Memorandum

To: U.S. Environmental Protection Agency; National Remedy Review Board (NRRB)
From: Ann Maest, PhD; Buka Environmental on behalf of Bluewater Valley Downstream Alliance (BVDA)
Date: 10 March 2021
Re: NRRB Written Submittal for BVDA on the Homestake Mill Superfund Site

1.0 Introduction

The comments contained herein are submitted on the behalf of the Bluewater Valley Downstream Alliance (BVDA) and present information relevant to the selection of remedies for cleanup of groundwater at the Homestake Mining Company Superfund Site in Grants, New Mexico. The comments further address technical issues related to Homestake Mining Company's (HMC) request to the Nuclear Regulatory Commission for Alternative Concentration Limits (ACLs) and to the Environmental Protection Agency for a Technical Impracticability (TI) Waiver for groundwater cleanup standards. The comments are divided into two sections: proposed remedies and assumptions, and independent evaluation of groundwater protection standards. Based on an examination of HMC's proposals, associated documents, and our own independent evaluations, we find that granting HMC a TI Waiver and ACLs for groundwater is premature and not based on the best available science.

2.0 Remedies and Assumptions

2.1 Overview

In the letter from HMC to the Nuclear Regulatory Commission (NRC)[1], HMC states: "The revised assessment in the GCAP shows that none of the range of proposed reasonable alternatives provide assurance of long-term compliance with the current groundwater protection standards. The revised assessment and the results of over 40 years of groundwater corrective action support the need for Alternative Concentration Limits to comply with the requirements of 10 CFR 40 Appendix A Criterion 5B(5)." The finding of "not reasonably achievable" was based on modeling indicating long-term mobilization of contaminants from the alluvial aquifer and long-term large tailings pile (LTP) seepage. The basis for this statement is questioned in Sections 2.2 and 2.3.

2.2 Ongoing Failed Remedies and Remedies Considered but Not Retained

Failed Remedies. HMC's 2020 Groundwater Corrective Action Program (GCAP)[2] proposes "continued groundwater collection, treatment and injection within the alluvial and Chinle aquifers using the existing infrastructure while an ACL application is prepared, reviewed, and approved."[1] Four alternatives are being considered by HMC, and three involve continued use of this same approach (GCAP, p. 8-5 – 8-7). The capture of contaminated LTP seepage has been incomplete, the treatment has not adequately removed the contaminants, and the approach has relied on extensive dilution with groundwater from the San Andres/Glorieta (SAG) aquifer.

Water management and treatment schematics for 2012 and 2018 show the volume of seepage draining from the LTP and entering the alluvial aquifer without treatment (GCAP, Figures 6-28, 6-29). A hydraulic barrier is supposed to exist downgradient of the tailings impoundments due to *injection* of treated and

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[1] Homestake Mining Company of California, 2020. Letter to Ron Linton, NRC, Re: Homestake Mining Company of California – Responses to NRC's "Request for Supplement Information, Groundwater Corrective Action Program," Docket No. 040-08903, License No. SUA-14-71. November 31. 9pp.
[2] Homestake Mining Company (HMC), 2020. Grants Reclamation Project, Groundwater Corrective Action Program (and appendices). US NRC License SUA-1471, State of New Mexico DP-200, November 13. 385pp.

SAG water (GCAP, p. 4-5). Normally, hydraulic barriers to groundwater flow are created by pumping rather than injection, or by installing a slurry wall or other physical barrier to limit groundwater flow. The alluvial aquifer groundwater contours indicate that contaminated seepage from the LTP can still be transported to downgradient locations on the west and east sides of the LTP (2018 Annual Monitoring Report; Figure 4.2-1).[3] A paleochannel in the alluvium on the west and southwest sides of the LTP has the highest measured hydraulic conductivity and is likely still transporting contaminants from the LTP to downgradient parts of the alluvial aquifer.[4] The shape of the uranium plume indicates that the paleochannel is an important preferential pathway for transporting contaminants from the LTP to downgradient areas in the San Mateo Creek basin (Figure 1).

