EPA Technical Review Comments Development and Screening of Remedial Alternatives Technical Memorandum Operable Unit 1: Groundwater Restoration and Operable Unit 2: Mill Decommissioning, Surface Soils, and Tailings Reclamation Homestake Mining Company Superfund Site April 22, 2020				
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1. General				
1			RE: Scope of Initial Phase of Feasibility Study	The National Remedy Review Process (NRRB) process was selected for the ongoing Feasibility Study (FS) at the Homestake Superfund site (Site) in October 2020 and has become an integral part of the FS process. As a result, the NRRB recommended, and EPA Region 6 agreed, that the initial phase of the FS process, the development and screening of remedial alternatives, required an expansion of the range of alternatives to be screened and the addition of remedial action objectives to be developed, specifically for source control measures. In a letter sent to EPA Region 6, dated November 16, 2021, the New Mexico Environment Department (NMED) stated that many of its concerns with the FS and the ongoing Technical Impracticability (TI) evaluation, which it presented to the NRRB in March 2021, aligned with the NRRB recommendations. These concerns tie specifically to the preliminary remedial alternatives evaluated in the Homestake Mining Company (Homestake) April 2020 Development and Screening of Remedial Alternatives Technical Memorandum (Technical Memorandum). NMED has requested that the range of alternatives be expanded to ensure protection of New Mexico's groundwater and surface water resources.
2			RE: National Remedy Review Board Recommendations for RAOs and Preliminary Remedial Alternatives	Based on the EPA Region 6 October 15, 2021, response to NRRB Recommendation No. 8 (Suite of Remedial Alternatives), the initial phase of the Feasibility Study (FS) process requires an expansion of the remedial action objectives (RAOs) and range of remedial alternatives, including source control actions, to be developed and screened for the Site. The additional RAOs are described in the Specific Comments contained herein. The additional remedial alternatives recommended by the NRRB are summarized below. a. <u>Groundwater Pump and Treat Alternative</u> – Utilization of pumping and treating for the impacted aquifers to prevent migration of contaminant plumes through containment rather than creating an hydraulic mound within the contaminated aquifers through injection of fresh water. The remediated water from the treatment systems could be reinjected into the alluvium, Chinle or the San Andres-Glorieta (SAG) aquifers, depending on the level to which it is treated. This alternative would eliminate the use of the SAG aquifer as a supplemental water supply for remedial purposes. b. <u>Permeable Reactive Barrier (PRB) Alternative</u> – Utilization of a PRB as a permanent component of an alternative, rather than only as a contingency. A PRB may be an option to replacing the current hydraulic mound approach for groundwater remediation. c. <u>Regional Waste Disposal Facility Alternative</u> – Utilization of a regional waste disposal facility or consolidation at another U.S. Department of Energy (DOE) facility as an alternative disposal option.

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				d. <u>On-site Removal and Disposal Source Control Alternative</u> – Construction of a lined cell adjacent to the existing tailing piles for disposal of tailing material. If the tailing material is moved to a lined cell, the primary source of contamination to groundwater (tailing seepage) would be substantially reduced, if not eliminated. e. <u>Cement Solidification/Stabilization of Base of Tailing Piles Alternative</u> – Utilization of a cement injection process for solidifying/stabilizing the base of the tailing piles to create a less permeable surface for limiting tailing seepage and migration to groundwater. f. <u>Combination Radon Barrier/Evapotranspiration Cover Alternative</u> – Utilization of a cover system for the tailing piles that is both a radon barrier and provides evapotranspiration (ET) to prevent the infiltration and percolation of precipitation through the piles that could impact groundwater as tailing seepage.
3			RE: Assessment of water treatment systems	As per NRRB Recommendation 8.a.(iii), an assessment is needed of the challenges that prevent the Reverse Osmosis (R.O.) and Zeolite water treatment systems from operating at full capacity. EPA recognizes that Homestake continues efforts to improve performance of these systems. However, understanding and resolving challenges associated with limited system operations may improve treatment capacity and system performance. Determining these treatment technology capabilities and limitations will inform alternatives evaluated to achieve RAOs for groundwater.
4			RE: Baseline Human Health Risk Assessments	In the EPA's Fifth Five-Year Review Report for the Site, completed in September 2021, a recommendation is made for EPA to recalculate the human health risk for radon in ambient air at the neighboring subdivisions (Operable Unit 3) using current toxicological data and the most recent version of the EPA Rad-PRG calculator, which was updated in October 2020. In considering the findings of the five-year review and the recommendation made, there is a need to update the Baseline Human Health Risk Assessment that was completed by Homestake in 2020 for the facility and land treatment areas (LTAs) using the updated Rad-PRG Calculator. EPA will provide a separate letter to Homestake requesting implementation of this work. The results of the updated risk assessment will need to be incorporated into this initial alternatives development and screening phase of the FS.
2. Introduction				

