STATE OF NEW MEXICO
BEFORE THE WATER QUALITY CONTROL COMMISSION

IN THE MATTER OF PROPOSED AMENDMENTS TO SURFACE WATER QUALITY STANDARDS FOR SAN ISIDRO ARROYO AND TRIBUTARIES **WQCC No. 19-03(R)**

PRE-FILED TECHNICAL TESTIMONY OF MR. JAMES S. BOSWELL
A WITNESS ON BEHALF OF PEABODY NATURAL RESOURCES COMPANY

I. Introduction

My name is James Boswell. I am testifying as an expert technical witness in support of Peabody Natural Resources Company's ("Peabody") Petition to Amend the Ground and Surface Water Protection Regulations. My testimony begins with an overview of my credentials, including my education, experience and current position. I will then go on to describe the genesis of the work plan that Peabody developed and implemented as part of its Use Attainability Analysis ("UAA") for the San Isidro Arroyo Watershed. This portion of my testimony will include explanations of the objectives of the work plan, characteristics of watershed, the watershed approach, site reconnaissance and stakeholder participation. I will then offer an overview of the New Mexico Environment Department ("NMED") Surface Water Quality Bureau's ("SWQB") Hydrology Protocol ("HP"), including a description of how the HP was implemented for Peabody's UAA. I will testify regarding the results of the HP for each particular watershed that Peabody evaluated. Finally, I will provide an overview of the UAA for the San Isidro Arroyo and the results that support a finding that the stream segments identified therein are ephemeral.

II. Education, Qualifications and Experience

My resume is Peabody Exhibit 22. I received a Bachelor of Science degree from Indiana University in Environmental Science with minors in Mathematics and Geology. I received a Master of Science Degree from Indiana University in Geological Sciences, specializing in Wetland

Hydrology and Numerical Modeling. At the beginning of 2019, I became a Licensed Professional Geologist in the State of Indiana. While pursuing my undergraduate and graduate degrees, from 2000-2005, I worked as a research assistant for the Indiana Geological Survey (IGS) Center for Geospatial Data Analysis. At the IGS, I contributed to several projects involving surface and groundwater monitoring and modeling across Indiana.

I have worked for Peabody since 2005, beginning my career as the Manager of Hydrology. In that position, I focused on hydrological issues for Peabody's domestic operations, including in the Appalachian, Midwest, and Western regions. In 2012, I became Manager of Environmental Operations, which included a move to Peabody's Flagstaff, Arizona office. In that position, I focused on Peabody's western operations in Arizona, New Mexico, Colorado, and Wyoming, including the Lee Ranch Mine. In that capacity, I worked on environmental permitting and regulatory affairs, managed watershed-scale sampling and analysis plans, and contributed to a number of environmental compliance projects at the different operations. It was during my time at the Flagstaff regional office, serving as Manager of Environmental Operations, that Peabody developed the UAA work plan for Lee Ranch Mine and conducted the field work associated with that work plan and the HP. In 2016, I became Senior Manager over Environmental Operations, where I continued much of my previous work with the western operations. In addition to my responsibilities as Manager of Environmental Operations, I was tasked with overseeing environmental regulatory issues at the state and federal levels for Peabody's western projects.

In April 2019, I became the Director of Environmental, Regulatory, and Permitting for Peabody. While my primary focus is now on the Midwestern operations, I continue to provide support to the Western operations and work on state regulatory affairs.

III. Work Plan Development

(i) Objectives

In order to understand how the work plan was developed, one must understand the objective of the work plan. The objective of the work plan is twofold: first to determine the proper hydrologic regime of the streams in the San Isidro watershed using the NMED Hydrology Protocol, and second to assess the results of the work plan to support development of a Use Attainability Analysis in order to request a proper reclassification of the streams within that watershed.

(ii) Consideration of major watershed characteristics and boundaries

In order to develop the work plan and ultimately implement the NMED Hydrology Protocol for the San Isidro watershed, a background evaluation of the site had to first be completed. This included an evaluation of the topography, geology, soil, vegetation, ecoregional classification, relative location of the mining operation in the watershed, and the location of hydrologic features. The work plan development also included review of the existing studies conducted in the area, which included the UAA conducted by NMED in 2012 on a smaller area of the San Isidro watershed as well as extensive research and analysis that was conducted for the Lee Ranch Mine permit application, included as Peabody Exhibit 8. This testimony summarizes the findings. The specific results of this evaluation are included in the administrative record.

Many of the characteristics of the San Isidro watershed can be differentiated into two primary areas of the watershed, the upper canyons and the lower rolling hills. The watershed's topography is steep, stream valleys are incised in the upper canyons while the rolling hills contain gentler slopes and broader valleys. The geology and soils of the watershed share a similar break, with the upper portion dominated by outcrops of sandstones with thin soils, and the lower portion underlain by the Mennefee formation consisting of finer grained sedimentary rocks with thicker overlying soils. The vegetation in the upper canyons consists of grasses as well as Pinyon-Juniper forest, and the lower valleys are dominated by grasses with occasional stands of Tamarisk. The Environmental Protection Agency ("EPA") level IV ecoregional break lies on this divide, with the canyons characterized as Semiarid Tablelands and the lower portion as San Juan / Chaco Tablelands and Mesas. The mining operation is located in the middle portion of the watershed with the primary drainages originating upgradient from the mine boundary and flowing across the mine to the lower portion of the watershed. Lastly, the primary hydrologic features of the watershed include San Isidro Arroyo, Mullatto Canyon, Arroyo Tinaja, and Doctor Arroyo. The workplan had to be developed to properly characterize all of these differences, which is what leads us to the watershed approach.

iii. The Watershed Approach

Peabody used the watershed approach to account for the different characteristics across the San Isidro watershed. NMED first mentioned the watershed approach in its first review of the draft work plan in October 1, 2015. The sub-watersheds were selected primarily based on review of topographic maps and aerial photos, available GIS data from various sources, the Lee Ranch Mine permit, NMED's previous 2012 UAA of portions of the San Isidro watershed, and discussions with onsite staff.