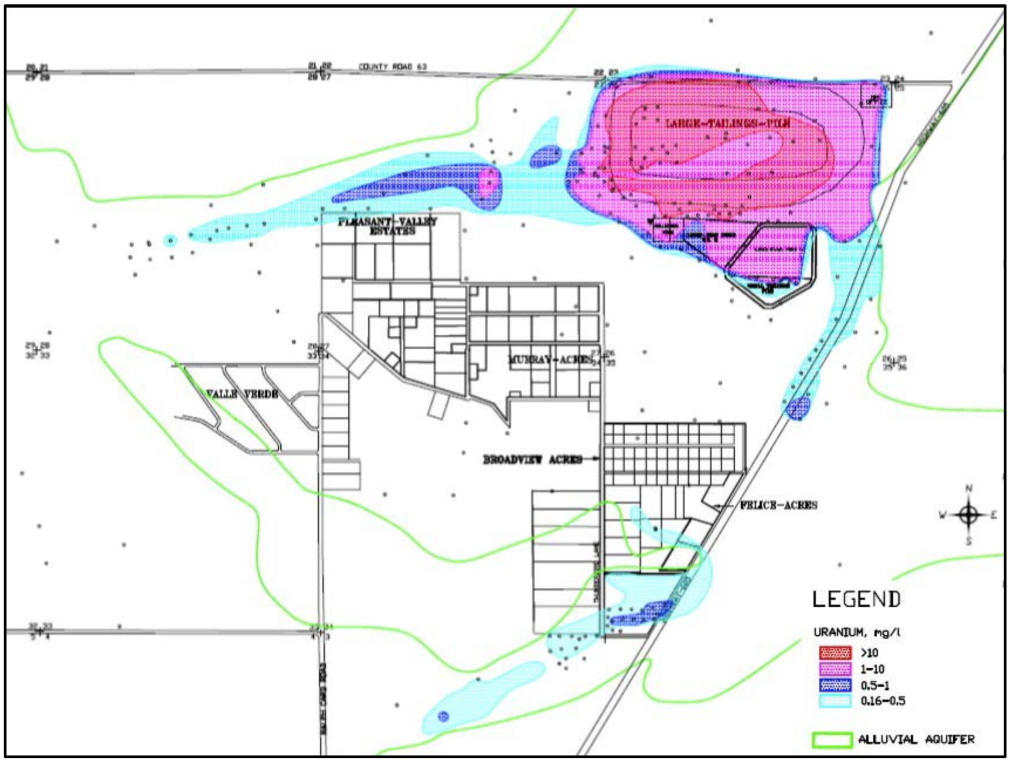

Figure 1. Uranium plumes in the alluvial aquifer in 2018.
Source: HMC and Hydro-Engineering, 2019. 2018 Annual Monitoring Report, Figure 1.1-14.

The treatment scheme uses reverse osmosis (RO) and at times zeolite treatment. The zeolite treatment system was started in 2012, and since 2016 has been used to remove uranium from the off-site collection water (GCAP, p. 6-11 – 6-12). The zeolite-treated water is mixed with the RO-treated water and the SAG water in the post-treatment tank (PTT) and sent directly to the aquifers (GCAP, Figure 6-29). The water balance for 2018 shows an average of 267 gallons per minute (gpm) of zeolite-treated water, 350 gpm of RO-treated water, and 128 gpm of SAG water reporting to the PTT in 2018 (GCAP, Figure 6-29). The water quality of the PTT, the RO product, and the zeolite product waters for 2018 is shown in the 2018 Monitoring Report (Tables 2.1-3, 2.1-5, and 2.1-6, respectively). In terms of uranium concentrations in 2018, the PTT water had only one exceedance of the uranium site standard (0.16 mg/L) but six exceedances of the State/EPA drinking water standard. The RO product water (after

[3] HMC, 2019. 2018 Annual Monitoring Report/ Performance Review for Homestake's Grants Project Pursuant to NRC License SUA-1571 and DP-200. 877 pp.

[4] Brown and Caldwell, 2018. Summary of San Mateo Creek Basin Hydrogeologic Site Conceptual Models, 101pp; p. 66 and Figure 44.

treatment) had only one exceedance of the site standard but four exceedances of the State/EPA standard. The zeolite-treated water had no exceedances of the site standard but 27 exceedances of the State/EPA water quality standard. Although only the site standards are relevant, the results show that if the applicable groundwater standards were lowered to the State/EPA standard, additional treatment upgrades would be needed, especially to the zeolite system. Importantly, the zeolite-treated water was proposed to be used in lieu of fresh water (SAG aquifer water) for reinjection,[5] possibly because of the reduction in allowable pumping volumes from the SAG aquifer by the New Mexico Environment Department (NMED). If this is the case, water with elevated uranium concentrations will continue to be spread throughout the site. An independent evaluation of the treatment system is needed.