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5	1-2	1.2.1 1st Paragraph First 3 Sentences	RE: *"The climate of western New Mexico and the Site is generally a mild, arid to semi-arid, continental climate characterized by low precipitation, abundant sunshine, low relative humidity, and a large annual and diurnal (day and night) temperature range. Precipitation in the area averages approximately 10 inches per year. The majority of annual precipitation typically occurs during July, August, and September."*	Given that the groundwater model predicts that the site will remain above remedial goals for up to 200 years, expand the climate section to acknowledge the potential project impacts of climate change. See for example, https://www.epa.gov/sites/default/files/2015-11/documents/what_climate_change_may_mean_for_the_albuquerque_region.pdf, some examples of which listed below: • Supply of water declines while demand increases. o 15% mid-range increase in water prices by 2030 o 103% mid-range increase in water prices by 2080 • Reduced streamflows = reduced assimilative capacity o Maintaining water quality will be more difficult and more costly for dischargers • Temperature o Projected 7.2º F increase in average annual maximum temperature o Projected 6.2º F increase in average annual minimum temperature • No change in annual mean precipitation but large increase in evapotranspiration • 0 – 0.2 inches/month mean decrease in snow (Nov. –Apr) • 0.1 inches/month mean decrease in runoff (Feb-June) • Statistically significant increase in length of droughts
6	1-3	1.2.2 5th Paragraph 4th Sentence	RE: *"Recent, high resolution soil investigations, showed the presence of highly heterogeneous sands, silts, and clays, as would be expected from fluvial deposition of eroded sediments over geologic time."*	Modify the text to provide a description of the high-resolution soil investigations performed, including the technologies used to perform the work and the scale of measurements associated with each technology. In addition, provide information on the relative presence of sands, silts, clays and any other soil classifications recorded or derived from the work.
7	1-4	1.2.2 2nd Paragraph 1st Sentence	RE: *"High resolution site characterization techniques were used in two supplemental studies at the Site; a study of background concentrations in alluvial aquifer groundwater and a tripolyphosphate pilot study."*	Modify the text to provide citations for the two supplemental studies.
8	1-4	1.2.2 2nd Paragraph 2nd Sentence	RE: "*Two geologic cross sections from these studies have been reproduced in this report to show the degree of heterogeneity in the alluvial aquifer at the Site. One cross section is located immediately upgradient of the LTP (Figure 1-3) and the other is located downgradient of the LTP (Figure 1-4). Both cross sections illustrate*	Modify the text to provide additional information on the nature of geologic heterogeneity at the site, specifically the differences in the presence of lower versus higher hydraulic conductivity (K) lithologic deposits. In addition, modify the text to describe how the groundwater monitoring wells shown in the figures are screened across multiple lithologies, and the effect that depth-integrated / flow-weighted averaging has on hydraulic head measurements and dissolved phase contaminant concentrations.

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			the scale and degree to which the sediments vary, both aerially and with depth.	
9	1-5	1.2.4.1 1st Paragraph 1st Bullet	RE: "*Hydraulic Containment. Water is added into the alluvial, Upper Chinle, and Middle Chinle aquifers to create a hydraulic barrier to limit the movement of contaminated groundwater. The hydraulic barrier in the alluvial aquifer is created and maintained downgradient of the LTP. Injection into the Upper Chinle and Middle Chinle occurs east of where the aquifer subcrops the alluvial aquifer, and facilitates collection of impacted groundwater for treatment (HMC 2019b)*."	As hydraulic containment is not limited to the injection of water into the aquifers at the site, please modify the text to include a description of groundwater extraction. Modify the text to describe whether and how the injection of water into the aquifers affects the vertical components of the hydraulic gradient and how this may, in turn, affect transport of contaminants to locations deeper in the aquifer system.
10	1-6	1.2.4.4 2nd Bullet	RE: Cover design	It is noted that the cover design appears to provide erosion protection; however, this can enhance the infiltration into the cover. Modify the text to discuss whether enhanced infiltration was considered, and whether its consideration was supported with simulations. Also describe the level of compaction of the cover placed and the moisture content of the cover material during installation and compaction, if applicable.
11	1-7	1.2.5 Table 1-1	RE: Radiological isotopes	Modify the table to identify the particular radiological isotopes concentrations listed; for example, "radium," "thorium," and "lead" presumably refer to "radium-226," "thorium-230," and "lead-210."
12	1-7	1.2.5.1 1st Paragraph 4th Sentence	RE: "*Thorium and Ra-226/228 have impacted the alluvial aquifer below the LTP."*	If "thorium" is referring to a specific isotope, revise the text to list that isotope.
13	1-8	1.2.5.2	RE: "*Soil*"	Modify the subsection title as follows: "***Surface and Subsurface Soil***". In addition, indicate what depth horizons surface and subsurface soils are considered to represent, and clarify whether tailings are included with the definition of soils.
14	1-9	1.2.5.3	RE: *Windblown remediation area*	In a separate letter, EPA will request Homestake to update its baseline human health risk assessment using the updated, October 2020 EPA RadPRG Calculator. This will allow EPA to determine if the windblown remediation performed as part of the reclamation efforts under UMTRCA satisfies CERCLA requirements for protectiveness. It will also allow the development

