2019 SUPPLEMENTAL TAILINGS AND ALLUVIAL CHARACTERIZATION STUDY
Grants Reclamation Project

Prepared For:

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXHIBITS

APPENDICES

1.0 INTRODUCTION

Homestake Mining Company (HMC) has requested that Worthington Miller Environmental, LLC (WME) conduct a supplemental characterization of tailings and underlying alluvium in the vicinity of the Large Tailings Pile (LTP) and Small Tailings Pile (STP), in addition to an assessment of alluvial conditions in the southern plume area (Southern Area), at the Grants Reclamation Project Site (Site) in Cibola County, New Mexico. The work entailed installation of borings through the tailings piles and San Mateo alluvium down to Chinle Formation bedrock, where groundwater monitoring wells were installed and solid samples were collected for geochemical and mineralogical characterization. A column study was also conducted to evaluate the potential for alluvium below the tailings to serve as a secondary source of constituents of concern (COCs) to groundwater. This report describes the study objectives, drilling and monitoring well installation procedures, and geochemical analysis of tailings and alluvium samples conducted during the 2019 investigation.

2.0 OBJECTIVES

The objectives of the supplemental tailings and alluvium characterization in the vicinity of the LTP and STP (Tailings Area) were to collect additional information needed to improve HMCs understanding of: (1) Vertical distributions of COCs in the LTP, STP, and underlying alluvium, (2) general geologic stratigraphy of the LTP, STP, and underlying perched, vadose, and saturated alluvial zones, (3) chemical forms of COCs in the alluvium and their potential as a future secondary source to groundwater, and (4) water quality associated with saturated fine- and coarse-grained alluvium below the LTP through installation of additional wells followed by future monitoring by HMC.

The objectives of the additional investigation in the Southern Area were to: (1) Characterize the physical properties, geochemical characteristics, and forms of uranium and associated COCs in the alluvial materials to assess potential mechanisms which may explain persistence of uranium in the southern plume, and (2) collect solid samples from the underlying bedrock for geochemical characterization to better understand the potential mechanisms controlling COC mobility in the Upper, Middle, and Lower Chinle Formations.

3.0 DRILLING AND MONITORING WELL INSTALLATION

The drilling program for the Tailings Area consisted of five borings with installation of three alluvial monitoring wells (WME-18, WME-19, WME-20) below the LTP (Figure 3-1) and two alluvial monitoring wells (WME-21, WME-22) below the STP (Figure 3-2). In the Southern Area, three borings (WME-23, WME-24, Q51) were advanced into the alluvium and underlying Chinle Formation where a single monitoring well (Q51) was completed in the San Mateo alluvium (Figure 3-3). Sonic

methods were initially utilized in the Tailings Area due to higher efficiency compared to other drilling methods. Difficulties were encountered in the Southern Area, however, due to the elevated alluvial silt content which produced heaving conditions not conducive to sonic methods. Rotary drilling techniques were subsequently utilized to complete all borings and monitoring wells in the Southern Area. Drilling and monitoring well installation followed general procedures outlined in HMC's Standard Operating Procedure No. 26 *Procedure for Drilling and Well Installation* as presented and discussed in the *2019 Supplemental Tailings and Alluvial Characterization Workplan* (WME, 2019a).

3.1 Monitoring Well Construction and Surface Completion

In the Tailings Area, borings were drilled by Yellow Jacket Drilling Services (Phoenix, AZ) using a Sonic drill rig with temporary casing advance capability. Drill cuttings were collected with an 8-in. diameter core barrel and wells were completed with flush-threaded 4-in. schedule 40 PVC pipe. All well screens are 5-ft. lengths with 0.010 slot size, and filter pack material consists of clean 10-20 silica sand. Boreholes were sealed with a high-solids bentonite grout and finished with bentonite chips. The surface completion for each well consists of an 8-in. diameter steel protective casing with a locking lid and a cement pad. Completion depths below the LTP (Wells WME-18, -19, and -20) and STP (Wells WME-21 and -22) were selected to target both fine- and coarse-grained zones in the underlying saturated alluvium.

In the Southern Area, borings were drilled by Yellow Jacket Drilling Services (Phoenix, AZ) using a CME auger rig with 8-in. diameter hollow stem augers. Augering was required due to difficulties with advancing the sonic rig into the massive fine-grained silt deposits encountered. Drill cuttings were collected with a 3-in. diameter 5-ft. long continuous split spoon. Well Q51 was completed with flush-threaded 4 in. schedule 40 PVC pipe. The well screen is 30 ft. long with 0.010 slot size. Filter pack material consists of clean 10-20 silica sand and a minimum of 3 ft. of time-release bentonite pellets were placed above the sand pack to ensure proper seal. The borehole was sealed with a high-solids bentonite grout and finished with bentonite chips. The surface completion for the well consists of an 8-in. diameter steel protective casing with a locking lid and a cement pad.

Table 3.1 provides construction information for each new monitoring well. Additional details regarding monitoring well construction and surface completions are presented in Appendix A (*Drilling and Monitoring Well Completion Memorandum - Tailings Area*) and Appendix B (*Drilling and Monitoring Well Completion Memorandum - Southern Area*). Photographs of materials recovered from the borings are provided on the enclosed CD as Exhibit A.

3.2 Borehole Geophysics

Upon well or borehole completion, downhole geophysical logging was conducted to collect natural gamma ray, spectral gamma, induction resistivity, induction conductivity, and thermal neutron data for delineating the general geologic stratigraphy and moisture content in the Tailings Area and Southern Area borings. This information was collected to understand stratigraphic relationships, uranium concentrations, and water table locations to assist with sample selection for more detailed geochemical testing. The borehole geophysics were conducted by Jet West Geophysical Services (Farmington, NM). All geophysical logs are included in Appendix A (*Drilling and Monitoring Well Completion Memorandum - Tailings Area*) and Appendix B (*Drilling and Monitoring Well Completion Memorandum - Southern Area*).

3.3 Monitoring Well Development

Following monitoring well installation and completion, Yellow Jacket Drilling Services (Phoenix, AZ) completed monitoring well development no sooner than 12 hours after well completion. All development water recovered from the wells was containerized and disposed in Evaporation Pond 1 (EP-1). A complete description of well development procedures is provided in HMC's Standard Operating Procedure No. 26 *Procedure for Drilling and Well Installation* as presented and discussed in the *2019 Supplemental Tailings and Alluvial Characterization Workplan* (WME, 2019a).

4.0 SAMPLING AND ANALYSIS PROCEDURES

Samples collected from both the Tailings Area and Southern Area were subjected to detailed geochemical and mineralogical analyses. The Tailings Area investigation focuses on total COC and metal concentrations in and below the LTP and STP to characterize their depth distribution (magnitude of downward migration), chemical forms, and potential mobility. The Southern Area investigation emphasizes total vs. leachable COC concentrations and mineralogical characteristics to understand factors controlling COC concentrations and persistence in the southern plume.

4.1 Tailings Area

In the Tailings Area (Figures 3-1 and 3-2), tailings solids were sampled from the middle and base of the LTP (35 ft. and 70 ft. bgs) and STP (10 ft. and 20 ft. bgs) to obtain additional data regarding the COC content of tailings. The remaining tests focused on evaluating depth distributions, chemical forms, and mobility of COCs in the underlying alluvium. During drilling, complete lithologic descriptions of the alluvium were recorded as a function of depth to the top of bedrock. Up to 16 samples were then collected from a zone extending from the top of the alluvium to bedrock. The majority of samples were collected near the top of the alluvial sampling zone where COC impacts

were expected to be greatest, with decreasing frequency to bedrock at an approximate frequency of: Ten samples from the upper third, 3 samples from the middle third, and 2 samples from the lower third. Composite samples ranged from 1 to 4 ft. in thickness and were selected to cover a range in lithology, particle size, and depth.

The resulting sampling intervals for the underlying alluvium are shown in Table 4.1. Each sample was thoroughly homogenized and securely packaged prior to shipping to Energy Laboratories (Casper, WY) for total constituent analyses, and to ACZ Laboratories (Steamboat Springs, CO) for particle size analysis, total organic carbon, and selective extraction. A summary of the testing methods for the tailings solids and underlying alluvium is described below:

- Total Metals, COCs, Total Organic Carbon (TOC), and Particle Size Analysis (PSA): All samples from each boring were analyzed for total COC and metals content to develop vertical concentration profiles for the underlying alluvium. A subset of four samples per boring was analyzed for TOC and PSA to evaluate potential correlations between COC concentrations with grain size and TOC content of the alluvium. Analytical methods are summarized at the bottom of Table 4.1.
- Selective Chemical Extraction: This procedure aims to provide supplemental information for understanding the geochemical partitioning of COCs within the underlying alluvium. The selective extraction technique modified from Tessier et al. (1979) was used to dissolve metals and COCs from the following phases: (1) Water soluble, (2) adsorbed, (3) carbonate bound, (4) oxide bound, (5) organically-bound, and (6) residual. Modification of the Tessier et al. (1979) procedure includes the addition of a water-soluble fraction (Ma and Rao, 1997) as Step 1, and replacement of $MgCl_2$ with $NaHCO_3$ in Step 2 to extract adsorbed rather than exchangeable fractions (Kohler et al., 2004). The modified selective extraction procedure is provided in Table 4.2 and included nine samples from the upper portion of the borings (Table 4.1).

4.2 Column Testing

Small-scale column leaching tests were conducted to understand the potential of the underlying alluvium as a future secondary source of COCs to groundwater. The column tests were conducted on-site by Arcadis (Highlands Ranch, Colorado) in conjunction with Geosyntec Consultants (Greenwood Village, Colorado) (Geosyntec, 2019). Alluvium collected from below the tailings were placed into a small column and leached with representative tailings water in an up flow configuration. Column effluents were analyzed for dissolved COCs and major ions to evaluate the potential for COC release from the underlying alluvium. A total of 6 columns (5 samples plus duplicate) were run to evaluate

leaching characteristics. The detailed procedures describing methods and materials for column construction, operation, and sampling are provided in Appendix C.

4.3 Southern Area

The Southern Area investigation was undertaken to provide information for evaluating the relative persistence of dissolved uranium in groundwater compared to the western plume area. San Mateo alluvium samples were collected from three borings to identify stratigraphic and mineralogic associations of COCs (particularly uranium) in both unsaturated and saturated alluvium. The sampling and analysis program for the alluvial material was designed to be consistent with the recent upgradient alluvial characterization reported by HMC (2018). The 2018 upgradient investigation demonstrated that naturally-occurring uranium in alluvial sediments acts as a local source of uranium to groundwater, and that variation in uranium concentrations is related to the heterogeneous nature of physical and mineralogical characteristics of the alluvium. Opportunistic testing of the underlying Chinle bedrock was also conducted to obtain basic geochemical information for assessing attenuation mechanisms and as potential input for future transport modeling.

Three borings (Figure 3-3) were completed in the Southern Area: (1) Q51 for sampling alluvium, Upper Chinle, and installation of an additional production well, (2) WME-23 for sampling alluvium and Middle Chinle, and (3) WME-24 for sampling alluvium and Lower Chinle. The Upper Chinle and Middle Chinle could not be penetrated by the auger and therefore only alluvium and Lower Chinle samples could be collected. A summary of the testing methods and sample numbers for the southern area alluvium and underlying Chinle bedrock are shown in Table 4.3 and include:

- Total Metals, COCs, TOC, and PSA: The concentrations of total metals, COCs, TOC, and PSA were used to develop vertical concentration profiles for the southern area alluvium, and to understand potential natural sources and geochemical and/or grain size controls on COC concentrations in groundwater. The downhole geophysical survey results were used to select six samples of varying lithology for total constituents from each boring, and a subset of three samples from each boring was analyzed for TOC and PSA (Table 4.3).
- Leachable Metals/COCs: Batch leachability testing was conducted using the Synthetic Precipitation Leach Procedure (SPLP) (USEPA, 1994). The procedure was modified to utilize an alkaline extraction, rather than the standard acidic extraction, which is more applicable to the San Mateo alluvial system (HMC, 2018; Kohler et al., 2004). Comparison between total concentrations and SPLP-extractable concentrations was proposed to provide a relative comparison of uranium mobility with depth and potential relationship to predominant grain size.

Leachability testing (six samples per boring) was conducted on the same six samples analyzed for total metals and COC content.

- Selective Chemical Extraction: This procedure (Table 4.2) was used to understand the partitioning of uranium and COCs in the Southern Area alluvium and Chinle bedrock, as described above for the LTP and STP underlying alluvium. Selective extraction also provides additional information related to the content of amorphous iron as it relates to attenuation of uranium and COCs. Selective extraction was conducted on the same samples that were analyzed for total and leachable metals, TOC, and PSA.
- Upper, Middle, and Lower Chinle Samples: Although general geochemical characterization of the Upper, Middle, and Lower Chinle formations was initially proposed, samples could not be obtained from the Upper and Middle Chinle by augering. However, a sample of the Lower Chinle from boring WME-24 was obtained and analyzed for cation exchange capacity (CEC), XRD, TOC, and selective extraction.

5.0 TAILINGS AREA RESULTS

Alluvium samples underlying the LTP and STP were evaluated for total constituent concentrations as a function of depth down to bedrock (Sections 2.0 and 4.0). A subset of the samples was analyzed for PSA and TOC to evaluate potential COC associations with organic matter and fine-grained materials, and nine samples were subjected to selective chemical extraction. Tailings samples were also collected from the middle and lower portion of the LTP and STP for characterization of total constituent concentrations. All relevant data are summarized in this section and the original complete ACZ and Energy laboratory reports are included in Exhibit B.

5.1 Underlying Alluvial Lithology for the Tailings Area

The underlying San Mateo alluvium is heterogeneous with lithologies ranging from predominantly clay to predominantly sand. Detailed lithologic logs for the underlying alluvium at each borehole are provided in Appendix A. Results from downhole geophysical logging were consistent with observations made during drilling with respect to variations in texture, moisture, and the location of the tailings/alluvium interface. A brief summary of the tailings and underlying lithology at each location is summarized below:

- WME-18 (LTP): Downhole geophysical measurements varied in response to textural changes in tailings with depth and to the tailings/alluvial boundary, where there was a notable shift in the conductivity, neutron, and gamma logs. The upper few feet of alluvium consists of fine sands with a number of alternating layers of clay and sand below. Gravel begins to be encountered 20 ft. below the alluvial surface and lithology is generally less variable with

depth. Sands and gravels with occasional clay stringers extend to bedrock, although a void was encountered at 96 ft. below the alluvial surface and the exact alluvial thickness at this location is not known. A shift in the neutron log at 36 ft. below the alluvial surface identifies the saturated zone at this location.

- WME-19 (LTP): Similar to WME-18, the upper portion of the alluvium is dominated by fine sand, with a number of underlying alternating clay and sand layers as reflected in the variable conductivity log. Gravel begins to be encountered 40 ft. below the alluvial surface and lithology is generally less variable with depth. A shift in the neutron log indicates significantly higher moisture below 52 ft. The tailings/alluvial boundary is apparent by lower gamma readings around 80 ft. and the neutron log shift identifies a saturated zone at 39 ft below the alluvial surface. A thin clay layer overlies the Chinle Formation bedrock which is overlain by wet gravelly sand.

- WME-20 (LTP): Tailings at this location consisted of alternating sequences of dry to moist sands/silts/clays transitioning to silty sands with clay. Increasing moisture content with depth is indicated by the gradual decrease in neutron readings with depth. Small spikes in gamma readings are associated with increases in conductivity which is consistent with the finer-textured zones. A sharp decrease in gamma ray and conductivity identifies the tailings/alluvium interface around 85 ft. Although lithologic logs indicate wet conditions below 62 ft., this was not apparent in the neutron log.

- WME-21 (STP): Increasing gamma and conductivity readings in association with decreasing neutron readings are consistent with an increase in fines with depth in the STP. The tailings/alluvium interface is apparent by the shift in the gamma, neutron, and conductivity logs at 24 ft. Decreasing gamma readings with depth reflect increasing grain sizes and distance from below the STP. The saturated zone was identified at approximately 35 ft. below the alluvial surface based on shift in the neutron log.

- WME-22 (STP): Similar to WME-21, the increasing gamma and conductivity readings in association with decreasing neutron readings are consistent with an increase in fines with depth. The tailings/alluvium interface is apparent by a sharp decrease in gamma and conductivity readings just below 20 ft. Decreasing gamma readings with depth reflect increasing grain sizes and distance from below the STP. The saturated zone was identified at approximately 40 ft. below the alluvial surface based on shift in the neutron log.

5.2 Total Metals and COCs - Tailings Solids

The tailings solids are heterogeneous and generally consist of alternating layers of poorly-graded sands, silts, and clays. Surface tailings tend to be loose and oxidizing, with increasing moisture and evidence of reducing conditions with depth (dark coloration, odor of H_2S). The results for total constituent concentrations of tailings material in the LTP and STP are provided in Table 5.1. Their chemical composition is dominated by aluminum, calcium, iron, potassium, and silicon (not

analyzed) which is consistent with previous mineralogical testing that identified clay minerals, calcite, and quartz as the main minerals present. The primary COC concentrations (uranium, molybdenum, selenium) are elevated and highly variable, with LTP concentrations (dry-weight basis) ranging from: (1) uranium (38 to 118 mg/kg), (2) molybdenum (4 to 19 mg/kg), and (3) selenium (79 to 192 mg/kg). Their concentrations in the STP range from: (1) uranium (4 to 245 mg/kg), (2) molybdenum (1 to 38 mg/kg), and (3) selenium (<1 to 427 mg/kg). In the STP, the COCs uranium, molybdenum, selenium, radium-226, and vanadium are significantly elevated in samples near the base of the pile compared to those near the middle of the pile.

5.3 Total Constituent Distributions In Tailings Area Underlying Alluvium

Samples of the alluvium underlying the LTP and STP were analyzed for total metals/COCs, TOC, and PSA. The TOC in these samples ranges from <0.1 to 0.5%, and the soil textures range from Sand (90% sand with 5% clay) to Clay (70% clay and 12.5% sand) (Table 5.2). The depth distributions for indicator constituents (chloride, sulfate), selected COCs (uranium, molybdenum, selenium, vanadium, radium) and dominant mineralogical components (aluminum, iron, calcium, magnesium, sodium, potassium) were evaluated and compared to their range in upgradient concentrations (where data were available) (Arcadis, 2018 and 2019) to estimate the extent of tailings impact in the alluvium. Radium has been shown to be immobile at the Site and therefore the range in background values for radium-226 and radium-228 were compiled from data collected in the Southern Area.

No upgradient data are available for chloride and sulfate, however they are generally elevated in the upper 10 ft. below the LTP and upper 20 ft. below the STP (Figure 5-1). Uranium is also elevated compared to upgradient concentrations down to 20 ft. at all locations, whereas molybdenum remains elevated throughout the profile below 20 ft. at most locations (Figure 5-2). Selenium and vanadium are elevated in the surficial alluvium below the STP compared to the LTP, and do not appear to have migrated more than 20 ft. below the LTP or STP (Figure 5-3). Radium-226 has also demonstrated limited migration to approximately 20 ft. below the LTP and STP, except for a few elevated measurements below 60 ft. at WME-18 and WME-19 (Figure 5-4). All radium-228 concentrations are within the range of upgradient soils with the exception of a single outlier (Figure 5-4).

The concentrations of total uranium (Energy Laboratories) and soluble uranium from selective extraction (ACZ Laboratories) in the alluvium, including prior soluble uranium results from boring WME-8 (WME, 2019b), are shown on Figure 5-5. A positive relationship exists between both total/soluble uranium and clay content, indicating that fine-grained materials have the potential to

store greater mass and release higher dissolved uranium concentrations compared to coarse-grained materials. Selenium is also positively correlated with clay content, although the correlation is not as strong, and molybdenum does not exhibit a positive correlation with clay content (Figure 5-6).

Quartz, potassium feldspar, calcite, and clays (smectite, illite, kaolinite) have been identified as the dominant mineralogical components of the San Mateo alluvium (Arcadis, 2018 and 2019; WME, 2019b). The variable depth distributions of aluminum and iron are due to lithologic variability where higher aluminum and iron concentrations are associated with high clay content (Figure 5-7). Calcium and magnesium would also be expected to vary with calcite and clay content as trends indicate (Figure 5-8). The tailings solutions contained elevated sodium due to the use of sodium carbonate/bicarbonate for alkaline extraction of uranium, and therefore elevated sodium concentrations are apparent down to about 25 ft. (Figure 5-9). Potassium concentrations in tailings were relatively low, and tend to vary according to mineralogical content with depth (Figure 5-9).

5.4 Selective Chemical Extractions for the Tailings Area

Selective chemical extraction was used to provide supplemental information regarding the partitioning of COCs within the underlying alluvium. During selective chemical extraction, a sample of alluvium is sequentially leached with a series of increasingly aggressive solutions to extract the COCs from various solid phase components (Section 4.1). While it is recognized that no chemical extraction can be 100% selective, these methods provide a general indication of solid-phase associations and allow for relative comparisons between samples. A few key elements were analyzed in the extracts to qualitatively evaluate their selectivity. Basic plots were then prepared showing the fraction of various extractable forms for tailings and alluvium. For example, mineralogical testing has indicated up to 21% calcite (calcium carbonate) in the alluvium (WME, 2019b). The calcium fractionation results for the alluvium samples (Figure 5-10) are consistent, indicating that most calcium exists in the carbonate bound form, and to a lesser extent in association with iron oxides; and, the low percentage of calcium in the residual fraction is consistent with quartz, K-feldspar, and Na-feldspar as predominant mineral components (WME, 2019b). Sodium selectivity could not be evaluated due to the high concentrations of sodium reagents used in several of the extraction steps.

Iron is relatively insoluble and thus the soluble and exchangeable forms should be minor components compared to iron oxides. Fractionation results overall show minimal iron in the soluble, exchangeable, and carbonate bound forms, although iron was extracted from the Fe/Mn oxide bound (non-crystalline) and residual (crystalline) fractions (Figure 5-11). The iron fractionation results are consistent with mineralogical identification of iron oxides (goethite, hematite) and aluminosilicate

clays which may contain iron. The amorphous iron oxide content ranged from 0.05% to 0.37% with an average of 0.22% as iron. Manganese often behaves similar to iron, although significant manganese was also associated with the carbonate bound fraction (Figure 5-12), either as an impurity in calcite or as manganese carbonate (rhodochrosite). Both aluminum and silicon are relatively insoluble and tend to occur mainly as major constituents of aluminosilicate clays, feldspars, and quartz, consistent with their predominance in the residual fractions (Figures 5-13 and 5-14). Overall these results demonstrate reasonable selectivity of the chemical extractions and support their use in evaluating the solid-phase forms of COCs in the alluvium.

Detectable uranium was extracted from all solid phases, however a significant fraction existed in the water soluble form, especially in samples containing appreciable clay (Figure 5-15). The remaining uranium tended to be associated with the adsorbed, carbonate bound, and Fe/Mn oxide bound fractions. Compared to uranium, a larger percentage of the molybdenum was water soluble and associated with the residual fraction (Figure 5-16). In contrast, a significant proportion of the selenium was organic/sulfide bound which reflects the immobilization of selenium due to slightly reducing conditions below the tailings (Figure 5-17). Some vanadium was water soluble, although the majority of vanadium was insoluble and associated with the residual phase, with lesser proportions being Fe/Mn oxide bound (Figure 5-18).

6.0 TAILINGS AREA COLUMN STUDY RESULTS

A summary of the composition of each column is provided in Table 6-1, including the total mass (mg) of constituents (chloride, molybdenum, selenium, sulfate, uranium, and vanadium) associated with each soil type (sand, silt/clay). The influent constituent concentrations are provided in Table 6-2, and effluent results are provided in Tables 6-3 through 6-8. Plots of constituent concentrations versus pore volume are presented in Figures 6-1 through 6-6, and on a mass-accounting basis in Figures 6-7 through 6-9. The mass-accounting was performed by evaluating the effluent concentrations based upon the concentration of constituents in each column, in order to understand what mass of the total concentration was leached into the effluent. Finally, the results of the column tests are compared to the selective extraction data for the soil that was used in each column, in Figures 6-10 (uranium) and 6-11 (molybdenum). For many of the depth intervals of soil used in the columns, selective extraction was not performed. In these cases, selective extraction results for a different depth interval of the same material (e.g., sand) was used for comparison to column testing results where available. Because selective extraction was not performed on any sand from WME-21, comparison of data from Column 6 to selective extraction results was not possible.

6.1 Major Ion Chemistry

In general, effluent concentrations of constituents were higher than influent concentrations, indicating desorption or leaching of constituents from soil. The concentrations of constituents in the effluent decreased with increasing pore volume. Effluent concentrations of chloride and sulfate were far greater than the influent at the beginning of the test in columns 2, 3, 4, and 6 and tapered off by the end. Moderate sourcing of chloride and sulfate occurred in columns 2 and 3 (soil from beneath the LTP; 50-150 mg/L increase over influent) while high sourcing of chloride and sulfate occurred in columns 4 and 6 (soil from beneath the STP; 300-600 mg/L increase over influent) and then tapered off by the conclusion of the test. These results suggest flushing of high chloride/sulfate porewater, desorption of ionically-bound species, or dissolution of salts, and also indicates that soil under the STP has a higher concentration of soluble chloride- and sulfate-based salts than under the LTP. Because most of the soil used in the column testing was recorded as moist or wet during soil sample collection, flushing of porewater or desorption of ionically-bound species are most likely.

In all but column 3, alkalinity exhibited lower effluent concentrations than influent concentrations, indicating a net consumption of alkalinity throughout the test. Alkalinity consumption decreased with increasing pore volume. In column 3, alkalinity was greater in the effluent than the influent, indicating generation of alkalinity from column soils. This was greatest at the beginning of the test and decreased with increasing pore volume. The soils collected from borehole WME-20 and used in column 3 (Table 6-1) were the shallowest of all of the soils used in the columns, and this is likely where significant carbonate and sulfate minerals concentrated (i.e., sulfate in the wet sand here at 0-1 ft bgs was 1300 mg/kg).

6.2 Uranium

Uranium was measured in column effluent at concentrations higher than the influent in all cases and showed a decreasing trend in all columns over the test period. Concentrations of uranium in the influent were 1.6 mg/L at the beginning of the test and remained relatively steady throughout the duration of the test, with a final concentration of 1.7 mg/L. Effluent samples from all columns in the first pore volumes were between 6-16 mg/L and at the end of the run of each column were between 2-6 mg/L. Because the soil was generally moist to wet, the higher initial concentrations may be due to flushing of high constituent concentration porewater. Columns 3, 5, and 6 showed the highest uranium effluent concentrations in the initial part of the test, though columns 3 and 5 exhibited decreasing concentrations over the duration of the test. Column 6 (sand beneath the STP) consistently exhibited the highest uranium effluent concentrations after 3 pore volumes. Column 1

(sand and clay beneath the LTP, with the lowest concentration of uranium in the soils of any of the columns) exhibited the lowest concentrations and the least amount of concentration change over the duration of the test.

6.3 Molybdenum

Molybdenum was measured in column effluent at concentrations higher than the influent in all cases and showed a decreasing trend in all columns over the test period. Concentrations of molybdenum in the influent were 5.68 mg/L at the beginning of the test and remained relatively steady throughout the duration of the test, with a final concentration of 6.06 mg/L. Effluent samples from all columns in the first pore volumes were between 6-46 mg/L and at the end of the run of each column were between 6-7.5 mg/L. Column 1 exhibited the lowest concentrations and the least amount of concentration change over the duration of the test. As was also the case for uranium, column 6 exhibited the highest concentrations over the majority of the test. The remaining columns exhibited rapidly decreasing (columns 3 and 5, both with relatively lower concentrations of molybdenum in the moist sands) and gradually decreasing (columns 2 and 4, both with high concentrations of molybdenum in dry sands in the columns) molybdenum effluent concentrations throughout the test.

6.4 Selenium

Selenium was measured in column effluent at concentrations higher than the influent for columns 1, 3, 4, and 5. Columns 2 and 6 yielded selenium effluent concentrations below the influent concentrations. The final influent selenium analytical result is anomalous and shows a selenium concentration that is higher than any other sample measured in this test (2.57 mg/L); because this is a significant change in concentration and because no other constituents show such a change, this result is viewed with suspicion.

6.5 Mass Accounting

A mass accounting method was utilized to show the amount of each constituent that was mobilized from column soil. In the first step, the mass mobilized was related back to the mass of each type of soil (sand/clay) in each column and the sand's or clay's constituent concentration as measured through total metals analysis (USEPA methods 3050B and 6020). In the second step, the mass mobilized was compared to the total mass of each constituent in the column and presented as a percent. In both cases, the influent concentrations were subtracted from the effluent concentrations (the resultant concentration is therefore attributable to mobilization from the soil in the columns) prior to conversion to mass per mass basis.

Figure 6-7 shows the cumulative mass of chloride, molybdenum, selenium, sulfate, uranium, and vanadium mobilized from each column over the duration of the test. Figure 6-8 shows the cumulative mass of just the trace constituents molybdenum, selenium, uranium, and vanadium to allow for better resolution in their relative behaviors. Trace constituents exhibit behaviors similar to the major ions (chloride and sulfate) in most cases. This suggests that trace metal mobility when exposed to tailing water is primarily associated with washout of residual porewater or weakly-sorbed species, rather than dissolution of trace constituent bearing minerals.

Figure 6-9 shows data as a cumulative percentage of the total mass of each constituent in the soil. In most cases, the amount of each constituent mobilized was between 0 and 100% of the total mass of each constituent in the column. However, in some cases, percentages below 0 occurred, indicating a net attenuation of that constituent (e.g., selenium in Column 2). In other cases, percentages above 100 occurred (e.g., molybdenum in Column 2); this could be due to a number of factors, but the most likely is that soil used in the column may have contained more molybdenum than the subsample that was analyzed via USEPA 3050B-6020 (total metals digestion and analysis).

The total amount of each constituent leached from each column was summed and plotted against the selective extraction results where data were available, for uranium (Figure 6-10) and molybdenum (Figure 6-11). The total amount of uranium and molybdenum leached from the columns over the duration of the test was lower than the amount extracted during the soluble fraction extraction for all cases where data exist except for molybdenum in Column 3. This supports the conclusion that the majority of the mobilized mass of uranium and molybdenum came from porewater or residual sorbed species, rather than from dissolution of more recalcitrant mineral forms.

6.6 Batch Testing

Batch tests showed no notable changes in aqueous concentrations of molybdenum, selenium, uranium, or vanadium, indicating that no significant leaching or attenuation occurred. Alkalinity decreased over the first 6 days from a baseline of 885 mg/L to 621 mg/L and persisted between 614-620 mg/L for the remainder of the 12-day test. Chloride and sulfate exhibited very similar behavior to each other, resulting in a small increase in concentration over the 12-day test of 264 to 272 mg/L for chloride and 1,620 to 1,670 for sulfate.

6.7 Column Test Summary

The column tests showed that alluvial soils directly beneath the LTP and STP harbor constituents that are easily mobilized upon contact with fluids. Most or all of the mobile constituent

concentrations can be attributed to soluble or weakly sorbed species that are subject to washout, as represented by the high chloride and sulfate concentrations, and the tendency of the trace metal leaching curves to follow the chloride and sulfate trends. The column effluent behavior, especially for conservative constituents such as chloride, may indicate a role of diffusive dual domain transport on long-term effluent concentrations. Higher effluent concentrations are observed during initial flushing due to displacement of residual porewater, dissolution of soluble salts, and desorption. Although effluent concentrations approach those of the influent with continued rinsing, they remain slightly elevated relative to the influent even beyond 10 pore volumes. The increases in chloride and sulfate measured at the end of the 12-day batch tests were of similar magnitude, and potentially demonstrates diffusion of constituents from micropores associated with fine-grained material into the primary porosity of the sample.

7.0 SOUTHERN AREA RESULTS

The Southern Area investigation included collection and analysis of alluvium samples from three separate borings to primarily evaluate the depth distributions and forms of uranium and other COCs (Section 2.0). A sample of the Lower Chinle Formation was also collected for general chemical and mineralogical characterization. The original lab reports including total metals and COCs, modified SPLP-extractable constituents, and selective extraction results are included as Exhibit C.

7.1 Alluvial Lithology for the Southern Area

The San Mateo alluvium in the Southern Area is heterogeneous with lithologies ranging from predominantly lean, stiff clay to predominantly unconsolidated sand and gravel with cobbles found near the alluvial bedrock interface. Detailed lithologic logs for the three Southern Area borings are provided in Appendix B. Results from downhole geophysical logging were consistent with and confirmed observations made during drilling with respect to variations in texture and moisture. A brief summary of the lithology in each borehole is provided below:

- Q51: The upper 40 feet of alluvium in well Q51 is mostly loose, dry sands, silts, and gravels. A one-foot interval of lean, stiff clay is picked up on the neutron log between 40 and 45 feet. This is the only clay layer at this location. The water table is seen at 50 feet. Below the water table, the lithology is dominantly sands and gravels.

- WME-23: The upper portion of the alluvium at this location is dominated by fine, loose, dry sands and silts. Lean, stiff, clay layers were observed between 14 and 15 feet and between 21 and 23 feet. The water table is at 55 feet. A thick clay layer is observed from 51 feet to 58 feet. Sands and gravels dominate the remaining lithology.

- WME-24: Like WME-23, the upper portion of the alluvium in WME-24 is dominated by fine, loose, dry silty sands and sand. The only lean, stiff clay layer encountered in the borehole was between 24 and 25 feet and is not very distinguishable on the geophysical logs. Groundwater was encountered at 65 feet and is confirmed by the neutron log. The lower portion of the borehole is dominated by coarse sands and gravels.

A generalized transect (Figure 7-1) indicates that the upper unsaturated zone is primarily composed of silt and fine sands, and to a lesser extent, medium sands. The saturated zone is dominated by coarse sands and gravelly sands. Boring WME-23, however, did contain a 7 ft.-thick layer of stiff clay at the water table. Figure 7-2 shows the locations of the three Southern Area borings in relation to the southern plume containing between 0.16 and 0.5 mg/L uranium, where higher uranium concentrations tend to occur in the vicinity of WME-23.

7.2 Total Constituent Distributions in Southern Area Alluvium

Selected alluvium samples from the Southern Borings were analyzed to determine the depth distributions and chemical forms of COCs in the unsaturated and saturated zones (Section 2.0). Lithologic descriptions indicated primarily silts above the water table and gravelly sands below the water table, with only a few thin isolated clay layers identified. Where adequate material was available for analysis, the clay-rich samples were targeted for testing, and select coarse-textured samples were analyzed for TOC and PSA.

Results from the Southern Borings indicate that TOC concentrations were below detection (<0.10%) in all samples, and the textural class of the samples ranges from Sand (92.5% sand with 7.5% clay) to Clay (60% clay with 7.5% sand) (Table 7.1). The COC results as a function of depth are only tabulated due to the large number of non-detectable results. Table 7.2 shows that the majority of uranium, molybdenum, and selenium results were below detection (detection limits varied depending on matrix effects) and cannot be differentiated from upgradient soils based on total content. The vanadium concentrations ranged from 11 to 39 mg/kg, also consistent with the measured range in upgradient concentrations (5 to 36 mg/kg) (Arcadis, 2018 and 2019).

The depth distributions for sulfate and chloride (1:1 water soluble) and several major elemental components in the Southern Area alluvium are shown on Figures 7-3 through 7-9. A general comparison of the 1:1 soluble chloride to groundwater conditions shows that soluble chloride concentrations in the Southern Area alluvium (Figure 7-3) were well below the range recently reported for upgradient groundwater (47-146 mg/L) (HMC and Hydro-Engineering, 2019). The general increase in chloride with depth is due to the downward migration of chloride present in

precipitation which becomes naturally concentrated as water moves through the rooting zone. Sulfate in the alluvium likely occurs as calcium sulfate (gypsum) or sodium sulfate (thenardite). Soluble sulfate concentrations were generally <200 mg/kg and relatively constant with depth, except for the WME-23 sample collected from 21 to 23 ft. bgs which contained elevated sulfate (and chloride) (1,000 mg/kg), likely due to the presence of a soluble salt (Figure 7-3).

The concentrations and depth distributions for aluminum and iron were similar to those from the Tailings Area (Section 5.3), where concentrations varied with depth and tended to be highest in clays (Figure 7-4). The variability in calcium concentrations is largely a function of calcite content (not measured), while magnesium tended to be more associated with clays (Figure 7-5), similar to the Tailings Area. Sodium and potassium concentrations are also variable with depth and tend to be associated with clays; the elevated sodium concentration at WME-23 from 21 to 23 ft. bgs is consistent with thenardite as the source of elevated sulfate in WME-23 (Figure 7-6).

7.3 Extractable Constituent Concentrations in Southern Area

A modified alkaline SPLP extraction procedure (Section 4.3) was used to evaluate the content of soluble and adsorbed uranium, molybdenum, selenium, vanadium, and select major constituents (aluminum, iron, manganese, calcium, magnesium, potassium) in the Southern Area alluvium. The extractable concentrations are presented on a solids basis (mg/kg) so they can be compared to their total concentrations (which were mostly below detection) in Table 7.2. The extractable uranium concentrations were low, ranging from 0.006 to 0.062 mg/kg (0.0003 to 0.0031 mg/L in the SPLP extract) and no consistent trends with depth were noted (Figure 7-7). The extractable uranium concentrations were also well within the range reported for upgradient soils (0.024 to 3.8 mg/kg) (Figure 7-7) (Arcadis, 2018). Similar results were obtained for extractable molybdenum, where no consistent trends with depth were observed, and the extractable concentrations (0.006 to 0.098 mg/kg) were either below or within the range of upgradient soils (0.04 to 0.84 mg/kg) (Figure 7-8) (Arcadis, 2018). Extractable selenium and vanadium concentrations generally decreased from the surface to the subsurface (Figure 7-9) and were also either below or within the range of measured upgradient concentrations (Arcadis, 2018). Extractable calcium, magnesium, and potassium concentrations (not shown) were low and relatively constant with depth, while extractable iron, aluminum, and manganese concentrations were below detection (Appendix E).

7.4 Selective Chemical Extractions for the Southern Area

A selective chemical extraction was used to provide supplemental information regarding the partitioning of COCs in the Southern Area alluvium, as described for the Tailings Area in Section 5.4. The selectivity of each extraction step was assessed by evaluating the relative proportions of a few key elements (calcium, aluminum, iron, silicon) in the alluvial extracts. Similar to the Tailings Area alluvium (Section 5.4), the results demonstrate reasonable selectivity of the chemical extractions to support their use in evaluating solid-phase forms of COCs in the alluvium. For example, the majority of calcium is carbonate bound (Figure 7-10), consistent with the presence of calcite in the alluvium. The majority of the iron is associated with the residual fraction (Figure 7-11) (present as either structural iron in clays or crystalline iron oxides), with lesser amounts of iron occurring as amorphous iron oxide which is consistent with previous mineralogical results (WME, 2019b, Arcadis 2018 and 2019). Aluminum and silicon (Figures 7-12 and 7-13) were also primarily associated with the residual fraction due to the presence of aluminosilicate clays and quartz.

The total uranium concentrations in the Southern Area alluvium (measured from a strong acid digestion, Method 3050) were generally <1 mg/kg (Table 7.2). The sum of uranium extracted from all selective extraction steps was consistent, and also showed the total uranium to be < 1 mg/kg. The extraction data on Figure 7-14 indicate the majority of uranium is associated with carbonates and iron/manganese oxides, but is also distributed among the soluble, adsorbed, and reduced (organic/sulfide) phases (uranium in the residual fractions were all reported as <3 mg/kg). In comparison, total uranium concentrations were elevated in the Tailings Area alluvium and mostly associated with the water soluble and adsorbed phases, suggesting that the uranium in the Southern Area alluvium is primarily naturally-occurring. The total molybdenum and selenium concentrations were also mostly <1 mg/kg, and consequently their concentrations in a majority of the extraction solutions were also non-detectable. Due to the high percentage of non-detectable molybdenum and selenium values, those results were not charted but are provided in Appendix E.

8.0 LOWER CHINLE FORMATION

Chemical and mineralogical results for the Lower Chinle Shale sample from boring WME-24 (95 - 100 ft.) are provided in Table 8.1. The sample is dominated by smectite and quartz, with lesser amounts of calcite, consistent with a shale lithology. Total organic carbon content was less than 0.10%. Total uranium, molybdenum, and selenium were all <1 mg/kg, while the higher vanadium content indicates it is associated with smectite. The amorphous iron content measured using selective extraction (Figure 7-11) was very low (<0.01%) compared to the overlying alluvium due to the

predominance of quartz and clay in the Lower Chinle Shale. The measured CEC (70.7 meq/100 g) is consistent with the measured content of smectite (77%) which in pure form has a CEC of approximately 100 meq/100 g (Brady, 1990). Based on the chemical and mineralogical results, the primary attenuation mechanism for COCs in the Lower Chinle would be surface complexation (adsorption) to the surfaces of clay minerals.

9.0 SUMMARY AND CONCLUSIONS

The Tailings Area investigation showed the LTP and STP tailings solids are heterogeneous and consist of alternating layers of poorly-graded sands, silts, and clays which become more reducing with depth. The COC concentrations in the tailings are highly variable but generally elevated compared to the underlying alluvium, which contain lithologies ranging from predominantly clay to predominantly sand. When compared to upgradient soils, impacts to the alluvium are apparent down to approximately 20 ft. based on the trends in sulfate, chloride, uranium, selenium, vanadium, and radium-226. In several borings however, molybdenum concentrations in the underlying alluvium are elevated at greater depths when compared to upgradient soil concentrations. A positive correlation exists between clay content and both total/soluble uranium, indicating that fine-grained materials have the potential to store greater mass and release higher dissolved uranium concentrations compared to coarse-grained materials. Results from selective chemical extraction are consistent with these observations, where significant fractions of uranium and molybdenum in the underlying alluvium are water soluble, even in samples containing appreciable clay. Selenium, however, tends to be more associated with organic matter and/or sulfides due to localized reducing conditions encountered in and below the tailings.

The column test results inform the future tailing management plans; to minimize the potential for constituents to become mobilized, transported, or to affect groundwater, fluid contact should be minimized. This may be achieved through a number of strategies, such as collection of seepage through drains/sumps or capping to prevent meteoric infiltration. Additional approaches could include application of a permeable reactive barrier of phosphate or other materials to sorb or otherwise retard downward constituent migration. Notably, the amount of chloride and sulfate that was mobilized was significantly greater in the columns constructed with STP soils (Columns 4-6) than those with LTP soils (Columns 1-3). This is thought to be because of the soils under the LTP received seepage that was diluted as a result of the LTP flushing program that was employed over a number of years, while the STP did not undergo such a flushing treatment.

The Southern Area investigation results are not completely conclusive to explain the persistence of the uranium plume to the south. Both total uranium and TOC concentrations were consistently below detection and therefore it is unlikely that organic materials are serving as a reservoir of stored uranium. Also, the saturated zone tends to be dominated by very coarse-grained materials which would transport dissolved uranium relatively quickly compared to fine-grained materials. One exception is a single 7-ft.-thick clay layer identified near the water table at WME-23. Although the total and extractable uranium in this zone was equal to or lower than other coarse-grained materials analyzed, its proximity to the core of the southern plume could potentially indicate that a higher abundance of fine-grained materials is slowing uranium transport just upgradient of WME-23. The potential for dual domain transport, where uranium diffusion into fine-grained materials can retard transport, is plausible based on both column testing results and observed correlations of uranium with clay content in the Tailings Area alluvium.

The concentrations of total uranium, molybdenum, selenium, and vanadium in the Southern Area alluvium are consistent with those for alluvium samples collected upgradient of the Site, and water-soluble indicator constituent concentrations (nitrate, chloride, sulfate) were either non-detectable or very low. Characterization of the underlying Lower Chinle confirm the shale material is dominated by smectite and quartz and that the primary attenuation mechanism for COCs in the Lower Chinle would be adsorption to the surfaces of clays.

10.0 REFERENCES

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Tables

Table 3.1 Well Completion Summary.

Well ID	Latitude	Longitude	Completion Lithology	Total Depth (ft. T.O.C.)	Top of Screen (ft. T.O.C.)
WME-18	35°14'39.86"N	107°52'6.33"W	San Mateo Alluvium	154.0	149.0
WME-19	35°14'31.39"N	107°51'40.49"W	San Mateo Alluvium	138.0	133.0
WME-20	35°14'32.06"N	107°52'2.88"W	San Mateo Alluvium	154.0	149.0
WME-21	35°14'5.83"N	107°51'40.06"W	San Mateo Alluvium	72.0	67.0
WME-22	35°14'5.83"N	107°51'45.77"W	San Mateo Alluvium	74.0	69.0
Q51	35°13'13.55"N	107°52'02.71"W	San Mateo Alluvium	76.0	46.0

Table 4.1 Sampling Intervals (ft. Below Alluvium Surface) for Alluvium in the Tailings Area.[1]

Sample	WME-18	WME-19	WME-20	WME-21	WME-22
1	**0 - 2**	**0 -3**	0 -1	**0 - 3**	**0 - 3**
2	2 - 4	3 - 6	**1 - 2**	**4 - 6**	3 - 6
3	**4 - 5**	**7 - 9**	2 - 4	6 - 8	7 - 10
4	5 - 7	9 - 11	4 - 5	8 - 9	10 - 13
5	7 -8	12 - 15	5 - 8	9 - 12	13 - 16
6	8 -10	15 - 18	8 -10	12 - 15	**17 - 19**
7	11 - 14	18 -19	13 - 16	18 -21	19 - 20
8	18 - 20	19 - 22	17 - 19	24 - 27	20 - 23
9	20 - 23	22 - 24	19 -21	29 - 32	23 - 25
10	23 - 27	30 -33	23 - 26	34 - 37	25 - 26
11	29 - 32	40 - 43	32 - 35	38 - 41	27 - 30
12	40 - 43	47 - 50	37 - 40	42 - 45	33 - 36
13	51 - 54	60 - 63	45 - 48	48 - 49	39 - 42
14	65 - 68	69 -72	53 - 56	--------	44 - 46
15	78 - 81	--------	64 - 67	--------	47 - 50
16	91 - 94	--------	75 - 77	--------	52 - 55

[1] All samples analyzed for total U, Mo, V, Se, Cl, SO_4, NO_3-N, $^{226+228}$Ra, Fe, Mn, Al, Ca, Mg, K, Na (USEPA 3050B with 6020B, Energy Laboratories). Shaded cells indicate intervals for additional analyses for particle size analysis (sand, silt, and clay), (Hydrometer, ASTM D422, ACZ Laboratories) and total organic carbon (Combustion Method ASA No. 9 29-2,2,4, Energy Laboratories). Bold numbers indicate intervals for selective extraction (Modified Tessier et al. (1979, Table 4.2), U, V, Mo, Se, Ca, Mg, Na, K, Al, Fe, Mn, Si, ACZ Laboratories).

Table 4.2 Selective Extraction Procedure for Alluvium and Chinle Bedrock Samples.

Extraction Step	Description	Reagent	Procedure
I	Water Soluble	Distilled water	1. Prepare sample by drying at 105 °C and grinding in agate mortar. 2. Weigh 2.0 g soil into 50 mL centrifuge tube. 3. Add 30 mL deionized H_2O. 4. Shake for 1 hr. 5. Centrifuge @ 12,000 g for 30 minutes. 6. Pipette supernatant into plastic syringe and filter through 0.45 µm pore-size syringe filter. 7. Analyze supernatant for U, V, Se, Mo, Ca, Mg, Na, K, Al, Fe, Mn, Si.
II	Adsorbed	0.0144 M $NaHCO_3$ / 0.0028 M Na_2CO_3	1. Add 16 mL of 0.0144 M $NaHCO_3$ / 0.0028 M Na_2CO_3 solution. 2. Shake for 1 hr. 3. Centrifuge @ 12,000 g for 30 minutes. 4. Pipette supernatant into plastic syringe and filter through 0.45 µm pore-size syringe filter. 5. Analyze supernatant for U, V, Se, Mo, Ca, Mg, Na, K, Al, Fe, Mn, Si. 6. Add 16 mL deionized H_2O into centrifuge tube containing the solid sample and hand shake for 1 minute. 7. Centrifuge @ 12,000 g for 30 minutes. 8. Pipette and discard supernatant.
III	Carbonate Bound	1 M NaOAc (pH = 5.0)	1. Add 16 mL of 1M NaOAc (adjusted to pH = 5 with HOAc). 2. Shake for 2.5 hr. 3. Repeat steps 3 through 8 in Extraction Step II.
IV	Iron/Manganese Oxide Bound	0.04 M $NH_2OH{\cdot}HCl$ in 25% (v/v) HOAc	1. Add 40 mL of 0.04 M $NH_2OH{\cdot}HCl$ in 25% (v/v) HOAc (pH ≈ 2). 2. Hand shake for 1 minute. 3. Place in oven at 96 ± 3 °C for 6 hrs. Hand shake every 1 hr. 4. After 6 hrs. remove from oven and hand shake. 5. Repeat steps 3 through 8 in Extraction Step II.
V	Organic/Sulfide Bound	0.02 M HNO_3 / 3.2 M NH_4OAc	1. Add 6 mL of 0.02 M HNO_3. 2. Add 10 mL of 30% H_2O_2 adjusted to pH = 2 with HNO_3. 3. Hand shake for 1 minute. 4. Place into oven at 85 ± 2 °C for 2 hours. 5. Hand shake for 1 minute after 1 hour and 2 hours. 6. Add 6 mL H_2O_2 (pH = 2 with HNO_3) and hand shake for 1 minute. 7. Heat to 85 ± 2 °C for 3 hours. Shake for 1 minute each hour. 8. Allow sample to cool to room temperature. 9. Add 10 mL of 3.2 M NH_4OAc in 20% (v/v) HNO_3. 10. Add 8 mL deionized H_2O. 11. Shake for 30 minutes. 12. Repeat steps 3 through 8 in Extraction Step II.
VI	Residual	HF/HNO_3	1. Digest final residue using EPA Method 3052. 2. Analyze digest for U, V, Se, Mo, Ca, Mg, Na, K, Al, Fe, Mn, Si.

Table 4-3 Geochemical Testing Summary for the Southern Borings.

Analyte	Boring ID			Total Number
	Q51	WME-23	WME-24	
San Mateo Alluvium				
Total Metals [1]	6	6	6	18
Total Organic Carbon	3	3	3	9
Leachable Metals [2]	6	6	6	18
Particle Size Distribution [3]	3	3	3	9
Selective Extraction [4]	3	3	3	9
Upper Chinle (Q51), Middle Chinle (WME-23), Lower Chinle (WME-24)				
Cation Exchange Capacity	-----	-----	1	1
X-Ray Diffraction	-----	-----	1	1
Total Organic Carbon	-----	-----	1	1
Selective Extraction	-----	-----	1	1

[1] USEPA 3050 with 6020B for Al, Fe, Ca, K, Na, P, V, U, Mo, Se.
[2] Modified USEPA 1312: SPLP with alkaline extraction. (U, V, Mo, Se, Ca, Mg, Na, K, Al, Fe, Mn, Si).
[3] Sand, silt, clay (Hydrometer).
[4] Modified Tessier et al. (1979) (U, V, Mo, Se, Ca, Mg, Na, K, Al, Fe, Mn, Si) - Table 4.2 (Fine and coarse grained material from unsaturated and saturated zone).

Table 5.1 Total Constituent Concentrations for LTP and STP Tailings Samples.[1]

Parameter	Large Tailings Pile (LTP)						Small Tailings Pile (STP)			
Location	WME-18		WME-19		WME-20		WME-21		WME-22	
Depth (ft. bgs)	35	70	35	70	35	70	10	20	10	20
Aluminum	11000	6860	2480	4550	6320	4790	11900	14800	5040	23600
Calcium	54200	19700	36600	16500	59600	15500	7140	27400	6790	16500
Chloride	280	89	110	72	590	180	90	3800	84	430
Iron	14900	10400	5610	7550	9510	9200	9910	24100	4390	19700
Magnesium	3330	1730	669	1260	3040	1450	3090	5330	1700	6000
Manganese	302	346	238	243	326	251	190	500	51	241
Moisture Content (%)	27.6	20.7	10.2	18.7	16.2	20.8	7.5	31	6	17.4
Molybdenum	14	17	4	4	19	10	1	38	2	32
Nitrate-N	<7	<6	<5	<6	<6	<6	40	<7	43	<6
Potassium	1890	1360	642	918	1500	1210	2860	2480	1220	5230
Radium-226 (pCi/g)	756 ±141	789 ±148	228 ±42.8	288 ±53.8	417 ±78.1	510 ±95.4	1.1 ±0.2	1610 ±301	0.8 ±0.2	428 ±80.2
Radium-228 (pCi/g)	6.4 ± 1.2	4.8 ± 0.9	1.7 ± 0.4	1.9 ± 0.5	1.9 ± 0.5	2.1 ± 0.5	<0.2	7.7 ± 1.4	0.4 ± 0.3	4.7 ± 0.9
Selenium	192	90	120	119	112	79	0.97	427	<1	93
Sodium	4980	3130	821	1710	4310	2550	577	12200	445	5110
Sulfate	2400	1300	710	500	5100	1200	230	6000	370	1700
Uranium	90	96	38	89	118	59	4	245	4	154
Vanadium	556	622	146	290	302	323	21	1430	10	145

[1] Dry-weight concentration (mg/kg unless otherwise indicated).

Table 5.2 Total Organic Carbon and Particle Size Analysis Results for Alluvium Below the LTP and STP.

Sample ID Location-Depth (ft.)	TOC	Clay	Sand	Silt	Textural Class
	% by weight				
WME-18-0-2	0.1	15	72.5	12.5	Sandy loam
WME-18-2-4	0.1	5	90	5	Sand
WME-18-4-5	0.5	70	12.5	17.5	Clay
WME-18-8-10	0.1	17.5	75	7.5	Sandy loam
WME-19-0-3	0.1	10	80	10	Sandy loam
WME-19-7-9	0.3	30	62.5	7.5	Sandy clay
WME-19-12-15	<0.1	10	77.5	12.5	Sandy loam
WME-19-18-19	0.3	60	10	30	Clay
WME-20-1-2	0.4	27.5	37.5	35	Clay loam
WME-20-2-4	0.2	15	75	10	Sandy loam
WME-20-5-8	0.2	20	75	5	Sandy loam
WME-21-0-3	0.1	27.5	57.5	15	Sandy clay
WME-21-4-6	0.4	25	57.5	17.5	Sandy clay
WME-21-8-9	<0.1	30	42.5	27.5	Clay loam
WME-21-12-15	<0.1	15	75	10	Sandy loam
WME-22-0-3	0.5	60	12.5	27.5	Clay
WME-22-10-13	0.3	22.5	67.5	10	Sandy clay
WME-22-13-16	0.1	20	67.5	12.5	Sandy loam
WME-22-17-19	<0.1	10	82.5	7.5	Loamy sand

Table 6-1 Laboratory Column Test Results – Composition.

Column	Percent of each lithology in column	Sample depth	Approx. DTW	Field water content	Contact with tailing drainage	U	Mo	Se	V	Cl	SO_4
		ft bta	ft bta			------------------mg/kg ----------------					
1 WME-18, LTP	80% Sand	11-14	35	wet	perched LTP drainage	**5**	2	0.9	13	**38**	**260**
	20% Clay	4-5		dry	outside of lens may be exposed, but clay is dry	4	2	**12**	**52**	25	200
2 WME-19, LTP	80% Sand	12-14	40	dry	below LTP drainage	2	**16**	1	8	**18**	260
	20% Clay	7-9		moist	perched LTP drainage	**52**	10	1	**9**	15	**510**
3 WME-20, LTP	80% Sand	0-1	62	wet	perched LTP drainage	28	5	**9**	**73**	84	500
	40% Sand	2-4		dry	below LTP drainage	5	**12**	1	11	140	**1200**
	20% Clay	1-2		moist	perched LTP drainage	**29**	10	1	33	**110**	720
4 WME-21, STP	80% Sand	12-15	35	dry	below STP drainage	17	**25**	0.9	14	200	1300
	20% Silty, sandy clay	4-6		moist	contact with STP drainage	**105**	22	**45**	**194**	**1000**	**2300**
5 WME-22, STP	80% Sand	27-30	39	moist	probably no contact with STP drainage	2	4	1	20	39	430
	20% Silty, sandy clay	0-3		unknown	outside of lens may be exposed	**124**	**25**	**50**	**54**	**470**	**1500**
6 WME-21, STP	100% Sand	18-21	35	dry	below STP drainage	10	8	1	12	97	570

bta = below top of alluvium
DTW = depth to water
ft = feet
LTP = Large Tailings Pile
mg/kg = milligram per kilogram
STP = Small Tailings Pile

Table 6-2 Laboratory Column Test Results – Tailing Water Used as Influent to Columns.

Influent (WF9 Tailing Water)					
Collection:	Day 2	Day 6	Day 8	Day 10	Day 12
In-lab pH w/ Accumet AB150 (standard units)					
pH	9.80	9.89	9.68	9.60	9.50
Anions, Ion Chromatography USEPA Method 300.0 (mg/L)					
Chloride	264	263	270	267	266
Sulfate	1620	1590	1630	1610	1620
Nitrate as N	0.03	0.04	<0.1	<0.10	<0.20
Nitrite as N	0.02H	0.06H	0.2H	0.2H	0.50
Nitrate + Nitrite as N	0.04	0.10	0.16	0.26	0.66
Total Metals by USEPA Method 6020 (ICP/MS) (mg/L)					
Molybdenum	5.68	5.87	5.96	5.64	6.06
Selenium	0.081	0.134	0.129	0.112	2.57
Uranium	1.59	1.66	1.70	1.63	1.72
Vanadium	0.04	0.05	0.05	0.04	0.21
Dissolved Metals by USEPA Method 6020 (ICP/MS) (mg/L)					
Molybdenum	-	-	5.71	5.38	5.78
Selenium	-	-	0.087	0.097	0.136
Uranium	-	-	1.6	1.55	1.64
Vanadium	-	-	0.04	0.04	0.04
Alkalinity by SM2320 (mg/L)					
Alkalinity, Total as $CaCO_3$	885	853	854	849	864

< = not detected at the reporting limit

H = analysis performed past recommended holding time

mg/L = milligram per liter

Table 6-3 Laboratory Column Test Results – Column 1.

Column 1: 80% WME-18 (11-14); 20% WME-18 (4-5)							
Collection:	Day 2	Day 3	Day 4	Day 6	Day 8	Day 10	Day 12
In-lab pH w/ Accumet AB150 (standard units)							
pH	9.01	9.23	9.18	9.32	9.40	9.39	9.32
Anions, Ion Chromatography USEPA Method 300.0 (mg/L)							
Chloride	279	280	273	280	273	272	269
Sulfate	1730	1740	1690	1730	1680	1670	1650
Nitrate as N	0.04	0.02	0.01	0.02	0.01	<0.10	<0.20
Nitrite as N	0.02H	0.02	0.01H	0.02H	0.04H	0.2H	0.60
Nitrate + Nitrite as N	0.05	0.03	0.03	0.04	0.05	0.19	0.51
Total Metals by USEPA Method 6020 (ICP/MS) (mg/L)							
Molybdenum	6.85	6.44	6.50	6.31	6.24	6.23	6.12
Selenium	0.300	0.263	0.228	0.194	0.186	0.199	0.18
Uranium	4.00	3.24	2.81	2.47	2.39	2.51	2.22
Vanadium	0.13	0.12	0.12	0.13	0.13	0.13	0.13
Dissolved Metals by USEPA Method 6020 (ICP/MS) (mg/L)							
Molybdenum	-	-	-	-	5.96	5.69	6.26
Selenium	-	-	-	-	0.192	0.207	0.193
Uranium	-	-	-	-	2.26	2.30	2.28
Vanadium	-	-	-	-	0.12	0.12	0.12
Alkalinity by SM2320 (mg/L)							
Alkalinity, Total as $CaCO_3$	695	757	783	809	818	811	820

< = not detected at the reporting limit

H = analysis performed past recommended holding time

mg/L = milligram per liter

Table 6-4 Laboratory Column Test Results – Column 2.

Column 2: 80% WME-19 (12-15); 20% WME-19 (7-9)							
Collection:	Day 2	Day 3	Day 4	Day 6	Day 8	Day 10	Day 12
In-lab pH w/ Accumet AB150 (standard units)							
pH	8.21	8.66	8.43	8.61	8.80	8.93	9.15
Anions, Ion Chromatography USEPA Method 300.0 (mg/L)							
Chloride	321	308	291	279	268	271	270
Sulfate	2230	2010	1910	1790	1680	1670	1650
Nitrate as N	0.51	0.16	0.1H	0.05	0.03	<0.10	<0.20
Nitrite as N	0.08H	0.05H	0.05	0.04H	0.07H	0.2H	0.6
Nitrate + Nitrite as N	0.59	0.21	0.16	0.09	0.10	0.24	0.61
Total Metals by USEPA Method 6020 (ICP/MS) (mg/L)							
Molybdenum	21.6	13.2	12.7	9.47	7.68	7.08	6.44
Selenium	0.057	0.058	0.047	0.043	0.053	0.069	0.079
Uranium	6.26	5.68	6.26	5.42	4.62	3.91	3.06
Vanadium	0.02	0.03	0.02	0.02	0.02	0.03	0.04
Dissolved Metals by USEPA Method 6020 (ICP/MS) (mg/L)							
Molybdenum	-	-	-	-	-	-	-
Selenium	-	-	-	-	-	-	-
Uranium	-	-	-	-	-	-	-
Vanadium	-	-	-	-	-	-	-
Alkalinity by SM2320 (mg/L)							
Alkalinity, Total as $CaCO_3$	431	557	544	576	626	653	701

< = not detected at the reporting limit

H = analysis performed past recommended holding time

mg/L = milligram per liter

Table 6-5 Laboratory Column Test Results – Column 3.

Column 3: 40% WME-20 (0-1); 40% WME-20 (2-4); 20% WME-20 (1-2)							
Collection:	Day 2	Day 3	Day 4	Day 6	Day 8	Day 10	Day 12
In-lab pH w/ Accumet AB150 (standard units)							
pH	9.74	9.71	9.62	9.68	9.66	9.62	9.62
Anions, Ion Chromatography USEPA Method 300.0 (mg/L)							
Chloride	232	296	297	288	283	280	280
Sulfate	2160	1840	1840	1780	1740	1730	1750
Nitrate as N	0.02	0.02	<0.01	0.01	<0.02	<0.1	<0.2
Nitrite as N	<0.01H	0.02H	0.02H	0.02H	0.04H	0.2H	0.5
Nitrate + Nitrite as N	0.02	0.04	0.02	0.03	0.06	0.21	0.42
Total Metals by USEPA Method 6020 (ICP/MS) (mg/L)							
Molybdenum	24.2	8.32	8.13	7.41	7.22	7.47	7.34
Selenium	0.622	0.168	0.156	0.142	0.122	0.13	0.141
Uranium	19.2	4.42	4.20	3.66	3.33	3.46	3.75
Vanadium	0.62	0.12	0.11	0.10	0.08	0.08	0.09
Dissolved Metals by USEPA Method 6020 (ICP/MS) (mg/L)							
Molybdenum	-	-	-	-	6.77	6.98	7.53
Selenium	-	-	-	-	0.111	0.12	0.134
Uranium	-	-	-	-	3.17	3.20	4.13
Vanadium	-	-	-	-	0.07	0.07	0.08
Alkalinity by SM2320 (mg/L)							
Alkalinity, Total as $CaCO_3$	1900	1210	1170	1120	1050	1030	1080
Total and Dissolved Organic Carbon by Method 5310C (mg/L)							
DOC	-	-	-	-	-	-	9.6
TOC	-	-	-	-	-	-	10.8

< = not detected at the reporting limit

H = analysis performed past recommended holding time

mg/L = milligram per liter

Table 6-6 Laboratory Column Test Results – Column 4.

Column 4: 80% WME-21 (12-15); 20% WME-21 (4-6)							
Collection:	Day 2	Day 3	Day 4	Day 6	Day 8	Day 10	Day 12
In-lab pH w/ Accumet AB150 (standard units)							
pH	8.65	8.65	8.60	8.75	8.98	9.03	9.25
Anions, Ion Chromatography USEPA Method 300.0 (mg/L)							
Chloride	828	595	562	489	360	343	304
Sulfate	3680	2960	2930	2610	2120	2060	1850
Nitrate as N	1.70	1.00	0.80	0.5	<0.1	<0.1	<0.1
Nitrite as N	0.2H	0.2H	0.2H	0.4H	0.5H	0.4H	0.60
Nitrate + Nitrite as N	1.87	1.15	1.07	0.8	0.53	0.36	0.59
Total Metals by USEPA Method 6020 (ICP/MS) (mg/L)							
Molybdenum	20.4	14.9	14.2	12.6	8.84	8.20	6.95
Selenium	1.82	1.17	1.15	0.968	0.495	0.453	0.239
Uranium	11.3	9.28	9.16	8.12	5.34	4.83	3.22
Vanadium	0.15	0.12	0.11	0.11	0.12	0.13	0.12
Dissolved Metals by USEPA Method 6020 (ICP/MS) (mg/L)							
Molybdenum	-	-	-	-	-	-	-
Selenium	-	-	-	-	-	-	-
Uranium	-	-	-	-	-	-	-
Vanadium	-	-	-	-	-	-	-
Alkalinity by SM2320 (mg/L)							
Alkalinity, Total as $CaCO_3$	560	600	600	616	669	758	757
Total and Dissolved Organic Carbon by Method 5310C (mg/L)							
DOC	-	-	-	-	-	-	-
TOC	-	-	-	-	-	-	-

< = not detected at the reporting limit

H = analysis performed past recommended holding time

mg/L = milligram per liter

Table 6-7 Laboratory Column Test Results – Column 5.