SAG water is proposed to be used in three of the four Alternatives in the GCAP. The SAG aquifer is a major regional aquifer used for industry, irrigation, municipal water supplies, and private water wells (GCAP, p. 3-12), and pumping the aquifer so extensively and using the water for questionable remediation measures should not be allowed. Well 943 was used as the pumping well from the SAG aquifer until 2017. Uranium concentrations first increased in the well in 2015 and continued to increase from 2016 to 2018 (RI Report, Figure 3-58). HMC has attributed the increases to poor well casing and leakage of higher-concentration groundwater from overlying aquifers and to the Bluewater Mill, but the NRC has rejected these theories and required more information.[6]

Another failed remedy used by HMC was land application and irrigation using groundwater that exceeded site water quality standards. This approach also contributed to expansion of plumes in the alluvial aquifer. Land application "was an integral part of the groundwater restoration program" (GCAP, p. 2-5). According to HMC's 2020 Remedial Investigation Report (RI Report),[7] from 2000 to 2012, nearly 10,000 ac-ft of mine-influenced waters derived largely from alluvial wells but also from some Chinle wells were used for irrigation (p. 3-2). Water from the SAG aquifer was also used for the land application process (GCAP, Fig. 6-28). Although the concentrations of uranium are described as "low," waters used for irrigation had *average* uranium concentrations that ranged from 0.12 to 0.38 mg/L (RI Report, Tables 3-3 and 3-5) – up to 2.4 times higher than the NRC groundwater cleanup value (0.16 mg/L) and over 12 times higher than the State's and EPA's primary maximum contaminant level (0.03 mg/L). Rather than remediating the groundwater contamination caused by land application, "Restrictive Covenants will be put in place for HMC's former land treatment areas (Section 2.7) that will prohibit residential and agricultural use of the land treatment areas and use of groundwater for drinking beneath the land treatment areas." (GCAP, p. 2-6).

Remedies Considered but not Retained. The GCAP (Table 8-1) includes information on remedial technologies considered but not retained. Source removal (removal of all tailings in the LTP) was not retained even though its effectiveness was rated as high because the "increase in truck and heavy equipment traffic could adversely affect community." Another reason cited was "…increase in human health risks from transporting waste…" HMC has essentially removed the community by purchasing homes, so these reasons are not valid. Another reason was costs. TI waivers should be based on "...engineering feasibility and reliability, with cost generally not a major factor unless compliance would

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[5] EPA, 2016. Fourth five-year review for HMC Superfund Site, p. 15. September, 115 pp.

[6] NRC, 2020. Letter to HMC and attachment: Results of U.S. Nuclear Regulatory Commission Staff Review of the May 10, 2019, "Response to the Homestake Mining Company of California letter, dated July 26, 2018: Proposed adjustment in groundwater monitoring of the San Andres-Glorieta aquifer near the Grants Reclamation Project. January 23, 13pp.

[7] HDR, 2020. Final Remedial Investigation Report. HMC Superfund Site. Operable Unites 1 and 2. June 22. 245 pp.

be inordinately costly."[8] The only reasonable remedy for long-term protection of the aquifers, especially the Chinle and SAG aquifers, is removal of the source (the LTP) and placement nearby on liners with a leachate-collection system and monitoring. Remediation of the vadose zone under and downgradient of the LTP will also likely be needed to remove that long-term source.

The cleanup of nuclear weapons and nuclear power plant sites (e.g., Hanford, Three Mile Island) appears to have been prioritized over cleanup of uranium mines and production facilities. And more removals are used as remedial measures at the nuclear sites. However, the two types of sites are inextricably linked when viewed through the lens of whole life-cycle analysis. Uranium mines and the associated processing facilities (e.g., mills) have supplied the raw materials for nuclear energy and nuclear weapons, yet these upstream facilities are often in less populated areas – many of which are on Native American reservations or lands (e.g., Church Rock on Navajo Nation lands) – that are undervalued. This perspective contravenes the Biden administration's emphasis on environmental justice and communities. The relative success stories from the cleanup of nuclear energy and nuclear weapons facilities demonstrates that similar successes could be achieved at uranium mines and production facilities, if these sites were given higher priority and funding. A summary of some of the cleanups touted as successes at the nation's nuclear sites includes:

