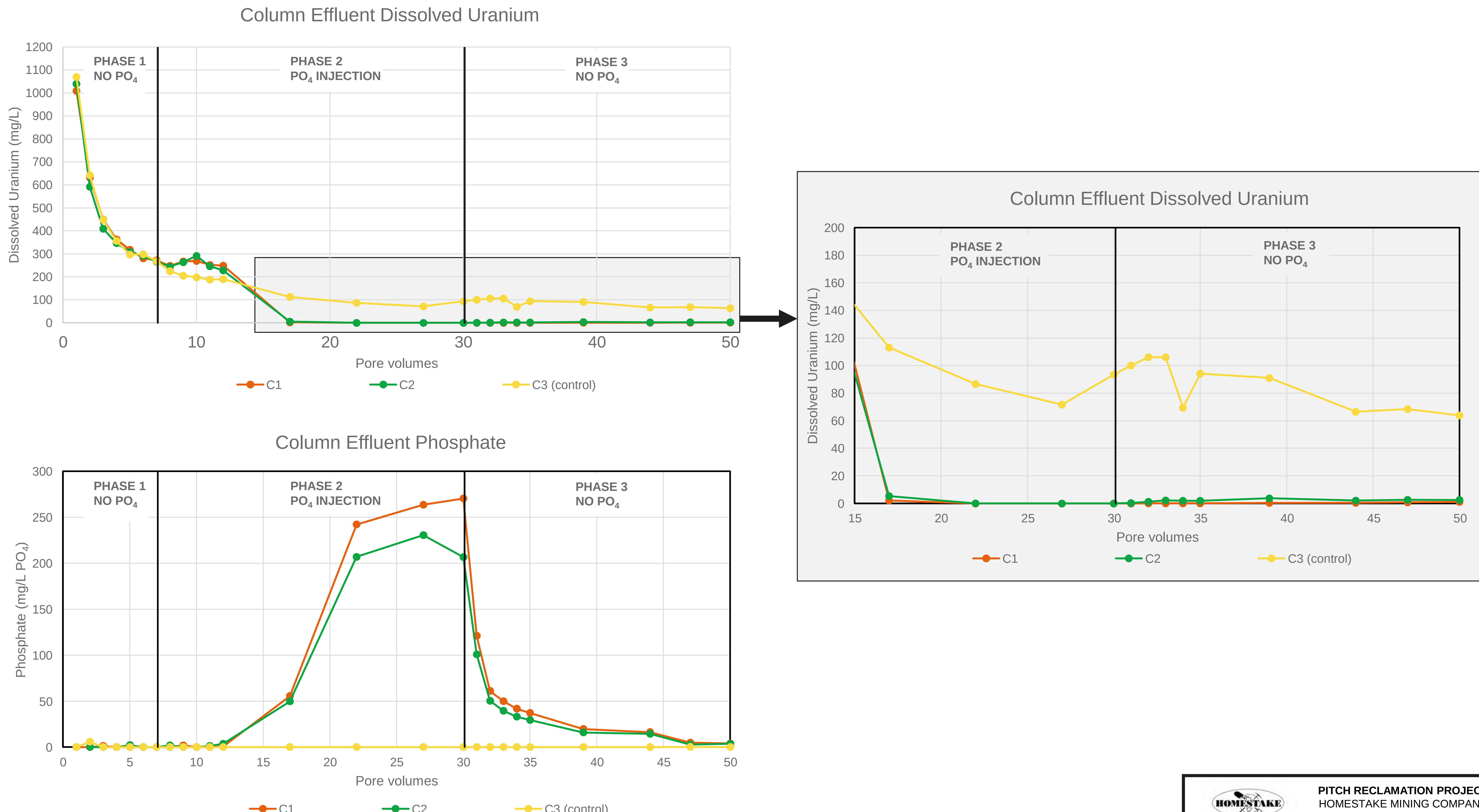
SARGENTS, COLORADO

SURFACE WATER MANAGEMENT

ARCADIS

FIGURE
6

Path: T:_ENV\AO000102_Pitch\GIS\MXD\2022\2022-02\Fig_6_Surface_Water_Management.mxd Date Saved: 2/23/2022 12:44:43 PM



Notes:
mg/L = milligrams per liter
PO_4 = phosphate

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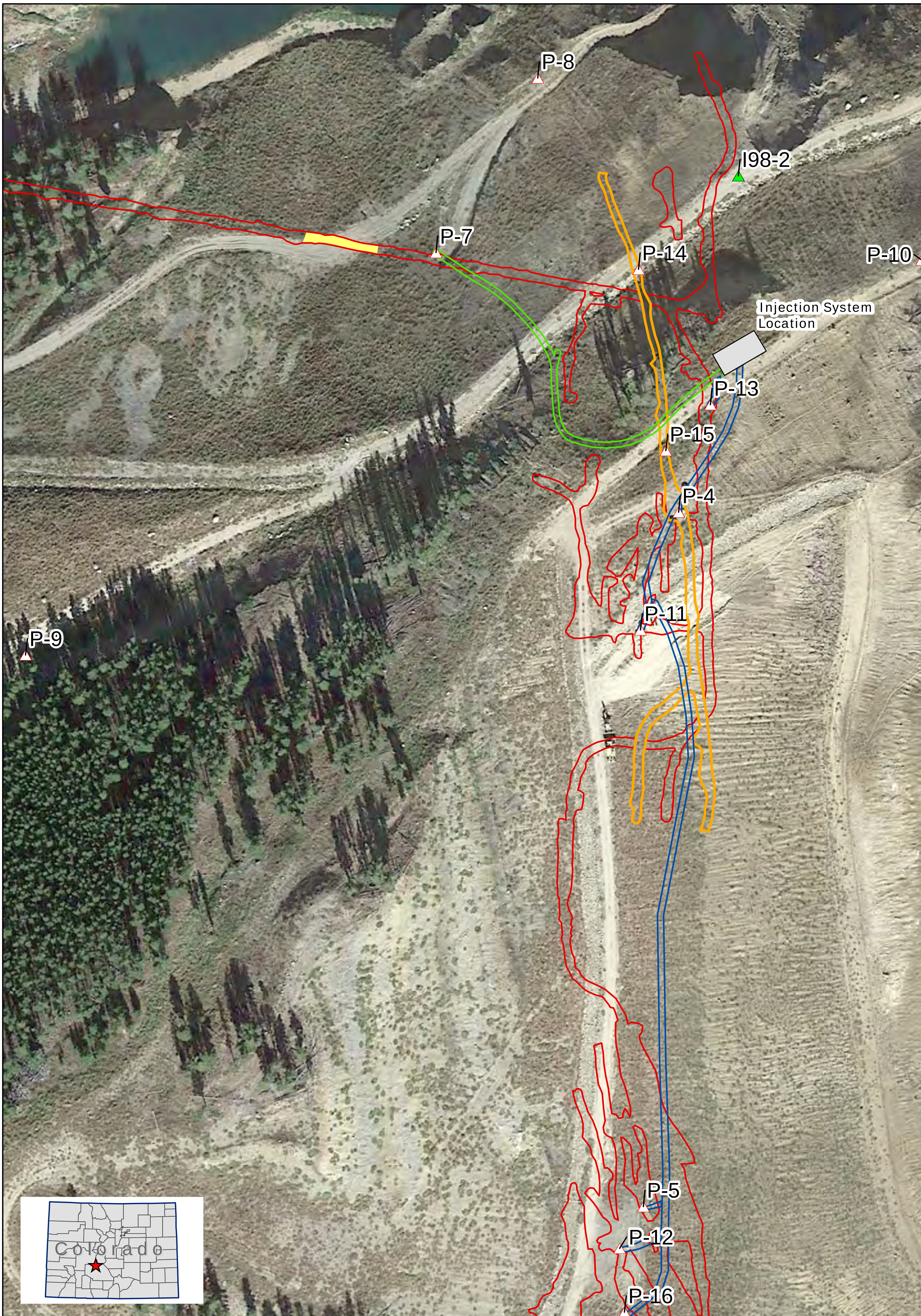
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

URANIUM PASSIVATION COLUMN TESTS RESULTS

ARCADIS

FIGURE
7



Legend

- Existing Monitoring/Recirculation Well
- Inclinometer
- Surface Water Sampling Point
- Injection System Location
- Extraction Piping (approximate)
- Injection Piping (approximate)
- 10,300 Level Underground Mine Workings
- 10,500 Level Underground Mine Workings
- Pinnacle Adit Plug

Feet
0 50 100

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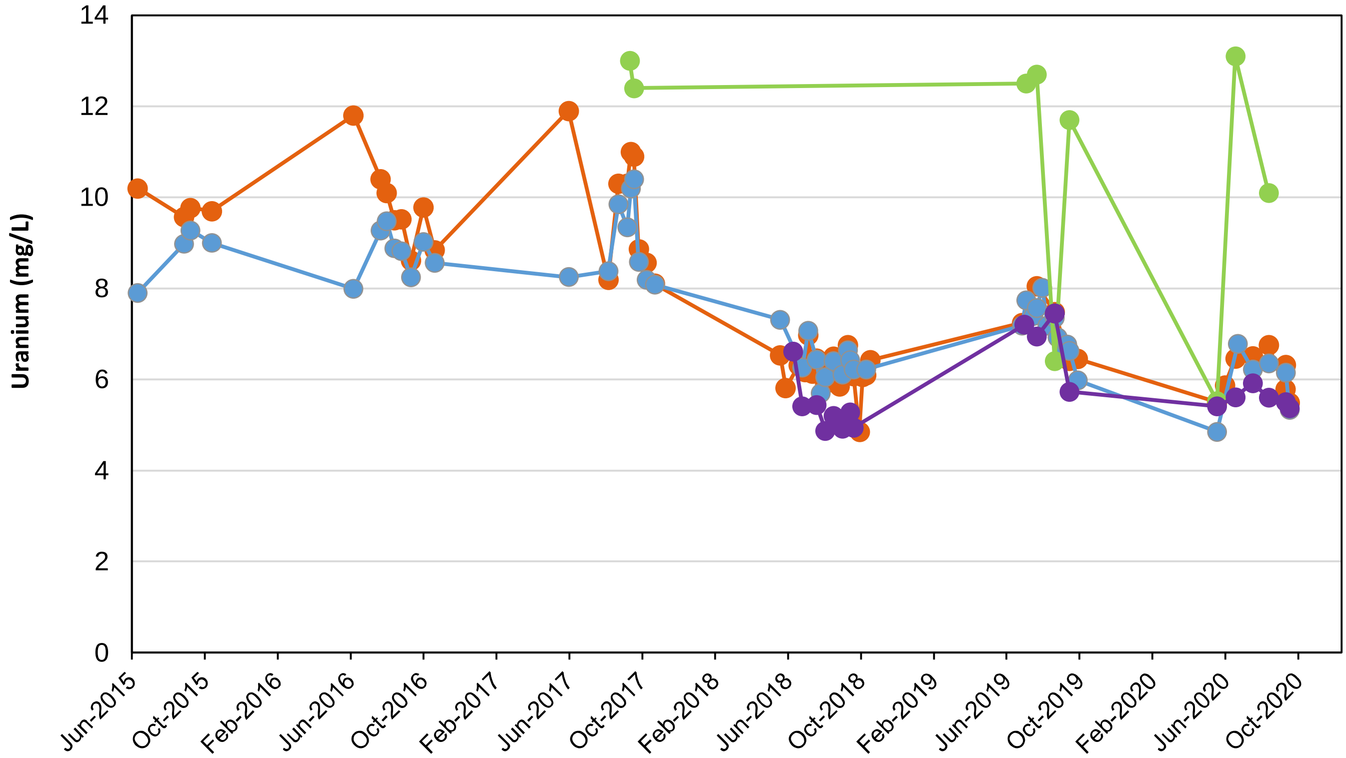
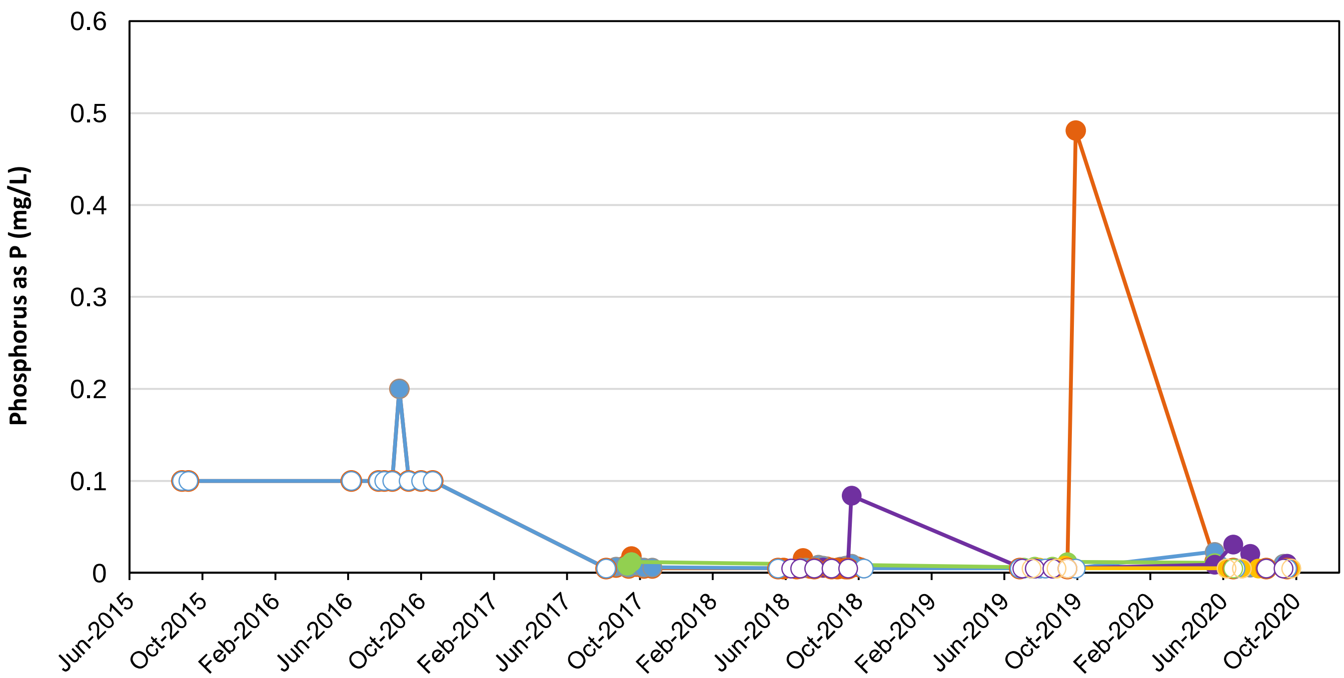
UNDERGROUND WORKINGS SYSTEM
PHOSPHATE INJECTION NETWORK

ARCADIS

FIGURE
8

Last Saved By: avi00976
T:_ENV\AO000102_Pitch\GIS\MXD\2020\2020-12\Figure 3-3 UW Phosphate Injection NetworkAS.mxd 1/21/2021 12:14:43 PM





- CFS
- CFS-2
- CFS-3
- CFS-4

mg/L = milligrams per liter
Detects indicated by full marker and non-detects indicated by open marker. Reporting limit is used for non-detects.
The CFS-3 9/5/2019 value is lower than expected; sample may have been collected from an incorrect location.

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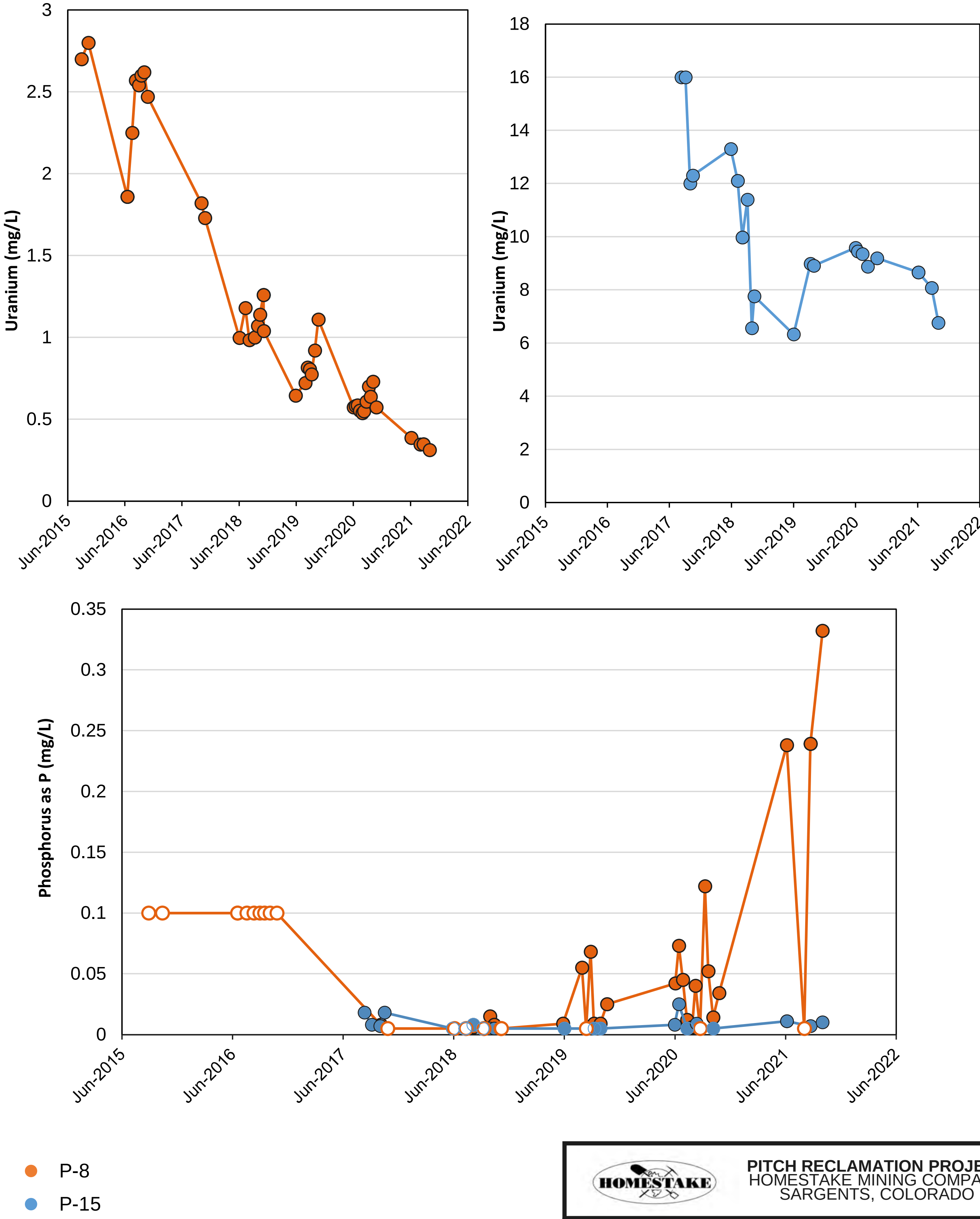
CHESTER FAULT SPRINGS URANIUM AND PHOSPHORUS RESULTS

ARCADIS

FIGURE
9



mg/L = milligrams per liter
Detects indicated by full marker and non-detects indicated by open marker. Reporting limit is used for non-detects.
Phosphorus data prior to 2017 are not shown due to higher reporting limit (0.1 mg/L).

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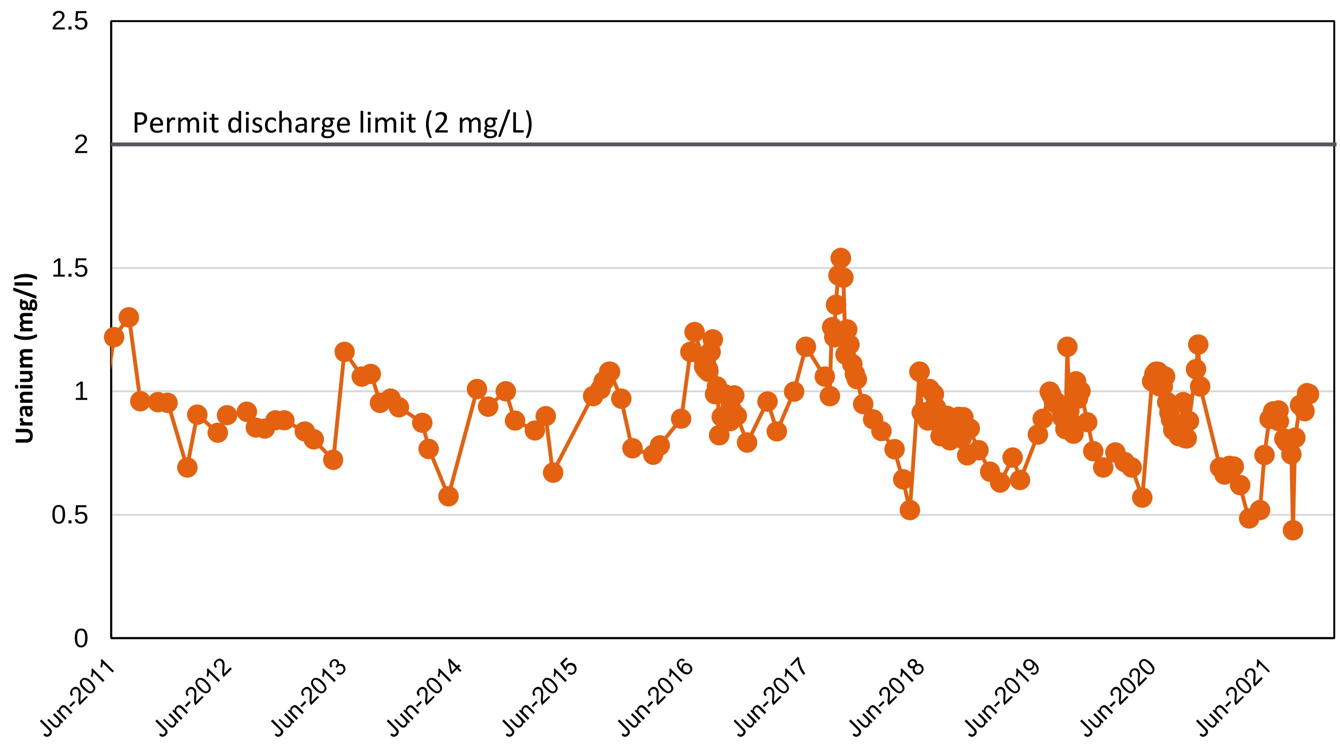
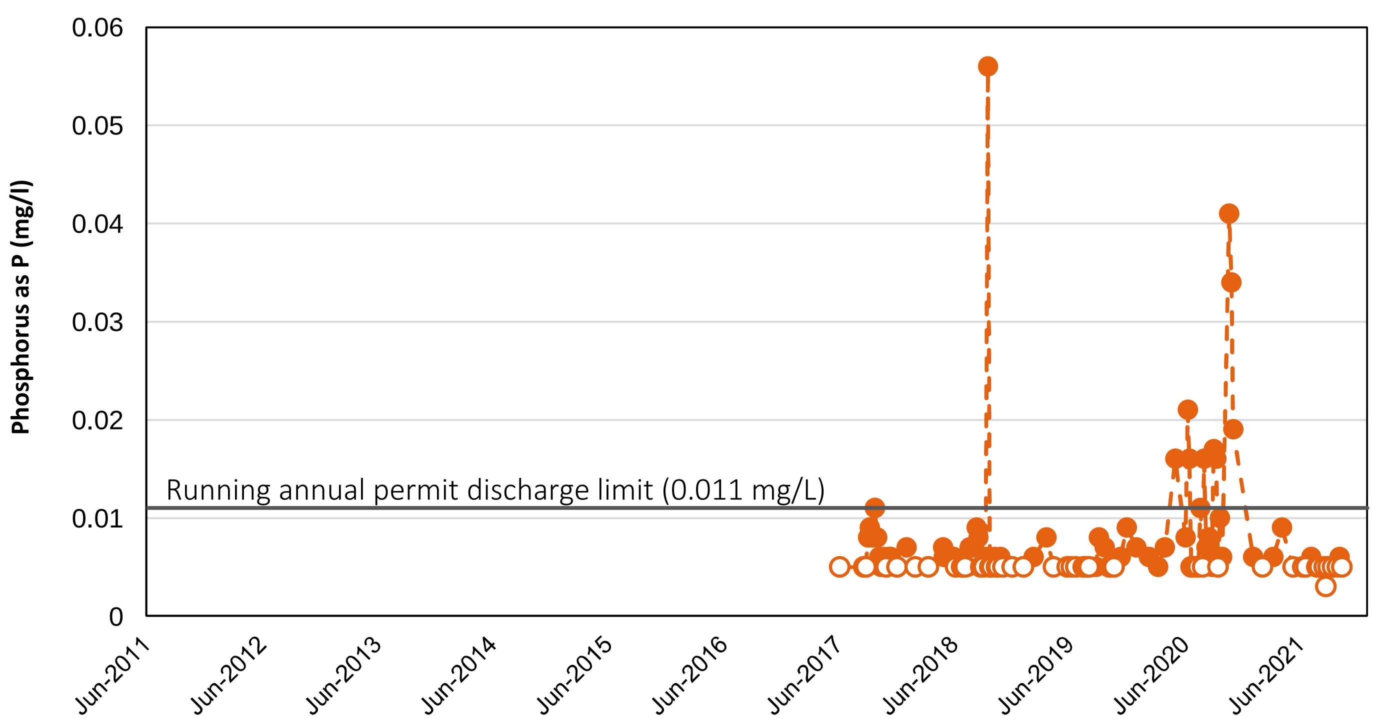
UNDERGROUND MINE WORKINGS
URANIUM AND PHOSPHORUS RESULTS

ARCADIS

FIGURE
10





● SW-33

mg/L = milligrams per liter
Detects indicated by full marker and non-detects indicated by open marker. Reporting limit is used for non-detects.
Phosphorus data prior to 2017 are not shown due to higher reporting limit (0.1 mg/L)

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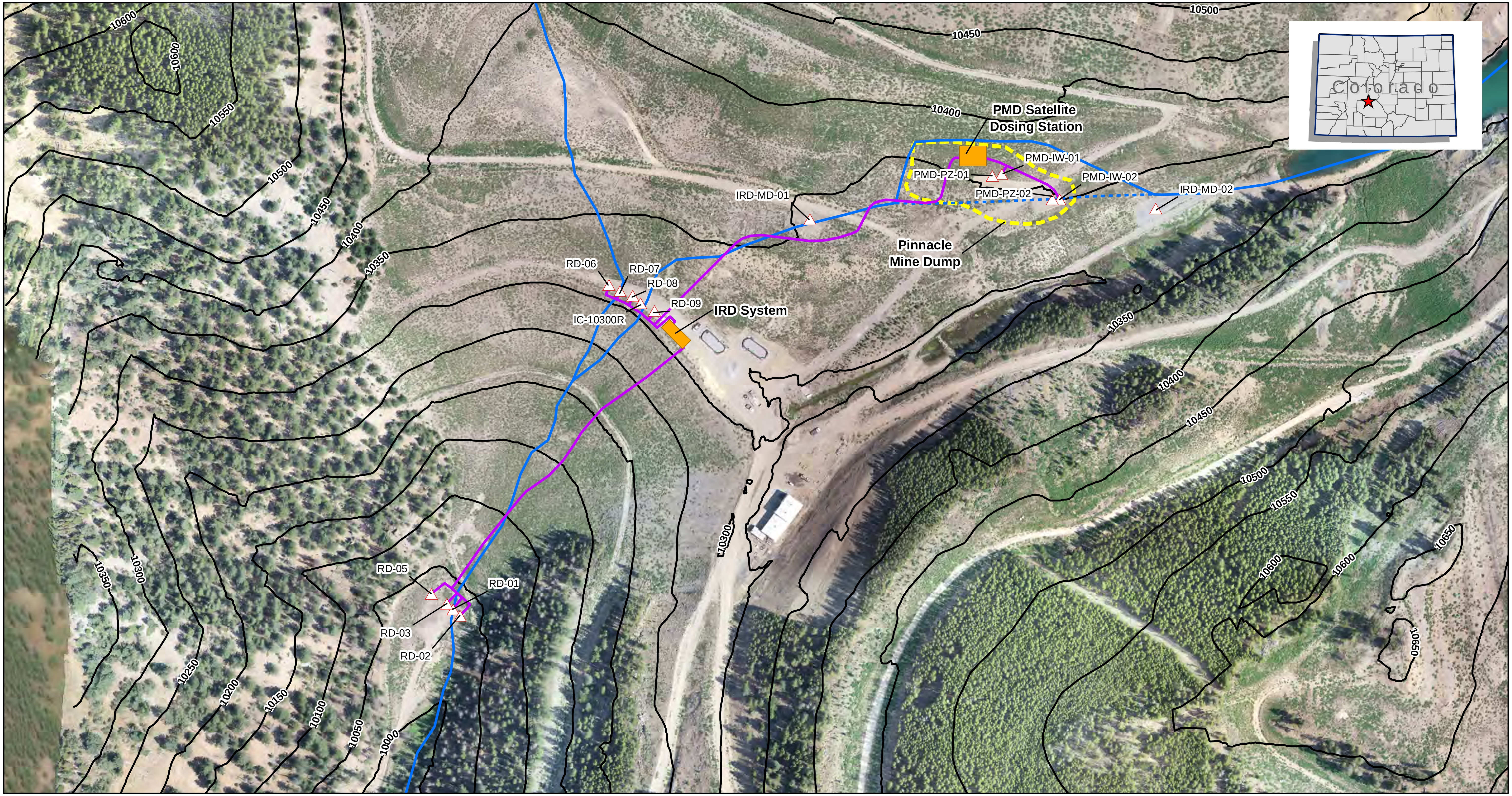
SW-33 URANIUM AND PHOSPHORUS RESULTS

ARCADIS

FIGURE
11



Legend

- Injection and Monitoring Wells
- Piping Line
- Former Surface Water Drainage (pre-PMD emplacement)
- Underground Former Surface Water Drainage (pre-PMD emplacement)
- Former Leach Pad Area

IRD = Indian Rock Dump
PMD = Pinnacle Mine Dump

0 250 500
SCALE IN FEET

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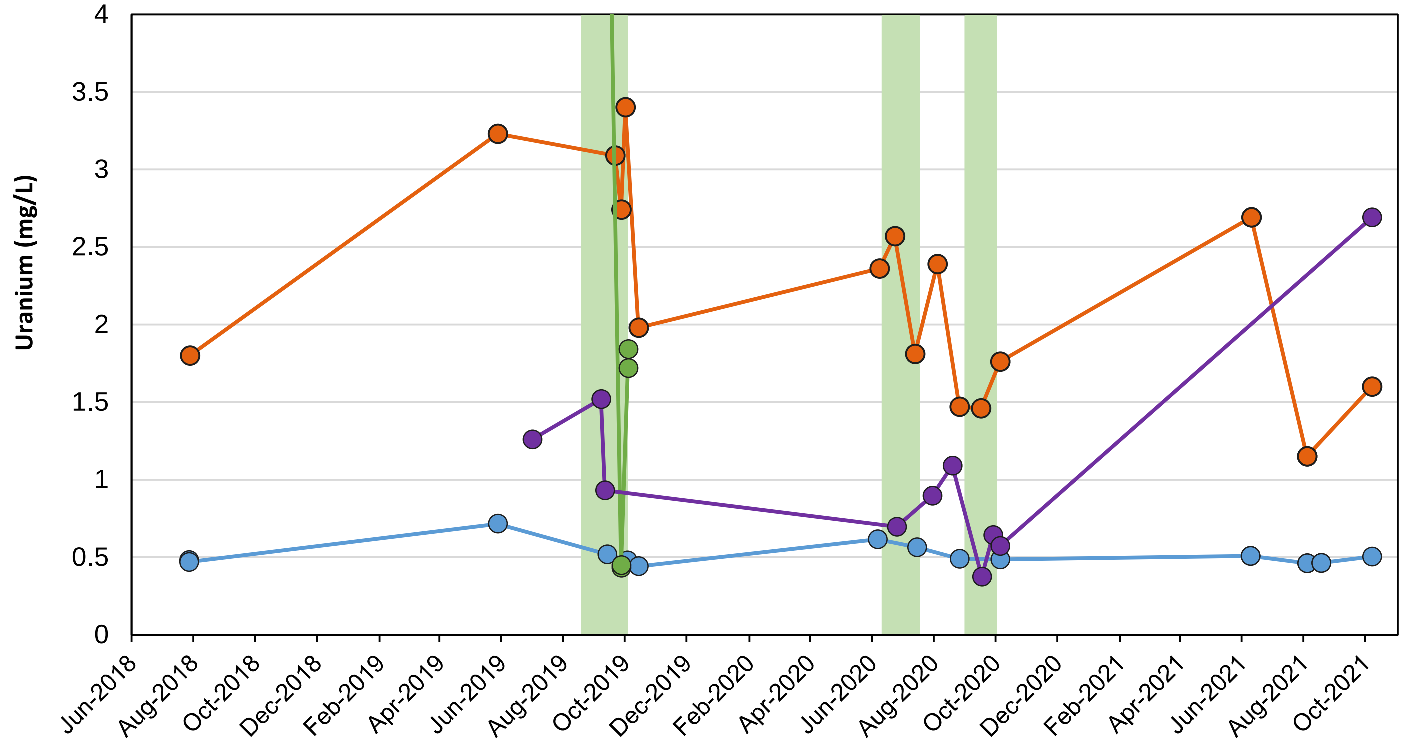
SARGENTS, COLORADO

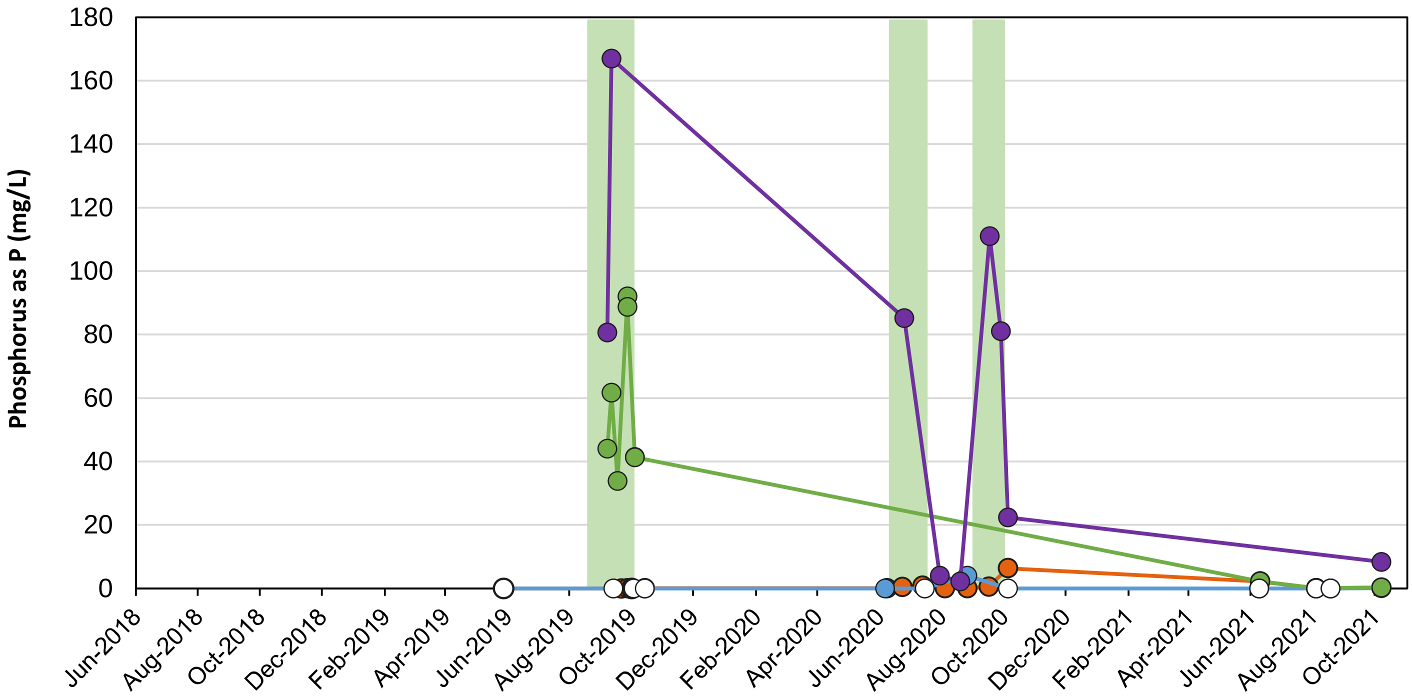
IRD PHOSPHATE INJECTION NETWORK

ARCADIS

FIGURE
12

Path: T:\ENVA0000102_Pitch\GIS\MXD\2020\2020-12\Figure 3-11 IRD system injection summary_V2.mxd Date Saved: 4/7/2021 10:44:54 AM





IRD-MD-01
IRD-MD-02
PMD-PZ-01
PMD-PZ-02

Injection into PMD

mg/L = milligrams per liter
PMD = Pinnacle Mine Dump
Detects indicated by full marker and non-detects indicated by open marker. Reporting limit is used for non-detects.

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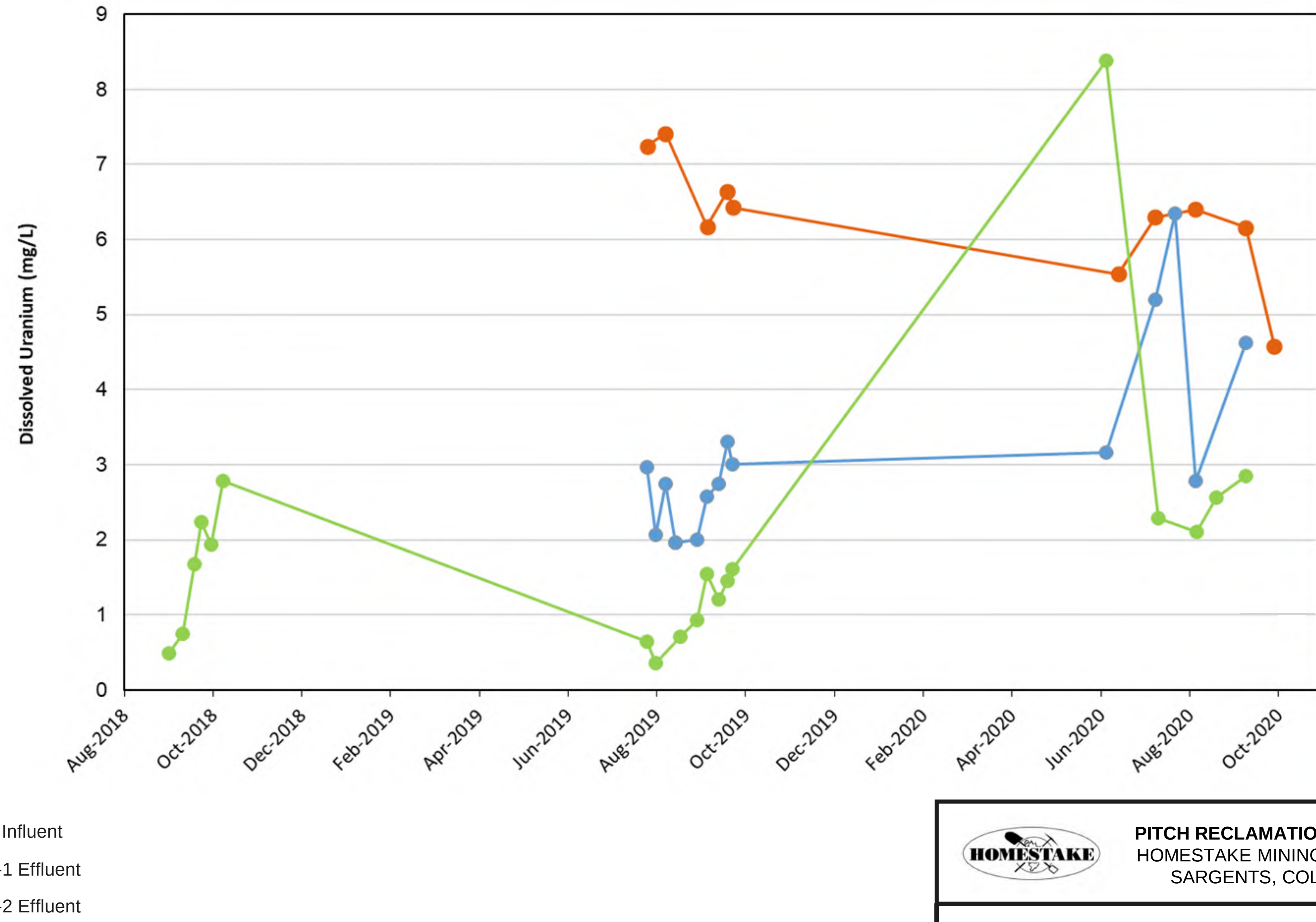
PMD MONITORING WELLS URANIUM AND PHOSPHORUS RESULTS

ARCADIS

FIGURE
13



Notes:
CFS = Chester Fault Springs
ETC = Engineered Treatment Cell
mg/L = milligrams per liter

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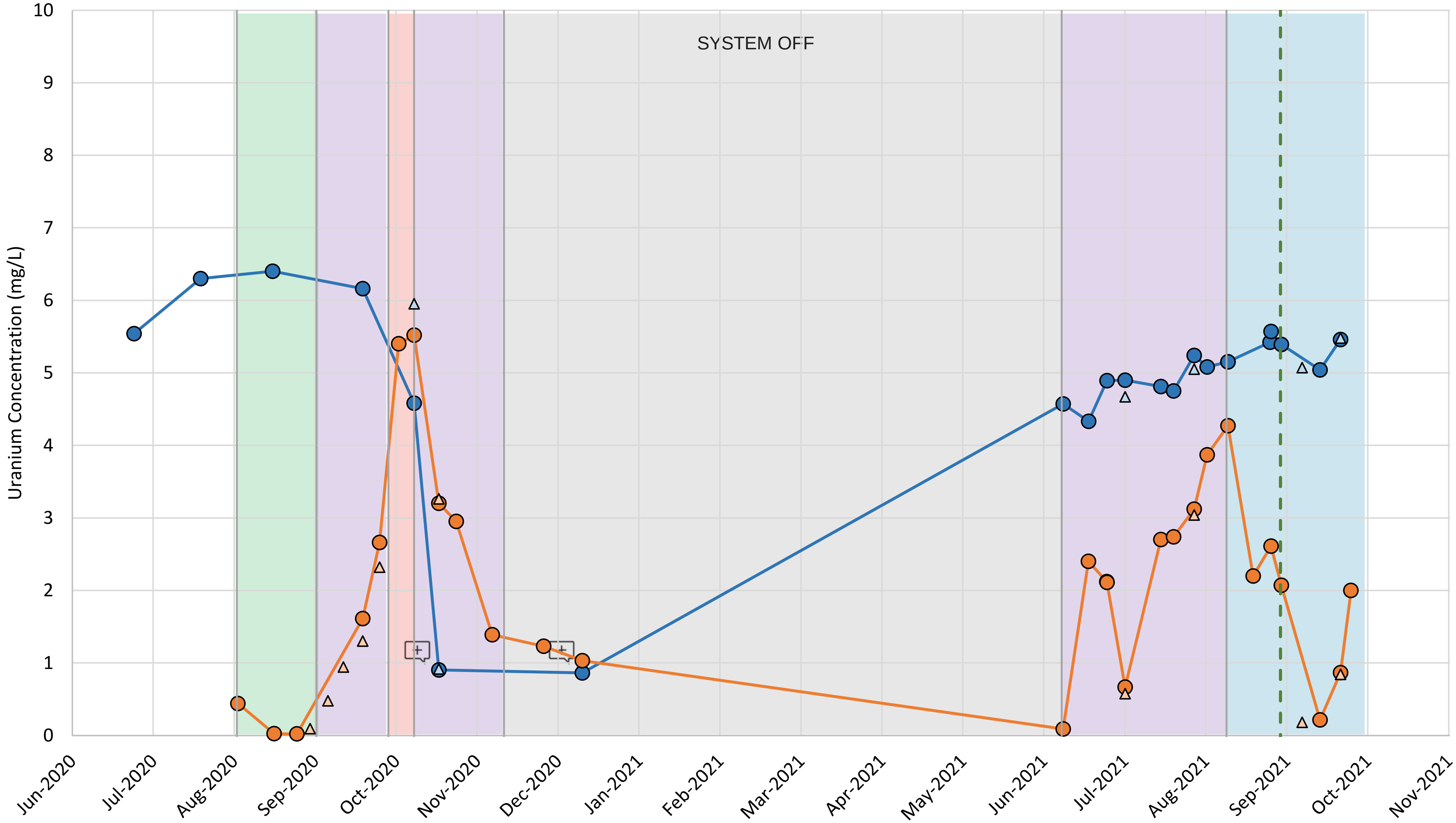
ETC-1 AND ETC-2 URANIUM RESULTS

ARCADIS

FIGURE
14



DISSOLVED TOTAL
Influent
Effluent
Cell dosed with emulsified vegetable oil (EVO)
Influent water temporarily switch to NPL water for winter operation

12-hour HRT
24-hour HRT
36-hour HRT
48-hour HRT

EVO = emulsified vegetable oil
HRT = Hydraulic Retention Time
mg/L = milligrams per liter

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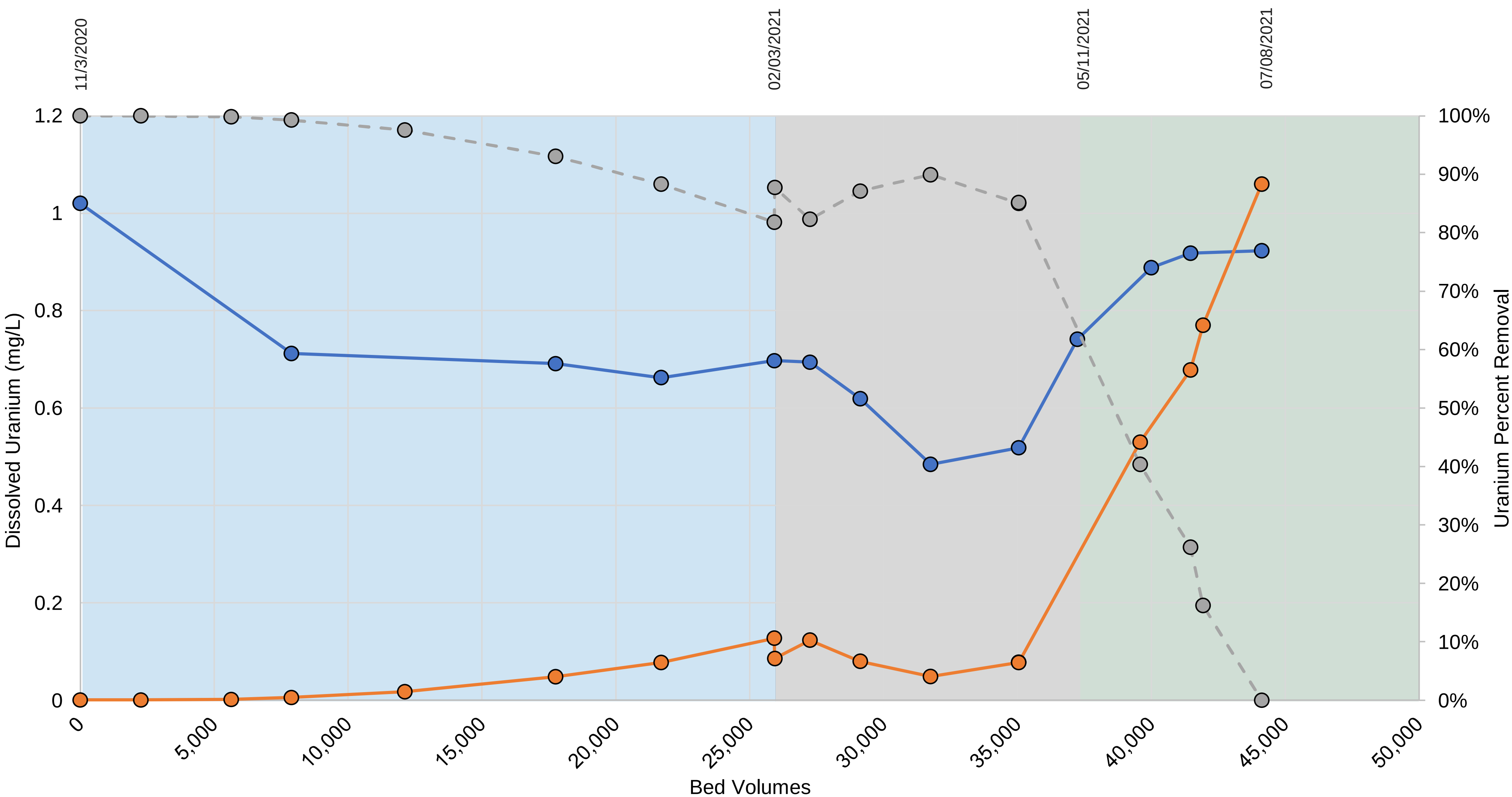
2020 ETC3
URANIUM RESULTS

ARCADIS

FIGURE
15



SW-33 (Column Influent)

FS20-IX-EFF (Column Effluent)

Percent Removal

4-minute EBCT (11/3/2020-2/3/2021)

15-minute EBCT (2/3/2021-5/11/2021)

10-minute EBCT (5/11/2021-7/8/2021)

Notes:

1. Percent removal was calculated using influent/effluent concentrations taken within 24 hours. Where concurrent influent/effluent concentrations were unavailable, influent data were interpolated to estimate percent removal.