Column 5: 80% WME-22 (27-30); 20% WME-22 (0-3)							
Collection:	Day 2	Day 3	Day 4	Day 6	Day 8	Day 10	Day 12
In-lab pH w/ Accumet AB150 (standard units)							
pH	9.16	8.76	9.19	9.12	9.02	9.02	9.09
Anions, Ion Chromatography USEPA Method 300.0 (mg/L)							
Chloride	381	540	275	277	269	273	267
Sulfate	2210	3200	1680	1730	1670	1670	1630
Nitrate as N	<0.1	0.40	<0.01	<0.01	<0.01	<0.1	<0.20
Nitrite as N	0.4H	0.7H	0.06H	0.05H	0.06H	0.2H	0.50
Nitrate + Nitrite as N	0.29	1.05	0.06	0.04	0.06	0.16	0.49
Total Metals by USEPA Method 6020 (ICP/MS) (mg/L)							
Molybdenum	12.8	22.3	7.55	6.90	6.36	6.66	6.16
Selenium	0.652	1.51	0.255	0.207	0.194	0.244	0.238
Uranium	14.5	32.5	5.47	4.03	3.17	2.89	2.23
Vanadium	0.05	0.04	0.04	0.04	0.04	0.04	0.05
Dissolved Metals by USEPA Method 6020 (ICP/MS) (mg/L)							
Molybdenum	-	-	-	-	6.71	6.35	6.27
Selenium	-	-	-	-	0.223	0.248	0.251
Uranium	-	-	-	-	3.41	2.85	2.32
Vanadium	-	-	-	-	0.03	0.04	0.04
Alkalinity by SM2320 (mg/L)							
Alkalinity, Total as $CaCO_3$	800	794	715	700	706	720	719

< = not detected at the reporting limit

H - analysis performed past recommended holding time

mg/L = milligram per liter

Table 6-8 Laboratory Column Test Results – Column 6.

Column 6: 100% WME-21 (18-21)				
Collection:	Day 3	Day 4	Day 6	Day 8
In-lab pH w/ Accumet AB150 (standard units)				
pH	8.61	8.53	8.66	8.69
Anions, Ion Chromatography USEPA Method 300.0 (mg/L)				
Chloride	637	430	294	280
Sulfate	3630	2610	1820	1720
Nitrate as N	1.04	0.40	0.02	<0.20
Nitrite as N	0.02H	0.01H	0.08H	0.30
Nitrate + Nitrite as N	1.06	0.41	0.10	0.30
Total Metals by USEPA Method 6020 (ICP/MS) (mg/L)				
Molybdenum	46.0	23.0	9.9	6.61
Selenium	0.077	0.049	0.037	0.063
Uranium	15.7	14.2	10.1	6.04
Vanadium	0.04	0.05	0.05	0.07
Dissolved Metals by USEPA Method 6020 (ICP/MS) (mg/L)				
Molybdenum	-	-	-	-
Selenium	-	-	-	-
Uranium	-	-	-	-
Vanadium	-	-	-	-
Alkalinity by SM2320 (mg/L)				
Alkalinity, Total as $CaCO_3$	491	567	619	639

< = not detected at the reporting limit

H = analysis performed past recommended holding time

mg/L = milligram per liter

Table 7.1 Total Organic Carbon and Particle Size Analysis Results for Southern Area Alluvium.

Sample ID Location-Depth (ft.)	TOC	Clay	Sand	Silt	Textural Class
	% by weight				
Q51-44-45	<0.1	60.0	7.5	32.5	Clay
Q51-45-48	<0.1	7.5	62.5	30.0	Sandy Loam
Q51-60-65	<0.1	5.0	87.5	7.5	Loamy Sand
WME-23-21-23	<0.1	35	10	55	Silty Clay Loam
WME-23-51-58	<0.1	35	37.5	27.5	Clay Loam
WME-23-58-65	<0.1	12.5	77.5	10	Sandy Loam
WME-24-36-45	<0.1	10	72.5	17.5	Sandy Loam
WME-24-70-75	<0.1	5.0	67.5	27.5	Sandy Loam
WME-24-88-95	<0.1	7.5	92.5	<0.1	Sand

Table 7.2 Total Uranium, Molybdenum, Selenium, and Vanadium Results for Southern Area Alluvium.

Sample ID Location-Depth (ft.)	Uranium	Molybdenum	Selenium	Vanadium
	mg/kg			
Q51-15-25	<1	<1	<1	17
Q51-30-35	<1	<1	<1	15
Q51-44-45	1	<1	<1	33
Q51-45-48	<1	<1	<1	14
Q51-60-65	<1	<1	<1	11
Q51-65-70	<1	1	0.1	16
WME-23-14-21	1	<1	<1	14
WME-23 21-23	2	<1	0.2	31
WME-23-40-44	<1	<1	0.2	39
WME-23-51-58	<1	<1	0.1	24
WME-23-58-65	<1	<1	0.2	29
WME-23-65-70	<1	<1	<1	16
WME-24-18-22	<1	<1	<1	14
WME-24-36-45	<1	<1	<1	13
WME-24-45-55	<1	<1	<1	13
WME-24-70-75	<1	<1	<1	24
WME-24-85-88	<1	<1	<1	11
WME-24-88-95	<1	<1	0.1	12

Table 8.1 Chemical and Mineralogical Results for the Lower Chinle Sample (Boring WME-24).

Parameter	WME-24 (95 - 100')
Quartz (%)	17
Calcite (%)	4
Smectite (%)	77
Unaccounted Mineral Phases (%)	<5
Total Organic Carbon (%)	<0.10
Amorphous Iron Oxide (%)	0.0068
Cation Exchange Capacity (meq/100g)	70.7
Total Uranium (mg/kg)	0.83
Total Molybdenum (mg/kg)	0.49
Total Selenium (mg/kg)	0.09
Total Vanadium (mg/kg)	119

Figures

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FIGURE 3-1
LTP BOREHOLE AND MONITORING WELL LOCATIONS

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_LS.PPT

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FIGURE 3-2
STP BOREHOLE AND MONITORING WELL LOCATIONS

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_LS.PPT

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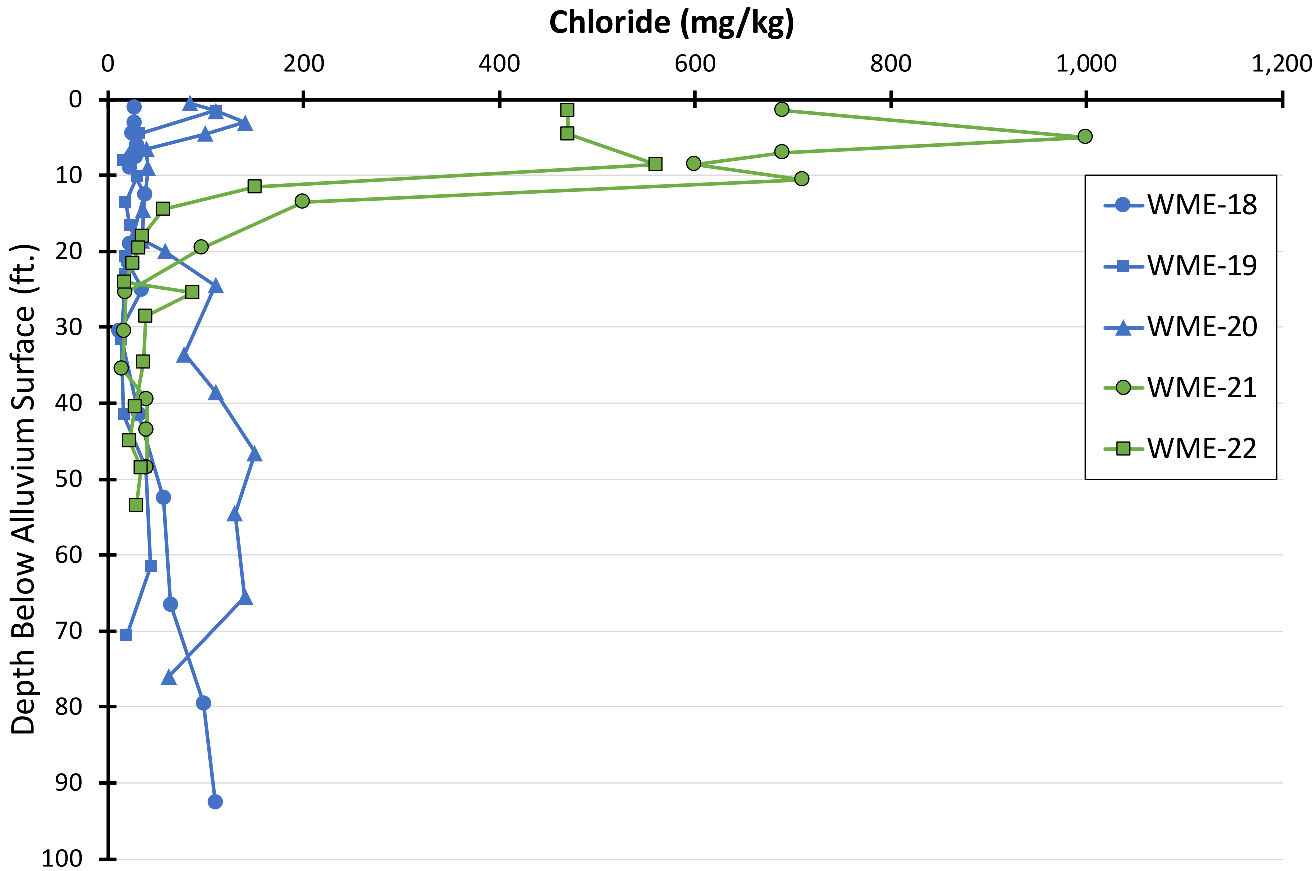
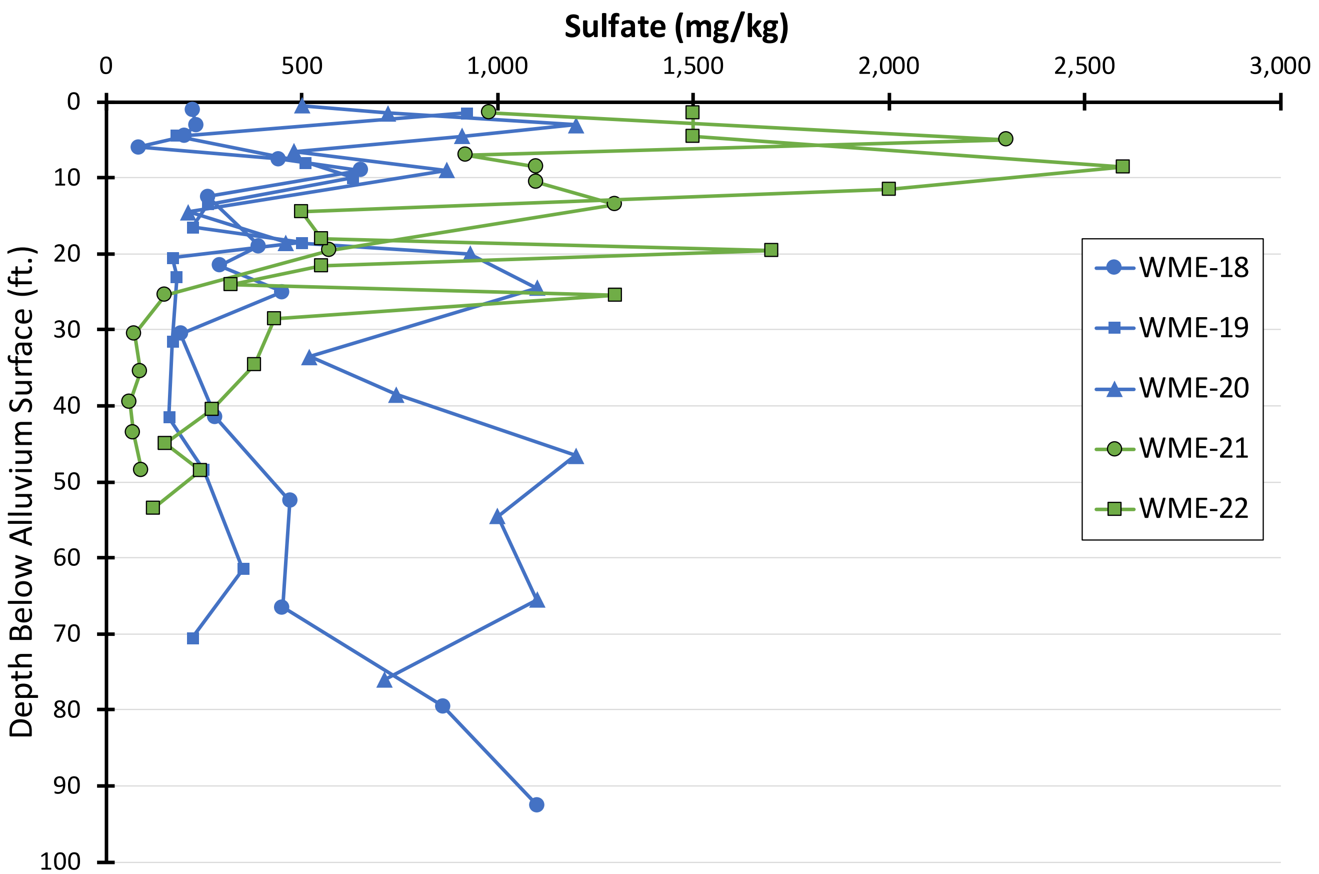
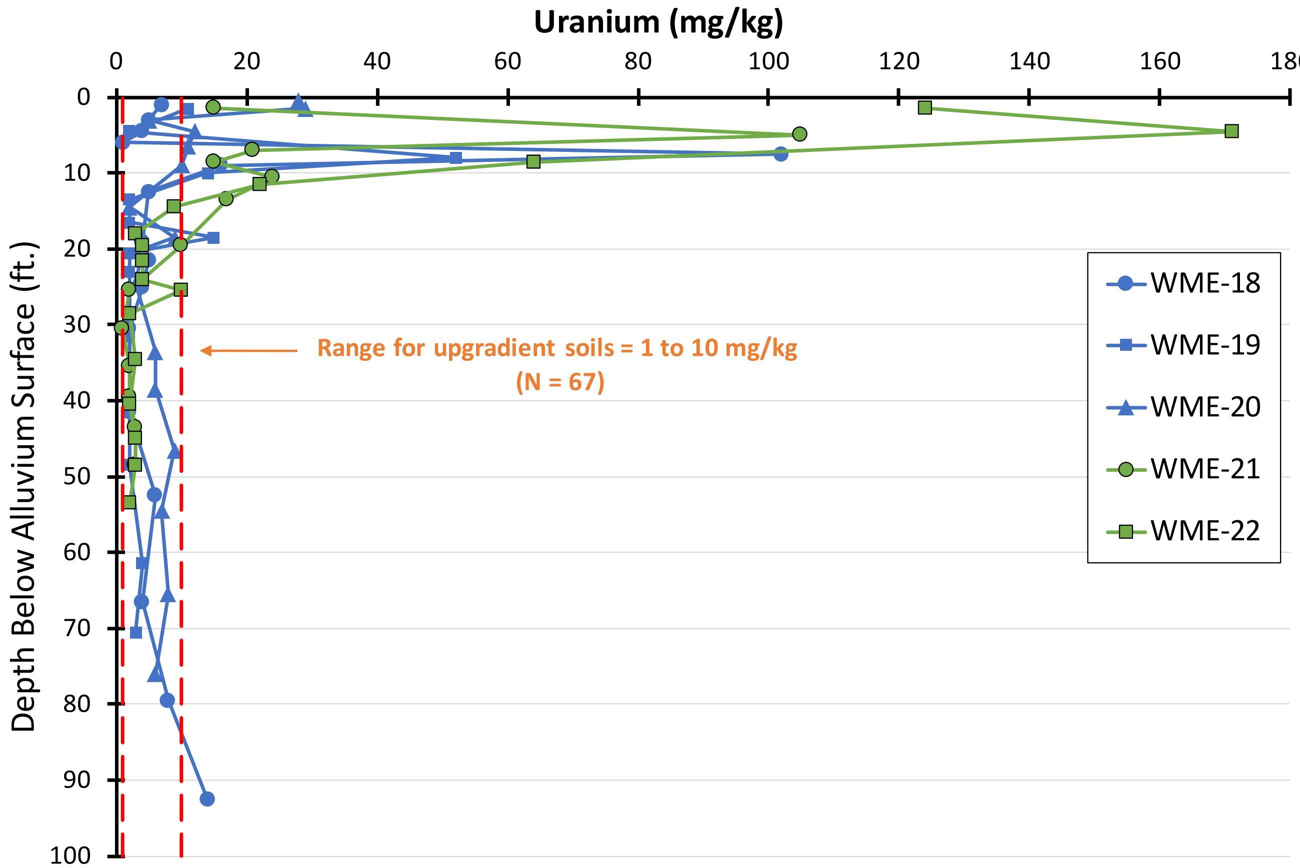
FIGURE 3-3
SOUTHERN BOREHOLE AND MONITORING WELL LOCATIONS

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_LS.PPT





WORTHINGTON MILLER ENVIRONMENTAL, LLC.	FIGURE 5-1 CHLORIDE AND SULFATE IN TAILINGS AREA ALLUVIUM	Date: April 2020 Project: HOMESTAKE File: 2019SC_FIGURES_PT.PPT



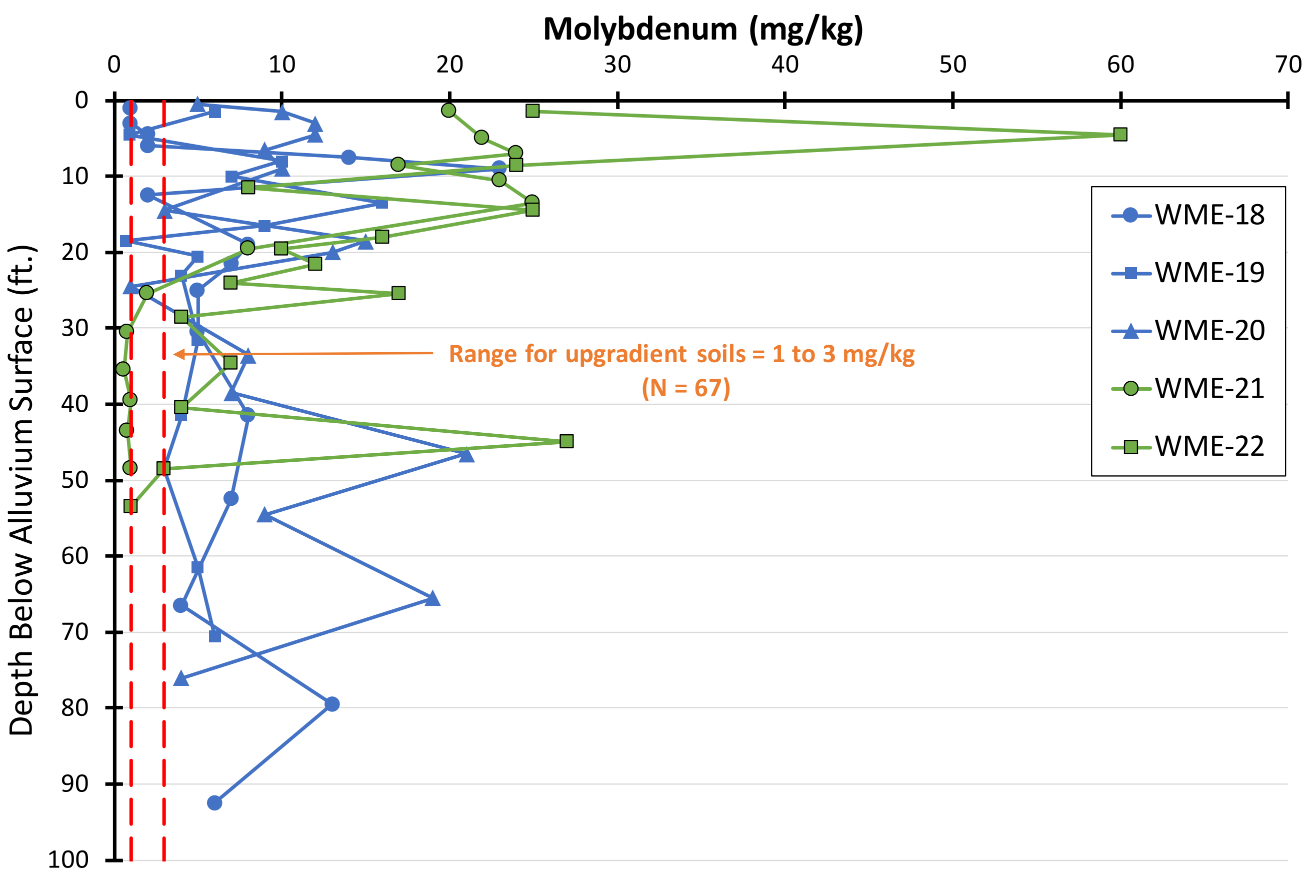


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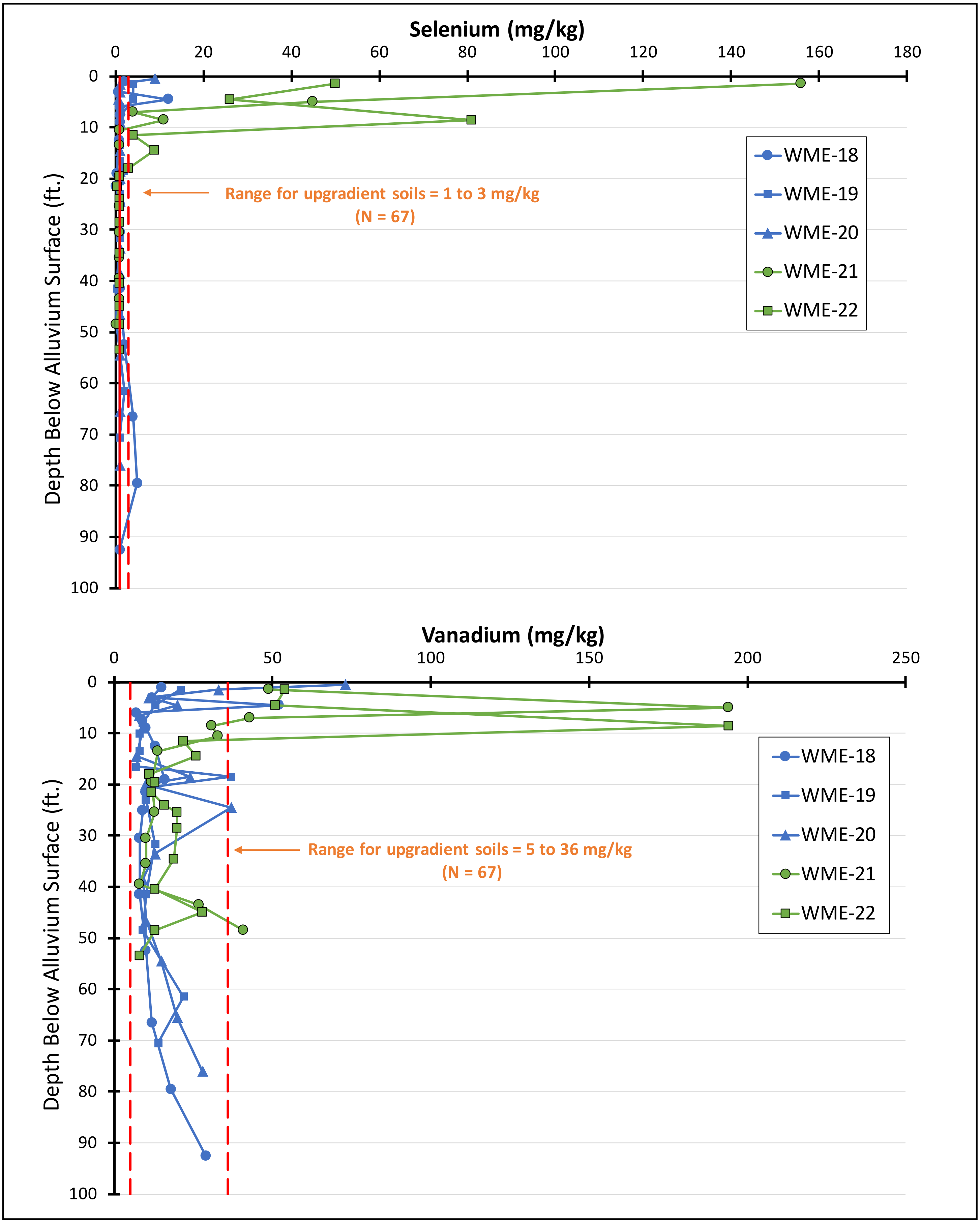
FIGURE 5-2
URANIUM AND MOLYBDENUM IN TAILINGS AREA ALLUVIUM

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_PT.PPT



WORTHINGTON MILLER ENVIRONMENTAL, LLC.	FIGURE 5-3 SELENIUM AND VANADIUM IN TAILINGS AREA ALLUVIUM	Date: April 2020 Project: HOMESTAKE File: 2019SC_FIGURES_PT.PPT

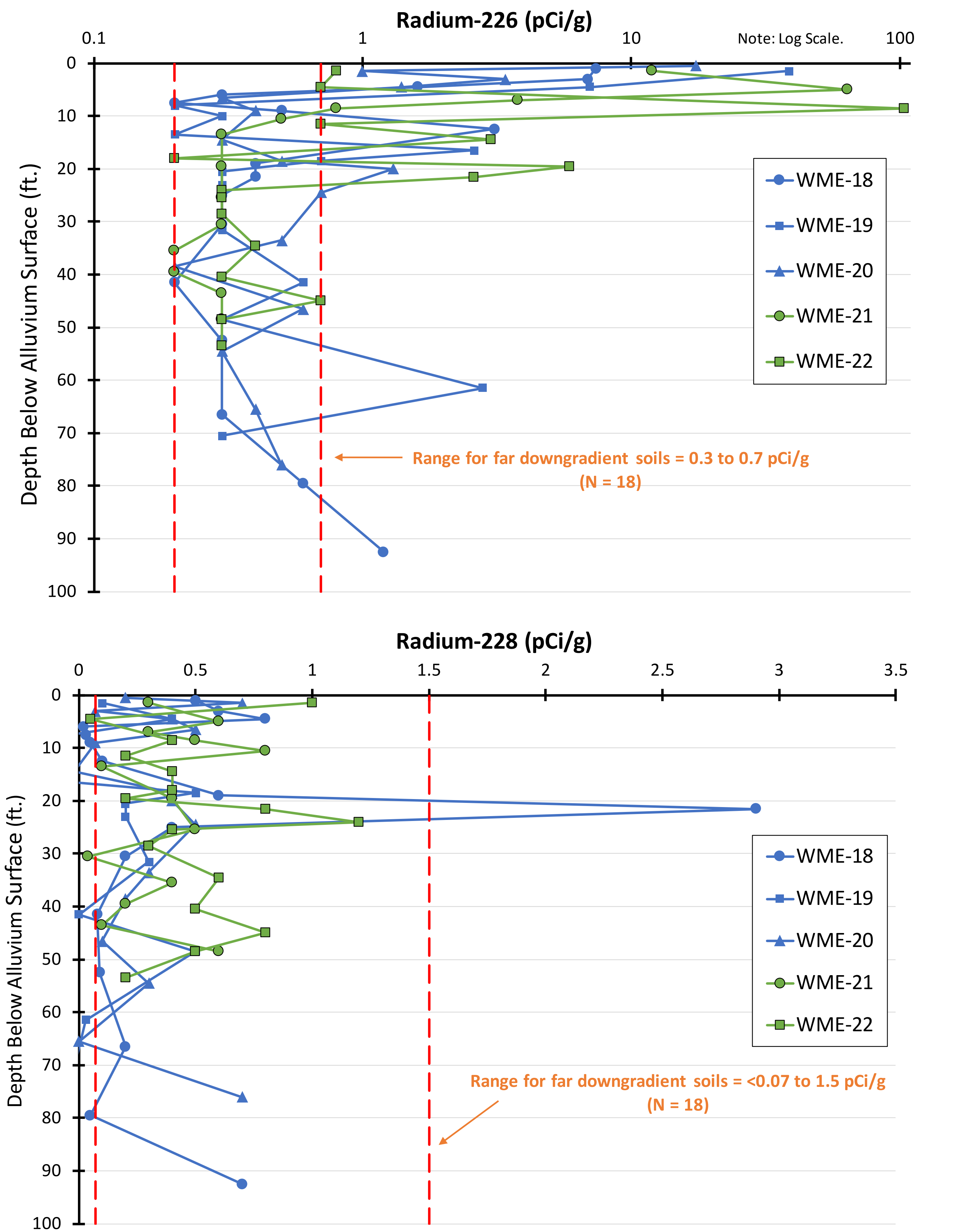


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FIGURE 5-4
RADIUM-226 AND RADIUM-228 IN TAILINGS AREA ALLUVIUM

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_PT.PPT

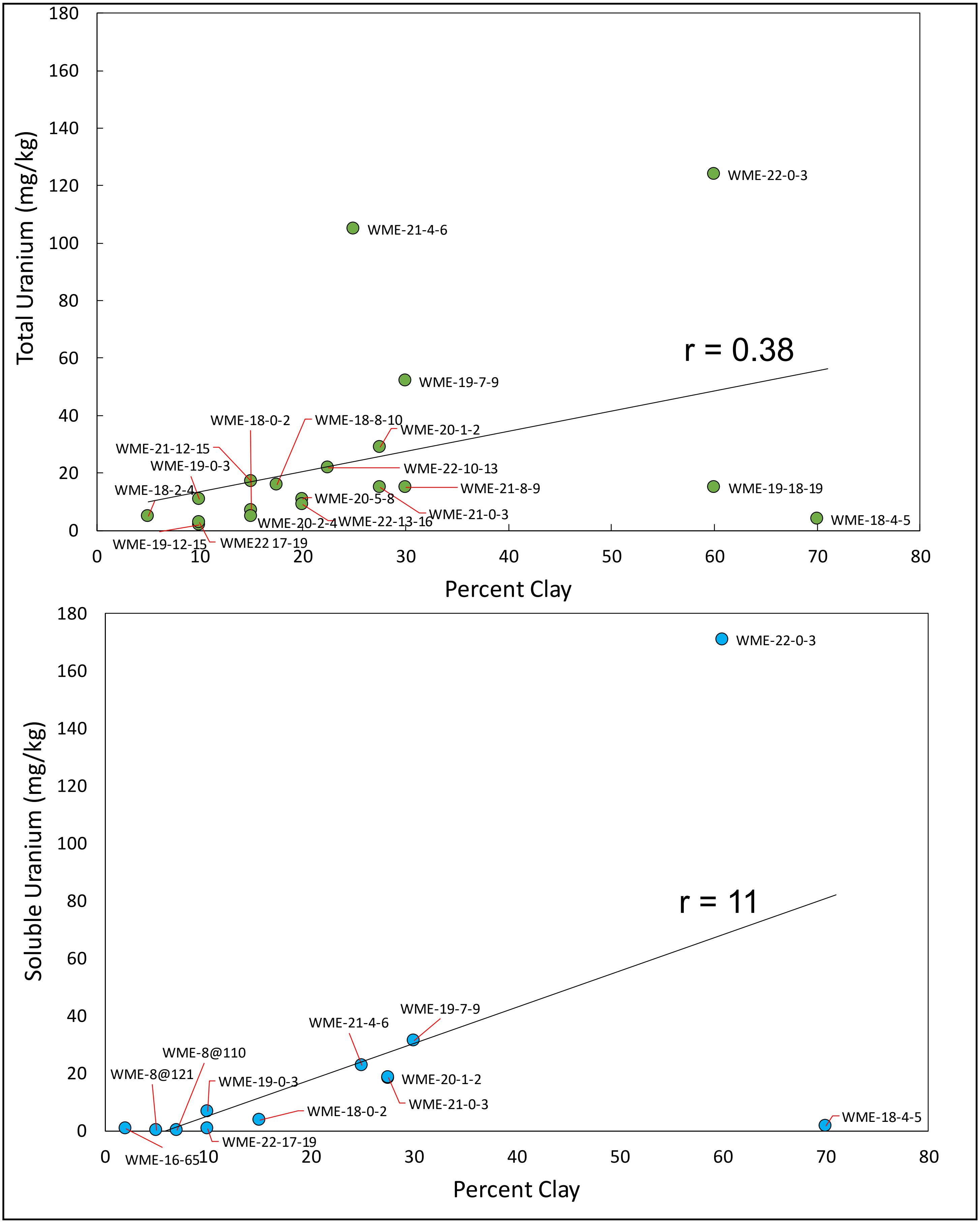

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FIGURE 5-5
TOTAL AND SOLUBLE URANIUM VS. CLAY IN TAILINGS AREA ALLUVIUM

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_PT.PPT

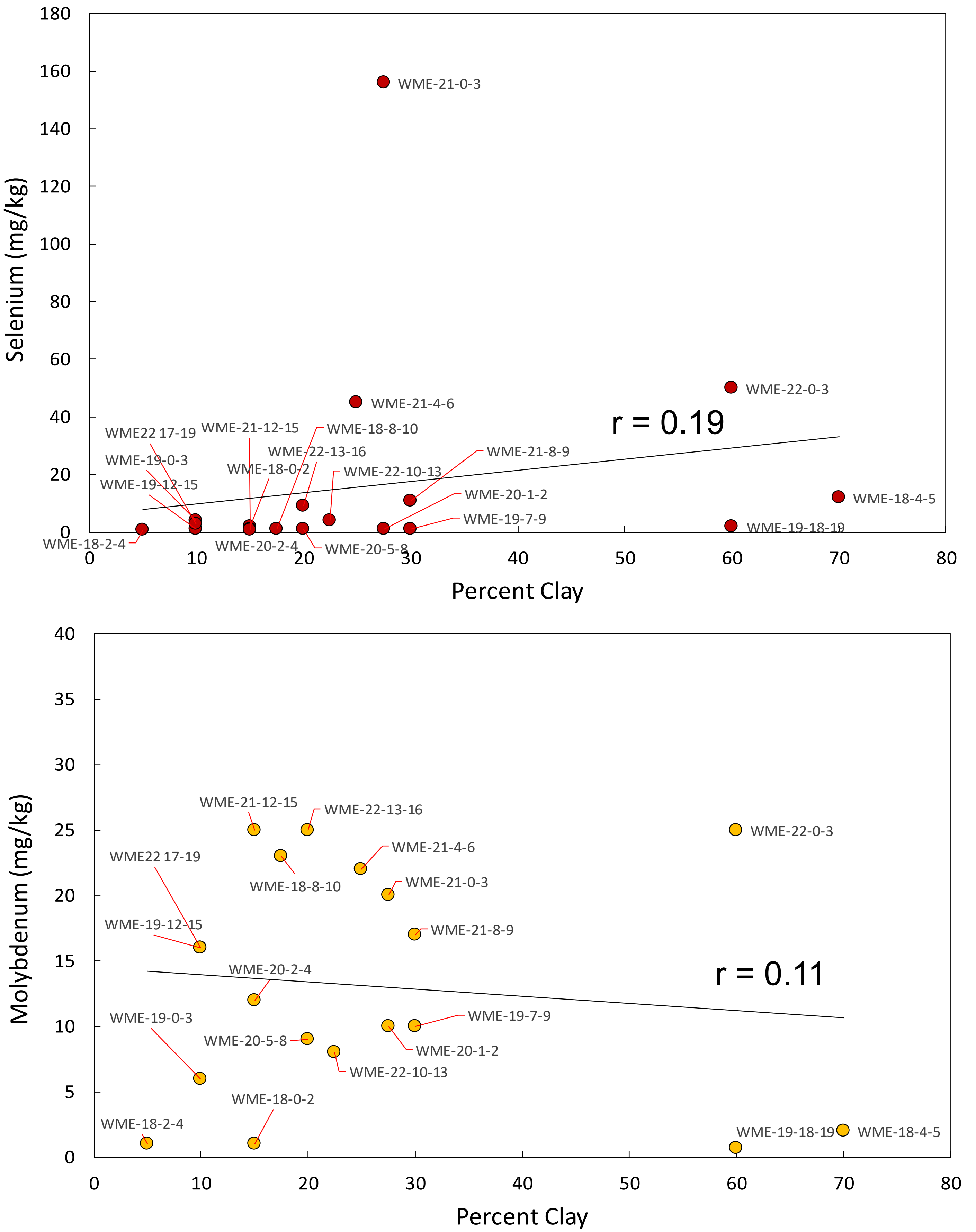

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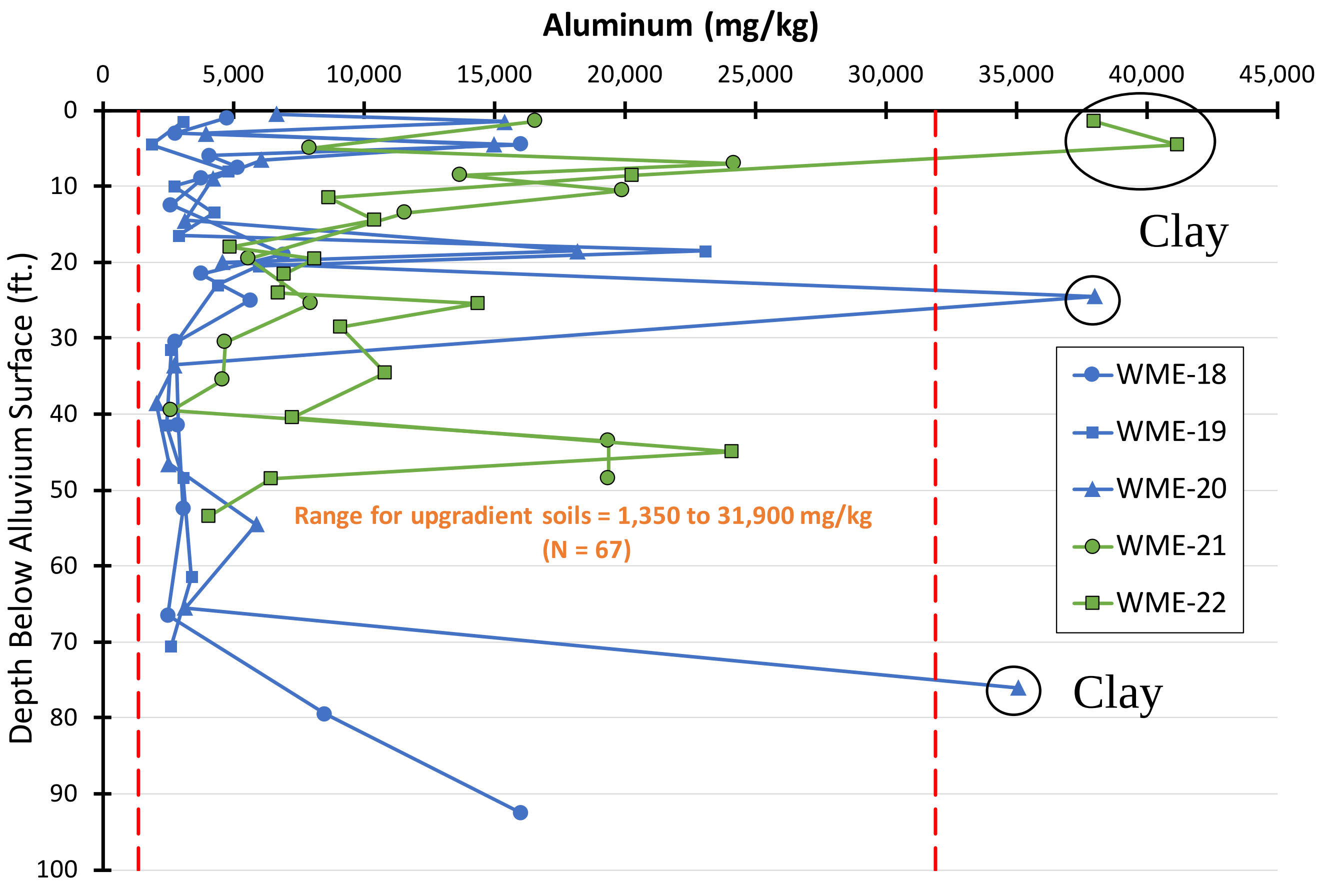
FIGURE 5-6
SELENIUM AND MOLYBDENUM VS.
CLAY IN TAILINGS AREA ALLUVIUM

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_PT.PPT



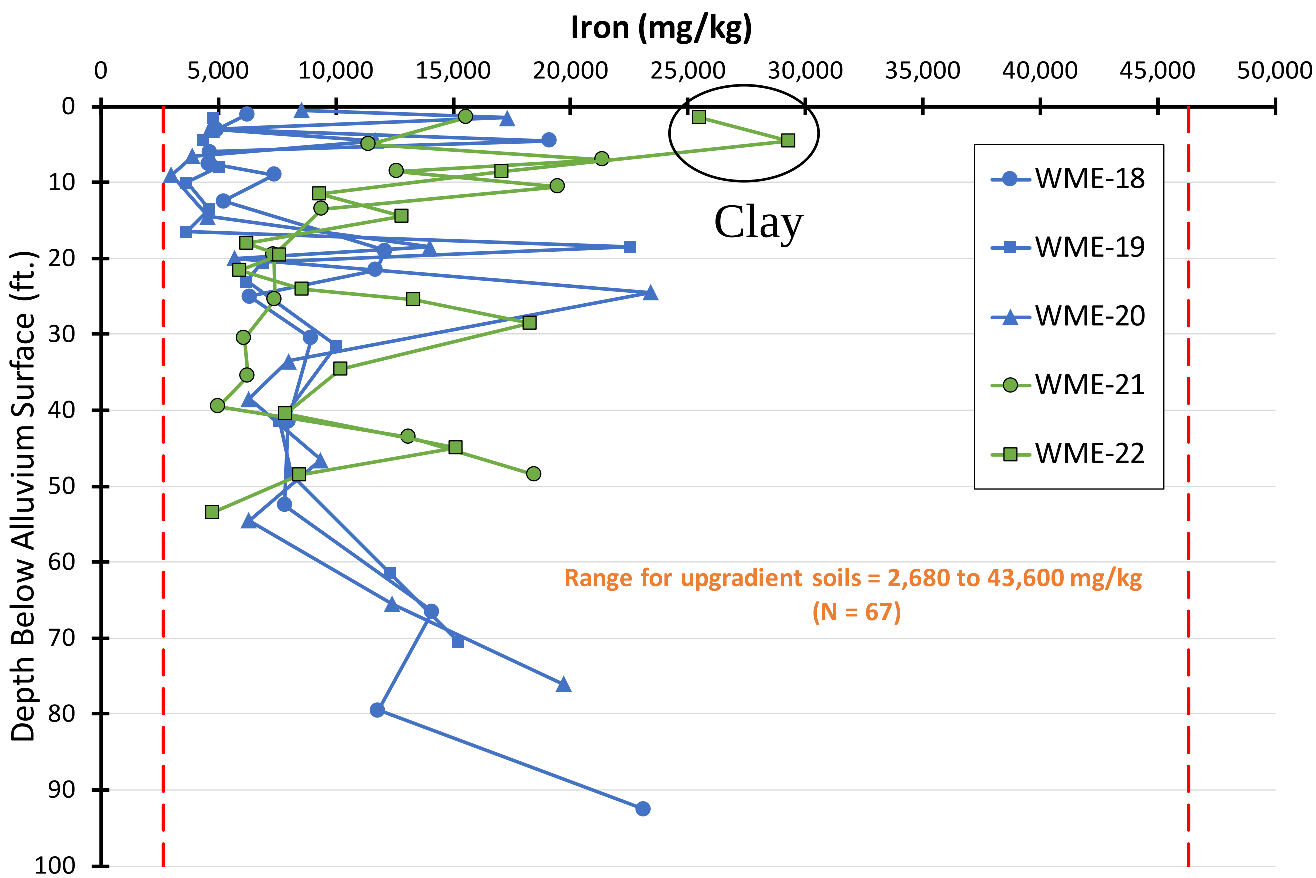


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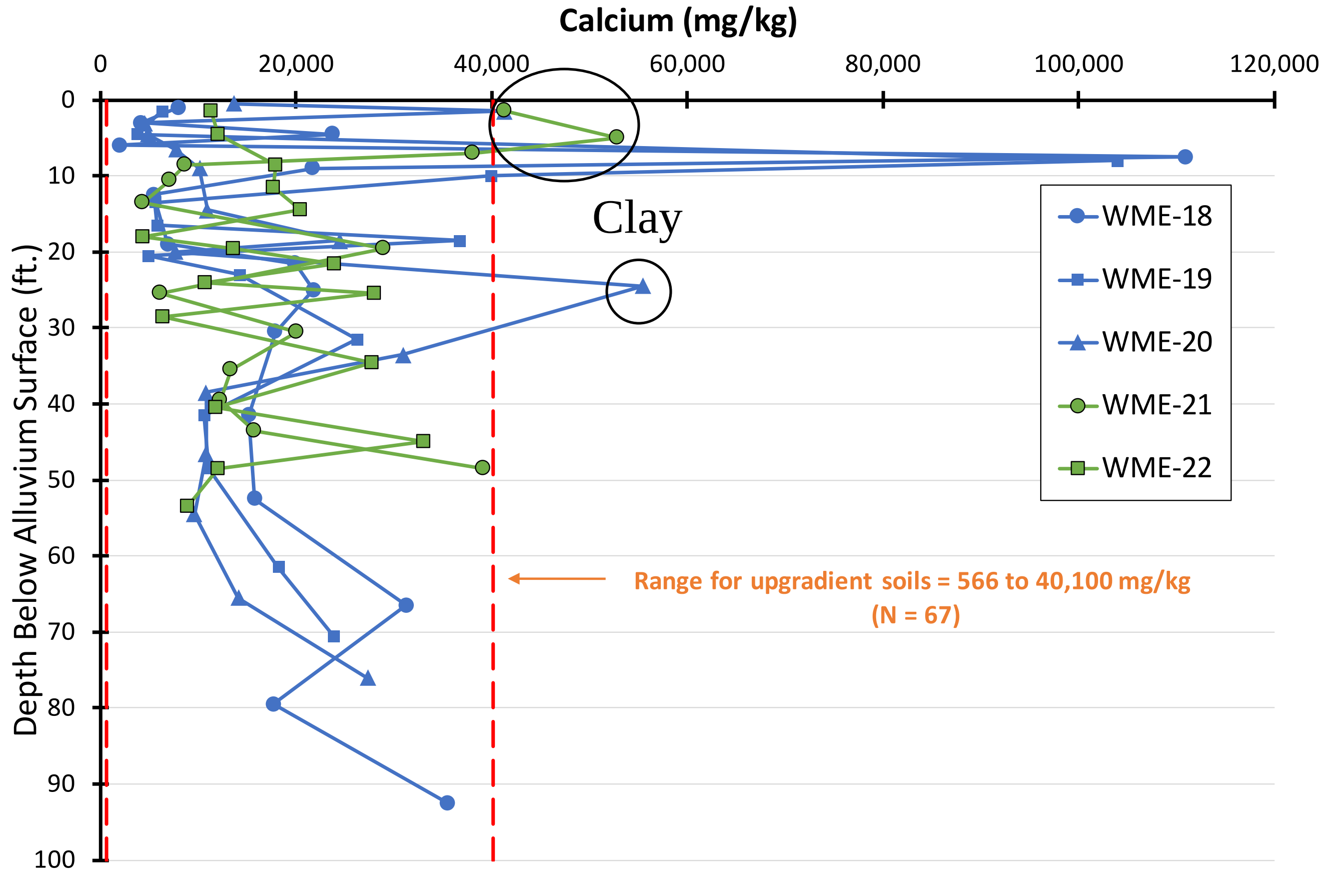
FIGURE 5-7
ALUMINUM AND IRON IN TAILINGS AREA ALLUVIUM

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_PT.PPT



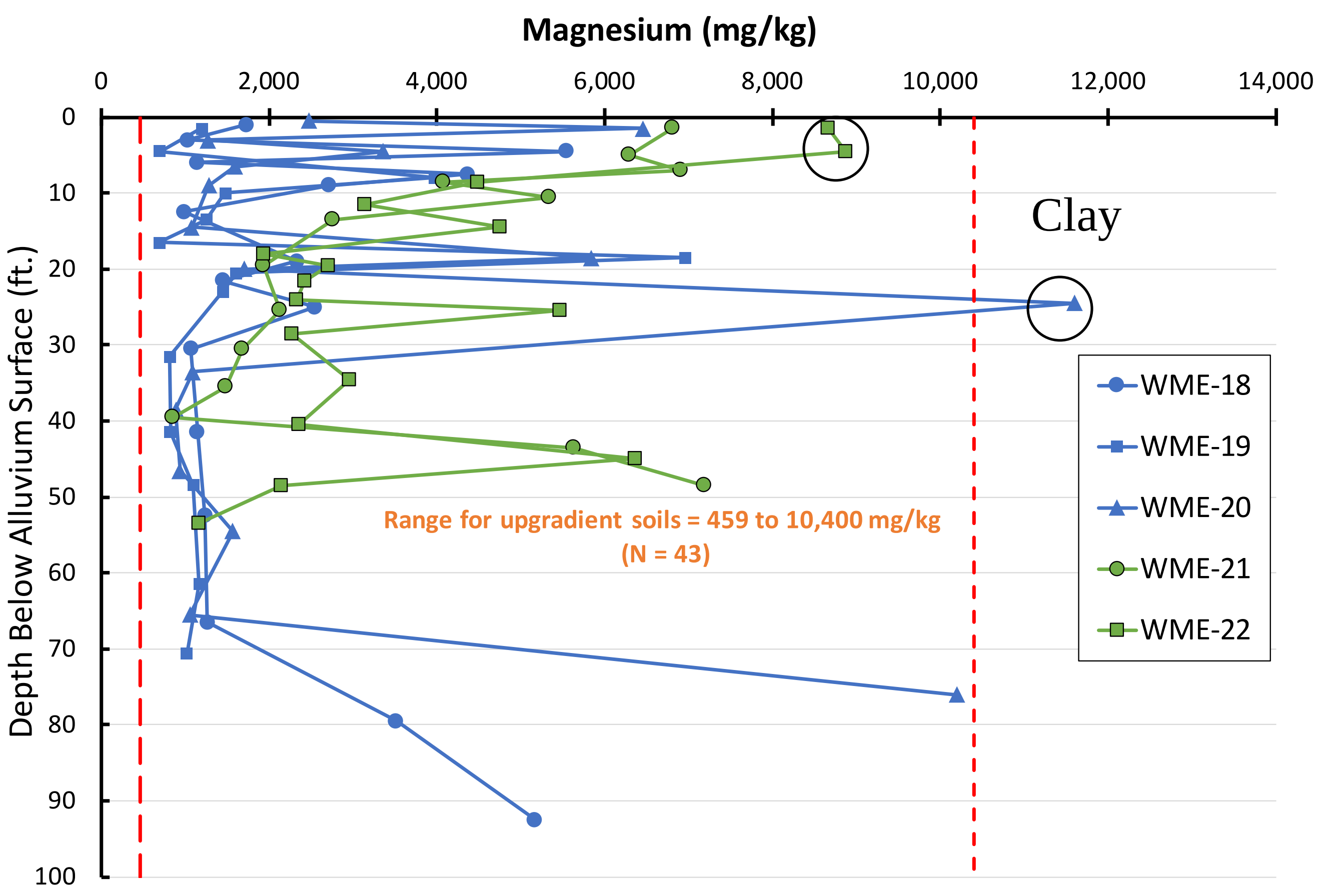


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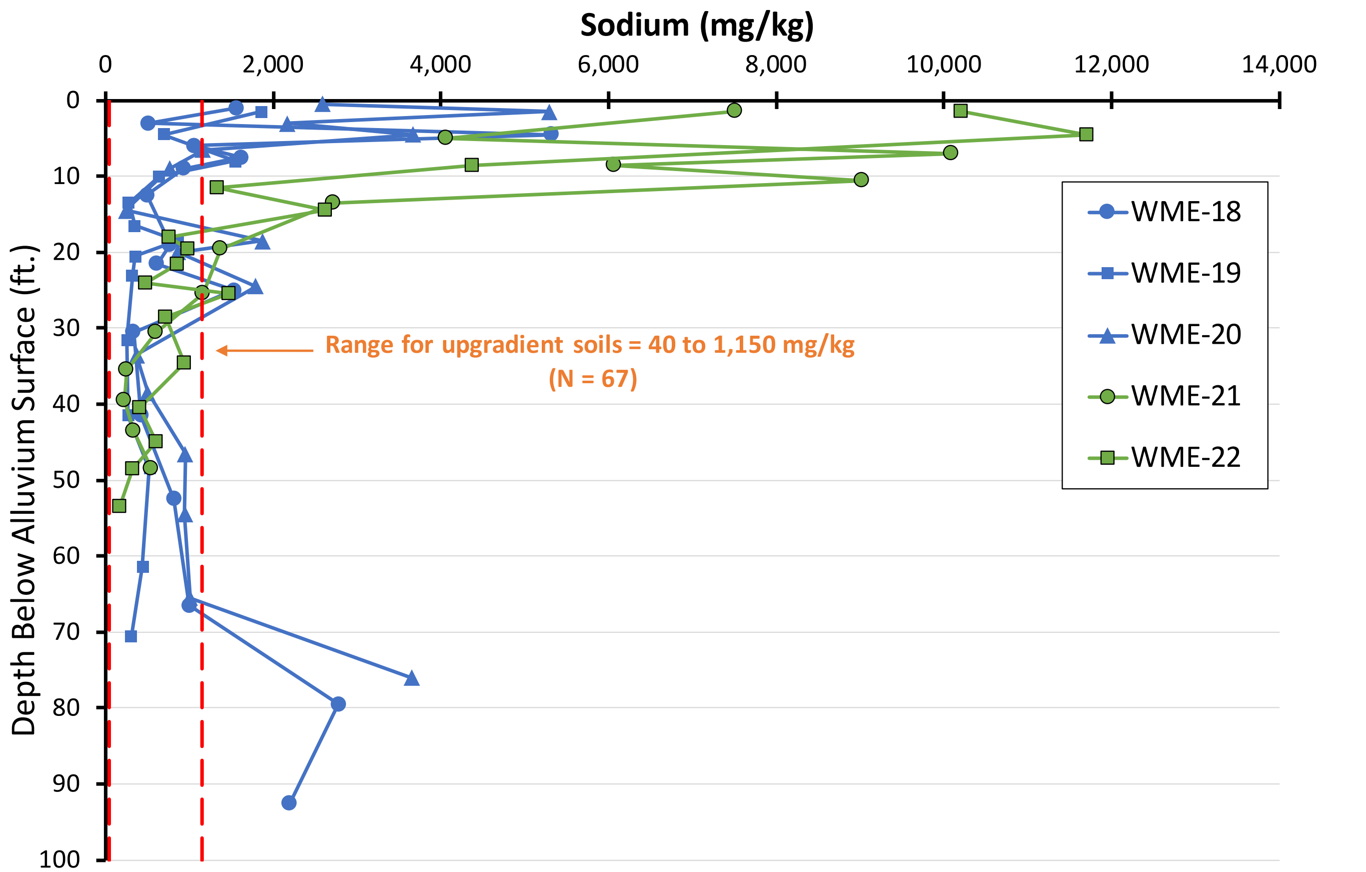
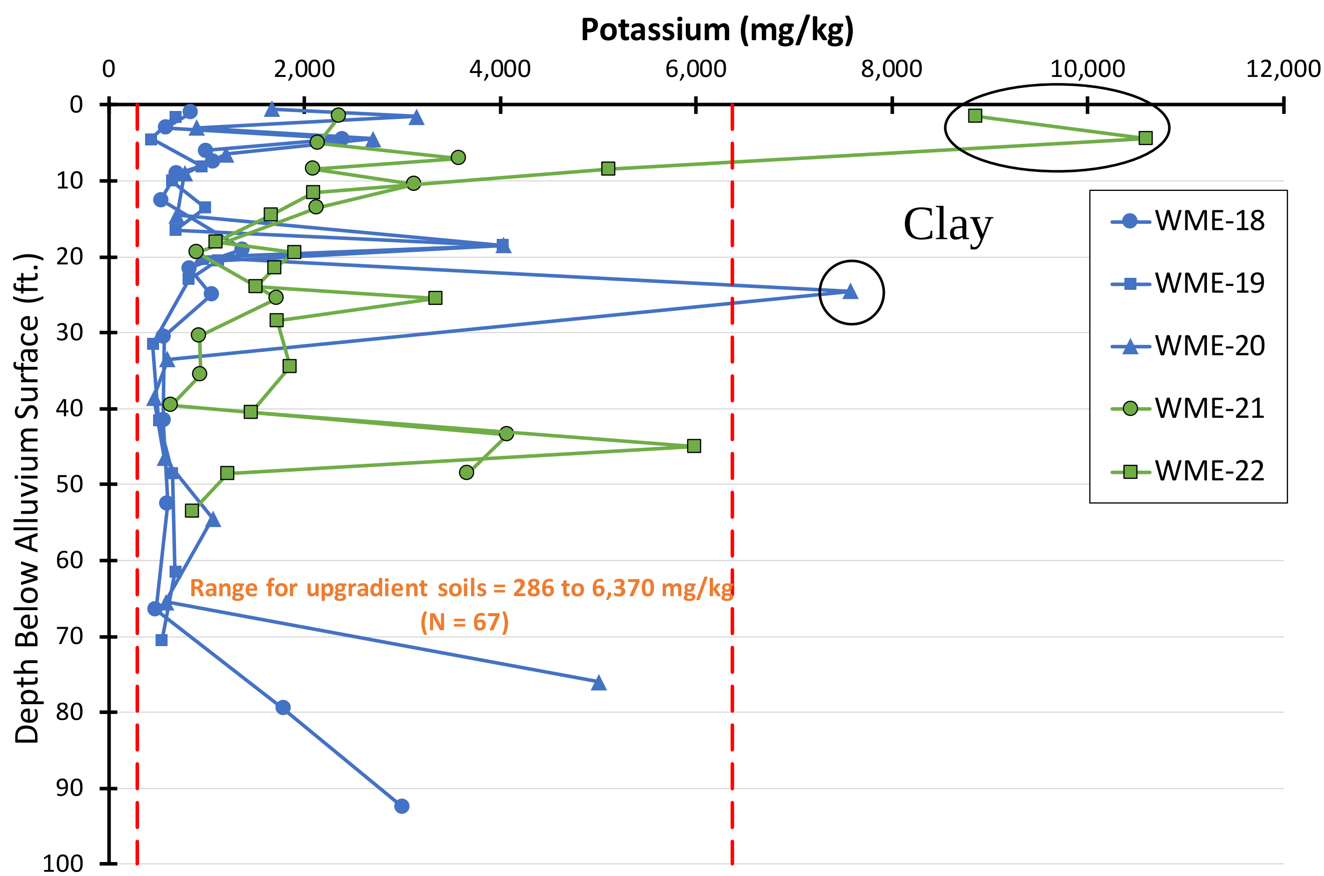
FIGURE 5-8
CALCIUM AND MAGNESIUM IN TAILINGS AREA ALLUVIUM

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_PT.PPT





WORTHINGTON MILLER ENVIRONMENTAL, LLC.	FIGURE 5-9 SODIUM AND POTASSIUM IN TAILINGS AREA ALLUVIUM	Date: April 2020 Project: HOMESTAKE File: 2019SC_FIGURES_PT.PPT

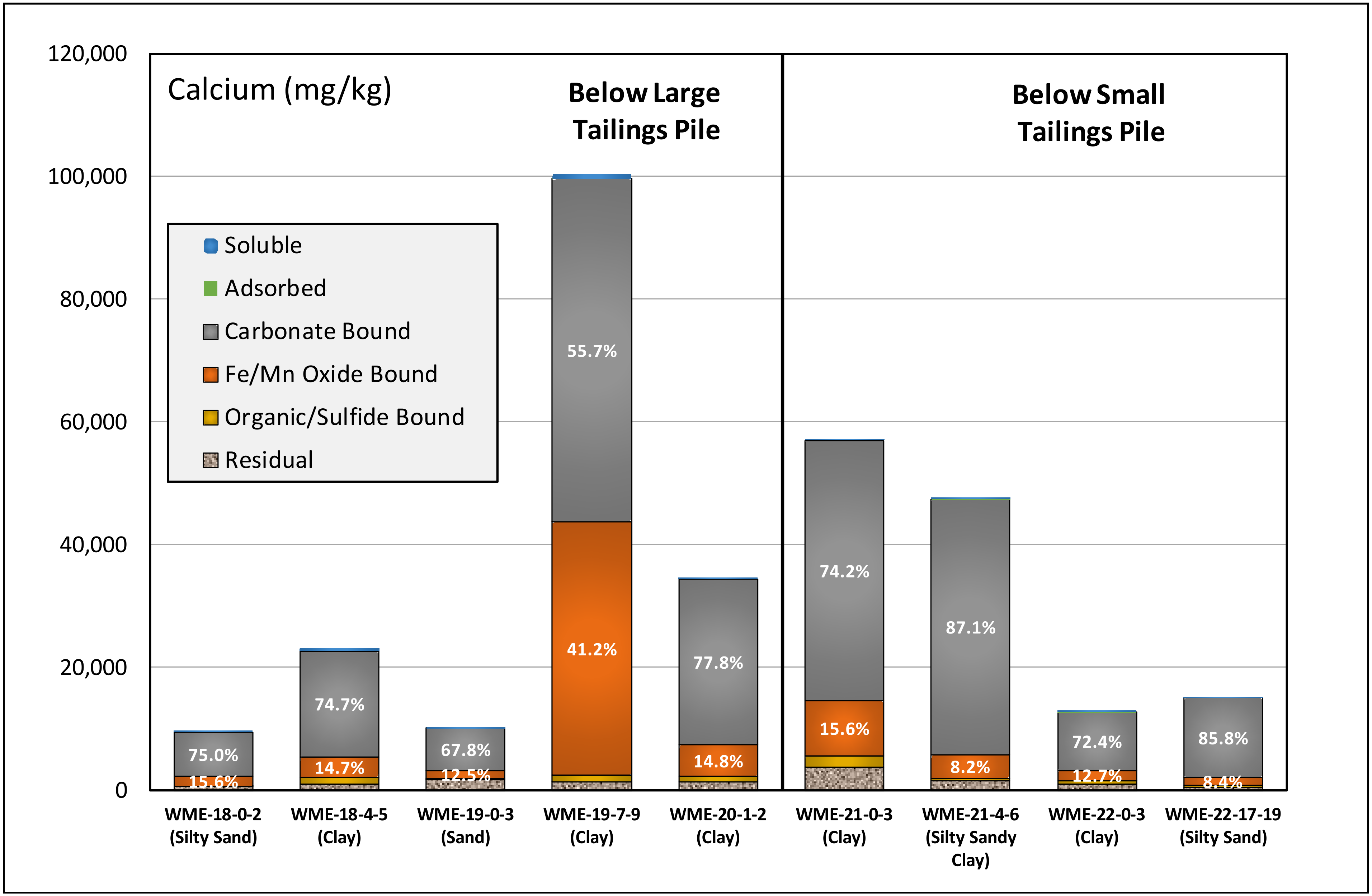


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FIGURE 5-10
SELECTIVE CHEMICAL EXTRACTION RESULTS FOR CALCIUM:
TAILINGS AREA