In response to NMED comments, the San Isidro watershed was subdivided into three tiers of watersheds, as shown on Figure 3, Peabody Exhibit 7. Tier 1 includes the headwater areas and is the smallest of the watershed tiers. There are four Tier 1 watersheds, including two in the upper canyon area, one in the lower rolling hills area, and one that included drainage from both the upper canyons and the rolling hills. The Tier 2 watershed is an intermediate watershed that encompassed two Tier 1 watersheds located in the canyons as well as a large area of the rolling hills. The Tier 2 watershed also corresponds to the lowermost sampling location used by NMED in the 2012 UAA. Lastly, the Tier 3 watershed is the largest of the watersheds and encompasses all other tiers. The Tier 3 watershed includes all of San Isidro Arroyo, prior to its confluence with Arroyo Chico.

The use of the watershed approach allowed Peabody to compare the different environmental characteristics of the area on an individual watershed basis by comparison of the Tier 1 watersheds. This approach allowed Peabody to determine if there are significant hydrologic differences between the upper canyons, the lower valleys, and the intermediate areas. It also ensured that every type of potential hydrologic regime was recognized and evaluated in detail through the evaluation of the larger Tier 2 and Tier 3 watersheds. The use of three tiers also maintains continuity as the evaluation progresses lower into the watershed, allowing comparison across tiers to determine if there are any significant differences. Ultimately, the Tier 3 watershed would have the highest potential for having sustained streamflow, due solely to its larger drainage area and its lowermost position in the watershed.

iv. <u>Site reconnaissance</u>

Peabody regional staff conducted an onsite field visit September 2 and 3, 2015 to review and finalize the locations selected for its work plan. Peabody staff walked both upstream and downstream locations to determine if the site was representative of the stream reaches in the area. During that visit, general observations were made about the consistency of the stream characteristics, including the geomorphology and channel dimensions, biological characteristics, and hydrological characteristics upstream and downstream of the proposed assessment sites. Based on the site reconnaissance, Peabody finalized the locations of proposed sampling and photo sites.

v. Location of sampling sites

Peabody's final proposal to NMED included ten "HP" sampling sites where the Hydrology Protocol would be implemented, and thirty-two additional "PP" photo points. The HP sites would be used to conduct the Hydrology Protocol and determine the appropriate flow regime for the representative reach of a stream. The PP locations would be used to ensure that all other areas within these watersheds would be accurately represented by the HP sites. The PP locations were generally located on smaller side tributaries or near specific surface water control structures (e.g. diversions and dikes) to ensure there were no isolated areas that were substantially different from the primary HP sites.

vi. Stakeholder participation

Peabody submitted the work plan to NMED, for comment and approval, and EPA, for comment, on September 14, 2015. A conference call with NMED and Lee Ranch Mine staff was held on September 29, 2015 to discuss the work plan. Informal comments on the work plan were received by both agencies on October 1, 2015. The work plan was significantly revised and resubmitted to NMED and to EPA on November 16, 2016. A conference call with EPA, NMED and Lee Ranch Mine staff was held on March 15, 2017. Formal comments to the revised work plan were received from NMED on March 22, 2017. Based on these comments, the work plan was revised again and a final work plan was submitted to the EPA and NMED on June 6, 2017. NMED provided verbal approval of the revised work plan prior to Peabody conducting the field work on June 19-21, 2017. NMED provided this approval in a letter dated January 12, 2018.

IV. Hydrology Protocol Summary

The Hydrology Protocol is a quantitative method of evaluating the hydrologic regime of a stream. The Hydrology Protocol uses field-based observations for a set of biological, hydrologic, and geomorphic indicators, and each indicator has a range of potential scores. The final score of the Hydrology Protocol is used to classify each stream as either ephemeral, intermittent, or perennial.

i. <u>Hydrology Protocol Level 1 Indicators</u>

The Hydrology Protocol has fourteen Level 1 indicators. These include 1) presence of water in a channel, 2) presence of fish, 3) presence of benthic macroinvertebrates, 4) presence of filamentous algae and periphyton, 5) differences in vegetation, 6) absence of rooted upland plants in streambed, 7) sinuosity, 8) floodplain and channel dimensions, 9) in-channel structure, 10) particle size and stream substrate sorting, 11) hydric soils, 12) sediment on plants or debris, 13) seeps and springs, and 14) iron oxidizing bacteria.