EBCT = empty bed contact time

mg/L = milligram per liter

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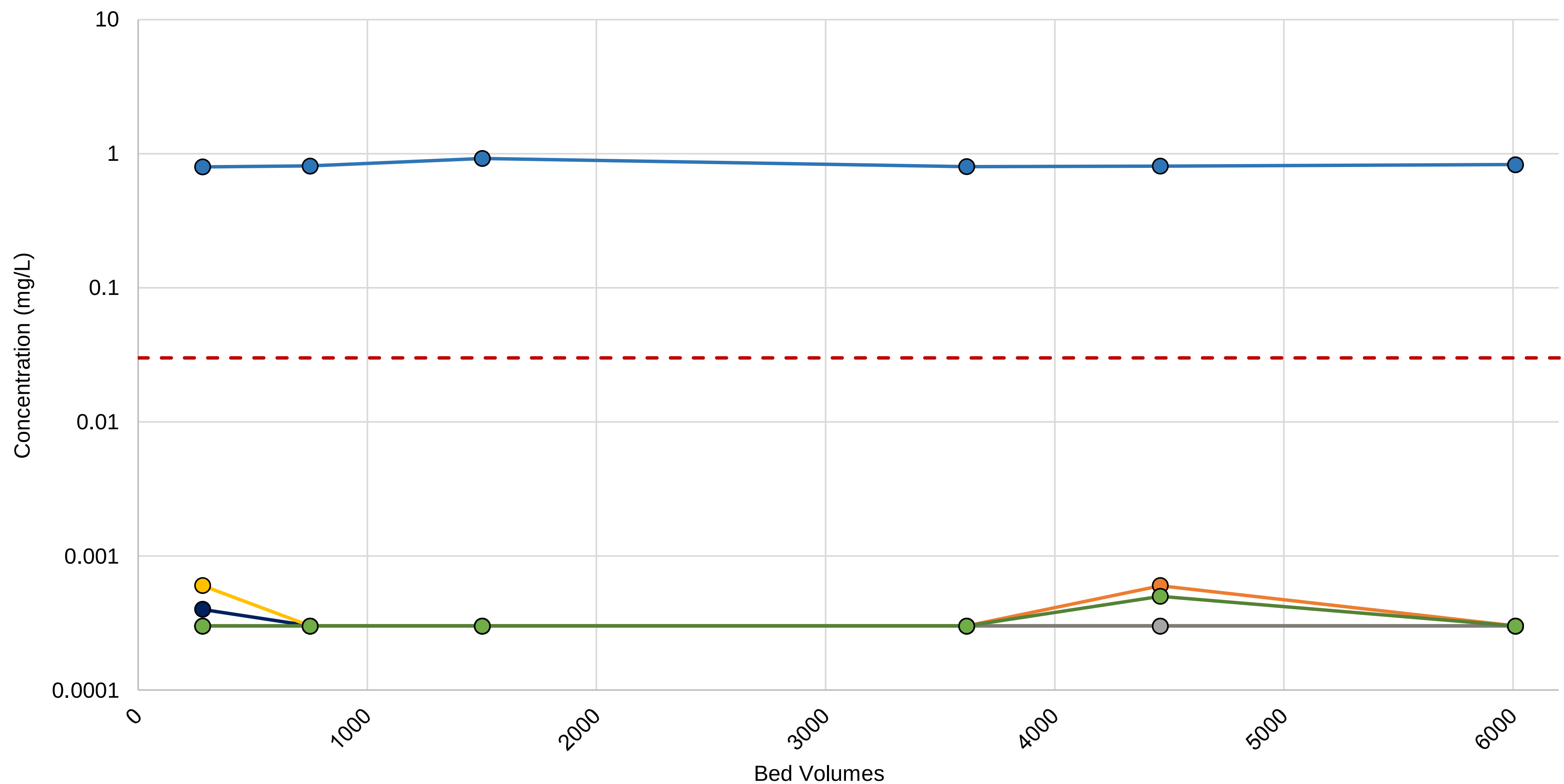
SW-33 ION EXCHANGE COLUMN URANIUM TREATMENT RESULTS

ARCADIS

FIGURE
16



Influent from NPL Surface Water (FS21-IX-NPL-INF)

Column 1 - Purolite PGW6002E Resin (FS21-IX-NPL1-EFF)

Column 2 - Purofine PFA300 Resin (FS21-IX-NPL2-EFF)

Column 3 - Ambersep 21K XLT Resin (FS21-IX-NPL3-EFF)

Column 4 - Amberlite PWA17 Resin (FS21-IX-NPL4-EFF)

Column 5 - Puromet MT A6002PF Resin (FS21-IX-NPL5-EFF)

Marshall Creek Water Supply Use Standard = 0.03 mg/L

Notes:
mg/L = milligram per liter
NPL = North Pit Lake

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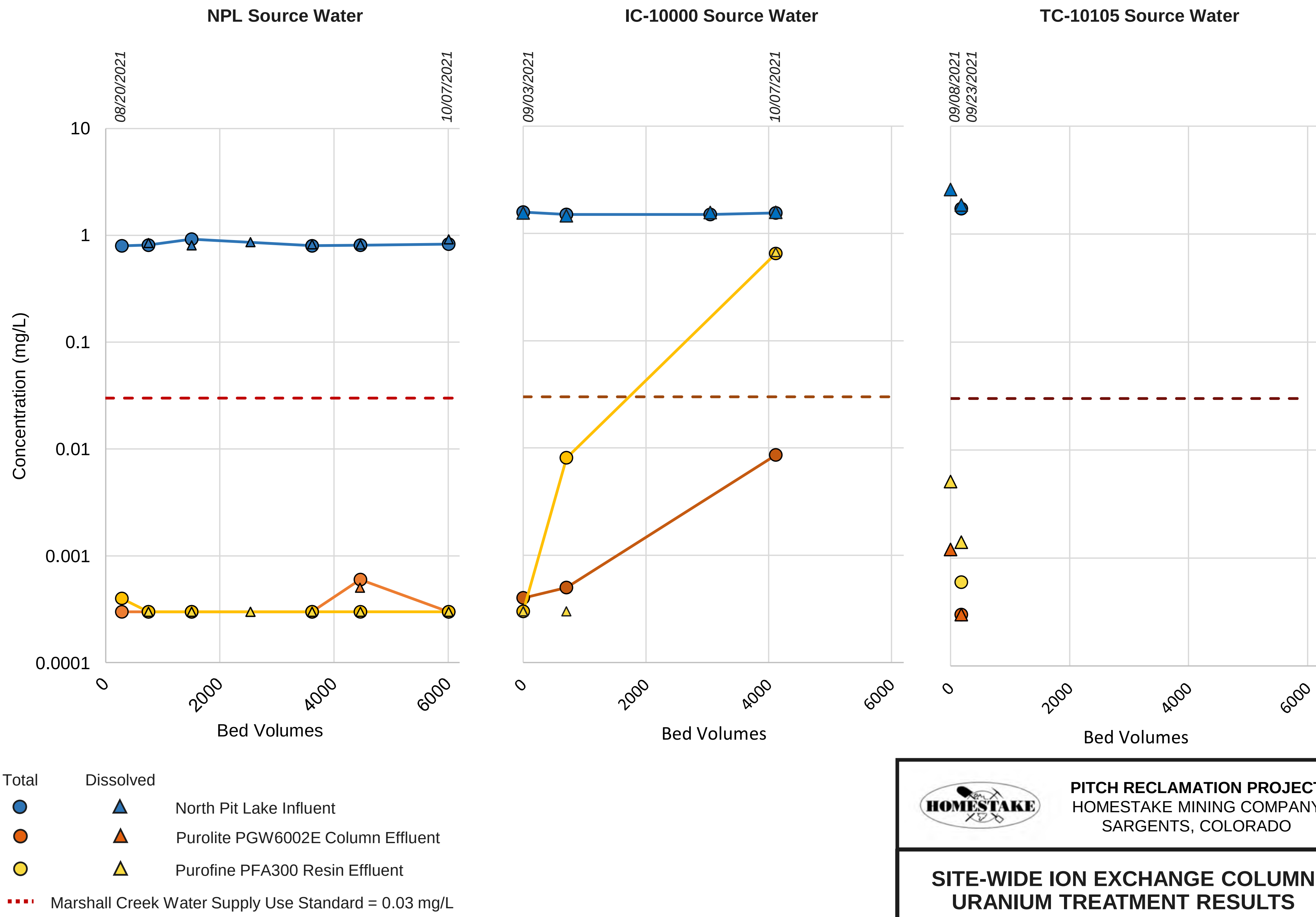
NORTH PIT LAKE ION EXCHANGE COLUMN URANIUM TREATMENT RESULTS

ARCADIS

FIGURE
17



Note:
mg/L = milligram per liter

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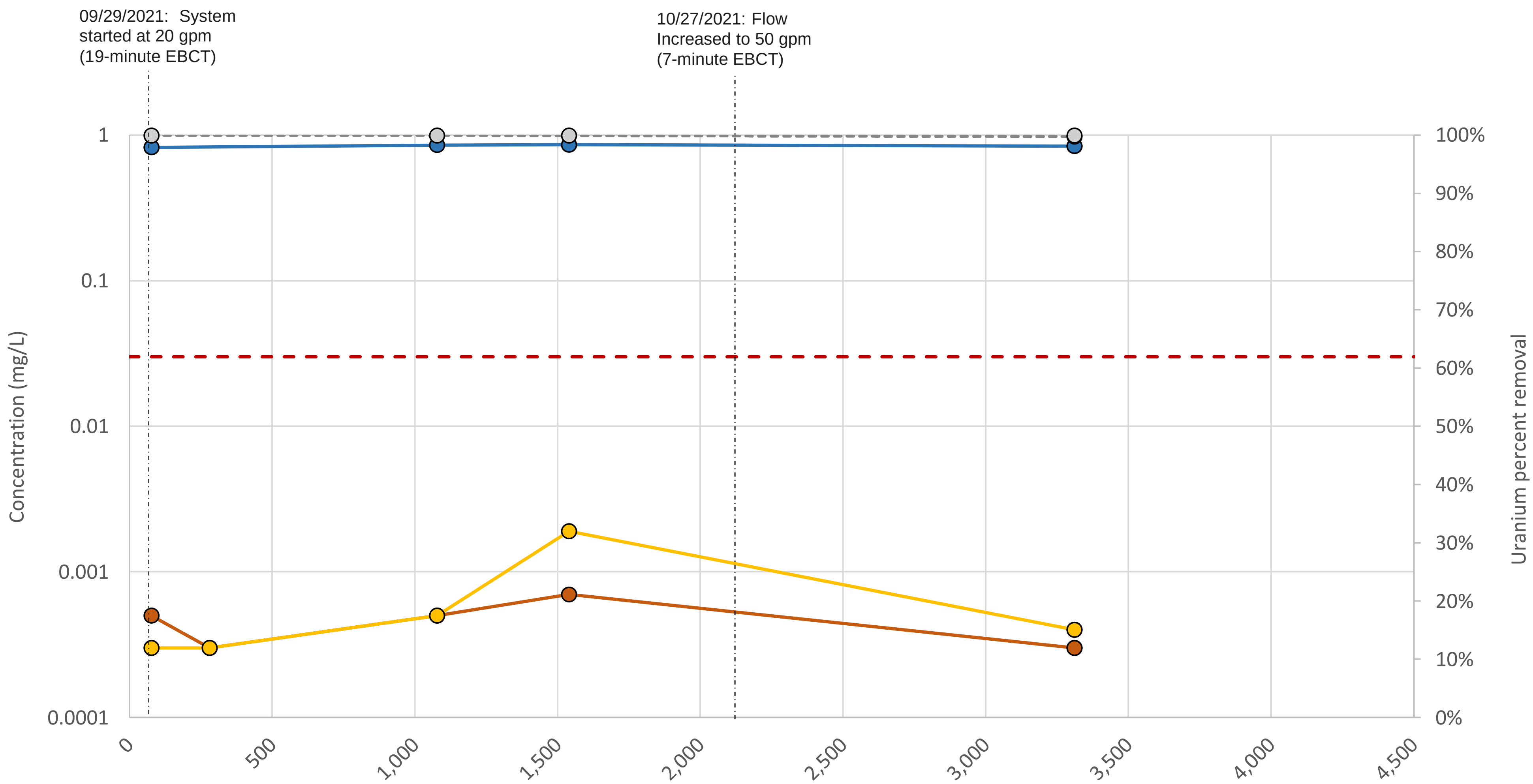
SARGENTS, COLORADO

SITE-WIDE ION EXCHANGE COLUMN URANIUM TREATMENT RESULTS

ARCADIS

FIGURE
18



Legend

- Influent (FS21-IX-INF)
- Midpoint, between lead and lag vessels (FS21-IX-2)
- Effluent (FS21-IX-EFF)
- Uranium percent removal (based on system effluent)
- Marshall Creek Water Supply Use Standard = 0.03 mg/L

Notes:

EBCT = empty bed contact time
gpm = gallon per minute
mg/L = milligram per liter
IX = ion exchange

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ION EXCHANGE FIELD DEMONSTRATION
URANIUM TREATMENT RESULTS

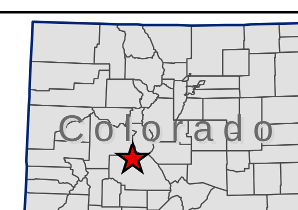
ARCADIS

FIGURE
19

Legend

- Mainstem Flow Profile Location
- Tributary Inflow Profile Location
- Diversion or Outflow Profile Location
- Indian Creek
- Marshall Creek
- Tomichi Creek

Note:
The precise location of SW-9A fluctuates east or west by approximately 0.1 mile depending on conditions at the time of monitoring.



0 1 2 Miles

PITCH RECLAMATION PROJECT
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INDIAN CREEK AND MARSHALL CREEK MONITORING LOCATIONS

ARCADIS

FIGURE 20

Path: T:_ENV\AO000102_Pitch\GIS\MXD\2021\2021-03\Fig_3-MC and IC Monitoring Locations.mxd | Last Saved By: vri00988 | Last Saved On: 3/18/2021

Path: T:_ENV\AO000102_PitchGIS\MXD\2021\2021-11\Figure F-1_SargentsMonitoringLocations.mxd

Legend

- Groundwater Well
- Surface Water Monitoring Point
- Irrigation Ditch Sample
- Surveyed Irrigation Ditch Location 2018
- Diversion Irrigation Ditch
- Culvert (Approximate)
- Marshall Creek
- Former Ore Stockpile Approximate Location

Notes:

1. All Data from Colorado Department of Natural Resources (CDNR) Aquamap GIS database unless otherwise noted.
2. USPS well was replaced by the HMC Office Well in October 2014.
3. D& RGW = Denver and Rio Grande Western Railway.

Feet
0 100 200

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SARGENTS, COLORADO

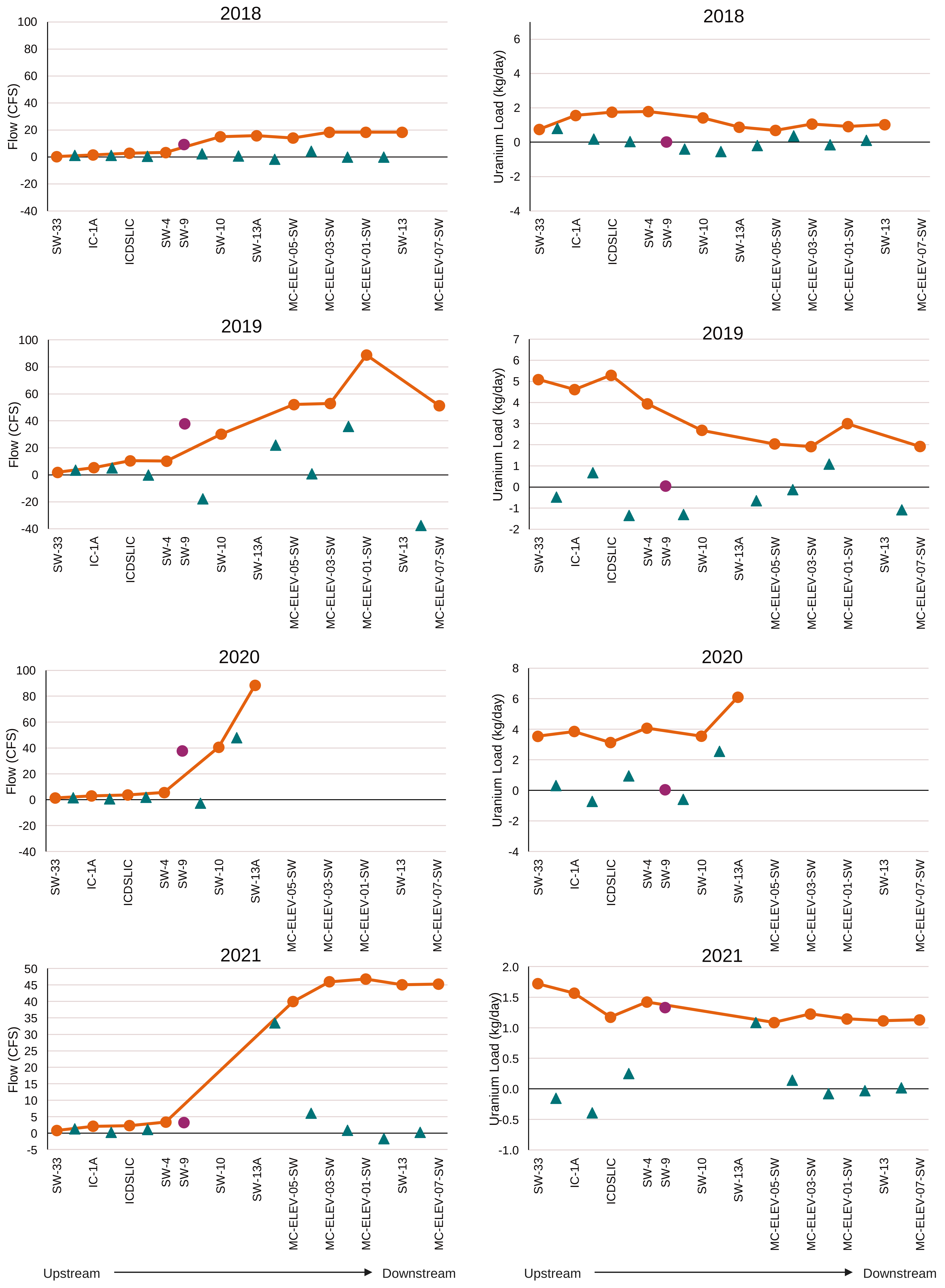
MARSHALL CREEK AND SARGENTS WATER SAMPLE LOCATIONS

ARCADIS

FIGURE
21

High Flow Surface Water Flows

High Flow Uranium Mass Flux



Legend

- Mainstem Indian Creek/Marshall Creek location
- Marshall Creek upstream of confluence with Indian Creek
- Gain/Loss from previous measured mainstem location

Notes

CFS = cubic feet per second
kg/day = kilograms per day

3/2/2022 9:59:04 AM

HOMESTAKE

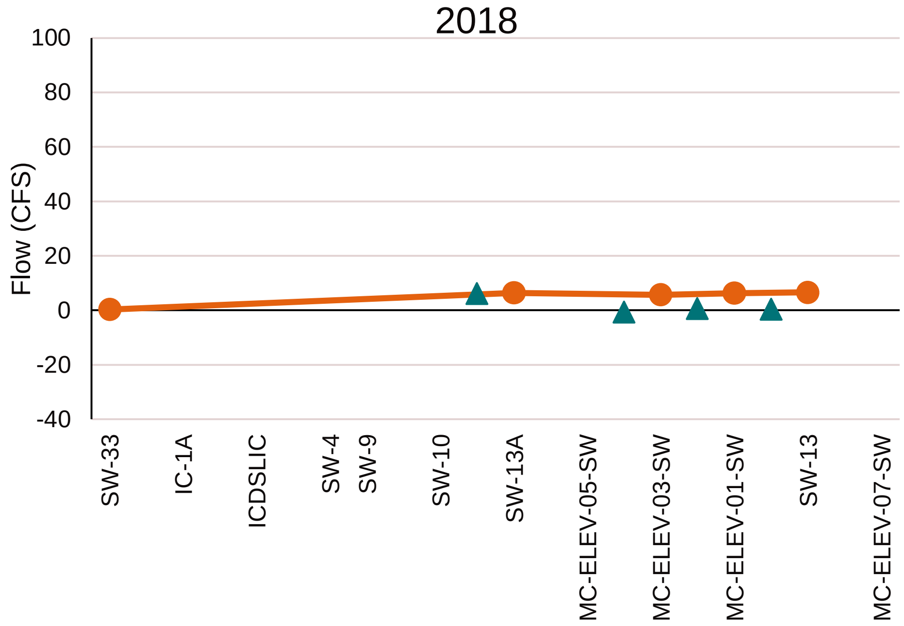
PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

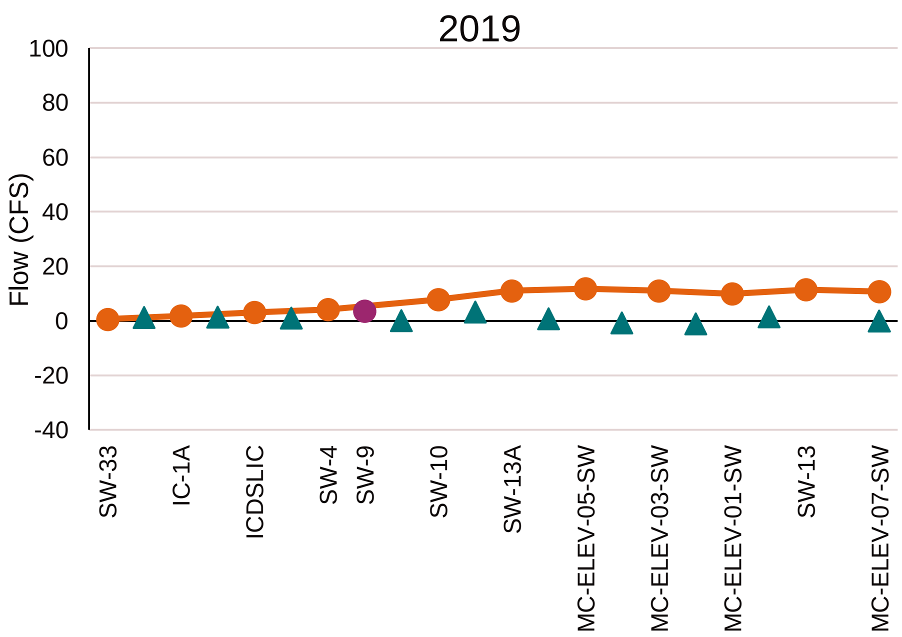
MARSHALL CREEK SURFACE WATER AND URANIUM LOAD GAIN/LOSS – HIGH FLOW

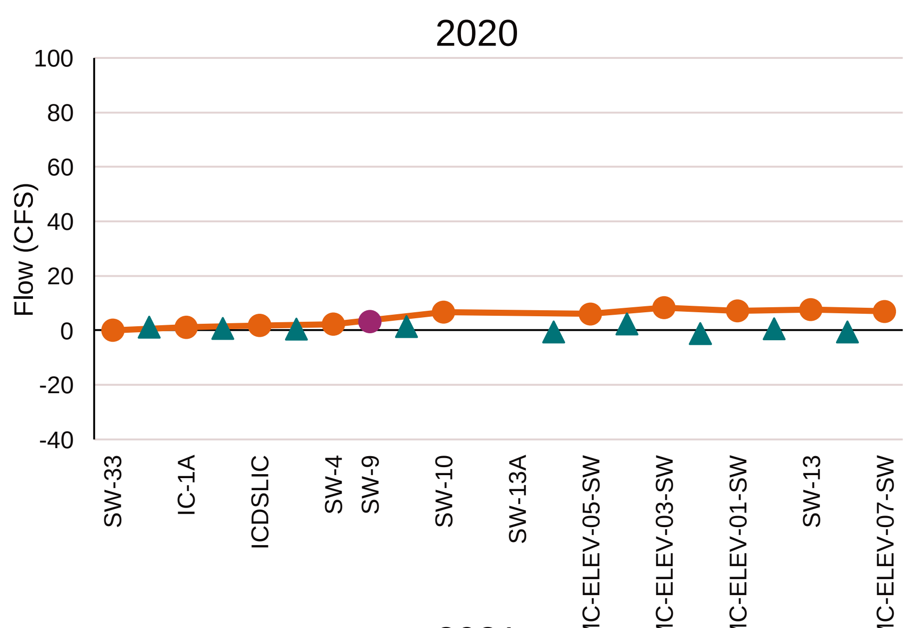
ARCADIS

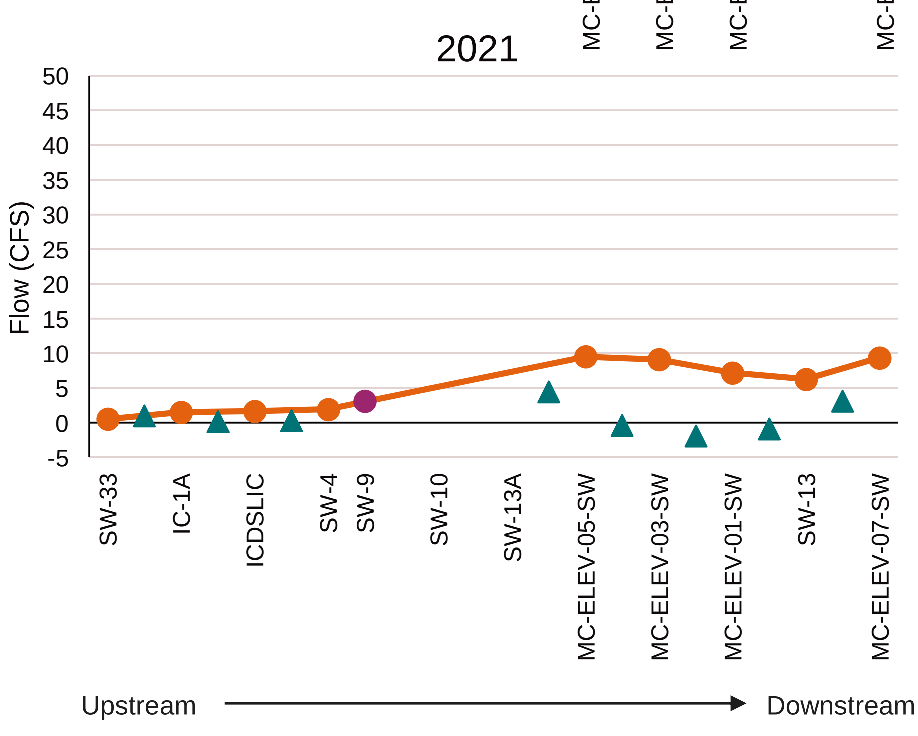
FIGURE
22a

Low Flow Surface Water Flows

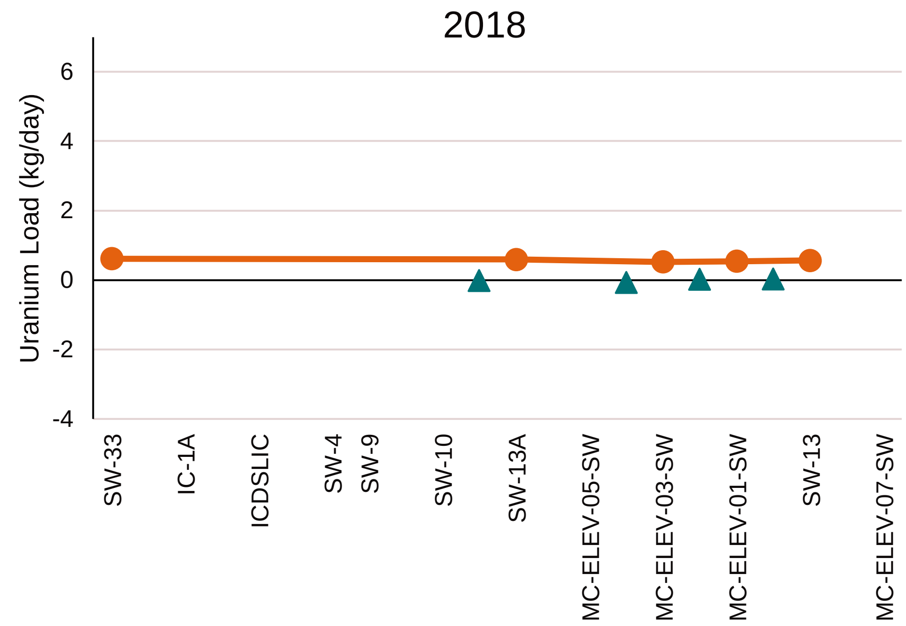


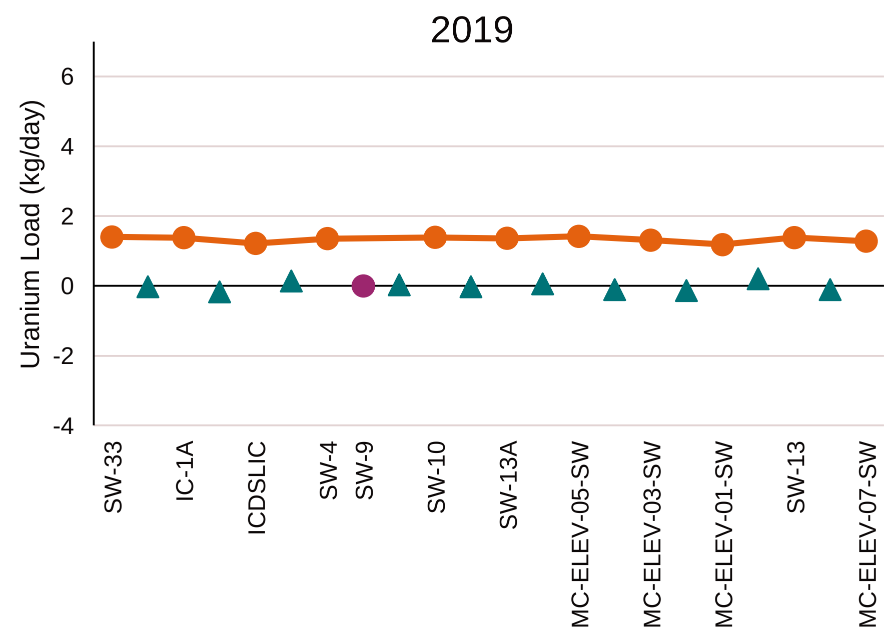


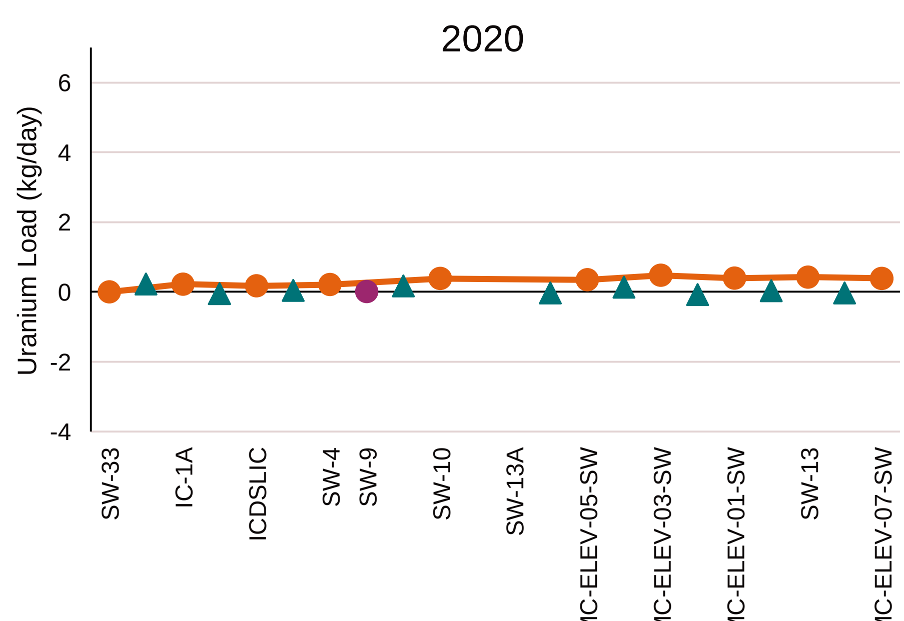


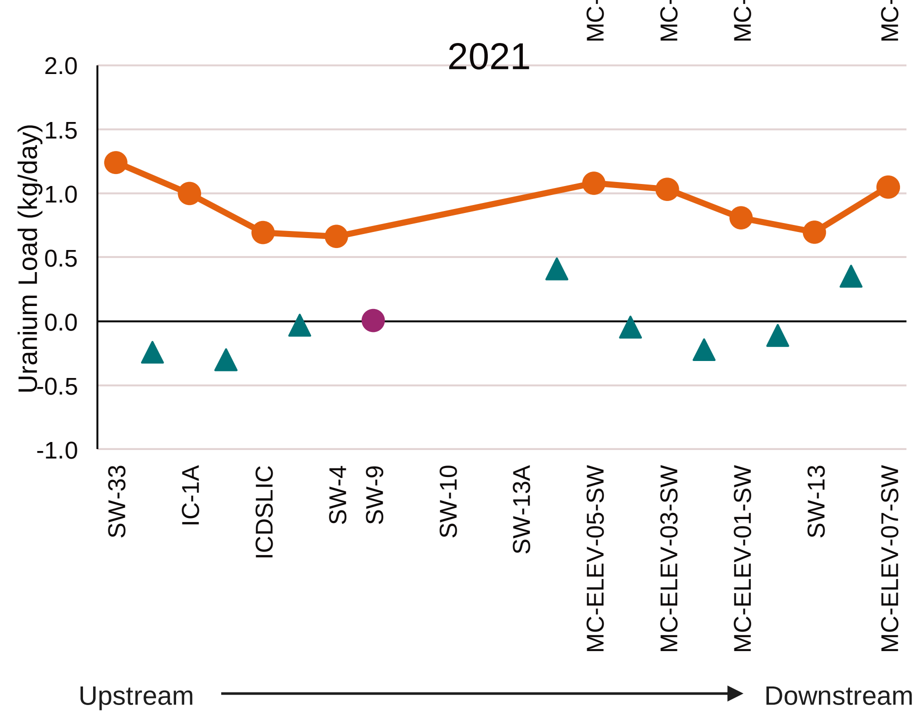


Low Flow Uranium Mass Flux









Legend

- Mainstem Indian Creek/Marshall Creek location
- Marshall Creek upstream of confluence with Indian Creek
- Gain/Loss from previous measured mainstem location

Notes

CFS = cubic feet per second
kg/day = kilograms per day

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

MARSHALL CREEK SURFACE WATER AND URANIUM LOAD GAIN/LOSS – LOW FLOW

ARCADIS

FIGURE
22b

3/2/2022 9:59:05 AM

Legend

- Groundwater Well
- Surface Water Monitoring Point
- Surveyed Irrigation Ditch Location 2018
- Diversion Irrigation Ditch
- Culvert (Approximate)
- Groundwater Flow Direction
- Potentiometric Contour
- Marshall Creek
- Former Ore Stockpile Approximate Location

Notes:
1. All Data from Colorado Department of Natural Resources (CDNR) Aquamap GIS database unless otherwise noted.
2. USPS well was replaced by the HMC Office Well in October 2014.
3. D& RGW = Denver and Rio Grande Western Railway.
4. *Groundwater Elevation not Used in Contouring.

N

0 100 200 Feet

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

SARGENTS POTENTIOMETRIC SURFACE MAP, HIGH-FLOW 2021

ARCADIS

FIGURE 23

Path: T:_ENV\AO000102_Pitch\GIS\MXD\2021\2021-11\Figure F-3_Sargents Potentiometric Surface Map High flow 2021_V1.mxd

Legend

- Groundwater Well
- Surface Water Monitoring Point
- Surveyed Irrigation Ditch Location 2018
- Diversion Irrigation Ditch
- Culvert (Approximate)
- Groundwater Flow Direction
- Potentiometric Contour
- Marshall Creek
- Former Ore Stockpile Approximate Location

Notes:
1. All Data from Colorado Department of Natural Resources (CDNR) Aquamap GIS database unless otherwise noted.
2. USPS well was replaced by the HMC Office Well in October 2014.
3. D& RGW = Denver and Rio Grande Western Railway.

N

0 100 200 Feet

HOMESTAKE

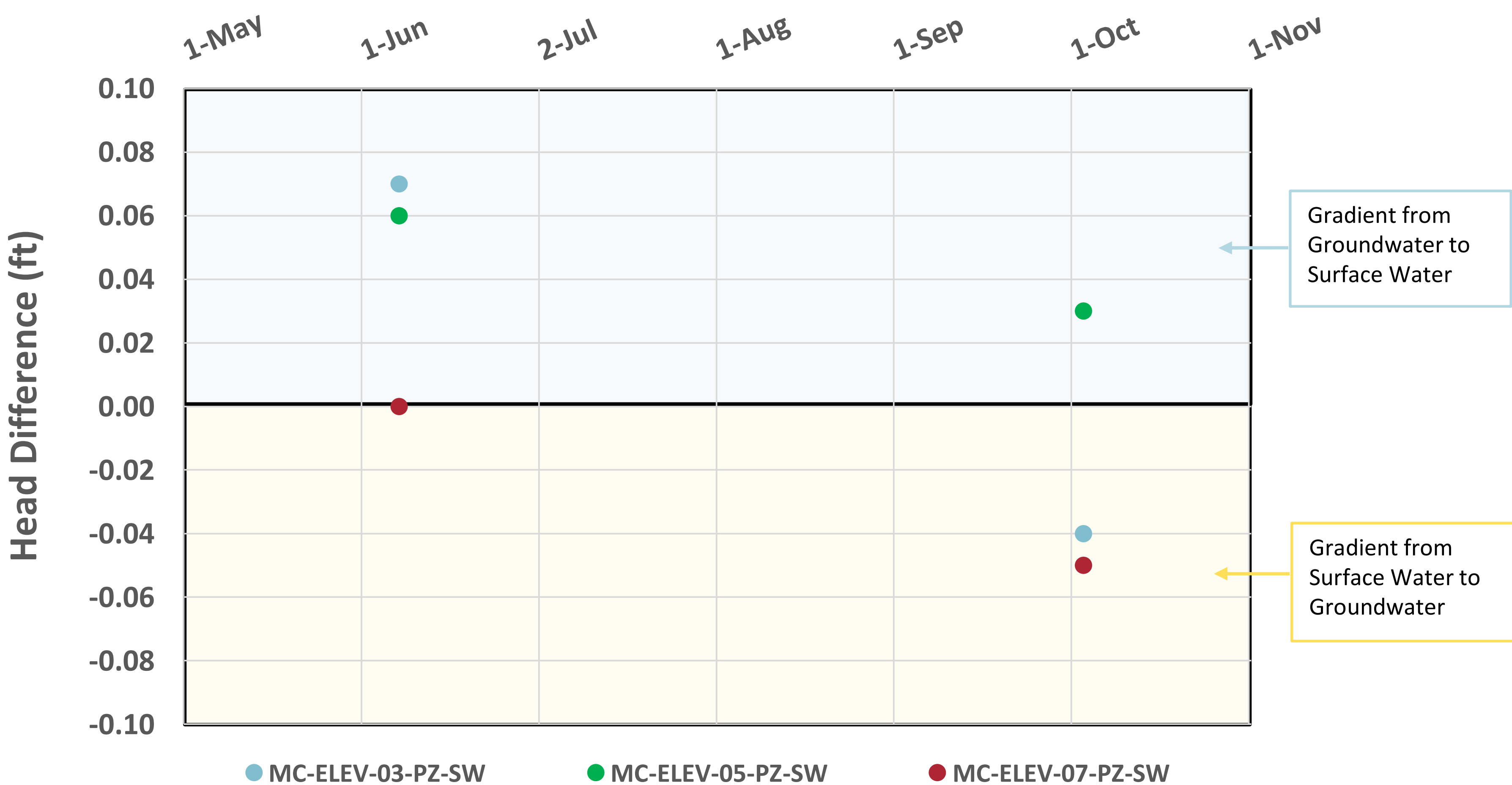
PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

SARGENTS POTENTIOMETRIC SURFACE MAP, LOW-FLOW 2021

ARCADIS

FIGURE 24

Path: T:_ENV\AO000102_Pitch\GIS\MXD\2021\2021-11\Figure F-4_Sargents Potentiometric Surface Map Low flow 2021_V1.mxd

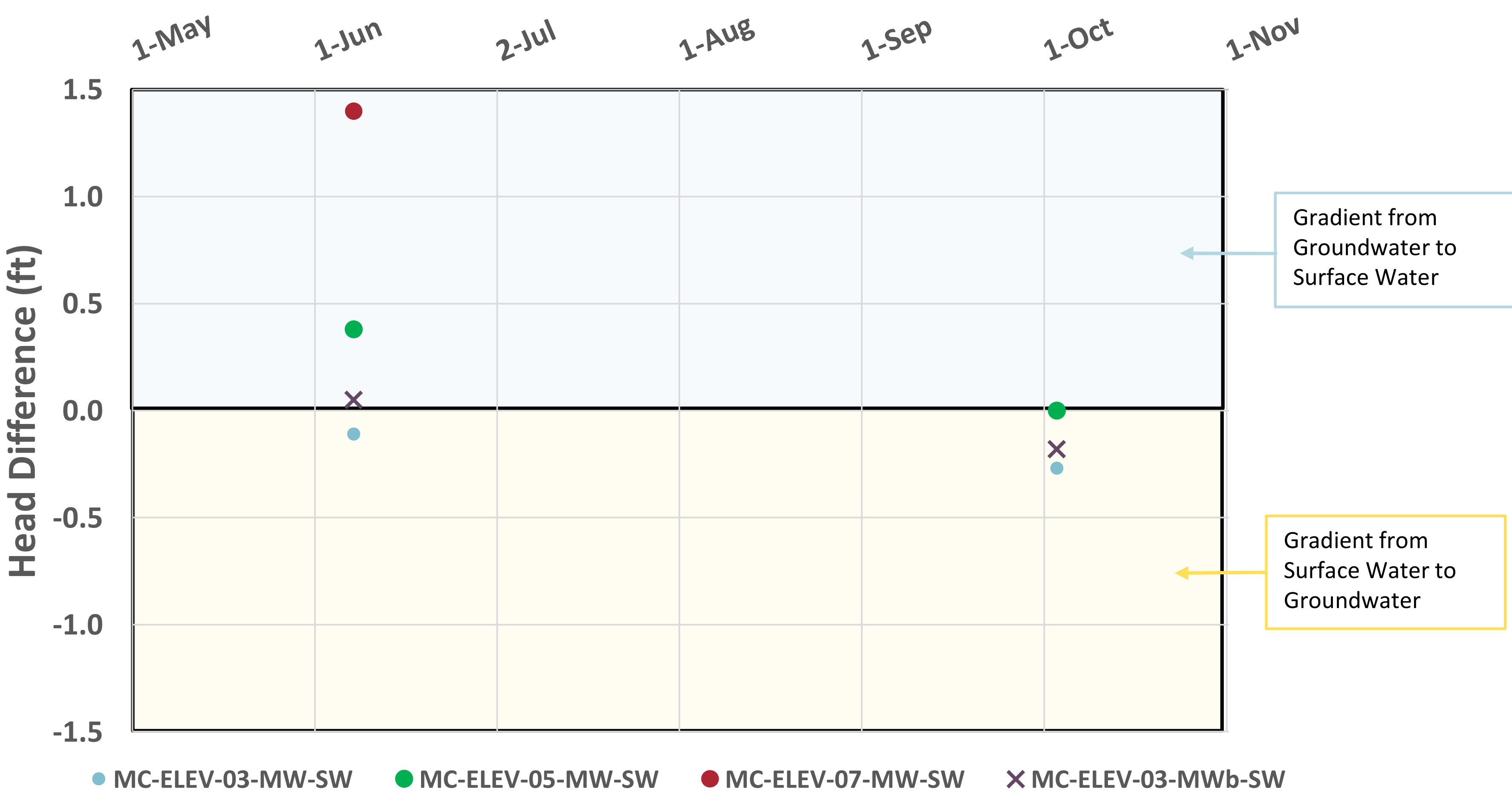


<u>Notes</u>
ft – feet
Readings collected manually

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

HEAD DIFFERENCE FROM PIEZOMETERS TO STILLING WELLS, JUNE-OCTOBER, 2021

FIGURE
25



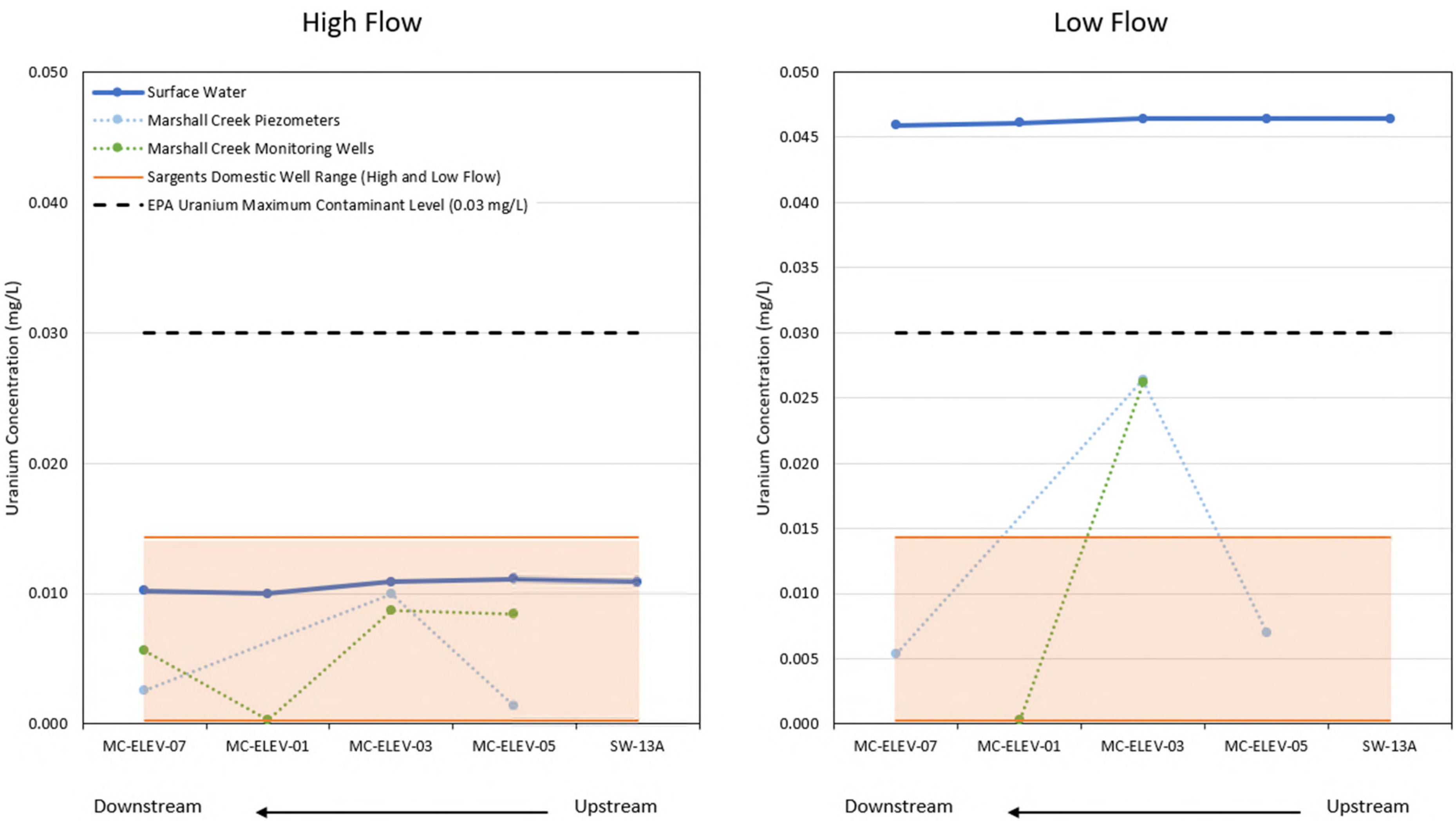
Notes
ft – feet
Readings collected manually

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

HEAD DIFFERENCE FROM MONITORING WELLS TO STILLING WELLS, JUNE-OCTOBER, 2021

ARCADIS

FIGURE
26



Notes
EPA = Environmental Protection Agency
mg/L = milligrams per liter

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

URANIUM IN SURFACE WATER AND GROUNDWATER AT MARSHALL CREEK GAIN/LOSS LOCATIONS, 2021

ARCADIS

FIGURE
27

Legend

- Groundwater Well
- Surface Water Monitoring Point
- Irrigation Ditch Sample
- Surveyed Irrigation Ditch Location 2018
- Diversion Irrigation Ditch
- Culvert (Approximate)
- Marshall Creek
- Former Ore Stockpile Approximate Location

MC-ELEV-01-MW	← Location ID
<0.0003	← High Flow
<0.0003	← Low Flow

Notes:
1. All Data from Colorado Department of Natural Resources (CDNR) Aquamap GIS database unless otherwise noted.
2. USPS well was replaced by the HMC Office Well in October 2014.
3. D& RGW = Denver and Rio Grande Western Railway.
4. All units for total uranium concentrations are in milligrams per liter.
5. -- = Not sampled

N

0 100 200 Feet

HOMESTAKE

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

SARGENTS AREA TOTAL URANIUM RESULTS

ARCADIS

FIGURE 28

Path: T:_ENV\AO000102_Pitch\GIS\MXD\2021\2021-11\Figure F-10_Total Uranium Water Concentrations.mxd

Appendix A

Photograph Log

Photograph Log

Homestake Mining Company
Pitch Reclamation Project

Photograph: 1

Date: 7/13/2018

Description: Uranium source zone characterization. Drill rig and support unit set up at location TC-OS-01

Photograph: 2

Date: 7/10/2020

Description:
North Pit Lake diversion ditch construction

Photograph Log

Homestake Mining Company
Pitch Reclamation Project

Photograph: 3

Date: 7/14/2021

Description:
Drilling and monitoring well installation beneath North Pit Lake

Photograph: 4

Date: 7/20/2021

Description:
Drilling and monitoring well installation beneath North Pit Lake

Photograph Log

Homestake Mining Company
Pitch Reclamation Project

Photograph: 5

Date: 2020

Description:
Rock dump toe drain investigation. Drilling site location and equipment setup for IC-9995 at Indian Rock Dump

Photograph: 6

Date: 2020

Description:
Completed monitoring well and bollard installation for IC-9995 at Indian Rock Dump

Photograph Log

Homestake Mining Company
Pitch Reclamation Project

Photograph: 7

Date: 9/11/2020

Description:

Laboratory column testing to evaluate uranium attenuation and passivation via phosphate injections

Photograph: 8

Date: 8/8/2020

Description:

Underground workings injection system

Photograph Log

Homestake Mining Company
Pitch Reclamation Project

Photograph: 9

Date: 2017

Description:

Underground workings injection system, phosphate reagent dosing system

Photograph: 10

Date: 8/8/2020

Description:

Underground workings injection well P-13

Photograph Log

Homestake Mining Company
Pitch Reclamation Project

Photograph: 11

Date: 6/4/2020

Description:

Well rehabilitation truck staged at injection well P-12

Photograph: 12

Date: 6/20/2020

Description:

Indian Rock Dump injection system

Photograph Log

Homestake Mining Company
Pitch Reclamation Project

Photograph: 13

Date: 6/20/2020

Description:

Indian Rock Dump injection system, phosphate reagent dosing system

Photograph: 14

Date: 5/18/2020

Description:

Pinnacle Mine Dump satellite dosing system

Photograph Log

Homestake Mining Company
Pitch Reclamation Project

Photograph: 15

Date: 7/8/2021

Description:

Biochemical reactor engineered treatment cell drums and media

Photograph: 16

Date: 7/9/2021

Description:

Biochemical reactor engineered treatment cell drums

Photograph Log

Homestake Mining Company
Pitch Reclamation Project

Photograph: 17

Date: 2017

Description:

Zero-valent iron ETC

Photograph: 18

Date: 2018

Description:

ETC-1 construction

Photograph Log

Homestake Mining Company
Pitch Reclamation Project

Photograph: 19

Date: 2018

Description:

ETC-1 construction

Photograph: 20

Date: 2018

Description:

ETC-1 construction

Photograph Log

Homestake Mining Company
Pitch Reclamation Project

Photograph: 21

Date: 2018

Description:

ETC-1 construction

Photograph: 22

Date: 8/27/2019

Description:

ETC-1

Photograph Log

Homestake Mining Company
Pitch Reclamation Project

Photograph: 23

Date: 6/3/2020

Description:

ETC-1, ETC-2, and 2019 BCRs prior to ETC-3 construction.

Photograph: 24

Date: 7/21/2020

Description:

ETC-3 construction

Photograph Log

Homestake Mining Company
Pitch Reclamation Project

Photograph: 25

Date: 8/13/2020

Description:

ETC-3 and post treatment tanks

Photograph: 26

Date: 7/27/2020

Description:

ETC-3 top

Photograph Log

Homestake Mining Company
Pitch Reclamation Project

Photograph: 27

Date: 11/4/2020

Description:

ETC-3 winter structure with mounted solar panels

Photograph: 28

Date: 11/3/2020

Description:

Ion exchange column test the SW-33 shed

Photograph Log

Homestake Mining Company
Pitch Reclamation Project

Photograph: 29

Date: 6/8/2021

Description:

Ion exchange column tests located at the Mine Shop

Photograph: 30

Date: 7/9/2021

Description:

IX field demonstration system structure under construction

Photograph Log

Homestake Mining Company
Pitch Reclamation Project

Photograph: 31

Date: 7/9/2021

Description:

IX field demonstration system structure nearly complete

Photograph: 32

Date: 11/1/2021

Description:

IX field demonstration system installed within structure

Photograph Log

Homestake Mining Company
Pitch Reclamation Project

Photograph: 33

Date: 2019

Description:

Marshal Creek gain/loss investigation. Drilling MC-ELEV-07-MW

Photograph: 34

Date: 2019

Description:

Marshal Creek gain/loss investigation. Installing Drilling MC-ELEV-07-PZ

Photograph Log

Homestake Mining Company
Pitch Reclamation Project

Photograph: 35

Date: 2019

Description:

Marshal Creek gain/loss investigation. stilling well and piezometer at MC-ELEV-07

Appendix 7

EJ Screen and Public Health Reports for Transport of IX Resin Radiological Waste

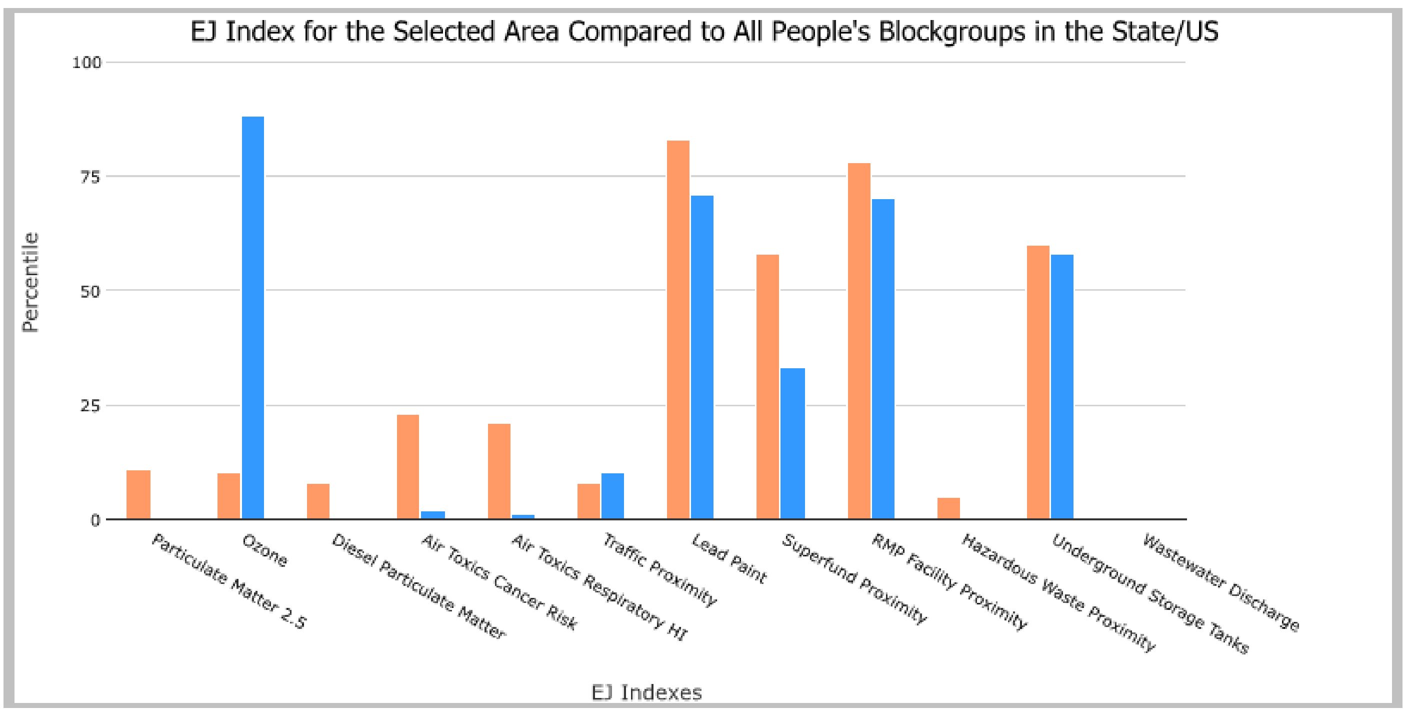
EJScreen Report (Version 2.1)

County: Saguache, COLORADO, EPA Region 8

Approximate Population: 6,730

Input Area (sq. miles): 3170.27

Selected Variables	State Percentile	USA Percentile
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	11	0
EJ Index for Ozone	10	88
EJ Index for Diesel Particulate Matter*	8	0
EJ Index for Air Toxics Cancer Risk*	23	2
EJ Index for Air Toxics Respiratory HI*	21	1
EJ Index for Traffic Proximity	8	10
EJ Index for Lead Paint	83	71
EJ Index for Superfund Proximity	58	33
EJ Index for RMP Facility Proximity	78	70
EJ Index for Hazardous Waste Proximity	5	0
EJ Index for Underground Storage Tanks	60	58
EJ Index for Wastewater Discharge	0	0



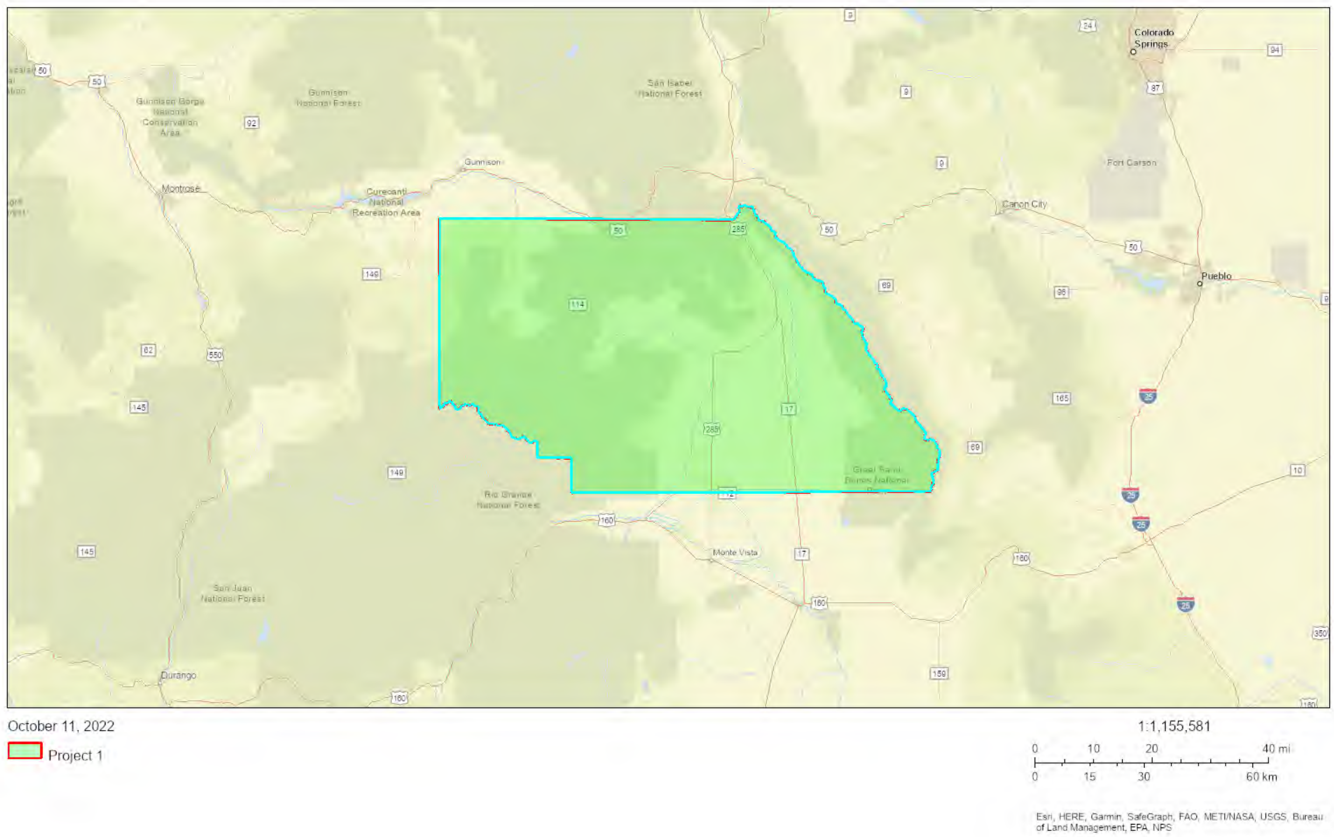
This report shows the values for environmental and demographic indicators and EJSCREEN indexes. It shows environmental and demographic raw data (e.g., the estimated concentration of ozone in the air), and also shows what percentile each raw data value represents. These percentiles provide perspective on how the selected block group or buffer area compares to the entire state, EPA region, or nation. For example, if a given location is at the 95th percentile nationwide, this means that only 5 percent of the US population has a higher block group value than the average person in the location being analyzed. The years for which the data are available, and the methods used, vary across these indicators. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJSCREEN documentation for discussion of these issues before using reports.