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_LS.PPT

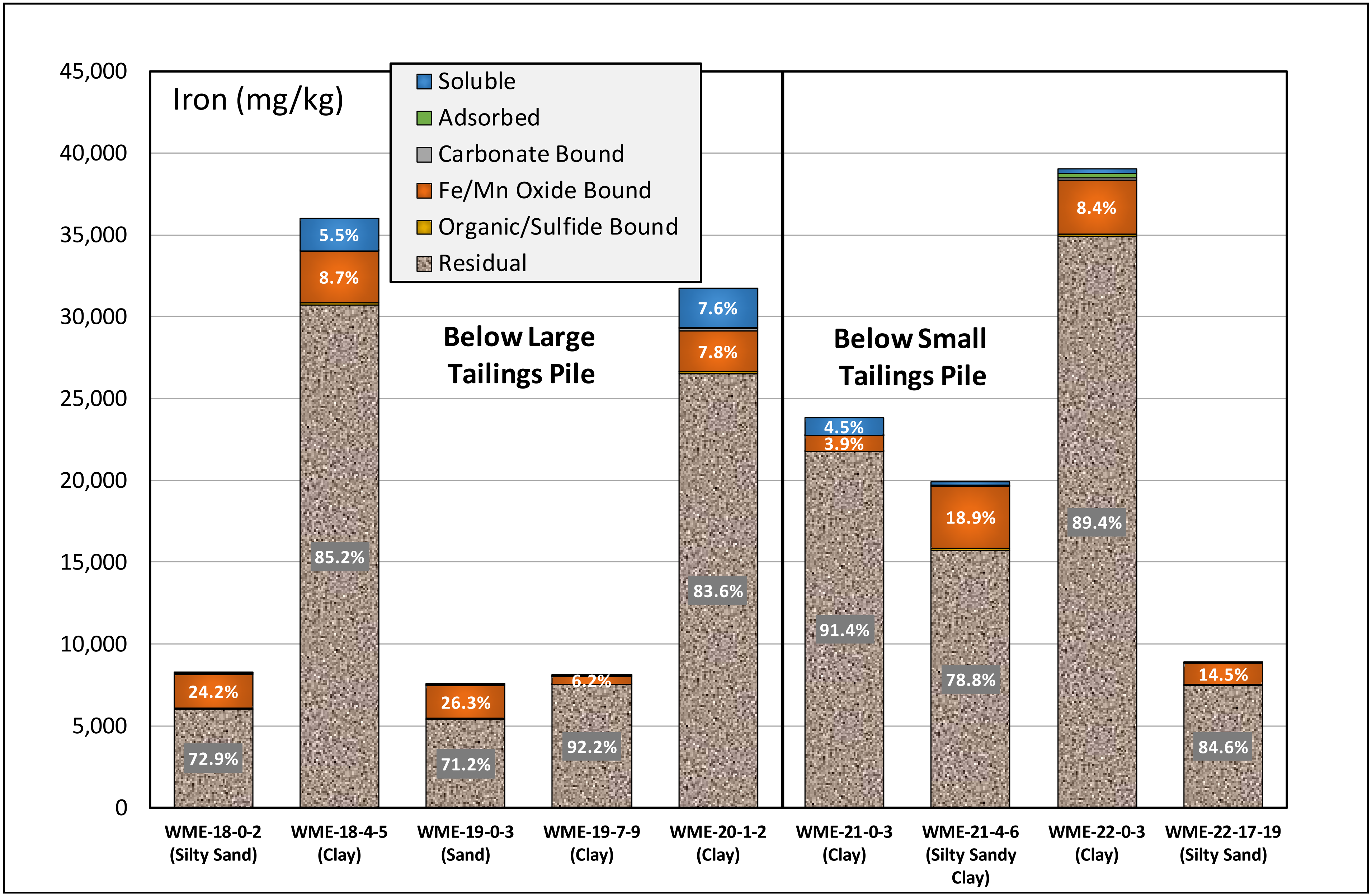

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FIGURE 5-11
SELECTIVE CHEMICAL EXTRACTION RESULTS FOR IRON: TAILINGS AREA

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_LS.PPT

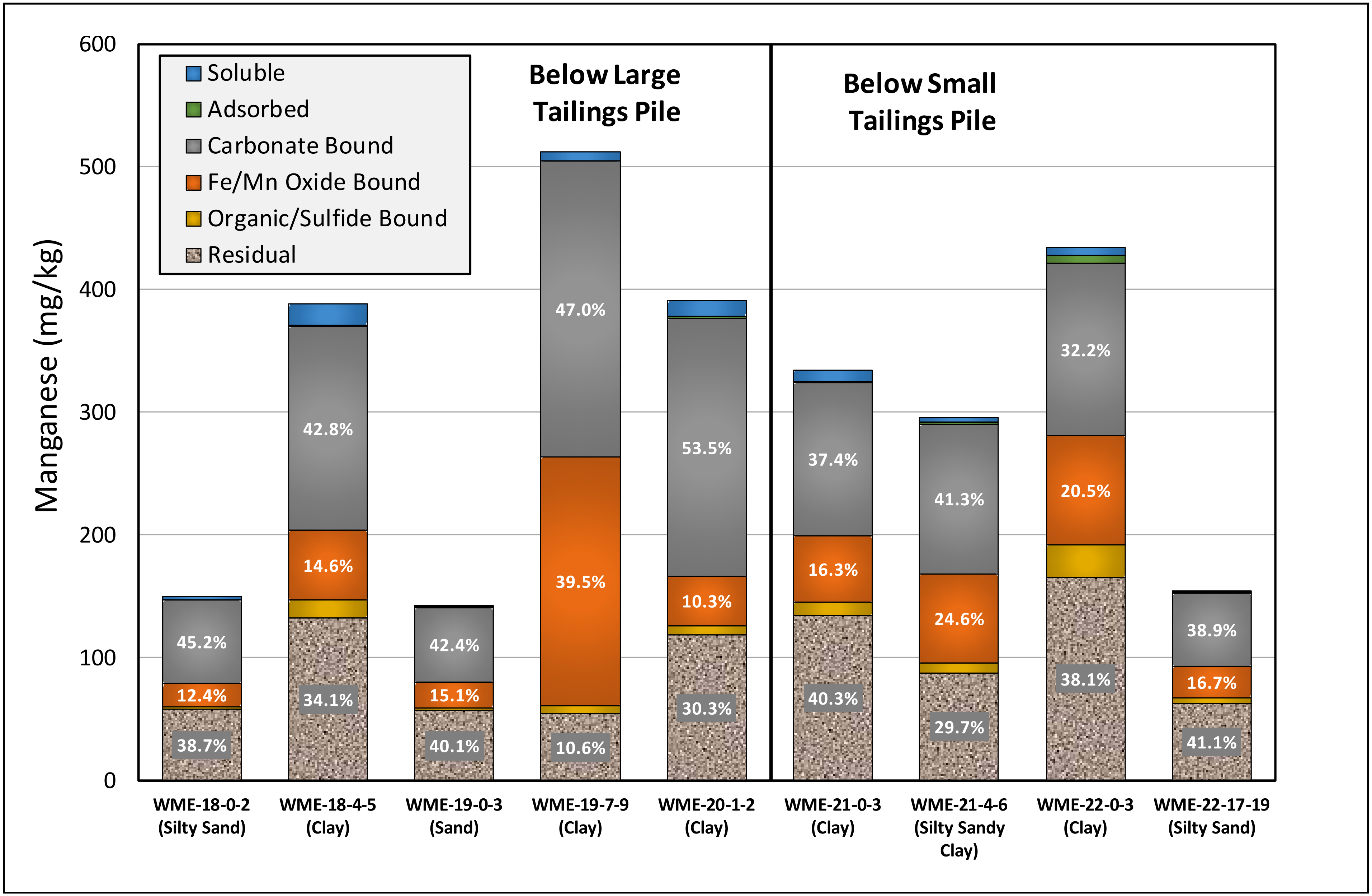

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FIGURE 5-12
SELECTIVE CHEMICAL EXTRACTION RESULTS FOR MANGANESE: TAILINGS AREA

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_LS.PPT

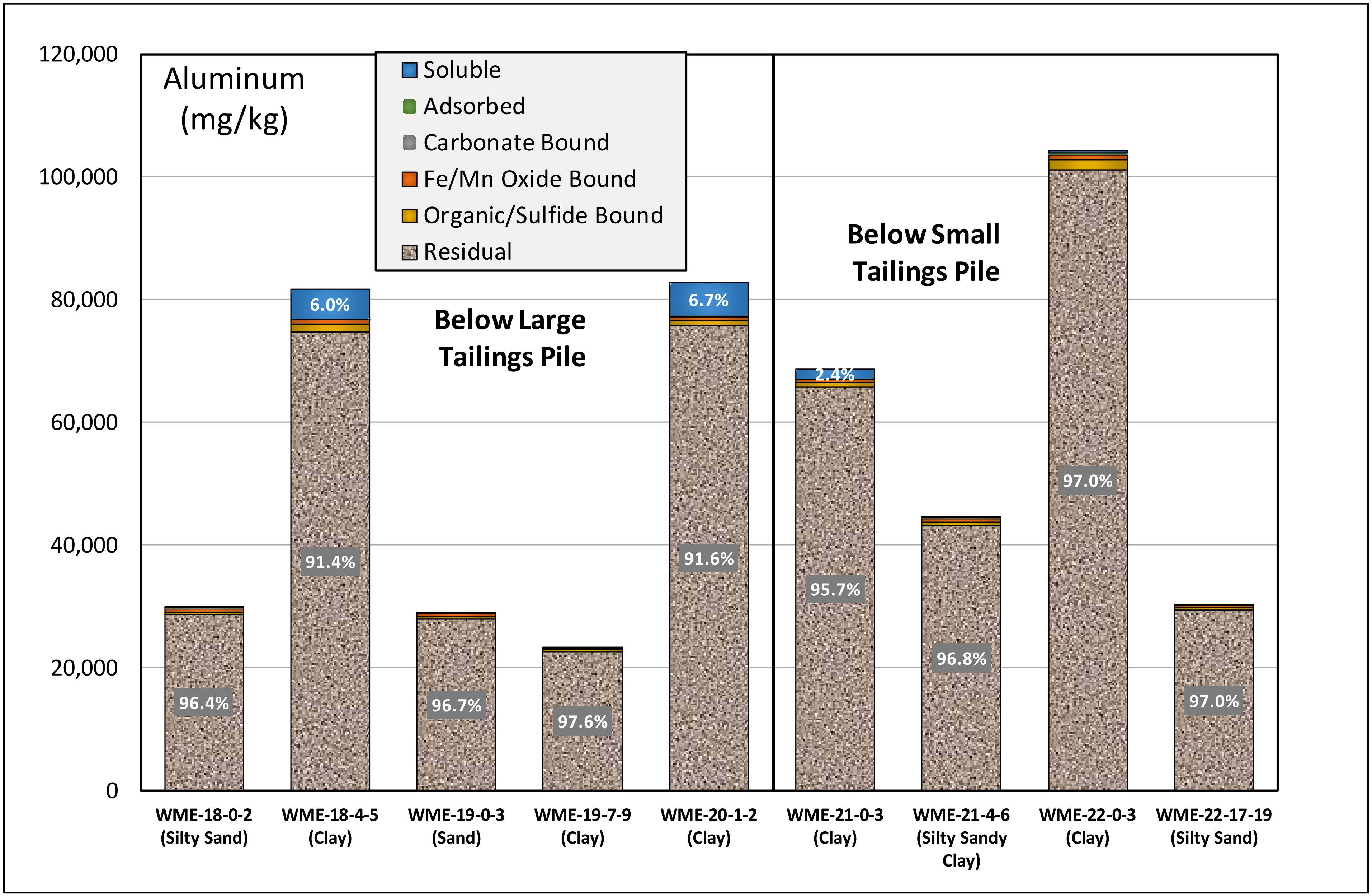

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FIGURE 5-13
SELECTIVE CHEMICAL EXTRACTION RESULTS FOR ALUMINUM:
TAILINGS AREA

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_LS.PPT

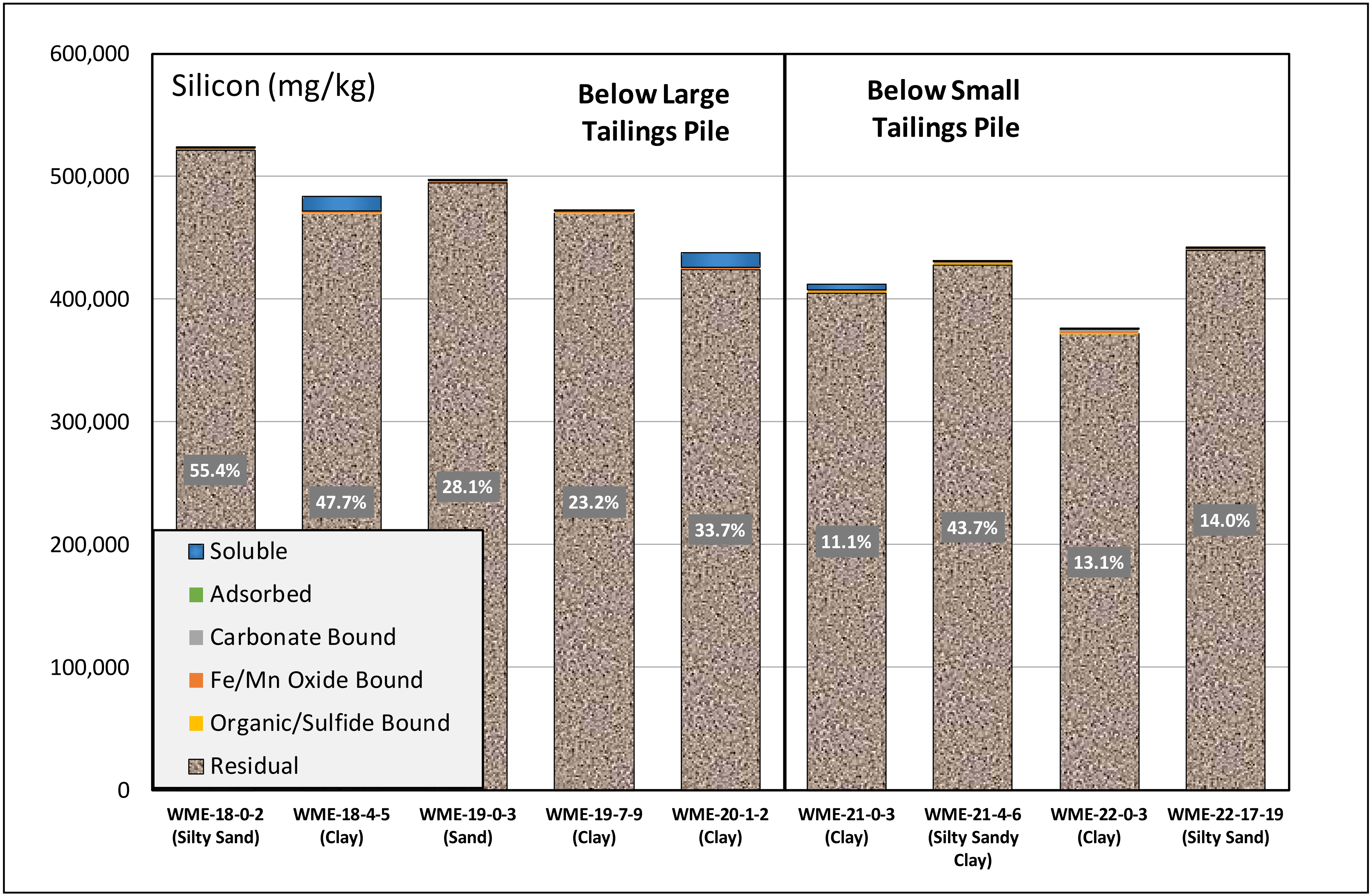

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FIGURE 5-14
SELECTIVE CHEMICAL EXTRACTION RESULTS FOR SILICON: TAILINGS AREA

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_LS.PPT

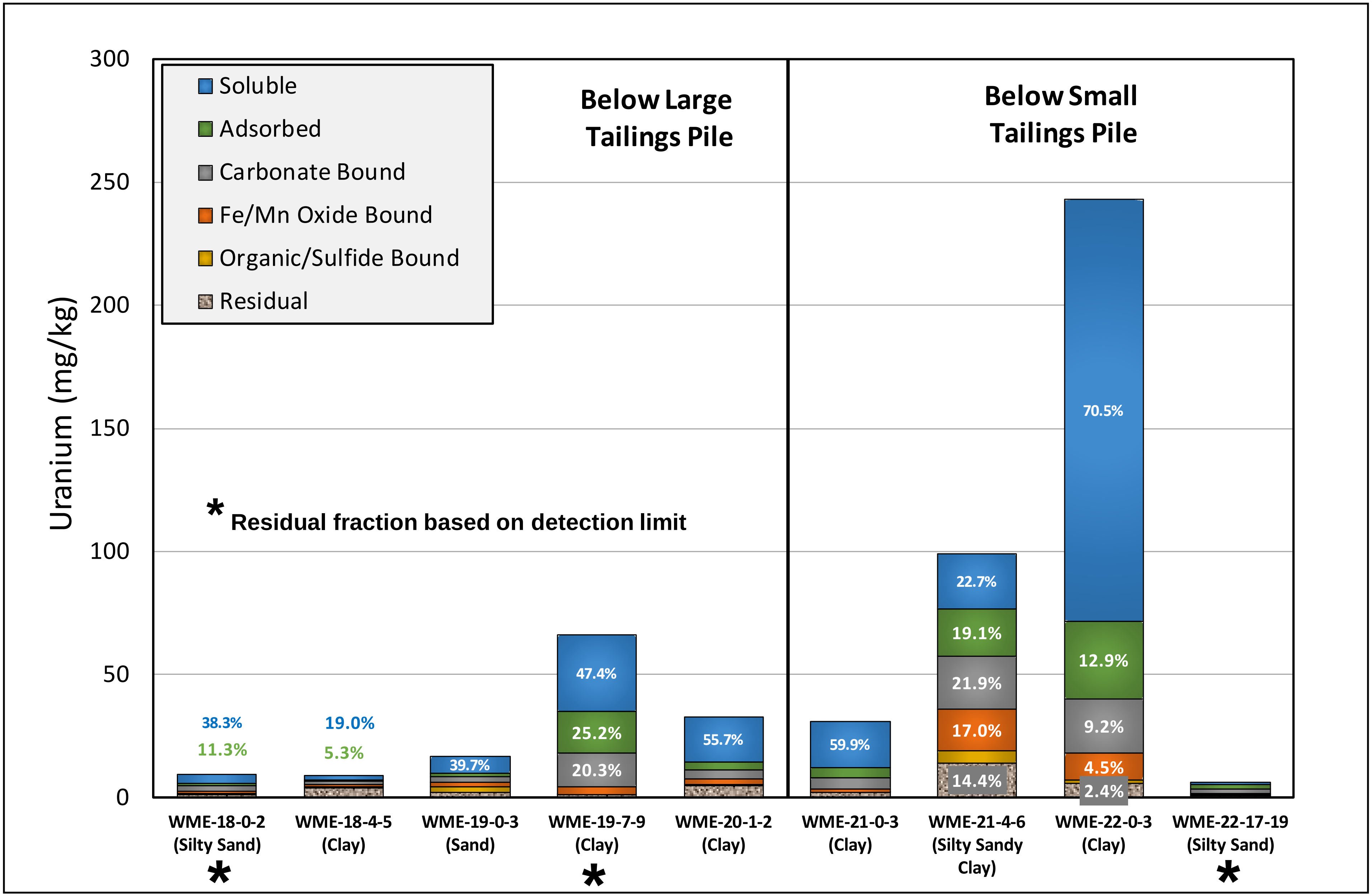

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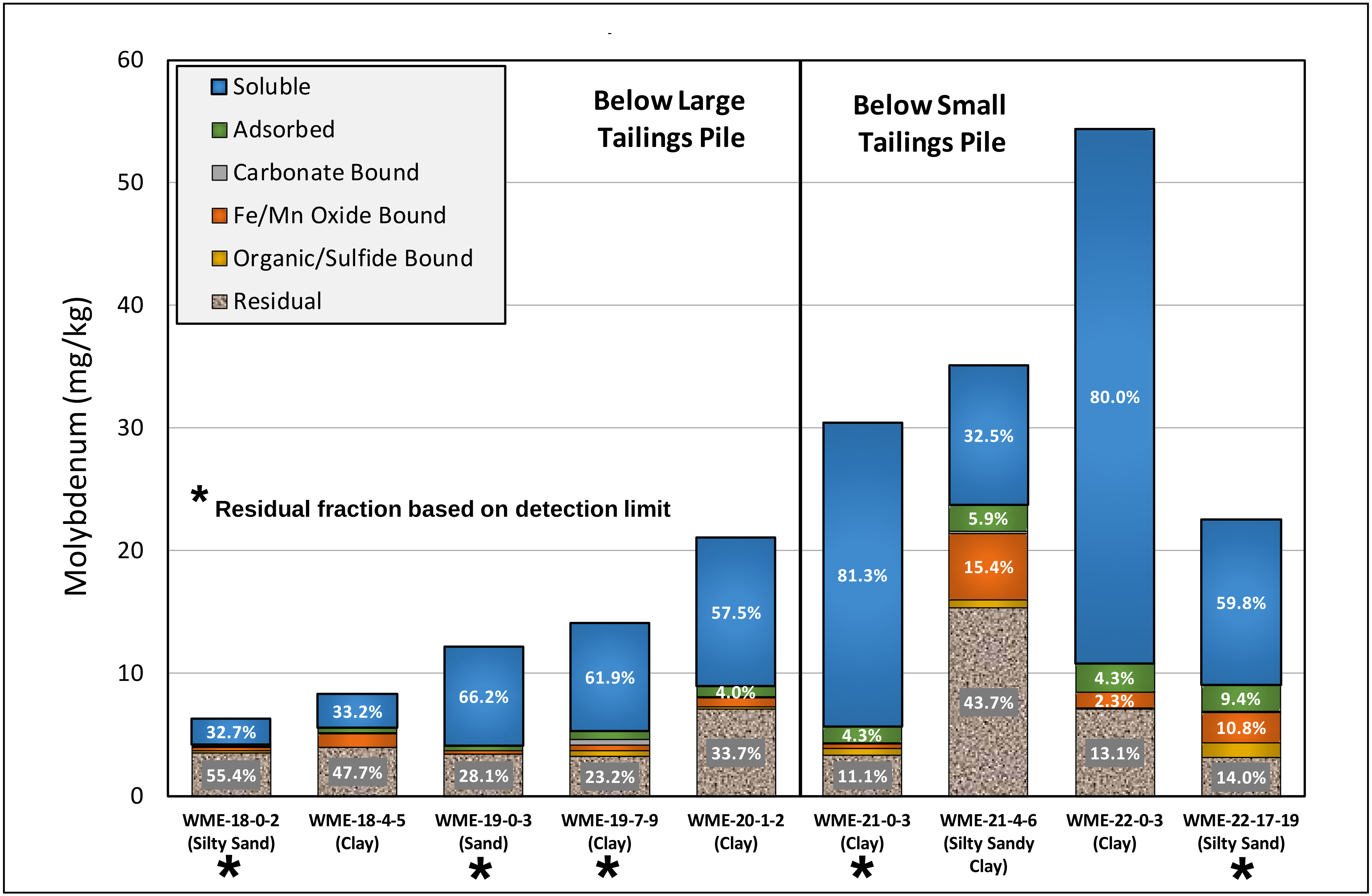
FIGURE 5-15
SELECTIVE CHEMICAL EXTRACTION RESULTS FOR URANIUM: TAILINGS AREA

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_LS.PPT



WORTHINGTON MILLER ENVIRONMENTAL, LLC.	FIGURE 5-16 SELECTIVE CHEMICAL EXTRACTION RESULTS FOR MOLYBDENUM: TAILINGS AREA

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_LS.PPT

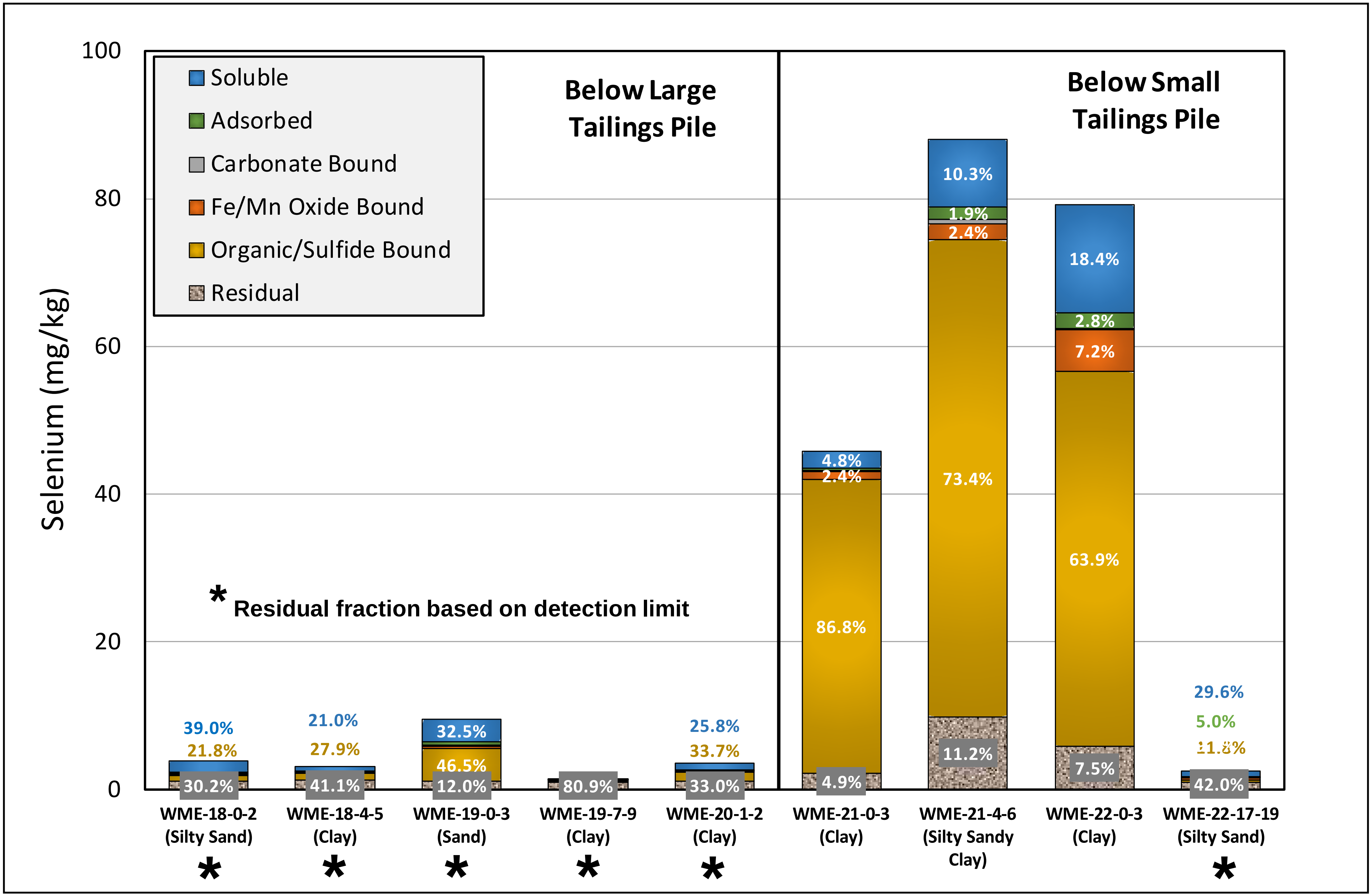


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FIGURE 5-17
SELECTIVE CHEMICAL EXTRACTION RESULTS FOR SELENIUM: TAILINGS AREA

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_LS.PPT

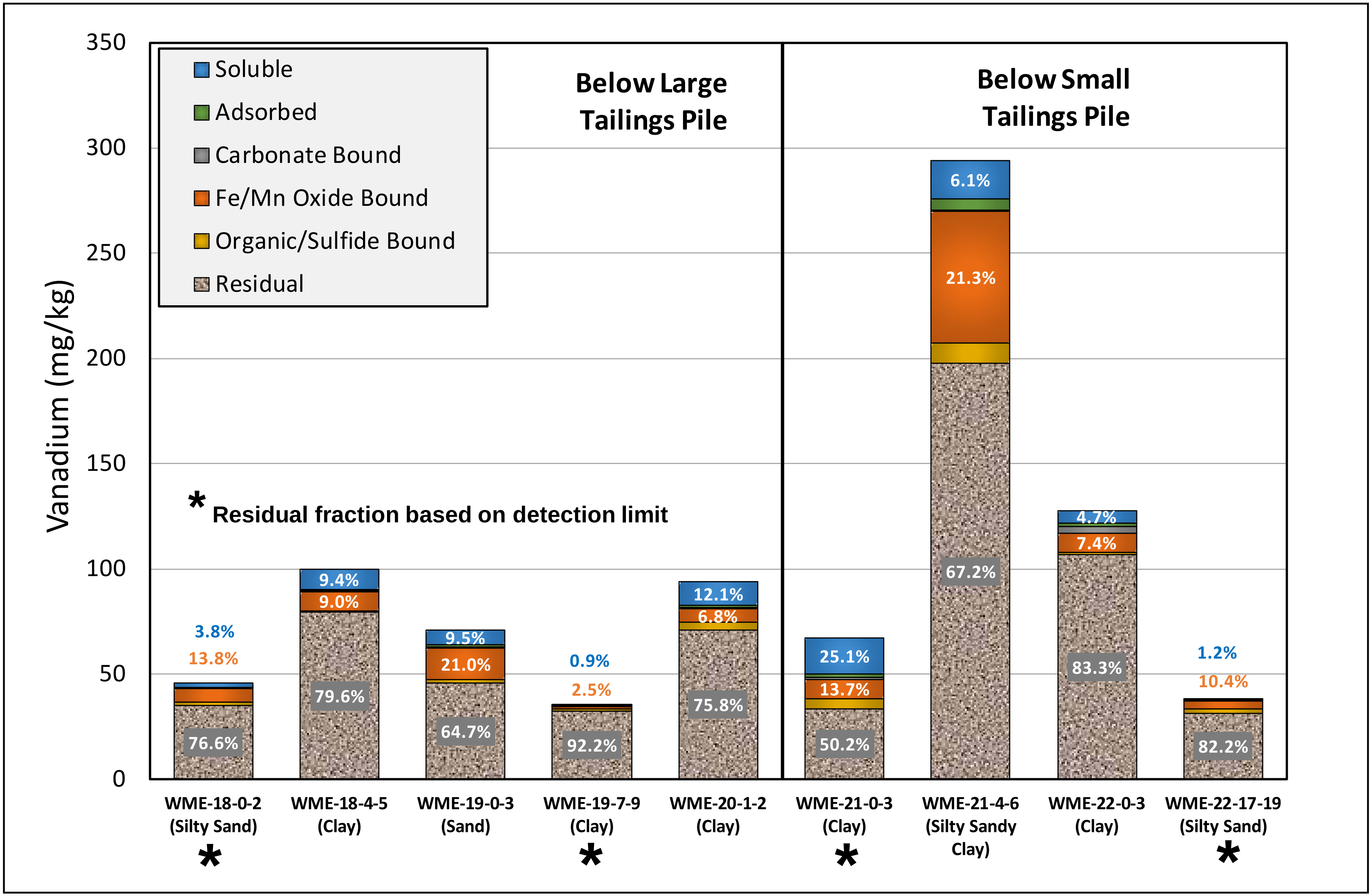

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FIGURE 5-18
SELECTIVE CHEMICAL EXTRACTION RESULTS FOR VANADIUM:
TAILINGS AREA

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_LS.PPT

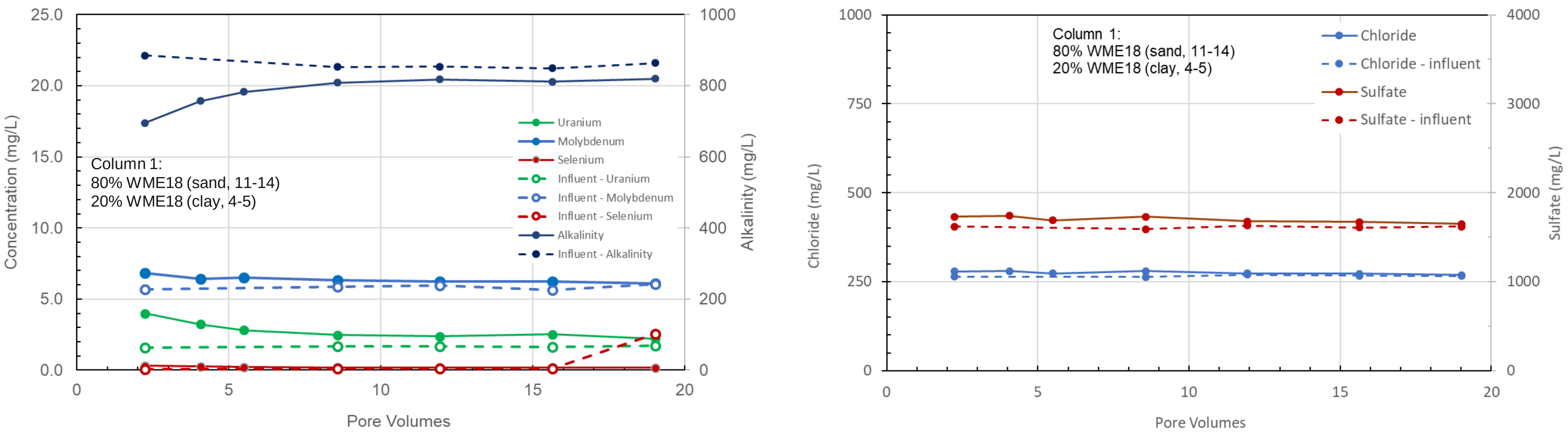


Figure 6-1: Column 1 Effluent Results With Comparison to Influent Concentrations.

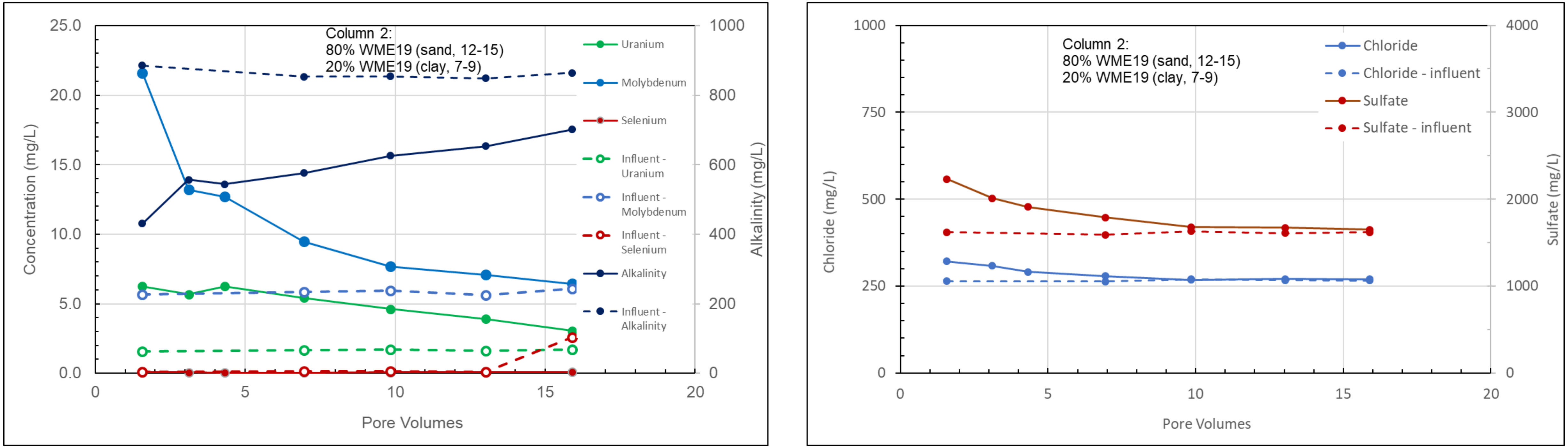
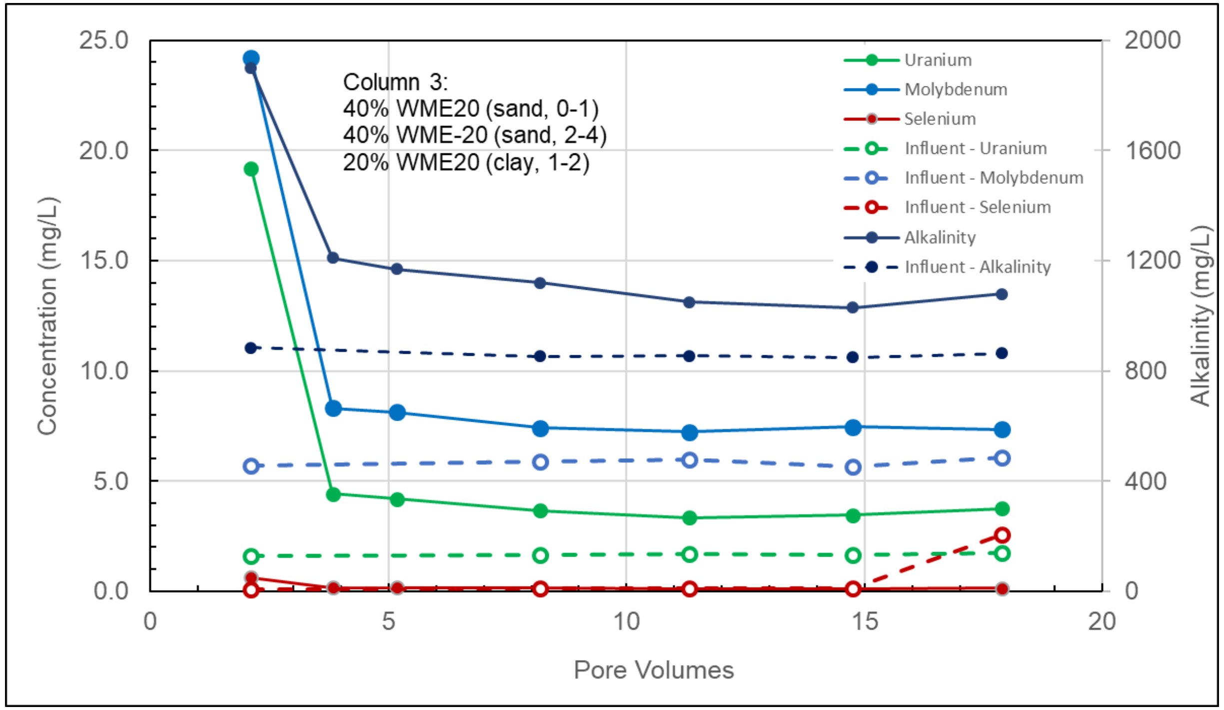


Figure 6-2: Column 2 Effluent Results With Comparison to Influent Concentrations.



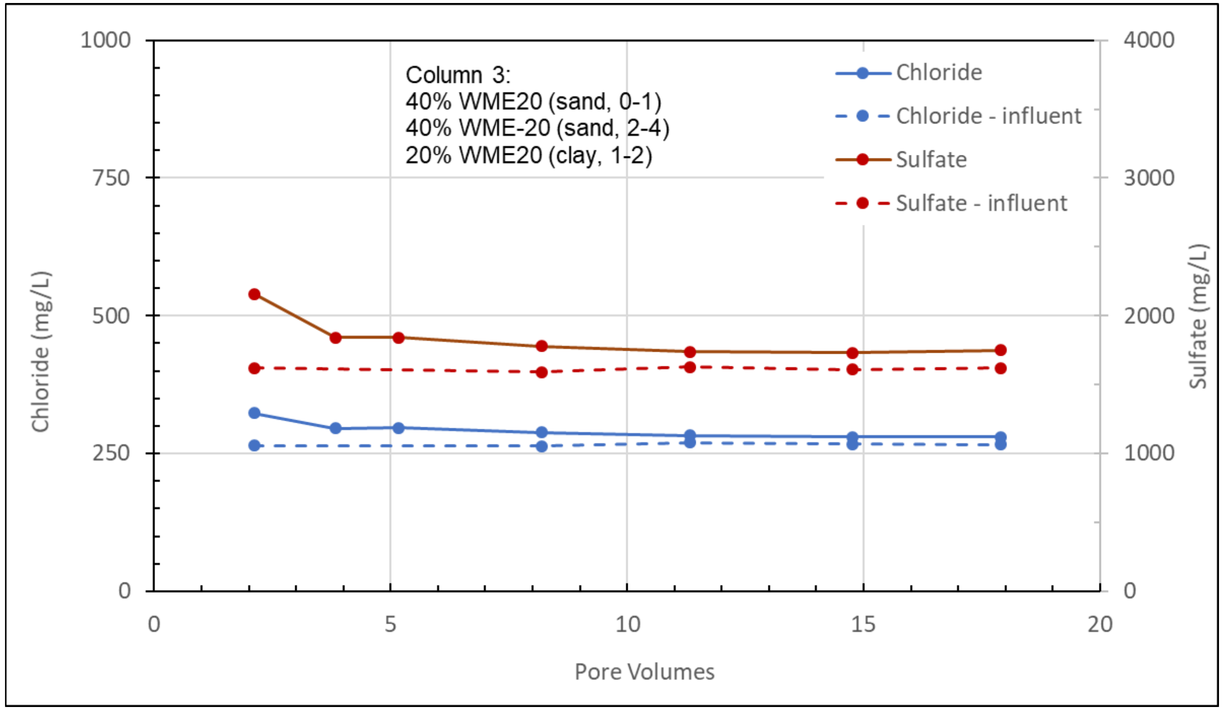
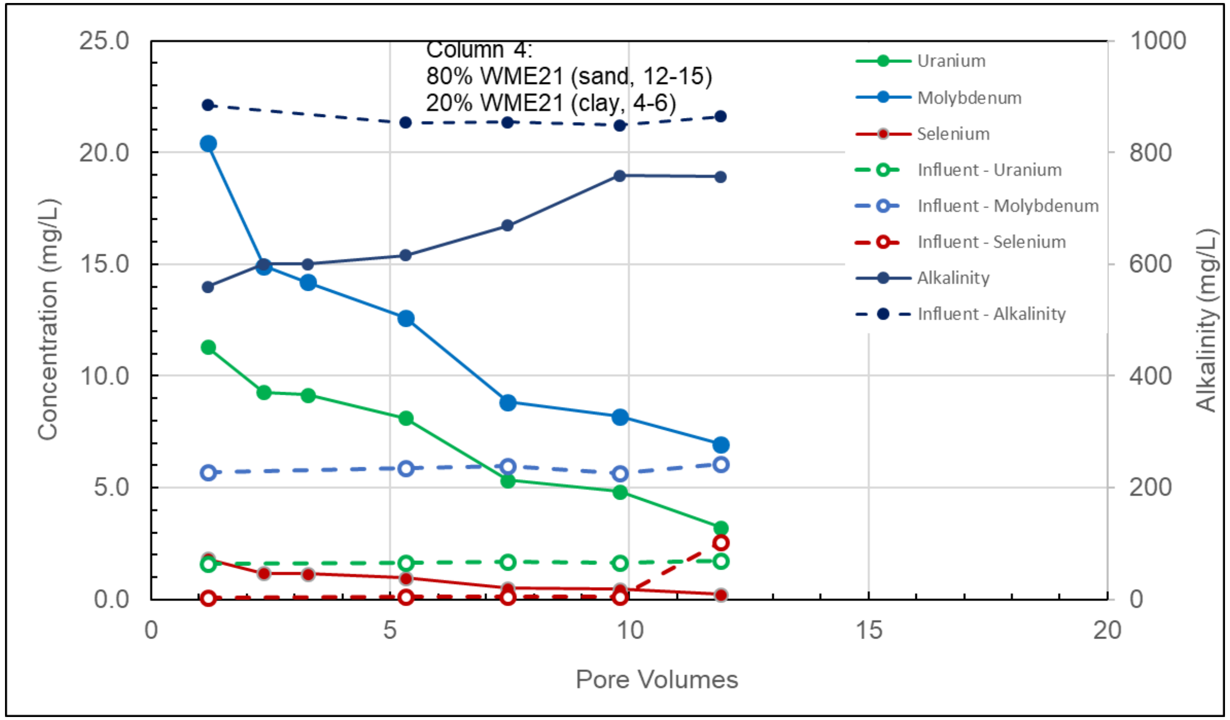


Figure 6-3: Column 3 Effluent Results With Comparison to Influent Concentrations.



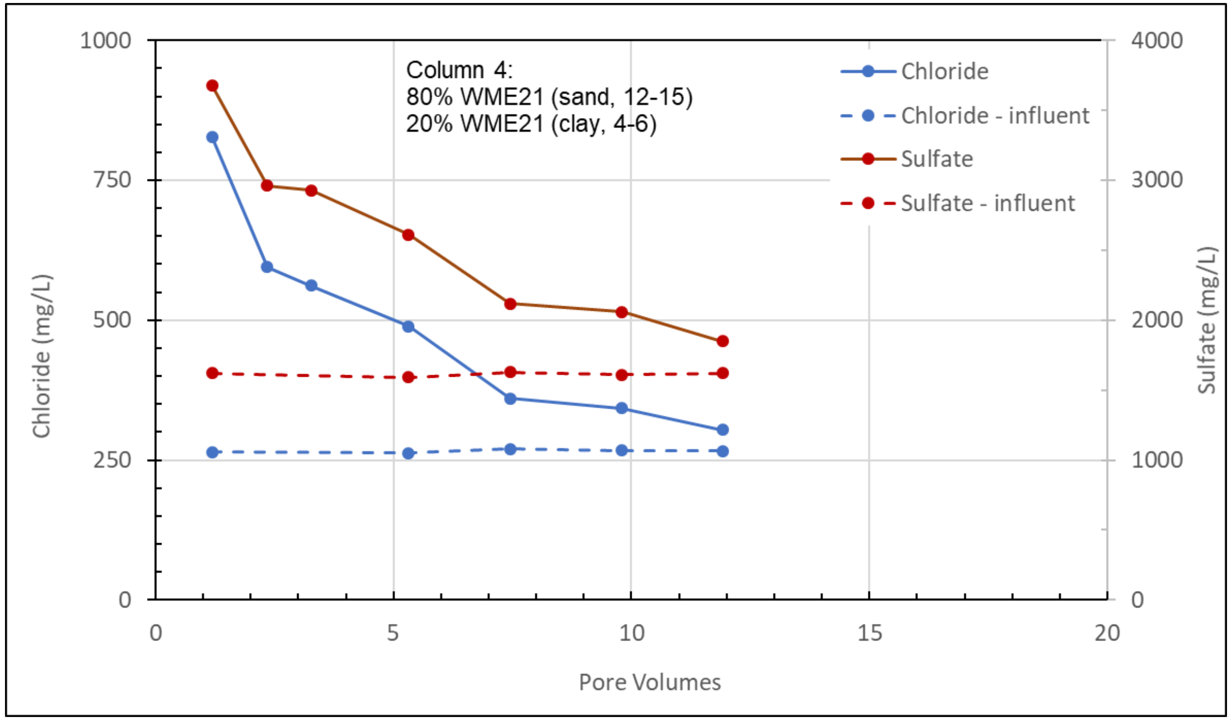
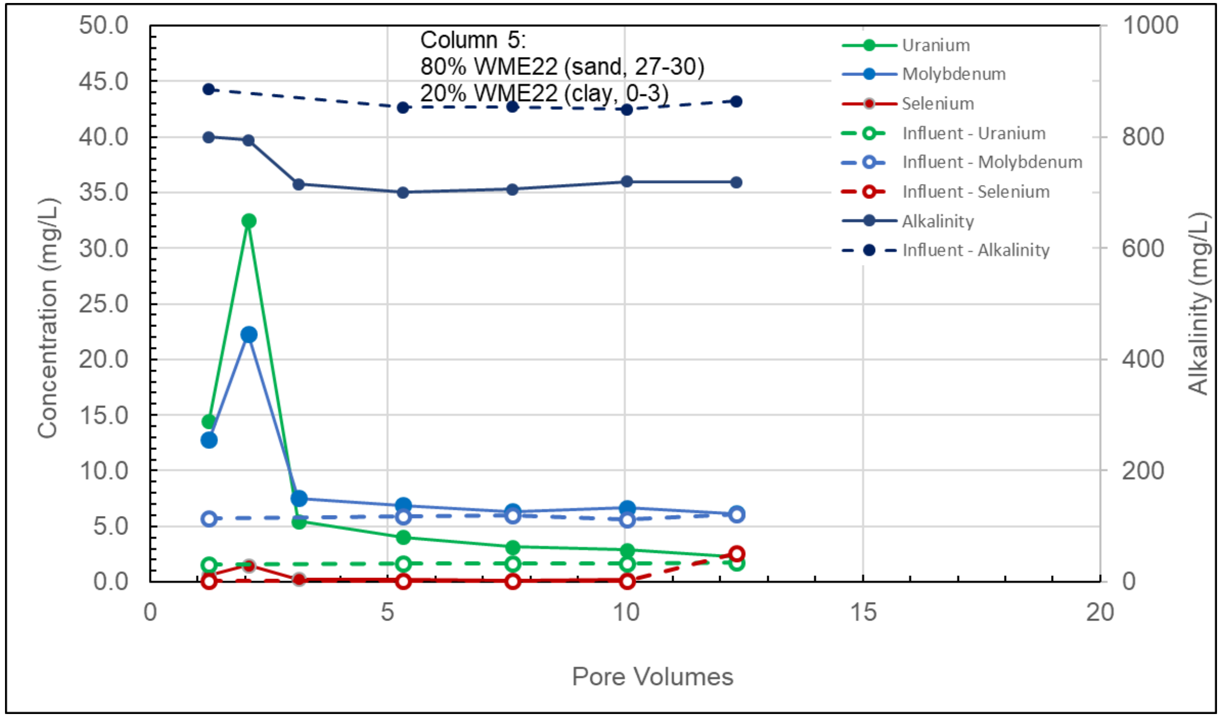


Figure 6-4: Column 4 Effluent Results With Comparison to Influent Concentrations.



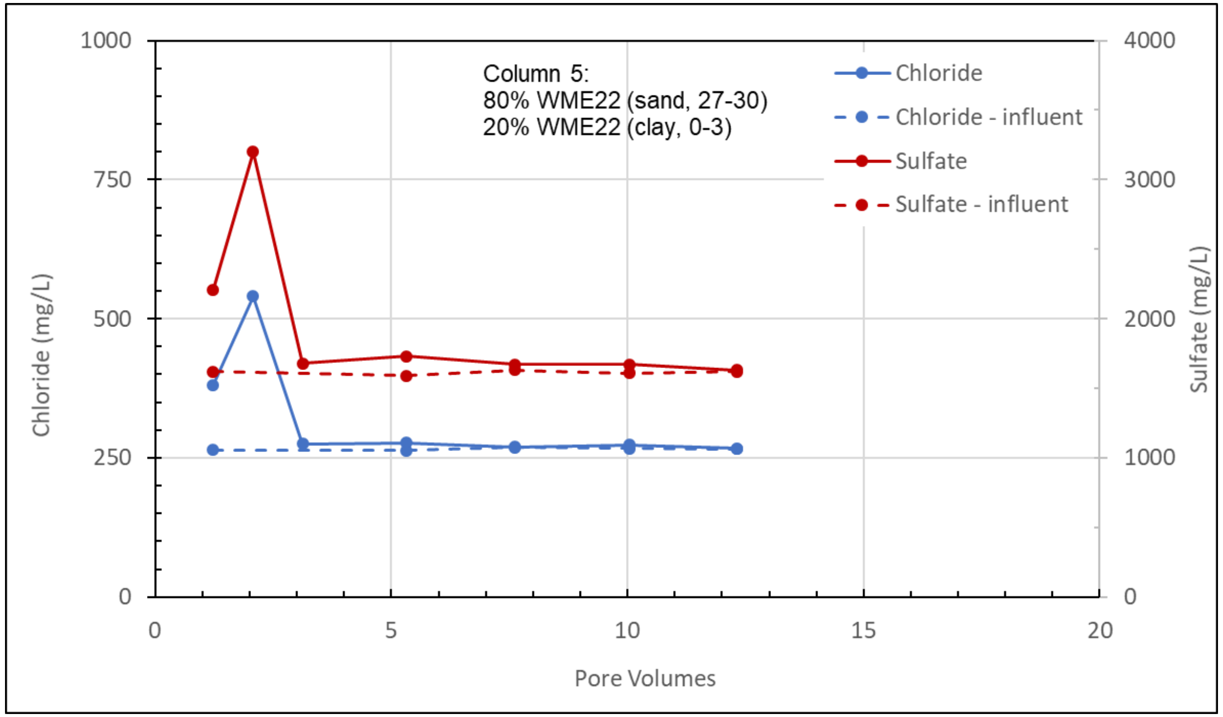


Figure 6-5: Column 5 Effluent Results with Comparison to Influent Concentrations.

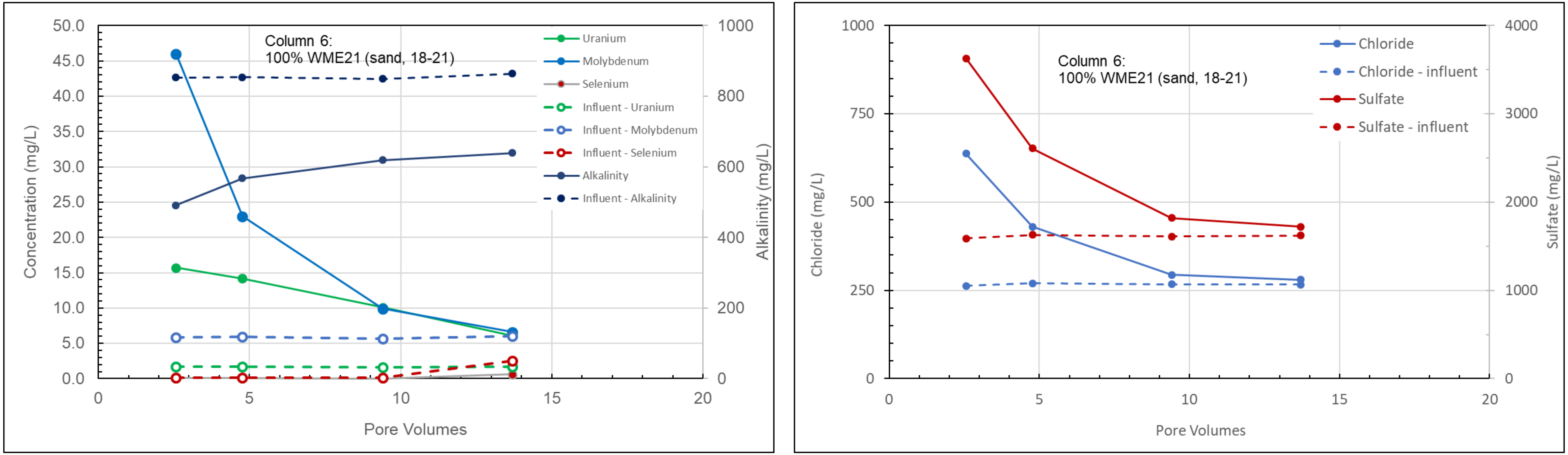


Figure 6-6: Column 6 Effluent Results With Comparison to Influent Concentrations.

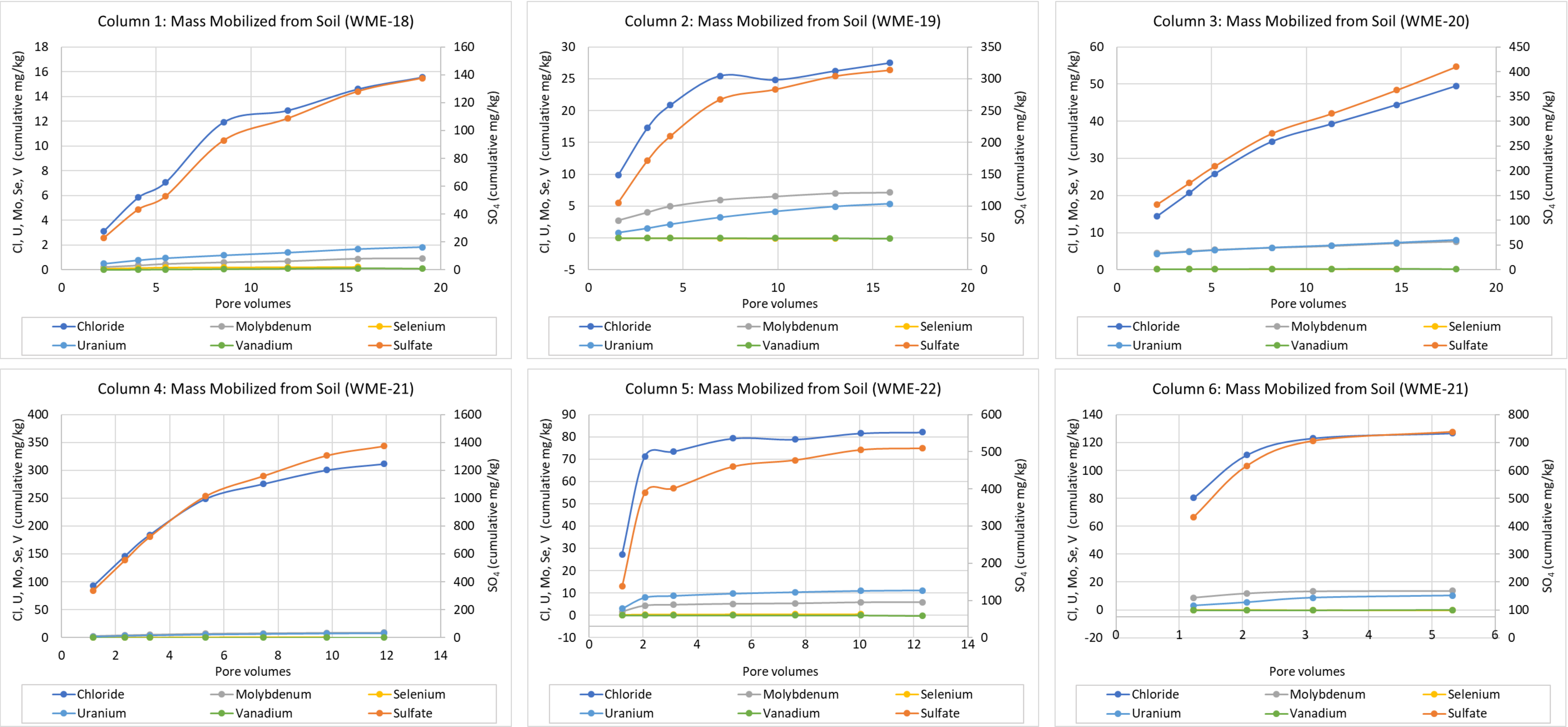


Figure 6-7: Cumulative Concentration of Constituents Mobilized From Each Column.

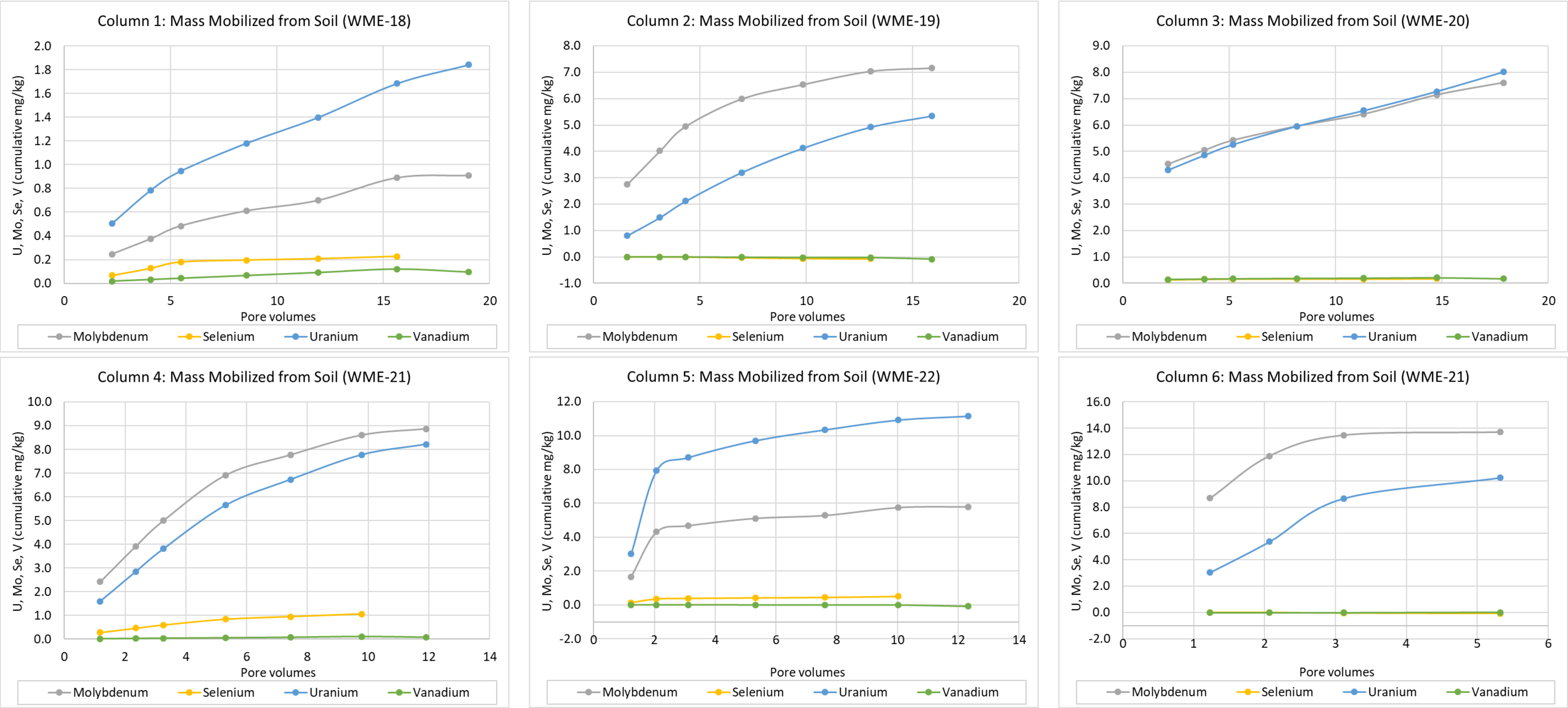


Figure 6-8: Cumulative Concentration of Constituents Mobilized From Each Column: Target Constituents of Concern.

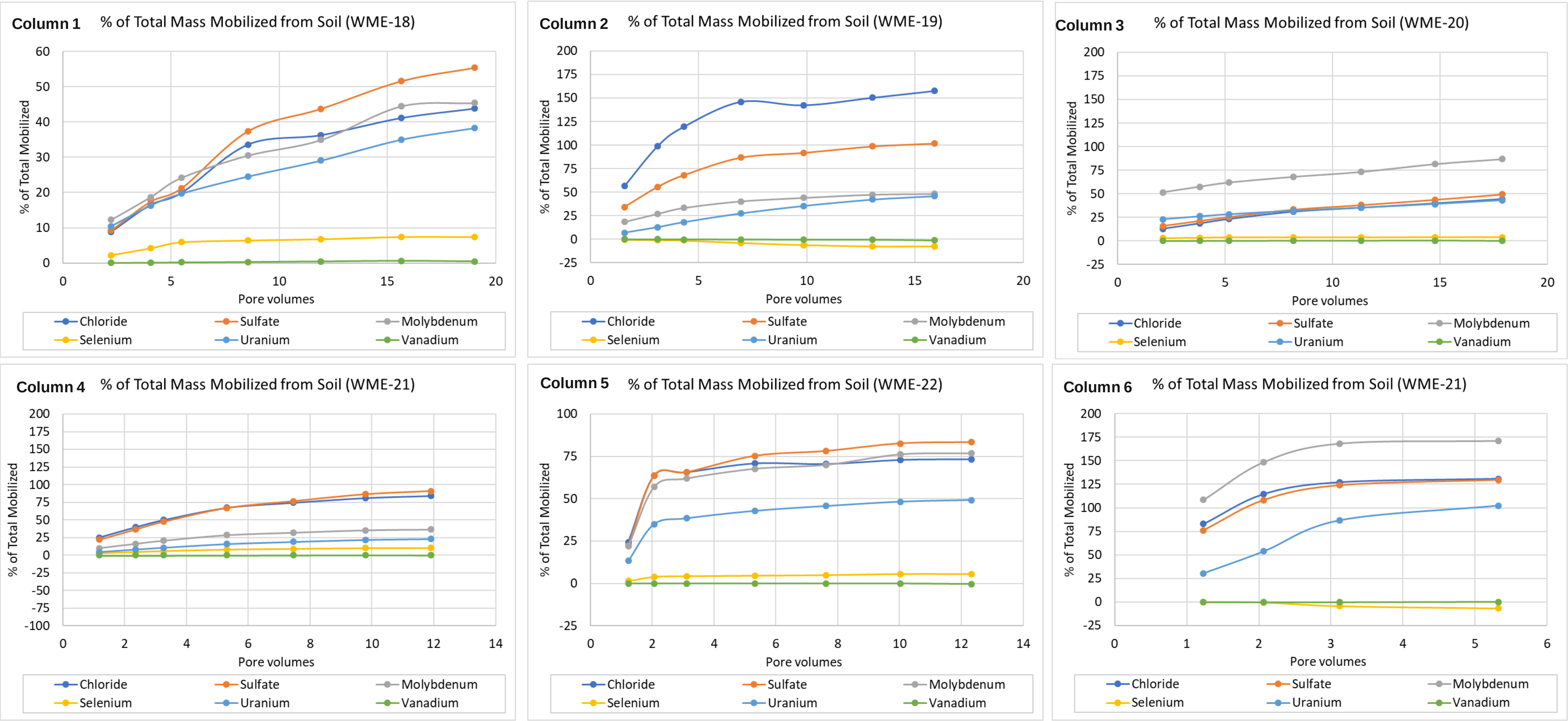


Figure 6-9: Cumulative Fraction (%) of Constituents Mobilized From Each Column, Relative to Total Concentration.