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				of a preliminary remediation goal (PRG) for RA-226 for soil should there be a need to develop an alternative in the FS to address any potential residual windblown contamination.
15	1-9	1.2.5.3 2nd Paragraph 5th, 6th and 7th Sentences	RE: "*As a result, the soil sample results were biased high. Out of 52 soil samples collected, the average Ra-226 concentration was 2.51 pCi/g. After review of these 52 samples indicated that the remediation goals were being met, the soil sampling rate was reduced to one sample per 900 gamma scans (one per 1,000 foot by 1,000 foot area). Seventy eight samples were collected using this method and the average Ra-226 concentration was 2.95 pCi/g.*"	Provide an explanation of the expected spatial variability of the RA-226 concentrations in soil and state whether or not a spacing of 1,000 ft between soil samples is likely to adequately capture the range of concentrations associated with that expected spatial variability. Incorporate anything learned from the high-resolution site characterization methods employed at the site about correlation lengths or variograms that is applicable to a determination as to the suitability of a 1,000 ft sample spacing for soil sampling. It is recommended that any future soil-related characterization efforts consider the use of x-ray fluorescence (XRF) screening and incremental sampling methodology (ISM) in improve characterization results and lower site uncertainty.
16	1-9	1.2.5.3 3rd Paragraph 1st and 2nd Sentences	RE: "*To evaluate the potential health risks within the windblown remediation area outside facility license boundaries, a preliminary remediation goal (PRG) range for Ra-226 for a trespasser scenario was calculated using the RadPRG calculator. The PRG range for 1x10-4 to 1x10-6 cancer risk was 0.98 – 98 pCi/g."*	Modify the text to include a reference to the document containing the RadPRG calculations.
17	1-10	1.2.5.4 4th Paragraph	RE: *"Total Effective Dose Equivalent (TEDE) to the nearest resident is calculated by adding net doses from inhalation of airborne particulate, from the exposure to radon, and from direct gamma radiation. The 2018 TEDE at HMC-4 was 52 mrem/yr and at HMC-5 was 50 mrem/yr. These are below the NRC limit of 100 mrem/yr (refer to 10 CFR 20.1301) for public exposure (HMC 2019c)."*	The text refers to a total effective dose equivalent (TEDE) to the nearest receptor determined using various radiological monitoring data. This TEDE is compared to the dose limit for members of the public and from all pathways of 100 millirems per year (mrem/yr) provided in 10 CFR 20.1301. The EPA notes that the dose limit of 10 CFR 20.1301, if applied to the site, may not be sufficiently protective (see Office of Solid Waste and Emergency Response [OSWER] Directive 9285.6-20: "Distribution of the 'Radiation Risk Assessment At CERCLA Sites: Q&A'"). Furthermore, the EPA notes that the NCP describes protectiveness generally by reference to the cancer risk range and non-cancer hazard index. No modification to the text is required.
18	1-10	1.2.5.5	RE: Update to Human Health Risk Assessment for Homestake Facility	As noted in General Comment No. 2, above, EPA will request, in a separate letter, that the baseline human health risk assessment for the Homestake Facility be updated using the October 2020 EPA RadPRG Calculator. If this work is done prior to Homestake submitting the revised Technical Memorandum, Homestake shall incorporate the results of the updated risk assessment into the Technical Memorandum.
19	1-10	1.2.5.5	RE: Update to Human Health Risk Assessment for Homestake Facility	As stated in NRRB Recommendation No. 6., and agreed to by Region 6, an analysis of the risk from exposure to radioactive tailing material should be performed as part of the baseline

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				human health risk assessment. This was not done in the original risk assessment as such exposure was not considered a realistic assumption when considering the UMTRCA regulations for preventing such exposure as preliminary ARARs to this CERCLA FS process. Nevertheless, EPA will request Homestake perform such calculations for a commercial/industrial future land use scenario as part of the update to the baseline human health risk assessment for the Homestake Facility. It is EPA's understanding that historical analytical data exists on tailing slimes and sands that can be used in the calculations.
20	1-12	1.2.5.6	RE: Update to Human Health Risk Assessment for Land Treatment Areas	As noted in General Comment No. 1, above, EPA will request, in a separate letter, that the baseline human health risk assessment for the LTAs be updated using the October 2020 EPA RadPRG Calculator. If this work is done prior to Homestake submitting the revised Technical Memorandum, Homestake shall document the results of the updated risk assessment into the Technical Memorandum.
21	1-12	1.2.5.6	RE: Update to Human Health Risk Assessment for Land Treatment Areas	As per the EPA Region 6 response to NRRB Recommendation No. 5.a., EPA will request, in a separate letter, that Homestake include the future residential land use scenario in the updated risk assessment for the LTAs. The results of the updated risk assessment will support the consideration of an institutional control or any other action in the FS alternatives being developed to protect human health at the LTAs. If this work is done prior to Homestake submitting the revised Technical Memorandum, Homestake shall modify the Technical Memorandum to include a summary of the updated risk assessment results.
22	1-12	1.2.5.6 1st Paragraph	RE: Human Health Risk Assessment for the Land Treatment Areas	Modify the text to provide an introduction/explanation of the "Land Treatment Areas" and how these areas related to the site OUs.
23	1-14	1.2.5.8	RE: Update to EPA Human Health Risk Assessment	As stated in the EPA Region 6 response to NRRB Recommendation No. 4.a. (ii), the Region is currently working with EPA's Superfund Remedial Program National Expert, the Office of Radiation and Indoor Air, and the Oak Ridge National Laboratory to model concentrations of radon being emitted from the large tailing pile and small tailing pile and transported, with daughter products, off site. Once this is completed, Region 6 will update the baseline human health risk assessment for the neighboring subdivisions, as per the recommendation made in the EPA's Fifth Five-Year Review Report. If this work is done prior to Homestake submitting the revised Technical Memorandum, Homestake shall report the findings of the EPA risk assessment in the Memorandum.
24	1-18	1.3	RE: ARARs	As per NRRB Recommendation No. 6.b., the Region reviewed EPA guidance entitled "Use of Uranium Drinking Water Standards Under 40 CFR Part 141 and 40 CFR Part 192 as Remediation Goals for Groundwater at CERCLA Sites" (EPA Directive No. 9283.1-14). The guidance identifies both the MCL (40 CFR Part 141) uranium mass concentration of 30 µg/L