The "water in a channel" indicator notes the presence or absence of water. For situations where there is no flowing or standing water, evidence of water, such as moist conditions under rocks and distinct riparian vegetation changes, can also be used to assist in scoring this indicator. The "fish," "benthic macroinvertebrate," and "filamentous algae / periphyton" indicators are qualitative indicators, noting the presence of aquatic life in the stream. Fish are typically observed in pools and runs, whereas benthic macroinvertebrates would be more easily observed in riffles on the undersides of rocks. Filamentous algae / periphyton can be found throughout a channel. If there is no water within the streambed, fish would be scored as a zero. For benthic macroinvertebrates however, evidence of macroinvertebrates such as sand casings or snail shells can be used to score the stream. Filamentous algae / periphyton will be attached to the streambed substrate, which also allows scoring in streams that may be dry at the time of sampling. All three of these indicators are based on the presence of aquatic life to quantify the frequency, duration, and magnitude of stream flows. Intermittent and perennial streams with more frequent flows for longer periods are more likely to support aquatic life than ephemeral streams which flow only for short durations following precipitation events. The “differences in vegetation” indicator scoring is based on both composition (i.e. species) of vegetation as well as density of vegetation. The composition of vegetation relies on the fact that some vegetation is more tolerant of dry conditions while other vegetation, such as macrophytes, are adapted to wetter conditions. Plants that have adapted to aquatic conditions typically rely on a water table that is closer to the surface, providing a more constant water supply, and are typically associated with intermittent or perennial streams. Ephemeral streams, which do not have a water table near the surface, cannot support aquatic plants. Density of vegetation in the riparian area is also indicative of soil moisture, with more frequent flows resulting in higher soil moistures and thus, greater densities. In this indicator, a compositional change in vegetation is the primary indicator and vegetation density would be the secondary indicator. The “rooted upland plants” indicator is used to differentiate perennial from intermittent or ephemeral channels. In channels that have a high frequency of flows, seed growth is prevented by the constant scouring of the channel, preventing establishment of roots. In channels that have flow for longer duration, plant establishment is prevented due to the prolonged inundation of the roots. There are exceptions to these situations, such as a lack of rooted upland plants in sand bed channels with high gradients, which can be driven by the appreciable sediment transport and associated scour and deposition that occurs during flash floods.

Following completion of the first six Level 1 indicators, the Hydrology Protocol allows for the assessment team to sum an intermediate score. If the total score is less than or equal to two (2) at this point, the reach can be determined to be ephemeral. However, as was stated in the work plan, the assessment team did not stop at this intermediate step and instead completed evaluation of all fourteen Level 1 indicators, regardless of the score at this point in the assessment.

The next set of Level 1 indicators are based on stream geomorphology, including stream sinuosity, floodplain and channel dimensions, instream structure (riffle-pool sequence), and particle size / sorting. "Sinuosity" is a ratio of stream length to valley length. The more meandering or sinuous a stream is, the higher the sinuosity value. Generally, higher in a watershed sinuosity will be low due the higher stream gradient. Moving downgradient, sinuosity will increase as the gradient and substrate particle size decrease. The greater the sinuosity, the higher probability that the stream has a more intermittent or perennial flow regime. Sinuosity can be influenced by bedrock outcrops and hillslopes encroaching in the floodplain and channel, increasing sinuosity that is not reflective of frequency or duration of flow. The "floodplain and channel dimension" indicator is used to determine the entrenchment or vertical confinement of a stream. Streams that are entrenched or incised are commonly associated with ephemeral streams whereas streams that have wide active floodplains are more associated with perennial streams. The measure of this indicator is the ratio of flood-prone area width to bankfull width. The bankfull width is the width of the stream at bankfull stage, or the depth of flow that typically occurs at least once every 1 – 2 years. The flood-prone width is the width of the stream or floodplain at twice the depth of the bankfull stage. Ephemeral channels that are more entrenched have a low ratio of flood-prone area width to bankfull width. On the other hand, perennial streams that frequently overtop their banks will have a high ratio of flood-prone area width to bankfull width. There are areas where this measurement can be misleading, such as in canyon streams where morphology is controlled by the surrounding bedrock more than channel scour and depositional processes and in braided streams with multiple active channels. The "instream structure" indicator is used to identify stream morphological features associated with more continuous flows. Perennial streams often show a riffle or pool sequence or a riffle or run sequence, depending on substrate. This alternating sequence is the result of transport of the bed materials under a wide range of flows which naturally sorts into the riffle pool complexes. More frequent riffle pool sequences are likely the result of higher magnitude and more continuous flows. In dry streams, riffle pool sequences may appear as the deposition of gravel in areas dominated by a sand bed. The final geomorphological indicator is for "particle size and substrate sorting." Particle size is a comparison of the bed material to the surrounding area outside of the channel. Ephemeral streams will have bed material that is composed of the same or similar material in the area outside of the channel. Intermittent and perennial streams will often have bed material unlike the surrounding area, and typically of larger size such as cobbles and boulders. Substrate sorting is a natural occurrence observed more often in perennial and intermittent streams where fine materials will be depositing in pools and coarser materials will be found in riffles. Ephemeral streams will have a more uniform bed material with little or no noticeable differential deposition.