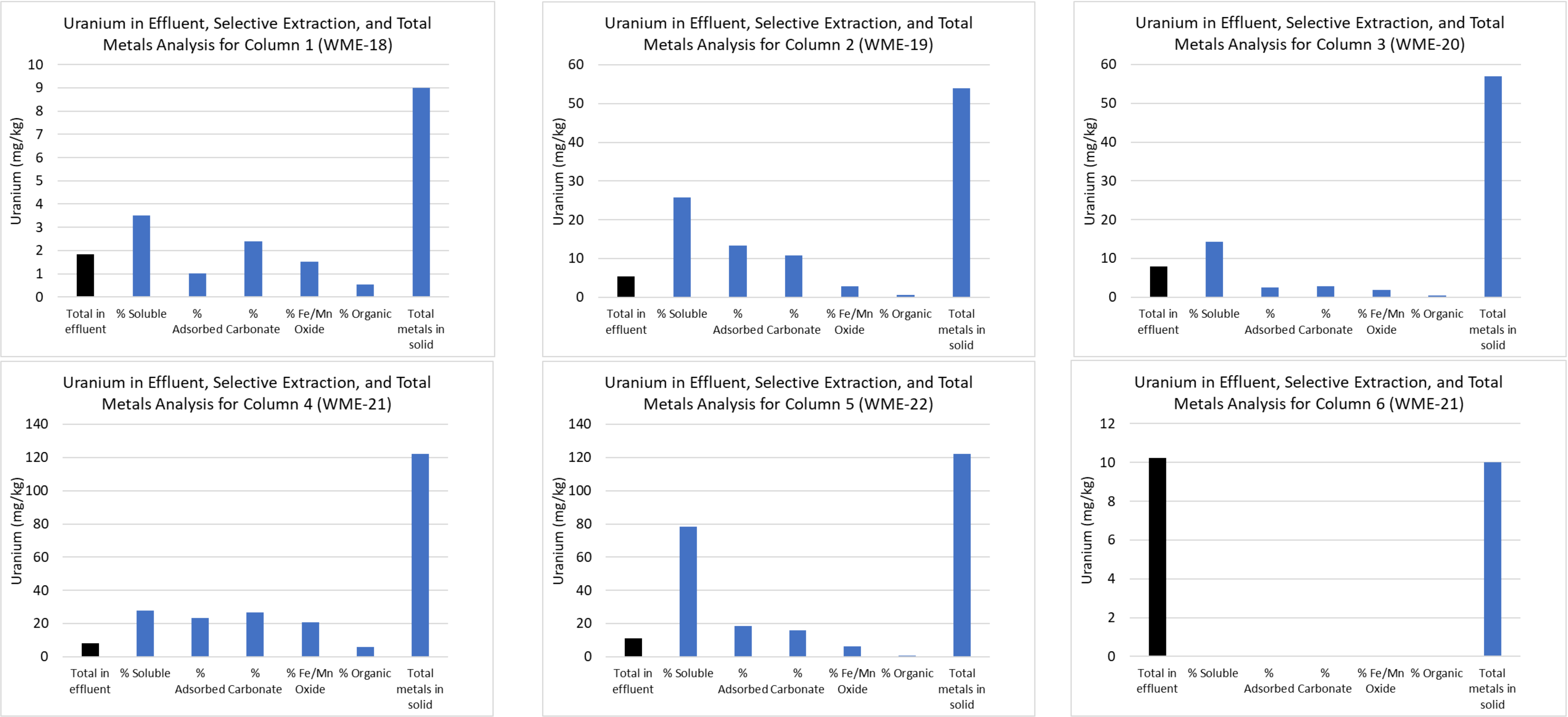


Figure 6-10: Uranium in Column Test Effluent Compared to SSE and Total Metals Results.

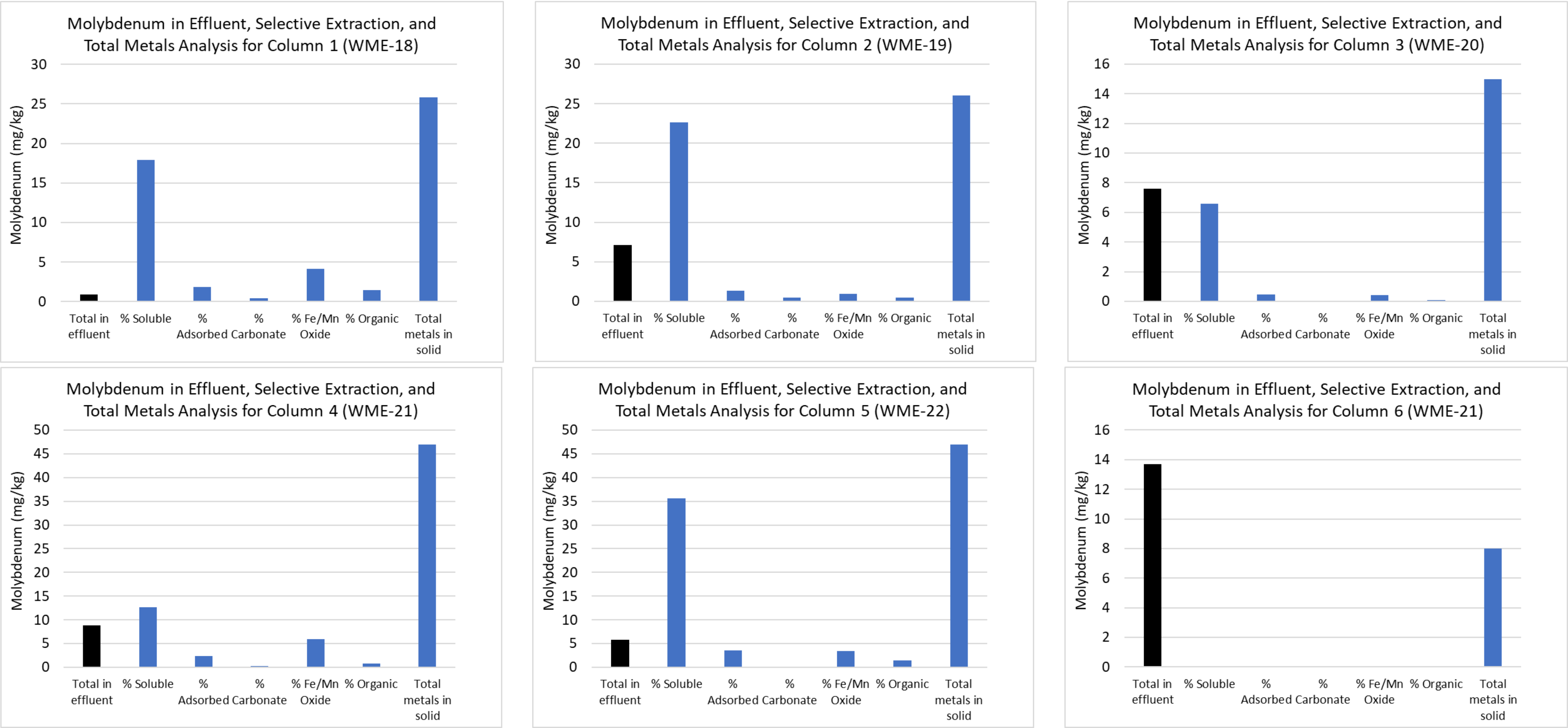


Figure 6-11: Molybdenum in Column Test Effluent Compared to SSE and Total Metals Results.

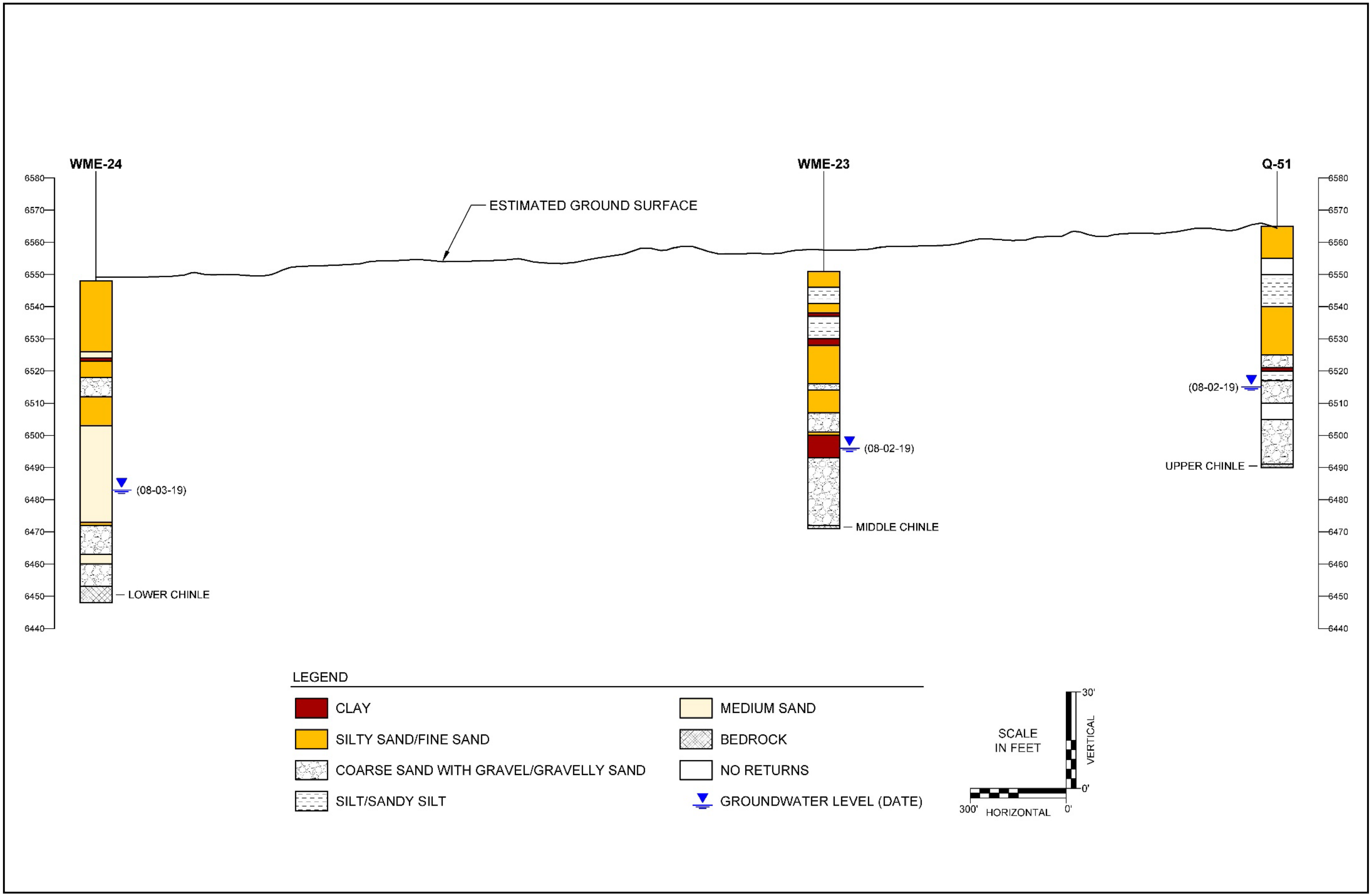


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FIGURE 7-1
GENERAL NE-SW TRANSECT FOR THE SOUTHERN AREA BORINGS

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_LS.PPT

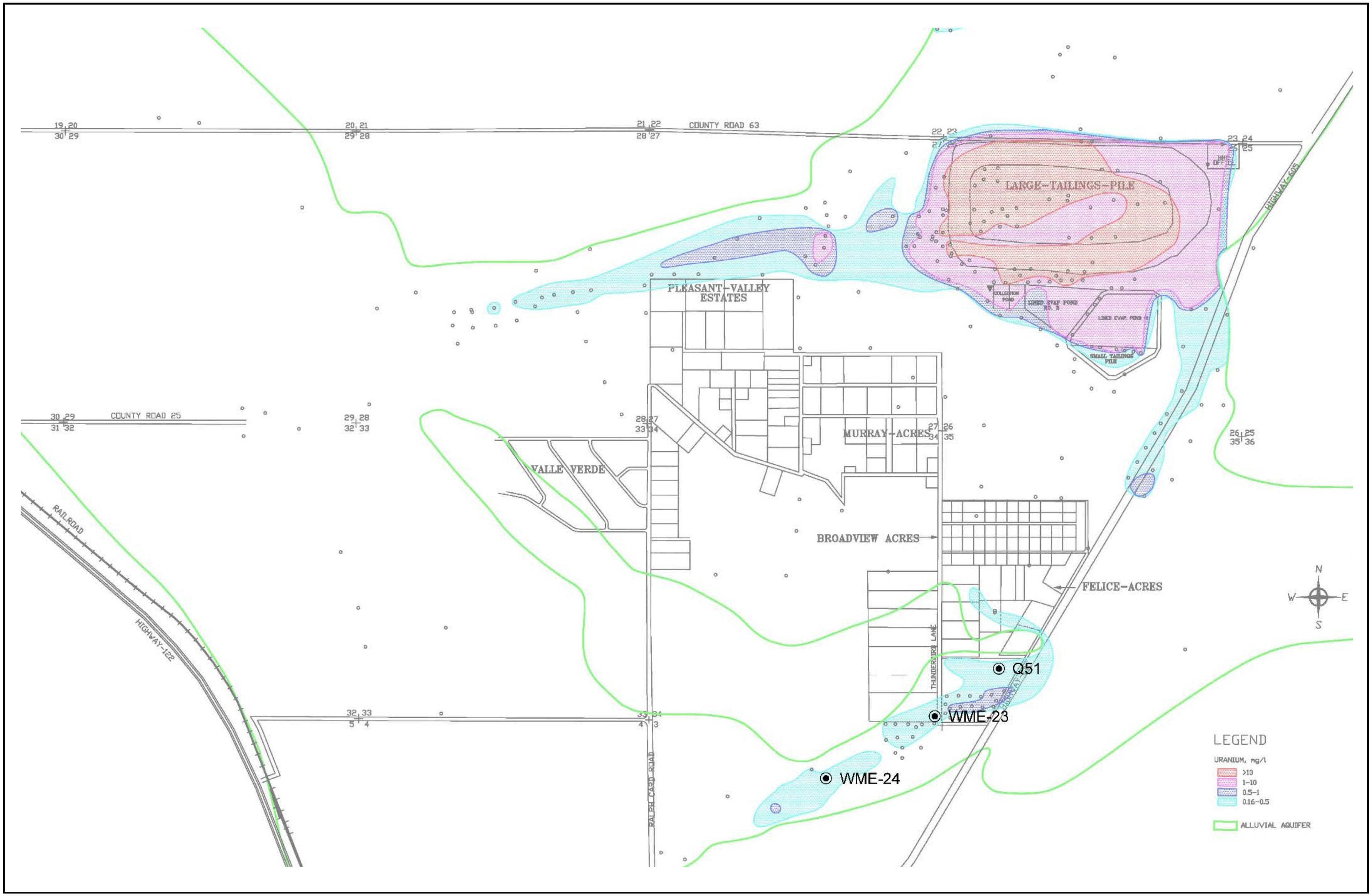

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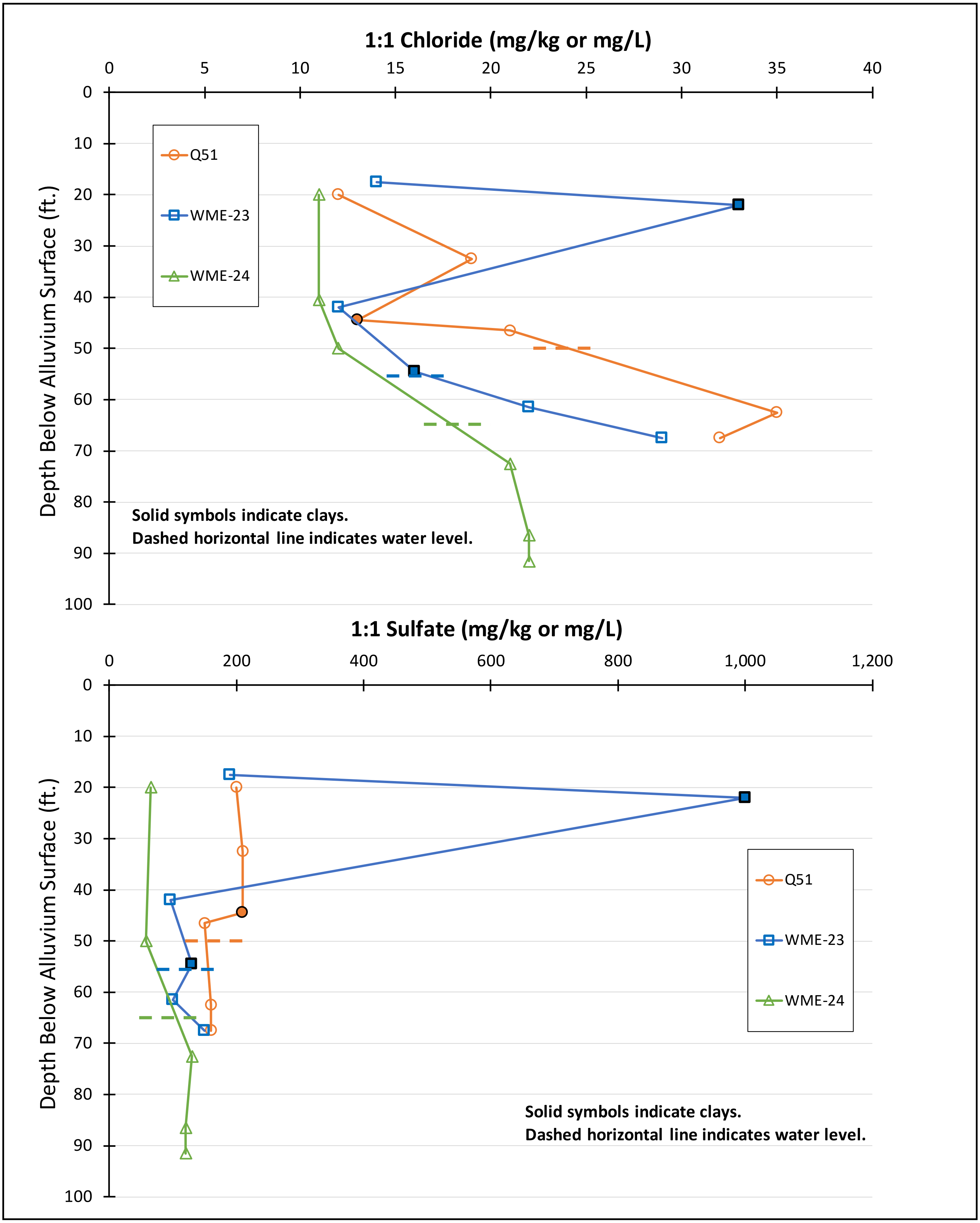
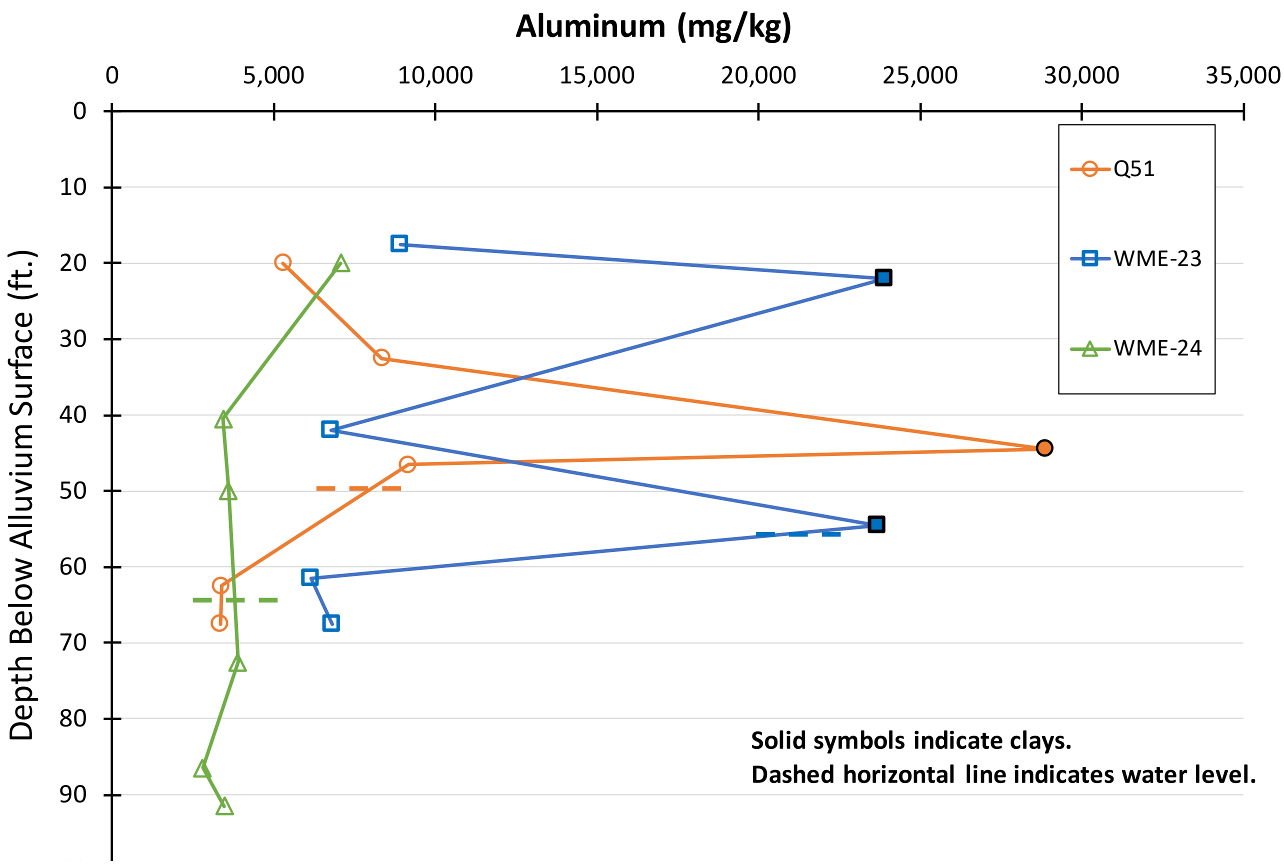
FIGURE 7-2
SOUTHERN AREA BORING LOCATIONS RELATIVE TO THE CURRENT URANIUM PLUME

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_LS.PPT



WORTHINGTON MILLER ENVIRONMENTAL, LLC.	FIGURE 7-3 CHLORIDE AND SULFATE IN SOUTHERN ALLUVIUM	Date: April 2020 Project: HOMESTAKE File: 2019SC_FIGURES_PT.PPT



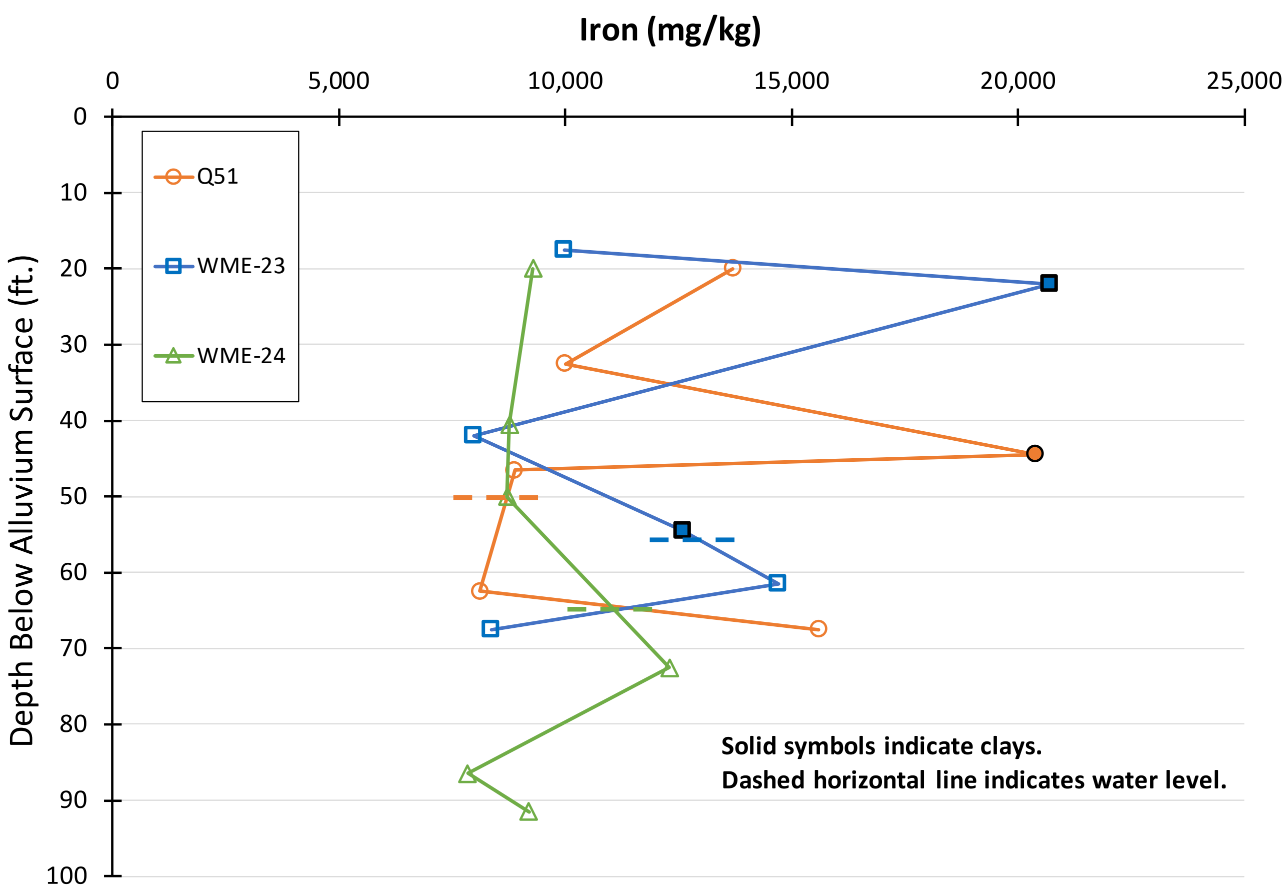


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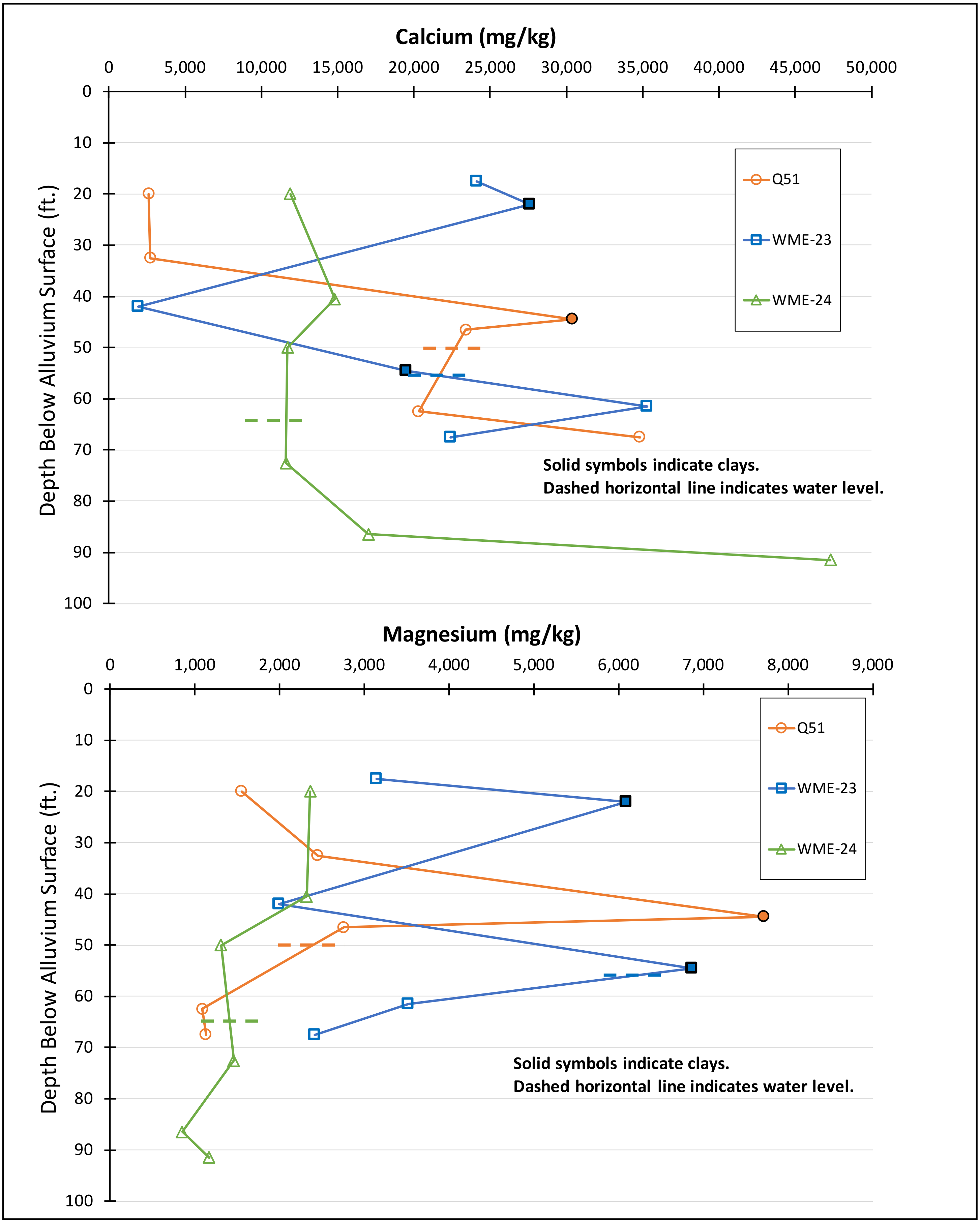
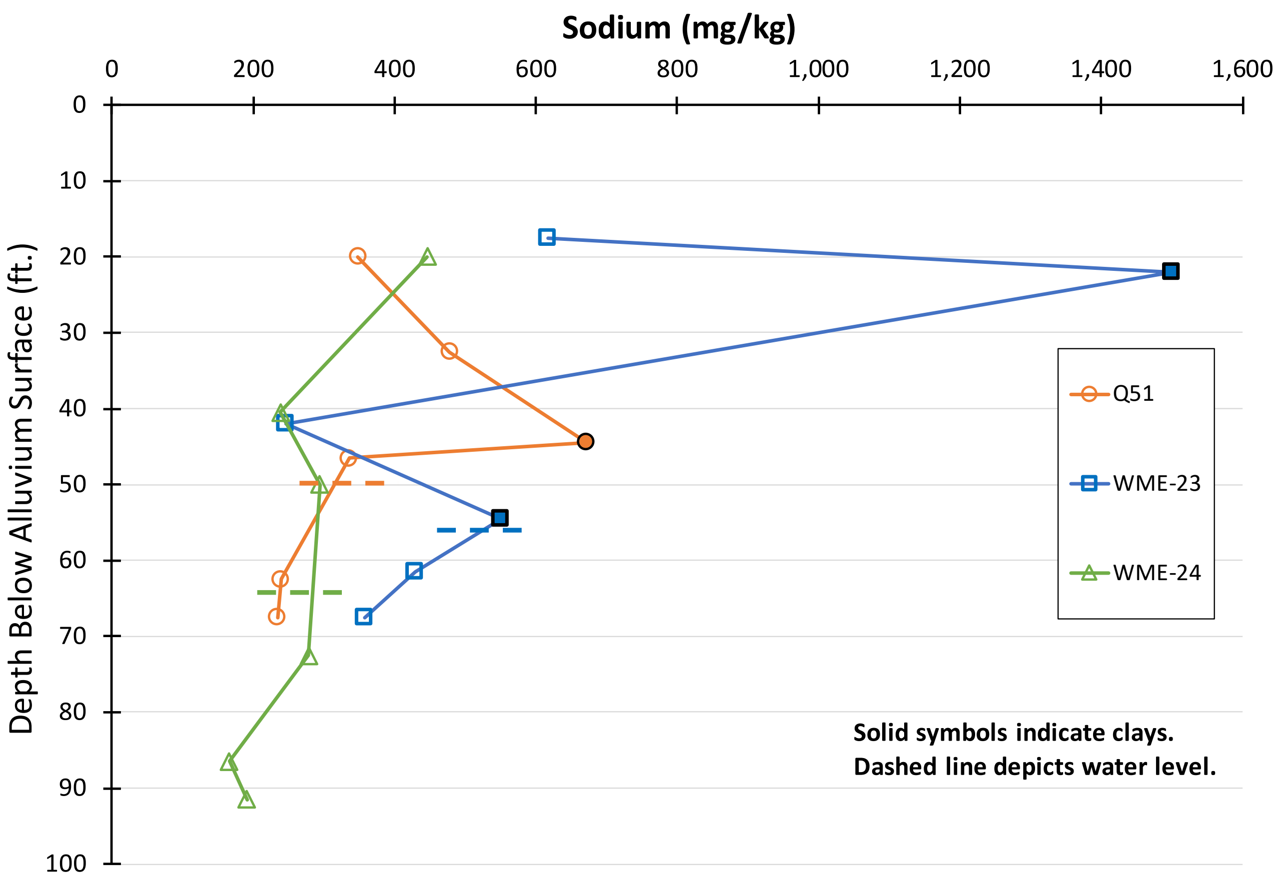
FIGURE 7-4
ALUMINUM AND IRON IN SOUTHERN ALLUVIUM

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_PT.PPT



WORTHINGTON MILLER ENVIRONMENTAL, LLC.	FIGURE 7-5 CALCIUM AND MAGNESIUM IN SOUTHERN ALLUVIUM	Date: April 2020 Project: HOMESTAKE File: 2019SC_FIGURES_PT.PPT



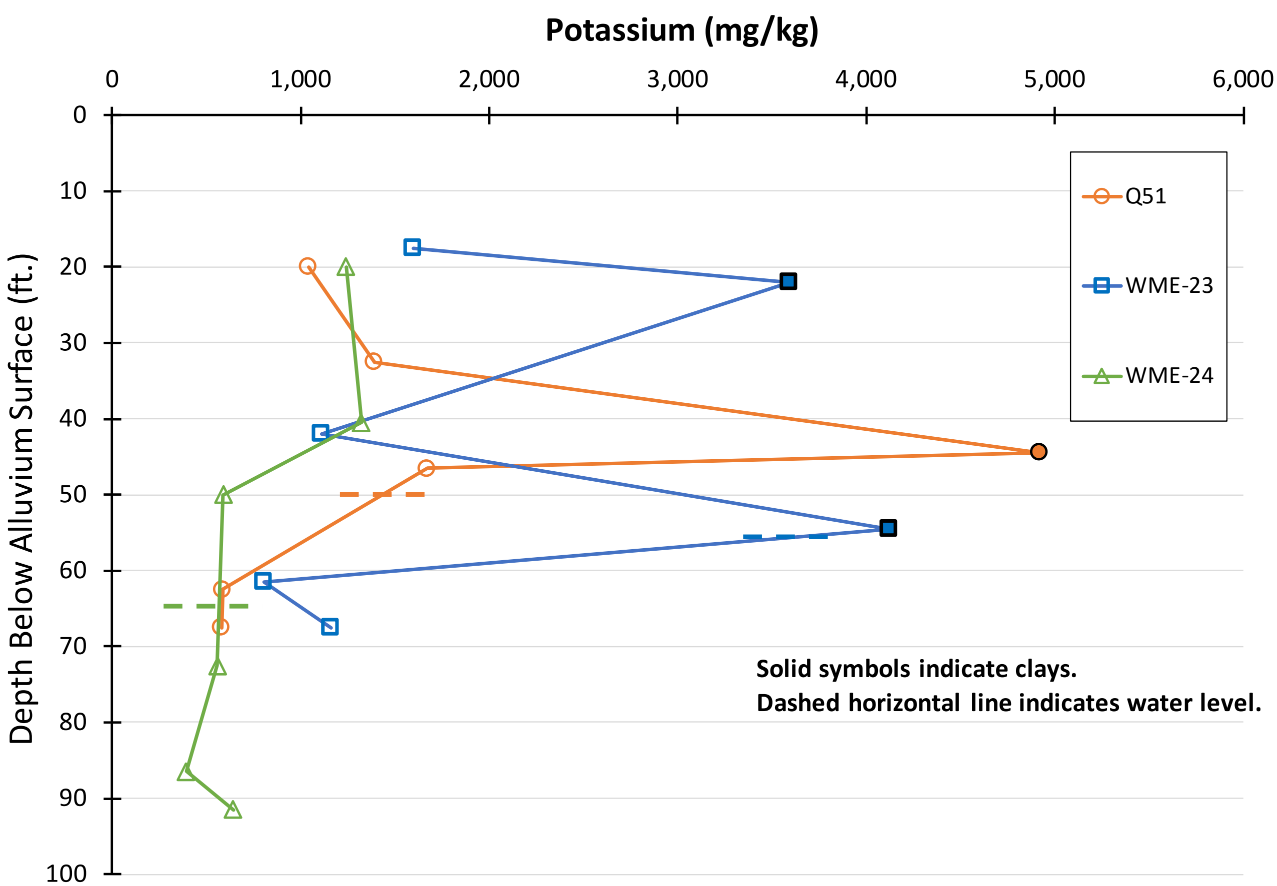


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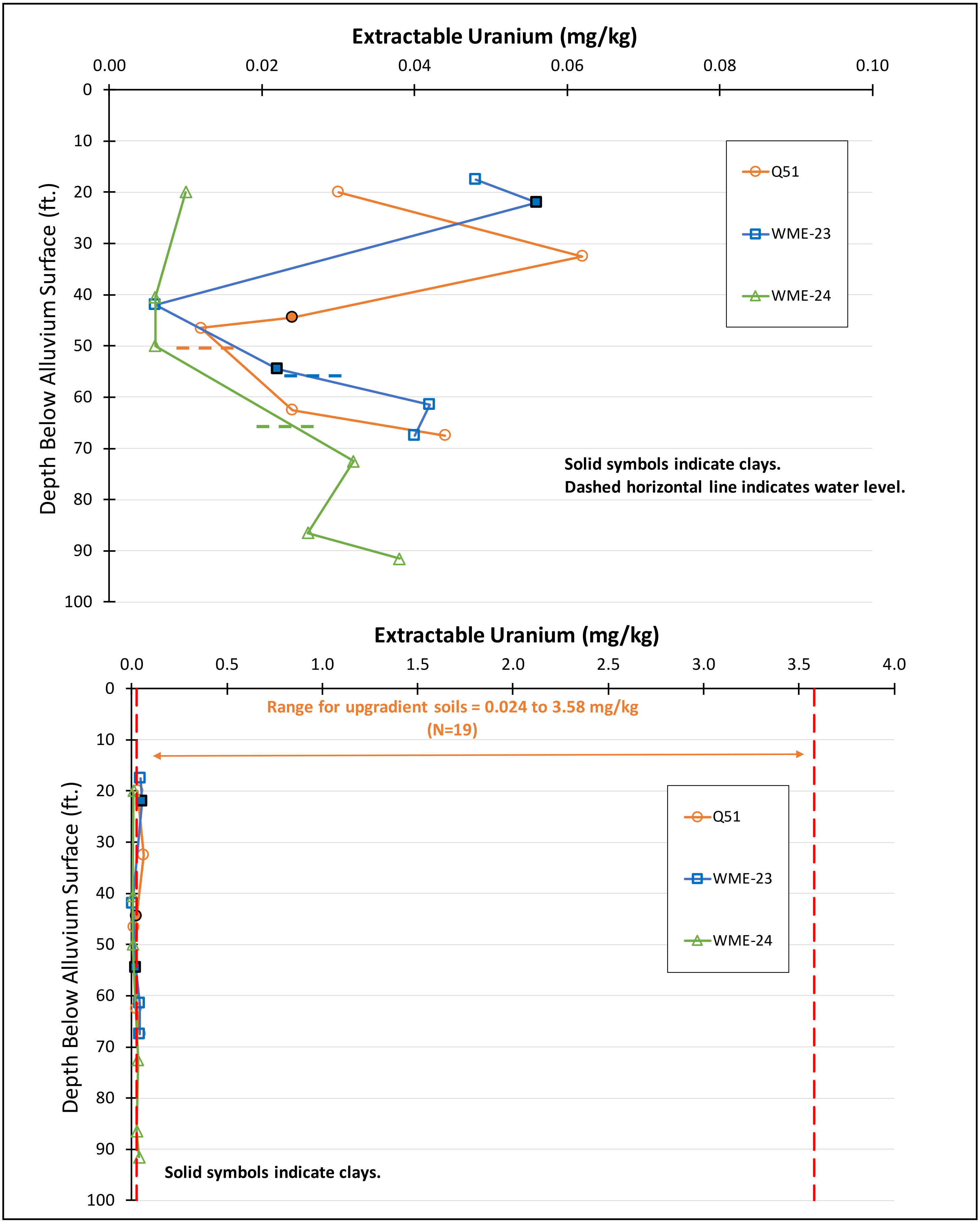
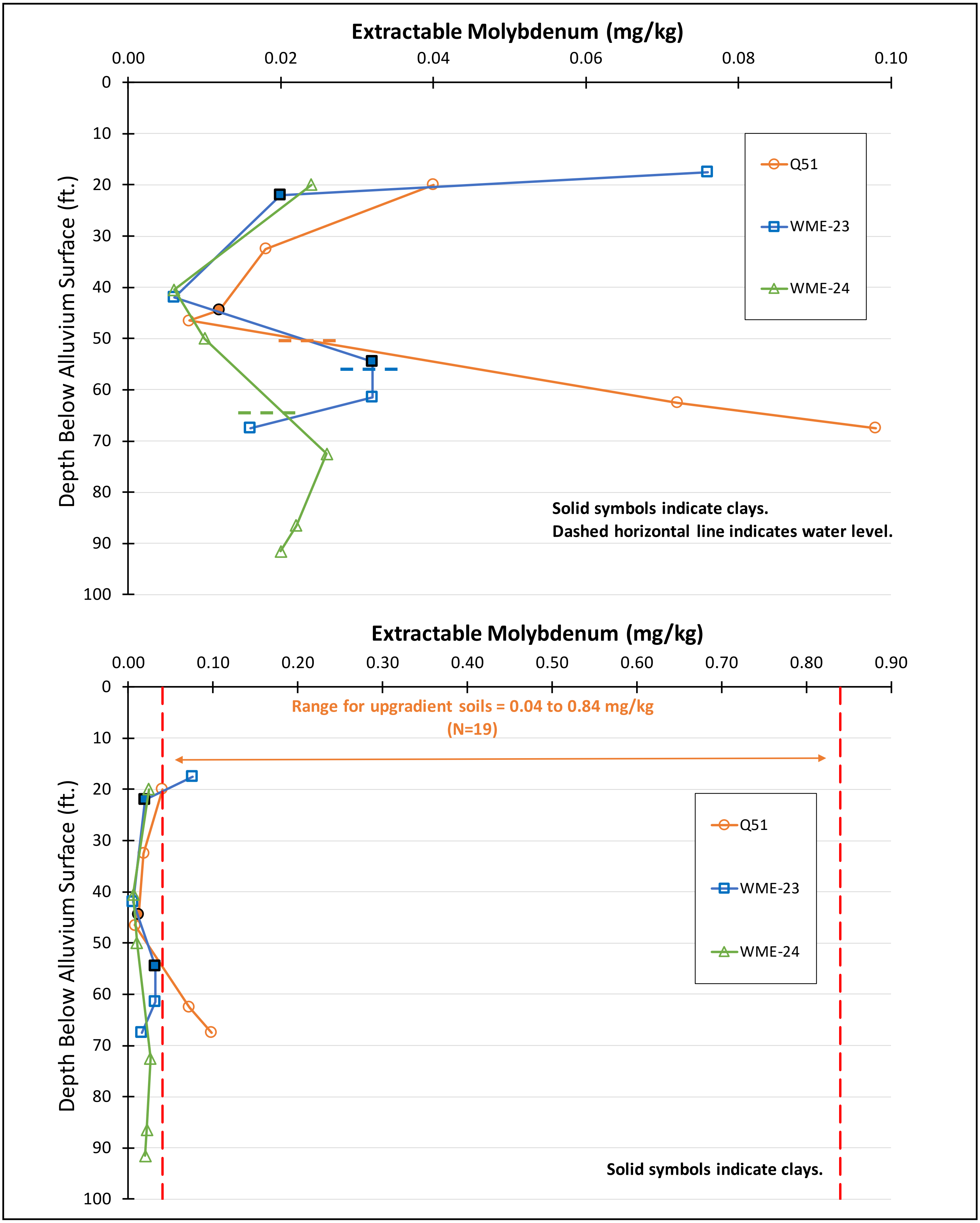
FIGURE 7-6
SODIUM AND POTASSIUM IN SOUTHERN ALLUVIUM

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_PT.PPT



WORTHINGTON MILLER ENVIRONMENTAL, LLC.	FIGURE 7-7 EXTRACTABLE URANIUM IN SOUTHERN ALLUVIUM	Date: April 2020 Project: HOMESTAKE File: 2019SC_FIGURES_PT.PPT



WORTHINGTON MILLER ENVIRONMENTAL, LLC.	FIGURE 7-8 EXTRACTABLE MOLYBDENUM IN SOUTHERN ALLUVIUM	Date: April 2020 Project: HOMESTAKE File: 2019SC_FIGURES_PT.PPT

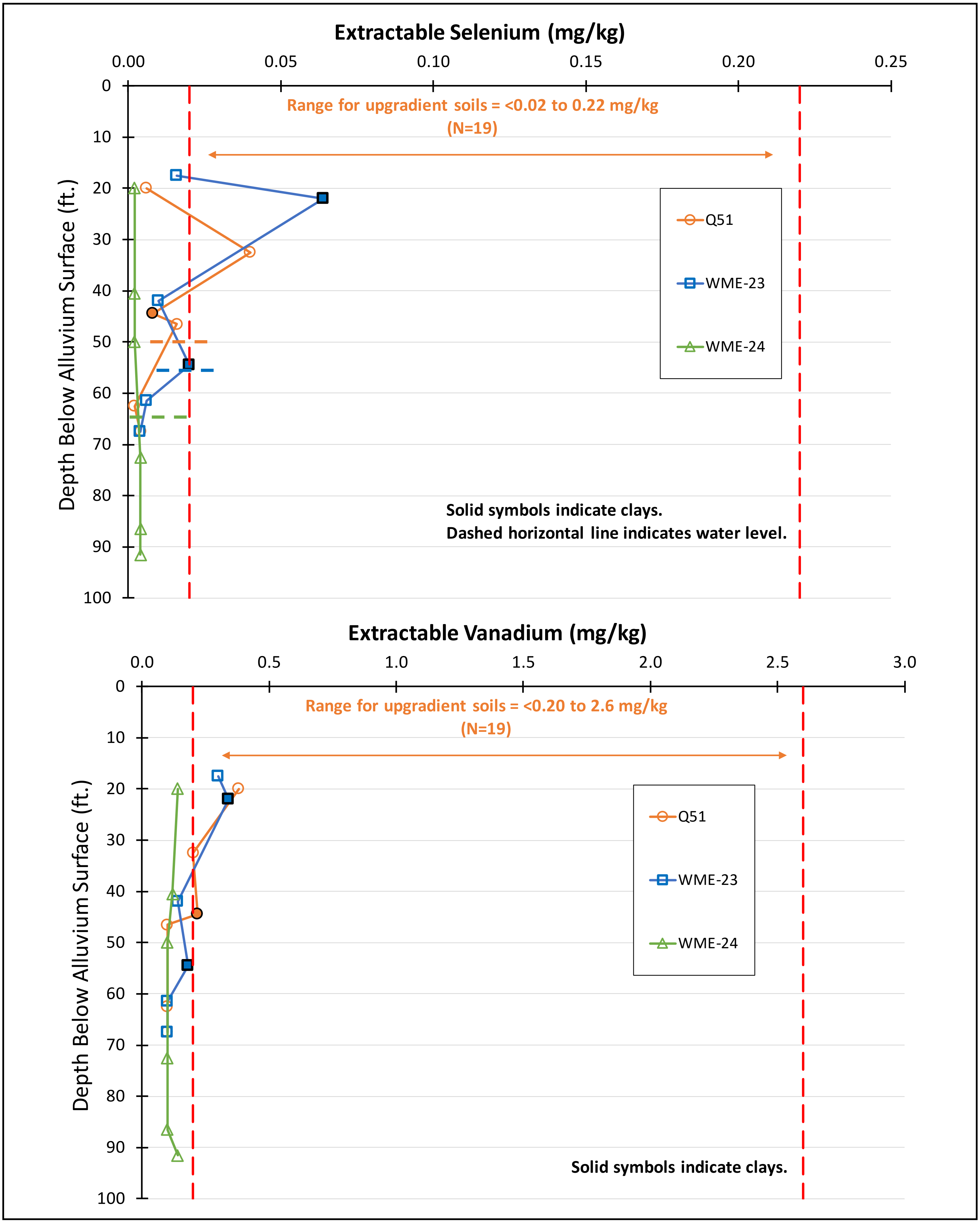


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FIGURE 7-9
EXTRACTABLE SELENIUM AND VANADIUM IN SOUTHERN ALLUVIUM

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_PT.PPT

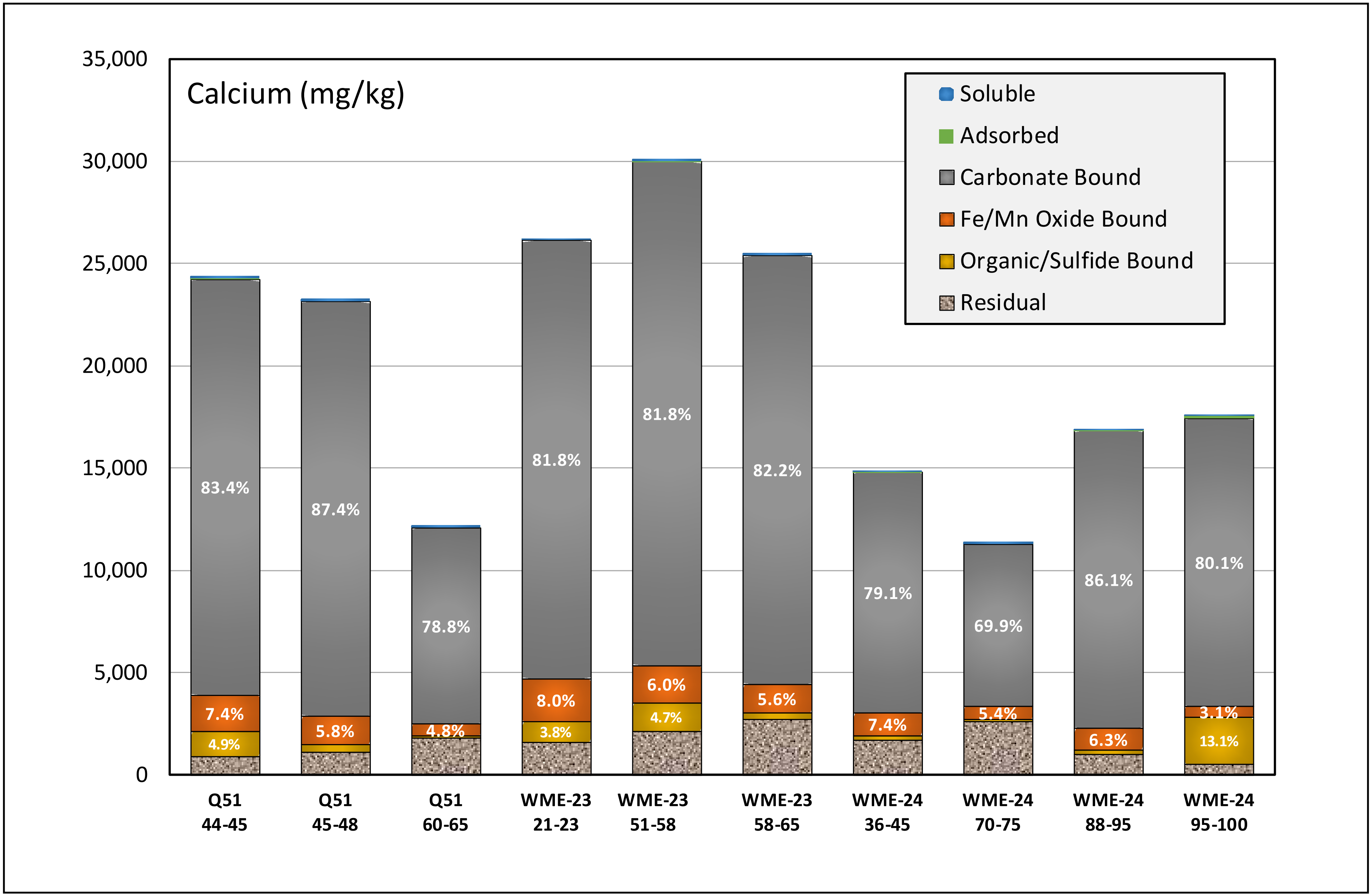

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FIGURE 7-10
SELECTIVE CHEMICAL EXTRACTION RESULTS FOR CALCIUM: SOUTHERN AREA

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_LS.PPT

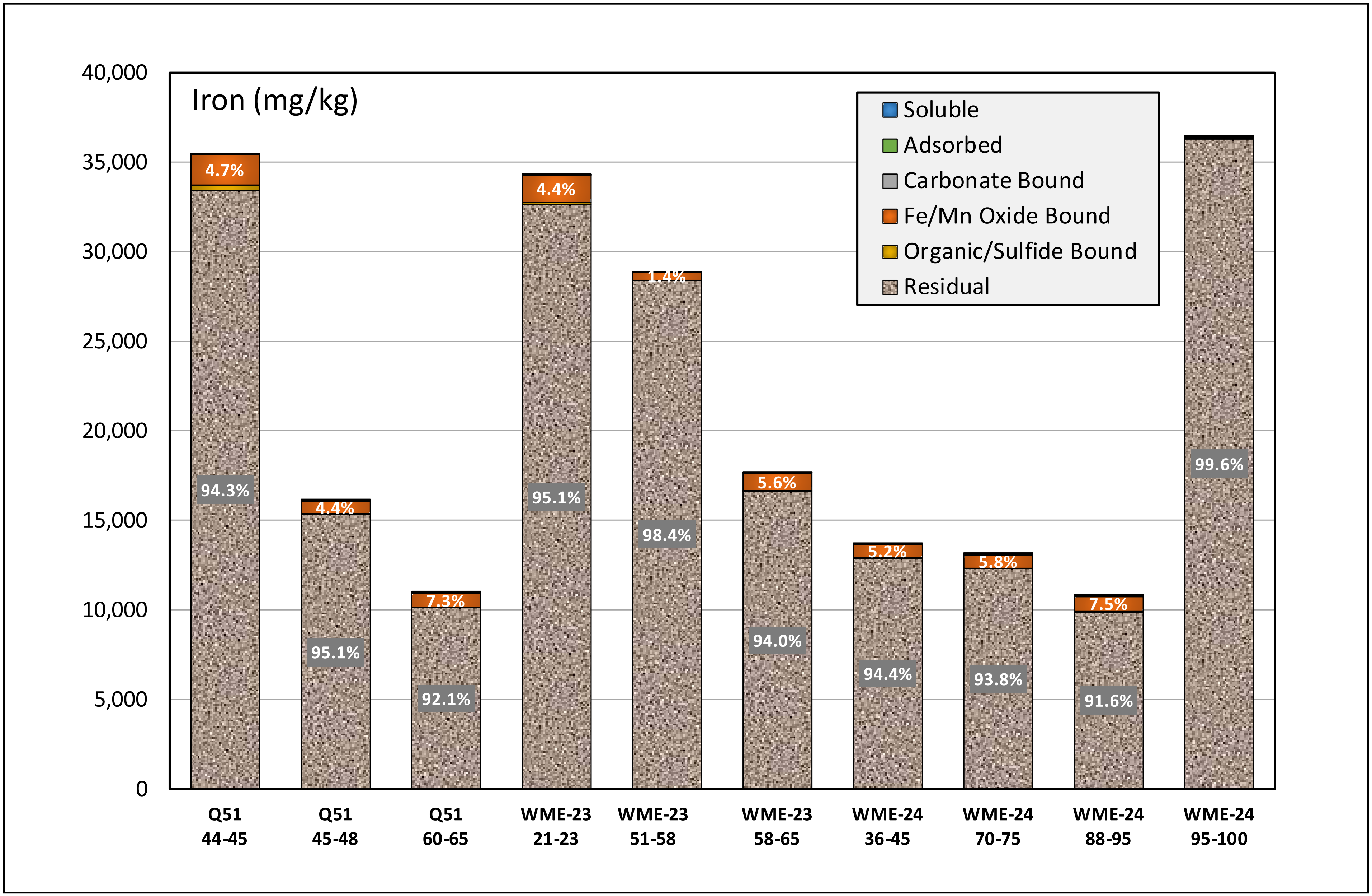

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FIGURE 7-11
SELECTIVE CHEMICAL EXTRACTION RESULTS FOR IRON: SOUTHERN AREA

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_LS.PPT

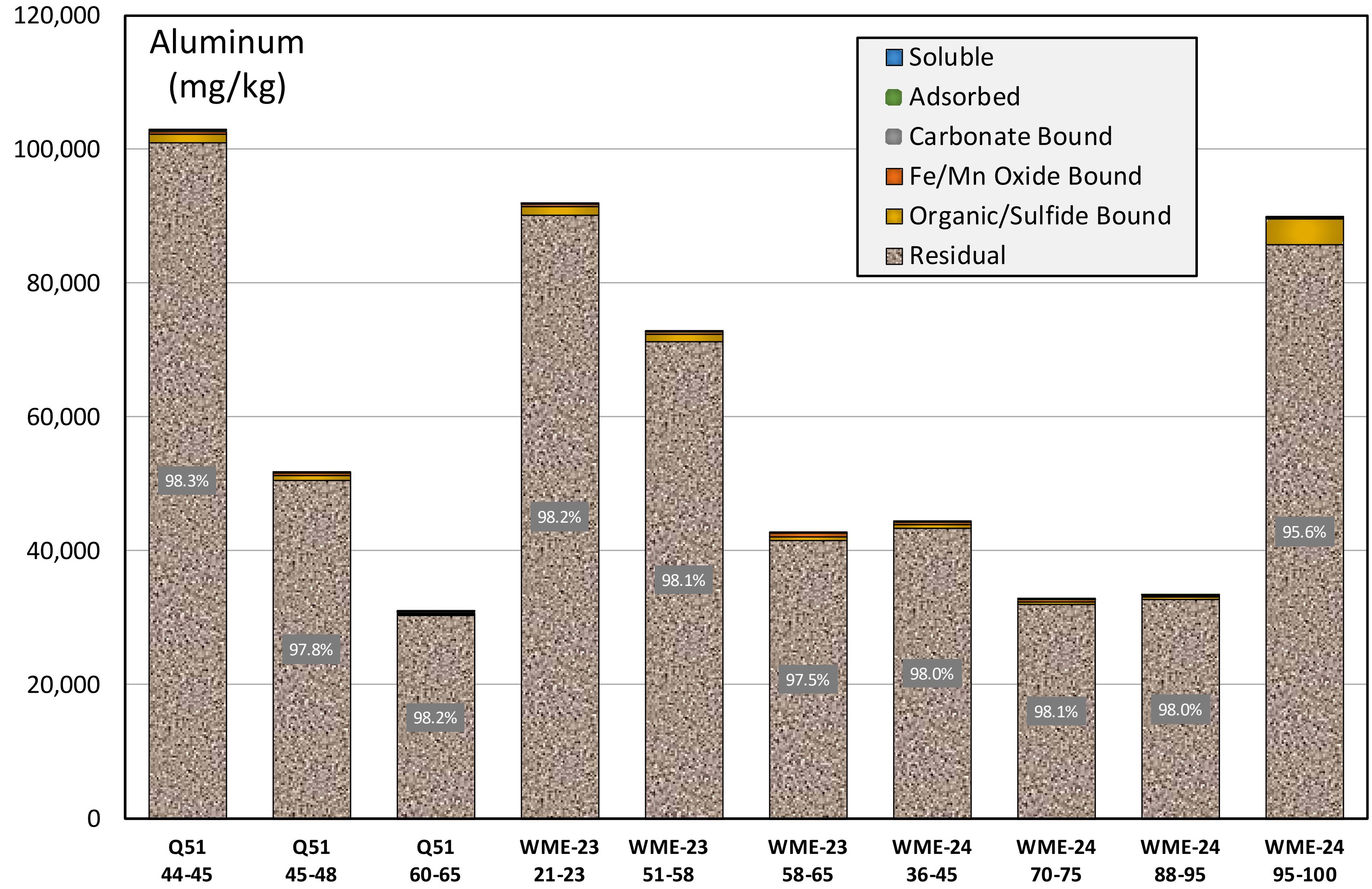

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FIGURE 7-12
SELECTIVE CHEMICAL EXTRACTION RESULTS FOR ALUMINUM: SOUTHERN AREA

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_LS.PPT

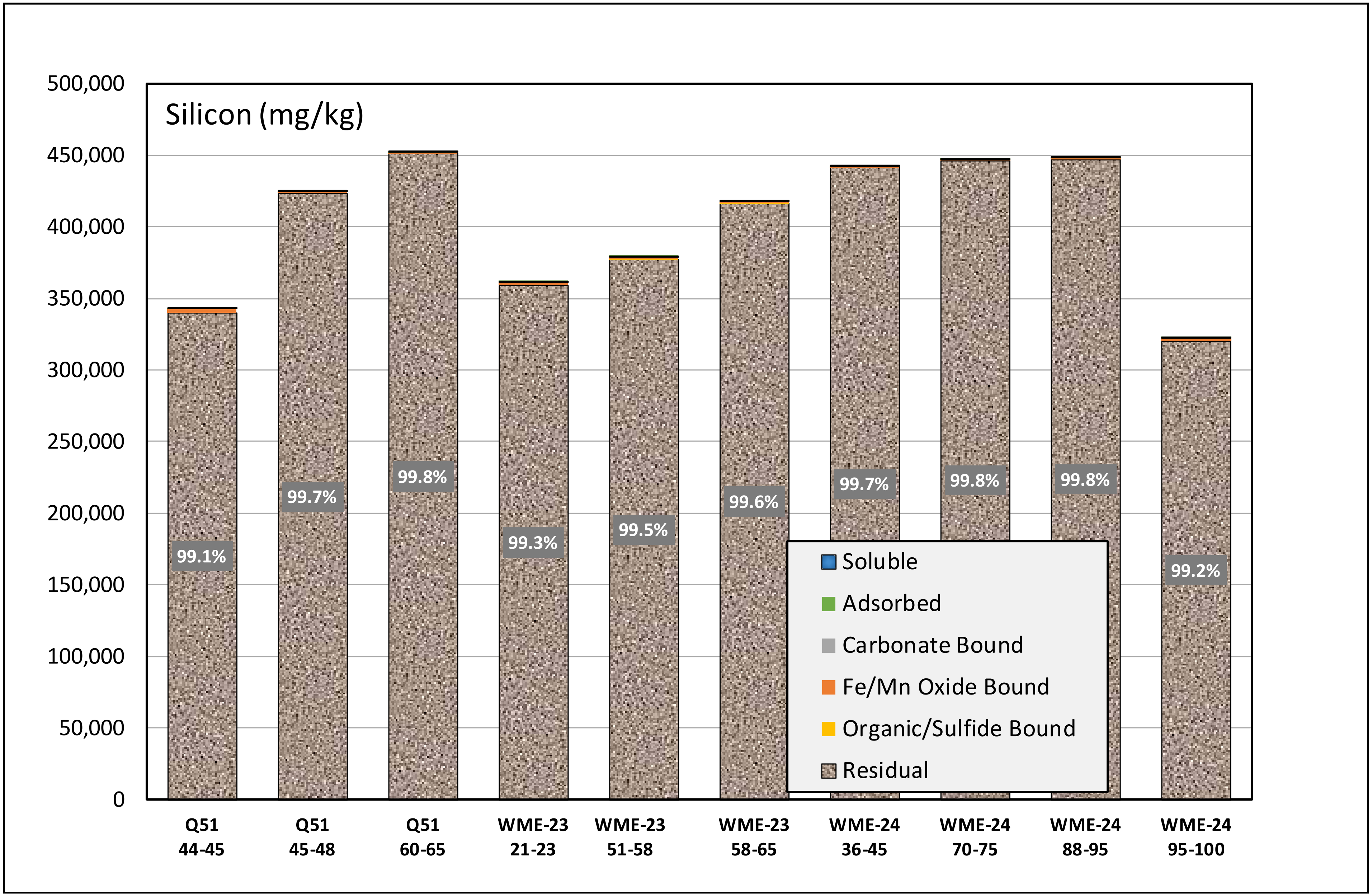

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FIGURE 7-13
SELECTIVE CHEMICAL EXTRACTION RESULTS FOR SILICON:
SOUTHERN AREA

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_LS.PPT

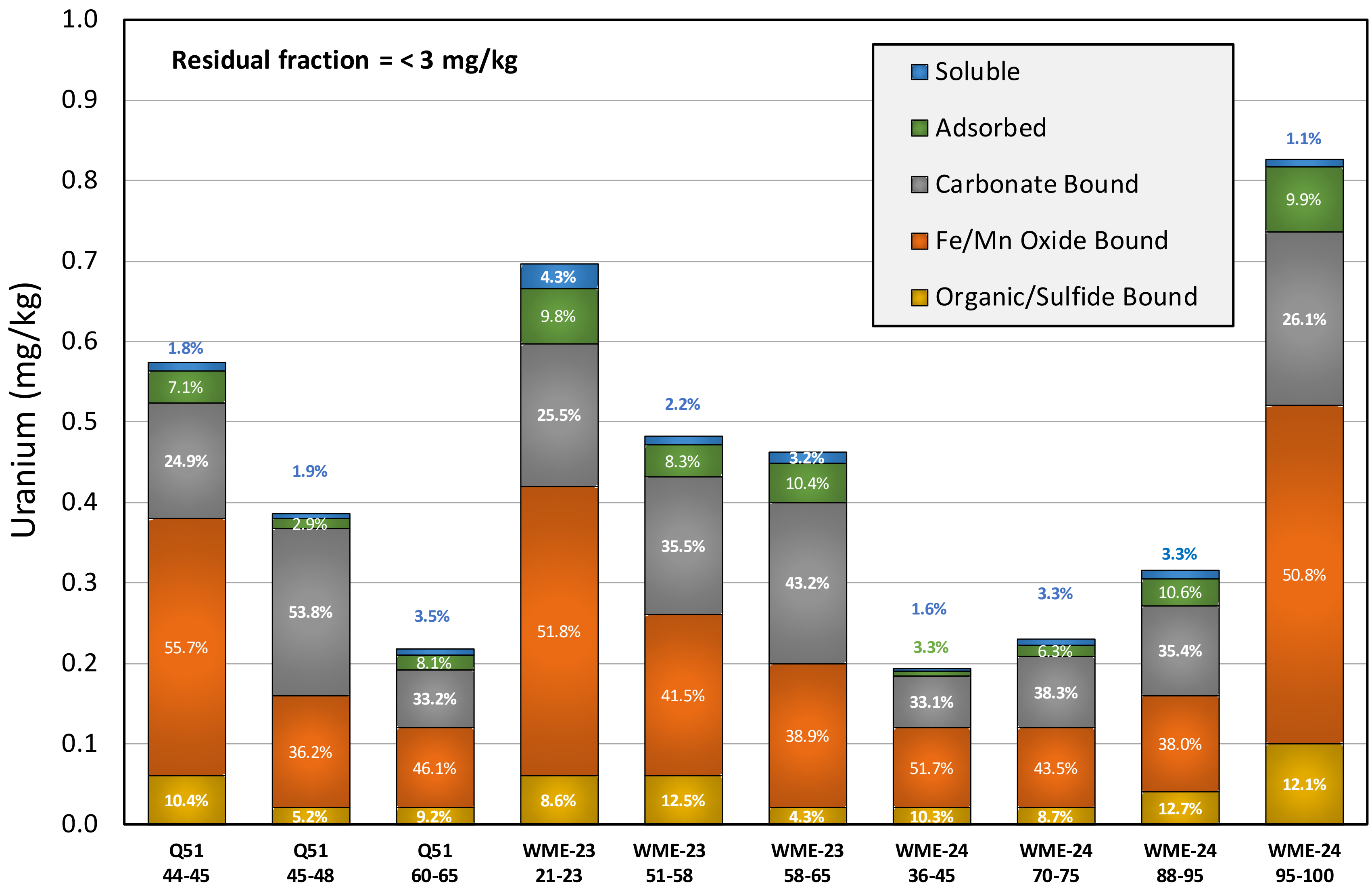

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FIGURE 7-14
SELECTIVE CHEMICAL EXTRACTION RESULTS FOR URANIUM: SOUTHERN AREA

Date:	April 2020
Project:	HOMESTAKE
File:	2019SC_FIGURES_LS.PPT

Appendix A

Drilling and Monitoring Well Completion Memorandum - Tailings Area

DRILLING AND MONITORING WELL COMPLETION MEMORANDUM - TAILINGS AREA

TO: Adam Arguello, Senior hydrologist, Homestake Mining Company

FROM: Rob Noble, P.G., and David Levy, Ph.D., Worthington Miller Environmental

SUBJECT: Completion Report for Monitoring Well Installation and Alluvial Boring Sample Collection for Geochemical Characterization in the tailings Area at the Homestake Grants Reclamation Project, Cibola County, New Mexico.