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				and the UMTRCA (40 CFR Part 192 [60 FR 2854, January 11, 1995]) uranium activity of 30 pCi/L as potentially relevant and appropriate requirements for CERCLA groundwater sites where uranium isotopes are contaminants of concern and the aquifers are current or potential sources of drinking water. In pertaining to the UMTRCA standard as a relevant and appropriate requirement, the sites cannot be designated Title I UMTRCA sites. Modify Table 1-7 to include the potentially relevant and appropriate UMTRCA uranium activity requirement of 30 pCi/L at 40 CFR Part 192 (60 FR 2854).
25	1-18	1.3	RE: ARARs	EPA Directive No. 9283.1-14 identifies the MCL preamble recommendation to public water systems concerning extreme pCi/µg conversion factors in uranium 2000 MCL rulemaking as a potentially To-Be-Considered (TBC) criterion. As stated in the Directive, in situations where the mix of uranium isotopes means that attaining the uranium MCL of 30 µg/L may results in residual activity levels of uranium of greater than 40 pCi/L for total uranium, and a site-specific risk assessment demonstrates that 30 pCi/L is protective, the 30 pCi/L standard is recommended as a suitable cleanup level in addition to 30 µg/L. Modify Table 1-7 to include the MCL preamble as a TBC.
26	1-24	Table 1-7 Clean Air Act Subpart H	RE: *"Regulates airborne emissions of radionuclides from DOE facilities to nearest off-site receptor—emissions of radionuclides cannot exceed 10 milli-Roentgen-Equivalent-Man per year (mrem/yr)."*	The table states that the Subpart H requirement is applicable when DOE assumes ownership of the site, but only for that portion of the site under DOE ownership and control. However, the requirement should also be evaluated as potentially relevant and appropriate as it relates to airborne emissions during cleanup, which is discussed in the EPA Memorandum "Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination" (OSWER No. 9200.4-18 dated August 22, 1997). Modify the table accordingly.
27	1-27	Table 1-7 NRC License SUA-1471. Determination and Rationale	RE: The determination of NRC License SUA-1471 as TBC.	Modify the "*Determination and Rationale*" column of the table to provide the rationale for this determination.
28	1-28	Table 1-7 Uranium Byproduct Material and Residual Non-Radioactive Material/End of closure period Requirement Synopsis	RE: *"Protect the public and the environment from nonradiological and radiological hazards. Provides standards for design and monitoring to be effective for one thousand years, and limit release of radon-222 from uranium byproduct materials to not exceed an average release rate of **20 PcI/m2x**."*	Correct the apparent typographical error "*20 PcI/m2x"* as follows: "***20 pCi/m^2/s***."

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29	1-34	1.4 1st Paragraph	RE: Technical Impracticability	Revise the title of this section as follows: “Technical Impracticability Evaluation”
30	1-34	1.4 2nd Paragraph	RE: Technical Impracticability	As the speculative assumption of a TI Waiver being the eventual outcome of a to-be-performed feasibility study is premature, modify the second paragraph of this section to read as follows: *“Site-specific factors may limit the ability of available remedial technologies to meet chemical-specific groundwater ARARs at the Site. An evaluation of technical impracticability to meet specific ARARs within a three-dimensional TI Zone is being performed concurrently with the FS and will be presented in a stand-alone evaluation report.”*
31	1-34	1.5 1st Paragraph of section	RE: RAOs	Delete the second to last sentence of the paragraph that states a TI waiver is planned.
32	1-34	1.5	RE: RAOs	Only one of the three preliminary RAOs addresses contamination from the radioactive tailing material, and that pertains to Rn-222 emissions. However, as stated in NRRB Recommendation No. 6, and agreed to by Region 6 in responses to the NRRB, controls required for the tailing material pertain to more than just the emanation of radon emissions. Please add the following preliminary RAOs to the Technical Memorandum that address OU2: • Prevent direct contact to contaminated media (including tailing material, stormwater, sediments, soil, and leachate) located on or emanating from the tailing piles and other areas of the Site. • Limit external radiation exposure from contaminated media (including tailing material, fill, leachate, and soil) located on or emanating from the tailing piles and other areas of the Site to levels that do not pose a human health risk above the acceptable excess lifetime carcinogenic risk range (10^{-4} to 10^{-6}) or a Hazard Index of 1 for non-carcinogenic risk. • Limit inhalation of contaminants of concern in air (including uranium, radium-226 and thorium-230) emanating from contaminated media (including tailing material, fill, sediment, and soil) at or emanating from the tailing piles and other areas of the Site to levels that do not pose a health risk above the acceptable excess lifetime carcinogenic risk range (10^{-4} to 10^{-6}) or a Hazard Index of 1 for non-carcinogenic risk. • Prevent seepage and migration of contaminants of concern from the tailing piles to groundwater at concentrations and quantities that have the potential to cause