EJScreen Report (Version 2.1)

County: Saguache, COLORADO, EPA Region 8

Approximate Population: 6,730

Input Area (sq. miles): 3170.27



Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0

EJScreen Report (Version 2.1)

County: Saguache, COLORADO, EPA Region 8

Approximate Population: 6,730

Input Area (sq. miles): 3170.27

Selected Variables	Value	State Avg.	%ile in State	USA Avg.	%ile in USA
Pollution and Sources					
Particulate Matter 2.5 ($\mu g/m^3$)	4.87	7.23	4	8.67	0
Ozone (ppb)	52.6	55.4	6	42.5	90
Diesel Particulate Matter* ($\mu g/m^3$)	0.0126	0.256	2	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	9.5	25	11	28	<50th
Air Toxics Respiratory HI*	0.095	0.33	9	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	7.5	650	4	760	7
Lead Paint (% Pre-1960 Housing)	0.27	0.18	71	0.27	55
Superfund Proximity (site count/km distance)	0.018	0.1	29	0.13	16
RMP Facility Proximity (facility count/km distance)	1.4	0.68	86	0.77	83
Hazardous Waste Proximity (facility count/km distance)	0.0087	0.88	2	2.2	0
Underground Storage Tanks (count/km^2)	0.37	2.7	33	3.9	36
Wastewater Discharge (toxicity-weighted concentration/m distance)	1.7E-08	0.38	0	12	0
Socioeconomic Indicators					
Demographic Index	43%	28%	80	35%	68
People of Color	41%	32%	71	40%	60
Low Income	45%	25%	84	30%	75
Unemployment Rate	10%	5%	87	5%	81
Limited English Speaking Households	6%	3%	84	5%	76
Less Than High School Education	14%	8%	80	12%	69
Under Age 5	5%	6%	56	6%	53
Over Age 64	23%	14%	80	16%	77

*Diesel particular matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update.

For additional information, see: www.epa.gov/environmentaljustice

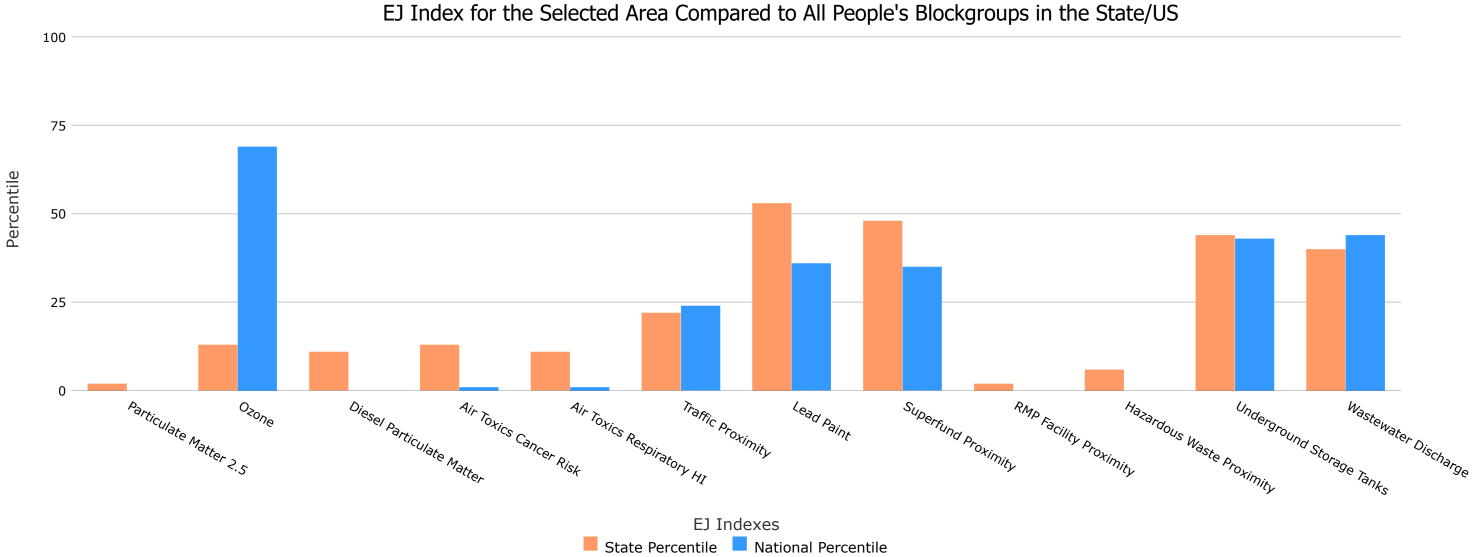
Save as PDF

EJScreen Report (Version 2.1)

County: Gunnison
COLORADO, EPA Region 8
Approximate Population: 17,119
Input Area (sq. miles): 3259.61

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	2	0
EJ Index for Ozone	13	69
EJ Index for Diesel Particulate Matter*	11	0
EJ Index for Air Toxics Cancer Risk*	13	1
EJ Index for Air Toxics Respiratory HI*	11	1
EJ Index for Traffic Proximity	22	24
EJ Index for Lead Paint	53	36
EJ Index for Superfund Proximity	48	35
EJ Index for RMP Facility Proximity	2	0
EJ Index for Hazardous Waste Proximity	6	0
EJ Index for Underground Storage Tanks	44	43
EJ Index for Wastewater Discharge	40	44

EJ Index for the Selected Area Compared to All People's Blockgroups in the State/US



This report shows the values for environmental and demographic indicators and EJScreen indexes. It shows environmental and demographic raw data (e.g., the estimated concentration of ozone in the air), and also shows what percentile each raw data value represents. These percentiles provide perspective on how the selected block group or buffer area compares to the entire state or nation. For example, if a given location is at the 95th percentile nationwide, this means that only 5 percent of the US population has a higher block group value than the average person in the location being analyzed. The years for which the data are available, and the methods used, vary across these indicators. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJScreen documentation for discussion of these issues before using reports.

October 25, 2022

Project 1

1:36,112

0 0.35 0.7 1.4 mi
0 0.5 1 2 km

Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA

Sites reporting to EPA	
Superfund NPL	1
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 (μg/m³)	4.64	7.23	0	8.67	0
Ozone (ppb)	53.8	55.4	12	42.5	91
Diesel Particulate Matter* (μg/m³)	0.0201	0.256	7	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	9.7	25	15	28	<50th
Air Toxics Respiratory HI*	0.097	0.33	12	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	54	650	18	760	25
Lead Paint (% Pre-1960 Housing)	0.15	0.18	61	0.27	41
Superfund Proximity (site count/km distance)	0.047	0.1	42	0.13	42
RMP Facility Proximity (facility count/km distance)	0.019	0.68	2	0.77	1
Hazardous Waste Proximity (facility count/km distance)	0.012	0.88	4	2.2	1
Underground Storage Tanks (count/km²)	1.3	2.7	50	3.9	51
Wastewater Discharge (toxicity-weighted concentration/m distance)	0.23	0.38	87	12	88
Socioeconomic Indicators					
Demographic Index	22%	28%	46	35%	37
People of Color	13%	32%	25	40%	30
Low Income	30%	25%	65	30%	53
Unemployment Rate	4%	5%	59	5%	53
Limited English Speaking	1%	3%	62	5%	57
Less Than High School Education	2%	8%	35	12%	19
Under Age 5	4%	6%	45	6%	42
Over Age 64	14%	14%	51	16%	43

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

For additional information, see: www.epa.gov/environmentaljustice (https://www.epa.gov/environmentaljustice)

EJScreen is a screening tool for pre-decisional use only. It can help identify areas that may warrant additional consideration, analysis, or outreach. It does not provide a basis for decision-making, but it may help identify potential areas of EJ concern. Users should keep in mind that screening tools are subject to substantial uncertainty in their demographic and environmental data, particularly when looking at small geographic areas. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJScreen documentation for discussion of these issues before using reports. This screening tool does not provide data on every environmental impact and demographic factor that may be relevant to a particular location. EJScreen outputs should be supplemented with additional information and local knowledge before taking any action to address potential EJ concerns.

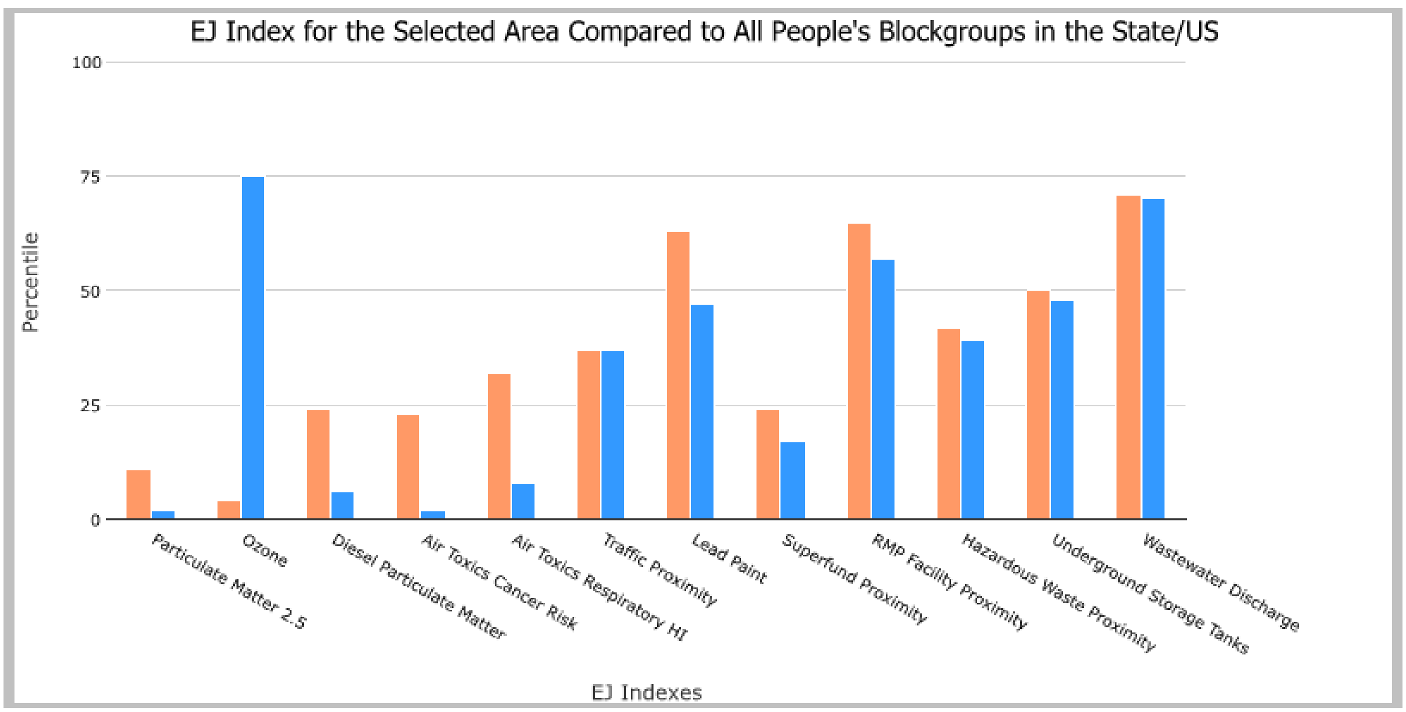
EJScreen Report (Version 2.1)

County: Montrose, COLORADO, EPA Region 8

Approximate Population: 42,280

Input Area (sq. miles): 2242.83

Selected Variables	State Percentile	USA Percentile
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	11	2
EJ Index for Ozone	4	75
EJ Index for Diesel Particulate Matter*	24	6
EJ Index for Air Toxics Cancer Risk*	23	2
EJ Index for Air Toxics Respiratory HI*	32	8
EJ Index for Traffic Proximity	37	37
EJ Index for Lead Paint	63	47
EJ Index for Superfund Proximity	24	17
EJ Index for RMP Facility Proximity	65	57
EJ Index for Hazardous Waste Proximity	42	39
EJ Index for Underground Storage Tanks	50	48
EJ Index for Wastewater Discharge	71	70



This report shows the values for environmental and demographic indicators and EJSCREEN indexes. It shows environmental and demographic raw data (e.g., the estimated concentration of ozone in the air), and also shows what percentile each raw data value represents. These percentiles provide perspective on how the selected block group or buffer area compares to the entire state, EPA region, or nation. For example, if a given location is at the 95th percentile nationwide, this means that only 5 percent of the US population has a higher block group value than the average person in the location being analyzed. The years for which the data are available, and the methods used, vary across these indicators. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJSCREEN documentation for discussion of these issues before using reports.

EJScreen Report (Version 2.1)

County: Montrose, COLORADO, EPA Region 8

Approximate Population: 42,280

Input Area (sq. miles): 2242.83

Sites reporting to EPA	
Superfund NPL	1
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	2

EJScreen Report (Version 2.1)

County: Montrose, COLORADO, EPA Region 8

Approximate Population: 42,280

Input Area (sq. miles): 2242.83

Selected Variables	Value	State Avg.	%ile in State	USA Avg.	%ile in USA
Pollution and Sources					
Particulate Matter 2.5 (µg/m^3)	5.07	7.23	6	8.67	0
Ozone (ppb)	51.5	55.4	3	42.5	90
Diesel Particulate Matter* (µg/m^3)	0.0434	0.256	15	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	10	25	22	28	<50th
Air Toxics Respiratory HI*	0.14	0.33	26	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	120	650	30	760	36
Lead Paint (% Pre-1960 Housing)	0.17	0.18	63	0.27	44
Superfund Proximity (site count/km distance)	0.016	0.1	24	0.13	13
RMP Facility Proximity (facility count/km distance)	0.6	0.68	67	0.77	63
Hazardous Waste Proximity (facility count/km distance)	0.23	0.88	32	2.2	34
Underground Storage Tanks (count/km^2)	2	2.7	60	3.9	58
Wastewater Discharge (toxicity-weighted concentration/m distance)	0.84	0.38	94	12	92
Socioeconomic Indicators					
Demographic Index	28%	28%	58	35%	47
People of Color	24%	32%	48	40%	44
Low Income	31%	25%	68	30%	56
Unemployment Rate	5%	5%	67	5%	61
Limited English Speaking Households	5%	3%	81	5%	74
Less Than High School Education	11%	8%	74	12%	60
Under Age 5	5%	6%	57	6%	55
Over Age 64	24%	14%	81	16%	78

*Diesel particular matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update.

For additional information, see: www.epa.gov/environmentaljustice

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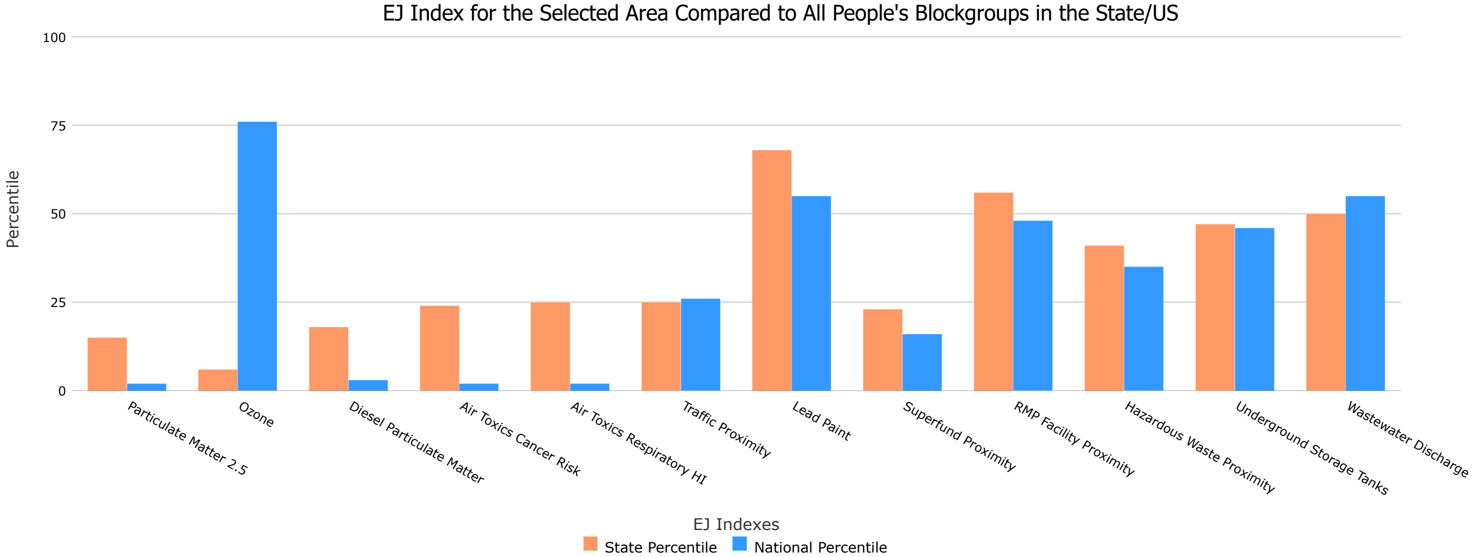
EJScreen Report (Version 2.1)

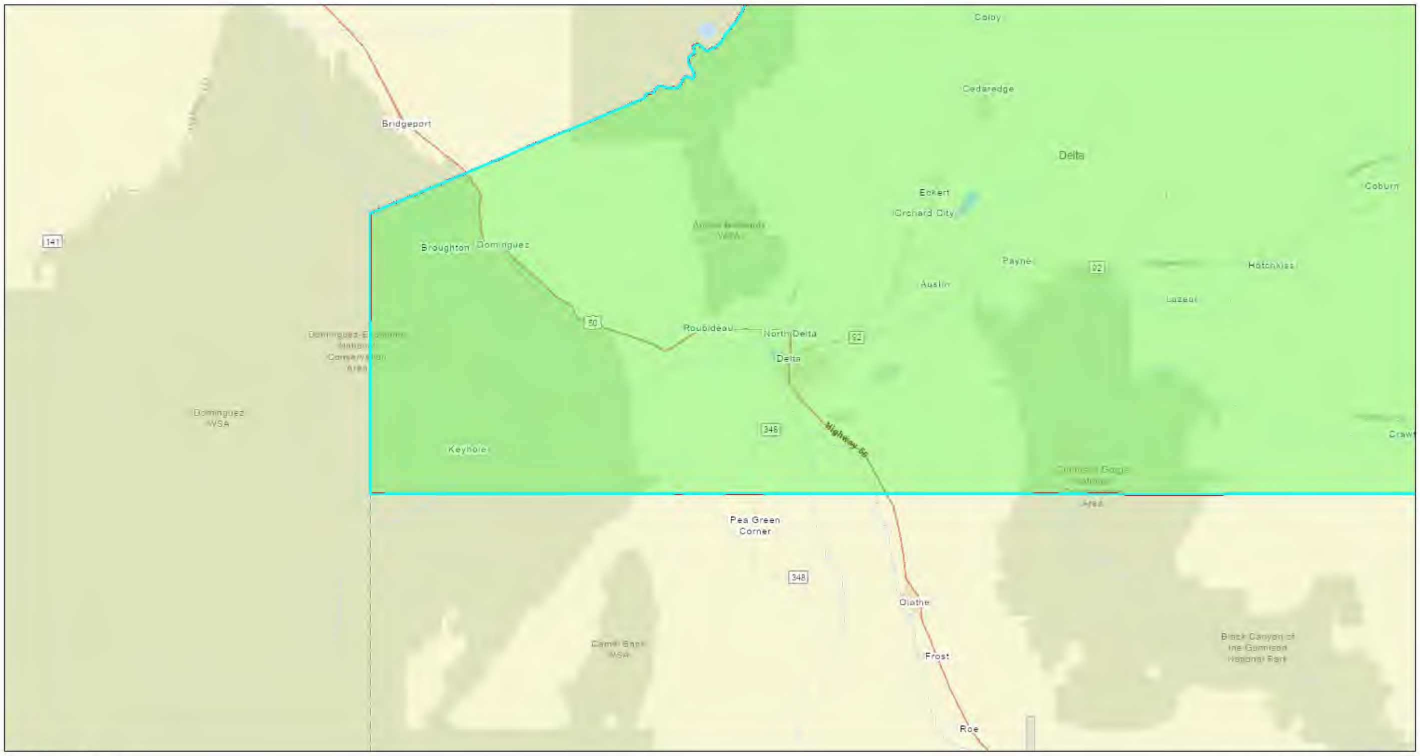
County: Delta
COLORADO, EPA Region 8
Approximate Population: 30,758
Input Area (sq. miles): 1148.60

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	15	2
EJ Index for Ozone	6	76
EJ Index for Diesel Particulate Matter*	18	3
EJ Index for Air Toxics Cancer Risk*	24	2
EJ Index for Air Toxics Respiratory HI*	25	2
EJ Index for Traffic Proximity	25	26
EJ Index for Lead Paint	68	55
EJ Index for Superfund Proximity	23	16
EJ Index for RMP Facility Proximity	56	48
EJ Index for Hazardous Waste Proximity	41	35
EJ Index for Underground Storage Tanks	47	46
EJ Index for Wastewater Discharge	50	55

EJ Index for the Selected Area Compared to All People's Blockgroups in the State/US



This report shows the values for environmental and demographic indicators and EJScreen indexes. It shows environmental and demographic raw data (e.g., the estimated concentration of ozone in the air), and also shows what percentile each raw data value represents. These percentiles provide perspective on how the selected block group or buffer area compares to the entire state or nation. For example, if a given location is at the 95th percentile nationwide, this means that only 5 percent of the US population has a higher block group value than the average person in the location being analyzed. The years for which the data are available, and the methods used, vary across these indicators. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJScreen documentation for discussion of these issues before using reports.



October 25, 2022

Project 1

1:288,895

0 2.75 5.5 11 mi
0 4.5 9 18 km

City of Delta, CO, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA

Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	1

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 ($\mu g/m^3$)	5.16	7.23	8	8.67	1
Ozone (ppb)	51.7	55.4	4	42.5	90
Diesel Particulate Matter* ($\mu g/m^3$)	0.0271	0.256	9	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	10	25	22	28	<50th
Air Toxics Respiratory HI*	0.11	0.33	20	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	58	650	19	760	26
Lead Paint (% Pre-1960 Housing)	0.24	0.18	69	0.27	52
Superfund Proximity (site count/km distance)	0.015	0.1	16	0.13	11
RMP Facility Proximity (facility count/km distance)	0.61	0.68	67	0.77	63
Hazardous Waste Proximity (facility count/km distance)	0.17	0.88	25	2.2	29
Underground Storage Tanks (count/km^2)	0.68	2.7	40	3.9	43
Wastewater Discharge (toxicity-weighted concentration/m distance)	0.014	0.38	56	12	72
Socioeconomic Indicators					
Demographic Index	29%	28%	60	35%	49
People of Color	19%	32%	38	40%	38
Low Income	40%	25%	78	30%	68
Unemployment Rate	7%	5%	76	5%	70
Limited English Speaking	1%	3%	65	5%	59
Less Than High School Education	10%	8%	72	12%	57
Under Age 5	5%	6%	50	6%	47
Over Age 64	26%	14%	85	16%	82

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

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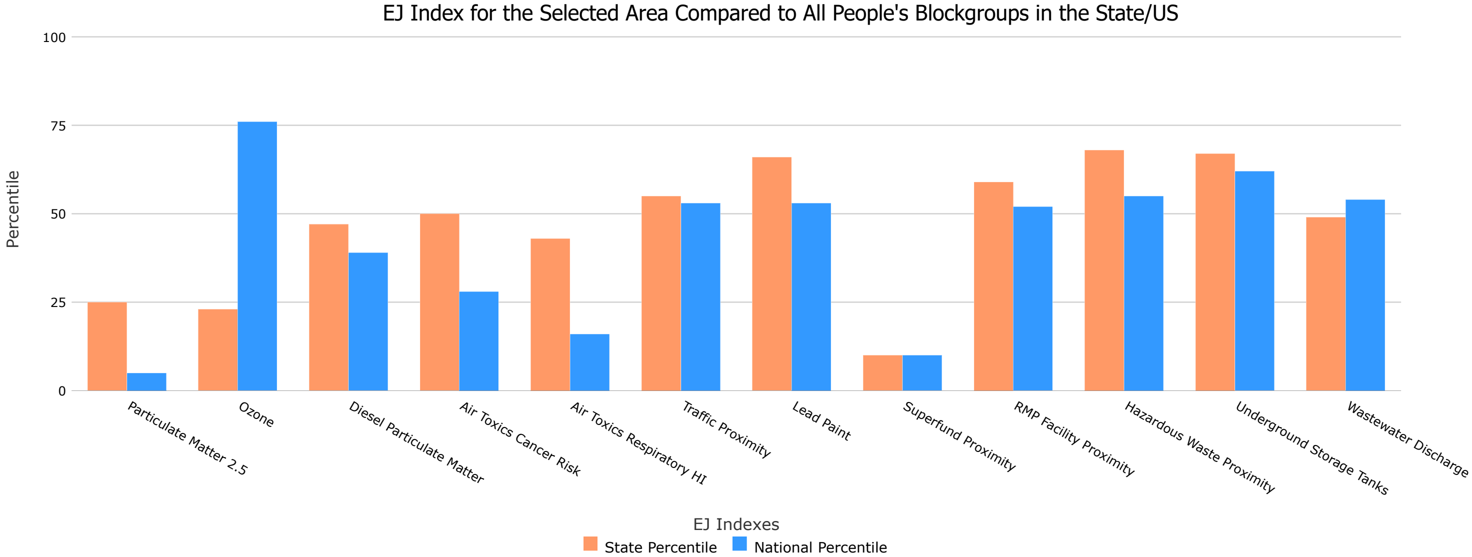
Save as PDF

EJScreen Report (Version 2.1)

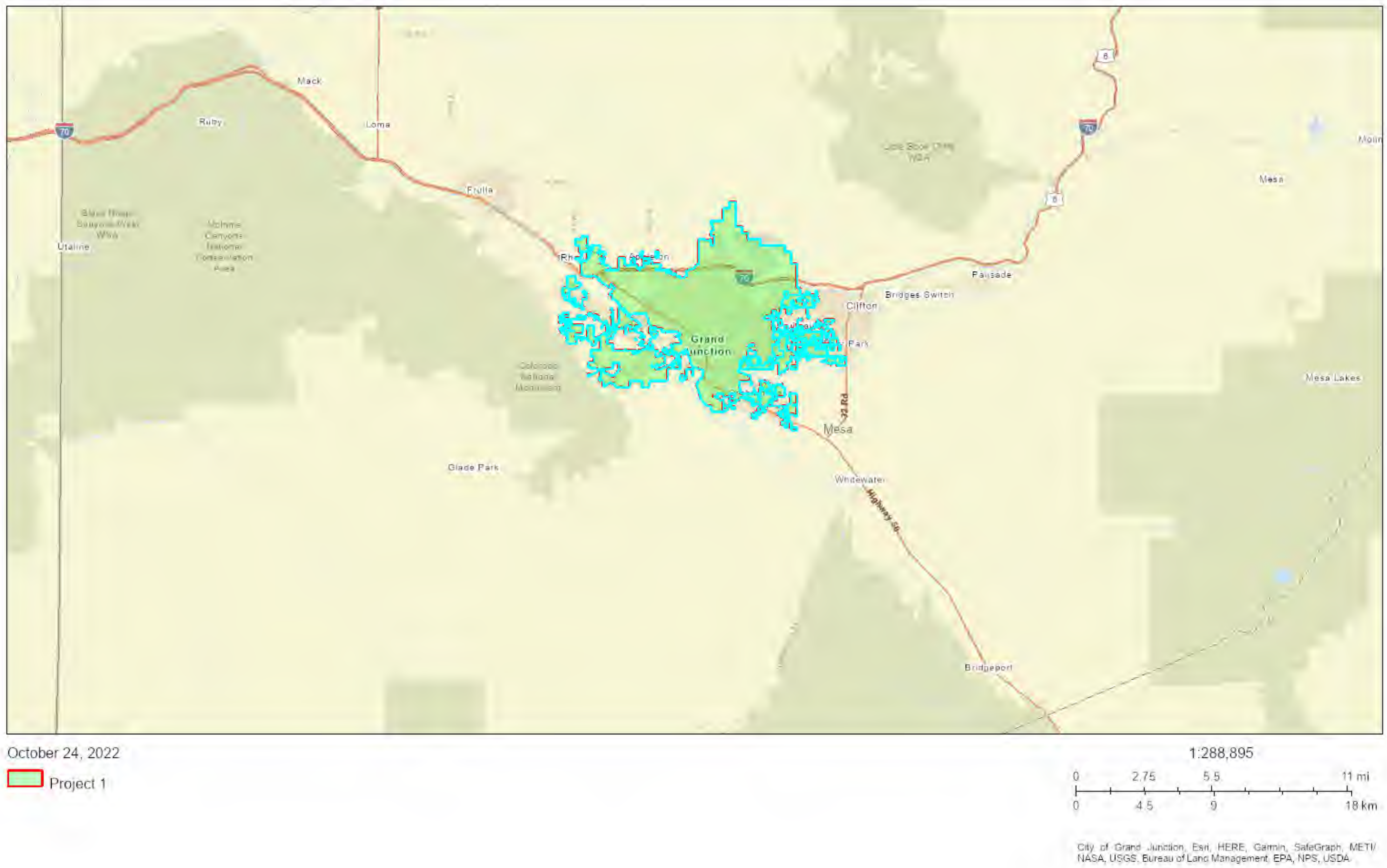
City: Grand Junction
COLORADO, EPA Region 8
Approximate Population: 62,934
Input Area (sq. miles): 40.08

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	25	5
EJ Index for Ozone	23	76
EJ Index for Diesel Particulate Matter*	47	39
EJ Index for Air Toxics Cancer Risk*	50	28
EJ Index for Air Toxics Respiratory HI*	43	16
EJ Index for Traffic Proximity	55	53
EJ Index for Lead Paint	66	53
EJ Index for Superfund Proximity	10	10
EJ Index for RMP Facility Proximity	59	52
EJ Index for Hazardous Waste Proximity	68	55
EJ Index for Underground Storage Tanks	67	62
EJ Index for Wastewater Discharge	49	54

EJ Index for the Selected Area Compared to All People's Blockgroups in the State/US



This report shows the values for environmental and demographic indicators and EJScreen indexes. It shows environmental and demographic raw data (e.g., the estimated concentration of ozone in the air), and also shows what percentile each raw data value represents. These percentiles provide perspective on how the selected block group or buffer area compares to the entire state or nation. For example, if a given location is at the 95th percentile nationwide, this means that only 5 percent of the US population has a higher block group value than the average person in the location being analyzed. The years for which the data are available, and the methods used, vary across these indicators. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJScreen documentation for discussion of these issues before using reports.



Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	5

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 (μg/m³)	5.53	7.23	15	8.67	2
Ozone (ppb)	54.4	55.4	17	42.5	92
Diesel Particulate Matter* (μg/m³)	0.14	0.256	31	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	19	25	47	28	<50th
Air Toxics Respiratory HI*	0.2	0.33	37	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	280	650	47	760	53
Lead Paint (% Pre-1960 Housing)	0.22	0.18	67	0.27	50
Superfund Proximity (site count/km distance)	0.012	0.1	7	0.13	7
RMP Facility Proximity (facility count/km distance)	0.35	0.68	54	0.77	52
Hazardous Waste Proximity (facility count/km distance)	0.89	0.88	63	2.2	54
Underground Storage Tanks (count/km²)	3.9	2.7	75	3.9	72
Wastewater Discharge (toxicity-weighted concentration/m distance)	0.7	0.38	94	12	92
Socioeconomic Indicators					
Demographic Index	28%	28%	58	35%	48
People of Color	21%	32%	42	40%	40
Low Income	34%	25%	72	30%	60
Unemployment Rate	7%	5%	76	5%	70
Limited English Speaking	2%	3%	67	5%	61
Less Than High School Education	10%	8%	70	12%	55
Under Age 5	5%	6%	55	6%	52
Over Age 64	20%	14%	72	16%	67

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

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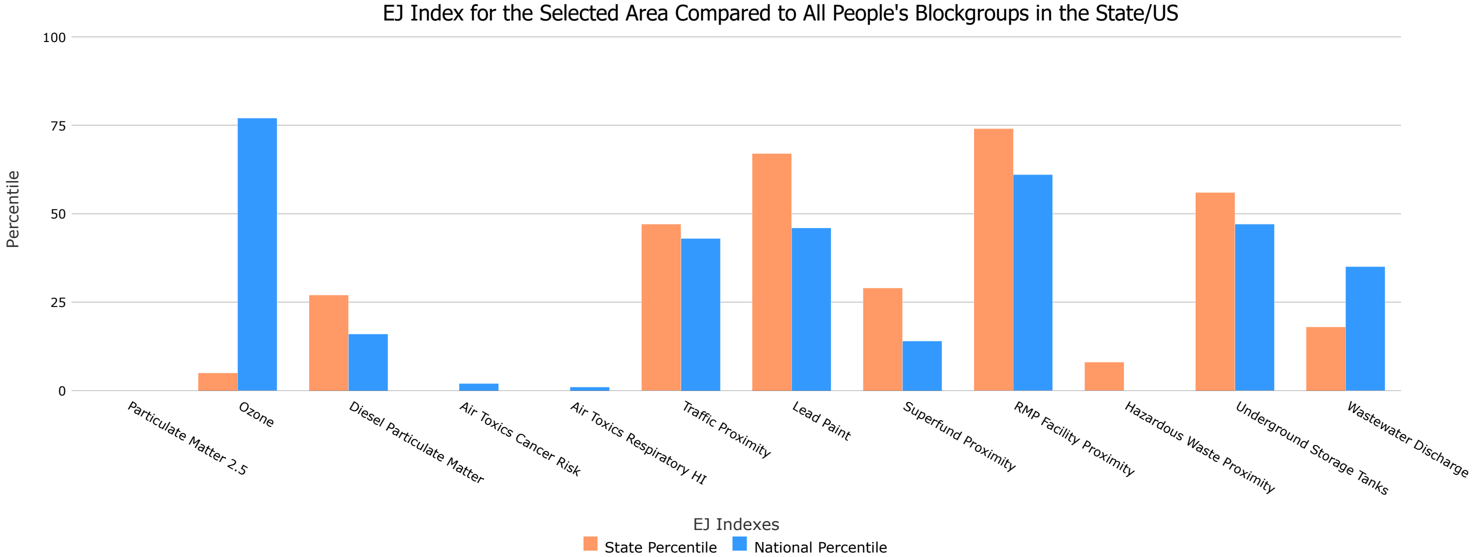
Save as PDF

EJScreen Report (Version 2.1)

County: Grand
UTAH, EPA Region 8
Approximate Population: 9,698
Input Area (sq. miles): 3684.91

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	0	0
EJ Index for Ozone	5	77
EJ Index for Diesel Particulate Matter*	27	16
EJ Index for Air Toxics Cancer Risk*	0	2
EJ Index for Air Toxics Respiratory HI*	0	1
EJ Index for Traffic Proximity	47	43
EJ Index for Lead Paint	67	46
EJ Index for Superfund Proximity	29	14
EJ Index for RMP Facility Proximity	74	61
EJ Index for Hazardous Waste Proximity	8	0
EJ Index for Underground Storage Tanks	56	47
EJ Index for Wastewater Discharge	18	35

EJ Index for the Selected Area Compared to All People's Blockgroups in the State/US



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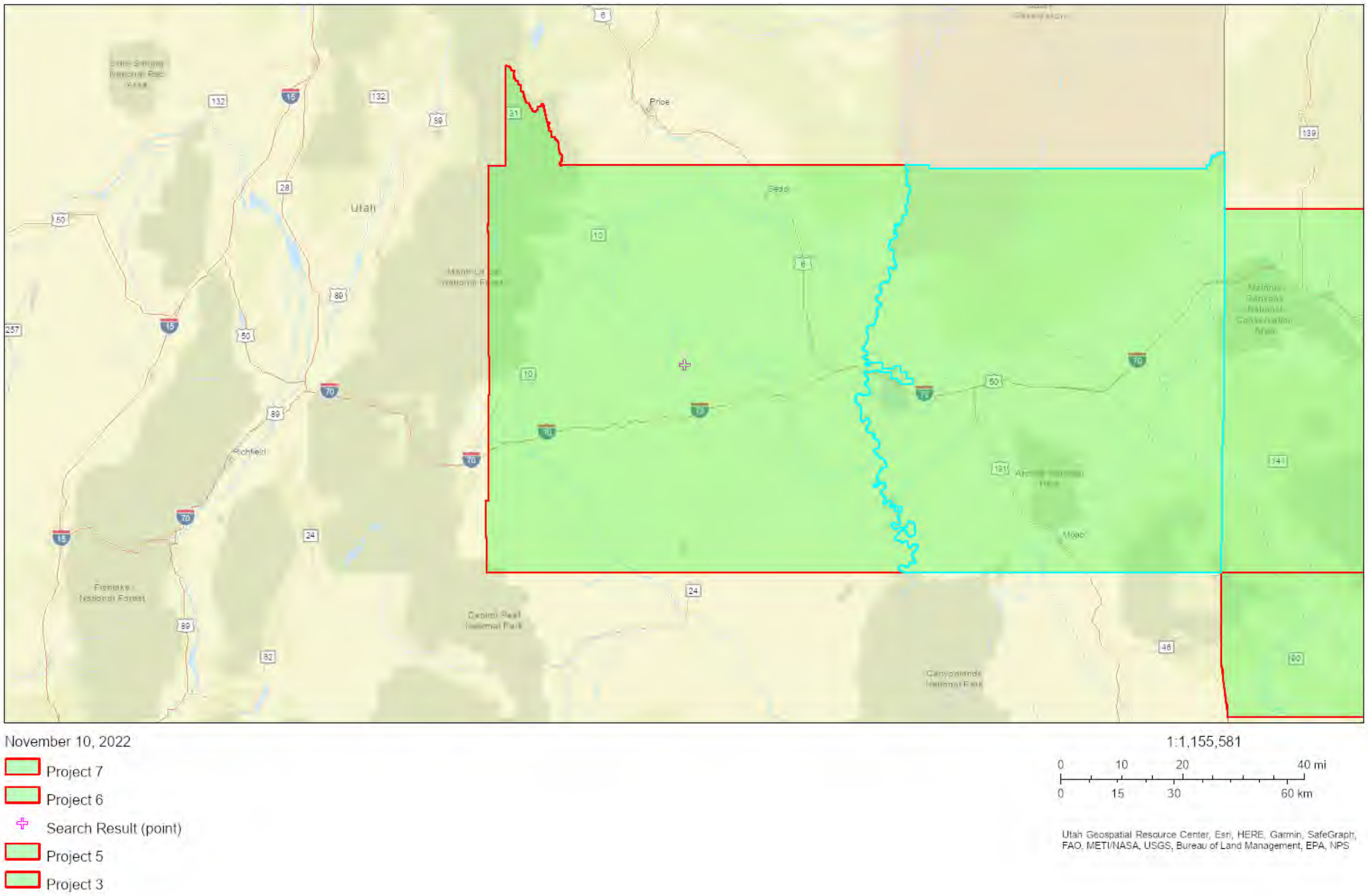

Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 ($\mu g/m^3$)	4.69	7.53	1	8.67	0
Ozone (ppb)	54.6	57.7	2	42.5	92
Diesel Particulate Matter* ($\mu g/m^3$)	0.0587	0.242	10	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	10	20	0	28	<50th
Air Toxics Respiratory HI*	0.1	0.29	0	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	150	720	33	760	41
Lead Paint (% Pre-1960 Housing)	0.14	0.17	60	0.27	40
Superfund Proximity (site count/km distance)	0.014	0.18	14	0.13	9
RMP Facility Proximity (facility count/km distance)	0.76	0.6	73	0.77	68
Hazardous Waste Proximity (facility count/km distance)	0.011	0.91	4	2.2	1
Underground Storage Tanks (count/km^2)	1.8	2.3	60	3.9	57
Wastewater Discharge (toxicity-weighted concentration/m distance)	8.4E-05	16	10	12	30
Socioeconomic Indicators					
Demographic Index	29%	24%	68	35%	49
People of Color	18%	22%	53	40%	36
Low Income	40%	25%	78	30%	68
Unemployment Rate	3%	4%	50	5%	39
Limited English Speaking	4%	2%	84	5%	73
Less Than High School Education	6%	7%	60	12%	40
Under Age 5	5%	8%	32	6%	51
Over Age 64	19%	11%	82	16%	63

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

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Save as PDF

EJScreen Report (Version 2.1)

County: Emery

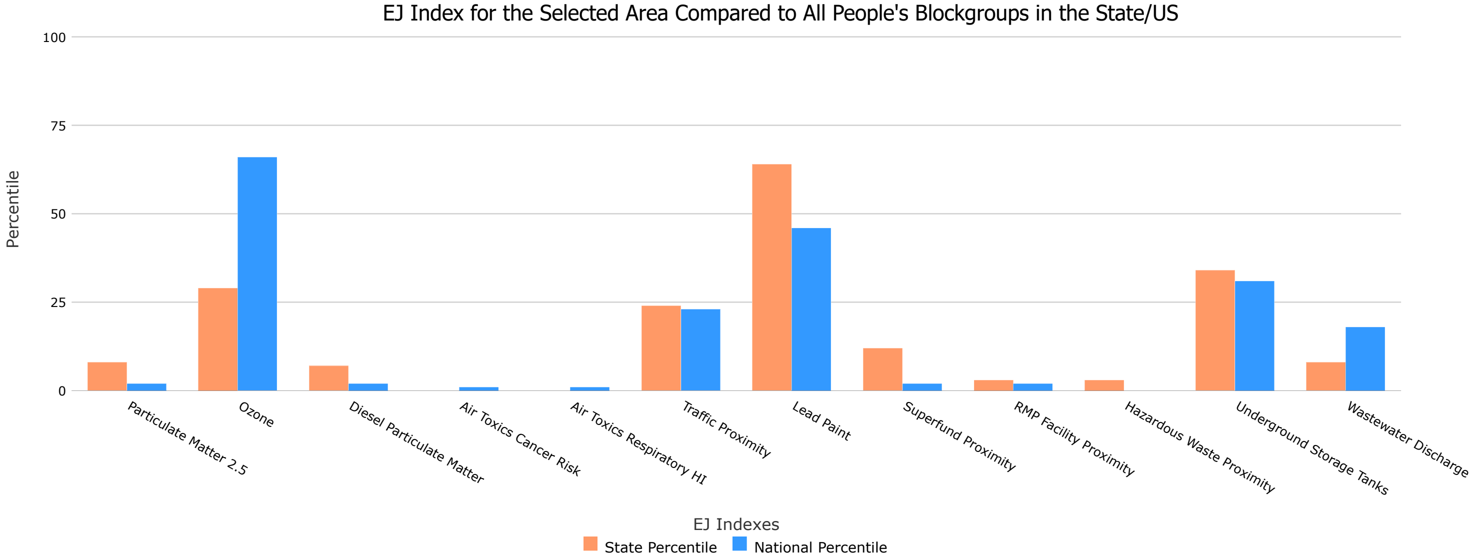
UTAH, EPA Region 8

Approximate Population: 10,099

Input Area (sq. miles): 4471.84

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	8	2
EJ Index for Ozone	29	66
EJ Index for Diesel Particulate Matter*	7	2
EJ Index for Air Toxics Cancer Risk*	0	1
EJ Index for Air Toxics Respiratory HI*	0	1
EJ Index for Traffic Proximity	24	23
EJ Index for Lead Paint	64	46
EJ Index for Superfund Proximity	12	2
EJ Index for RMP Facility Proximity	3	2
EJ Index for Hazardous Waste Proximity	3	0
EJ Index for Underground Storage Tanks	34	31
EJ Index for Wastewater Discharge	8	18

EJ Index for the Selected Area Compared to All People's Blockgroups in the State/US



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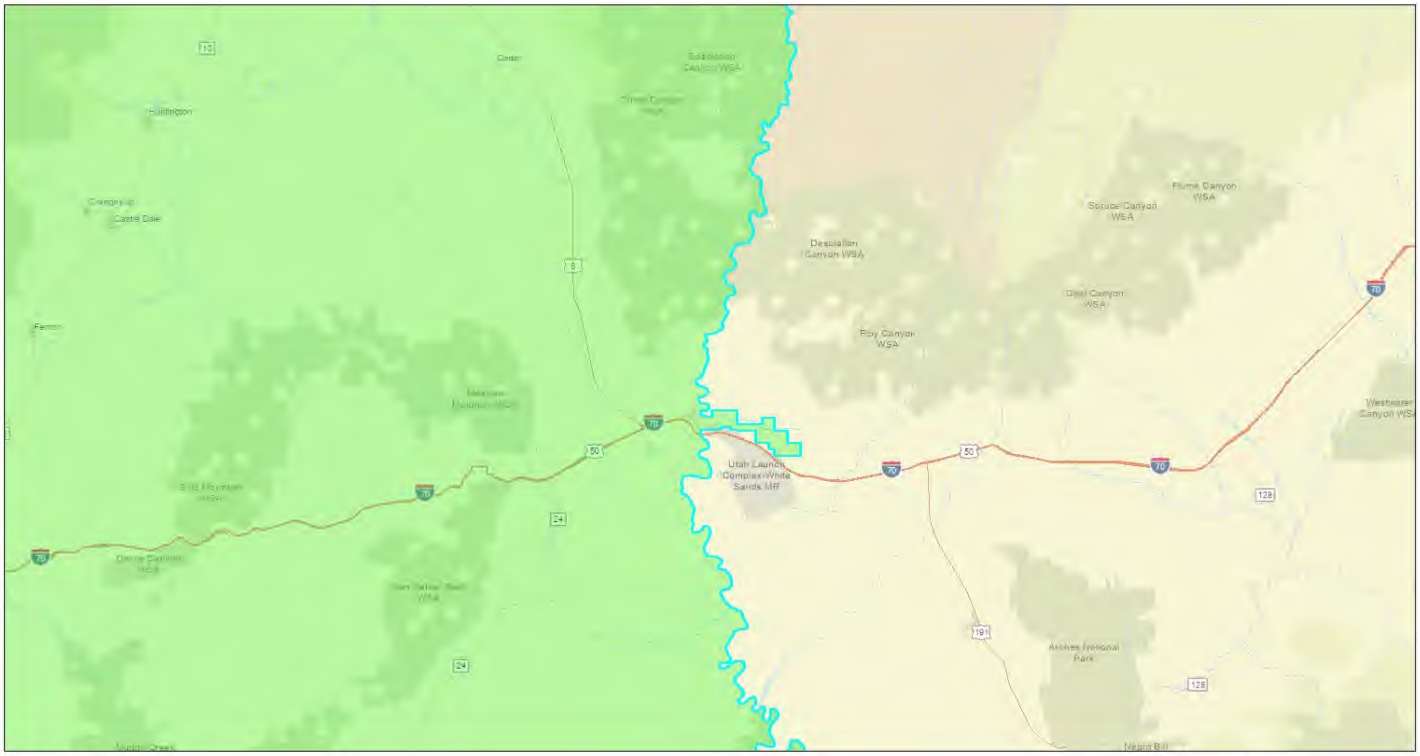

October 25, 2022

Project 1

1:577,791

0 5 10 20 mi

0 5 10 20 km

Utah Geospatial Resource Center, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, Bureau of Land Management, EPA, NPS

Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 (μg/m³)	5.09	7.53	5	8.67	1
Ozone (ppb)	56.9	57.7	24	42.5	95
Diesel Particulate Matter* (μg/m³)	0.0285	0.242	4	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	10	20	0	28	<50th
Air Toxics Respiratory HI*	0.1	0.29	0	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	54	720	18	760	25
Lead Paint (% Pre-1960 Housing)	0.24	0.17	71	0.27	52
Superfund Proximity (site count/km distance)	0.0061	0.18	9	0.13	2
RMP Facility Proximity (facility count/km distance)	0.028	0.6	1	0.77	2
Hazardous Waste Proximity (facility count/km distance)	0.009	0.91	1	2.2	0
Underground Storage Tanks (count/km²)	0.3	2.3	31	3.9	34
Wastewater Discharge (toxicity-weighted concentration/m distance)	0.00029	16	12	12	39
Socioeconomic Indicators					
Demographic Index	19%	24%	45	35%	31
People of Color	9%	22%	27	40%	22
Low Income	29%	25%	63	30%	53
Unemployment Rate	4%	4%	64	5%	50
Limited English Speaking	1%	2%	67	5%	58
Less Than High School Education	6%	7%	56	12%	38
Under Age 5	6%	8%	45	6%	62
Over Age 64	17%	11%	78	16%	56

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Save as PDF

EJScreen Report (Version 2.1)

County: Carbon

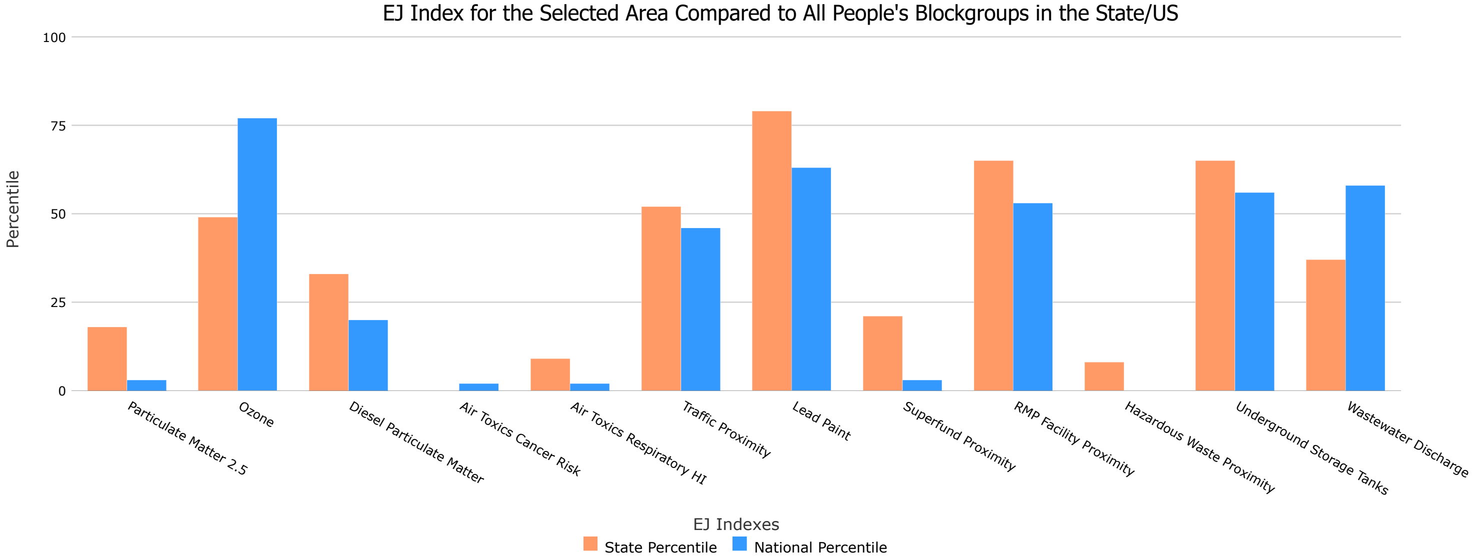
UTAH, EPA Region 8

Approximate Population: 20,401

Input Area (sq. miles): 1485.29

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	18	3
EJ Index for Ozone	49	77
EJ Index for Diesel Particulate Matter*	33	20
EJ Index for Air Toxics Cancer Risk*	0	2
EJ Index for Air Toxics Respiratory HI*	9	2
EJ Index for Traffic Proximity	52	46
EJ Index for Lead Paint	79	63
EJ Index for Superfund Proximity	21	3
EJ Index for RMP Facility Proximity	65	53
EJ Index for Hazardous Waste Proximity	8	0
EJ Index for Underground Storage Tanks	65	56
EJ Index for Wastewater Discharge	37	58