The "hydric soil" indicator is based on the fact that hydric soils develop when the water level is elevated for sufficient time to create reduced conditions in the soil. Hydric soils indicators include oxidized roots, gray or black soils, and the presence of clay soils. Hydric soils that are found above the base of the channel are indicative of an intermittent or potentially perennial stream reach. Hydric soils found below the base of the channel may be indicative of ephemeral or potentially intermittent conditions. The indicator of "sediment and debris on plants" is used to show that a recent flow event occurred and deposited material on the surrounding vegetation. The presence of sediment and debris on plants is indicative of the fact that a flow occurred, provides insight on the magnitude of the flow, and the regularity with which it is found provides some information on the frequency and extent of these events. The supplemental indicators of "seeps and springs" and "iron oxidizing bacteria" are simple presence / absence indicators. These indicators carry a high score as they are indicative of at least seasonal connection to a groundwater source, from either the deeper bedrock or shallow alluvial material.

ii. Hydrology Protocol Level 1 Scoring

Following evaluation of waterways for all fourteen Level 1 indicators, the score of all fourteen indicators is summed. The total is used to determine the appropriate stream classification as follows:

Total < 9: ephemeral

Total ≥ 9 and < 12: recognized as intermittent until further analysis indicates ephemeral

Total ≥ 12 and ≤ 19: intermittent

Total > 19 and ≤ 22: recognized as perennial until further analysis indicates intermittent

Total > 22: perennial

If, after completing the Level 1 indicators, a hydrological determination cannot be made because more information is required, a Level 2 evaluation must be completed. All of the streams in this study were accurately characterized following completion of the Level 1 indicators and no site was required to continue with the Level 2 indicators. The Level 2 indicators are applicable to channels which contain water and aquatic life, focusing on the elevation of the groundwater table and the presence and types of bivalves, amphibians, benthic macroinvertebrates, and fish. If any of the streams in this watershed underwent a Level 2 evaluation, the total score would be zero, based on the absence of water and aquatic life in all observed reaches except Doctor Springs.

V. Hydrology Protocol Results

i. Level 1 Office Procedures

Prior to conducting the field work on June 19-21, 2017, Peabody completed the Level 1 office procedures recommended by the UAA. This included the review of maps (mine hydrology maps, historic and recent aerial photos, USGS topographic maps), surface water and groundwater data collected under the Lee Ranch Mine MMD permit, available USGS gauge data, spring information, the post-mine topography plan, and recent meteorological and climatic conditions. Sampling was conducted in June, which aligns with the recommended timeframe, late-May to mid-July, found in the Hydrology Protocol. The climatic conditions indicators (Palmer Drought Severity Index, Standardized Precipitation Index, and Palmer Z Index) were within the thresholds listed in the Hydrology Protocol with a neutral long-term precipitation pattern and normal short-term and long-term drought indices. Nothing in this office review required Peabody to delay or modify the workplan, so it continued with the field work as planned.

ii. Introduction to HP Results

I led the sampling team for the HP. Joining me in the field were Chad Gaines, serving as onsite environmental staff, John Cochran, serving as regional staff hydrologist, and Jennifer Johnson, an environmental intern. We coordinated with the NMED to plan an onsite visit for one of the days we intended to complete the field work. The purpose of the onsite visit was to allow NMED to observe, review, and verify the work being conducted by Peabody staff. This visit also allowed for comparison of scoring methodologies between Peabody and NMED. Shelly Lemon and Brian Dahl from the NMED SWQB participated in the field work on June 20, 2017.

Peabody staff purposely took a very conservative approach to scoring the channels they studied. There are some Hydrology Protocol indicators that can give misleading scores as a byproduct of the calculation, definition, or procedure. For example, tamarisk was noted in a few locations. Tamarisk, or salt cedar, is a drought tolerant plant with a very deep tap root. This tree is not an indicator of an elevated water table. Nonetheless, if tamarisk was present, the staff considered this a riparian vegetation change and increased the Differences in Vegetation indicator and scored that accordingly, even though the Differences in Vegetation indicator was intended to score for more obligate riparian vegetation types, such as macrophytes.

Another example we encountered were channels that lacked vegetation within the channel. As I previously explained, this indicator was intended to score conditions where a constant flow within the stream would inundate roots and prevent vegetation from growing. In some of the channels within the San Isidro watershed, the bed substrate is dominated by sand. The infrequent but high magnitude flash floods that occur in this area cause significant bed movement, scour, and deposition, preventing vegetation from establishing. Additionally, many of these channels are used as wildlife travel corridors, and erosion and consumption due to wildlife has a significant effect on instream vegetation establishment. Nonetheless, these sand bed channels were given elevated scores in the rooted upland plants indicator, even though this was not the intent of this indicator in the Hydrology Protocol.

A final example of how Peabody staff conservatively scored their observations is for streams that have an elevated ratio of flood prone area width to bankfull width, indicative of a wide active floodplain. The channel geometry measuring process can be an issue on streams where bankfull height is difficult to identify, such as where the channel has been compacted due to wildlife and cattle or where multiple channels exist. The majority of the major streams in the San Isidro watershed are incised and typically only have limited floodplains bounded on both sides by historical terraces. However, various issues caused some sites that were clearly incised to have inflated flood-prone width to bankfull width ratios. This could be due to compaction by cattle and wildlife causing a larger than normal bankfull depth or the presence of multiple channels within one low lying area. In other cases, the bankfull depth and width was based on the smaller active channel within the outer terraces. In these situations, the channel itself can be clearly incised and not able to overtop the surrounding terraces. However, the Floodplain Ratio indicator may still be elevated, due to minor topographical changes within the smaller active channel. The team scored these sites high, even though it is clear that the stream is incised and rarely to never actually overtops the bank into the actual floodplain, which in some cases was over twenty feet above the channel bottom.