- Rocky Flats, Colorado. Made plutonium triggers for nuclear weapons. The Rocky Flats Cleanup Agreement authorized DOE to perform most of the cleanup through removal actions. The Savannah River Site in South Carolina, the Waste Isolation Pilot Plant (WIPP) in New Mexico, the Nevada Test Site, and the Hanford Site in Washington State received materials or wastes from Rocky Flats.[9] The cleanup was completed for approximately $7 billion. Although not a perfect remediation and concerns still exist, the site today is a wildlife refuge.
- Oak Ridge, Tennessee. Erected for the Manhattan Project to develop an atomic weapon to end World War II. The remediation project generated more than 1.7 million cubic yards of waste. Approximately 10 percent of the waste was sent out of state for disposal. The remaining 90 percent was disposed safely at onsite disposal facilities. This decades-long environmental cleanup effort marks the first uranium enrichment complex in the world that was successfully removed.[10] At least $2.9 billion will be spent on the cleanup, and costs are expected to be well over that amount by completion in 2046.[11]
- Hanford, Washington State. A nuclear production complex established in 1943 as part of the Manhattan Project.[12] The groundwater pump-and-treat system has operated since 2008 will be continued and expanded. Their numerous improvements have resulted in "significant reduction of

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[8] EPA, 1993. Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration. Directive 9234.2-25 (p. 10). September. 30pp.

[9] GAO, 2006. Nuclear Cleanup of Rocky Flats. DOE can use lessons learned to improve oversight of other sites' cleanup activities. July. 122 pp.

[10] DOE Office of Environmental Management. 2020. DOE's cleanup of nuclear waste sites a continuing success. August 20. https://www.energy.gov/orem/articles/does-cleanup-nuclear-waste-sites-continuing-success

[11] DOE Office of Environmental Management. 2018. https://www.energy.gov/em/articles/oak-ridge-cleanup-contractor-hits-2-billion-contract-mark

[12] DOE Office of Environmental Management. 2019. Hanford Builds on Groundwater Cleanup Success, Plans for Treatment Expansion. https://www.energy.gov/em/articles/hanford-builds-groundwater-cleanup-success-plans-treatment-expansion

areas of groundwater contamination." The low-range cost estimate for the cleanup was estimated at $323.2 billion.[13]

In stark contrast to the cleanups of U.S. nuclear facilities, much less money has been spent on remediation of uranium mill sites, and those near communities of color (e.g., Church Rock and the Homestake Mill) have received even less attention and funding. A comparison of waste volumes, cleanup costs, and remedial approaches for uranium tailings sites with groundwater contamination will be included in the presentation by BVDA to the NRRB on March 25, 2021.

2.3 Issues with Granting a TI Waiver for the HMC Superfund Site

The granting of a TI waiver for cleanup of the HMC Superfund Site is premature for the following reasons:

- The conceptual models are incomplete or incorrect. The conceptual models presented by HMC and their consultants (e.g., HDR, 2020. Final Remedial Investigation Report, Fig. 4-1; GCAP, Figs. 3-17, 4-18) do not provide a "…three-dimensional representation that conveys what is known or suspected about contamination sources, release mechanisms, and the transport and fate of those contaminants"[14] or an adequate or complete description of the "site geology, hydrology, ground-water contamination sources, transport, and fate" that is required to secure a TI waiver.[8] Missing elements include:
  - Understanding the fluxes and sources of contamination in the SAG aquifer (well 943). NRC has not accepted HMC's arguments that the increasing uranium concentrations result from input of concentrations from overlying aquifers or the Bluewater Mill. Because of the uncertainty and the importance of the SAG aquifer as a regional resource, NRC requires further investigation.[6]
  - Including the influence of the upgradient plume derived from mine water discharges sourced from the Ambrosia Lake mine area, for which HMC is a responsible party, in the conceptual model and the cleanup proposal. An evaluation of the restoration potential of the site must include "A demonstration that contamination sources have been identified and have been, or will be, removed and contained to the extent practicable."[8] The proposal for ACLs to "automatically adjust upward" based on upgradient monitoring results, influenced by infiltration of mine water discharges, allows HMC to skirt responsibility for upgradient sources and on-site contamination. Increasing concentrations of uranium and selenium in wells north of the LTP have been attributed "a perennial supply of recharge effluent" from upstream mines.[15] The "slow, multi-decadal rise in alluvial groundwater levels" is attributed to infiltration of mine water discharges, mixing with native alluvial groundwater, and movement of alluvial groundwater from upgradient historical mines and remediation discharges (GCAP, p. 3-12).
- Site background/GWPS values need to be re-evaluated. NMED and EPA need to complete their reassessment of background groundwater quality before issuing a ROD or a TI waiver. Our