EJ Index for the Selected Area Compared to All People's Blockgroups in the State/US



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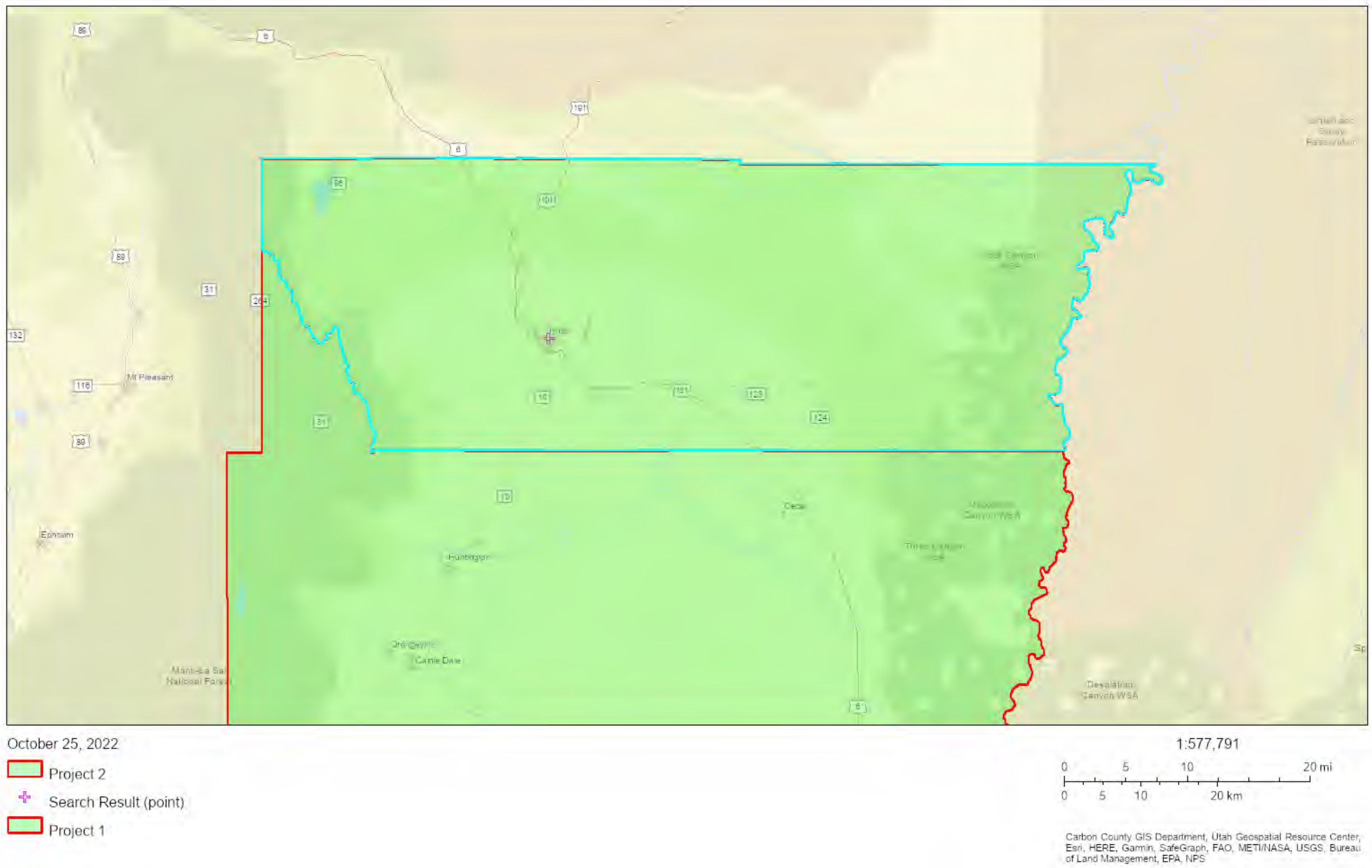

Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 (μg/m^3)	5.32	7.53	7	8.67	1
Ozone (ppb)	57.5	57.7	29	42.5	96
Diesel Particulate Matter* (μg/m^3)	0.0847	0.242	15	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	10	20	0	28	<50th
Air Toxics Respiratory HI*	0.12	0.29	10	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	210	720	39	760	47
Lead Paint (% Pre-1960 Housing)	0.42	0.17	84	0.27	67
Superfund Proximity (site count/km distance)	0.0074	0.18	11	0.13	2
RMP Facility Proximity (facility count/km distance)	0.5	0.6	61	0.77	58
Hazardous Waste Proximity (facility count/km distance)	0.011	0.91	4	2.2	1
Underground Storage Tanks (count/km^2)	2.7	2.3	71	3.9	64
Wastewater Discharge (toxicity-weighted concentration/m distance)	0.011	16	27	12	70
Socioeconomic Indicators					
Demographic Index	27%	24%	66	35%	47
People of Color	17%	22%	51	40%	35
Low Income	37%	25%	74	30%	65
Unemployment Rate	7%	4%	83	5%	69
Limited English Speaking	1%	2%	66	5%	57
Less Than High School Education	8%	7%	68	12%	48
Under Age 5	6%	8%	41	6%	60
Over Age 64	17%	11%	79	16%	58

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

For additional information, see: www.epa.gov/environmentaljustice (https://www.epa.gov/environmentaljustice)

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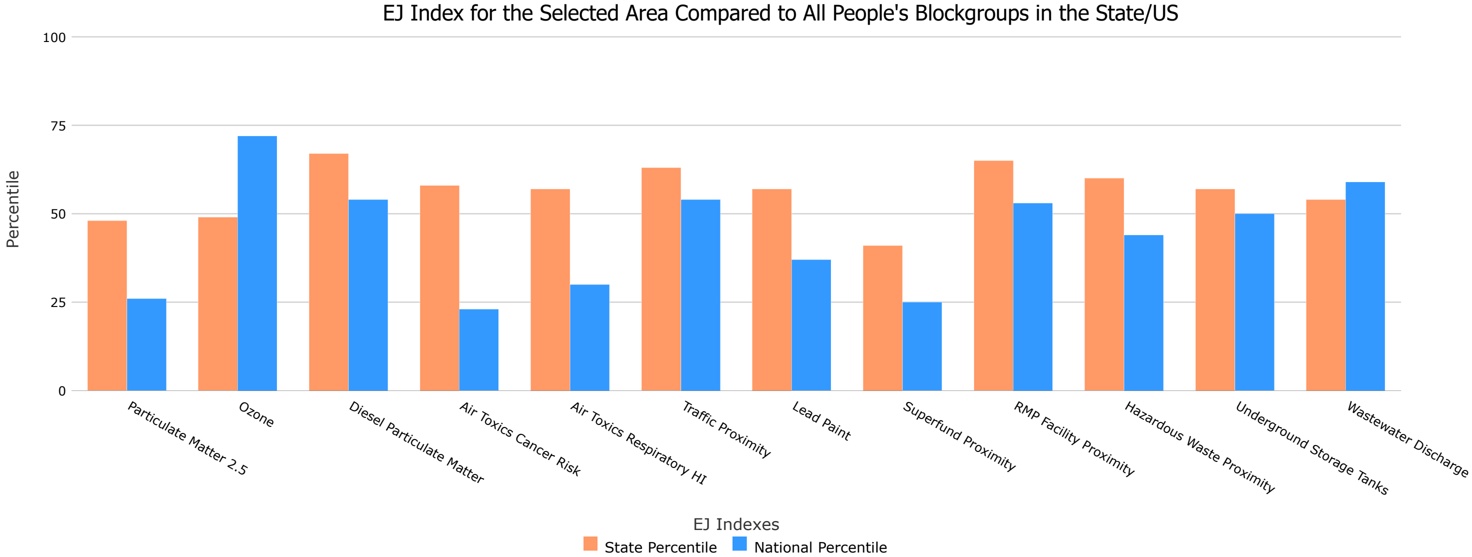
EJScreen Report (Version 2.1)

County: Utah
UTAH, EPA Region 8
Approximate Population: 621,506
Input Area (sq. miles): 2144.21

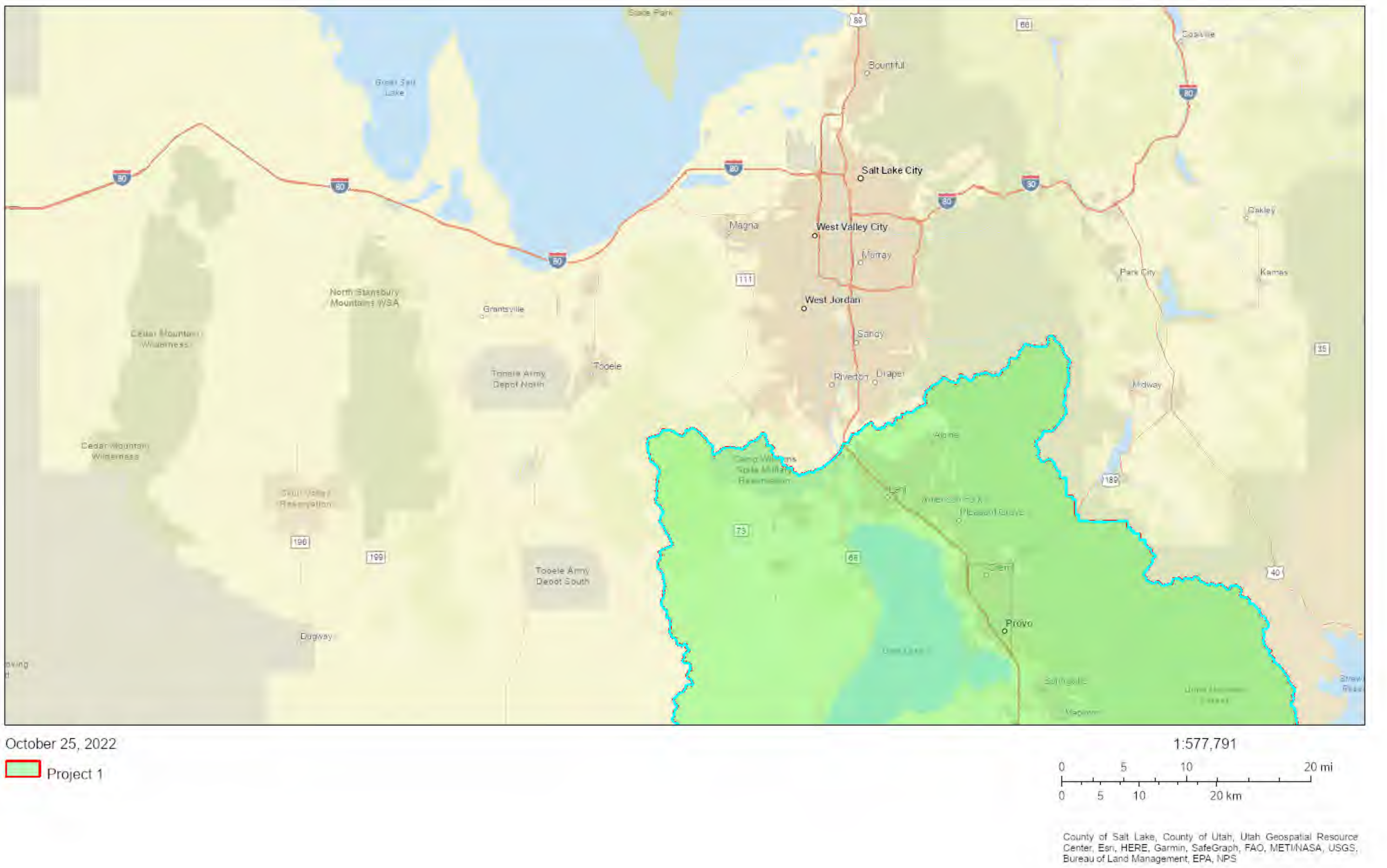
(The study area contains 14 blockgroup(s) with zero population.)

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	48	26
EJ Index for Ozone	49	72
EJ Index for Diesel Particulate Matter*	67	54
EJ Index for Air Toxics Cancer Risk*	58	23
EJ Index for Air Toxics Respiratory HI*	57	30
EJ Index for Traffic Proximity	63	54
EJ Index for Lead Paint	57	37
EJ Index for Superfund Proximity	41	25
EJ Index for RMP Facility Proximity	65	53
EJ Index for Hazardous Waste Proximity	60	44
EJ Index for Underground Storage Tanks	57	50
EJ Index for Wastewater Discharge	54	59

EJ Index for the Selected Area Compared to All People's Blockgroups in the State/US



This report shows the values for environmental and demographic indicators and EJScreen indexes. It shows environmental and demographic raw data (e.g., the estimated concentration of ozone in the air), and also shows what percentile each raw data value represents. These percentiles provide perspective on how the selected block group or buffer area compares to the entire state or nation. For example, if a given location is at the 95th percentile nationwide, this means that only 5 percent of the US population has a higher block group value than the average person in the location being analyzed. The years for which the data are available, and the methods used, vary across these indicators. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJScreen documentation for discussion of these issues before using reports.



Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	11

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 (μg/m³)	7.44	7.53	26	8.67	20
Ozone (ppb)	57.6	57.7	31	42.5	96
Diesel Particulate Matter* (μg/m³)	0.27	0.242	57	0.294	50-60th
Air Toxics Cancer Risk* (lifetime risk per million)	20	20	78	28	<50th
Air Toxics Respiratory HI*	0.26	0.29	63	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	770	720	73	760	76
Lead Paint (% Pre-1960 Housing)	0.12	0.17	57	0.27	38
Superfund Proximity (site count/km distance)	0.025	0.18	31	0.13	23
RMP Facility Proximity (facility count/km distance)	0.64	0.6	68	0.77	65
Hazardous Waste Proximity (facility count/km distance)	0.53	0.91	52	2.2	45
Underground Storage Tanks (count/km²)	1.6	2.3	58	3.9	55
Wastewater Discharge (toxicity-weighted concentration/m distance)	35	16	94	12	98
Socioeconomic Indicators					
Demographic Index	23%	24%	56	35%	39
People of Color	18%	22%	53	40%	36
Low Income	27%	25%	59	30%	49
Unemployment Rate	4%	4%	64	5%	49
Limited English Speaking	2%	2%	71	5%	61
Less Than High School Education	5%	7%	52	12%	33
Under Age 5	9%	8%	71	6%	82
Over Age 64	8%	11%	35	16%	18

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

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EJScreen Report (Version 2.1)

County: Salt Lake

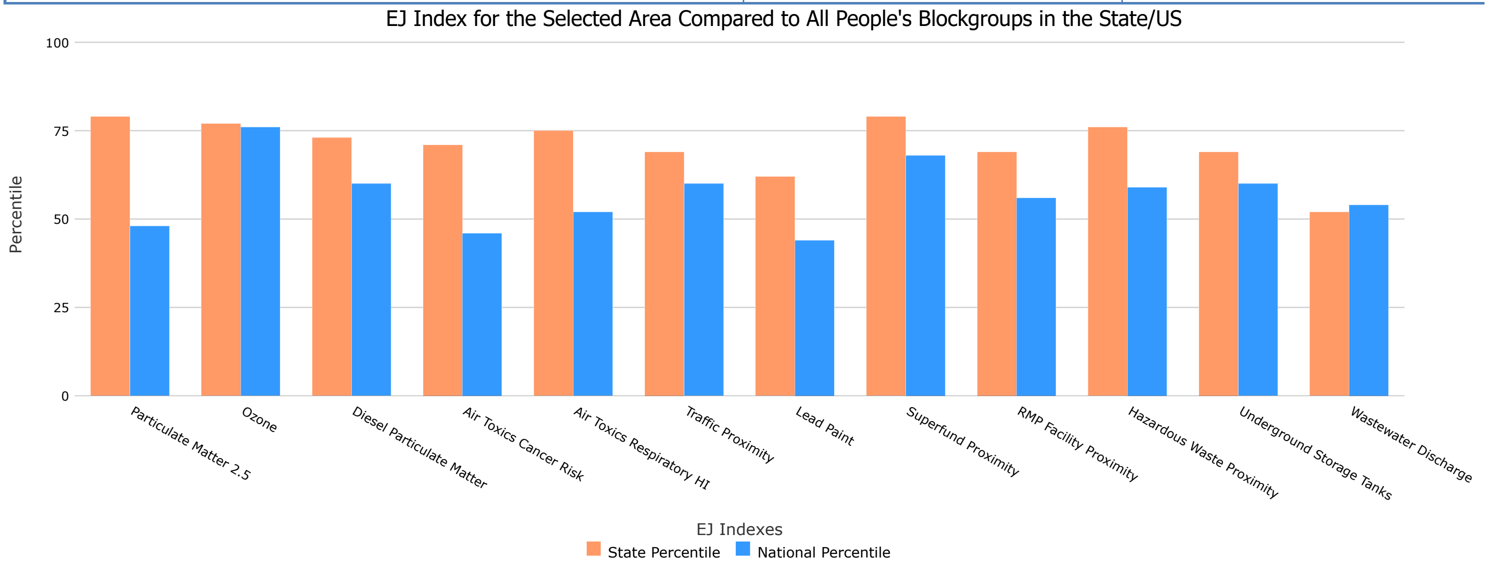
UTAH, EPA Region 8

Approximate Population: 1,146,215

Input Area (sq. miles): 805.73

(The study area contains 2 blockgroup(s) with zero population.)

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	79	48
EJ Index for Ozone	77	76
EJ Index for Diesel Particulate Matter*	73	60
EJ Index for Air Toxics Cancer Risk*	71	46
EJ Index for Air Toxics Respiratory HI*	75	52
EJ Index for Traffic Proximity	69	60
EJ Index for Lead Paint	62	44
EJ Index for Superfund Proximity	79	68
EJ Index for RMP Facility Proximity	69	56
EJ Index for Hazardous Waste Proximity	76	59
EJ Index for Underground Storage Tanks	69	60
EJ Index for Wastewater Discharge	52	54



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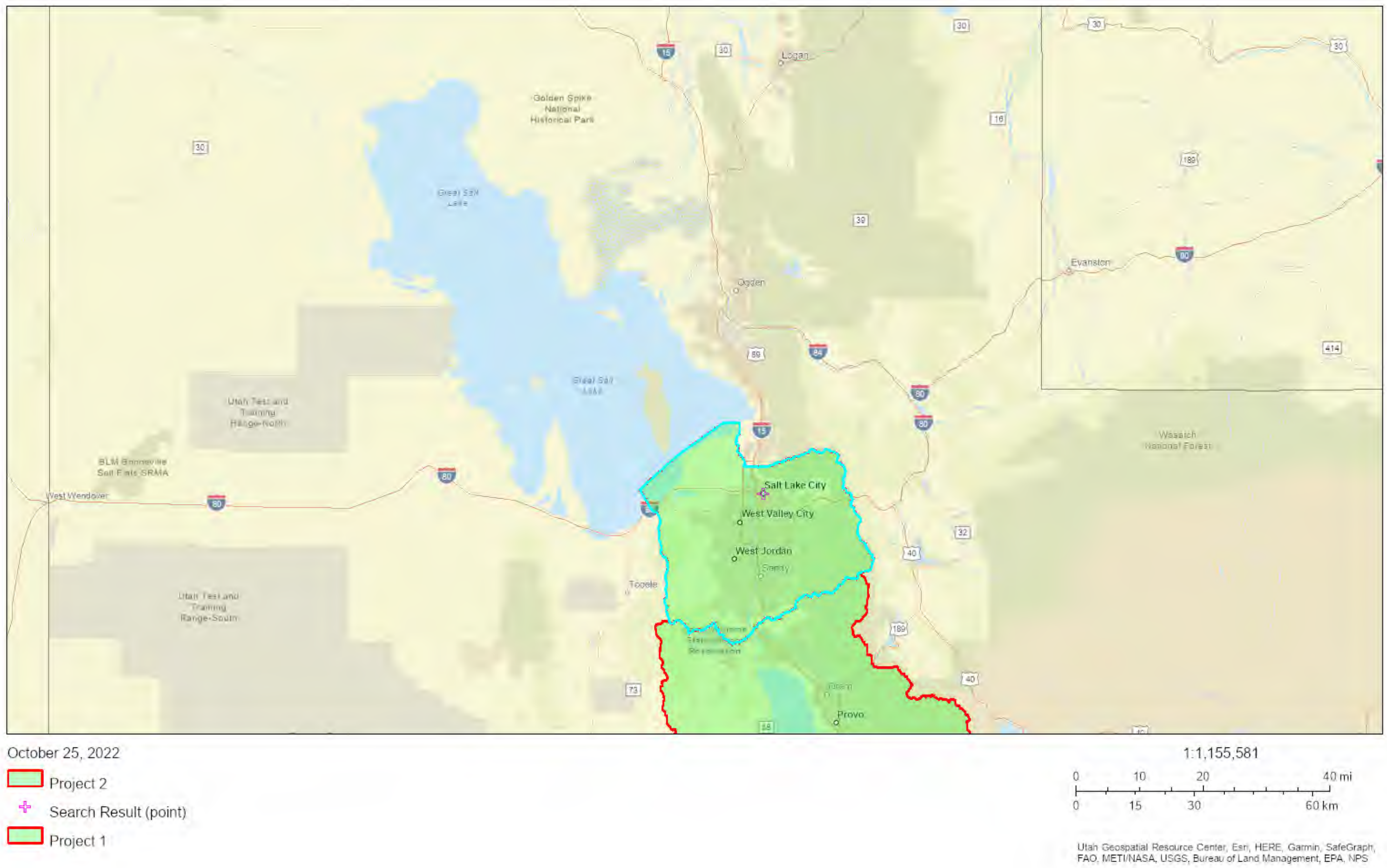

Sites reporting to EPA	
Superfund NPL	6
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	56

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 ($\mu g/m^3$)	8.17	7.53	64	8.67	38
Ozone (ppb)	58.5	57.7	75	42.5	97
Diesel Particulate Matter* ($\mu g/m^3$)	0.294	0.242	64	0.294	60-70th
Air Toxics Cancer Risk* (lifetime risk per million)	25	20	90	28	60-70th
Air Toxics Respiratory HI*	0.36	0.29	89	0.36	60-70th
Traffic Proximity (daily traffic count/distance to road)	850	720	75	760	78
Lead Paint (% Pre-1960 Housing)	0.2	0.17	67	0.27	47
Superfund Proximity (site count/km distance)	0.28	0.18	85	0.13	90
RMP Facility Proximity (facility count/km distance)	0.57	0.6	65	0.77	62
Hazardous Waste Proximity (facility count/km distance)	1.5	0.91	78	2.2	63
Underground Storage Tanks (count/km^2)	2.9	2.3	73	3.9	66
Wastewater Discharge (toxicity-weighted concentration/m distance)	1.6	16	78	12	94
Socioeconomic Indicators					
Demographic Index	27%	24%	64	35%	46
People of Color	29%	22%	74	40%	50
Low Income	24%	25%	52	30%	43
Unemployment Rate	4%	4%	64	5%	49
Limited English Speaking	3%	2%	79	5%	69
Less Than High School Education	8%	7%	71	12%	50
Under Age 5	7%	8%	54	6%	70
Over Age 64	11%	11%	52	16%	30

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

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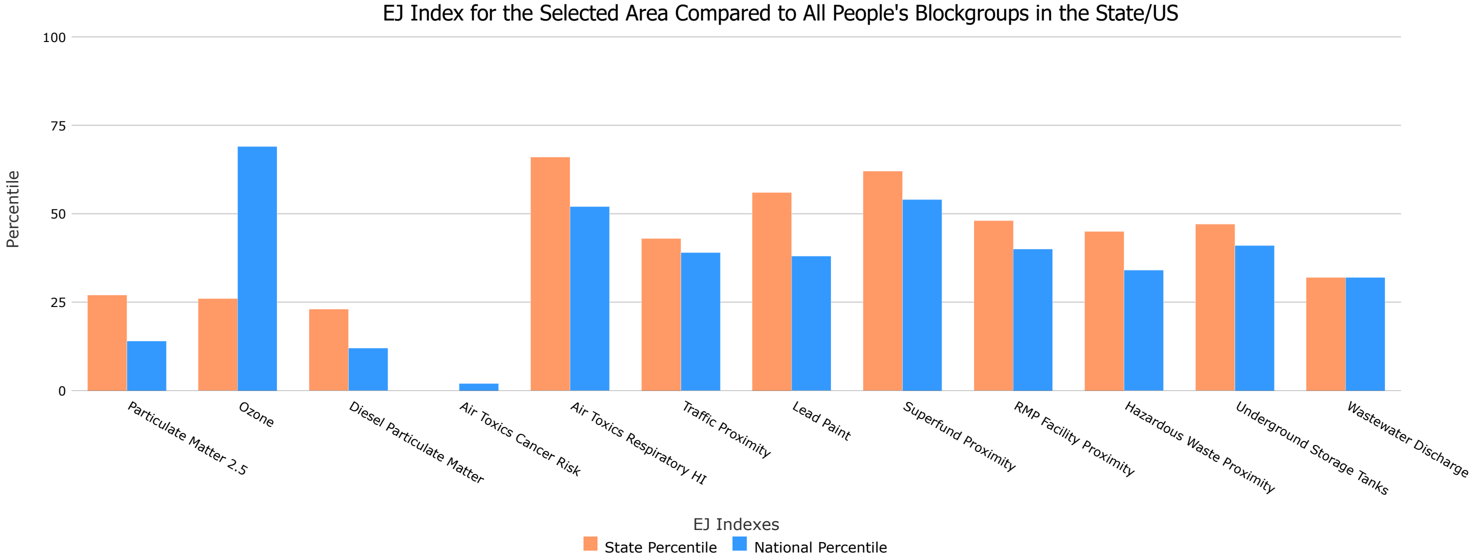
EJScreen Report (Version 2.1)

County: Tooele
UTAH, EPA Region 8
Approximate Population: 69,740
Input Area (sq. miles): 7285.95

(The study area contains 1 blockgroup(s) with zero population.)

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	27	14
EJ Index for Ozone	26	69
EJ Index for Diesel Particulate Matter*	23	12
EJ Index for Air Toxics Cancer Risk*	0	2
EJ Index for Air Toxics Respiratory HI*	66	52
EJ Index for Traffic Proximity	43	39
EJ Index for Lead Paint	56	38
EJ Index for Superfund Proximity	62	54
EJ Index for RMP Facility Proximity	48	40
EJ Index for Hazardous Waste Proximity	45	34
EJ Index for Underground Storage Tanks	47	41
EJ Index for Wastewater Discharge	32	32

EJ Index for the Selected Area Compared to All People's Blockgroups in the State/US



This report shows the values for environmental and demographic indicators and EJScreen indexes. It shows environmental and demographic raw data (e.g., the estimated concentration of ozone in the air), and also shows what percentile each raw data value represents. These percentiles provide perspective on how the selected block group or buffer area compares to the entire state or nation. For example, if a given location is at the 95th percentile nationwide, this means that only 5 percent of the US population has a higher block group value than the average person in the location being analyzed. The years for which the data are available, and the methods used, vary across these indicators. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJScreen documentation for discussion of these issues before using reports.

Sites reporting to EPA	
Superfund NPL	3
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	10

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 (μg/m³)	6.74	7.53	17	8.67	10
Ozone (ppb)	56.4	57.7	19	42.5	94
Diesel Particulate Matter* (μg/m³)	0.0795	0.242	14	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	11	20	19	28	<50th
Air Toxics Respiratory HI*	0.65	0.29	99	0.36	95-100th
Traffic Proximity (daily traffic count/distance to road)	180	720	36	760	44
Lead Paint (% Pre-1960 Housing)	0.17	0.17	63	0.27	44
Superfund Proximity (site count/km distance)	0.1	0.18	56	0.13	67
RMP Facility Proximity (facility count/km distance)	0.28	0.6	47	0.77	47
Hazardous Waste Proximity (facility count/km distance)	0.28	0.91	40	2.2	37
Underground Storage Tanks (count/km²)	0.91	2.3	44	3.9	46
Wastewater Discharge (toxicity-weighted concentration/m distance)	4.8	16	83	12	96
Socioeconomic Indicators					
Demographic Index	21%	24%	50	35%	35
People of Color	18%	22%	53	40%	36
Low Income	24%	25%	52	30%	44
Unemployment Rate	5%	4%	75	5%	60
Limited English Speaking	1%	2%	68	5%	59
Less Than High School Education	8%	7%	68	12%	48
Under Age 5	8%	8%	59	6%	74
Over Age 64	9%	11%	42	16%	23

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

For additional information, see: www.epa.gov/environmentaljustice (https://www.epa.gov/environmentaljustice)

Centers for Disease Control and Prevention
CDC 24/7: Saving Lives. Protecting People.™
(../showHome.action)

Saguache County, Colorado†

County highlighted in the State

POPULATION: 6,226

INCOME

Average Household Income

Saguache County: $37,004

Colorado: $77,104

Residents who live below the poverty line

25.4%

Saguache County

9.4%

Colorado

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 2 are between the ages of 0 and 19 years

About 1 are between the ages of 20 and 34 years

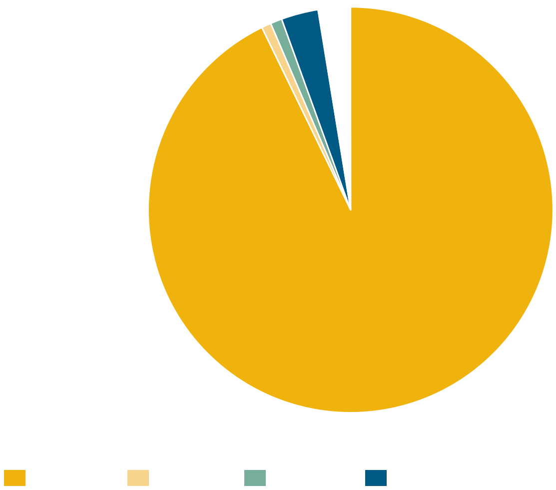
About 2 are between the ages of 35 and 49 years

About 4 are 50 years and older

ETHNICITY

4 are Hispanic and 6 are non-Hispanic

RACE



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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

9.7% 7.0%

Colorado National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=8&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Saguache County residents were exposed to unhealthy levels of ozone for **0 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Saguache County residents were exposed to unhealthy levels of ozone for **0 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

ıttps://twitter.com/share?

%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=8109&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

5.1 µg/m^{3}*

Saguache County, Colorado

12.0μg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (μg/m³)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and
- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0μg/m³**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Saguache County** was **5.1μg/m³**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (μg/m³)

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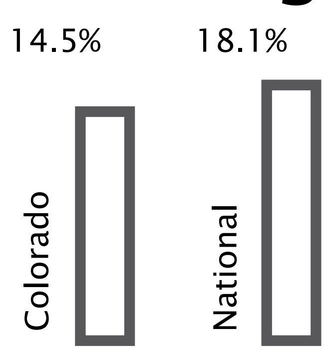
%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

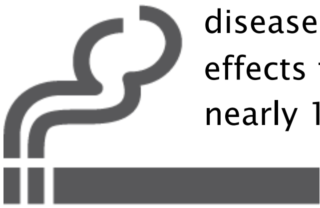
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=8109&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†





Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=8&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†

0 Days

with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Saguache County had **0 Days** with maximum temperatures above 90°F during May–September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

ıttps://twitter.com/share?

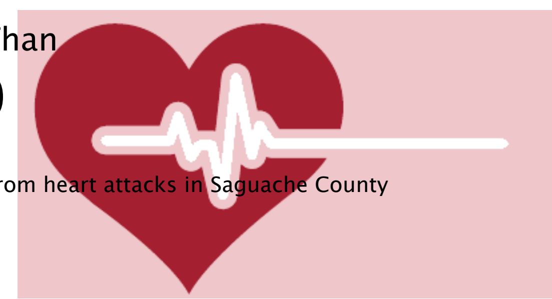
%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=8109&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†



Less Than

10

deaths from heart attacks in Saguache County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

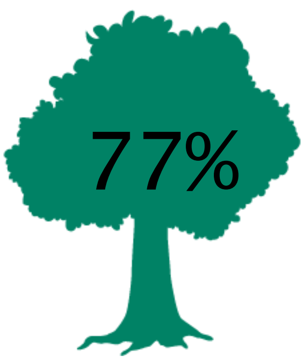
In 2020, there were

- **Less than 10 deaths** from heart attacks in Saguache County.
- **1,006 deaths** from heart attacks in Colorado.

Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=8109&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†



Live within half a mile of a park in Saguache County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

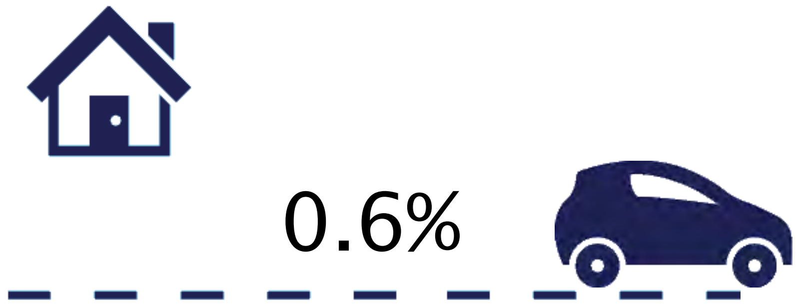
77% of people living in **Saguache County** lived within half a mile of a park.

74% of people living in **Colorado** lived within half a mile of a park.

Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=8109&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†



of Saguache County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **0.6%** of the population of Saguache County lived within 150 meters* of a major highway.

In 2011, **27.3%** of Saguache County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=8109&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

The Colorado Tracking Network (https://coepht.colorado.gov/) has more state-specific information about your health and the environment.

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Gunnison County, Colorado†

County highlighted in the State

POPULATION: 15,505

INCOME

Average Household Income

Gunnison County: $60,408

Colorado: $77,104

Residents who live below the poverty line

11.6%

Gunnison County

9.4%

Colorado

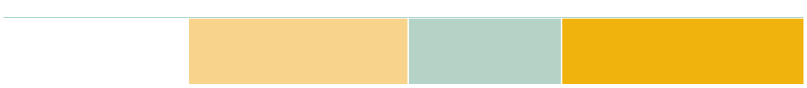
QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE



About 2 are between the ages of 0 and 19 years

About 3 are between the ages of 20 and 34 years

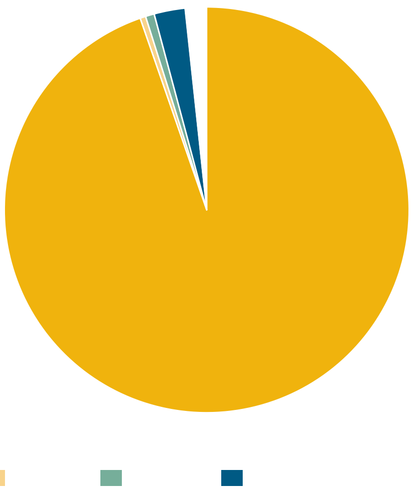
About 2 are between the ages of 35 and 49 years

About 3 are 50 years and older

ETHNICITY

1 are Hispanic and 9 are non-Hispanic

RACE



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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

9.7% 7.0%

Colorado National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=8&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Gunnison County residents were exposed to unhealthy levels of ozone for **2 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Gunnison County residents were exposed to unhealthy levels of ozone for **2 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=8051&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

4.9 $\mu g/m^{3}$*

Gunnison County, Colorado

12.0µg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (µg/m³)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and
- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0µg/m³**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Gunnison County** was **4.9µg/m³**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (µg/m³)

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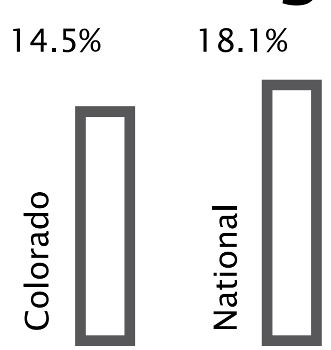
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=8051&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†



PERCENTAGE OF CURRENT ADULT SMOKERS

Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=8&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†

0 Days

with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Gunnison County had **0 Days** with maximum temperatures above 90°F during May–September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=8051&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†

Less Than

10

deaths from heart attacks in Gunnison County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **Less than 10 deaths** from heart attacks in Gunnison County.
- **1,006 deaths** from heart attacks in Colorado.

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Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=8051&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Gunnison County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

90% of people living in **Gunnison County** lived within half a mile of a park.

74% of people living in **Colorado** lived within half a mile of a park.

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;3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20#environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=8051&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†

of Gunnison County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **5.2%** of the population of Gunnison County lived within 150 meters* of a major highway.

In 2011, **0.0%** of Gunnison County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=8051&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

The Colorado Tracking Network (https://coepht.colorado.gov/) has more state-specific information about your health and the environment.

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Montrose County, Colorado†

County highlighted in the State

POPULATION: 40,744

INCOME

Average Household Income

Montrose County: $50,707

Colorado: $77,104

Residents who live below the poverty line

13.2%

Montrose County

9.4%

Colorado

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 3 are between the ages of 0 and 19 years

About 2 are between the ages of 20 and 34 years

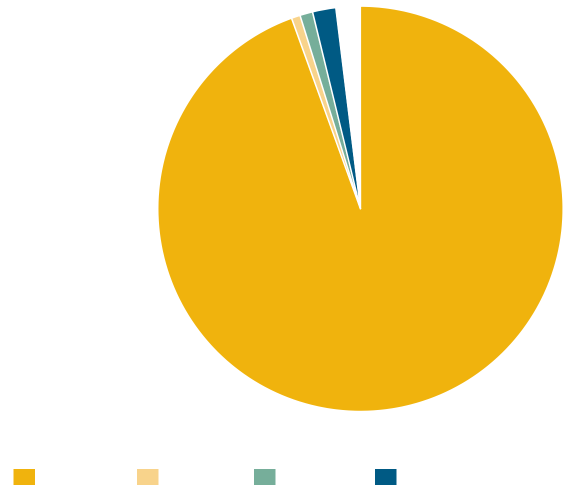
About 2 are between the ages of 35 and 49 years

About 4 are 50 years and older

ETHNICITY

2 are Hispanic and 8 are non-Hispanic

RACE



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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

9.7% 7.0%

Colorado National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=8&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Montrose County residents were exposed to unhealthy levels of ozone for **1 Day** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Montrose County residents were exposed to unhealthy levels of ozone for **1 Day** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=8085&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

5.5 µg/m³*

Montrose County, Colorado

12.0 µg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (µg/m³)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and

- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0μg/m³**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Montrose County** was **5.5μg/m³**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (μg/m³)

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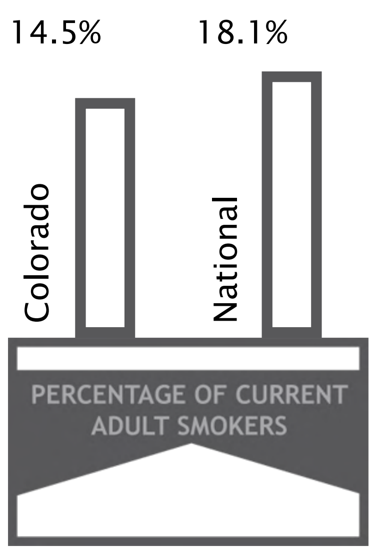
%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

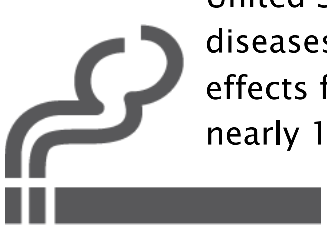
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=8085&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†



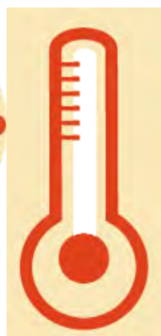


Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=8&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†



19 Days

with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Montrose County had **19 Days** with maximum temperatures above 90°F during May-September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

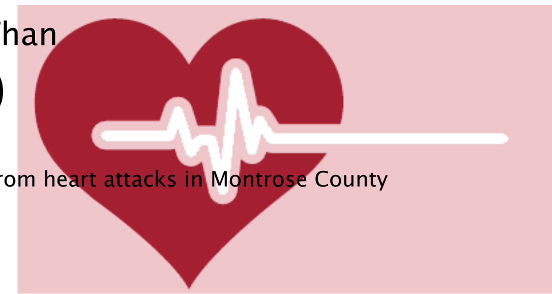
Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=8085&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†

Less Than

10



deaths from heart attacks in Montrose County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **Less than 10 deaths** from heart attacks in Montrose County.
- **1,006 deaths** from heart attacks in Colorado.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

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† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Montrose County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

65% of people living in **Montrose County** lived within half a mile of a park.

74% of people living in **Colorado** lived within half a mile of a park.

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;3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20#environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=8085&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†

5.0%

of Montrose County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **5.0%** of the population of Montrose County lived within 150 meters* of a major highway.

In 2011, **23.5%** of Montrose County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=8085&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

The Colorado Tracking Network (https://coepht.colorado.gov/) has more state-specific information about your health and the environment.

Visit CDC's Tracking Network today.

www.cdc.gov/ephtracking (http://www.cdc.gov/ephtracking/)

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subject=Please%20add%20me%20to%20CDC's%20Environmen
serv.&body=Please%20fill%20in%20the%20information%20bel

(../showHome.action)

Delta County, Colorado†

County highlighted in the State

POPULATION: 30,326

INCOME

Average Household Income

Delta County: $51,525

Colorado: $77,104

Residents who live below the poverty line

15.1%

Delta County

9.4%

Colorado

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 2 are between the ages of 0 and 19 years

About 1 are between the ages of 20 and 34 years

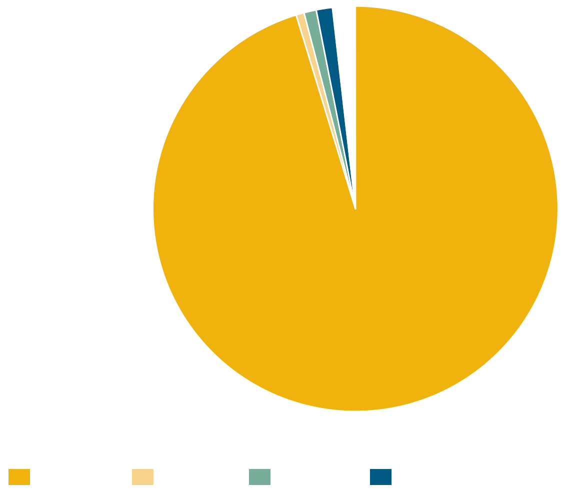
About 2 are between the ages of 35 and 49 years

About 5 are 50 years and older

ETHNICITY

1 are Hispanic and 9 are non-Hispanic

RACE



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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

9.7% 7.0%

Colorado National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=8&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Delta County residents were exposed to unhealthy levels of ozone for **1 Day** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Delta County residents were exposed to unhealthy levels of ozone for **1 Day** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=8029&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

5.6µg/m³*

Delta County, Colorado

12.0µg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (µg/m³)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and

- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0μg/m³**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Delta County** was **5.6μg/m³**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (μg/m³)

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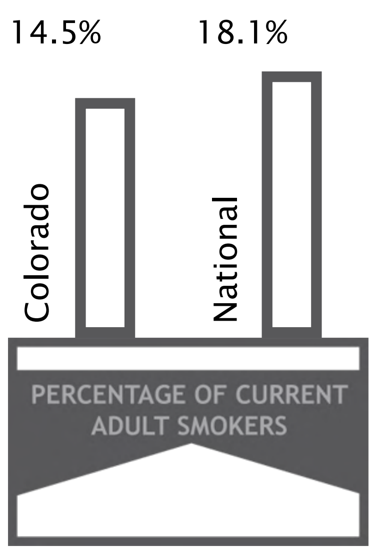
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=8029&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†



Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=8&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†

24 Days

with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Delta County had **24 Days** with maximum temperatures above 90°F during May-September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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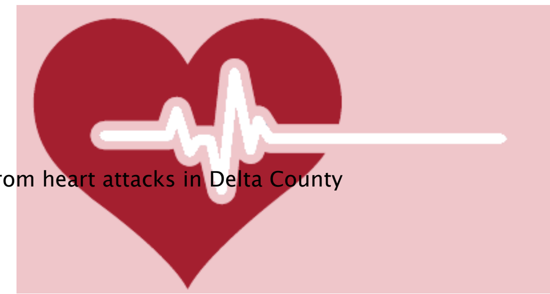
Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=8029&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†

12



deaths from heart attacks in Delta County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **12 deaths** from heart attacks in Delta County.
- **1,006 deaths** from heart attacks in Colorado.

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Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=8029&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Delta County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

66% of people living in **Delta County** lived within half a mile of a park.

74% of people living in **Colorado** lived within half a mile of a park.

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† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†

0.8%

of Delta County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **0.8%** of the population of Delta County lived within 150 meters* of a major highway.

In 2011, **0.0%** of Delta County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=8029&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

The Colorado Tracking Network (https://coepht.colorado.gov/) has more state-specific information about your health and the environment.

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Centers for Disease Control and Prevention
CDC 24/7: Saving Lives. Protecting People.™ (../showHome.action)

Mesa County, Colorado†

County highlighted in the State

POPULATION: 147,699

INCOME

Average Household Income

Mesa County: $60,249

Colorado: $77,104

Residents who live below the poverty line

11.2%

Mesa County

9.4%

Colorado

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 3 are between the ages of 0 and 19 years

About 2 are between the ages of 20 and 34 years

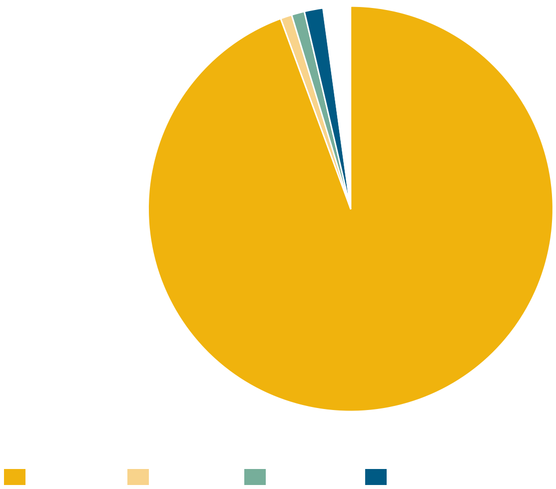
About 2 are between the ages of 35 and 49 years

About 4 are 50 years and older

ETHNICITY

1 are Hispanic and 9 are non-Hispanic

RACE



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Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

9.7% 7.0%

Colorado National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=8&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Mesa County residents were exposed to unhealthy levels of ozone for **3 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Mesa County residents were exposed to unhealthy levels of ozone for **3 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=8077&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

5.9 μg/m³*

Mesa County, Colorado

12.0 μg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (μg/m³)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and

- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0μg/m³**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Mesa County** was **5.9μg/m³**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (μg/m³)

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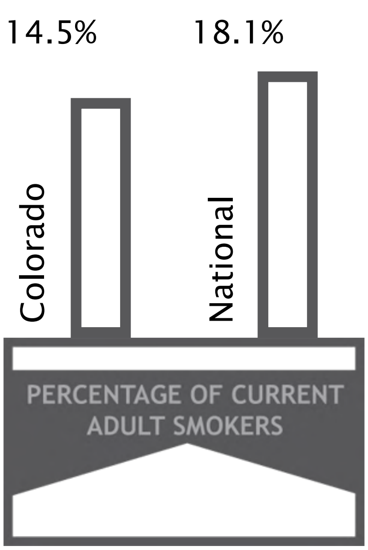
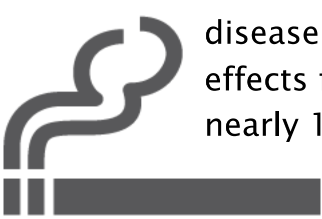
Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=8077&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†





Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=8&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†

65 Days

with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Mesa County had **65 Days** with maximum temperatures above 90°F during May-September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

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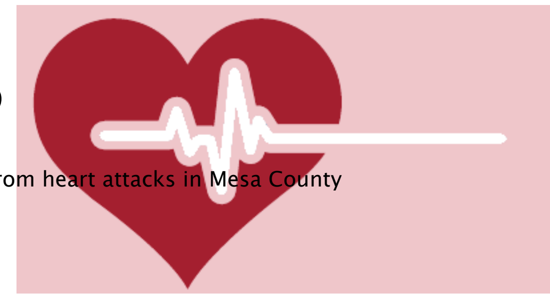
Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=8077&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†

36

deaths from heart attacks in Mesa County



The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **36 deaths** from heart attacks in Mesa County.
- **1,006 deaths** from heart attacks in Colorado.

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Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=8077&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Mesa County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

59% of people living in **Mesa County** lived within half a mile of a park.

74% of people living in **Colorado** lived within half a mile of a park.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=8077&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†

5.3%

of Mesa County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **5.3%** of the population of Mesa County lived within 150 meters* of a major highway.

In 2011, **3.8%** of Mesa County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=8077&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

The Colorado Tracking Network (https://coepht.colorado.gov/) has more state-specific information about your health and the environment.

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subject=Please%20add%20me%20to%20CDC's%20Environmen
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(../showHome.action)

Grand County, Utah†

County highlighted in the State

POPULATION: 9,367

INCOME

Average Household Income

Grand County: $53,535

Utah: $75,705

Residents who live below the poverty line

12.2%

Grand County

8.8%

Utah

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 2 are between the ages of 0 and 19 years

About 2 are between the ages of 20 and 34 years

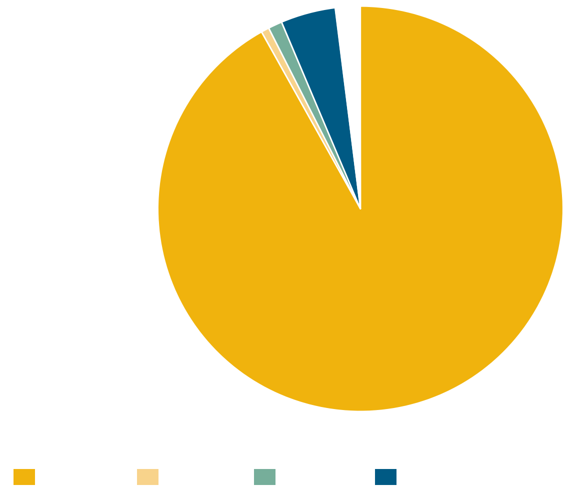
About 2 are between the ages of 35 and 49 years

About 4 are 50 years and older

ETHNICITY

1 are Hispanic and 9 are non-Hispanic

RACE



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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

9.9% 7.0%

Utah National

Percent of **children** who currently have asthma

5.7% 8.3%

Utah National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=49&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Grand County residents were exposed to unhealthy levels of ozone for **1 Day** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Grand County residents were exposed to unhealthy levels of ozone for **1 Day** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=49019&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

4.9 $\mu g/m^3$*

Grand County, Utah

12.0μg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (μg/m³)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and
- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0μg/m³**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Grand County** was **4.9μg/m³**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (μg/m³)

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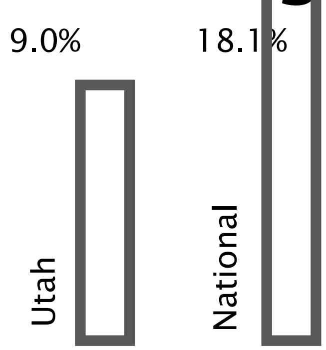
%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

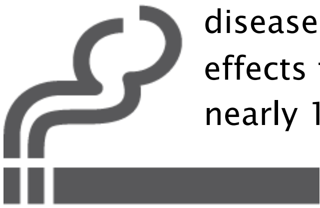
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=49019&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†





Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=49&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†

62 Days

with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Grand County had **62 Days** with maximum temperatures above 90°F during May–September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=49019&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†

Less Than

10

deaths from heart attacks in Grand County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **Less than 10 deaths** from heart attacks in Grand County.
- **473 deaths** from heart attacks in Utah.

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Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=49019&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Grand County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

96% of people living in **Grand County** lived within half a mile of a park.

75% of people living in **Utah** lived within half a mile of a park.

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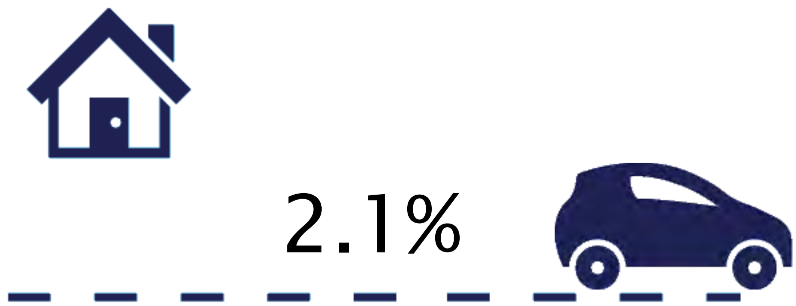
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=49019&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†



of Grand County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **2.1%** of the population of Grand County lived within 150 meters* of a major highway.

In 2011, **16.7%** of Grand County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=49019&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

The Utah Tracking Network (http://epht.health.utah.gov/) has more state-specific information about your health and the environment.