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				exceedance of numeric ARARs, Site-specific risk-based cleanup levels, or naturally-occuring background levels, whichever are higher, for groundwater.
33	1-34	1.5	RE: RAO1	Revise preliminary RAO1 as follows: *"Prevent ingestion by humans of groundwater containing Site-related contaminants of concern in excess of numeric ARARs or Site-specific risk-based cleanup levels."*
34	1-34	1.5	RE: RAO2	Revise preliminary RAO2 as follows: *"Restore groundwater quality in those portions of the alluvial, Upper Chinle, Middle Chinle, and Lower Chinle aquifers that have been impacted by the Site to numeric ARARs, Site-specific risk-based cleanup levels or background levels, whichever are higher, for contaminants of concern."*
35	1-34	1.5	RE: RAO3	Revise preliminary RAO3 as follows: *"Limit inhalation of Site-related radon (Rn-222) emissions and radioactive decay products of radon by limiting average radon flux from the LTP and STP to 20 pCi/m^{2}s or levels that do not pose a human health risk in exceedance of the acceptable excess lifetime carcinogenic risk range of 10^{-4} to 10^{-6} or a Hazard Index of 1 for non-carcinogenic risk, whichever are lower."*
36	1-34	1.5	RE: RAO to protect SAG Aquifer	RAO2 indicates that groundwater will be restored in those portions of the alluvial, Upper Chinle, Middle Chinle, and Lower Chinle aquifers that have been impacted by tailing seepage from the Site. An additional RAO is needed to ensure long-term protection of the San Andres-Glorieta (SAG) aquifer from site contamination. Based on Homestake's draft SAG report, dated May 2021, there is evidence to suggest that the alluvial and SAG aquifers are hydraulically connected downgradient of the Site. Alluvial groundwater that flows over a SAG subcrop area recharges the SAG aquifer. Therefore, a new RAO for the protection of the SAG aquifer is warranted to ensure a component of the alternative selection process is included in the FS for protecting the SAG against groundwater contamination from the Site. Please modify this section accordingly.
37	1-35	1.5	RE: *"RAO1 and RAO2 address OU1 while RAO4 addresses OU2."*	"*RAO4*" should apparently be "*RAO3*." Modify the text to correct this apparent error. Since EPA is requiring the addition of several new RAOs, this comment may be irrelevant.
3. Areas and Volumes of Contaminated Media				
38	2-1	2	RE: Mine-water discharges as a possibly off-site source of groundwater contamination	Modify this section by adding a new fourth paragraph that reads as follows: *"Potential off-site sources of groundwater contamination are the mine-water discharges from legacy uranium mines that operated in the upper part of the San Mateo Creek drainage basin from the late 1950s to early 1980s. State and federal regulatory agencies have documented*

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				impacts to alluvial groundwater from these discharges upgradient of the LTP. Concentrations of uranium, selenium, and other constituents above federal drinking water standards and state of New Mexico groundwater standards are reported."
39	2-1	2 4th Paragraph	RE: *"Based on mass isoconcentration contours for uranium in the alluvial aquifer, the estimated dissolved uranium mass remaining in the plume in 2019 was approximately 75,000 kg, compared to an estimated dissolved mass in the plume of approximately 70,000 kg calculated in 2009 (HMC 2020), which is an indication that ongoing remediation efforts are providing limited, if any, long-term benefit"*	Regarding the numerical modeling completed, modify the text to discuss when draindown is expected to be completed. In addition: • Describe how the flushing of the tailings changes the expected draindown timing. • Present the estimated mass released during the flushing process. • Provide a conclusion regarding whether the flushing met the expected results of the flushing. • Provide an estimate of the contaminant mass remaining in the tailings pile.
26	2-1	2 Paragraph 4	RE: *"Based on mass isoconcentration contours for uranium in the alluvial aquifer, the estimated dissolved uranium mass remaining in the plume in 2019 was approximately 75,000 kg, compared to an estimated dissolved mass in the plume of approximately 70,000 kg calculated in 2009 (HMC 2020), which is an indication that ongoing remediation efforts are providing limited, if any, long-term benefit"*	Modify the text to provide a discussion of the accuracy of the mass calculation that considers the spatial density of the data and whether the 5,000 kg difference in mass (7%) is within expected error bounds. If the mass of contaminants within the alluvial aquifer did actually increase by 5,000 kg over 10 years, that increase is an indication that the remedial actions employed at the site were insufficient, rather than there being an indication that there is no possible remedy that would be effective, or at minimum, more effective. Additionally, provide a discussion of the premise that that as long as the source area continues to add contaminant mass to the groundwater system, it is likely that any technology focused on the dissolved plume only will not obtain optimal results. Mitigating additional inputs of contaminant mass to groundwater via the removal, containment, or immobilization of the contaminant mass below ground surface in the immediate vicinity of the tailings piles warrants consideration. Further, much of the mass is still within the footprint or immediate environs of the tailings pile.
4. Treatability Studies				
27	3-1	3.1	RE: Tripolyphosphate Treatment	As the tripolyphosphate treatment proved to be effective in the groundwater system, modify the text to discuss consideration of applying this treatment directly to the tailings as a source control measure (for example, injection into the tailings mass).
28	3-1	3.1 3rd Paragraph 1st Bullet	RE: Tripolyphosphate treatment *"Up to 97 percent of the uranium was removed from the dissolved phase in the S Area."*	As the pilot studies indicated that tripolyphosphate treatment was successful in immobilizing uranium in groundwater and the treatment effect was persistent in certain areas, consideration of utilizing this technology as part of a multi-technology remedy is warranted.
29	3-5	3.3	RE: In Situ Biological Treatment	The results of the in situ biological treatment pilot test indicated that this technology reduced concentrations of uranium, molybdenum and selenium on the East test site, which represented an area of low hydraulic conductivity (K). As a primary justification of TI is that the effects of back-diffusion from low permeability zones prevent achievement of cleanup standards, present