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[13] DOE, 2019. Lifecycle report. https://www.hanford.gov/files.cfm/2019_Hanford_Lifecycle_Report_w-Transmittal_Letter.pdf

[14] EPA, 2015. Use of monitored natural attenuation for inorganic contaminants in groundwater at Superfund sites. August. 83pp. (p. 6)

[15] Weston Solutions, Inc. 2018. Phase 2 groundwater investigation report for the San Mateo Creek Basin legacy uranium mines sites. October. 244 pp. (p. ES-4 – ES-5).

independent evaluation of background values in the alluvial and Chinle aquifers is presented in Section 3.0 of this memorandum.

- The modeling to evaluate the fate and transport of hazardous constituents at the site only includes uranium and molybdenum. Predicted concentrations for all other hazardous constituents are based on the results for uranium (U) and molybdenum (Mo). (GCAP, Section 7.0). Our work has shown that selenium behaves differently than U, yet its fate and transport will not be specifically considered.
- The basis for concluding that long-term groundwater restoration is not reasonably achievable (GCAP, p. 9-4) relies on modeling that is not supported by site-specific characterization or laboratory experiments. The GCAP evaluation of Alternative 4 assumes that “immobile U” (U in clays) will diffuse into “mobile U” pathways (sandy sections) forever (GCAP, Section 7.0), even if groundwater in the mobile pathways is completely restored. This conclusion relies on an unproven assumption that U will adsorb onto clays or ferrihydrite ($Fe(OH)_3$, also referred to as HFO; GCAP, Appendix F). The extensive U plumes in the alluvium, as shown in Figure 1 in this memorandum, demonstrate that U is highly mobile in this bicarbonate-rich, oxidized, and somewhat basic groundwater environment. Under these pH and redox conditions, the dominant U species are calcium uranyl carbonate complexes, as noted in the GCAP (Appendix F, p. 18). These species are either uncharged or negatively charged and will not substantially adsorb onto HFO under site groundwater conditions. However, the modeling conducted for evaluating the alternatives assumes U will be present as a positively charged ion, UO_2^{2+}, which is much more likely to adsorb to HFO. This poorly adsorbing species constitutes less than 0.0001 percent of other more strongly adsorbates, such as calcium, copper, zinc, and bicarbonate bound to HFO based on modeling simulations conducted by NMED. The related GCAP discussion refers to two tables that do not exist in the document (see GCAP, p. 7-2), and they select the “improved constants published by Mahoney et al. (2009),” yet these constants are for the free uranyl complex (UO_2^{2+}) rather than the calcium uranyl carbonate complexes that exist in groundwater under site conditions. This approach will overestimate “immobile U” and create an unsupported source for diffusion back into the alluvium after modeled remediation. An independent examination of the modeling performed for the alternatives evaluation needs to be conducted that honors site conditions.
- Modeling efforts to evaluate the effectiveness of proposed remedial measures and whether certain measures should be retained did not include a scenario with removal of the LTP. A site in New Jersey that received a TI waiver for arsenic, beryllium, and lead in groundwater based the evaluation on modeling that included no source removal and the implementation of source removal.[16] A similar exercise should be done for the HMC Superfund site to determine its restoration potential. The GCAP contains completely contradictory statements about long-term seepage from the LTP: Seepage from the LTP will continue after the final cover is installed and impact groundwater quality (GCAP, p. 9-4); and the tailings do not represent a significant residual source term upon prolonged weathering (GCAP, Appendix F, p. 16). The tailings leachate itself is the best measure of long-term leaching potential from the tailings, not results from the short-term tests upon which the latter statement is based. The finding in the GCAP that corrective action in impracticable is not based on removal of the source materials, which will continue to leach in perpetuity. For this site, removal of the LTP is the most effective remedial approach; it sits at the top of the mitigation hierarchy, which favors control or elimination of the sources over treatment.

[16] EPA, 2012. Summary of Technical Impracticability Waivers at National Priorities List Sites (p. A-23).