DATE: May 29, 2019

1.0 Introduction

Between April 29th and May 14th, 2019, three monitoring wells were installed below the Large Tailings Pile (LTP) and two monitoring wells were installed below the Small Tailings Pile (STP) at the Homestake Grants Reclamation Project Site (Site). All work was performed according to the *2019 Supplemental Tailings and Alluvial Characterization Work Plan* (WME, 2019) which describes the proposed monitoring well installation and sampling collection objectives for the 2019 investigation.

2.0 Monitoring Well Drilling and Installation

Five new monitoring wells were drilled and installed in the San Mateo alluvium: Wells WME-18, WME-19 and WME-20 were completed in the alluvium underlying the LTP (Figure 1), while WME-21 and WME-22 were completed in the alluvium underlying the STP (Figure 2). Boreholes were drilled by Yellow Jacket Drilling Services (Phoenix, AZ) using a Sonic drill rig with temporary casing advance capability. Nine-inch diameter temporary steel casing was advanced during drilling to prevent borehole collapse. Drill cuttings were collected with an 8-inch diameter core barrel. All wells were completed with flush-threaded 4-in. schedule 40 PVC pipe. All well screens are 5-ft. lengths with 0.010 slot size. Filter pack material consists of clean 10-20 silica sand. At least 5 ft. of time-release bentonite pellets were placed on top of the sand pack to ensure proper seal. Boreholes were sealed with a high-solids bentonite grout and finished with bentonite chips. The surface completion for each well consists of an 8-in. diameter steel protective casing with a locking lid and a cement pad. Table 1 provides construction information for each new monitoring well. Well completion diagrams are provided in Attachment A and field notes are provided in Attachment B.

Table 1: Well Completion Information.

Well ID	Latitude	Longitude	Completion Lithology	Total Depth (ft. T.O.C.)	Top of Screen (ft. T.O.C.)
WME-18	35°14'39.86"N	107°52'6.33"W	San Mateo Alluvium	154.0	149.0
WME-19	35°14'31.39"N	107°51'40.49"W	San Mateo Alluvium	138.0	133.0
WME-20	35°14'32.06"N	107°52'2.88"W	San Mateo Alluvium	154.0	149.0
WME-21	35°14'5.83"N	107°51'40.06"W	San Mateo Alluvium	72.0	67.0
WME-22	35°14'5.83"N	107°51'45.77"W	San Mateo Alluvium	74.0	69.0

3.0 Tailings and Alluvium Lithology

The tailings are highly heterogeneous and generally consist of alternating layers of poorly-graded sands, silts, and clays. Surface tailings tend to be loose and oxidizing, with increasing moisture and evidence of reducing conditions with increasing depth. The underlying San Mateo alluvium is also very heterogeneous with lithologies ranging from predominantly clay to predominantly sand. Detailed lithologic logs for the underlying alluvium at each borehole are provided in Attachment C and the geophysical logs are presented in Attachment D. Results from downhole geophysical logging were consistent with and confirmed observations made during drilling with respect to variations in texture, moisture, and the location of the tailings/alluvium interface. A brief summary of the tailings and underlying lithology at each location is summarized below:

- WME-18 (LTP): Downhole geophysical measurements varied in response to textural changes in tailings with depth and to the tailings/alluvial boundary, where there was a notable shift in the conductivity, neutron, and gamma logs. The upper few feet of alluvium consists of fine sands with a number of alternating layers of clay and sand below. Gravel begins to be encountered 20 ft. below the alluvial surface and lithology is generally less variable with depth. Sands and gravels with occasional clay stringers extend to bedrock, although a void was encountered at 96 ft. below the alluvial surface and the exact alluvial thickness at this location is not known. A shift in the neutron log at 115 ft. identifies the saturated zone below the LTP at this location.
- WME-19 (LTP): Similar to WME-18, the upper portion of the alluvium is dominated by fine sand, with a number of underlying alternating clay and sand layers as reflected in the variable conductivity log. Gravel begins to be encountered 40 ft. below the alluvial surface and lithology is generally less variable with depth. A shift in the neutron log indicates significantly higher moisture below 52 ft. The tailings/alluvial boundary is apparent by lower gamma readings around 80 ft. and the neutron log shift identifies a saturated zone at 120 ft. A thin clay layer overlies the Chinle Formation bedrock which is overlain by wet gravelly sand.
- WME-20 (LTP): Tailings at this location consisted of alternating sequences of dry to moist sands/silts/clays transitioning to silty sands with clay. Increasing moisture content with depth is indicated by the gradual decrease in neutron readings with depth. Small spikes in gamma readings are associated with increases in conductivity which is consistent with the finer-textured zones. A sharp decrease in gamma ray and conductivity identifies the tailings/alluvium interface around 85 ft. Although lithologic logs indicate wet conditions below 148 ft., this was not apparent in the neutron log.
- WME-21 (STP): Increasing gamma and conductivity readings in association with decreasing neutron readings are consistent with an increase in fines with depth in the STP. The tailings/alluvium interface is apparent by the shift in the gamma, neutron, and conductivity logs at 24 ft. Decreasing gamma readings with depth reflect increasing grain sizes and distance from below the STP. The saturated zone was identified at approximately 56 ft. based on shift in the neutron log.

- WME-22 (STP): Similar to WME-21, the increasing gamma and conductivity readings in association with decreasing neutron readings are consistent with an increase in fines with depth. The tailings/alluvium interface is apparent by a sharp decrease in gamma and conductivity readings just below 20 ft. Decreasing gamma readings with depth reflect increasing grain sizes and distance from below the STP. The saturated zone was identified at approximately 62 ft. based on shift in the neutron log.

4.0 Monitoring Well Development

All monitoring wells were allowed to sit for at least 24 hours before development. All monitoring wells were developed by Yellow Jacket Drilling Services. Wells were surged with a surge block, bailed with a PVC bailer and pumped with a small down-hole pump.

5.0 References

Worthington Miller Environmental LLC (WME). 2019. 2019 Supplemental Tailings and Alluvial Characterization Work Plan. Prepared for Homestake Mining Company of California. April.

Figures

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FIGURE 1
LTP BOREHOLE AND MONITORING WELL LOCATIONS

Date:	MAY 2019
Project:	HOMESTAKE
File:	BH-LOCATIONS-01

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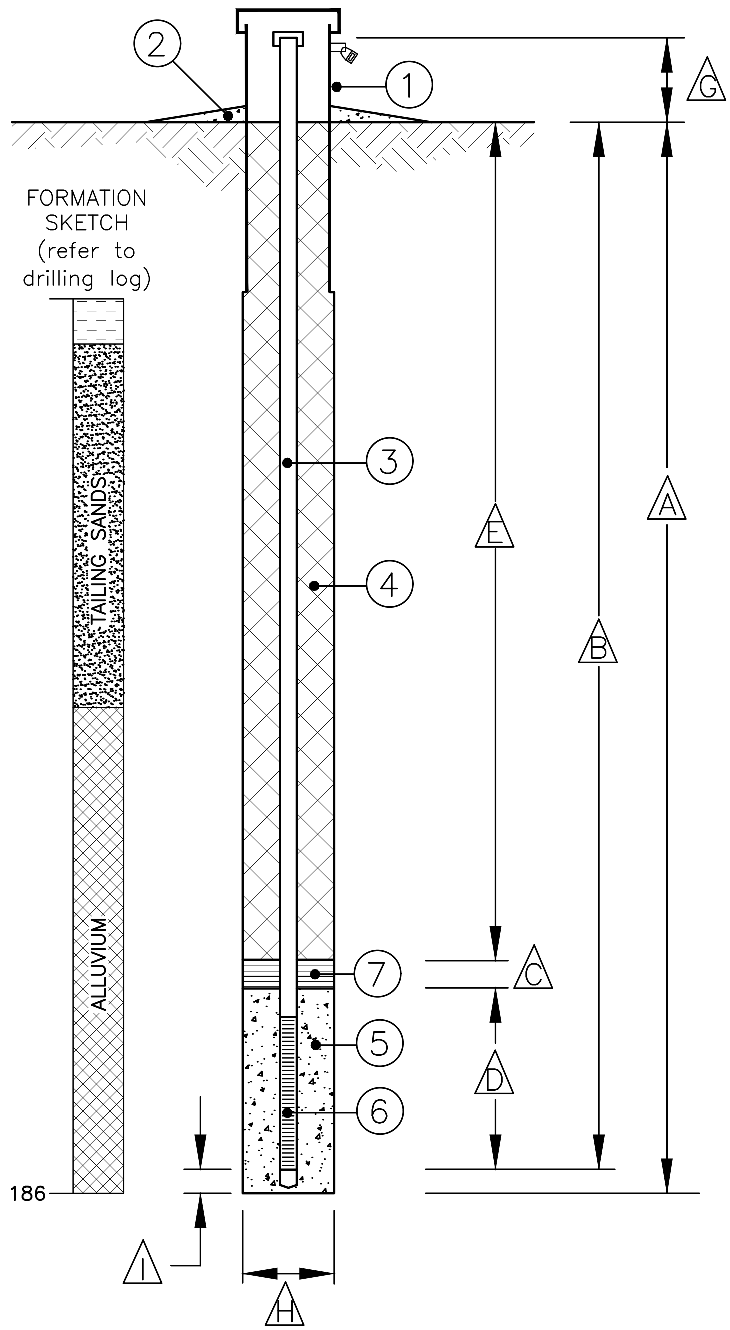
FIGURE 2
STP BOREHOLE AND MONITORING WELL LOCATIONS

Date:	FEBRUARY 2019
Project:	HOMESTAKE
File:	BH-LOCATIONS-01

Attachment A

WME-18
MONITORING WELL CONSTRUCTION INFORMATION SHEET



Project HOMESTAKE GRP

Well number WME-18

Date 05-16-2019

Drilling company YELLOW JACKET

Location LTP

Date drilled 04-30-2019

Date completed 04-30-2019

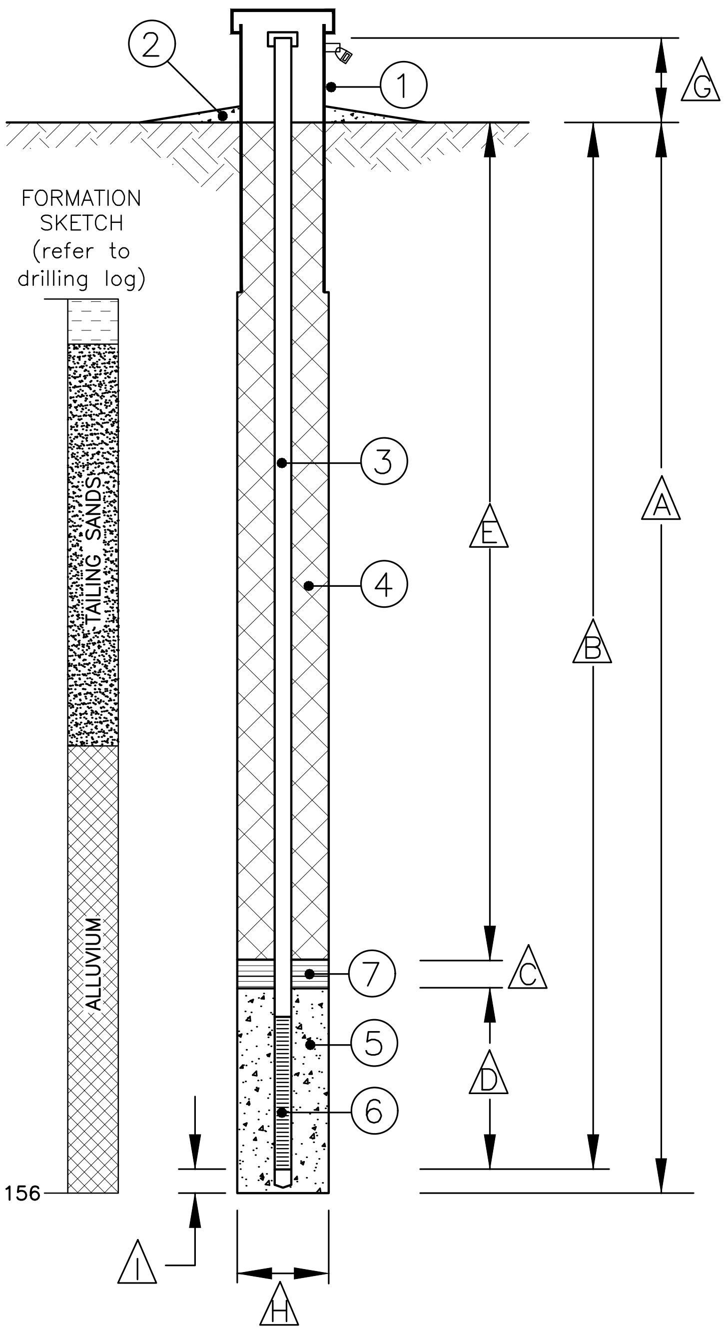
Materials:

1. Protective casing? (Yes) No
   Height above ground 3.0 ft
   Type STEEL Length 5' Dia. 8"
2. Cement pad? (Yes) No
3. Solid pipe: Type PVC Length 151 Dia. 4"
4. Seal type: HIGH SOLIDS BENTONITE GROUT
5. Filter pack: 10-20 SILICA SAND
6. Well screen: Type PVC Length 5' Dia. 4"
   Slot size 0.010
7. Seal type: TR30 BENTONITE PELLETS

Dimensions:

A	Total depth of boring	186	ft
B	Total depth of finished well	154	ft
C	Seal: Interval	135-147	ft
D	Filter pack: Interval	147-154	ft
E	Seal: Interval	0-147	ft
G	Height of stick-up	2.0	ft
H	Borehole diameter	8.0	in
I	Length of endcap	0.4	ft

WME-19
MONITORING WELL CONSTRUCTION INFORMATION SHEET



Project HOMESTAKE GRP
Well number WME-19
Date 05-16-2019
Drilling company YELLOW JACKET
Location LTP
Date drilled 05-06-2019
Date completed 05-07-2019

Materials:

(1) Protective casing? (Yes) No
Height above ground 3.0 ft
Type STEEL Length 5' Dia. 8"

(2) Cement pad? (Yes) No

(3) Solid pipe: Type PVC Length 135 Dia. 4"

(4) Seal type: HIGH SOLIDS BENTONITE GROUT

(5) Filter pack: 10-20 SILICA SAND

(6) Well screen: Type PVC Length 5' Dia. 4"
Slot size 0.010

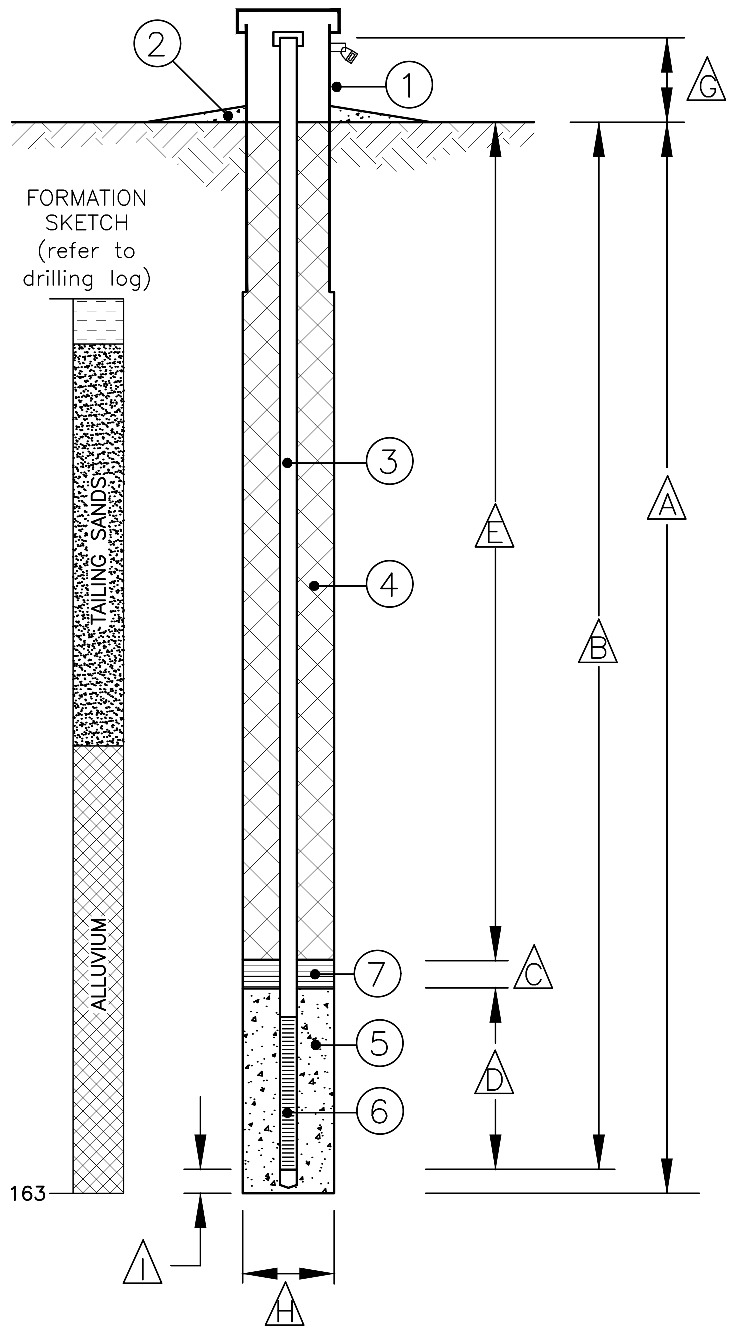
(7) Seal type: TR30 BENTONITE PELLETS

Dimensions:

A	Total depth of boring	156	ft
B	Total depth of finished well	138	ft
C	Seal: Interval	123-127	ft
D	Filter pack: Interval	127-138	ft
E	Seal: Interval	0-127	ft
G	Height of stick-up	2.0	ft
H	Borehole diameter	8.0	in
I	Length of endcap	0.4	ft

Z:\Project Files\Homestake\CAD\Figures\WC-WME WELLS.dwg SAVED: 5/23/19 PRINTED: 5/23/19 BY: TOM

WME-20
MONITORING WELL CONSTRUCTION INFORMATION SHEET



Project HOMESTAKE GRP
Well number WME-20
Date 05-16-2019
Drilling company YELLOW JACKET
Location LTP
Date drilled 05-09-2019
Date completed 05-09-2019

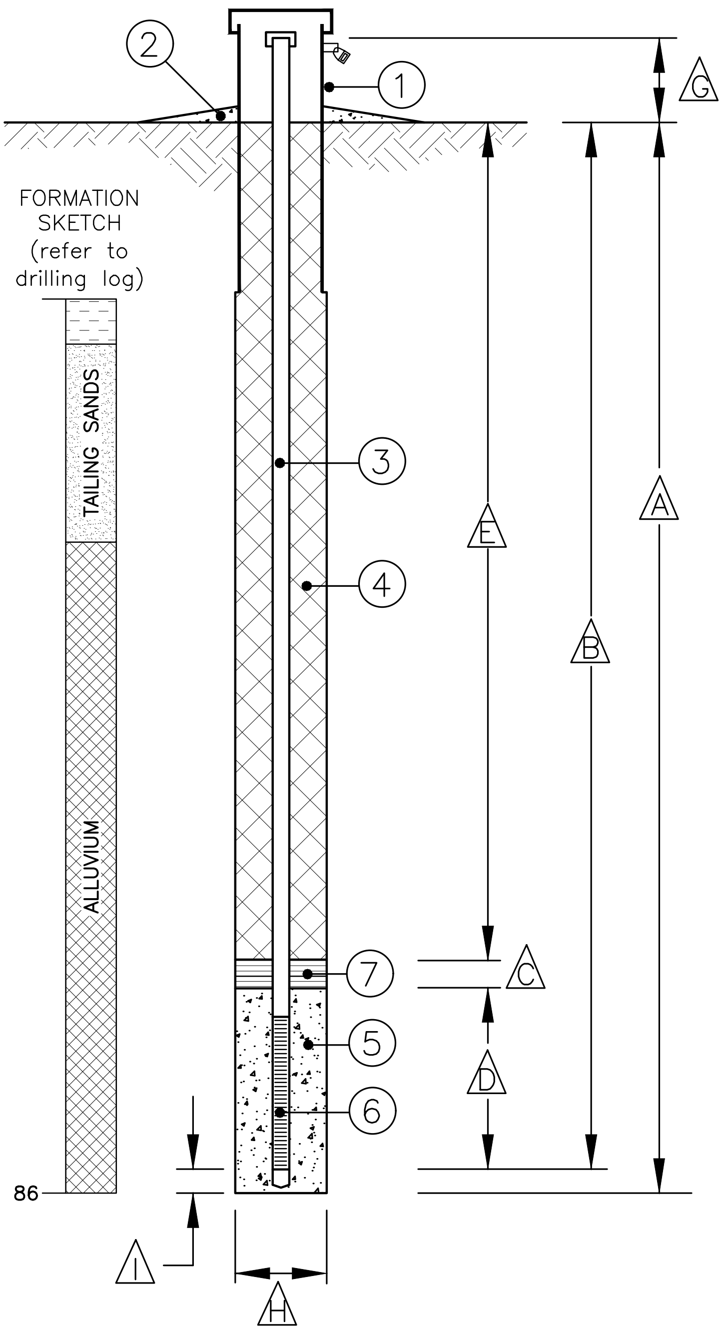
Materials:

1. Protective casing? (Yes) No
   Height above ground 3.0 ft
   Type STEEL Length 5' Dia. 8"
2. Cement pad? (Yes) No
3. Solid pipe: Type PVC Length 151 Dia. 4"
4. Seal type: HIGH SOLIDS BENTONITE GROUT
5. Filter pack: 10-20 SILICA SAND
6. Well screen: Type PVC Length 5' Dia. 4"
   Slot size 0.010
7. Seal type: TR30 BENTONITE PELLETS

Dimensions:

A	Total depth of boring	163	ft
B	Total depth of finished well	154	ft
C	Seal: Interval	140-146	ft
D	Filter pack: Interval	146-154	ft
E	Seal: Interval	0-146	ft
G	Height of stick-up	2.0	ft
H	Borehole diameter	8.0	in
I	Length of endcap	0.4	ft

WME-21
MONITORING WELL CONSTRUCTION INFORMATION SHEET



Project HOMESTAKE GRP
Well number WME-21
Date 05-16-2019
Drilling company YELLOW JACKET
Location STP
Date drilled 05-10-2019
Date completed 05-10-2019

Materials:

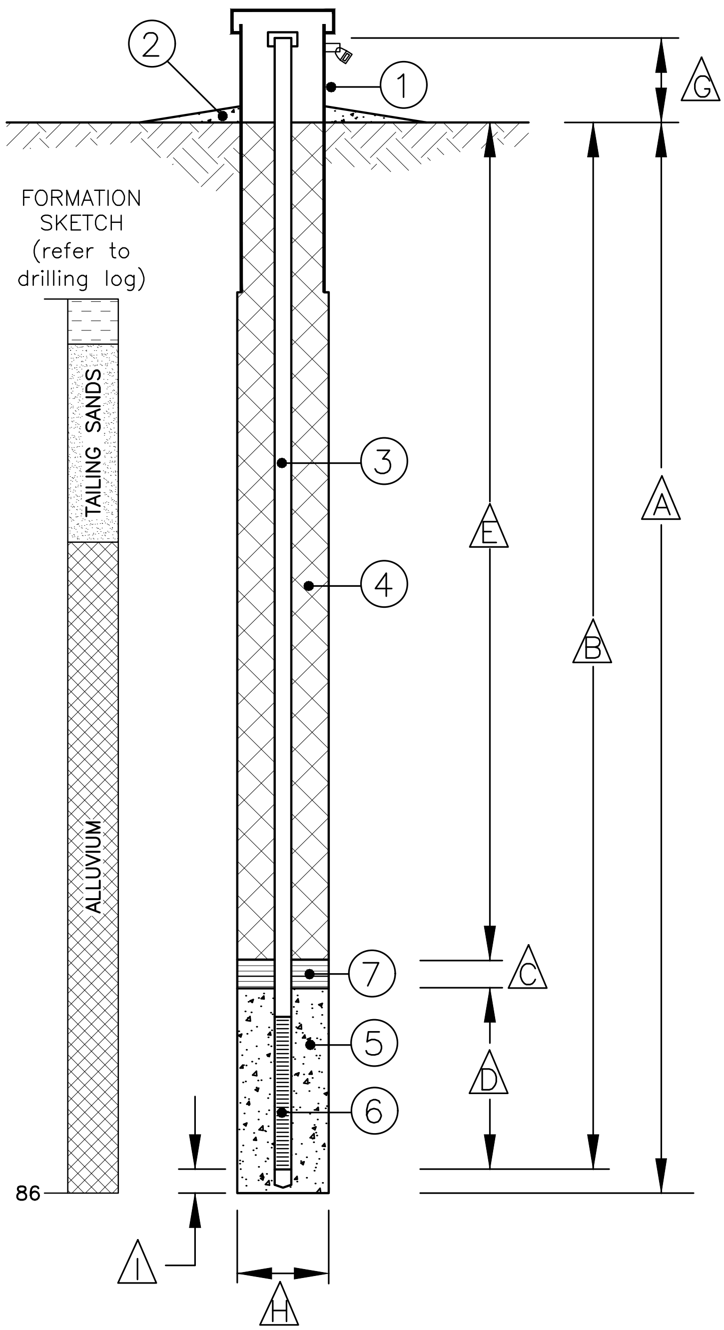
1. Protective casing? (Yes) No
   Height above ground 3.0 ft
   Type STEEL Length 5' Dia. 8"
2. Cement pad? (Yes) No
3. Solid pipe: Type PVC Length 69 Dia. 4"
4. Seal type: HIGH SOLIDS BENTONITE GROUT
5. Filter pack: 10-20 SILICA SAND
6. Well screen: Type PVC Length 5' Dia. 4"
   Slot size 0.010
7. Seal type: TR30 BENTONITE PELLETS

Dimensions:

A	Total depth of boring	86	ft
B	Total depth of finished well	72	ft
C	Seal: Interval	57-64	ft
D	Filter pack: Interval	64-72	ft
E	Seal: Interval	0-57	ft
G	Height of stick-up	2.0	ft
H	Borehole diameter	8.0	in
I	Length of endcap	0.4	ft

WME-22

MONITORING WELL CONSTRUCTION INFORMATION SHEET



Project HOMESTAKE GRP

Well number WME–22

Date 05–16–2019

Drilling company YELLOW JACKET

Location STP

Date drilled 05–12–2019

Date completed 05–12–2019

Materials:

1. Protective casing? (Yes) No
   Height above ground 3.0 ft
   Type STEEL Length 5' Dia. 8"
2. Cement pad? (Yes) No
3. Solid pipe: Type PVC Length 71 Dia. 4"
4. Seal type: HIGH SOLIDS BENTONITE GROUT
5. Filter pack: 10–20 SILICA SAND
6. Well screen: Type PVC Length 5' Dia. 4"
   Slot size 0.010
7. Seal type: TR30 BENTONITE PELLETS

Dimensions:

A	Total depth of boring	86	ft
B	Total depth of finished well	74	ft
C	Seal: Interval	61–66	ft
D	Filter pack: Interval	66–74	ft
E	Seal: Interval	0–66	ft
G	Height of stick–up	2.0	ft
H	Borehole diameter	8.0	in
I	Length of endcap	0.4	ft

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Attachment B

MONDAY APRIL 29, 2019
SUPPLEMENTAL GEOCHEM.

0630 MEET DRILLERS @ WAL MART
0650 ARRIVE @ SITE
0700 RAD / SAFETY TRAINING.
0945 FILL WATER TRUCK.
0950 STAKE WELL LOCATIONS
w/ ADAM A.
1100 LUNCH BREAK
1130 RIG @ WME-18
PROJECTED MINIMUM
DEPTH = 174'
DRILL CREW
TRISTAN
JOSH ALSTER
HUNTER
1400 TOWER UP ON WME-18
1417 SPUD IN WME-18
1422 0'-5' LEAN CLAY. STIFF.
10R 4/4 WEAK RED. MOTTLING.
DRY. NON-PLASTIC.
- CLAY CAP.
1430 5'-10': ~~WEAK~~ POORLY GRADED SAND
w/ SILT. FINE SAND.
10YR 5/1 GRAY. LOOSE. DRY.
TAILINGS SAND.

MONDAY APRIL 29, 2019
WME-18

1440 10'-20' SAME AS ABOVE
5YR 5/4 REDDISH BROWN
20'-30' SANDY LEAN CLAY.
SOFT - MED.
GLAY 1 4/N. DARK GRAY
w/ BLACK STRINGERS.
LOW PLASTICITY. WET/MOIST.
TAILINGS.
1445 SAMPLE WME-18-T-~~35~~ 35
1452 30-50' - SAME AS ABOVE.
SULFER SMELL.
1515 COLLECT WME-18-T-70
50'-60' SAME AS ABOVE
60'-70': LEAN CLAY w/ TRACE
SAND. MED STIFF
5Y 4/1 DARK GRAY
LOOSE, SULFUR SMELL
WET.
1600 @ 92': BAG NATIVE @ 92'
70'-82' SAME AS ABOVE

MONDAY APRIL 29, 2019
WME-18

82'-84': (0-2' BELOW) SANDY SILT. LOOSE. 2.5Y 5/3 LIGHT OLIVE BROWN. MOIST. NON-PLASTIC.

84'-86' (2-4) SAND FINE-MED. POORLY GRADED. LOOSE. 10 YR 5/4 YELLOWISH BROWN. WET. NON-PLASTIC. NON-COHESIVE. PERCHED ZONE.

86-87' SAME. ~~(4-5)~~ (4-5)

87'-88': CLAY. LEAN. HARD.
~~(5-6)~~ 2.5Y 3/2 VERY DARK GRAYISH BROWN. SLIGHT MOISTURE. HIGH PLASTICITY. COHESIVE. "CONFINING LAYER"

88'-89' ~~(6-7)~~ SAND. LOOSE.
(6-7) 5YR 3/2 DARK REDDISH BROWN. DRY. POORLY GRADED. FINE SAND.

89'-90' ~~(7-8)~~ CLAY. LEAN. HARD.
(7-8 2.5YR ~~3/~~ 3/1 VERY DARK GRAY. SLIGHT MOISTURE. HIGH PLASTICITY. COHESIVE. "CONFINING LAYER"

MONDAY APRIL 29, 2019
WME-18

90'-92' (~~8~~-10): CLAY w/ SAND. HIGHLY MOTTLED. DARK GRAY - LIGHT GRAY. BLACK STRINGERS. ORGANIC MATERIAL. DENSE - LOOSE. DRY. "PALEOSOL" VADOSE ZONE.

@ 1630 ~~@ 96'~~ 96':
92'-96' (10-14) SAND. LOOSE. WET. POORLY GRADED. FINE SAND. 10YR 4/2 DARK GRAYISH BROWN. NON-PLASTIC. CLAY STRINGERS @ 96'

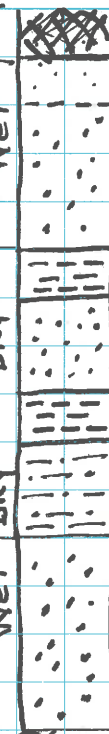
1640 - LIGHTENING SPOTTED STORM APPROACHING. SHUT DOWN FOR DAY.

1700 SIGN OUT

1710 OFF SITE.

Depth Below Tailings	Depth Below Ground	Lithology	
0	82		Silty Sand
-1	83		
-2	84		
-3	85		Fine Sand
-4	86		
-5	87		
-6	88		
-7	89	25	107
-8	90	26	108
-9	91	27	109
-10	92	28	110
-11	93	29	111
-12	94	30	112
-13	95	31	113
-14	96	32	114
-15	97	33	115
-16	98	34	116
-17	99	35	117
-18	100	36	118
-19	101	37	119
-20	102	38	120
-21	103	39	121
-22	104	40	122
-23	105	41	123
-24	106	42	124

Depth Below Tailings	Depth Below Ground		Lithology
0 Alluvial Surface	82		Silty Sand
1	83	Wet	
2	84	Wet	Fine Sand
3	85	Wet	Sand
4	86	Wet	(Wet)
5	87		Dense Clay
6	88	Dry	Fine Sand
7	89	Dry	(Dry)
8	90		Dense Clay
9	91	Dry	Sandy Clay
10	92	Dry	(Mottled)
11	93	Wet	Fine Sand
12	94	Wet	(Wet)
13	95	Wet	
14	96	Wet	



43	125	51	133	59	141	67	149
44	126	52	134	60	142	68	150
45	127	53	135	61	143	69	151
46	128	54	136	62	144	70	152
47	129	55	137	63	145	71	153
48	130	56	138	64	146	72	154
49	131	57	139	65	147	73	155
50	132	58	140	66	148	74	156

'94 = 176'

TUESDAY APRIL 30, 2019

WME-18

0630 ARRIVE @ SITE
0640 WARM UP RIG
0700 SUPPLIES ARRIVE @ YARD.
0740 RETURN TO RIG
0742 SAFETY MEETING.
- PPE
- SLIPS/TRIPS
- RIGHT TOOL FOR JOB.

0800 BEGIN DRILLING FROM 96'
0821 DOWN FOR ROD REPAIR.
WEATHER: 50°F, PARTLY CLOUDY. BREEZE.
0908 FIXED... PULL SAMPLE FROM 96'-100'.
96-100': SILTY SAND. LOOSE 10YR 6/4 LIGHT YELLOWISH BROWN. SLIGHTLY MOIST-DRY. NON-PLASTIC. POORLY GRADED.
0928 @ 116' BGS.

TUESDAY APRIL 30, 2019

WME-18

100'-102': SANDY LEAN CLAY. SOFT. 10YR 5/3 BROWN. ML-CL. LOW PLASTICITY. SLIGHTLY MOIST. SOME MOTTLING.

102'-105': ~~POORLY~~ WELL GRADED SAND w/ CLAY AND TRACE GRAVEL. SP-SC LOW PLASTIC FINES. LOOSE-MED DENSE SAND. GRAVEL UP TO 1". 10YR 5/4 YELLOWISH BROWN. SLIGHTLY MOIST-DRY.

105'-110': SILTY CLAY. w/ TRACE GRAVEL. SOFT-MEDIUM. 5YR 4/4 REDDISH BROWN. ML-CL. SLIGHTLY MOIST. NON-COHESIVE.

DEPTH BELOW TAILINGS	DEPTH BELOW GROUND		LITHOLOGY
18	100		
19	101	MOIST	SANDY CLAY
20	102		
21	103		SAND
22	104	DRY	w/ GRAVEL
23	105		
24	106		
25	107	MOIST	SILTY CLAY
26	108		w/ GRAVEL
27	109		
28	110		
29	111		
30	112	MOIST-DRY	FINE SAND
31	113		w/ CLAY
32	114		
33	115		
34	116		▼ WATER? TABLE,
35	117		
36	118		GRAVELLY
37	119	WET	SAND w/
38	120		TRACE CLAY.
39	121		WET
40	122		

WME-18

DEPTH BELOW TAILINGS	DEPTH BELOW GROUND		LITHOLOGY
0	82		ALLUVIAL SURFACE
1	83		SILTY
2	84	WET	SAND
3	85		FINE
4	86		SAND
5	87		DENSE CLAY
6	88		FINE
7	89	DRY	SAND
8	90		DENSE CLAY
9	91		SANDY CLAY
10	92		MOTTLED
11	93		
12	94	WET	FINE
13	95		SAND
14	96		CLAY STRINGERS
15	97		
16	98	DRY	SILTY
17	99		SAND
18	100		

TUESDAY APRIL 30, 2019
WME-18

110'-116': POORLY GRADED SAND w/ CLAY. LOOSE-MED. DENSE. 5YR 4/4 REDDISH BROWN. FINE SAND ML-CL. LOW-MED. PLASTICITY. SLIGHT MOIST-DRY.

1010 @ 126'

116'-126' WELL GRADED SAND w/ CLAY AND GRAVEL, LOOSE. SW-SC. PLASTIC FINES. AS STRINGERS GRAVEL UP TO 1" DIAMETER 5YR 4/4 REDDISH BROWN. WET!

1035 @ 146'

126'-143': POORLY GRADED FINE SAND w/ TRACE CLAY STRINGERS AND TRACE GRAVEL UP TO 1" DIA. 5YR 4/4 REDDISH BROWN. LOOSE SAND. STIFF CLAY STRINGERS. WET.

TUESDAY APRIL ~~29~~ 30, 2019
WME-18

~~145~~
143'-145': LEAN CLAY. VERY STIFF. 5YR 4/4 REDDISH BROWN. HIGH PLASTICITY. WET.

145'-146': POORLY GRADED FINE SAND. LOOSE. 5YR 4/4 REDDISH BROWN. WET.

11:00 LUNCH BREAK
11:50 RESUME DRILLING @ 146'

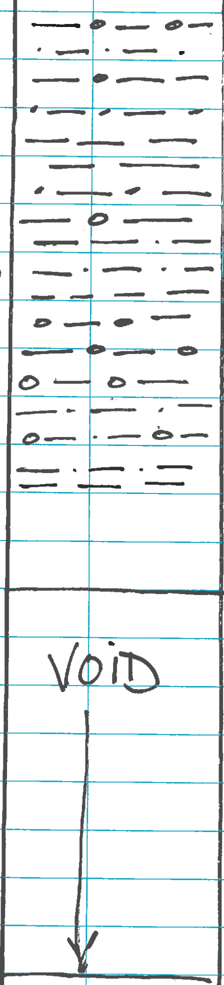
146'-155': WELL GRADED GRAVELLY SAND w/ TRACE CLAY LENSES. <5% SW LOOSE. 5YR 4/4 REDDISH BROWN. HIGHLY PLASTIC FINES. <5%. WET.

~~155~~
1245 @ 172' - CORE BARREL EMPTY. TRIP BACK IN.

DEPTH BELOW TAILINGS	DEPTH BELOW GROUND		LITHOLOGY
40	122		WELL SORTED
41	123	WET	SAND w/
42	124		GRAVEL &
43	125		TRACE CLAY
44	126		
45	127		
46	128		
47	129		
48	130	WET	POORLY SORTED
49	131		FINE SAND
50	132		w/ TRACE OF
51	133		CLAY AS
52	134		STRINGERS.
53	135		
54	136		
55	137		
56	138		
57	139		
58	140		
59	141		
60	142		
61	143		
62	144		LEAN CLAY
6			

DEPTH BELOW TAILINGS	DEPTH BELOW GROUND		MOISTURE	LITHOLOGY
62	144			LEAN
63	145			CLAY
64	146			FINE SAND
65	147	COMPLETION INT.		
66	148			
67	149			GRAVELLY
68	150			SAND
69	151		WET	
70	152			
71	153			
72	154			
73	155	*		
74	156			FINE
75	157			SAND
76	158			(?)*
77	159			
78	160			SANDY
79	161			LEAN
80	162			CLAY
81	163		MOIST	w/GRAVEL
82	164			
83	165			
84	166			
85	167			

DEPTH BELOW TAILINGS	DEPTH BELOW GROUND	MOISTURE	LITHOLOGY	
85	167			
86	168			SANDY
87	169			LEAN
88	170			CLAY
89	171			w/ GRAVEL
90	172	MOIST		
91	173			
92	174			
93	175			
94	176			
95	177			
96	178			
97	179			
98	180		VOID	VOID
99	181			
100	182			
101	183			
102	184			
103	185			
104	186			



TUESDAY APRIL 30, 2019

WME-18

1330 @176' ONLY 10' RETURNS FOR 156-176'. BOREHOLE COLLAPSING. NEED TO ADVANCE MORE CASING.
CAVING @ 166.
UNKNOWN WHERE 156-176 RETURNS CAME FROM.

156-158': POORLY GRADED FINE SAND. LOOSE. 5YR 4/4 REDDISH BROWN. WET.

158'-176': ?? SANDY LEAN CLAY w/ GRAVEL. VERY STIFF. 10YR 3/2 VERY DARK GRAYISH BROWN. CH. HIGH PLASTICITY. MOIST. COHESIVE.

1415 VOID @ 178'-186'
HEAD DROPS
1422 BROKEN ROD DUE TO VOID ENCOUNTER.
80' OUT. 120' IN HOLE.

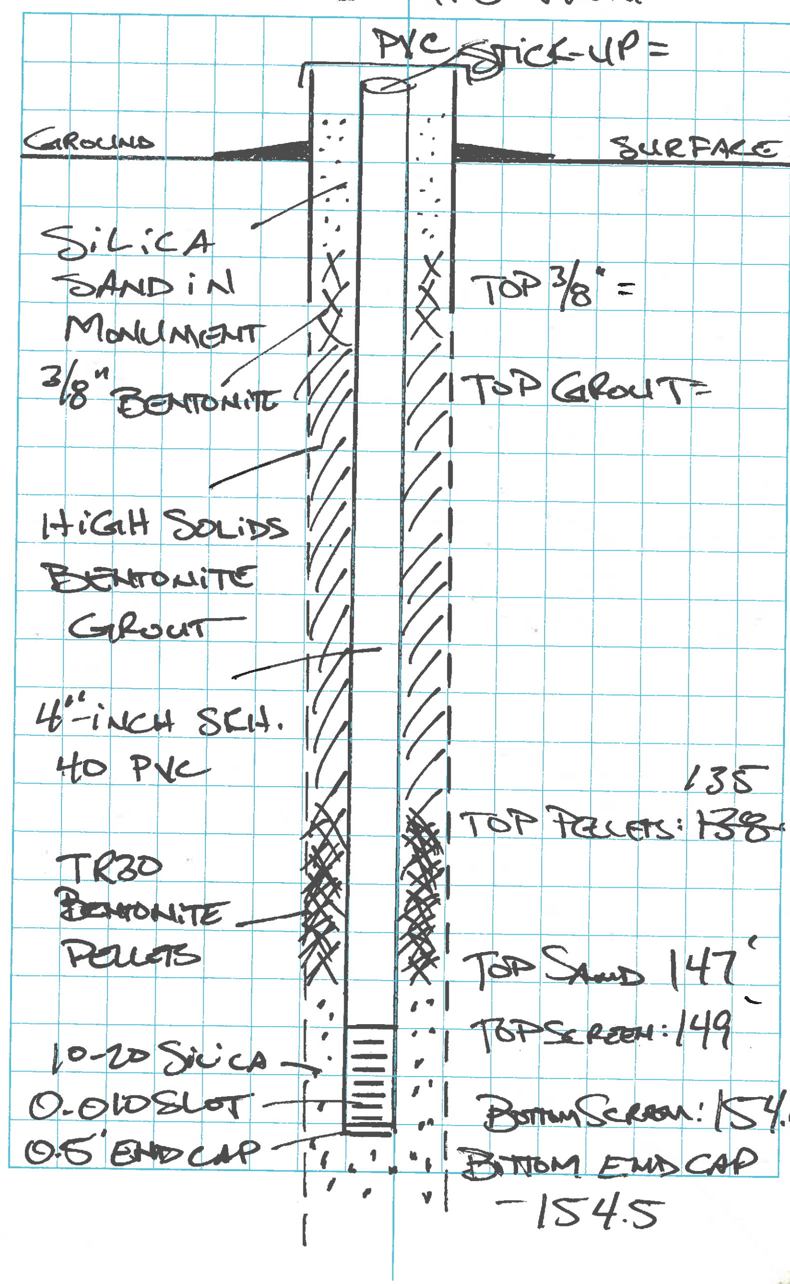
TUESDAY APRIL 30, 2019
WME-18

1540 OUT OF HOLE.
T.D. = 157' BGS.
MUST PULL CASING
~190' IN HOLE.
TARGET COMPLETION INTERVAL
= 150'-155' w/ SAND TO
~147' BGS.

1555 160' CASING IN HOLE.
T.D. = 147.
*HEAVING SAND IN CASING
*RISK OF LOSING CASING
DOWN BOREHOLE IF RE-DRILL.
+ DRILLER
1600 WILL ATTEMPT TO SET WELL
AND LOAD HOLE w/ WATER TO
LOWER PVC TO TARGET DEPTH.

WME-18 PVC COUNT:
5' SCREEN: I
10' BLANK: ~~IIII~~ ~~IIII~~ IIIII
5' BLANK: I

WME-18 COMPLETION



TUESDAY APRIL 30, 2019
WME-18

1720 160' TOTAL PVC IN HOLE.
BOTTOM OF WELL @ 155'

1730 WELL SET TO 154.5' BGS.
- PULLED UP ½' ON FIRST CASING.
1801 SAND PACK TO 147' BGS.
- PULL CASING.

1800 BENTONITE "COATED"
TIME RELEASED PELLETS
INSTALLED TO 138' BGS.
- PULL CASING TO 136'.

1900 LEAVE SITE

WEDNESDAY MAY 1, 2019
WME-18

0700 ARRIVE @ SITE
0725 SAFETY MEETING @ SITE.
ACTIVITIES:
- GROUT WME-18 TO SURFACE.
- MOVE TO WME-19
- SET MONUMENT @ WME-18
- BREAK FOR 4 DAYS.

0740 TAG GR HOLE @ 135' BGS.
PREPARE TO GROUT HOLE
0915 BENTONITE GROUT TO 10'

WME-18 SAMPLE DEPTHS
0-2, 2-4, 4-5, 6-7, 7-8,
8-10, 11-14-DUP, 18-20, 20-23,
23-27, 29-32, 40-43, 51-54.
65-68, 78-81, 91-94

0920 PREPARE TO COLLECT
SAMPLES.

WEDNESDAY MAY 8, 2019
WME-18

0922 WME-08-0-2
0924 WME-18-2-4
0928 WME-18-4-5
0935 WME-18-~~5~~-7
0940 WME-18-7-8
0943 WME-18-8-10
0949 WME-18-11-14
0955 WME-18-11-14-DUP
1000 WME-18-18-20
1020 WME-18-23-27
1027 WME-18-29-32
1049 WME-18-40-43
1056 WME-18-51-54
1106 WME-18-65-68
1111 WME-18-78-81
1117 WME-18-91-94
1010 WME-18-20-23

12:30 LEAVE SITE

MONDAY MAY 6, 2019
WME-19

06:50 ARRIVE @ SITE.
07:00 DRILLERS ON SITE.
07:20 SAFETY MEETING @ R.G.
09:40 SPUD IN WME-19
0-5': LEAN CLAY. STIFF ~~10YR~~ 10R 4/4 WEAK RED. NON-PLASTIC. DRY. MOTTLING. "CLAY CAP."
DRIVE CASING TO 5'
09:55 @ 15'
5-10': POORLY GRADED SAND w/ SILT & CLAY. FINE SAND. 5Y 5/2 OLIVE GRAY. LOOSE. DRY. TAILINGS.

10:00 COLLECT WME-19-7-35
10-35': POORLY GRADED SAND w/ SILT. FINE SAND. 5Y 4/1 DARK GRAY. MOIST. LOOSE. TAILINGS.
10:20 @ 55'.
35'-55' - SAME AS ABOVE.

Monday May 6. 2019
WME-19

10:25 Stop work to replace jaws.
10:55 Resume drilling.
11:00 Collect WME-19-T-75.
~~86~~ 55-75': Poorly Graded Sand w/ trace clay. 5Y 4/1 Dark Gray. Wet. Loose. Clay High Plasticity. Tailings.
1110 Hard drilling @ 90'.
1118 @ 94' Trip out
1130 Break for lunch.
1230 Resume @ 94' → add casing

75-82': Same as above.
82'-89: Poorly Graded Fine Sand w/ Lean Clay. 10YR 5/4 Yellowish Brown. Loose. Moist.-Wet. Clay as thin lenses. High Plasticity. Med. Soft.
89'-91' Lean Clay. Dense. 5YR 4/3 Reddish Brown. High Plasticity. S. Moist. "Confining Layer"

Monday May 6. 2019
WME-19

91-93': Silty Sandstone w/ clay. ~~Soft-Moderate~~. 10YR 7/2 Light Gray. Dry. "Vadose Zone" Loose-Medium Dense.

1245 Clean out hole to 94'.
1308 Resume drilling @ 94'.
1315 Hydraulic Hose Ruptures.
1405 Rig Fixed.
1425 @ 106'.

93'-94': Sandy Clay. Hard. 5Y 4/1 Dark Gray. Dry. Low Plasticity. Friable. Fine Sand Fraction.

94'-~~98~~ 100: Poorly Graded Fine Sand. Loose. 10YR 6/4 Light Yellowish Brown. to 5YR 5/4 Reddish Brown. Dry! Non-Plastic.

WME-19

ALLUVIUM	TOTAL	MOISTURE		LITHOLOGY (TAILINGS)
0	82			
1	83			
2	84			FINE
3	85	WET	WET	SAND w/
4	86			TRACE CLAY
5	87			
6	88			
7	89			
8	90		MOIST	LEAN HARD
9	91			CLAY
10	92	DRY		SILTY
11	93			SANDSTONE
12	94			LEAN CLAY
13	95			
14	96			POORLY
15	97	DRY		GRADED
16	98			FINE
17	99			SAND
18	100			
19	101	DRY		LEAN CLAY
20	102			
21	103	MOIST-DRY		FINE
22	104			SAND
23	105			

WME-19

ALLUVIUM	TOTAL	MOISTURE	LITHOLOGY
23	105		FINE
24	106		SAND
25	107		
26	108	MOIST	V. FINE
27	109		SILTY SAND
28	110		
29	111		
30	112		SILTY CLAY
31	113		FINE SAND
32	114	↑	w/ TRACE CLAY.
33	115		FINE SAND
34	116		
35	117	MOIST	
36	118		NO
37	119		RETURNS.
38	120		
39	121		
40	122		
41	123		
42	124		FINE
43	125		SAND
44	126	WET	TRACE CLAY
45	127		& GRAVEL
46	128		

MONDAY MAY 6. 2019
WME-19

100-101 : LEAN CLAY. VERY DENSE.
10YR 4/2 DARK GRAYISH BROWN.
SLIGHT MOIST. HIGH PLASTICITY.
TRACE MOTTLING.

10~~0~~-106 : POORLY GRADED FINE SAND. LOOSE.
5YR 4/6 YELLOWISH RED. SLIGHTLY
MOIST-DRY. YELLOW & RED STAINING.

106-111 SILTY SAND. SM ML. LOOSE-MEDIUM
DENSE. 2.5Y 4/6 RED.
VERY FINE SAND. MOIST.

111-112 SILTY CLAY. MED. DENSE.-DENSE.
5YR 3/4. DARK REDDISH BROWN.
MOIST. HIGH PLASTICITY.

112-114 POORLY GRADED SILTY SAND w/CLAY. LOOSE
5YR 4/4 REDDISH BROWN. VERY FINE
SAND. MOIST. MED-LOW PLASTICITY.

MONDAY MAY 6. 2019
WME-19

114-116 POORLY GRADED SAND. LOOSE.
5YR 5/4 REDDISH BROWN.
SLIGHT MOIST. FINE SAND
TRACE CLAY LENSES.

~~[illegible]~~ 15:15 @ ~~[illegible]~~ 136' BGS.

116-122 NO RETURNS.

122-130 POORLY GRADED FINE SAND
w/ TRACE CLAY & GRAVEL.
LOOSE. WET!
5YR 4/4 REDDISH BROWN.
CLAY AS LENSES. MED-DENSE.
HIGH PLASTICITY. <5% GRAVEL.

130-138 POORLY GRADED FINE SAND.
CLEAN. LOOSE. WET.
5YR 4/4 REDDISH BROWN.

15:45 @ 156' BGS.

WME-19

ALLUVIUM	TOTAL		LITHOLOGY
46	128		FINE SAND w TRACE CLAY & GRAVEL
47	129		
48	130	WET	
49	131		
50	132		POORLY GRADED FINE SAND
51	133		
52	134		
53	135		
54	136		
55	137		
56	138	WET	
57	139		
58	140		
59	141		FINE SAND w/ GRAVEL
60	142		
61	143		
62	144		
63	145		
64	146		
65	147		
66	148		
67	149		
68	150	WET	
69	151		

WME-19

ALLUVIUM	TOTAL		LITHOLOGY
69	151		GRAVELLY SAND
70	152	WET	
71	153		
72	154		
73	155		
74	156		LEAN CLAY
75	157		
76	158	DRY	BEDROCK SANDSTONE
77	159		
78	160		
79	161		CHINLE Fm.
80	162		
81	163		
82	164		
83	165		
84	166		
85	167		
86	168		
87	169		
88	170		

MONDAY MAY 6, 2019
WME-19

16:30 HIT BEDROCK @ 156' BGS.

138-155: POORLY GRADED SAND w/ GRAVEL. LOOSE. WET. 5YR 4/4 REDDISH BROWN. GRAVEL FRACTION INCREASES TOWARDS BOTTOM.

155-156 - CLAY. LEAN. V. DENSE. 10R 4/6 RED.

156' BEDROCK. CHINLE FM. SANDSTONE. WEATHERED & MOTTLED. DARK RED 10R 3/6

~~17~~ 17:20 HOLE CASED TO 151' BGS. CLEAN HOLE

18:30 TAG HOLE @ 135'. (HEAVING SAND)
18:50 LEAVE SITE.

TUESDAY MAY 7, 2019
WME-19

06:30 ARRIVE @ SITE
06:40 SAFETY MEETING
07:05 SIGN IN @ OFFICE
07:45 FILL WATER TANKS.
NOTE: DISCUSS w/ ADAM A. SETTING WELL IN FINE SAND @ 130'-138'.

10:20 WELL SET @ 138' BGS. SCREEN 138'-133'.

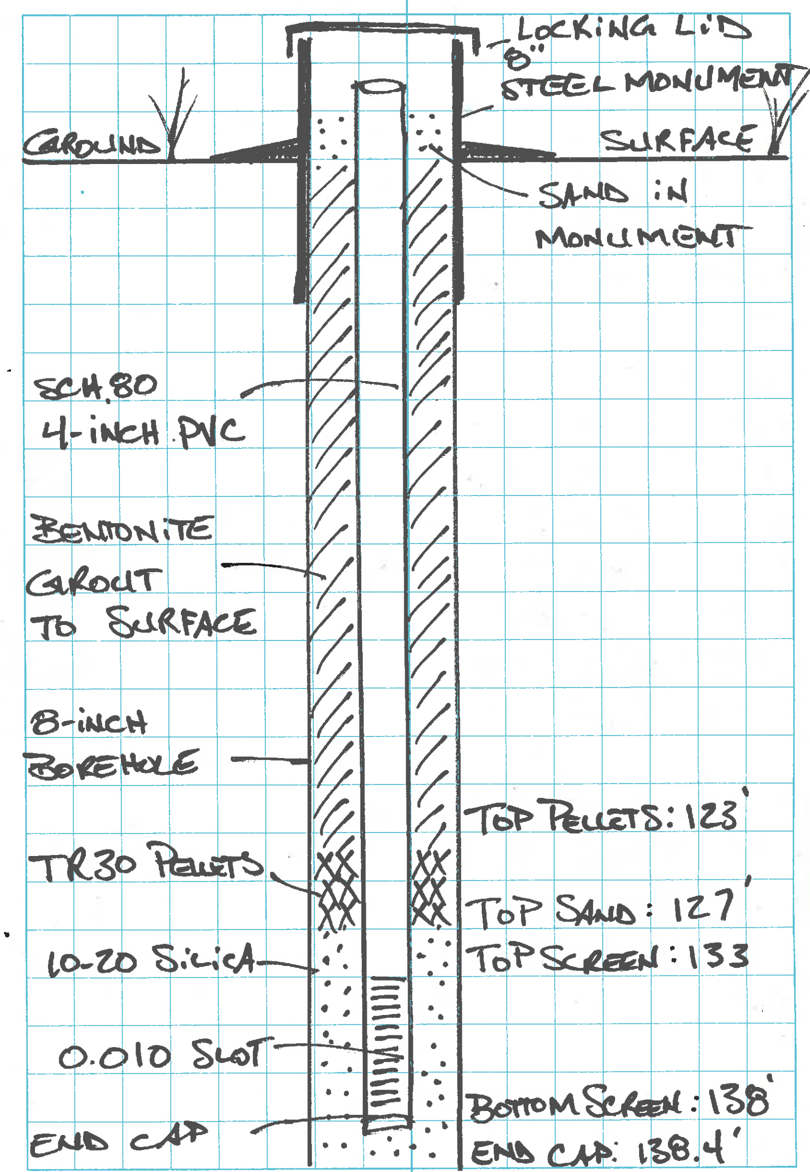
WME-19 SAMPLE INTERVALS.
0-3 (DUP), 3-6, 7-9, 9-11
12-15, 15-18, 18-19, 19-22
22-24, 30-33, 40-43, 47-50
60-63, 69-72

TUESDAY MAY 7, 2019

WME-19 SAMPLES

10:35	~~WME-0-3~~ WME-19-0-3
10:40	WME-19-0-3-DUP
10:45	WME-19-3-6
10:51	WME-19-7-9
11:05	WME-19-9-11
11:10	WME-19-12-15
11:15	WME-19-15-18
11:18	WME-19-18-19
11:22	WME-19-19-22
11:27	WME-19-22-24
11:32	WME-19-30-33
11:35	LUNCH BREAK
12:35	RETURN TO RIG.
	SAND TO 129' BGS
	CHIPS TO 123' BGS.
12:55	WME19-40-43
13:03	WME-19-47-50
13:07	WME-19-60-63
13:13	WME-19-69-72
13:50	GROUT TO SURFACE
	PREPARE TO MOBILIZE TO WME-20
15:30	RIG @ WME-20.
17:00	SPUD IN
17:05	LIGHTENING SPOTTED
17:30	OFF SITE.

WME-19 COMPLETION



N.T.S.

WEDNESDAY MAY 8, 2019

WME-20

06:30 ARRIVE @ SITE
06:45 SAFETY MEETING @ RIG.
FUEL RIG.
07:35 SPUD IN

0-5': CLAY, LEAN, STIFF
10R 4/4 WEAK RED.
NON-PLASTIC.
5'-15' POORLY GRADED FINE SAND w/
SILT & CLAY, 5Y 5/2 OLIVE GRAY.
LOOSE DRY TAILINGS.
07:[illegible] @ 35'
07:50 WME-20-T-35

15-35' POORLY GRADED FINE SAND w/
SILT & CLAY. MOIST-DRY.
5Y 5/2 OLIVE GRAY.

08:10 @ 55' SAME AS ABOVE.
08:40 @ 75':
COLLECT WME-20-T-70

WEDNESDAY MAY 8, 2019

WME-20

55-75': SILTY SAND w/ CLAY.
5Y 4/1 DARK GRAY.
LOOSE. SOFT. NON-PLASTIC.
TAILINGS.

08:50 @ 98'.

75-85': SAME AS ABOVE.

85'-86': SLIMEY CLAY. SOFT-STIFF
5Y 4/1 DARK GRAY.
TAILINGS.

86' = TOP ALLUVIUM.

86'-87': POORLY GRADED SILTY FINE
SAND. 10YR 3/2 VERY DARK
GRAYISH BROWN. LOOSE.
NON-PLASTIC.

WEDNESDAY MAY 8. 2019

WME-20

87'-88': LEAN CLAY. VERY STIFF. 10YR 3/2 VERY DARK GRAYISH BROWN. MOIST. HIGH PLASTICITY.

88'-90': POORLY GRADED VERY FINE SAND. 10YR 4/3 BROWN. LOOSE. NON-PLASTIC. MOIST-WET.

90'-91': LEAN CLAY. VERY STIFF. 10 YR 4/2 DARK GRAYISH BROWN. HIGH PLASTICITY.

91-94': SANDY CLAY. STIFF. LOW PLASTICITY. PARTIALLY FRIABLE. MOTTLING. 10 YR 3/2 VERY DARK GRAYISH BROWN. POORLY GRADED FINE - V. FINE SAND. SLIGHT MOIST -

94'-96' : POORLY GRADED SILTY FINE SAND. LOOSE. DRY. NON-PLASTIC. SLIGHT MOISTURE-DRY.