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				a discussion of the potential applicability of this technology to the low K portions of the aquifer system and/or the tailings pile as part of a comprehensive remedial approach.
30	3-15	3.3 2nd and 3rd Paragraphs	RE: In Situ Biological Treatment	Modify the text to present a discussion as to whether the variable success of the technology is due, in part, to the East Site having two injection wells and two pumping wells, whereas the West site had one injection well and two pumping wells.
5. General Response Actions				
	4-1	4	RE: General	This section needs to be expanded to discuss not only the response actions taken at the Site in the past, but new response actions that will be screened and analyzed in the FS to achieve the RAOs. For example, there should be a discussion of the off-site and on-site disposal options for the tailing material that shall be screened based on EPA comments contained herein on RAOs and preliminary remedial alternatives.
	4-1	4 2nd Paragraph	RE: Potential off-site source of groundwater contamination	Modify the second paragraph by adding the following sentence: *"Potential off-site sources of groundwater contamination are the mine-water discharges in the alluvial aquifer upgradient of the LTP."*
31	4-1	4 4th Paragraph 4th Sub-bullet and throughout Table 5.1	RE: *"Groundwater Monitoring – HMC has been monitoring groundwater for more than four decades."*	Remove groundwater monitoring from the bulleted list of institutional controls (IC) as it is not an IC and the fact that groundwater monitoring has been performed for more than four decades is not relevant to a screening of remedial alternatives.
32	4-2	4 2nd Bullet	RE: Tailings flushing	Modify the text by removing the discussion of tailing flushing. Rather than limiting contaminant transport, tailings flushing released chemical mass from the tailings into the vadose zone and groundwater system, thus it is not a source control measure.
33	4-2	4 3rd Paragraph 1st Sentence	RE: *"Monitoring data also suggest that radon in air, although only slightly above background and **within codified Federal limits**, presents a risk to future on-site workers."*	Modify the text to specify which specific "*codified Federal limits*" are being referred to.
34	4-2	4 3rd Paragraph 1st Bullet 2nd Sentence	RE: *"Several ICs applicable to this **RAO** have already been implemented, including:"*	Modify the text to specify which RAO(s) are being referenced.
35	4-4	4 1st Paragraph 1st Sentence	RE: *"Soil reclamation will meet NRC requirements, as articulated in the Reclamation Plan will be protective under CERCLA consistent with CERCLA guidance."*	Modify the text to provide the basis for the determination that the NRC requirements will be protective under CERCLA and consistent with CERCLA guidance.

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36	4-4	4 3rd Paragraph 2nd Sentence	RE: *"Reclamation which includes **CERCLA-compliant soil remediation** will be carried forward as a component of all assembled remedial alternatives for OU2."*	Modify the text to describe what is "*CERCLA-compliant soil remediation*."
6. Identification and Screening of Remedial Technologies and Process Options				
37	5-1	5 2nd Paragraph	RE: "*TI Waiver of specific ARARs within a three-dimensional zone is appropriate for OU1 due to the infeasibility of restoring groundwater within a reasonable timeframe at a reasonable cost. Identification of general response options and remedial technologies, as well as initial and detailed screening presented within this section and the assembly of alternatives presented in Section 6 was developed independent of the TI demonstration and may need to be re-evaluated as the TI Waiver Evaluation and Site FS develop."*	Modify the second paragraph by deleting the first sentence that states a TI Waiver is appropriate. As stated by EPA in a previous comment, statements in this Technical Memorandum about the appropriateness of a TI Waiver is premature. Further, in the November 16, 2021, letter to EPA, NMED reiterates its position stated in comments to the NRRB: *"NMED strongly believes that groundwater remediation would achieve greater success if all active treatment systems were operated at full capacity for extending periods of time or if active treatment systems were expanded."* Modify the second sentence as follows: *"…Section 6 was developed independent of the TI evaluation and may need to be re-evaluated as such evaluation progresses."*
38	5-1	5 3rd Paragraph of section	RE: RAOs	Modify paragraph to reflect the update to preliminary RAOs directed by EPA in Comment Nos. 32-36, above.
Table 5-1 Initial Screening of Candidate Remedial Technologies and Process Options for Groundwater Restoration and Human Health Protection"				
39	5-4	Engineering Controls	RE: Containment – Groundwater extraction and treatment	Modify this section of the table to include groundwater extraction and treatment as a process option for the containment remedial technology.
40	5-4	Collection	RE: Wells – Horizontal Drains/Wells	The tailing flushing program, which ceased in 2015, has resulted in a significant amount of saturation remaining in the tailing material at the LTP. This saturation will likely take decades to drain out to where it ceases to be a source of contamination to the underlying groundwater, even if an impermeable cap or ET cover is constructed to reduce infiltration of precipitation. The use of horizontal drains extending through the entire LTP at its base or just below its base, and/or horizontal extraction wells placed just below the vadose zone-alluvial aquifer interface beneath the LTP, shall be evaluated for controlling the loading of additional contaminant mass to the groundwater system from the tailing pile. Installation of the horizontal drains and wells both need to be considered to maximize containment at the LTP and removal of contaminant mass stored immediately below the tailing pile in the vadose zone, which discharges over time to the underlying alluvial aquifer. Modify the table accordingly.
41	5-5	In situ treatment	RE: Biological - Phytoextraction	As its name implies, phytoextraction is an extraction technology not an in situ biological technology and is recommended be considered under Engineering Controls. Further, the trees