3.0 Independent Evaluation of Groundwater Protection Standards

3.1 Overview

A complete reevaluation of background groundwater quality and the current GWPS has been recommended and is currently being conducted by EPA.[5] BVDA and the Multicultural Alliance for a Safe Environment (MASE) conducted its own evaluation of background groundwater quality by hiring Ann Maest, PhD and Tom Myers, PhD to complete an independent review of existing ("current") Groundwater Protection Standards (GWPS) for selenium and uranium, which are the primary groundwater contaminants around the Homestake site. The GWPS for the Homestake Mining Company's Grants Reclamation Project were proposed by Homestake and accepted by the NMED, the U.S. Environmental Protection Agency (EPA), and the Nuclear Regulatory Commission (NRC) in 2006 (NRC 2006; Arcadis 2018 and 2019). These values are referred to as "current" GWPS. The GWPS are intended to represent non-mining-influenced groundwater quality. Homestake (2015, p. 1-2) states that uranium concentrations used in the background analysis completed in 2004 have not been affected by upgradient mining and are representative of local natural conditions.

However, current GWPS values do not accurately reflect pre-mining/milling-influenced, background conditions because the standards are based on many sample results that reflect mining influence. A re-evaluation of background water quality data for the alluvial and Chinle aquifers found that representative non-mining-influenced concentrations were well below the current GWPS values. The re-evaluated GWPS values are referred to as "proposed" GWPS. The studies conducted by Maest (2020) and Myers (2020) examined the underlying data for the current GWPS values and excluded values indicating increasing selenium and uranium concentrations over time, as they were representative of mining influence. Due to page limitations, the procedure used for determining proposed selenium GWPS values for the alluvial aquifer is described, and the approach for the Chinle aquifer was similar. A similar approach was used to determine proposed uranium GWPS values for the alluvial and Chinle aquifers. The full reports by Myers and Maest are available online.[17] Our work has prompted the NMED, with support from EPA, to conduct its own, ongoing re-evaluation of GWPS values for the alluvial and Chinle aquifers for uranium, selenium, and other mining-related constituents.

3.2 Selenium GWPS Re-evaluation and Proposed Values

The current GWPS for the alluvial aquifer are based on values from 1995 to 2004 for the "near-upgradient" wells and include wells DD, ND, P, P1, P2, P3, P4, Q, and R (NRC, 2016; Arcadis, 2019). However, very few wells in the center of the alluvial aquifer were unaffected by mine-influenced water in the period from 1995 to 2004 (the period selected for the current GWPS), as shown in Figure 2. All alluvial wells except DD, P1, and P2 used in the current GWPS evaluation had increasing concentrations of selenium during this time period, indicating mine-related influence, likely from upgradient mines in the San Mateo Creek basin.

The following assumptions and approaches were used to calculate proposed GWPS values:

- Water quality data showing a consistent increase or decrease in concentration over time and across seasons or years for the identified contaminants of concern is an indication of mine-influenced water and should not be used for the background evaluation. Unexplained spikes that do not correlate with seasonal water-level variability should also not be used.