WEDNESDAY MAY 8. 2019

WME -20

10:00 @106' HARD DRILLING 104-106. LESS THAN 10' OF RETURNS IN CORE.

* 104-106 SAME AS 94-96'
* TAILINGS SANDS ABOVE.
* ASK DRILLER TO CASE HOLE CLEAN HOLE AND RE-DRILL.
* 96'-108' CUTTINGS LIKELY IN HOLE.

~~98': 96-98': SAME AS ABOVE.~~

10:30 RAIN STARTS.

10:31 CONTINUED DIFFICULT DRILLING 106-109.

10:34: BROKEN ROD IN HOLE GO FISH.

11:00 RODS OUT. BREAK 4 LUNCH.

11:55 RETURN TO RIG.

12:00 CALL MICK @ JET WEST TO INFORM SCHEDULE IS UNKNOWN @ THIS POINT. HE SAID THEY WILL WORK w/ US.

WME-20

ALLUVIUM	TOTAL		LITHOLOGY
0	86		ALLUVIAL SURFACE
1	87	WET	SILTY SAND
2	88	MOIST	LEAN CLAY
3	89		POORLY GRADED
4	90		V. FINE SAND.
5	91	DRY	LEAN CLAY
6	92		
7	93		SANDY CLAY
8	94		FRIABLE
9	95		POORLY GRADED
10	96		FINE SAND
11	97		POORLY GRADED
12	98		FINE SAND W/ CLAY
13	99	DRY	
14	100		POORLY GRADED
15	101		FINE SAND
16	102		
17	103	MOIST	CLAYEY SAND
18	104		LEAN CLAY
19	105		
20	106		FINE SAND
21	107		FINE SAND (RED)
22	108		LEAN CLAY

WME-20

ALLUVIUM	TOTAL		LITHOLOGY
22	108		
23	109		
24	110	MOIST	
25	111		LEAN
26	112		CLAY
27	113		
28	114		
29	115		
30	116		
31	117	MOIST	GRAVELY SAND
32	118		W/ CLAY
33	119		
34	120		GRAVELLY
35	121		SAND
36	122		
37	123		
38	124		
39	125	MOIST	FINE
40	126		SAND
41	127		
42	128		LEAN CLAY
43	129		FINE SAND
44	130		~~SAND~~ CLAY
45	131		SAND

WEDNESDAY MAY 8. 2019
WME-20

12:20 RESUME DRILLING OPERATIONS.
12:23 HYDRAULIC LEAK ON SONIC HEAD. - LOOSE FITTING.
12:24 RESUME DRILLING.
12:38 @ 106'
13:05 @ 116'
13:10 LIGHTENING - STOP WORK.
13:40 RETURN TO RIG.

96-98 POORLY GRADED FINE SAND w/ TRACE CLAY. LOOSE, SOFT. 10YR 5/6 YELLOWISH BROWN. SLIGHTLY MOIST
98-102 POORLY GRADED FINE SAND, LOOSE 10YR 5/6 YELLOWISH BROWN. NON-PLASTIC.
102-103 CLAYEY SAND. SOFT-MED. DENSE. FINE SAND. PLASTIC. MOIST
103-105 LEAN CLAY. DENSE. HIGH PLASTICITY. SLIGHT MOIST. 10R 4/6 RED.
105-106: POORLY ~~SORTED~~ GRADED FINE SAND. LOOSE. DRY. 10YR 5/6 YELLOWISH BROWN. NON-PLASTIC.

WEDNESDAY MAY 8. 2019
WME-20

106-107: POORLY SORTED SILTY/SAND w/ TRACE CLAY. LOOSE. SLIGHT PLASTICITY. 10R 4/6 RED.
107-116 LEAN CLAY. V. STIFF HIGH PLASTICITY. MOIST. 10R 4/6 RED.

14:30 HAIL STORM! SEEK SHELTER.
14:50 RESUME DRILLING

116-118: GRAVELLY SAND w/ TRACE CLAY. POORLY GRADED FINE SAND. CLAY LENSES. SOFT. HIGH PLASTICITY. 10YR 4/4 BROWN LOOSE. MOIST
118-122 GRAVELLY SAND. FINE. LOOSE. 10YR 4/4 BROWN. NON-PLASTIC. GRAVEL UP TO 1" DIA. MOIST

WME-20

ALLUVIUM	TOTAL		LITHOLOGY
45	131	MOIST	POORLY GRADED FINE SAND.
46	132		
47	133		
48	134		
49	135		
50	136		LEAN CLAY
51	137	SLIGHTLY MOIST	POORLY GRADED SILTY SAND
52	138		
53	139		
54	140		
55	141		
56	142		
57	143		
58	144		
59	145		
60	146		
61	147		
62	148		LEAN CLAY
63	149	WET	FINE SAND w/GRAVEL
64	150		
65	151		
66	152		
67	153		
68	154		

WME-20

ALLUVIUM	TOTAL		LITHOLOGY
68	154	WET	FINE SAND w/GRAVEL
69	155		
70	156		
71	157		
72	158		
73	159	MOIST	CLAYEY SAND
74	160		SANDY CLAY
75	161	DRY	CLAY
76	162		
77	163		
T.D.			CHINLE Fm

WEDNESDAY MAY 8, 2019
WME-20

122'-127': POORLY GRADED FINE SAND
LOOSE. 5YR 4/4 REDDISH
BROWN. NON-PLASTIC.
MOIST.
127-128': LEAN CLAY, V. STIFF
HIGH PLASTICITY.
~~10R 4/6 RED~~.
10R 3/3 DUSKY RED.
MOIST.
128-129: SAME AS 122-127.
129-130 SAME AS 127-128.
130-135: SAME AS 122-127
135-136: LEAN CLAY. SAME AS 127-128
136-146: POORLY GRADED SILTY SAND.
V. FINE. 5R 4/4 REDDISH
BROWN. TRACE MOTTLING.
SLIGHTLY MOIST.

16:30 @ 163 - BEDROCK.

17:30 OFF SITE

WEDNESDAY MAY 8, 2019
WME-20

146'-147': SAME AS ABOVE.

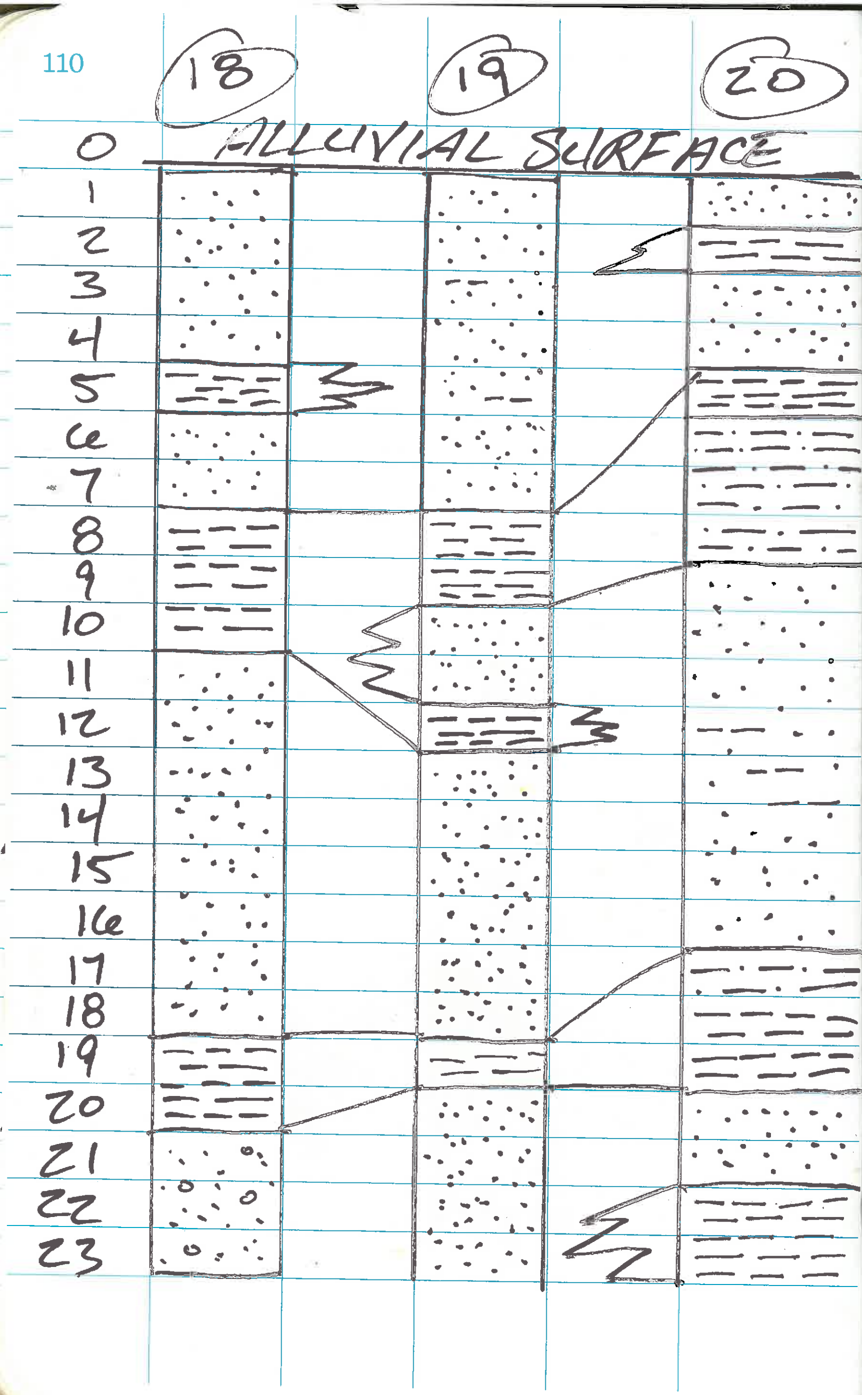
147'-148': LEAN CLAY. STIFF.
HIGH PLASTICITY.
2.5YR 4/3 REDDISH BROWN.

148'-158': POORLY GRADED SAND w/
SOME GRAVEL. FINE SAND
GRAVEL UP TO 2".
NON-PLASTIC. LOOSE.
WET!

158-159: CLAYEY GRAVELY SAND.
SOFT. LOOSE. GRAVEL UP TO
2" 5YR 4/4 REDDISH BROWN

159-160 SANDY CLAY. STIFF
TRACE GRAVEL. PLASTIC.
5YR 3/4 DARK REDDISH BROWN

160'-163': LEAN CLAY. HARD. NON-PLASTIC
MOTTLED. FRIABLE.
10R 5/3 WEAK RED.
163' - CHINLE FM.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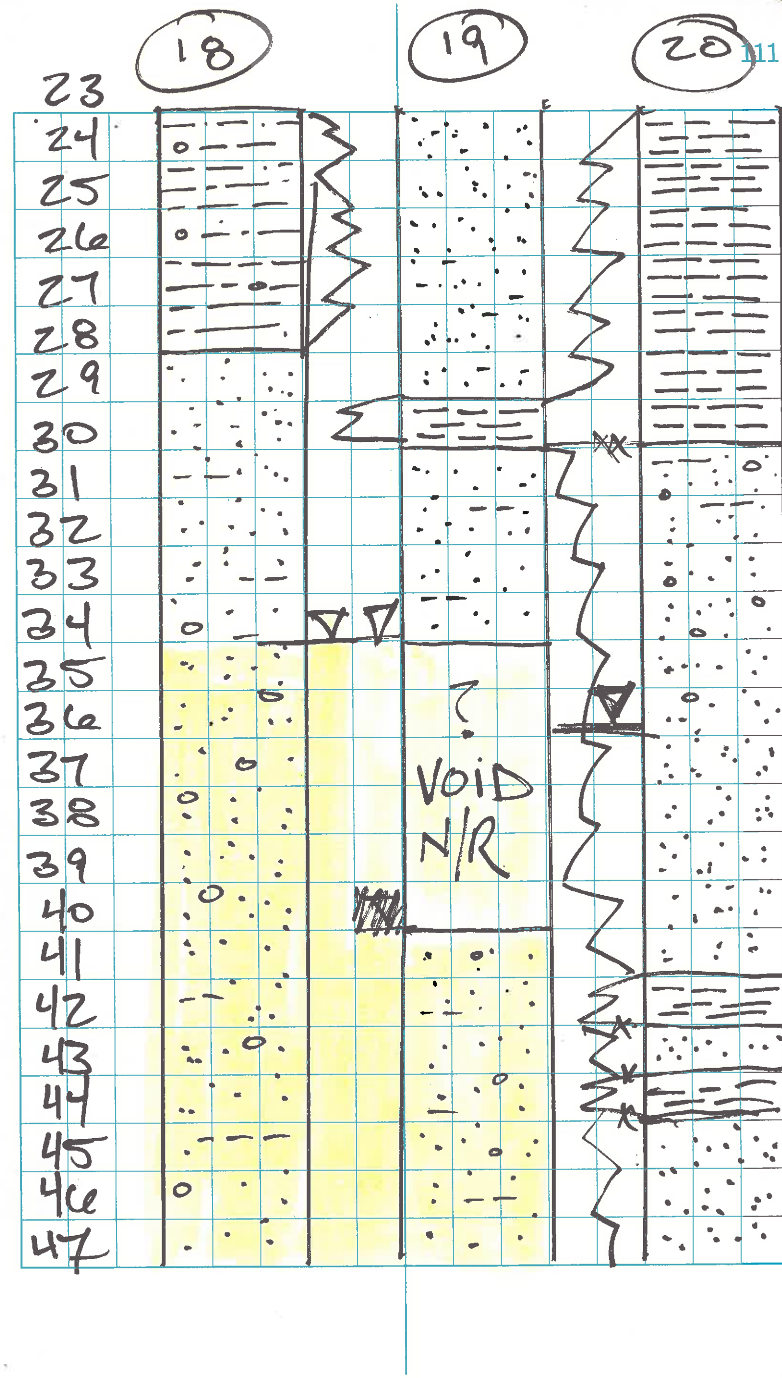
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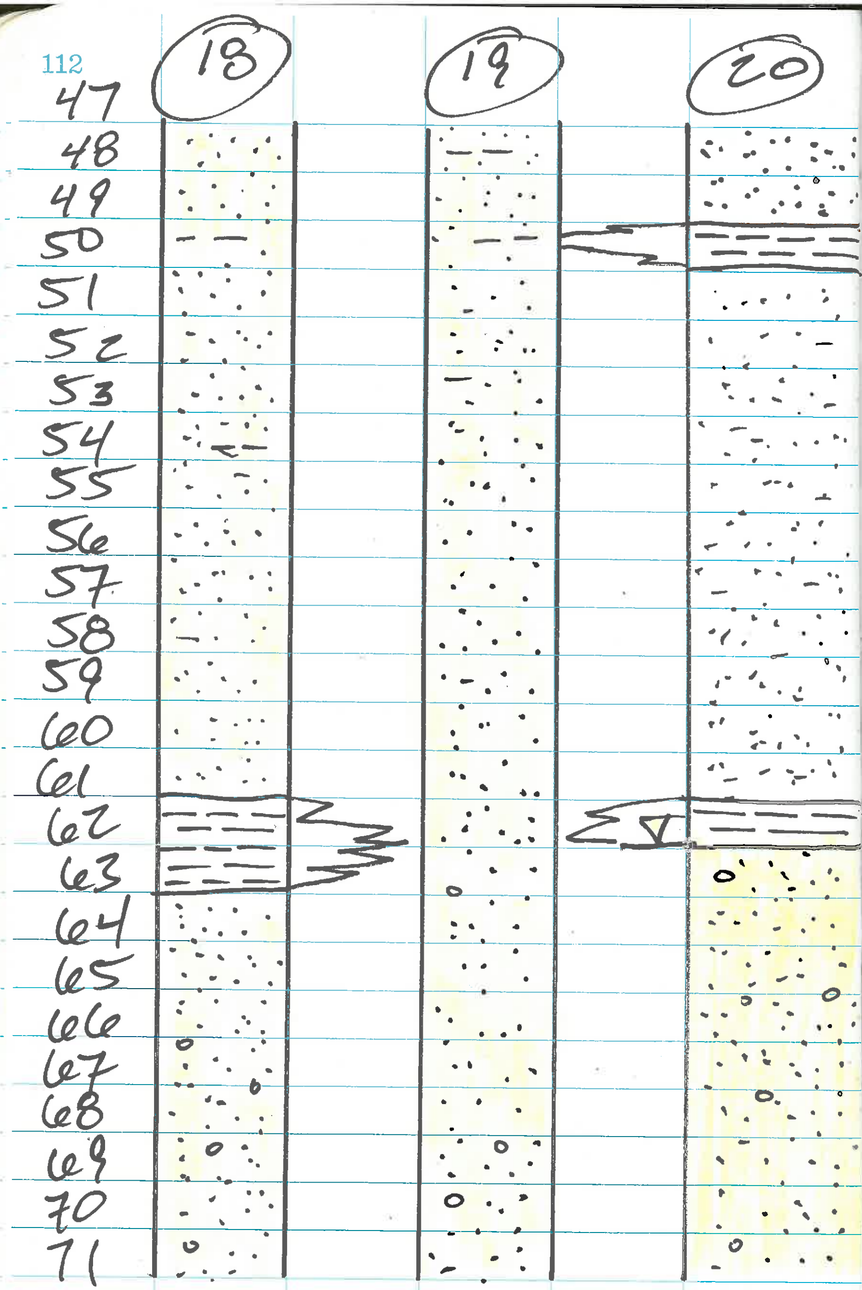
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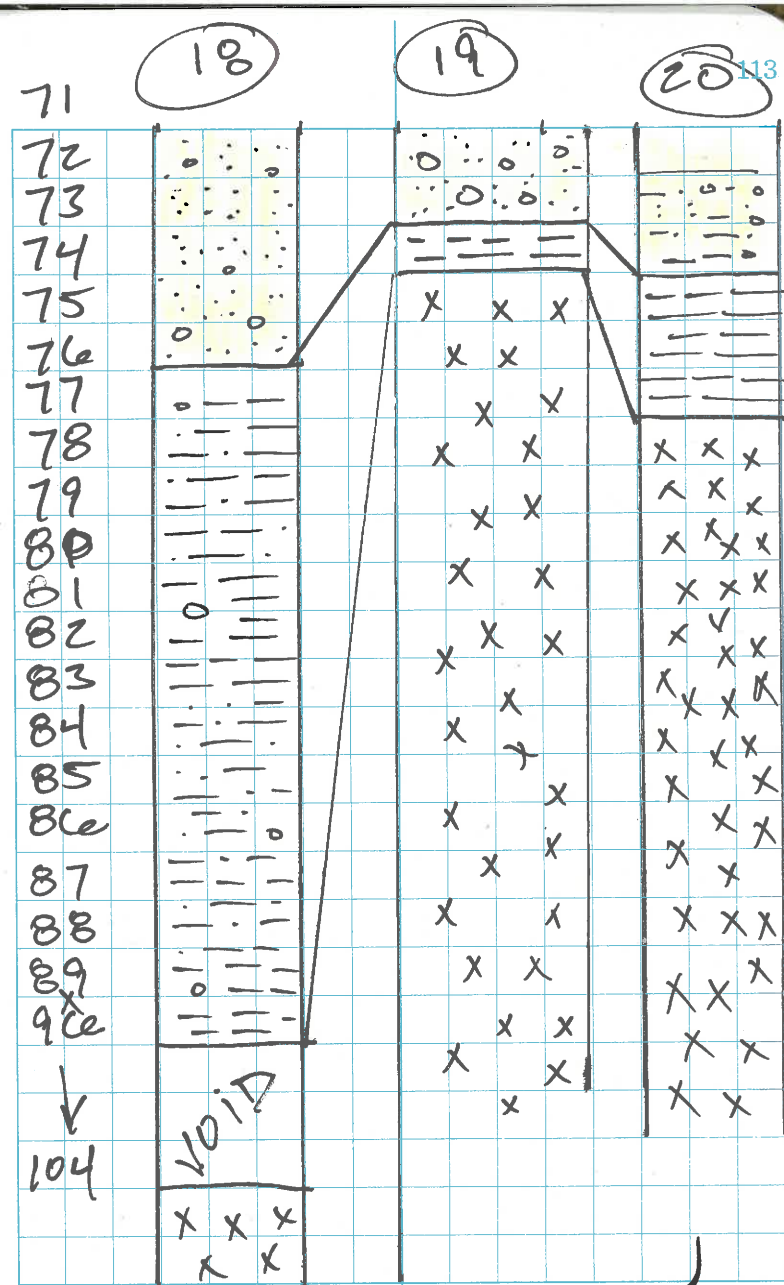
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104
VOID

THURSDAY MAY 9, 2019

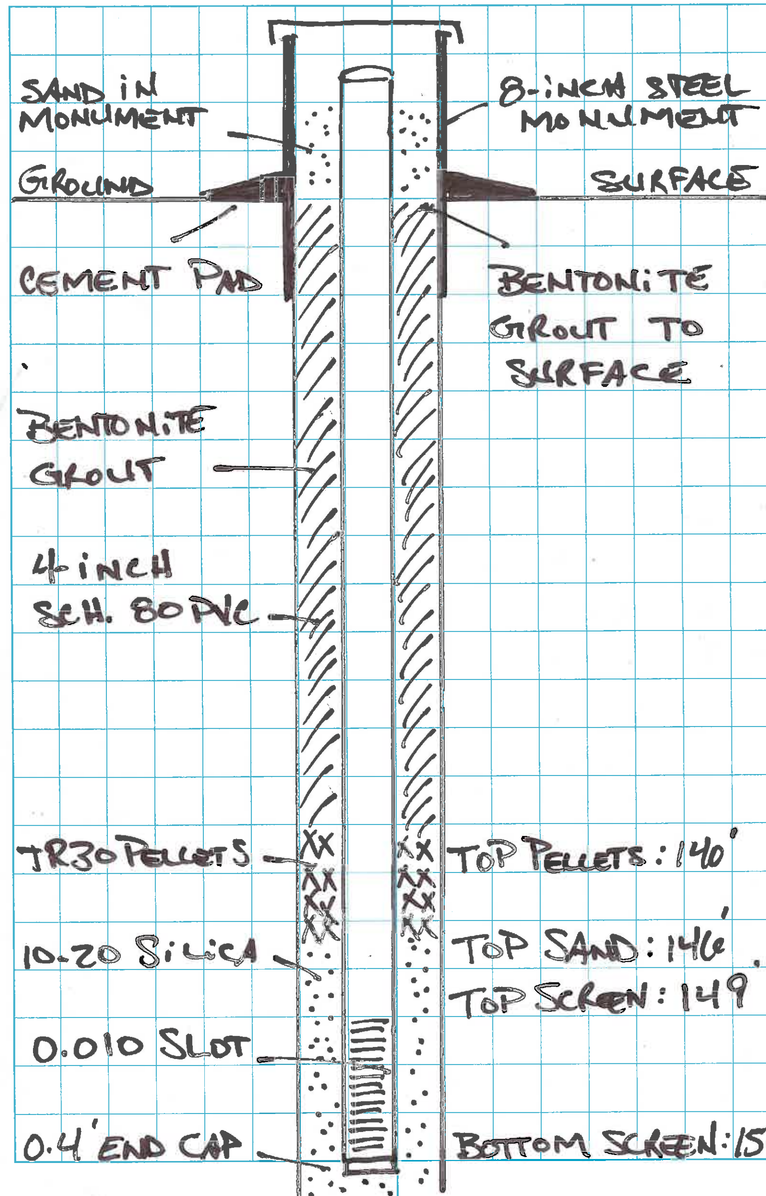
WME-20

0600 ARRIVE @ SITE.
0610 SAFETY MEETING.
0630 CLEAN OUT HOLE
0840 RODS OUT. SAND UP TO 135'.
0910 160' PVC IN HOLE
HEAVING SAND UP TO 145'
0940 PVC IN TO 154.
SCREEN 154-149'.
1000 SAND TO 146'.

WME-20 SAMPLE INTERVALS:
0-1, 1-2, 2-4, 4-5, 5-8
8-10, 13-16, 17-19, 19-21
23-26, 32-35, 37-40,
45-48, 53-56, 64-67, 75-77

1030 TR30 PELLETS TO 140'.
1500 GROUT TO SURFACE.
1620 TOWER UP ON WME-21.
1720 SPUD IN WME-21
1725 WME-21-T-10 COLLECTED

WME-20 WELL COMPLETION



THURSDAY MAY 9, 2019

WME-20

SAMPLE COLLECTION

10:15 WME-20-0-1
10:20 WME-20-1-2
10:25 WME-20-2-4
10:38 WME-20-4-5
10:42 WME-20-5-8
10:48 WME-20-8-10
10:52 WME-20-13-16
10:55 WME-20-17-19
11:04 WME-20-19-21
11:08 WME-20-23-26
11:13 WME-20-32-35
11:17 WME-20-37-40
11:21 WME-20-45-48
11:24 WME-20-53-56
11:28 WME-20-64-67
11:31 WME-20-75-77

THURSDAY MAY 9, 2016

WME-21

1735 @ 26'
1737 COLLECT WME-21-T-20

ALLUVIUM @ 24'
17:42 @ 36'

24'-26': LEAN CLAY. V. STIFF
HIGH PLASTICITY.
TRACE MOTTLING. MOIST.
2.5Y 3/2 VERY DARK
GRAYISH BROWN.

26'-28': LEAN CLAY. STIFF. MODERATE
PLASTICITY. ABUNDANT
MOTTLING (WHITE). LIGHTLY
FISSLE. 7.5YR 4/2 BROWN
SLIGHTLY MOIST.

28'-30': SILTY SANDY CLAY. LEAN.
V. FINE SAND. ABUNDANT
MOTTLING. DRY.
CLAY = 10YR 3/2 V. DARK GRAY BROWN.
SAND = 10YR 5/8 YELLOWISH BROWN

PLUS: MANUFACTURED
WOOD!

WME-21

ALLUVIUM	TOTAL	Moisture	Description
0	24		
1	25	MOIST	LEAN CLAY
2	26		
3	27		
4	28		
5	29	SLIGHTLY MOIST	SILTY SAND CLAY
6	30		
7	31		LEAN CLAY
8	32		
9	33		SANDY CLAY
10	34		LEAN CLAY
11	35		
12	36		
13	37	DRY	SANDY SILT W/ TRACE GRAVEL
14	38		
15	39		
16	40		
17	41		
18	42		
19	43		
20	44		
21	45		
22	46		
23	47		

FRIDAY MAY 10 2019

WME-21

06:10 ARRIVE @ SITE
06:20 SAFETY MEETING.
06:30 WARM UP RIG.
07:15 RESUME DRILLING @ 34'.

30'-32': LEAN CLAY. STIFF. MOD-LOW PLASTICITY. ABUNDANT MOTTLING. DRY. 7.5YR 4/2 BROWN.

32'-33' SANDY CLAY. STIFF. MOD-HIGH PLASTICITY. TRACE MOTTLING (WHITE). SLIGHTLY MOIST-DRY. V. FINE SAND LOOSE.
CLAY: 10YR 3/2 V. DARK GRAY BROWN.
SAND: 10 YR 5/6 YELLOWISH BROWN.

33-36' LEAN CLAY. STIFF. HIGH PLASTICITY. S. MOIST. 7.5YR 5/3 BROWN.

36-~~46~~ 56 SANDY SILT w/ TRACE GRAVEL. MEDIUM DENSE-LOOSE. NON-PLASTIC. NONCOHESIVE. DRY. 5YR 4/4 REDDISH BROWN.

FRIDAY MAY 10, 2019

WME-21

~~46'-48'~~ ~~56~~ 56-58': SAME AS ABOVE. WET

~~48-52~~ ~~56-58~~ 58-62': POORLY GRADED FINE SAND w/ TRACE GRAVEL. LOOSE. NON-PLASTIC. WET 7.5 YR 4/4 BROWN.

~~52-56~~ 62-66': WELL GRADED GRAVELY SAND. LOOSE. NON-PLASTIC. WET. 7.5 YR 3/3 DARK BROWN.

68-73 → ~~66-71~~: GRAVELY LEAN CLAY w/ SAND. MEDIUM-STIFF. MOIST-WET HIGH PLASTICITY. COHESIVE. 2.5 YR 4/4 REDDISH BROWN

66-68: LEAN CLAY w/ TRACE SAND STIFF. HIGH PLASTICITY. 2.5 YR 4/4 REDDISH BROWN.

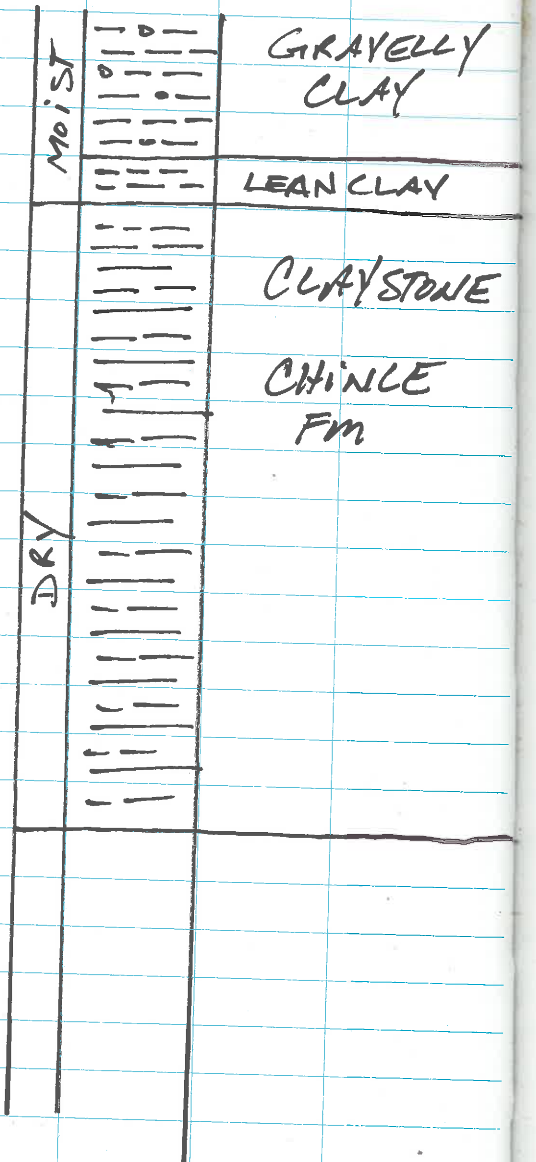
73-74: LEAN CLAY. STIFF. HIGH PLASTICITY. MOIST. 2.5YR 4/4 REDDISH BROWN

WME-21

ALLUVIUM	TOTAL	Moisture	LITHOLOGY
23	47	S. MOIST-DRY	SANDY SILT w/ TRACE GRAVEL
24	48		
25	49		
26	50		
27	51		
28	52		
29	53		
30	54		
31	55		
32	56		
33	57	WET	
34	58		
35	59		FINE SAND w/ GRAVEL
36	60		
37	61		
38	62		
29	63		WELL GRADED SAND w/ GRAVEL
40	64		
41	65		
42	66		
43	67	MOIST	GRAVELLY CLAY
44	68		
45	69		
46	70		

ALLUVIUM	TOTAL
46	70
47	71
48	72
49	73
50	74
51	75
52	76
53	77
54	78
55	79
56	80
57	81
58	82
59	83
60	84
61	85
62	86

WME-21



FRIDAY MAY 10, 2019

WME-21

74'-86: CLAYSTONE. MED HARD.
NON-PLASTIC. MOTTLED.
DRY 10R 4/6 RED.
CHINLE FORMATION.

09:30 DISCUSS COMPLETION
INTERVAL w/ ADAM A.

TARGET = GRAVELLY CLAY FROM
~~78-68~~ 72-67

10:45 WELL SET TO 72'
5' SCREEN

11:18 SAND TO 64'

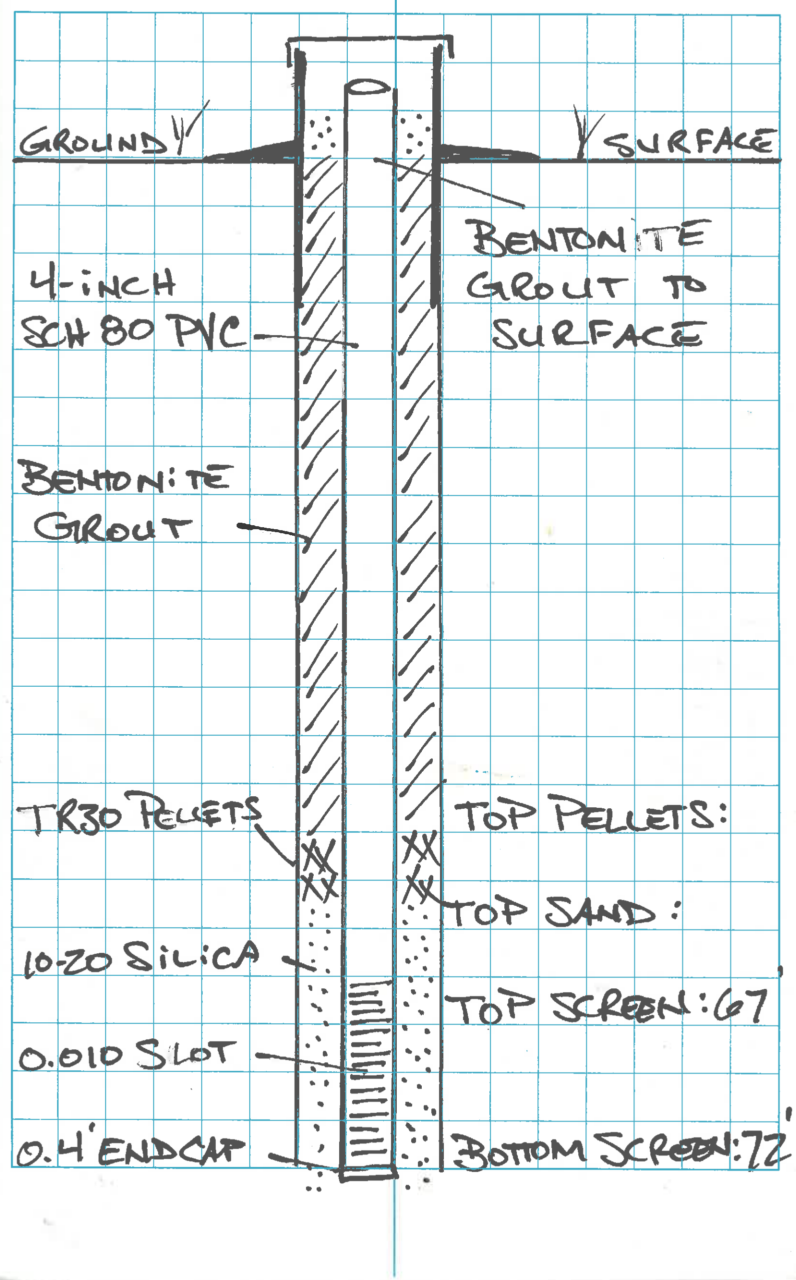
FRIDAY MAY 10, 2019

WME-~~21~~ SAMPLES

14:58 WME-21-0-3
15:15 WME-21-4-6
15:23 WME-21-6-8
15:30 WME-21-8-9
16:06 WME-21-9-12
16:10 WME-21-12-15
16:15 WME-21-18-21
16:20 WME-~~24-27~~ 21-24-27
16:25 WME-21-29-32
16:30 WME-21-34-37
16:35 WME-21-38-41
16:40 WME-21-42-45
16:45 WME-21-48-49
~~16:50 WME-21-9-12-DUP~~ NOT ENOUGH SAMPLE
16:50 WME-21-21-24 DUP

16:59 SPUD IN WME-22
17:05 COLLECT WME-22-T-10
17:17 @ 20'
17:20 COLLECT WME-22-T-20
ALLUVIUM @ 21' BGS

WME-21 WELL COMPLETION



FRIDAY MAY 10, 2019

WME-22

21-22: LEAN CLAY. STIFF. HIGH PLASTICITY. 10YR 3/3 DARK BROWN. COHESIVE. MOIST.

22-~~30~~ 26' FAT CLAY. MED. STIFF. HIGH PLASTICITY. ORGANICS PRESENT (BLACK). GLEY 1 2.5/N. BLACK. MOIST.

26'-~~29~~ 27: SAME AS ABOVE w/ GRAVEL.

~~29-32~~ 27-~~29~~ 30: SAME AS 22-26':

~~29-33~~:

~~30~~- 30-33: SANDY CLAY w/ GRAVEL. MED STIFF. HIGH PLASTICITY. V. FINE SAND. TRACE GRAVEL. SOME MOTTLING. SLIGHTLY MOIST- DRY.

33-36 CLAYEY SAND. V. FINE. MED STIFF - LOOSE. HIGH PLASTICITY. FAT CLAY. MOTTLING. ORGANICS. 7.5YR 4/6 STRONG BROWN.

WME-22

36-37: SILTY LEAN CLAY. V. STIFF. HIGH PLASTICITY. MOIST 5YR 4/3 REDDISH BROWN.

37-39: V. FINE SILTY SAND. LOOSE POORLY GRADED. NON-PLASTIC. 5YR 6/6 YELLOWISH RED. DRY.

39-40: LEAN CLAY. V. STIFF. HIGH PLASTICITY. 2.5YR 4/4 REDDISH BROWN. SLIGHTLY MOIST.

40-42': VERY FINE SILTY SAND LOOSE - SLIGHTLY DENSE. NON-PLASTIC. NON-COHESIVE. DRY. 5YR 5/6 YELLOWISH RED.

42-45: SAME AS ABOVE. 10R 4/6 RED!

45-46 LEAN CLAY. STIFF. HIGH PLASTICITY. SLIGHT MOIST. 10 R 4/6 RED.

WME-22

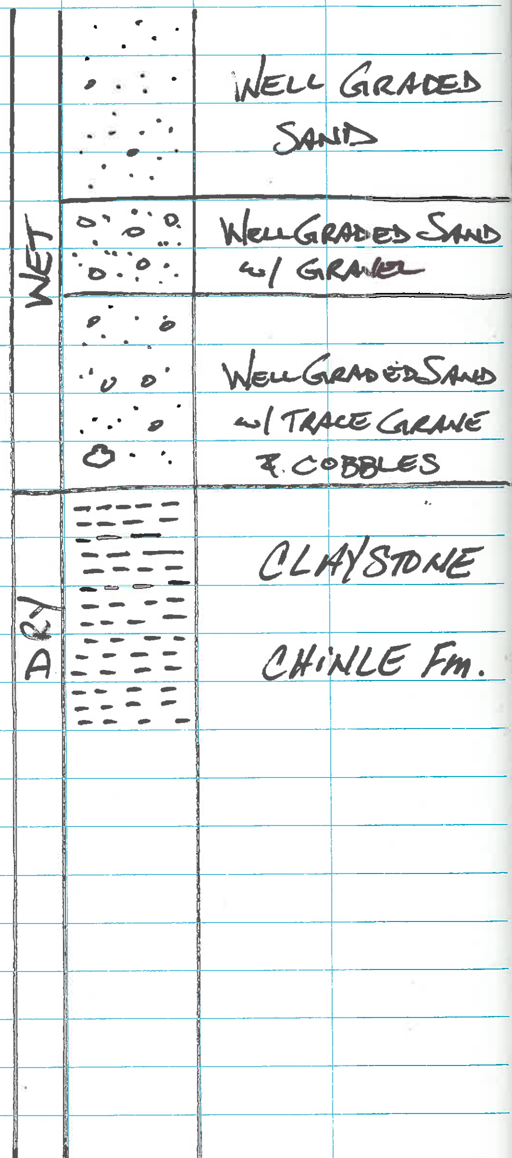
Alluvium	Total	Moisture	Lithology
0	21	Moist	Lean Clay
1	22	Moist	Fat Stiff Clay
2	23	Moist	Fat Stiff Clay
3	24	Moist	Fat Stiff Clay
4	25	Moist	Fat Stiff Clay
5	26	Moist	Fat Stiff Clay
6	27	Moist	Fat Clay w/ Gravel
7	28	Moist	Fat Stiff Clay
8	29	Moist	Fat Stiff Clay
9	30	Moist	Fat Stiff Clay
10	31	Moist	Sandy Clay w/ Gravel
11	32	Moist	Sandy Clay w/ Gravel
12	33	Moist	Sandy Clay w/ Gravel
13	34	Moist	Clayey Sand
14	35	Moist	Clayey Sand
15	36	Moist	Clayey Sand
16	37	Moist	Silty Lean Clay
17	38	Dry	Silty Sand
18	39	Dry	Silty Sand
19	40	Dry	Lean Clay
20	41	Dry	Very Fine Silty Sand
21	42	Dry	Very Fine Silty Sand
22	43	Dry	Very Fine Silty Sand
23	44	Dry	Very Fine Silty Sand

WME-22

Alluvium	Total	Moisture	Lithology
23	44	Moist	V. Fine Silty Sand
24	45	Moist	V. Fine Silty Sand
25	46	Moist	Lean Clay
26	47	Moist	Very Fine Silty Sand
27	48	Moist	Very Fine Silty Sand
28	49	Moist	Very Fine Silty Sand
29	50	Moist	Very Fine Silty Sand
30	51	Moist	Very Fine Silty Sand
31	52	Moist	Very Fine Silty Sand
32	53	Moist	Very Fine Silty Sand
33	54	Moist	Very Fine Silty Sand
34	55	Moist	Very Fine Silty Sand
35	56	Moist	Very Fine Silty Sand
36	57	Moist	Very Fine Silty Sand
37	58	Moist	Very Fine Silty Sand
38	59	Wet	Very Fine Silty Sand
39	60	Wet	Very Fine Silty Sand
40	61	Wet	Very Fine Silty Sand
41	62	Wet	Very Fine Silty Sand
42	63	Wet	Gravelly Sand
43	64	Wet	Gravelly Sand
44	65	Wet	Sandy Clay
45	66	Wet	Sandy Clay
46	67	Wet	

WME-22

ALLUVIUM	TOTAL
46	67
47	68
48	69
49	70
50	71
51	72
52	73
53	74
54	75
55	76
56	77
57	78
58	79
59	80
60	81



FRIDAY MAY 10, 2019

WME-22

46-50: SANDY SILT w/ TRACE GRAVEL. LOOSE-SLIGHTLY DENSE. NON-PLASTIC. DRY. 2.5 YR 4/4 REDDISH BROWN

50-~~66~~ 56: SAME AS ABOVE 7.5 YR 6/6 REDDISH YELLOW

~~66-68~~ 56-58: SAME AS ABOVE 2.5 YR 4/4 REDDISH BROWN

~~68-72~~ 58-62: SAME AS ABOVE 7.5 YR 4/4 BROWN

WET @ 58'

62-64: WELL GRADED SAND w/ TRACE GRAVEL. LOOSE. NON-PLASTIC 7.5 YR 4/4 BROWN AND SOME BLACK.

64-66: SANDY CLAY. MED. STIFF-SOFT-PLASTIC. FINE SAND. 2.5 YR 4/4 REDDISH BROWN. WET.

FRIDAY MAY 10, 2019

WME-22

66-70: WELL GRADED SAND w/ TRACE GRAVEL. LOOSE. NON-PLASTIC. WET 7.5 YR 4/4 BROWN.

70-72: WELL GRADED GRAVELY SAND LOOSE. NON-PLASTIC. GRAVEL UP TO 2". 2.5 YR 4/4 REDDISH BROWN AND TRACE BLACK. WET.

72-76 WELL GRADED SAND w/ TRACE GRAVEL AND COBBLES UP TO 6". LOOSE. NON-PLASTIC. WET. 7.5 YR 4/4 BROWN.

76-86 : CLAYSTONE. DENSE. NON-PLASTIC. DRY. 2.5 YR 3/6 DARK RED.

19:00 LEAVE SITE.

SATURDAY MAY 11, 2019

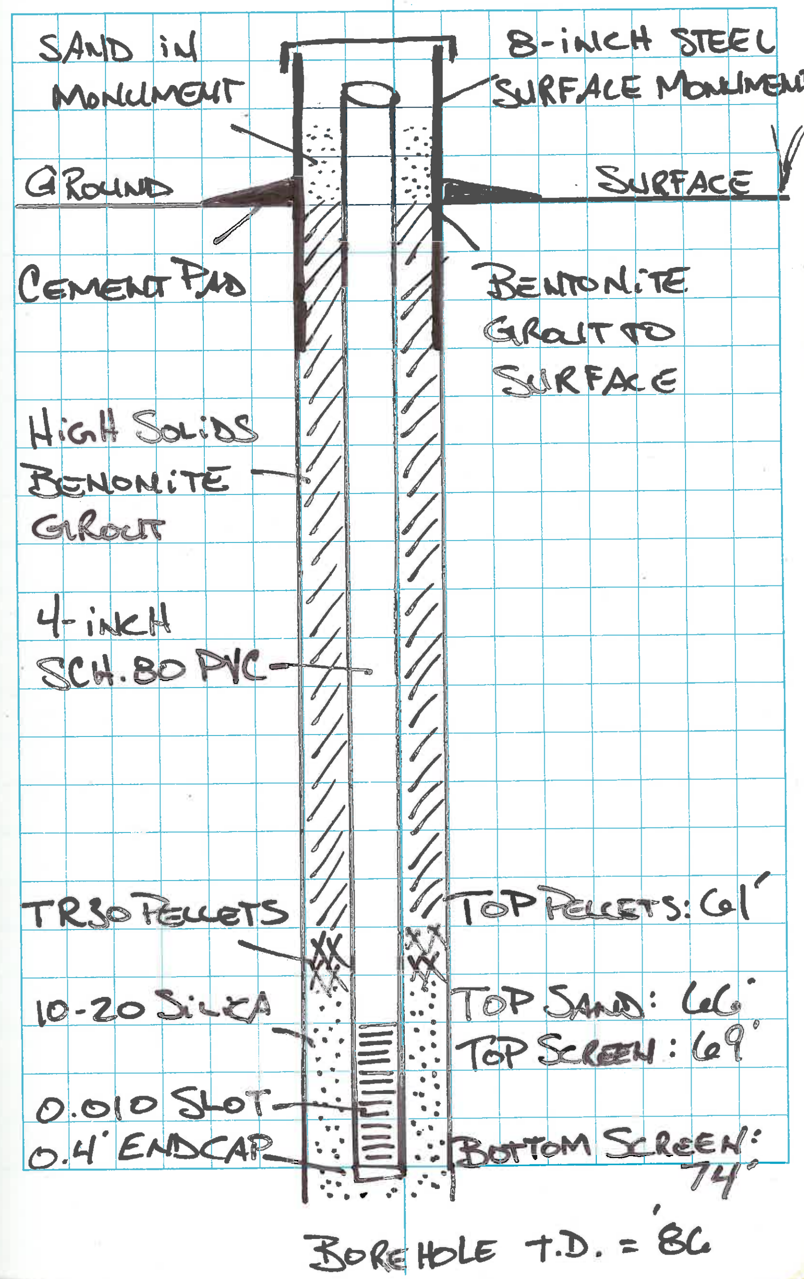
WME-22

07:00 ARRIVE @ SITE.
07:15 SAFETY MEETING.
07:30 WARM UP RIG.
08:00 SET CASING TO 75'.
08:10 DOWN FOR REPAIRS
08:40 CASING @ 75'
08:45 CLEAN HOLE TO 75'
0850 DISCUSS COMPLETION w/ ADAM A. TARGET 74' TD.
0930 80' PVC SET TO 74' BGS + 5' SCREEN.
1015 SAND TO 66' BGS
1050 TR30 TIME RELEASE PELLETS TO 61' BGS.
11:00 LUNCH BREAK.
12:00 RETURN TO RIG.
12:05 PREPARE TO GROUT HOLE.
15:00 HOLE GROUT TO SURFACE
15:45 MOVE TO DECON PAD.
16:30 OFF SITE

SUNDAY MAY 12, 2019

0800 ARRIVE @ SITE.
0810 SAFETY MEETING.
0815 DRILLERS BEGIN DECON.
TAKE SUBSAMPLES FOR
WME-18, WME-19 + WME-20
1300 DRILLERS FINISH DECON &
BEGIN SURFACE COMPLETIONS
@ WME-18, 19, 20, 21 & 22
1630 LEAVE SITE.

WME-22 WELL COMPLETION



Attachment C

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

DATE: 05/30/19

BOREHOLE NO.: **WME-18**

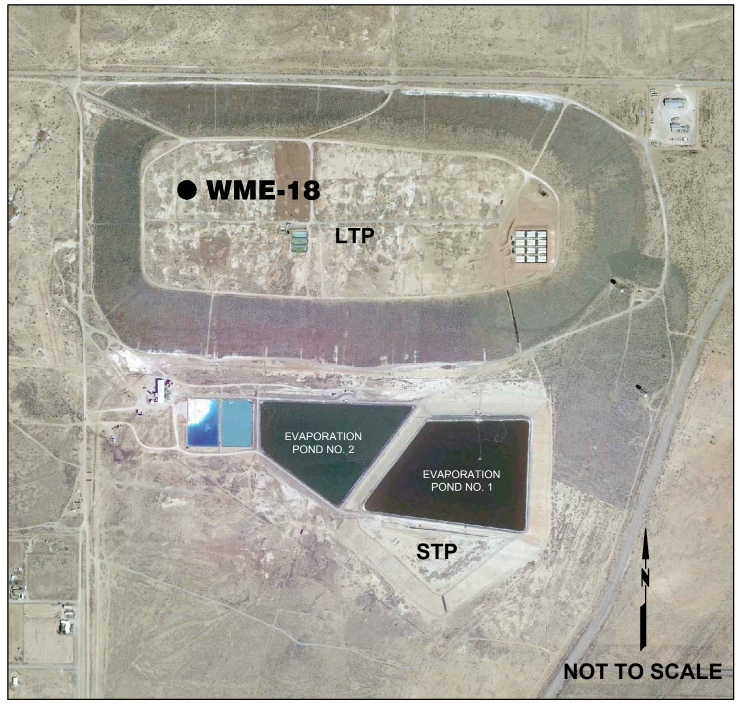
PROJECT INFORMATION

PROJECT: GRANTS RECLAMATION PROJECT

CLIENT: HOMESTAKE MINING COMPANY

LOCATION: GRANTS, NEW MEXICO

BOREHOLE LOCATION



FIELD INFORMATION

BOREHOLE LOGGED BY: ROB NOBLE

SAMPLING METHOD: CONTINUOUS CORE

DRILLING INFORMATION

DRILLING COMPANY: YELLOW JACKET DRILLING

DRILLER: TRISTAN TRUAX

START DATE/TIME: APRIL 29, 2019 @ 14:17

DRILLING COMPLETION DATE/TIME: APRIL 30, 2019 @ 14:15

BORING DEPTH: 186' BGS

BORING DIA.: 8-INCH

DRILLING METHOD: SONIC

BOREHOLE COMPLETION INFORMATION

WELL I.D.: WME-18

START DATE/TIME: APRIL 30, 2019 @15:40

COMPLETE TIME: MAY 1, 2019 @ 08:15

ELEVATION - TOP OF BORING:

SCREENED INTERVAL: 149' - 154' BGS

GROUNDWATER CONDITIONS

NOTES:

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

PROJECT: GRANTS RECLAMATION PROJECT **PAGE:** 2 OF 6

CLIENT: HOMESTAKE MINING COMPANY **DATE:** 05/30/19

BOREHOLE NO.: WME-18

ALLUVIUM DEPTH (FT)	TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
0	82		**0 - 2': SANDY SILT** LOOSE, NON-PLASTIC, MOIST, 2.5Y 5/3, LIGHT OLIVE BROWN.
2	84		**2' - 4': SAND** LOOSE, NON-PLASTIC, NON-COHESIVE, POORLY GRADED, FINE SAND, WET, 10YR 5/4, YELLOWISH BROWN.
4	86		**4' - 5': CLAY** LEAN, DENSE, HIGH PLASTICITY, MOIST, 2.5Y 3/2, VERY DARK GRAYISH BROWN.
			5' - 7': SAND LOOSE, POORLY GRADED, FINE, NON-COHESIVE, DRY, 5YR 3/2, DARK REDDISH BROWN.
6	88		
			7' - 8': CLAY LEAN, DENSE, HIGH PLASTICITY, MOIST, 2.5YR 3/1, VERY DARK GRAY.
8	90		**8' - 10': CLAY WITH SAND** HIGHLY MOTTLED, DENSE-LOOSE, ABUNDANT ORGANIC MATERIAL, DARK GRAY WITH BLACK STRINGERS, PALEOSOL, DRY.
10	92		**10' - 14': SAND** LOOSE, POORLY GRADED, FINE, NON-PLASTIC, WET, 10YR 4/2, DARK GRAYISH BROWN, CLAY STRINGERS AT 14'.
12	94		
14	96		**14' - 18': SILTY SAND** LOOSE, POORLY GRADED, VERY FINE, NON-PLASTIC, MOIST - DRY, 10YR 6/4, LIGHT YELLOWISH BROWN.
16	98		
18	100		**18' - 20': SANDY LEAN CLAY** SOFT, LOW PLASTICITY, SLIGHTLY MOIST, SOME MOTTLING, 10YR 5/3, BROWN.
20	102		

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

PROJECT: GRANTS RECLAMATION PROJECT **PAGE:** 3 OF 6

CLIENT: HOMESTAKE MINING COMPANY **DATE:** 05/30/19

BOREHOLE NO.: **WME-18**

ALLUVIUM DEPTH (FT)	TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
20	102		**20' - 23': WELL GRADED SAND WITH CLAY AND TRACE GRAVEL** LOW PLASTICITY, LOOSE - MEDIUM DENSE, GRAVEL UP TO 1", SLIGHTLY MOIST, 10YR 5/4, YELLOWISH BROWN.
22	104		
24	106		**23' - 28': SILTY CLAY WITH TRACE GRAVEL** SOFT - MEDIUM DENSE, NON-COHESIVE, SLIGHTLY MOIST, 5YR 4/4, REDDISH BROWN.
26	108		
28	110		**28' - 34': POORLY GRADED SAND WITH CLAY** LOOSE - MEDIUM PLASTICITY, SLIGHTLY MOIST TO DRY, 5YR 4/4, REDDISH BROWN.
30	112		
32	114		
34	116		**34' - 44': WELL GRADED SAND WITH CLAY AND GRAVEL** LOOSE PLASTIC, FINES AS THIN LENSES, GRAVEL UP TO 1", WET, 5YR 4/4, REDDISH BROWN.
36	118		
38	120		
40	122		

WORTHINGTON MILLER ENVIRONMENTAL, LLC.	**BORELOLE LOG**	**BOREHOLE NO.:**
	PROJECT: GRANTS RECLAMATION PROJECT **PAGE:** 4 OF 6	**WME-18**
	CLIENT: HOMESTAKE MINING COMPANY **DATE:** 05/30/19	

ALLUVIUM DEPTH (FT)	TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
40	122		**34' - 44': WELL GRADED SAND WITH CLAY AND GRAVEL** LOOSE, PLASTIC, FINES AS THIN LENSES, GRAVEL UP TO 1", WET, 5YR 4/4, REDDISH BROWN.
42	124		
44	126		**44' - 61': POORLY GRADED FINE SAND** WITH TRACE CLAY AND TRACE GRAVEL, UP TO 1" DIA. LOOSE SAND, STIFF CLAY LENSES, WET, 5YR 4/4, REDDISH BROWN.
46	128		
48	130		
50	132		
52	134		
54	136		
56	138		
58	140		
60	142		

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

BOREHOLE NO.: **WME-18**

PROJECT: GRANTS RECLAMATION PROJECT **PAGE:** 5 OF 6

CLIENT: HOMESTAKE MINING COMPANY **DATE:** 05/30/19

ALLUVIUM DEPTH (FT)	TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
60	142		**44' - 61': POORLY GRADED FINE SAND** WITH TRACE CLAY AND TRACE GRAVEL, UP TO 1" DIA. LOOSE SAND, STIFF CLAY LENSES, WET, 5YR 4/4, REDDISH BROWN.
62	144		**61' - 63': LEAN CLAY** VERY STIFF, HIGH PLASTICITY, WET, 5YR 4/4, REDDISH BROWN.
			63' - 64': POORLY GRADED FINE SAND LOOSE, NON-PLASTIC, WET, 5YR 4/4, REDDISH BROWN.
64	146		**64' - 74': WELL GRADED GRAVELLY SAND** WITH TRACE CLAY, LESS THAN 15% LOOSE, HIGH PLASTICITY, WET, 5YR 4/4, REDDISH BROWN.
66	148		
68	150		
70	152		
72	154		
74	156		**74' - 76': POORLY GRADED FINE SAND** LOOSE, NON-PLASTIC, WET, 5YR 4/4, REDDISH BROWN.
76	158		**76' - 94': SANDY LEAN CLAY WITH GRAVEL** VERY STIFF, HIGH PLASTICITY, COHESIVE, MOIST, 10YR 3/2, VERY DARK GRAYISH BROWN.
78	160		
80	162		

WORTHINGTON MILLER ENVIRONMENTAL, LLC.	BOREHOLE LOG	BOREHOLE NO.:
	PROJECT: GRANTS RECLAMATION PROJECT PAGE: 6 OF 6	WME-18
	CLIENT: HOMESTAKE MINING COMPANY DATE: 05/30/19	

ALLUVIUM DEPTH (FT)	TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
80	162		**76' - 94': SANDY LEAN CLAY WITH GRAVEL** VERY STIFF, HIGH PLASTICITY, COHESIVE, MOIST, 10YR 3/2, VERY DARK GRAYISH BROWN.
82	164		
84	166		
86	168		
88	170		
90	172		
92	174		
94	176		**94' - 100': VOID**
96	178		
98	180		
100	182		

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

DATE: 05/30/19

BOREHOLE NO.: **WME-19**

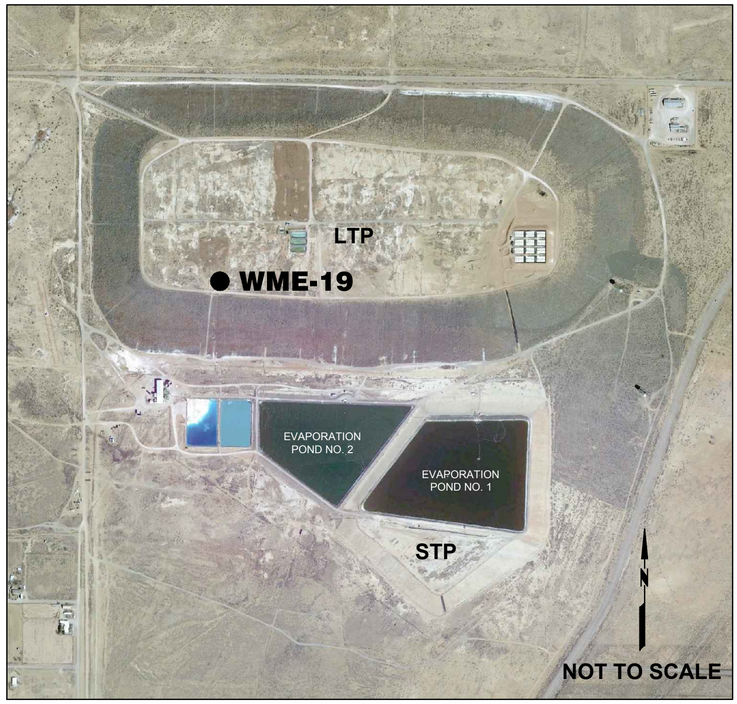
PROJECT INFORMATION

PROJECT: GRANTS RECLAMATION PROJECT

CLIENT: HOMESTAKE MINING COMPANY

LOCATION: GRANTS, NEW MEXICO

BOREHOLE LOCATION



FIELD INFORMATION

BOREHOLE LOGGED BY: ROB NOBLE

SAMPLING METHOD: CONTINUOUS CORE

DRILLING INFORMATION

DRILLING COMPANY: YELLOW JACKET DRILLING

DRILLER: TRISTAN TRUAX

START DATE/TIME: MAY 6, 2019 @ 09:40

DRILLING COMPLETION DATE/TIME: MAY 6, 2019 @ 18:30

BORING DEPTH: 156' BGS

BORING DIA.: 8-INCH

DRILLING METHOD: SONIC

BOREHOLE COMPLETION INFORMATION

WELL I.D.: WME-19

START DATE/TIME: MAY 7, 2019 @ 07:45

COMPLETE TIME: MAY 7, 2019 @ 13:50

ELEVATION - TOP OF BORING:

SCREENED INTERVAL: 133' - 138' BGS

GROUNDWATER CONDITIONS

NOTES:

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

PROJECT: GRANTS RECLAMATION PROJECT **PAGE:** 2 OF 5

CLIENT: HOMESTAKE MINING COMPANY **DATE:** 05/30/19

BOREHOLE NO.: WME-19

ALLUVIUM DEPTH (FT)	TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
0 – 7	82 – 89		**0 - 7': POORLY GRADED FINE SAND WITH LEAN CLAY LENSES** LOOSE, HIGH PLASTICITY, FINES, MEDIUM SOFT, MOIST - WET, 10YR 5/4, YELLOWISH BROWN.
7 – 9	89 – 91		**7' - 9': LEAN CLAY** VERY STIFF, HIGH PLASTICITY, MOIST, 5YR 4/3. REDDISH BROWN.
9 – 11	91 – 93		**9' - 11': SILTY SANDSTONE WITH CLAY** LOOSE - MEDIUM DENSE, SOFT CLAY, MEDIUM PLASTICITY, DRY, 10YR 7/2, LIGHT GRAY.
11 – 12	93 – 94		**11' - 12': SANDY CLAY** HARD, FRIABLE, LOW PLASTICITY, FINE SAND, DRY, 5Y 4/1, DARK GRAY.
12 – 18	94 – 100		**12' - 18': POORLY GRADED FINE SAND** LOOSE, NON-PLASTIC, NON-COHESIVE, DRY, 10YR 6/4, LIGHT YELLOWISH BROWN.
18 – 19	100 – 101		**18' - 19': LEAN CLAY** VERY STIFF, HIGH PLASTICITY, TRACE MOTTLING, SLIGHTLY MOIST, 10YR 4/2, DARK GRAYISH BROWN.
19 – 20	101 – 102		**19' - 24': POORLY GRADED FINE SAND** LOOSE, NON-PLASTIC, SLIGHTLY MOIST - DRY, 5YR 4/6, YELLOWISH RED.

Depth scale: Alluvium depth 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20; Total depth 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 102.

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BOREHOLE LOG

PROJECT: GRANTS RECLAMATION PROJECT **PAGE:** 3 OF 5

CLIENT: HOMESTAKE MINING COMPANY **DATE:** 05/30/19

BOREHOLE NO.: **WME-19**

ALLUVIUM DEPTH (FT)	TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
20	102		**19' - 24': POORLY GRADED FINE SAND** LOOSE, NON-PLASTIC, SLIGHTLY MOIST - DRY, 5YR 4/6, YELLOWISH RED.
22	104		
24	106		**24' - 29': SILTY SAND** LOOSE - MEDIUM DENSE, VERY FINE, NON-PLASTIC, MOIST, 2.5Y 4/6, RED.
26	108		
28	110		
			29' - 30': SILTY CLAY MEDIUM STIFF - STIFF, HIGH PLASTICITY, MOIST, 5YR 3/4, DARK REDDISH BROWN.
30	112		**30' - 32': POORLY GRADED SILTY SAND WITH TRACE CLAY** LOOSE, MEDIUM - LOW PLASTICITY, MOIST, 5YR 4/4, REDDISH BROWN.
32	114		**19' - 24': POORLY GRADED FINE SAND** LOOSE, NON-PLASTIC, SLIGHTLY MOIST - DRY, 5YR 5/4, REDDISH BROWN.
34	116		**34' - 40': NO RETURNS.**
36	118		
38	120		
40	122		

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

PROJECT: GRANTS RECLAMATION PROJECT **PAGE:** 4 OF 5

CLIENT: HOMESTAKE MINING COMPANY **DATE:** 05/30/19

BOREHOLE NO.: **WME-19**

ALLUVIUM DEPTH (FT)	TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
40 – 48	122 – 130		**40' - 48': POORLY GRADED FINE SAND WITH TRACE GRAVEL AND CLAY** LOOSE, GRAVEL UP TO 1" DIAMETER, CLAY AS THIN LENSES, HIGH PLASTICITY, SOFT, WET, 5YR 4/4, REDDISH BROWN.
48 – 56	130 – 138		**48' - 56': POORLY GRADED FINE SAND** CLEAN, LOOSE, NON-PLASTIC, WET, 5YR 4/4, REDDISH BROWN.
56 – 60	138 – 142		**56' - 73': POORLY GRADED FINE SAND WITH GRAVEL** LOOSE, NON-PLASTIC, GRAVEL UP TO 2" DIAMETER, WET, 5YR 4/4, REDDISH BROWN.