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(../showHome.action)

Emery County, Utah†

County highlighted in the State

POPULATION: 10,716

INCOME

Average Household Income

Emery County: $61,893

Utah: $75,705

Residents who live below the poverty line

10.9%

Emery County

8.8%

Utah

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 3 are between the ages of 0 and 19 years

About 2 are between the ages of 20 and 34 years

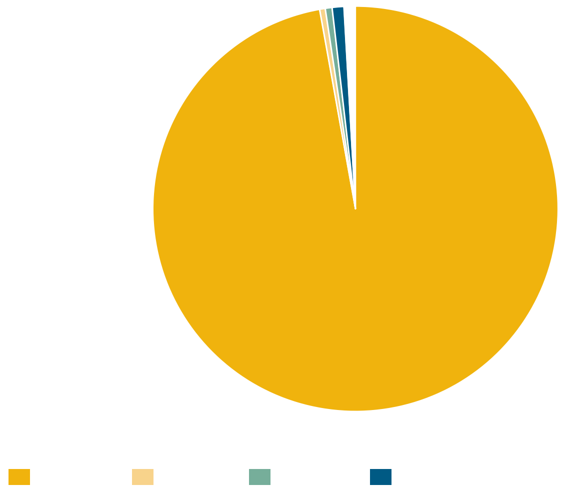
About 2 are between the ages of 35 and 49 years

About 3 are 50 years and older

ETHNICITY

1 are Hispanic and 9 are non-Hispanic

RACE



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Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

9.9% 7.0%

Utah National

Percent of **children** who currently have asthma

5.7% 8.3%

Utah National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=49&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Emery County residents were exposed to unhealthy levels of ozone for **4 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Emery County residents were exposed to unhealthy levels of ozone for **4 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=49015&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

5.4µg/m³*

Emery County, Utah

12.0μg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (μg/m³)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and
- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0μg/m³**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Emery County** was **5.4μg/m³**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (μg/m³)

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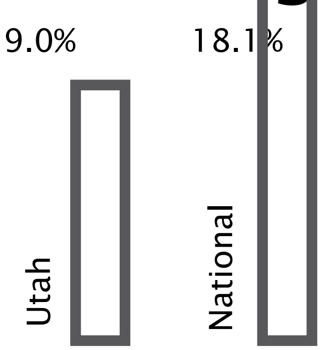
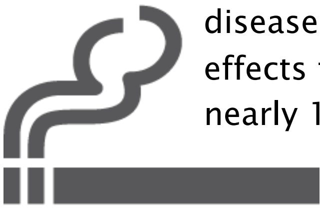
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=49015&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†





Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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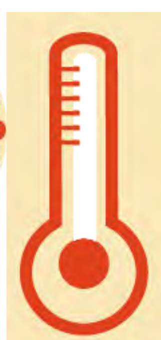
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=49&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†

8 Days



with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Emery County had **8 Days** with maximum temperatures above 90°F during May-September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=49015&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

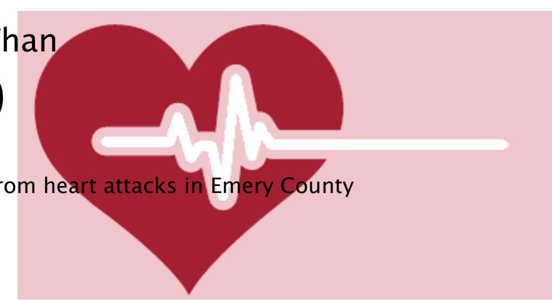
† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†

Less Than

10

deaths from heart attacks in Emery County



The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **Less than 10 deaths** from heart attacks in Emery County.
- **473 deaths** from heart attacks in Utah.

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Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=49015&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Emery County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

95% of people living in **Emery County** lived within half a mile of a park.

75% of people living in **Utah** lived within half a mile of a park.

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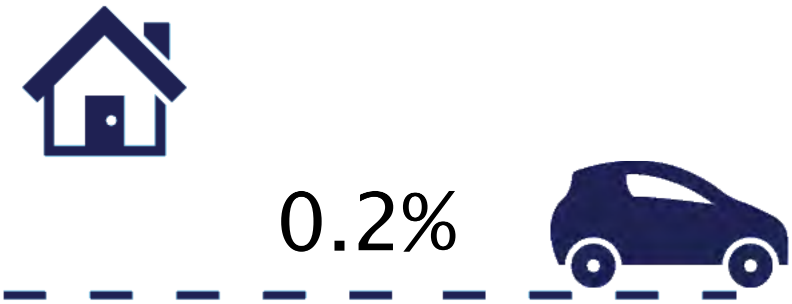
3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20#environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=49015&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†



of Emery County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **0.2%** of the population of Emery County lived within 150 meters* of a major highway.

In 2011, **0.0%** of Emery County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=49015&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

The Utah Tracking Network (http://epht.health.utah.gov/) has more state-specific information about your health and the environment.

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serv.&body=Please%20fill%20in%20the%20information%20bel

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Carbon County, Utah†

County highlighted in the State

POPULATION: 20,931

INCOME

Average Household Income

Carbon County: $52,110

Utah: $75,705

Residents who live below the poverty line

16.4%

Carbon County

8.8%

Utah

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 3 are between the ages of 0 and 19 years

About 2 are between the ages of 20 and 34 years

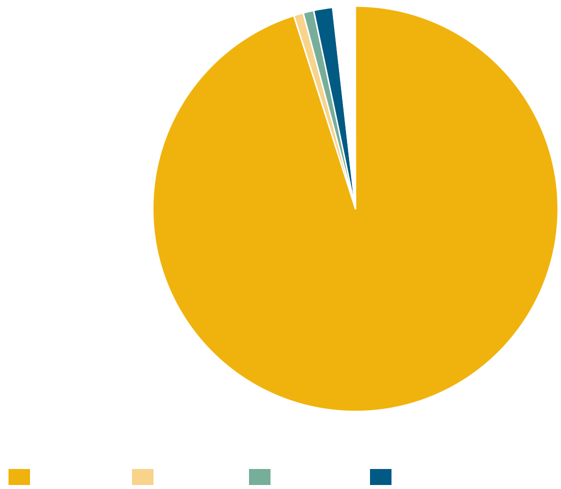
About 2 are between the ages of 35 and 49 years

About 3 are 50 years and older

ETHNICITY

1 are Hispanic and 9 are non-Hispanic

RACE



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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

9.9% 7.0%

Utah National

Percent of **children** who currently have asthma

5.7% 8.3%

Utah National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=49&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Carbon County residents were exposed to unhealthy levels of ozone for **5 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Carbon County residents were exposed to unhealthy levels of ozone for **5 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=49007&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

5.7 μg/m³*

Carbon County, Utah

12.0 μg/m^3*

Annual National Standard

*Micrograms Per Cubic Meter (μg/m^3)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and
- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0μg/m^3**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Carbon County** was **5.7μg/m^3**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (μg/m^3)

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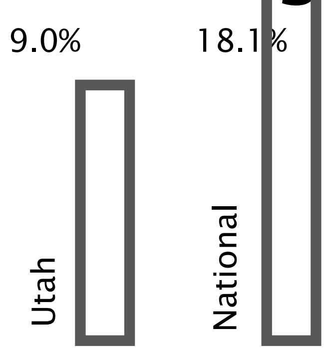
%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

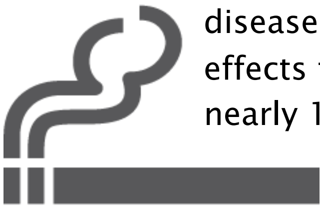
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=49007&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†





Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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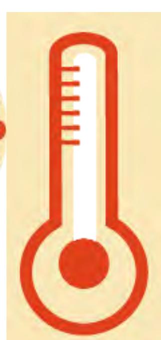
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=49&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†



7 Days

with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Carbon County had **7 Days** with maximum temperatures above 90°F during May–September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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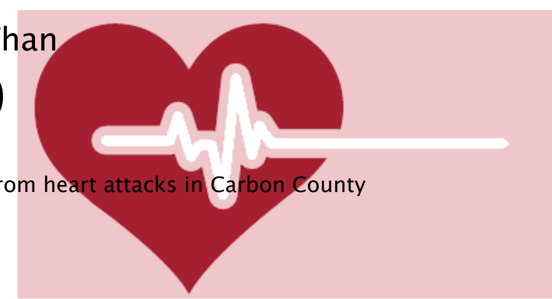
%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=49007&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†



Less Than

10

deaths from heart attacks in Carbon County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **Less than 10 deaths** from heart attacks in Carbon County.
- **473 deaths** from heart attacks in Utah.

Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=49007&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Carbon County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

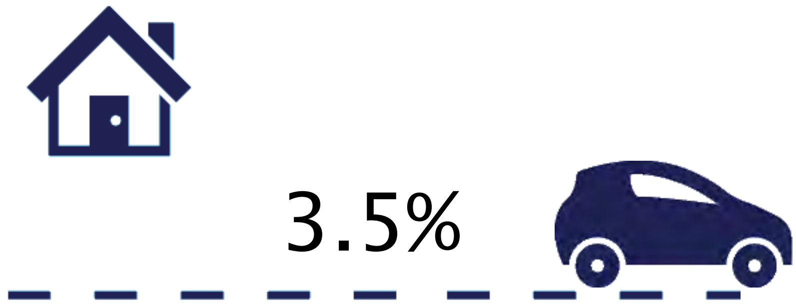
72% of people living in **Carbon County** lived within half a mile of a park.

75% of people living in **Utah** lived within half a mile of a park.

Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=49007&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†



of Carbon County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **3.5%** of the population of Carbon County lived within 150 meters* of a major highway.

In 2011, **9.1%** of Carbon County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=49007&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

The Utah Tracking Network (http://epht.health.utah.gov/) has more state-specific information about your health and the environment.

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Utah County, Utah†

County highlighted in the State

POPULATION: 551,926

INCOME

Average Household Income

Utah County: $79,505

Utah: $75,705

Residents who live below the poverty line

9.7%

Utah County

8.8%

Utah

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 4 are between the ages of 0 and 19 years

About 3 are between the ages of 20 and 34 years

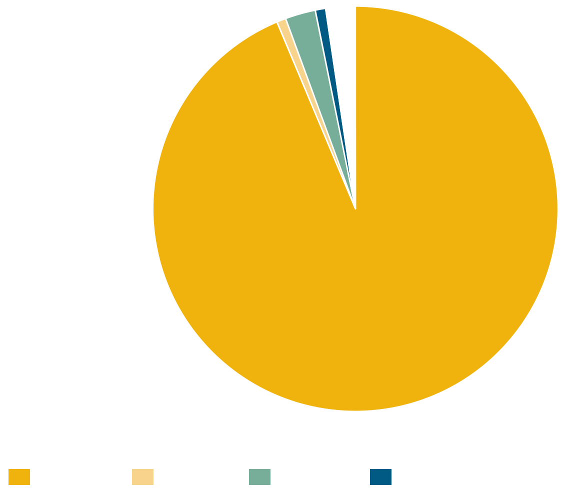
About 2 are between the ages of 35 and 49 years

About 2 are 50 years and older

ETHNICITY

1 are Hispanic and 9 are non-Hispanic

RACE



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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

9.9% 7.0%

Utah National

Percent of **children** who currently have asthma

5.7% 8.3%

Utah National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=49&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Utah County residents were exposed to unhealthy levels of ozone for **22 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Utah County residents were exposed to unhealthy levels of ozone for **22 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=49049&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

9.1 µg/m³*

Utah County, Utah

12.0µg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (µg/m³)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and
- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0µg/m³**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Utah County** was **9.1µg/m³**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (µg/m³)

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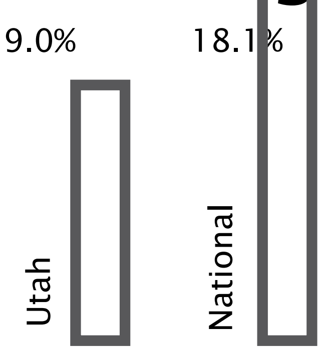
%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

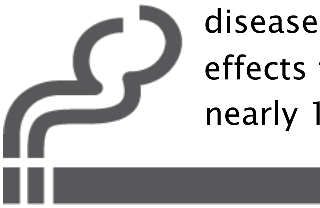
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=49049&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†





Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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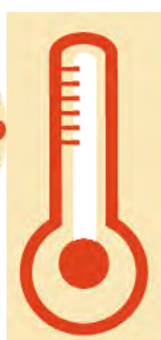
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=49&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†

54 Days



with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Utah County had **54 Days** with maximum temperatures above 90°F during May-September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

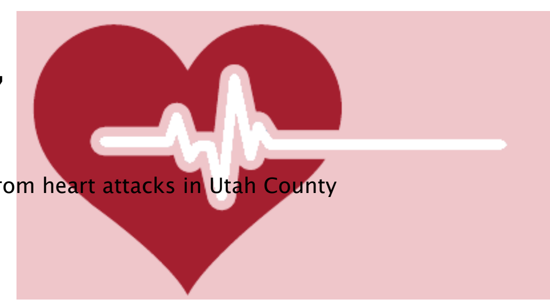
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=49049&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†

57



deaths from heart attacks in Utah County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **57 deaths** from heart attacks in Utah County.
- **473 deaths** from heart attacks in Utah.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=49049&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Utah County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

84% of people living in **Utah County** lived within half a mile of a park.

75% of people living in **Utah** lived within half a mile of a park.

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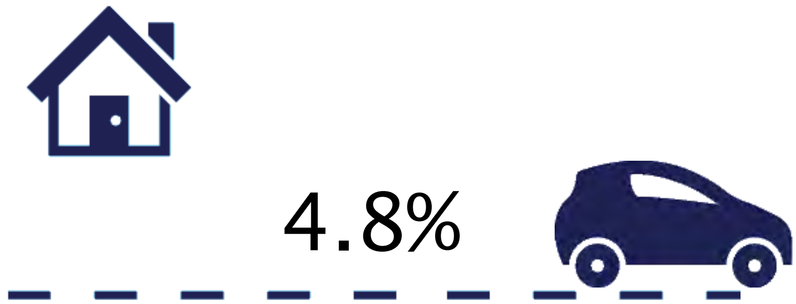
;3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20#environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=49049&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†



of Utah County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **4.8%** of the population of Utah County lived within 150 meters* of a major highway.

In 2011, **2.4%** of Utah County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=49049&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

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Salt Lake County, Utah†

County highlighted in the State

POPULATION: 1,080,866

INCOME

Average Household Income

Salt Lake County: $79,941

Utah: $75,705

Residents who live below the poverty line

9.0%

Salt Lake County

8.8%

Utah

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 3 are between the ages of 0 and 19 years

About 2 are between the ages of 20 and 34 years

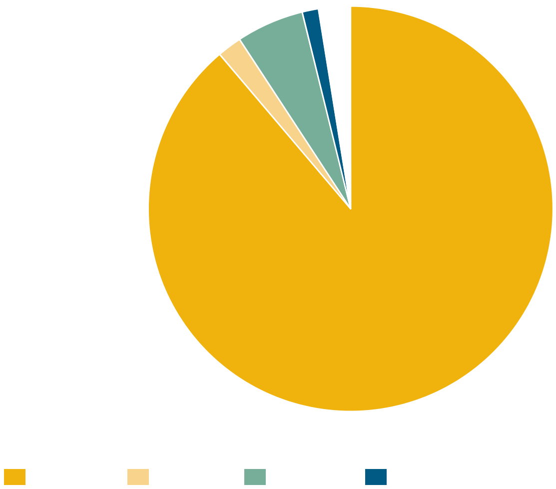
About 2 are between the ages of 35 and 49 years

About 3 are 50 years and older

ETHNICITY

2 are Hispanic and 8 are non-Hispanic

RACE



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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

9.9% 7.0%

Utah National

Percent of **children** who currently have asthma

5.7% 8.3%

Utah National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=49&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Salt Lake County residents were exposed to unhealthy levels of ozone for **31 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Salt Lake County residents were exposed to unhealthy levels of ozone for **31 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=49035&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

10.0µg/m³*

Salt Lake County, Utah

12.0μg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (μg/m³)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and
- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0μg/m³**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Salt Lake County** was **10.0μg/m³**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (μg/m³)

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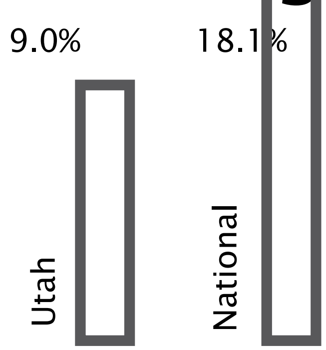
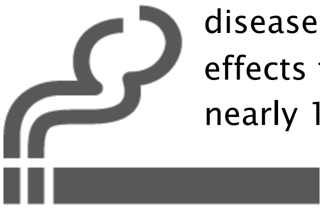
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=49035&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†





Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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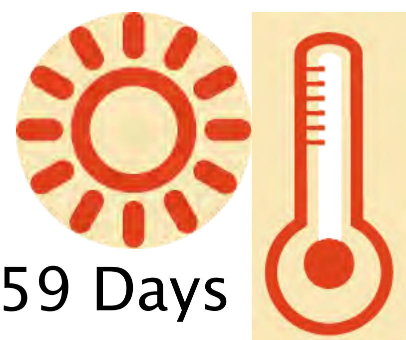
Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=49&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†



59 Days

with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Salt Lake County had **59 Days** with maximum temperatures above 90°F during May–September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=49035&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†

170

deaths from heart attacks in Salt Lake County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **170 deaths** from heart attacks in Salt Lake County.
- **473 deaths** from heart attacks in Utah.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=49035&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Salt Lake County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

78% of people living in **Salt Lake County** lived within half a mile of a park.

75% of people living in **Utah** lived within half a mile of a park.

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Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=49035&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†

3.1%

of Salt Lake County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **3.1%** of the population of Salt Lake County lived within 150 meters* of a major highway.

In 2011, **1.6%** of Salt Lake County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=49035&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

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Tooele County, Utah†

County highlighted in the State

POPULATION: 60,718

INCOME

Average Household Income

Tooele County: $80,196

Utah: $75,705

Residents who live below the poverty line

5.3%

Tooele County

8.8%

Utah

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 4 are between the ages of 0 and 19 years

About 2 are between the ages of 20 and 34 years

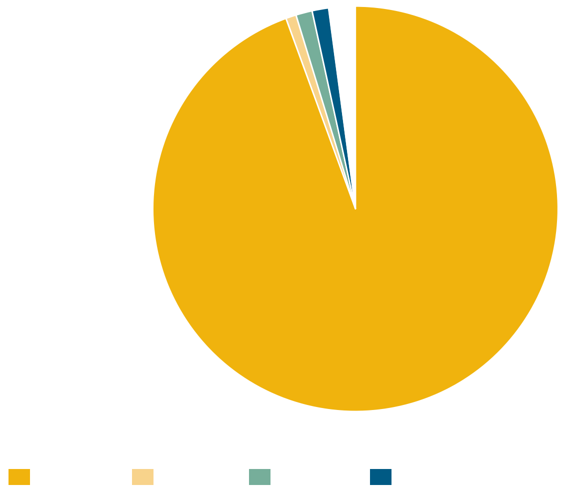
About 2 are between the ages of 35 and 49 years

About 2 are 50 years and older

ETHNICITY

1 are Hispanic and 9 are non-Hispanic

RACE



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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

9.9% 7.0%

Utah National

Percent of **children** who currently have asthma

5.7% 8.3%

Utah National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=49&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Tooele County residents were exposed to unhealthy levels of ozone for **6 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Tooele County residents were exposed to unhealthy levels of ozone for **6 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=49045&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

8.6μg/m³*

Tooele County, Utah

12.0µg/m^3*

Annual National Standard

*Micrograms Per Cubic Meter (µg/m^3)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and
- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0µg/m^3**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Tooele County** was **8.6µg/m^3**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (µg/m^3)

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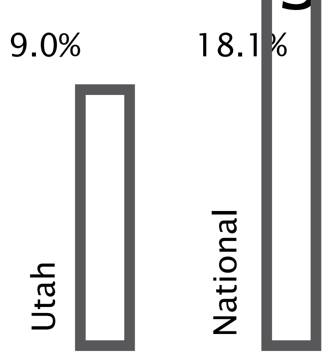
%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

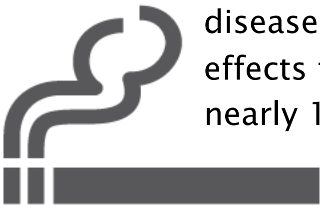
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=49045&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†





Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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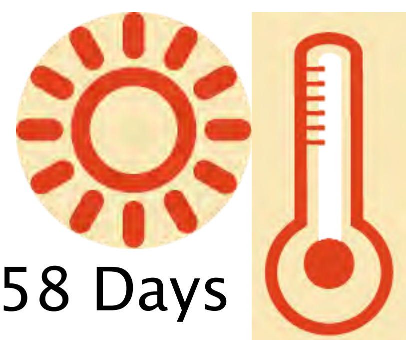
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=49&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†



58 Days

with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Tooele County had **58 Days** with maximum temperatures above 90°F during May–September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=49045&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†

Less Than

10

deaths from heart attacks in Tooele County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **Less than 10 deaths** from heart attacks in Tooele County.
- **473 deaths** from heart attacks in Utah.

ıttps://twitter.com/share?

%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=49045&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Tooele County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

61% of people living in **Tooele County** lived within half a mile of a park.

75% of people living in **Utah** lived within half a mile of a park.

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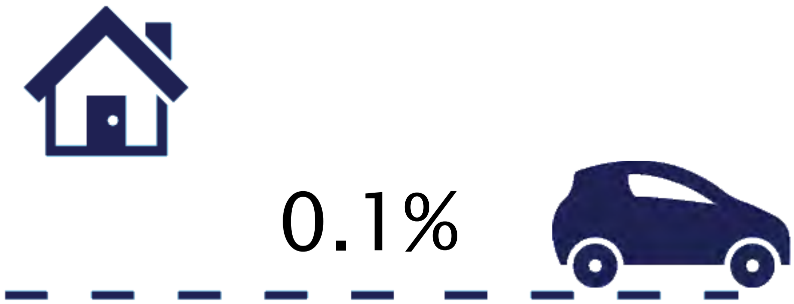
;3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20#environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=49045&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†



of Tooele County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **0.1%** of the population of Tooele County lived within 150 meters* of a major highway.

In 2011, **0.0%** of Tooele County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=49045&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

The Utah Tracking Network (http://epht.health.utah.gov/) has more state-specific information about your health and the environment.

Visit CDC's Tracking Network today.

www.cdc.gov/ephtracking (http://www.cdc.gov/ephtracking/)

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subject=Please%20add%20me%20to%20CDC's%20Environmen
serv.&body=Please%20fill%20in%20the%20information%20bel

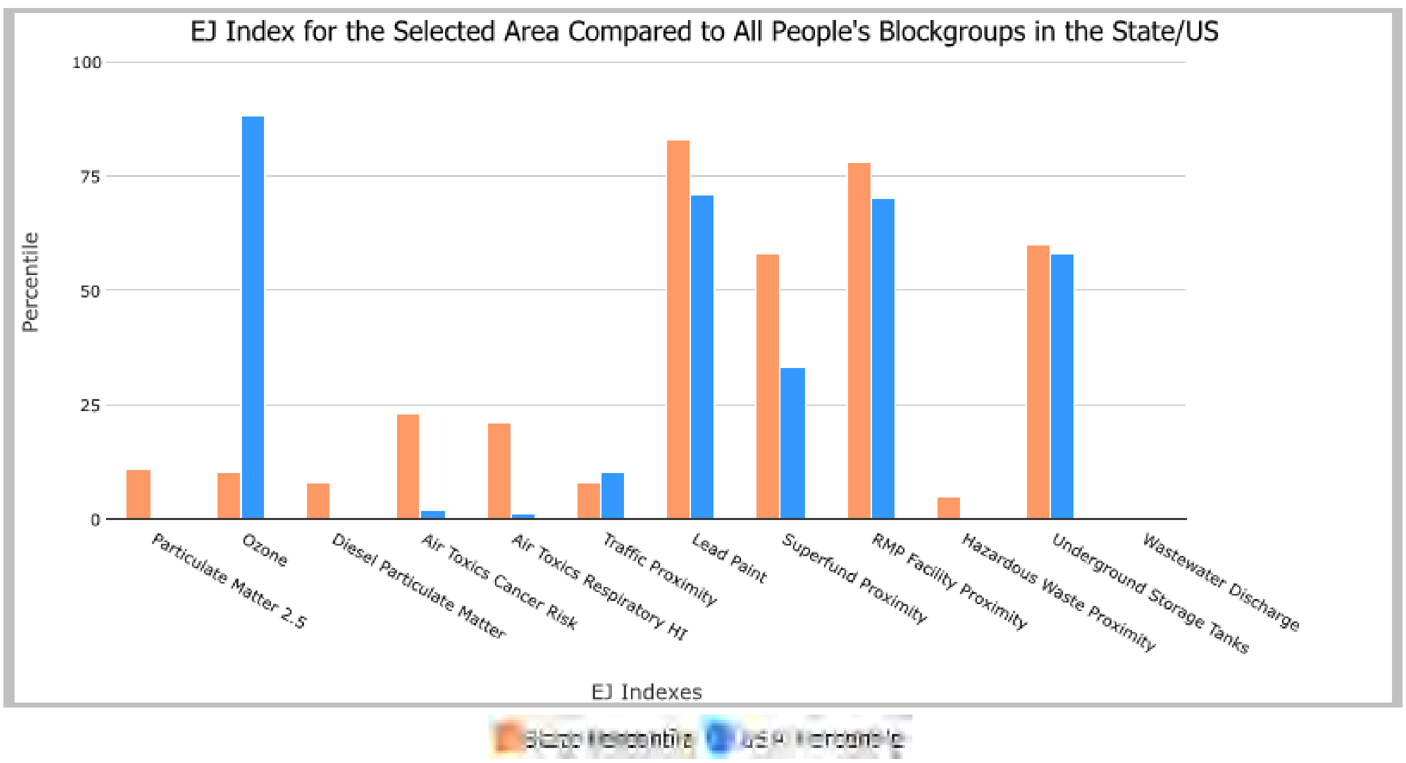
EJScreen Report (Version 2.1)

County: Saguache, COLORADO, EPA Region 8

Approximate Population: 6,730

Input Area (sq. miles): 3170.27

Selected Variables	State Percentile	USA Percentile
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	11	0
EJ Index for Ozone	10	88
EJ Index for Diesel Particulate Matter*	8	0
EJ Index for Air Toxics Cancer Risk*	23	2
EJ Index for Air Toxics Respiratory HI*	21	1
EJ Index for Traffic Proximity	8	10
EJ Index for Lead Paint	83	71
EJ Index for Superfund Proximity	58	33
EJ Index for RMP Facility Proximity	78	70
EJ Index for Hazardous Waste Proximity	5	0
EJ Index for Underground Storage Tanks	60	58
EJ Index for Wastewater Discharge	0	0



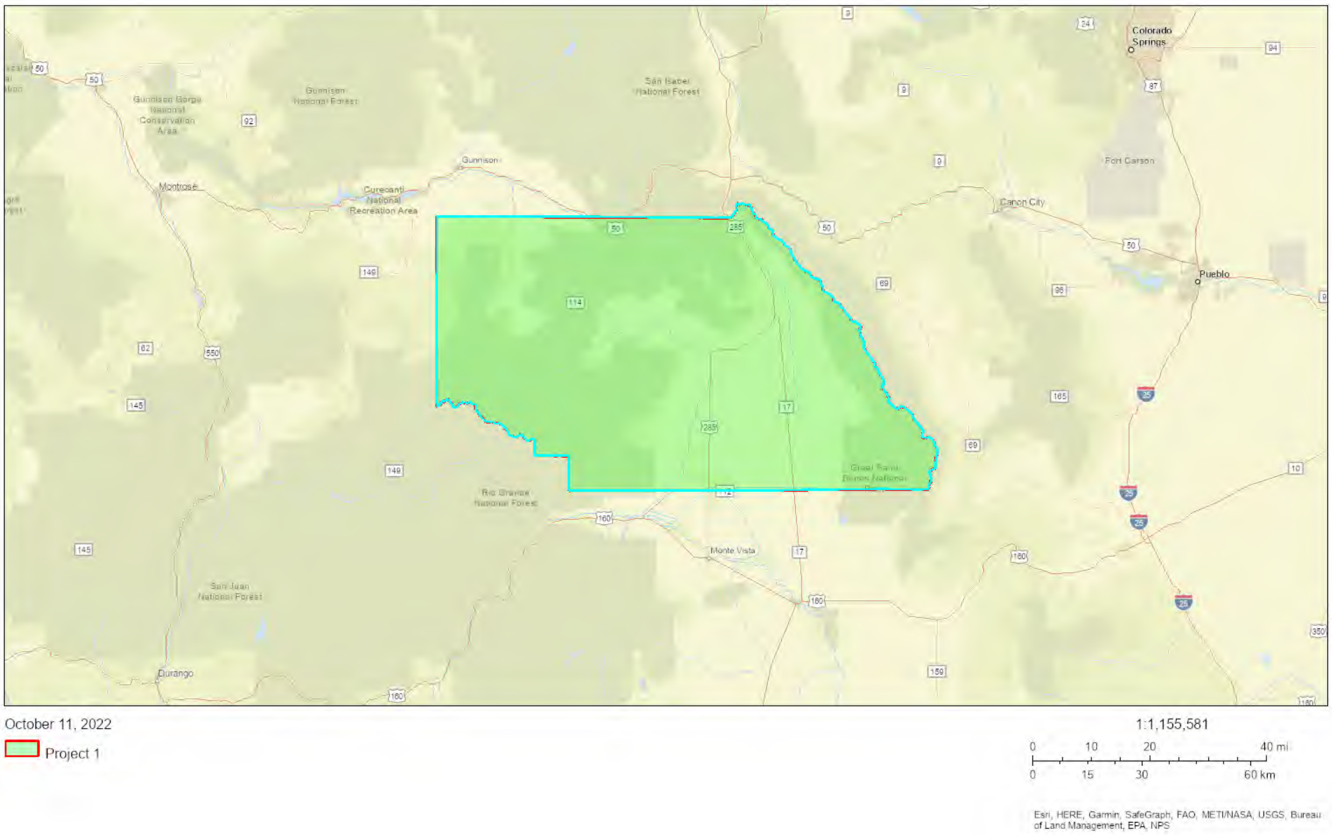
This report shows the values for environmental and demographic indicators and EJSCREEN indexes. It shows environmental and demographic raw data (e.g., the estimated concentration of ozone in the air), and also shows what percentile each raw data value represents. These percentiles provide perspective on how the selected block group or buffer area compares to the entire state, EPA region, or nation. For example, if a given location is at the 95th percentile nationwide, this means that only 5 percent of the US population has a higher block group value than the average person in the location being analyzed. The years for which the data are available, and the methods used, vary across these indicators. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJSCREEN documentation for discussion of these issues before using reports.

EJScreen Report (Version 2.1)

County: Saguache, COLORADO, EPA Region 8

Approximate Population: 6,730

Input Area (sq. miles): 3170.27



Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0

EJScreen Report (Version 2.1)

County: Saguache, COLORADO, EPA Region 8

Approximate Population: 6,730

Input Area (sq. miles): 3170.27

Selected Variables	Value	State Avg.	%ile in State	USA Avg.	%ile in USA
Pollution and Sources					
Particulate Matter 2.5 (μg/m^3)	4.87	7.23	4	8.67	0
Ozone (ppb)	52.6	55.4	6	42.5	90
Diesel Particulate Matter* (μg/m^3)	0.0126	0.256	2	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	9.5	25	11	28	<50th
Air Toxics Respiratory HI*	0.095	0.33	9	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	7.5	650	4	760	7
Lead Paint (% Pre-1960 Housing)	0.27	0.18	71	0.27	55
Superfund Proximity (site count/km distance)	0.018	0.1	29	0.13	16
RMP Facility Proximity (facility count/km distance)	1.4	0.68	86	0.77	83
Hazardous Waste Proximity (facility count/km distance)	0.0087	0.88	2	2.2	0
Underground Storage Tanks (count/km^2)	0.37	2.7	33	3.9	36
Wastewater Discharge (toxicity-weighted concentration/m distance)	1.7E-08	0.38	0	12	0
Socioeconomic Indicators					
Demographic Index	43%	28%	80	35%	68
People of Color	41%	32%	71	40%	60
Low Income	45%	25%	84	30%	75
Unemployment Rate	10%	5%	87	5%	81
Limited English Speaking Households	6%	3%	84	5%	76
Less Than High School Education	14%	8%	80	12%	69
Under Age 5	5%	6%	56	6%	53
Over Age 64	23%	14%	80	16%	77

*Diesel particular matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update.

For additional information, see: www.epa.gov/environmentaljustice

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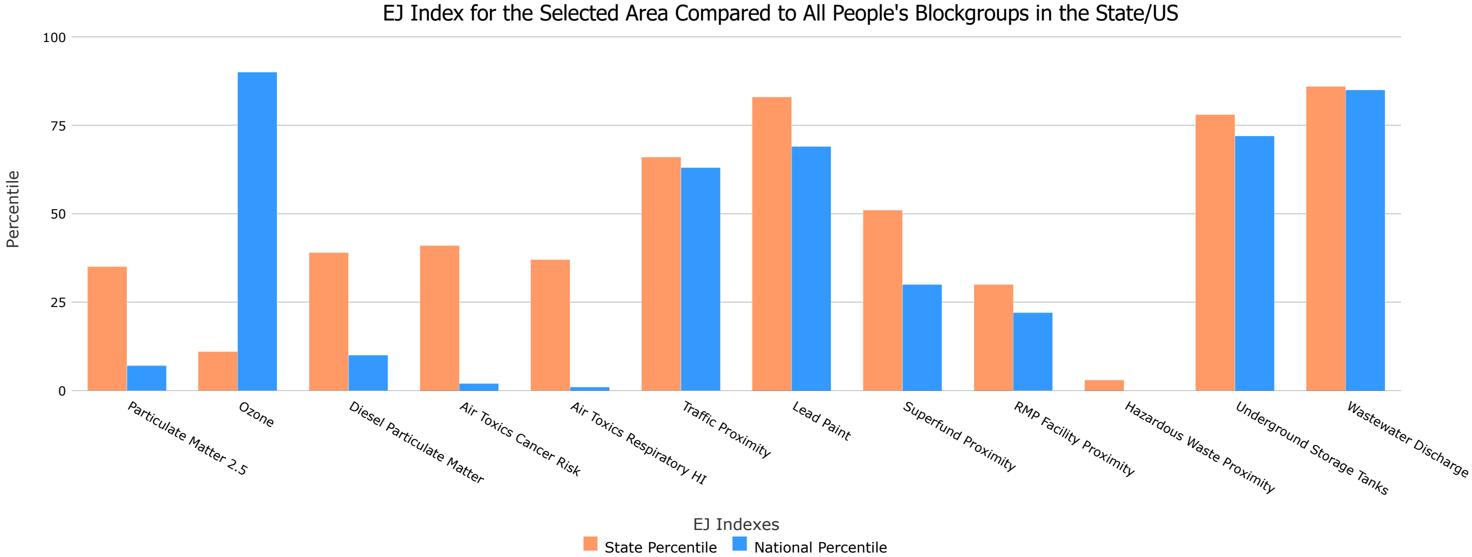
EJScreen Report (Version 2.1)

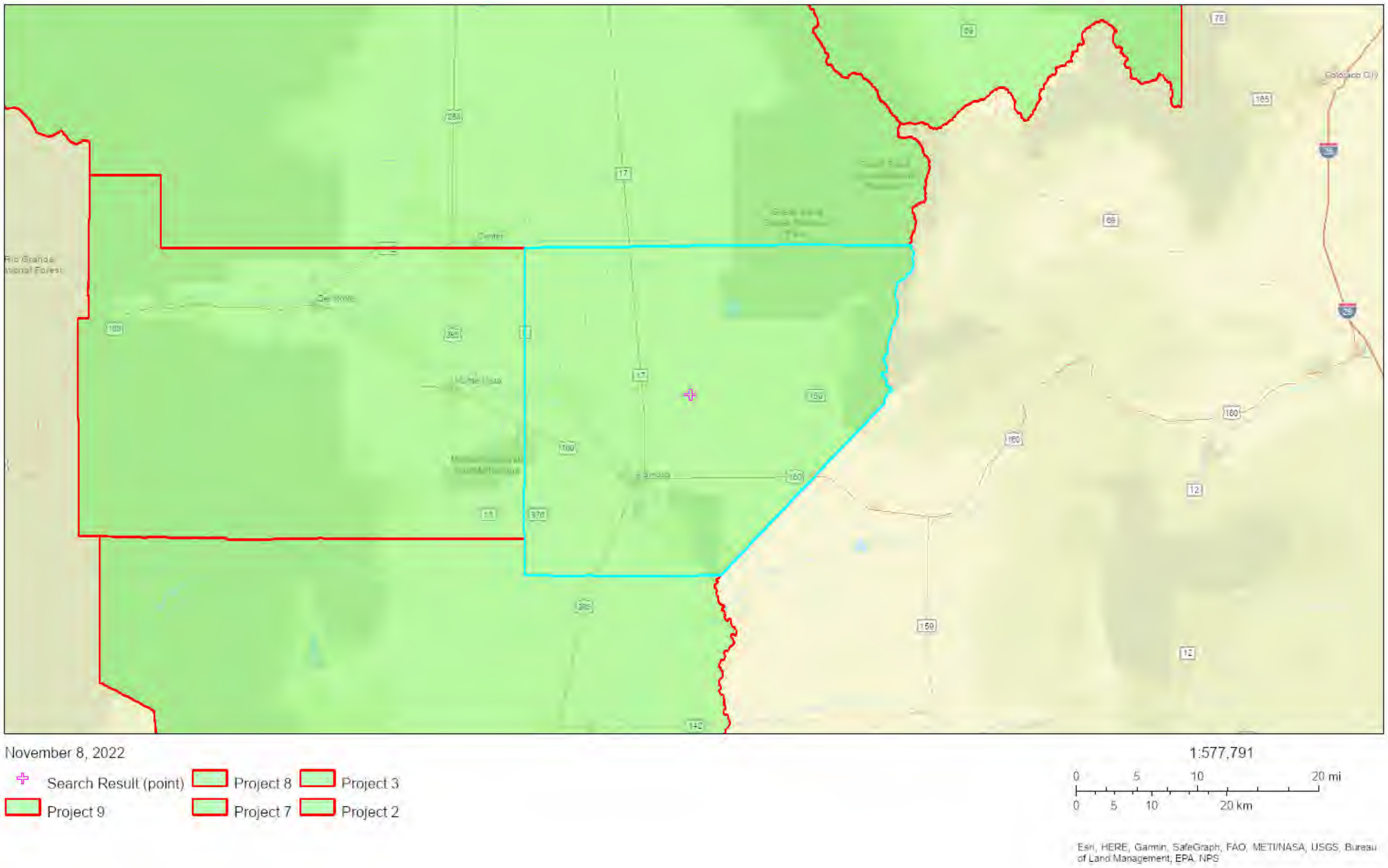
County: Alamosa
COLORADO, EPA Region 8
Approximate Population: 16,153
Input Area (sq. miles): 723.29

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	35	7
EJ Index for Ozone	11	90
EJ Index for Diesel Particulate Matter*	39	10
EJ Index for Air Toxics Cancer Risk*	41	2
EJ Index for Air Toxics Respiratory HI*	37	1
EJ Index for Traffic Proximity	66	63
EJ Index for Lead Paint	83	69
EJ Index for Superfund Proximity	51	30
EJ Index for RMP Facility Proximity	30	22
EJ Index for Hazardous Waste Proximity	3	0
EJ Index for Underground Storage Tanks	78	72
EJ Index for Wastewater Discharge	86	85

EJ Index for the Selected Area Compared to All People's Blockgroups in the State/US



This report shows the values for environmental and demographic indicators and EJScreen indexes. It shows environmental and demographic raw data (e.g., the estimated concentration of ozone in the air), and also shows what percentile each raw data value represents. These percentiles provide perspective on how the selected block group or buffer area compares to the entire state or nation. For example, if a given location is at the 95th percentile nationwide, this means that only 5 percent of the US population has a higher block group value than the average person in the location being analyzed. The years for which the data are available, and the methods used, vary across these indicators. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJScreen documentation for discussion of these issues before using reports.



Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 (μg/m³)	5.43	7.23	12	8.67	1
Ozone (ppb)	52.3	55.4	5	42.5	90
Diesel Particulate Matter* (μg/m³)	0.0447	0.256	15	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	10	25	22	28	<50th
Air Toxics Respiratory HI*	0.1	0.33	18	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	190	650	39	760	45
Lead Paint (% Pre-1960 Housing)	0.2	0.18	66	0.27	48
Superfund Proximity (site count/km distance)	0.016	0.1	19	0.13	12
RMP Facility Proximity (facility count/km distance)	0.06	0.68	11	0.77	8
Hazardous Waste Proximity (facility count/km distance)	0.0074	0.88	1	2.2	0
Underground Storage Tanks (count/km²)	2.8	2.7	67	3.9	65
Wastewater Discharge (toxicity-weighted concentration/m distance)	0.055	0.38	69	12	81
Socioeconomic Indicators					
Demographic Index	49%	28%	85	35%	73
People of Color	53%	32%	82	40%	68
Low Income	45%	25%	84	30%	75
Unemployment Rate	7%	5%	76	5%	70
Limited English Speaking	4%	3%	81	5%	73
Less Than High School Education	13%	8%	78	12%	65
Under Age 5	7%	6%	68	6%	66
Over Age 64	14%	14%	51	16%	43

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

For additional information, see: www.epa.gov/environmentaljustice (https://www.epa.gov/environmentaljustice)

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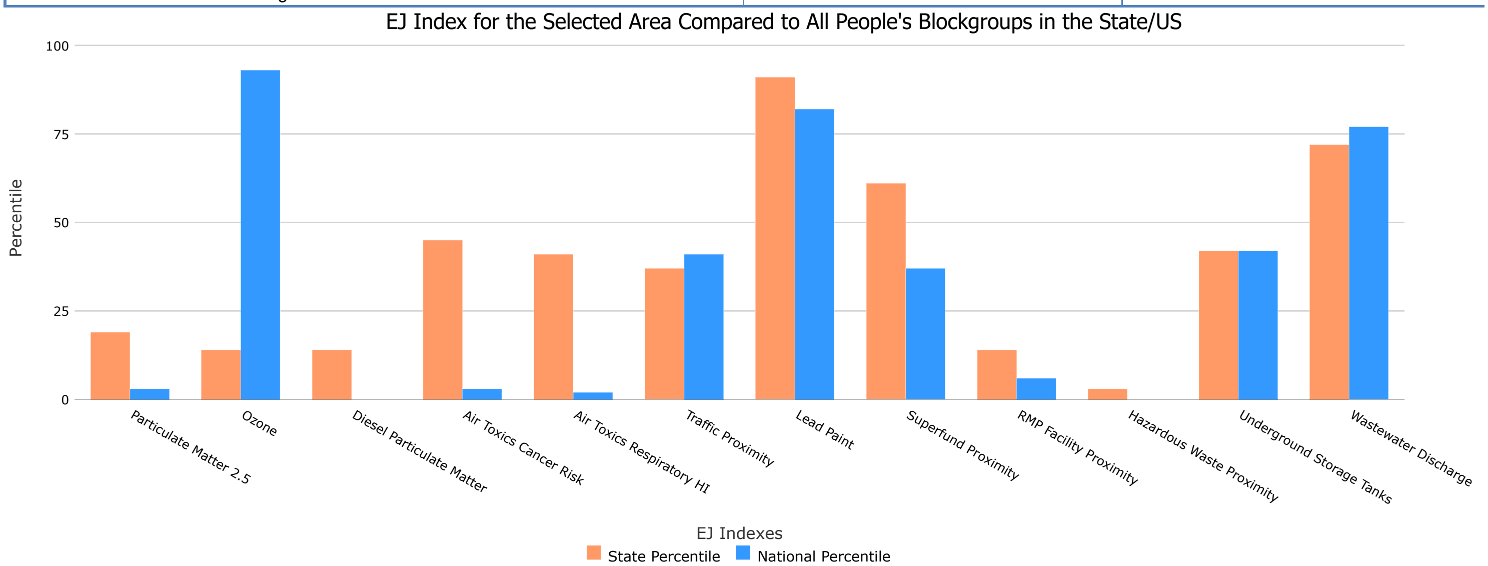
EJScreen Report (Version 2.1)

County: Conejos
COLORADO, EPA Region 8
Approximate Population: 8,130
Input Area (sq. miles): 1290.99

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	19	3
EJ Index for Ozone	14	93
EJ Index for Diesel Particulate Matter*	14	0
EJ Index for Air Toxics Cancer Risk*	45	3
EJ Index for Air Toxics Respiratory HI*	41	2
EJ Index for Traffic Proximity	37	41
EJ Index for Lead Paint	91	82
EJ Index for Superfund Proximity	61	37
EJ Index for RMP Facility Proximity	14	6
EJ Index for Hazardous Waste Proximity	3	0
EJ Index for Underground Storage Tanks	42	42
EJ Index for Wastewater Discharge	72	77



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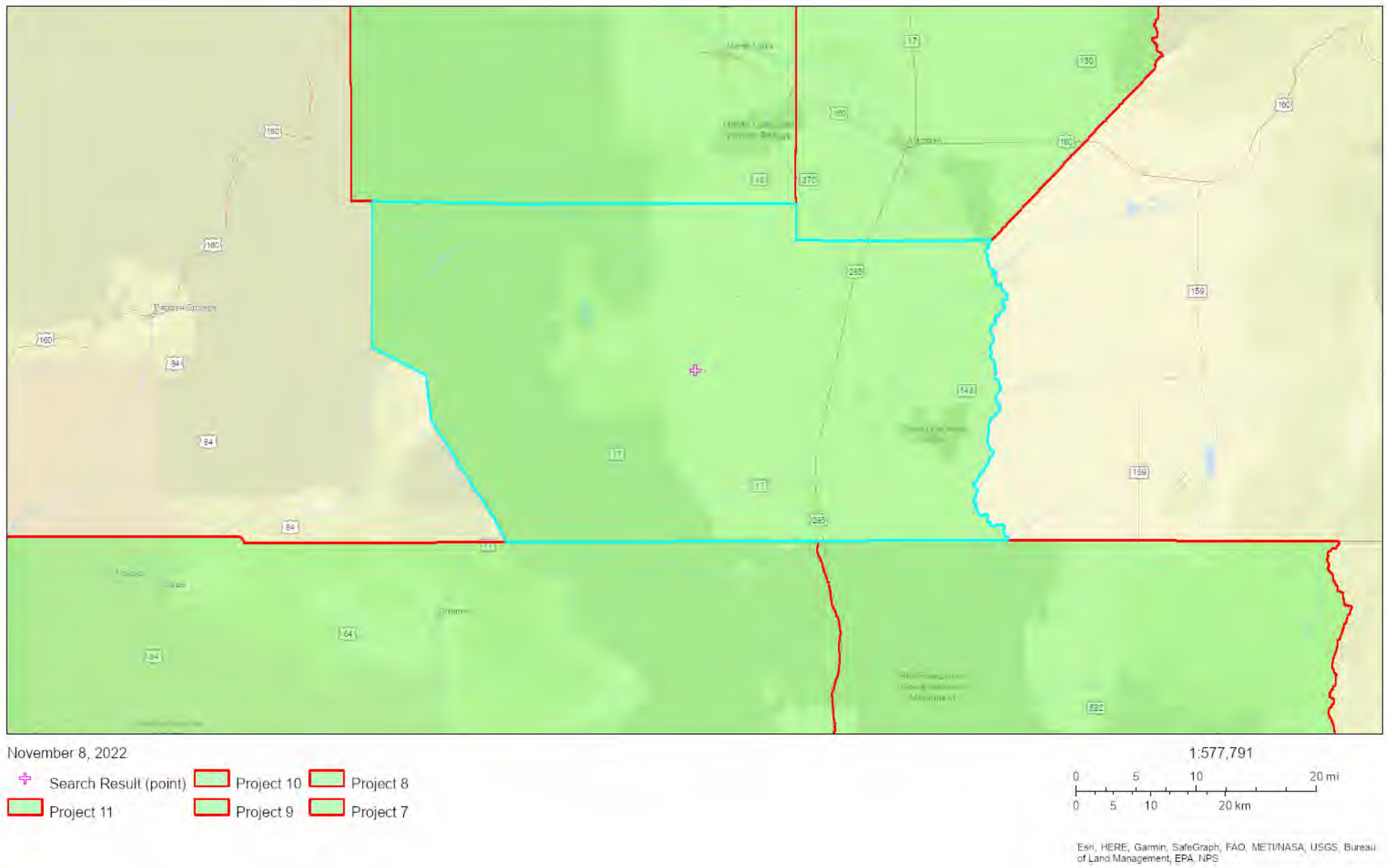

Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 ($\mu g/m^3$)	5.01	7.23	5	8.67	0
Ozone (ppb)	52.7	55.4	6	42.5	90
Diesel Particulate Matter* ($\mu g/m^3$)	0.0143	0.256	3	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	10	25	22	28	<50th
Air Toxics Respiratory HI*	0.1	0.33	18	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	35	650	13	760	19
Lead Paint (% Pre-1960 Housing)	0.36	0.18	76	0.27	63
Superfund Proximity (site count/km distance)	0.017	0.1	25	0.13	14
RMP Facility Proximity (facility count/km distance)	0.027	0.68	4	0.77	2
Hazardous Waste Proximity (facility count/km distance)	0.0076	0.88	1	2.2	0
Underground Storage Tanks (count/km^2)	0.016	2.7	22	3.9	22
Wastewater Discharge (toxicity-weighted concentration/m distance)	0.0031	0.38	44	12	59
Socioeconomic Indicators					
Demographic Index	55%	28%	90	35%	79
People of Color	55%	32%	84	40%	70
Low Income	55%	25%	91	30%	84
Unemployment Rate	10%	5%	87	5%	81
Limited English Speaking	10%	3%	91	5%	84
Less Than High School Education	12%	8%	76	12%	64
Under Age 5	6%	6%	65	6%	63
Over Age 64	19%	14%	70	16%	64

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

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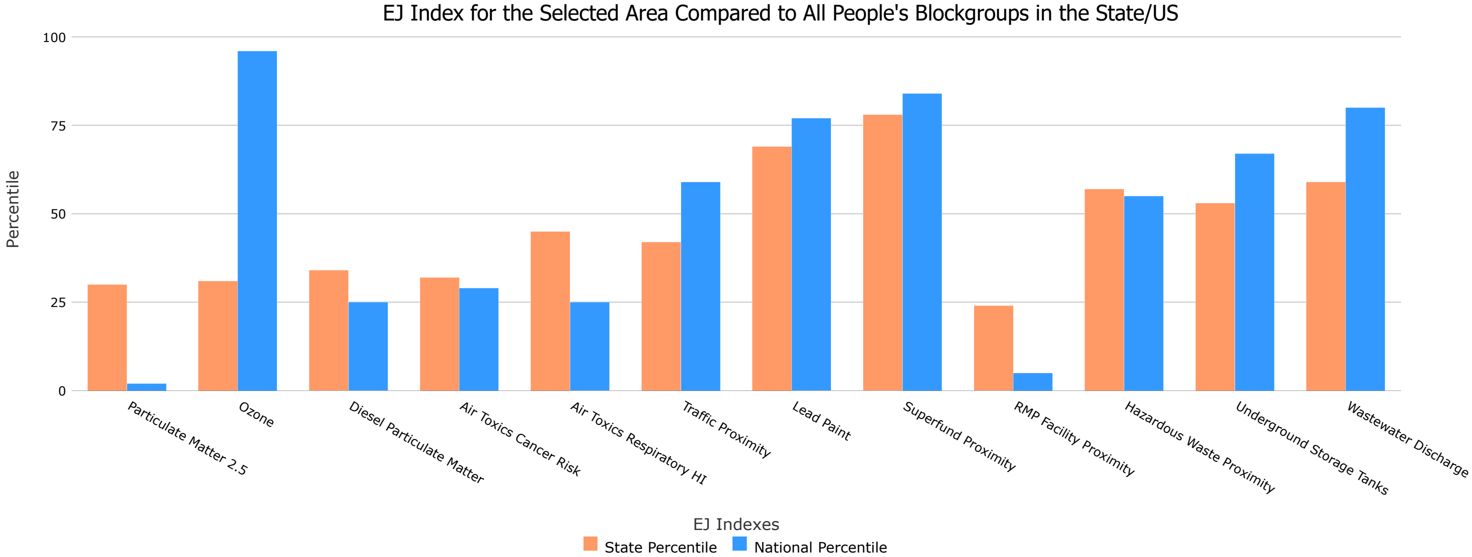
EJScreen Report (Version 2.1)

County: Rio Arriba
NEW MEXICO, EPA Region 6
Approximate Population: 38,962
Input Area (sq. miles): 5896.15

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	30	2
EJ Index for Ozone	31	96
EJ Index for Diesel Particulate Matter*	34	25
EJ Index for Air Toxics Cancer Risk*	32	29
EJ Index for Air Toxics Respiratory HI*	45	25
EJ Index for Traffic Proximity	42	59
EJ Index for Lead Paint	69	77
EJ Index for Superfund Proximity	78	84
EJ Index for RMP Facility Proximity	24	5
EJ Index for Hazardous Waste Proximity	57	55
EJ Index for Underground Storage Tanks	53	67
EJ Index for Wastewater Discharge	59	80