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				that take up the contaminants do not necessarily treat the COCs, and they may remain in the biomass.
42	5-7	Engineering Controls/ Containment	RE: Process Options	As per EPA General Comment No. 1.a., above, include an additional “Hydraulic Barrier” process option for an “Engineering Controls” general response action, “Containment” remedial technology candidate that specifies only water extraction. There would be no water injection. There is a concern for continuing the use of the SAG aquifer as a supplemental fresh water source for the water injection program.
43	5-7	In-Situ Treatment/Chemical Treatment	RE: Process Options	As per EPA General Comment No. 1.b., above, include PRBs as a permanent process option for an “In-Situ Treatment” general response action, “Chemical Treatment” remedial technology candidate.
44	5-7	Discharge/Off-Site Discharge	RE: Process Options	In the last column of the table (Applicability) for the “Discharge” general response action, “Off-Site Discharge” remedial technology, it states that the Rio San Jose is more than five miles from the Site. However, a review of Site maps show the stream to be about two miles from the R.O. treatment plant. Reassess and modify table accordingly. EPA considers this process option to be potentially applicable.
Table 5-2 Initial Screening of Candidate Remedial Technologies and Process Options for OU2				
45	5-8	Engineering Controls/ Containment	RE: Process Options	As per EPA General Comment No. 1.f, above, include an additional “Capping” process option for the “Engineering Controls” general response action, “Containment” remedial technology, candidate that consists of a cap to provide evapotranspiration, in addition to radon and dermal barrier. There is a concern that the infiltration and percolation of precipitation through the radon barrier cover and tailing piles will result in a continuing, long-term source of tailing seepage to groundwater.
46	5-8	Removal and Disposal	RE: Process Options	As per EPA General Comment No. 1.c., above, include additional process options for a regional waste disposal facility or consolidation at another DOE facility as an alternative disposal option with the “Removal and Disposal” general response action and remedial technology candidate.
47	5-8	Removal and Disposal	RE: Process Options	As per EPA General Comment No. 1.d., above, include an on-site disposal process option with the “Removal and Disposal” general response action and remedial technology candidate. With this option, a new lined cell would be constructed adjacent to the existing tailing piles for permanent disposal of the tailing material.
48	5-8	Ex-Situ Treatment/ Physical	RE: Process Options	As per EPA General Comment No. 1.e., above, include a cement solidification/stabilization process option with the “Ex-Situ Treatment” general response action, “Physical” remedial

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				technology candidate that a cement injection process for solidifying/stabilizing the base of the tailing piles.
Table 5-3 Detailed Screening of Technologies and Process Options for Groundwater				
49	5-13 et seq	General	RE: *Source control*	None of the technologies considered are true source controls. None of the options focus on creating conditions to limit the transport of contaminants from the tailings material and the alluvium below the LTP. More focus is needed on source control and processes that limit infiltration and promote conditions within the aquifer that limit migration of contaminants. Consistent with 40 CFR § 300.430(e)(3), modify the table and subsequent sections to evaluate source control action(s) that are focused on: 1) prevention of additional contaminant mass entering the subsurface from the tailing pile; 2) removal of contaminant mass to the maximum extent feasible; and 3) preventing the transport, via groundwater, of the contaminant mass present in the vadose zone and the saturated alluvium from under and immediately surrounding the tailing pile. Consider multiple technologies, including but not limited to: • hydraulic control with mass removal, • adjusting in-situ geochemical conditions via injections to minimize the mobility of COCs, • interception of leachate from the tailing pile and recovery of contaminant mass beneath the tailing pile with horizontal wells, and • recovery of mass from groundwater beneath the LTP via horizontal or angled wells installed with directional drilling. This comment also applies to Table 5-1 for the initial screening of technologies and process options.
50	5-13	Engineering Controls	RE: *Injection – Tailings Flushing* *"Tailings flushing was effective in enhancing draindown of contaminated pore water"*	Modify to state that tailing flushing was effective in reducing the COC mass within the tailings pile. The flushing did not enhance "*draindown of contaminated pore water*" as that draindown would be much further along if additional water had not been added to the tailings over many years. While tailing flushing reduced the overall contaminant mass in the tailings pile, significant mass remains. In addition, it is not clear that all of the leachate generated during this flushing program was recovered and prevented from increasing the mass flux to the vadose zone and aquifer and subsequent transport through the aquifer.
51	5-14	Engineering Controls	RE: Capping – Impermeable Cap	Impermeable capping technology should be retained. While capping does have a high capital cost, it is also a proven engineering control technique that has other chemical benefits beyond radiological exposure protection; for example, promoting reducing conditions within the tailings pile.
52	5-14	Engineering Controls	RE: Capping – Impermeable Cap	Modify the table to clarify "*venting [of an impermeable cap] might be required to control radon gas migration and buildup below the ground surface"* versus below the impermeable cap on the LTP.