Depth scale: 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60 (alluvium); 122, 124, 126, 128, 130, 132, 134, 136, 138, 140, 142 (total).

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

PROJECT: GRANTS RECLAMATION PROJECT **PAGE:** 5 OF 5

CLIENT: HOMESTAKE MINING COMPANY **DATE:** 05/30/19

BOREHOLE NO.: **WME-19**

ALLUVIUM DEPTH (FT)	TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
60	142		**56' - 73': POORLY GRADED FINE SAND WITH GRAVEL** LOOSE, NON-PLASTIC, GRAVEL UP TO 2" DIAMETER, WET, 5YR 4/4, REDDISH BROWN.
62	144		
64	146		
66	148		
68	150		
70	152		
72	154		
			73' - 74': LEAN CLAY VERY STIFF, HIGH PLASTICITY, MOIST, 10R 4/6, RED.
74	156		**74' - 80': CLAYSTONE** DRY, DENSE, CHINLE FORMATION.
76	158		
78	160		
80	162		

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

DATE: 05/30/19

BOREHOLE NO.: **WME-20**

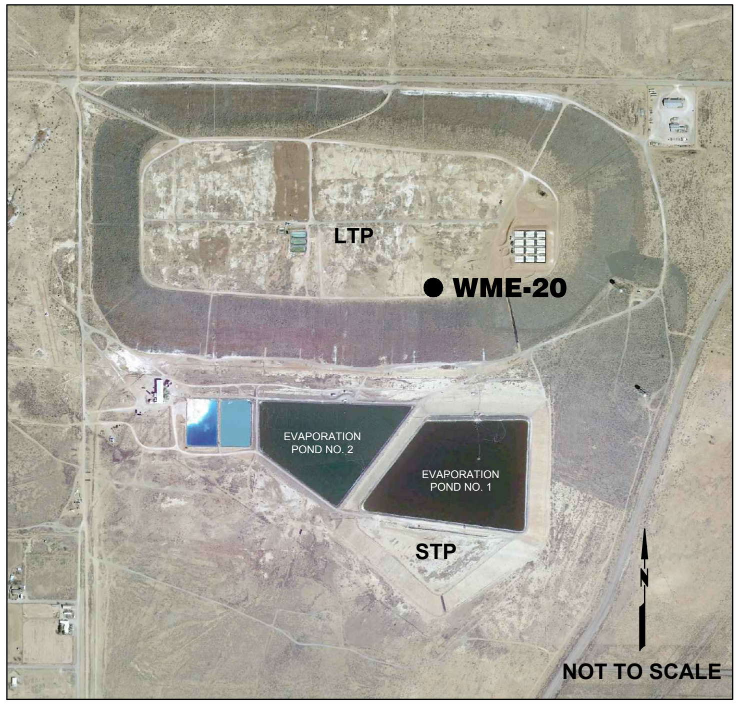
PROJECT INFORMATION

PROJECT: GRANTS RECLAMATION PROJECT

CLIENT: HOMESTAKE MINING COMPANY

LOCATION: GRANTS, NEW MEXICO

BOREHOLE LOCATION



FIELD INFORMATION

BOREHOLE LOGGED BY: ROB NOBLE

SAMPLING METHOD: CONTINUOUS CORE

DRILLING INFORMATION

DRILLING COMPANY: YELLOW JACKET DRILLING

DRILLER: TRISTAN TRUAX

START DATE/TIME: MAY 8, 2019 @ 07:35

DRILLING COMPLETION DATE/TIME: MAY 8, 2019 @ 16:30

BORING DEPTH: 163' BGS

BORING DIA.: 8-INCH

DRILLING METHOD: SONIC

BOREHOLE COMPLETION INFORMATION

WELL I.D.: WME-20

START DATE/TIME: MAY 9, 2019 @ 06:30

COMPLETE TIME: MAY 9, 2019 @ 15:00

ELEVATION - TOP OF BORING:

SCREENED INTERVAL: 149' - 154' BGS

GROUNDWATER CONDITIONS

NOTES:

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

PROJECT: GRANTS RECLAMATION PROJECT **PAGE:** 2 OF 5

CLIENT: HOMESTAKE MINING COMPANY **DATE:** 05/30/19

BOREHOLE NO.: WME-20

ALLUVIUM DEPTH (FT)	TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
0	86		**0 - 1': POORLY GRADED SILTY FINE SAND** LOOSE, NON- PLASTIC, WET, 10YR 3/2, VERY DARK GRAYISH BROWN.
			1' - 2': LEAN CLAY VERY STIFF, HIGH PLASTICITY, MOIST,10YR 3/2, VERY DARK GRAYISH BROWN.
2	88		**2' - 4': POORLY GRADED FINE SAND** LOOSE, NON- PLASTIC, NON-COHESIVE, MOIST - WET, 10YR 4/3, BROWN.
4	90		**4' - 5': LEAN CLAY** VERY STIFF, HIGH PLASTICITY, MOIST, 10YR 4/2, VERY DARK GRAYISH BROWN.
6	92		**5' - 8': SANDY CLAY** STIFF, LOW PLASTICITY, PARTIALLY FRIABLE, SOME MOTTLING, VERY FINE SAND, POORLY GRADED, SLIGHTLY MOIST, 10YR 3/2, VERY DARK GRAYISH BROWN.
8	94		**8' - 10': POORLY GRADED SILTY FINE SAND** LOOSE, NON- PLASTIC, NON-COHESIVE, SLIGHTLY MOIST - DRY, 10YR 5/6, YELLOWISH BROWN.
10	96		**10' - 12': POORLY GRADED FINE SAND WITH TRACE CLAY** LOOSE, SOFT, SLIGHTLY MOIST, SLIGHTLY COHESIVE, DRY, 10YR 5/6, YELLOWISH BROWN.
12	98		**12' - 16': POORLY GRADED FINE SAND** LOOSE, NON- PLASTIC, MOIST - DRY, 10YR 5/6, YELLOWISH BROWN.
14	100		
16	102		**16' - 17': CLAYEY SAND** SOFT - MEDIUM DENSE, PLASTIC, FINE SAND, MOIST, 10YR 5/6, YELLOWISH BROWN.
			17' - 19': LEAN CLAY STIFF, HIGH PLASTICITY, MOIST, 10YR 4/6, RED.
18	104		
			19' - 20': POORLY GRADED FINE SAND LOOSE, NON- PLASTIC, NON-COHESIVE, MOIST.
20	106		

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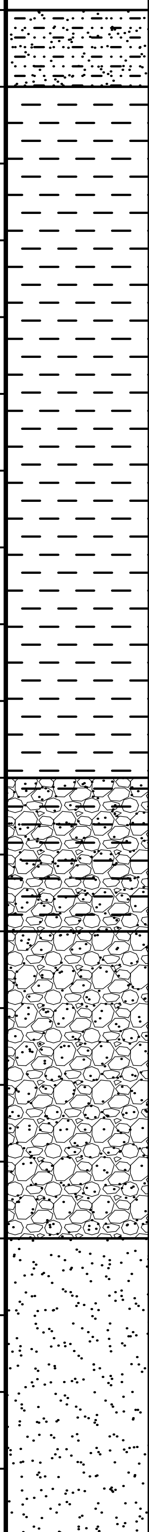
BOREHOLE LOG

BOREHOLE NO.: **WME-20**

PROJECT: *GRANTS RECLAMATION PROJECT* **PAGE:** *3 OF 5*

CLIENT: *HOMESTAKE MINING COMPANY* **DATE:** *05/08/19*

ALLUVIUM DEPTH (FT)	TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
20	106		**20' - 21': POORLY GRADED SILTY SAND WITH TRACE CLAY** LOOSE, SLIGHT PLASTICITY, MOIST, 10R 4/6, RED.
			21' - 22': LEAN CLAY VERY STIFF, HIGH PLASTICITY, MOIST, 10R 4/6, RED.
22	108		
24	110		
26	112		
28	114		
30	116		**30' - 32': POORLY GRADED FINE GRAVELLY SAND WITH TRACE CLAY** LOOSE, CLAY LENSES, SOFT, HIGH PLASTICITY, MOIST, 10YR 4/4, BROWN.
32	118		**32' - 36': GRAVELLY SAND** FINE, LOOSE, NON-PLASTIC, NON-COHESIVE, GRAVEL UP TO 1" DIAMETER, MOIST, 10YR 4/4, BROWN.
34	120		
36	122		**36' - 41': POORLY GRADED FINE SAND** LOOSE, NON-PLASTIC, MOIST, 10YR 4/4, BROWN.
38	124		
40	126		

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

PROJECT: GRANTS RECLAMATION PROJECT **PAGE:** 4 OF 5

CLIENT: HOMESTAKE MINING COMPANY **DATE:** 05/0819

BOREHOLE NO.: **WME-20**

ALLUVIUM DEPTH (FT)	TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
40	126		**36' - 41': POORLY GRADED FINE SAND** LOOSE, NON-PLASTIC, MOIST, 10YR 4/4, BROWN.
			41' - 42': LEAN CLAY STIFF, HIGH PLASTICITY, MOIST, 10R 3/3, DUSKY RED.
42	128		**42' - 43': POORLY GRADED FINE SAND** LOOSE, NON-PLASTIC, NON-COHESIVE, MOIST, 5YR 4/4, REDDISH BROWN.
			43' - 44': LEAN CLAY STIFF, HIGH PLASTICITY, MOIST, 10R 3/3, DUSKY RED.
44	130		**44' - 49': POORLY GRADED FINE SAND** LOOSE, NON-PLASTIC, NON-COHESIVE, MOIST, 5YR 4/4, REDDISH BROWN.
46	132		
48	134		
			49' - 50': LEAN CLAY VERY STIFF, HIGH PLASTICITY, MOIST, 10R 3/3 DUSKY RED.
50	136		**50' - 61': POORLY GRADED SILTY FINE SAND** TRACE MOTTLED, LOOSE, NON-PLASTIC, MOIST, 5YR 4/4, REDDISH BROWN.
52	138		
54	140		
56	142		
58	144		
60	146		

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

PROJECT: GRANTS RECLAMATION PROJECT **PAGE:** 5 OF 5

CLIENT: HOMESTAKE MINING COMPANY **DATE:** 05/08/19

BOREHOLE NO.: **WME-20**

ALLUVIUM DEPTH (FT)	TOTAL DEPTH (FT)	LITHOLOGY DESCRIPTION
60	146	**50' - 61': POORLY GRADED SILTY FINE SAND** TRACE MOTTLED, LOOSE, NON-PLASTIC, MOIST, 5YR 4/4, REDDISH BROWN.
		61' - 62': LEAN CLAY VERY STIFF, HIGH PLASTICITY, MOIST, 2.5YR 4/3, REDDISH BROWN.
62	148	**62' - 72': POORLY GRADED FINE SAND WITH TRACE GRAVEL** UP TO 2" DIAMETER, LOOSE, NON-PLASTIC, WET, 5YR 4/4, REDDISH BROWN.
64	150	
66	152	
68	154	
70	156	
72	158	**72' - 73': CLAYEY GRAVELLY SAND** WELL GRADED, LOOSE, GRAVEL UP TO 2" DIAMETER, SOFT CLAY, HIGH PLASTICITY, WET, 5YR 4/4, REDDISH BROWN.
		73'- 74': SANDY CLAY STIFF, PLASTIC, TRACE GRAVEL, WET, 5YR 3/4, DARK REDDISH BROWN.
74	160	**74' - 77': LEAN CLAY** HARD, NON-PLASTIC, MOTTLED, FRIABLE, DRY, 10R5/3, RED, CHINLE FORMATION.
76	162	
78	164	
80	166	

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

DATE: 05/09/19

BOREHOLE NO.: WME-21

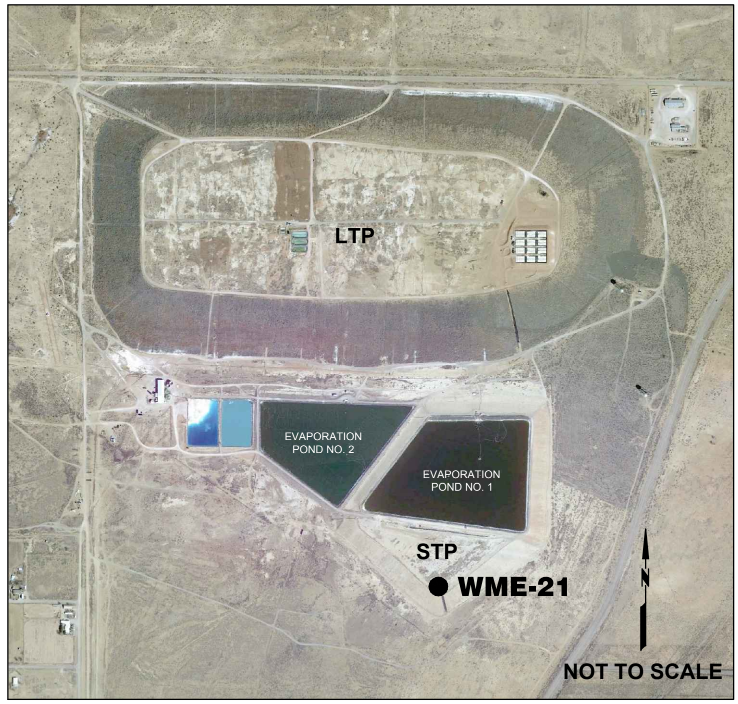
PROJECT INFORMATION

PROJECT: GRANTS RECLAMATION PROJECT

CLIENT: HOMESTAKE MINING COMPANY

LOCATION: GRANTS, NEW MEXICO

BOREHOLE LOCATION



FIELD INFORMATION

BOREHOLE LOGGED BY: ROB NOBLE

SAMPLING METHOD: CONTINUOUS CORE

DRILLING INFORMATION

DRILLING COMPANY: YELLOW JACKET DRILLING

DRILLER: TRISTAN TRUAX

START DATE/TIME: MAY 09, 2019 @ 17:20

DRILLING COMPLETION DATE/TIME: MAY 10, 2019 @ 09:30

BORING DEPTH: 86' BGS

BORING DIA.: 8-INCH

DRILLING METHOD: SONIC

BOREHOLE COMPLETION INFORMATION

WELL I.D.: WME-21

START DATE/TIME: MAY 10, 2019 @ 09:30

COMPLETE TIME: MAY 10, 2019 @ 14:10

ELEVATION - TOP OF BORING:

SCREENED INTERVAL: 67' - 72' BGS

GROUNDWATER CONDITIONS

NOTES:

WORTHINGTON
MILLER
ENVIRONMENTAL, LLC.

BOREHOLE LOG

BOREHOLE NO.: **WME-21**

PROJECT: *GRANTS RECLAMATION PROJECT* **PAGE:** *2 OF 4*

CLIENT: *HOMESTAKE MINING COMPANY* **DATE:** *05/09/19*

ALLUVIUM DEPTH (FT)	TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
0	24		**0 - 2': LEAN CLAY** VERY STIFF, HIGH PLASTICITY, TRACE MOTTLING, MOIST, 2.5Y 3/2, VERY DARK GRAYISH BROWN.
2	26		**2' - 4': LEAN CLAY** STIFF, MODERATE PLASTICITY, ABUNDANT MOTTLING (WHITE), LIGHTLY FISSLE, SLIGHTLY MOIST, 7.5YR 4/2, BROWN.
4	28		**4' - 6': SILTY SANDY CLAY** LEAN, VERY FINE SAND, ABUNDANT MOTTLING (WHITE), CLAY = 10YR 3/2, VERY DARK GRAY BROWN, SAND = 10YR 5/8, YELLOWISH BROWN, PLUS - MANUFACTURED WOOD.
6	30		**6' - 8'': LEAN CLAY** STIFF, MEDIUM - LOW PLASTICITY, ABUNDANT MOTTLING (WHITE), DRY, 7.5YR 4/2 BROWN.
8	32		**8' - 9': SANDY CLAY** STIFF, MEDIUM HIGH PLASTICITY, TRACE MOTTLING (WHITE), SLIGHTLY MOIST - DRY, VERY FINE LOOSE SAND.
			9' - 12': LEAN CLAY STIFF, HIGH PLASTICITY, SLIGHTLY MOIST, 7.5YR 5/3, BROWN.
10	34		
12	36		**12' - 34': SANDY SILT WITH TRACE GRAVEL** MEDIUM DENSE - LOOSE, NON-PLASTIC, NON-COHESIVE, DRY, 5YR 4/4, REDDISH BROWN.
14	38		
16	40		
18	42		
20	44		

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

PROJECT: GRANTS RECLAMATION PROJECT **PAGE:** 3 OF 4

CLIENT: HOMESTAKE MINING COMPANY **DATE:** 05/30/19

BOREHOLE NO.: **WME-21**

ALLUVIUM DEPTH (FT)	TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
20	44		**12' - 34': SANDY SILT WITH TRACE GRAVEL** MEDIUM DENSE - LOOSE, NON-PLASTIC, NON-COHESIVE, DRY, 5YR 4/4, REDDISH BROWN.
22	46		
24	48		
26	50		
28	52		
30	54		
32	56		
34	58		**34' - 38': POORLY GRADED FINE SAND WITH TRACE GRAVEL** LOOSE, NON-PLASTIC, WET, 7.5YR 4/4, BROWN.
36	60		
38	62		**38' - 42': WELL GRADED GRAVELLY SAND** LOOSE, NON-PLASTIC, WET, 7.5YR 3/3, BROWN.
40	64		

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

PROJECT: GRANTS RECLAMATION PROJECT **PAGE:** 4 OF 4

CLIENT: HOMESTAKE MINING COMPANY **DATE:** 05/30/19

BOREHOLE NO.: WME-21

ALLUVIUM DEPTH (FT)	TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
40	64		**38' - 42': WELL GRADED GRAVELLY SAND** LOOSE, NON-PLASTIC, WET, 7.5YR 3/3, BROWN.
42	66		**42' - 44': LEAN CLAY WITH TRACE SAND** STIFF, HIGH PLASTICITY, MOIST, 2.5YR 4/4, REDDISH BROWN.
44	68		**44' - 49': GRAVELLY LEAN CLAY WITH SAND** MEDIUM STIFF - STIFF, HIGH PLASTICITY, COHESIVE, MOIST - WET, 2.5YR 4/4, REDDISH BROWN.
46	70		
48	72		
			49' - 50': LEAN CLAY STIFF, HIGH PLASTICITY, MOIST, 2.5YR 4/4, REDDISH BROWN.
50	74		**50' - 60': CLAYSTONE** MEDIUM HARD, NON-PLASTIC, MOTTLED, DRY, 10R 4/6, RED, CHINLE FORMATION.
52	76		
54	78		
56	80		
58	82		
60	84		

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

DATE: 05/30/19

BOREHOLE NO.: **WME-22**

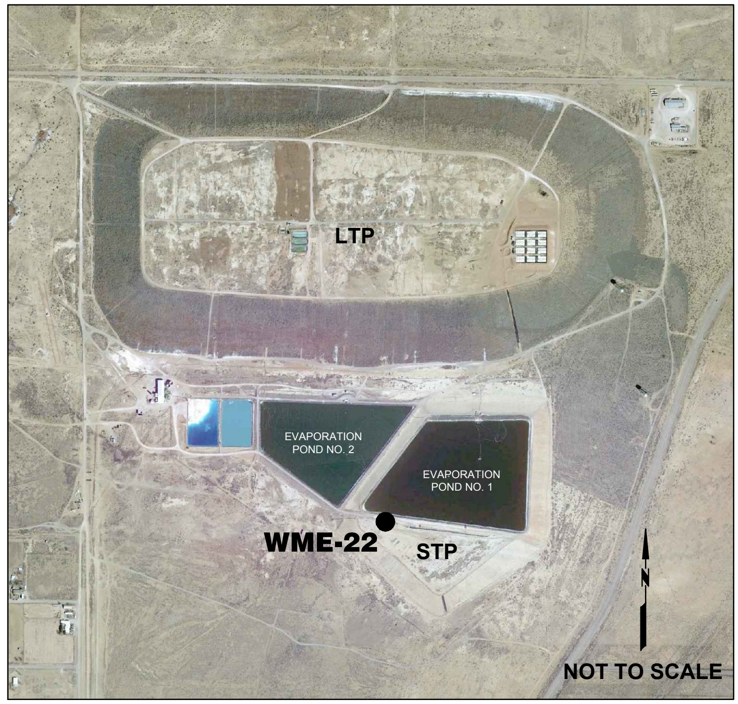
PROJECT INFORMATION

PROJECT: GRANTS RECLAMATION PROJECT

CLIENT: HOMESTAKE MINING COMPANY

LOCATION: GRANTS, NEW MEXICO

BOREHOLE LOCATION



FIELD INFORMATION

BOREHOLE LOGGED BY: ROB NOBLE

SAMPLING METHOD: CONTINUOUS CORE

DRILLING INFORMATION

DRILLING COMPANY: YELLOW JACKET DRILLING

DRILLER: TRISTAN TRUAX

START DATE/TIME: MAY 10, 2019 @ 16:59

DRILLING COMPLETION DATE/TIME: MAY 10, 2019 @ 19:00

BORING DEPTH: 86' BGS

BORING DIA.: 8-INCH

DRILLING METHOD: SONIC

BOREHOLE COMPLETION INFORMATION

WELL I.D.: WME-22

START DATE/TIME: MAY 11, 2019 @ 08:50

COMPLETE TIME: MAY 11, 2019 @ 15:10

ELEVATION - TOP OF BORING:

SCREENED INTERVAL: 69' - 74' BGS

GROUNDWATER CONDITIONS

NOTES:

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

PROJECT: GRANTS RECLAMATION PROJECT **PAGE:** 2 OF 4

CLIENT: HOMESTAKE MINING COMPANY **DATE:** 05/30/19

BOREHOLE NO.: **WME-22**

ALLUVIUM DEPTH (FT)	TOTAL DEPTH (FT)	LITHOLOGY DESCRIPTION
0 - 1	21 - 22	**0 - 1': LEAN CLAY** STIFF, HIGH PLASTICITY, COHESIVE, MOIST, 10YR 3/3, DARK BROWN.
1 - 5	22 - 26	**1' - 5': FAT CLAY** STIFF, HIGH PLASTICITY, ORGANICS (BLACK), MOIST, GLAY 1, 2.5/N, BLACK.
5 - 6	26 - 27	**5' - 6': FAT CLAY WITH GRAVEL** MEDIUM STIFF, HIGH PLASTICITY, COHESIVE, MOIST, GLAY 1, 2.5/N, BLACK.
6 - 9	27 - 30	**6' - 9': FAT CLAY** MEDIUM STIFF, HIGH PLASTICITY, ORGANICS (BLACK), MOIST, GLAY 1, 2.5/N, BLACK.
9 - 12	30 - 33	**9' - 12': SANDY CLAY WITH GRAVEL** MEDIUM STIFF, HIGH PLASTICITY, VERY FINE SAND, TRACE GRAVEL, SOME MOTTLING, SLIGHTLY MOIST - DRY, 7.5YR 4/6, STRONG BROWN.
12 - 15	33 - 36	**12' - 15': CLAYEY SAND** VERY FINE, MEDIUM STIFF - LOOSE, HIGH PLASTICITY, FAT CLAY, MOTTLING, ORGANICS, MOIST, 7.5YR 4/6, STRONG BROWN.
15 - 16	36 - 37	**15' - 16': SILTY LEAN CLAY** VERY STIFF, HIGH PLASTICITY, MOIST, 5YR 4/3, REDDISH BROWN.
16 - 18	37 - 39	**16' - 18': VERY FINE SILTY SAND** LOOSE, POORLY GRADED, NON-PLASTIC, MOIST, 5YR 6/6, YELLOWISH RED.
18 - 19	39 - 40	**18' - 19': LEAN CLAY** VERY STIFF, HIGH PLASTICITY, SLIGHTLY MOIST, 2.5YR 4/4, REDDISH BROWN.
19 - 21	40 - 41	**19' - 21': VERY FINE SILTY SAND** LOOSE - SLIGHTLY DENSE, NON-PLASTIC, NON-COHESIVE, DRY, 5YR 5/6, YELLOWISH RED.

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

PROJECT: GRANTS RECLAMATION PROJECT **PAGE:** 3 OF 4

CLIENT: HOMESTAKE MINING COMPANY **DATE:** 05/30/19

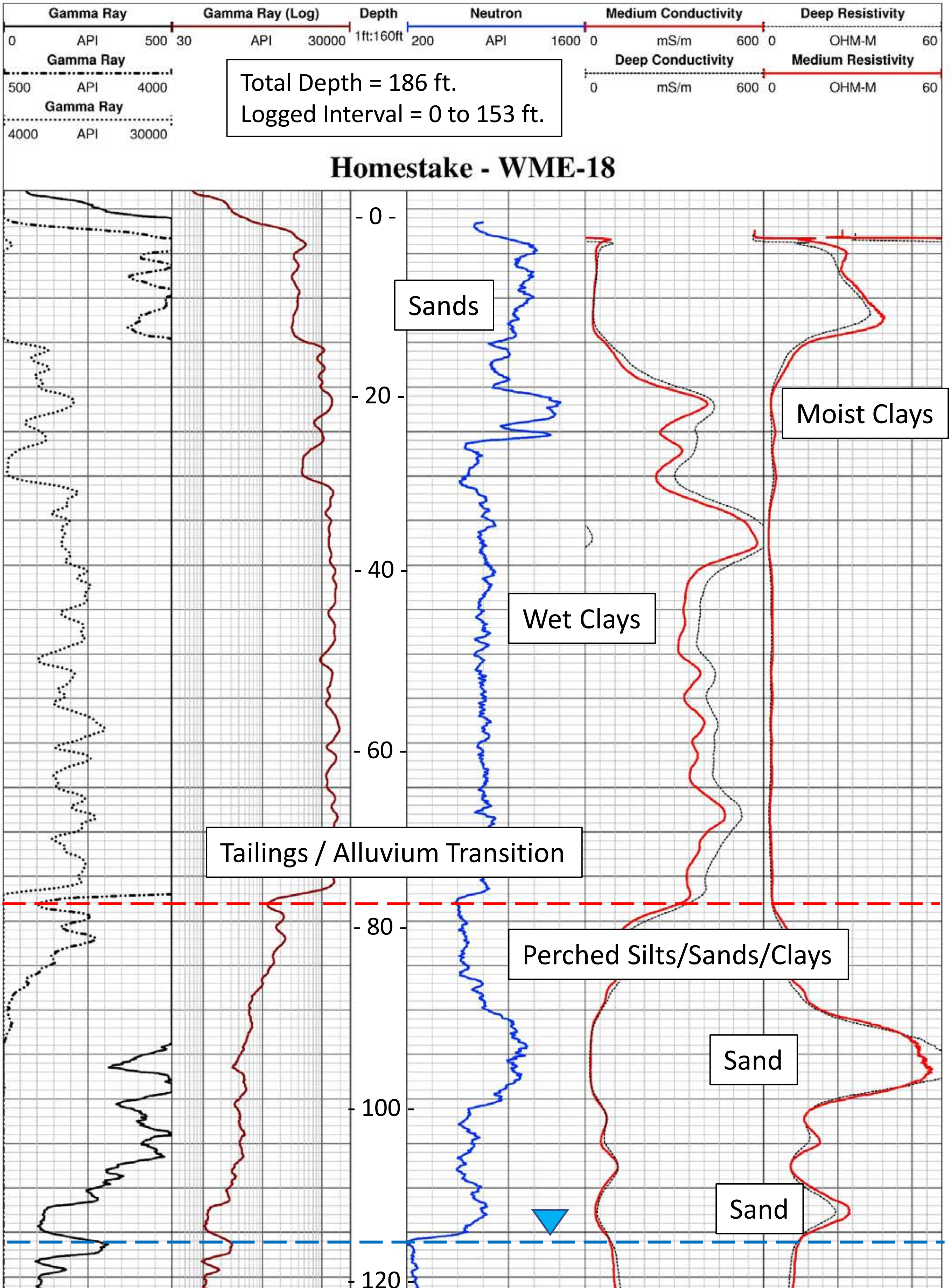
BOREHOLE NO.: **WME-22**

ALLUVIUM DEPTH (FT)	TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
20	41		
			19' - 21': VERY FINE SILTY SAND LOOSE - SLIGHTLY DENSE, NON-PLASTIC, NON-COHESIVE, DRY, 5YR 5/6, YELLOWISH RED.
	42		**21' - 24': VERY FINE SILTY SAND** LOOSE, NON-PLASTIC, NON-COHESIVE, POORLY GRADED, DRY, 10R 4/6, RED.
22			
	44		
24			**24' - 25': LEAN CLAY** STIFF, HIGH PLASTICITY, SLIGHTLY MOIST, 10R 4/6, RED.
	46		**25' - 29': SANDY SILT WITH TRACE GRAVEL** LOOSE - SLIGHTLY DENSE, NON-PLASTIC, DRY, 2.5YR 4/4, REDDISH BROWN.
26			
	48		
28			
	50		**29' - 35': SANDY SILT WITH TRACE GRAVEL** LOOSE - SLIGHTLY DENSE, NON-PLASTIC, DRY, 7.5YR 6/6, REDDISH YELLOW.
30			
	52		
32			
	54		
34			
	56		**35' - 37': SANDY SILT WITH TRACE GRAVEL** LOOSE - SLIGHTLY DENSE, NON-PLASTIC, DRY, 2.5YR 4/4, REDDISH BROWN.
36			
	58		**37' - 41': SANDY SILT WITH TRACE GRAVEL** LOOSE - SLIGHTLY DENSE, NON-PLASTIC, DRY, 7.5YR 4/4, BROWN.
38			
	60		
40			

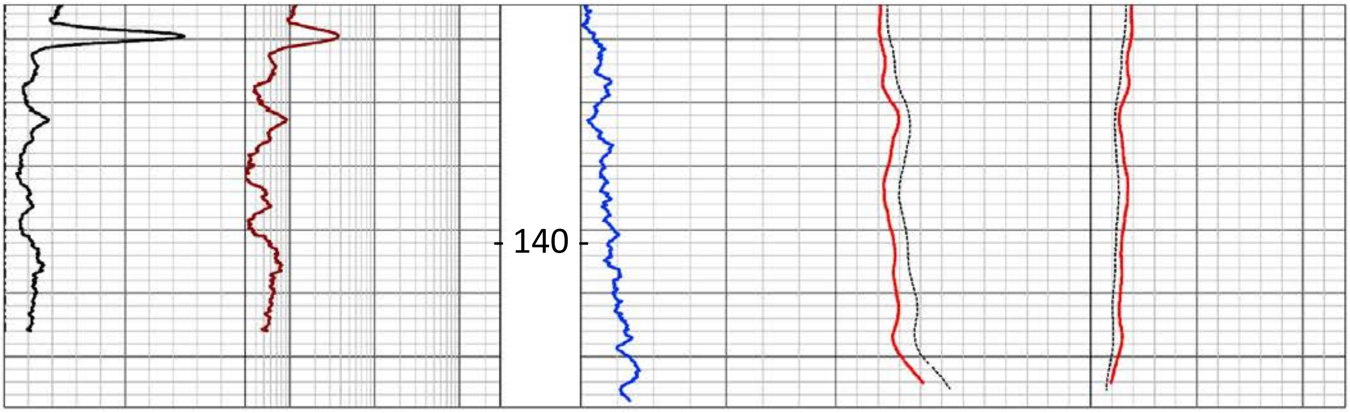
WORTHINGTON MILLER ENVIRONMENTAL, LLC.	BOREHOLE LOG	BOREHOLE NO.:
	PROJECT: GRANTS RECLAMATION PROJECT PAGE: 4 OF 4	WME-22
	CLIENT: HOMESTAKE MINING COMPANY DATE: 05/30/19	

ALLUVIUM DEPTH (FT)	TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
40	61		**37' - 41': SANDY SILT WITH TRACE GRAVEL** LOOSE - SLIGHTLY DENSE, NON-PLASTIC, DRY, 7.5YR 4/4, BROWN.
	62		**41' - 43': WELL GRADED SAND WITH TRACE GRAVEL** LOOSE, NON-PLASTIC, WET, 7.5YR 4/4, BROWN.
42			
	64		**43' - 45': SANDY CLAY** MEDIUM STIFF - SOFT, PLASTIC, FINE SAND, WET, 2.5YR 4/4, REDDISH BROWN.
44			
	66		**45' - 49': WELL GRADED SAND WITH TRACE GRAVEL** LOOSE, NON-PLASTIC, WET, 7.5YR 4/4, BROWN.
46			
	68		
48			
	70		**49' - 51': WELL GRADED GRAVELLY SAND** LOOSE, NON-PLASTIC, GRAVEL UP TO 2" DIAMETER, WET, 2.5YR 4/4, REDDISH BROWN.
50			
	72		**51' - 55': WELL GRADED SAND WITH TRACE GRAVEL AND COBBLES** UP TO 6" DIAMETER, LOOSE, NON-PLASTIC, WET, 7.5YR 4/4, BROWN.
52			
	74		
54			
	76		**55' - 60': CLAYSTONE** DENSE, NON-PLASTIC, DRY, 2.5YR 3/6, DARK RED, CHINLE FORMATION.
56			
	78		
58			
	80		
60			

Attachment D



Gamma Ray
0 API 500
Gamma Ray
500 API 4000
Gamma Ray
4000 API 30000
Gamma Ray (Log)
30 API 30000
Depth
1ft:160ft
Neutron
200 API 1600
Medium Conductivity
0 mS/m 600
Deep Conductivity
0 mS/m 600
Deep Resistivity
0 OHM-M 60
Medium Resistivity
0 OHM-M 60
Total Depth = 186 ft.
Logged Interval = 0 to 153 ft.
Homestake - WME-18
0
20
40
60
80
100
120
Sands
Moist Clays
Wet Clays
Tailings / Alluvium Transition
Perched Silts/Sands/Clays
Sand
Sand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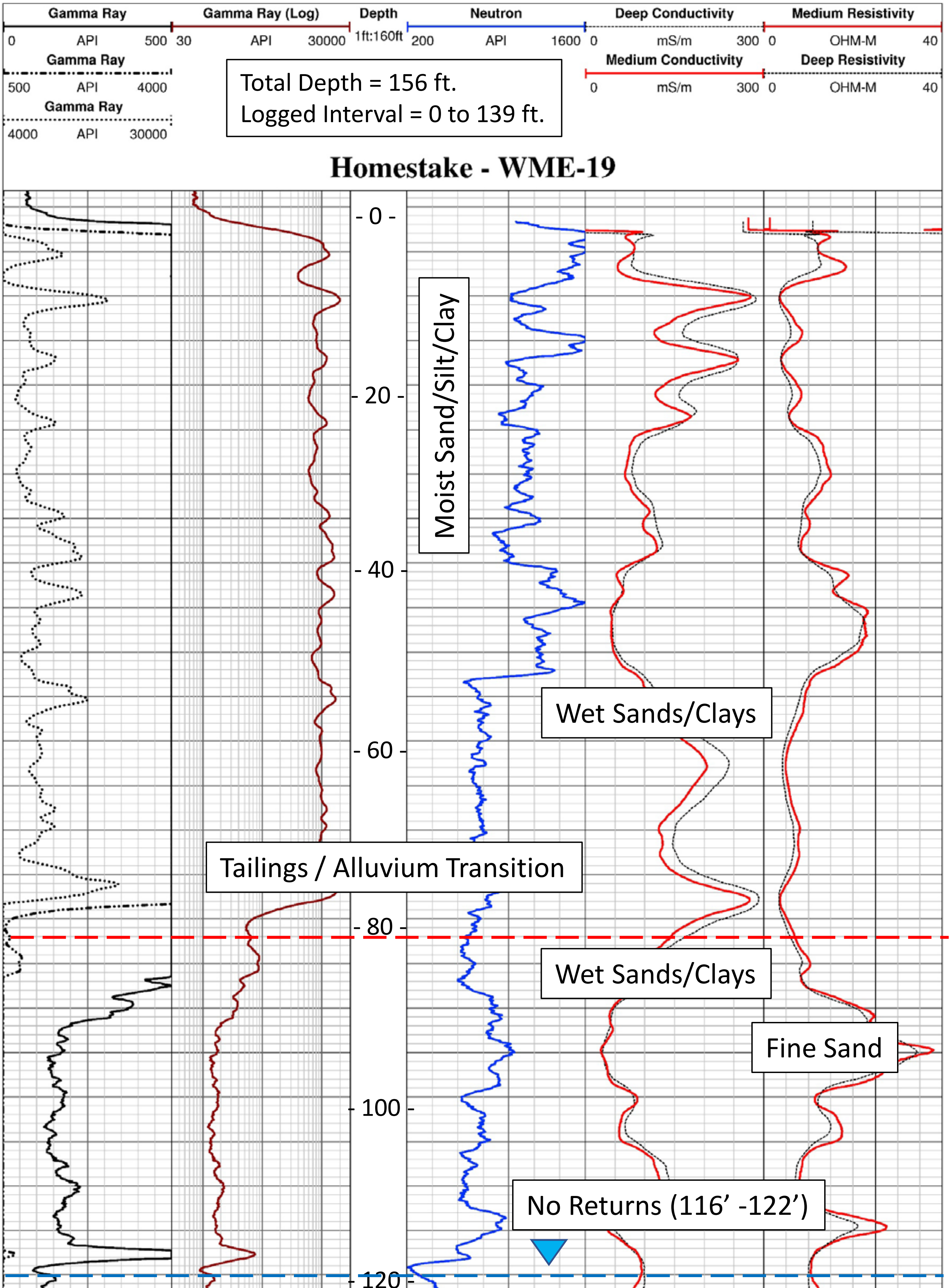
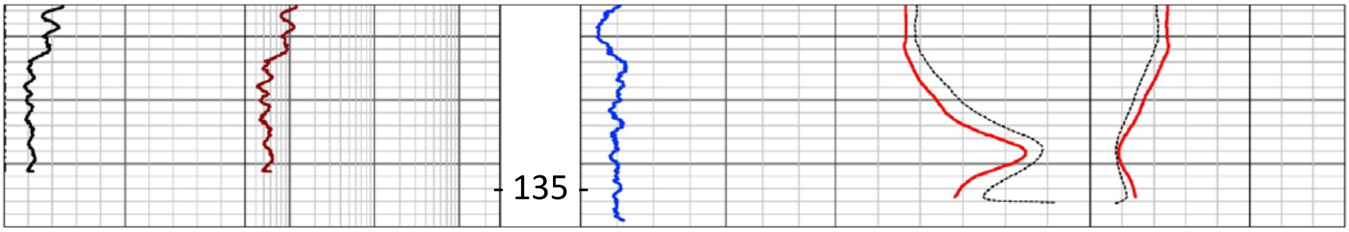


Gamma Ray
0 API 500
Gamma Ray
500 API 4000
Gamma Ray
4000 API 30000
Gamma Ray (Log)
30 API 30000
Depth
1ft:160ft
Neutron
200 API 1600
Deep Conductivity
0 mS/m 300
Medium Conductivity
0 mS/m 300
Medium Resistivity
0 OHM-M 40
Deep Resistivity
0 OHM-M 40
Total Depth = 156 ft.
Logged Interval = 0 to 139 ft.
Homestake - WME-19
0
20
40
60
80
100
120
Moist Sand/Silt/Clay
Wet Sands/Clays
Tailings / Alluvium Transition
Wet Sands/Clays
Fine Sand
No Returns (116' -122')



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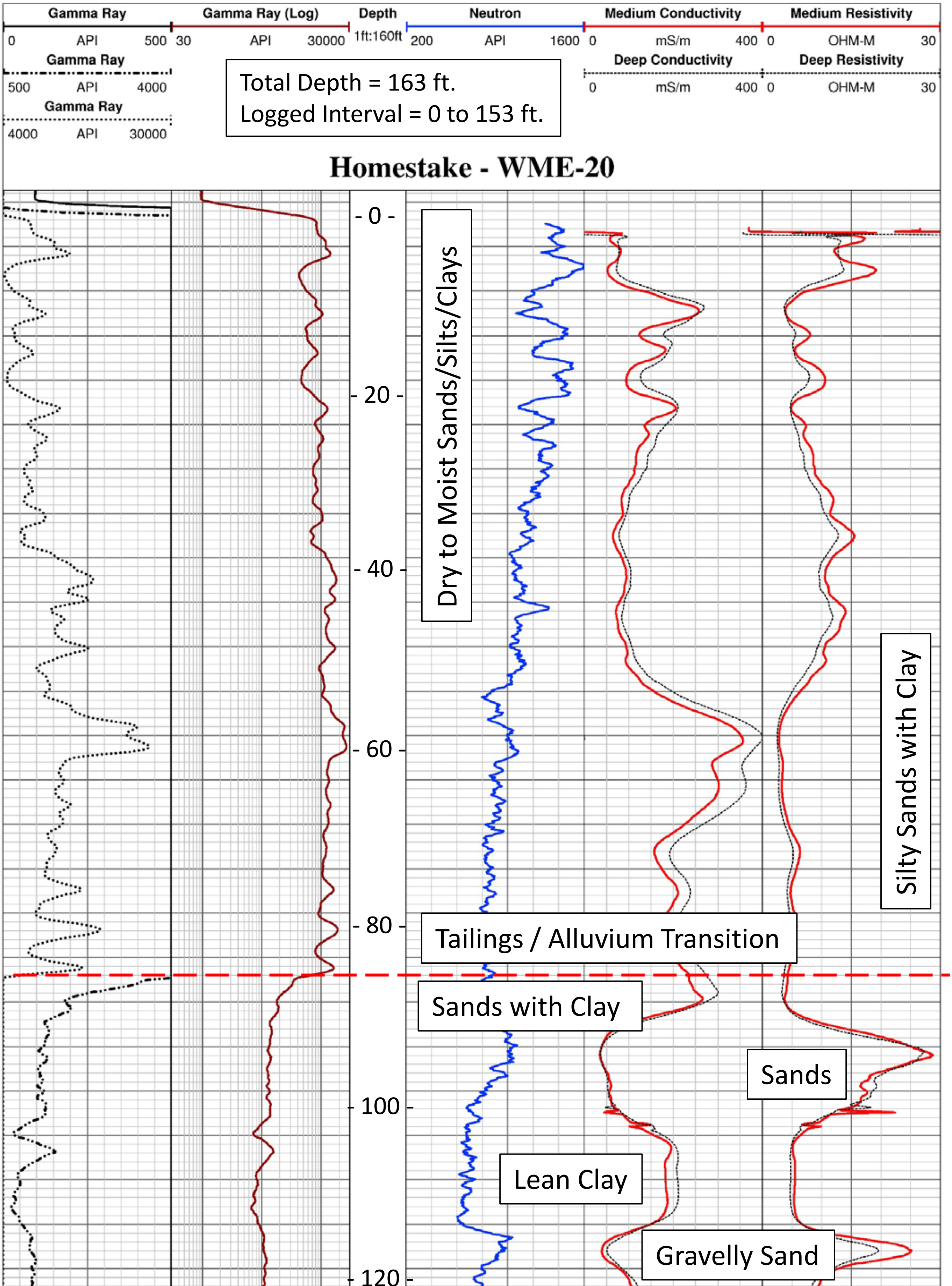
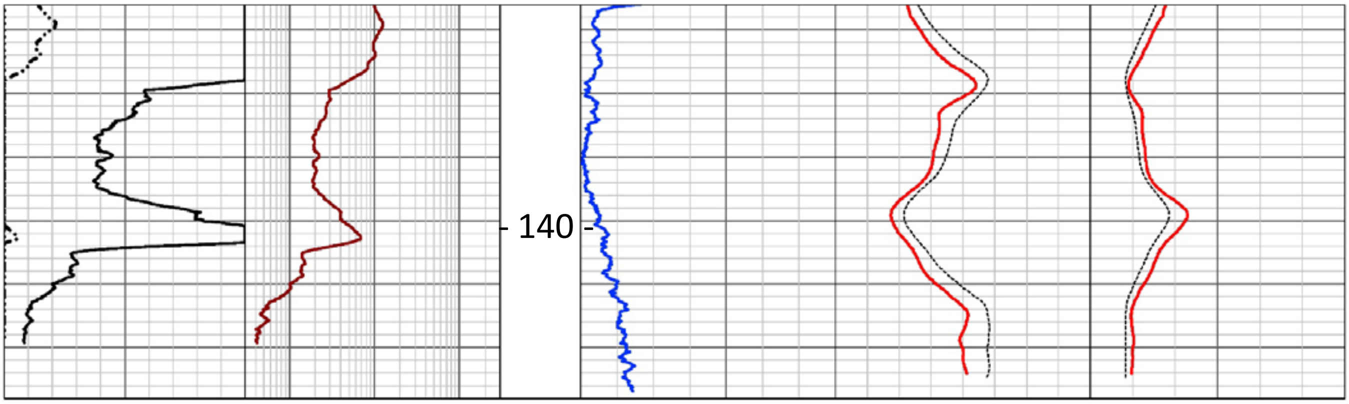


Gamma Ray
0 API 500
Gamma Ray
500 API 4000
Gamma Ray
4000 API 30000
Gamma Ray (Log)
30 API 30000
Depth
1ft:160ft
Neutron
200 API 1600
Medium Conductivity
0 mS/m 400
Deep Conductivity
0 mS/m 400
Medium Resistivity
0 OHM-M 30
Deep Resistivity
0 OHM-M 30
Total Depth = 163 ft.
Logged Interval = 0 to 153 ft.
Homestake - WME-20
- 0 -
- 20 -
- 40 -
- 60 -
- 80 -
- 100 -
- 120 -
Dry to Moist Sands/Silts/Clays
Silty Sands with Clay
Tailings / Alluvium Transition
Sands with Clay
Sands
Lean Clay
Gravelly Sand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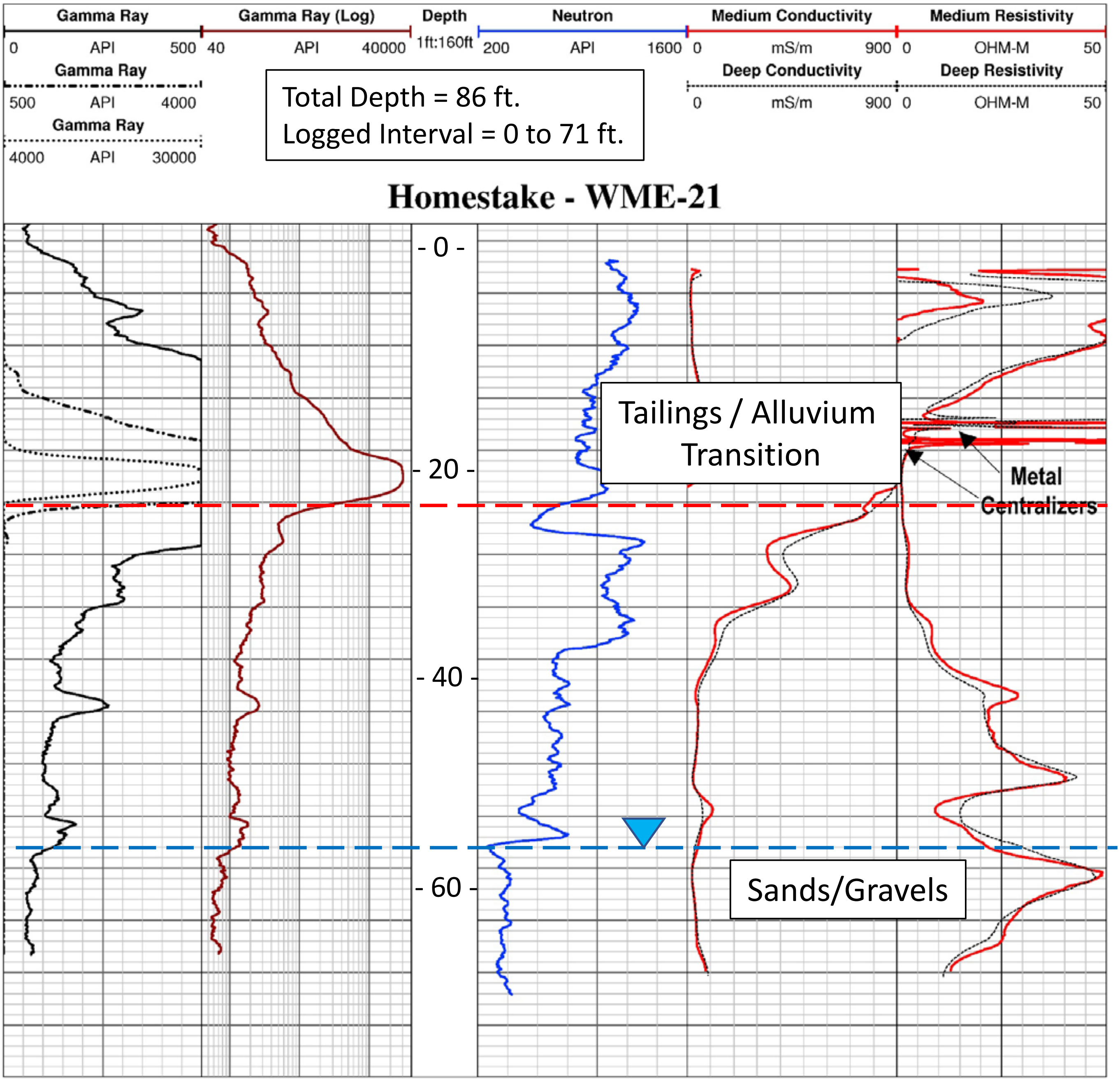
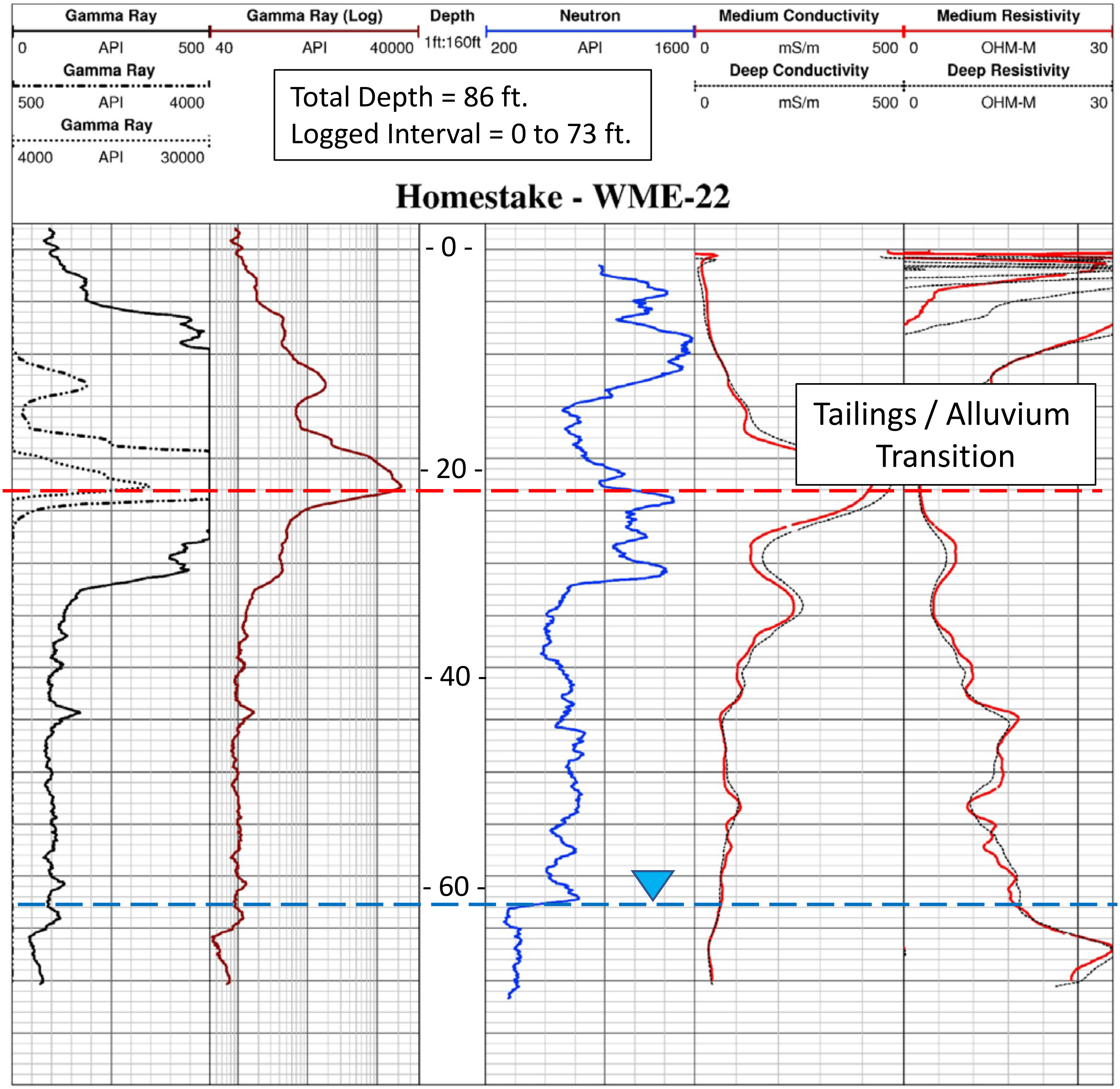

Gamma Ray
0 API 500
Gamma Ray
500 API 4000
Gamma Ray
4000 API 30000
Gamma Ray (Log)
40 API 40000
Depth
1ft:160ft
Neutron
200 API 1600
Medium Conductivity
0 mS/m 900
Deep Conductivity
0 mS/m 900
Medium Resistivity
0 OHM-M 50
Deep Resistivity
0 OHM-M 50
Total Depth = 86 ft.
Logged Interval = 0 to 71 ft.
Homestake - WME-21
- 0 -
- 20 -
- 40 -
- 60 -
Tailings / Alluvium Transition
Metal Centralizers
Sands/Gravels



Gamma Ray
0 API 500
Gamma Ray
500 API 4000
Gamma Ray
4000 API 30000
Gamma Ray (Log)
40 API 40000
Depth
1ft:160ft
Neutron
200 API 1600
Medium Conductivity
0 mS/m 500
Deep Conductivity
0 mS/m 500
Medium Resistivity
0 OHM-M 30
Deep Resistivity
0 OHM-M 30
Total Depth = 86 ft.
Logged Interval = 0 to 73 ft.
Homestake - WME-22
- 0 -
- 20 -
- 40 -
- 60 -
Tailings / Alluvium Transition

Appendix B
Drilling and Monitoring Well Completion Memorandum - Southern Area

DRILLING AND MONITORING WELL COMPLETION MEMORANDUM - SOUTHERN PLUME AREA

TO: ADAM ARGUELLO, SENIOR HYDROLOGIST, HOMESTAKE MINING COMPANY

FROM: ROB NOBLE, P.G., AND DAVID LEVY, PH.D., WORTHINGTON MILLER ENVIRONMENTAL

SUBJECT: COMPLETION REPORT FOR MONITORING WELL INSTALLATION AND ALLUVIAL BORING SAMPLE COLLECTION FOR GEOCHEMICAL CHARACTERIZATION IN THE SOUTHERN PLUME AREA AT THE HOMESTAKE GRANTS RECLAMATION PROJECT, CIBOLA COUNTY, NEW MEXICO.

DATE: AUGUST 26, 2019

1.0 Introduction

Between July 31st and August 4th, 2019, one monitoring well was installed and two additional boreholes were drilled for solids analyses in the Southern Plume Area (Southern Area) at the Homestake Grants Reclamation Project Site (Site) (Figure 1). All work was performed according to the *2019 Supplemental Tailings and Alluvial Characterization Work Plan* (WME, 2019) which describes the proposed monitoring well installation and sampling collection objectives for the 2019 investigation.

2.0 Monitoring Well Drilling and Installation

One new monitoring well (Q51) was drilled and installed in the San Mateo alluvium in the Southern Area. The borehole was drilled by Yellow Jacket Drilling Services (Phoenix, AZ) using a CME auger rig with 8-inch diameter hollow stem augers. Drill cuttings were collected with a 3-inch diameter 5-foot long continuous split spoon.

The well was completed with flush-threaded 4 inch schedule 40 PVC pipe. The well screen is 30 feet long with 0.010 slot size. Filter pack material consists of clean 10-20 silica sand. At least 3 feet of time-release bentonite pellets were placed on top of the sand pack to ensure proper seal. The borehole was sealed with a high-solids bentonite grout and finished with bentonite chips. The surface completion for the well consists of an 8 inch diameter steel protective casing with a locking lid and a cement pad. Table 1 provides construction information for the new monitoring well. A well completion diagram is provided in Attachment A and field notes are provided in Attachment B.

Table 1: Well Completion Information.

Well ID	Latitude	Longitude	Completion Lithology	Total Depth (ft TOC)	Top of Screen (ft TOC)
Q51	35°13’13.55"N	107°52’02.71"W	San Mateo Alluvium	76.0	46.0

3.0 Alluvium Lithology

The San Mateo alluvium is very heterogeneous with lithologies ranging from predominantly lean, stiff clay to predominantly unconsolidated sand and gravel with cobbles found near the alluvial bedrock interface. Detailed lithologic logs for the underlying alluvium at each borehole are provided

in Attachment C and the geophysical logs are presented in Attachment D. Results from downhole geophysical logging were consistent with and confirmed observations made during drilling with respect to variations in texture, and moisture. A brief summary of the lithology in each borehole is provided below:

- Q51: The upper 40 feet of alluvium in well Q51 is mostly loose, dry sands, silts, and gravels. A one-foot interval of lean, stiff clay is picked up on the neutron log between 40 and 45 feet. This is the only clay layer at this location. The water table is seen at 50 feet. Below the water table, the lithology is dominantly sands and gravels.
- WME-23: The upper portion of the alluvium at this location is dominated by fine, loose, dry sands and silts. Lean, stiff, clay layers were observed between 14 and 15 feet and between 21 and 23 feet. The water table is at 55 feet. A thick clay layer is observed from 51 feet to 58 feet. Sands and gravels dominate the remaining lithology.
- WME-24: Like WME-23, the upper portion of the alluvium in WME-24 is dominated by fine, loose, dry silty sands and sand. The only lean, stiff clay layer encountered in the borehole was between 24 and 25 feet and is not very distinguishable on the geophysical logs. Groundwater was encountered at 65 feet and is confirmed by the neutron log. The lower portion of the borehole is dominated by coarse sands and gravels.

4.0 Monitoring Well Development

The Q51 monitoring well was allowed to sit for at least 24 hours before development. The monitoring well was developed by Yellow Jacket Drilling Services. Wells were surged with a surge block, bailed with a PVC bailer. Approximately 50 gallons of water was removed from the well and put in a container for safe disposal. The well was nearly bailed dry. No fines remained in the well.

5.0 References

Worthington Miller Environmental LLC (WME). 2019. 2019 Supplemental Tailings and Alluvial Characterization Work Plan. Prepared for Homestake Mining Company of California. April.

Figures

WORTHINGTON
MILLER
ENVIRONMENTAL, LLC.

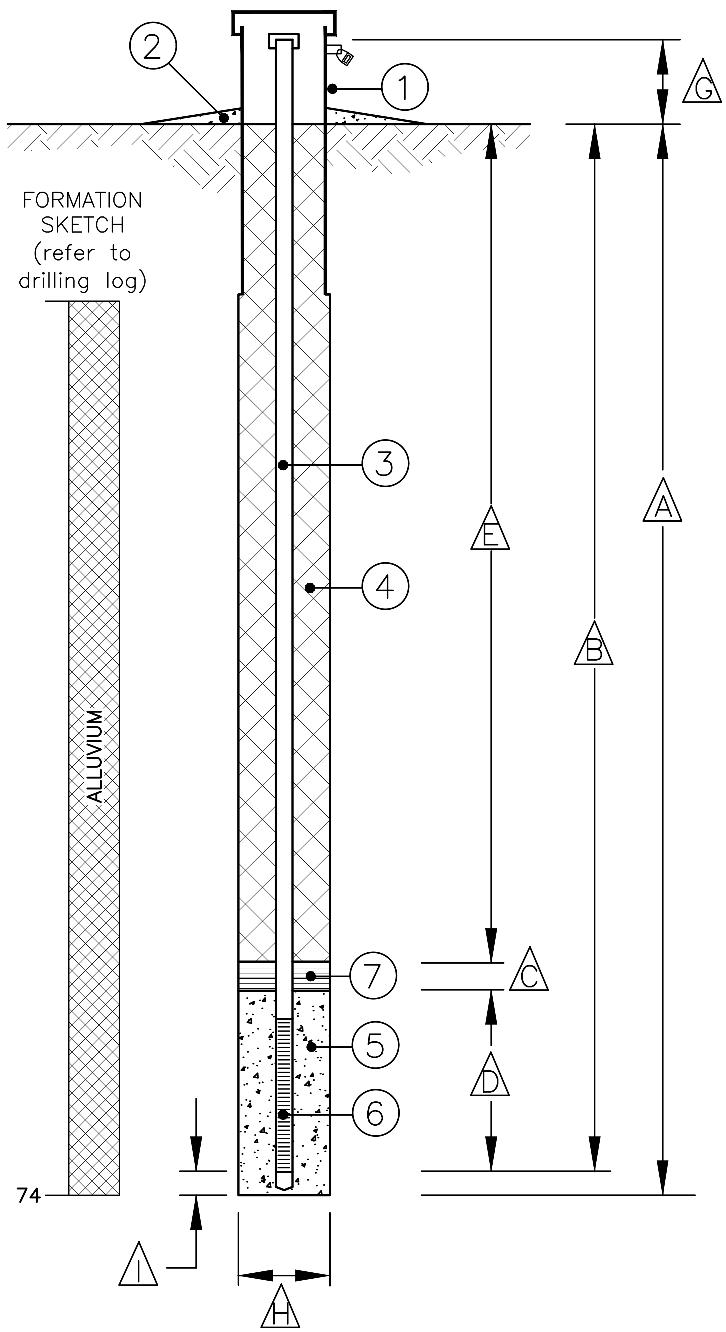
FIGURE 1
SOUTHERN BOREHOLE AND MONITORING WELL LOCATIONS

Date:	August 2019
Project:	HOMESTAKE
File:	BH-LOCATIONS-01

Attachment A

Q51

MONITORING WELL CONSTRUCTION INFORMATION SHEET



Project HOMESTAKE GRP

Well number Q51

Date 08-07-2019

Drilling company YELLOW JACKET

Location SOUTHERN AREA

Date drilled 07-31-2019

Date completed 08-02-2019

Materials:

1. Protective casing? (Yes) No
   Height above ground 2.5 ft
   Type STEEL Length 5' Dia. 8"
2. Cement pad? (Yes) No
3. Solid pipe: Type PVC Length 46' Dia. 4"
4. Seal type: HIGH SOLIDS BENTONITE GROUT
5. Filter pack: 10-20 SILICA SAND
6. Well screen: Type PVC Length 30' Dia. 4"
   Slot size 0.010
7. Seal type: COATED BENTONITE PELLETS

Dimensions:

A	Total depth of boring	74	ft
B	Total depth of finished well	73.6	ft
C	Seal: Interval	36-39	ft
D	Filter pack: Interval	39-74	ft
E	Seal: Interval	0-36	ft
G	Height of stick-up	2.0	ft
H	Borehole diameter	8.0	in
I	Length of endcap	0.3	ft

Attachment B

WEDNESDAY JULY 31, 2019
SOUTHERN AREA
BORINGS & Q51 WELL.

0450 LEAVE TELLURIDE.
1020 ARRIVE @ SITE.
1030 REVIEW SAFETY PLAN.
1130 MOBILIZE TO Q51
1140 BREAK FOR LUNCH
1230 SAFETY MEETING.
1300 TOWER UP
1321 SPUD IN WELL Q51
1330 DOWN FOR REPAIR.
1530 TOWER BACK UP.
1538 0'-5': SANDY SILT w/ TRACE GRAVEL. DRY. GREENISH GRAY.
1600 ~~10~~ 5'-10' SAME AS ABOVE.
10'-15' NO RETURNS.
-SILT.
1620 15'-20' GRAVELLY SANDY SILT. LOOSE. DRY. POORLY GRADED. DRY, LIGHT BROWN.
1630 20'-25' SAME AS ABOVE.

WEDNESDAY JULY 31. 2019
SOUTHERN AREA - Q51
16:40 25'-30': VERY FINE SAND. LOOSE. POORLY SORTED. DRY. REDDISH BROWN.
16:50 30'-35': FINE SAND w/ TRACE CLAY & GRAVEL. LOOSE. DRY. WELL SO
17:00 35'-40': FINE SAND w/ GRAVEL. LOOSE. DRY. WELL GRADED. LIGHT REDDISH BROWN.
17:10 SCAN OUT... LEAVE SITE.