These examples demonstrate that the sampling team took a very conservative approach to scoring the streams it evaluated. The sampling team felt that this conservative approach was consistent with the UAA regulatory language, which requires characterizing a stream based on its "highest attainable use", including any potential uses not currently being attained.

I will now go on to discuss the particular results for each watershed that was included in the evaluation.

v. <u>HP Site Descriptions and results: Upper Canyon Watersheds 1A and 1B</u>

The upper canyon Tier 1 watershed includes watershed 1A in Arroyo Tinaja, and 1B in Mulatto Canyon. There were three HP sites, HP 11, HP 13, and HP 14, completed in these watersheds, with several more photopoint sites. One of these HP sites was the same as the one chosen by the NMED in 2011, when they conducted a more limited UAA.

These watersheds are characterized as the upper canyon areas. They are the highest elevation of any evaluated watershed and have the steepest streambed slopes within the watershed. The channels here have extremely steep banks and show evidence of significant erosion. The channels are significantly entrenched and have a sand and pebble dominated substrate (high energy), with some silt also present.

Scores of zero (poor) were received for the following indicators: presence of water, fish, macroinvertebrates, algae / periphyton, in channel structure (riffle-pool), hydric soils, seeps and springs, and iron oxidizing bacteria. The channels received weak scores for sinuosity (≤1) and sediment on plants and debris (≤0.5), moderate scores for floodplain / channel dimensions (≤1.5) and particle size sorting / substrate sorting (≤1.5), and moderate to strong scores for absence of rooted upland plants in streambed (2 – 3).

At the base of the headwater canyons, these channels are incised and show a low sinuosity and are higher gradient streams. The "floodplain and channel dimensions" indicator is difficult to measure in these incised channels that show little to no evidence of flow and likely never actually overtop the upper bank or historic terrace into the floodplain. *See* UAA Appendix D, Photos HP11 upstream, HP13 bankfull width, and HP14 bankfull. Nonetheless, the sampling team retained the moderate scores resulting from the ratio calculation. Some of these sites showed the presence of isolated cobble, thus receiving a moderate score for substrate sorting. *See* UAA Appendix D, Photo HP14 cobble. For the "rooted upland plants" indicator, these sites are a good example of the issue previously identified with scoring. Site HP13 shows little to no vegetation within the channel. *See* UAA Appendix D, Photo HP13 Upstream. However, this is likely due to sand dominated beds, erosion and consumption on wildlife travel corridors, and potentially infrequent erosive flow events. Nonetheless, Peabody staff scored this indicator as a "3", the highest score for the "Rooted Upland Plants" indicator.

Additional sites were visited as photo points, including PP151, PP12A, and PP12B. *See* UAA Appendix A, Lee Ranch Mine Photo Log. Site 151 was located further upgradient into the canyons and is well represented by the Hydrology Protocol locations that were chosen. It showed an incised sand bed channel with steep side slopes and little to no in-channel vegetation. Sites 12A and 12B show that these channels, although displayed on USGS topographic maps, are actually discontinuous in nature. These sites are areas of deposition or fill in the scour-transport-fill landform sequence, which is explained in more detail in the UAA and other Peabody witnesses' testimony. No clear channels were evident at these sites, which are located at the base of the upper canyons. Nonetheless, the photo points show that the locations selected for the Hydrology Protocol are representative of these watersheds as a whole, with no photo point locations showing evidence contrary to the HP sites located further downgradient in the watershed.

Site HP11 also corresponded to a duplicate Hydrology Protocol conducted by NMED staff. NMED staff rated site HP11 with a total score of 6. Peabody staff rated the same site with a total score of 5. The similarity in the scores from two independent sampling groups is indicative of the accuracy of the Hydrology Protocol.

Overall, these channels showed clear characteristics of ephemeral channels at both the photo points and the Hydrology Protocol locations. There were no signs that indicate these channels are intermittent streams, which would show signs of prolonged flow due to a connection with the water table. There was no evidence of water or aquatic life and the channels showed ephemeral channel morphologies and vegetation characteristics.

vi. <u>HP Site Descriptions and Results: Tier 1 Watershed 1C</u>

Moving on, Tier 1, Watershed 1C is the headwater portion of San Isidro Arroyo located in the lower valley that is characterized by the rolling hills topography. It is located mid-elevation in the watershed and the stream has lower slopes than the upper canyons. Site HP15 is located upstream of clean water dike or diversion near the mine permit boundary and is within a wide valley. Riparian vegetation, specifically tamarisk, was present and visible from aerial photos. Hydrology protocol scores were zero (poor) for the following indicators: presence of water, fish, macroinvertebrates, algae / periphyton, in channel structure (riffle-pool), hydric soils, seeps and springs, and iron oxidizing bacteria. Scores were weak for sinuosity (few bends, mostly straight) and sediment on plants and debris (sediment in isolated areas along stream). Scores were moderate for differences in vegetation and absence of rooted upland plants indicators, due to the presence of tamarisk. *See* UAA Appendix D, Photos HP15 upstream and HP15 downstream. As I explained previously, tamarisk is a drought tolerant species with a deep taproot and is not indicative of a shallow water table. Floodplain and channel dimensions scored strong; however, this section of stream contained multiple channels / livestock paths, and this indicator is likely inflated due to the difficulty of measuring a bankfull width in a low-lying area with multiple channels. While this is a low-lying area, there still was no evidence of Hydric Soils. *See* UAA Appendix D, Photos HP 15 soil profile (1) and (2). The high score of the floodplain and channel dimensions is another example of some of the indicators being somewhat artificially inflated due to the conditions in the field as was previously mentioned. Nonetheless, the total score of this stream was still only 8, clearly indicating this reach is an ephemeral stream.