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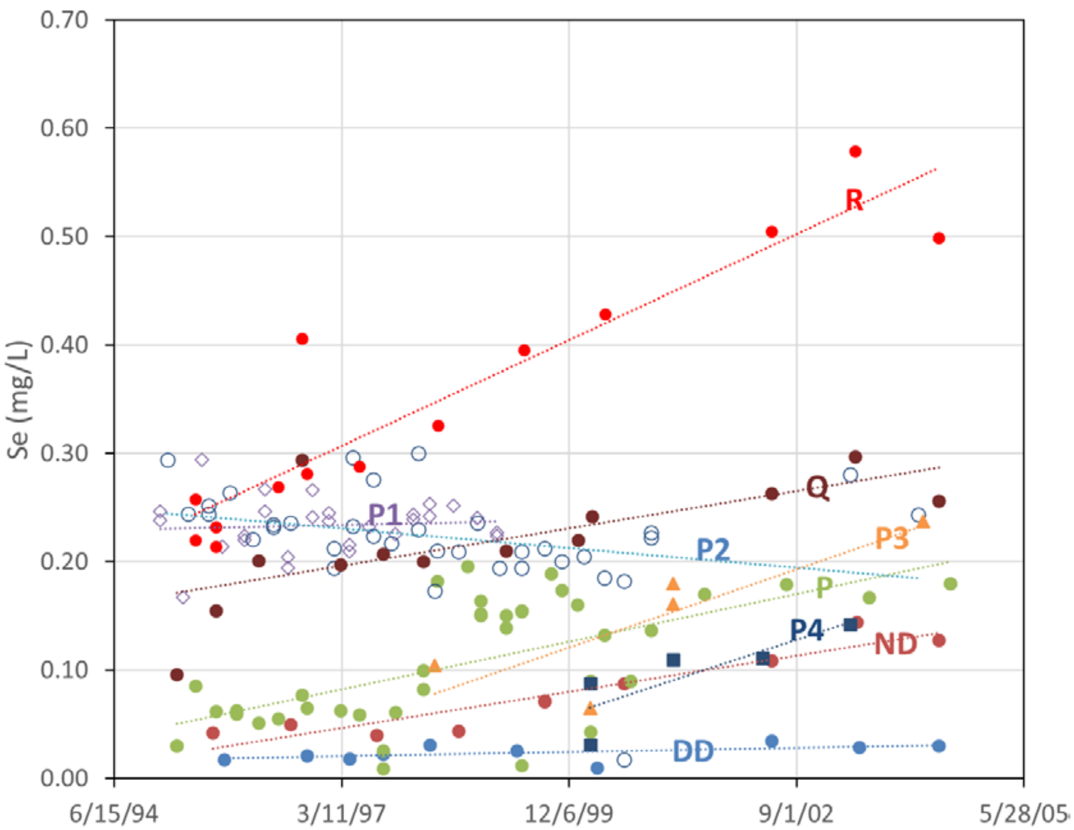
[17] Maest report: https://swuraniumimpacts.org/wp-content/uploads/2021/03/20.03-Maest-Background-Study.pdf; Myers report: https://swuraniumimpacts.org/wp-content/uploads/2021/03/20.03-Myers-Background-Report.pdf

- Water quality samples from wells in identified contaminant plumes in the alluvial aquifer for a given time period have been affected by mine discharge and should not be used for the background evaluation.
- Results from wells before selenium concentrations began to increase can be used for background water quality.
- Using these assumptions, the total number of values used for alluvial groundwater was 131. Because only 9.2% of the values were below detection, they were replaced by ½ the detection limit.
- The 95th percentile was used to calculate the GWPS; therefore, differences in the low concentration range do not affect the high percentile values.



Data source: Homestake Access groundwater chemistry database.

Figure 2. Selenium concentrations from 1995 through 2004 in the near-upgradient wells selected for determining current GWPS values. The increasing concentration trends for all wells except P1, P2, and DD indicate that these groundwater data should not have been used for background because they are influenced by mining activity.

The proposed GWPS excludes wells Q and R and uses wells P (1995-1997), DD (1981-2014), ND (1983-1998), and 916 (1994-2005). Selenium concentrations in wells P1 and P2 have consistent concentrations over the narrow period of sampling (see Figure 2), but concentrations are similar to those in R and Q, which are known to be affected by mining-related sources. While wells R and Q had lower concentrations before the early 1990s, wells P1 and P2 were not sampled during this timeframe. P3 concentrations increased from the first sampling, so this well was excluded from consideration as background. Well P concentrations jumped in 1998, and concentrations from 1998 forward are not used.

The selenium concentrations in the "far-upgradient" wells (921, 920, 950, 916, 922, 914) were not used for calculating current GWPS values. Well 916 is the only far upgradient well with information on total depth and the screened interval.[18] Far upgradient well 916 was therefore also used for the proposed GWPS evaluation.

Table 1 compares current and proposed GWPS values for the alluvial aquifer; the Chinle Mixing Zone; and the Upper, Middle, and Lower Chinle Non-Mixing Zones. All proposed GWPS values are lower than the current GWPS values because the samples that reflect mining influence have been excluded. The proposed GWPS value for the Upper Chinle Mixing Zone is about half that of the Upper Chinle Non-Mixing Zone and about six times lower than the alluvial value, suggesting that the stratigraphically lower Chinle non-mixing zone was not contaminated by selenium moving from the Alluvial aquifer through the Upper Chinle Mixing Zone. The largest differences between current and proposed GWPS values are for the Alluvial and Lower Chinle Non-Mixing Zones.