~~WEDNESDAY~~ THURSDAY AUGUST 1, 2019
@ 51

0615 ARRIVE @ OFFICE - SIGN IN
0630 SAFETY MEETING.
0700 START DRILLING @ 40' BGS.
0705 40'-44': GRAVELLY SAND.
LOOSE. WELL GRADED.
GRAVEL UP TO 1" DIAMETER
MOIST. LIGHT BROWN.
0707 44-45': CLAY. DENSE. LEAN.
MOIST. DARK REDDISH BROWN.
0720 45'-48': V. FINE SANDY SILT.
LOOSE. V. POORLY GRADED.
MOIST. REDDISH BROWN.
0722 48-50' GRAVELLY SAND. WELL GRADED
LOOSE. MEDIUM BROWN.
WET.
1740 48'-55' SAME AS ABOVE
0800 HEAVING SANDS IN STEM.
0810 CORE BARREL SUB BROKEN
WHEN STUCK IN HOLE.
NO RETURNS 55-60'
USE SMALLER SPLIT SPOONS
TO CONTINUE... DRILLER
CALLS FOR NEW SUB.

THURSDAY AUGUST 1, 2019
@ 51

0845 60-65 : GRAVELLY SAND.
LOOSE. WELL GRADED.
WET. MEDIUM BROWN.
0915 65'-70': SAME AS ABOVE.
0930 DRILLER'S HELPER LEAVES
TO GET REPLACEMENT SUB
FOR CONTINUOUS CORE
BARREL. USING 18" SPLIT
SPOON TO CONTINUE.
1010 70'-75': SAME AS ABOVE.
W/ TRACE CLAY. STIFF.
1020 SPLIT SPOON @ REFUSAL
@ 73'. BEDROCK?
GOING IN W/ ROCK CORE.
1040 REFUSAL @ 74' BGS.
NO BEDROCK SAMPLE
COLLECTED. REFUSAL
1050 PULL 6" AUGERS
1130 LUNCH BREAK
1200 GO IN W/ 8-INCH AUGERS.
1250 PREPARE TO SET WELL
1330 SHUT DOWN FOR LIGHTENING.

Q51

Depth	Moisture	Lithology	Sample Volume
1–10		Sandy Silt w/ Trace Gravel	1 Gal. (1–5); 2 Gal. (6–10)
11–15	Dry	No Returns	0 Gal.
16–23		Gravelly Sandy Silt	1.5 Gal

Q51

Depth	Moisture	Lithology	Sample Volume
24–25		Gravelly Sand Silt	
26–30		Very Fine Sand	1 Gal.
31–35	Dry	V. Fine Sand w/ Trace Clay + Gravel	1.5 Gal.
36–40		Fine Sand Trace Gravel	1 Gal.
41–44	Moist	Gravelly Sand	3/4 Gal.
45		Stiff Clay	1 Gal.
46		Sandy Silt	< 1 Gal

QS1

DEPTH		LITHOLOGY	SAMPLE VOLUME
47	MOIST	V. FINE SANDY SILT	
48			
49	WET	GRAVELLY SAND	1 GAL.
50			
51			
52			
53			
54			
55			
56		NO RETURNS	0 GAL.
57			
58			
59			
60			
61		GRAVELLY SAND	1 GAL
62			
63			
64			
65			
66			1 GAL.
67			
68			
69			

QS1

DEPTH		LITHOLOGY	SAMPLE VOLUME
70	WET	GRAVELLY SAND	1/2 GAL.
71			
72			
73			
74		T.D.	
75		REFUSAL - BEDROCK	

THURSDAY AUGUST 1, 2019
QS1

1500 RESUME SETTING WELL
1515 WELL SET TO 74' BGS
1550 SAND TO 39' BGS.
1600 PELLETS TO 36' BGS.
1601 LIGHTENING... SHUT DOWN FOR DAY.

FRIDAY AUGUST 2, 2019
QS1 & WME-23

0615 ARRIVE @ OFFICE
0640 SAFETY MEETING
- WEATHER/LIGHTENING PROBABLE!
0650 PULL AUGERS
PRE PARE TO GROUT HOLE.
0810 MOBILIZE TO WME-23
0824 TOWER UP ON WME-23.
0835 SPUD IN WME-23.
0838 0'-5': SILTY SAND w/ TRACE CLAY. DRY. LOOSE. POORLY GRADED. REDDISH BROWN.
0845 5'-10': V. FINE SANDY SILT. LOOSE. DRY. POORLY GRADED. LIGHT BROWN.
0900 10'-13': FINE SAND. LOOSE. DRY. TRACE GRAVEL. LIGHT YELLOWISH BROWN.
0901 13'-14': CLAY. V. STIFF. MOTTLED. DRY. DARK BROWN.

FRIDAY AUGUST 2, 2019
WME-23

0902 14'-15' : SILT. LOOSE.
DRY. V. WELL SORTED.
YELLOWISH-BROWN.

0920 15'-20' : SAME AS ABOVE.

0945 20'-21' SAME AS ABOVE.

0946 21'-23' : CLAY. STIFF. DRY.
FRIABLE. MOTTLED.
DARK REDDISH BROWN.

0947 23'-25' : SILTY SAND. LOOSE
DRY. V. FINE-MED.
LIGHT REDDISH BROWN.

1000 25'-27' : SAME AS ABOVE.

1001 27'-30' : V. FINE SILTY SAND.
LOOSE. DRY. VERY
WELL SORTED. REDDISH
BROWN.

1011 30'-35' : SAME AS ABOVE.

1025 35'-37' : GRAVELLY SAND.
LOOSE. MOIST.
VERY POORLY SORTED.
GRAVEL UP TO 2" DIA.
LIGHT BROWN.

FRIDAY AUGUST 2, 2019
WME-23

1026 ~~ST~~ 37'-40' : SILTY SAND
w/ TRACE CLAY. LOOSE.
MOIST. IRON STAINING.
LIGHT YELLOWISH BROWN.

1035 40'-44' : VERY FINE SILTY
SAND. LOOSE. MOIST.
TRACE GRAVEL. TRACE
CLAY. LIGHT YELLOWISH
BROWN.

1036 44'-45' : GRAVELLY SAND.
LOOSE. MOIST.
GRAVEL UP TO 1" DIA.
MEDIUM BROWN.

1050 45'-50' : SAME AS ABOVE.

1105 50'-51' : FINE SAND. LOOSE.
WET. VERY WELL SORTED.
LIGHT BROWN.

1106 51'-55' : CLAY. VERY STIFF.
MOIST. HIGH PLASTICITY.
DARK RED.

1115 55-58 : SAME AS ABOVE.

FRIDAY AUGUST 2, 2019
WME-23

1116 58-60 GRAVELLY SAND. LOOSE. WET. VERY POORLY SORTED. DARK RED.
1135 60'-65' : SAME AS ABOVE.
1150 65-70' : GRAVELLY SAND w/ COBBLES UP TO 4" DIA. TRACE CLAY. WET. LOOSE. VERY POORLY SORTED. MED. DARK BROWN.
1210 LIGHTENING - SHUT DOWN.
1330 ALL CLEAR - RESUME
1340 70'-75' : SAME AS ABOVE
1405 75-79 : SAME AS ABOVE.
1406 79-79.5 - DECOMPOSED CHINLE Fm. FRACTURED SANDSTONE AND DECOMPOSED CLAYS. MOTTLING. IRON STAINING. DARK REDDISH BROWN.

FRIDAY AUGUST 2, 2019
WME-23

1410 GO IN w/ SPLIT SPOON CORE TO ATTEMPT TO SAMPLE UPPER CHINLE Fm.
1420 MOSTLY ALLUVIUM IN BARREL. SMALL AMOUNT OF CHINLE RECOVERED.
1422 RETRY CHINLE SAMPLE.
1428 HEAVING SAND IN BOTTOM. NO SAMPLE.

@0851 T.D. = 73.6' BGS
DTW = 49.80' BGS

SATURDAY AUGUST 3, 2019
WME-24

0630 ARRIVE @ WME-23.
0635 SAFETY MEETING.
- MOBILIZATION
- WEATHER/LIGHTENING.
0710 MOBILIZE TO WME-24
0720 SPUD IN WME-24
0728 0'-5': VERY FINE SILTY SAND. LOOSE-SLIGHTLY DENSE. DRY. TRACE ROOTS. WELL SORTED. DARK Z GAL. YELLOWISH BROWN.
0735 5'-10': VERY FINE SILTY SAND W/ TRACE GRAVEL. LOOSE. DRY. POORLY SORTED. DARK YELLOWISH BROWN. 1.5 GAL. COLLECTED.
0800 ~~10'-15~~ 10'-15' SAME AS ABOVE.
0815 15'-18': SAME AS ABOVE. ABUNDANT VOLCANIC COBBLES.
0816 18'-20': VERY FINE SAND W/ SILT. LOOSE. DRY. VERY WELL SORTED. YELLOWISH BROWN.

SATURDAY AUGUST 3, 2019
WME-24

0830 20'-22': SAME AS ABOVE
0831 22'-24': GRAVELLY CLAYEY SAND. LOOSE-SLIGHTLY DENSE. VERY POORLY SORTED. "MIXED BAG". GRAVEL UP TO 2". MOTTLED CLAY. DRY.
~~0832 24'-25'~~ YELLOWISH BROWN.
0832 24'-25' CLAY. LEAN. MED. DENSE. DRY. SLIGHTLY FRIABLE. LIGHT REDDISH BROWN.
0838 25'-30': ~~GRAVELLY~~ FINE SAND W/ SOME GRAVEL. GRAVEL UP TO 2" DIA. WELL SORTED SAND. LOOSE. DRY. YELLOWISH BROWN.
0845 30'-35': GRAVELLY SAND. LOOSE. DRY. VERY POORLY SORTED. GRAVEL UP TO 3" DIAMETER. LIGHT BROWN.

SATURDAY AUGUST 3, 2019
WME 24

0905 35-36' VERY COARSE SANDY GRAVEL w/ TRACE COBBLES LOOSE. DRY. DARK GRAY.
0906 36'-40': FINE SAND. LOOSE. DRY. VERY WELL SORTED. LIGHT YELLOWISH BROWN.
0915 40'-45': SAME AS ABOVE
0930 45'-50' FINE-MEDIUM SAND w/ SOME GRAVEL UP TO 2" DIAMETER. LOOSE. DRY POORLY SORTED. LIGHT YELLOWISH BROWN.
0942 50'-55' SAME AS ABOVE
0955 55'-60' SAME AS ABOVE w/ SLIGHT MOISTURE.
1011 60'-65': SAME AS ABOVE. WET @ 64'.
1020 FISHING FOR CORE BARREL.
1100 BARREL OUT
1102 65'-70': SAME AS ABOVE WET!

SATURDAY AUGUST 3, 2019
WME-24

1119 70'-75': SAME AS ABOVE
1139 75'-76': FINE SAND w/ SOME CLAY. LOOSE. SOFT. WET. VERY WELL SORTED. MEDIUM BROWN.
1140 76'-80': VERY COARSE SAND w/ ABUNDANT GRAVEL UP TO 2" DIAMETER. LOOSE. WET. VERY POORLY SORTED. MEDIUM BROWN, BLACK & WHITE.
1155 80'-85' SAME AS ABOVE.
1305 85'-88': MEDIUM SAND. LOOSE. WET VERY WELL SORTED. MEDIUM BROWN.
1306 88'-90' COARSE SAND w/ TRACE GRAVEL. TRACE CLAY. LOOSE. SOFT. WET.
1340 90'-95' SAME AS ABOVE. DECOMPOSED CHINLE @ 95'

SATURDAY AUGUST 3, 2019

WME-24

1410 95'-100': CHINLE FORMATION.
CLAYSTONE. DENSE.
GREASY/SMEARS.
VERY SLIGHT MOISTURE
TO DRY. LIGHT GRAY.
MOTTLED.

1420 100'-105' CHINLE FORMATION
SAME AS ABOVE.

T.D. @ 105'.

1520 PVC IN TO 105'.

1530 LIGHTEN OVERHEAD.
STORM APPROACHING.

1535 LEAVE SITE.

SUNDAY AUGUST 4, 2019

WME-24

0730 ARRIVE @ SITE.
VERY MUDDY.

0735 SAFETY MEETING

0745 BEGIN PULLING AUGERS.

0930 AUGERS OUT.

0945 MOBILIZE TO Q51
FOR DEVELOPEMENT.

1000 @ Q51 DTW = 49.80'
START SURGE AND BAIL

1100 50 GALLONS REMOVED.
NO FINES IN BAILER.
DTW = 68.00' BGS.

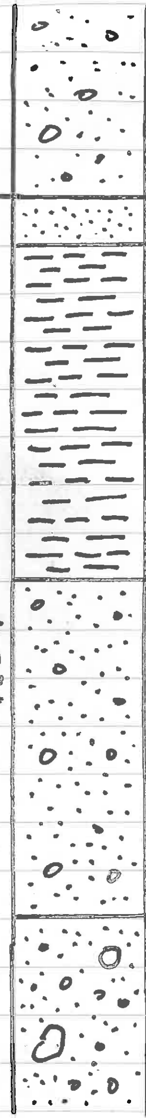
WME-23

Depth	Moisture	Lithology	Sample Volume
1–5	Dry	Silty Sand w/ Trace Clay	2 Gal
6–10	Dry	V. Fine Sandy Silt	2 Gal
11–13	Dry	Fine Sand	3/4 Gal
14	Dry	Stiff Clay	1 Gal
15–21	Dry	Silt	1 Gal
22–23	Dry	Stiff Clay	1 Gal

WME-23

Depth	Moisture	Lithology	Sample Volume
24–27	Dry	Silty Sand	3/4 Gal 1/2 Gal
28–35	Dry	V. Fine Silty Sand	1.5 Gal
36–37	Moist	Gravelly Sand	1/2 Gal
38–40	Moist	Silty Sand w/ Trace Gravel	1 Gal
41–44	Moist	V. Fine Silty Sand	1.5 Gal
45–46	Moist	Gravelly Sand	

WME-23



Depth		Lithology	Sample Volume
47		Gravelly Sand	1 Gal
48			
49			
50	▼		
51		Fine Sand	1/2 Gal
52		Very Stiff Clay	4 Gal
53			
54			
55			
56			
57			
58			
59	WET	Gravelly Sand	2.5 Gal
60			
61			
62			
63			
64			
65			
66		Gravelly Sand w/ Cobbles	
67			
68			
69			

WME-23

Depth		Lithology	Sample Volume
70	WET	Gravelly Sand w/ Cobbles	5 Gal
71			
72			
73			
74			
75			
76			
78			
79			
80		Chinle Fm.	
		T.D.	8 oz.

WME-24

DEPTH		LITHOLOGY	SAMPLE VOLUME
1			
2		V. FINE	
3		SILTY	2 GAL
4		SAND	
5			
6			
7			
8			
9		V. FINE	
10		SILTY	3 1/2
11		SAND	GAL
12	[illegible]	w/ TRACE	
13		GRAVEL	
14			
15			
16			
17			
18			
19			
20		V. FINE	2
21		SILTY SAND	GAL
22			
23		CLAY, GRAVEL, SAND	1/2 GAL

WME-24

DEPTH		LITHOLOGY	SAMPLE VOLUME
24		CLAY, GRAVEL, SAND	
25		STIFF CLAY	1/4 GAL
26			
27		FINE SAND	1
28		w/ SOME	GAL
29		GRAVEL	
30			
31			
32		GRAVELLY	1
33		SAND	GAL
34			
35			
36	[illegible]	COARSE GRAVEL	1/4 GAL
37			
38			
39			
40		FINE	2
41		SAND	GAL
42			
43			
44			
45			
46		SAND w/ GRAVEL	

WME-24

DEPTH		LITHOLOGY	SAMPLE VOLUME
47	DRY	SAND w/GRAVEL	3.5 GAL
48			
49			
50			
51			
52			
53			
54			
55			
56	MOIST		4 GAL
57			
58			
59			
60			
61			
62			
63			
64 ▼			
65	WET		2 GAL
66			
67			
68			
69			

WME-24

DEPTH		LITHOLOGY	SAMPLE VOLUME
70	WET	SAND w/GRAVEL	2 GAL
71			
72			
73			
74			
75			
76		FINE SAND w/CLAY	1/2 GAL
77		COARSE SAND AND GRAVEL	4 GAL
78			
79			
80			
81			
82			
83			
84			
85			
86		MEDIUM SAND	1 GAL
87			
88			
89		COARSE SAND w/ TRACE GRAVEL & CLAY	
90			
91			
92			

WME-24

DEPTH		LITHOLOGY	SAMPLE VOLUME
93	WET	COARSE SAND	3
94		w/ TRACE	GAL
95		GRAVEL & CLAY	
96	DRY		
97			
98			
99		CHINLE	4+
100		Fm.	GAL
101		CLAYSTONE	
102			
103			
104			
105			
		T.D.	

MONDAY AUGUST 5, 2019

SOUTHERN AREA GEOPHYSICS.

0730 ARRIVE @ SITE.
MEET TOM STAATZ
w/ JET WEST.
0745 @ QS1 - SET-UP.
1120 QS1 LOG COMPLETE
1125 SET UP ON WME-25

Attachment C

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

DATE: 08/07/19

BOREHOLE NO.: Q51

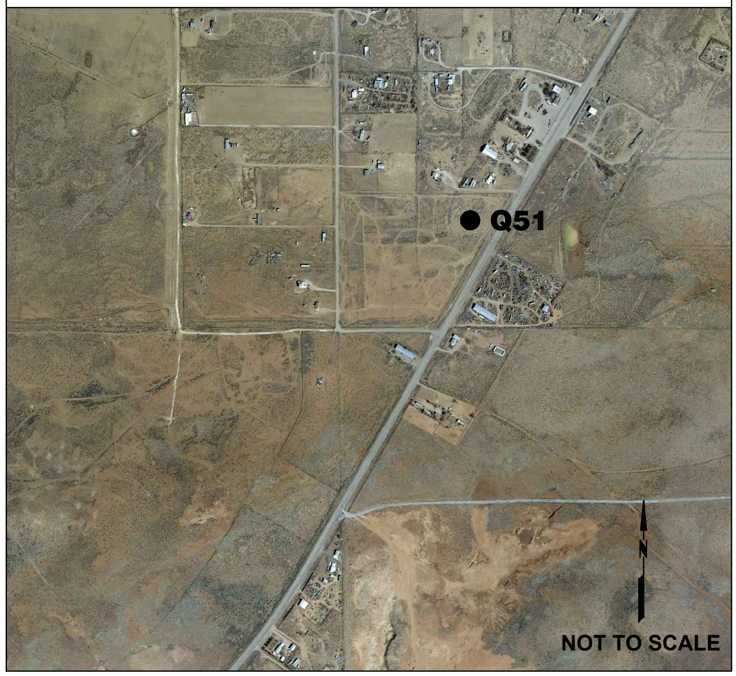
PROJECT INFORMATION

PROJECT: GRANTS RECLAMATION PROJECT

CLIENT: HOMESTAKE MINING COMPANY

LOCATION: GRANTS, NEW MEXICO

BOREHOLE LOCATION



FIELD INFORMATION

BOREHOLE LOGGED BY: ROB NOBLE

SAMPLING METHOD: CONTINUOUS CORE
SPLIT SPOON

DRILLING INFORMATION

DRILLING COMPANY: YELLOW JACKET DRILLING

DRILLER: STEVE LARA

START DATE/TIME: JULY 31, 2019 @ 15:30

DRILLING COMPLETION DATE/TIME: AUGUST 1, 2019 @ 10:40

BORING DEPTH: 74' BGS

BORING DIA.: 8-INCH

DRILLING METHOD: AUGER

BOREHOLE COMPLETION INFORMATION

WELL I.D.: NO WELL COMPLETION - BORING ONLY.

START DATE/TIME: AUGUST 1, 2019 @ 12:50

COMPLETE TIME: AUGUST 2, 2019 @ 08:00

ELEVATION - TOP OF BORING:

SCREENED INTERVAL: 44' - 74' BGS

GROUNDWATER CONDITIONS

DTW = 49.80'

NOTES:

WORTHINGTON
MILLER
ENVIRONMENTAL, LLC.

BOREHOLE LOG

PROJECT: GRANTS RECLAMATION PROJECT **PAGE:** 2 OF 5

CLIENT: HOMESTAKE MINING COMPANY **DATE:** 08/07/19

BOREHOLE NO.: **Q51**

TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
0		**0 - 10': SILTY SAND WITH TRACE GRAVEL** LOOSE, DRY, GREENISH GRAY.
2		
4		
6		
8		
10		**10' - 15': NO RETURNS**
12		
14		
16		**15' - 25': GRAVELLY SANDY SILT** LOOSE, DRY, WELL SORTED, LIGHT BROWN.
18		
20		

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

BOREHOLE NO.: **Q51**

PROJECT: *GRANTS RECLAMATION PROJECT* **PAGE:** *3 OF 5*

CLIENT: *HOMESTAKE MINING COMPANY* **DATE:** *08/07/19*

TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
20–25		**15' - 25': GRAVELLY SANDY SILT** LOOSE, DRY, WELL SORTED, LIGHT BROWN.
25–30		**25' - 30': VERY FINE SAND** LOOSE, DRY, POORLY SORTED, REDDISH BROWN.
30–35		**30' - 35': FINE SAND WITH TRACE CLAY AND GRAVEL** LOOSE, DRY, WELL SORTED, REDDISH BROWN.
35–40		**35' - 40': FINE SAND WITH SOME GRAVEL** LOOSE, DRY, POORLY SORTED, LIGHT REDDISH BROWN.

Depth scale: 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

PROJECT: *GRANTS RECLAMATION PROJECT* **PAGE:** *4 OF 5*

CLIENT: *HOMESTAKE MINING COMPANY* **DATE:** *08/07/19*

BOREHOLE NO.: **Q51**

TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
40 – 44		**40' - 44': GRAVELLY SAND** LOOSE, MOIST, POORLY SORTED, GRAVEL UP TO 1" DIAMETER, LIGHT BROWN.
44 – 45		**44' - 45': CLAY** STIFF, LEAN, MOIST, DARK REDDISH BROWN.
45 – 48		**45' - 48': VERY FINE SANDY SILT** LOOSE, WELL SORTED, MOIST, REDDISH BROWN.
48 – 55		**48' - 55': GRAVELLY SAND** LOOSE, WET, POORLY SORTED, MEDIUM BROWN.
55 – 60		**55' - 60': NO RETURNS**

WORTHINGTON
MILLER
ENVIRONMENTAL, LLC.

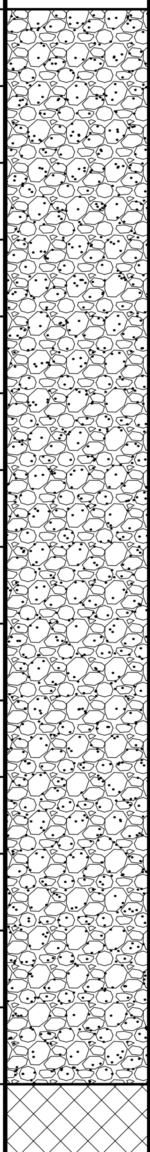
BOREHOLE LOG

PROJECT: GRANTS RECLAMATION PROJECT **PAGE:** 5 OF 5

CLIENT: HOMESTAKE MINING COMPANY **DATE:** 08/07/19

BOREHOLE NO.: **Q51**

TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
60 – 74		**60' - 74': GRAVELLY SAND** LOOSE, WET, POORLY SORTED, BROWN.
74 – 75		**74' - 75': CHINLE FORMATION**, QUARTZITE SANDSTONE VERY DENSE, DRY, LIGHT GRAY.



Depth scale (FT): 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80

WORTHINGTON
MILLER
ENVIRONMENTAL, LLC.

BOREHOLE LOG

DATE: 08/08/19

BOREHOLE NO.: **WME-23**

PROJECT INFORMATION

PROJECT: GRANTS RECLAMATION PROJECT

CLIENT: HOMESTAKE MINING COMPANY

LOCATION: GRANTS, NEW MEXICO

BOREHOLE LOCATION

FIELD INFORMATION

BOREHOLE LOGGED BY: ROB NOBLE

SAMPLING METHOD: CONTINUOUS CORE
SPLIT SPOON

DRILLING INFORMATION

DRILLING COMPANY: YELLOW JACKET DRILLING — DRILLER: STEVE LARA

START DATE/TIME: AUGUST 2, 2019 @ 08:35

DRILLING COMPLETION DATE/TIME: AUGUST 2, 2019 @ 14:30

BORING DEPTH: 80' BGS — BORING DIA.: 8-INCH

DRILLING METHOD: AUGER

BOREHOLE COMPLETION INFORMATION

WELL I.D.: NO WELL COMPLETION - BORING ONLY.

START DATE/TIME: — COMPLETE TIME:

ELEVATION - TOP OF BORING: — SCREENED INTERVAL:

GROUNDWATER CONDITIONS

NOTES:

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BOREHOLE LOG

PROJECT: *GRANTS RECLAMATION PROJECT* **PAGE:** *2 OF 5*

CLIENT: *HOMESTAKE MINING COMPANY* **DATE:** *08/08/19*

BOREHOLE NO.: **WME-23**

TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
0 – 5		**0 - 5': SILTY SAND WITH TRACE CLAY** LOOSE, DRY, WELL SORTED, REDDISH BROWN.
5 – 10		**5' - 10': VERY FINE SANDY SILT** LOOSE, DRY, WELL SORTED, LIGHT BROWN.
10 – 13		**10' - 13': FINE SAND** LOOSE, DRY, WELL SORTED, LIGHT YELLOWISH BROWN.
13 – 14		**13' - 14': CLAY** VERY STIFF, LEAN, DRY, MOTTLED, DARK BROWN.
14 – 20		**14' - 21': SILT** LOOSE, DRY, VERY WELL SORTED, YELLOWISH BROWN.

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

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BOREHOLE LOG

PROJECT: *GRANTS RECLAMATION PROJECT* **PAGE:** *3 OF 5*

CLIENT: *HOMESTAKE MINING COMPANY* **DATE:** *08/08/19*

BOREHOLE NO.: **WME-23**

TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
20 – 21		**14' - 21': SILT** LOOSE, DRY, VERY WELL SORTED, YELLOWISH BROWN.
21 – 23		**21' - 23': CLAY** STIFF, LEAN, DRY, FRIABLE, MOTTLED, DARK REDDISH BROWN.
23 – 27		**23' - 27': SILTY SAND** LOOSE, DRY, VERY FINE TO MEDIUM SAND, LIGHT REDDISH BROWN.
27 – 35		**27' - 35': VERY FINE SILTY SAND** LOOSE, DRY, VERY WELL SORTED, REDDISH BROWN.
35 – 37		**35' - 37': GRAVELLY SAND** LOOSE, MOIST, VERY POORLY SORTED, GRAVEL UP TO 2" DIAMETER, LIGHT BROWN.
37 – 40		**37' - 40': SILTY SAND WITH TRACE CLAY** LOOSE, MOIST, IRON STAINING, LIGHT YELLOWISH BROWN.

Depth scale: 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

PROJECT: *GRANTS RECLAMATION PROJECT* **PAGE:** *4 OF 5*

CLIENT: *HOMESTAKE MINING COMPANY* **DATE:** *08/08/19*

BOREHOLE NO.: **WME-23**

TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
40		**40' - 44': VERY FINE SILTY SAND** LOOSE, MOIST, TRACE GRAVEL, TRACE CLAY, LIGHT YELLOWISH BROWN.
42		
44		**44' - 50': GRAVELLY SAND** LOOSE, MOIST, POORLY SORTED, GRAVEL UP TO 1" DIAMETER, MEDIUM BROWN.
46		
48		
50		**50' - 51': FINE SAND** LOOSE, WET, VERY WELL SORTED, LIGHT BROWN.
		51' - 58': CLAY VERY STIFF, LEAN, MOIST, HIGH PLASTICITY, DARK RED.
52		
54		
56		
58		**58' - 65': GRAVELLY SAND** LOOSE, WET, VERY POORLY SORTED, DARK RED.
60		

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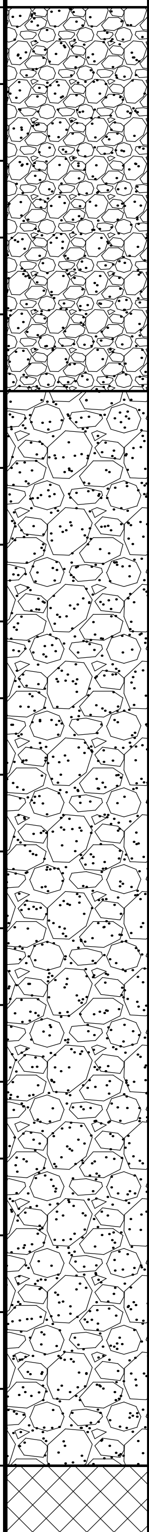
BOREHOLE LOG

PROJECT: *GRANTS RECLAMATION PROJECT* **PAGE:** *5 OF 5*

CLIENT: *HOMESTAKE MINING COMPANY* **DATE:** *08/08/19*

BOREHOLE NO.: **WME-23**

TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
60, 62, 64		**58' - 65': GRAVELLY SAND** LOOSE, WET, VERY POORLY SORTED, DARK RED.
66, 68, 70, 72, 74, 76, 78		**65' - 79': GRAVELLY SAND WITH COBBLES UP TO 4" DIAMETER** TRACE CLAY, LOOSE, WET, VERY POORLY SORTED, MEDIUM DARK BROWN.
80		**79' - 80': CHINLE FORMATION.**



WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

DATE: 08/08/19

BOREHOLE NO.: **WME-24**

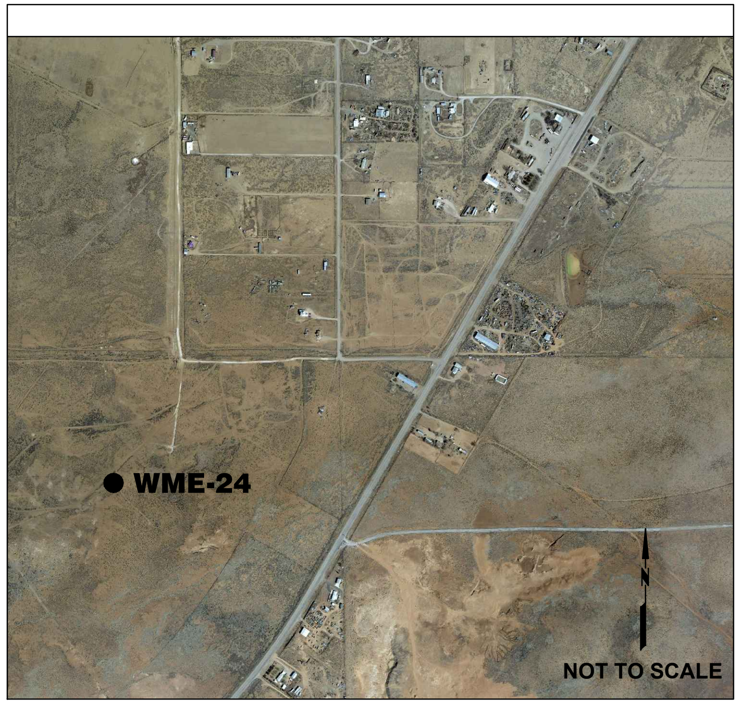
PROJECT INFORMATION

PROJECT: GRANTS RECLAMATION PROJECT

CLIENT: HOMESTAKE MINING COMPANY

LOCATION: GRANTS, NEW MEXICO

BOREHOLE LOCATION



FIELD INFORMATION

BOREHOLE LOGGED BY: ROB NOBLE

SAMPLING METHOD: CONTINUOUS CORE

SPLIT SPOON

DRILLING INFORMATION

DRILLING COMPANY: YELLOW JACKET DRILLING

DRILLER: STEVE LARA

START DATE/TIME: AUGUST 3, 2019 @ 07:20

DRILLING COMPLETION DATE/TIME: AUGUST 3, 2019 @ 14:20

BORING DEPTH: 105' BGS

BORING DIA.: 8-INCH

DRILLING METHOD: AUGER

BOREHOLE COMPLETION INFORMATION

WELL I.D.: NO WELL COMPLETION - BORING ONLY.

START DATE/TIME:

COMPLETE TIME:

ELEVATION - TOP OF BORING:

SCREENED INTERVAL:

GROUNDWATER CONDITIONS

NOTES:

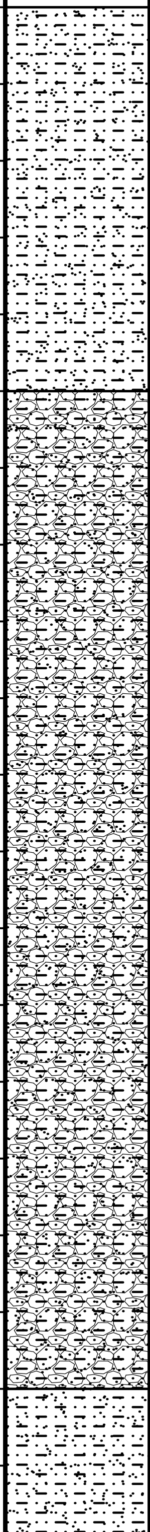
WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

PROJECT: *GRANTS RECLAMATION PROJECT* **PAGE:** *2 OF 6*

CLIENT: *HOMESTAKE MINING COMPANY* **DATE:** *08/08/19*

BOREHOLE NO.: **WME-24**

TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
0 – 5		**0 - 5': VERY FINE SILTY SAND** LOOSE TO SLIGHTLY DENSE, DRY, TRACE ROOTS, WELL SORTED, DARK YELLOWISH BROWN.
5 – 18		**5' - 18': VERY FINE SILTY SAND WITH TRACE GRAVEL** LOOSE, DRY, WELL SORTED, DARK YELLOWISH BROWN.
18 – 20		**18' - 22': VERY FINE SAND WITH TRACE SILT** DRY, VERY WELL SORTED, YELLOWISH BROWN.

Depth scale (ft): 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

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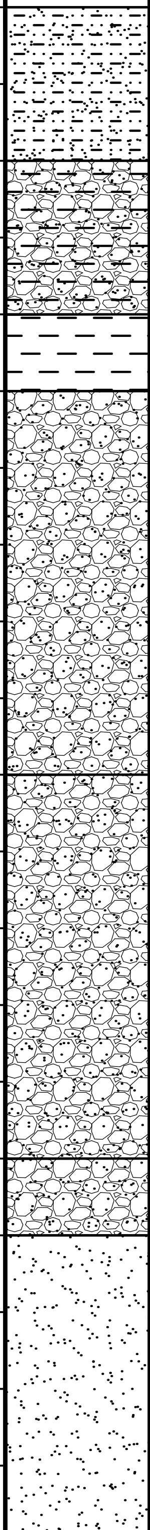
BOREHOLE LOG

PROJECT: *GRANTS RECLAMATION PROJECT* **PAGE:** *3 OF 6*

CLIENT: *HOMESTAKE MINING COMPANY* **DATE:** *08/08/19*

BOREHOLE NO.: **WME-24**

TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
20		**18' - 22': VERY FINE SAND WITH TRACE SILT** DRY, VERY WELL SORTED, YELLOWISH BROWN.
22		**22' - 24': GRAVELLY CLAYEY SAND** LOOSE TO SLIGHTLY DENSE, VERY POORLY SORTED, GRAVEL UP TO 2" DIAMETER, ,OTTLED CLAY, DRY, YELLOWISH BROWN.
24		**24' - 25': CLAY** LEAN, MEDIUM STIFF, LOW PLASTICITY, SLIGHTLY FRIABLE, DRY, LIGHT REDDISH BROWN.
26, 28		**25' - 30': FINE SAND WITH GRAVEL UP TO 2" DIAMETER** WELL SORTED SAND, LOOSE, DRY, YELLOW BROWN.
30, 32, 34		**30' - 35': GRAVELLY SAND** LOOSE, DRY, VERY POORLY SORTED, GRAVEL UP TO 3" DIAMETER, LIGHT BROWN.
		30' - 36': VERY COARSE SANDY GRAVEL WITH TRACE COBBLES LOOSE, DRY, DARK GRAY.
36, 38, 40		**36' - 45': FINE SAND** LOOSE, DRY, VERY WELL SORTED, LIGHT YELLOWISH BROWN.



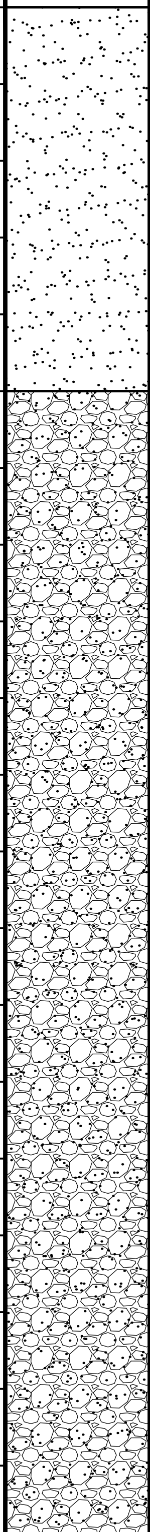
WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

PROJECT: GRANTS RECLAMATION PROJECT **PAGE:** 4 OF 6

CLIENT: HOMESTAKE MINING COMPANY **DATE:** 08/08/19

BOREHOLE NO.: **WME-24**

TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
40 – 45		**36' - 45': FINE SAND** LOOSE, DRY, VERY WELL SORTED, LIGHT YELLOWISH BROWN.
45 – 60		**45' - 60': FINE TO MEDIUM SAND WITH SOME GRAVEL UP TO 2" DIAMETER** LOOSE, DRY, POORLY SORTED, LIGHT YELLOWISH BROWN.

Depth scale: 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60

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BOREHOLE LOG

PROJECT: *GRANTS RECLAMATION PROJECT* **PAGE:** *5 OF 6*

CLIENT: *HOMESTAKE MINING COMPANY* **DATE:** *08/08/19*

BOREHOLE NO.: **WME-24**

TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
60		**60' - 75': FINE TO MEDIUM SAND WITH SOME GRAVEL UP TO 2" DIAMETER** LOOSE, WET, VERY POORLY SORTED, LIGHT YELLOWISH BROWN.
62		
64		
66		
68		
70		
72		
74		
		75' - 76': FINE SAND WITH SOME CLAY LOOSE, SOFT, WET, WELL SORTED, MEDIUM BROWN.
76		**76' - 85': VERY COARSE SAND WITH ABUNDANT GRAVEL UP TO 2" DIAMETER** LOOSE, WET, VERY POORLY SORTED, MEDIUM BROWN, BLACK AND WHITE.
78		
80		

WORTHINGTON MILLER ENVIRONMENTAL, LLC.

BOREHOLE LOG

BOREHOLE NO.: **WME-24**

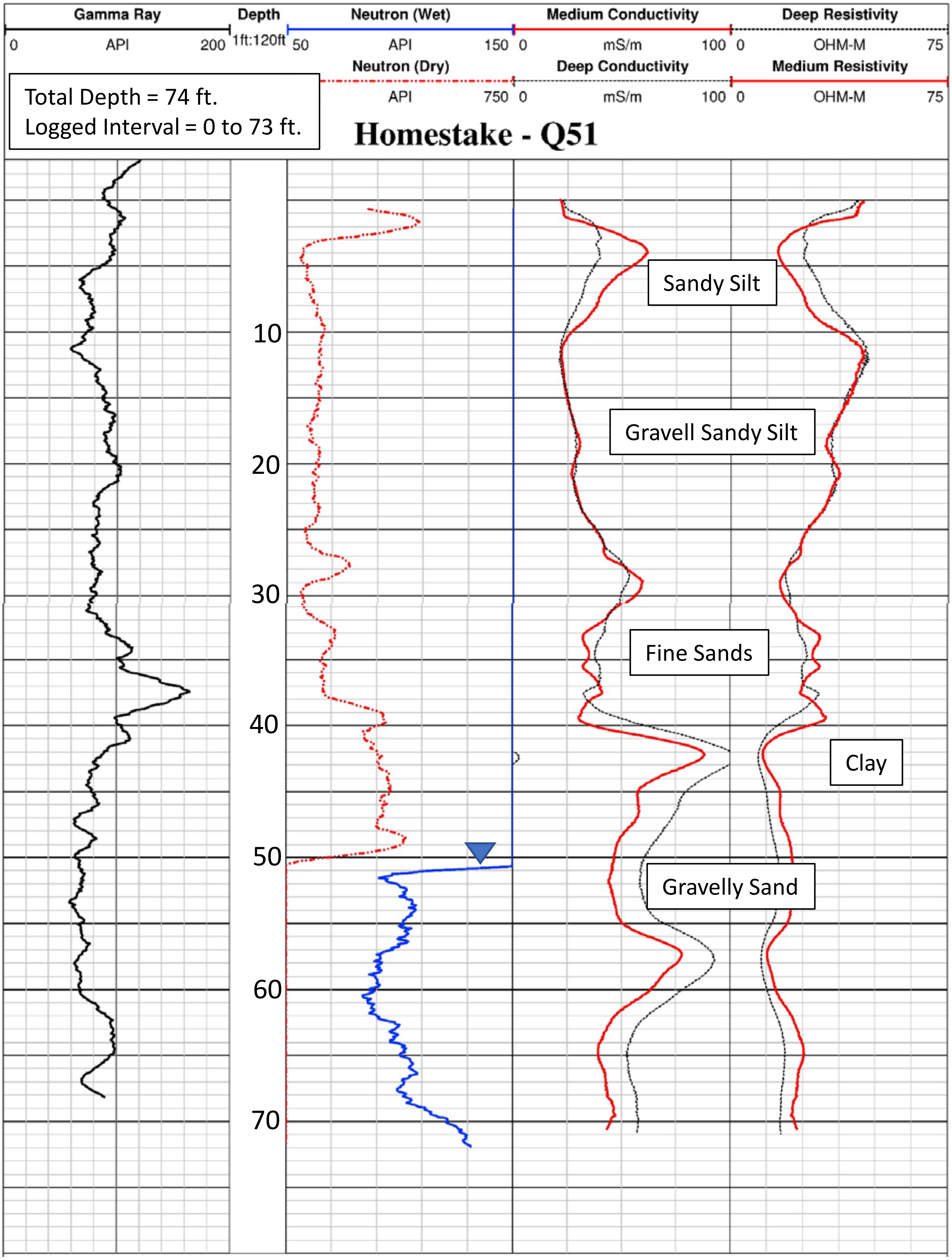
PROJECT: GRANTS RECLAMATION PROJECT **PAGE:** 6 OF 6

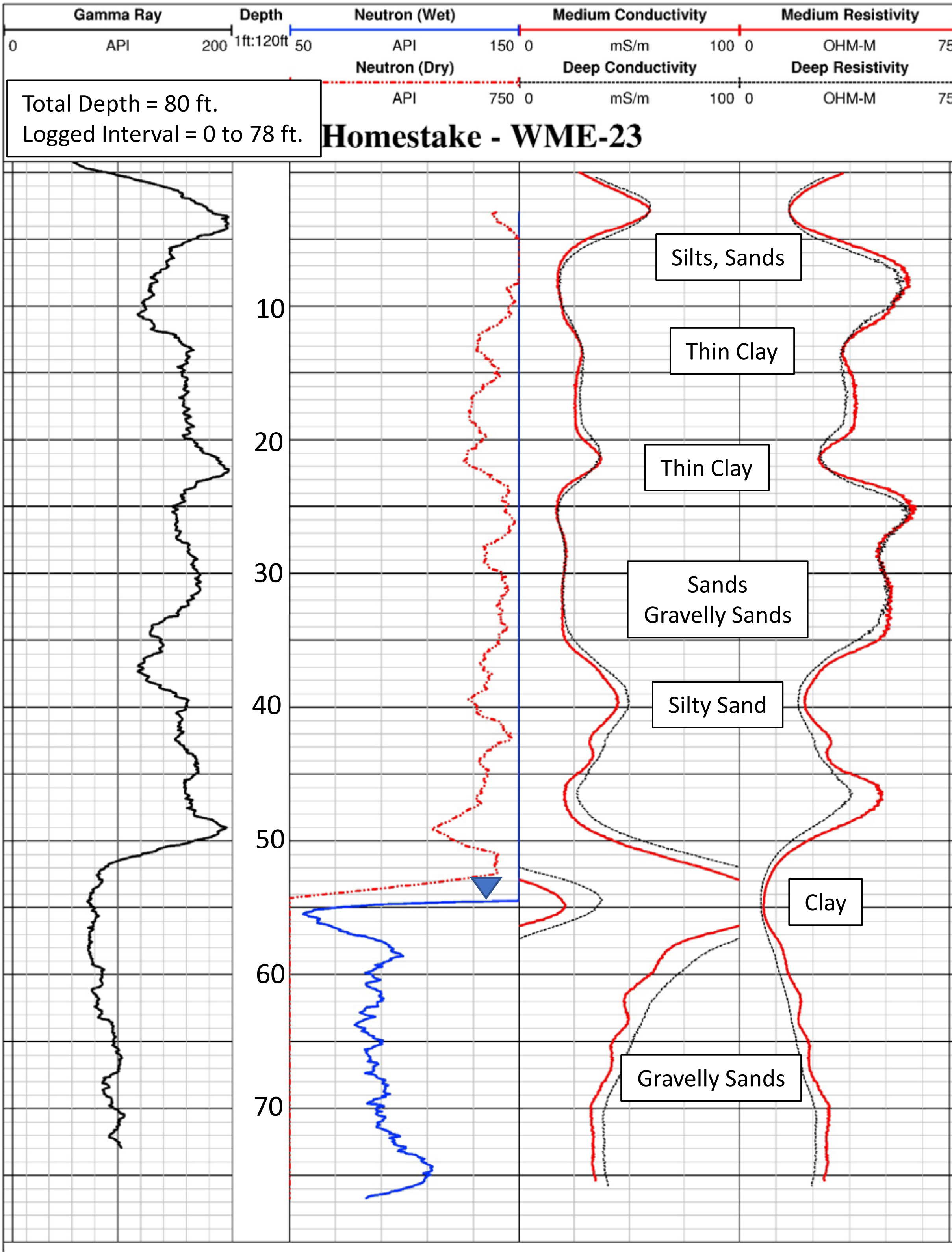
CLIENT: HOMESTAKE MINING COMPANY **DATE:** 08/08/19

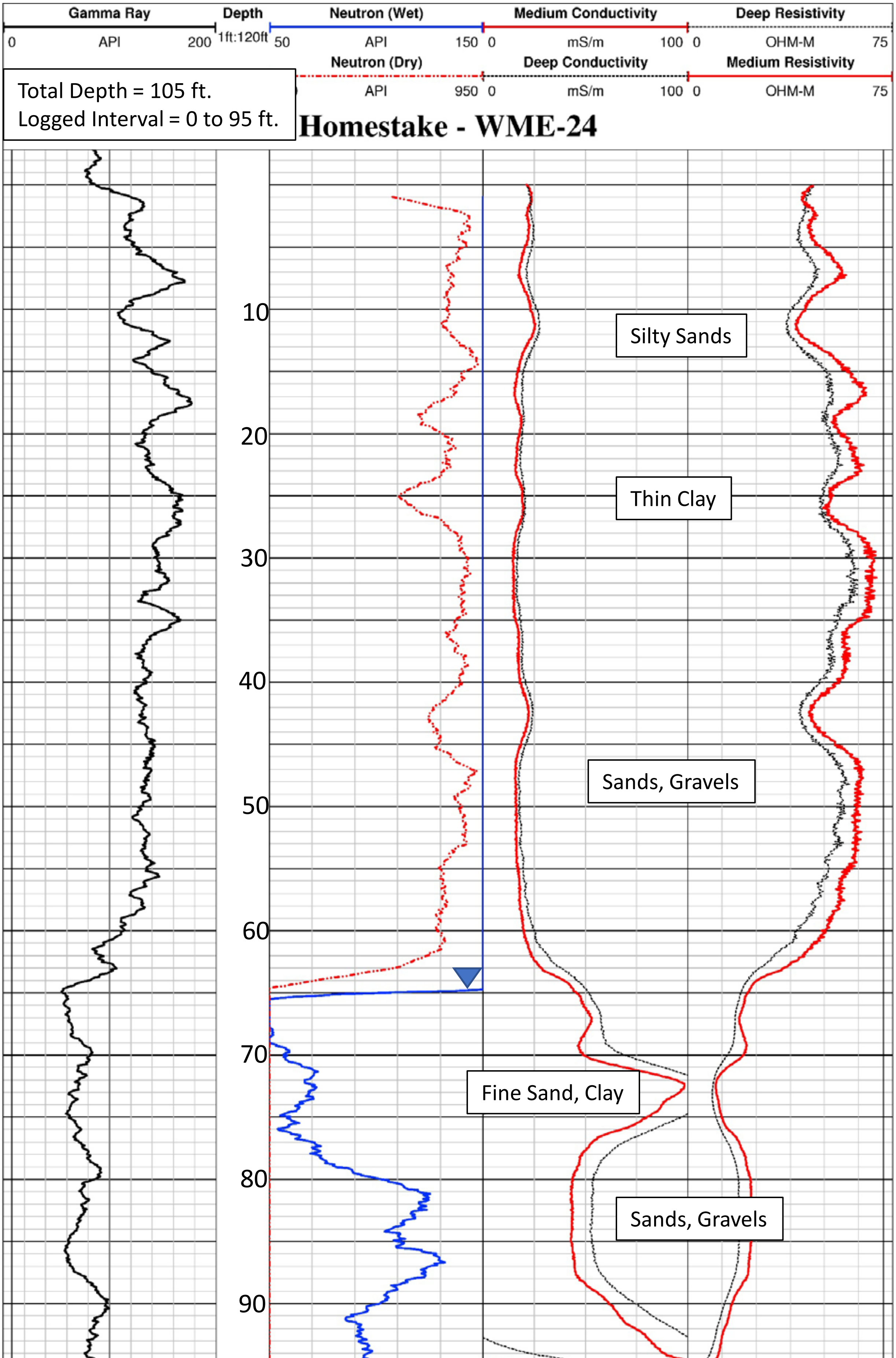
TOTAL DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION
80 – 85		**76' - 85': VERY COARSE SAND WITH ABUNDANT GRAVEL UP TO 2" DIAMETER** LOOSE, WET, VERY POORLY SORTED, MEDIUM BROWN, BLACK AND WHITE.
85 – 88		**85' - 88': MEDIUM SAND** LOOSE, WET, VERY WELL SORTED, MEDIUM BROWN.
88 – 95		**88' - 95': COARSE SAND WITH TRACE GRAVEL** TRACE CLAY, LOOSE, SOFT, WET, MEDIUM BROWN.
95 – 100		**95' - 105': CHINLE FORMATION: CLAYSTONE** DENSE, GREASY/SMEARS, VERY SLIGHT MOISTURE TO DRY, LIGHT GRAY, MOTTLED.

Depth scale: 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100

Attachment D


Gamma Ray
0 API 200
Depth
1ft:120ft
Neutron (Wet)
50 API 150
Neutron (Dry)
API 750
Medium Conductivity
0 mS/m 100
Deep Conductivity
0 mS/m 100
Deep Resistivity
0 OHM-M 75
Medium Resistivity
0 OHM-M 75
Total Depth = 74 ft.
Logged Interval = 0 to 73 ft.
Homestake - Q51
10
20
30
40
50
60
70
Sandy Silt
Gravell Sandy Silt
Fine Sands
Clay
Gravelly Sand


Gamma Ray
0 API 200
Depth
1ft:120ft
Neutron (Wet)
50 API 150
Neutron (Dry)
API 750
Medium Conductivity
0 mS/m 100
Deep Conductivity
0 mS/m 100
Medium Resistivity
0 OHM-M 75
Deep Resistivity
0 OHM-M 75
Total Depth = 80 ft.
Logged Interval = 0 to 78 ft.
Homestake - WME-23
10
20
30
40
50
60
70
Silts, Sands
Thin Clay
Thin Clay
Sands
Gravelly Sands
Silty Sand
Clay
Gravelly Sands



Gamma Ray
0 API 200
Depth
1ft:120ft
Neutron (Wet)
50 API 150
Neutron (Dry)
API 950
Medium Conductivity
0 mS/m 100
Deep Conductivity
0 mS/m 100
Deep Resistivity
0 OHM-M 75
Medium Resistivity
0 OHM-M 75
Total Depth = 105 ft.
Logged Interval = 0 to 95 ft.
Homestake - WME-24
10
20
30
40
50
60
70
80
90
Silty Sands
Thin Clay
Sands, Gravels
Fine Sand, Clay
Sands, Gravels

Appendix C
Laboratory Bench Scale Study - Materials and Methods

Appendix C: Laboratory Bench Scale Study – Materials and Methods

1 INTRODUCTION

A bench-scale study was performed to evaluate the leaching characteristics of uranium (U), molybdenum (Mo), and selenium (Se) from alluvial soil collected from beneath the tailing piles at the Grants Reclamation Project (site). Column tests were performed by Arcadis over two weeks at the site. Homestake Mining Company of California (HMC) staff provided radiological protection oversight for drilling operations and column testing and a radiation work permit (RWP) was prepared for this testing. This work was performed by a collaborative team consisting of Shannon Ulrich, geochemist at Arcadis, Dave Levy, geochemist at Worthington Miller Environmental LLC (WME), and Jeff Gillow, geochemist at Jacobs Engineering Group. Ricky Sams, Arcadis laboratory specialist, performed the column test work on site.

2 OBJECTIVES

This work consisted of a set of six flow-through columns and 15 batch (bottle) tests. The objectives of this column study and batch testing include:

- To develop an understanding of the potential future source term for groundwater as it relates to alluvial soil underneath the LTP and STP.
- Through column testing, evaluate leaching of U, Mo, Se and other constituents from alluvial soil collected from beneath the LTP and STP.
- Obtain a detailed leaching profile for U, Mo, Se, and other constituents from the soil, including concentrations in leachate based upon pore volume of tailing water pumped through columns.
- Evaluate the interaction of U, Mo, and Se present in LTP porewater with underlying alluvial soils as this relates to ongoing drain down of the water within the LTP.

The objectives of the batch test experiments also included the following:

- Evaluate the interaction of Mo in LTP porewater with alluvial soil, specifically to determine the potential for the precipitation of the mineral powellite ($CaMoO_4$).

3 MATERIALS AND METHODS

Soil for column testing was collected from underneath the Large Tailings Pile (LTP) and Small Tailings Pile (STP) by WME. Soil samples were characterized and analyzed for total metals and other chemical parameters. After assessment of the analytical data, soil samples were selected for inclusion in the column leaching tests and batch tests to evaluate constituent mobility. Alluvial soil was selected for testing based upon the total concentration of uranium, as well as lithology, with representative sand (coarse-grained) and silt/clay (fine-grained) lithologies chosen.

Soil for batch testing was collected from an upgradient (background) location (borehole BK2, Arcadis 2019) using rotosonic drilling. Batch test soil was comprised of 50% soil from 10-11 feet depth below ground surface (bgs) and 50% soil from 14-15 feet depth bgs. All testing performed in this study used tailing water obtained from the LTP from well WF9.

3.1 Soil Sampling and Selection for Column Testing

The rotosonic drilling program consisted of installation of three borings in the LTP (WME-18, -19, and -20) and two borings in the STP (WME-21 and -22). During drilling, the alluvial soil samples were stored in plastic bags according to lithology and 15 samples were collected from the sampling zone which extends from the top of the alluvium (below each pile) to the top of bedrock. The sampling depths were determined based upon field observations; 10 samples were taken from the upper section of the boring, 3 samples from the middle section, and 2 samples from the lower section. The highest constituent concentrations were expected in the upper section, hence the greater sample numbers here. Field observations and lithology guided sample collection, and samples were submitted for the analysis of total metals, total organic carbon, and particle size analysis. Alluvial soil was stored at the site, sealed in plastic bags, until the total metals data was available. In order to protect soil from prolonged exposure to air (and resultant sulfide oxidation that may occur), the bagged soil was placed in gallon buckets and then placed into large plastic bags.

Upon receipt of the total metals data, samples were selected for column testing, primarily based on lithology (sand or clay) and the highest concentrations of constituents (with U most important, followed by Mo, Se, vanadium (V)). Columns 1-5 were constructed using 80% of a higher permeability material like sand and 20% with a lower permeability material like clay or silty fine sand. This was done to facilitate fluid flow through the coarse-grained fraction of the columns and provide a source of fine-grained material to the matrix since the fine-grained materials are generally higher in constituent concentrations and are thought to be important to constituent leaching and attenuation. Column 6 was constructed using only sand, in order to evaluate the role that the silts/clays play in sourcing constituents to the water.

3.2 Column Construction

Soils from the following locations and depths in feet were selected for evaluation:

- WME 18 (11–14’), sand
- WME 18 (4–5’), clay
- WME 19 (12–15’), sand
- WME 19 (7–9’), clay
- WME 20 (0–1’), sand
- WME 20 (1–2’), clay
- WME 21 (12–15’), sand
- WME 21 (4–6’), silty, sandy clay
- WME 22 (27–30’), sand
- WME 22 (0–3’), silty, sandy clay
- WME 21 (18–21’), sand

Six columns were constructed using clear 3-inch diameter Schedule 40 polyvinyl chloride (PVC) pipes in 18-inch lengths. The column dimensions were developed based upon the concept of “representative elementary volume” or REV for column tests (DEMEAU 2012). The REV ranges from 40 to 100; a REV of 100 was selected for its appropriateness in evaluating hydrochemical processes associated with constituent mobility. The appropriate diameter of the column is calculated by multiplying the average grain size of the sand/silt that will be placed in the column by 100. In this case, because sand dominated the alluvial soil material and grain size was estimated at approximately

0.5 millimeters (mm)), a minimum column diameter of 50 mm or approximately 2 inches was calculated. A diameter of 3 inches was selected to minimized preferential flow due to boundary effects where alluvial material contacts the column. To further encourage laminar flow and to disrupt preferential flow patterns within the columns, a “spacer” was utilized in the center of each column. The spacers consist of two perforated acrylic discs sandwiched together that are the same diameter as the inner diameter of the column. These create approximately 121 cm3 of void space within the columns and allow for better flow throughout the study. Swagelok connections and 1/8” Teflon tubing was used for water flow on the influent and effluent sides of the columns. Both influent and effluent ends of each column were packed with glass wool as a screening material to keep the solid media and precipitates from accumulating in and plugging the influent and effluent tubing. A pressure gauge was installed on the influent side of each column in order to monitor pressure buildup throughout the testing duration.

The six columns used three 3-channel peristaltic pumps that were procured from Cole Parmer. Masterflex Vyton tubing and pump-heads were used to maintain steady target flowrates. The flow rates of each column were set to a target of 0.5 milliliters (mL) per minute (min) and maintained at that flow rate to the extent practicable.

Differentiations in the flow rate were caused by intermittent plugging of small orifices within the column system. The soils used in this study each contained a fraction of fine and/or colloidal particles that accumulated in the tubing and other smaller flow-through spaces.

The influent for Columns 1 - 6 flowed from one 5-gallon plastic jug containing WF9 tailing water. Each column influent line was submerged in the tailing water and the mouth of the jug was sealed with Teflon tape. In order to preserve the chemistry of the tailing water and limit exposure to oxygen, the jug was constantly purged with nitrogen gas. Fresh samples of WF9 tailing water were collected periodically throughout the duration of the column study. Nitrogen was also constantly supplied into the headspace of the effluent vessels to limit the exposure to oxygen prior to collection of analytical samples.

The columns were “dry packed” with alluvial soil, though the soil was not air-dried prior to use; this was done to preserve the chemical form of constituents and to prevent changes to mineralogy due to drying/oxidation. The moist alluvial soil was transferred into the columns using a plastic scoop. Using this approach, soil was placed in the columns in lifts and the columns were shaken/tapped/swirled to get even compaction of the soil into the column to avoid creating preferential flow paths and voids in the packed columns. The moisture content was determined on each of the soil samples and the mass of soil added to each column was recorded to determine porosity. Based on the analytical data, decisions were made to pack columns 1-5 with 80% sand-dominated soil and 20% clayey soil by weight. Column 6 was packed with sand-dominated soil.

- The first column (#1) contained 80% sandy alluvial soil from WME 18 (11–14’) with a total mass of 2,882 grams (g) mixed with 20% clay from WME 18 (4–5’) with a total mass of 693 g. The porosity for this column was calculated to be 10%.
- The second column (#2) contained 80% sandy alluvial soil from WME 19 (12–15’) with a total mass of 2,871 g mixed with 20% clay from WME 19 (7–9’) with a total mass of 685 g. The porosity for this column was calculated to be 13%.

- The third column (#3) contained 80% sandy alluvial soil from equal parts WME 20 (0–1') and WME 20 (2–4') with a total mass of 2600 g. Soils from these locations were mixed with 20% clay from WME 20 (1–2') with a total mass of 525 g. The porosity for this column was calculated to be 12%.
- The fourth column (#4) contained 80% sandy alluvial soil from WME 21 (12–15') with a total mass of 2558 g mixed with 20% clay from WME 21 (4–6) with a total mass of 690 g. The porosity for this column was calculated to be 16%.
- The fifth column (#5) contained 80% sandy alluvial soil from WME 22 (27–30') with a total mass of 2160 g mixed with 20% clay from WME 22 (0–3') with a total mass of 440 g. The porosity for this column was calculated to be 18%.
- The sixth column (#6) originally contained 60% of sandy alluvial soil from WME 22 (27–30') totaling 1900 g mixed with 40% clay soil from WME 22 (0–3') totaling 780 g. This higher clay mixture caused flow problems when beginning the experiments. After three days of maintenance and unsuccessful troubleshooting, the team decided to tear down and repack Column #6 with a different soil sample. Since it was hypothesized that the clay was the cause of the flow issues, the decision was made to pack the column with 100% sandy alluvium from WME 21 (18–21') totaling 3272 g. The porosity for the repacked column was calculated to be 7%.

3.3 Column Operation

Column operation started by initiating flow of WF9 tailing water (in an up-flow configuration, to push air bubbles through the column) through the columns such that one pore volume was displaced in a 24-hour period. Each column started out with a flow setting of 0.4 mL/min. Pressure gauges at the influent side of each column provided a measure of pressure within each column and some back-pressure was observed which impeded the flow of water through the columns. Once the columns were saturated and effluent flow was observed, periodic flow rate checks were performed using a graduated cylinder placed at the effluent end of the tubing and measured for actual volume over time. The target flow rate throughout the study was 0.5 mL/min.

The initial few pore volumes required close attention in order to optimize the flow rate and movement of tailing water through the column. Samples were collected of the first two pore volumes (Day 2 and Day 3 of operation) to obtain information about the "first flush" of constituents from the columns; these are the weakly-sorbed constituents and constituents that are easily mobilized due to the re-working of the alluvial soils during sampling and placement in the column. After the first 1-2 pore volumes, effluent sampling was performed every 2 days for the duration of the test. Influent WF9 tailing water samples were collected periodically to compare with effluent sample data. Effluent and influent pH was measured on each sampling day. Permeability differences between the columns caused slight differences in the flow rates and as a result, samples collected at the same time across all columns represent chemistry at different pore volumes.

All samples were collected and preserved for analysis at Energy Laboratories, Inc. (ELI) in Casper, Wyoming. Water samples for total metals analysis (U, Mo, Se, V) were preserved with nitric acid.

Samples for analysis of chloride, sulfate, nitrate-N and alkalinity were cooled to 4°C. All samples were shipped on ice per chain-of-custody procedures. Total metals were analyzed by EPA method 6020C, chloride, sulfate, and nitrate-N were analyzed by EPA method 300.0, and alkalinity was analyzed by SM2320B.

3.4 Column Disassembly

At the end of the column tests, columns were dismantled, and soil was washed out into individual waste buckets with lids and stored onsite. The lab waste or other impacted materials were collected for disposal in the on-site byproduct material (11.e.(2)) waste disposal trenches located on the STP. The columns, parts, and pumps were cleaned and surveyed for radiological contamination and when deemed acceptable, they were reserved in storage at the HMC facilities for potential future use.

3.5 Batch Testing

Batch testing was performed to assess the sorption of metals from site tailing water to background alluvial soils. The set of batch tests include mixing in 1-Liter (L) bottles equal amounts of alluvial site soil with tailing water containing low concentrations of Mo, Se, U, and vanadium (V). Two soils BK2 (10–11') and BK2 (14–15') were collected from the same location in the background area via rotosonic drilling. Equal parts of each soil were added into 15 individual 1-L plastic bottles totaling 250 g (125g + 125g) of soil per batch. Each reactor received 500 mL of tailing water from WF9. The reactors were shaken daily and monitored for pH every two days. The bottles were also sampled for alkalinity, chloride, sulfate, nitrate, nitrite, and dissolved metals (Mo, Se, U, V) every two days to be analyzed by ELI. Samples were preserved, shipped, and analyzed as column test samples above.

3.6 References

Arcadis. 2019. Supplemental Background Soil and Groundwater Investigation Report. Grants Reclamation Project, Cibola County, New Mexico. Prepared for Homestake Mining Company of California. August.

DEMEAU. 2012. Guidelining protocol for soil-column experiments assessing fate and transport of trace organics. <https://demeau fp7.eu/sites/files/D123a%20Guidelines%20Column%20experiments.pdf

Exhibit A

Photographs of Borings (CD)

Exhibit B
Laboratory Reports - Tailings Area

Exhibit C
Laboratory Reports - Southern Area (CD)