Photo points 156, 157, and 158 were also included to ensure representativeness of the Hydrology Protocol site. *See* UAA Appendix A, Lee Ranch Mine Photo Log. These sites also showed ephemeral characteristics and there was no evidence of recent or prolonged streamflow at any of these sites. Site PP157 showed higher entrenchment, as would be expected higher in the watershed. Site PP156 was located on a stream downgradient from the upper canyons that was delineated by the USGS National Hydrography Dataset, but this site barely showed channel characteristics and is an area of deposition or fill on a discontinuous ephemeral stream. Site PP158 shows similar characteristics to HP15, with more than one shallow channel likely the result of the shallow slope and use as a travel corridor by wildlife and cattle.

All sites within this watershed are characteristic ephemeral streams. One stream again showed a discontinuous nature typical of the scour-transport-fill landform sequence. The primary

Hydrology Protocol site showed artificially elevated score for three of the indicators due to the conservative approach used by Peabody sampling staff, but still resulted in a total score characteristic of ephemeral streams. Photo points located higher in the watershed showed stream characteristics consistent with the results of the Hydrology Protocol sampling location.

vii. <u>HP Site Descriptions and Results: Tier 2 Watershed 2ABC</u>

The next site downgradient from these watersheds is the Tier 2 watershed ABC. This site includes drainage from the combination of upper canyons (1A, 1B) and the lower rolling hills / valleys (1C). Numerous additional photo points were included in this watershed to capture potential effects of tributaries or NPDES locations. HP21 is located in rolling hills topography following the confluence of three major tributaries, San Isidro, Tinaja, and Mulatto, where there is the highest potential for non-ephemeral flow. The lower portion of watershed also has higher potential to intercept alluvial groundwater if it were present, although there is no evidence to suggest any significant alluvial groundwater is present in this watershed.

The Tier 2 Watershed 2ABC received a total score of 8. Scores of zero were given for the following indicators: presence of water, fish, macroinvertebrates, algae / periphyton, in channel structure (riffle-pool), particle size or substrate sorting, hydric soils, seeps and springs, and iron oxidizing bacteria. A poor score was applied for sediment on plants and debris (0.5). Moderate scores were given for differences in vegetation (2), sinuosity (2), floodplain and channel dimensions, and absence of rooted upland plants in streambed (2). No indicators scored strongly (3).

The site is a small entrenched channel with a wider floodplain containing several abandoned historical channels. The floodplain is entrenched with steep channel terraces. *See* UAA Appendix D, HP21 upstream. There is significant evidence of mass wasting or sloughing of the upper terrace walls. The site had moderate sinuosity, which would be expected based on its intermediate location in the San Isidro Arroyo watershed. Floodplain and channel dimensions were again difficult to measure in this channel, due to the multiple paths used for travel by livestock and wildlife, likely contributing to the moderate score for floodplain and channel dimensions. Tamarisk was present, which, again, gave the site an artificially inflated score for differences in vegetation. Similar to other sites, the channel bottom was compacted due again to livestock and wildlife use, which is the most likely reason for absence of rooted upland plants and the higher associated score. *See* UAA Appendix D, Photo HP21 vegetation in channel.

Numerous additional photo points were included within this watershed, including San Isidro and its tributaries, PP152, PP153, PP154, PP170, PP286, and PP287, Mulatto Canyon and its tributaries, PP281 and PP282, and Arroyo Tinaja and its tributaries, PP169, PP283, PP284, and PP285. *See* UAA Appendix A, Lee Ranch Mine Photo Log. These sites were used to ensure the chosen Hydrology Protocol location was representative, and to determine if there were any noticeable changes to the streams as a result of the confluence with side tributaries or Lee Ranch outfalls. Arroyo Tinaja shows an example of the channel characteristics of these discontinuous ephemeral streams. Comparing sites PP169, PP283, PP284, and PP285, moving downstream, there is very little change in channel morphology or vegetation. Arroyo Tinaja has a clearly defined channel in its headwaters, but it can be seen that lower in the watershed, where the channel slope lessens, there is little to no evidence of flow at all. In many cases there is not even a defined channel, even though these locations are shown as streams on USGS topographic maps. This is yet another example of the scour-transport-fill sequence previously mentioned. Mulatto Canyon and San Isidro Arroyo show some locations with a very defined channel. *See* Appendix A, Lee Ranch Mine Photo Log, PP281 Downstream, PP153 Upstream, representative of the HP21 location while other reaches of these streams show little to no defined channel; *see also* Appendix A, Lee Ranch Mine Photo Log, PP170 Upstream, PP287 Downstream. In all cases, it was determined that site HP21, which contains a clearly defined channel lower in the watershed, was the most representative of these intermediate locations. None of these photo point locations showed an abrupt change in characteristics following confluences with other drainages or NPDES outfalls.