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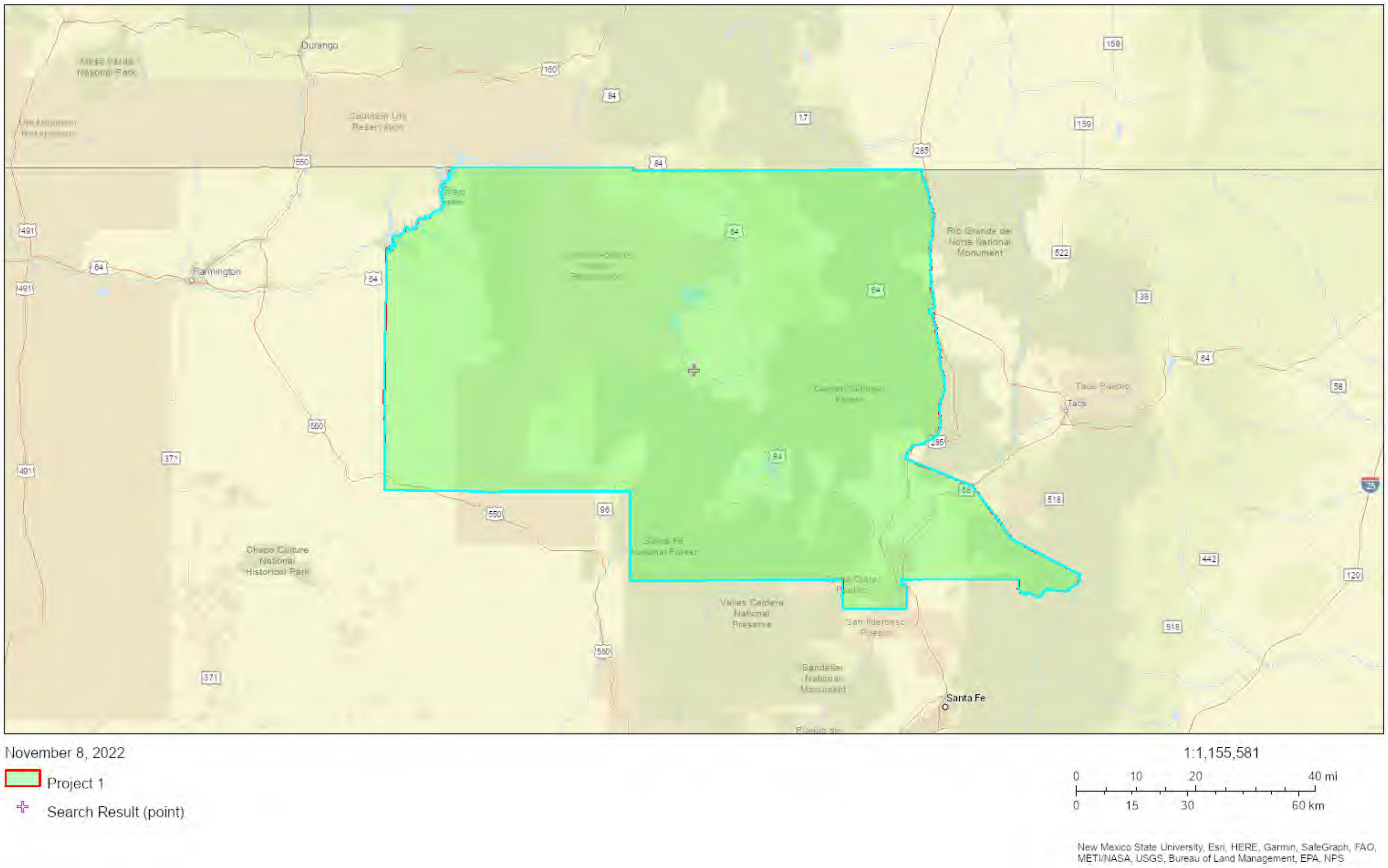

Sites reporting to EPA	
Superfund NPL	1
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	1

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 (μg/m³)	4.64	5.54	20	8.67	0
Ozone (ppb)	54.6	56	18	42.5	92
Diesel Particulate Matter* (μg/m³)	0.0546	0.198	23	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	14	20	47	28	<50th
Air Toxics Respiratory HI*	0.17	0.23	50	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	140	510	35	760	39
Lead Paint (% Pre-1960 Housing)	0.18	0.18	61	0.27	45
Superfund Proximity (site count/km distance)	0.22	0.14	87	0.13	87
RMP Facility Proximity (facility count/km distance)	0.019	0.24	17	0.77	1
Hazardous Waste Proximity (facility count/km distance)	0.25	0.81	56	2.2	35
Underground Storage Tanks (count/km²)	1.4	3.3	58	3.9	53
Wastewater Discharge (toxicity-weighted concentration/m distance)	0.015	3.5	63	12	72
Socioeconomic Indicators					
Demographic Index	65%	51%	73	35%	86
People of Color	88%	63%	82	40%	88
Low Income	43%	39%	55	30%	72
Unemployment Rate	7%	7%	63	5%	71
Limited English Speaking	3%	5%	55	5%	67
Less Than High School Education	13%	14%	57	12%	67
Under Age 5	6%	6%	64	6%	62
Over Age 64	19%	17%	59	16%	65

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

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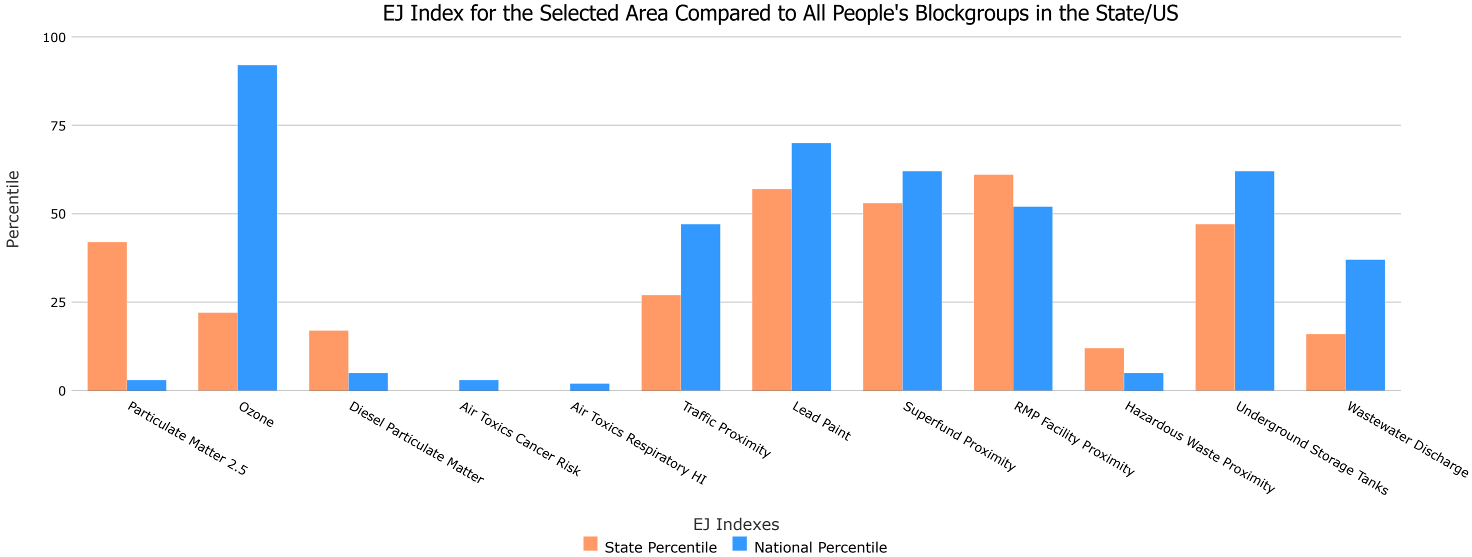
EJScreen Report (Version 2.1)

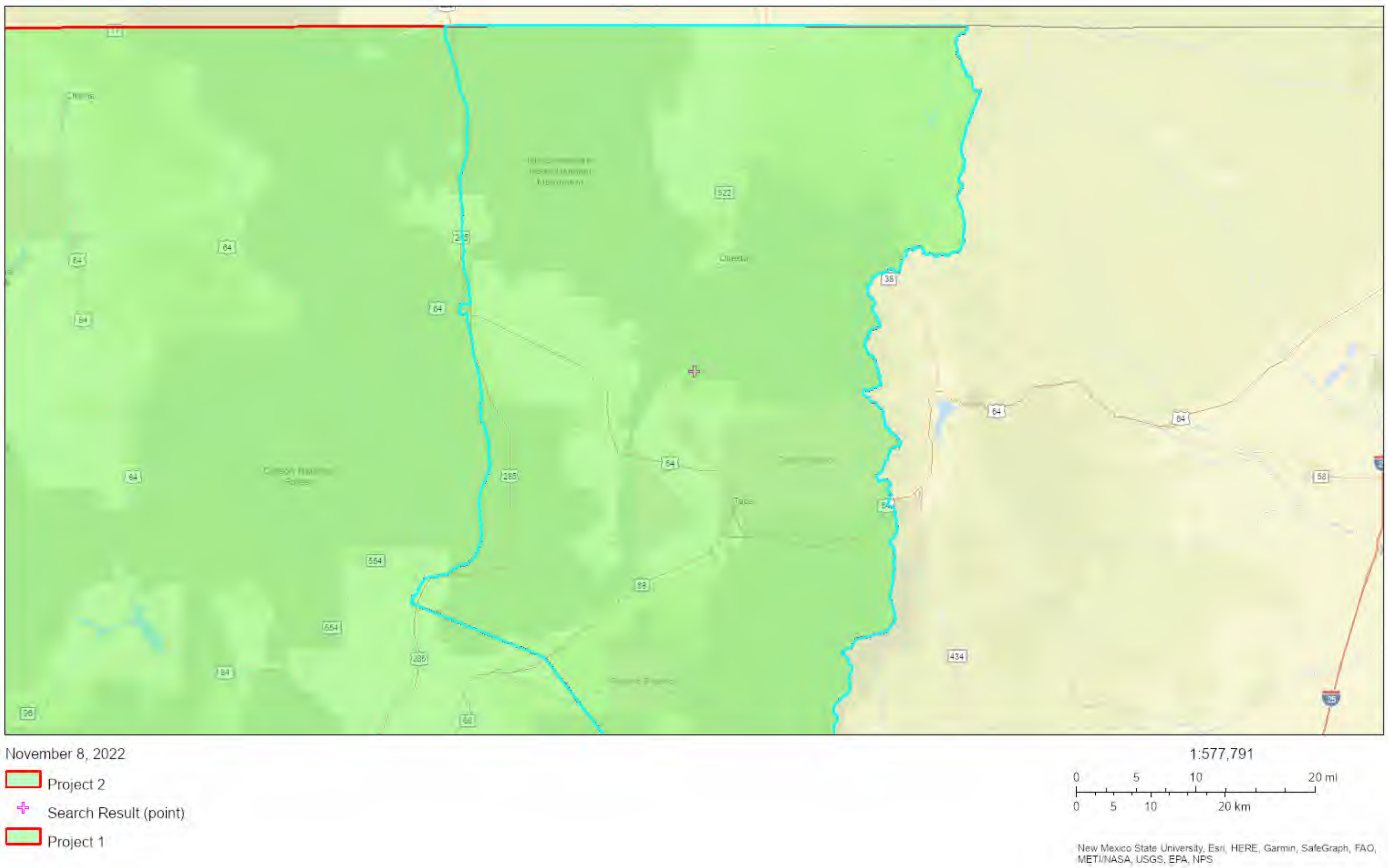
County: Taos
NEW MEXICO, EPA Region 6
Approximate Population: 32,759
Input Area (sq. miles): 2203.67

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	42	3
EJ Index for Ozone	22	92
EJ Index for Diesel Particulate Matter*	17	5
EJ Index for Air Toxics Cancer Risk*	0	3
EJ Index for Air Toxics Respiratory HI*	0	2
EJ Index for Traffic Proximity	27	47
EJ Index for Lead Paint	57	70
EJ Index for Superfund Proximity	53	62
EJ Index for RMP Facility Proximity	61	52
EJ Index for Hazardous Waste Proximity	12	5
EJ Index for Underground Storage Tanks	47	62
EJ Index for Wastewater Discharge	16	37

EJ Index for the Selected Area Compared to All People's Blockgroups in the State/US



This report shows the values for environmental and demographic indicators and EJScreen indexes. It shows environmental and demographic raw data (e.g., the estimated concentration of ozone in the air), and also shows what percentile each raw data value represents. These percentiles provide perspective on how the selected block group or buffer area compares to the entire state or nation. For example, if a given location is at the 95th percentile nationwide, this means that only 5 percent of the US population has a higher block group value than the average person in the location being analyzed. The years for which the data are available, and the methods used, vary across these indicators. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJScreen documentation for discussion of these issues before using reports.



Sites reporting to EPA	
Superfund NPL	1
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 (μg/m³)	5.05	5.54	32	8.67	0
Ozone (ppb)	54.4	56	16	42.5	92
Diesel Particulate Matter* (μg/m³)	0.031	0.198	15	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	10	20	0	28	<50th
Air Toxics Respiratory HI*	0.1	0.23	0	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	90	510	29	760	32
Lead Paint (% Pre-1960 Housing)	0.18	0.18	62	0.27	45
Superfund Proximity (site count/km distance)	0.039	0.14	45	0.13	36
RMP Facility Proximity (facility count/km distance)	0.16	0.24	63	0.77	29
Hazardous Waste Proximity (facility count/km distance)	0.017	0.81	11	2.2	1
Underground Storage Tanks (count/km²)	0.75	3.3	48	3.9	44
Wastewater Discharge (toxicity-weighted concentration/m distance)	0.0011	3.5	40	12	50
Socioeconomic Indicators					
Demographic Index	53%	51%	54	35%	77
People of Color	65%	63%	52	40%	75
Low Income	42%	39%	54	30%	70
Unemployment Rate	8%	7%	68	5%	76
Limited English Speaking	4%	5%	60	5%	71
Less Than High School Education	9%	14%	43	12%	52
Under Age 5	4%	6%	45	6%	41
Over Age 64	26%	17%	78	16%	83

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

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EJScreen Report (Version 2.1)

County: Santa Fe

NEW MEXICO, EPA Region 6

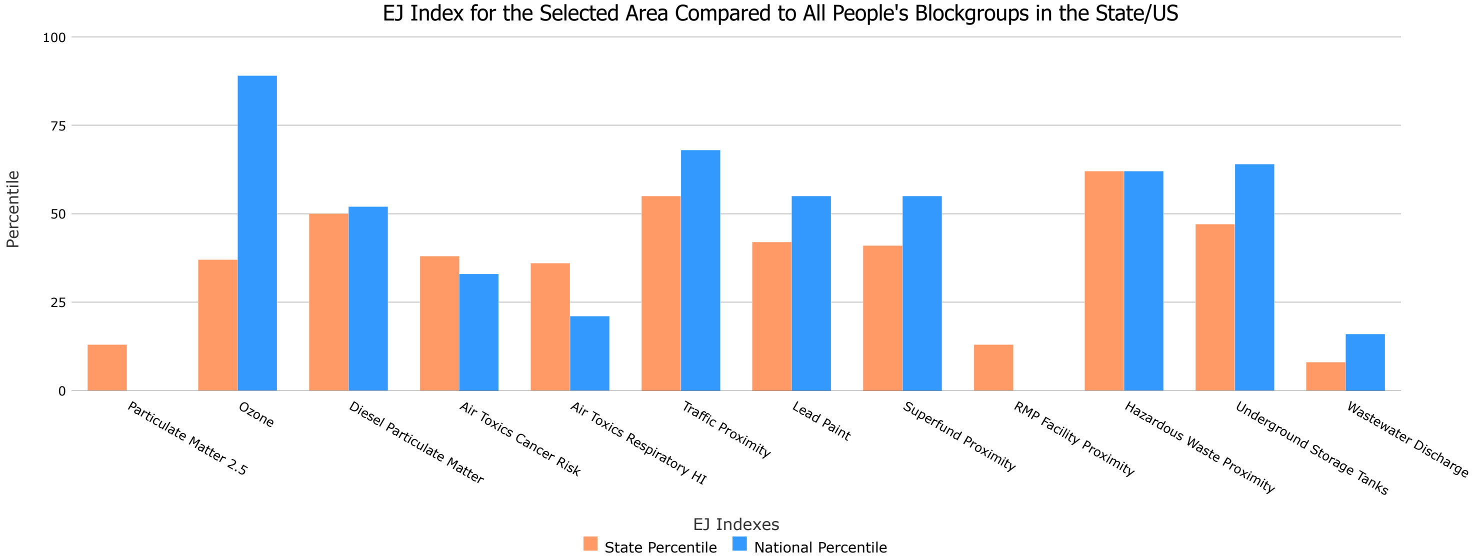
Approximate Population: 150,319

Input Area (sq. miles): 1911.39

(The study area contains 1 blockgroup(s) with zero population.)

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	13	0
EJ Index for Ozone	37	89
EJ Index for Diesel Particulate Matter*	50	52
EJ Index for Air Toxics Cancer Risk*	38	33
EJ Index for Air Toxics Respiratory HI*	36	21
EJ Index for Traffic Proximity	55	68
EJ Index for Lead Paint	42	55
EJ Index for Superfund Proximity	41	55
EJ Index for RMP Facility Proximity	13	0
EJ Index for Hazardous Waste Proximity	62	62
EJ Index for Underground Storage Tanks	47	64
EJ Index for Wastewater Discharge	8	16

EJ Index for the Selected Area Compared to All People's Blockgroups in the State/US



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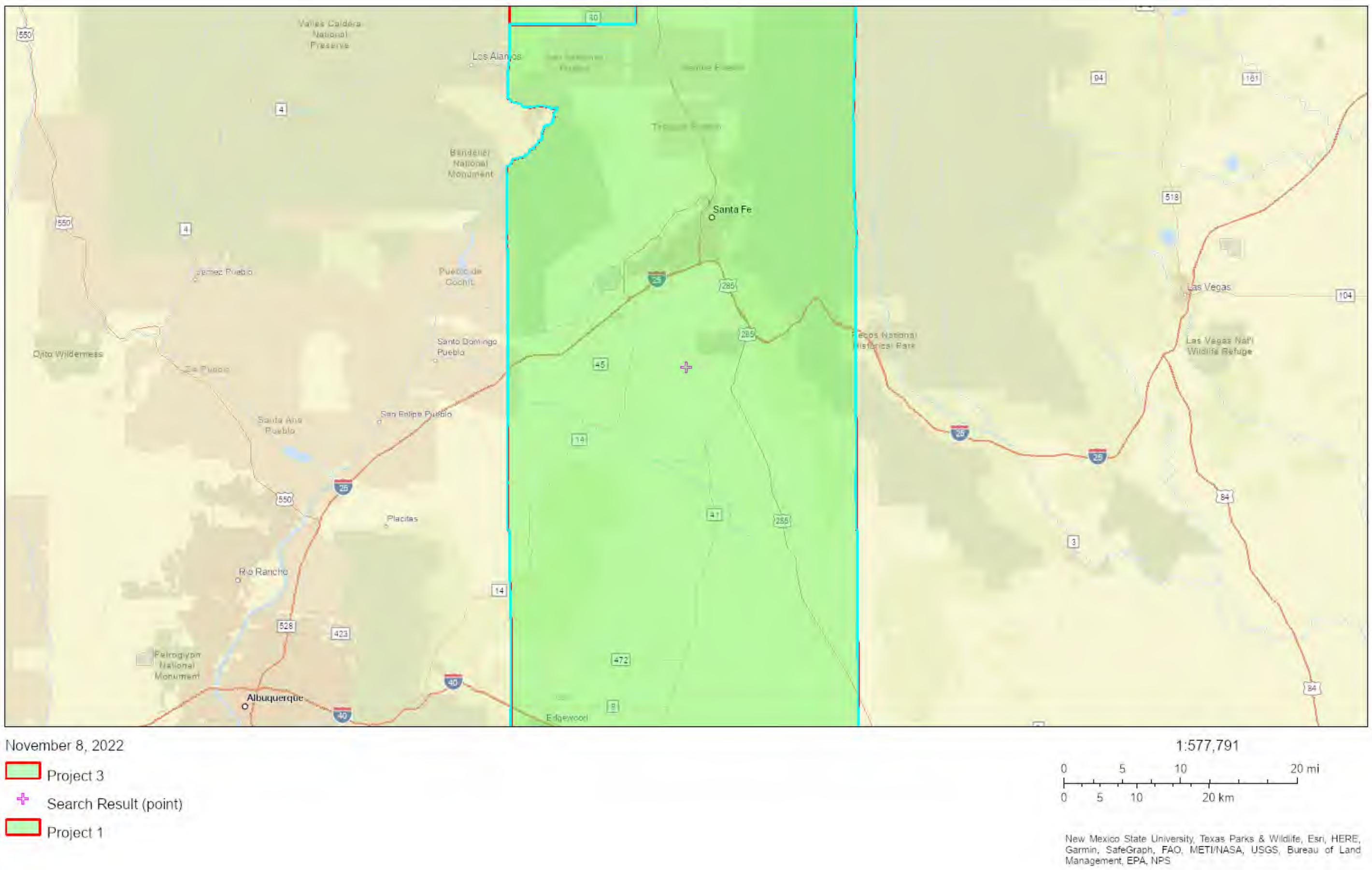

Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	5

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 (μg/m³)	4.42	5.54	9	8.67	0
Ozone (ppb)	55.8	56	37	42.5	94
Diesel Particulate Matter* (μg/m³)	0.143	0.198	52	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	16	20	61	28	<50th
Air Toxics Respiratory HI*	0.18	0.23	53	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	440	510	66	760	63
Lead Paint (% Pre-1960 Housing)	0.16	0.18	57	0.27	42
Superfund Proximity (site count/km distance)	0.04	0.14	45	0.13	36
RMP Facility Proximity (facility count/km distance)	0.015	0.24	14	0.77	0
Hazardous Waste Proximity (facility count/km distance)	0.63	0.81	68	2.2	48
Underground Storage Tanks (count/km²)	2	3.3	64	3.9	59
Wastewater Discharge (toxicity-weighted concentration/m distance)	0.00044	3.5	32	12	42
Socioeconomic Indicators					
Demographic Index	44%	51%	40	35%	69
People of Color	57%	63%	42	40%	71
Low Income	32%	39%	38	30%	57
Unemployment Rate	5%	7%	52	5%	58
Limited English Speaking	4%	5%	60	5%	70
Less Than High School Education	10%	14%	48	12%	57
Under Age 5	4%	6%	46	6%	42
Over Age 64	24%	17%	73	16%	79

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

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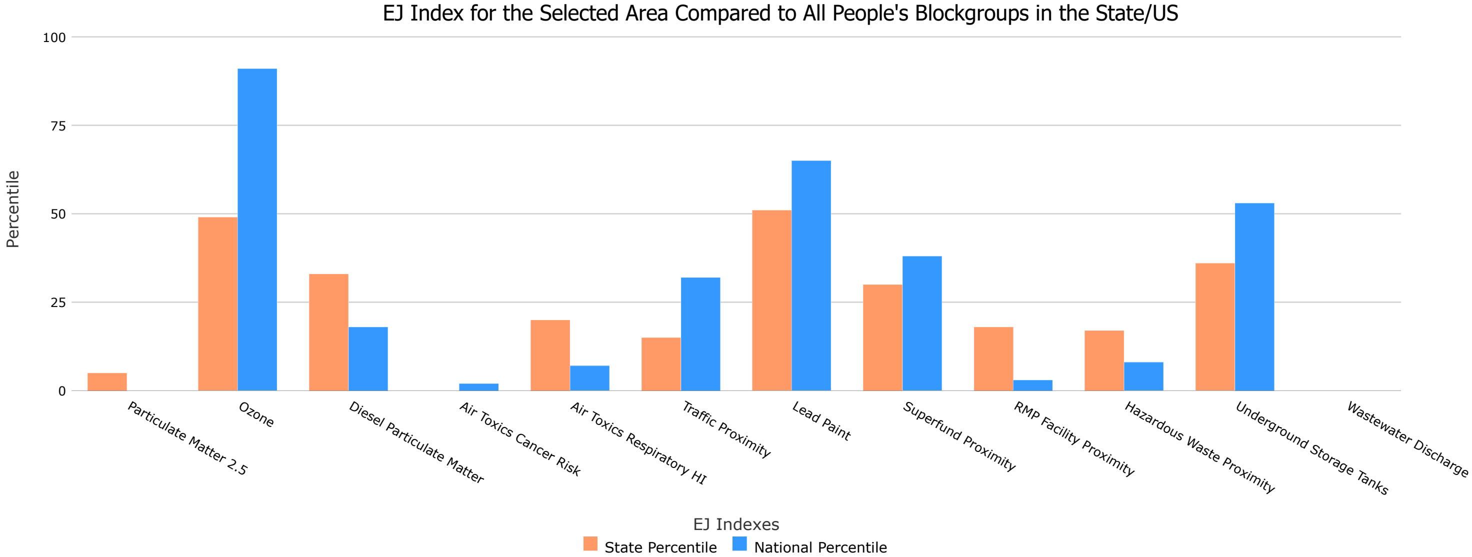
EJScreen Report (Version 2.1)

County: Torrance
NEW MEXICO, EPA Region 6
Approximate Population: 15,477
Input Area (sq. miles): 3346.09

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	5	0
EJ Index for Ozone	49	91
EJ Index for Diesel Particulate Matter*	33	18
EJ Index for Air Toxics Cancer Risk*	0	2
EJ Index for Air Toxics Respiratory HI*	20	7
EJ Index for Traffic Proximity	15	32
EJ Index for Lead Paint	51	65
EJ Index for Superfund Proximity	30	38
EJ Index for RMP Facility Proximity	18	3
EJ Index for Hazardous Waste Proximity	17	8
EJ Index for Underground Storage Tanks	36	53
EJ Index for Wastewater Discharge	N/A	N/A

EJ Index for the Selected Area Compared to All People's Blockgroups in the State/US



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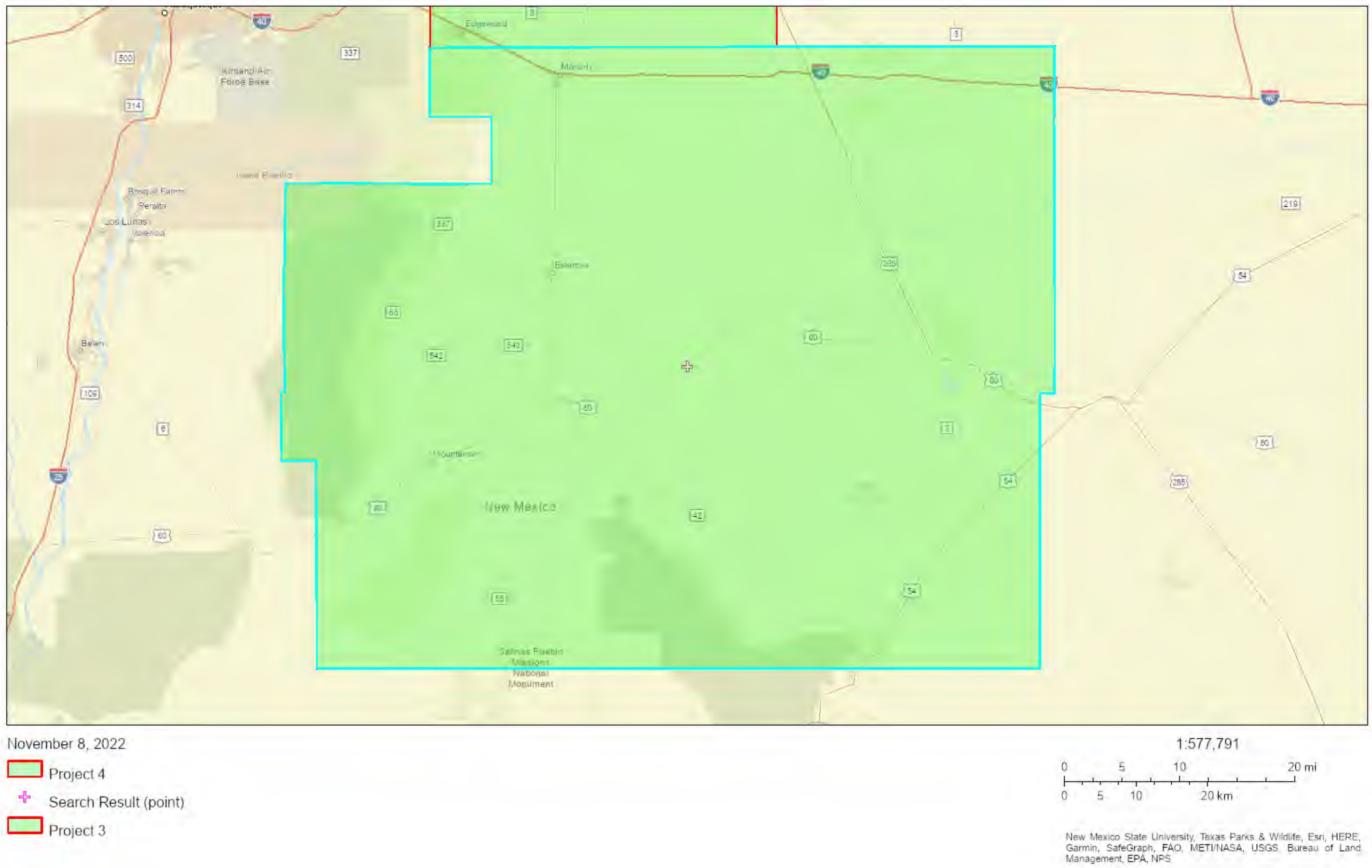

Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 (μg/m³)	4.22	5.54	2	8.67	0
Ozone (ppb)	56.1	56	49	42.5	94
Diesel Particulate Matter* (μg/m³)	0.0609	0.198	26	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	10	20	0	28	<50th
Air Toxics Respiratory HI*	0.12	0.23	28	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	33	510	17	760	19
Lead Paint (% Pre-1960 Housing)	0.17	0.18	60	0.27	44
Superfund Proximity (site count/km distance)	0.018	0.14	27	0.13	16
RMP Facility Proximity (facility count/km distance)	0.019	0.24	17	0.77	1
Hazardous Waste Proximity (facility count/km distance)	0.023	0.81	16	2.2	3
Underground Storage Tanks (count/km²)	0.27	3.3	38	3.9	34
Wastewater Discharge (toxicity-weighted concentration/m distance)	N/A	3.5	N/A	12	N/A
Socioeconomic Indicators					
Demographic Index	49%	51%	46	35%	73
People of Color	50%	63%	34	40%	66
Low Income	48%	39%	63	30%	78
Unemployment Rate	9%	7%	73	5%	79
Limited English Speaking	3%	5%	55	5%	67
Less Than High School Education	15%	14%	60	12%	70
Under Age 5	5%	6%	52	6%	48
Over Age 64	21%	17%	62	16%	69

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

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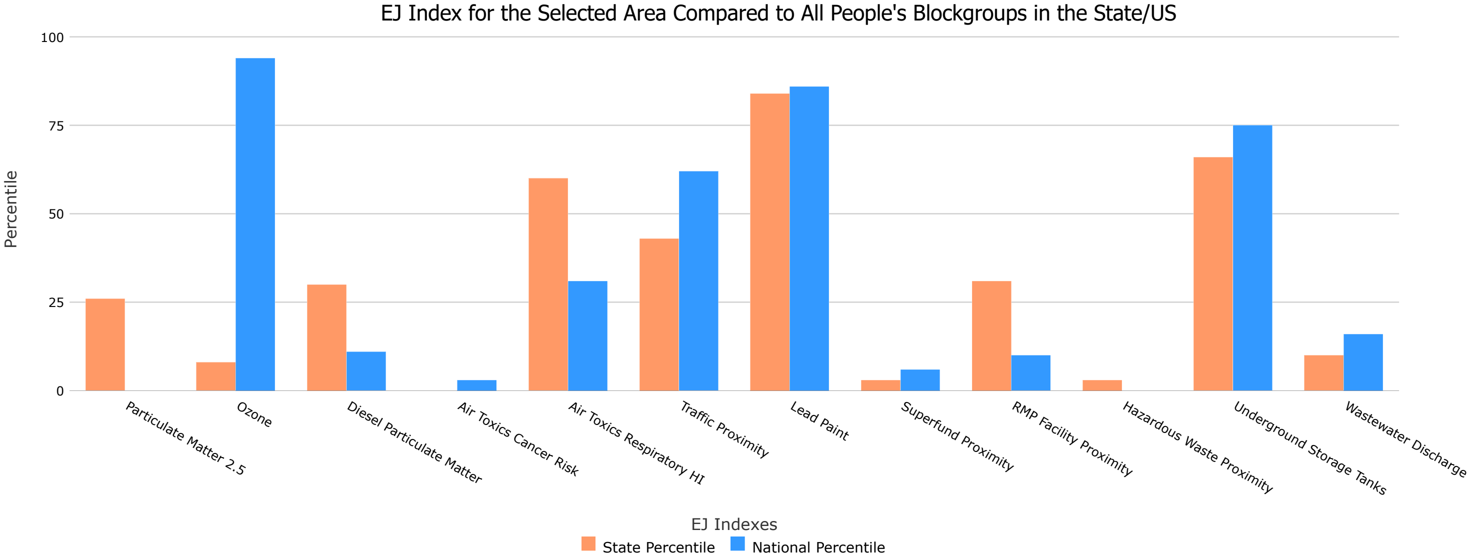
EJScreen Report (Version 2.1)

County: Guadalupe
NEW MEXICO, EPA Region 6
Approximate Population: 4,336
Input Area (sq. miles): 3030.87

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	26	0
EJ Index for Ozone	8	94
EJ Index for Diesel Particulate Matter*	30	11
EJ Index for Air Toxics Cancer Risk*	0	3
EJ Index for Air Toxics Respiratory HI*	60	31
EJ Index for Traffic Proximity	43	62
EJ Index for Lead Paint	84	86
EJ Index for Superfund Proximity	3	6
EJ Index for RMP Facility Proximity	31	10
EJ Index for Hazardous Waste Proximity	3	0
EJ Index for Underground Storage Tanks	66	75
EJ Index for Wastewater Discharge	10	16

EJ Index for the Selected Area Compared to All People's Blockgroups in the State/US



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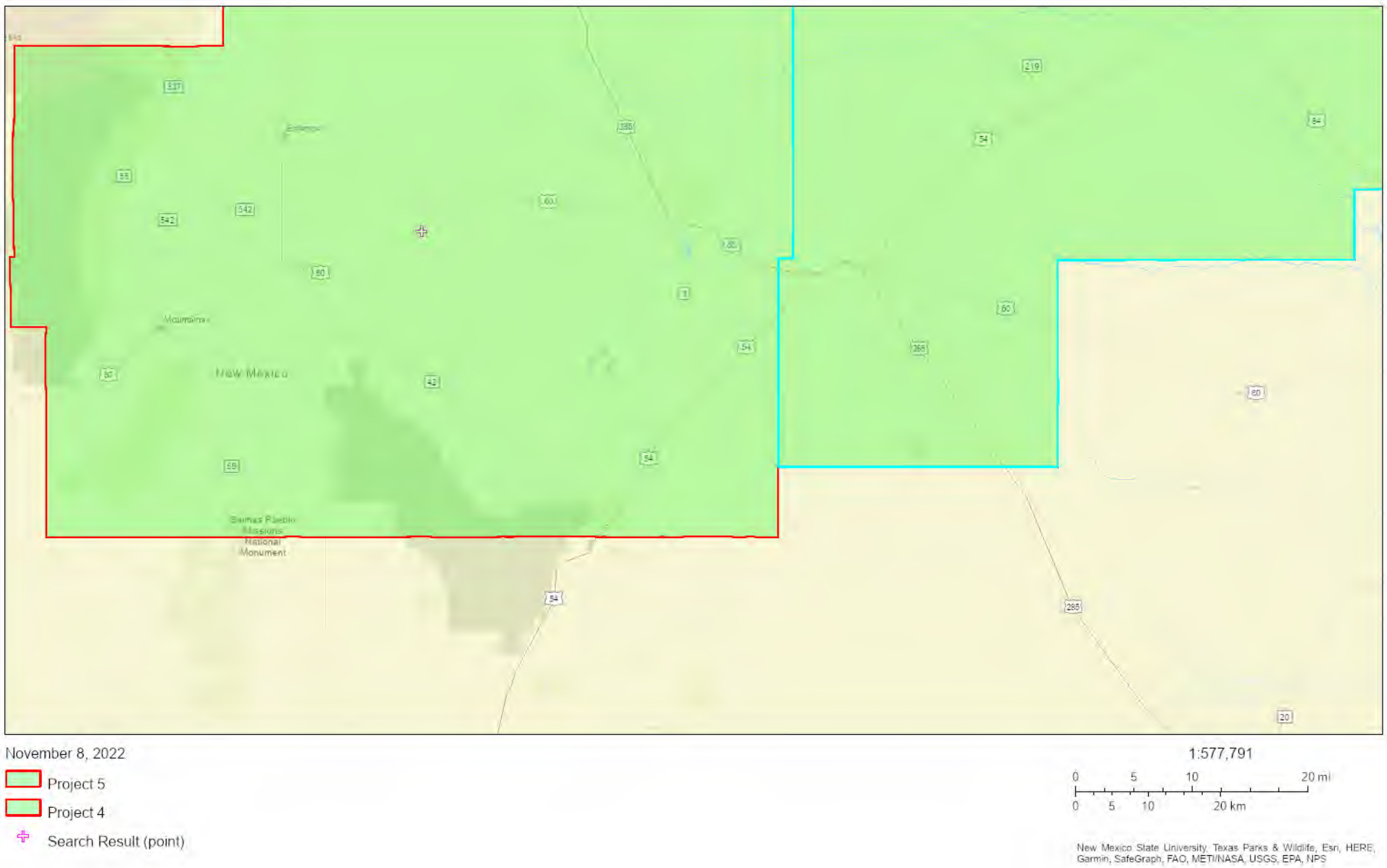

Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0

Selected Variables	**Value**	**State**		**USA**	
		Avg.	**%tile**	**Avg.**	**%tile**
Pollution and Sources					
Particulate Matter 2.5 (μg/m³)	4.61	5.54	19	8.67	0
Ozone (ppb)	52.5	56	5	42.5	90
Diesel Particulate Matter* (μg/m³)	0.0449	0.198	20	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	10	20	0	28	<50th
Air Toxics Respiratory HI*	0.2	0.23	63	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	120	510	33	760	37
Lead Paint (% Pre-1960 Housing)	0.35	0.18	77	0.27	62
Superfund Proximity (site count/km distance)	0.0061	0.14	1	0.13	2
RMP Facility Proximity (facility count/km distance)	0.033	0.24	23	0.77	3
Hazardous Waste Proximity (facility count/km distance)	0.0076	0.81	1	2.2	0
Underground Storage Tanks (count/km²)	1.9	3.3	63	3.9	58
Wastewater Discharge (toxicity-weighted concentration/m distance)	2.6E-07	3.5	9	12	5
Socioeconomic Indicators					
Demographic Index	59%	51%	63	35%	82
People of Color	81%	63%	74	40%	84
Low Income	40%	39%	52	30%	69
Unemployment Rate	7%	7%	61	5%	69
Limited English Speaking	12%	5%	85	5%	87
Less Than High School Education	17%	14%	68	12%	76
Under Age 5	5%	6%	50	6%	46
Over Age 64	21%	17%	63	16%	70

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

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EJScreen Report (Version 2.1)

County: Lincoln

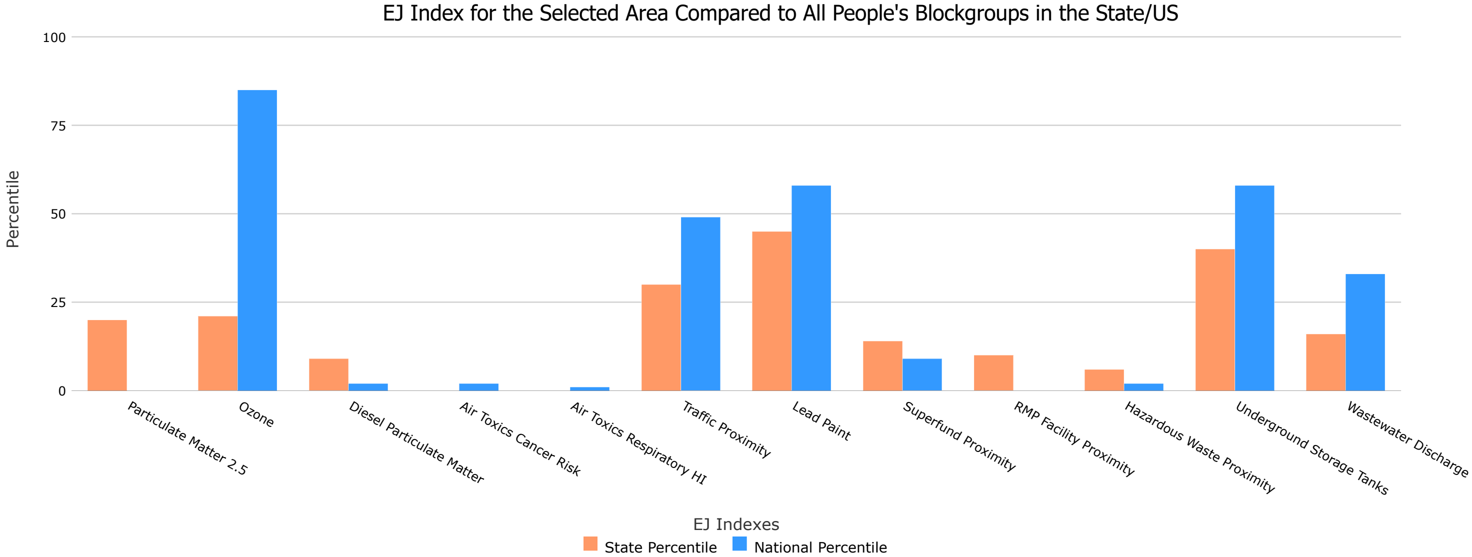
NEW MEXICO, EPA Region 6

Approximate Population: 19,640

Input Area (sq. miles): 4831.30

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	20	0
EJ Index for Ozone	21	85
EJ Index for Diesel Particulate Matter*	9	2
EJ Index for Air Toxics Cancer Risk*	0	2
EJ Index for Air Toxics Respiratory HI*	0	1
EJ Index for Traffic Proximity	30	49
EJ Index for Lead Paint	45	58
EJ Index for Superfund Proximity	14	9
EJ Index for RMP Facility Proximity	10	0
EJ Index for Hazardous Waste Proximity	6	2
EJ Index for Underground Storage Tanks	40	58
EJ Index for Wastewater Discharge	16	33

EJ Index for the Selected Area Compared to All People's Blockgroups in the State/US



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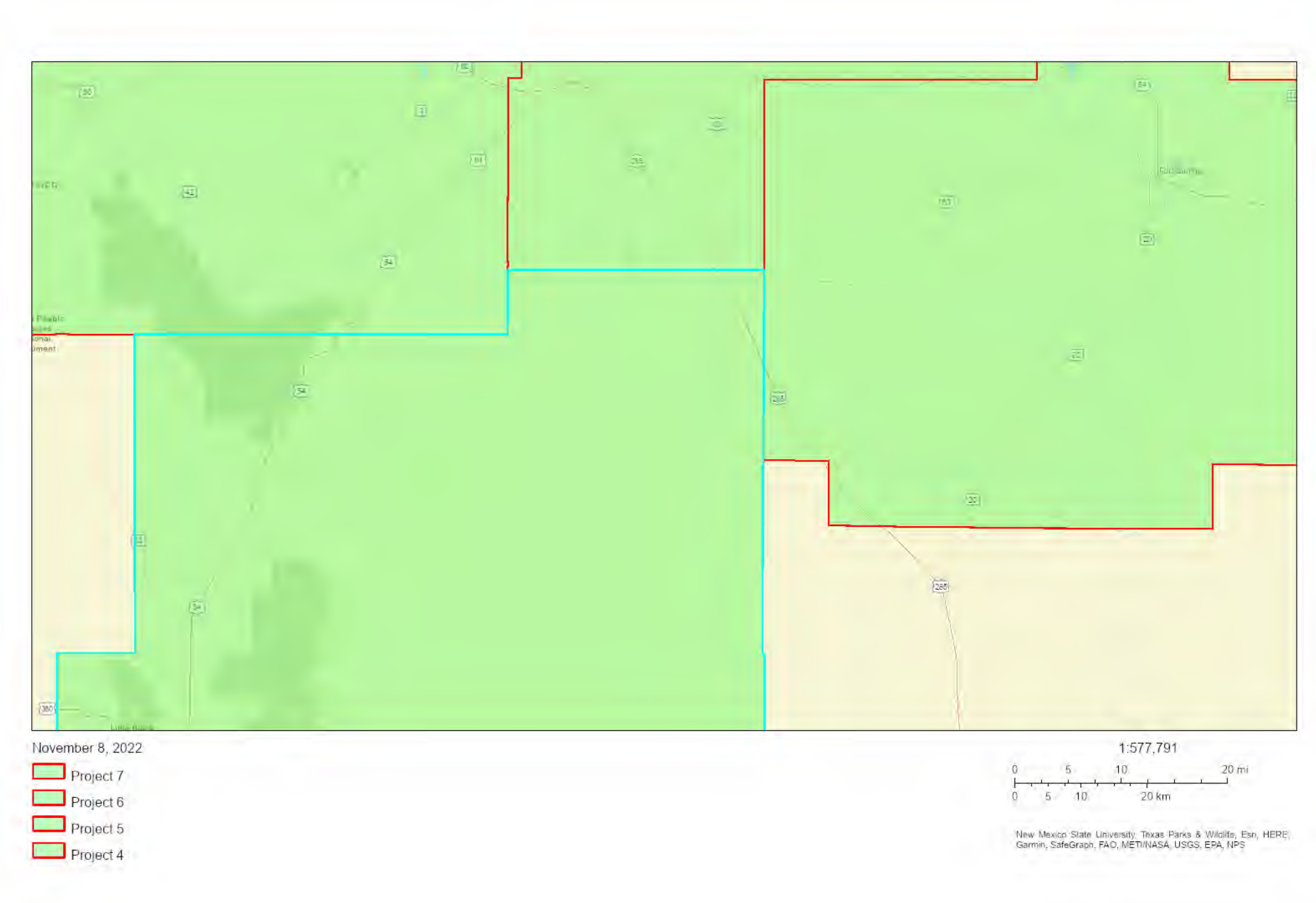

Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 (μg/m^3)	4.7	5.54	22	8.67	0
Ozone (ppb)	54.8	56	21	42.5	92
Diesel Particulate Matter* (μg/m^3)	0.0216	0.198	8	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	10	20	0	28	<50th
Air Toxics Respiratory HI*	0.1	0.23	0	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	130	510	35	760	39
Lead Paint (% Pre-1960 Housing)	0.15	0.18	56	0.27	41
Superfund Proximity (site count/km distance)	0.0099	0.14	13	0.13	4
RMP Facility Proximity (facility count/km distance)	0.014	0.24	7	0.77	0
Hazardous Waste Proximity (facility count/km distance)	0.014	0.81	6	2.2	1
Underground Storage Tanks (count/km^2)	0.97	3.3	51	3.9	47
Wastewater Discharge (toxicity-weighted concentration/m distance)	0.00011	3.5	27	12	32
Socioeconomic Indicators					
Demographic Index	39%	51%	31	35%	63
People of Color	39%	63%	20	40%	59
Low Income	38%	39%	49	30%	66
Unemployment Rate	5%	7%	53	5%	59
Limited English Speaking	2%	5%	51	5%	64
Less Than High School Education	10%	14%	46	12%	55
Under Age 5	4%	6%	46	6%	42
Over Age 64	29%	17%	82	16%	87

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

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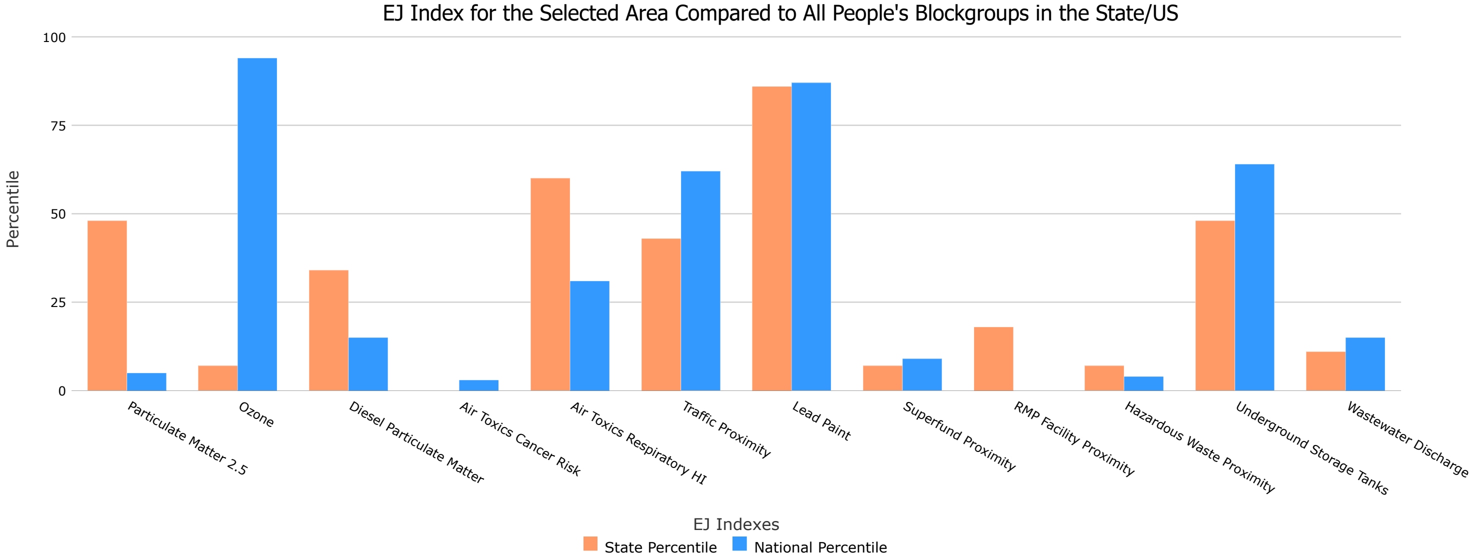
EJScreen Report (Version 2.1)

County: De Baca
NEW MEXICO, EPA Region 6
Approximate Population: 1,995
Input Area (sq. miles): 2334.33

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	48	5
EJ Index for Ozone	7	94
EJ Index for Diesel Particulate Matter*	34	15
EJ Index for Air Toxics Cancer Risk*	0	3
EJ Index for Air Toxics Respiratory HI*	60	31
EJ Index for Traffic Proximity	43	62
EJ Index for Lead Paint	86	87
EJ Index for Superfund Proximity	7	9
EJ Index for RMP Facility Proximity	18	0
EJ Index for Hazardous Waste Proximity	7	4
EJ Index for Underground Storage Tanks	48	64
EJ Index for Wastewater Discharge	11	15

EJ Index for the Selected Area Compared to All People's Blockgroups in the State/US



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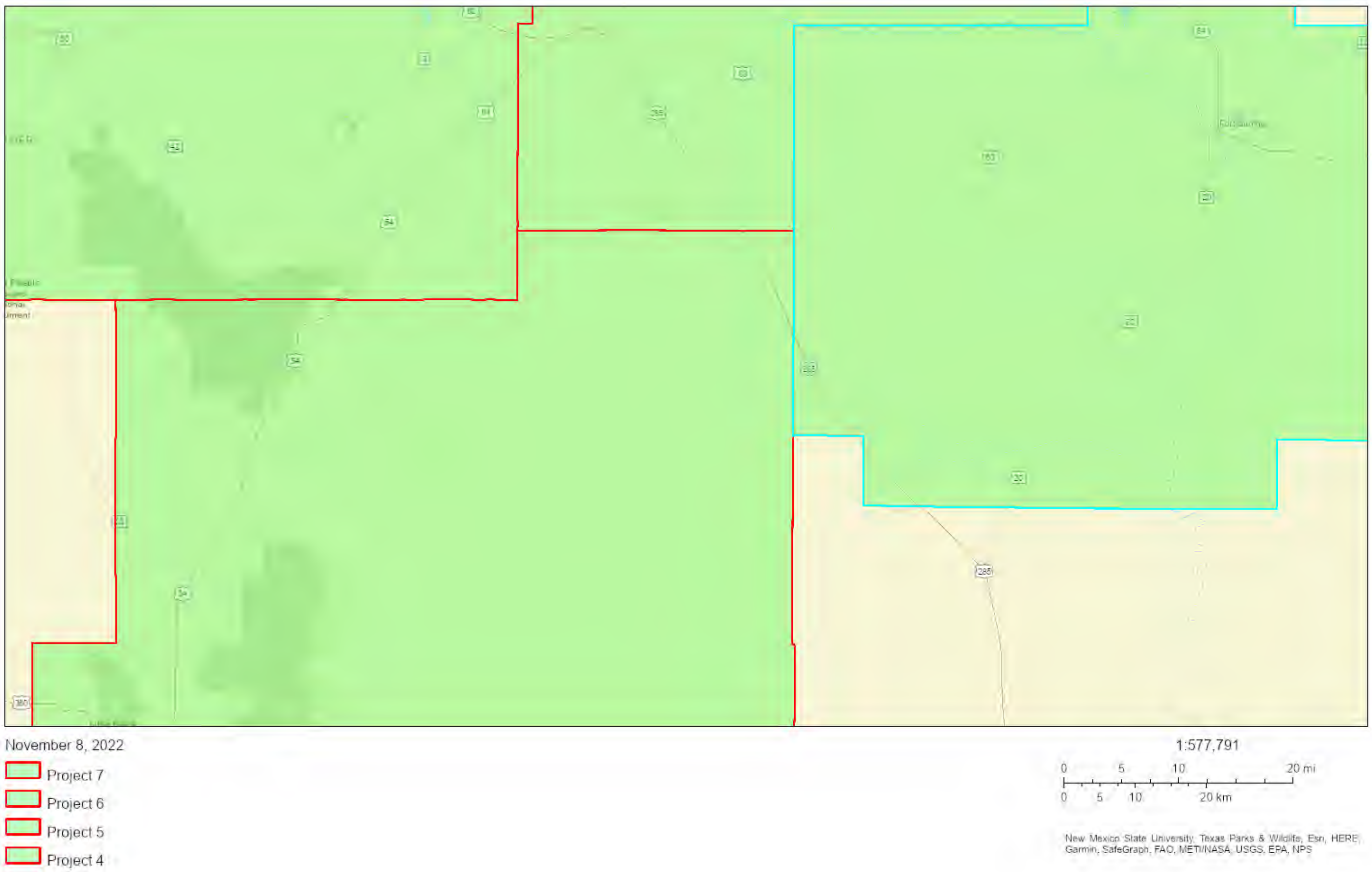

Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 (μg/m³)	5.11	5.54	34	8.67	1
Ozone (ppb)	51.6	56	4	42.5	90
Diesel Particulate Matter* (μg/m³)	0.0556	0.198	23	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	10	20	0	28	<50th
Air Toxics Respiratory HI*	0.2	0.23	63	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	92	510	29	760	32
Lead Paint (% Pre-1960 Housing)	0.45	0.18	84	0.27	70
Superfund Proximity (site count/km distance)	0.0083	0.14	4	0.13	3
RMP Facility Proximity (facility count/km distance)	0.015	0.24	12	0.77	0
Hazardous Waste Proximity (facility count/km distance)	0.012	0.81	5	2.2	1
Underground Storage Tanks (count/km²)	0.32	3.3	39	3.9	35
Wastewater Discharge (toxicity-weighted concentration/m distance)	1.8E-07	3.5	7	12	5
Socioeconomic Indicators					
Demographic Index	59%	51%	63	35%	82
People of Color	69%	63%	59	40%	78
Low Income	49%	39%	64	30%	78
Unemployment Rate	10%	7%	75	5%	81
Limited English Speaking	1%	5%	45	5%	59
Less Than High School Education	18%	14%	69	12%	77
Under Age 5	10%	6%	86	6%	86
Over Age 64	15%	17%	42	16%	46

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

For additional information, see: www.epa.gov/environmentaljustice (https://www.epa.gov/environmentaljustice)

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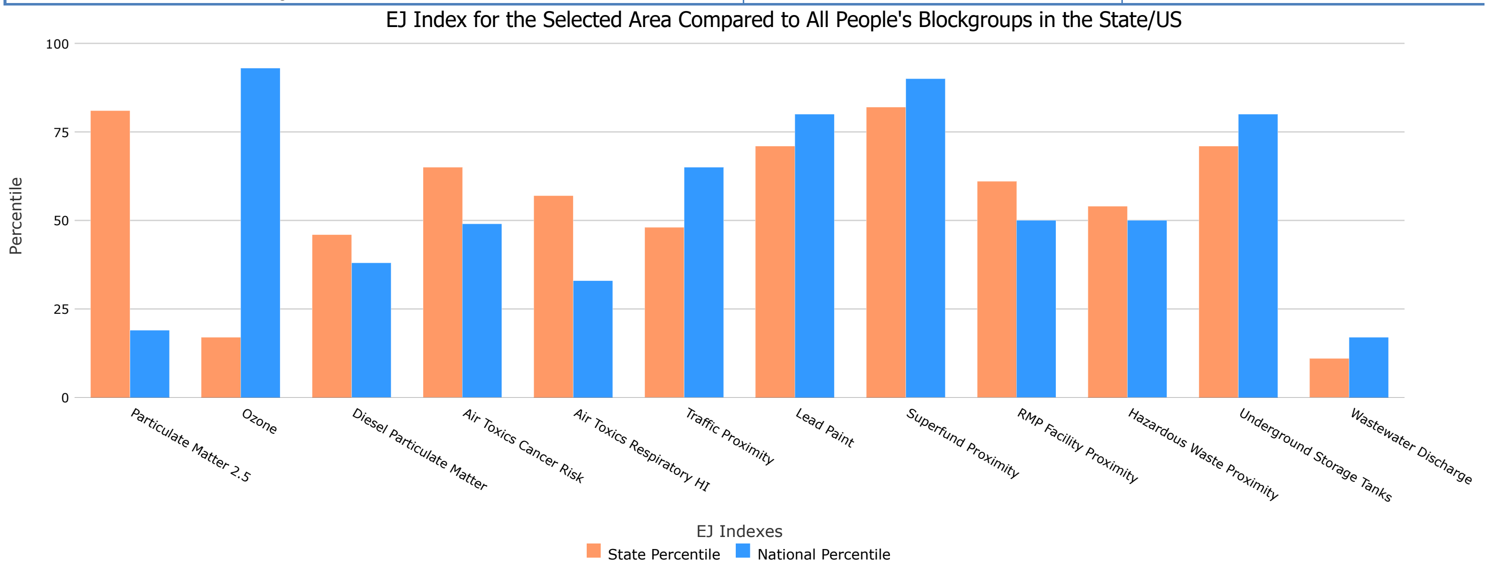
EJScreen Report (Version 2.1)

County: Chaves
NEW MEXICO, EPA Region 6
Approximate Population: 64,912
Input Area (sq. miles): 6075.05

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	81	19
EJ Index for Ozone	17	93
EJ Index for Diesel Particulate Matter*	46	38
EJ Index for Air Toxics Cancer Risk*	65	49
EJ Index for Air Toxics Respiratory HI*	57	33
EJ Index for Traffic Proximity	48	65
EJ Index for Lead Paint	71	80
EJ Index for Superfund Proximity	82	90
EJ Index for RMP Facility Proximity	61	50
EJ Index for Hazardous Waste Proximity	54	50
EJ Index for Underground Storage Tanks	71	80
EJ Index for Wastewater Discharge	11	17



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Sites reporting to EPA	
Superfund NPL	2
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	2

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 (μg/m³)	6.26	5.54	80	8.67	6
Ozone (ppb)	53.9	56	13	42.5	91
Diesel Particulate Matter* (μg/m³)	0.0927	0.198	40	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	20	20	80	28	<50th
Air Toxics Respiratory HI*	0.21	0.23	65	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	190	510	41	760	45
Lead Paint (% Pre-1960 Housing)	0.31	0.18	74	0.27	59
Superfund Proximity (site count/km distance)	0.7	0.14	95	0.13	96
RMP Facility Proximity (facility count/km distance)	0.13	0.24	54	0.77	22
Hazardous Waste Proximity (facility count/km distance)	0.19	0.81	51	2.2	30
Underground Storage Tanks (count/km²)	8.3	3.3	89	3.9	86
Wastewater Discharge (toxicity-weighted concentration/m distance)	6.6E-07	3.5	11	12	8
Socioeconomic Indicators					
Demographic Index	54%	51%	55	35%	78
People of Color	62%	63%	48	40%	74
Low Income	47%	39%	62	30%	77
Unemployment Rate	5%	7%	54	5%	60
Limited English Speaking	6%	5%	68	5%	76
Less Than High School Education	21%	14%	75	12%	81
Under Age 5	7%	6%	68	6%	65
Over Age 64	16%	17%	47	16%	51

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

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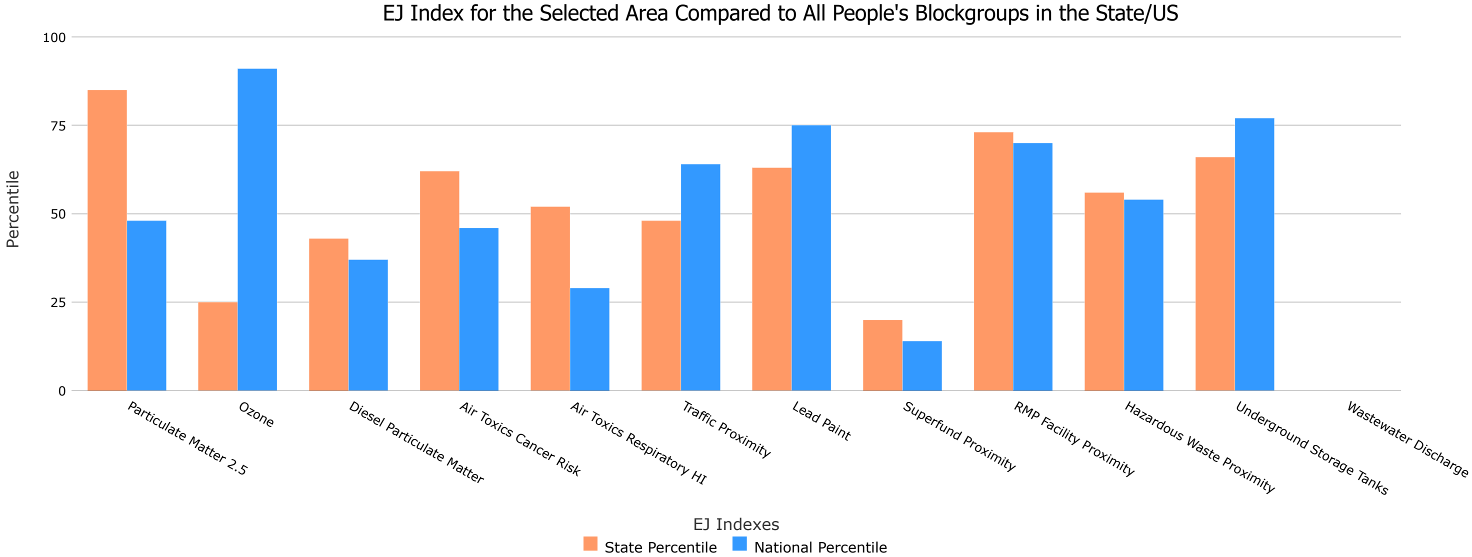
EJScreen Report (Version 2.1)

County: Lea
NEW MEXICO, EPA Region 6
Approximate Population: 70,359
Input Area (sq. miles): 4394.67

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	85	48
EJ Index for Ozone	25	91
EJ Index for Diesel Particulate Matter*	43	37
EJ Index for Air Toxics Cancer Risk*	62	46
EJ Index for Air Toxics Respiratory HI*	52	29
EJ Index for Traffic Proximity	48	64
EJ Index for Lead Paint	63	75
EJ Index for Superfund Proximity	20	14
EJ Index for RMP Facility Proximity	73	70
EJ Index for Hazardous Waste Proximity	56	54
EJ Index for Underground Storage Tanks	66	77
EJ Index for Wastewater Discharge	0	0

EJ Index for the Selected Area Compared to All People's Blockgroups in the State/US



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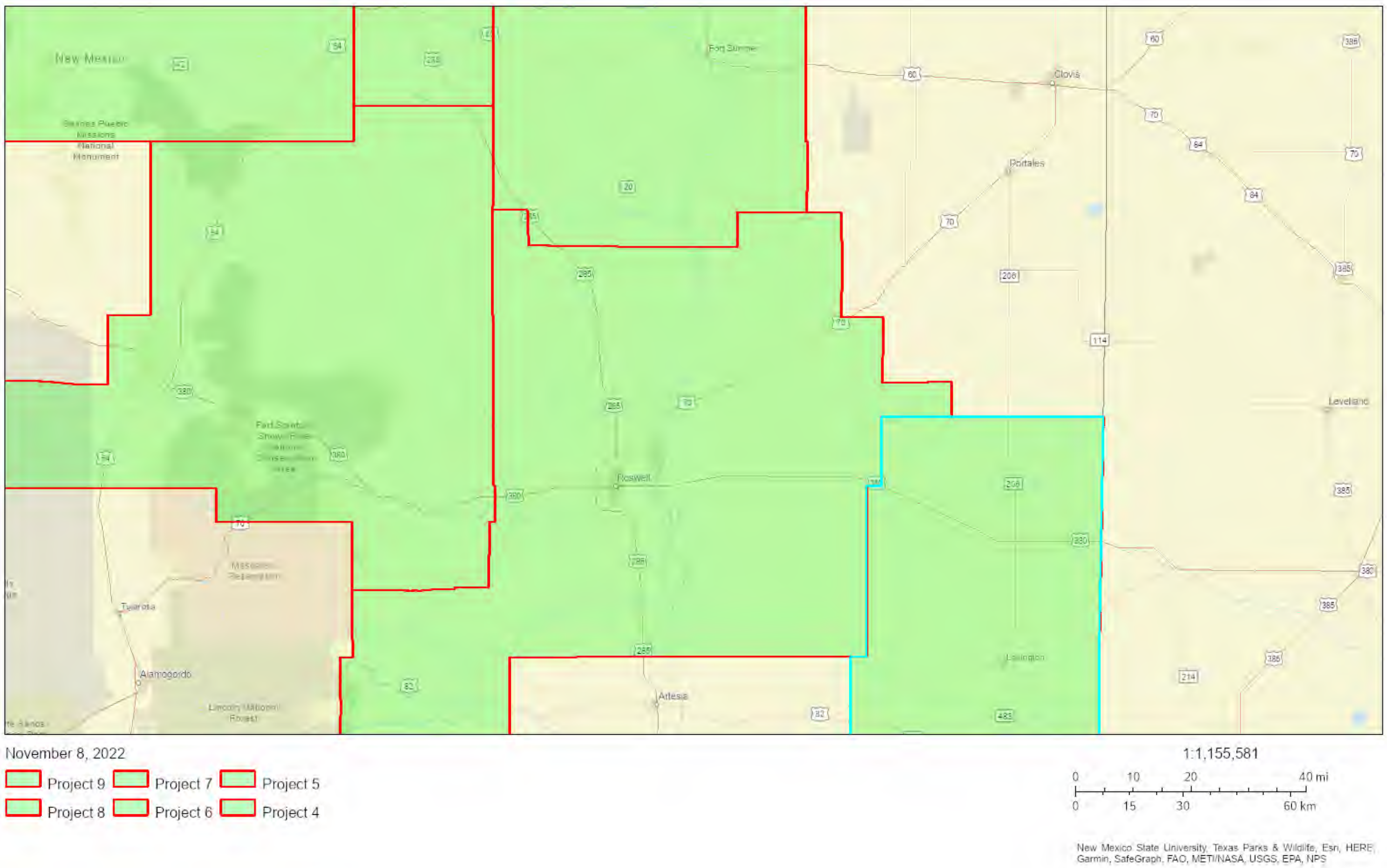

Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	3

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 (μg/m³)	7.49	5.54	97	8.67	21
Ozone (ppb)	54.7	56	20	42.5	92
Diesel Particulate Matter* (μg/m³)	0.0953	0.198	40	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	20	20	80	28	<50th
Air Toxics Respiratory HI*	0.2	0.23	64	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	240	510	48	760	50
Lead Paint (% Pre-1960 Housing)	0.28	0.18	71	0.27	55
Superfund Proximity (site count/km distance)	0.011	0.14	19	0.13	5
RMP Facility Proximity (facility count/km distance)	0.47	0.24	84	0.77	57
Hazardous Waste Proximity (facility count/km distance)	0.2	0.81	52	2.2	32
Underground Storage Tanks (count/km²)	3.7	3.3	76	3.9	71
Wastewater Discharge (toxicity-weighted concentration/m distance)	2.6E-13	3.5	0	12	0
Socioeconomic Indicators					
Demographic Index	50%	51%	49	35%	75
People of Color	66%	63%	54	40%	76
Low Income	35%	39%	44	30%	62
Unemployment Rate	7%	7%	62	5%	70
Limited English Speaking	8%	5%	77	5%	82
Less Than High School Education	24%	14%	80	12%	86
Under Age 5	8%	6%	75	6%	74
Over Age 64	11%	17%	28	16%	31

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

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EJScreen Report (Version 2.1)

County: Yoakum

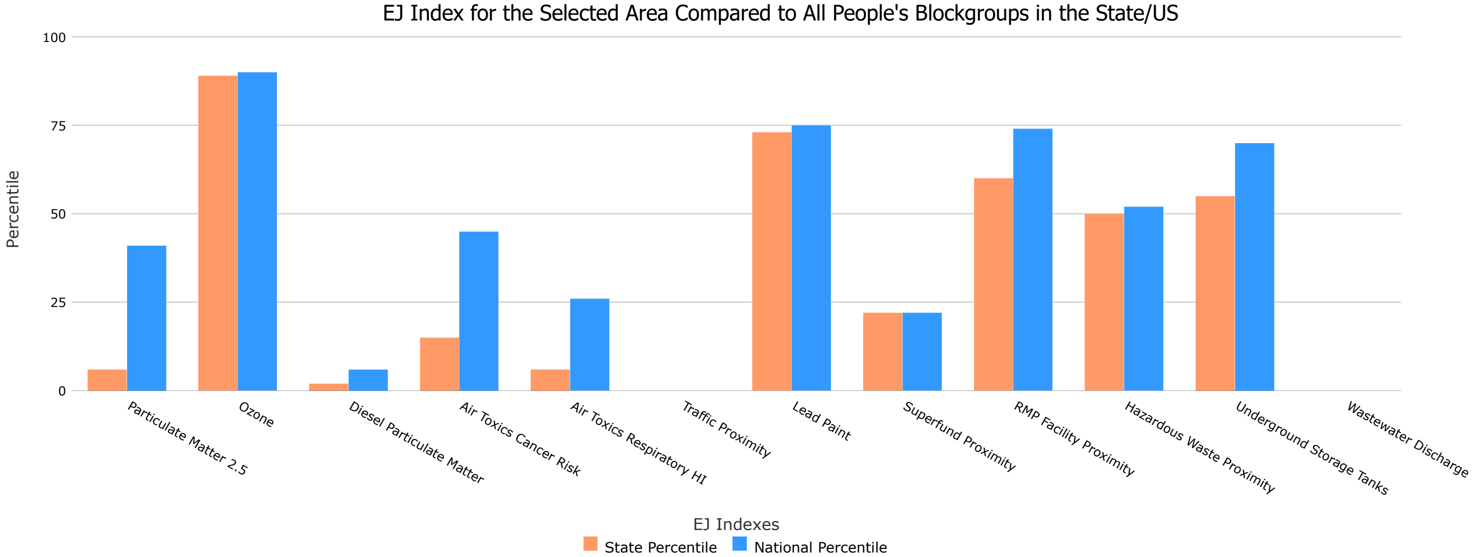
TEXAS, EPA Region 6

Approximate Population: 8,612

Input Area (sq. miles): 799.72

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	6	41
EJ Index for Ozone	89	90
EJ Index for Diesel Particulate Matter*	2	6
EJ Index for Air Toxics Cancer Risk*	15	45
EJ Index for Air Toxics Respiratory HI*	6	26
EJ Index for Traffic Proximity	N/A	N/A
EJ Index for Lead Paint	73	75
EJ Index for Superfund Proximity	22	22
EJ Index for RMP Facility Proximity	60	74
EJ Index for Hazardous Waste Proximity	50	52
EJ Index for Underground Storage Tanks	55	70
EJ Index for Wastewater Discharge	N/A	N/A

EJ Index for the Selected Area Compared to All People's Blockgroups in the State/US



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Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	1

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 (µg/m^3)	7.35	9.5	3	8.67	19
Ozone (ppb)	53.5	40	98	42.5	91
Diesel Particulate Matter* (µg/m^3)	0.0388	0.211	1	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	20	31	19	28	<50th
Air Toxics Respiratory HI*	0.2	0.35	8	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	N/A	570	N/A	760	N/A
Lead Paint (% Pre-1960 Housing)	0.24	0.14	73	0.27	52
Superfund Proximity (site count/km distance)	0.013	0.084	13	0.13	8
RMP Facility Proximity (facility count/km distance)	0.86	0.94	65	0.77	71
Hazardous Waste Proximity (facility count/km distance)	0.2	0.72	41	2.2	31
Underground Storage Tanks (count/km^2)	2.1	2.3	60	3.9	60
Wastewater Discharge (toxicity-weighted concentration/m distance)	N/A	0.38	N/A	12	N/A
Socioeconomic Indicators					
Demographic Index	48%	46%	55	35%	73
People of Color	69%	59%	59	40%	77
Low Income	28%	33%	44	30%	50
Unemployment Rate	5%	5%	62	5%	61
Limited English Speaking	16%	7%	83	5%	90
Less Than High School Education	31%	16%	81	12%	91
Under Age 5	9%	7%	74	6%	81
Over Age 64	11%	13%	44	16%	30

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

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EJScreen Report (Version 2.1)

County: Gaines

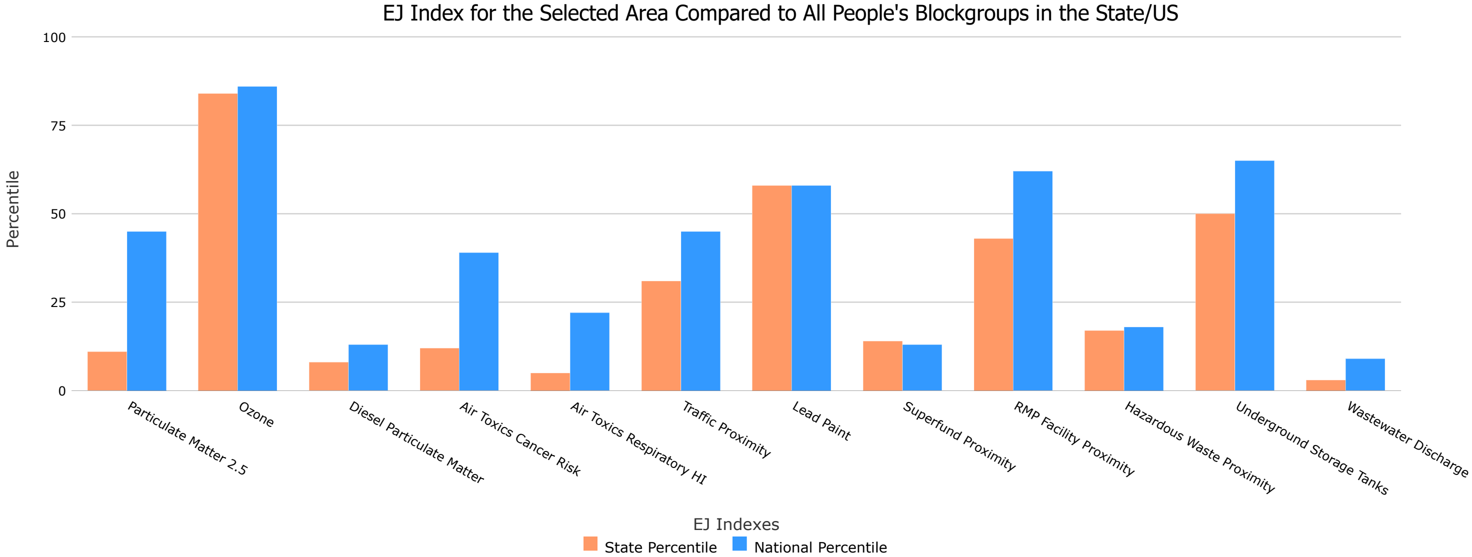
TEXAS, EPA Region 6

Approximate Population: 21,077

Input Area (sq. miles): 1502.84

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	11	45
EJ Index for Ozone	84	86
EJ Index for Diesel Particulate Matter*	8	13
EJ Index for Air Toxics Cancer Risk*	12	39
EJ Index for Air Toxics Respiratory HI*	5	22
EJ Index for Traffic Proximity	31	45
EJ Index for Lead Paint	58	58
EJ Index for Superfund Proximity	14	13
EJ Index for RMP Facility Proximity	43	62
EJ Index for Hazardous Waste Proximity	17	18
EJ Index for Underground Storage Tanks	50	65
EJ Index for Wastewater Discharge	3	9

EJ Index for the Selected Area Compared to All People's Blockgroups in the State/US



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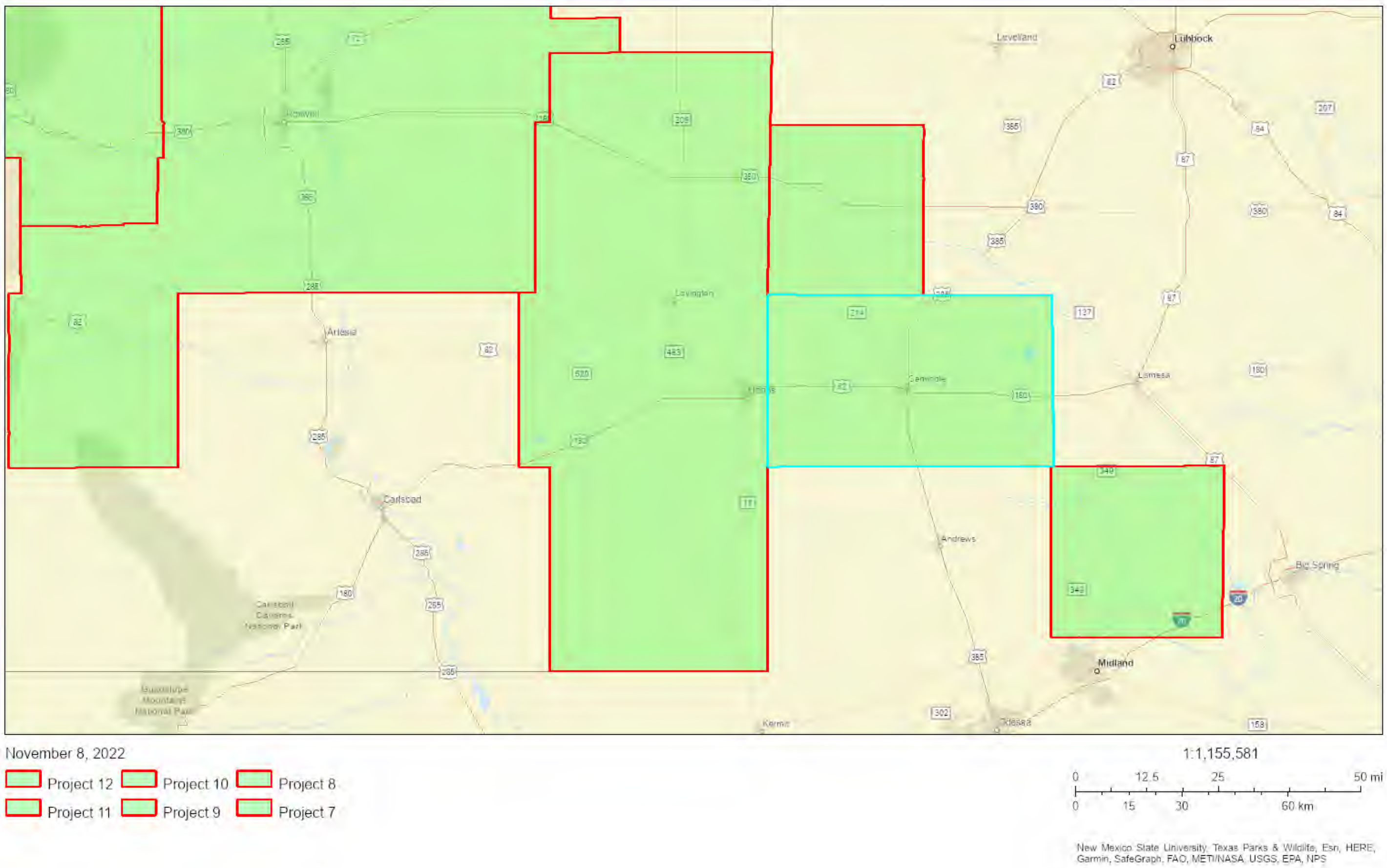

Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 (μg/m³)	7.67	9.5	7	8.67	25
Ozone (ppb)	53.3	40	98	42.5	91
Diesel Particulate Matter* (μg/m³)	0.057	0.211	4	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	20	31	19	28	<50th
Air Toxics Respiratory HI*	0.2	0.35	8	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	83	570	28	760	31
Lead Paint (% Pre-1960 Housing)	0.17	0.14	66	0.27	44
Superfund Proximity (site count/km distance)	0.011	0.084	9	0.13	6
RMP Facility Proximity (facility count/km distance)	0.32	0.94	41	0.77	50
Hazardous Waste Proximity (facility count/km distance)	0.041	0.72	11	2.2	7
Underground Storage Tanks (count/km²)	2.6	2.3	65	3.9	63
Wastewater Discharge (toxicity-weighted concentration/m distance)	1.6E-06	0.38	4	12	10
Socioeconomic Indicators					
Demographic Index	40%	46%	44	35%	64
People of Color	45%	59%	38	40%	63
Low Income	35%	33%	54	30%	62
Unemployment Rate	4%	5%	51	5%	50
Limited English Speaking	13%	7%	79	5%	88
Less Than High School Education	38%	16%	88	12%	95
Under Age 5	11%	7%	81	6%	87
Over Age 64	9%	13%	35	16%	23

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EJScreen Report (Version 2.1)

County: Andrews

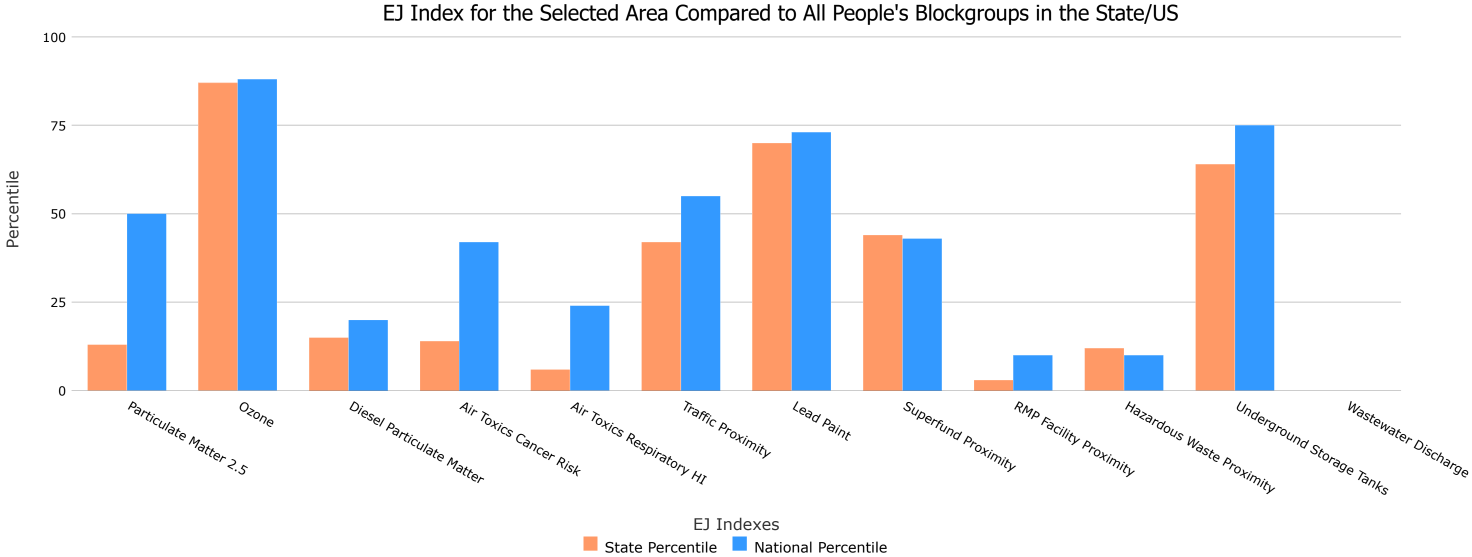
TEXAS, EPA Region 6

Approximate Population: 18,227

Input Area (sq. miles): 1501.08

Selected Variables	Percentile in State	Percentile in USA
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	13	50
EJ Index for Ozone	87	88
EJ Index for Diesel Particulate Matter*	15	20
EJ Index for Air Toxics Cancer Risk*	14	42
EJ Index for Air Toxics Respiratory HI*	6	24
EJ Index for Traffic Proximity	42	55
EJ Index for Lead Paint	70	73
EJ Index for Superfund Proximity	44	43
EJ Index for RMP Facility Proximity	3	10
EJ Index for Hazardous Waste Proximity	12	10
EJ Index for Underground Storage Tanks	64	75
EJ Index for Wastewater Discharge	0	0

EJ Index for the Selected Area Compared to All People's Blockgroups in the State/US



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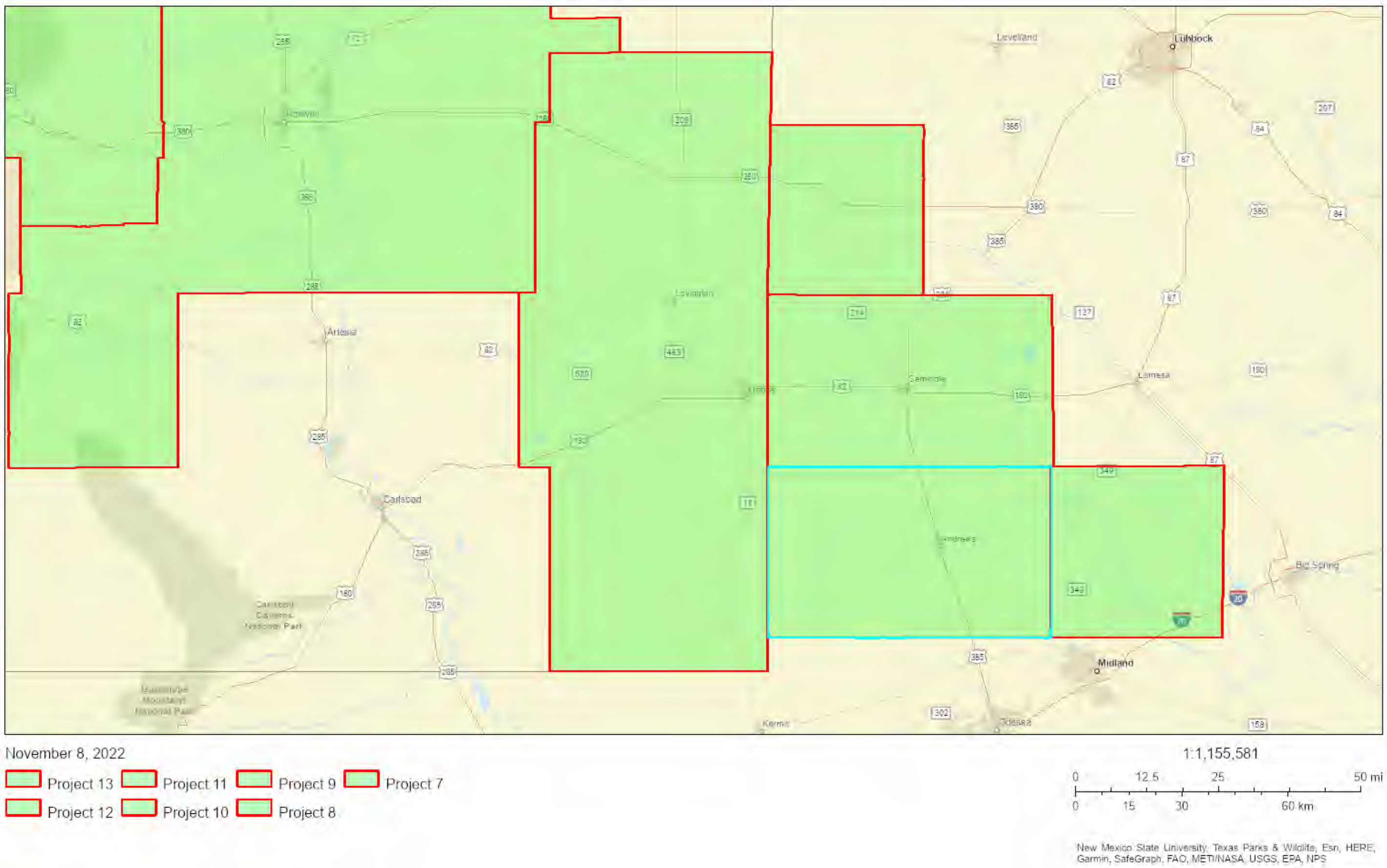


Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	2

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter 2.5 (μg/m³)	7.71	9.5	8	8.67	27
Ozone (ppb)	53	40	98	42.5	91
Diesel Particulate Matter* (μg/m³)	0.0686	0.211	7	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	20	31	19	28	<50th
Air Toxics Respiratory HI*	0.2	0.35	8	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	130	570	37	760	38
Lead Paint (% Pre-1960 Housing)	0.29	0.14	77	0.27	57
Superfund Proximity (site count/km distance)	0.022	0.084	31	0.13	20
RMP Facility Proximity (facility count/km distance)	0.039	0.94	1	0.77	3
Hazardous Waste Proximity (facility count/km distance)	0.027	0.72	6	2.2	4
Underground Storage Tanks (count/km²)	4.9	2.3	85	3.9	77
Wastewater Discharge (toxicity-weighted concentration/m distance)	5.6E-09	0.38	0	12	1
Socioeconomic Indicators					
Demographic Index	45%	46%	50	35%	69
People of Color	60%	59%	52	40%	73
Low Income	29%	33%	46	30%	52
Unemployment Rate	4%	5%	52	5%	51
Limited English Speaking	7%	7%	67	5%	80
Less Than High School Education	23%	16%	72	12%	85
Under Age 5	9%	7%	70	6%	78
Over Age 64	10%	13%	39	16%	26

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

For additional information, see: www.epa.gov/environmentaljustice (https://www.epa.gov/environmentaljustice)

EJScreen is a screening tool for pre-decisional use only. It can help identify areas that may warrant additional consideration, analysis, or outreach. It does not provide a basis for decision-making, but it may help identify potential areas of EJ concern. Users should keep in mind that screening tools are subject to substantial uncertainty in their demographic and environmental data, particularly when looking at small geographic areas. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJScreen documentation for discussion of these issues before using reports. This screening tool does not provide data on every environmental impact and demographic factor that may be relevant to a particular location. EJScreen outputs should be supplemented with additional information and local knowledge before taking any action to address potential EJ concerns.

Centers for Disease Control and Prevention (../showHome.action)
CDC 24/7: Saving Lives. Protecting People.™

Saguache County, Colorado†

County highlighted in the State

POPULATION: 6,226

INCOME

Average Household Income

Saguache County: $37,004

Colorado: $77,104

Residents who live below the poverty line

25.4%

Saguache County

9.4%

Colorado

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 2 are between the ages of 0 and 19 years

About 1 are between the ages of 20 and 34 years

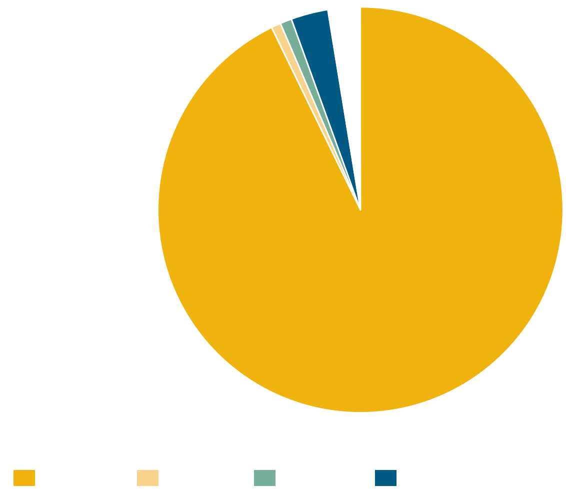
About 2 are between the ages of 35 and 49 years

About 4 are 50 years and older

ETHNICITY

4 are Hispanic and 6 are non-Hispanic

RACE



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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

9.7% 7.0%

Colorado National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=8&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Saguache County residents were exposed to unhealthy levels of ozone for **0 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Saguache County residents were exposed to unhealthy levels of ozone for **0 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=8109&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

5.1 μg/m³*

Saguache County, Colorado

12.0µg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (µg/m³)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and
- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0µg/m³**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Saguache County** was **5.1µg/m³**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (µg/m³)

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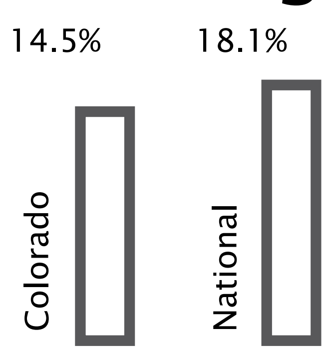
%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=8109&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†



PERCENTAGE OF CURRENT ADULT SMOKERS

Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=8&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†

0 Days

with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Saguache County had **0 Days** with maximum temperatures above 90°F during May-September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=8109&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

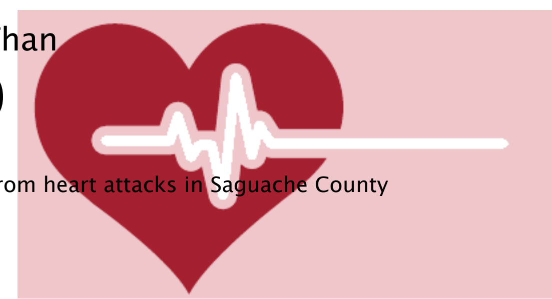
† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†

Less Than

10

deaths from heart attacks in Saguache County



The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **Less than 10 deaths** from heart attacks in Saguache County.
- **1,006 deaths** from heart attacks in Colorado.

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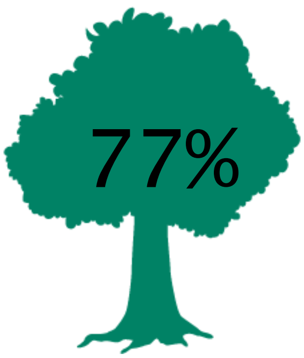
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=8109&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†



Live within half a mile of a park in Saguache County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

77% of people living in **Saguache County** lived within half a mile of a park.

74% of people living in **Colorado** lived within half a mile of a park.

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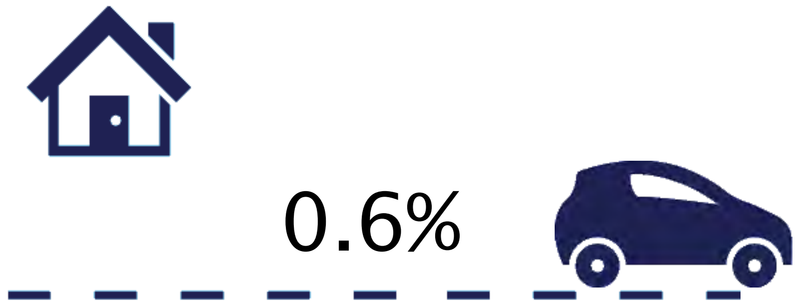
ɜA%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20#environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=8109&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†



of Saguache County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **0.6%** of the population of Saguache County lived within 150 meters* of a major highway.

In 2011, **27.3%** of Saguache County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=8109&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

The Colorado Tracking Network (https://coepht.colorado.gov/) has more state-specific information about your health and the environment.

Visit CDC's Tracking Network today.

www.cdc.gov/ephtracking (http://www.cdc.gov/ephtracking/)

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subject=Please%20add%20me%20to%20CDC's%20Environmen
serv.&body=Please%20fill%20in%20the%20information%20bel

Alamosa County, Colorado†

County highlighted in the State

POPULATION: 16,256

INCOME

Average Household Income

Alamosa County: $38,213

Colorado: $77,104

Residents who live below the poverty line

19.6%

Alamosa County

9.4%

Colorado

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 3 are between the ages of 0 and 19 years

About 3 are between the ages of 20 and 34 years

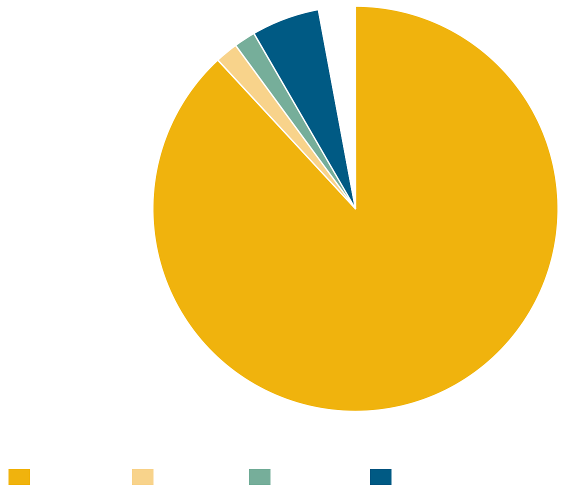
About 1 are between the ages of 35 and 49 years

About 3 are 50 years and older

ETHNICITY

5 are Hispanic and 5 are non-Hispanic

RACE



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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

9.7% 7.0%

Colorado National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=8&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Alamosa County residents were exposed to unhealthy levels of ozone for **0 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Alamosa County residents were exposed to unhealthy levels of ozone for **0 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=8003&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

5.6μg/m³*

Alamosa County, Colorado

12.0μg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (μg/m³)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and

- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0μg/m³**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Alamosa County** was **5.6μg/m³**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (μg/m³)

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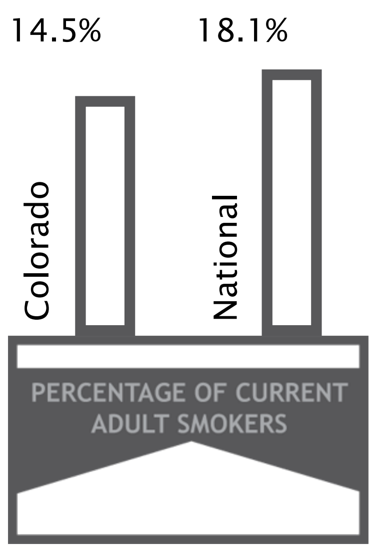
%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=8003&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†



Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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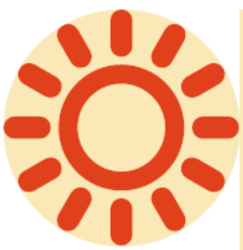
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

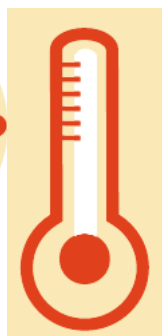
Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=8&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†



5 Days



with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Alamosa County had **5 Days** with maximum temperatures above 90°F during May-September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

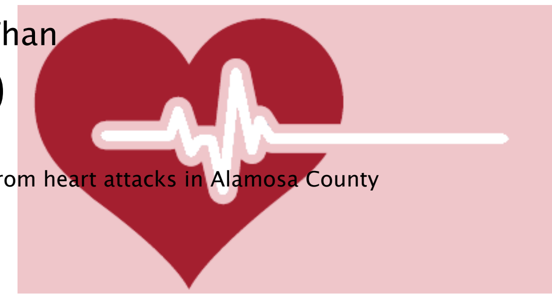
Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=8003&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†

Less Than

10



deaths from heart attacks in Alamosa County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **Less than 10 deaths** from heart attacks in Alamosa County.
- **1,006 deaths** from heart attacks in Colorado.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=8003&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Alamosa County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

16% of people living in **Alamosa County** lived within half a mile of a park.

74% of people living in **Colorado** lived within half a mile of a park.

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;3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20#environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=8003&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†

7.1%

of Alamosa County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **7.1%** of the population of Alamosa County lived within 150 meters* of a major highway.

In 2011, **11.1%** of Alamosa County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=8003&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

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Conejos County, Colorado†

County highlighted in the State

POPULATION: 8,258

INCOME

Average Household Income

Conejos County: $40,944

Colorado: $77,104

Residents who live below the poverty line

19.9%

Conejos County

9.4%

Colorado

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 3 are between the ages of 0 and 19 years

About 2 are between the ages of 20 and 34 years

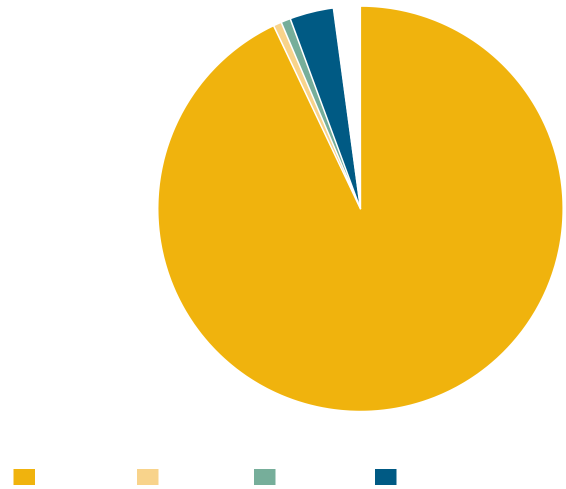
About 2 are between the ages of 35 and 49 years

About 4 are 50 years and older

ETHNICITY

5 are Hispanic and 5 are non-Hispanic

RACE



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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

9.7% 7.0%

Colorado National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=8&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Conejos County residents were exposed to unhealthy levels of ozone for **0 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Conejos County residents were exposed to unhealthy levels of ozone for **0 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=8021&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

5.3 μg/m³*

Conejos County, Colorado

12.0 μg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (μg/m³)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and

- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0μg/m³**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Conejos County** was **5.3μg/m³**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (μg/m³)

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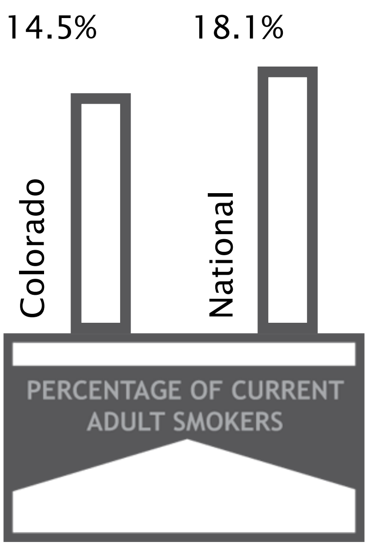
%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=8021&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†

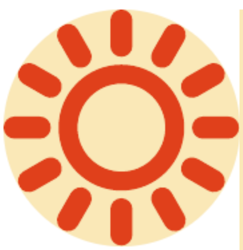


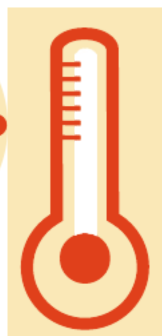
Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=8&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†





0 Days

with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Conejos County had **0 Days** with maximum temperatures above 90°F during May-September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

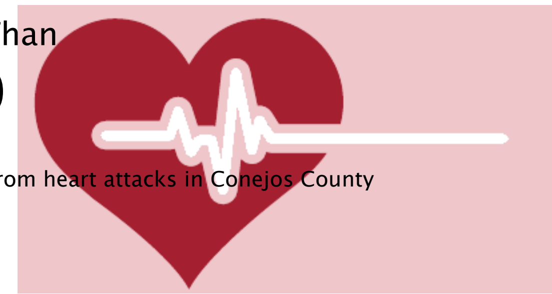
Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=8021&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†

Less Than

10



deaths from heart attacks in Conejos County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **Less than 10 deaths** from heart attacks in Conejos County.
- **1,006 deaths** from heart attacks in Colorado.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=8021&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Conejos County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

71% of people living in **Conejos County** lived within half a mile of a park.

74% of people living in **Colorado** lived within half a mile of a park.

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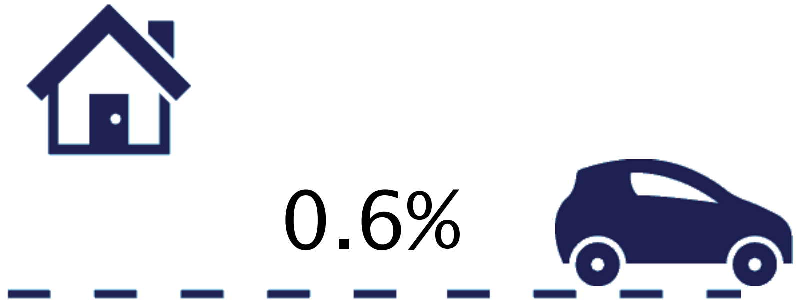
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=8021&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†



of Conejos County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **0.6%** of the population of Conejos County lived within 150 meters* of a major highway.

In 2011, **30.0%** of Conejos County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

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† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

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Rio Arriba County, New Mexico†

County highlighted in the State

POPULATION: 40,088

INCOME

Average Household Income

Rio Arriba County: $44,579

New Mexico: $52,021

Residents who live below the poverty line

22.2%

Rio Arriba County

17.5%

New Mexico

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 3 are between the ages of 0 and 19 years

About 2 are between the ages of 20 and 34 years

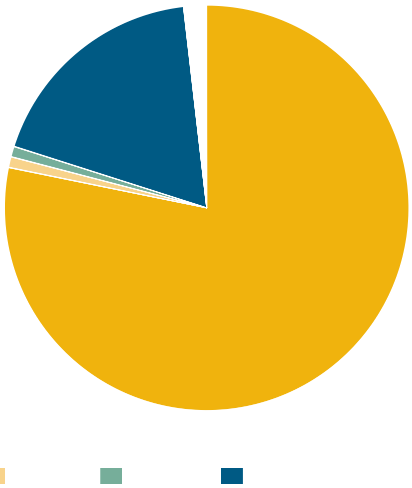
About 2 are between the ages of 35 and 49 years

About 4 are 50 years and older

ETHNICITY

7 are Hispanic and 3 are non-Hispanic

RACE



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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

8.4% 7.0%

New Mexico National

Percent of **children** who currently have asthma

5.4% 8.3%

New Mexico National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=35&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Rio Arriba County residents were exposed to unhealthy levels of ozone for **3 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Rio Arriba County residents were exposed to unhealthy levels of ozone for **3 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=35039&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

5.5μg/m³*

Rio Arriba County, New Mexico

12.0μg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (μg/m^3)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and
- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0μg/m³**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Rio Arriba County** was **5.5μg/m³**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (μg/m^3)

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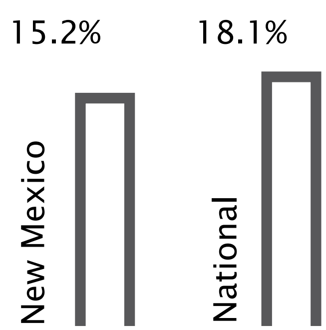
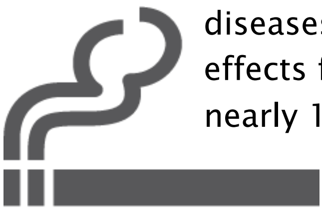
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=35039&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†





Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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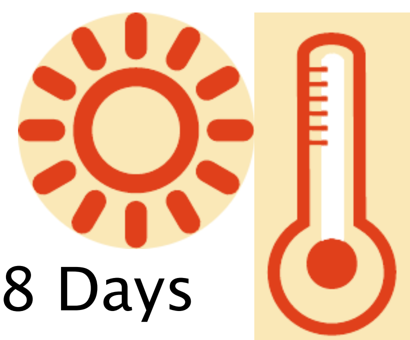
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=35&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†



8 Days

with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Rio Arriba County had **8 Days** with maximum temperatures above 90°F during May–September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=35039&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†

15

deaths from heart attacks in Rio Arriba County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **15 deaths** from heart attacks in Rio Arriba County.
- **631 deaths** from heart attacks in New Mexico.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=35039&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Rio Arriba County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

52% of people living in **Rio Arriba County** lived within half a mile of a park.

59% of people living in **New Mexico** lived within half a mile of a park.