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			"Venting might be required to control radon gas migration and buildup below the ground surface."	
53	5-14	Engineering Controls	RE: Capping – Impermeable Cap *"Based on previous investigations, sources of clay suitable for construction of an impermeable cap may not be locally available."*	Modify the table to provide more information to support the statement that "clay suitable for construction of an impermeable cap may not be locally available". In modified text, indicate the nearest source(s) of suitable clay that has/have been identified.
54	5-14	In-Situ Treatment	RE: Chemical Treatment – Chemical Precipitation	This technology needs to be retained and complimentary technologies for removal of selenium and molybdenum be evaluated. Further, this technology warrants consideration as a source control option for contaminant mass in the aquifers (*see* Specific Comment No. 49, above).
55	5-15	Ex-Situ Treatment	RE: Off-Site Treatment – Well Head "*Technically easy to implement; however, the need to obtain access agreements with private parties complicates implementation*."	Based on its effectiveness and middle range capital and operations and maintenance costs, well head treatment is recommended be retained in the event other factors in the future lessen the complications for obtaining access agreements with private parties.
Table 5-5 Summary of Detailed Screening of Technologies and Process Options for Groundwater				
56	5-20	General	RE: Technologies listed in the table	Modify the information in Table 5-5 as applicable according to comments provided on specific technologies in Table 5-2.
6 Assembly of Remedial Alternatives				
57	6-1	6	RE: Expansion of Alternatives	Homestake developed the four alternatives to address the groundwater RAO: 1) No Action, 2) Institutional Controls and Monitored Natural Attenuation, 3) Institutional Controls, Injection to Create a Hydraulic Barrier, Collection using Extraction Wells, Treatment with Adsorption and Membrane Filtration, and Discharge to Evaporation Ponds, and 4) Institutional Controls, Injection to Create a Hydraulic Barrier, Collection using Extraction Wells, Treatment with Adsorption and Membrane Filtration, In-situ Treatment, and Discharge to Evaporation Ponds. Homestake is directed to include the following alternatives in an expanded FS: • Evaluate alternatives that include pump and treat to reduce existing concentrations of groundwater contaminants in the San Mateo Creek alluvial aquifer that are present outside of the NRC license boundary to preliminary remediation goals (PRGs) established by EPA for the CERCLA process. EPA and NMED are currently reassessing groundwater background and anticipate that CERCLA PRGs will reflect numeric ARARs for groundwater or background levels significantly lower than currently established by Homestake. Restoration of the aquifer to CERCLA PRGs will reduce

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				the reliance on modeling to demonstrate long-term protection of downgradient aquifers, including the SAG aquifer. • Evaluate alternatives that create a hydraulic capture zone through groundwater extraction within the NRC license boundary coupled with achievement of PRGs in the San Mateo Creek alluvial aquifer outside of the NRC license boundary. This alternative contemplates active capture to maintain long-term hydraulic containment of ongoing sources beneath the tailing impoundment instead of injection of potable water to create a groundwater mound. Maintaining long-term hydraulic capture through extraction will significantly reduce the strain on remaining potable water sources in the region and eliminates the reliance on modeling to demonstrate long-term protection of groundwater aquifers, including the SAG aquifer. Different variations of such alternatives likely will need to be evaluated to determine the most optimal pump and treat system to meet RAOs for groundwater restoration. Determining treatment capacity needed to achieve RAOs for pulling back contaminant plumes will need to be determined. Evaluation of treatment capabilities will dictate how the treated water can be managed following treatment • Consider long-term pump and treat options beyond 50 years to maintain containment of groundwater contamination within the current NRC license boundary. Evaluation of long-term pump and treat systems should include consideration for providing treated water for industrial or other uses to offset previous, current, and future use of the SAG aquifer. It is not an unusual requirement for groundwater treatment to extend for a period of 100 years or more to address groundwater contamination at mine sites. The Chino Mine and Tyrone Mine, both copper mines in southwest New Mexico, are required to construct and operate treatment systems for a minimum of 100 years to contain contamination associated with mine operations and the open pit capture zone. The Questa Mine Superfund Site in northern New Mexico is subject to similar requirements for long-term groundwater containment and treatment. Financial assurance is in place to cover costs associated with these long-term containment strategies, and the net present value of the long-term costs to reclaim and remediate these sites are similar to or greater than those predicted for the Site by Homestake in the draft FS Report. Numerous other examples exist of mine sites in the western United States with requirements for long-term water treatment beyond 50 years. This may be an appropriate time to evaluate a regional approach to the disposition of the Site relative to other potential legacy uranium mining and milling impacts in the basin. The Site sits at the nexus of basin-wide impacts, as discussed in previous comments above, and it may be appropriate to evaluate the future remediation strategy in a basin wide context. A treatment system is in place and Site activities are currently preventing or limiting the downgradient migration of poor quality alluvial groundwater north and upgradient of the Site towards potable

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				water supplies. This upgradient groundwater exceeds federal drinking water standards and state groundwater standards and is likely impacted by historic mine-water discharges from legacy uranium mines that recharged the alluvial aquifer. Homestake is one of the potentially responsible parties that are conducting a CERCLA groundwater remedial investigation and feasibility study (RI/FS) under an administrative settlement agreement and consent order with EPA for the Central Study Area of the San Mateo Creek Basin. Should the results of investigations for the Central Study Area show the poor quality alluvial groundwater is attributed to the historic mine-water discharges, remedial alternatives to be evaluated in a CERCLA FS will likely include active groundwater restoration. Further, EPA may determine from Central Study Area groundwater investigations or other studies that upgradient contamination has likely already impacted the Site. Hence, future remedial strategies for the Site may directly impact remedial strategies for upgradient and downgradient contamination and, ultimately, any solution may need to consider commingled impacts.
58	6-1 and 6-2	6	RE: Alternatives assemblies	Modify the lists of alternative assemblies as applicable according to comments provided on specific technologies in Table 5-2.