The HP21 location was also independently evaluated by NMED staff on June 20, 2017. NMED scored this stream in the range of 6.0 – 9.0, which classifies it as ephemeral. Similarly, Peabody staff determined a total score of 8.0. As stated previously, the accuracy of these two independent scores validates both the Hydrology Protocol procedure as well as the sampling teams that conducted the field work.

Overall, the sampling results indicate that the San Isidro Arroyo is an ephemeral stream at this point in the watershed. It displays classic ephemeral characteristics, with incised channels in areas of scour and nearly no visible channel in areas of fill or deposition. The scores resulting from the Hydrology Protocol validate that the proper classification for this stream is ephemeral and the photo points verify that there are no isolated areas of abnormal hydrologic characteristics that are not already accurately represented by the HP sites that were chosen.

viii. <u>HP site descriptions and results: Tier 1 Watershed 1D – Doctor Arroyo</u>

I will now discuss Tier 1 Watershed 1D- Doctor Arroyo. This watershed, from headwaters to mouth, is located in the lower valley and is characterized by the rolling hills topography. No part of this watershed is located in the upper canyons. There is a known spring, Doctor Springs, located approximately midway between the headwaters and the confluence with San Isidro Arroyo. The spring within Doctor Arroyo is not an ephemeral feature and has been excluded from this Hydrology Protocol evaluation. The spring was also identified by MMD as an important hydrological feature in this area and was excluded from the Lee Ranch Mine boundary. The sites that were chosen for sampling were intended to properly delineate the portions of Doctor Arroyo that exhibit ephemeral features from those that exhibit non-ephemeral features due to the spring's influence.

Sites HP16, HP17, and HP18 are all located in Doctor Arroyo. HP16 is the furthest upstream and is located where the MMD permit boundary exclusion begins. HP17 is further downstream and is located where the MMD permit boundary exclusion ends. Finally, HP18 is located the furthest downstream on Doctor Arroyo just prior to confluence with San Isidro Arroyo. Doctor Spring is located between HP16 and HP17.

The total scores for the HP protocol at these locations ranged from 6.5 to 8. Poor scores (0) were received for water in channel, fish, benthic macroinvertebrates, filamentous algae / periphyton, in-channel structure / riffle pool sequence, hydric soils, seeps and springs, and iron oxidizing bacteria / fungi. Weak scores (1) were received for absence of rooted upland plants. Differences in vegetation ranged from Poor (0) to Moderate (2). Sinuosity ranged from Weak (1) to Strong (3). Floodplain and channel dimensions ranged from Moderate (1.5) to Strong (3). Particle size or stream substrate sorting ranged from Poor (0) to Moderate (1.5). Lastly, sediment on plants and debris ranged from Poor (0) to Weak (0.5).

The upper locations HP16 and HP17 both scored strongly on the floodplain and channel dimensions. This again was a byproduct of the wide shallow area with multiple abandoned channels and cattle and wildlife paths present. *See* UAA Appendix D, Photos HP16 downstream, HP17 downstream, HP17 base of stream channel. Nonetheless, these upper sites were characterized as ephemeral channels with low sinuosity, no instream structure or sorting, and no evidence of frequent or prolonged flow. The intermittent Doctor Springs, located between these two HP sites, would be accurately delineated and protected by the HP16 and HP17 sites, which coincide with the MMD permit boundary.

Lower in the Doctor Arroyo watershed, the channel becomes more incised with a sand bed channel with steep banks and historical terraces. *See* UAA Appendix D, Photos HP18 downstream. HP18 scored strongly for sinuosity, and showed a moderate floodplain and channel dimension characteristic, and scored moderate for stream substrate sorting due to the presence of some isolated pebble deposition areas. Tamarisk was present but was also present on the historical terraces in the surrounding uplands and scored poorly for differences in vegetation. All hydrology, geomorphology, and biological characteristics were that of an ephemeral stream prior to its confluence with San Isidro Arroyo.

Numerous photo points were included in this watershed to characterize the headwaters, the contributing tributaries, and the spring area. *See* Photo points PP159, PP160, PP161, PP290, PP291, PP168, PP292, PP163, PP164, and PP166. These photos indicate that all intermediate portions of Doctor Arroyo and contributing tributaries exhibit consistent ephemeral characteristics and were accurately represented by the chosen HP sites. *See* UAA Appendix A, Photos PP159 upstream, PP161 upstream, and PP166 downstream. The only site that exhibited non-ephemeral characteristics is PP160, which is located immediately downstream of Doctor Springs and is being excluded from this UAA. *See* UAA Appendix A, Photos PP160 upstream and downstream.

vii. <u>HP Site Descriptions and Results: Tier 3 Watershed 3ABCD – San Isidro Arroyo</u>

I will now move on to discuss the Tier 3 Watershed 3ABCD- San Isidro Arroyo. The final sampling location is HP31 located the furthest downstream on San Isidro Arroyo just prior to its confluence with Arroyo Chico. This site receives drainage from all previously discussed watersheds. This site has a higher potential for showing intermittent characteristics due to the large drainage area capturing surface water runoff, with potential to sustain intermittent flows, and the lower position in the watershed, giving it a higher potential for intercepting the water table if alluvial groundwater exists.