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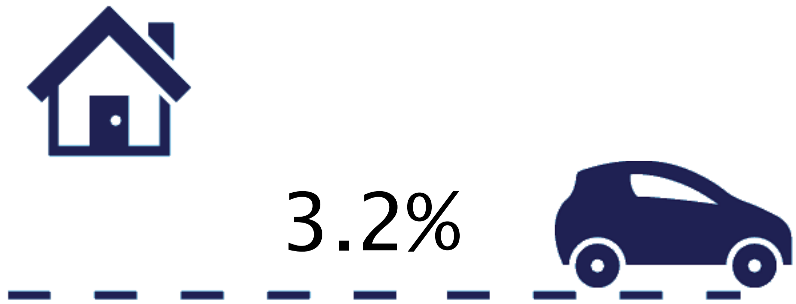
;3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20#environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=35039&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†



of Rio Arriba County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **3.2%** of the population of Rio Arriba County lived within 150 meters* of a major highway.

In 2011, **3.7%** of Rio Arriba County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=35039&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

The New Mexico Tracking Network (https://nmtracking.org/) has more state-specific information about your health and the environment.

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Centers for Disease Control and Prevention
CDC 24/7: Saving Lives. Protecting People.™ (../showHome.action)

Taos County, New Mexico†

County highlighted in the State

POPULATION: 33,030

INCOME

Average Household Income

Taos County: $43,032

New Mexico: $52,021

Residents who live below the poverty line

18.2%

Taos County

17.5%

New Mexico

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 2 are between the ages of 0 and 19 years

About 2 are between the ages of 20 and 34 years

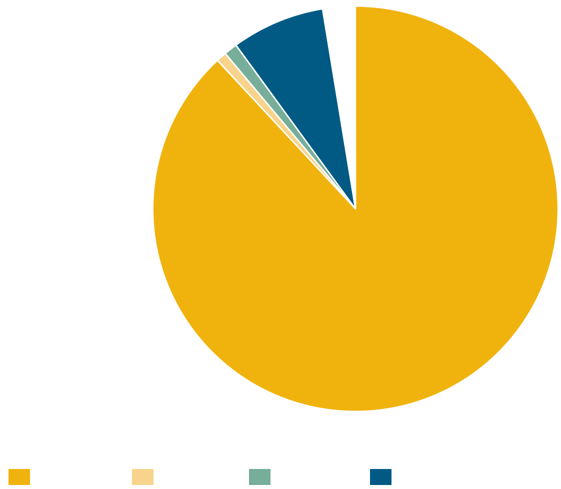
About 2 are between the ages of 35 and 49 years

About 5 are 50 years and older

ETHNICITY

6 are Hispanic and 4 are non-Hispanic

RACE



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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

8.4% 7.0%

New Mexico National

Percent of **children** who currently have asthma

5.4% 8.3%

New Mexico National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=35&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Taos County residents were exposed to unhealthy levels of ozone for **2 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Taos County residents were exposed to unhealthy levels of ozone for **2 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=35055&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF PM$_{2.5}$

6.3 $\mu g/m^3$*

Taos County, New Mexico

12.0μg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (μg/m^3)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and
- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0μg/m^3**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Taos County** was **6.3μg/m^3**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (μg/m^3)

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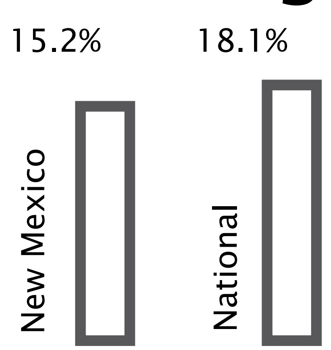
%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

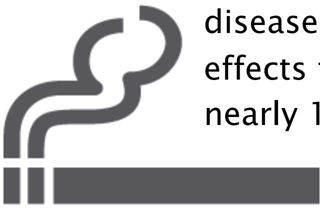
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=35055&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†





Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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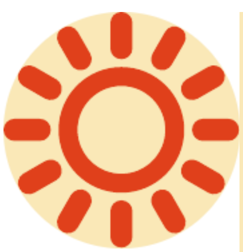
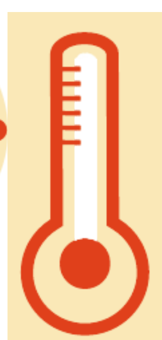
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=35&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†





0 Days

with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Taos County had **0 Days** with maximum temperatures above 90°F during May–September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=35055&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†

10

deaths from heart attacks in Taos County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **10 deaths** from heart attacks in Taos County.
- **631 deaths** from heart attacks in New Mexico.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=35055&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Taos County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

47% of people living in **Taos County** lived within half a mile of a park.

59% of people living in **New Mexico** lived within half a mile of a park.

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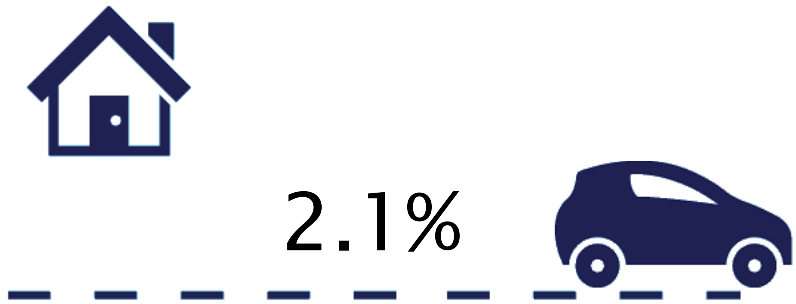
;3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20#environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=35055&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†



of Taos County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **2.1%** of the population of Taos County lived within 150 meters* of a major highway.

In 2011, **16.0%** of Taos County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=35055&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

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Santa Fe County, New Mexico†

County highlighted in the State

POPULATION: 147,306

INCOME

Average Household Income

Santa Fe County: $61,791

New Mexico: $52,021

Residents who live below the poverty line

12.4%

Santa Fe County

17.5%

New Mexico

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 2 are between the ages of 0 and 19 years

About 2 are between the ages of 20 and 34 years

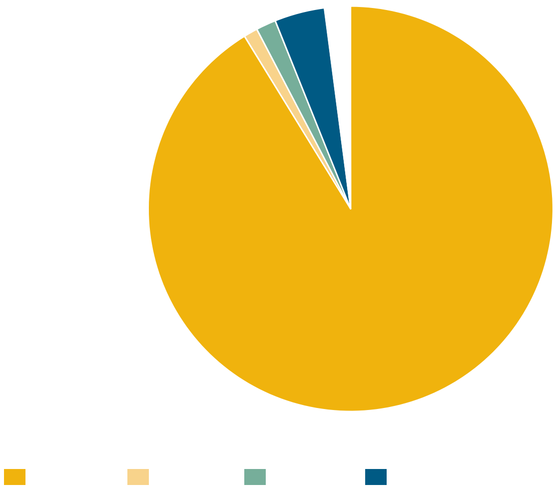
About 2 are between the ages of 35 and 49 years

About 4 are 50 years and older

ETHNICITY

5 are Hispanic and 5 are non-Hispanic

RACE



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Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

8.4% 7.0%

New Mexico National

Percent of **children** who currently have asthma

5.4%	8.3%
New Mexico	National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=35&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Santa Fe County residents were exposed to unhealthy levels of ozone for **3 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Santa Fe County residents were exposed to unhealthy levels of ozone for **3 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=35049&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

3.7 μg/m^3*

Santa Fe County, New Mexico

12.0μg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (μg/m³)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and
- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0μg/m³**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Santa Fe County** was **3.7μg/m³**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (μg/m³)

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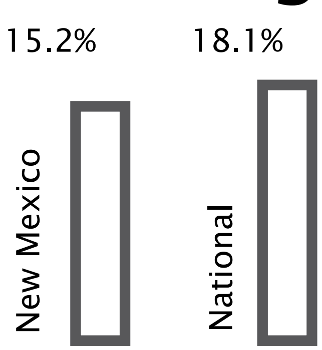
%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

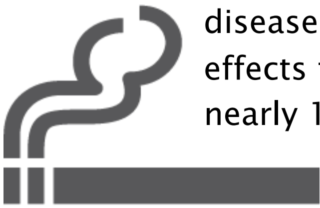
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=35049&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†





Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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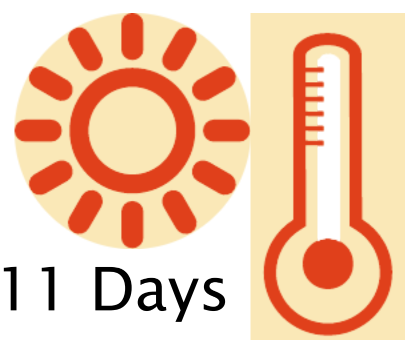
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=35&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†



11 Days

with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Santa Fe County had **11 Days** with maximum temperatures above 90°F during May–September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=35049&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†

33

deaths from heart attacks in Santa Fe County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **33 deaths** from heart attacks in Santa Fe County.
- **631 deaths** from heart attacks in New Mexico.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=35049&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Santa Fe County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

58% of people living in **Santa Fe County** lived within half a mile of a park.

59% of people living in **New Mexico** lived within half a mile of a park.

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;3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20#environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=35049&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†

4.4%

of Santa Fe County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **4.4%** of the population of Santa Fe County lived within 150 meters* of a major highway.

In 2011, **2.2%** of Santa Fe County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=35049&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

The New Mexico Tracking Network (https://nmtracking.org/) has more state-specific information about your health and the environment.

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Torrance County, New Mexico†

County highlighted in the State

POPULATION: 15,713

INCOME

Average Household Income

Torrance County: $39,532

New Mexico: $52,021

Residents who live below the poverty line

21.6%

Torrance County

17.5%

New Mexico

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 3 are between the ages of 0 and 19 years

About 2 are between the ages of 20 and 34 years

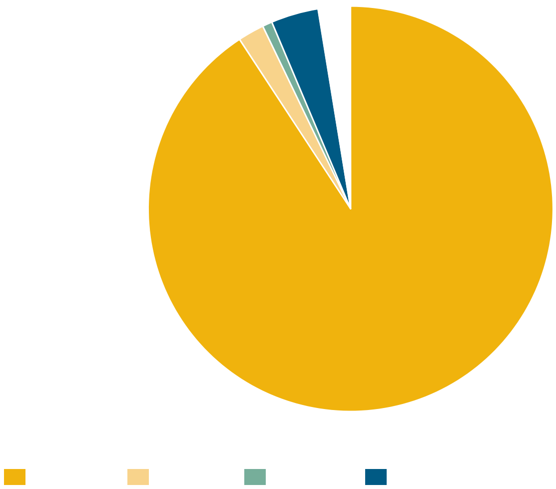
About 2 are between the ages of 35 and 49 years

About 4 are 50 years and older

ETHNICITY

4 are Hispanic and 6 are non-Hispanic

RACE



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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

8.4% 7.0%

New Mexico National

Percent of **children** who currently have asthma

5.4% 8.3%

New Mexico National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=35&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Torrance County residents were exposed to unhealthy levels of ozone for **6 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Torrance County residents were exposed to unhealthy levels of ozone for **6 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=35057&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

4.5 μg/m³*

Torrance County, New Mexico

12.0µg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (µg/m³)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and
- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0µg/m³**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Torrance County** was **4.5µg/m³**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (µg/m³)

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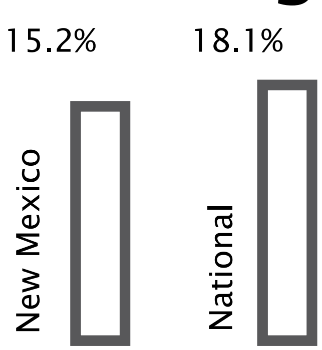
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=35057&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†



PERCENTAGE OF CURRENT ADULT SMOKERS

Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=35&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†

15 Days

with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Torrance County had **15 Days** with maximum temperatures above 90°F during May–September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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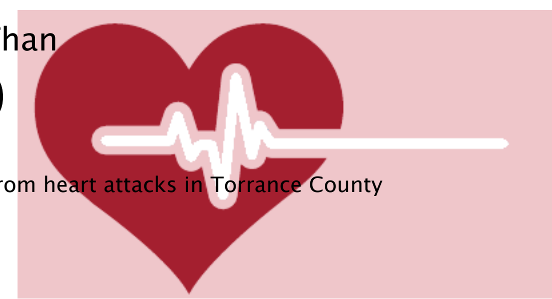
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=35057&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†



Less Than

10

deaths from heart attacks in Torrance County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **Less than 10 deaths** from heart attacks in Torrance County.
- **631 deaths** from heart attacks in New Mexico.

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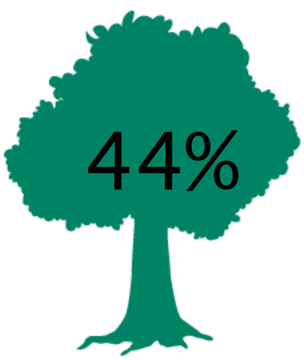
Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=35057&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†



Live within half a mile of a park in Torrance County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

44% of people living in **Torrance County** lived within half a mile of a park.

59% of people living in **New Mexico** lived within half a mile of a park.

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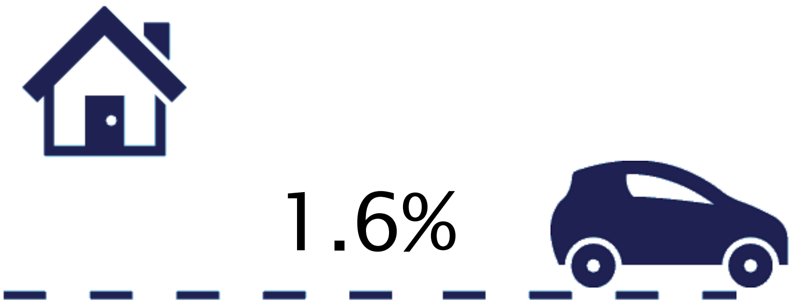
ɜ3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20#environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=35057&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†



of Torrance County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **1.6%** of the population of Torrance County lived within 150 meters* of a major highway.

In 2011, **0.0%** of Torrance County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=35057&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

The New Mexico Tracking Network (https://nmtracking.org/) has more state-specific information about your health and the environment.

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Guadalupe County, New Mexico†

County highlighted in the State

POPULATION: 4,560

INCOME

Average Household Income

Guadalupe County: $36,554

New Mexico: $52,021

Residents who live below the poverty line

23.5%

Guadalupe County

17.5%

New Mexico

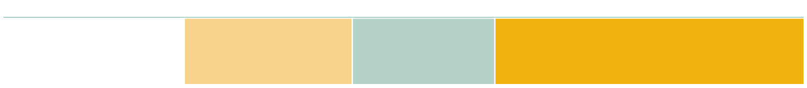
QUICK FACTS:

Out of 10 people living in this county

SEX

6 are male & 4 are female

AGE



About 2 are between the ages of 0 and 19 years

About 2 are between the ages of 20 and 34 years

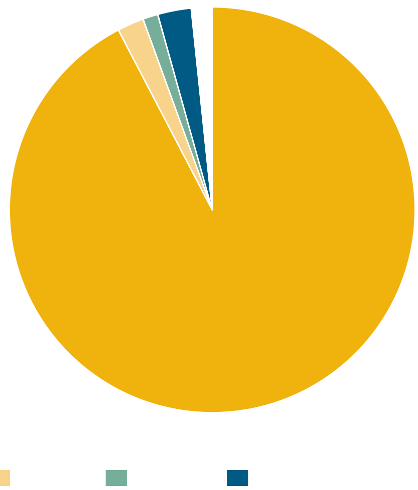
About 2 are between the ages of 35 and 49 years

About 4 are 50 years and older

ETHNICITY

8 are Hispanic and 2 are non-Hispanic

RACE



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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

8.4% 7.0%

New Mexico National

Percent of **children** who currently have asthma

5.4% 8.3%

New Mexico National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=35&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Guadalupe County residents were exposed to unhealthy levels of ozone for **0 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Guadalupe County residents were exposed to unhealthy levels of ozone for **0 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=35019&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

4.6μg/m³*

Guadalupe County, New Mexico

12.0μg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (μg/m³)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and
- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0μg/m³**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Guadalupe County** was **4.6μg/m³**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (μg/m³)

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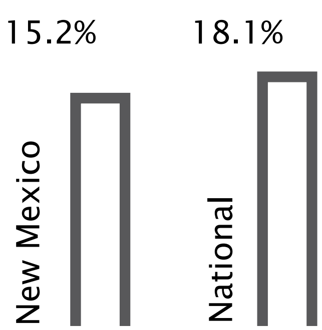
%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

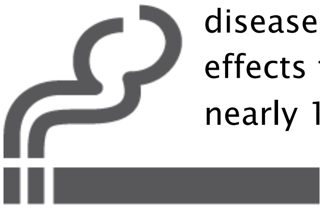
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=35019&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†





Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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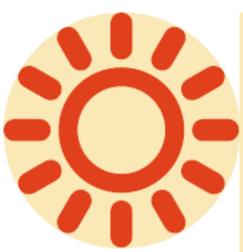
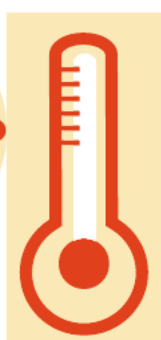
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=35&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†





55 Days

with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Guadalupe County had **55 Days** with maximum temperatures above 90°F during May–September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=35019&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†

Less Than

10

deaths from heart attacks in Guadalupe County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **Less than 10 deaths** from heart attacks in Guadalupe County.
- **631 deaths** from heart attacks in New Mexico.

Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=35019&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Guadalupe County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

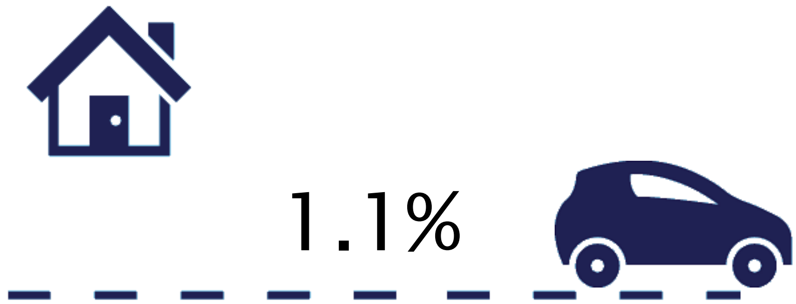
36% of people living in **Guadalupe County** lived within half a mile of a park.

59% of people living in **New Mexico** lived within half a mile of a park.

Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=35019&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†



of Guadalupe County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **1.1%** of the population of Guadalupe County lived within 150 meters* of a major highway.

In 2011, **12.5%** of Guadalupe County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=35019&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

The New Mexico Tracking Network (https://nmtracking.org/) has more state-specific information about your health and the environment.

Visit CDC's Tracking Network today.

www.cdc.gov/ephtracking (http://www.cdc.gov/ephtracking/)

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subject=Please%20add%20me%20to%20CDC's%20Environmen
serv.&body=Please%20fill%20in%20the%20information%20bel

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Lincoln County, New Mexico†

County highlighted in the State

POPULATION: 20,023

INCOME

Average Household Income

Lincoln County: $47,254

New Mexico: $52,021

Residents who live below the poverty line

13.7%

Lincoln County

17.5%

New Mexico

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 2 are between the ages of 0 and 19 years

About 1 are between the ages of 20 and 34 years

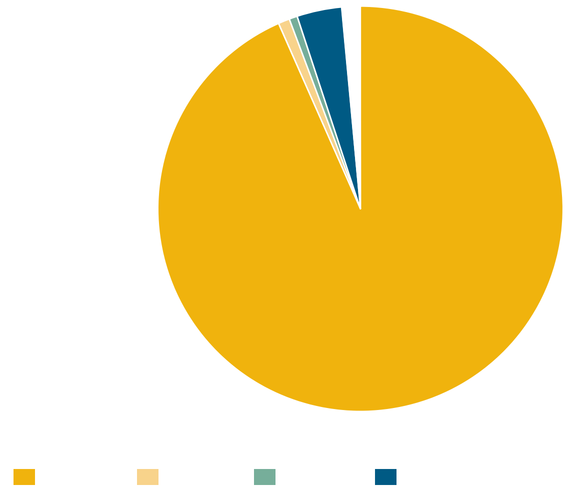
About 1 are between the ages of 35 and 49 years

About 5 are 50 years and older

ETHNICITY

3 are Hispanic and 7 are non-Hispanic

RACE



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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

8.4% 7.0%

New Mexico National

Percent of **children** who currently have asthma

5.4% 8.3%

New Mexico National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=35&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Lincoln County residents were exposed to unhealthy levels of ozone for **6 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Lincoln County residents were exposed to unhealthy levels of ozone for **6 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=35027&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

5.0 $\mu g/m^3$*

Lincoln County, New Mexico

12.0μg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (μg/m³)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and
- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0μg/m³**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Lincoln County** was **5.0μg/m³**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (μg/m³)

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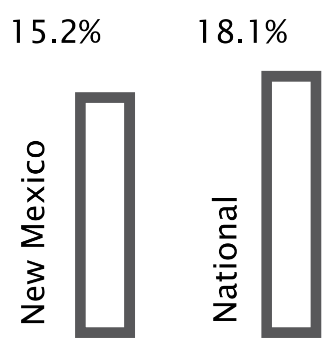
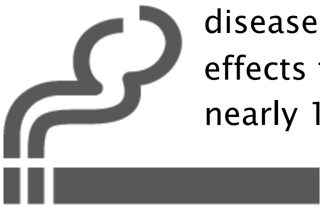
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=35027&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†





Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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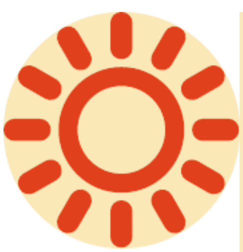
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

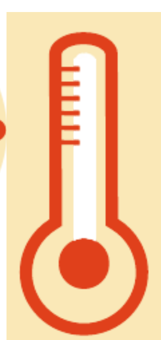
Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=35&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†



1 Day



with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Lincoln County had **1 Day** with maximum temperatures above 90°F during May-September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=35027&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†

Less Than

10

deaths from heart attacks in Lincoln County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **Less than 10 deaths** from heart attacks in Lincoln County.
- **631 deaths** from heart attacks in New Mexico.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=35027&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Lincoln County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

70% of people living in **Lincoln County** lived within half a mile of a park.

59% of people living in **New Mexico** lived within half a mile of a park.

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Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=35027&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†

1.1%

of Lincoln County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **1.1%** of the population of Lincoln County lived within 150 meters* of a major highway.

In 2011, **46.7%** of Lincoln County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=35027&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

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De Baca County, New Mexico†

County highlighted in the State

POPULATION: 1,891

INCOME

Average Household Income

De Baca County: $34,746

New Mexico: $52,021

Residents who live below the poverty line

18.6%

De Baca County

17.5%

New Mexico

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 2 are between the ages of 0 and 19 years

About 1 are between the ages of 20 and 34 years

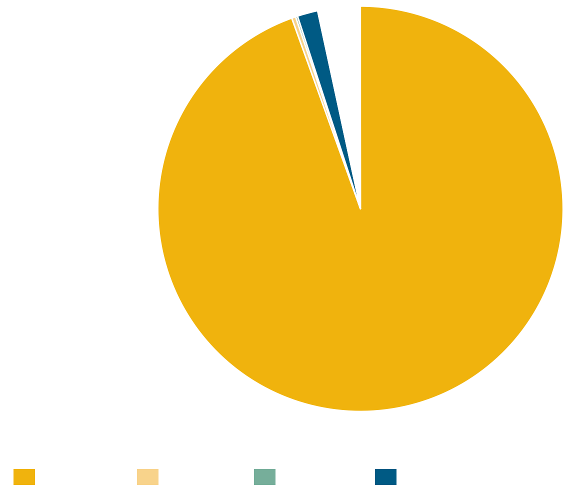
About 2 are between the ages of 35 and 49 years

About 5 are 50 years and older

ETHNICITY

4 are Hispanic and 6 are non-Hispanic

RACE



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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

8.4% 7.0%

New Mexico National

Percent of **children** who currently have asthma

New Mexico	National
5.4%	8.3%

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=35&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

De Baca County residents were exposed to unhealthy levels of ozone for **0 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

De Baca County residents were exposed to unhealthy levels of ozone for **0 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=35011&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

5.1 μg/m^{3}*

De Baca County, New Mexico

12.0μg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (μg/m³)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and
- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0μg/m³**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **De Baca County** was **5.1μg/m³**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (μg/m³)

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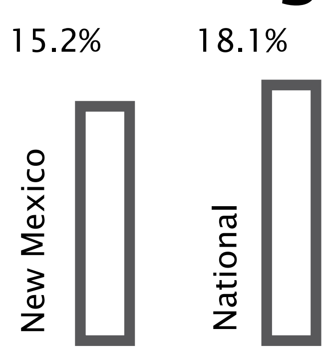
%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

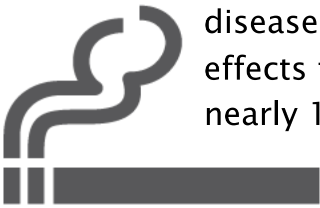
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=35011&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†





Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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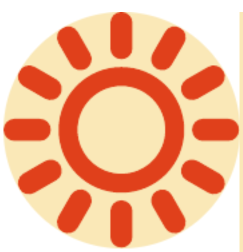
%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

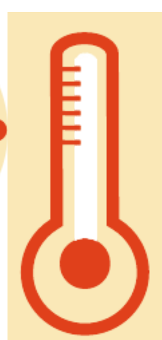
Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=35&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†



88 Days



with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

De Baca County had **88 Days** with maximum temperatures above 90°F during May–September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

ıttps://twitter.com/share?

%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=35011&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†

Less Than

10

deaths from heart attacks in De Baca County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **Less than 10 deaths** from heart attacks in De Baca County.
- **631 deaths** from heart attacks in New Mexico.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=35011&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in De Baca County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

46% of people living in **De Baca County** lived within half a mile of a park.

59% of people living in **New Mexico** lived within half a mile of a park.

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;3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20#environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=35011&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†

0.4%

of De Baca County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **0.4%** of the population of De Baca County lived within 150 meters* of a major highway.

In 2011, **100.0%** of De Baca County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=35011&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

The New Mexico Tracking Network (https://nmtracking.org/) has more state-specific information about your health and the environment.

Visit CDC's Tracking Network today.

www.cdc.gov/ephtracking (http://www.cdc.gov/ephtracking/)

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subject=Please%20add%20me%20to%20CDC's%20Environmen
serv.&body=Please%20fill%20in%20the%20information%20bel

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Chaves County, New Mexico†

County highlighted in the State

POPULATION: 66,041

INCOME

Average Household Income

Chaves County: $43,687

New Mexico: $52,021

Residents who live below the poverty line

18.1%

Chaves County

17.5%

New Mexico

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 3 are between the ages of 0 and 19 years

About 2 are between the ages of 20 and 34 years

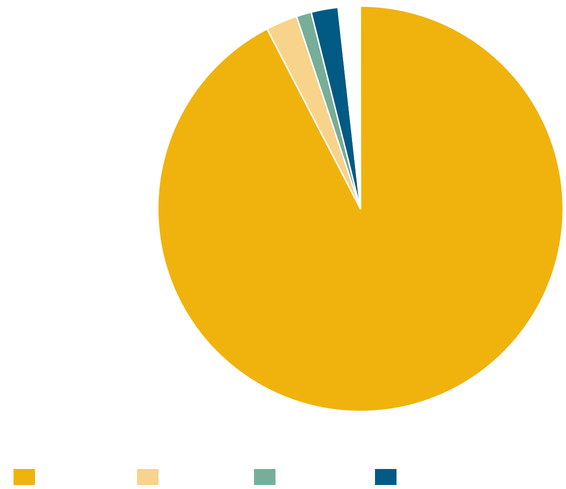
About 2 are between the ages of 35 and 49 years

About 3 are 50 years and older

ETHNICITY

5 are Hispanic and 5 are non-Hispanic

RACE



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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

8.4% 7.0%

New Mexico National

Percent of **children** who currently have asthma

5.4%	8.3%
New Mexico	National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=35&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Chaves County residents were exposed to unhealthy levels of ozone for **8 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Chaves County residents were exposed to unhealthy levels of ozone for **8 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=35005&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

6.7 µg/m³*

Chaves County, New Mexico

12.0µg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (µg/m³)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and
- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0µg/m³**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Chaves County** was **6.7µg/m³**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (µg/m³)

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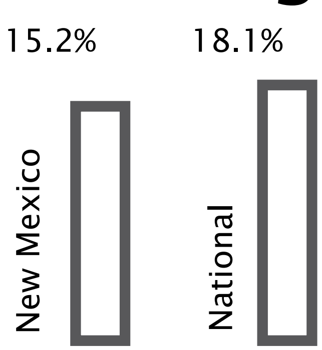
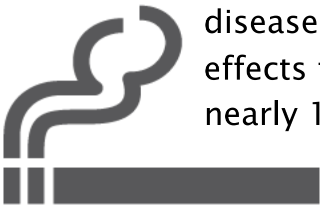
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=35005&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†





Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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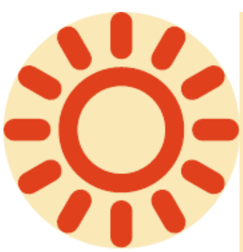
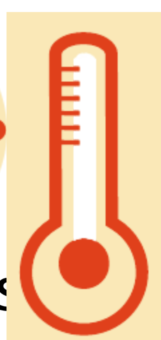
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=35&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†





109 Days

with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Chaves County had **109 Days** with maximum temperatures above 90°F during May–September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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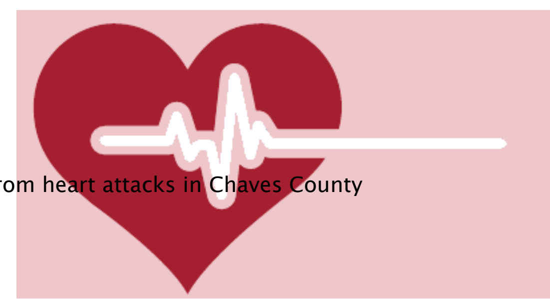
Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=35005&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†

23



deaths from heart attacks in Chaves County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **23 deaths** from heart attacks in Chaves County.
- **631 deaths** from heart attacks in New Mexico.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=35005&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Chaves County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

44% of people living in **Chaves County** lived within half a mile of a park.

59% of people living in **New Mexico** lived within half a mile of a park.

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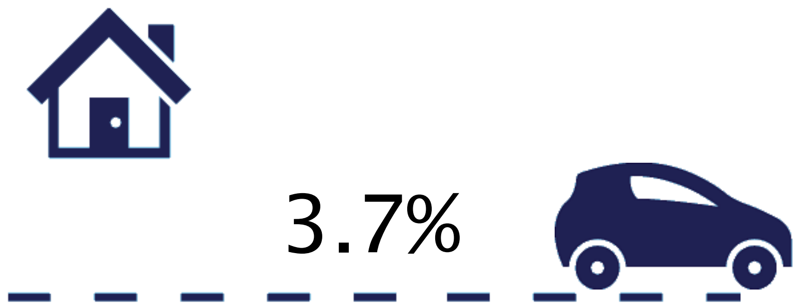
;3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20#environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=35005&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†



of Chaves County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **3.7%** of the population of Chaves County lived within 150 meters* of a major highway.

In 2011, **0.0%** of Chaves County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=35005&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

The New Mexico Tracking Network (https://nmtracking.org/) has more state-specific information about your health and the environment.

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serv.&body=Please%20fill%20in%20the%20information%20bel

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CDC 24/7: Saving Lives. Protecting People.™ (../showHome.action)

Lea County, New Mexico†

County highlighted in the State

POPULATION: 68,347

INCOME

Average Household Income

Lea County: $63,012

New Mexico: $52,021

Residents who live below the poverty line

15.1%

Lea County

17.5%

New Mexico

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 3 are between the ages of 0 and 19 years

About 2 are between the ages of 20 and 34 years

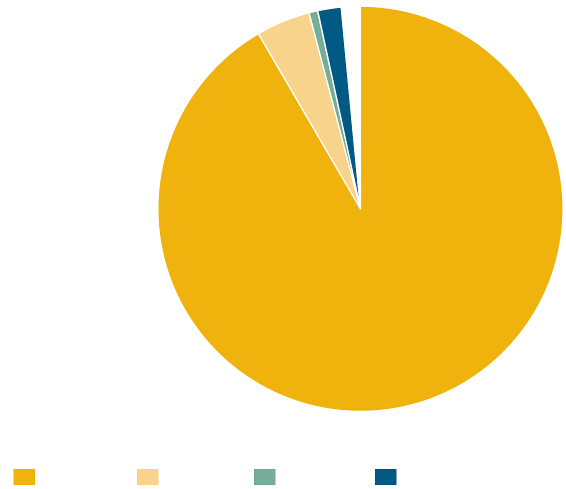
About 2 are between the ages of 35 and 49 years

About 3 are 50 years and older

ETHNICITY

5 are Hispanic and 5 are non-Hispanic

RACE



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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

8.4% 7.0%

New Mexico National

Percent of **children** who currently have asthma

5.4%	8.3%
New Mexico	National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=35&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Lea County residents were exposed to unhealthy levels of ozone for **6 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Lea County residents were exposed to unhealthy levels of ozone for **6 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=35025&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

8.0 $\mu g/m^3$*

Lea County, New Mexico

12.0μg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (μg/m^3)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and
- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0μg/m^3**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Lea County** was **8.0μg/m^3**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (μg/m^3)

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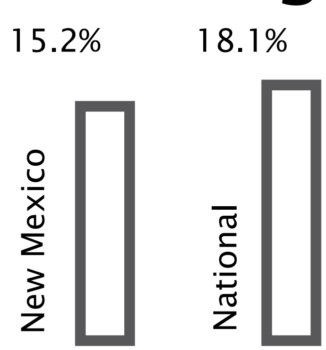
%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=35025&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†



PERCENTAGE OF CURRENT ADULT SMOKERS

Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=35&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†

85 Days

with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Lea County had **85 Days** with maximum temperatures above 90°F during May–September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=35025&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†

16

deaths from heart attacks in Lea County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **16 deaths** from heart attacks in Lea County.
- **631 deaths** from heart attacks in New Mexico.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=35025&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Lea County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

45% of people living in **Lea County** lived within half a mile of a park.

59% of people living in **New Mexico** lived within half a mile of a park.

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;3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20#environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=35025&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†

of Lea County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **2.3%** of the population of Lea County lived within 150 meters* of a major highway.

In 2011, **2.6%** of Lea County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

ıttps://twitter.com/share?

%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=35025&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

The New Mexico Tracking Network (https://nmtracking.org/) has more state-specific information about your health and the environment.

Visit CDC's Tracking Network today.

www.cdc.gov/ephtracking (http://www.cdc.gov/ephtracking/)

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serv.&body=Please%20fill%20in%20the%20information%20bel

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Yoakum County, Texas†

County highlighted in the State

POPULATION: 8,160

INCOME

Average Household Income

Yoakum County: $62,636

Texas: $64,044

Residents who live below the poverty line

10.6%

Yoakum County

13.6%

Texas

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 3 are between the ages of 0 and 19 years

About 2 are between the ages of 20 and 34 years

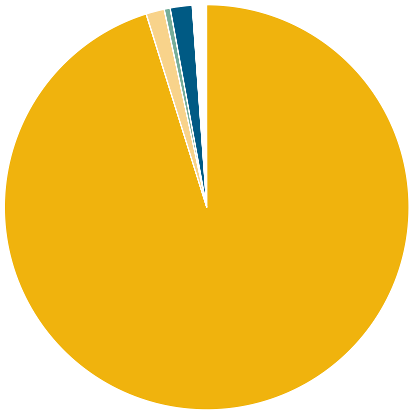
About 2 are between the ages of 35 and 49 years

About 3 are 50 years and older

ETHNICITY

6 are Hispanic and 4 are non-Hispanic

RACE



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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

7.1%	7.0%
Texas	National

Percent of **children** who currently have asthma

6.8% 8.3%

Texas National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=48&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Yoakum County residents were exposed to unhealthy levels of ozone for **4 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Yoakum County residents were exposed to unhealthy levels of ozone for **4 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=48501&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

7.4 $\mu g/m^3$ *

Yoakum County, Texas

12.0 $\mu g/m^3$*

Annual National Standard

*Micrograms Per Cubic Meter ($\mu g/m^3$)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and
- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0$\mu g/m^3$**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

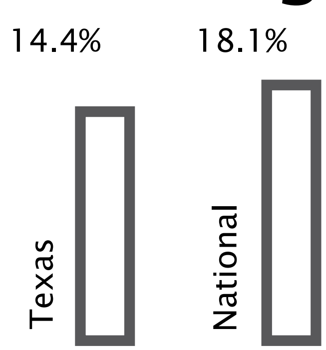
In 2018, the annual level of $PM_{2.5}$ in **Yoakum County** was **7.4$\mu g/m^3$**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) ($\mu g/m^3$)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=48501&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†



PERCENTAGE OF CURRENT ADULT SMOKERS

Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=48&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†

82 Days

with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Yoakum County had **82 Days** with maximum temperatures above 90°F during May-September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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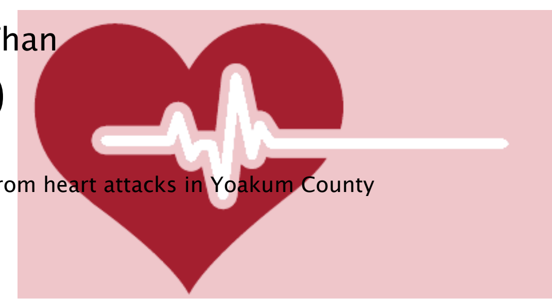
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=48501&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†



Less Than

10

deaths from heart attacks in Yoakum County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **Less than 10 deaths** from heart attacks in Yoakum County.
- **9,493 deaths** from heart attacks in Texas.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=48501&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Yoakum County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

1% of people living in **Yoakum County** lived within half a mile of a park.

36% of people living in **Texas** lived within half a mile of a park.

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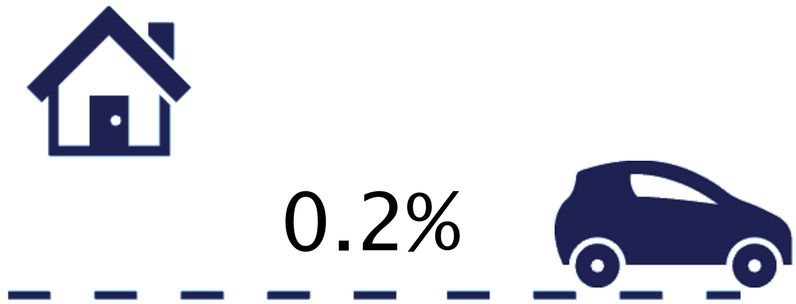
† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†



of Yoakum County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **0.2%** of the population of Yoakum County lived within 150 meters* of a major highway.

In 2011, **0.0%** of Yoakum County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=48501&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

Visit the Tracking Network for more information about your health and the environment.

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Gaines County, Texas†

County highlighted in the State

POPULATION: 18,965

INCOME

Average Household Income

Gaines County: $67,171

Texas: $64,044

Residents who live below the poverty line

13.2%

Gaines County

13.6%

Texas

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 4 are between the ages of 0 and 19 years

About 2 are between the ages of 20 and 34 years

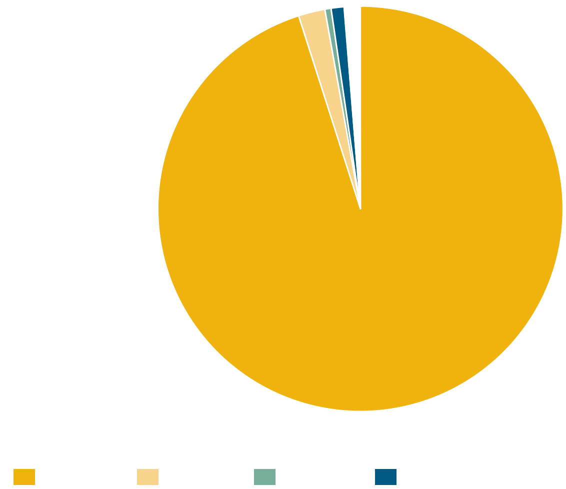
About 2 are between the ages of 35 and 49 years

About 2 are 50 years and older

ETHNICITY

4 are Hispanic and 6 are non-Hispanic

RACE



Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

7.1% 7.0%

Texas National

Percent of **children** who currently have asthma

6.8% 8.3%

Texas National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=48&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Gaines County residents were exposed to unhealthy levels of ozone for **3 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Gaines County residents were exposed to unhealthy levels of ozone for **3 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=48165&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

7.8 µg/m³*

Gaines County, Texas

12.0μg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (μg/m³)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and
- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0μg/m³**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Gaines County** was **7.8μg/m³**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (μg/m³)

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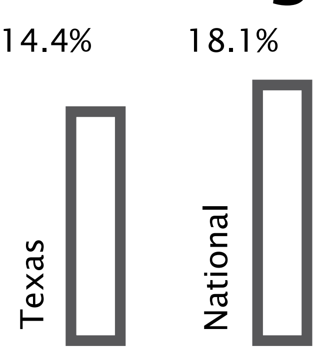
%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

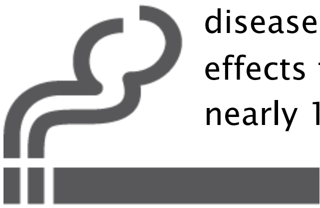
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=48165&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†





Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

ıttps://twitter.com/share?

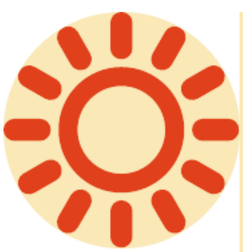
%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

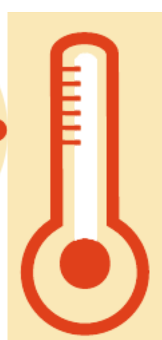
Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=48&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†



91 Days



with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Gaines County had **91 Days** with maximum temperatures above 90°F during May–September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

- Stay cool.
- Stay hydrated.
- Stay informed.

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%3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=48165&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†

Less Than

10

deaths from heart attacks in Gaines County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **Less than 10 deaths** from heart attacks in Gaines County.
- **9,493 deaths** from heart attacks in Texas.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=19D1C8B6-45AB-4216-A2CC-2DCC250FD1FE&fips=48165&G5=9999) | Learn more about this topic (../showHeartAttack.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Gaines County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

14% of people living in **Gaines County** lived within half a mile of a park.

36% of people living in **Texas** lived within half a mile of a park.

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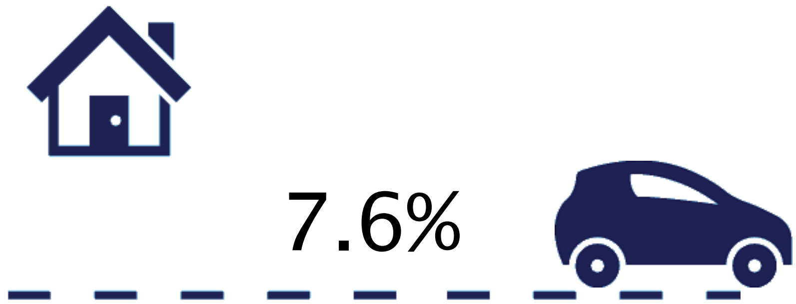
;3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20#environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=16F809E7-BD81-4A24-8588-F6A3A62B866E&fips=48165&G5=9999) | Learn more about this topic (../showPcMain.action)

† 2015 data from the National Environmental Public Health Tracking Network (../showHome.action)

Proximity To Highways†



of Gaines County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **7.6%** of the population of Gaines County lived within 150 meters* of a major highway.

In 2011, **9.1%** of Gaines County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

Discover the data (/../DataExplorer/?query=75C3D4C4-D2CC-4E1B-A26C-FA01EE02076C&fips=48165&G5=9999) | Learn more about this topic (../showProximityToHighways.action)

† 2011 data from the National Environmental Public Health Tracking Network (../showHome.action)

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Centers for Disease Control and Prevention (../showHome.action)
CDC 24/7: Saving Lives. Protecting People.™

Andrews County, Texas†

County highlighted in the State

POPULATION: 16,808

INCOME

Average Household Income

Andrews County: $74,918

Texas: $64,044

Residents who live below the poverty line

10.2%

Andrews County

13.6%

Texas

QUICK FACTS:

Out of 10 people living in this county

SEX

5 are male & 5 are female

AGE

About 3 are between the ages of 0 and 19 years

About 2 are between the ages of 20 and 34 years

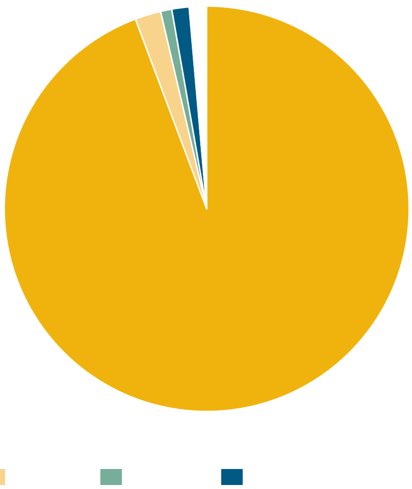
About 2 are between the ages of 35 and 49 years

About 3 are 50 years and older

ETHNICITY

5 are Hispanic and 5 are non-Hispanic

RACE



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Discover the data (../../DataExplorer?query=C7380B65-728D-4621-A122-47283CF8B444&G5=9999) | Learn more about this topic (../InfoByLocation/showPcMain.action)

† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Asthma†

Percent of **adults** who currently have asthma

7.1% 7.0%

Texas National

Percent of **children** who currently have asthma

6.8% 8.3%

Texas National

Asthma is a chronic disease that affects the airways that carry oxygen in and out of the lungs. Asthma can cause

- shortness of breath,
- wheezing,
- coughing, and
- tightness in the chest.

Asthma attacks have been linked to many factors, including exposure to environmental hazards like

- allergens,
- tobacco smoke, and
- indoor and outdoor air pollution.

Asthma can be controlled by taking medication and avoiding triggers that can cause an attack.

Discover the data (/../DataExplorer/?query=1F12A3B5-E744-4857-9110-401524CC8D8E&fips=48&G5=9999) | Learn more about this topic (../showAsthma.action)

† 2019 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Ground-Level Ozone†

Andrews County residents were exposed to unhealthy levels of ozone for **4 Days** in 2018.

Ozone occurs naturally in the sky and helps protect us from the sun's harmful rays. But ground-level ozone can be bad for your health and the environment. Ground-level ozone is one of the biggest parts of smog.

When ozone levels are above the national standard, everyone should try to limit their contact with it by reducing the amount of time spent outside.

Andrews County residents were exposed to unhealthy levels of ozone for **4 Days** in 2018.

Check the EPA's Air Quality Index (AQI) at AirNow.gov (http://www.AirNow.gov) to see the current air quality conditions for your location. You can use the AQI to plan your daily activities to reduce exposure to ozone.

Discover the data (/../DataExplorer/?query=1C537D70-420B-4B25-ABBE-F1B6FAD2C30B&fips=48003&G5=9999) | Learn more about this topic (../showAirHealth.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Air Quality: Particulate Matter†

ANNUAL AMBIENT CONCENTRATION OF $PM_{2.5}$

7.9 μg/m^3*

Andrews County, Texas

12.0μg/m³*

Annual National Standard

*Micrograms Per Cubic Meter (μg/m³)

Air pollution is a leading environmental threat to human health. Particles in the air like dust, dirt, soot, and smoke are one kind of air pollution called particulate matter. Fine particulate matter, or $PM_{2.5}$, is so small that it cannot be seen in the air. Breathing in $PM_{2.5}$ may

- lead to breathing problems,
- make asthma symptoms or some heart conditions worse, and
- lead to low birth weight.

The national standard for annual $PM_{2.5}$ levels is **12.0μg/m³**. When $PM_{2.5}$ levels are above 12, this means that air quality is more likely to affect your health.

In 2018, the annual level of $PM_{2.5}$ in **Andrews County** was **7.9μg/m³**. *

* Micrograms per cubic meter (../InfoByLocation/images/content/PM2-5_5.jpg) (μg/m³)

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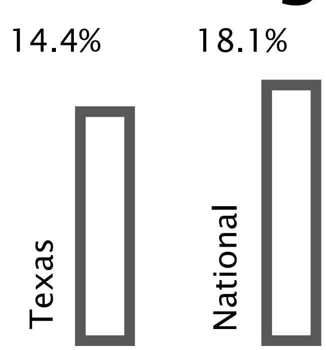
out%20the%20people%20in%20my%20county.%20Visit%20https://ephtracking.cdc.gov/InfoByLocation%2F%20to%20find%20out%20facts%20for%20your%20county.)

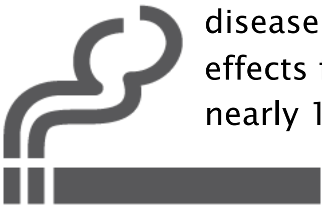
Discover the data (/../DataExplorer/?query=4E04F504-A4A2-405C-85AB-9BC6B3F7325D&fips=48003&G5=9999) | Learn more about this topic (../showAirLanding.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Smoking†



PERCENTAGE OF CURRENT ADULT SMOKERS



Tobacco use is the single most preventable cause of death and disease in the United States. Smoking harms nearly every organ of the body. It causes many diseases and reduces the health of smokers in general. The negative health effects from cigarette smoking account for an estimated 500,000 deaths, or nearly 1 of every 5 deaths, each year in the United States.

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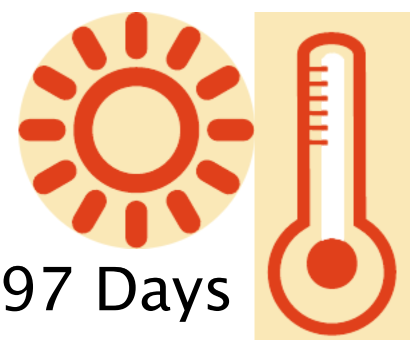
Discover the data (/../DataExplorer/?query=2B83BA8E-9849-47BF-92C2-2CA0D51CC90C&fips=48&G5=9999) | Learn more about this topic (../showHBSmokingPrevalence.action)

† 2018 data from the National Environmental Public Health Tracking Network (../showHome.action)

Extreme Heat†



97 Days

with temperatures above 90°F

Extreme summer heat is increasing in the United States, and climate projections indicate that extreme heat events will be more frequent and intense in coming decades. Extremely hot weather can cause illness or even death. Knowing how hot it gets in your area can help you prepare for extremely hot temperatures and prevent heat related illness (http://emergency.cdc.gov/disasters/extremeheat/heattips.asp).

Andrews County had **97 Days** with maximum temperatures above 90°F during May–September 2021.

Heat-related death or illnesses are preventable if you follow a few simple steps.

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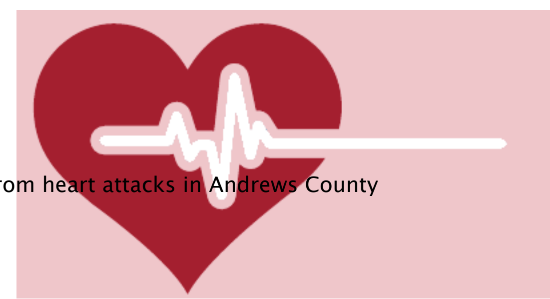
Discover the data (/../DataExplorer/?query=51ED8370-BE00-4813-A4F8-AE641EF61672&fips=48003&G5=9999) | Learn more about this topic (../showClimateChangeExtremeHeat.action)

† 2021 data from the National Environmental Public Health Tracking Network (../showHome.action)

Heart Attacks†



11

deaths from heart attacks in Andrews County

The environment is one of several factors (../showHeartExpRisk.action) that can lead to an increased risk for heart disease. High levels of air pollution and extreme hot and cold temperatures have been linked to increases in heart disease and deaths from heart attacks. A heart attack happens when a part of the heart muscle dies or gets damaged because of reduced blood supply.

In 2020, there were

- **11 deaths** from heart attacks in Andrews County.
- **9,493 deaths** from heart attacks in Texas.

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† 2020 data from the National Environmental Public Health Tracking Network (../showHome.action)

Access To Parks†

Live within half a mile of a park in Andrews County

Having access to places for physical activity, like parks, encourages people to get active and do so more often. The closer you live to a park, the more likely you are to walk or bike there. Walking and biking to parks can decrease air pollution and car crashes, which in turn, can reduce chronic disease rates and traffic-related injuries.

In 2015,

58% of people living in **Andrews County** lived within half a mile of a park.

36% of people living in **Texas** lived within half a mile of a park.

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;3A%2F%2Fephtracking.cdc.gov%2FInfoByLocation%2F&text=Check%20out%20#environmental%20health%20in%20your%20county&hashtags=PublicHealth,Tracking)

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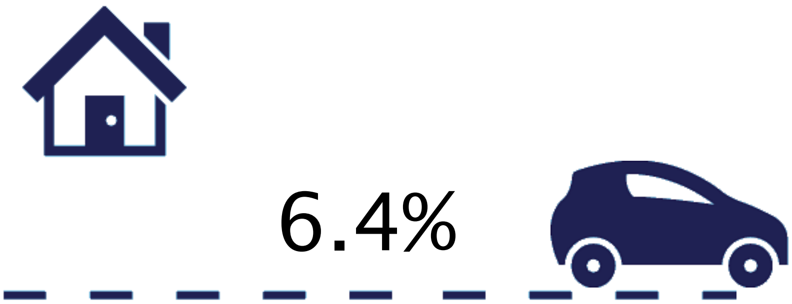
Proximity To Highways†



of Andrews County population that live within 150m of a highway

Traffic-related air pollution is a major cause of unhealthy air quality, especially in urban areas. Many health problems have been linked to exposure to traffic-related air pollution. The closer your home or school is to a major highway, the more likely you and your family are to be exposed to traffic-related air pollution.

In 2011, **6.4%** of the population of Andrews County lived within 150 meters* of a major highway.

In 2011, **0.0%** of Andrews County public schools (preK-4th grade) were sited within 150 meters* of a major highway.

* 150 meters is about 2 blocks.

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