Table 1. Current and Proposed Groundwater Protection Standards for Selenium

Aquifer	Current GWPS	Proposed GWPS	Basis for Recommendations
Alluvial	0.32	0.063	Excluded wells Q, R, P1, P2 – mining influence
Chinle Mixing Zone: Combined	0.14	0.079	See below
Chinle Mixing: Upper	Not determined	0.011	Excluded well CW9 (outlier)
Chinle Mixing: Middle		0.078	Excluded wells CW17, WR25 (mining influence)
Chinle Mixing: Lower		0.082	Included all well, all time periods
Upper Chinle Non-Mixing Zone	0.06	0.024	Excluded wells CW3 (2002 onward-mining influence), CW13 (east of East Fault and used for remediation), CW18 (east of East Fault)
Middle Chinle Non-Mixing Zone	0.07	0.02	Excluded DW1, DW2, ACW (spikes and increases), CW14 (high concentrations and used for freshwater injection), CW28 (mining influence)
Lower Chinle Non-Mixing Zone	0.32	0.022	Excluded CW16, CW29 (off-site collection well used for remediation), CW32 (extreme outlier), CW41 (2010 onward-mining influence)

The independent evaluation of selenium GWPS values has the following recommendations:

- Re-evaluate background water quality for all COCs and all aquifers, excluding data that reflect mining influence.
- Remediate Upper Chinle Mixing Zone to a lower (more protective) selenium concentration than the middle and lower Chinle mixing zones.

[18] Homestake Mining Company and Hydro-Engineering LLC. 2018. 2017 Annual Monitoring Report/Performance Review for Homestake's Grants Project Pursuant to NRC License SUA-1471 and Discharge Plan DP-200. Prepared for: U.S. Nuclear Regulatory Commissions and New Mexico Environment Department. March. 714 pp.

- Study the relative transport rates of COCs to help predict future extent of contaminant plumes – will help focus remediation on preventing spread of existing and future contamination.

3.3 Uranium GWPS Re-evaluation and Proposed Values

A similar independent study was conducted on the current and proposed GWPS values for U in the alluvial and Chinle aquifers. See footnote 17 for details. A comparison of the current and proposed GWPS values and the basis for the recommendation can be found in Table 2.

Table 2. Current and Proposed Groundwater Protection Standards for Uranium

Aquifer	Current GWPS (mg/L)	Proposed GWPS (mg/L)	Basis for Recommendations
Alluvial	0.16	0.04	Statistics from the near upgradient wells, not including well DD, from 1995 through 2004, manually adjusted by the understanding that many wells in the far upgradient well field and in wells southwest of the LTP have much lower U concentrations.
Upper Chinle	0.09	0.03	A reasonable background for the Upper Chinle non-mixing zone is 0.03 mg/l based on data from before 7/22/87 at CW3 and 931. All other wells have been affected by LTP seepage during the period for which concentrations are available.
Middle Chinle	0.07	0.04	Background based on frequency analysis of HMC's Middle Chinle well data from 1982 through 2002 excepting wells and observations described in the text. Recommended background accounts for the many Middle Chinle wells throughout the area with very low concentrations early in the period by using a lower estimate even though the data is not amenable to being added to the frequency analysis. U concentrations varied, but most were initially very low.
Lower Chinle	0.03	0.03	Almost all concentrations prior to 6/26/2002 are <0.03 mg/l
Chinle Mixing Zone	0.18	0.05	Based on the 95% exceedance for the Upper and Lower Chinle and well CW15 from the Middle Chinle, with data from 1987 through 2018. LTP seepage has affected much of the data used by HMC in the Middle Chinle.

4.0 Summary and Conclusions

- Granting HMC a TI Waiver and ACLs for groundwater is premature and not based on the best available science. Major uncertainties exist regarding the site conceptual model, incorrect background groundwater quality, and the modeling used to conclude that a TI waiver and ACLs are needed.
- The finding that groundwater restoration is “not reasonably achievable” is based on faulty modeling assumptions that are not representative of site conditions. Removal of the LTP should also be considered in the modeling effort to examine the effects on long-term groundwater quality.
- For this site, removal of the tailings is the most effective solution for long-term groundwater protection. The argument that costs are too high is typical for legacy uranium mines, whereas legacy nuclear facility cleanups costing billions have been approved by the DOE. The argument that tailings removal would adversely affect the community is irrelevant because HMC has effectively eliminated the community. Long-term protection of the SAG aquifer is essential so it can continue its role as the primary regional water supply source.