The Hydrology Protocol site HP31 received a total score of 7, pointing to an ephemeral channel. Scores of zero were applied for the following indicators: presence of water, fish, macroinvertebrates, algae / periphyton, in channel structure (riffle-pool), particle size or substrate sorting, hydric soils, seeps and springs, and iron oxidizing bacteria. The site received a low score for sediment on plants and debris (0.5) and sinuosity (1). Moderate scores were observed for differences in vegetation (2), floodplain and channel dimensions (1.5), and absence of rooted upland plants in streambed (2).

Overall this location shows geomorphic, hydrologic, and biotic characteristics consistent with sites HP21 and HP18. The site had a relatively narrow active channel compared to the surrounding terrace and floodplain. *See* UAA Appendix D, Photos HP31 upstream, HP31 downstream, and HP31 channel bottom. Some characteristics scored moderately, mainly due to the conservative nature of the scoring. There was some tamarisk present but it was not dominant, causing an elevated score for differences in vegetation. The channel bottom was compacted due to wildlife and cattle use and had little to no vegetation, receiving a moderate score for Absence of rooted upland plants. All other indicators were characteristic for ephemeral streams. There was no evidence of hydric soils or frequent wetting and drying cycles.

viii. <u>Summary of Hydrology Protocol Results</u>

Peabody sampling staff performed the Hydrology Protocol on numerous sites across the San Isidro watershed. All sites scored within the ephemeral stream category after completing the entire Level 1 evaluation. The large number of photo points used at sites not subject to the

Hydrology Protocol showed characteristics consistent with the Hydrology Protocol locations. Therefore, it was determined that the Hydrology Protocol locations are representative of the entire San Isidro watershed. The one sampling location that exhibits intermitted characteristics was Doctor Springs, and the limitations of the intermittent characteristics were accurately delineated by the Hydrology Protocol locations bounding both the upstream and downstream limits of the spring.

These sampling results are consistent with the UAA that was conducted by NMED in 2012 on the Mulatto Canyon watershed. The study completed by Peabody took a broader, more intensive look at these streams and ultimately arrives at the same conclusion NMED did in 2012 - that these stream reaches are accurately classified as ephemeral. Concurrent sampling conducted by NMED alongside, but independent of, Peabody sampling staff evidences that Peabody's scoring methodologies were accurate. The conservative approach to the Hydrology Protocol scoring was taken out of an abundance of caution to accurately characterize the highest attainable use of these streams. Therefore, in my professional opinion, the correct classification for these streams is ephemeral. This would result in a highest attainable use of livestock watering, wildlife habitat, limited aquatic life, and secondary contact.

VI. Use Attainability Analysis

Peabody compiled the results of the Hydrology Protocol as well as the Level 1 office procedures to create the Use Attainability Analysis. Similar to the work plan, the UAA was developed in coordination with the NMED and EPA. On June 26, 2018 the Draft UAA was completed and submitted to NMED and EPA for their review. NMED provided comments on August 24, 2018. EPA provided comments via email on September 6, 2018 and in a letter to

Peabody on September 25, 2018. Peabody revised the UAA into its final form and provided a response to technical comments received on November 6, 2018.

Peabody then published the UAA in the Albuquerque Journal and the Gallup Independent on March 11, 2019. *See* Peabody Exhibit 24, Lee Ranch Mine UAA Public Notice Documents. Letters providing public notice of the UAA were mailed to stakeholders, including NMED, EPA, MMD, BLM, Cibola County, the City of Grants, the Continental Divide Electric Cooperative, Fernandez Company Ltd., the Hopi Tribe, McKinley County, the Navajo Nation, the New Mexico Gas Company, Public Service of New Mexico, the State of New Mexico Land Office, and U.S. West Communications. *See* Peabody Exhibit 24. The public notice of the UAA was also posted at 17 of the nearby Chapter Houses. *See* Peabody Exhibit 24.

The public notice announced availability of the UAA at the Public Library in Grants, New Mexico and the McKinley County Courthouse in Gallup, New Mexico. *See* Peabody Exhibit 24. The public notice announced a public meeting being held on March 26, 2019 at the Public Library in Grants, New Mexico to answer any questions from the public. *See* Peabody Exhibit 24. Peabody staff and NMED staff Jennifer Fullam and Diana Aranda attended the public meeting. Peabody presented a summary of the UAA and reviewed the primary findings of the UAA. NMED staff indicated that they agreed with the conclusions of the UAA and provided and discussed their comments on the regulatory language for the stream segments. The public notice also invited comment on the UAA beginning March 13, 2019 and ending April 12, 2019. *See* Peabody Exhibit 24. Peabody received comments from NMED in a letter dated March 29, 2019 addressing the regulatory language used to describe the stream segments. These were the only comments received on the final UAA. Peabody has addressed these comments to reach agreement with NMED on the refined proposed regulatory language, which is Peabody Exhibit 9.

Conclusion

In conclusion, it is my expert opinion that this UAA provides a comprehensive hydrologic analysis of the waters within the San Isidro watershed. The UAA provides abundant scientific support for classifying waters within the San Isidro watershed as ephemeral streams, including Arroyo Tinaja, Mulatto Canyon, San Isidro Arroyo, and Doctor Arroyo, and all tributaries to these waters, excluding the specific areas delineated by the regulatory language.

This concludes my direct testimony.